Reports of the Short Term Scientific Missions (STSM) performed during the ICSHNet COST Action (IS1408)

N.	Date	Participant	Home Institution	Host Institution	Title of the Short Term Scientific Mission
1	5-20 April 2016	Isabell Rumrich	Institute for Health and Welfare, Kuopio, Finland	Department of Epidemiology, Lazio Regional Health	Review of methods for Health Impact Assessment of Industrially Contaminated Sites in Europe
2	10-16 April 2016	Andreja Kukec	Faculty of Medicine, University of Ljubljana, Slovenia	Swiss Tropical and Public Health Institute (Swiss TPH), Basel, Switzerland (CH)	Industrially Contaminated Sites and Health Network (ICSHNetwork)
3	5-16 December 2016	Dovilé Adamonité	European Environment and Health Youth Coalition, Lithuania	University of Antwerp, Belgium	Review of Practises for Involving Adolescents in Environmental Health Risk Communication and Risk Governance of Industrially Contaminated Sites
4	2-12 April 2016	Andreja Kukec	Faculty of Medicine, University of Ljubljana, Slovenia	National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland	STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland
5	13-22 December 2017	Andreja Kukec	Faculty of Medicine, University of Ljubljana, Slovenia	National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland	STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland (from Slovenia to Finland)
6	13-22 December 2017	Tanja Rejc	National Institute of public health, Ljubljana, Slovenia	National Institute for Health and Welfare (THL)	STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland (from Slovenia to Finland)
7	7-13 February 2018	Rebecca Hams	Public Health England, Chilton - United Kingdom	Universiteit Utrecht, Netherlands	Methods for estimating ingestion exposure to common contaminants
8	8 March- 6 April 2018	Stephanie Gaengler	Cyprus University of Technology, Limassol - Cyprus	Istituto superiore di Sanità, Rome Italy	Health impact assessment around an industrial waste incinerator in Mantua, Italy
9	21-31 March 2018	Elena Roxana Ardeleanu	"Vasile Alecsandri" University of Bacau, Romania	VITO NV, Belgium	Human biomonitoring as a tool for exposure assessment in Industrially Contaminated Sites - lessons learned
10	3-10 April 2018	Rebecca Hams	Public Health England, Chilton - United Kingdom	Universiteit Utrecht, Netherlands	Environmental surveillance programme gap analysis

Reports of the Short Term Scientific Missions (STSM) performed during the ICSHNet COST Action (IS1408)

11	11-20 April 2018	Lorenzo Vaccari	Università degli Studi di Modena e Reggio Emilia, Italy	Aristotle University of Thessaloniki	Assimilation of HBM data using the INTEGRA integrated exposure modeling platform: Modena Incinerator case study
12	17-23 April 2018	Dovilé Adamonité	European Environment and Health Youth Coalition, Lithuania	Istituto Superiore di Sanità, Rome, Italy	Towards a consensus on industrially contaminated sites policy priorities and response: report of the fourth COST Action Plenary Conference
13	19-27 April 2018	Roberto Pasetto	Istituto Superiore di Sanità, Rome - Italy	WHO European Centre for Environment and Health	the ICSHNet Special Issue on 'Environmental health challenges from industrial contamination' accounting for the WHO perspective
14	3-21 September 2018	Stephanie Gaengler	Cyprus University of Technology, Limassol - Cyprus	Istituto superiore di Sanità, Rome - Italy	Health Impact of the Mantua (Italy) Chemical Industrial Site
15	4-11 December 2018	Dovilé Adamonité	European Environment and Health Youth Coalition, Lithuania	WHO European Centre for Environment and Health	Promoting ICSHNet outcomes in policy making in environment and health
16	14-18 January 2019	Roberta Valentina Gagliardi	Istituto Superiore di Sanità, Rome - Italy	Universiteit Utrecht, Netherlands	Air pollution exposure assessment approaches
17	20 February - 2 March 2019	Dejean Easmon-George	Brunel University, London, United Kingdom	Department of Epidemiology of Lazio region, Rome	A scoping review of the epidemiological methods used to investigate the health effects of Industrially Contaminated Sites
18	10-24 March 2019	Borko Bajic	Institute of Public Health, Podgorica, Montenegro	Istituto superiore di Sanità, Rome - Italy	Using SENTIERI approach in health risk assessment in industrially contaminated sites in Montenegro
19	8-16 April 2019	Nataša Dragić	Institute of public health of Vojvodina, Novi Sad, Serbia	THL Public Health Solutions, Kuopio, Finland	Industrially Contaminated Sites and Health Network (ICSHNet) - Health risk and health impact
20	15-19 April 2019	Walter Cristiano	Istituto Superiore di Sanità, Rome - Italy	Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany (DE)	Application of effect based methods in Industrial Contaminated Sites
21	15-19 April 2019	Kevin di Domenico	Istituto Superiore di Sanità, Rome - Italy	Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany (DE)	Application of effect based methods in Industrial Contaminated Sites

Univerza v Ljubljani
Medicinska fakulteta

Department of Public Health
Zaloška 4
1000 Ljubljana, Slovenia
tel. 01 543 75 40
fax. 01 543 75 41
e-mail: marjan.bilban@zvd.si

Basel, April 16, 2016

Mr. Pietro Comba, PhD (STSM coordinator)
Head, Unit of Environmental Epidemiology
Department of Environment and Primary Prevention
Istituto Superiore di Sanità
Viale Regina Elena 299
Italy

Subject: **STSM Scientific Report during the period 10th-16th April 2016, "Industrially Contaminated Sites and Health Network (ICSHNetwork)" related to the COST Action IS1408**

Purpose of the visit	- Introduction with methods and tools for health impact assessment (HIA) for the industrial hot spot (general, applicable for Slovenian cases). - Discousse above the necessary needed health and environmental data for HIA analysis. - Working on country own hot spot examples; the most polluted area in Slovenia cold Zasavje. In my PhD I already did same research in this polluted region. In my PhD I elucidated outdoor air pollution problem and health effects in children. Now I would like to expend my research on other possible environmental elements (for example: water and soil contamination). Also I would like to discousse above including stakeholders, polluters and other, which are important in HIA process. - Discussion above the possibility to prepare some scientific article based on methodology for linkage health and environmental data in complex's terrain Zasavje (we could prepare draft of two scientific articles: first will based in existing data and second on expended data). - Discussion above future scientific collaboration in another example of industrial hot spot in Slovenia (e.g. Celje vally).
Description of the work carried out during the visit	- Based on the previous results in the Zasavje region, with college in Swiss THP have discuses above holistic health impact assessment (HIA) in these region. How we can identify different impact in environment (soil contamination, water contamination, food contamination, noise, food production in industrial contamination said...) on health. We also discussed above methods and tools. - Based on different industrial hot spots in Slovenia, we discussed above different methods and tolls for HIA and how preparing the

	protocol for some project: human biomonitoring, evidence based in individual level (cohort study). - I have prepared results for two scientific articles. - They showed me The Swiss Literature Database on Air Pollution and Health (LUDOK).
Description of the main results obtained and Projected publications/articles resulting or to result from the STSM	- During the visit the Swiss THP in collaboration with college from Swiss THP I prepared: • Health and environmental data in Slovenia for HIA (Holistic health impact assessment in Slovenia Industrial contaminated areas) (in Appendix 1) • Statistical analysis between health and environmental data in Zasavje region standardize in potential confounders data using Poisson regression analysis (in Appendix 2). • Draft for scientific articles with title: Linkage health and environmental data in highly complex terrain in Zasavje region for evidence base decision making (in Appendix 3). • Draft for methodological scientific article in highly complex terrains: Developing model for holistic health impact assessment (in Appendix 4). • Short literature review between exposure and birth outcomes (Appendix 5).
Future collaboration with host institution	- Finalize and try publish a draft set of articles. - Preparing protocol for human biomonitoring studies in the most industrial pollution areas in Slovenia / Switzerland. Preparing good examples for COST action IS1408. - Preparing protocol for cohort study in Zasavje region, Slovenia (evidence based between environmental contaminations and different health outcomes).
Confirmation by the host institute of the successful execution of the mission	- In attachment: Letter of Completion of STSM
Other comments	STSM is a good challenge for young researchers from different reasons: - exchange of scientific experience, - planning future collaborations and - preparation of scientific articles.

With kindest regards,

Andreja Kukec

Appendix 1: Health and environmental data in Slovenia for HIA.

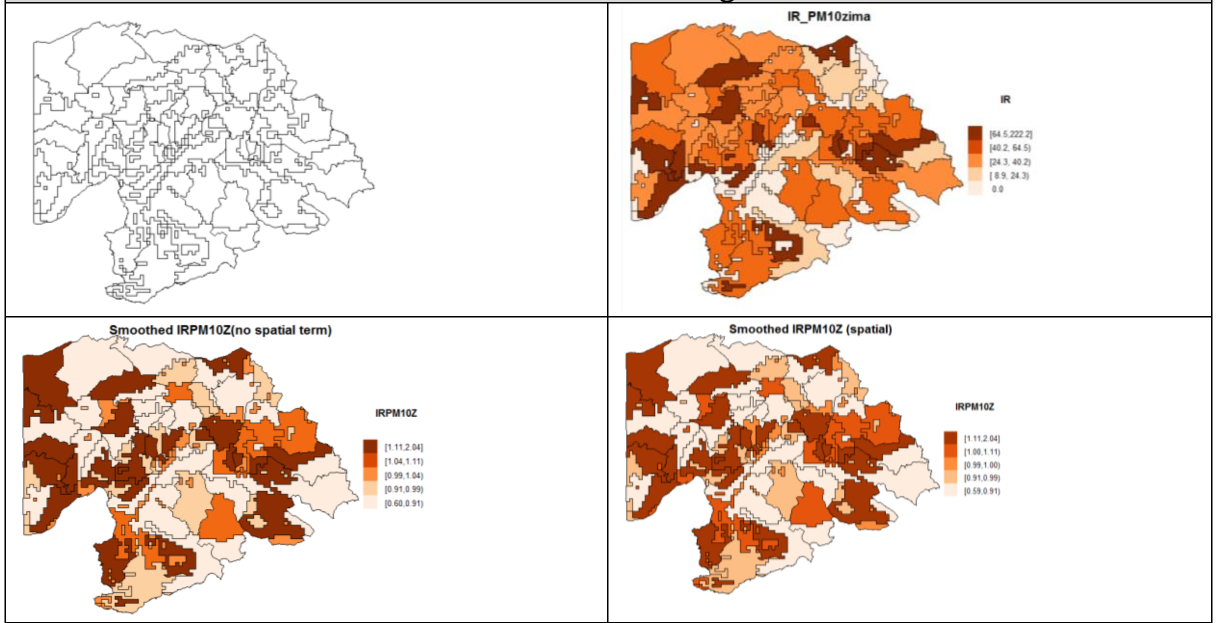
ENVIRONMENTAL DATA	Monitoring (M)/Project (P)	Spatial and time resolution of data	Type of data
OUDDOOR AIR POLLUTION	M	3 fixed measuring stations (24 average concentration)	PM_{10}, SO_2, NO_2, O_3 $PM_{2.5}$ (Ljubljana station and heavy metals daily values 2014 and 2015: Al, V, Cr, Mn, Fe, Ni, Co, Cu, Zn, Mo, Ga, As, Se, Sr, Cd, Sb, Tl, Pb, Ag, Ba, Cs, Rb)
	P	Mobile satiation: 1 fixed measuring stations in Ljubljana 2012, 2013	UFP different sizes in Particle Number Concentration - PNC: 0,01-0,02 µm, 0,02-0,03 µm, 0,03-0,05 µm, 0,05-0,07 µm in 0,07-0,10 µm
	P	Modelling data: l×w×h = domain: 20 km×20 km×6 km; fine spatial resolution on complex terrain: l × w × h = 200 m × 200 m × 10 m (100x100 cells); time resolution: 1 hr-calculated 24 hr MED-HISS project 4.4 x 4.4 km for	PM_{10}, SO_2, NO_2 at the level of small spatial units 2011 to 2016 PM_{10}, $PM_{2.5}$, NO_2 and O_3 in Slovenia at the level of municipalities 2010 to 2014
SOIL POLLUTION	P	Research of soil pollution in Slovenia (ROTS): first1989 – 2006: sample locations (National Environmental Action Programme) spatial resolution 8X8 km, 4x4 km and 2x2 km (geocoding data). 2006: 30 location in Slovenia (8x8 and 4x4 km)	As, Cd, Co, Cr, Cu, F, Hg, Mo, Ni, Pb, Zn, HCH compounds, DDT, DDD, DDE, Polychlorinated biphenyls (PCBs), Polycyclic aromatic hydrocarbons (PAHs), Atrazin, Simazin
WATER POLLUTION	M	SURFACE WATERS *Quality of Rivers Evaluation of Chemical Status of Rivers River Quality Assessment Using Saprobic Index and Beginnings of Ecological Status Evaluation *River Quality Assessment Using Saprobic Index and Beginnings of Ecological Status Evaluation *Quality of Lakes GROUNDWATER *Groundwater Quality **The frequency of sampling**: number of residents in the supply area, the volume of distributed water, the number and frequency of sampling (2 to 6x/year): chemical, microbiological and radiological parameters	General physico-chemical parameters: Nitrate, Sulphate Priority list of chemical status parameters: Cadmium, dichloroethane, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclohexane, Pentachlorophenol, Mercury, Tetrachloroethene, Trichlorobenzene, Trichloroethene, Trichloromethane Indicative list of parameters: Copper, Boron, Zinc, Chromium, Nickel, Lead, Dichloromethane, Alachlor, Metolachlor, Atrazine…. Total phosphorus, Nitrogen inorganic, Transparency... Parameters measured at the sampling (T, pH, conductivity, redox potential, oxygen); Basic parameters (colour, turbidity, CODMn, TOC, ammonium, nitrite, nitrate); Group pollution parameters (mineral oils, PCB, AOX, detergents); Metals and metalloids; Pesticides and their metabolites (organochlorine, organophosphorus, triazines, triazinones, triazoles, anilines, amides, imides, benzonitriles).....
WASTE/ LANDFILL	M	Name and address of the company (geocoding)	List of processors waste (number), disposers, collectors List of landfill: status (operated, in the process of closing) Report (2010-2014): the type and quantity of waste (kg)

HEALTH DATA	Register (R)/ information system (IS)/Project (P)	Spatial and time resolution of data	Type of data	Size of observed population
VISTIS THE PRIMARY HEALTH CARE CENTRE	IS	Permanent residence address (geocoding data), daily	Date of consultation, type of consultation, code of diagnosis ICD-10 (consultations: first, follow-up, short), age in years, sex	Slovenia (2015): 2063077 (M: 1022554; F: 1040523). Spatial resolution: 6031 settlements, 210 municipalities; 68 administrative units, 12 statistical regions, Age (0 to 100+), gender SURS, CHMS, EHIS data above possible confounders (socio-economic status, activity, live style..)
MORTALITY	R	Administrative units level, municipalities… Permanent residence address (geocoding data) from 2015 onwards; yearly	Cause of Death ICD 10 sex, 5 years age groups	
MORBIDITY	R	Administrative units level, municipalities… Permanent residence address (geocoding data) from 2015 onwards; yearly	Number of hospitalization ICD 10 (main diagnoses), sex, 5 years age groups	
CANCER REGISTER	R (PORTAL SLORA)	Statistical region (12) Permanent residence address (geocoding data); yearly Incidence from 1961 to 2012 Mortality from 1985 to 2012 Partial and lifetime prevalence 1961 to 2012 Survival - observed and relative survival from 1985 to 2012	All or selected cancer ICD 10 Incidence, crude incidence rate, age standardized incidence rate, Mortality, crude mortality rate, age standardized mortality rate Lifetime prevalence, less than 1 year after diagnosis, 1-4 years after diagnosis, 5-9 years after diagnosis, 10+ years after diagnosis observed and relative survival (1, 3, 5, 10 years); age (all, 0-19, 20+)	
PERINATAL INFORMATION SYSTEM	R	14 maternity hospitals, administrative units, municipalities … Permanent residence address (geocoding data) from 2015 onwards; yearly	Data on pregnant women and newborns (two forms: the birth record and newborn): all stillbirths, regardless of birth weight and stillbirths all with a birth weight of 500 g and more. 200 variables: ICD-10: hospital admission / discharge; main diagnosis and additional Data on women: age, permanent residence address, marital status, education level (mother and father), employment activities, cause and type of treatment, health Insurance, complicates diagnosis, therapeutic or diagnostic procedure, number of previous childbirth / live births / previous abortions, use of contraception, prenatal care, BMI, family history, lifestyle factors during pregnancy (smoking, drug use, alcohol consumption, physical activity, diseases after pregnancy, medication use, breastfeeding problems,..). Newborns: time of birth, sex, birth weight, gestational age, breastfeeding, congenital malformations	Number of births /year: 1988 (26442), 2010 (22002), 2011 (21567), 2012 (21500), 2013 (20634), 2014 (20611)

HEALTH DATA	Register (R)/ information system (IS)/Project (P)	Spatial and time resolution of data	Type of data	Size of observed population
PREVALENCE OF RESPIRATORY DISEASES	P (Cross-sectional study)	Zasavje region (permanent residence address data): May to June 2008 6-11 years of age, in total 1790 schoolchildren (response rate)	A questionnaire about their child's past health issues, especially if they involved acute and chronic respiratory diseases, as well as several conditions that could influence respiratory diseases: outdoor and indoor air conditions, smoking habits, living conditions, socio-economic conditions and others.	*all population 0 to 85+ (42516; M: 20826, F: 21690) Children population 0 to 11: (4623; M: 2410, F: 2213)
BIOMONITORING OF ENVIRONMENTAL CHEMICALS	P (Proposal for a pilot program biomonitoring of environmental chemicals for 2010-2014): human biomonitoring	12 statistical region in Slovenia (low polluted area, urban environment, high polluted area-industry..)	The selected population for the survey were men and women from 20 to 40 years, who are expecting their first child and living in the same geographical area for at least 5 years and breastfeeding mothers of the first child to the age of 6 to 8 weeks (inclusion criteria: health status, BMI). Sample: For each selected area / region should be obtained 50 samples of each gender and of each selected biological tissue or bodily fluids. Toxic metals (cadmium, lead, mercury, arsenic) and POPs (dioxins, furans, organic chlorine pesticides, polychlorinated biphenyls) in body fluids (blood, breast milk, urine) and hair. Additional analyzes included the more important parameters in blood, where it provides some essential elements (selenium, copper and zinc), and in urine samples, which lays down certain biochemical indicators of kidney damage.	Methodology: EU projects PHIME, COPHES in DEMOCOPHES

Appendix 2: Statistical analysis between health and environmental data in Zasavje region standardize in potential confounders data.

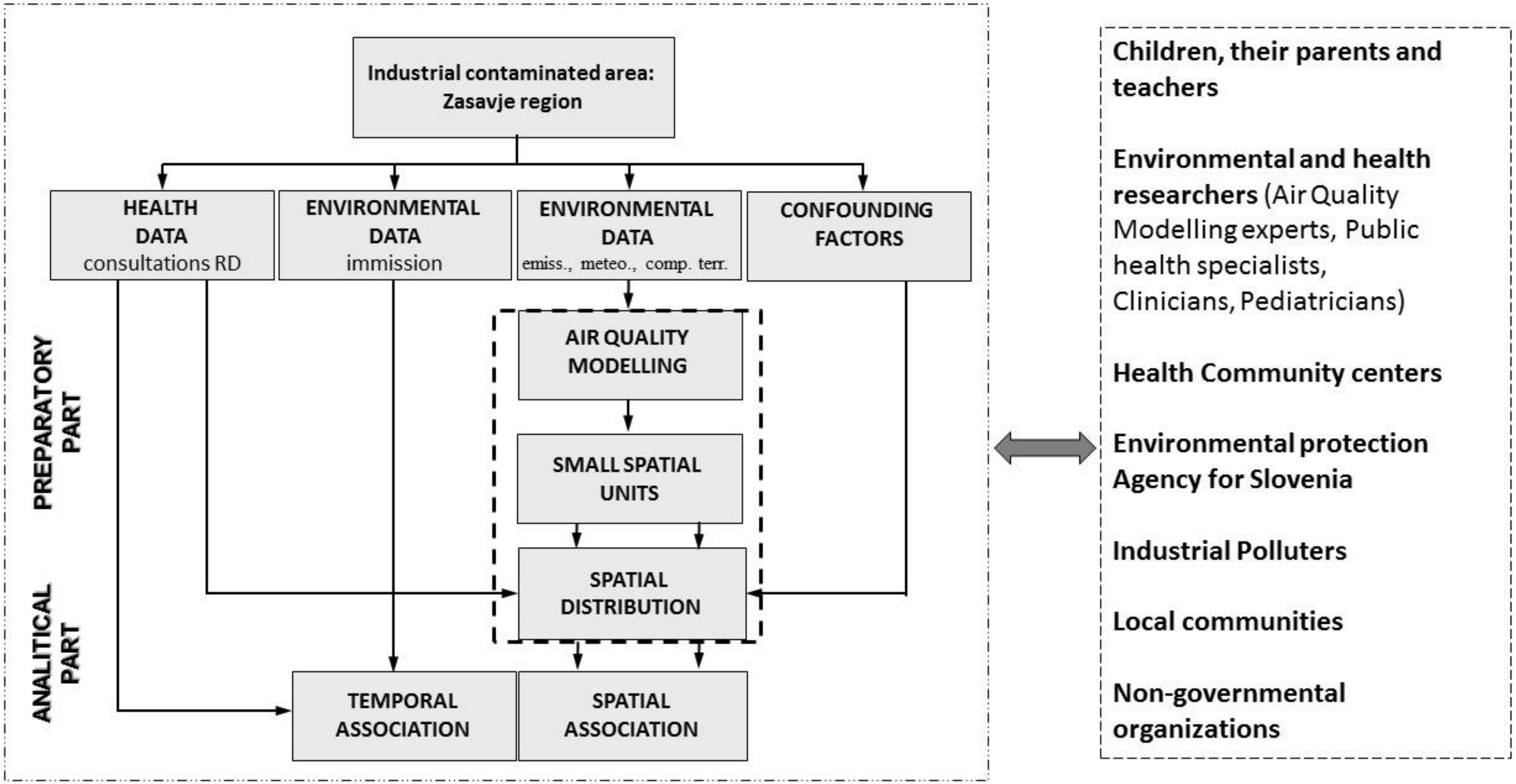
PM_{10} winter average



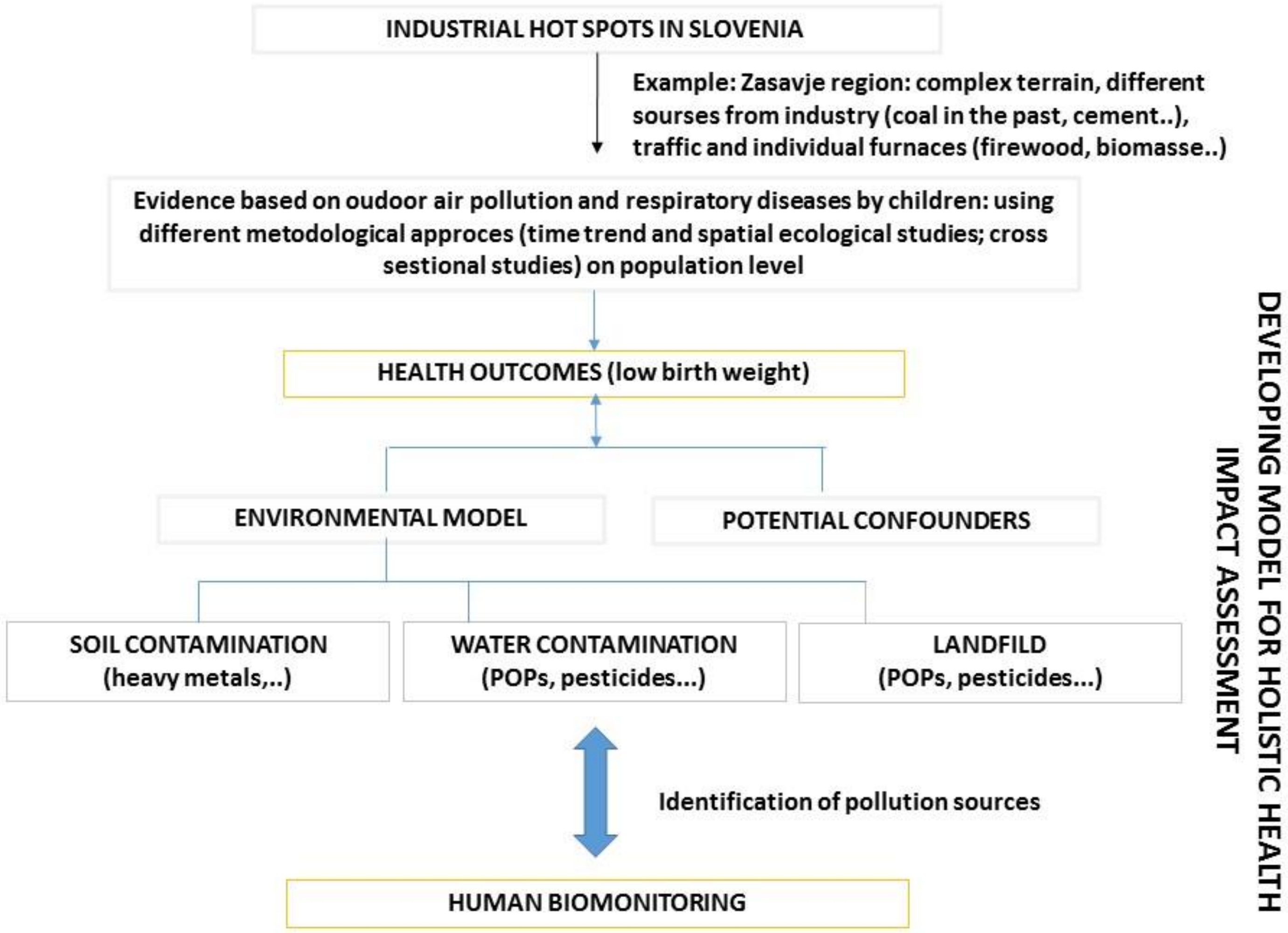
EXPLENATORY FACTOR/ COUNFOUNDERS	without spatial term			with spatial term		
	RR	97,5 % CI		RR	97,5 % CI	
		lower	upper		lower	upper
1 (lowest)	1.000	0.354	1.099	0.635	0.354	1.099
2	1.139	0.773	1.690	1.139	0.773	1.690
3	1.281	0.844	1.979	1.281	0.844	1.979
4	1.089	0.709	1.675	1.089	0.709	1.675
5 (highest)	1.708*	1.051	2.795	1.708*	1.051	2.795
Family history	0.994	0.884	1.117	0.994	0.884	1.117
Childs health complication just after delivery	0.894	0.728	1.104	0.894	0.728	1.104
Breastfeeding duration	1.109*	1.004	1.230	1.109*	1.004	1.230
Humidity of dwelling place	1.016	0.819	1.256	1.016	0.819	1.256

Legende: * Positive association at the 2,5 % significance level. PM_{10} level of pollution: 1 = negligible level of air pollution; 2 = low level of air pollution; 3 = moderate level of air pollution; 4 = noticeable level of air pollution; 5 = the level of air pollution reaching or exceeding the limit value

Appendix 3: Linkage health and environmental data in highly complex terrain in Zasavje region for evidence base decision making.



Appendix 4: Developing model for holistic health impact assessment in highly complex terrains.



Appendix 5: Short literature review between exposure and birth outcomes.

Study	Population	Health Outcome	Exposure	Methods for association	Conclusion
Mayhoub et al., 2014 The MecoExpo Cohort Study	The cohort comprised 993 mother-newborn pairs was recruited between January 2011 and January 2012.	Birth outcomes: Neonatal data - gestational age (weeks of amenorrhea), birth weight (g), birth length (cm) and head circumference at birth (cm) were extracted from medical records by the maternity clinic's pediatrician.	Questionnaire, medical records (44 items) Each mother completed a questionnaire that probed occupational, domestic, environmental and dietary sources of parental exposure to pesticides during her pregnancy.	Multivariate regression analyses: associations between the characteristics of parental pesticide exposure during pregnancy and the corresponding birth outcomes. Confoundings: mother's age and body mass index (BMI), parity, diabetes, hypertension, tobacco use, alcohol use, drug abuse, socioprofessional category (educational level and type of work), and the baby's gender	Maternal occupational exposure: low birth weight OR: 4.2 (1.2, 15.4). Paternal occupational exposure to pesticides was associated with a lower than average gestational age at birth (20.7 weeks; p=0.0002) and an elevated risk of prematurity (OR: 3.7 [1.4, 9.7]).
Kim et al., 2014	Four Longitudinal Birth Cohort Studies. CHAMACOS, HOME, Columbia, and Mount Sinai birth cohorts. The study combined participants from cohorts that measured urinary DAP metabolites during pregnancy. The pooled dataset included 1235 women. Enrollment Years 1999-2000 (CHAMACOS) 2003-2006 (HOME) 1998-2006 (Columbia) 1998-2002 (Mount Sinai)	Birth weight, length, or head circumference overall	Concentrations of 3 diethyl phosphate (ΣDEP) and 3 dimethyl phosphate (ΣDMP) metabolites of OP pesticides (summed to six dialkyl phosphates (ΣDAPs)) were measured in maternal urine. spot urine samples were collected from pregnant women at the time of interview	Multivariable linear regression and mixed effects models were used to examine associations with birth outcomes. Confounders: demographic information (age, marital status, race, ethnicity, country of birth, educational attainment), behavioral factors (smoking, alcohol, drug use during pregnancy), and pregnancy health (parity, prenatal care use, pregnancy complications).	We found no significant associations of ΣDEP, ΣDMP, or ΣDAPs with birth weight, length, or head circumference overall.

COST Action IS1408 – Industrially Contaminated Sites and Health Network (ICSHNet)

Working Group 3 on Health Risk and Health Impact Assessment

Short Term Scientific Mission Report

Name: Isabell Rumrich
STSM Topic: Review of methods for Health Impact Assessment of Industrially Contaminated Sites in Europe
Home institution: Nation Institute for Health and Welfare, Kuopio Finland
Host institution: Department of Epidemiology, Regional Health Service of Lazio, Rome, Italy
Official Host: Carla Ancona
Duration: 5th to 20th April 2016
Cost STSM reference number: COST-STSM-ECOST-STSM-IS1408-050416-073187

Table of Contents

Purpose of the Short Term Scientific Mission

The aim of my STSM was to create an outline for the networking summary, which would feed into the final report of the Action. To meet this aim, the main focus of the mission was to proceed with the review work conducted within Working Group 3 (WG3)

.

Description of the work carried out

During my STSM in Rome I was working fulltime at the Department of Epidemiology, Regional Health Service of Lazio (DEP), as well as the Istituto Superiore di Sanità (ISS), Department of Environment and Primary Prevention and the Unit of Statistics (see Appendix 1).

WG 3 members are assigned case studies, which they shall summarize using a review template. During my stay in Rome I filled the old template for 11 of the identified case studies from Finland and Italy to see how the template works and how it could be modified to make the summarizing easier. Subsequently, I updated the review template in terms of structure and items to be collected. Additionally, I started to design a systematic literature search in PubMed to identify published case studies. The systematic search was designed according to Cochrane guidelines. For eight participating countries no case studies have been identified so far. A mail asking for case studies or reports has been sent to country representatives.

Description of the main results

Update of review template

The latest version of the review template intended to be used for summarizing case studies in a systematic way, was divided into 4 separate tables (study dimensions, exposure assessment, health impact assessment, risk management). The updated version consists of only one table, with separate sections for epidemiological studies and another section for modelling or extrapolation studies (see Appendix 2). Additionally, fewer items are collected in the updated version, which should make it easier to fill out the template with the main characteristics of the studies.

Literature search

Eight different search strategies have been tried to identify relevant articles (see Appendix 3). The number of retrieved items ranged between 128 and 25.542. For two search strategies, resulting in 203 and 374 hits, the titles have been screened to gain an overview how specific the search was. For both search about 50 potential new case studies have been identified. The fraction of seemingly irrelevant articles was 54% and 75% respectively. The high fraction of irrelevant articles shows clearly that the search strategies need refinement to be more specific.

Mail to representatives of countries without any case study

Up to date there has been two calls to identify case studies in WG 3: a first initial call within WG 3 and then a call for case studies to be presented in the Report of the first Plenary Conference of the Action (1st-2nd October, Rome). Eight countries did not provide any case study at either of the calls (Bulgaria, Croatia, Czech Republic, Denmark, Iceland, Ireland, Israel, Portugal). The representatives of each country have been contacted by email. They have been requested to send one or more papers or reports on studies carried out in your country within the next two weeks.

Future collaboration with the host institution

The collaboration with the host institution will continue in the future with preliminary discussion about future STSM with colleagues from DEP visiting Kuopio or vice versa.

Projected publications/articles resulting or to result from the STSM

The aim of the STSM was to create an outline of the networking summary that would feed into the formulation of recommendations in the final report of the action. The work accomplished in Rome was more basic work developing the tools to collect the networking summary and therefore will not explicitly result in the report.

Confirmation by the host institution of the successful execution of the Short Term Scientific Mission

Rome, 19 th April 2016

Isabell Rumrich
National Institute for Health and Welfare
Kuopio, Finland

Cc: Pietro Comba
STSM Coordinator
COST Action IS1408
Istituto Superiore di Sanità
Viale Regina Elena, 299
00161- Rome, Italy

Otto Hänninen
National Institute for Health and Welfare
Kuopio, Finland

Ref. Confirmation of the successful execution of the Short Term Scientific Mission related to COST Action IS1408

Dear Ms. Rumrich,

After your stay at the Department of Epidemiology, of the Regional Health Service of Lazio, I would like to confirm the successful execution of your Short Term Scientific Mission during the period 5th-20th April 2016 supporting Working Group 3 activities of the Cost Action IS1408 "Industrially Contaminated Sites and Health Network (ICSHNet)".

Best regards,

Carla Ancona

Senior researcher of the Host institution (Department of Epidemiology, Regional Health Service of Lazio, Rome, Italy)

SISTEMA SANITARIO REGIONALE ASL ROMA 1 REGIONE LAZIO
via C. Colombo, 112 - 00147 Roma - Tel. (+39) 06.99722161/162- Fax (+39) 06.99722111
www.deplazio.net

Other comments

The STSM was not only useful for bringing the WG 3 review work forward, but also for networking within and outside the Action. I met Susanna Mitrova (DEP), who gave an introduction to systematic literature searches and the Cochrane library. Elena Parmelli explained the GRADE approach to evaluate credibility of studies. Additionally, I had the chance to join the Etiological and Occupational Epidemiology Unit meeting at DEP, where Ester R. Alessandrini presented the Methods and Results of a study in Taranto, an industrially contaminated site in Sicily (South Italy).

Within the Action WG 3, I mainly worked with Carla Ancona, who was my official host, and her colleague Martina Golini at DEP. At ISS I worked mainly with Roberta Pirastu, Roberto Pasetto and Amerigo Zona, who introduced me to the methods used in the SENTIERI project. I spent one day with Susanna Conti, Unit of Statistics (ISS), who was responsible for the handling of the mortality and morbidity data within the SENTIERI project

Overall, my STSM contributed to the progress of the review work of Action WG 3, but also to my personal development and capacities. Having a background in Environmental Health, spending two weeks with epidemiologists taught be a lot of the approaches and methods they use, from which I will benefit a lot in my PhD project.

Appendices

Appendix 1. Schedule of the STSM

My STSM to Rome was divided between the two Institutions participating in the COST Action WG 3: Department of Epidemiology (DEP) of Regional Health Service of Lazio and Istituto Superiore di Sanità (ISS), Department of Environment and primary Prevention and the Unit of Statistics.

Date	Morning	Afternoon
5th		Arrival
6th	**DEP** Welcome and planning	**DEP** Review WG3 case studies Introduction to everyone
7th	**DEP** Introduction of search methods : Cochrane reviews. Zuzana Mitrova	**DEP** Review WG3 case studies Unit Presentation (Taranto study)
8th	**DEP** Grade approach. Laura Amato, Elena Parmelli	**DEP** Literature search
9th	Weekend	
10th		
11th	**ISS** Planning of the activities at ISS (Roberto Pasetto, Roberta Pirastu)	**ISS** Mail to participating countries Review WG3 case studies
12th	**ISS** Introduction to SENTIERI approach and combining analytical and descriptive epi. Studies in ICS (Roberta Pirastu)	**ISS** Self study → articles (SENTIERI), Review template
13th	**ISS** GRADE approach to the evidence evaluation in SENTIERI - I (Amerigo Zona, Roberta Pirastu)	**ISS** Self study → Review template
14th	**ISS** STSM Report	**ISS** STSM Report
15th	**ISS** Unit of Statistics of ISS: Introduction to SENTIERI approach, concerning the use of data on mortality and on hospital discharge records to characterize the health profile of populations living in Italian contaminated sites	**ISS** Unit of Statistics of ISS: Introduction to SENTIERI approach, concerning the use of data on mortality and on hospital discharge records to characterize the health profile of populations living in Italian contaminated sites
16th	Weekend	
17th		
18th	**DEP**	**DEP**
19th	Day off	Day off
20th	Departure	

Appendix 2. Updated review template

COST Action IS1408
Industrially Contaminated Sites and Health Network

Working Group 3
"Methods and tools for health risk and health impact assessment"

ICS Case study review template

{{{The grey items in the table can probably be removed because they are too detailed or duplicate. Still, the table is rather long and for a more detailed review. For later summarizing all studies it would be easier to use one Excel file. If the file is located on a GoogleDrive, all reviewers could fill out the same table in the same file and it would not be necessary to merge all reviews later.}}}

A.1	**Reference**	*Author, year*	
A.2	**Publication type and language if not English**	*Peer-reviewed article, report, abstract, poster, conference*	
A.3	**Review team**	*Names of reviewers*	
A.4	**Date**	*Date of review*	
	B. Background		
B.1	**Country, Region/Municipality**	*Contaminated site*	
B.2	**Study type**	*Was the study an observational study, exposure assessment or health risk assessment?*	
B.3	**Population**	*Residents on site*	

B.4	**Route of exposure**	*Exposure via (i) air; (ii) water; (iii) soil; (iv) food; (v) all*	
B.5	**Pollutant(s)**	*(suspected) pollutants at the site*	
B.6	**Source(s)**	*Source of contamination (e.g. incinerator, chemical industry, landfill)*	
B.7	**Conflict of Interest**	*Is there a high probability of conflict of interest? If yes, explain*	
	C. Exposure assessment		
C.1	**Exposure assessment method**	*How was the exposure status of the population assessed? How was "exposed" defined?*	
C.2	**Temporal coverage**	*Over which period of time where measurements taken?*	
C.3	**Averaging times**	*In terms of measurements, which time periods have been averaged?*	
C.4	**Methods used**	*How were the emissions from the contamination source(s) assessed?*	
C.5	**Descriptive statistics (Pollutant)**	*In which statistical grouping has the pollutant concentration been reported?*	
	If the study is an observational study, fill out section D. If the study is modelled or extrapolates from other contaminated sites, fill out section E.		
	D. Epidemiological approach		

D.1	**Design**	*Study design and information whether residential or occupational study*	
D.2	**Health outcomes**	*Which health outcomes have been included?*	
D.3	**Study period**	*Period under study*	
D.4	**Participants**	*Study size and if applicable targeted subpopulation (workers, children, newborns,...)*	
D.5	**Risk parameter**	*Which statistical measure of risk has been used (HR, RR, SMR, SIR)?*	
D.6	**Comparison group**	*How was the comparison group defined?*	
D.7	**Results**	*A short summary of the main findings*	
	E. Modelling/ Extrapolation approach		
E.1	**Reference site**	*Which site/study has been used as reference site (=similar site with already conducted assessment)?*	
E.3	**Health outcomes**	*Which health outcomes have been included?*	
E.4	**Used Exposure-Response Function**	*Which Exposure-Response functions have been used for the assessment (including references)?*	
E.5	**Definition of exposed population**	*How was the exposure status assessed/categorized?*	
E.6	**Risk parameter**	*Which statistical measure of risk has been used (attributable death, attributable cases, DALYs)?*	
E.7	**Results**	*A short summary of the main findings*	

	F. Risk Management		
F.1	**Recommendations / Measures taken after study**	*Did the study conclude any risk management recommendations? Or have there been any actions taken independent from the study?*	
F.2	**What?**	*Which recommendations where given or which actions where taken for risk management?*	

Appendix 3. Literature search for case studies on "industrially contaminated sites and health"

So far all case studies have been identified by Action members based on their personal expertise in the topic. A systematic literature search is needed to identify additional case studies to gain a comprehensive overview of the current state of research on industrially contaminated sites in Europe. Such a systematic literature can only identify those studies, which are published in Journals indexed by the databases. Reports, governmental or agency based recommendations and guidelines and other grey literature are still only found based on the expertise of the Action members.

The below search is only a starting point to test different search strategies in one database (PubMed).

PECO for search strategy

Population: all
Exposure: industrial contamination
Comparison: non-exposed population
Outcome: all

Concept map for research literature reviews (*Synonyms from Thesaurus.com)*

Define key concept and find synonyms (connect with OR)
Connect concepts with AND

Table 1. Concepts used in the literature seach

	Concept 1	Concept 2	Concept 3	Concept 4
OR	industr*	contaminat*	observational	Europe
OR	factory	pollu*	ecological	
OR	production		cohort	
OR	manufactor*		case-control	

Search in PubMed

industr*[tiab] AND contaminat*[tiab] AND Europe → ***1449 items***

(industr*[tiab] OR factory[tiab] OR production[tiab] OR manufactor*[tiab]) AND (contaminat*[tiab] OR pollu*[tiab]) AND Europe → ***4686 items***

(industr*[tiab] OR factory[tiab] OR production[tiab] OR manufactor*[tiab]) AND (contaminat*[tiab] OR pollu*[tiab]) AND Europe AND (observational[tiab] OR ecological[tiab] OR cohort[tiab] OR case-control[tiab]) → ***374 items***

(industr*[tiab] OR factory[tiab] OR production[tiab] OR manufactor*[tiab]) AND (contaminat*[tiab] OR pollu*[tiab]) AND Europe AND (observational OR ecological OR cohort OR case-control) → ***425 items***

Additional concepts to narrow the search
5) (mortality OR morbidity OR cancer)

Combined search strategies:
6) 1) + 5) → 128 items
7) 2) + 5) → 495 items
8) 4) + 5) → 203 items

Search 8) Observations
Search query used in PubMed 8th April 2016
(industr*[tiab] OR factory[tiab] OR production[tiab] OR manufactor*[tiab]) AND (contaminat*[tiab] OR pollu*[tiab]) AND Europe AND (observational OR ecological OR cohort OR case-control) AND (mortality OR morbidity OR cancer)
Often only name of town/region, which is contaminated, in the title, so not too clear that it is about industrial contamination.

Table 2. Seach query 8 result based on screening of titles

Category	# of article	% of articles
Total identified	203	100
By WG provided case studies	4	2
New studies	53	26
Unclear	27	18
Occupational studies	9	4
irrelevant	110	54

Search 3) Observations
Search query used in PubMed 8th April 2016
(industr*[tiab] OR factory[tiab] OR production[tiab] OR manufactor*[tiab]) AND (contaminat*[tiab] OR pollu*[tiab]) AND Europe AND (observational[tiab] OR ecological[tiab] OR cohort[tiab] OR case-control[tiab])
Many non-human or fully environmental studies

Table 3. Search query 3 result based on screening of titles

Category	# of article	% of articles
Total identified	374	100
By WG provided case studies	3	1
New studies	55	15
Unclear	29	8
Occupational studies	7	2
Irrelevant	280	75

Synonyms for Concepts 1 and 2, as well as exposure

From Pasetto et al, 2010. Measures of material and social circumstances to adjust for deprivation in small.area studies of environment and health: review and perspectives

("high risk factories" OR "environmental crisis" OR "landfill site" OR "chemical industry" OR petroleum OR "iron industry" OR "steel industry" OR "coke industry" OR "industrial complexes" OR "oil refineries" OR "power plant" OR "mine industry" OR "mining industry" OR "ship industry" OR "ships industry" OR "naval industry" OR cokeworks OR "coke works" OR air pollution OR asbestos OR "pesticide factory" OR "pesticides factory" OR "pesticides factories" OR "mineral fibers" OR "mineral fibres" OR electromagnetic fields OR elf OR "television transmitters" OR "radio transmitters" OR radiofrequency OR radio frequencies OR "radio frequency" OR "radio frequencies" OR waste disposal OR sewage OR landfills OR incinerated OR incinerator OR incinerators OR "natural radiation" OR "natural radioactivity" OR radon OR "coke plant" OR "coke plants" OR "solid waste" OR "military sites" OR "industrial areas" OR foundry OR foundries OR "petrochemcial industry" OR "waste combustion plant" OR "waste combustion plants" OR radio OR television OR "environmental pressure" OR "high power transmitter" OR "high power transmitters" OR "sewage plant" OR "sewage plants") OR (coke OR extraction and processing industry OR coal mining OR sewage OR refuse disposal OR electromagnetic fields OR radio waves OR television OR asbestos OR air pollution OR aerosol OR incineration OR environmental pollution OR hazardous waste OR odors OR odours OR chemical industry OR hazardous substances OR air pollutants OR environmental exposure OR environmental pollutants OR book industry OR tanning OR textile OR tobacco industry) AND (exposure OR proximity OR distance OR "living near" OR "residents near" OR indwelling OR environmental illness OR "resident near" OR "close to" OR "residents living within" OR "proximity of residence" OR "populations living within" OR "populations living in areas" OR municipality OR municipalities OR "popluation of" OR "populations of" OR "distance from" OR "living within" OR census OR areas OR "residents living close to" OR "areas of residence" OR "deaths within" OR "cancers within") AND (observational[tiab] OR ecological[tiab] OR cohort[tiab] OR case-control[tiab])

→ 25542 items

Scientific report

Search for best and new emerging practices for involving ***youth*** *in environmental health risk communication and risk governance*

STSM Reference Number	COST-STSM-IS1408-35497
Agreed Title of the STSM	"Review of Practises for Involving Adolescents in Environmental Health Risk Communication and Risk Governance of Industrially Contaminated Sites"
STSM Applicant	Dovile Adamonyte, MPH
STSM Supervisor	Prof. dr. Ilse Loots, UA-FSW and IMDO
Home Institution	European Environment and Health Youth Coalition Minties st. 24-31, Vilnius LT-09224, Lithuania
Host Institution	University of Antwerp, Faculty of Social Sciences, Research group Society and Environment Sint-Jacobsstraat 2, B-2000, Antwerp , Belgium
STSM date	5-16 December 2016
Name of the action	Action IS1408 - Industrially Contaminated Sites and Health Network (ICSHNet)

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List of definitions

Young people - adolescents (10-19 years) and youth (15-24 years) are referred to as young people, encompassing the ages of 10-24 years (1)

Industrially contaminated sites - Areas hosting or having hosted human activities which have produced or might produce environmental contamination of soil, surface or groundwater, air, food-chain, resulting or being able to result in human health impacts (2)

Risk communication - exchange of information about (health or environmental) risks among risk assessors, managers, news media, interested groups and the general public (3)

Risk governance - at the national level, the structure and processes for collective decision making involving governmental and non-governmental actors. At the global level, governance embodies a horizontally organised structure of functional self-regulation encompassing state and non-state actors bringing about collectively binding decision without superior authority (4)

Citizen science - the collection and analysis of data relating to the natural world by members of the general public, typically as part of a collaborative project with professional scientists (5)

Abstract

Background. Policy makers are continually faced with the challenge of making high quality decisions while remaining responsive to the young people those decisions affect. Meeting the industrially contaminated sites challenge in the environmental health policy arena poses particular problems because issues are often technically complex and value-laden, and multiple interests operate in an atmosphere of mistrust. **Methods.** The search set out to include any type of study design on the evidence, experience or evaluation of capacity-building of young people and policy-makers in existing good and new emerging practices in environmental health risk communication and risk governance with young people. Data were searched on Web of Science, Pubmed, Google Scholar databases. Reports in English were included. Additional papers were identified by hand-searching references and contacting experts, non-governmental organizations and young researchers in the field. Database searches yielded 450 abstracts and 4 additional papers were identified. Following screening, 25 full papers were reviewed, of which 8 fulfilled inclusion criteria for the review. Data were extracted from all included papers and synthesized into a narrative review. **Results.** Only a small number of best and new emerging practices for involving youth in environmental health risk communication and risk governance for young people, policy-makers and planners in European region were described. Decision-making designed to maximize the health benefits of any such reduction or remediation of environmental contamination should also take wider considerations into account, including opportunities for personal health-improving activities related to an improved physical, social and economic environment. **Conclusion.** The efforts to effectively build on methodologies to involve groups of young people in the policy research process provides the ideal space for researchers and young carrier investigators to focus on ways to innovate and still uphold the rights of young people to engage in participatory communication and governance.

Keywords. Young people, meaningful participation, active involvement, citizen science, policy making, contamination, pollution, environmental health.

1. Introduction

No problem can be solved from the same level
of consciousness that created it.
Albert Einstein

A significant part of the European population consists out of young people (6) who can play an important and positive active role in shaping the development of present and future contamination patterns as well as providing societal support for healthy arrangements.

After the commitments were made by Member States in the Parma Declaration on Environment and Health in 2010, only about a quarter of the European Region Member States have reported about meaningful youth engagement (6). This indicates that strengthening youth involvement in the World Health Organization European Environment and Health Process still needs significant improvement, and that Member States need to make a greater and more sustained effort to demonstrate a stronger commitment to implementing the Parma commitments to youth across the Region.

As a consequence of poisoning and contamination, when describing the health or risk profile of populations living in the surroundings of contaminated sites, it is necessary to consider proper subgroups by age. In particular young people should be taken into account, given their high sensitivity to environmental agents.

Therefore, policy makers are continually faced with the challenge of making high quality decisions while remaining responsive to the young people those decisions affect. Meeting the industrially contaminated sites challenge in the environmental health policy arena poses particular problems because issues are often technically complex and value-laden, and multiple interests operate in an atmosphere of mistrust. Intergenerational justice is also of relevance, as unsustainable waste management practices leave a toxic legacy behind, adversely affecting people in the future.

1.1. Aim and objectives

Giving special attention to a practice of involving young people in communication activities in contaminated sites, the aim of STSM is to complete a selective international literature search for best and new emerging practices for involving young people in environmental health risk communication and risk governance.

Objectives of the STSM are following:

- To select and analyse international literature on best and new emerging practices for involving young people in environmental health industrially contaminated sites risk communication and risk governance.
- To prepare a report of good and emerging practices in environmental health risk communication and risk governance with young people.

1.2. Participation ladder

This review presents a framework for evaluating mechanisms that involve the young people in environmental decision-making, risk communication and risk governance. *Table 1* shows one or more forms of participation for each aspired level of participation on the participation ladder, going back to Arnstein, 1969 (7). For each rung of the ladder an extended table shows what that level means for the direction of communication (one-way or two-way, indicated by arrows), which forms of participation can be considered, and the advantages and pitfalls associated with this (8).

Table 1. Forms of participation for each aspired level of participation on the participation ladder.

Source: Stakeholder Participation Guidance for the Netherlands Environmental Assessment Agency: Main Document. MNP/RU Nijmegen; 2008.

Aspired level of participation		Direction of communication	Forms of participation	Advantages	Disadvantages/pitfalls
Interactive	Co-decide	PM* <-> SH**	• Not very common in practice • Examples: joint management of nature databases and participation in working groups • The main target group is fellow scientists	• Optimal use of participants' resources • Fulfils democratic motives	• In extreme cases the stakeholders determine the content of PM reports • PM risks losing control
	Co-produce	PM <-> SH	• Interactive scenario-development • Alternation of research and participation; research-led participation	• Increases commitment of participants • Reflective approach to co-production can make a major contribution to the	• Demands open-mindedness from the PM • PM has to commit to results to some extent, which is only possible if everyone is open to this • Intensive process

Aspired level of participation		Direction of communication	Forms of participation	Advantages	Disadvantages/pitfalls
			process • Use of participatory methods	production of knowledge • Ideally, generates support and produces knowledge	• Participants' choice and quality of the facilitator are key factors for success
	Take advice Consult	PM <- SH	• Interactive workshops for: - defining the problem - research design - conclusions • Bilateral sessions • Review of project design and conclusions - written reports - workshops • Themed workshops for knowledge production	• Can result in new perspectives • Highly goal-oriented approach. Can be put into action at key moments in a project	• Less easy for the PM to steer the process; process can produce unintended results • Stakeholders may disagree with the framing; can lead to unrest • Difficult to guarantee transparency
Non-interactive	Listen	PM <- SH	• Set up feedback channels • Keep an eye on the media • Receive complaints, protest and criticism	• PM gets answers to questions it did not ask: prevents tunnel vision • PM is able to draw attention to problems at an early stage	• Difficult to draw a line between where listening brings benefits and where it does not • Can be very time-consuming
	Study	PM <- SH	• Surveys • Interviews • Focus groups	• Large numbers of stakeholders can be reached with relatively little effort • Information can be collected in a very targeted way	• A strong framing effect may occur: other factors which were not asked about may be relevant
	Inform	PM-> SH	• Presentations	• Takes relatively little time and effort	• Can cause dissatisfaction among stakeholders • No opportunity to make a contribution, no 'real' participation
	No participation	PM SH	None	• Project receives little attention. Under certain circumstances, this may be desirable	• No feedback • No utilisation of external sources of information • No legitimisation

*PM – policy makers, SH** - stakeholders

This framework distinguishes between an interactive and non-interactive approach. For instance, surveys of the views of stakeholders ("What does the population think?") are often considered to be participation, but they are not participation in the strict sense, because the element of interaction is absent if no feed-back is provided on further use of the input. Surveys or group interviews are tried and tested methods of social science research which can produce very useful information and, depending on the objective of the practice or research, may be preferable to interactive methods, but they are not participation (8).

1.3. Policy and project management cycles.

Policy and managements cycles are systematic processes showing how environmental and social issues as well as other public problems are acknowledged and processed in policymaking towards solutions in different, step-by-step sequences (9).

Progression through the policy cycle is intentionally iterative in a sense that policy activities are recurrent and instruments are also used repetitively to effectively solve the pressing problem (10). Policies are formulated through a policy process that engages stakeholders in producing new or revised policies within a particular institutional context (11).

1.4. Citizen science

Citizen engagement in scientific and technological projects, or so-called citizen science, has been widely seen as providing opportunities for education and communication to reduce the remaining distance between laypeople and science (12). It is typically proposed as a win-win situation where citizens are offered the possibility to contribute to scientific research projects designed by professional researchers. Prevailing interpretations consider that through their participation, citizens increase their interest in scientific learning (13) while contributing to the development of projects of scientists (14). By contrast, a less empirically explored and documented conceptualization of citizen science understands citizens as active agents capable of developing science that can potentially address their needs and concerns (15). Such an approach is translated into activities intended to build capacities among citizens to have a meaningful voice in scientific practice while addressing the prevailing perception that scientific research and scientists are removed from societal concerns and needs (16). As citizen science in this second interpretation can be understood as joint knowledge production,

the concept represents an additional field of practices in youth participation to risk governance.

2. Methods

This literature review formed part of the Short Term Scientific Mission, which focuses on best and new emerging practices for involving adolescents and young people in environmental health risk communication and risk governance. An investigation of existing evidence-based strategies and practices is an important precursor of the COST Action IS1408 *Industrially Contaminated Sites and Health Network* (ICSHNet), since one of its objectives is to build the capacity of policy-makers and young people to strengthen the environmental health management of industrially contaminated sites.

2.1. Eligibility criteria

In view of the anticipated scarcity and heterogeneity of relevant literature, the criteria used for selection of studies into this review were intentionally broad and inclusive. The review set out to include any type of study design, review or report on the evidence, experience or evaluation of capacity-building of young people and policy-makers in existing good and/or new emerging practices in environmental health risk communication and/or risk governance with young people. Papers published in English (time period 1996 - December 2016) were included. The envisaged regional spread was among European region and articles that reported from very low-income countries were excluded in order to keep control on the homogenity of domestic contexts. Cases, developed in deprived areas or disadvantaged communities however, were included. Studies examining adult populations, i.e., the mean/median age of at least 18 as criterion or - when it was not possible to have direct information on that - it clearly concerned an adult population.

2.2. Search strategy

The following electronic bibliographic databases were searched on 6-9 December 2016: Web of Science and Pubmed. This number comprises 298 papers identified in the first database search up to 8 December 2016, a further 152 papers identified in the second database search up to 9 December 2016 and 4 papers identified by contacting experts or key informants, hand-searching references, and searching the internet. In addition to database searches, the

reference lists of included papers were hand-searched for relevant studies, experts, non-governmental organizations and young researchers in the field were contacted to identify any further studies (*Annex 1*). Grey literature including reports and web-based resources were identified via the Google Scholar search and young experts in the field who shared their opinions and perception of youth communication activities in the field of industrially contaminated sites (17).

2.3. Study selection and data extraction

In the search, the 412 papers excluded at the stage of abstract review were either not eligible for inclusion due to their subject matter, because they were duplicates, based in low income countries or due to language (*Annex 2*).

In regards to the literature search, it was considered and defined that a good practice of involving the young people in environmental decision-making, risk communication and risk governance is the one which shows interactive two-way communication aspired level of participation. Studies with a mere focus on informing, educating and sensitizing young people or youth, stayed out of our scope. In addition, studies and practices were considered as new emerging when the overarching objective is youth-initiated, directed and controlled and young people behave as autonomous learners, they think critically about their actions and decisions regarding scientific practice and policy.

3. Results of the review

Following the process of systematic searching, 8 papers fulfilled the inclusion criteria and were included in this review.

Included papers describe 4 interactive and two-way communication good and emerging practises listed in the *Table 2* where young people were actively involved in an attempt to have their voice heard in the decisions that affected their lived-lives and for them to exercise their rights and duties as citizens by using research and policy as a tool for change. One intervention aimed to explore the potential of citizen science approach to drive transformative learning, understood as students' empowerment and increased capacities to think as autonomous learners of science within collaborative contexts (18). Another intended to empirically explore, and build theory upon, how teenagers construct their political action from

a constructivist approach a suitable method (19). The scope of the third practice was to review the relationships between human health and the environment by implementing participatory initiatives (20) and the last study aimed to demonstrate that communities can affect policy decisions if they are organized, informed and committed to the issue and the process (21).

Table 2. Summary of interactive practises, main achievements and lessons learned

Interactive practice intervention	Achievements and lessons learned
Students and researchers co-created a research project based on a question generated by the students (18)	For secondary school students it was a transformative learning experience, because: (i) relationships and interactions were characterized as transparent and trust building and were elective, not imposed (ii) participants were engaged in a continuous deliberative process about the meaning and rationality of their actions, decisions, achievements, or limitations while conducting research (iii) based on the philosophy of slow science the project was planned on a long-term, flexible basis (3-10 years), had no performance targets, but had some task deadlines
Workshop and interviews (19)	Activists aged between 17 and 19, constructed their political action as 4 different processes: (i) moving from consciousness to action (ii) moving from personal experience to shared goals (iii) moving from social activities to political activities (iv) moving from single to multiple arenas
Workshop discussion (20)	Understanding of the relationships between human health and the environment was improved by implementing the following steps: (i) Construction of the problems - the role of the community, or general public, in identifying a local health problem depends similarly on the recognition of a common cause for concern (ii) Identification of contamination causes, responsibilities of citizens and stakeholders to tackle the environmental health pollution (iii) Important value in the process: communication, trust and time
Multi-faceted community-based participatory research program (21)	Achievements: (i) framework was mutually established to inform, educate and empower the community to take control of their own destiny (ii) increased capacity of community members to perform research on issues of concern and present findings in appropriate contexts (iii) findings have important implications for pollution prevention, risk reduction activities and strategies, and environmental health policy for other economically disadvantaged and overburdened communities

Two other articles specifically focused on literature review by analysing the legacy of young people's involvement in policy research (22) and providing a common understanding of means to solve complex problems involving both the environment and human health as well

as to stimulate new ways of working for the improvement of health in contaminated situations and areas for research (23). Results show that the formulation of strategies for improving human health in contaminated situations should ideally involve representatives of all stakeholder groups, who should be informed by the best possible scientific and medical advice. This will include improved methods of risk assessment, which may lead to recommendations of reduced human exposure via restrictions on emissions and remediation of contamination. But overall, decision-making designed to maximise the health benefits of any such reduction or remediation of environmental contamination should also take wider considerations into account, including opportunities for personal health-improving activities related to an improved physical, social and economic environment.

4. Discussion and conclusions

The efforts to effectively build on methodologies to involve groups of young people in the policy research process provides the ideal space for researchers and young carrier investigators to focus on ways to innovate and still uphold the rights of young people to engage in participatory communication and governance. Involving young people in decision making and research matters; for policy makers and supervisors of research projects in contaminated sites thinking outside the box approach is important:

- Young people can engage in research without any prior research skills training because young people are able to design their own experiments, to analyze data, and to reflect on results by applying their scientific and political knowledge that is meaningful in their own societal context.
- Overarching objective should be about youth-initiated, directed and controlled practice and young people to behave as autonomous learners and to think critically about their actions and decisions regarding scientific practice and policy. Most of these skills, values, and attitudes (e.g., critical thinking, individual responsibility, ability to work as part of a team) have been identified in studies (24) as important for citizens to acquire in order to participate effectively not only in scientific research but also in their daily life activities.
- Policy officers and decision-makers should not judge what young people have to say in research by using the same scientific and policy standards as well as criteria used to determine

the credibility and trustworthiness of professional research; relationships and interactions should be characterized as transparent and trust building.

Lack of existing research data

The process of literature review has shown the existing lack of specific research data in the field of industrially contaminated sites and involvement of youth in environmental health risk communication and risk governance. Furthermore, the few published descriptions of practices and studies are difficult to compare due to methodological differences as well as geographical spread. For instance, many industrially contaminated sites have traditionally been located in run-down areas with high unemployment rates, so that conflicts between economic interests and the impact on environmental quality and people’s health is a common problem (afterwards) that generates great concern and controversy among residents (6). Researches network of COST Action IS1408 Industrially Contaminated Sites and Health Network could be a platform to gather new data and document aforementioned initiatives and practices.

Youth participation in policy making, risk governance and communication: a mixed picture

Following the Rules for Participation in and Implementation of COST Activities (25), it is known that COST aims to encourage participation of young talents and next generation leaders in science and technology, promote working opportunities for early career investigators (26). It is essential to give the involvement opportunity and visibility to young people participating in the processes focused at both dealing with industrially contaminated sites and promoting health. Review emphasizes that young people due to their creativity and dynamism are capable to provide new perspectives to old problems. Moreover, the meaningful participation raises awareness of the responsibility young people carry towards the environment as future decision-makers and inhabitants of the planet and thus familiarizes them with the processes required for designing and implementing research and policies related to health and environment (17). The review also showed some challenges young people face in the research and policy process. Youth efforts to bring about these processes were not always fruitful because, as their political action gained complexity, youth faced greater constraints for challenging power due to age-based exclusion, state-centered definitions of politics, and adult disinterest in youth demands (22).

Practise implemented in Sweden (19) reported a barrier towards age group. Usually 16-19 years old students fell outside the scope of civil society organizations due to consideration that this age group is related to adult life and young adults.

5. Future collaboration with the host institution

The future collaboration with the host institution will be focused on identification of new practises emerging youth involvement in environmental health risk communication and governance and dissemination of resulting main outcomes among *WG4 Risk management and communication* members. Cases, identified by the COST-network and already documented, could be screened within Working Group 4. Cases not yet described, could be encouraged to report and publish their design and results.

6. Dissemination and communication of STSM results

The results of good and emerging practices description will provide governments, local authorities, young people groups, COST Action members with resources and guidance on how to contribute to effective communication with the local population, media and other stakeholders in the field of industrially contaminated sites.

D. Adamonyte and Prof. I. Loots submitted the manuscript of the report *Search for best and new emerging practices for involving youth in environmental health risk communication and risk governance* for the WHO Public Health Panorama Journal on "Environment and health: challenges old and new" (June 2017 issue). Also participants of the STSM are intended to publish results of the report in the Third Plenary Conference of the COST Action which will be held in Aristotle University Of Thessaloniki, Research Dissemination Center, Thessaloniki, Greece (6-7 February 2017).

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Annex 1. Search strategy

Keywords. Young people, meaningful participation, active involvement, citizen science, policy making, contamination, pollution, environmental health.

- **Young people**

  Search: (adolescen* OR teen* OR child* OR youth OR young*)

- **Risk communication AND risk governance AND citizen science AND policy making**

  #1 Search: (risk communicat* OR risk governan* OR citizen science)

  #2 Search: (activism OR political action* OR community involv* OR movement*)

  #3 Search: (youth perception* OR active involv* OR meaningful participat*)

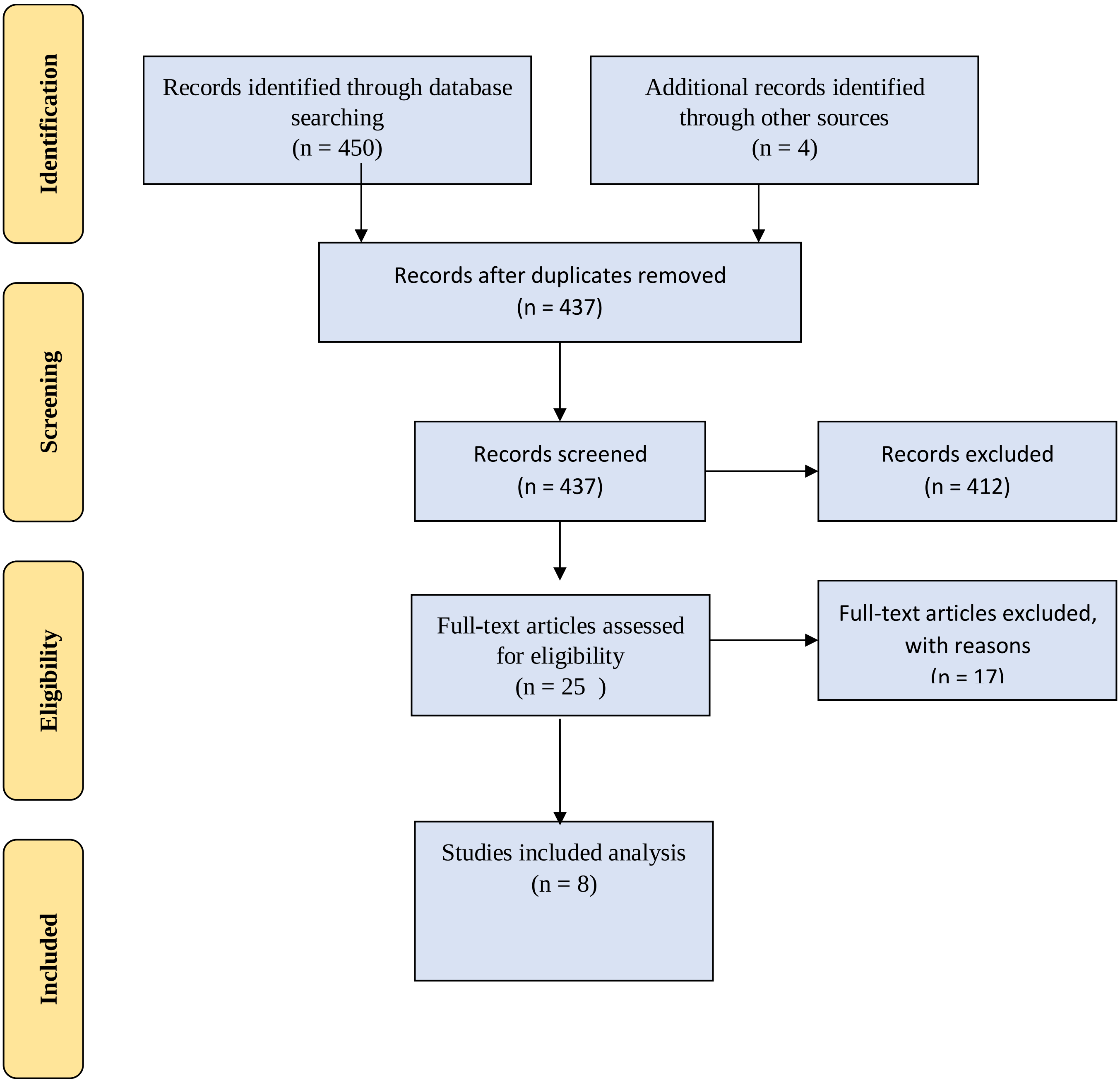
- **Contamination AND pollution AND environmental health**

  #1 Search: (industrial contaminated site* OR contaminated)

  #2 Search: (environment* OR natur* OR contaminated OR pollution)

- **Timespan:** 1996-2016.
- **Regional spread:** European countries
- **Language:**English

Annex 2. PRISMA flow diagram for selection of articles



Annex 3. Timeframe of STSM

Tasks	**December 2016**											
	5	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Introductory meeting and development on STSM items	+											
Selection of literature		+	+	+								
Review of literature					+	+	+					
Report writing								+	+	+		
Outcomes and self-evaluation											+	+
Travelling												+

Annex 4. Confirmation by the host institution of the successful execution of the STSM

Antwerp, 9/1/2017

Iavarone Ivano

Environmental Epidemiology Unit, Department of Environment And Primary Prevention

Italian National Institute of Health

Head, WHO Collaborating Centre for Environmental Health in Contaminated Sites

and Chair of the COST ACTION IS1408

Industrially Contaminated Sites and Health Network (ICSHNet)

Pietro Comba

appointed STSM Coordinator COST Action IS1408

Istituto Superiore di Sanità

Rome, Italy

Ilse Loots,

UAntwerpen, Research group S&E, FSW and IMDO, Belgium

Host institution

Ref. Confirmation of the successful execution of the Short Term Scientific Mission related to COST Action IS1408

Dear Ms. Dovile Adamonyte,

After your stay at the Research group Society and Environment of the University of Antwerp, I would like to confirm the successful execution of your Short Term Scientific Mission during the period 5-16 December 2016, supporting Working Group 4 activities of the Cost Action IS1408 "Industrially Contaminated Sites and Health Network (ICSHNet)". The work has been fruitful and it was a very nice experience to cooperate with such a skilled visitor.

Best regards,

Professor at the University of Antwerp, Faculty of Social Sciences and IMDO, Antwerp, Belgium

Univerza v Ljubljani Medicinska fakulteta

Department of Public Health
Zaloška 4
1000 Ljubljana, Slovenia
tel. 01 543 75 40
fax. 01 543 75 41
e-mail: marjan.bilban@zvd.si

Kuopio, April 12, 2017

Mr. Pietro Comba, PhD (STSM coordinator)
Head, Unit of Environmental Epidemiology
Department of Environment and Primary Prevention
Istituto Superiore di Sanità
Viale Regina Elena 299
Italy

Subject: **STSM Scientific Report during the period 2th-12th April 2017, "Industrially Contaminated Sites and Health Network (ICSHNetwork)" related to the COST Action IS1408**

Purpose of the visit	1. Introduction with **methods and tools for health risk (HRA) and impact assessment (HIA)** for the industrial hot spot (general, applicable for Slovenian cases). 2. Preparing **systematic review of health risk and impact assessment** for the industrial hot spot (research strategy, health and environmental data, how are in analysis included social determinants and other environmental determinants, which tolls and methodology was used in epidemiological research, general conclusion, future research) which will be useful for WG3 of COST IS1408. 3. Discuss the needed **health and environmental data, tools and methods for HRA and HIA analysis in Slovenia** (two examples): a. Zasavje region which is the most polluted are in Slovenia due to outdoor air pollution and soil contamination and b. in the field of indoor air quality in school environment (example of best practices in Finland, methodology how assess the HRA and HIA). 4. Preparing **scientific article based on systematic review of HRA and HIA** for the industrial hot spot. 5. Discussion on **future scientific collaboration** in another example of industrial hot spot in Slovenia and Finland.
Description of the work carried out during the visit	1. Based on the literature review and discussion with colleagues from THL, Kuopio who had experiences in this field I have during my STMS visits **improve the knowledge above HIA and HRA**. We have been very applicable and try to discuss how we could methods and tools based on HIA and HRA implemented in different environmental health determinants related to assess and reduce burden of diseases in ICS. I will also implement these approaches in Slovenia. 2. Before we have start with preparing the strategy for **systematic review article**, we have the welcome meeting. It was very useful because we meet together especially our research topic and that very help me organize the future activities for preparing review article. 3. Based on different industrial hot spots in Slovenia (Zasavje region, Celje, Mežica) we discussed above **different methods and tolls for HIA and HRA**. We discussed above availability of routinely collected health and environmental data in

	Slovenia and Finland. Based on this discussion we try in the future to prepare project proposal(s) and research articles (eg. Birth outcomes and burden of diseases related to environmental contaminants). 4. I and my co-worker in **review papers** have prepared research strategy, based on exclusion and inclusion criteria, we identify the useful article for final analysis and we start with analysis of article above HIA and burden of diseases in ICS. We will continue with these activities also after my STSM. The colleges from THL, Kuopio introduce me with actual project in THL in the field of outdoor air pollution, indoor air pollution, water contamination, radiation. 5. In Environment and Health seminar (April 12, 2017) I have opportunity to present my work related to my PhD thesis. The title of seminar was "Analysing outdoor air pollution effects on (pre)school children in Slovenia" (Appendix 1).
Description of the main results obtained and Projected publications/articles resulting or to result from the STSM	During the STSM in THL, Kuopio in collaboration with colleges who worked there I have: • improved the knowledge above HIA and HRA and how we could these methods and tools used in ICS also in Slovenia. • prepared a research strategy of review articles above HIA and HRA related to burden of diseases in ICS, found useful article and start with analysis (Appendix 2).
Future collaboration with host institution	• Finalize the systematically review articles and publish. Preparing good examples for COST action IS1408. • Collaboration in the different actual European and national projects (outdoor and indoor air pollution). • Preparing proposals for future collaboration in European and national project in the field of environmental and social determinants related to burden of diseases.
Confirmation by the host institute of the successful execution of the mission	In attachment: Letter of Completion of THL, Kuopio
Other comments	STSM is a good challenge for researchers from main reasons: • knows experts from different part of sciences they work, research, skills, • exchange of scientific experience with other experts, • planning future collaborations in different projects and • preparation of scientific articles from interdisciplinary point of view. It was good STSM exchancing experinces in the THL, Kuopio especially I would like to thank professor Otto Hänninen and his co-workers. It was in my pleasure to have an opportunity to work with them.

With kindest regards,

Andreja Kukec

Environment and Health seminar

ANALYSING OUTDOOR AIR POLLUTION EFFECTS ON (PRE-)SCHOOL CHILDREN IN SLOVENIA

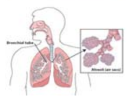
Andreja Kukec

PhD thesis:
https://repozitorij.ung.si/Dokument.php?id=2662&lang=slv

Kuopio, April 2017

Quality of outdoor air pollution is one of the major public health problem

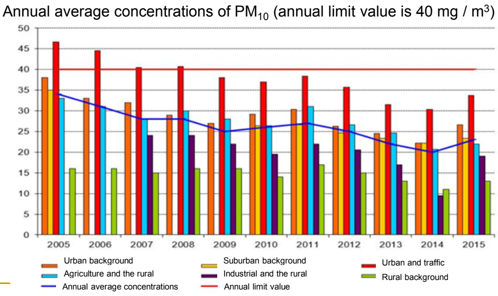
- adult daily inhaled from **10 to 20 m³ of air**
- outdoor air pollution - **a mixture** of different **pollutants** (the spread of pollutants, complex terrain)
- **health effects**: respiratory diseases (asthma, COPB), cardiovascular diseases (stroke), birth outcomes
- **vulnerable population groups**: children, elderly, patients with chronic diseases



AIR QUALITY DATA in Slovenia

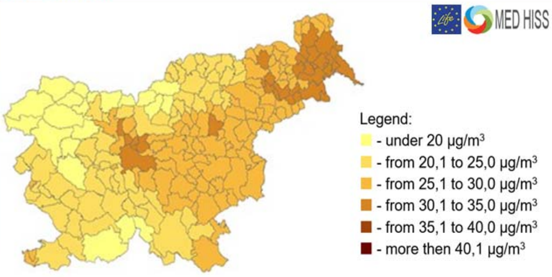
- **Outdoor air pollution level** (Monitoring station, Slovenia Environmental Agency)
  - SO_2, (in the past), PM_{10}, O_3

Annual average concentrations of PM_{10} (annual limit value is 40 mg / m³)



AIR QUALITY DATA in Slovenia

Concentration of annual mean of PM_{10} µg/m³ at municipalities level in all country in 2011

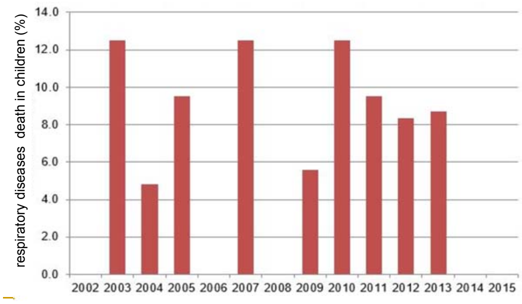


RESPIRATORY DISEASES BY CHILDREN in Slovenia

- Data sources
  - **routinely data collection** from medical record (mortality and hospitalization databases, National institute of public health)
  - **cross-sectional** and **ecological** studies
  - **environmental indicators portal** (Slovenian environmental agency and National institute of public health)
    - **Infant mortality** due to respiratory diseases **(year 2013; EU: 12.9%, Slovenia: 8.7%)**
    - **Asthma and allergic** diseases in children (**prevalence** of asthma **16 % by children** 1 to 8 years)
    - **Exposure** of Slovenian population and **children to PM_{10}** in outdoor air pollution (**15% of children are exposed** to the concentration between **30 and 40 µg PM_{10} / m³**)

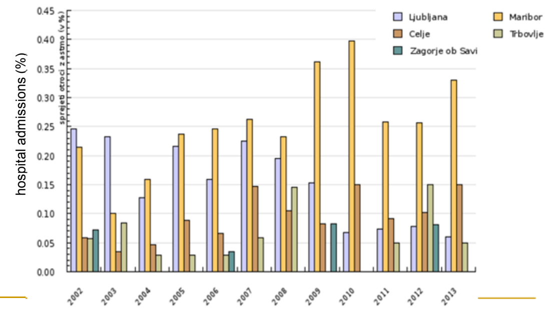
INFANT MORTALITY due to respiratory diseases in Slovenia

Respiratory diseases (ICD, J00-J99) death by children in Slovenia in the period 2002-2015



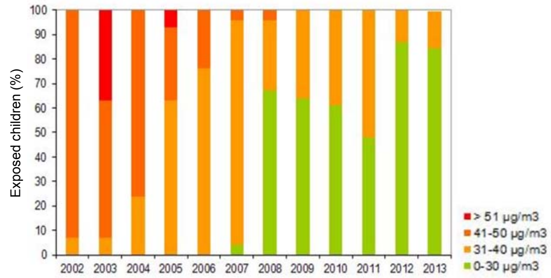
ASTHMA and ALLERGIC diseases by children in Slovenia

Asthma hospital admissions of children (0-14 years) in the period 2002-2013



EXPOSURE of Slovenian children to PM_{10} in outdoor

Exposure of children (0-15 years old) concentrations of PM_{10} in outdoor air in Slovenia in the period 2002-2013



THE ZASAVJE REGION

- **very complex terrain**
- **industrial contaminated sites: numerous sources** (18) of outdoor air pollution (Cement plant, Termal power plant, Glass industry, Chemical plant), coal mine in the past
- **outdoor air pollutants** (SO_2, PM_{10}, O_3)
- social-economic conditions

OVERALL AIM

To assess the association between the frequency of consultations in Community Health Centers due to respiratory diseases in children and outdoor air pollution in Zasavje region

RESEARCH PROCESS: SIX PHASES

Ph1: quality and completeness of health data

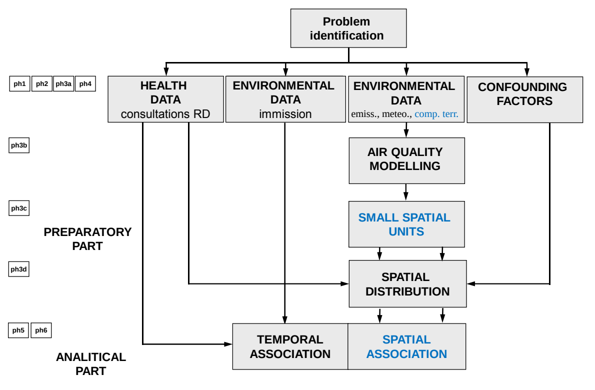
Ph2: quality and completeness of air quality data (fixed measurement stations)

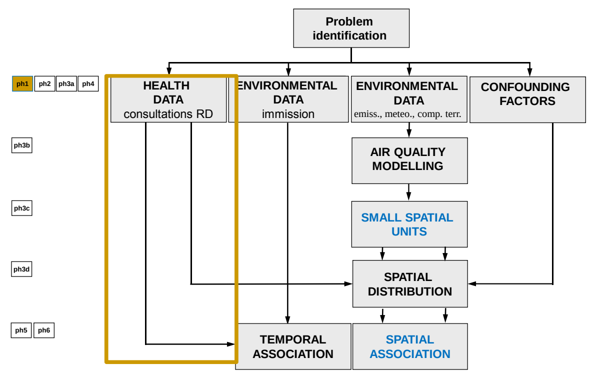
Ph3: air quality modelling process (dispersion of observed pollutants)

Ph4: prevalence of acute and chronic respiratory diseases and potential confounders data

Ph5: daily temporal association between respiratory disease and air quality

Ph6: spatial association between respiratory disease and air quality (grid 200 x 200 m)





Ph1: quality and completeness of health data

AIM

To assess the quality and completeness of health data on consultations due to respiratory diseases in the community health centers and to describe the temporal variability of health data

Ph1: quality and completeness of health data

METHODS

Period and units of observation

- January 1, 2006 - December 31, 2011; **single days** (N=2.191)

Data sources

- **health information systems** (community health centres)
- **daily number of consultations** due to the respiratory diseases by children (**first**: newly discovered diagnosis, or acute exacerbation of chronic disease, **follow-up**: further consideration of the known chronic disease, **short**)

WHO International Classification of Diseases, version 10 (ICD-10)

- J00-J06 (acute upper respiratory tract infection),
- J10-J18 (influenza and pneumonia),
- J20-J22 (other acute lower respiratory tract infection),
- J30-J32 (other diseases of upper respiratory tract) and
- J40-J46 (chronic lower respiratory tract disease).

Ph1: quality and completeness of health data

METHODS

Assessment of the quality and completeness of data

- clear distinction of consultations (respiratory diseases and **other diseases)**
- clear distinction (**different types** of respiratory diseases consultations)

Study design

- ecological temporal variability study

Ph1: quality and completeness of health data

RESULTS

Assessment of the quality and completeness of data

– clear distinction between consultations due to **various disease** YES

– clear distinction between **different types** (first, follow-up, short) of **respiratory diseases** consultations YES

– **completeness** of the available data (all time of observation, geocoding data) YES

– **problems** with the **usefulness** of the health data (difference of diagnostic coding)

Ph1: quality and completeness of health data

RESULTS

The number of children in the municipalities of the Zasavje region, Slovenia, who visited the community health centres due to any chronic respiratory disease from January 1, 2006 to December 31, 2011, organised by the year of observation.

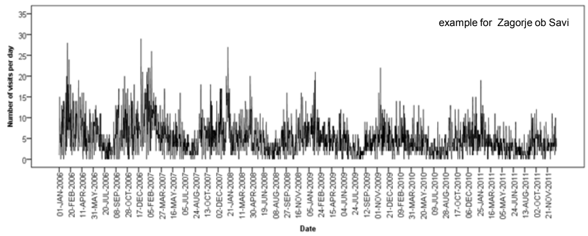
Year	Municipality								
	Zagorje			Trbovlje			Hrastnik		
	N_{pop}	N_{CRD}	$\%_{CRD}$	N_{pop}	N_{CRD}	$\%_{CRD}$	N_{pop}	N_{CRD}	$\%_{CRD}$
2006	1715	22	1.28	1394	66	4.73	907	21	2.31
2007	1710	21	1.23	1390	70	5.03	905	15	1.66
2008	1719	16	0.93	1397	74	5.29	909	26	2.86
2009	1745	27	1.55	1422	76	5.34	896	15	1.67
2010	1761	23	1.31	1422	64	4.50	902	27	2.99
2011	1797	23	1.28	1443	36	2.49	890	14	1.57

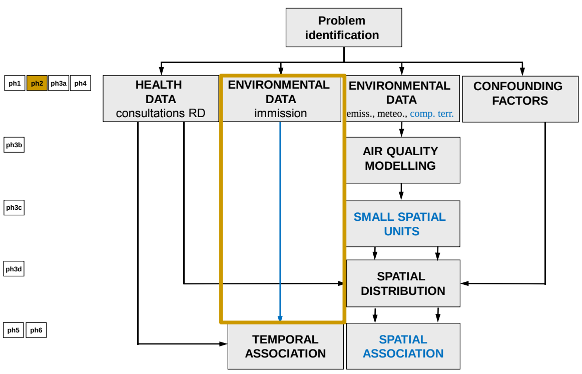
Abbreviations: N_{pop} – number of all children in the population; N_{CRD} – number of children who visited the community health centre due to any chronic respiratory disease; $\%_{CRD}$ - percentage of children who visited the community health centre due to any chronic respiratory disease.

Ph1: quality and completeness of health data

RESULTS

Description and temporal variability of data





Ph2: quality and completeness of air quality data

AIM

To assess the quality and completeness of immission data collected in the system of National automated network for monitoring air quality and to describe the temporal variability

Ph2: quality and completeness of air quality data

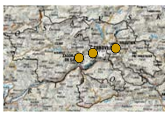
METHODS

Period and units of observation

- January 1, 2006 - December 31, 2011; **single days** (N=2.191)

Data sources

- **three fixed measuring stations**
- daily concentration of PM_{10}, SO_2, NO_2, O_3



Assessment of the quality and completness of data

- monitoring of outdoor air pollutants
- measurement failures

Study design

- ecological temporal variability study

Ph2: quality and completeness of air quality data

RESULTS

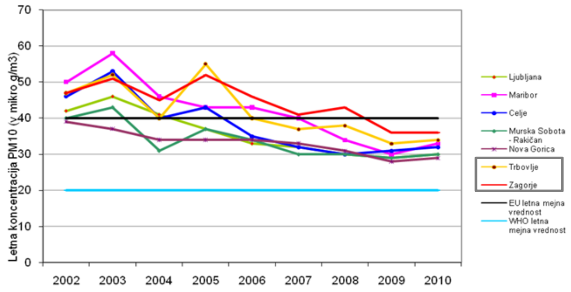
Assessment of the quality and completeness of data

- **completeness** of the available data **NO**
  - **monitoring of outdoor** air pollutants at all three measuring station (lack of measurements of certain pollutants)
    - PM_{10}, SO_2, O_3: Zagorje, Hrastnik (PM_{10} from 2010), Trbovlje (NO_2)
    - not measurements $PM_{2.5}$, chemical compositions
  - **measurement failures**
    - certain percentage of data missing in all observed pollutants (2.5-9.5%)
    - inspecting or calibrating the measuring device or a blocked filter

Ph2: quality and completeness of air quality data

RESULTS

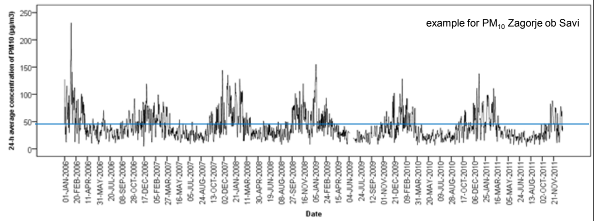
PM_{10} concentrations (annual average concentration)

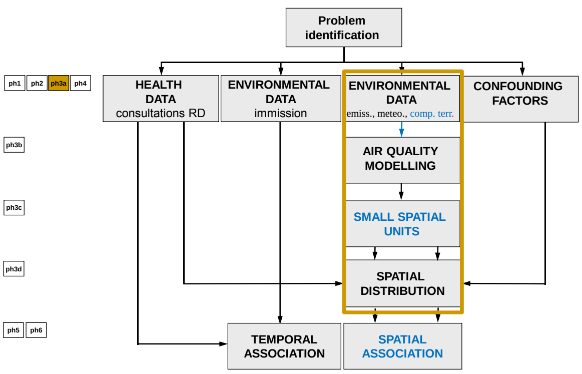


Ph2: quality and completeness of air quality data

RESULTS

Description and temporal variability of data





Ph3: air quality modelling process

AIM

To assess the level of outdoor air pollutants in Zasavje region at the level of small spatial units (grid 200 x 200 m) and to describe their spatial variability

Ph3: air quality modelling process

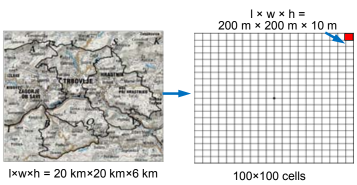
METHODS

Period of observation

– 1-year (January 1, 2011 and December 31, 2011)

Process of modelling dispersion of air pollution (4 steps)

AREA OF MODELLING → INPUT DATA → PROCESS → OUTPUT



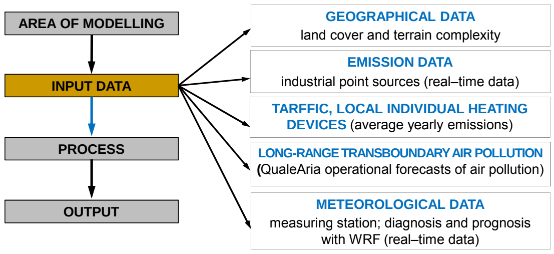
Ph3: air quality modelling process

METHODS

Period of observation

– 1-year (January 1, 2011 and December 31, 2011)

Process of modelling dispersion of air pollution (4 steps)



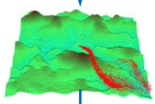
Ph3: air quality modelling process

METHODS

Process of modelling dispersion of air pollution (4 steps)

AREA OF MODELLING → INPUT DATA → **PROCESS** → OUTPUT

Numerical Lagrangian particle model SPRAY with the Monte Carlo simulation



Half-hourly concentrations in each cell for PM_{10}, SO_2, NO_2

2017-04-11 Kukec A., 2013: Outdoor air pollution and school children (PhD theses) 31

Ph3: air quality modelling process

METHODS

Process of modelling dispersion of air pollution (4 steps)

AREA OF MODELLING → INPUT DATA → PROCESS → **OUTPUT**

Half-hourly concentrations in each cell for PM_{10}, SO_2, NO_2

PM_{10} average summer and winter modelled concentrations

SO_2 average annual modelled concentrations

NO_2 average annual modelled concentrations

Maps (colour-coded levels of modelled concentrations)

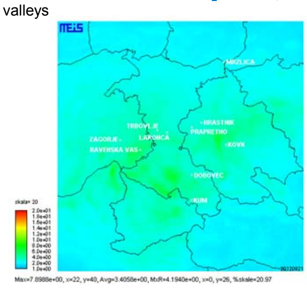
2017-04-11 Kukec A., 2013: Outdoor air pollution and school children (PhD theses) 32

Ph3: air quality modelling process

RESULTS

Estimation of dispersion of air pollutants

– modelled concentrations of SO_2 do not tipically spread through the three side valleys



Spatial variability
example for SO_2 annual average

- – negligible level (≤ 4 ug/m³)
- – low level (4.1 – 8 ug/m³)
- – moderate level (8.1 – 12 ug/m³)
- – noticeable level (12.1 – 16 ug/m³)
- – the level of PM_{10} reaching the limit value (16.1 – 20 ug/m³)
- – the level of PM_{10} exceeding the limit value (≥ 20.1 ug/m³)

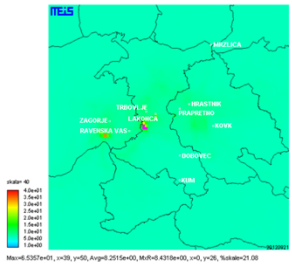
2017-04-11 Kukec A., 2013: Outdoor air pollution and school children (PhD theses) 33

Ph3: air quality modelling process

RESULTS

Estimation of dispersion of air pollutants

– modelled concentrations of **PM_{10}** spread with prevailing winds from the biggest polluters in the direction of the three side valleys



Spatial variability
example for PM_{10} winter average

- – negligible level (≤ 8 ug/m³)
- – low level (8.1 – 16 ug/m³)
- – moderate level (16.1 – 24 ug/m³)
- – noticeable level (24.1 – 32 ug/m³)
- – the level of PM_{10} reaching the limit value (32.1 – 40 ug/m³)
- – the level of PM_{10} exceeding the limit value (≥ 40.1 ug/m³)

2017-04-11 Kukec A., 2013: Outdoor air pollution and school children (PhD theses) 34

Ph3: air quality modelling process

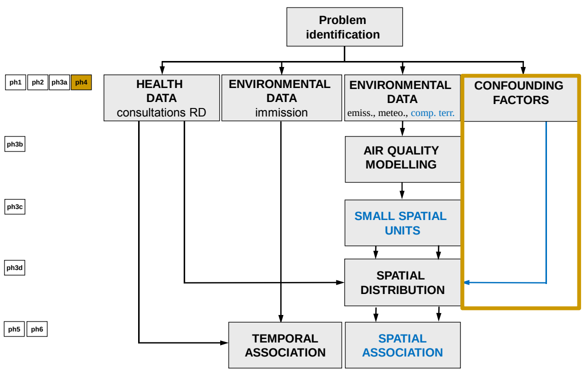
RESULTS

Problems with input data

- completeness of emission data NO
  - only for 5 industrial sources of 18
  - data available for two biggest sources (thermal power and cement plants)
  - only for the year 2011

KUKEC, A, BOŽNAR, MZ, MLAKAR, P, GRAŠIČ, B, HERAKOVIČ, A, ZADNIK, V, ZALETEL-KRAGELJ, L, FARKAŠ-LAINŠČAK, J, ERŽEN, I. Methodological approach in determination of small spatial units in a highly complex terrain in atmospheric pollution research : the case of Zasavje region in Slovenia. Geospatial Health, 2014, 8 (2): 527-535.

2017-04-11 Kukec A., 2013: Outdoor air pollution and school children (PhD theses) 35



2017-04-11 Kukec A., 2013: Outdoor air pollution and school children (PhD theses) 36

Ph4: prevalence of respiratory diseases and potential confounders data

AIM

To assess the prevalence of acute and chronic respiratory diseases by children in Zasavje region and to identify major potential confounders data in the region to be included into spatial analysis

Ph4: prevalence of respiratory diseases and potential confounders data

METHODS

Study design

- cross-sectional study, February / March 2008
- **schoolchildren** of Zasavje from 1th to 5th grade of primary school (6-11 years of age, in total 1790 schoolchildren)

Data collection and analysis

- questionnaire
  - **Chronic respiratory diseases** diagnosed by a physician (asthma, chronic bronchitis, mucoviscidosis, bronchiectasiae, etc.)
  - **Acute respiratory diseases** (wheeze, runny nose, etc.)
    - child's past and present health status; exposure to **potential confounding factors**: outdoor and indoor air conditions, smoking habits, living conditions, socio-economic conditions
- methods of analysis (logistic regression)

Ph4: prevalence of respiratory diseases and potential confounders data

RESULTS

Response rate

- 65.5 % (1172 of 1790)

Table 1 *Description of schoolchildren residing in Zasavje, Slovenia, that responded to the survey on impact of outdoor air pollution on respiratory diseases burden in Zasavje, 2008*

Characteristic		N_{tot}	N_{cat} (%)
Sex	Boys	975	476 (48.8)
	Girls		499 (51.2)
Grade	1st (6 to 7 years old)	980	168 (17.1)
	2nd (7 to 8 years old)		171 (17.4)
	3rd (8 to 9 years old)		216 (22.0)
	4th (9 to 10 years old)		209 (21.3)
	5th (10 to 11 years old)		216 (22.0)
Estimated level of outdoor air pollution of permanent residence area	Low	951	268 (28.2)
	Moderate		308 (32.4)
	High		375 (39.4)

Legend: N_{tot} *= total number of respondents;* N_{cat} *= number of respondents within the category.*

Ph4: prevalence of respiratory diseases and potential confounders data

RESULTS

Prevalence of chronic and acute respiratory diseases

Exposure assessment (estimate of outdoor air pollution level)	PREVALENCE (%) **chronic respiratory diseases**	PREVALENCE (%) **acute respiratory diseases**
low pollution areas	**3.0** (8 of 268)	**7.8** (21 of 268)
moderate pollution areas	**7.5** (23 of 307)	**13.3** (41of 308)
high pollution areas	**9.7** (36 of 371)	**15.9** (59 of 372)
	(p= 0.005)	**(p= 0.017)**

KUKEC, A, FARKAŠ-LAINŠČAK, J, ERŽEN, I, ZALETEL-KRAGELJ, Li. A prevalence study on outdoor air pollution and respiratory diseases in children in Zasavje, Slovenia, as a lever to trigger evidence-based environmental health activities. Arhiv za higijenu rada i toksikologiju, 2013, 64 (1): 9-22,

Ph4: prevalence of respiratory diseases and potential confounders data

RESULTS

Table 3 *Results of logistic regression analysis of impact of level of outdoor air pollution on chronic respiratory diseases in 780 schoolchildren residing in Zasavje, Slovenia, that responded to the survey on impact of outdoor air pollution on respiratory diseases burden in Zasavje, 2008*

Explanatory/confounding factor		OR	95 % C.I. limits for OR lower	95 % C.I. limits for OR upper	p
Estimated level of outdoor air	Low	1.00			
pollution of permanent	Moderate	2.27	0.93	5.54	0.071
residence area	High	2.91	1.21	7.00	0.017
Sex	Girls	1.00			
	Boys	1.55	0.87	2.76	0.141
Age	8 years or less	1.00			
	9 years or more	0.95	0.51	1.76	0.872
Family history of chronic	No	1.00			
respiratory disease	Yes	2.27	1.25	4.13	0.007
Pregnancy complications	No	1.00			
	Yes	1.46	0.81	2.65	0.211
Smoking of mother during	No	1.00			
pregnancy	Yes	1.31	0.59	2.88	0.507
Distress of mother during	No	1.00			
pregnancy	Yes	0.85	0.39	1.85	0.689
Child's health complication just	No	1.00			
after the delivery	Yes	0.91	0.35	2.38	0.855
Breast-feeding duration	8 months or more	1.00			
	Less than 8 months	2.59	1.32	5.07	0.006

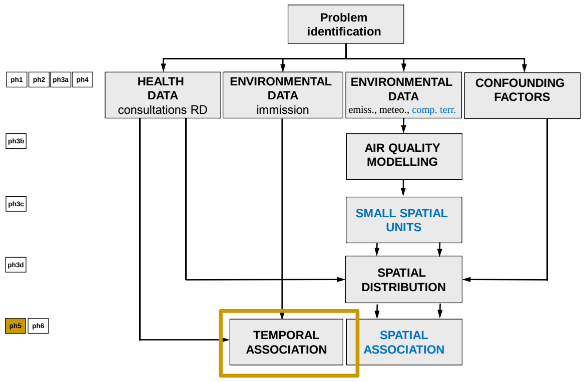
Ph4: prevalence of respiratory diseases and potential confounders data

RESULTS

Table 3 *Results of logistic regression analysis of impact of level of outdoor air pollution on chronic respiratory diseases in 780 schoolchildren residing in Zasavje, Slovenia, that responded to the survey on impact of outdoor air pollution on respiratory diseases burden in Zasavje, 2008*

Explanatory/confounding factor		OR	95 % C.I. limits for OR lower	95 % C.I. limits for OR upper	p
Exposure to passive smoking in	No	1.00			
early childhood	Yes	0.95	0.43	2.09	0.896
Exposure to passive smoking in	No	1.00			
present time	Yes	0.89	0.36	2.19	0.840
Very high or high humidity of	No	1.00			
dwelling place	Yes	1.20	0.47	3.04	0.700
Exposure to animal allergens in	No	1.00			
early childhood	Yes	0.61	0.29	1.29	0.200
Exposure to animal allergens in	No	1.00			
present time	Yes	0.84	0.41	1.75	0.645
Social class	Middle or higher	1.00			
	Lowest or labour	1.25	0.66	2.38	0.487
Family structure	Living with both parents	1.00			
	Other	1.54	0.64	3.72	0.333
Number of people living in	2 to 3	1.00			
same household	4	1.60	0.72	3.58	0.252
	5 or more	1.52	0.60	3.79	0.377

Abbreviations: OR – odds ratio; C.I. – confidence interval



Ph5: temporal association
temporal association between respiratory disease and air quality

AIM

To assess the daily temporal association between frequency of first consultations to the community health centers due to respiratory diseases and the level of outdoor air pollution adjusted to potential confounders

Time-trend study design

KUKEC, A, ERŽEN, I, FARKAŠ, J, ZALETEL-KRAGELJ, L. Impact of air pollution with PM10 on primary health care consultations for respiratory diseases in children in the Zasavje region, Slovenia: a time-trend study. Slovenian Journal of Public Health, 2014, 53 (1): 55-68.

Ph5: temporal association
temporal association between respiratory disease and air quality

METHODS

Period and units of observation

- January 1, 2006 - December 31, 2011; single days (N=2.191)

Methods of temporal relationship analysis (example of PM_{10} in Zagorje Municipality)

HEALTH OUTCOME
- daily number of first consultations for respiratory diseases in the community health centers

EXPLANATORY FACTOR
- 24-hr average of PM_{10} concentration
- lags 0 to 5 days from exposure to the consultation day

COVARIATES
- other pollutants
- meteorological data (T, Rh)
- seasonal data (season of the year, work day, holiday, influenza season)

POISSON REGRESSION MODELS
- univariat model
- single-pollutant model (lags)
- multi-pollutant model

Ph5: temporal association
temporal association between respiratory disease and air quality

RESULTS

Multivariate temporal analysis

– positively and statistically significantly association between daily consultations due to respiratory diseases and

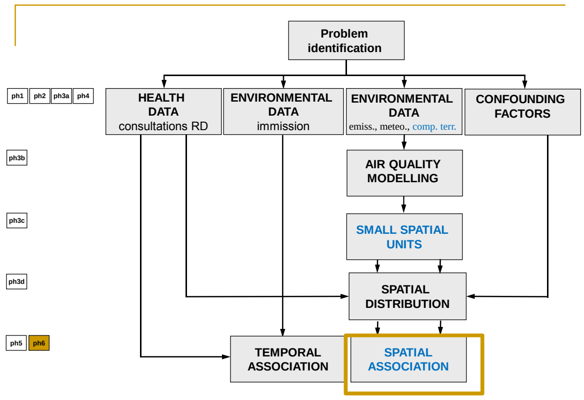
- PM_{10} 24-hr average concentration, lag 0 (Zagorje municipality)
  IRR =1.007; CI: 1.007-1.008
- PM_{10} 24-hr average concentration, lag 0 (Trbovlje municipality)
  IRR =1.010; CI: 1.009-1.011
- Ozone daily maximum 8-hr average concentration, lag 1 (Zagorje municipality)
  IRR =1.002; CI: 1.001-1.004
- SO_2 24-hr average concentration, lag 0 (Hrastnik municipality)
  IRR =1.024; CI: 1.015-1.033

Ph5: temporal association
temporal association between respiratory disease and air quality

RESULTS

(example Zagorje)

Explanatory factor/covariate		IRR	95 % C.I. limits for IRR		p
			lower	upper	
PM_{10} 24-hr average concentration, lag 0		1.003	1.002	1.004	<0.001
SO_2 24-hr average concentration, lag 0		0.983	0.976	0.989	<0.001
Ozone daily maximum 8-hr average concentration, lag 1		1.002	1.001	1.004	0.003
Temperature 24-hr average		0,998	0.991	1.005	0.633
Relative humidity 24-hr average		1.003	1,001	1,005	0.014
Season of the year	Summer	1.000			
	Autumn	1.092	1.057	1.128	<0.001
	Winter	1.732	1.478	2.030	<0.001
	Spring	1.111	1.039	1.188	0.002
Work day	No	1.000			
	Yes	2.297	2.125	2.486	<0.001
Holiday	No	1.000			
	Yes	0.739	0.674	0.809	<0.001
Influenza season	No	1.000			
	Yes	1.260	1.160	1.369	<0.001



Ph6: spatial association temporal association between respiratory disease and air quality

AIM

To assess the spatial association between frequency of first consultations to the community health centers due to respiratory diseases and the level of outdoor air pollution at the grid level

Spatial multiple-group study design

KUKEC, A, ZALETEL-KRAGELJ, L, FARKAŠ-LAINŠČAK, J, ERŽEN, I, HERAKOVIČ, A, BOŽNAR, MZ, MLAKAR, P, GRAŠIČ, B, ZADNIK, V. Health geography in case of Zasavje: Linking of air pollution and respiratory diseases data. Acta Geogr Slov, 2014, 54 (2), 2014: 345-362.

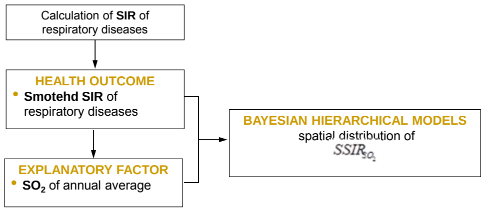
Ph6: spatial association temporal association between respiratory disease and air quality

METHODS

Period and units of observation

- January 1, 2011 - December 31, 2011; grid (200 x 200 m)

Methods of spatial relationship analysis (example of SO_2 annual average)



Ph6: spatial association temporal association between respiratory disease and air quality

RESULTS

Statistical characteristics of the smoothed standardized incidence rate of respiratory diseases Bayesian hierarchical models with explanatory variables included - in four models of small spatial units for the year 2011.

Model of small spatial units	DIC	$Frac_{Spatial}$	β (95 % C.I. limits)
PM_{10} winter average ($\mu g/m^3$)	446.20	0.109	➡ 0.07 (-0.03 – 0.18)
PM_{10} summer average ($\mu g/m^3$)	380.43	0.789	-0.04 (-0,19 – 0.11)
SO_2 annual average ($\mu g/m^3$)	406.78	0.657	➡ 0.24 (0.01 – 0.51)
NO_2 annual average ($\mu g/m^3$)	457.13	0.322	0.05 (-0.05 – 0.16)

Abbreviations: DIC – deviance information criterion, $Frac_{Spatial}$ – spatial fraction; C.I. – confidence interval

CONCLUSION

Ph1: quality and completeness of health data

- Different recording of health data into the health information system
  - to harmonize health information system

Ph2: quality and completeness of air quality data

- Exposure misclassification, lack of same pollutants ($PM_{2.5}$, chemical composition)
  - air pollution modelling system

Ph3: air quality modelling process

- Estimate of observed pollutants at the level of grid (200 x 200 m)
- Problems with input data in the modelling process
  - Change the national legislation (reported of data from different pollution sources)

CONCLUSION

Ph4: prevalence of respiratory diseases and potential confounders data

- The prevalence of **chronic respiratory diseases** was **3.0 %** in low pollution areas, **7.5 %** in moderate pollution areas, and **9.7 %** in high pollution areas (p=0.005)
- The prevalence of **acute respiratory diseases** was **7.8** % in low pollution areas, **13.3 %** in moderate pollution areas and **15.9 %** in high pollution areas (p=0.010)
- **Potential confounders**: family history respiratory diseases, health complications just after the delivery, duration of breastfeeding of less than 8 months and who lived in a dwelling place with high or very high humidity

CONCLUSION

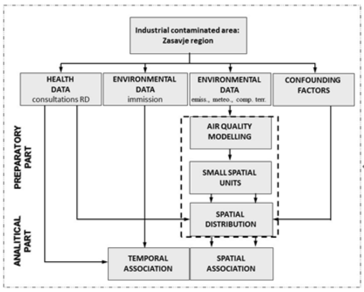
Ph5: daily temporal association between respiratory diseases and air quality

- PM_{10} 24-hr average concentration, lag 0 (↑10 $\mu g/m^3$)
  - Zagorje (**IRR =1.072, p<0.001**)
  - Trbovlje (**IRR =1.105, p<0.001**)

Ph6: spatial association between respiratory disease and air quality (200 m grid)

- a statistically significant positive association can only be observed in the effect of the average annual SO_2 concentration of respiratory diseases (**Regression coefficient=0.24, CI=0.01-0.51**)
- developed the methodology to link AQ and health data (confounders to be added in the future)

EVIDENCE BASED FOR DECISION MAKING



Children, their parents and teachers

Environmental and health researchers (Air Quality Modelling experts, Public health specialists, Clinicians, Pediatricians)

Health Community centers

Environmental protection Agency for Slovenia

Industrial Polluters

Local communities

Non-governmental organizations

2017-04-11 Kukec A., 2013: Outdoor air pollution and school children (PhD theses) 55

Appendix 2: Research strategy of review articles above HIA and HRA related to burden of diseases in ICS

Health impact assessment (HIA)

Steps	**PUB MED**	**WEB OF SCIENCE**
STEP 1 Research strategy	(((industr*[Title/Abstract] OR polluted site[Title/Abstract] OR contaminated site[Title/Abstract] OR contaminated soil[Title/Abstract] OR manufactor*[Title/Abstract])) AND health impact assessment[Title/Abstract]) NOT (food industry OR safety) Results: 25	**TITLE:**(industr* OR polluted site OR contaminated site OR contaminated soil OR manufactor*) *AND* **TITLE:** (health impact assessment) *NOT* **TOPIC:** (food industry OR safety) AND **TITLE:** (review) Results: 62
STEP 2 Title and abstract (exclusion criteria: english, HIA or EHIA, contaminated side)	Results: 16	Results: 18
STEP 3 Full text analysis (inclusion criteria: methods, tools, full text available exclusion criteria: epidemiological studies, double, health risk assessment)	Results: 9	Results: 8
STEP 4		
STEP 5 Final analysis	17	

STEP 2: title and abstract

Article (Authors)	**Title**	**Key words**	**YES/ NO**
PubMed			
Drewry J et al., 2017	The extractive industry in Latin America and the Caribbean: health impact assessment as an opportunity for the health authority.	Extractive industries; Health authority; Health impact assessment; Latin America	YES
Chanchang C et al., 2016	Environmental and health impact assessment for ports in Thailand.	EHIA; EIA; HIA; port; wharf	YES
Vardoulakis S et al., 2016	Challenges and Opportunities for Urban Environmental Health and Sustainability: the HEALTHY-POLIS initiative.	Environmental determinants of health, Knowledge translation, Public health, Urban planning, Housing, Transport, Climate change, Air pollution, Integrated assessment	YES
Nieuwenhuijsen MJ, 2016	Urban and transport planning, environmental exposures and health-new concepts, methods and tools to improve health in cities.	health impact assessment, determinants of health, urban planning,	NO
Solomon GM, 2016	Cumulative Environmental Impacts: Science and Policy to Protect Communities.	CalEnviroScreen; biomonitoring; environmental justice; health impact assessment; risk assessment	YES
Turner LR, 2013 not ICS	Motivators and barriers to incorporating climate change-related health risks in environmental health impact assessment.	environmental health impact assessment; climate change; public policy; data linkage; health indicators; focus group	YES

Article (Authors)	Title	Key words	YES/ NO
Spickett J,2015 not ICS	Health impact assessment in Mongolia: current situation, directions, and challenges	Mongolia; health impact assessment; health promotion; inequalities in health; occupational and environmental health; population health; public health	YES
**Winkler MS, 2012	Health impact assessment of industrial development projects: a spatio-temporal visualization.	large-scale industrial projects in complex eco-epidemiological settings typically require combined environmental, social and health impact assessments. We present a generic, spatio-temporal health impact assessment (HIA) visualization, which can be readily adapted to specific projects and key stakeholders, including poorly literate communities that might be affected by consequences of a project	YES
Patil RR, 2011	Environmental health impact assessment of National Aluminum Company, Orissa	Aluminum smelter plant, Environmental Health; Orissa	NO
Forastiere F, 2011	Health impact assessment of waste management facilities in three European countries	We conducted a health impact assessment of landfilling and incineration in three European countries: Italy, Slovakia and England.	YES
Yorifuji T, 2005	Health impact assessment of particulate matter in Tokyo, Japan	air pollution, particulate matter, risk assessment	NO
Martuzzi M, 2003 *epidemiology	Health impact assessment of air pollution: providing further evidence for public health action	air pollution, elderly, health impact assessment, public health	YES
Tarkowski S., 2002 +epidemiology	Risk assessment of chemicals -- the role of epidemiological methods.	The paper discusses methodological approaches in the evaluation of epidemiological data for health risk assessment.	NO
McCarthy M, 2002 +epidemiology	A health impact assessment model for environmental changes attributable to development projects.	The study objective was to identify environmental health risk estimates for these developments from the epidemiological literature and to develop, and apply these within, a mathematical health impact assessment model.	NO
Basham J., 2001	Application of COMEAP dose-response coefficients within a regulatory health impact assessment methodology. Committee on the Medical Effects of Air Pollutants.		NO
Spickett JT, 1995	A review of environment health impact assessment.	Assessment of the environmental health impact of a development is most often concentrated on a particular aspect, such as a method of transportation of chemicals, or of manufacturing a certain component--those areas which are seen as having the greatest risks associated with them. Rarely is a broad screening of potential environmental health impacts included.	NO

WEB OF SCIENCE			
Article (Authors)	**Title**	**Key words**	**YES/ NO**
Winkler M., 2012 +duble	Health impact assessment of industrial development projects: a spatio-temporal visualization	developing country; health impact assessment; industrial development project; spatio-temporal visualization	NO
Barbosa, EM., 2012 Portuguese language	Health and environmental licensing: a methodological proposal for assessment of the impact of the oil and gas industry	Health impact assessment; Environmental management; Environmental licensing; Oil and gas industry	NO
Kryzanowski, JA., 2011	A Holistic Model for the Selection of Environmental Assessment Indicators to Assess the Impact of Industrialization on Indigenous Health	Aboriginal health; environmental impact assessment; determinant of health; indicators	YES
Van Caneghem J., 2010	Assessment of the impact on human health of industrial emissions to air: Does the result depend on the applied method?	Impact assessment; Human health; Industry; Characterization factor	YES
Morra, P., 2009	The assessment of human health impact caused by industrial and civil activities in the Pace Valley of Messina	Human health risk assessment; Environmental impact; Fate and transport models; Municipal solid waste incinerator; Pollutants exposure	YES
Triolo, L., 2008	Air pollution impact assessment on agroecosystem and human health characterisation in the area surrounding the industrial settlement of Milazzo (Italy): a multidisciplinary approach	agriculture; air pollution; crop losses; geographical epidemiology; mortality; oil refinery; microbial communities; thermoelectric plant; toxic elements	NO
Boer, A., 2005	Industrial development and health: Does health impact assessment fuel or ease this tension?	This paper offers perspectives, through some of the findings of a human health impact assessment, on the “conflict” between industrial development and human health.	NO
Tarkowski, S., 2002 +epidemiology and duble	Public health assessment of the impact of industrial emissions in the Lodz region**		NO
Hamed, MM., 2000	Impact of random variables probability distribution on public health risk assessment fromcontaminated soil	public health; soil; contamination; probability; density; distribution; reliability; Monte Carlo; risk assessment	NO
Awasthi A., 2016 +risk assessment	Environmental pollution of electronic waste recycling in India: A critical review	E-waste; Environmental pollution; Heavy metal; India; Health risk	NO
van der Kuijp TJ., 2013	Health hazards of China's lead-acid battery industry: a review of its market drivers, production processes, and health impacts	Lead-acid battery; China; Pb; Lead pollution; Lead poisoning; Heavy metals	YES

Article (Authors)	Title	Key words	YES/ NO
Avci, H., 2013 + risk assessment	Heavy metals in vegetables irrigated with wastewaters in gaziantep, turkey: a review of causes and potential for human health risks	Gaziantep; heavy metals; risk assessment; vegetable crops; wastewater irrigation	NO
Herva M., 2013	Review of combined approaches and multi-criteria analysis for corporate environmental evaluation	Corporate sustainability; Ecological Footprint; Life Cycle Assessment; Environmental Risk Assessment; Multi-Criteria Analysis	NO
Pires, A., 2010	Solid waste management in European countries: A review of systems analysis techniques	Solid waste management; Systems analysis; Integrated solid waste management; Sustainability	YES
Stanek, LW., 2011 +health risk	Air Pollution Toxicology-A Brief Review of the Role of the Science in Shaping the Current Understanding of Air Pollution Health Risks	particulate matter; ozone; hazardous air pollutants; toxicity; historical perspective	NO
Azizullah, A., 2010	Water pollution in Pakistan and its impact on public health - A review	Health impact; Major pollutants; Pakistan; Water pollution; Sources of pollution	YES
Pereira, ME., 2009	Mercury pollution in Ria de Aveiro (Portugal): a review of the system assessment	Anthropogenic mercury contamination; Coastal management; Environmental assessment; Key environmental processes	NO
Rodrigues, SM, 2009	A review of regulatory decisions for environmental protection: Part II-The case-study of contaminated land management in Portugal	Soil protection; Regulatory decisions; Contaminated land; Risk management; Portugal	YES

**free full text is not available

Helath risk assessment (HRA)

Steps	PUB MED	WEB OF SCIENCE
STEP 1 Research strategy	industr* OR polluted site OR contaminated site OR contaminated soil OR manufactor* health risk assessment NOT food industry OR safety AND review Results: 28	TITLE: (industr* OR polluted site OR contaminated site OR contaminated soil OR manufactor*) AND TITLE: (health risk assessment) NOT TOPIC: (food industry OR safety) Results: 82
STEP 2 Title and abstract (exclusion criteria: english, HRA or EHRA, contaminated side)	Results: 9	Results: 55
STEP 3 Full text analysis (inclusion criteria: methods, tools, full text available exclusion criteria: epidemiological studies, double, health impact assessment)	Results: 5	Results:
STEP 4 Final analysis		

Article (Authors)	**Title**	**Key words**	**YES/ NO**
PubMed			
Cachada A., 2016	Risk assessment of urban soils contamination: The particular case of polycyclic aromatic hydrocarbons	Ecological risk assessment; Human health risk assessment; Polycyclic aromatic hydrocarbons; Urban soils	YES
Ruby MV., 2016	Oral Bioavailability, Bioaccessibility, and Dermal Absorption of PAHs from Soil-State of the Science	This article summarizes the existing studies, identifies data gaps, and provides recommendations for the direction of future research to support new default or site-specific bioavailability adjustments for use in human health risk assessment.	NO
Utembe W, 2015	Hazards identified and the need for health risk assessment in the South African mining industry	Mining; cyanide; dust; hazard; heavy metals; silicosis	YES
Martin SC., 2014	Community health risk assessment of primary aluminum smelter emissions.	Primary aluminum production is an industrial process with high potential health risk for workers. We consider in this article how to assess community health risks associated with primary aluminum smelter emissions.	YES
Åkesson A., 2014	Non-renal effects and the risk assessment of environmental cadmium exposure.	Our objective was to review available information on health effects of Cd exposure with respect to human health risk assessment.	YES
Stricklin DL.,2008	Risk assessment in international operations	This work highlights the specific challenges of risk assessment that are unique to the deployment setting such as the assessment of exposures to a variety of diverse hazards concurrently	NO
Markus J, 2001	A review of the contamination of soil with lead II. Spatial distribution and risk assessment of soil lead	These studies are also summarised and a brief description of the basis for their use presented. Finally, environmental and health risk assessment is discussed and some methodologies in use around the world reviewed.	YES
Bernard A., 1997	Biomonitoring of early effects on the kidney or the lung	The ultimate goal, however, is the development and validation of biomarkers that have a sufficient toxicological relevance to be used for health risk assessment.	NO

Article (Authors)	Title	Key words	pdf
Paustenbach DJ., 1990	Health risk assessment and the practice of industrial hygiene	The appropriate use of risk assessment methods should allow scientists and risk managers to set scientifically valid environmental and occupational standards for air contaminants	NO
Web of Science			
Kumar, M., 2017	A study of trace element contamination using multivariate statistical techniques and health riskassessment in groundwater of Chhaprola Industrial Area, Gautam Buddha Nagar, Uttar Pradesh, India	Industrial area; National capital region; Spatio-chemical; Background radiation; Hazard quotient; Hazard index	
Khan, ZI., 2017	Potential health risk assessment of potato (Solanum tuberosum L.) grown on metal contaminated soils in the central zone of Punjab, Pakistan	Solanum tuberosum; Health risk index; Metals and metalloids; Pollution load index	
Bejaoui, I., 2016	Health Risk Assessment in Calcareous Agricultural Soils Contaminated by Metallic Mining Activity Under Mediterranean Climate	Absorption; Heavy metals; Plants; Pollution; Soil	
Wcislo, E., 2016	Human health risk assessment in restoring safe and productive use of abandoned contaminated sites	Human health risk assessment; Land use scenarios; Risk-based remedial levels; Contaminated site reuse	
Cocarta, DM., 2016	Carcinogenic risk evaluation for human health risk assessment from soils contaminated with heavy metals	Exposure; Metals; Risk assessment; Soil pollution	NO
Ahmad, K., 2016	Health risk assessment of heavy metals and metalloids via dietary intake of a potential vegetable (Coriandrum sativum L.) grown in contaminated water irrigated agricultural sites of Sargodha, Pakistan	heavy metals and metalloids; enrichment factor; health risk index; Sargodha	
Zhou, H., 2016	Accumulation of Heavy Metals in Vegetable Species Planted in Contaminated Soils and the Health Risk Assessment	target hazard quotient (THQ); vegetable; health risk; heavy metal; accumulation	
Bhutiani, R., 2016	Water Quality, Pollution Source Apportionment and Health Risk Assessment of Heavy Metals in Groundwater of an Industrial Area in North India	Groundwater: heavy metals; Industrial area; Haridwar; Health risk	

Article (Authors)	Title	Key words	pdf
Krishna, AK., 2016	Distribution, correlation, ecological and health risk assessment of heavy metal contamination in surface soils around an industrial area, Hyderabad, India	Heavy metal contamination; Soil; Health risk assessment; Factor and cluster analysis; Correlation; Pollution index	NO
Chen, WH., 2016	Investigating the differences between receptor and dispersion modeling for concentration prediction and health risk assessment of volatile organic compounds from petrochemical industrialcomplexes	Volatile organic compound; Dispersion modeling; Receptor modeling; Concentration prediction; Excess lifetime cancer risk; Hazard quotient	
Kumar, B., 2016	Quantification of nitrophenols, chlorophenols, and hexachlorocyclohexanes in agricultural soils in the vicinity of industrial area for the assessment of human health hazard and risk	nitrophenols; chlorophenols; hexachlorocyclohexanes; agriculture soil; average daily intake; health hazard	
Moradi, A., 2016	A human health risk assessment of soil and crops contaminated by heavy metals in industrial regions, central Iran	bio-accumulation factor; estimated daily intake; contamination load index; health risk; heavy metal pollution	
Zhang, Y., 2016	Heavy metals pollution and health risk assessment of atmospheric dust of less than 100 mu m along a typical industrial corridor, central China	industrial corridor; national highway G316; atmospheric dust; heavy metals; pollution characteristics; heath risk assessment	NO
Hou, W., 2015	Distribution and Health Risk Assessment of Polycyclic Aromatic Hydrocarbons in Soil from a Typical Contaminated Urban Coking Sites in Shenyang City	Contaminated site; PAHs; Exposure dose; Carcinogenic risk; Non-carcinogenic risk; Health risk assessment	NO
Utembe, W., 2015	Hazards identified and the need for health risk assessment in the South African mining industry	Mining; hazard; dust; silicosis; cyanide; heavy metals	
Uddh-Soderberg TE., 2015	An assessment of health risks associated with arsenic exposure via consumption of homegrown vegetables near contaminated glassworks sites	Health risk assessment; Arsenic; Homegrown vegetables; Bioconcentration factor; Probabilistic exposure assessment; Hazard quotient; Cancer risk	
Roy, M., 2015	Metal Uptake in Plants and Health Risk Assessments in Metal-Contaminated Smelter Soils	metal contamination; toxicity; chemical extraction; metal availability; health risk assessments	ON LINE
Li, J., 2015	Source identification and health risk assessment of Persistent Organic Pollutants (POPs) in the topsoils of typical petrochemical industrial area in Beijing, China	Persistent Organic Pollutants; Petrochemical industrial area; Beijing, China; Source identification; Risk assessment	

Article (Authors)	Title	Key words	pdf
Xiao, Q., 2015	Assessment of heavy metal pollution and human health risk in urban soils of steel industrial city (Anshan), Liaoning, Northeast China	Urban soil; Heavy metal; Pollution index; Health risk; Spatial distribution	
Osipova, NA., 2015	Geochemical Approach to Human Health Risk Assessment of Inhaled Trace Elements in the Vicinity of Industrial Enterprises in Tomsk, Russia	snow cover; insoluble snow residue; human health risk assessment; Tomsk; atmospheric pollution; Russia; metals	
Augustsson, ALM., 2015	Metal uptake by homegrown vegetables - The relative importance in human health risk assessments at contaminated sites	Contaminated land; Exposure assessment; Metal uptake by homegrown vegetables; Risk assessment	
Ren, WX., 2015	Reconsidering brownfield redevelopment strategy in China's old industrial zone: a health risk assessment of heavy metal contamination	Health risk assessment; Heavy metal; Land use; Phytoremediation; Brownfield redevelopment sites	
Xu, X., 2015	Ecological and health risk assessment of metal in resuspended particles of urban street dust from an industrial city in China	Environmental health; metal contamination; risk assessment; street dust	
Li, PY., 2014	Origin and assessment of groundwater pollution and associated health risk: a case study in an industrial park, northwest China	Groundwater pollution; Heavy metal; Groundwater quality; Health risk assessment; Entropy weight; Water quality assessment	
Jiang, YF., 2014	Status, source and health risk assessment of polycyclic aromatic hydrocarbons in street dust of an industrial city, NW China	Polycyclic aromatic hydrocarbons; Street dust; Principal component analysis; Health risk assessment	
Wang, LJ., 2014	Contamination assessment and health risk of heavy metals in dust from Changqing industrial park of Baoji, NW China	Heavy metal; Pollution assessment; Health risk; Dust; Baoji	NO
Zhao, L., 2014	Source identification and health risk assessment of metals in urban soils around the Tanggu chemical industrial district, Tianjin, China	Urban soil; Heavy metals; Multivariate statistical analysis; Spatial distribution; Source identification; Risk assessment	
Dyck, R., 2013	Application of data fusion in human health risk assessment for hydrocarbon mixtures on contaminated sites	Data fusion; Human health risk assessment; Contaminated sites; Dempster-Shafer theory; Petroleum hydrocarbons	
Jiang, SJ., 2013	Distribution and Health Risk Assessment of Total Petroleum Hydrocarbon in a Gas Station Contaminated Site in Chongqing, China	Gas station; Total petroleum hydrocarbon; Contaminated site; Risk assessment	
Article (Authors)	**Title**	**Key words**	**pdf**
Bade, R., 2013	Human Health Risk Assessment of Soils Contaminated with Metal(loid)s by Using DGT Uptake: A Case Study of a Former Korean Metal Refinery Site	human health risk assessment; metal(loid)s; diffusive gradients in thin films; hazardous index; physiologically based extraction test	
McKnight, US., 2013	A system dynamics model for the screening-level long-term assessment of human health risks at contaminated sites	System dynamics; EDSS; Contaminated sites; Risk-based land management; Uncertainty; Monitored natural attenuation; Human health risk assessment; Vensim	
Chabukdhara, M., 2013	Heavy metals assessment in urban soil around industrial clusters in	Metals; Urban soil; Industrial city; Non-cancer and cancer risk; Cluster analysis	

	Ghaziabad, India: Probabilistic health risk approach		
Zhang, XD., 2011	Assessment of BTEX-induced health risk under multiple uncertainties at a petroleum-contaminated site: An integrated fuzzy stochastic approach	in-ground water; addressing uncertainty; monte-carlo; variability; remediation; methodology; management; propagation; simulation; exposure	ON-LINE
Yang, M., 2011	Human Health Risk Assessment Model of Organic Pollution in Groundwater: Shijiazhuang Industrial Zone	groundwater pollution; organic contaminants; residual rate; assessment model; human health risk	NO
Kao, WY., 2011	Evaluation of Incremental Population and Individual Carcinogenic Risks of PCDD/Fs from Steel and Iron Industry in Taiwan by a Site-specific Health Risk Assessment Method	Sinter plant; Electric arc furnace; Steel and iron industry; PCDD/Fs risk assessment; Population risk	
Topuz, E., 2011	Integration of environmental and human health risk assessment for industries using hazardous materials: A quantitative multi criteria approach for environmental decision makers	Environmental risk assessment; Human health risk assessment; Hazardous materials; Analytic hierarchy process; Fuzzy logic	
Park, IS., 2011	Determination of a risk management primer at petroleum-contaminated sites: Developing new human health risk assessment strategy	Total petroleum hydrocarbon; Human health risk assessment; TPH fractionation method; Ultrasonication-based analytical process; TPHCWG Direct Method	
Kendrovski, V-. 2011	Industrial waste disposal. environmental health risk assessment at ohis site in Skopje	health risk assessment; health risk matrix; inorganic mercury; lindane isomers; sanitation	ON-LINE
Baciocchi, R., 2010	Human health risk assessment: Models for predicting the effective exposure duration of on-site receptors exposed to contaminated groundwater	Contaminated sites; Risk analysis; Fate and transport; Exposure duration; On-site receptors; Depleting source	
Park, IS., 2010	A novel total petroleum hydrocarbon fractionation strategy for human health risk assessment for petroleum hydrocarbon-contaminated site management	Human health risk assessment; Total petroleum hydrocarbon; TPH fractionation method; Aliphatic fractions; Aromatic fractions	
Uribe-Hernandez, R., 2010	Environmental and health risk assessment of an oil contaminated site in the Mexican tropical southeast	risk assessment; health assessment; polycyclic aromatic; PAH; BaP; contaminated soil; CalTOX; oil waste; Mexican southeast	NO
Yang, WR., 2009	Distribution and health risk assessment of organochlorine pesticides (OCPs) in industrial site soils: A case study of urban renewal in Beijing, China	pollution; hexachlorocyclohexane isomers (HCHs); dichlorodiphenyltrichloroethane isomers (DDXs); soil profiles; Monte Carlo; sensitivity	
Silverman, KC., 2007	Comparison of the industrial source complex and AERMOD dispersion models: Case study for human health risk assessment	Study compared the two models as well as their enhanced versions that incorporate the Plume Rise Model Enhancements (PRIME) algorithm. PRIME takes into account the effects of building downwash on plume dispersion.	
Loney, CB., 2007	Comparison of contaminated site human health risk assessment approaches in Canada: Application of provincial methods to a hypothetical site	human health risk assessment; guidance; variability	NO

Article (Authors)	Title	Key words	pdf
Kao, WY., 2007	Site-specific health risk assessment of dioxins and furans in an industrial region with numerous emission sources	sinter plant; incinerators; electric furnace; metallurgical industry; PCDD/F; risk assessment	
Jasso-Pineda, Y., 2007	An Integrated Health Risk Assessment Approach to the Study of Mining Sites Contaminated With Arsenic and Lead	Metals; Comet assay; Integrated risk assessment	
Nathanail, CP., 2005	Generic and site-specific criteria in assessment of human health risk from contaminated soil	contaminated soils; generic assessment; site assessment; risk assessment; human health	ON-LINE
Wcislo, E., 2005	A Human Health Risk Assessment software for facilitating management of urban contaminated sites: A case study: The Massa site, Tuscany, Italy	human health risk assessment; human health risk assessment software; urban contaminated sites; risk-based concentrations; remedial goals; site management	ON-LINE
Iturbe, R., 2004	TPH-contaminated mexican refinery soil: Health risk assessment and the first year of changes	health risk assessment; metals; PAHs; refinery soil; TPHs	NO
Proctor, DM., 2002	Assessment of human health and ecological risks posed by the uses of steel-industry slags in the environment	steel slag; environmental health risk assessment; metals; bioavailability; stochastic analysis	NO
Hamed, MM., 2000	Impact of random variables probability distribution on public health risk assessment from contaminated soil	public health; soil; contamination; probability; density; distribution; reliability; Monte Carlo; risk assessment	NO
Hamed, MM., 1999	Probabilistic sensitivity analysis of public health risk assessment from contaminated soil	sensitivity; probability; public health; risk soil; contamination; modeling; reliability; Monte Carlo	NO
Sheehan, PJ., 1991	Assessment of the human health risks posed by exposure to chromium-contaminated soils	lung-cancer mortality; potassium dichromate; hexavalent chromium; metal-compounds; young-children; north-america; bound tcdd; dust; nickel; lead	NO
Murphy, BL., 1989	Health risk assessment for arsenic contaminated soil**		NO
Hawley, JK., 1985	Assessment of health risk from exposure to contaminated soil**		NO

Timetable for STMS (2 to 12 April)

Work plane	3.4	4.4	5.4	6.4	7.4	8.4	9.4	10.4	11.4	12.4
Welcome meeting and discussions										
Aim of review article										
General information (guidelines, books..) above HIA and HRA										
Step 1: Search strategy and bibliographical base										
Step 2: identify the article (title/abstract)										
Step 3: Identify the article (in/exclusion criteria)										
Step 4: final analysis (Table: overwrite the important facts from article – from step 3)										
Step 5: inclusion other documents										
Draft of article, chosen the journal of publication										
Synthesis of data (Step 4)										
Introduction, Methods, Results, Discussion, Conclusion										
First draft for readings of authors (end of May)										

DEPARTMENT OF ENVIRONMENT AND HEALTH

Report of Short Term Scientific Mission

Towards a consensus on industrially contaminated sites policy priorities and response: report of the fourth COST Action Plenary Conference

STSM Applicant	Dovile Adamonyte, MPH
STSM Supervisor	Dr Ivano Iavarone
Home Institution	European Environment and Health Youth Coalition Minties st. 24-31, Vilnius LT-09224, Lithuania
Host Institution	Istituto Superiore di Sanità - Department of Environment and Health, Unit of Social and Environmental Epidemiology Viale Regina Elena 299, Rome, Italy
STSM dates	17/04/2018 - 23/04/2018

Table of Contents

1. Introduction

Waste and contaminated sites have been included as a priority in the Declaration of the Sixth Ministerial Conference on Environment and Health (Ostrava, Czech Republic 15 June 2017). The Ostrava Declaration includes a commitment towards …"*preventing and eliminating the adverse environmental and health effects, costs and inequalities related to waste management and contaminated sites, by advancing towards the elimination of uncontrolled and illegal waste disposal and trafficking, and sound management of waste and contaminated sites in the context of transition to a circular economy*".

Interested Member States of the WHO Regional Office for Europe will address the topic in the coming years and consider it when developing their Portfolios for Action.

Members of the COST Action on Industrially Contaminated Sites and Health network (ICSHNet) participated in the Ostrava ministerial conference, organizing the Side Event SE11 "Impact of industrially contaminated sites on human populations – a global environmental health priority".

The Fourth Plenary Conference of the ICSHNet COST Action was recently held at the WHO European Centre for Environment and Health, United Nations Campus, Bonn, Germany, 20- 22 February 2018. A Consensus Statement on Industrially Contaminated Sites and Health was discussed and agreed during the Conference and the Management committee of the Action agrees on the opportunity that this document be taken to the meeting of the EH Task Force of the European Environment and Health Process, scheduled for 20-21 March 2018 in Bonn.

Giving special attention to the need to support Member States of the WHO European Region in development of National Portfolios for action on environment and health, explicitly for the waste and contaminated sites, the STSM aimed at finalizing a Technical Report of the Action Plenary Conference and working groups meetings held in Bonn in 20-22 February 2018.

2. Methods

This literature review formed one part of the STSM, which focused on waste and contaminated sites. The student reviewed and analysed materials (presentations, interventions) and information relevant to the Conference's scope and provided by the COST Action Core Group and Conference participants. Nonetheless, the student collected additional data and information from open and reliable sources and Internet. Timeframe of STSM is provided in the *Annex 1*.

3. Results

The table below presents main characteristics of the STSM's results.

Structure		Content
Introductory part	Acknowledgements	This part explains the scope and indicates list of contributors.
	Acronyms	This part contains out of main acronyms used in the report.
	Executive Summary and Introduction	Based on current available estimates, almost 1.5 million deaths per year in the WHO European Region are attributable to environmental risks that could be avoided and/or eliminated. Industrially Contaminated sites (ICS), in particular, represent a major environmental health issue, as they embrace many risk factor including air, water, soil and food chain contamination, but also hazardous chemicals and wastes. Building on previous experiences and on available evidence and policy needs, the COST Action on ICSHNet since 2015 has been greatly contributing to consolidate the awareness and policy profile of Contaminates Sites as a public health priority in Europe. This report describes the activities carried out during the ICSHNet COST Action Plenary Conference, and Working Group, Core Group and management committee meetings – held in Bonn, Germany, 20–22 February 2018, and co-organised with WHO.
	Scope and purpose	The overall objective of the conference was to respond to questions regarding relevant available evidence, experiences, resources and proactive approaches compelling enough to undertake the actions in the Ostrava Declaration in various dimensions, e.g. economic, social, health.

Structure		Content
	Setting the scene: the Action meets the EEHP	This chapter provides an overview of the WHO European Environment and Health Process in connection with the COST Action on ICSHNet: Waste and contaminated sites have been included as a priority in the Declaration of the Sixth Ministerial Conference on Environment and Health (Ostrava, Czech Republic 15 June 2017). The Ostrava Declaration includes a commitment towards …"*preventing and eliminating the adverse environmental and health effects, costs and inequalities related to waste management and contaminated sites, by advancing towards the elimination of uncontrolled and illegal waste disposal and trafficking, and sound management of waste and contaminated sites in the context of transition to a circular economy*". Interested Member States of the WHO Regional Office for Europe will address the topic in the coming years and consider it when developing their Portfolios for Action. Members of the COST Action on ICSHNet participated in the Ostrava ministerial conference, organizing the Side Event SE11 "Impact of industrially contaminated sites on human populations – a global environmental health priority". The Fourth Plenary Conference of the ICSHNet COST Action was recently held at the WHO European Centre for Environment and Health (ECEH), United Nations Campus, Bonn, Germany, 20- 22 February 2018. A Consensus Statement on Industrially Contaminated Sites and Health was discussed and agreed during the Conference and the Management committee of the Action agrees on the opportunity that this document be taken to the meeting of the EH Task Force of the European Environment and Health Process (EEHP), scheduled for 20-21 March 2018 in Bonn. Giving special attention to the need to support Member States of the WHO European Region in development of National Portfolios for action on environment and health, explicitly for the waste and contaminated sites, the STSM

Structure		Content
		aimed at finalizing a Technical Report of the Action Plenary Conference and working groups (WG) meetings held in Bonn in 20-22 February 2018.
Conference outcomes	Follow-up meeting of the Students of Thessaloniki school	The training school "Environmental health in industrially contaminated sites" was one of the milestones of this Action, created to strengthen the in-country capacity to respond to the environmental health challenges posed by ICSs, through the training of early career investigators (ECI). These researchers are essential to the success of this Action and for spreading knowledge methods through different scientific communities in the future. The aim of this training course was to strengthen in-country capacity to respond to the environmental health challenges posed by ICSs by creating and assisting a European "cohort" of investigators dealing with Industrial contamination and population health issues. The course aimed to provide these researchers with a scientific basis on knowledge of methods along with risk and uncertainty of the research, also matched to practical skills for evaluating the health effects and impact of industrially contaminated sites. The target audience were ECI, PhD students, and researchers from government agencies and research institutes of health or environment, university departments, and other sectors related to industrial contamination and health. The selected students participating represented a wide geographic spread, ensuring a uniform distribution across the ICS Network countries. 25 out of 33 countries involved in the Action (76 per cent) identified candidates to participate in the training. A total number of 46 trainees, well balanced by gender (54 per cent females), with an age range of 24 to 56 years, attended the school. The Thessaloniki school learning experience emphasized an obvious need of capacity building. The burden of issues related to ICS is substantial and yet there is a great need in most countries to continue tackling these issues. Training

Structure		Content
		is one of the main priorities in capacity building and is essential to address such issues. The training part of the COST Action ICSHNet held in Thessaloniki was developed specifically to support and facilitate countries dealing with environmental health issues of ICSs to develop their expertise and be more effective. The training course proved successful and provided trainers with tools to better address these issues. Even more, it will further contribute to improving and strengthening training materials.
	Progress with the Action survey	One of the major objectives and tasks of the COST Action is to assess the availability and quality of information on population, environmental and health data, research tools, and communication strategies that have been or are being applied in Industrially Contaminated Sites (ICS) in all participating countries. To this purpose an Action survey has been designed to identify information needs and research gaps in a sample of ICS identified by Action countries. The other major parallel task of the Action is to review and identify research tools and sound methodologies available to face environmental health issues in ICS. Integrating the information obtained with the Action survey with the knowledge learned on suitable methodologies will facilitate the identification of a range of different approaches for charactering the potential impacts on health in ICS that can fit to the data and resources available in different regions and ICS scenarios across Europe. The Action survey is conducted by using the online Action Questionnaire (AQ) applied to the entire list of 100 ICS previously identified and reported by members of the COST Action. This online survey consists of 84 questions organised in eight sections: industrial activities operating at the site, main contaminants, population, exposure, health data, health studies, communication strategies, and references available. The mentioned groups of topics correspond to the activities of the four Working Groups (WGs) the Action

Structure		Content
		is composed by. It is expected that members of Action will submit the AQ in April 2018.
	The policy agenda in industrially contaminated sites and health: perspectives and opportunities	The objective of the session was to discuss perspectives and opportunities of efficient awareness and policy profile of Contaminates Sites consolidation as a public health priority in Europe. This part presents for presentations given by experts. Topics of presentations: (a) Contaminated sites in the Ostrava agenda; (b) Circular economy and industrially contaminated sites; (c) Industrial emissions: overview of the European Pollutant Release and Transfer Register; and (d) The environment and health EU research agenda.
	The German experience with remediation of industrially contaminated sites	Since 1984 in the inner city of Stuttgart about 100 volatile chlorinated hydrocarbons (CHC) contaminated sources have been investigated and partly remediated so far. There are 700 additional potentially contaminated sites documented. CHC chemicals were applied as solvent agents mainly in the mechanical engineering and electrical industry as well as by dry cleaners. Although the application stopped, the pollution is still remaining in the groundwater. Aiming to sustainable improve the groundwater quality in Stuttgart's city area and to ensure a permanent protection of Stuttgart's mineral springs, the MAGPlan ("Management plan to prevent threats from point sources on the good chemical status of groundwater in urban areas") project was developed. MAGPlan project applied the concept of „Integral management of contaminated sites". It focused on the spatiotemporal analysis of CHC migration and the associated degradation and transformation processes between the contamination sources and the mineral springs and spas. Due to the complex hydrogeological conditions, new and advanced investigation strategies and methods were used which, in combination, allowed for multiple lines of proof. The overarching principle is an iterative-adaptive approach with gradual improvement of the level of knowledge.

Structure		Content
		The results of the integral investigation of the groundwater and the contaminated sites and the measures required to ensure a good groundwater status are summarized in the groundwater management plan. In reports, maps, data bases, and with a computer-based visualization tool, it provides the basis for an optimal treatment of CHC contaminants in groundwater. The management plan sets priorities for contaminated site remediation. The numerical transport model provides the opportunity to analyze different remediation scenarios for individual sites and to make predictions of future contaminant migration. Sites with a particularly high remediation priority can be identified. Furthermore, interactions between contamination sources and receptors in the project area can be included in the risk assessment and the evaluation of the sites. The remediation feasibility study as part of the groundwater management plan describes the measures to be taken in order to achieve the remediation targets. For those sites with high priority, additional investigation and remediation efforts will be developed. Through the contribution of political committees, the groundwater management plan has received a binding character. The Stuttgart City Council acknowledged the implementation and financing of the groundwater management plan developed in MAGPlan on 1st July 2015. The strategy of integral contaminated site management will function as an important guideline and a trend setting component for groundwater protection in Europe and Stuttgart in future. They were published by extensive dissemination activities among experts and also in Stuttgart's public. The public relation activities ask for understanding of the necessary activities and try to encourage persons concerned to fight against deficits of groundwater quality in the same way. Hence the project contributes an important part to implement the directive 2000/60/EC (Water Framework Directive) of the European Union. Therefore, the communication strategy was developed. The strategy aimed at periodic information of target groups; raising of public awareness for groundwater protection; improvement of the acceptance for necessary actions and strengthening the individual responsibility. The European Union co-financed the project, running from 2010 to 2014. 50 per cent of the total costs are subsidies by the EU program LIFE. The other half is taken over by the City of Stuttgart and the Federal State of Baden-Württemberg.

Structure		Content
	Round table towards consensus on industrially contaminated sites policy priorities and response	**Rationale** In Europe, earlier industrialization and poor environmental management practices have left a legacy of thousands of contaminated sites. Past and current industrial activities can cause local and diffuse contamination, to such an extent that it might threaten human health of resident populations, especially in vulnerable subgroup. Moreover, health, environment, and social aspects are strongly interconnected, local communities are often alarmed, and both scientists and policy makers have expressed concern. Distinct research initiatives on the health impact of contaminated sites have provided considerable evidence, however data are sparse, and assessments have seen a fragmentation of objectives and methods. It is therefore urgent to promote coordination and collaboration between researchers and risk managers to identify common strategies at European level to deal with this issue more systematically. Building on available evidence and policy needs, the COST Action (and previous work lead by WHO) has greatly contributed to consolidate the awareness and policy profile of Contaminates Sites as a public health priority in Europe. **Goals and discussion** The Chair of round table session invited panelists to share their views on current progress within the ICSHNet COST Action; outcomes of the Ostrava Conference; and inputs as well as suggestions made in the plenary session before the round table from their own institutional and professional perspectives.
	Working groups' activities	**WG1 – Environment and health data** Goals of Working Group 1 for collaborative work include the identification of criteria and requirements to standardize and harmonize the collection and organization of data on environment, health and other characteristics of populations residing in industrially contaminated sites, accounting for needs and priorities across countries. This represents a crucial propaedeutic basis to address the production of reliable assessments of the health risks and impacts of different sources of pollution in contaminated areas.

Structure		Content
		WG2 – Methods and tools for exposure assessment Goals of Working Group 2 for collaborative networking activities concern the identification of needs and priorities across participating countries to evaluate exposures to environmental contaminants in populations residing in industrial areas. A parallel objective is to review and critically evaluate the available methods and tools and to define recommendations and on how exposure should be estimated to carry out informative health impact assessments in different scenarios. **WG3 – Methods and tools for health risk and health impact assessment** Goals of Working Group 3 for collaborative work concern the identification of needs and priorities on methods and strategies to assess environmental health risks and impacts. A specific objective is to review and evaluate available methodologies on health risk and impact assessments, accounting also for social inequalities. Therefore, the working group aims to identify appropriate tools to carry out comparative analyses on the health impact of ICS within and across countries. **WG4 – Risk management and communication** Working Group 4 aims to evaluate needs and priorities across countries on how to contribute to effective communication with the local population, media and other stakeholders, accounting for different scenarios. Goals for collaborative networking activities concern the provisions of guidance on risk management and risk communication on environmental health risks in ICS, including the transfer of scientific findings into the policy making process. Issues of environmental justice should be addressed with a focus on vulnerable subgroups such as children, women

Structure		Content
		and disadvantaged communities.
Summary	Conclusions Way forward	This part presents the main outcomes of the conference.

4. Future collaboration with the host institution

The future collaboration with the host institution will be focused on identification and development of waste and industrially contaminates sites practises in the policy decision making. Therefore, the dissemination of resulting main outcomes among *WG4 Risk management and communication* members is strongly envisioned.

Moreover, the student was privileged to be part of the Istituto Superiore di Sanità and WHO European Centre for Environment and Health Editorial Board which will provide a joint scientific report on waste and industrially contaminates sites.

5. Dissemination and communication of STSM results

The final Conference report will provide governments, local authorities, young people groups, COST Action members with resources and guidance on how to contribute to effective prevention and reduction of industrially contaminated sites.

Annex 1. Timeframe of STSM

Tasks	**April 2018**						
	17	**18**	**19**	**20**	**21**	**22**	**23**
Travelling	+						
Introductory meeting and development on STSM items		+					
Selection of literature		+	+	+			
Review of literature				+	+	+	+
Report writing		+	+	+	+	+	+
Travelling							+

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

To: Mr. Pietro Comba, Phd (STSM coordinator)
Head, Unit of Environmental Epidemiology
Department of Environment and Primary Prevention
Instituto Superiore di Sanità
Viale Regina Elena 299
Italy

Action number: IS1408
STSM title: Human biomonitoring as a tool for exposure assessment in Industrially contaminated sites – lessons learned
STSM start and end date: 21/03/2018 to 31/03/2018
Grantee name: Elena Roxana Ardeleanu

PURPOSE OF THE STSM/

- To develop an extensive research regarding Human Biomonitoring (HBM) to assess exposure and early health effects related to Industrially Contaminated Sites, based on a selection of case studies.
- To select case studies from the expertise within the COST action as input for the paper
- To make a good first draft of the paper, based on the goals of the COST Action IS1408 and on the discussions run during the Fourth Plenary Conference of the Action Industrially Contaminated Sites and Health Network (ICSHNet), WHO European Centre for Environment and Health (ECEH), UN Campus, Bonn, Germany, 21-22 February 2018.
- The purpose of this article is to reflect on experiences with HBM studies in Europe in ICS, based on case studies from within the working group, and to describe challenges and lessons learned in developing strategies to address environmental health impact and to promote interventions and public health in contaminated areas

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

- We summarized main characteristics of a selection of 6 cases spread over different countries: Belgium, Cyprus, Hungary, Italy, Poland, and Portugal
- We discussed the topics to be documented for each site, underlying:
  - the study design
  - the characteristics of the population-based studies
  - if influencing factors were addressed (e.g. distance metrics, diet, life style factors,...)
  - information on exposure – effects biomarkers
  - the involvement of stakeholders
  - the reporting issues related to the study (if publication has been done, if policies and/or media were involved, if public communication took place)
  - the study outcomes
  - possible impact on remediating actions
  - lessons learned (successes and difficulties).
- We analyzed the importance of the HBM in ICS
- We have pointed out some issues that need to be considered when carrying out a study

DESCRIPTION OF THE MAIN RESULTS OBTAINED

During the visit to Flemish Institute for Technological Research (VITO), Mol, Belgium, with my collegues from the host instute

- I was an interface between the participating members which send the above information and the paper coordinator (Ann Colles), to organize the material, to ensure a high degree of consistency of the information pieces.
- I integrated the received information into a consistent draft paper, drawing the overall conclusions regarding: lessons learned from the experiences revealed by the participating members, PROs and CONs, what useful approaches/things can be done and what has to be avoided.
- The draft paper has 16 pages.

FUTURE COLLABORATIONS (if applicable)

- Finalize and publish the article
- Potential presentation of the paper general framework and outcomes at the next training events of the Action

Other comments: STSM is a good challenge for young researchers from different reasons:

- exchange of scientific experience;
- planning future collaborations;
- preparation of scientific articles.

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: IS1408
STSM title: Health impact assessment around an industrial waste incinerator in Mantua, Italy
STSM start and end date: 08/03/2018 to 06/04/2018
Grantee name: Stephanie Gaengler

PURPOSE OF THE STSM

(max.500 words)

The Unit of Environmental and Social Epidemiology is preparing a short training course on spatial analyses methods using GIS, with specific focus on industrially contaminated sites, with the goal to make these training materials available to the member countries of this COST action (ICSHNet). This STSM served to train my spatial analysis skills and to pilot the training program prepared by Marco De Santis.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

(max.500 words)

In the first two days at the National Health Institute (Istituto Superiore di Sanità, ISS), I was introduced to the work of the Unit of Environmental and Social Epidemiology. I reviewed the work that has been done on the different industrially contaminated sites here in Italy, which later on also served as examples in the exercises of the training I received.

Within this training the following topics were covered: Overview of ArcMap and ArcCatalog, Geoprocessing including the use of toolboxes, application of the ArcGIS extensions Spatial Analyst and the Geostatistical Analyst. Besides the theoretical background, exercises on spatial analysis were part of the training. These included, the mapping of Italian all cancer mortality form 2004-2014, the application of the RIF (Rapid Inquiry Facility) tool developed by the Small Area Health Statistics Unit at the Imperial College of London, investigation of the presence of a cluster of mesothelioma in Sicily and all cancer cluster in Liguria, with the help of SatScan. Moreover, geocoding of addresses was done in QGIS.

The training taught me the basics on spatial analysis, in order to apply these tools to various spatial problems in the field of environmental epidemiology and on the dataset of the case-control study that is set in Mantua, Italy. The study site of the case-control study is located in the residential area around the industrial zone of Mantua. In preparation of this investigation, meetings with other group members were held during my STSM

at the ISS. A meeting with Marta Benedetti on the study design of a case-control study, and case classification of soft tissue sarcoma. With Roberto Pasetto I had the chance to discuss about the relevance of socio-economic status in environmental health with special reference to contaminated sites. Moreover, in a meeting with Amerigo Zona, the methods and findings of the epidemiological surveillance of Italian contaminated sites within the Sentieri project were covered.

In addition to the meetings with the group members of the Environmental and Social Epidemiology Unit, I held a Seminar on my doctoral research at the Cyprus International Institute for Environmental and Public Health at the Cyprus University of Technology with the title "Exposure assessment to disinfection byproducts: from personal exposure to population health" (Annex 1). This led to an interesting discussion and a series of further meetings within the Department of Environment and Health and the Department of Food Safety, Nutrition and Animal Health.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

(max. 500 words)

Visit to industrially contaminated sites

The Istituto Zooprofilattico Sperimentale del Mezzogiorno in Portici, does various work on environmental and animal health, including cohort studies on the population living in contaminated sites in the South of Italy. My visit to this Institute in Portici, introduced me to the already conducted and ongoing studies e.g. Campania Trasparente or SPES, in the areas affected by the illegal dumping of hazardous waste in the Region of Campania.

Moreover, I visited the Epidemiological Observatory of Mantua Health Agency, which is involved in the investigation of soft tissue sarcoma case-control study around the industrial site of Mantua. During the visit I had the chance to get a personal impression of the study site that includes the areas of Lunetta, Frassino, Valetta Valsecchi and Virgiliana, which are located around the contaminated site. The data analysis of this project is ongoing, and I will be part of this procedure as a continuation of this STSM.

The Mantua Study

The database of the case-control study in Mantua currently underlies a final check and can then be used for the statistical analysis. The preliminary analysis plan has been set up and will subsequently be executed as a collaboration of the Team of the Environmental and Social Epidemiology Unit and me. Additionally, the results will be written and published in form of a peer reviewed scientific publication within the next months.

Within this STSM I learned the theory and how to apply spatial analysis in environmental epidemiology and especially around industrially contaminated sites. This training plan taught by Marco De Santis incorporated theoretical aspects of spatial analysis as well as its practical use. Moreover, I benefitted from broad experience of the members of the ISS to improve my research skills with regards to industrially contaminated sites and beyond. Moreover, within the meetings held at the ISS, I could identify common research paths with the Cyprus University of Technology and therefore new possibilities for collaborations in the future are opened.

FUTURE COLLABORATIONS (if applicable)

(max.500 words)

The work on the Mantua study

Within the STSM the frame of the study analysis has been set and will be continued as collaboration between the two institutions, CUT and ISS. The newly acquired skills will then be applied to conduct a follow-up study on the risk of soft tissue sarcoma for the population living near the former industrial waste incinerator in Mantua, using a case-control study design. Within this study better exposure assessment tools specifically with the use of geographic information systems (GIS), will be applied to better classify the surrogate measure of exposure (distance to point source) among the study participants. This follow-up study results and the concomitant risk estimates will then be compared against those measured 20 years ago during the initial assessment as presented in the Comba et al (2003) manuscript.

Activities in the Department of Environment and Health of ISS

On the 23.03.2018 I met with Emanuela Testai from the Unit of Mechanism, Biomarkers and Models. Since the toxicity of trihalomethanes was one of her research topics, she was able to give valuable input for the development of future studies on the exposure assessment and metabolic effects of trihalomethane exposure. Moreover, we discussed about possibilities to incorporate genetics information in environmental exposure studies, on example studies she has been involved in, in Rome and Taranto.

Activities in the Department of Food Safety, Nutrition and Animal Health of ISS

On the 19.03.2018 I got the opportunity to meet Umberto Agrimi, the Head of the Department of Food Safety, Nutrition and Animal Health. After an introduction to the work of the Department, Francesco Cubadda introduced me to their work on chemical food safety and nutrition including a tour around the laboratory facilities. Moreover, Stefano Morabito introduced me to their work on biological contaminants and showed me around the laboratory.

ANNEX I

ISTITUTO SUPERIORE DI SANITÀ

Istituto Superiore di Sanità

Roma, 05/04/2018
VIALE REGINA ELENA, 299
0161 ROMA
TELEGRAMMI: ISTISAN ROMA
TELEFONO: 06 49901
TELEFAX: 06 49387118
http://www.iss.it

This is to certify that Dr. **Stefanie Gängler** from the Water and Health Laboratory, Cyprus international Institute for Environmental and Public Health, Cyprus University of Technology, gave a seminar on *"Exposure assessment to disinfection byproducts: from personal exposure to population health"* on March 19th, 2018.

The Head of
the Unit of Environmental
and Social Epidemiology

(Dr. Pietro Comba)

The Head of
Department of
Environment and Health

(Dr. Eugenia Dogliotti)

EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: IS1408
STSM title: Methods for estimating ingestion exposure to common contaminants
STSM start and end date: 07/02/2018 to 13/02/2018
Grantee name: Rebeca Hams

PURPOSE OF THE STSM

The purpose of this STSM was to enable collaboration between researchers and to build on the effort of working group two (currently developing reviews of exposure assessment methods) to lay the groundwork to develop an epidemiological protocol focusing on methods for estimating ingestion exposure to common contaminants in the framework of industrially contaminated sites (ICS).

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

The specific aim of the STSM was to develop methodology that can be used to estimate ingestion exposure to common contaminants and clarify how to apply the methods developed to industrially contaminated sites (ICS). This included reviewing food characteristics such as consumption of 'Local' versus 'non-locally' sourced foods.

Methods were developed to estimate the proportion of specific food items grown by consumers within different regions. This methodology drew on information from several sources including; average population uptake of grow your own food crops, analysis of the most frequently grown food crops and regional agricultural profiles. This information could then be linked to a specific ICS or applied at larger geographies e.g. regions.

Land use surrounding ICS was also reviewed both as a literature search and for available data sources. This included the following questions:

a. Is there a predominant land use type near ICS?
b. Proximity of humans to ICS
c. Are certain crops more likely in areas close to ICS?
d. Are certain crops more likely to absorb contamination than others in relation to ICS.

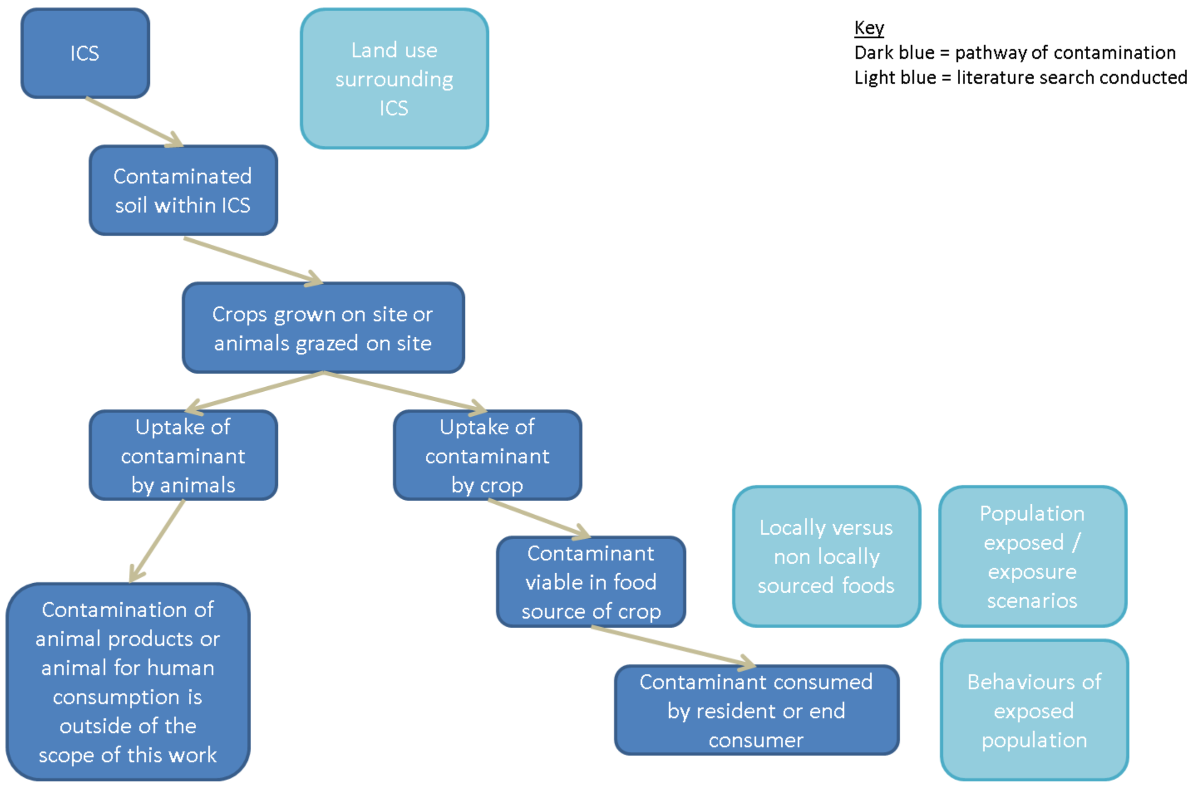
To help understand the population exposed, examples of different exposure scenarios were discussed and reviewed including limitations of the approaches identified.

Funded by the Horizon 2020 Framework Programme of the European Union

DESCRIPTION OF THE MAIN RESULTS OBTAINED

During the STSM, discussions between collaborators facilitated development of methodologies that could contribute to the overall aim of the project. Figure 1 below highlights soil contamination as a route of ingestion and where literature searches were conducted as part of this project (shown by light blue boxes).

Figure 1. Soil contamination as a route of ingestion



In addition to the literature searches, sources of data for land use and contaminated sites were investigated. This has led to the identification of an EU wide dataset for land use and within England and Wales a number of categories of ICS are available in Geographical Information Systems (GIS) for analysis.

FUTURE COLLABORATIONS (if applicable)

The work from this STSM will be used in conjunction with ongoing collaborative efforts cumulating in a methods paper demonstrating the developed methodology. The methodology will be illustrated with two cases studies. This will also be adapted for a manuscript for a peer review publication.

Using GIS it may also be possible to explore the relationships between land use (specifically categories of food crops) in the vicinity of ICS.

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: IS1408
STSM title: Environmental surveillance programme gap analysis
STSM start and end date: 03/05/2018 to 10/05/2018
Grantee name: Rebeca Hams

PURPOSE OF THE STSM

The purpose of this STSM was to support the undertaking of a gap analysis of environmental surveillance programmes across Europe. The STSM provided dedicated time and space to work on this project that would otherwise have been very difficult to complete in the given timeframe. The project supported the aims of working group one to identify the needs and priorities to guide the collection and organization of environmental and health data concerning industrially contaminated sites.

Working alongside the working group one lead (Piedad Martin-Olmedo) the host of the STSM and with support from my home institution (Giovanni Leonardi) I was able to help deliver a review "Information gap analysis of National Environmental Surveillance Program as a tool for characterizing health impact of industrially contaminated sites".

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

During the STSM the work focused on a gap analysis and producing a manuscript for peer review publication. The aim of the study was to identify the needs and priorities to guide the collection and organization of environmental and health data concerning ICSs. We also had three specific objectives:

(i) to identify examples of studies where environmental data were used to develop valid population exposure models relevant to ICSs;

(ii) to identify examples of studies where health data were used to develop valid epidemiology and/or surveillance programmes relevant to ICSs.

(iii) to provide a critical analysis of the dimensions required to develop environmental public health tracking on ICS.

The study methods comprised of two parts; a structured literature review that included reviewing over 300 abstracts and over 25 full text articles for inclusion in the study and a review of literature about the topic known to the research team. After agreeing which studies would be included both categories of studies were reviewed, I took charge of reviewing the studies identified from the literature search. Following the review process, the gaps within each category were brought together to highlight the overall gaps in this topic and

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to link to the study objectives. The results of the study described key characteristics of the included studies while the discussion section of the paper focused on identifying gaps and providing a critical analysis of these gaps and how they relate to developing an environmental public health tracking system specific to ICS.

At the end of the STSM, a draft manuscript had been written and shared with co-authors for final comments prior to submitting to the journal.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

The main output of the STSM was a draft manuscript for a special edition of the Journal Epidemiologia e Prevenzione. Over the coming days and weeks, the manuscript will be first submitted to the journal and any requested clarifications or revisions made prior to the proposed publication of the special edition.

FUTURE COLLABORATIONS (if applicable)

With my host and home institution we are currently exploring some of the gaps identified through this work and the possibilities of future collaborations. These future collaborations may include other members of the COST action and / or go beyond the end date of this current COST action.

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

Action number: IS1408 – 39704: Industrially Contaminated Sites And Health Network (ICSHNet)
STSM title: COST STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland (from Slovenia to Finland)
STSM start and end date: 13/12/2017 to 22/12/2017
Grantee name: AGA-IS1408-3: 2017-05-01 – 2018-04-30

PURPOSE OF THE STSM/

The most important reason for my **Short Scientific Mission (STSM) in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland** was to finalizing the work (articles and chapter HIA) with professor Otto Hänninen and his colleagues from National Institute in the field of "Methods and tools for health risk and health impact assessment".

Professor Hänninen and I proposed the following objectives for STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland: The aim of our STSM was:

1. the preparation of **systematic review and chapter of health risk and health impact assessment** for the industrial hot spots (research strategy, health and environmental data, in analysis included social determinants and other environmental determinants, tolls and methodology used in epidemiological researches, general conclusions, future researches) which is very useful for the WG3 (COST IS1408).
2. discussion about the (necessary needed) **health and environmental data, tolls and methods for HRA and HIA** analysis in Slovenia (two examples):
    - Zasavje region which is the most polluted area in Slovenia due to outdoor air pollution and soil contamination and
    - in the field of indoor air quality in school environment (examples of good practices in Finland, methodology how to assess the HRA and HIA).
3. preparing **scientific article based on systematic review of HRA and HIA** for the industrial hot spots.
4. discussion about future **scientific collaboration** in another example of industrial hot spot in Slovenia and Finland.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

According to purpose of STSM, my work was carried out based on **different approaches** (as discussed with experts from THL, Kuopio, literature review and written the book chapter and review article).

1. Preparation of the **systematic review and chapter of health risk and impact assessment** for the industrial hot spots (work team: professor Otto Hänninen, assistant professor Andreja Kukec, Kairong Xiong, PhD, Tanja Rejc, BSc):
   - evaluation of the **progress of review from STMS in April 2017**, **summary ot the final articles included in the analysis** and **presentation of results** (flow chart, table).
   - professor Hänninen presented us the main conclusions from Granada, Spain, 22 November 2017 Core Group meeting, and 23-24 2017 November, meeting of WG1.
   - professor Hänninen presented us the **document of Small Group 2** (proposal of Sarah Dack) for preparing Strategy for prioritization and chapter **health impact assessment**.
   - our team prepared the **proposal for content of the book** and **draft version of health risk assessment**.
2. Discussion about the necessary **needed health and environmental data**, **tolls and methods for HRA and HIA analysis** in Slovenia:
   - the colleges from THL, Kuopio presented me the **european (EU) and national project in THL in the field of outdoor and indoor air pollution** (from exposure assessment, risk assessment to risk communication, good practices how to reduce the impact on health, actions plans). This knowledge could be very useful for my work in the EU in national project in which Slovenia is involved.
3. Preparation of the **scientific article** based on the systematic review of HRA and HIA for the industrial hot spots.
   - during the STSM we were preparing the **results of review article**, **now we continue our work on article** (we would like to finish and submit the article WG3 members by the end of January 2018).
4. Discussion about the **future scientific collaborations** in other examples of industrial hot spots in Slovenia and Finland
   - implementation of the **strategy for prioritization in different contaminated sites** in both countries.
   - the **perinatal exposure to environmental and social risk factors** is very interesting topic for both countries.
   - **bilateral projects** between countries in the field of environmental health.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

The main results of STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland was:

1. **draft chapter on health risk and impact assessment** for the industrial hot spot which will be useful for WG3 (COST IS1408) (more detail information are available in Appendix 1).
2. draft of **scientific articles based on systematic review of HRA and HIA** for the industrial hot spots (results of article review - more detailed information are available in Appendix 2).
3. Plan for future scientific collaboration in the field of health risk and impact assessment, improvement health related to environmental determinants (indoor and outdoor air quality, pregnancy outcomes).

FUTURE COLLABORATIONS (if applicable)

During my STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland many opportunities for future collaboration can be made:

1. WG3 (COST IS1408)
   - continue the work for chapter HIA, HRA and other activities related to WG3.
   - finalising the systematic review of HRA and HIA.

2. OTHER ACTIVITIES IN THE FIELD OF ENVIRONMENTAL PUBLIC HELATH
   - preparation of the epidemiological study protocol and analysis for Finish and Slovenian birth population from perinatal information system (prenatal exposure and effects of environmental and social determinates).
   - I would also like to invite professor Hänninen in our team (preparation of the meta-analysis article with the title: "Association between prenatal exposures to ambient air pollution and birth weight, low birth weight and preterm birth: meta-analysis and identification of environmental public health challenges, Prospero register number: CRD42018081540).

From different point of view, especially scientific it was good STSM. As usual it was in my pleasure to have opportunity to work with professor Otto Hänninen and his co-workers.

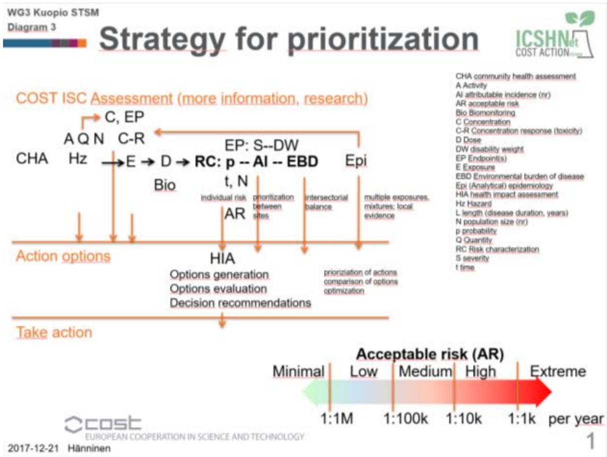
With best regards,

Andreja Kukec

Appendix 1: Draft of working document chapter of health risk and impact assessment for the industrial hot spot (draft version was created 21.December 2017, 8.1.2018 Sarah Dack give as the suggestions)

Content proposal

2.1 Qualitative expert judgment prioritization
2.2 Public Health Assessment (PHA)
2.3 Epidemiology
2.3.1 Descriptive epi. (incl. CHA)
2.3.2 Analytical epi.
2.4 COST ICSs Assessment (ICSA)
2.4.1 Site characteristic (A, Q, N, H)
2.4.2 Hazard identification
2.4.3 Biomonitoring
2.4.3 Health risk assessment (incl. HIA + EBD)
2.5 Cumulative risk assessment (CRA)
2.6 Cost benefit analysis



Chapter 1 (2.4.3) Health Risk assessment (HRA)

Andreja Kukec[1, 2], Kairong Xiong[3], Tanja Rejc[2], Otto Hänninen[4]

[1]Centre of Public Health, Faculty of Medicine, University of Ljubljana, Slovenia
[2]National Institute of Public Health, Slovenia
[3]Guangdong University of Technology, Guangdong, China
[4]National Institute for Health and Welfare, Kuopio, Finland

Definition and the process

Risk assessment (RA) is a process intended to calculate or estimate the risk to a given population, including the identification of attendant uncertainties, following exposure to a particular agent, taking into account the inherent characteristics of the agent of concern as well as the characteristics of the specific target system (WHO 2004).

A human health risk assessment (HRA) is the process to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals in contaminated environmental media, now or in the future (EPA https://www.epa.gov/risk/human-health-risk-assessment). *past exposure

After planning and scoping HRA includes four major steps: hazard identification, dose-response assessment, exposure assessment, and risk characterization. In the Figure 1 are present four major steps with crucial questions for decision making during the process.

We will put the text bellow in the Figure (Schema)

1. Hazard Identification (Hazard identification (HI): determining whether exposure to a stressor can cause an increase in the incidence of specific adverse health effects (e.g. cancer, birth defects) or whether the adverse health effect is likely to occur in humans)
What are the health effects that can be caused by exposure to some agent in question?
- What is the quality and weight of evidence supporting this identification?
- Is there any interaction between the identified hazards and other agents in the environment?
- Is the onset of health effects immediate or delayed?
- Is there is a critical window of exposure?
- Has the carcinogenic and/or genotoxic potential of the identified hazards been addressed?
- sources of data:
- toxicokinetics (body absorbs, distributes, metabolizes, and eliminates specific chemicals), toxicodynamics (mechanisms by which a chemical may impact human health)
2. Dose-response assessment
Dose–response assessment: Describes how the likelihood and severity of adverse health effects (the responses) are related to the amount and condition of exposure to an agent (the dose provided).
- What is the intensity of exposure?
- Is appropriate dose–response data available, and has the data been appropriately scaled in translation from animal to human?
- Has the potency of the agent been determined for both acute and chronic dosing?
- Does a threshold or non-threshold model best describe the data?
- Is there a level bellow which some chemicals don't pose a human health risk?
- Non-linear dose-response assessment (NOAEL or LOAEL)
- Linear dose-response assessment (CR, SF, IUR)
3. Exposure assessment (Exposure assessment is the process of measuring or estimating the magnitude, frequency, and duration of human exposure to an agent in the environment, or estimating future exposures for an agent that has not yet been released. An exposure assessment includes some discussion of the size, nature, and types of human populations exposed to the agent, as well as discussion of the uncertainties in the above information)
- What is the duration, timing, frequency and consistency of exposure?
- Are exposures continuous, intermittent or episodic, or do they show clear patterns?
- Have all exposure routes (ingestion, inhalation, dermal) have been considered?
- Are exposures intergenerational or cumulative, or should they be aggregated?
- Are some people more likely to be exposed to environmental stressors (work, where they play, where they eat?)
- frequency, duration, timing and consistency
- data availability about exposure
- routes (ingestion, inhalation, dermal)
- quantifying exposure (point of Contact Measurement, Scenario Evaluation, Reconstruction)
- intergenerational or cumulative, or should they be aggregated
- exposure description
    · past, current or future
    · intergenerational or cumulative, aggregated
    · pollutants level
    · population (more likely to be exposed due their activity, workplace, …)
c) Human health risk
4. Human health risk characterization (Risk characterization: The objective is to summarize and integrate information from the proceeding steps of the risk assessment to synthesize an overall conclusion about risk)
- What is the estimated incidence of the adverse health effects in a given population?
- summarize risk characterisation
    · qualitative or quantitative (type of endpoint)
    · findings, assumptions, limitations, uncertainties
- individual/ population characteristic (age, gender, immune status, social status…)
- TCCR (Transparency, Clarity, Consistency, Reasonableness)

Figure 1: Human health risk assessment process with four major steps and crucial questions for decision making (References WHO; EPA)

Examples of HRA studies in ICSs

There exists different global studies of HRA in Industrial contaminated sites (ICSs). This chapter identifies an initial list of review scientific articles in the three most contaminated industrial sites (incinerator, landfill, cement plants) and different methods and tools (more detail Appendix; we will summarize important information in text). Table 1 example of HRA at ICSs in Europe (Cangialosi G et al., 2008).

Table 1: Example of human health risk assessment assessment at industrially contaminated sites in Europe (Cangialosi G et al., 2008).

Steps	Indicator	Case study Cangialosi G et al.
1 HAZARD IDENTIFICATION	- sources of data	(non)carcinogenic chemicals pollutants: PCDD/Fs, Cd, Pb, Hg , point sources - municipal solid waste (MSW) (monitoring data MSW)
	- toxicokinetics (body absorbs, distributes, metabolizes, eliminates specific chemicals)	inhalation rate, exposure frequency, ingestion rate, exposed skin surface area, soil-skin adhesion factor, vegetable ingestion rate, dairy product ingestion rate, contaminated fish rate, fish ingestion rate
	- toxicodynamics (mechanisms by which a chemical may impact human health)	
2 DOSE/EXPOSURE –RESPONSE ASSESSMENT	- Non-linear dose-response assessment (NOAEL or LOAEL)	/
	- Linear dose-response assessment (CR, SF, IUR)	- total daily intake [mg kg-1 d-1] of each contaminant - CR
3 EXPOSURE ASSESSMENT	- study area and population	Taranto city (Southern Italy): 10×10 km2 area; 30,000 inhabitants
	- frequency, duration, timing and consistency	operated since 1988, long term effect
	- data availability above exposure	- air emission from MSW (recorded from 2003), concentration of contaminants in water, soil, vegetation and animals, meteorological data, (Italian Ministry of Environmental Protection, other studies, IARC, USEPA)
	- routes	- inhalation, ingestion, dermal contact
	- quantifying exposure (point of contact measurement, scenario evaluation, reconstruction)	- mathematical models: pollutants transport in environmental media (hybrid plume dispersed air pollution model GIADA; introduce equations calculating pollutant concentrations in soil, water, vegetation)
	- exposure description	
	past, current or future	past
	intergenerational or cumulative, aggregated	estimate for each 1600 square cells with a 250 m side (used for GIS); cumulative concentration for each contaminant of concern at soil
	pollutants level	air emissions 62,000 tons of MSW per year average air concentrations at ground level and dry depositions, water
	population (more likely to be exposed due their activity, workplace,…)	two receptor groups (children, adult)

4 RISK CHARACTERISATION	- summarize risk characterisation	
	qualitative or quantitative	- HQ, CR - individual risk (sum of risks in all 1600 cells, each pathway and target group) - global risk (carcinogenic pollutants)
	findings, assumptions, limitations, uncertainties	- CR is very small compared with background levels - global risk distribution for carcinogenic pollutants: higher levels in urbanized areas - significant exposure pathways: direct inhalation and food ingestion - approach calculating the risk in conditions of reasonable maximum exposure (RME) – future alternative approaches involving probabilistic assessment - assessment pollutants limited on regularly measured for surveillance - not included sources of kiln, petroleum refinery as very busy local automobile
	- individual/ population characteristic (age, gender, immune status, social status…)	children, adult
	- TCCR (Transparency, Clarity, Consistency, Reasonableness)	/

Suggestions HRA

	Current state	Update
Definition	A human health risk assessment (HRA) is the process to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals in contaminated environmental media, now or in the future (EPA https://www.epa.gov/risk/human-health-risk-assessment).	Health risk assessment should aim at describing the nature (e.g. type of disease, cause of mortality) and quantify its probability. Additionally, if possible, it is also useful to estimate the number of cases. Further, when the type of disease is known, the magnitude of the risk can be described using years of life lost, years lived with disability (with disability weighting) and expressed in DALYs.
Exposure assessment	now or in the future exposure	(past, current or the future exposure)
Endpoints	cancer, non-cancer in majority of article	Type(s) of cancer, non-cancer (type(s) of toxic effect) using epi data and RR-based analysis it would be possible to link to background burden of disease data and express the impact according to ICD (e.g. asthma, COPB, stroke)
Risk characterization	Probability (cancer risk calculated in lifetime), doesn't report the number of cases in majority of article	Probability (cancer risk calculated per lifetime; annually; per person; per population group) Estimate the number of cases in the population Estimate the EBD (YLD, YLL, DALY)
Strategy for prioritizations	RC (risk characterizations): in the majority of the cases in the HRA at ICSs reported as the CR (cancer risk) is acceptable (bellow 10-6), consequently no further actions well be taken.	To choose which action options we will take we should consider scale of acceptable risk per year (five stages from minimal to extreme), life time, population size: - if risk is considered as minimal or low we can proceed with AI (attributable incidence) and EBD (environmental burden of disease), - if risk is considered as medium, high or extreme we

		can proceed with AR (acceptable risk) and continue with HIA (health impact assessment). High individual risk level is used to trigger consideration for risk reduction (options generation and evaluation) Medium risk sites should be prioritized based in the attributable impact. Low risk sites should be included in intersectoral risk comparisons and assessment of public health impacts of chronic low exposures, impacts on developmental origin of diseases etc.

Health Imapact Assessment (HIA)

Andreja Kukec[1, 2], Kairong Xiong[3], Tanja Rejc[2], Otto Hänninen[4]
[1]Centre of Public Health, Faculty of Medicine, University of Ljubljana, Slovenia
[2]National Institute of Public Health, Slovenia
[3]Guangdong University of Technology, Guangdong, China
[4]National Institute for Health and Welfare, Kuopio, Finland

Chapter 2. Definition and the process

Health impact assessment (HIA) "a combination of procedures, methods, and tools by which a policy, programme, or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population". Using qualitative, quantitative and techniques, HIA aims to produce recommendations that will help decision-makers and other stakeholders make choices about alternatives and improvements to prevent disease/injury and to actively promote health (http://www.who.int/hia/about/defin/en/)

Health impact assessment includes six major steps: screening, scoping, assessment, recommendation, reporting, monitoring and evaluation (https://www.cdc.gov/healthyplaces/hia.htm).

We will put the text bellow in the Figure (Schema)
Screening: need and value of HIA
- Is the project likely to pose any significant health problems?
- Are health effects expected to be negligible?
- Are health effects already well known and controllable?
Scoping: identification of the health impacts and setting boundaries
- What are the potential health impacts?
- What are possible hazards and benefits, what is their nature, size and measurability (how comprehensive)
Assessment: identifying affected populations and quantifying health impacts of the decision
- What are the risks and benefits (type and magnitude of) positive and negative effects?
- Who will be affected?
- What is the magnitude of hazards and benefits?
Recommendation: strategies to manage identified adverse health impacts and maximize benefits to health
- Can risk be avoided or minimized?
- How we evaluate and compare risks and benefits?
Reporting: development of the HIA report, communication of findings and recommendation
-what are the conclusions and recommendations to remove / mitigate negative impacts on health
Evaluation / monitoring: impacts on decision making processes and decision, impacts of decision on health determinants
- Is the HIA process effective and are health outcomes improved as a result of it?
Figure 1: the process of HIA

Add examples from Europe

Recommendation HIA

	Current state	Update
Definition	HIA "a combination of procedures, methods, and tools by which a policy, programme, or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population". Using qualitative, quantitative and participatory techniques, HIA aims to produce recommendations that will help decision-makers and other stakeholders make choices about alternatives and improvements to prevent disease/injury and to actively promote health (http://www.who.int/hia/about/defin/en/) HIA is a process that helps evaluate the potential health effects of a plan, project, or policy before it is built or implemented. HIA brings potential positive and negative public health impacts and considerations to the decision-making process for plans, projects, and policies that fall outside traditional public health arenas, such as transportation and land use. An HIA provides practical recommendations to increase positive health effects and minimize negative health effects (CDC, 2016)	HIA is a process that helps evaluate the potential public health effects (positive and negative) of a plan, project, or policy before it is built or implemented. HIA process use qualitative and quantitative methods and recommend decision-makers and other stakeholders the choices about improvements and alternatives to prevent disease/injury and promote public health.
Endpoints	Adverse health effects	Estimate the number of cases in the population (from HRA)

Recommendation Strategy for prioritization

	Current state	Update
Hazard identification	Different level of data about Hz in the strategy for prioritization	All needed data should be collected in hazard identification step. - toxicokinetics (body absorbs, distributes, metabolizes, eliminates specific chemicals) - toxicodynamics (mechanisms by which a chemical may impact human health) and number of cases of endpoint in humans who may be exposed to environmental contaminants (e.g. chemical, physical, biological) in past, current or in the future.

Appendix 2: List of identified review papers on human health risk assessment at industrially contaminated sites in Europe (PubMed & WoS, 2017)

	Author/Type ICSs	Active years of working	Effected population	Pollutants	Endpoints	Main founding
Incinerator	Boudet C et al., 1999	operated science 1971	405,000	VOC, Ni, Cd	non-cancer, cancer	CR: benzene 2.6×10^{-10} (95%CI: $1.2\times10^{-10}-5.4\times10^{-10}$); Ni 8.6×10^{-8} (95%CI: $4.3\times10^{-8}-17.3\times10^{-8}$); Cd 1.5×10^{-8} (95%CI: $7.2\times10^{-9}-3.1\times10^{-8}$)
	Cangialosi F et al., 2008	operated science 1988	30,000	dioxins/furans, Cd, Pb, Hg	non-cancer, cancer	cancer mortality over a lifetime (100,000 people): 4.643×10^{-4}
	Cordioli M et al., 2013	operate in early 2013	191,330	PM_{10}, PCDD/F, PAH, Cd, Hg	mortality, morbidity, cancer (lung cancer), stroke, acute bronchitis, asthma, lower respiratory symptoms	HI (i.e. 15%) n. of cases (i.e. 0.65) and maximum mortality: (i.e. +0.001% increase in the expected annual number of deaths)
	Lorene P et al., 2005	operated since 1974	zone: 100,000	SO_2, PM, HCl, Pb, Hg, Cd, dioxins	respiratory system (irritation), neuro-behavioral effects, lung cancer, renal effects, all types of cancer, developmental risks	$CR_{individual}$ less than 10^{-6}
	Meneses M. et al., 2004	Operated since 1975		PCDD/Fs	cancer, non-cancer	CR 1.07E 07 and 3.08E 09, before and after installation of the clean air system
	Morselli L. et al., 2011	/	52,565	As, Cd, Cr, Ni, Pb, B(a)P, PCDD/PCDF	cancer, non-cancer	$CR_{individual}$ less than 10^{-6} n. of cases 0.0089
	Roberts RJ. et al., 2006	/	25,398	dioxins/furans, PAHs, As, Cd, SO_2, PM_{10}, $PM_{2.5}$	cancer, mortality	overall risk 2.49×10^{-7} or 1 in 4 million
	Vilavert L. 2012	operated since 1991.	/	PCDD/Fs	cancer, non-cancer	CR less than 10^{-6}
Landfill	Davoli E. et al., 2010	operated since 1991.	/	dioxins/furans, PAHs, VCM	cancer, non-cancer	CR less than 10^{-6}
	Durmusoglu E. et al., 2010.	/	/	BTEX	cancer, non-cancer	CR 6.75E^{-06} (lower then designated acceptable risk level of 1.0E^{-04})
	Mari M. et al., 2009.	operated since 1984	/	As, Cd, Cr, Hg, Ni, Pb, PCDD/Fs	cancer, non-cancer	/
	Martí V. et al., 2014	operated (80s), closure (1995)	/	VOCs	cancer, non-cancer	HI and CR acceptable (HI < 1 and CR < 10^{-5})
Cement plants	Sánchez-Soberón F et al., 2015	/	/	PM (10, 2.5, 1)	cancer, non-cancer	CR less than 10^{-5}
	Rovira J. et al., 2010	operated since 1968	/	As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Sn, Tl, V, Zn, PCDD/Fs	cancer, non-cancer	CR less than 10^{-5}
	Rovira J. et al., 2014	started (last century), new production (2010)	65,000	As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Sn, Tl, V, Zn,dioxins/furans	cancer, non-cancer	CR less than 10^{-5}
	Schuhmacher M et al., 2004	operated since 1902	80,976 5042 (high polluted	NO_2, SO_2, PM_{10}, metals, PCDD/Fs	respiratory, cardiovascular admissions, emergency room visits, asthma, cancer	$CR_{total\ pop}$ 0,03 $CR_{high\ exposed\ pop}$ 0,2

	Author/Type ICSs	Pollutants	Methods	Tools & Models
Incinerator	Boudet C et al., 1999	VOC, Ni, Cd	quantitative risk (properbility)	dispersion modeling (Gaussian plume model), time-activity patterns, life-long exposures
	Cangialosi F et al., 2008	dioxins/furans, Cd, Pb, Hg	health impact (n of cases)	matrix of environmental exposure factors, dispersion model (GIADA model),
	Cordioli M et al., 2013	PM_{10}, PCDD/F, PAH, Cd, Hg	health impact (n of cases)	a multicompartment model, EPA HHRAP Protocol atmospheric dispersion modeling
	Glorennec P et al., 2005	SO_2, PM, HCl, Pb, Hg, Cd, dioxins	quantitative risk (properbility)	multimedia model, gaussian plume dispersion model, POL'ER software, CalTox
	Meneses M. et al., 2004	PCDD/Fs	quantitative risk (properbility)	air dispersion modeling (Gaussian plume model, ISCST3 (Industrial Source Complex-Short Term, Version 3) model, vegetation and soil modeling
	Morselli L. et al., 2011	As, Cd, Cr, Ni, Pb, B(a)P, PCDD/PCDF	health impact (n of cases)	industrial source complex (ISC3) calculation code, GIS
	Roberts RJ. et al., 2006	dioxins/furans, PAHs, As, Cd, SO_2, PM_{10}, $PM_{2.5}$	health impact (n of cases)	multimedia model, Atmospheric Dispersion Modeling System (ADMS3),
	Vilavert L. 2012	PCDD/Fs	quantitative risk (properbility)	active and passive sampling devices, EPA HHRAP Protocol
Landfill	Davoli E. et al., 2010	dioxins/furans, PAHs, VCM	quantitative risk (properbility)	dispersion modelling, atmospheric transport
	Durmusoglu E. et al., 2010.	BTEX	quantitative risk (properbility)	US EPA method TO-17
	Mari M. et al., 2009.	As, Cd, Cr, Hg, Ni, Pb, PCDD/Fs	semi quantitative methods	active samplers (TE-1000 PUF and TE-6070DV Air Sampler Tisch Environmental, Cleves, OH, USA)
	Martí V. et al., 2014	VOCs	quantitative risk (properbility)	EPA HHRAP Protocol, simulations
Cement plants	Sánchez-Soberón F et al., 2015	PM (10, 2.5, 1)	quantitative risk (properbility)	monitoring
	Rovira J. et al., 2010	As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Sn, Tl, V, Zn, PCDD/Fs	quantitative risk (properbility)	sampling
	Rovira J. et al., 2014.	As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Sn, Tl, V, Zn,dioxins/furans	quantitative risk (properbility)	air dispersion model, measured (soil, vegetation), human exposure - different scenarios
	Schuhmacher M et al., 2004	NO_2, SO_2, PM_{10}, metals, PCDD/Fs	health impact (n of cases)	ISC3-ST model (Gaussian dispersion model from US EPA), GIS

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: IS1408
STSM title: Editing the ICSHNet Special Issue on 'Environmental health challenges from industrial contamination' accounting for the WHO perspective
STSM start and end date: 19/04/2018 to 27/04/2018
Grantee name: Roberto Pasetto

PURPOSE OF THE STSM

Roberto Pasetto, together with the Action coordinator Ivano Iavarone, is involved in editing a journal Special Issue on 'Environmental health challenges from industrial contamination' planned within the Cost Action work and budget plan for the 3rd grant period. The Special Issue will include several manuscripts on methods for studying exposure, and health risk associable to industrially contaminated sites. The STSM should help in finalizing the collection of papers of the Special Issue taking into accounting for the WHO perspective on the topic of industrially contaminated sites.

WORK PLAN

- Collection of the papers of the Special Issue from different authors

- Consideration of issues emerging from the Sixth European Ministerial Conference on Environment and Health in editing the Action Special Issue

- Editing the contributions for the Special Issue accounting for the WHO perspective

- Submission of the Special Issue to the journal Epidemiologia e Prevenzione

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

I interacted with reference persons for each manuscript of the Special Issue finalizing the collection of all the papers and compiling the Table of Contents.

I interacted with the staff of the WHO, in particular with Marco Martuzzi, to understand the WHO perspectives on the interconnections between the topics of industrially contaminated sites, waste and health.

I verified that the contents of the Special Issue recall the Declaration of the six Ministerial Conference on Environment and Health (Ostrava, Czech Republic, 2017), in particular with reference to the priority to prevent and eliminate the adverse environmental and health effects, costs and inequalities related to waste management and contaminated sites in the context of a transition towards a circular economy.

Funded by the Horizon 2020 Framework Programme
of the European Union

I verified for each potential manuscript for the Special Issue the fulfilment with the instructions for authors, compiling a list of additional requirements for each contribution accounting for the WHO perspective as described in the two previous points.

I interacted with editors of the journal Epidemiologia e Prevenzione agreeing with them on the deadlines, the operations for submitting the papers, the content of a letter from the Journal declaring the reception for publication of the collection of manuscripts of the Special Issue, the operations that will follow to the first submission of the papers before their publication.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

- Collection of all the manuscripts included in the following Table of contents.

Title: *Environmental health challenges from industrial contamination*

Editorial. Iavarone I and Pasetto R. Environmental health challenges from industrial contamination.

Original articles

Martin-Olmedo P et al. Information gap analysis of National Environmental Surveillance Program as a tool for characterizing health impact of Industrially contaminated sites.

Hoek G et al. A review of exposure assessment methods for epidemiological studies of health effects related to Industrially Contaminated sites.

Sarigiannis DA and Karakitsios SP. Addressing complexity of health impact assessment in industrially contaminated sites via the exposome paradigm.

Xiong K et al. Methods of health risk and impact assessment at industrially contaminated sites: a systematic review.

Ancona C et al. A review of the epidemiological methods used to investigate the health effects of Industrially contaminated sites.

Shaddik G et al. Towards an assessment of the health impact of industrially contaminated sites in Europe.

Iavarone I et al. Cancer incidence in children and young adults living in industrially contaminated sites, from the Italian experience to the development of an international surveillance system.

Commentary. Savitz D. When is epidemiologic research a helpful response to industrial contamination?

- Inclusion of the perspective from WHO on the topic and contaminated sites and waste in the editorial of the Special Issue and in the introduction or discussion of some of the manuscripts.
- Submission of the manuscripts to the journal Epidemiologia e Prevenzione using the online platform.
- Reception of the letter from the journal declaring the reception for publication of the collection of manuscripts of the Special Issue.
- Definition of the editorial steps preceding the publication.

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

Action number: IS1408 – 39706: Industrially Contaminated Sites And Health Network (ICSHNet)
STSM title: COST STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland (from Slovenia to Finland)
STSM start and end date: 13/12/2017 to 22/12/2017
Grantee name: AGA-IS1408-3: 2017-05-01 – 2018-04-30

PURPOSE OF THE STSM/

For my career of young scientific researcher there were several reasons for my Short Scientific Mission (STSM) in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland.
Together with professor Hänninen and professor Kukec we proposed the following objectives for STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland:

1. **development of guidelines for health impact assessment of industrially contaminated sites** into the overall aim of WG3 based on systematic review.
2. **finalising systematic review of health risk and health impact assessment** (review of case studies, guidelines and scientific literature) for the industrial hot spots which will be useful for WG3 (COST IS1408).
3. **discussion about the future scientific collaboration** in other examples of industrial hot spots in Slovenia and Finland (e.g. young researcher career project).

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

Our work during STSM was focused on:

1. Preparing the **systematic review and chapter of health risk and impact assessment** for the industrial hot spots (work team: professor Otto Hänninen, assistant professor Andreja Kukec, Kairong Xiong, PhD, Tanja Rejc, BSc):
   - professor Hänninen informed us about the main conclusions from Core Group meeting in Granada, Spain (November 22, 2017), and meeting of WG1 (November 23-24, 2017).
   - professor Hänninen also presented us the **document of Small Group 2** (proposal of Sarah Dack) witch served us as a guideline for preparation of the Strategy for prioritization and chapter on **health impact assessment**.
   - our team than prepared the **proposals for content** and **draft version of the chapter on health risk assessment**.
2. preparing the **scientific article** based on systematic review of HRA and HIA for the industrial hot spot.
   - during the STSM we prepared the **results of the reviewed articles** so we can **now continue with the work on the article** from the WG3 members (we would like to finish and submit it by January 2018)
3. discussion about **future scientific collaboration** (young researcher career project)
   - with professor Hänninen and other co-workers in THL.

DESCRIPTION OF THE MAIN RESULTS OBTAINED
The main results of STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland was: 1. **draft of chapter of health risk and health impact assessment** for the industrial hot spots which will be useful for WG3 (COST IS1408) (more detailed information are available in Appendix 1). 2. draft of **scientific article based on systematically review of HRA and HIA** for the industrial hot spots (results of review article - more detail information are available in Appendix 2).
FUTURE COLLABORATIONS (if applicable)
During my STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland we offer many opportunity for future collaboration: 1. WG3 (COST IS1408) • continue in the book chapter HIA, HRA and other activities related to WG3. • finalising the systematically review of HRA and HIA.

In my opinion, STSM in National Institute for Health and Welfare (THL), Public Health Solutions, Kuopio, Finland, was a very good, very useful scientific experience and opportunity for my career as a young scientific researcher. During my bachelor and master's degree I have already learned some basics in health impact and risk assessment approaches and management process, but STSM was a great opportunity for me to gain and expand the experience and knowledge of this field witch could be also very useful for my future work.

I would like to thank you for the opportunity to participate in the STSM and thank you to professor Otto Hänninen and his co-workers for all the shared knowledge and experience and also for the hospitality.

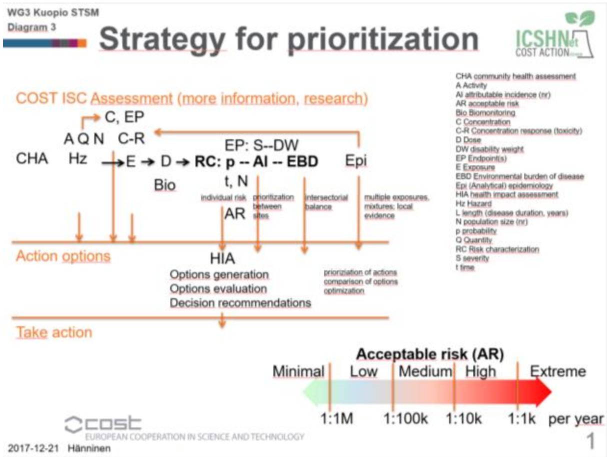
With best regards,

Tanja Rejc

Appendix 1: Working document chapter of health risk and impact assessment for the industrial hot spot (draft version was created 21.December 2017, 8. January 2018 Sarah Dack give as the suggestions)

Content proposal

2.1 Qualitative expert judgment prioritization
2.2 Public Health Assessment (PHA)
2.3 Epidemiology
2.3.1 Descriptive epi. (incl. CHA)
2.3.2 Analytical epi.
2.4 COST ICSs Assessment (ICSA)
2.4.1 Site characteristic (A, Q, N, H)
2.4.2 Hazard identification
2.4.3 Biomonitoring
2.4.3 Health risk assessment (incl. HIA + EBD)
2.5 Cumulative risk assessment (CRA)
2.6 Cost benefit analysis



Chapter 1 (2.4.3) Health Risk assessment (HRA)

Andreja Kukec[1, 2], Kairong Xiong[3], Tanja Rejc[2], Otto Hänninen[4]

[1]Centre of Public Health, Faculty of Medicine, University of Ljubljana, Slovenia
[2]National Institute of Public Health, Slovenia
[3]Guangdong University of Technology, Guangdong, China
[4]National Institute for Health and Welfare, Kuopio, Finland

Definition and the process

Risk assessment (RA) is a process intended to calculate or estimate the risk to a given population, including the identification of attendant uncertainties, following exposure to a particular agent, taking into account the inherent characteristics of the agent of concern as well as the characteristics of the specific target system (WHO 2004).

A human health risk assessment (HRA) is the process to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals in contaminated environmental media, now or in the future (EPA https://www.epa.gov/risk/human-health-risk-assessment). *past exposure

After planning and scoping HRA includes four major steps: hazard identification, dose-response assessment, exposure assessment, and risk characterization. In the Figure 1 are present four major steps with crucial questions for decision making during the process.

We will put the text bellow in the Figure (Schema)

1. Hazard Identification (Hazard identification (HI): determining whether exposure to a stressor can cause an increase in the incidence of specific adverse health effects (e.g. cancer, birth defects) or whether the adverse health effect is likely to occur in humans)
What are the health effects that can be caused by exposure to some agent in question?
- What is the quality and weight of evidence supporting this identification?
- Is there any interaction between the identified hazards and other agents in the environment?
- Is the onset of health effects immediate or delayed?
- Is there is a critical window of exposure?
- Has the carcinogenic and/or genotoxic potential of the identified hazards been addressed?
- sources of data:
- toxicokinetics (body absorbs, distributes, metabolizes, and eliminates specific chemicals), toxicodynamics (mechanisms by which a chemical may impact human health)
2. Dose-response assessment
Dose–response assessment: Describes how the likelihood and severity of adverse health effects (the responses) are related to the amount and condition of exposure to an agent (the dose provided).
- What is the intensity of exposure?
- Is appropriate dose–response data available, and has the data been appropriately scaled in translation from animal to human?
- Has the potency of the agent been determined for both acute and chronic dosing?
- Does a threshold or non-threshold model best describe the data?
- Is there a level bellow which some chemicals don’t pose a human health risk?
- Non-linear dose-response assessment (NOAEL or LOAEL)
- Linear dose-response assessment (CR, SF, IUR)
3. Exposure assessment (Exposure assessment is the process of measuring or estimating the magnitude, frequency, and duration of human exposure to an agent in the environment, or estimating future exposures for an agent that has not yet been released. An exposure assessment includes some discussion of the size, nature, and types of human populations exposed to the agent, as well as discussion of the uncertainties in the above information)
- What is the duration, timing, frequency and consistency of exposure?
- Are exposures continuous, intermittent or episodic, or do they show clear patterns?
- Have all exposure routes (ingestion, inhalation, dermal) have been considered?
- Are exposures intergenerational or cumulative, or should they be aggregated?
- Are some people more likely to be exposed to environmental stressors (work, where they play, where they eat?)
- frequency, duration, timing and consistency
- data availability about exposure
- routes (ingestion, inhalation, dermal)
- quantifying exposure (point of Contact Measurement, Scenario Evaluation, Reconstruction)
- intergenerational or cumulative, or should they be aggregated
- exposure description
· past, current or future
· intergenerational or cumulative, aggregated
· pollutants level
· population (more likely to be exposed due their activity, workplace, …)
c) Human health risk
4. Human health risk characterization (Risk characterization: The objective is to summarize and integrate information from the proceeding steps of the risk assessment to synthesize an overall conclusion about risk)
- What is the estimated incidence of the adverse health effects in a given population?
- summarize risk characterisation
· qualitative or quantitative (type of endpoint)
· findings, assumptions, limitations, uncertainties
- individual/ population characteristic (age, gender, immune status, social status…)
- TCCR (Transparency, Clarity, Consistency, Reasonableness)

Figure 1: Human health risk assessment process with four major steps and crucial questions for decision making (References WHO; EPA)

Examples of HRA studies in ICSs

There exists different global studies of HRA in Industrial contaminated sites (ICSs). This chapter identifies an initial list of review scientific articles in the three most contaminated industrial sites (incinerator, landfill, cement plants) and different methods and tools (more detail Appendix; we will summarize important information in text). Table 1 example of HRA at ICSs in Europe (Cangialosi G et al., 2008).

Table 1: Example of human health risk assessment assessment at industrially contaminated sites in Europe (Cangialosi G et al., 2008).

Steps	Indicator	Case study Cangialosi G et al.
1 HAZARD IDENTIFICATION	- sources of data	(non)carcinogenic chemicals pollutants: PCDD/Fs, Cd, Pb, Hg , point sources - municipal solid waste (MSW) (monitoring data MSW)
	- toxicokinetics (body absorbs, distributes, metabolizes, eliminates specific chemicals)	inhalation rate, exposure frequency, ingestion rate, exposed skin surface area, soil-skin adhesion factor, vegetable ingestion rate, dairy product ingestion rate, contaminated fish rate, fish ingestion rate
	- toxicodynamics (mechanisms by which a chemical may impact human health)	
2 DOSE/EXPOSURE –RESPONSE ASSESSMENT	- Non-linear dose-response assessment (NOAEL or LOAEL)	/
	- Linear dose-response assessment (CR, SF, IUR)	- total daily intake [mg kg-1 d-1] of each contaminant - CR
3 EXPOSURE ASSESSMENT	- study area and population	Taranto city (Southern Italy): 10×10 km2 area; 30,000 inhabitants
	- frequency, duration, timing and consistency	operated since 1988, long term effect
	- data availability above exposure	- air emission from MSW (recorded from 2003), concentration of contaminants in water, soil, vegetation and animals, meteorological data, (Italian Ministry of Environmental Protection, other studies, IARC, USEPA)
	- routes	- inhalation, ingestion, dermal contact
	- quantifying exposure (point of contact measurement, scenario evaluation, reconstruction)	- mathematical models: pollutants transport in environmental media (hybrid plume dispersed air pollution model GIADA; introduce equations calculating pollutant concentrations in soil, water, vegetation)
	- exposure description	
	past, current or future	past
	intergenerational or cumulative, aggregated	estimate for each 1600 square cells with a 250 m side (used for GIS); cumulative concentration for each contaminant of concern at soil
	pollutants level	air emissions 62,000 tons of MSW per year average air concentrations at ground level and dry depositions, water
	population (more likely to be exposed due their activity, workplace,…)	two receptor groups (children, adult)

4 RISK CHARACTERISATION	- summarize risk characterisation	
	qualitative or quantitative	- HQ, CR - individual risk (sum of risks in all 1600 cells, each pathway and target group) - global risk (carcinogenic pollutants)
	findings, assumptions, limitations, uncertainties	- CR is very small compared with background levels - global risk distribution for carcinogenic pollutants: higher levels in urbanized areas - significant exposure pathways: direct inhalation and food ingestion - approach calculating the risk in conditions of reasonable maximum exposure (RME) – future alternative approaches involving probabilistic assessment - assessment pollutants limited on regularly measured for surveillance - not included sources of kiln, petroleum refinery as very busy local automobile
	- individual/ population characteristic (age, gender, immune status, social status…)	children, adult
	- TCCR (Transparency, Clarity, Consistency, Reasonableness)	/

Suggestions HRA

	Current state	Update
Definition	A human health risk assessment (HRA) is the process to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals in contaminated environmental media, now or in the future (EPA https://www.epa.gov/risk/human-health-risk-assessment).	Health risk assessment should aim at describing the nature (e.g. type of disease, cause of mortality) and quantify its probability. Additionally, if possible, it is also useful to estimate the number of cases. Further, when the type of disease is known, the magnitude of the risk can be described using years of life lost, years lived with disability (with disability weighting) and expressed in DALYs.
Exposure assessment	now or in the future exposure	(past, current or the future exposure)
Endpoints	cancer, non-cancer in majority of article	Type(s) of cancer, non-cancer (type(s) of toxic effect) using epi data and RR-based analysis it would be possible to link to background burden of disease data and express the impact according to ICD (e.g. asthma, COPB, stroke)
Risk characterization	Probability (cancer risk calculated in lifetime), doesn't report the number of cases in majority of article	Probability (cancer risk calculated per lifetime; annually; per person; per population group) Estimate the number of cases in the population Estimate the EBD (YLD, YLL, DALY)
Strategy for prioritizations	RC (risk characterizations): in the majority of the cases in the HRA at ICSs reported as the CR (cancer risk) is acceptable (bellow 10-6), consequently no further actions well be taken.	To choose which action options we will take we should consider scale of acceptable risk per year (five stages from minimal to extreme), life time, population size: - if risk is considered as minimal or low we can proceed with AI (attributable incidence) and EBD (environmental burden of disease), - if risk is considered as medium, high or extreme we

		can proceed with AR (acceptable risk) and continue with HIA (health impact assessment). High individual risk level is used to trigger consideration for risk reduction (options generation and evaluation) Medium risk sites should be prioritized based in the attributable impact. Low risk sites should be included in intersectoral risk comparisons and assessment of public health impacts of chronic low exposures, impacts on developmental origin of diseases etc.

Health Imapact Assessment (HIA)

Andreja Kukec[1, 2], Kairong Xiong[3], Tanja Rejc[2], Otto Hänninen[4]
[1]Centre of Public Health, Faculty of Medicine, University of Ljubljana, Slovenia
[2]National Institute of Public Health, Slovenia
[3]Guangdong University of Technology, Guangdong, China
[4]National Institute for Health and Welfare, Kuopio, Finland

Chapter 2. Definition and the process

Health impact assessment (HIA) “a combination of procedures, methods, and tools by which a policy, programme, or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population”. Using qualitative, quantitative and techniques, HIA aims to produce recommendations that will help decision-makers and other stakeholders make choices about alternatives and improvements to prevent disease/injury and to actively promote health (http://www.who.int/hia/about/defin/en/)

Health impact assessment includes six major steps: screening, scoping, assessment, recommendation, reporting, monitoring and evaluation (https://www.cdc.gov/healthyplaces/hia.htm).

We will put the text bellow in the Figure (Schema)
Screening: need and value of HIA
- Is the project likely to pose any significant health problems?
- Are health effects expected to be negligible?
- Are health effects already well known and controllable?
Scoping: identification of the health impacts and setting boundaries
- What are the potential health impacts?
- What are possible hazards and benefits, what is their nature, size and measurability (how comprehensive)
Assessment: identifying affected populations and quantifying health impacts of the decision
- What are the risks and benefits (type and magnitude of) positive and negative effects?
- Who will be affected?
- What is the magnitude of hazards and benefits?
Recommendation: strategies to manage identified adverse health impacts and maximize benefits to health
- Can risk be avoided or minimized?
- How we evaluate and compare risks and benefits?
Reporting: development of the HIA report, communication of findings and recommendation
-what are the conclusions and recommendations to remove / mitigate negative impacts on health
Evaluation / monitoring: impacts on decision making processes and decision, impacts of decision on health determinants
- Is the HIA process effective and are health outcomes improved as a result of it?

Figure 1: the process of HIA

Add examples from Europe

Recommendation HIA

	Current state	Update
Definition	HIA "a combination of procedures, methods, and tools by which a policy, programme, or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population". Using qualitative, quantitative and participatory techniques, HIA aims to produce recommendations that will help decision-makers and other stakeholders make choices about alternatives and improvements to prevent disease/injury and to actively promote health (http://www.who.int/hia/about/defin/en/) HIA is a process that helps evaluate the potential health effects of a plan, project, or policy before it is built or implemented. HIA brings potential positive and negative public health impacts and considerations to the decision-making process for plans, projects, and policies that fall outside traditional public health arenas, such as transportation and land use. An HIA provides practical recommendations to increase positive health effects and minimize negative health effects (CDC, 2016)	HIA is a process that helps evaluate the potential public health effects (positive and negative) of a plan, project, or policy before it is built or implemented. HIA process use qualitative and quantitative methods and recommend decision-makers and other stakeholders the choices about improvements and alternatives to prevent disease/injury and promote public health.
Endpoints	Adverse health effects	Estimate the number of cases in the population (from HRA)

Recommendation Strategy for prioritization

	Current state	Update
Hazard identification	Different level of data about Hz in the strategy for prioritization	All needed data should be collected in hazard identification step. - toxicokinetics (body absorbs, distributes, metabolizes, eliminates specific chemicals) - toxicodynamics (mechanisms by which a chemical may impact human health) and number of cases of endpoint in humans who may be exposed to environmental contaminants (e.g. chemical, physical, biological) in past, current or in the future.

Appendix 2: List of identified review papers on human health risk assessment at industrially contaminated sites in Europe (PubMed & WoS, 2017)

	Author/Type ICSs	Active years of working	Effected population	Pollutants	Endpoints	Main founding
Incinerator	Boudet C et al., 1999	operated science 1971	405,000	VOC, Ni, Cd	non-cancer, cancer	CR: benzene 2.6×10^{-10} (95%CI: $1.2\times10^{-10}-5.4\times10^{-10}$); Ni 8.6×10^{-8} (95%CI: $4.3\times10^{-8}-17.3\times10^{-8}$); Cd 1.5×10^{-8} (95%CI: $7.2\times10^{-9}-3.1\times10^{-8}$)
	Cangialosi F et al., 2008	operated science 1988	30,000	dioxins/furans, Cd, Pb, Hg	non-cancer, cancer	cancer mortality over a lifetime (100,000 people): 4.643×10^{-4}
	Cordioli M et al., 2013	operate in early 2013	191,330	PM_{10}, PCDD/F, PAH, Cd, Hg	mortality, morbidity, cancer (lung cancer), stroke, acute bronchitis, asthma, lower respiratory symptoms	HI (i.e. 15%) n. of cases (i.e. 0.65) and maximum mortality: (i.e. +0.001% increase in the expected annual number of deaths)
	Lorene P et al., 2005	operated since 1974	zone: 100,000	SO_2, PM, HCl, Pb, Hg, Cd, dioxins	respiratory system (irritation), neuro-behavioral effects, lung cancer, renal effects, all types of cancer, developmental risks	$CR_{individual}$ less than 10^{-6}
	Meneses M. et al., 2004	Operated since 1975		PCDD/Fs	cancer, non-cancer	CR 1.07E 07 and 3.08E 09, before and after installation of the clean air system
	Morselli L. et al., 2011	/	52,565	As, Cd, Cr, Ni, Pb, B(a)P, PCDD/PCDF	cancer, non-cancer	$CR_{individual}$ less than 10^{-6} n. of cases 0.0089
	Roberts RJ. et al., 2006	/	25,398	dioxins/furans, PAHs, As, Cd, SO_2, PM_{10}, $PM_{2.5}$	cancer, mortality	overall risk 2.49×10^{-7} or 1 in 4 million
	Vilavert L. 2012	operated since 1991.	/	PCDD/Fs	cancer, non-cancer	CR less than 10^{-6}
Landfill	Davoli E. et al., 2010	operated since 1991.	/	dioxins/furans, PAHs, VCM	cancer, non-cancer	CR less than 10^{-6}
	Durmusoglu E. et al., 2010.	/	/	BTEX	cancer, non-cancer	CR 6.75E^{-05} (lower then designated acceptable risk level of 1.0E^{-04})
	Mari M. et al., 2009.	operated since 1984	/	As, Cd, Cr, Hg, Ni, Pb, PCDD/Fs	cancer, non-cancer	/
	Martí V. et al., 2014	operated (80s), closure (1995)	/	VOCs	cancer, non-cancer	HI and CR acceptable (HI < 1 and CR < 10^{-5})
Cement plants	Sánchez-Soberón F et al., 2015	/	/	PM (10, 2.5, 1)	cancer, non-cancer	CR less than 10^{-5}
	Rovira J. et al., 2010	operated since 1968	/	As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Sn, Tl, V, Zn, PCDD/Fs	cancer, non-cancer	CR less than 10^{-5}
	Rovira J. et al., 2014	started (last century), new production (2010)	65,000	As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Sn, Tl, V, Zn,dioxins/furans	cancer, non-cancer	CR less than 10^{-5}
	Schuhmacher M et al., 2004	operated since 1902	80,976 5042 (high polluted	NO_2, SO_2, PM_{10}, metals, PCDD/Fs	respiratory, cardiovascular admissions, emergency room visits, asthma, cancer	$CR_{total\ pop}$ 0,03 $CR_{high\ exposed\ pop}$ 0,2

	Author/Type ICSs	Pollutants	Methods	Tools & Models
Incinerator	Boudet C et al., 1999	VOC, Ni, Cd	quantitative risk (properbility)	dispersion modeling (Gaussian plume model), time-activity patterns, life-long exposures
	Cangialosi F et al., 2008	dioxins/furans, Cd, Pb, Hg	health impact (n of cases)	matrix of environmental exposure factors, dispersion model (GIADA model),
	Cordioli M et al., 2013	PM_{10}, PCDD/F, PAH, Cd, Hg	health impact (n of cases)	a multicompartment model, EPA HHRAP Protocol atmospheric dispersion modeling
	Glorennec P et al., 2005	SO_2, PM, HCl, Pb, Hg, Cd, dioxins	quantitative risk (properbility)	multimedia model, gaussian plume dispersion model, POL'ER software, CalTox
	Meneses M. et al., 2004	PCDD/Fs	quantitative risk (properbility)	air dispersion modeling (Gaussian plume model, ISCST3 (Industrial Source Complex-Short Term, Version 3) model, vegetation and soil modeling
	Morselli L. et al., 2011	As, Cd, Cr, Ni, Pb, B(a)P, PCDD/PCDF	health impact (n of cases)	industrial source complex (ISC3) calculation code, GIS
	Roberts RJ. et al., 2006	dioxins/furans, PAHs, As, Cd, SO_2, PM_{10}, $PM_{2.5}$	health impact (n of cases)	multimedia model, Atmospheric Dispersion Modeling System (ADMS3),
	Vilavert L. 2012	PCDD/Fs	quantitative risk (properbility)	active and passive sampling devices, EPA HHRAP Protocol
Landfill	Davoli E. et al., 2010	dioxins/furans, PAHs, VCM	quantitative risk (properbility)	dispersion modelling, atmospheric transport
	Durmusoglu E. et al., 2010.	BTEX	quantitative risk (properbility)	US EPA method TO-17
	Mari M. et al., 2009.	As, Cd, Cr, Hg, Ni, Pb, PCDD/Fs	semi quantitative methods	active samplers (TE-1000 PUF and TE-6070DV Air Sampler Tisch Environmental, Cleves, OH, USA)
	Martí V. et al., 2014	VOCs	quantitative risk (properbility)	EPA HHRAP Protocol, simulations
Cement plants	Sánchez-Soberón F et al., 2015	PM (10, 2.5, 1)	quantitative risk (properbility)	monitoring
	Rovira J. et al., 2010	As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Sn, Tl, V, Zn, PCDD/Fs	quantitative risk (properbility)	sampling
	Rovira J. et al., 2014.	As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Sn, Tl, V, Zn,dioxins/furans	quantitative risk (properbility)	air dispersion model, measured (soil, vegetation), human exposure - different scenarios
	Schuhmacher M et al., 2004	NO_2, SO_2, PM_{10}, metals, PCDD/Fs	health impact (n of cases)	ISC3-ST model (Gaussian dispersion model from US EPA), GIS

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: IS1408

STSM title: *Assimilation of HBM data using the INTEGRA integrated exposure modeling platform: Modena Incinerator case study*

STSM start and end date: 11/04/2018 to 20/04/2018

Grantee name: Lorenzo Vaccari

PURPOSE OF THE STSM/

The main goal of this STSM was to learn how to use a full-chain multi-pathway exposure software called INTEGRA that can provide us with satisfying results in assessing the exposure (and related risk for human health) caused by the emission of contaminants from Modena (Italy) incinerator. This aim has been achieved.

In detail, I learned the first essential steps to make a simulation in INTEGRA to assess the exposure of Modena population to PM10 from the plant located in the north of the city.

In 2010 the Local Health Authority (AUSL) of Modena, in collaboration with ARPAE Emilia-Romagna, conducted a human biomonitoring pilot study (HBM) on the general population living and working near this modern municipal solid waste incinerator, analyzing urine and blood samples taken from 168 volunteers. Subjects with residence and workplace within 4 km of the incinerator were considered exposed and subjects outside this area were considered unexposed.

During my thesis work, I used these data to check estimated values obtained with simulations performed with a software package called Merlin-Expo, in order to validate this tool via statistical analysis.

The next step in my work is to test other software platforms to verify the suitability of this approach to estimate the full-chain exposure without using direct measurements. One of these platforms is INTEGRA.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

INTEGRA is a very user-friendly software with a helpful graphical interface. Many windows guide you through a clear and complete exposure scenario construction process that starts from the selection of chemical of interest and ends in the choice of output variables you want to know. Many simulation steps are between these two. First of all the geographical location, person info and the simulation length are required. Within each simulation it is possible to assess the exposure of one person only, so we will obtain

a statistically significant and comparable result after at least 49 simulations. Two exposure assessment frameworks are available in INTEGRA platform: Tier 1 and Tier 2 module. Tier 2 model “concerns a quantitative analysis framework to provide refined quantitative assessment of aggregate exposure that are used for quantitative risk characterization when coupled to regulatory risk metrics/thresholds” (INTEGRA manual). Thus, I opted for this module. In the first window of Tier 2 module you have to choose if you want to start your exposure scenario analysis from the partial fractions of the contaminant released from several industrial processes or products or from the direct emissions from the industrial sector in environmental media. However, since we have already the concentrations in food and air of the pollutants of interest, we don’t need such result. The same applies to the ‘Multimedia modelling’ window where meteorological parameters to estimate air pollutant dispersion are required. In fact, we have already estimated the PM10 dispersion in the atmosphere with ADMS-Urban. The most important window for this project is definitely the ‘Exposure route’ window, where it is required to the user to configure the different exposure pathways: Inhalation, oral and dermal. To configure inhalation route I decided to develop simulations with two monthly average values for the contaminant outdoor concentration parameter. In fact INTEGRA gives the possibility to select only two values for the outdoor concentration: one is the average value during the weekend and the other is the average value during the rest of the week. Thus, I decided to put the PM10 monthly average value at home for the outdoor concentration at the weekend and the PM10 monthly average value at workplace for the outdoor concentration during workdays. I chose not to add indoor locations because of two main reasons. The first one is that I have already considered indoor/outdoor concentration factor in the parameter “outdoor concentration”. The second one is that we didn’t consider the indoor exposure in Merlin simulations and we have no availability data for Anthracene and Fluoranthene emitted by indoor sources. With regard to activity pattern INTEGRA allows to choose between fifty different activities, but I selected “unspecified time use” only to have an average monthly value that could fit with outdoor concentration parameter. The other exposure route taken into consideration in my simulations is the oral route. First of all, I entered the contaminant concentration in the different food type we analyzed. Then I selected the amount of food type ingested per day.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

During my ten days period in Thessaloniki I learned especially software architecture and how the Physiologically Based Pharmacokinetic (PBPK) model inside the platform works. I found out that INTEGRA computational platform is a multi-media, multi-route, single compound modeling tool composed by a series of individual modeling compartments based on equations taken from important studies.

Moreover, I have understood some differences between INTEGRA and Merlin-Expo approach. While Merlin focuses mainly on outdoor sources in INTEGRA many indoor sources are also considered in the exposure scenario to assess not only an exposure from industrial plants but a complete exposure to a pollutant.

INTEGRA allows to develop simulations even without available data for many parameters, because the platform proposes default values for them. On the other hand Merlin doesn’t provide default range for the majority of parameters.

INTEGRA’s main advantage is that its internal dosimetry module tracks the time course in the tissues of human body not only of the parent compound but also of its first three metabolites. PBPK model implemented in Merlin follows parent compound pathway only, overlooking the issue that for many pollutants the metabolites are much more toxic. As a consequence, I ran simulations selecting the concentrations in some tissues and urine for parent compound and its first three metabolites as outputs.

Like in Merlin, in INTEGRA has been implemented an advanced stochastic tool that allows the user to execute a simulation using probability density functions instead of a deterministic value for many input parameters.

In a INTEGRA simulation it's not possible to define a time series for contaminants concentrations in outdoor and indoor air (as we did with Merlin), because only 2 average values for each simulation are allowed. Thus, I decided to develop some different simulations for each subject by varying the outdoor concentration parameter at subject home and at subject workplace.

INTEGRA gives also the possibility to assess backward exposure which is responsible for human biomarker values measured thanks to an Exposure Reconstruction module inside the platform. Thanks to this very useful function we are making simulations starting from human biomonitoring data as input to understand if we have assessed some input parameters in the exposure scenario at best. We are performing each exposure reconstruction simulation with ten exposure variables as output (ten is the maximum number of variables that INTEGRA can compute).

INTEGRA mainly focuses on organic pollutants, so there aren't available heavy metals data. We intend to add the Lead in the chemical library in order to perform a simulation with this contaminant and compare the results with those found in Merlin. Lead chemical and physical properties will be taken from literature and lead toxicological properties from Merlin.

I concluded some INTEGRA simulations on Anthracene and Fluoranthene concentrations in urine of some subjects (exposed and unexposed).

In the near future, the estimated values on the entire population studied obtained through INTEGRA will be compared to real data (concentration measured in urine and blood) derived from HBM campaign first, and then with Merlin-Expo estimated concentrations.

FUTURE COLLABORATIONS (if applicable)

We intend to continue to cooperate with Prof. Sarigiannis group and we will continue to compare different "full-chain" exposure software. Thus, we will also look for collaborations with other software developers as soon as we can.

Report of the Short Term Scientific Mission

Promoting Industrially Contaminated Sites and Health Network (ICSHNet) outcomes in policy making in environment and health

STSM Applicant	Dovile Adamonyte
STSM Supervisor	Dr Marco Martuzzi
Home Institution	European Environment and Health Youth Coalition Minties st. 24-31, Vilnius LT-09224, Lithuania
Host Institution	WHO European Centre for Environment and Health Platz der Vereinten Nationen 1, Bonn, Germany
STSM dates	4/12/2018 - 11/12/2018

Table of Contents

1. Introduction

The activities of Industrially Contaminated Sites and Health Network (ICSHNet) have raised the profile of the theme of industrially contaminated sites (ICS) and health substantially. The scientific community with an interest in the matter, already numerous at the beginning of the action, has expanded; interest in younger generations of investigators has been stimulated by various training activities; and the policy dimension has been strengthened through various initiatives involving officers from government agencies of participating countries. The latter efforts have contributed to the adoption of ICS among the priorities of the Declaration of the Sixth Ministerial Conference on Environment and Health (Ostrava, Czech Republic 15 June 2017). This recognition is an extremely promising basis for concrete action in terms of identification of priority sites, assessment of health impacts, remediation and further raising of awareness of the issue.

In order to facilitate this take-up, however, more resources must be developed and made available. In particular, accessible and simple public domain documentation is essential that provides guidance, methodology, selected bibliographies, listings of web resources.

The STSM aimed:

1. To provide a support for the revision of a guidance document on dealing with the health implications of contaminated sites which is being drafted by World Health Organization Regional Office for Europe (WHO) and COST Action experts.
2. To help in finalisation of the ICSHNet documents already drafted and awaiting publication, such as the meeting report of the Fourth Plenary Conference of the ICSHNet COST Action which was held at the WHO European Centre for Environment and Health, United Nations Campus, Bonn, Germany, 20- 22 February 2018.

2. Description of the work carried out during the STSM

The guidance document is addressing different areas of the topic, including: background (definition of the issue, summary of the available evidence, knowledge gaps), how to deal with contaminated sites (assessing exposures and health impacts, public health response, communication with the public and stakeholders, prevention and priority sites identification), lessons learnt from key case studies.

Another document, the report of the fourth Plenary Conference COST Action IS1408 on

ICSHNet *Towards a consensus on industrially contaminated sites policy priorities and response*, outlines the key points and recommendations made by ISCHNet members and meeting participants in relation to health and contaminated sites.

Aiming to enhance above mentioned documents the student conducted a literature search focused on waste and contaminated sites during the STSM. The grantee reviewed and analysed materials (presentations, interventions) and information relevant to the Action's topic. Moreover, the additional data and information from open and reliable sources and Internet were collected.

3. Description of the main results obtained

The table below presents main characteristics of the STSM's results.

Structure		Content
Introductory part	Acknowledgements	This part explains the scope and indicates list of contributors.
	Acronyms	This part contains out of main acronyms used in the report.
	Executive Summary and Introduction	Based on current available estimates, almost 1.5 million deaths per year in the WHO European Region are attributable to environmental risks that could be avoided and/or eliminated. Industrially Contaminated sites (ICS), in particular, represent a major environmental health issue, as they embrace many risk factor including air, water, soil and food chain contamination, but also hazardous chemicals and wastes. Building on previous experiences and on available evidence and policy needs, the COST Action on ICSHNet since 2015 has been greatly contributing to consolidate the awareness and policy profile of Contaminates Sites as a public health priority in Europe. This report describes the activities carried out during the ICSHNet COST Action Plenary Conference, and Working Group, Core Group and management committee meetings – held in Bonn, Germany, 20–22 February 2018, and co-organised with WHO.
	Scope and purpose	The overall objective of the conference was to respond to questions regarding relevant available evidence, experiences, resources and proactive approaches compelling enough to undertake the actions in the Ostrava Declaration in various dimensions, e.g. economic, social, health.

Structure		Content
	Setting the scene: the Action meets the EEHP	This chapter provides an overview of the WHO European Environment and Health Process in connection with the COST Action on ICSHNet: Waste and contaminated sites have been included as a priority in the Declaration of the Sixth Ministerial Conference on Environment and Health (Ostrava, Czech Republic 15 June 2017). The Ostrava Declaration includes a commitment towards …"*preventing and eliminating the adverse environmental and health effects, costs and inequalities related to waste management and contaminated sites, by advancing towards the elimination of uncontrolled and illegal waste disposal and trafficking, and sound management of waste and contaminated sites in the context of transition to a circular economy*". Interested Member States of the WHO Regional Office for Europe will address the topic in the coming years and consider it when developing their Portfolios for Action. Members of the COST Action on ICSHNet participated in the Ostrava ministerial conference, organizing the Side Event SE11 "Impact of industrially contaminated sites on human populations – a global environmental health priority". The Fourth Plenary Conference of the ICSHNet COST Action was recently held at the WHO European Centre for Environment and Health (ECEH), United Nations Campus, Bonn, Germany, 20- 22 February 2018. A Consensus Statement on Industrially Contaminated Sites and Health was discussed and agreed during the Conference and the Management committee of the Action agrees on the opportunity that this document be taken to the meeting of the EH Task Force of the European Environment and Health Process (EEHP), scheduled for 20-21 March 2018 in Bonn. Giving special attention to the need to support Member States of the WHO European Region in development of National Portfolios for action on environment and health, explicitly for the waste and contaminated sites, the STSM

Structure		Content
		aimed at finalizing a Technical Report of the Action Plenary Conference and working groups (WG) meetings held in Bonn in 20-22 February 2018.
Conference outcomes	Follow-up meeting of the Students of Thessaloniki school	The training school "Environmental health in industrially contaminated sites" was one of the milestones of this Action, created to strengthen the in-country capacity to respond to the environmental health challenges posed by ICSs, through the training of early career investigators (ECI). These researchers are essential to the success of this Action and for spreading knowledge methods through different scientific communities in the future. The aim of this training course was to strengthen in-country capacity to respond to the environmental health challenges posed by ICSs by creating and assisting a European "cohort" of investigators dealing with Industrial contamination and population health issues. The course aimed to provide these researchers with a scientific basis on knowledge of methods along with risk and uncertainty of the research, also matched to practical skills for evaluating the health effects and impact of industrially contaminated sites. The target audience were ECI, PhD students, and researchers from government agencies and research institutes of health or environment, university departments, and other sectors related to industrial contamination and health. The selected students participating represented a wide geographic spread, ensuring a uniform distribution across the ICS Network countries. 25 out of 33 countries involved in the Action (76 per cent) identified candidates to participate in the training. A total number of 46 trainees, well balanced by gender (54 per cent females), with an age range of 24 to 56 years, attended the school. The Thessaloniki school learning experience emphasized an obvious need of capacity building. The burden of issues related to ICS is substantial and yet there is a great need in most countries to continue tackling these issues. Training

Structure		Content
		is one of the main priorities in capacity building and is essential to address such issues. The training part of the COST Action ICSHNet held in Thessaloniki was developed specifically to support and facilitate countries dealing with environmental health issues of ICSs to develop their expertise and be more effective. The training course proved successful and provided trainers with tools to better address these issues. Even more, it will further contribute to improving and strengthening training materials.
	Progress with the Action survey	One of the major objectives and tasks of the COST Action is to assess the availability and quality of information on population, environmental and health data, research tools, and communication strategies that have been or are being applied in Industrially Contaminated Sites (ICS) in all participating countries. To this purpose an Action survey has been designed to identify information needs and research gaps in a sample of ICS identified by Action countries. The other major parallel task of the Action is to review and identify research tools and sound methodologies available to face environmental health issues in ICS. Integrating the information obtained with the Action survey with the knowledge learned on suitable methodologies will facilitate the identification of a range of different approaches for charactering the potential impacts on health in ICS that can fit to the data and resources available in different regions and ICS scenarios across Europe. The Action survey is conducted by using the online Action Questionnaire (AQ) applied to the entire list of 100 ICS previously identified and reported by members of the COST Action. This online survey consists of 84 questions organised in eight sections: industrial activities operating at the site, main contaminants, population, exposure, health data, health studies, communication strategies, and references available. The mentioned groups of topics correspond to the activities of the four Working Groups (WGs) the Action

Structure		Content
		is composed by. It is expected that members of Action will submit the AQ in April 2018.
	The policy agenda in industrially contaminated sites and health: perspectives and opportunities	The objective of the session was to discuss perspectives and opportunities of efficient awareness and policy profile of Contaminates Sites consolidation as a public health priority in Europe. This part presents for presentations given by experts. Topics of presentations: (a) Contaminated sites in the Ostrava agenda; (b) Circular economy and industrially contaminated sites; (c) Industrial emissions: overview of the European Pollutant Release and Transfer Register; and (d) The environment and health EU research agenda.
	The German experience with remediation of industrially contaminated sites	Since 1984 in the inner city of Stuttgart about 100 volatile chlorinated hydrocarbons (CHC) contaminated sources have been investigated and partly remediated so far. There are 700 additional potentially contaminated sites documented. CHC chemicals were applied as solvent agents mainly in the mechanical engineering and electrical industry as well as by dry cleaners. Although the application stopped, the pollution is still remaining in the groundwater. Aiming to sustainable improve the groundwater quality in Stuttgart's city area and to ensure a permanent protection of Stuttgart's mineral springs, the MAGPlan ("Management plan to prevent threats from point sources on the good chemical status of groundwater in urban areas") project was developed. MAGPlan project applied the concept of „Integral management of contaminated sites". It focused on the spatiotemporal analysis of CHC migration and the associated degradation and transformation processes between the contamination sources and the mineral springs and spas. Due to the complex hydrogeological conditions, new and advanced investigation strategies and methods were used which, in combination, allowed for multiple lines of proof. The overarching principle is an iterative-adaptive approach with gradual improvement of the level of knowledge.

Structure		Content
		The results of the integral investigation of the groundwater and the contaminated sites and the measures required to ensure a good groundwater status are summarized in the groundwater management plan. In reports, maps, data bases, and with a computer-based visualization tool, it provides the basis for an optimal treatment of CHC contaminants in groundwater. The management plan sets priorities for contaminated site remediation. The numerical transport model provides the opportunity to analyze different remediation scenarios for individual sites and to make predictions of future contaminant migration. Sites with a particularly high remediation priority can be identified. Furthermore, interactions between contamination sources and receptors in the project area can be included in the risk assessment and the evaluation of the sites. The remediation feasibility study as part of the groundwater management plan describes the measures to be taken in order to achieve the remediation targets. For those sites with high priority, additional investigation and remediation efforts will be developed. Through the contribution of political committees, the groundwater management plan has received a binding character. The Stuttgart City Council acknowledged the implementation and financing of the groundwater management plan developed in MAGPlan on 1st July 2015. The strategy of integral contaminated site management will function as an important guideline and a trend setting component for groundwater protection in Europe and Stuttgart in future. They were published by extensive dissemination activities among experts and also in Stuttgart's public. The public relation activities ask for understanding of the necessary activities and try to encourage persons concerned to fight against deficits of groundwater quality in the same way. Hence the project contributes an important part to implement the directive 2000/60/EC (Water Framework Directive) of the European Union. Therefore, the communication strategy was developed. The strategy aimed at periodic information of target groups; raising of public awareness for groundwater protection; improvement of the acceptance for necessary actions and strengthening the individual responsibility. The European Union co-financed the project, running from 2010 to 2014. 50 per cent of the total costs are subsidies by the EU program LIFE. The other half is taken over by the City of Stuttgart and the Federal State of Baden-Württemberg.

Structure		Content
	Round table towards consensus on industrially contaminated sites policy priorities and response	**Rationale** In Europe, earlier industrialization and poor environmental management practices have left a legacy of thousands of contaminated sites. Past and current industrial activities can cause local and diffuse contamination, to such an extent that it might threaten human health of resident populations, especially in vulnerable subgroup. Moreover, health, environment, and social aspects are strongly interconnected, local communities are often alarmed, and both scientists and policy makers have expressed concern. Distinct research initiatives on the health impact of contaminated sites have provided considerable evidence, however data are sparse, and assessments have seen a fragmentation of objectives and methods. It is therefore urgent to promote coordination and collaboration between researchers and risk managers to identify common strategies at European level to deal with this issue more systematically. Building on available evidence and policy needs, the COST Action (and previous work lead by WHO) has greatly contributed to consolidate the awareness and policy profile of Contaminates Sites as a public health priority in Europe. **Goals and discussion** The Chair of round table session invited panelists to share their views on current progress within the ICSHNet COST Action; outcomes of the Ostrava Conference; and inputs as well as suggestions made in the plenary session before the round table from their own institutional and professional perspectives.
	Working groups' activities	**WG1 – Environment and health data** Goals of Working Group 1 for collaborative work include the identification of criteria and requirements to standardize and harmonize the collection and organization of data on environment, health and other characteristics of populations residing in industrially contaminated sites, accounting for needs and priorities across countries. This represents a crucial propaedeutic basis to address the production of reliable assessments of the health risks and impacts of different sources of pollution in contaminated areas.

Structure		Content
		WG2 – Methods and tools for exposure assessment Goals of Working Group 2 for collaborative networking activities concern the identification of needs and priorities across participating countries to evaluate exposures to environmental contaminants in populations residing in industrial areas. A parallel objective is to review and critically evaluate the available methods and tools and to define recommendations and on how exposure should be estimated to carry out informative health impact assessments in different scenarios. **WG3 – Methods and tools for health risk and health impact assessment** Goals of Working Group 3 for collaborative work concern the identification of needs and priorities on methods and strategies to assess environmental health risks and impacts. A specific objective is to review and evaluate available methodologies on health risk and impact assessments, accounting also for social inequalities. Therefore, the working group aims to identify appropriate tools to carry out comparative analyses on the health impact of ICS within and across countries. **WG4 – Risk management and communication** Working Group 4 aims to evaluate needs and priorities across countries on how to contribute to effective communication with the local population, media and other stakeholders, accounting for different scenarios. Goals for collaborative networking activities concern the provisions of guidance on risk management and risk communication on environmental health risks in ICS, including the transfer of scientific findings into the policy making process. Issues of environmental justice should be addressed with a focus on vulnerable subgroups such as children, women

Structure		Content
		and disadvantaged communities.
Summary	Conclusions Way forward	Available evidence on the health impact of industrially contaminated sites, if somewhat sparse, is rich and provides strong indications of the significant role that these sites play on people living in their vicinity. Unsurprisingly, given the heterogeneous nature of the risk factors involved mentioned above, many different health effects have been documented, including mortality, morbidity, hospital admissions, reproductive outcomes. The issue of human health in industrially contaminated areas is best addressed with a strong sustainability perspective, taking into account, on the one side, the evidence on health effects and impacts, but considering the broader context of environmental and ecosystem health, as well as the economic and social environment – including the occupational opportunities that arise from industrial activities. All of this requires an intersectoral approach, and has to be seen as a part of a social negotiation, where the legitimate needs and aspirations of vulnerable groups, residents, workers, investors and business are taken into account, in a fair process. The Fourth Plenary Conference of the ICSHNet resulted in clear and actionable conclusions and recommendations on how to underline the importance as well as relevance of industrially contaminated sites for public health: • By carrying out the survey, using the AQ, it is expected to further collect and evaluate available data, tools and experiences in ICS. • By the end of 2018 the working groups of the Action will provide main results gained by developing analysis on available tools and methodologies; health and population data for the health impact assessment; assessment of population exposure to industrial chemicals; and strategies of risk governance and communication in ICS. • In collaboration with the relevant environmental health agencies, scientists and the community at large to COST Action members commit to further engage in work contributing to the Ostrava agenda efforts, drawing on established methodologies and successful case studies, and promote stronger technical and scientific exchanges on good practices between countries.

4. Future collaboration with the host institution

The future collaboration with the host institution will be focused on identification and development of waste and ICS practises in the policy decision making. Therefore, the dissemination of resulting main outcomes among *WG4 Risk management and communication* members is strongly envisioned.

Furthermore, the grantee was invited to take an active role in the upcoming WHO and COST Action meeting “Contaminated sites and health: developing guidance and tools” which will take place in Bonn, Germany, 15-16 January 2019. The main objective of this consultation meeting is to gather expert advice, from scientists and practitioners, on formulating guidance for dealing with the health implications of contaminated sites, so as to make it as relevant and useful as possible for Member States and public health agencies in general.

5. Dissemination and communication of STSM results

A draft document, being prepared by WHO and the COST Action, will be tabled for discussion at the WHO and COST Action meeting “Contaminated sites and health: developing guidance and tools”; the guidance document will then be presented in the final ICSHNet Conference, which will be held in Rome, Italy, 21-22 February 2019 to the full Action group, and will thereafter be finalised and published jointly by WHO and COST.

The final Conference report will provide governments, local authorities, young people groups, COST Action members with resources and guidance on how to contribute to effective prevention and reduction of industrially contaminated sites. The report will be available prior to the final COST Action Conference.

SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: IS1408
STSM title: Using SENTIERI approach in health risk assessment in industrially contaminated sites in Montenegro
STSM start and end date: 10/03/2019 to 24/03/2019
Grantee name: Borko Bajić

PURPOSE OF THE STSM:

The main purpose of this STSM was to upgrade capacities of Institute of Public Health of Montenegro in assessing the health impact of industrially contaminated sites and to evaluate the possible use of SENTIERI (Epidemiological Study of Residents in Italian Contaminated Sites) approach in industrially contaminated sites in Montenegro. Institute of Public Health of Montenegro has a goal to perform a health risk assessment for the population living in contaminated sites, primarily in Pljevlja municipality located in the northern part of the country. Population living in this municipality are exposed for a long time to environmental hazards related to coal mining, lead-zinc mine, thermal power plant, and unsolved industrial waste problems. This site is of highest concern because of air quality data measured by the only station located in the city evidence very high PM10 concentrations during all the year, with frequent values of about 100 pg/mc and a maximum value of 460 ug/mc. In addition, in this area, large use of biomass for the domestic heating system is made. Since 2016, Institute of Public Health of Montenegro participated in the COST action and has been introduced to the research methodology and different approaches in accessing the impact of industrially contaminated sites on health. Having in mind available data on exposures and health data of population living in this and other municipalities in Montenegro with contaminated sites issues, SENTIERI approach is accepted as the optimal way to perform health risk/impact assessment.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSM:

On the first day of the STSM at Istituto Superiore di Sanita, an introductory meeting was held with the Head of the Department of Epidemiology of the Environment and Social Medicine Prof. Pietro Comba. Main objectives of the STSM were discussed and a framework plan of actions for STSM agreed. Prof. Comba presented the overall situation, main scientific papers related to contaminated sites, different types of industrial activities and contaminated areas and health issues in Italy as well as examples from all over the world. In the afternoon joint meeting was held with other colleagues from Department of Epidemiology of the Environment and Social Medicine: Anna Bastone, Lucia Facco, Daniela Marsili, Maria Eleonora Soggiu, Roberto Pesetto, Ivano Iavarone, Gaetano Settimo, Benedetti Marta, Amerigo Zone, Marco De Santis, Caterina Bruno, and Alessandra Fabri. During the meeting, contaminated sites and health issues in Montenegro is presented to colleagues and based on that final agenda and plan for the STSM agreed. Except for participants from this Center, host prof Comba also arranged meetings with experts from different departments who have a lot of experience in environmental health assessment - Sussana Conti, Giada Minell, Luca Lucentini, and Simona Gaudi. Following days of the mission was organized in the form of intensive work and meetings with colleagues dealing with different aspects of industrially contaminated sites and health issues the framework of Sentieri approach. Meetings dedicated to Sentieri project-hypothesis formulation and ecological study design, explained in detail the focus of Sentieri approach regarding the mortality of residents and causal association with environmental exposure. Classification of epidemiological evidence into three categories (sufficient, limited and inadequate) as well as cancer incidence was one of the main issues discussed during the meetings. Studies Cancer incidence in Italian contaminated sites and

Mesothelioma incidence in the neighborhood of an asbestos-cement plant located in a national priority contaminated site clearly demonstrated the destructive impact of different forms of environmental pollution on health. Meeting dedicated to asbestos environmental exposure was an opportunity to learn more about this very important carcinogen and its appearance and various applications in Italy and the rest of the world. Meeting dedicated to endocrine disruptors and hormone-sensitive tumors in the contaminated area was an opportunity to learn more on complexity in evaluating the impact of different pluripotent chemicals based on literature and exposure data over a period of time. Meetings dedicated to air pollution in contaminated sites was also opportunity to discuss the possibility to improve the monitoring system in the contaminated area with the aim to control air quality for the main pollutants as well as to identify the contribution of the different sources to the pollution data measured. Discussion about different dispersion model was held, suggesting for aerial sources the AP42 model of USEPA could be an optimal way to access pollution distribution for thermal power plant like the one which is positioned in Pljevlja. Meeting dedicated to hazardous waste was an opportunity to learn more on the health effects of the residence in the vicinity of hazardous waste sites. A presented systematic review of scientific literature clearly shows evidence of causal relationship with hazardous waste and different neoplastic and non-neophastic diseases. There are also limited evidence of the association between the exposure to hazardous waste and adverse birth outcomes, including low birth weight, pre-term birth, congenital anomalies overall and anomalies of the urogenital, connective and musculoskeletal systems. Meetings dedicated to Communication strategy in contaminated sites and Inequalities and environmental justice presented the importance of communicating activities regarding health impact assessment in all stages of this scientific process. Wherever assessment on environmental inequalities was carried out, an overburden of socioeconomic deprivation and vulnerabilities was observed. Meetings with representatives of Statistical service at Institute, clarify methods of proper usage of morbidity and mortality data in environmental health impact assessment. Meeting with an expert for GIS clearly demonstrated how geographical and health data can be presented together in a simple and easily understandable way for everybody by the people familiar with this software.
On Monday 18 March host prof Comba kindly allowed me to participate on Initial Conference on Interdepartmental Mission of Children Health and Environmental Pollution organized at Istituto Superiore di Sanita. This conference gathered key scientists from different departments of Istituto Superiore di Sanita as well as experts from other institutions from Italy with extensive experience in the environmental health impact area.

DESCRIPTION OF THE MAIN RESULTS OBTAINED:

Working with experienced experts from Instituto Superiore di Sanita in Rome during STSM helped me to upgrade my knowledge and to prioritize actions necessary for health risk assessment in industrially contaminated sites in my country. The extensive work performed for a long time regarding contaminated sites and health by the Istituto Superiore di Sanita generated firm ground necessary for performing high-quality impact assessment in industrially contaminated sites. During STSM all steps in health impact assessment process were evaluated starting from hypothesis formulation, using methods and different indicators (proximity, intensity, emissions) for exposure assessment. Improving exposure assessment with questionnaires and different forms of biomonitoring was understood as a necessity especially when data on exposure and different population groups are limited. Characterization of health risk and impact regarding exposure data and scientific evidence was recognized as a key element of Sentieri approach. Already performed classification of scientific evidence by experts working in Sentieri project will have also a very important influence in national studies of Industrially contaminated sites in Montenegro. This types of evidence are the major arguments in health impact assessment, especially when there are limited scientific studies like in Montenegro. Presented scientific research and results showing excess hospitalization related to different diseases in sites where there are expected according to scientific literature are confirming this importance. In line with new evidence and scientific publication published every ear in this area, there is a plan to update this classification in the coming period by Sentieri experts, which will be of great importance for health impact assessment also in my country. Importance of risk communication (population, media, decision-makers, scientific community) was understood as very important, especially in countries like Montenegro where environmental issues often have political connotations. Importance of engagement of different health professionals especially primary health care practitioners, pediatricians and occupational medicine specialist in health risk assessment was understood as a high priority. Value of this approach was clearly demonstrated at the Initial Conference on Interdepartmental Mission of Children Health and Environmental Pollution. During this Conference number of experts with different backgrounds in professional orientations presented their research, efforts, and commitments to work on improving children health within a number of environmental challenges. Scientific literature review on hazardous waste and

health effects problems gave a completely new perspective having in mind that 95 different health outcomes (diseases and disorders) can be connected to residential exposure to hazardous waste. Environmental inequalities are also a very important aspect to be included in all stages of the assessment process. Since environmental inequalities intersect three dimensions: social, territorial and environmental this aspect clearly demand the cooperation of different stakeholders and experts in accessing the impact of contaminated sites. Using routine health data (mortality, morbidity, hospitalization, cancer incidence (children, adults) is a first and very important step in making health profiles of population leaving in contaminated sites. Number of experts during STSM clearly point out the importance of having as much as possible high quality of morbidity and mortality data. This aspect also point out the importance of good cooperation among different experts and institutions in the country, because health impact assessment should be carried out in successive stages following a standardized process. Improvements needed for establishing and maintaining national surveillance systems in ICS must take into account all above-mentioned aspects especially cooperation among different stakeholders, and experts.
Besides intensive communication, during STSM experts generously shared a number of high-quality publication and powerpoint presentations in this field.

FUTURE COLLABORATIONS

This visit strengthened cooperation and communication of experts working in the same field in these two National public health institutes. Small countries like Montenegro don't have a sufficient number of experts for these activities, and cooperation is a key element in conducting necessary risk/health impact assessments. This STSM served as a continuation of good collaboration already established in the framework of the ICSHNet COST Action. During the STSM issue of future collaborations was discussed with many experts. It was agreed to continue cooperation and assistance at various stages related to the assessment of the impact on health for the population living close to industrially contaminated areas in Montenegro. One of the major interests in future cooperation was regarding environment impact on children health. Following the health profiles of this vulnerable group of the population living close to contaminated areas through cancer registers and sources of data is a good way to monitor changes in the impact of contaminated areas on population health and effectiveness of policies and different decisions.
Institute of Public Health of Montenegro is looking forward this and other initiatives from partner institutions in the coming period, especially from Istituto Superiore di Sanita and Department of Epidemiology of the Environment and Social Medicine where is located WHO Collaborating Centre for Environmental Health in Contaminated Sites. Participation at Initial Conference on Interdepartmental Mission of Children Health and Environmental Pollution organized at Istituto Superiore di Sanita was also an excellent opportunity to meet and make the first steps in cooperation with experts from other sectors in Institute as well as from different institutions in Italy.Waste and contaminated sites are included as priorities in the framework of the Ostrava Declaration in 2017 and most of the countries including Montenegro will include this issue in Environment and Health Portfolio of Actions. This would be a legal obligation and framework necessary to look on different contaminated sites and health effects on national as well as international level.

Relationships established with experts from the Istituto Superiore di Sanita and in particular with host Prof. Pietro Comba ensure further good cooperation both on a friendly and at the professional level.

COST
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: IS1408
STSM title: Application of effect based methods in Idustrial Contaminated Sites
STSM start and end date: 15/04/2019 to 19/04/2019
Grantee name: Walter Cristiano

PURPOSE OF THE STSM:

The general purpose of this short term scientific mission (STSM) was to reinforce the relationships between the Italian Institute of Health (ISS) and the Helmholtz Centre for Environmental Research (UFZ), with the aim of improving a shared environmental monitoring strategy focused on the effect-based methods (e. g. bioassays). Such tools have been increasing across European Union in monitoring plans for the environmental quality assessment and have been becoming essential in the ecosystem management in the last few years. Therefore, the use of effect-based methods needs to be involved into monitoring programmes to detect chemical compounds (e. g. chemical substances and mixtures) in the environment and its effects on living organisms, including humans. The specific objectives of this SMTS were indeed aimed at acquiring new competences to perform innovative ecotoxicological bioassays. The outputs should therefore help in providing important analytical and methodological skills suitable for the analysis on industrial contaminated sites, as defined by the Cost Action on the Industrially Contaminated Sites and Health Network (ICSHNet).

DESCRIPTION OF WORK CARRIED OUT DURING THE STSM:

I spent a short period at the the Helmholtz Centre for Environmental Research (UFZ) located in Leipzig, Saxony, Germany. This period was basically focused on the achievement of new skills visiting the facilities inside the UFZ and receiving education on different experimental activities. I was hosted at the Department of Effect-Directed Analysis led by the Professor Werner Brack and I worked strictly together with Dr. Riccardo Massei. I was involved in the study of *in vivo* and *in vitro* tests to investigate the effects of aquatic pollutants on freshwater biodiversity. My work was specifically focused on experimental methods for the neurotoxicity and mutagenicity assessment. Neurotoxic effects can be reveled by different kind of analysis, such as behavioural tests. I worked mainly with the model organism zebrafish (*Danio rerio*) to investigate the effects of chemical contamintation on its early life stages. Following the innovative ecohealth approach, this biological model is particularly important both for revealing the effects on aquatic biodiversity that for providing preliminary results on indirect effects on human health. The most part of my work was indeed concerned on the comprehension of how environmental pollutants affect the nervous system of zebrafish. To do this, it is necessary to combine different bioassays with chemical analysis on the environmental samples of reference. Therefore, a test battery is essential to reveal potential hidden neurotoxic effects caused by a large amount of chemical compounds and mixtures, and I had the opportunity to work together with other researchers in improving my knowledge of such assays. For instance, a new method for the neurotoxic assessment in zebrafish is based on looking at the alterations in the spontaneous movements of embryos. Abnormal movements may indicate a damage in the developing nervous structures provoked by potential neurotoxic compounds. However, neurotoxicity can also be revealed by analysing the locomotor activity of early larvae. I was then involved in behavioural observations on zebrafish larvae at around 96 hours post fertilisation, using specific recording devices and dedicated softwares. During my staying at the UFZ, I was also involved in mutagenicity bioassays using different strains of *Salmonella* species. This work was important in the general understanding of the most popular ecotoxicological tests such as the Ames

test. Beyond experimental laboratory activities, an important part of my scientific experience in Leipzig allowed me to acquire new rearing procedures to maintain fish tanks and individuals. Indeed, I visited the fish facility stored at the UFZ and I was trained by expert staff members in order to improve my management skills of a breeding fish room. Moreover, my work at the UFZ ended with an oral presentation on the activities and roles of the Italian Institute of Health (ISS) as well as the goal of the Cost Action on the Industrially Contaminated Sites and Health Network (ICSHNet).

DESCRIPTION OF THE MAIN RESULTS OBTAINED:

This visiting period gave me the opportunity to face with challenging methods for investigating the pollution effects of chemicals usually revealed in contaminated sites. I gained new operational skills to improve my laboratory procedures performed at Unit of Ecosystems and Health of the Italian Institute of Health (ISS) and to adopt new methods for the aquatic ecosystem analysis. This STSM supported the internationalisation of my work group in ISS, strengthening the relationships with one of the most important European centre for the environmental research.

FUTURE COLLABORATIONS:

This STMS aims to improve the collaboration among the Italian Institute of Health and the team group of the Effect-Directed Analysis of the Helmholtz Centre for Environmental Research (UFZ). First of all, new potential studies could be defined by these two research centres to share the efforts in the management and monitoring of specific industrial contaminated European sites. Moreover, future visiting exchanges coud be encouraged among the researchers of these two institutes. Furthermore, whereas the fundamental institutional role of the ISS, future works could allow the elaboration of new monitoring methods with regulatory purposes.

Approved

U.A

SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: IS1408
STSM title: Application of effect based methods in Industrial Contaminated Sites
STSM start and end date: 15/04/2019 to 19/04/2019
Grantee name: di Domenico Kevin

PURPOSE OF THE STSM:

The main purpose of this STSM was to improve our knowledge in the field of ecotoxicological testing by viewing the methods in use at the Helmholtz Centre for Environmental Research (UFZ) centre in Leipzig. In this regard, methods used for the testing of contaminated water samples wich make use of Zebrafish were the main interest: by visiting the facilities used in order to breed and maintain the fish, and by observing the techniques used to collect the eggs for ecotoxicological testing we intended to improve the performances of our tests in Rome. A further aim of the STSM was to pave the way to new collaborations between the UFZ and the Istituto Superiore di Sanità (ISS) in Rome.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSM:

On the first day of my stay in Liepzig i met my host, Doctor Werner Brack and received an overview of the main activities and the structure of the UFZ centre by Doctor Riccardo Massei. The main objectives of the STSM were discussed and a program of the STSM activities was defined.

The activities of the first day were focused on the use of Zebrafish in ecotoxicological testing, on the techniques used in order to carry out a suitable water sampling from a river basin and on methods and instruments used for chemical characterization. I had the opportunity to visit the facility were the Zebrafish eggs are obtained and Doctor Massei arranged a meeting with the expert in charge of breeding the fish who explained the main characteristics of the facility and the protocols used to feed the fish and collect the eggs. Then Doctor Massei showed me the laboratory and the instruments used for the tests with Zebrafish, and explained me in detail the procedures of some of the tests in use at the centre that make use of Zebrafish for detection of environmental pollutants. Regarding water sampling, Doctor Massei showed me a portable filtration system developed by UFZ able to filtrate hundreds of litres of water in a short period of time and suitable to concentrate all suspension matter in a single cartridge, thereby making sampling operations much easier.

On my second day at the centre, i witnessed some procedures as part of a short test with Zebrafish. In this case spontaneous movements of the tail during the early stages of embryo life were observed and counted during a short period of time in order to detect possible abnormalities caused by chemical pollutants. For this purpose, small groups of embryos were placed under a microscope with a built-in camera and connected to an LCD screen able to record videos for an established amount of time.

On my third day, Doctor Walter Cristiano and I held a brief overview of the activities and the structure of the Department of Environment and Health of the (ISS) we work in, in the presence of Doctor Brack, Doctor Massei and other researchers working at the centre. During the meeting we had the opportunity to explain some projects that are currently under development at the ISS and the purpose of our stay in Lipzeig.

MAIN RESULTS:

This stay in Lipzeig at the UFZ centre helped me to upgrade and increase my understanding of ecotoxicological procedures and testing, in particular with regard to the use of Zebrafish, and the knowledge obtained will be surely useful for my research activities. Furthermore, during the STSM I had the chance to learn about many possible future development in ecotoxicological research and about different applications of already existing methods. In particular, shortened versions of the acute toxicity test with Zebrafish, aimed to detect specific ascpects of toxicity and neurotoxicity effects, could provide new ideas for future projects at the ISS. The notions obtained during my visit at the Zebrafish facility and my meeting with local experts will be extremely useful to improve my knowledge about Zebrafish breeding and this will allow to increase and maximize the results in our facility in Rome. By reproducing the same environmental parameters (water quality, temperature, light…) and the same feeding and mating procedures I hope it will be possible for us to obtain an even greater number of eggs and so as to perform tests even more efficiently.

FUTURE COLLABORATIONS

This visit strengthened communication and relationship between ISS and UFZ. During the STSM, the issue of future collaborations was discussed in many aspects. Given the common interest for some specific fields of ecotoxicology, there is a real chance of future opportunities to share knowledge and ideas and to cooperate to new scientific projects that will be defined in the near future. In particular, joint projects could involve ecotoxicological testing and chemical characterization of water samples.

SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: IS 1408
STSM title: Industrially Contaminated Sites and Health Network (ICSHNet)
STSM start and end date: 08/04/2019 to 16/04/2019
Grantee name: Nataša Dragić

PURPOSE OF THE STSM:

(max.200 words)

The overall objective of my STSM was to acquire and improve expertise in environmental health risk assessment and impact assessment by collaborating with experts in environmental health research.

The specific aims were to:

(i) gain new knowledge about methodological approach of environmental health impact assessment and health risk assessment in order to apply the results at the practical level, which supports economically and environmentally reasonable decision making to achieve population wellbeing ("healthy policies");

(ii) learn to recognize and understand the basic steps and data needed for health impact/risk assessment (air pollutants (best indicator), exposure, health outcome, concentration-response curve, relative risk, burden of disease data (Years of Life Lost, Years Lived with Disability, Disability – Adjusted Life Year) in the field of industrially contaminated sites, especially in urban areas, and apply learned concepts independently;

(iii) conduct a health impact assessment of a of the leading environmental risk factors (air pollution) in Serbia;

(iv) establish future collaboration between Finnish and Serbian researchers (based on the applied methodology for exposure assessment, health impact assessment, as well as health risk estimates (epidemiological research) and provide the results for country/district/municipality level of interest, prepare scientific reports (conference presentation (abstracts), full scientific paper).

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

(max.500 words)

During the STSM my full time work in Research Centre Neulanen, National Institute for Health and Welfare (THL), Kuopio was in line with the Program of hosting institution THL (**Appendix 1**).

First two days were intended to meet various THL environmental health. Based on my skills regarding to association of environmental risk factors (mostly air pollution) and health, a working program deepen the

knowledge about health impact/risk assessment and available techniques for air pollution exposure assessment was developed.

At the end of the second day (09.04.2019), I had opportunity to present some of my previous ecological-epidemiological results (Title: **Urban air pollution and cardiovascular and cerebrovascular diseases in Novi Sad, Serbia**; handout in **Appendix 2**) as well as introduce my country and home institution at the Environment and health research seminars series.

The next three days of the STSM were used to strengthen my expertise in air pollution exposure assessment and risk and health impact. This included review of availably literature, discussion with the available researcher of host institution about relevant data for air pollution exposure (EEA, MSc Antti Korhonen), global and European health estimates of burden of disease (GHE, MSc Heli Lehtomäki), recommended relative risk for health outcome of interest (WHO), online tools (GBD) importance and purpose of using geographical information systems (methodology for modeled data and population weighted concentration).

In the same days, with the improvement of my knowledge and skills regarding air pollution exposure assessment, under the host supervision I started to review necessary database about air pollution data (particulate matter $PM_{2.5}$), number of population at country level as well district level and (with host research team support) in order to estimate population weighted concentrations for impact assessment. An abstract presenting the results was developed with the title: Population exposure to ambient fine particulate matter ($PM_{2.5}$) in Serbia (**Appendix 3**).

During the rest of the days, based on the PM2.5 exposure assessment results for Serbia and using the capability of host research team, as well as my own health impact/effects assessment knowledge, I estimated the deaths attributable to air pollution in Serbia. The results are presented in the abstract with the title: Health effect assessment of ambient fine particulate matter ($PM_{2.5}$) in Serbia (**Appendix 4**).

Poster presentations of the exposure assessment and health impact assessment were drafted (**Appendix 5**) during the last day of STSM under host supervision. Possibility to present the results at a future conference were discussed, as well as the preparation of a full scientific paper.

During STSM I also got opportunity to learn about basic work organization and research results from filed of radiation (mostly electromagnetic fields), health impact modelling using online tools (Opasnet), persistent organic pollutant exposure and analytics in Finland, drinking water safety and waterborne outbreaks in Finland, as well as basic information for „Moodle" learning platform (online teaching training for university teachers; MSc Isabell Rumrich) and software tool AirQ+.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

STSM my full time work in Research Centre Neulanen, National Institute for Health and Welfare, Kuopio enabled me to:

- see important and useful role of global and regional database for air pollution exposure, health estimated burden of diseases and risk estimates, as well as online tools (health impact modelling, QGIS and AirQ+) for researchers in the field of public health and environmental science;
- apply the basic methodological approach for air pollution exposure assessment and health impact/effects assessment;
- estimate air pollution exposure in Serbia and demonstrate the use of health effect assessments (quantify the mortality potentially associated with air pollution);
- establish cooperation with colleagues, exchange opinions regarding the results of previous and most recent research related to the health impacts assessment and risk assessments;
- find that the way of cooperation, communication, pleasant atmosphere, the individual effort of each of the research team with excellent and expert supervision can contribute to excellent results.

FUTURE COLLABORATIONS (if applicable)

In cooperation with whole researcher team from host institution:

- write a full scientific paper based on previous abstracts for a publication in international peer-reviwed scientific journal;

- develop an adequate methodological approach for analysis air pollution impacts and health risksin some Serbian industrial contaminated areas, make comparative analyses of the health impact at different levels of contaminated areas within Serbia and with different European countries;

- prepare future research activities in areas of environmental epidemiology (long-term and short-term study based on data from Finland and Serbia to revise the associations observed in this type of study).

24.04.2019.

Nataša Dragić

STSM Programme

Appendix 1

MD Nataša Dragić
Kuopio Visit 8-16.4.2019

Venue: Research Centre Neulanen

National Institute for Health and Welfare
Neulaniementie 4, 70200 KUOPIO

Hosts: Otto Hänninen, tel. 0400 673 207, otto.hanninen@thl.fi
Isabell Rumrich, tel. 044 300 4394
Heli Lehtomäki, tel. 040 572 6417

Office hours: 8-16 (morning flex 7-9, afternoon 15-17)
Lunch break/typical 11-12 (minimum 30 min, max=flex)

2019-04-06 Arrival AY365 13:50 Kuopio Airport
2019-04-07

2019-04-08 Monday

(keep your passport with you on Monday and Tuesday)

8:30 Meeting with Isabell Rumrich

9:00 Radiation and Chemical Research group (RCR) - Informal team meeting
Place: SN401, Snellmania, UEF
Chair: Jonne Naarala, Head of Group, Vice Head of Department
Agenda:
- Journal Club presentation/Research update: Mikko Herrala, PhD (topic to be confirmed, most likely in vitro/in vivo effects of electromagnetic fields)
- Funding possibilities; Conference/Meeting attendance
- Administrative news & any other business

12:00 Lunch

13:00 MSc Heli Lehtomäki, health impact assessment and air pollution burden of disease work. Planning the visit activities.

2019-04-09 Tuesday

9:00 Identification, assistant Heli Leinonen (passport needed!)

9:30 Health impact modelling using online tools: Opasnet, Climate Neutral Helsinki 2035, Jupyter Notebook etc., Doc. Jouni Tuomisto, group leader

Planning/working/preparations for the presentation

14:30 Seminar presentation

18:00– World's largest smoke sauna, Rauhalahti, and dipping in the lake ice opening (cancelled)

2019-04-10 Wednesday

9:00 MSc Antti Korhonen geographical information systems in air pollution exposure assessment; European Environmental Agency air quality estimates 2015

13:00 – 15:00 Online teaching training for university teachers, giving online remote presence presentations in Moodle environment by MSc Antti Kauppila, University of Eastern Finland; with Isabell Rumrich

2019-04-11 Thursday

10:00 Visit to Chemical risk-team, introduction to persistant organic pollutant exposure and analytics in Finland, PhD Päivi Ruokojärvi, Department of Health Safety

12:00 -13:30 Visit to Water hygiene group, Docent Ilkka Miettinen, Department of Health Safety

2019-04-12 Friday

2019-04-13 Horseback riding (cancelled)
2019-04-14

2019-04-15 Monday

Preparation of the mission report
Writing conference abstracts
Preparation of posters

Visit to Puijo-tower and Lunch at Vendace Restaurant Sampo

2019-04-16 Tuesday

Follow-up plans

2019-04-17 Departure AY362 8:50

Resulting documents

Dragić N, Korhonen A, Lehtomäki H, Hänninen O, 2019. Population exposure to ambient fine particulate (PM2.5) matter in Serbia. Conference abstract (2pp) and poster to be submitted to 53rd International Congress "Days of Preventive Medicine„ September 2019; Niš, Serbia.

Dragić N, Korhonen A, Lehtomäki H, Hänninen O, 2019. Health effect assessment of ambient fine particulate matter (PM2.5) in Serbia. Conference abstract (2pp) and poster to be submitted to 12th EPH Conference; 20 - 23 November 2019, Marseille, France.

Appendix 2

PPT presentation on Tuesdey seminars

"Urban air pollution and cardiovascular and cerebrovascular diseases in Novi Sad, Serbia"

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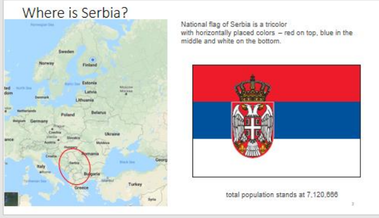

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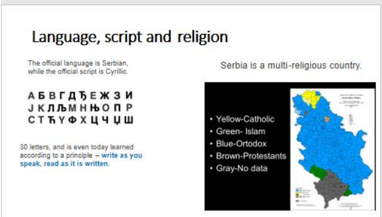

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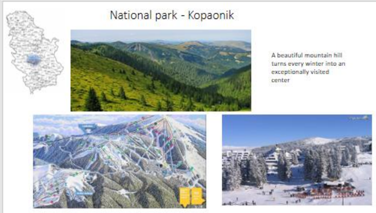

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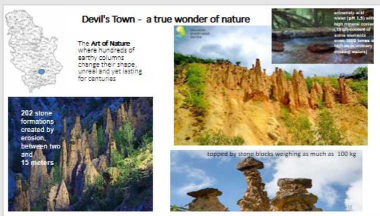

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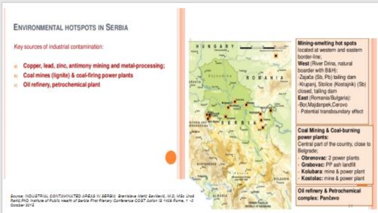

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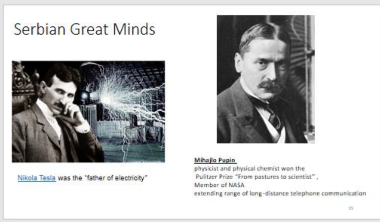

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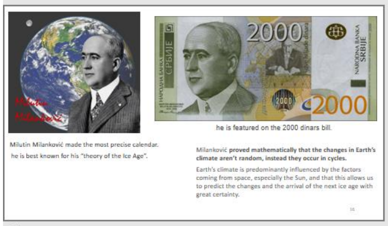

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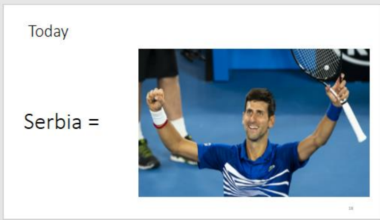

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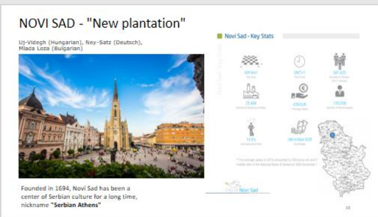
Appendix 2

<u>PPT presentation on Tuesdey seminars</u>

"Urban air pollution and cardiovascular and cerebrovascular diseases in Novi Sad, Serbia"



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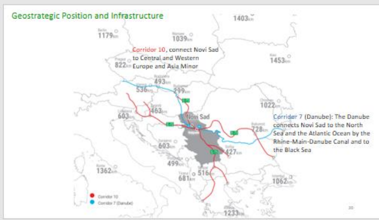

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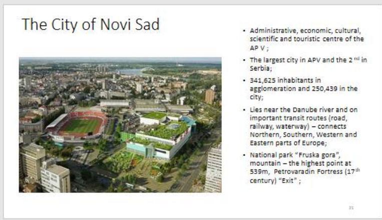

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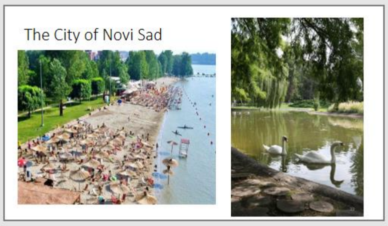

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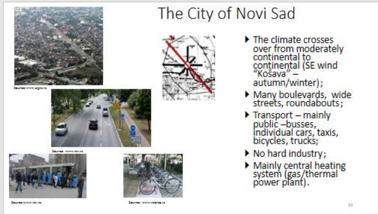

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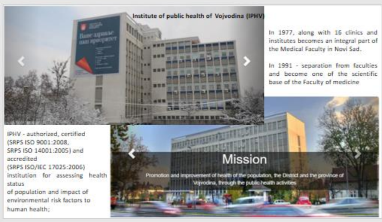

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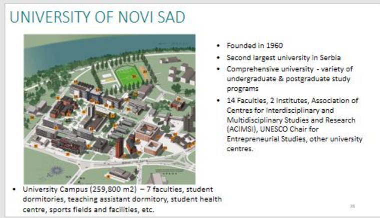

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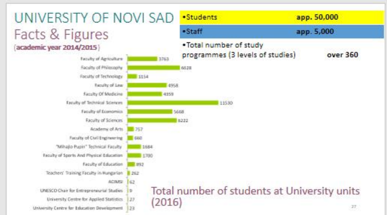

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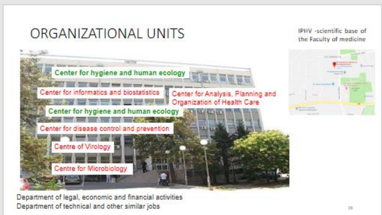

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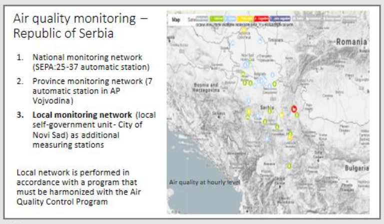

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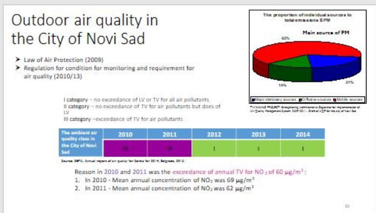

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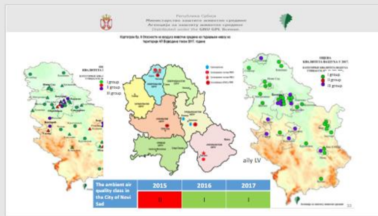

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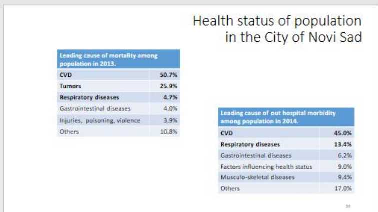

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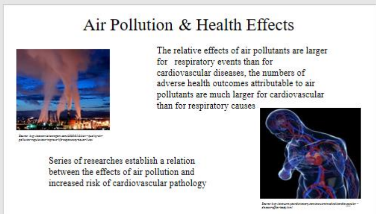

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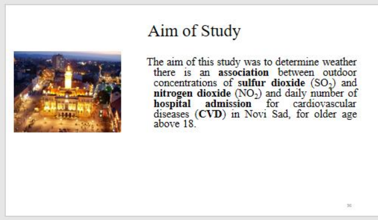

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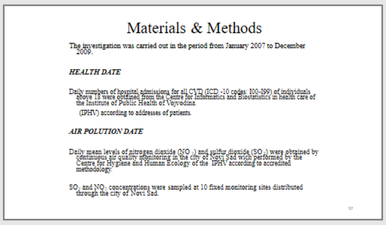
Appendix 2

PPT presentation on Tuesday seminars
"Urban air pollution and cardiovascular and cerebrovascular diseases in Novi Sad, Serbia"



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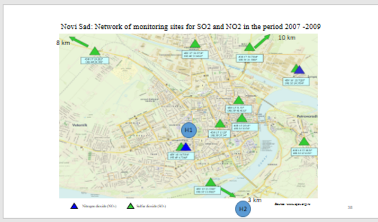

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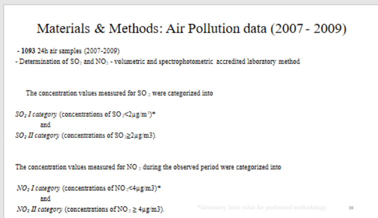

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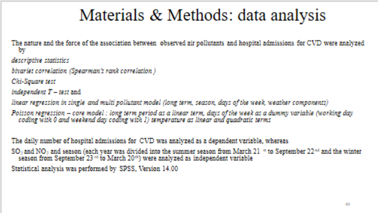

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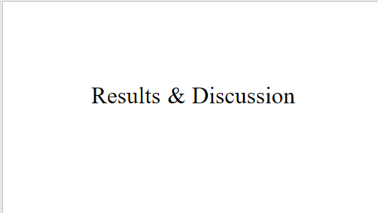

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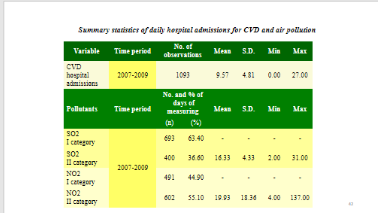

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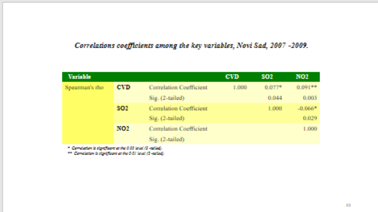

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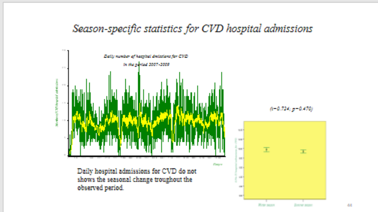

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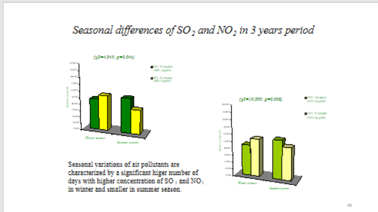

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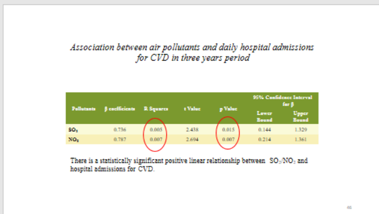

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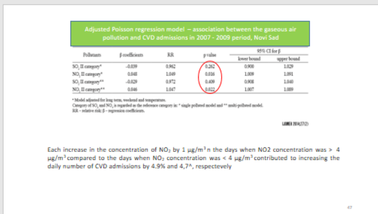

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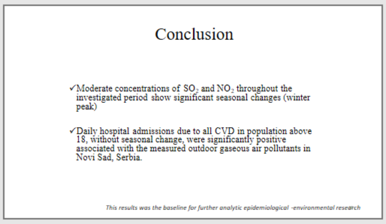

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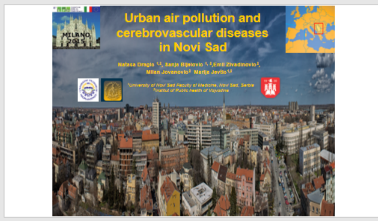

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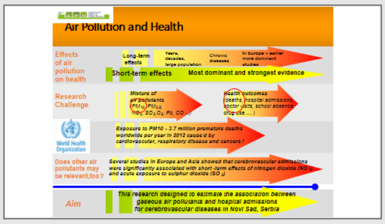

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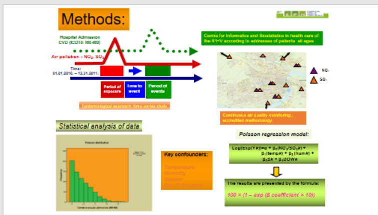

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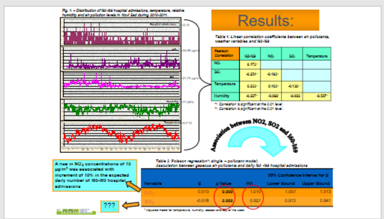

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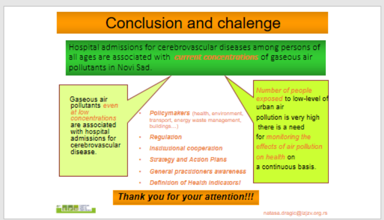

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Abstract I

POPULATION EXPOSURE TO AMBIENT FINE PARTICULATE ($PM_{2,5}$) MATTER IN SERBIA

Nataša Dragić[1,2], Antti Korhonen[3,4], Heli Lehtomäki[3,4], Otto Hänninen[3]

[1] University of Novi Sad, Serbia
[2] Institute of Public Health of Vojvodina, Serbia
[3] National Institute for Health and Welfare (THL), Finland
[4] University of Eastern Finland (UEF), Finland

INTRODUCTION

According to World Health Organization (WHO) air pollution is one of the largest risk factors for public health (1). In Europe of all air pollutants fine particulates ($PM_{2.5}$) are recognized as the best indicators of adverse health effects (2). To evaluate or quantitative the health effects of air pollution requires the population exposure estimate.

OBJECTIVES

The aim of this study is to evaluate data about annual concentrations of $PM_{2.5}$ in Serbia in 2015 for exposure estimate. Specifically, (i) to present the spatial variability of the concentrations; (ii) compare available annual monitoring results with the spatial model; and provide (iii) aggregated population weighted exposure values for health impact assessment on districts and national level.

MATERIALS AND METHOD

We used EEA's interpolated air quality map of $PM_{2.5}$ (3) for 2015 and Geostat population grid 2011 (4) both at 1 x 1 km^2 resolutions, to describe spatial variability of population-weighted $PM_{2.5}$ concentrations (PWC) in Serbia at district level (n=30). Because of the missing data of regular $PM_{2.5}$ monitoring for Serbia we used modeled annual $PM_{2.5}$ and compare to observed annual mean concentrations of neighboring countries (5). Hence, in 2015 there was no $PM_{2.5}$ measurements in Serbia, observed concentrations were derived from measured PM_{10} annual concentrations by using ratio of $PM_{2.5}$ and PM_{10} measurements (0.67) in Serbia in 2016. Modeled value of $PM_{2.5}$ for Serbia were compared to gridded $PM_{2.5}$ value (spatial vs observed (in this case modeled)). All results of PWC $PM_{2.5}$ were presented in a map and compared to guideline value of WHO (10µg/m^3) as well as with national limit value (25 µg/m^3).

RESULTS

Due to modeled data for 2015 on national level the average value of PWC of PM2.5 was 23.3 (wsd ±4.9) µg/m^3. The agreement between modelled and observed concentrations was fairly good with coefficient of determination (R^2) being 0.75. Average observed and modelled concentrations at monitoring station locations (n=7) were 30.8 µg/m 3 and 24.8 µg/m 3 respectively. According to correlation greed value with monitoring value of neighboring countries the overall R^2 was 0.67. Correlation of concentrations was high in all other neighboring countries (R^2 0.87-0.93), except Bulgaria and Romania (R^2 0.01 and 0.03 respectively) situated east of Serbia. Comparing PWC between district the lowest one was in North Banat (17.6 µg/m^3) (north-eastern regions of Serbia) and highest one was in Kosovo districts (27.9 µg/m^3) (south regions of Serbia). In all district the annual value of PWC of $PM_{2.5}$ was above WHO guideline value, while national limit value for $PM_{2.5}$ was exceeded in 13 districts.

CONCLUSION

Temporal coverage and availability of monitoring data of $PM_{2.5}$ on the national level are limited. Even if the EEA model is in good agreement with the monitoring data, it would be important at national level that monitoring data would be available with better spatial and temporal coverage. Annual $PM_{2.5}$ concentrations in all Serbian districts were above WHO value and could have adverse health impacts on Serbian population. That way is important to evaluate health impact based on the EEA model to reach overall picture about health impacts.

REFERENCES

1.World Health Organization. Ambient (outdoor) air quality and health Fact sheet https://www.who.int/airpollution/ambient/health-impacts/en/ (accessed 2019-04-11)

2. Lelieveld J, Klingmuller K , Pozzer A, Poschl U, Fnais M, Daiber A, et al. Cardiovascular disease burden from ambient air pollution in Europe reassessed using novel hazard ratio functions.European Heart Journal. 2019 (00):1–7.

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6. Serbian EPA, 2019. Open data http://data.sepa.gov.rs/en/. (accessed 2019-04-10)

Abstract II

HEALTH EFFECT ASSESSMENT OF AMBIENT FINE PARTICULATE MATTER ($PM_{2,5}$) IN SERBIA

Nataša Dragić[1,2], Heli Lehtomäki[3,4], Antti Korhonen[3,4], Otto Hänninen[3]

[1] *University of Novi Sad, Serbia*
[2] *Institute of Public Health of Vojvodina, Serbia*
[3] *National Institute for Health and Welfare (THL), Finland*
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INTRODUCTION

The latest European study of burden of diseases from ambient pollution conclude that the health impacts attributable to ambient air pollution may be substantially higher than previously assumed (1). International estimates have not been elaborated in Serbia in more detail before.

OBJECTIVES

The overall aim of this work is to demonstrate the use of health effect assessments in Serbia. Specifically we want to (i) quantify the mortality potentially associated with air pollution and (ii) look at the district distribution of these effects.

MATERIALS AND METHOD

Exposure data for Serbia were obtained from European Environmental Agency model (2) and evaluated against regional observations separately (3). Health impact assessment was conducted using population attributable fraction (PAF) methods for $PM_{2.5}$ at national and district level. Deaths attributable to $PM_{2.5}$ exposure were calculated in national level using WHO Global Health Estimates 2015 data (4) for natural cause background mortality for 30+ years of age for Serbia, and Health Statistical Yearbook of Republic of Serbia 2015 for mortality data in district level (not available for Kosovo). Concentration response function from WHO recommendations was used (RR=1.062 per 10 µg/m^3, 95%CI:1.04-1.083) (5) for natural mortality.

RESULTS

In 2015 the natural cause mortality in Serbia was 102,000 deaths and the $PM_{2.5}$ exposure was 23.9 (SD 5.2) µg/m3. Lowest calculated PAF was in North Banat (10.0%) and the highest was in Kosovo districts (15.4%). Total of 13.600 (PAF=13.4%) deaths in Serbia in 2015 were attributable to air pollution. According to district the range of attributable deaths number were from 206 (Toplica) to 2718 (Belgrade).

CONCLUSION

This is the first results of health effect assessment of air pollution in Serbia at district level. In totally 13,200 deaths were attributable to air pollution ($PM_{2.5}$) exposure. District distribution of PAF shows that the lowest PAF was in the north Serbia while the highest one was on South. These results indicate that air pollution must be included in policy decision for environment improving in order to improving public health, as well as that HIA is a tool which in understandable level describe impact of air pollution.

REFERENCES

1. Lelieveld J, Klingmuller K , Pozzer A, Poschl U, Fnais M, Daiber A, et al. Cardiovascular disease burden from ambient air pollution in Europe reassessed using novel hazard ratio functions.European Heart Journal. 2019 (00):1–7.
2. Héroux ME, Anderson HR, Atkinson R, Brunekreef B, Cohen A, Forastiere F, et al. Quantifying the health impacts of ambient air pollutants: recommendations of a WHO/Europe project. International Journal of Public Health.2015;60(5):619-627.
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4. WHO 2019. GHE data for 2015. Downloaded from https://www.who.int/gho/publications/world_health_statistics/2015/en/ (accessed 2019-04-12)
5. Horalek J, de Smet P, de Leeuw F, Kurfürst P, Benešová N. European air quality maps for 2015: PM10, PM2.5, Ozone, NO2 and NOx spatial estimates and their uncertainties, 2018.

POSTER I

53. International Congress "Days of Preventive Medicine, September 2019; Niš, Serbia

POPULATION EXPOSURE TO AMBIENT FINE PARTICULATE ($PM_{2,5}$) MATTER IN SERBIA

Nataša Dragić[1,2], Antti Korhonen[3,4], Heli Lehtomäki[3,4], Otto Hänninen[3]

[1] University of Novi Sad, Serbia
[2] Institute of Public Health of Vojvodina, Serbia
[3] National Institute for Health and Welfare (THL), Finland
[4] University of Eastern Finland (UEF), Finland

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In Europe of all air pollutants fine particulates ($PM_{2.5}$) are recognized as the best indicators of adverse health effects (2). To evaluate or quantitative the health effects of air pollution requires the population exposure estimate.

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The aim of this study is to evaluate data about annual concentrations of $PM_{2.5}$ in Serbia in 2015 for exposure estimate.

Specifically, (i) to present the spatial variability of the concentrations; (ii) compare available annual monitoring results with the spatial model; and provide (iii) aggregated population weighted exposure values for health impact assessment on districts and national level.

Methods

We used EEA's interpolated air quality map of $PM_{2.5}$ (3) for 2015 and Geostat population grid 2011 (4) both at 1 x 1 km² resolutions, to describe spatial variability of population-weighted $PM_{2.5}$ concentrations (PWC) in Serbia at district level (n=30).

Because of the missing data of regular $PM_{2.5}$ monitoring for Serbia we used modeled annual $PM_{2.5}$ and compare to observed annual mean concentrations of neighbouring countries (5) (Fig 1).

Hence, in 2015 there was no $PM_{2.5}$ measurements in Serbia, observed concentrations were derived from measured PM_{10} annual concentrations by using ratio of $PM_{2.5}$ and PM_{10} measurements (0.67) in Serbia in 2016. Modeled value of $PM_{2.5}$ for Serbia were compared to gridded $PM_{2.5}$ value (spatial vs observed) (Fig 2).

All results of PWC $PM_{2.5}$ were presented in a map and compared to guideline value of WHO (10 µg/m³) as well as with national limit value (25 µg/m³).

Results

Estimated population weighted exposure to PM2.5 in Serbia in 2015 was 23.3 µg/m³ (SD ±4.9).

Comparison of predicted levels against available observed data from neighbouring countries yielded coefficient of determination (R^2) of 0.67 (Figure 1). Correlation (R) of concentrations was high in all other neighboring countries (93-96%), except Bulgaria and Romania (11 and 17%, respectively), situated east of Serbia (Fig 1).

PM2.5 level was not monitored in Serbia in 2015 and was estimated using PM2.5/PM10 ratio from 2016 (Fig 2).

Population exposures in Serbia were lowest in North Banat district (17.6 µg/m³) (north-eastern regions of Serbia) and highest in Kosovo districts (27.9 µg/m³) (southern regions of Serbia) (Fig 3).

The WHO annual air quality guideline value (10 µg m⁻³) was exceeded in all 30 districts, while national limit value (25 µg m⁻³) was exceeded in 13 districts (Fig 3.).

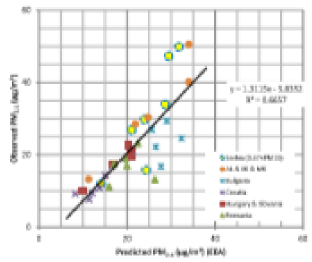

Figure 1. Comparison of observed $PM_{2.5}$ versus predicted corresponding annual levels in 2015 in neighbouring countries. Serbian levels are estimated from PM10 using PM2.5/PM10 ratio from 2016.

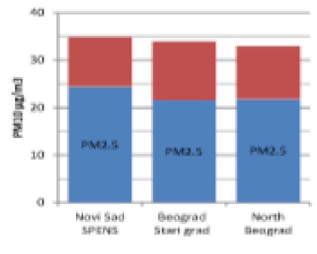

Figure 2. Comparison of PM2.5 and PM10 levels in Serbia in 2016. The mean ratio (67%) was used to estimate PM2.5 levels in 2015 from PM10 data due to lack of PM2.5 measurements.

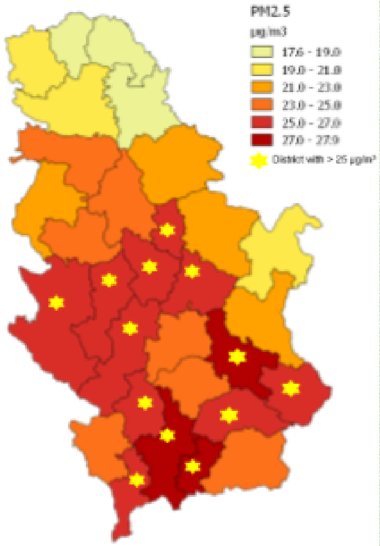

Figure 3. Population-weighted $PM_{2.5}$ concentrations in Serbia according to districts in 2015 as well as district with where annual concentrations exceeded national limit value 25µg/m³ in 2015

Conclusion

Temporal coverage and availability of monitoring data of $PM_{2.5}$ on the national level are limited.

Even if the EEA model is in good agreement with the monitoring data, it would be important at national level that monitoring data would be available with better spatial and temporal coverage.

Annual $PM_{2.5}$ concentrations in all Serbian districts were above WHO value and could have adverse health impacts on Serbian population. That way is important to evaluate health impact based on the EEA model to reach overall picture about health impacts.

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National Institute for Health and Welfare

Acknowledgements. This work was supported by COST Action IS1408 Short Term Scientific Mission and internal funding by National Institute for Health and Welfare, and based on methodologies developed in Academy of Finland project BATMAN (285672), NordForsk under the Nordic Programme on Health and Welfare project #75007 (Nordic WelMa), EU LIFE+ project Index-Air (LIFE15 ENV/PT/000674).

POSTER II

12th EPH Conference: 20 - 23 November 2019, Marseille, France

HEALTH EFFECT ASSESSMENT OF AMBIENT FINE PARTICULATE MATTER ($PM_{2,5}$) IN SERBIA

Nataša Dragić[1,2], Heli Lehtomäki[3,4], Antti Korhonen[3,4], Otto Hänninen[3]

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Specifically we want to (i) quantify the mortality potentially associated with air pollution and (ii) look at the district distribution of these effects.

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Lowest calculated population attributable deaths was in North Banat (10.0%) and the highest was in Kosovo districts (15.4%) (Fig 1a).

Total of 13,600 (PAF=13.4%) deaths in Serbia in 2015 were attributable to air pollution.

According to district the range of attributable deaths number were from 206 (Toplica) to 2718 (Belgrade) (Fig 1b).

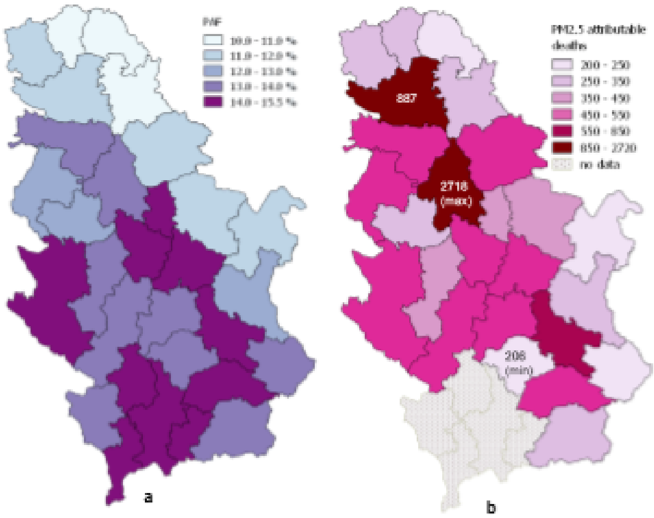

Figure 1. Population attributable fraction (PAF) for $PM_{2.5}$ (**a**) and number of attributable deaths (**b**) in 2015 due to $PM_{2.5}$ exposure at district level in Serbia

Conclusion

This is the first results of health effect assessment of air pollution in Serbia at district level. In total 13,200 deaths were attributable to air pollution ($PM_{2.5}$) exposure.

Air pollution ($PM_{2.5}$) contribution to population attributable deaths was lowest in the north Serbia while the highest was in South.

These results indicate that air pollution must be included in policy decision for environment improving in order to improve public health, as well as that HIA is a tool which in understandable level describe impact of air pollution.

References

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National Institute for Health and Welfare

SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: IS1408
STSM title: A scoping review of the epidemiological methods used to investigate the effects of Industrially Contaminated Sites on child health and pregnancy outcomes, with an indepth focus on waste related Industrially Contaminated Sites
STSM start and end date: 20/02/2019 to 02/03/2019
Grantee name: Dejean Easmon – George
Home institution: Brunel University, Uxbridge, London, England
Host institution: Department of Epidemiology, Regional Health Service of Lazio, Rome, Italy
Official Host: Carla Ancona
Duration: 20th feb to 2nd March 2019

PURPOSE OF THE STSM:

The purpose was to perform a scoping review of various epidemiological methods to investigate the health effects of Industrially Contaminated Sites (ICS) on children and pregnancy outcomes. More specifically, the aim was to identify a range of health outcomes that have been assessed in relation to waste related ICS exposure. The motivation behind these actions were that, we wanted to assess the global distribution of such studies, the specific child health effects and pregnancy outcomes associated with ICS exposure, and to identify the potential gaps in this field of research.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

(max.500 words)

My search criteria was discussed and validated by a team of researchers, from there they discussed and explained their own search critereas too, enabling us to compare the differences and similarities between our search criterias.

Over the course of the STSM, a flow chart of the various search strategies used by each researcher was compiled.

The search results compiled by each researcher were then cross-referenced and compared in order to compile a more accurate and precise body of results. This was done using STATA and Microsoft Excel.

After having a group discussion, it was decided that there would be a specific focus on the relationship between waste-related ICS and their associated child health effects and effects on pregnancy outcomes.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

The main results obtained were a series of tables that outline the health effects of waste related ICS on child populations and pregnancy outcomes.
Two maps have also been made. One showing the locations of all the ICS associated with child health effects and pregnancy outcomes and the second showing the locations of all the waste related ICS associated with child health effects and pregnancy outcomes.

FUTURE COLLABORATIONS (if applicable)

The collaboration with the host institution will continue in the future with remote discussion about a paper to be prepared on the topic.

Comments

The STSM was not only useful for performing a scoping review of various epidemiological methods to investigate the health effects of Industrially Contaminated Sites (ICS) on children and pregnancy outcomes, but also for networking within and outside the COST Action.
I mainly worked with Carla Ancona, who was my official host, and her colleague Manuela De Sario at DEP. I met Lisa Bauleo (DEP) who helped with GIS maps. I spent one day at ISS with Roberto Pasetto, who introduced me to the methods used in the SENTIERI project. Overall, my STSM contributed to the progress of the review work of Action WG 3, but also to my personal development and capacities. Having a background in Environmental Health, spending a weeks with epidemiologists taught be a lot of the approaches and methods they use, from which I will benefit a lot in my PhD project

COST
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SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: IS1408
STSM title: Health Impact of the Mantua (Italy) Chemical Industrial Site
STSM start and end date: 03/09/2018 to 21/09/2018
Grantee name: Stephanie Gaengler

PURPOSE OF THE STSM/

(max.500 words)

The Unit of Environmental and Social Epidemiology of the Department of Environmental Health of Istituto Superiore di Sanità (ISS) works on projects concerning the health impact of contaminated sites, consistently with the goals of the COST Action “Industrially Contaminated Sites and Health Network”. This STSM was set up to collaborate on the health impact assessment of the industrially contaminated site of Mantua, Italy, which is considered a National Priority Contaminated Site due to the major dimensions of the chemical industrial site and its proximity to the residential areas of Mantua. Within this STSM the state of the art of residential cohort studies around industrially contaminated sites was to be assessed using a literature search, and a search of the mortality data base at the national Board of New Technologies, Energy and Environment (ENEA) research center to identify the missing causes of death of 449 subjects of the residential cohort from Mantua.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

(max.500 words)

In the first days of the STSM the literature search was set up in collaboration with Letizia Sampaolo from the Department of Servizio Conoscenza e Communicazione at the ISS, searching the databases Pubmed, HCAplus, EMBASE, Toxcenter, Scisearch and Biosis. Subsequently, in a field visit in Mantua, the task allocation and the methodology used for the data collection and analysis were discussed. Furthermore, the criteria for the search of the ENEA mortality database were determined. In the third phase, I went to the ENEA research center and searched the ENEA mortality database with the help of Raffaella Uccelli, using probabilistic linkage of the database entries and cohort participants. This was done in two steps, as additional information was retrieved on participants by Paola Ballotari from the Epidemiological Observatory in Mantua, that were not identified in the first round e.g. municipality of death or last residence. In the final stage of the STSM the extraction of the relevant studies from the literature search, the preparations for the report and further collaborations were done.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

During this STSM a literature search was done in different databases to identify studies on residential cohort studies around industrially contaminated sites from petrochemical- or chemical industry or incinerators. For this purpose, two search strategies were employed, i) using keywords identified previously by the Unit of Environmental and Social Epidemiology and ii) a broader search with the terms ((residential cohort study) AND (industrial OR industry OR (chemical industry))), to find all relevant studies. This strategy resulted in 91 entries in the first search and 182 entries in the second search (data of search: 03.09.2018). Studies on occupational exposures, without residential cohort design, assessing asbestos exposure or mining, were excluded, which resulted in a total of 20 relevant studies (Appendix).

The mortality database search at the ENEA research center for the 449 participants with missing cause of death resulted in a successful linkage of 67%, based on date of birth, date of death, gender and last residence. This percentage could be increased to 75% after a second search, making use of additional information on an updated last residence or municipality of death, retrieved from the cohort databased held by the Epidemiological Observatory, Valpadana Territorial Health Agency in Mantua.

FUTURE COLLABORATIONS (if applicable)

(max.500 words)

This project will result in future collaboration between the Cyprus International Institute for Environmental and Public Health, at the Cyprus University of Technology and the Unit of Environmental and Social Epidemiology of the Department of Environmental Health of Istituto Superiore di Sanità (ISS) in the form of the preparation of a scientific publication of the results of this study and beyond.

APPENDIX

References identified in the literature search

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SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: IS1408
STSM title: Air pollution exposure assessment approaches
STSM start and end date: 14/01/2019 to 18/01/2019
Grantee name: Roberta Valentina Gagliardi

PURPOSE OF THE STSM:

The Institute for Risk Assessment Sciences (IRAS) of Utrecht University is a leading Institution in the field of the environmental epidemiology and exposure assessment in general,and specifically in thr case of Industrially Contaminated Sites and Health.
The STSM has been scheduled in order to deepen the knowledge on the most advanced methodological approaches concerning air pollution exposure assessment, to be applied in the oil and gas productive area of the Agri Valley (Basilicata Region –Italy). This area, in fact, currently houses one of the biggest onshore European reservoir (crude oil and gas) and the largest existing oil/gas pre-treatment plant in a populated area. In this context, an appropriate exposure assessment to environmental factors associated to oil and gas extraction activitities assumes a key role in any epidemiological or risk assessment study to be carried out in the area.
Whithin the STSM have been analysed main scientific results currently available for the examined area.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

During the STSM, daily meetings with the Dr G. Hoek and Dr. K. De Hoogh have been arranged to discuss several issues concerning the design of an appropriate study of exposure assessment.
The first day has been dedicated to the presentation of the study object. Preliminary information concerning the area at study has been illustrated concerning, respectively:

- main features territory's,
- population involved,
- type of industrial process
- research activities already carried out, ongoing or planned in the examined area.

Subsequently, to better define the characteristics of the site, the following items have been analyzed in greater detail:
the plant emissions (both conveyed and fugitive emissions);
the main markers of the industrial process, namely SO_2, NO_2, H_2S, VOCs;
the results of some air dispersion modelling activity already realized in the area, as well as the potential impact areas associated to the oil/gas pre-treatment plant emissions;
the monitoring activity on air pollution performed by the Regional Environmental Protection Agency around the oil/gas pre-treatment plant, through a network of fixed monitoring stations, a network of passive devices, a mobile laboratory.
An in-depth analysis on the air pollution data was done to compare two closing period of the plant (each of 4 months) with the normal operating period, in order to highlight significant changes in the plant's emission regime.

Moreover, a further analysis has been done to compare H_2S concentration data obtained by the passive systems network with those obtained by the fixed monitoring stations network.
During the STSM I also had the opportunity to attend a seminar on “Pneumonia among Dutch residents living near livestock farms – Analysis over 2014-2016”, as well as to see the mobile laboratories of IRAS equipped to monitor the urban air pollution.

The final stage of the STSM has been dedicated to discuss potential solutions to be adopted in an air pollution exposure assessment in the Agri Valley and the key points to take into account for the preparations of the final report.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

The work done allowed highlighting some criticalities in the available data on the air pollution of the Agri Valley, as well as main gaps to be filled in order to be able to carry out an effective air pollution exposure assessment in the area. Both Dr. Hoek and Dr. De Hoogh provided many interesting and valuable comments. On this basis, the following suggestions have been identified.
First of all, the need of an air dispersion modelling activity to evaluate areas with greater / less impact around the oil/gas pre-trea tment plant, as well as a background point, taking into account the current plant layout and the declared emission fluxes.
Then, the main markers of the industrial processes which takes place in the oil/gas pre-treatment plant (i.e. SO_2, NO_2, H_2S, VOCs) should be monitored through a network of passive devices, suitably arranged so as to identify any spatial gradients.
Passive devices should be placed at least in the two Municipalities closest to the oil / gas pre-treatment plant and between them and the plant; any other municipalities potentially affected by the emissions of pollutants due to the oil / gas pre-treatment plant should be preliminarily identified on the basis of the results obtained through the air dispersion model.
The duration of the sampling activity should last at least one year to highlight any seasonal component in the pollutants concentration trends.
Moreover, it would be desirable to carry out some joint measurements campaigns both with passive devices and a with mobile laboratory, in order to obtain an increased spatial and temporal resolution in the data.

FUTURE COLLABORATIONS (if applicable)

This STSM could hopefully contribute to a future collaboration between the Department of Environmental Health of Istituto Superiore di Sanità (ISS) and the the Institute for Risk Assessment Sciences (IRAS) of Utrecht University.