HEIMTSA

Health and **E**nvironment **I**ntegrated **M**ethodology
and **T**oolbox for **S**cenario **A**ssessment

Newsletter No. 6

Contents

Overview

Fintan Hurley, Institute of Occupational Medicine (IOM), Scotland/UK

HEIMTSA, and its sister projects INTARESE (www.intarese.org) and 2-FUN (www.2-fun.org) all finish at the end of January 2011. This is a busy time as we work to complete the many linked tasks of the projects separately and together. Things are taking shape well, and this final Newsletter is a brief overview of some of the main outcomes of HEIMTSA itself and its collaboration with INTARESE especially, and with 2-FUN also.

HEIMTSA set out to develop and extend methods of Integrated Environmental Health Impact Assessment (IEHIA), to provide worked examples of their use, to provide tools, and to build capacity. There are currently four main areas of scientific activity linked with these original aims; most of them now are joint activities with INTARESE:

1. **Common Case Study** - we are close to finishing the Common Case Study of the environmental health effects of EU policies designed to limit greenhouse gas emissions in Europe and to adapt to global warming. This is a very big undertaking, spanning policies in several sectors, including energy, transport, and agriculture; and covering health effects of many different pollutants. It is the most comprehensive worked example of HEIMTSA and INTARESE, and builds on the many project-specific case studies.

2. **Underlying methodology** - this is being written up in the many Deliverable reports of HEIMTSA (and of INTARESE); again, as far as practicable, these are being developed as a unified activity.

3. **Toolbox** - there is still a lot of activity on the Toolbox. The Guidance System and a Toolkit are being developed principally by INTARESE, and the Computational System/Platform principally by HEIMTSA. Both are described in more detail in this Newsletter. Together they provide information about the purpose and methods of IEHIA, they give access to particular datasets, models and other tools, and they provide an environment for the detailed and complex linked computations of a full analysis.

The Toolbox is best looked on as a work-in-progress; well enough developed to be useful and used, but with a need to incorporate further developments in the months and years ahead. We are currently looking to see how best to keep it alive and up-to-date as a well-maintained going concern.

4. **Dissemination** - we are actively involved in dissemination events, including the end-of-project meetings in Brussels in late January, and planning further ones through 2011 and beyond.

In addition, there are management and other associated reports to provide to the European Commission.

All in all, it's been an interesting and busy four years. I thank the HEIMTSA project team for its excellent work, and I thank also INTARESE and 2-FUN, the Advisory Board and the many others with whom we have worked closely. It's been a pleasure and a privilege to work with so many excellent scientists from a wide range of disciplines.

We are all indebted to the Commission for this opportunity to work in a sustained way on IEHIA methods and tools.

And finally, I thank you, the Newsletter readers, and all others who will engage with some or all of our work, for your interest – please let us know what you think, as you use the work we have done, because that will be the best test of its value.

Fintan Hurley
Project co-ordinator

Integrated Environmental Health Impact Assessment System (IEHIAS)

Joachim Roos, University of Stuttgart, Germany

The Integrated Environmental Health Impact Assessment System (IEHIAS) is one of the main outcomes and legacies of the HEIMTSA and INTARESE projects.

Its purpose is to collect the results of the projects and provide users with information about environmental health impact assessment. Therefore, the IEHIAS conveys the methods developed and enhanced in the projects as well as details on resources such as models, tools and data to the users. Additionally, the IEHIAS contains assessment reports as examples of the application of the methods.

This large amount of content requires structuring to enable the users to quickly find and access the desired information. Based on the information needs, three main user groups for the IEHIAS have been identified. These groups are assessors, policy makers and students and other interested people.

It is quite obvious that the information needs of these groups differ greatly, as assessors plan to carry out their own assessments and need very detailed information on certain parts of the assessment, policy makers are looking for information on opportunities and limits associated with the methodologies, whereas interested people might more need a basic introduction to the topic.

IEHIAS provides structured information for all these user groups. It consists of an introductory part, providing overview information on integrated environmental health impact assessment; the so-called "Guidance System", containing the methodology and last but not least the "Toolkit", which provides the user with detailed information on models, tools and other resources.The structure of the Guidance System follows the four consecutive phases of conducting an assessment – issue framing, design, execution and appraisal – to make the information needed for each step easily accessible.

If you are, for example, planning to conduct an assessment, the purpose of the assessment is to answer certain questions. A question to be answered might be:"How high are the health impacts of increasing the fuel tax for transport?". As this question is ambiguous, it cannot yet form the basis for an assessment, but has to be refined in a clear and structured way. The issue framing part of the Guidance System contains information on how this can be done. Further into the assessment, information on modeling the causal chain or impact pathway might be needed – this kind of information can be found in the execution part of the Guidance System.

Last but not least, the Toolkit comprises model and data fact sheets and examples for applied methods. Assuming that the question mentioned above has been more clearly defined as "How high are the impacts on human health in Europe of increasing the fuel tax for transport by 10 cent/l in the year 2020?" during the issue framing process, emission scenarios have to be generated. Using the Toolkit, a model capable of creating such emission scenarios can easily be found, as the models were arranged in different browseable categories. These scenarios can in turn form the input for a full chain model to calculate the impacts on human health. Needless to say that the Toolkit also contains information on full chain models.

Fig.1: Guidelines and Toolbox for Integrated Environment and Health Impact Assessment at www.integrated-assessment.eu

Computational System in the IEHIAS – 'HEIMTSA Toolbox'

Denis Sarigiannis, University of Thessaloniki, GR & Alberto Gotti, JRC, Ispra, IT

The HEIMTSA platform (http://heimtsa.jrc.ec.europa.eu/heimtsatb/) **is the computational environment that brings together the different tools available from the HEIMTSA consortium addressing all the aspects of the full chain for health impact assessment of Community policies.**

The platform allows the execution of complex calculations serving the needs of integrated health impact assessment of environment-related stressors and policies.

The platform consists of an integrated set of stand-alone ('loosely-coupled') modules, designed to link together seamlessly, in order to demonstrate the impact of a range of policies on health. This system covers emissions of all relevant substances into air, water and soil, the transmission and chemical transformation of these substances across all environmental media, and includes indoor air quality and road traffic noise as key stressors as well. The platform closely links models and datasets for an integrated, cross-media impact assessment, implementing the assessment chain for a first time covering the full impact pathway. This closely-coupled modelling system allows for a full exploration of trade-offs and synergies of individual policy options and provides at the same time flexibility for the evaluation of different variations of policy options

The models are operated as a distributed system, run and maintained by the model developers. The individual modules are linked via fast internet based data exchange protocols (e.g. implementing GRID FTP). The platform has been built in order to allow the user to execute each step from emission to monetary valuation or to execute one single part (e.g. from concentration to exposure) or to skip one or more parts (e.g. directly from concentration to health impact).

Results are reported and presented in innovative ways, through the visualization module, including the generation of maps that describe the spatial distribution of health impacts and the presentation of the distribution of impacts on different groups of the population. This module, accessible to the user from the GUI of HEIMTSA platform, allows the user to process spatial data stored in the HEIMTSA Db coming from each step of the full-chain and to visualize the results using Web application client with geo-processing services. This module performs basic interactive functionalities for visualizing geospatial data as well as for carrying out deeper analysis of the data through specific services.

After the registration procedure every user accessing the platform can launch an execution but before it starts one of the platform administrators has approve it (Figure 2).

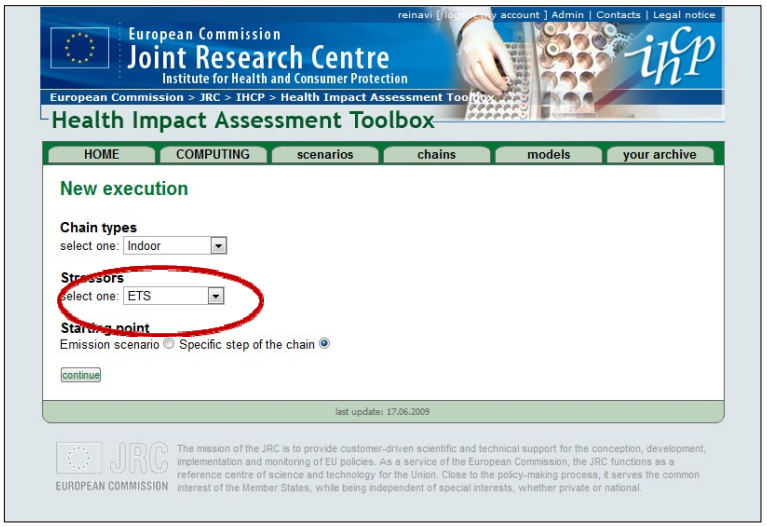

Fig. 2: Guided procedure for the execution of a chain

For each step already executed of the full-chain the user can download the output files generated and, when available, invoke the visualization module to see on a GIS environment the results obtained (Figure 3). All the information about an execution is stored into the database of the platform and all the input/output files of the models are stored into the server file system.

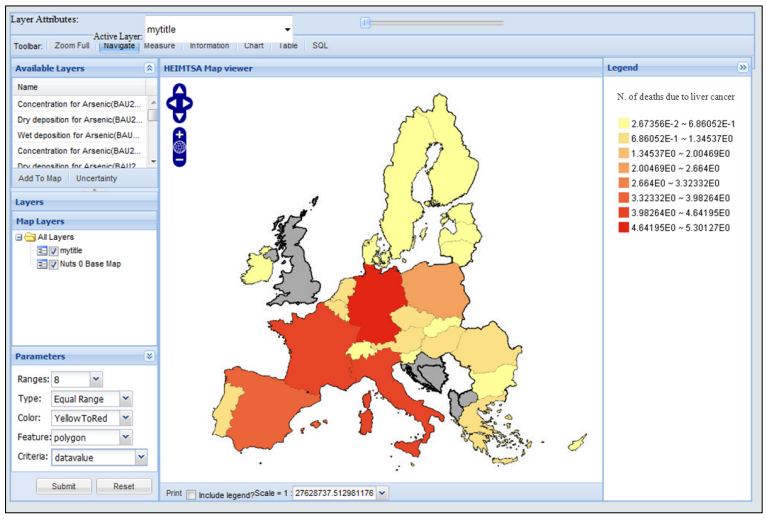

Fig. 3: Spatial distribution of mortality due to liver cancer associated to Arsenic exposure over Europe in 2020 (BAU Emission Scenario).

Estimating Health Impacts in the Common Case Study

Hilary Cowie, Amy Shafrir, Fintan Hurley, Brian Miller, IOM, Scotland/UK

Within the HEIMTSA-INTARESE full chain methodology, estimation of health impacts follows assessment of exposure scenarios-baseline, and alternative taking account of the policies being evaluated. Methods for linking exposures with health differ according to whether risk estimates come from epidemiology or toxicology. The Common Case Study (CCS) includes numerous environmental risk factors, including outdoor air, indoor air, noise, pesticides and POPs, and so it uses both approaches. For most of these pollutants causal relationships with health are established; at issue is the size of the policy-attributable health effects in the EU-wide target population of the CCS.

This short article summarises how the epidemiological approach was implemented in the CCS, with special reference to the most influential pathway: the effects on mortality of long-term exposure to fine respirable particles ($PM_{2.5}$), which is particularly complex methodologically.

One key element is the exposure-(or concentration-)response function (ERF), usually expressed as % change per unit exposure in the risk of disease or other health effect (e.g. minor physical symptoms, hospital admissions, death). ERFs used in the CCS followed detailed epidemiological review, often including meta-analysis of results across several studies, and drawing on evaluations of established expert groups. Uncertainty was typically expressed via confidence intervals, but sometimes included expert elicitation to capture, for example, transferability of ERFs between populations. Sometimes conversion factors were needed so that exposure estimation and ERFs used the same exposure metric.

For mortality and annual average $PM_{2.5}$ both HEIMTSA (detailed epidemiological review) and INTARESE (review and meta-analysis) independently endorsed a risk estimate of 6% increase in mortality hazard (95% CI 2-11%) per 10μg/m^3 $PM_{2.5}$ previously used in the EU CAFE and other policy applications.

Sources of background rates (incidence or prevalence) across the EU for the identified health outcomes were reviewed. Routinely collected mortality data by age and sex were easily available; background rates for most other health effects required extrapolation from individual countries or specific studies. Care and judgement were needed to ensure that ERFs and background rates used consistent definitions of the same health effect.

ERFs and background rates were linked to provide a set of impact functions, typically expressed as the number of additional cases per year per unit exposure per 100,000 population. Sometimes this was simple; more usually some processing and judgement were needed, for consistency in time resolution or sub-population, including adjusting background rates to apply to the unexposed population only.

Mortality from long-term exposure to $PM_{2.5}$ presented particular difficulties, because changes in mortality risks affect population size and age distribution over time. Using life table methods to take account of these population dynamic aspects, we estimated the long-term impact, in life-years, of a 1-year reduction in 2010 of 1μg/m^3 annual average $PM_{2.5}$.

Analyses in England and Wales, Italy and Sweden gave consistent results over countries and sexes; a weighted average of 95.3 life years per 1μg/m^3 $PM_{2.5}$ per 100,000 population aged 30+ was used for Western Europe. Impacts for Poland were somewhat higher, with a corresponding value of 125.5 life years used for Eastern European countries.

Monetisation of Health Outcomes

Alistair Hunt, University of Bath, UK

The full-chain approach to health impact assessment that has been used in HEIMTSA allows for the aggregation, in monetary terms, of the disparate health end-points resulting from pollution. Use of the money metric is designed to capture people's personal preferences in relation to the health end-points. Thus, the common measure is of the individual's willingness to pay (WTP) to avoid a specific health condition. Whilst there is a pre-existing body of work, the breadth of the coverage of environmental media in HEIMTSA has necessitated both a re-evaluation of existing unit value estimates and an expansion of the number of end-point unit values required.

Table 1 presents a summary of the unit values derived in the course of the HEIMTSA project. These values are the result of both an evaluation of the evidence available in the existing literature and new empirical research undertaken in the project. For each health end-point, the unit values are identified on the basis of an informal meta-analysis of the evidence, accounting for the distribution of available values and an assessment of the quality and geographical focus of each study. Thus, studies whose results converge on modal values, which use state-of-the-art non-market valuation techniques, and that are undertaken within the EU, are given greater weight in determining the range of values for each health end-point. It is obvious from the values presented in Table 1, and specifically the range of values associated with a number of the end-points, that there is considerable uncertainty in health valuation. For example, for valuation of life-years and neuro-developmental disorders, there is a difference between low and high estimates of factors of 5 and 8, respectively. In cases such as for anaemia, there is insufficient evidence even to provide a range. The uncertainty derives from a combination of the paucity of the evidence base, the difficulty that people have with identifying their preferences for (avoidance of) health conditions, and the lack of maturity in the study methods themselves. Thus, in the instance of valuing avoidance of the risks of premature death, methods are only now being developed that successfully communicate to survey respondents the small changes in risk that tighter environmental regulation would result in. For example, computer graphics allow such information to be presented in a variety of ways, often with an accompanying voice-over.

The uncertainty presents a challenge in the use of such values though sophisticated modelling approaches such as Monte Carlo Analysis lend themselves to the treatment of this uncertainty. Such approaches are likely to be equally necessary in dealing with the uncertainty attendant in preceding stages of the full-chain approach. It is also worth emphasising that the HEIMTSA project has afforded the first attempt at monetising a more complete range of health impacts. In so doing, it has served to establish a baseline for health impact assessment to work with from now, and highlights where the gaps are for future empirical research.

Health End-Point	Low	Central	High
Sleep disturbance	400	1,045	1,320
Hypertension	740	800	930
Acute myocardial infarction	2,200	4,470	31,660
Increased mortality risk (infants)	1,384,900	3,777,000	3,777,000
New cases of chronic bronchitis	-	251,800	-
Increased mortality risk - VSLacute	944,250	1,384,900	4,721,250
Life expectancy reduction - Value of Life Years	50,360	75,540	180,040
Respiratory hospital admissions	2,520	4,785	6,800
Cardiac hospital admissions	2,520	4,785	6,800
Work loss days (WLD)	-	370	-
Restricted activity days (RADs)	-	165	-
Minor restricted activity days (MRAD)	-	50	-
Lower respiratory symptoms	-	50	-
LRS excluding cough	-	50	-
Cough days	-	50	-
Medication use / bronchodilator use	-	1	-
Lung cancer	58,170	605,580	3,526,210
Leukaemia	1,722,310	3,346,420	5,990,320
Neuro-development disorders	3,780	12,590	27,700
Skin cancer	9,220	11,710	22,540
Osteoporosis	2,520	4,785	6,800
Renal dysfunction	19,190	25,600	34,500
Anaemia	-	630	-

Table 1: Summary of Monetary Values relating to specific health end-points (€, 2010)

Portrait of a Young Scientist – Lydia Gerharz

University of Münster, Germany

Lydia is the last one in our series about young scientists who has the opportunity to be portrayed in the HEIMTSA newsletter.

Thank you for this interview at short notice, Lydia. As always, we begin with your education. What is your background?

In 2007 I received a diploma in Landscape Ecology with majors in Atmospheric Sciences, Chemistry and Geoinformatics at the University of Münster.

And afterwards you stayed at the University of Münster?

Yes, subsequent to my diploma I began with my PhD in combination with a position as research assistant at the Institute for Geoinformatics.

In this context, what are you working on?

I am involved in the HEIMTSA project until its finalisation end of January 2011. From February this year on I will be working on UncertWeb, a 7th FP EU project about the uncertainty enabled model web.

What was/is your role in the HEIMTSA project?

First, I was involved in WP1.3, working on uncertainty visualization (project year 2 & 3). During the last two years, I have been contributing to WP2.1 & WP5.3, still working on the development of a tool (LAMA – TooL for Air Pollution Exposure Modelling & Assessment; see HEIMTSA Newsletter 5) for air pollution exposure modelling in the Common Case Study that has been developed jointly with HEIMTSA's 'sister' project INTARESE.

HEIMTSA is finishing soon. Looking back, what have you been learning during the course of the project?

A lot ☺. I think the most important lesson was to learn how complicated it can be to work with a large group of researchers, but also how to manage work in smaller, more focussed groups. And how important it is to start with realising small pieces to reach a larger goal (e.g. in HEIMTSA the full chain vision but also my PhD).

Can you share with us the experience you made as young scientist in the research community?

I have made very different experiences. I think I started, like other young scientists in the research community, with a rather enthusiastic attitude, eager to begin working – but sometimes it is disappointing to realise that long discussions are usually part of research before the actual work can start. Generally I found a lot of support from more experienced scientists, which was very helpful.

And what were your experiences as young woman in the research community?

So far, I made only positive experiences. I never felt treated differently than male colleagues. But I also have to say that nowadays there is a large proportion of young female researchers, so actually I never felt like it's something special to be a woman in research.

Do you have any role models?

I admire people that work hard and still manage to have enough time for both family and work. And I think the key in research is with growing work experience and daily routine to stay creative and open-minded.

And last, but not least, what are your future plans?

Finishing my PhD soon!

Lydia, thank you very much for this interview, and success with the finalization of your PhD!

Upcoming events

20-21 January 2011
Final HEIMTSA, INTARESE, 2-FUN meeting
Brussels, Belgium

25 January 2011
Introductory Workshop on Integrated Environmental Health Impact Assessment (IEHIA)
Brussels, Belgium
http://ec.europa.eu/health/risk_assessment/events/ev_20110126_preconference_en.htm#fullwidth

26-28 January 2011
2nd International Conference on Risk Assessment "Global Risk Assessment Dialogue"
Brussels, Belgium
http://ec.europa.eu/health/risk_assessment/events/ev_20110126_en.htm#fullwidth

06-09 February 2011
Environmental Health 2011
Salvador, Brazil
http://www.environmentalhealthconference.com

15-16 March 2011
Food Safety Workshop 'Endocrine Disruptive Effects of Pesticides from Low Dose Exposure: Evidence for Non-Monotonic Dose Response Curves?'
Brussels, Belgium

14-15 April 2011
XI HIA International Conference
Andalusian School of Public Health, Granada, Spain
http://www.hiainternationalconference.org/

18-19 May 2011
SETAC Europe & ISES joint special session: Emerging Exposure Science for developing Chemical Regulatory Policy: REACh, Biocides, TSCA reform
Milan, Italy
http://ises.setac.eu/?contentid=317

25-27 July 2011
Environmental Health Risks 2011
Riga, Latvia
http://www.wessex.ac.uk/11-conferences/environmentalhealthrisk-2011.html

13-16 September 2011
23rd International ISEE conference
Barcelona, Spain
http://www.isee2011.org/

Links to HEIMTSA's 'sister' projects:

INTARESE
INTegrated **A**ssessment of Health **R**isks of **E**nvironmental **S**tressors in **E**urope
http://www.intarese.org/

2-FUN
Full-chain and **UN**certainty Approaches for Assessing Health Risks in **FU**ture E**N**vironmental Scenarios
http://www.2-fun.org/

Health and Environment Networking Portal
http://www.henvinet.eu

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