Esercizio pratico su calcolo degli attribuibili e DALYs

3 esempi

- Calcolo dei casi attribuibili su una città con dati da Internet
- Utilizzo di AIRQ+
- Sorgenti puntuali

Casi attribuibili

Formula generale per il calcolo dei casi attribuibili:

$$AC = AFexp * Ratepopgen * Popexp$$

dove:

AC = casi attribuibili;
AFexp = frazione attribuibile negli esposti (RR – 1) / RR;
Ratepopgen = tassi di malattia di background nella popolazione (proxy of rate in unexposed people)
Popexp = popolazione esposta

Esposti
Vs
Non esposti

$$AC = AFexp * Ratepopgen *(\Delta C/10)*Pop_{exp}$$

dove :

ΔC / 10: incremento di concentrazione dell'inquinante per il quale si stima l'impatto (controfattuale).

Livelli differenti
di esposizione

DALYs

- Disability Adjusted Life Years

$$DALYs = AC * DW * L$$

where:

AC = attributable cases;

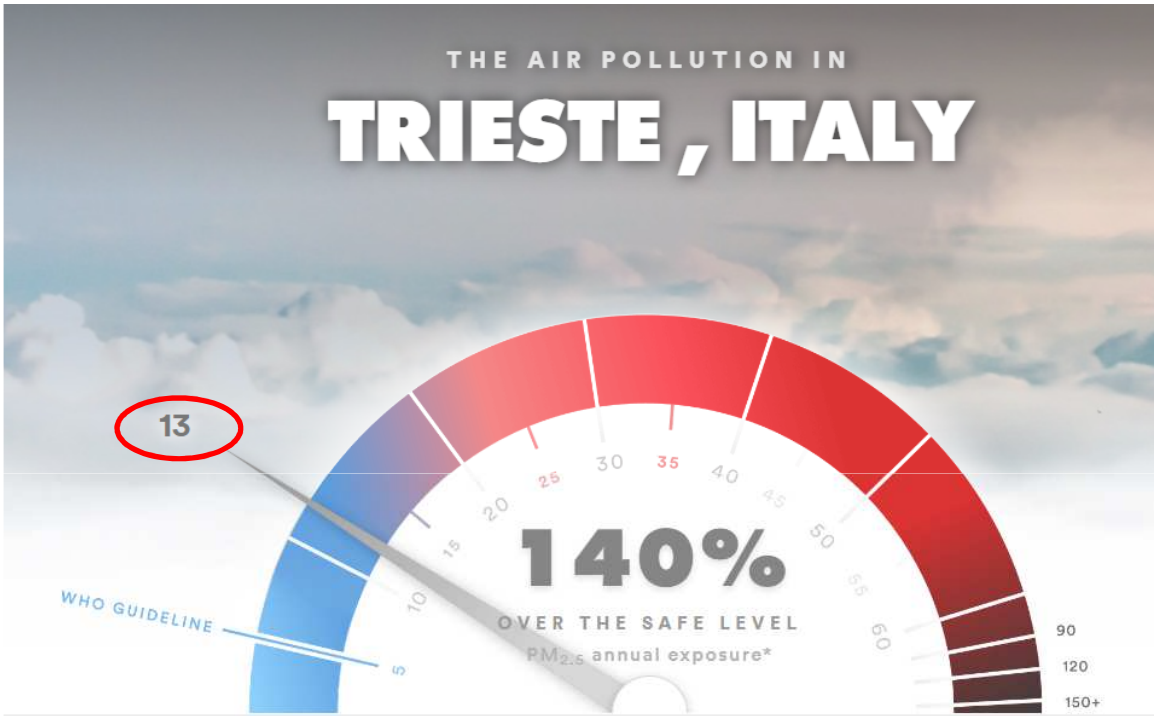
DW = Disability Weight

L = disease duration

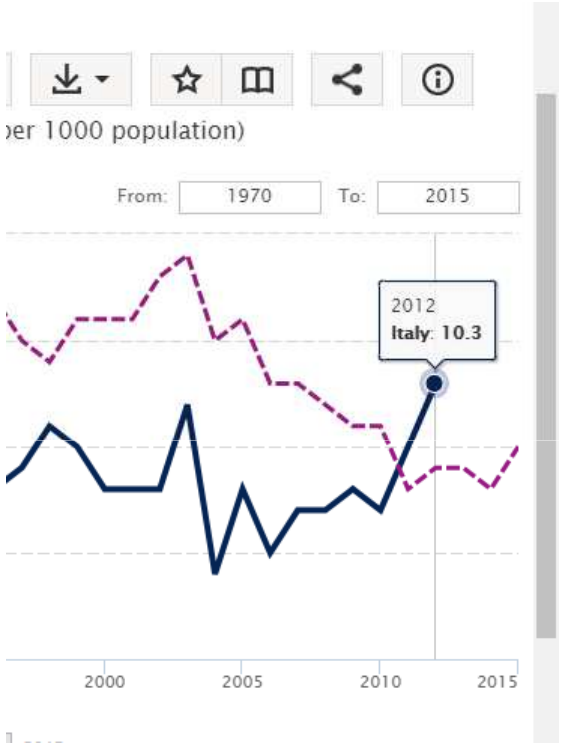
Mortality=1
Cancer=0.44/12.6 y
Respiratory symptoms=0.08
Low Birth Weight = 0.106/ 79.6 years
Congenital Anomalies = 0.17 / 79.6 years
Annoyance = 0.03

**source: Victorian Burden of Disease*

Stima “grossolana” di AC per Trieste



https://gateway.euro.who.int/en/hfa-explorer/



Popolazione: 205.000 (Wikipedia)

CRF: 1.08 (stima WHO per la mortalità naturale - 10 µg/m3 di incremento di PM2.5

$$AC = AFexp*B_0*(\Delta C/10)*P_{exp}$$

AC (Trieste)= ((1.08-1)/1.08)*(205000*0.0103) *((13-5)/10)*1=0.074*2112*0.8=125

5.9% della mortalità naturale

Air quality

- News
- Events
- Policy
- **Activities**
- Data and statistics
- Publications
- Partners
- Contact us

AirQ+: software tool for health risk assessment of air pollution

Quantifying the effects of exposure to air pollution in terms of public health has become a critical component in policy discussion. WHO/Europe's software tool AirQ+ performs calculations that allow quantification of the health effects of exposure to air pollution, including estimates of the reduction in life expectancy.

AirQ+ estimates:

- the effects of short-term changes in air pollution (based on risk estimates from time-series studies);
- the effects of long-term exposures (using life-tables approach and based on risk estimates from cohort studies).

AIRQ+

- AirQ+ can be used, with some limitations, for cities, countries or regions to estimate:
- How much of a particular health effect is attributable to selected air pollutants?
- Compared to the current scenario, what would be the change in health effects if air pollution levels changed in the future?

AIRQ+

- AirQ+ enables users to use pre-loaded datasets for:
- relative risks (RRs) for selected pollutant health end-points pairs;
- conversion factors between PM2.5 and PM10 at the national level; and worldwide solid fuel use statistics at the national level.

- AirQ+ requires users to load their own data for the population studied:
- Air quality (average levels or frequency of days with specific levels)
- Population (e.g., number of adults aged ≥ 30 years)
- Health (e.g., baseline rates of health outcomes)
- AirQ+ also enables users to load their own data for pollutants not included in AirQ+ if RRs are available

arpae
emilia-romagna

World Health Organization
REGIONAL OFFICE FOR Europe

AirQ+ 1.0 example of calculations

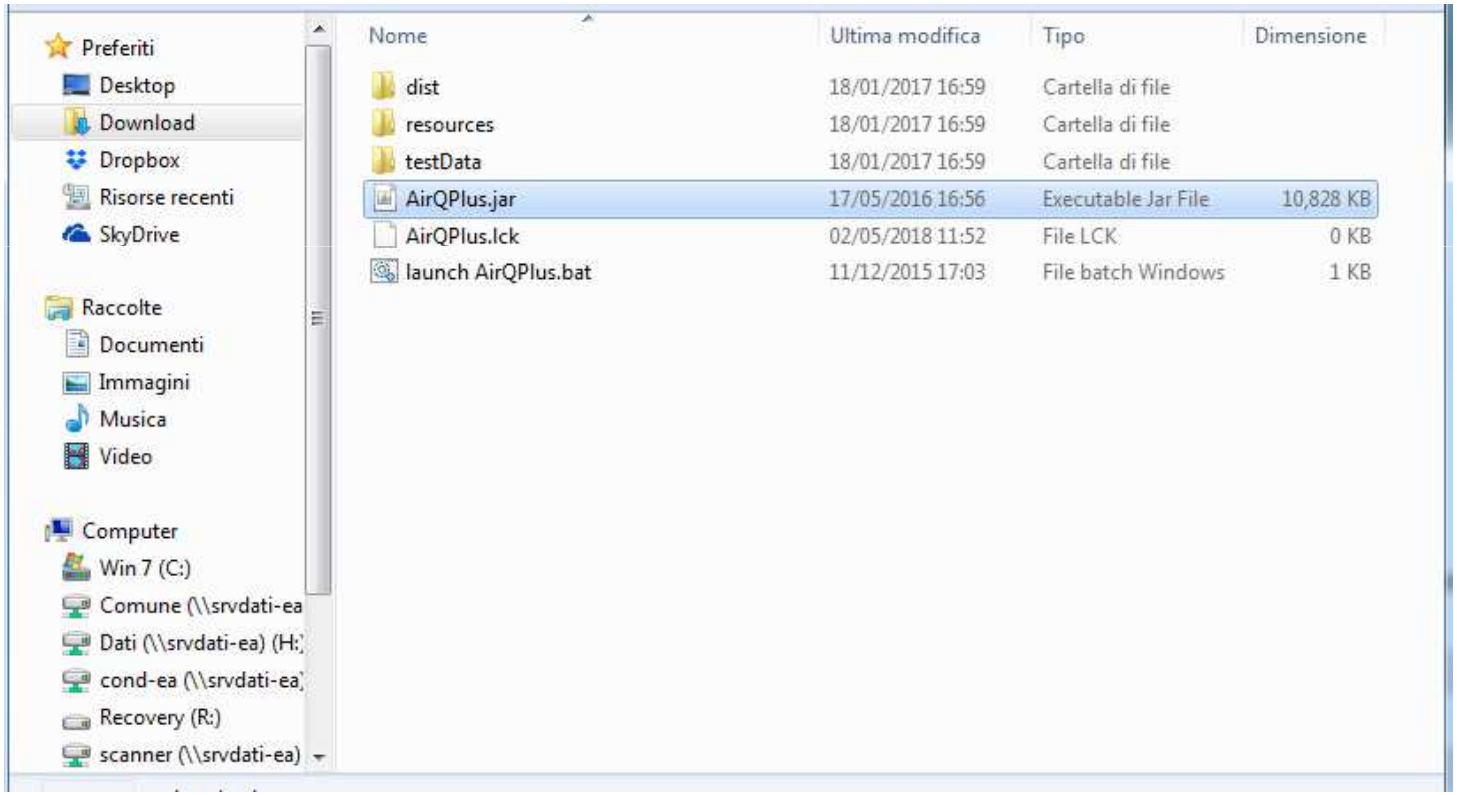
(April 2016)

Pierpaolo Mudu, Christian Gapp and Maria Dunbar

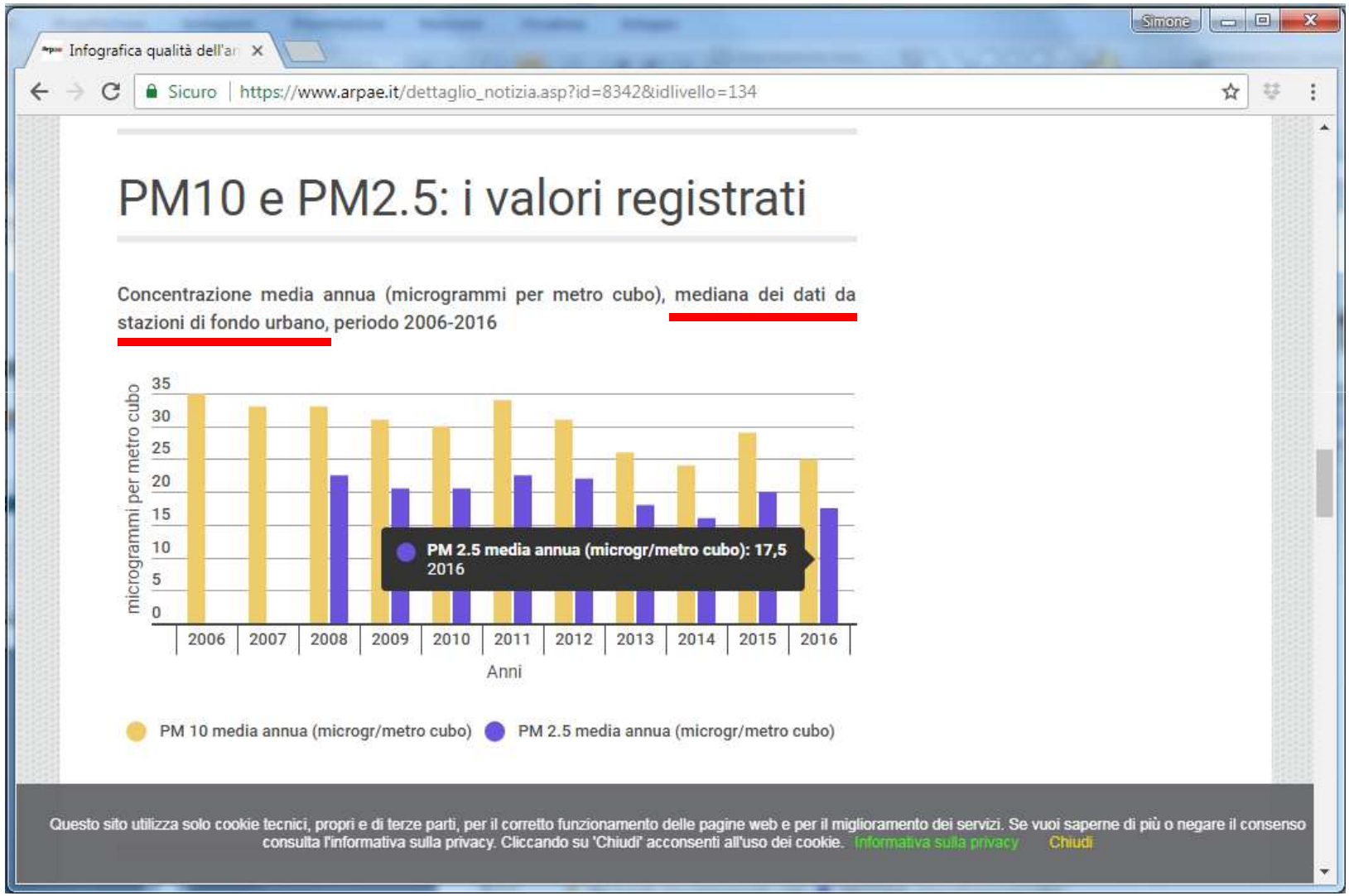
Contents

Installation of AirQ+

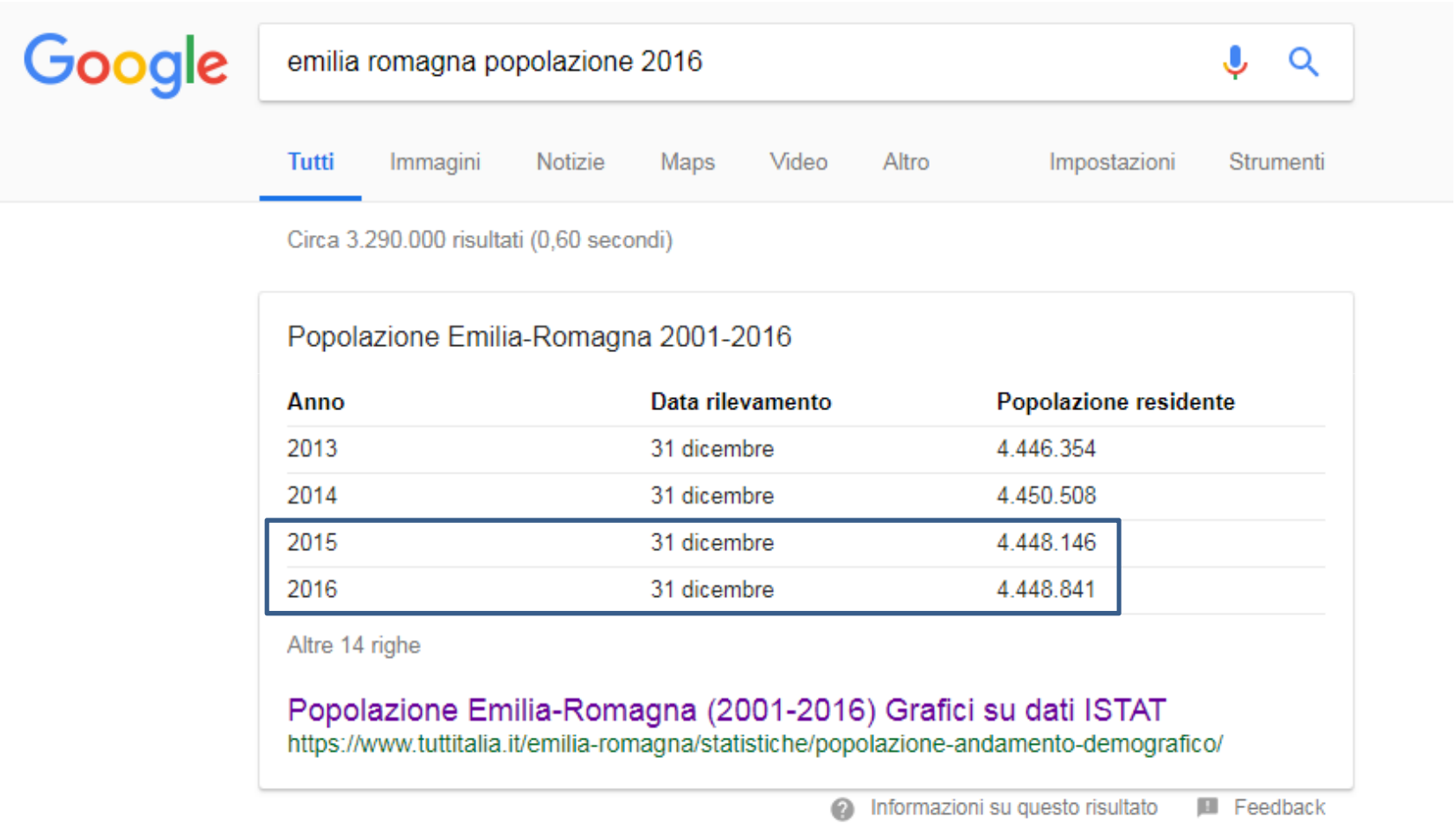
The AirQ+ files and folders are distributed in a compressed zip folder. There is no dedicated installation necessary. It is recommended to create a dedicated folder for AirQ+ on your local hard drive. All files must be copied to that folder without changing their names or relative location. The program can be started by double-clicking AirQPlus.jar.



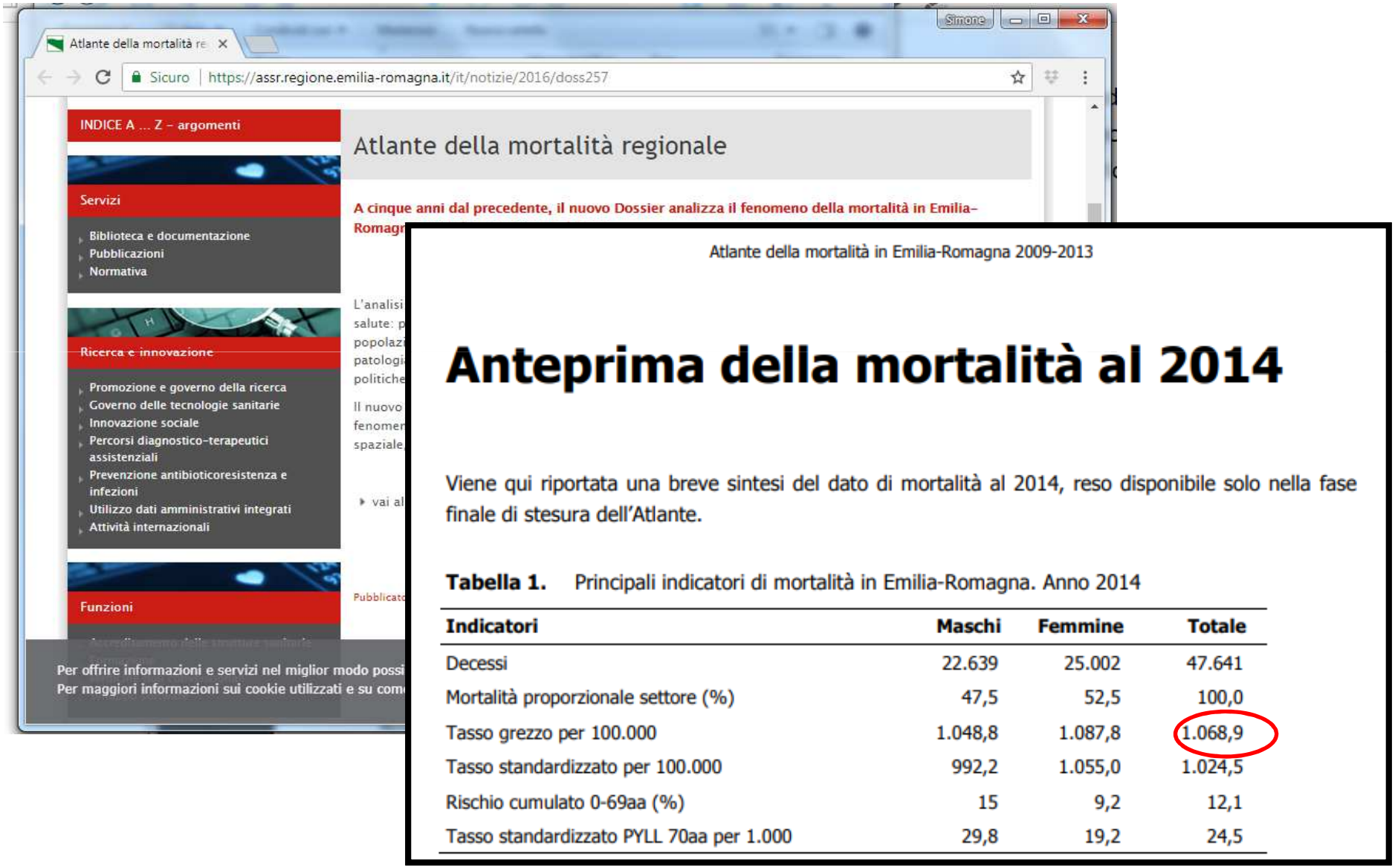
Dato di inquinamento

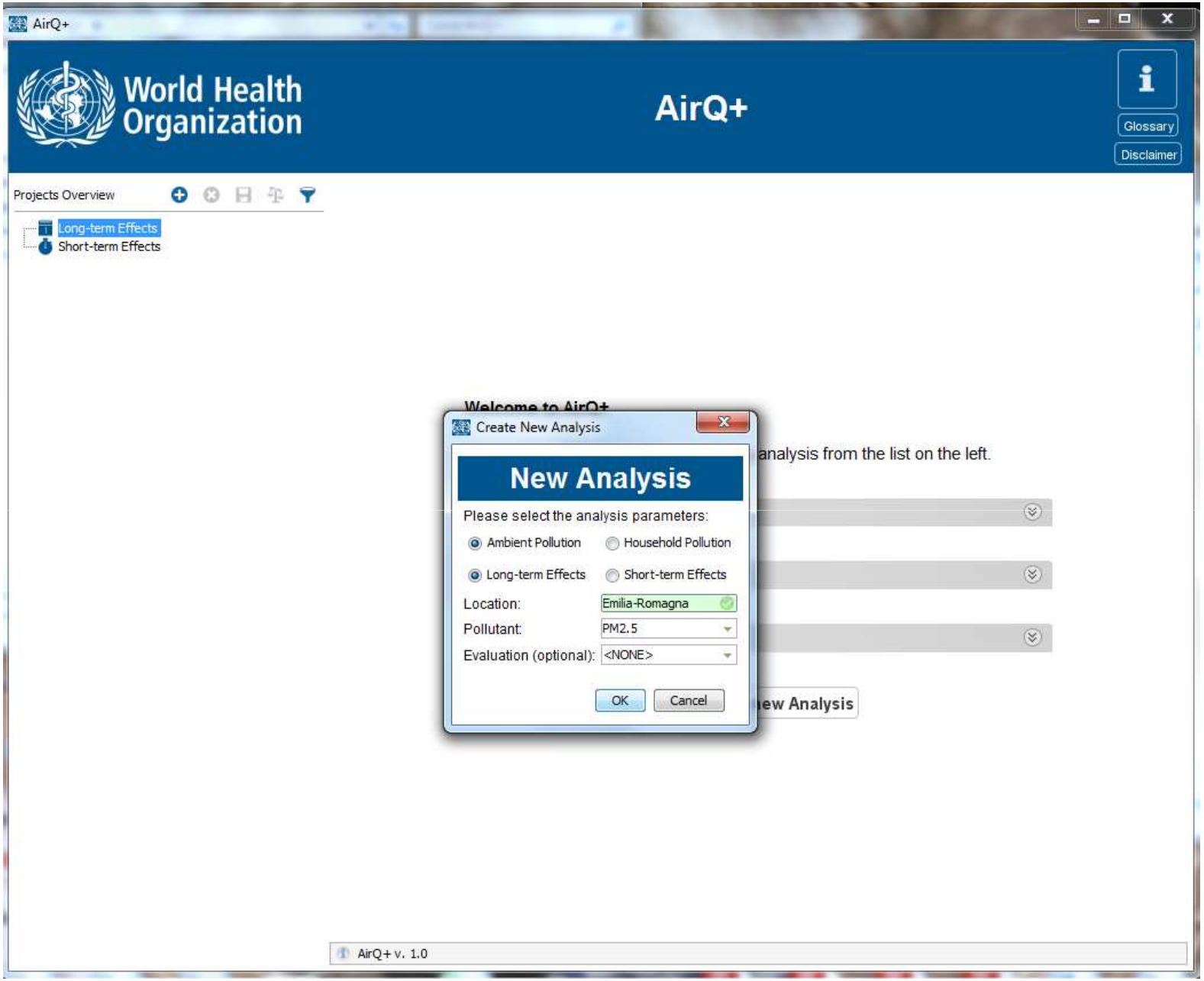


Popolazione



Tasso mortalità

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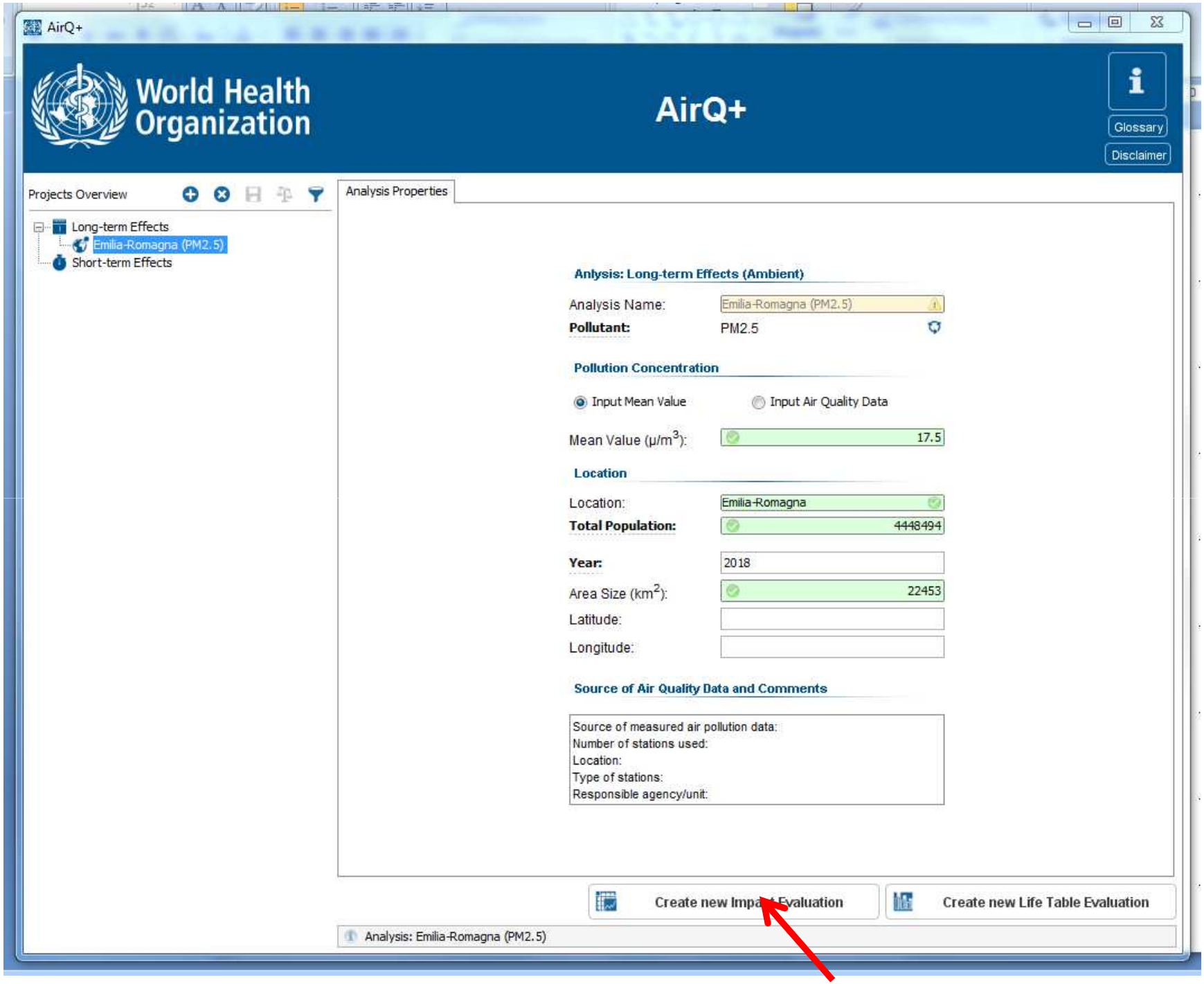
Long-term Effects
Short-term Effects
Welcome to AirQ+
analysis from the list on the left.
Create New Analysis
New Analysis
Please select the analysis parameters:
Ambient Pollution
Household Pollution
Long-term Effects
Short-term Effects
Location:
Emilia-Romagna
Pollutant:
PM2.5
Evaluation (optional):
<NONE>
OK
Cancel
ew Analysis
AirQ+ v. 1.0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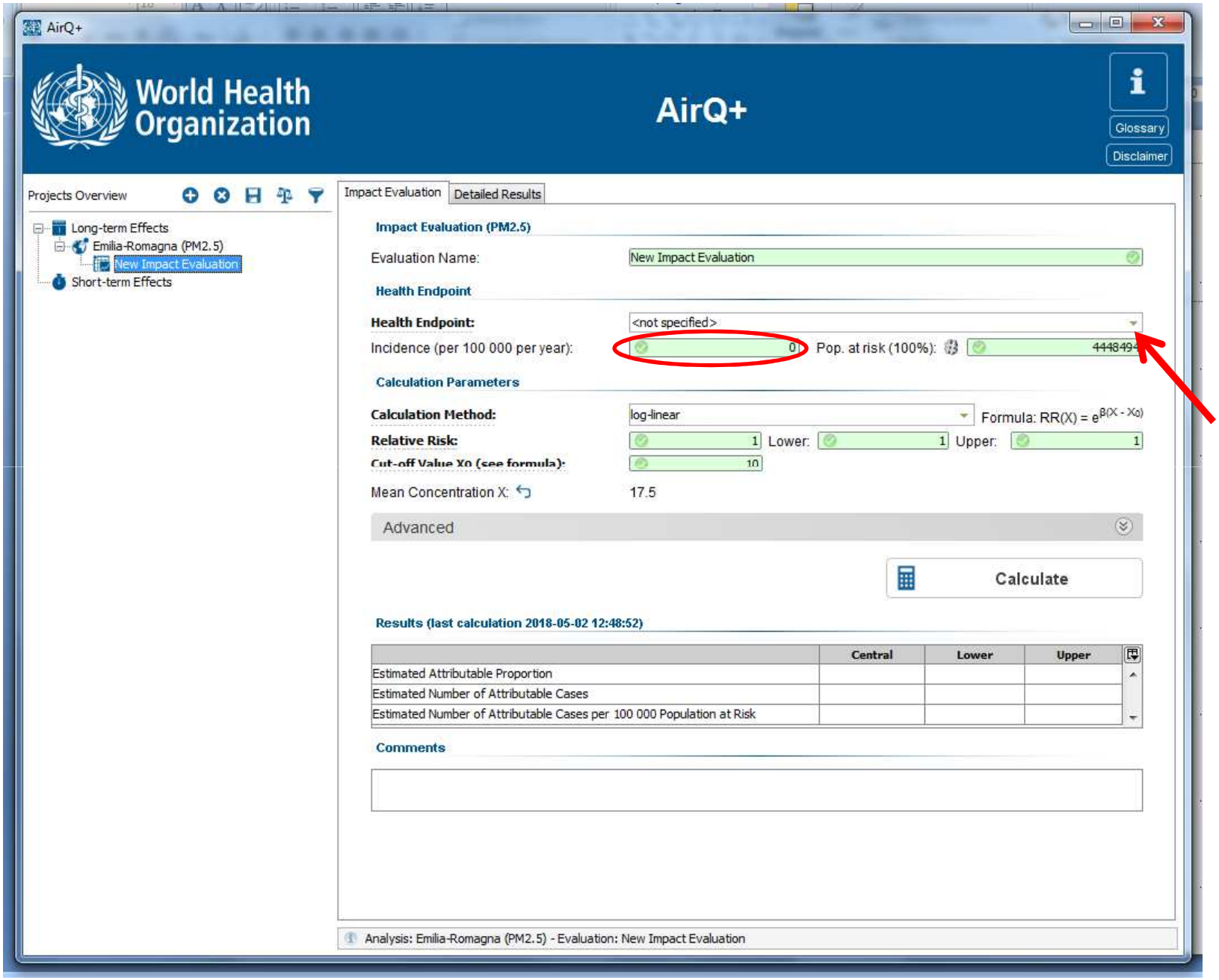
Emilia-Romagna (PM2.5)
Short-term Effects
Analysis Properties
Anlysis: Long-term Effects (Ambient)
Analysis Name:
Emilia-Romagna (PM2.5)
Pollutant:
PM2.5
Pollution Concentration
Input Mean Value
Input Air Quality Data
Mean Value (µ/m3):
17.5
Location
Location:
Emilia-Romagna
Total Population:
4448494
Year:
2018
Area Size (km2):
22453
Latitude:
Longitude:
Source of Air Quality Data and Comments
Source of measured air pollution data:
Number of stations used:
Location:
Type of stations:
Responsible agency/unit:
Create new Impact Evaluation
Create new Life Table Evaluation
Analysis: Emilia-Romagna (PM2.5)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Impact Evaluation
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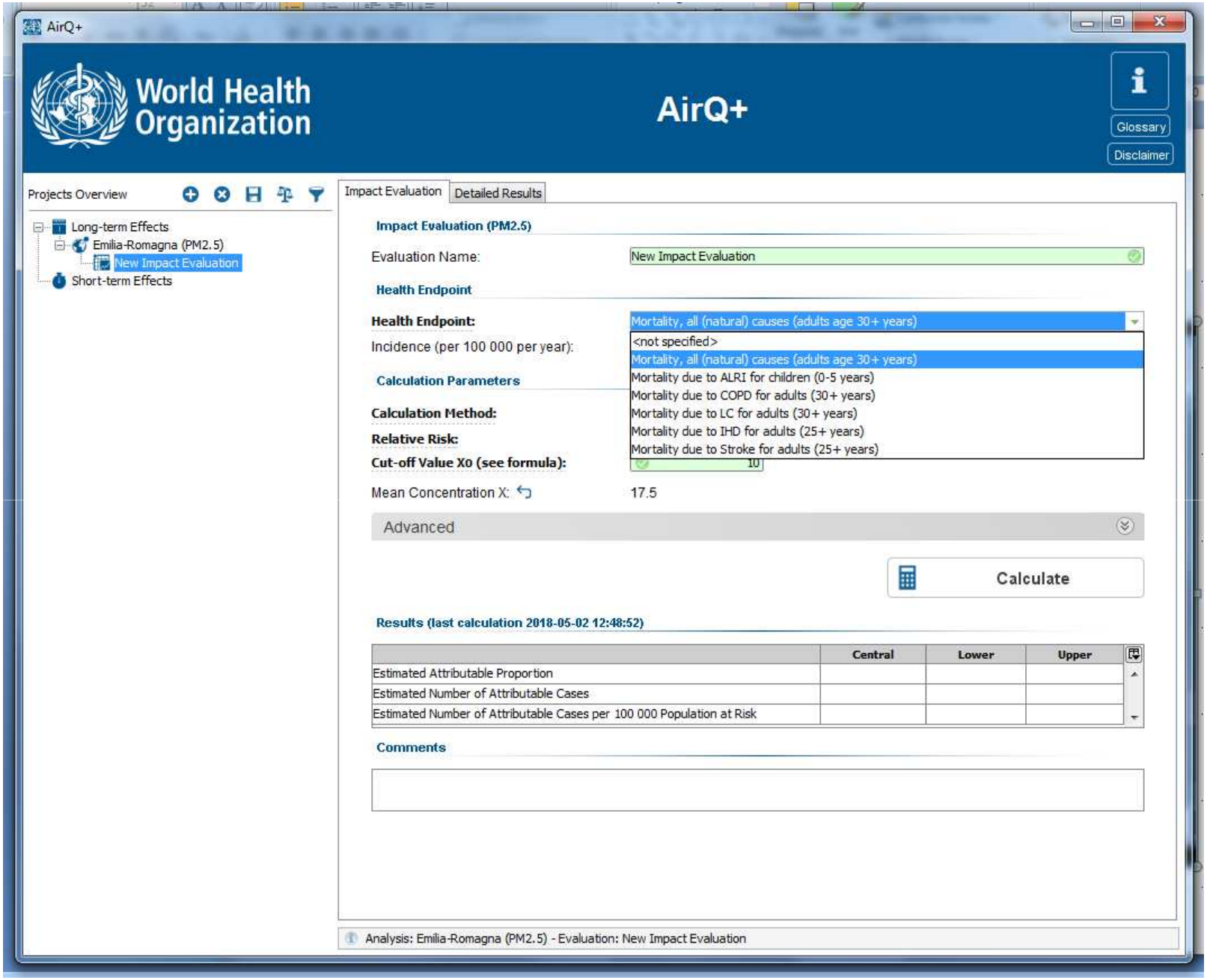
Impact Evaluation (PM2.5)
Evaluation Name:
New Impact Evaluation
Health Endpoint
Health Endpoint:
<not specified>
Incidence (per 100 000 per year):
0
Pop. at risk (100%):
Calculation Parameters
Calculation Method:
log-linear
Formula: RR(X) = e^β(X - X0)
Relative Risk:
1
Lower:
1
Upper:
1
Cut-off Value X0 (see formula):
10
Mean Concentration X:
17.5
Advanced
Calculate
Results (last calculation 2018-05-02 12:48:52)
Central
Lower
Upper
Estimated Attributable Proportion
Estimated Number of Attributable Cases
Estimated Number of Attributable Cases per 100 000 Population at Risk
Comments
Analysis: Emilia-Romagna (PM2.5) - Evaluation: New Impact Evaluation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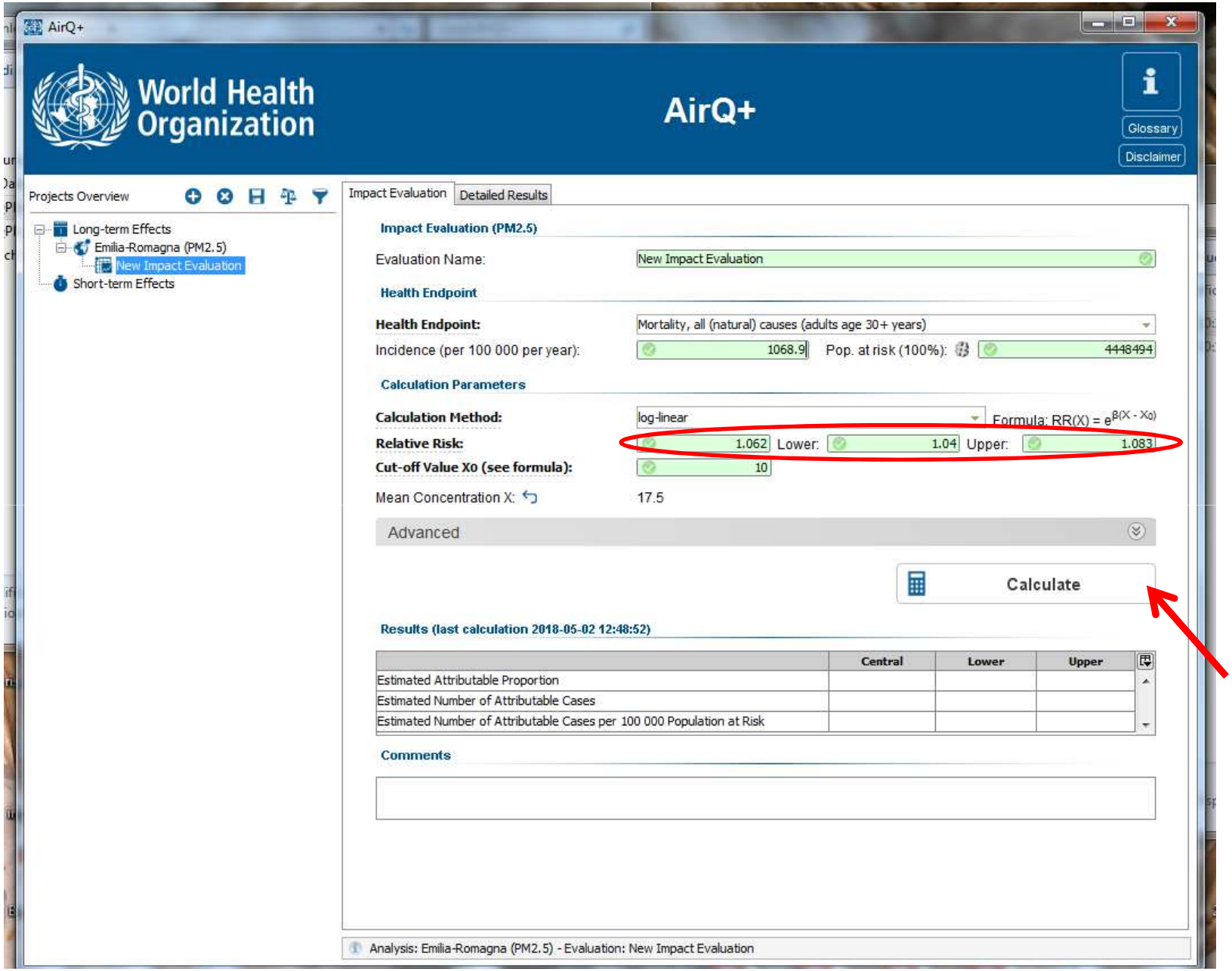
Evaluation Name:
New Impact Evaluation
Health Endpoint
Health Endpoint:
Mortality, all (natural) causes (adults age 30+ years)
Incidence (per 100 000 per year):
<not specified>
Mortality, all (natural) causes (adults age 30+ years)
Mortality due to ALRI for children (0-5 years)
Mortality due to COPD for adults (30+ years)
Mortality due to LC for adults (30+ years)
Mortality due to IHD for adults (25+ years)
Mortality due to Stroke for adults (25+ years)
Calculation Parameters
Calculation Method:
Relative Risk:
Cut-off Value X0 (see formula):
10
Mean Concentration X:
17.5
Advanced
Calculate
Results (last calculation 2018-05-02 12:48:52)
Central
Lower
Upper
Estimated Attributable Proportion
Estimated Number of Attributable Cases
Estimated Number of Attributable Cases per 100 000 Population at Risk
Comments
Analysis: Emilia-Romagna (PM2.5) - Evaluation: New Impact Evaluation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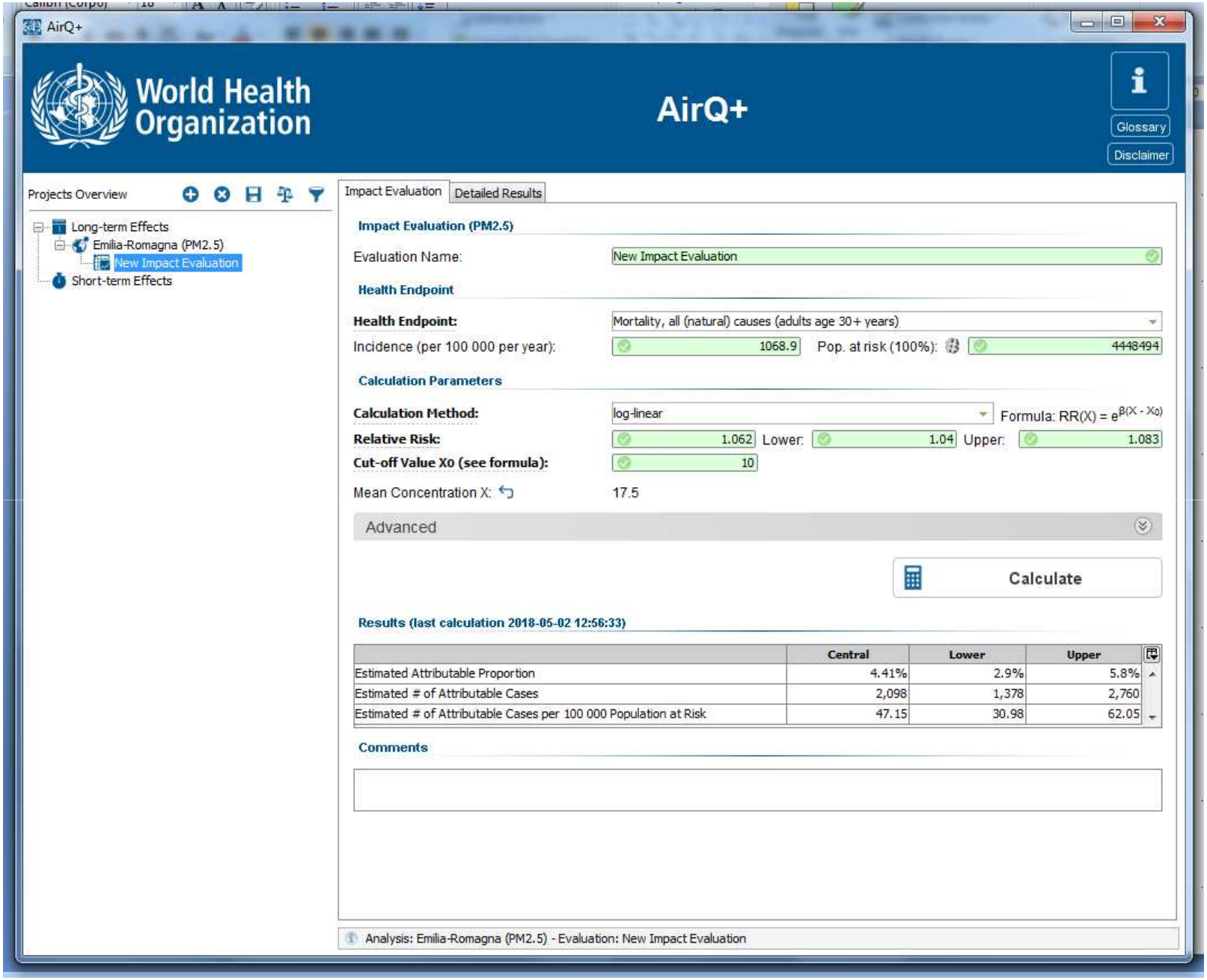
Impact Evaluation (PM2.5)
Evaluation Name:
New Impact Evaluation
Health Endpoint
Health Endpoint:
Mortality, all (natural) causes (adults age 30+ years)
Incidence (per 100 000 per year):
1068.9
Pop. at risk (100%):
4448494
Calculation Parameters
Calculation Method:
log-linear
Formula: RR(X) = e^β(X - X0)
Relative Risk:
1.062
Lower:
1.04
Upper:
1.083
Cut-off Value X0 (see formula):
10
Mean Concentration X:
17.5
Advanced
Calculate
Results (last calculation 2018-05-02 12:48:52)
Central
Lower
Upper
Estimated Attributable Proportion
Estimated Number of Attributable Cases
Estimated Number of Attributable Cases per 100 000 Population at Risk
Comments
Analysis: Emilia-Romagna (PM2.5) - Evaluation: New Impact Evaluation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Health Endpoint:
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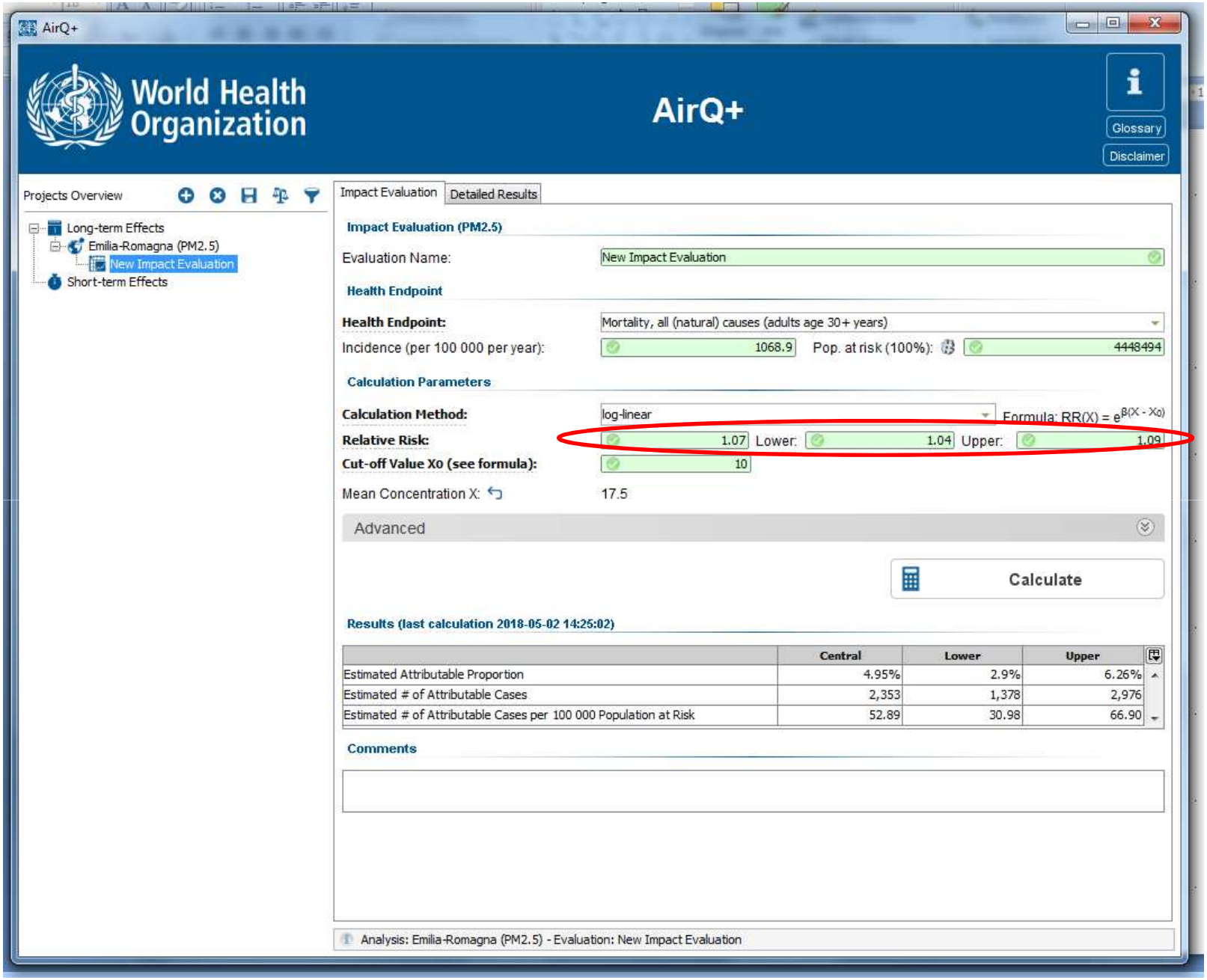
Incidence (per 100 000 per year):
1068.9
Pop. at risk (100%):
4448494
Calculation Parameters
Calculation Method:
log-linear
Formula: RR(X) = e^β(X - X0)
Relative Risk:
1.062
Lower:
1.04
Upper:
1.083
Cut-off Value X0 (see formula):
10
Mean Concentration X:
17.5
Advanced
Calculate
Results (last calculation 2018-05-02 12:56:33)
Central
Lower
Upper
Estimated Attributable Proportion
4.41%
2.9%
5.8%
Estimated # of Attributable Cases
2,098
1,378
2,760
Estimated # of Attributable Cases per 100 000 Population at Risk
47.15
30.98
62.05
Comments
Analysis: Emilia-Romagna (PM2.5) - Evaluation: New Impact Evaluation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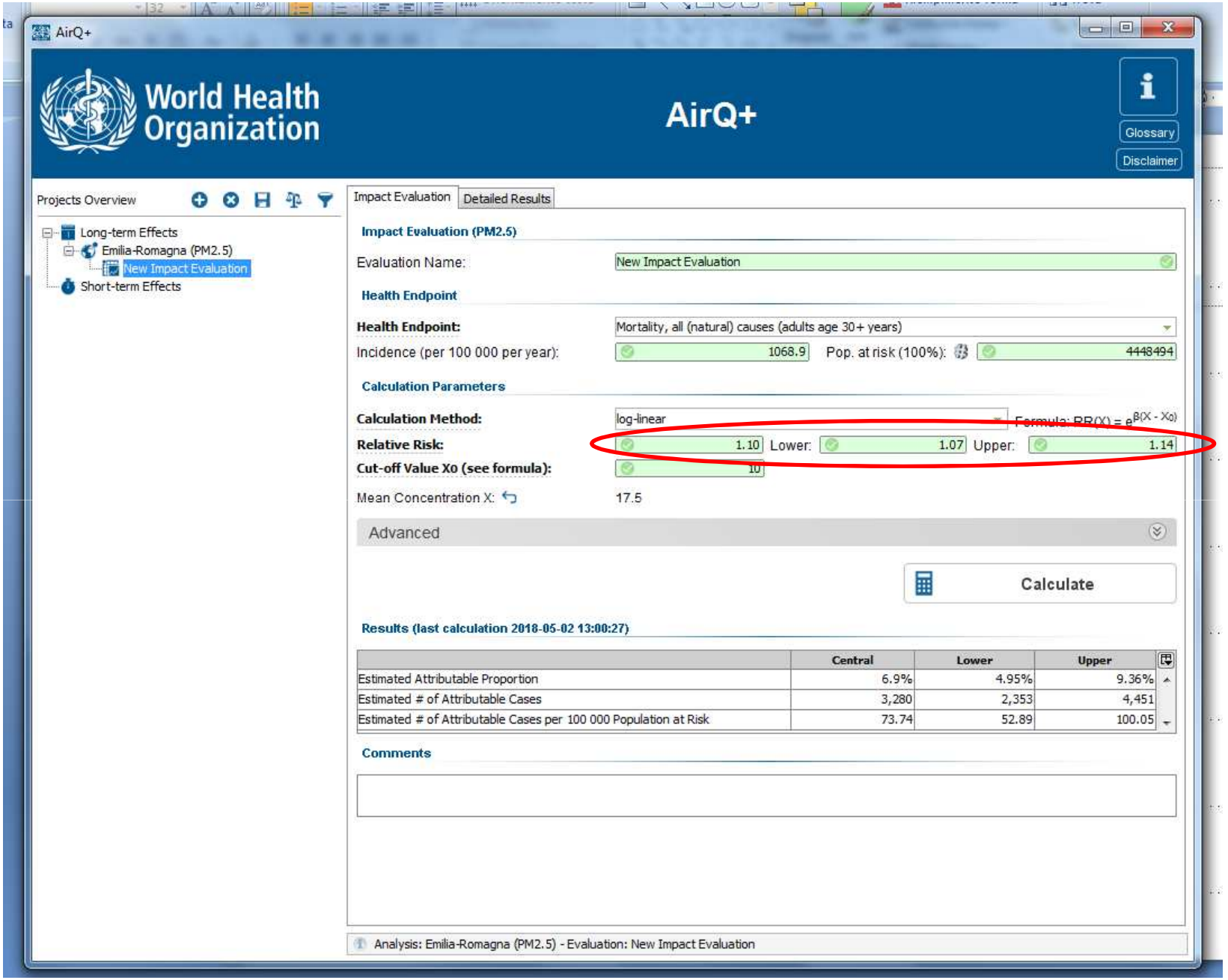
Impact Evaluation (PM2.5)
Evaluation Name:
New Impact Evaluation
Health Endpoint
Health Endpoint:
Mortality, all (natural) causes (adults age 30+ years)
Incidence (per 100 000 per year):
1068.9
Pop. at risk (100%):
4448494
Calculation Parameters
Calculation Method:
log-linear
Formula: RR(X) = e^β(X - X0)
Relative Risk:
1.07
Lower:
1.04
Upper:
1.09
Cut-off Value X0 (see formula):
10
Mean Concentration X:
17.5
Advanced
Calculate
Results (last calculation 2018-05-02 14:25:02)
Central
Lower
Upper
Estimated Attributable Proportion
4.95%
2.9%
6.26%
Estimated # of Attributable Cases
2,353
1,378
2,976
Estimated # of Attributable Cases per 100 000 Population at Risk
52.89
30.98
66.90
Comments
Analysis: Emilia-Romagna (PM2.5) - Evaluation: New Impact Evaluation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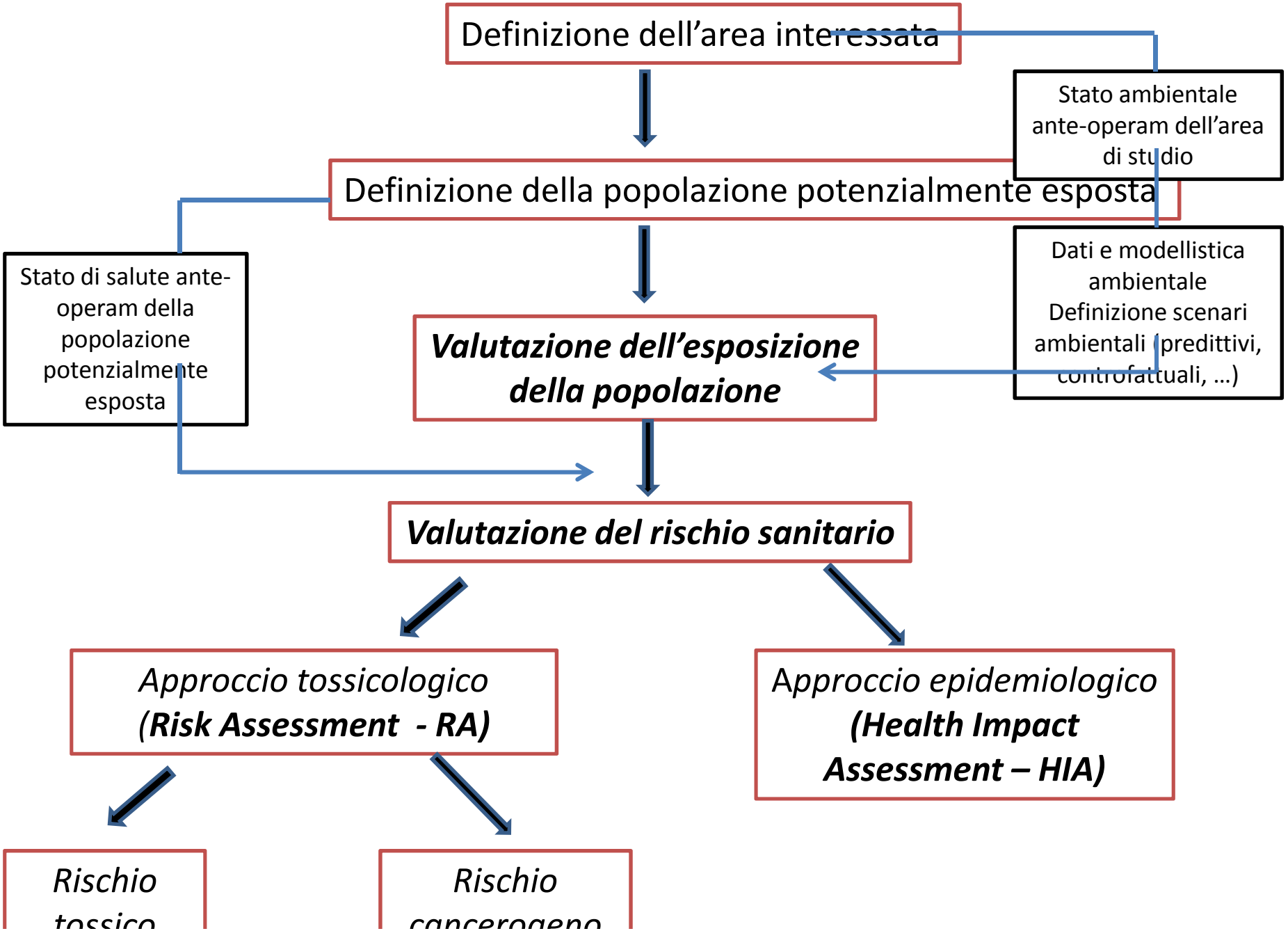
Impact Evaluation
Detailed Results
Impact Evaluation (PM2.5)
Evaluation Name:
New Impact Evaluation
Health Endpoint
Health Endpoint:
Mortality, all (natural) causes (adults age 30+ years)
Incidence (per 100 000 per year):
1068.9
Pop. at risk (100%):
4448494
Calculation Parameters
Calculation Method:
log-linear
Formula: RR(X) = e^β(X - X0)
Relative Risk:
1.10
Lower:
1.07
Upper:
1.14
Cut-off Value X0 (see formula):
10
Mean Concentration X:
17.5
Advanced
Calculate
Results (last calculation 2018-05-02 13:00:27)
Central
Lower
Upper
Estimated Attributable Proportion
6.9%
4.95%
9.36%
Estimated # of Attributable Cases
3,280
2,353
4,451
Estimated # of Attributable Cases per 100 000 Population at Risk
73.74
52.89
100.05
Comments
Analysis: Emilia-Romagna (PM2.5) - Evaluation: New Impact Evaluation

Caso di sorgente puntuale

Diagramma di flusso della procedura



HEALTH IMPACT ASSESSMENT: Approccio epidemiolog

Numero di ***casi annuo dell'esito sanitario considerato*** dovuti all'esposizione ad una determinato incremento di concentrazione (N_{ER}):

$$N_{ER} = P_{exp} * I_{av} * (RR_{10} - 1) * {}^{\Delta C}/_{10}$$

Dove:

P_{exp} = popolazione esposta

I_{av} = ***incidenza media*** di un dato esito sanitario nella popolazione

RR_{10} = ***Relative Risk*** da studi epidemiologici, solitamente per 10 µg/m^3 di inquinante

ΔC = differenza tra la concentrazione di riferimento e quella osservata

RISK ASSESSMENT: Approccio tossicologico

Numero di ***casi lifetime*** (nel corso di 70 anni) di ***tumore generico*** attribuibili all'inalazione di una determinata sostanza inquinante (N_L):

Rischio (R)

$$N_L = P_{exp} * C_{air} * IUR$$

Dove:

P_{exp} = popolazione esposta

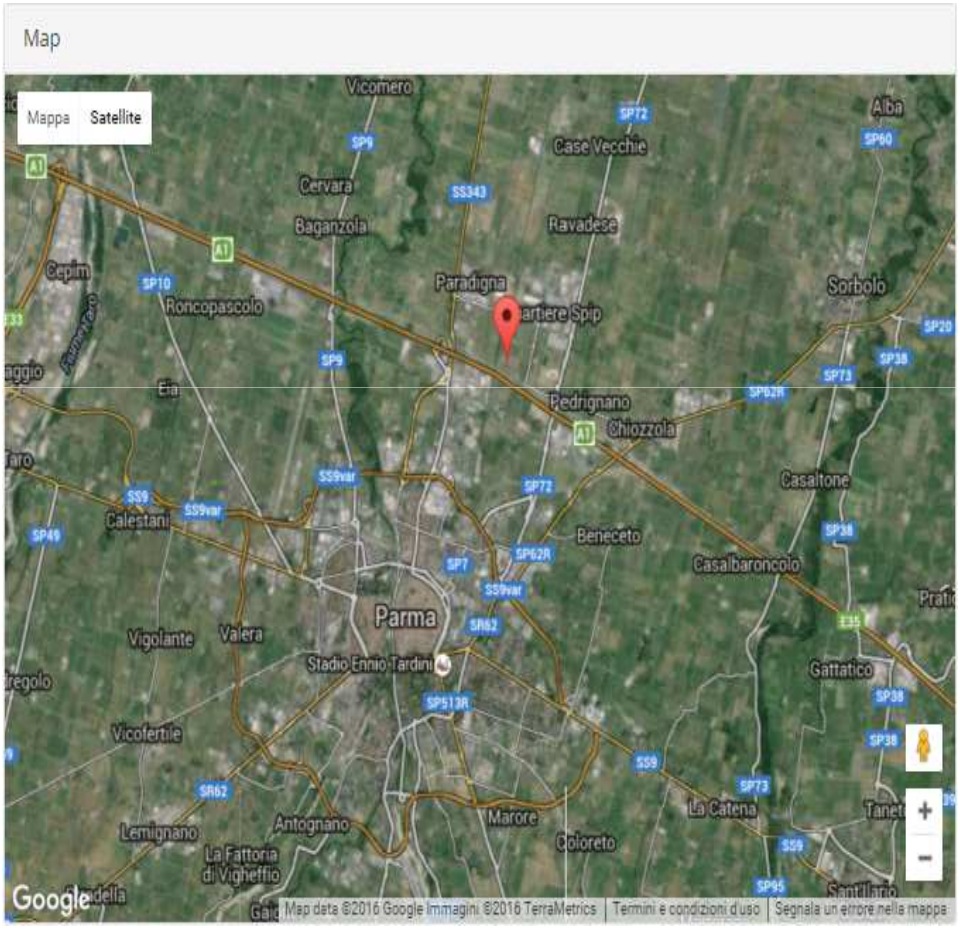
C_{air}= concentrazione media a cui è esposta la popolazione

IUR = ***inhalation unit risk***, fattore di rischio unitario da inalazione per ogni sostanza

Caso Studio

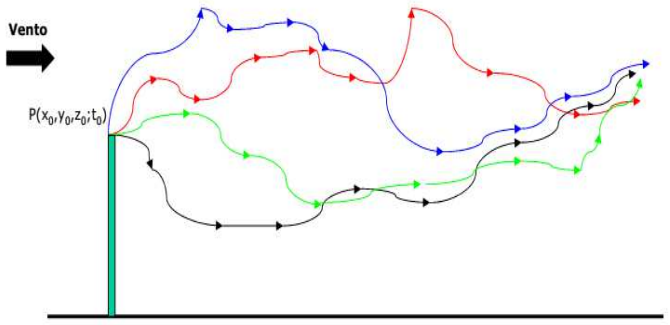
Termovalorizzatore del *Polo Ambientale Integrato dei rifiuti di Parma (PAIP):*

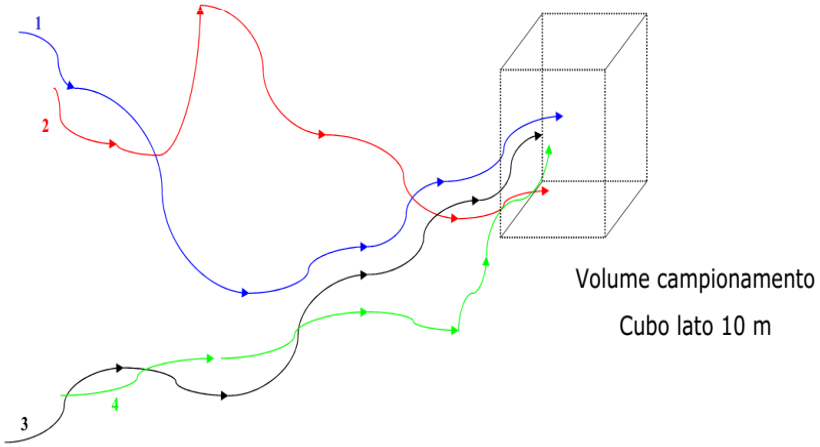
- Dati emissivi forniti da ARPAE
- Dispersione degli inquinanti in atmosfera simulata col modello lagrangiano a particelle ***Lapmod***, fornito da ARPAE, per valutare l'***esposizione*** della popolazione
- Applicazione dei due metodi di valutazione dell'impatto sulla salute



Il modello lagrangiano a particelle

- Sistema di coordinate mobile (***lagrangiano***)
- Emissione descritta da un certo numero di ***particelle*** emesse ad ogni step temporale
- Il moto di ogni singola particella è descritto da un punto di vista **probabilistico**, ed è dato dall'interazione con l'aria ci





Particella 1 → Q_1 = 5 mg/m^3

Particella 1 → Q_2 = 10 mg/m^3

Particella 1 → Q_3 = 7 mg/m^3

Particella 1 → Q_4 = 20 mg/m^3

$$C(x,y,z;t) = \frac{Q_1+Q_2+Q_3+Q_4}{V} = \frac{5+10+7+20}{10\cdot 10\cdot 10}\cdot\frac{mg}{m^3} = 42\mu g/m_3$$

Dati meteorologici

File di input meteo prodotto dal software ***CALMET***:

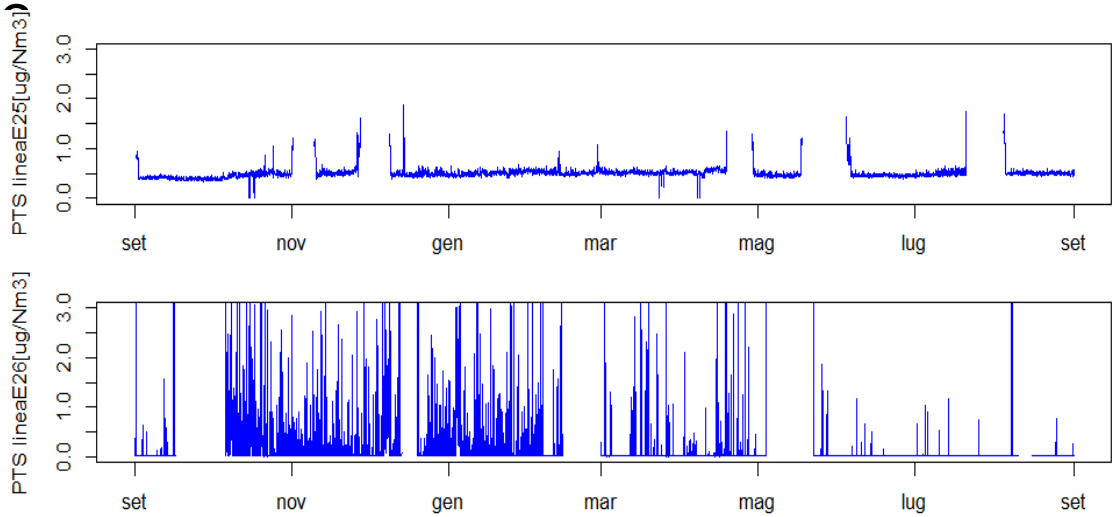
- Utilizza in input i dati di output al suolo e in quota di ***Cosmo***
- Integrati con i dati ***Rirer*** di una o più stazioni meteorologiche

Modello tridimensionale:

- Vento
- Temperatura
- Lunghezza Monin-Obukhov
- Velocità di frizione
- Velocità convettiva
- Altezza PBL
- Precipitazione

Simulazione PAI di Parma
Lapmod

<u>Dati SME</u> : medie semi-orarie delle misurazioni sulle emissioni al camino, effettuate in continu

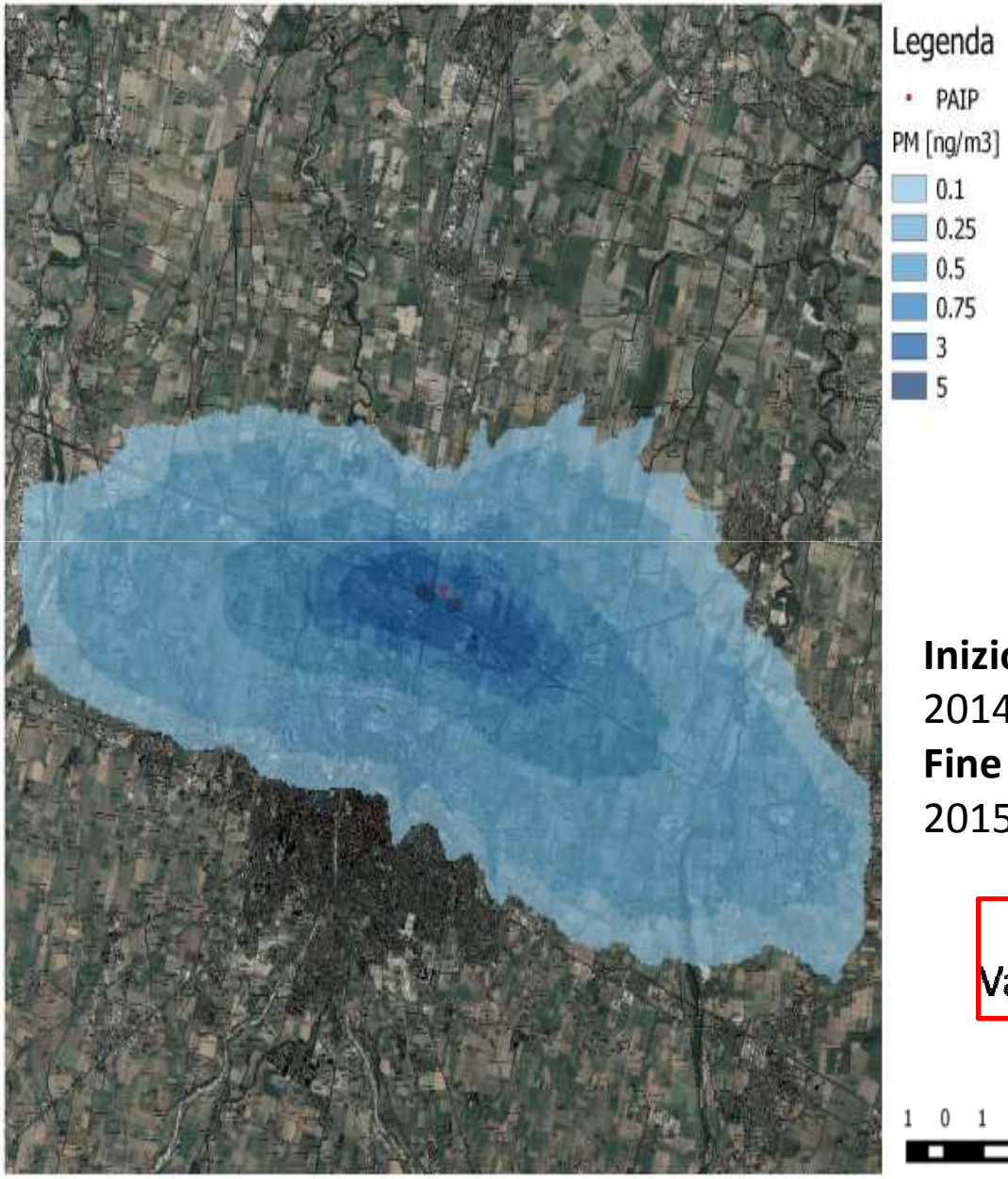


Medie orarie:

- Concentrazioni in uscita delle ***polveri totali sospese*** (*PTS*)
- Temperatura di uscita dei fumi
- Portata secca di uscita dei fumi

- *2* ***sorgenti*** *puntiformi con galleggiamento* con coordinate coincidenti, una per ogni linea di incenerimento
- Altezza del camino di 70 metri e diametro di 1.56 metri

Output Lapmod



Concentrazione media annua

Inquinante: Polveri Totali Sospese

Dominio spaziale: Griglia 20x20 km

Celle 200x200 m

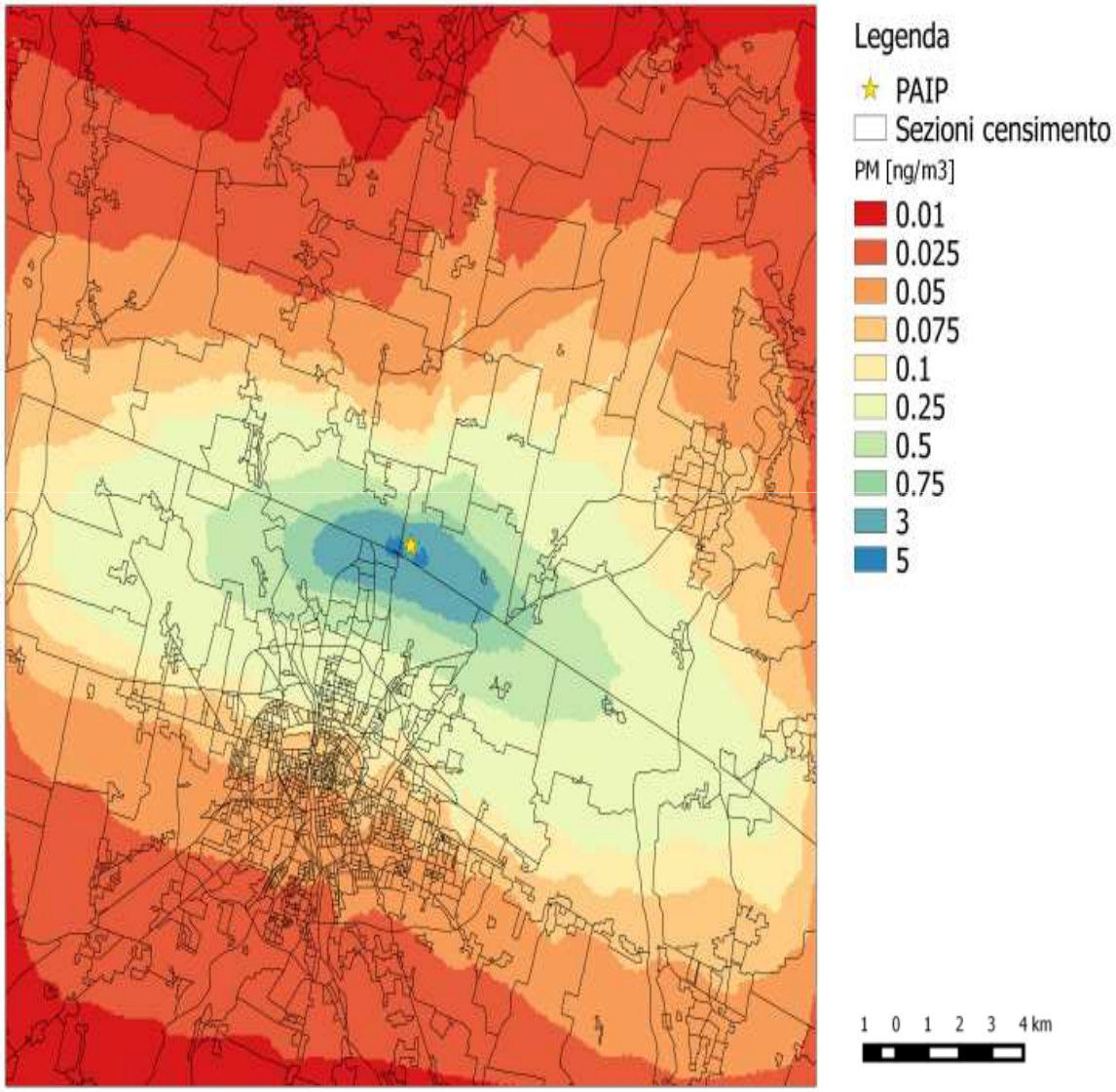
Altezza 1.5 m

Inizio simulazione: 1 settembre 2014 ore 0.00

Fine simulazione: 1 settembre 2015 ore 0.00

Valore massimo: $4 * 10^{-3}\ \mu g/m^3$

Esposizione della popolazione

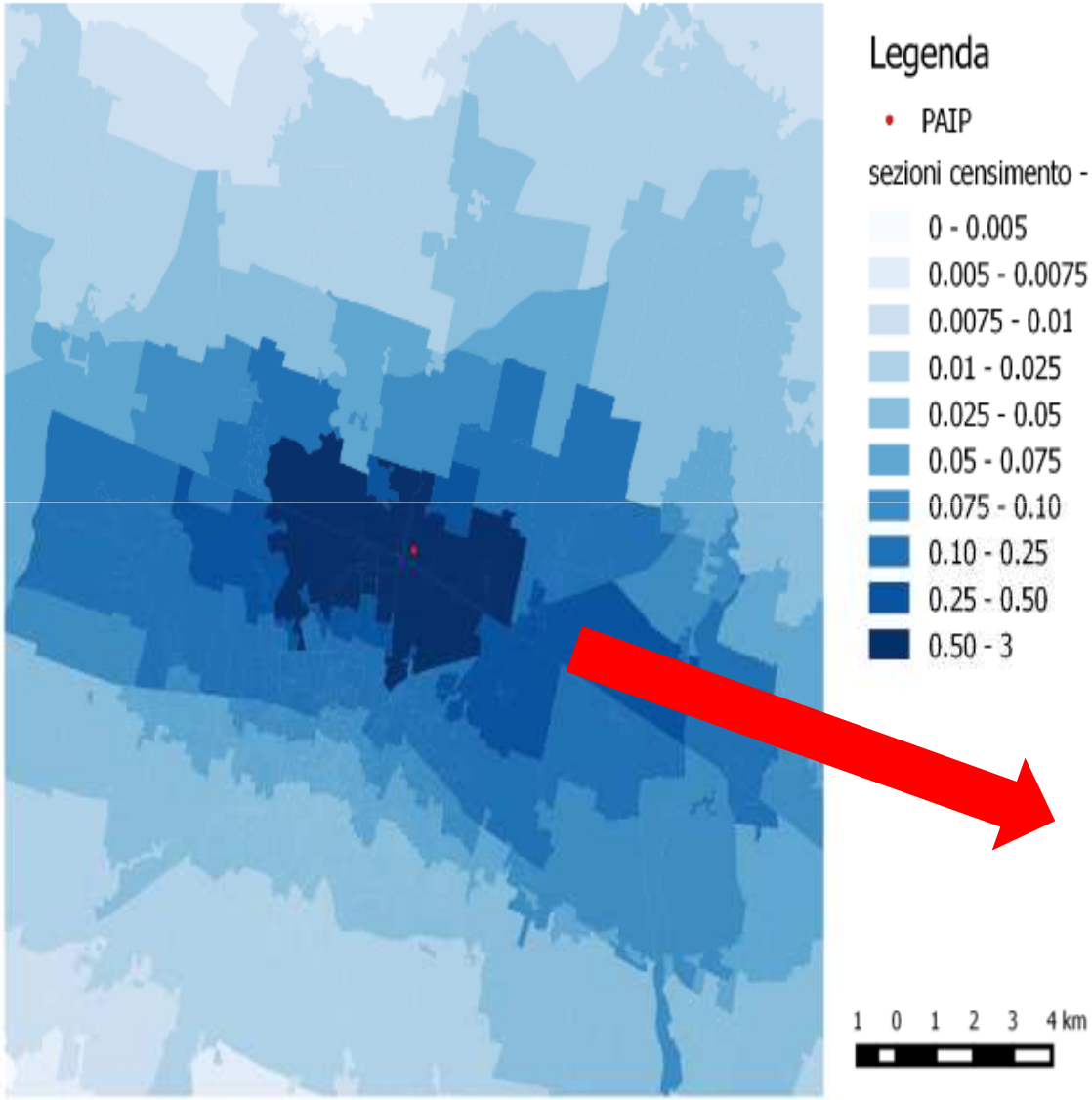


<u>Sezioni di censimento</u> contenenti il numero della popolazione suddivisa in ***classi di età quinquennali*** e ***sesso***

Valore di <u>concentrazione medio</u> per ogni sezione

<u>Esposizione</u> della popolazione

Concentrazione media per sezione di censiment



Per ogni sezione è stato associato un valore di ***concentrazione media*** alla ***popolazione residente esposta***

$$P_{exp} \quad , \quad C_{air}$$

HEALTH IMPACT ASSESSMENT: Applicazione del metodo

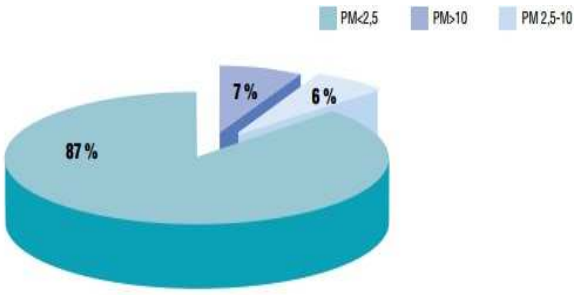
$$N_{ER} = P_{exp} * I_{av} * (RR_{10} - 1) * {}^{\Delta C}/_{10}$$

Incidenza di base di ***tumore a trachea, bronchi e polmone*** nella popolazione suddivisa per *genere* e *classi di età (ISTAT)*

RR10	**1.09 [$\mu g/m^3$]$^{-1}$**
I.C.	(1.04 – 1.14)

Relative Risk per tumore a trachea, bronchi e polmone riferito al ***PM2.5*** *(Hamra et al, 2014)*

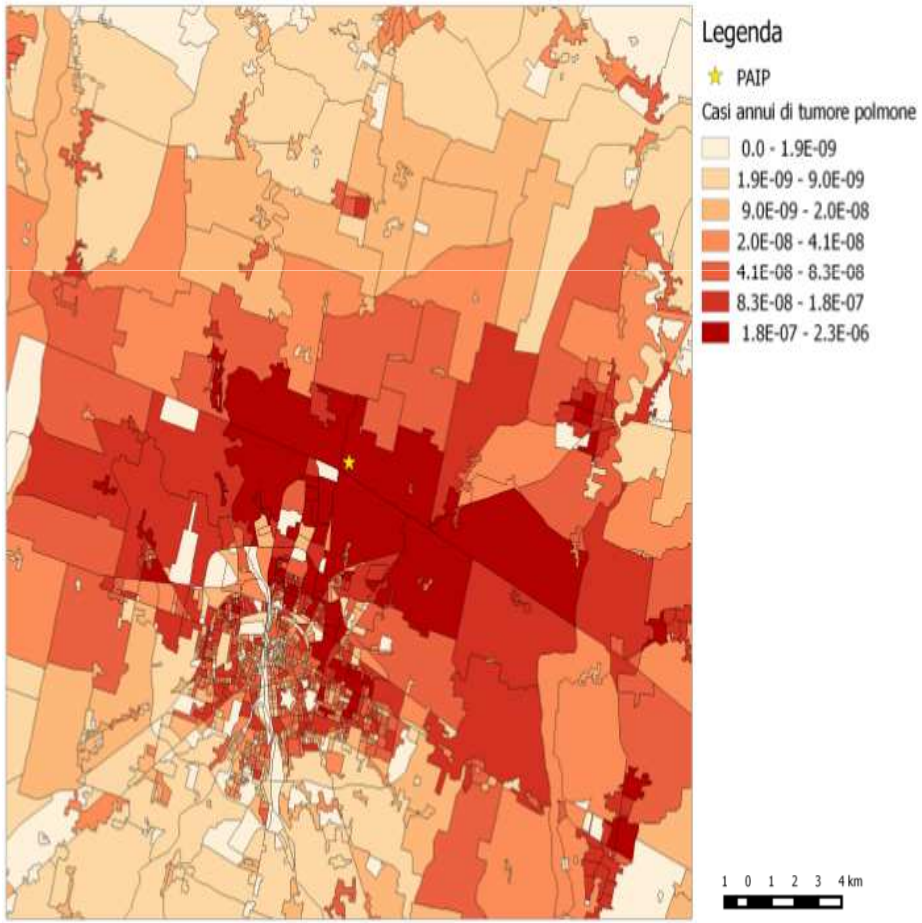
$$C_{air} * 0.87$$



Percentuale di ***PM2.5*** nelle Polveri Totali emesse (Moniter, 2011)

HEALTH IMPACT ASSESSMENT: Risultati

Incremento annuo di ***casi tumorali alla trachea, bronchi e polmone*** dovuti all'esposizione alla concentrazione media di particolato emesso dall'impianto di incenerimento in un anno di funzionamento (N_{FR})



Casi annui (N_{ER})	Range variabilità
7.06E-05	2.72E-05 - 1.37E-04

Range di variabilità ottenuto eseguendo il calcolo con gli estremi dell'intervallo di confidenza del RR_{10}

RISK ASSESSMENT: Applicazione metodo

$$N_L = P_{exp} * C_{air} * IUR$$

Inquinante	Frazione PTS	IUR $[\mu g/m^3]^{-1}$
Cadmio	0.0004	0.00180
Arsenico	0.0023	0.00430
Piombo	0.0909	0.00001
Cromo	0.0172	0.01200
Cobalto	0.0493	0.00900
Nichel	0.0302	0.00048
TCDD equiv.	2.4 E-08	38.00000
BaP equiv.	0.0017	0.00110
TOTALE	**0.1920**	

(Fonte: EPA)

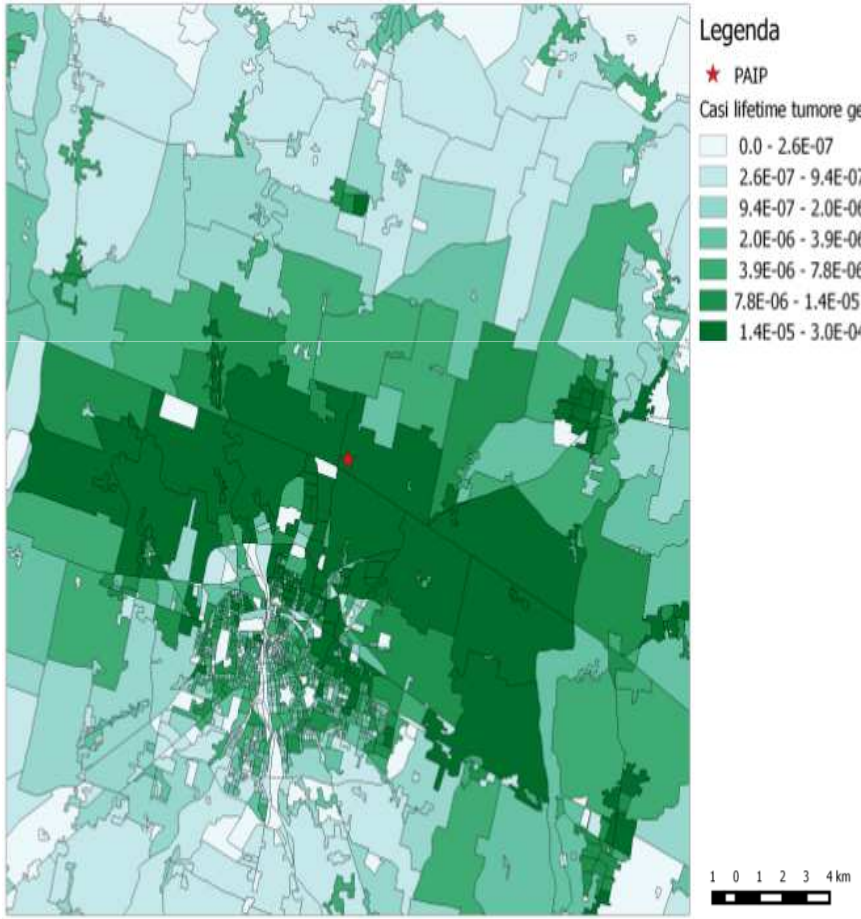
Speciazione del particolato attraverso i dati campionati da *Gruppo Iren S.P.A.*

Le sostanze identificate costituiscono ***circa il 20%*** delle Polveri Totali emesse

RISK ASSESSMENT: Risultati

Numero di ***casi lifetime*** (nel corso di 70 anni) di ***tumore generico*** attribuibili all'inalazione di particolato emesso dall'impianto di incenerimento nel corso di un anno di funzionamento (N_L):

$$N_L = \sum_{sez\ i} \sum_{sost\ j} P_{exp,i} * R_{j,i}$$



Casi Lifetime (N_L)	Range variabilità
7.15E-03	6.12E-03 - 9.06E-03

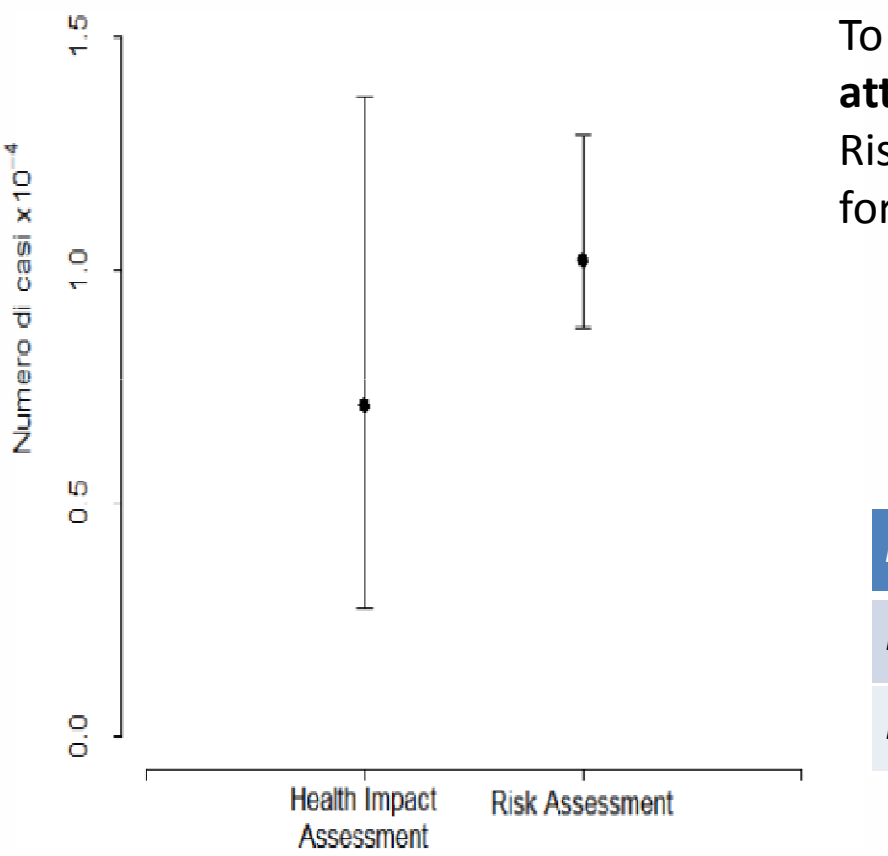
Range di variabilità ottenuto eseguendo il calcolo con la concentrazione minima e massima individuate in ogni sezione di censimento

Rischio cumulativo (TR) entro i limiti di accettabilità (DLgs 152/2006, Allegato I):

Rischio cumulativo (TR)	Total Tolerable Risk
1.74E-06	*1E-05*

$$TR = max_{sez}\left(\sum_{sost\ j} R_j\right)$$

RA vs HIA



To allow a "comparison", **yearly attributable cases** have been derived for Risk Assessment approach using the formula (Roosli et al, 2008):

$$RAy = N_L/70$$

Where N_L=lifetime cases

Method	*AC*	*Range*
HIA	*7.06E-05*	*2.72E-05 - 1.37E-04*
RAy	*1.02E-04*	*8.75E-05 - 1.29E-04*

Conclusioni 1/2

In questo studio sono stati confrontati due metodi per la valutazione dell'impatto sanitario dell'inquinamento atmosferico, applicandoli al caso studio del termovalorizzatore di Parma:

- ***"Health Impact Assessment "***

- ***" Risk Assessment "***

Criticità emerse nell'applicazione al caso studio:

- Il *Risk Assessment* si riferisce a ***tutti i tipi di tumore***, l'*Health Impact Assessment* solo a ***trachea, bronchi e polmone;***
- Le sostanze utilizzate per il *caso tossicologico* costituiscono ***circa il 20%*** delle Polveri totali emesse;
- È stato necessario risalire al ***numero di casi annuo*** per il *Risk Assessment* per omogeneizzare temporalmente i risultati;
- Per risalire alla concentrazione di ***PM2.5***, nel *caso epidemiologico*, è stato applicato un fattore di 0.87;
- Il ***Relative Risk*** epidemiologico si riferisce ad una miscela di polveri derivante da ambiente urbano, potenzialmente differente da quella emessa da un inceneritore;

Conclusioni 2/2

Considerando le *differenze* insite nei due metodi, le *criticità* incontrate e *l'ordine di grandezza* dei valori, i risultati ottenuti possono ritenersi ***simili*** come dimostrato anche dalla ***sovrapposizione dei range di variabilità.***

L'applicazione dei due metodi ***non può considerarsi equivalente,*** in quanto questi mettono in luce aspetti diversi della stessa tematica, affrontandola da un punto di vista differente.

Non è possibile stabilire quale metodo sia il migliore; si potrebbe ipotizzare di *avvalersi di* ***entrambi gli strumenti*** per ottenere una stima comprensiva dei diversi aspetti e valutare, eventualmente, se dare maggiore rilevanza ad uno dei due metodi, in base al caso specifico.

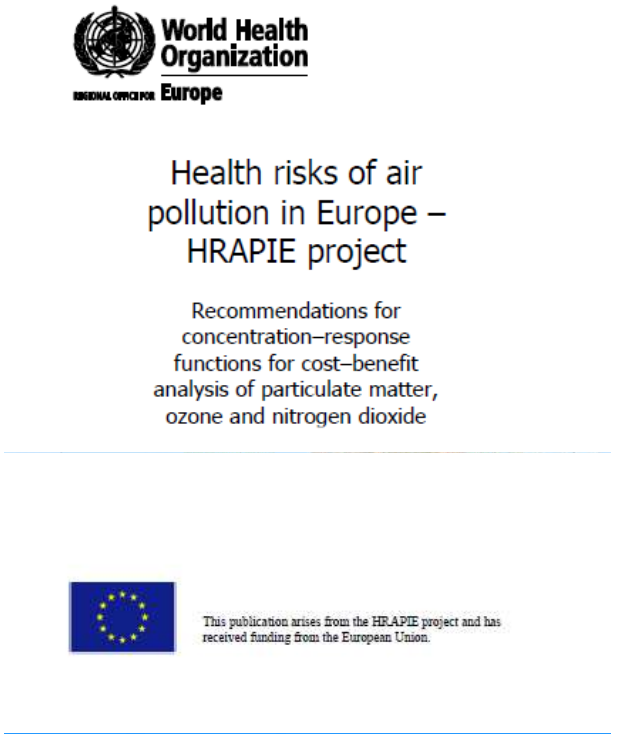
Impatto sulla popolazione europea di inquinamento legato alle discariche

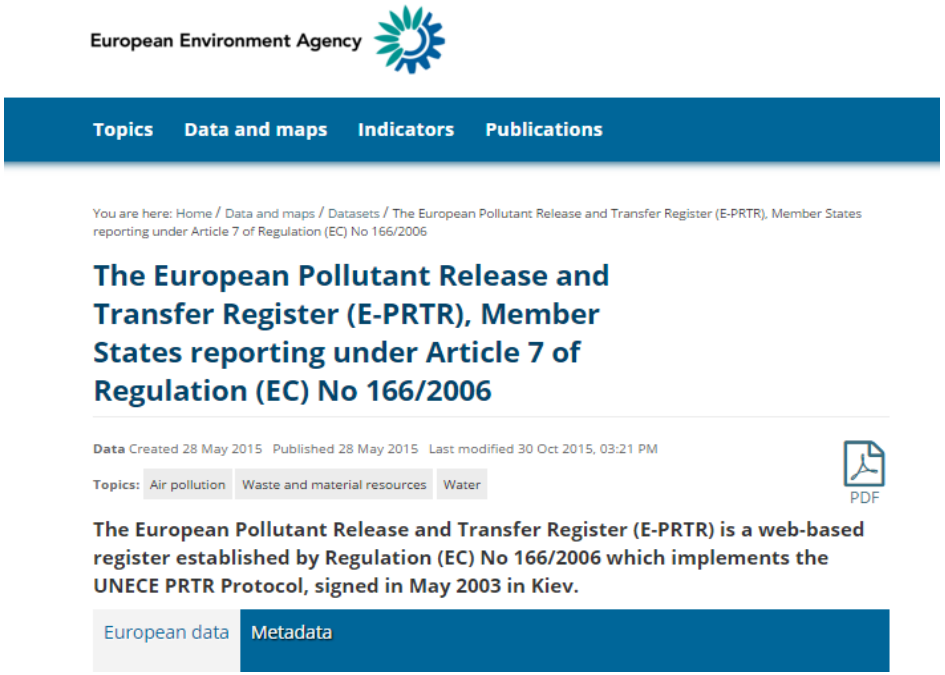
Esempio di calcolo a livello di singoli Stati

- Uso dei RR da letteratura
- Calcolo della popolazione esposta tramite uso di database europei
  - Approccio GIS alla stima dell'esposizione
- Calcolo degli AC (casi attribuibili)
- Combinazione di differenti outcome di salute tramite l'utilizzo dei DALYs

Data collection

- Location of plants
- Population database
- European health statistics
- Relative risks



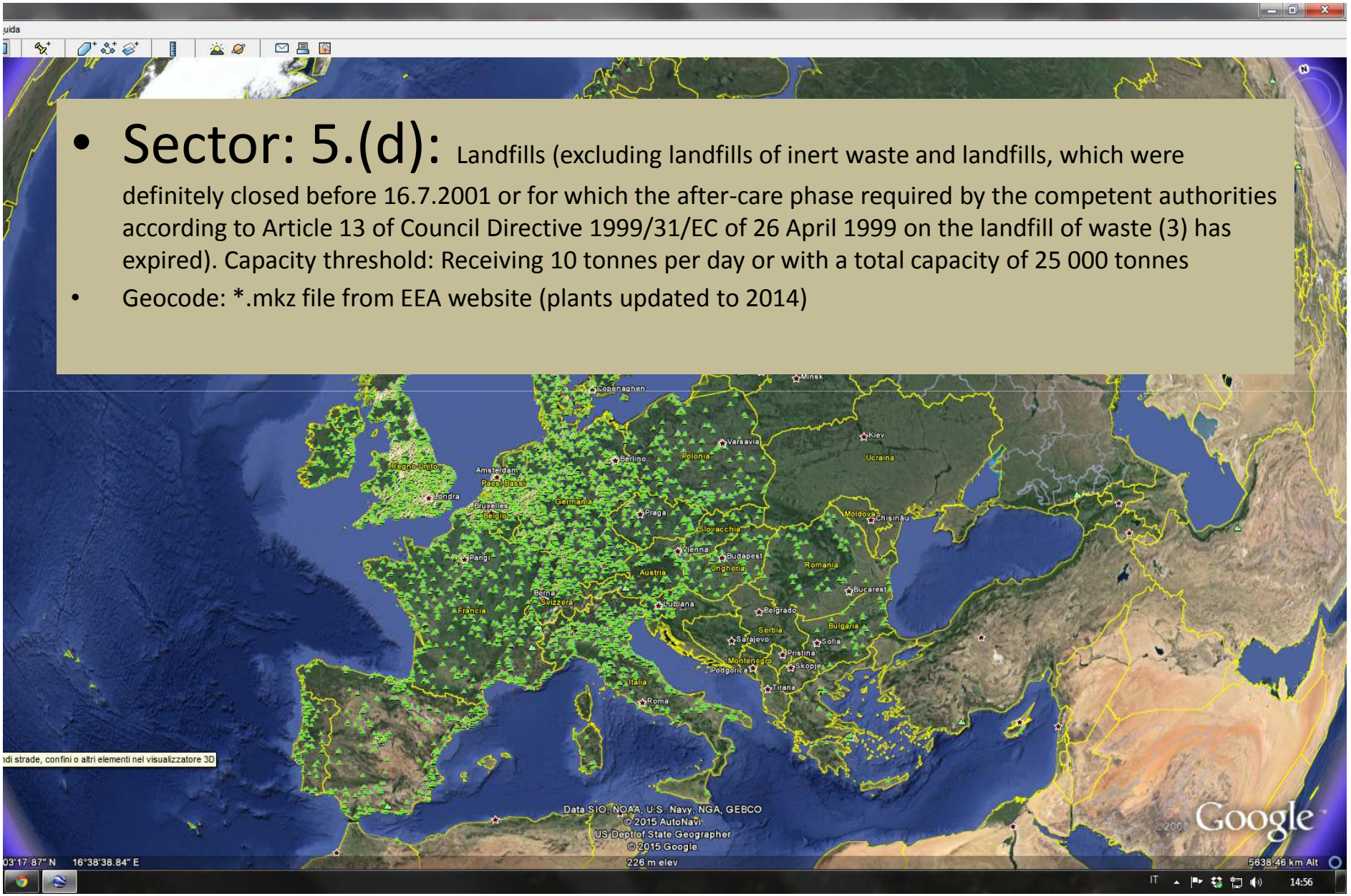


http://www.eea.europa.eu/data-and-maps/data/member-states-reporting-art-7-under-the-european-pollutant-release-and-transfer-register-e-prtr-regulation-10

E-PRTR

- E-PRTR: registro europeo – copertura 2007-2014 per tutti gli Stati membri, Islanda, Liechtenstein, Norvegia, Serbia and Svizzera.
- Article 7 of the Regulation sets the requirements for the annual reporting by Member States which covers the releases to air and water for 91 substances, as well as the transfers of pollutants in water and the transfer of waste from industrial facilities across 65 sectors. The register includes information of more than 30.000 facilities in 32 countries.

E-PRTR (Settore 5.d – dati 2014)



- **Sector: 5.(d):** Landfills (excluding landfills of inert waste and landfills, which were definitely closed before 16.7.2001 or for which the after-care phase required by the competent authorities according to Article 13 of Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste (3) has expired). Capacity threshold: Receiving 10 tonnes per day or with a total capacity of 25 000 tonnes
- Geocode: *.mkz file from EEA website (plants updated to 2014)

Table 1: Number of facilities reporting for each country by year.

	2007	2008	2009	2010	2011	2012	2013	2014
Austria	20	17	18	15	16	13	10	12
Belgium	22	23	23	17	17	20	17	16
Bulgaria	14	19	22	24	23	28	30	31
Croatia	0	0	0	0	0	0	0	6
Cyprus	0	0	0	0	1	1	1	1
Czech Republic	6	2	4	10	7	12	14	14
Denmark	52	39	27	23	15	27	24	22
Estonia	8	8	8	5	5	4	5	4
Finland	56	50	51	53	50	56	56	58
France	135	160	162	172	182	199	190	185
Germany	248	249	242	234	222	210	202	188
Greece	7	7	8	7	6	5	5	6
Hungary	14	16	17	14	15	8	11	20
Iceland	1	2	2	2	2	2	2	2
Ireland	30	31	33	33	34	33	34	33
Italy	100	115	118	128	128	120	149	163
Latvia	0	0	1	0	0	1	1	2
Liechtenstein	0	0	0	0	0	0	0	0
Lithuania	7	8	8	5	5	4	5	3
Luxembourg	2	2	2	2	2	2	2	2
Malta	2	2	0	2	2	2	2	0
Netherlands	26	25	29	29	26	26	27	27
Norway	48	58	59	60	66	65	55	56
Poland	77	78	78	77	68	72	74	67
Portugal	42	43	41	45	48	48	51	49
Romania	48	47	43	45	43	42	40	43
Serbia	0	0	0	0	0	0	0	1
Slovakia	9	13	16	8	7	6	9	10
Slovenia	20	35	39	32	29	23	26	24
Spain	121	123	139	143	151	155	153	149
Sweden	42	53	66	80	85	87	87	90
Switzerland	1	2	1	2	1	1	1	1
United Kingdom	250	261	251	253	254	258	245	259
Total	1408	1488	1508	1520	1510	1530	1528	1544

Population

Dati disponibili a una risoluzione di 100x100 metri.
Popolazione ricavata dal Censimento 2001 (Eurostat).

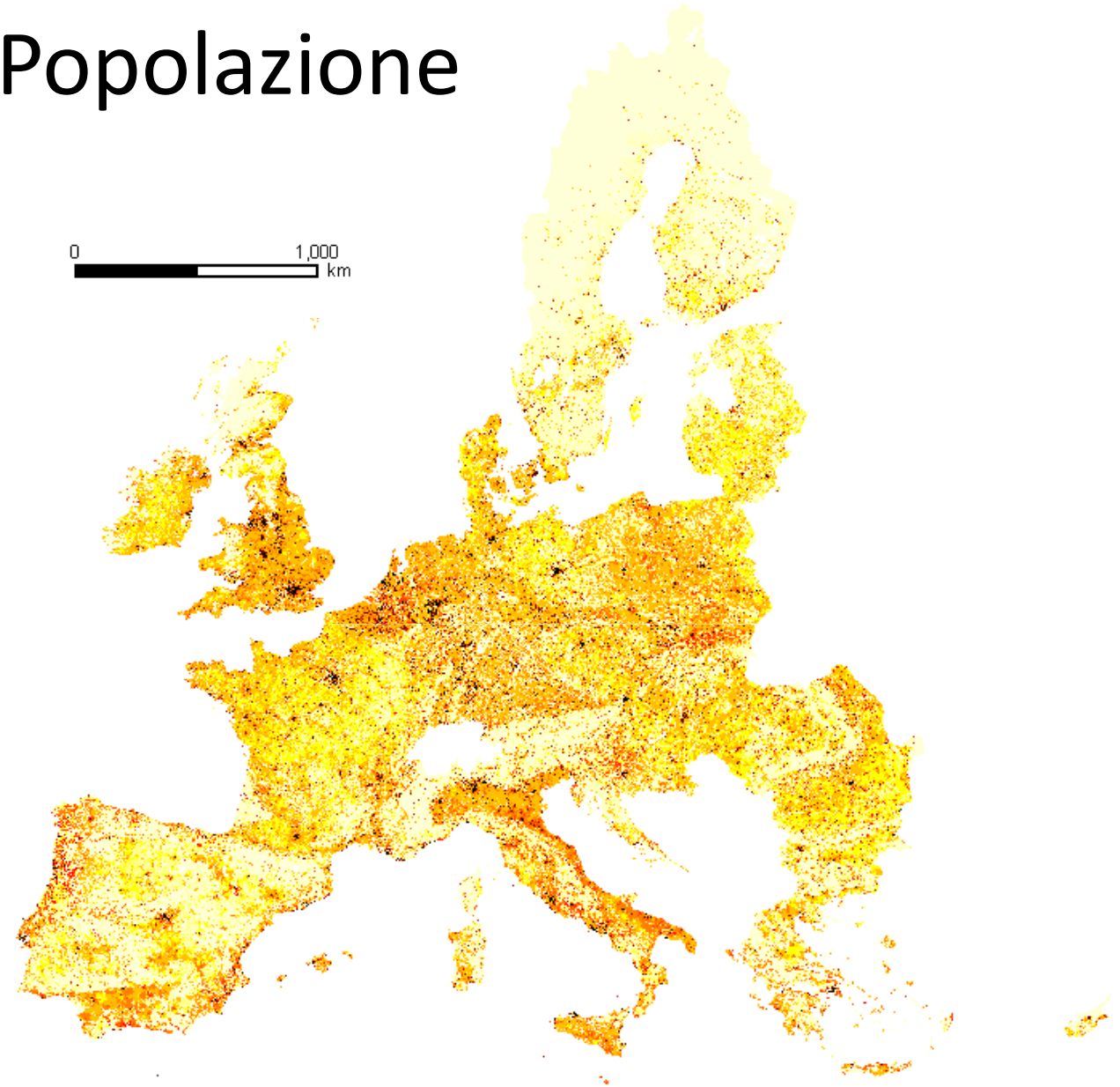
Proprietà: Joint Research Centre (JRC)

http://www.eea.europa.eu/data-and-maps/data/population-density-disaggregated-with-corine-land-cover-2000-2

Reference:

Gallego F.J., 2010, A population density grid of the European Union, Population and Environment. 31: 460-473
http://www.springerlink.com/content/h22617v812p51014/?p=a5de0fad279b474187e630362f4f2fc8&pi=3

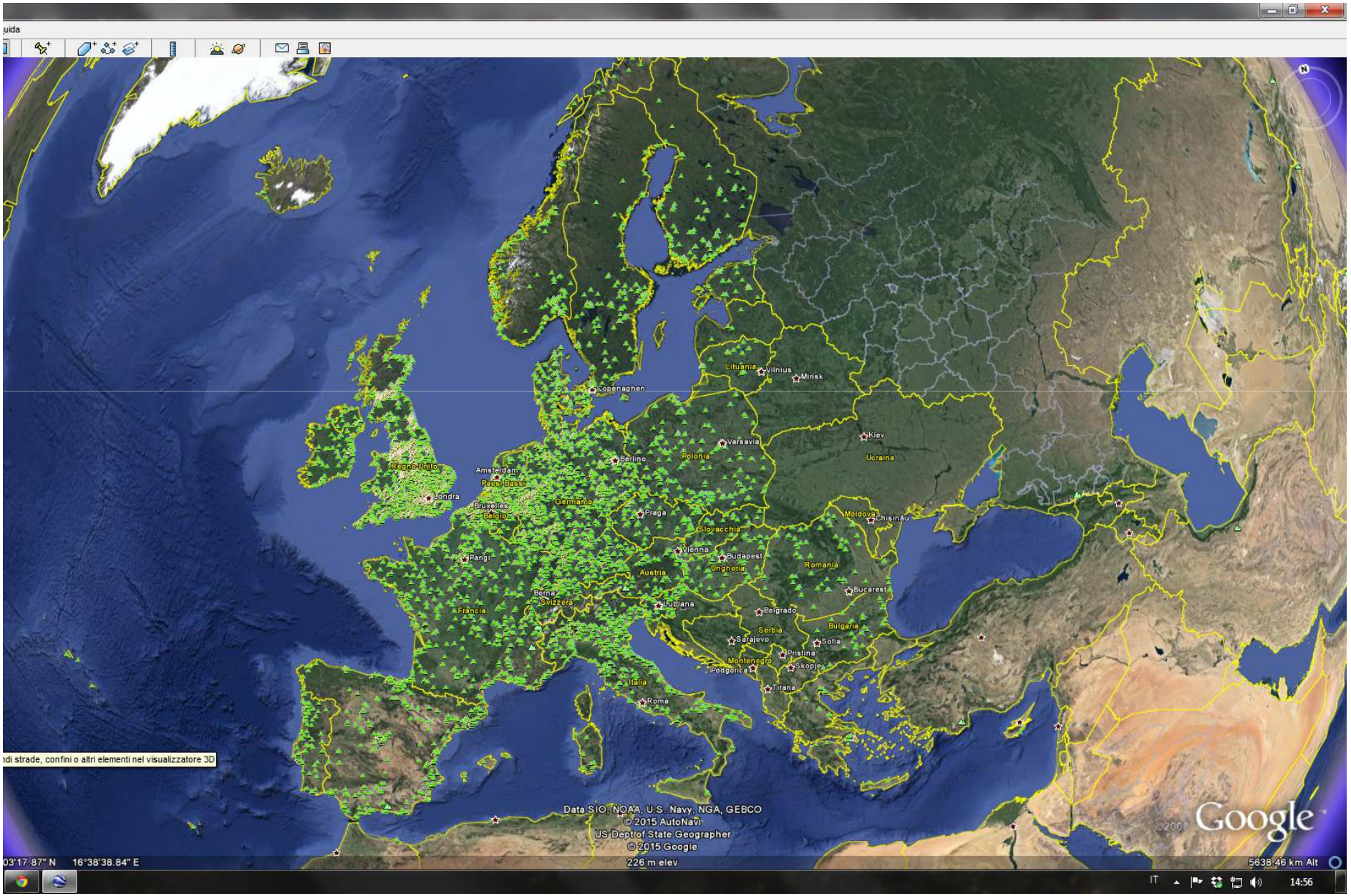
Popolazione



AF – dati dalla letteratura

Exposure buffer	Exopsure index	Health outcome	Risk	Ref.
2 km	Distance	Congenital anomalies	RR=1.02 (99%CI=1.01-1.03)	Elliott et al. 2001
		Annoyance from odour	5.4%	Herr et al. 2003
		Low birth weight	1.06 (99%CI=1.052-1.062)	Elliott et al. 2001
5 km	H2S (model)	Respiratory diseases	1.09 (95%CI=1.00-1.19)	Golini et al. 2016

E-PRTR data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Minsk
Copenaghen
Varsavia
Kiev
Polonia
Ucraina
Berlino
Regno Unito
Amsterdam
Paesi Bassi
Londra
Bruxelles
Belgio
Germania
Praga
Moldova
Chisinau
Slovacchia
Vienna
Budapest
Ungheria
Romania
Parigi
Austria
Bucarest
Berna
Svizzera
Lubiana
Francia
Belgrado
Serbia
Bulgaria
Sarajevo
Sofia
Pristina
Montenegro
Skopje
Podgorica
Italia
Tirana
Roma
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 AutoNavi
US Dept of State Geographer
© 2015 Google
Google
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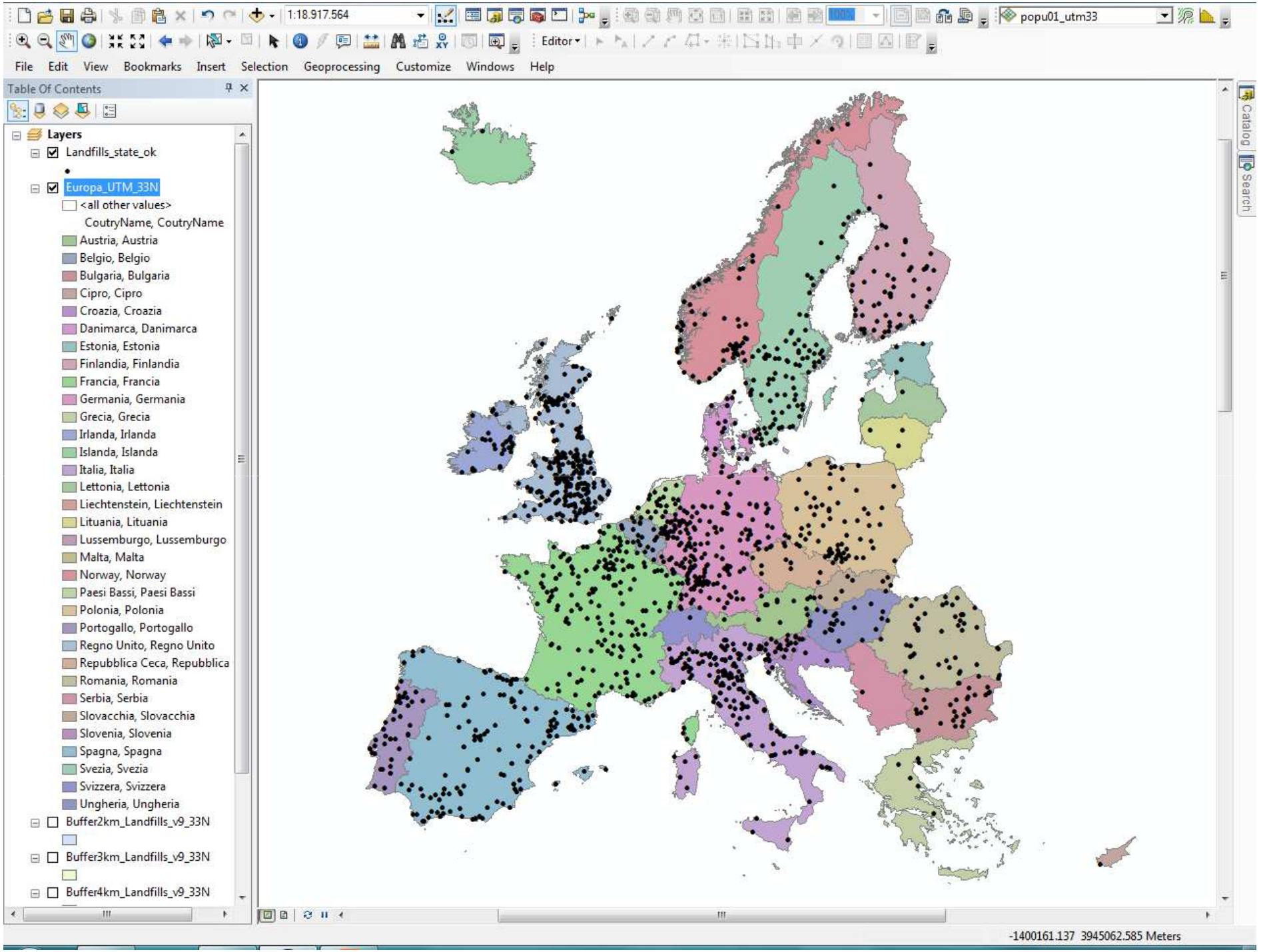
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Finlandia, Finlandia
Francia, Francia
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Liechtenstein, Liechtenstein
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Malta, Malta
Norway, Norway
Paesi Bassi, Paesi Bassi
Polonia, Polonia
Portogallo, Portogallo
Regno Unito, Regno Unito
Repubblica Ceca, Repubblica
Romania, Romania
Serbia, Serbia
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Svizzera, Svizzera
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Buffer3km_Landfills_v9_33N
Buffer4km_Landfills_v9_33N
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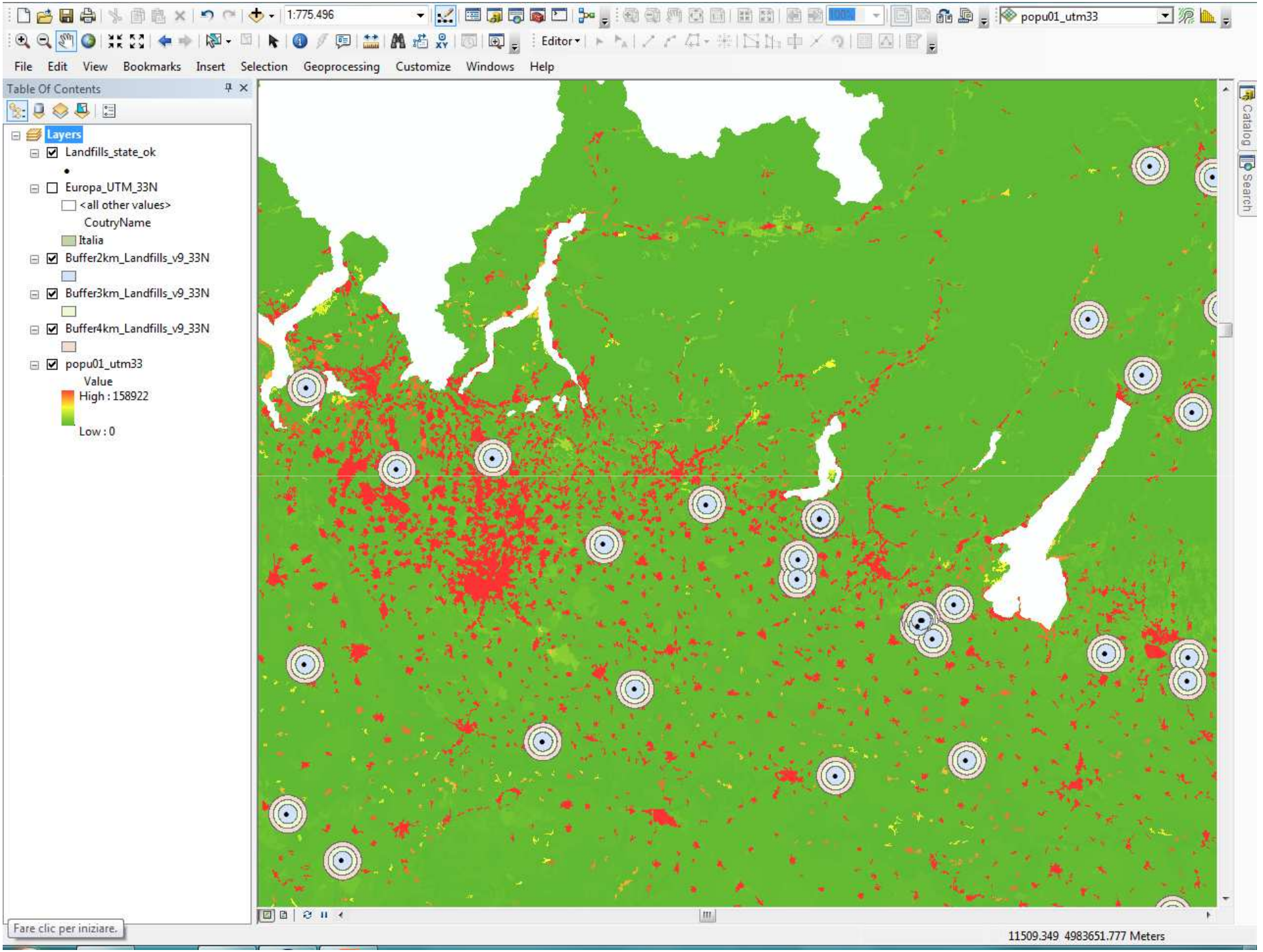
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Buffer3km_Landfills_v9_33N
Buffer4km_Landfills_v9_33N
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Low : 0
Catalog
Search
Fare clic per iniziare.
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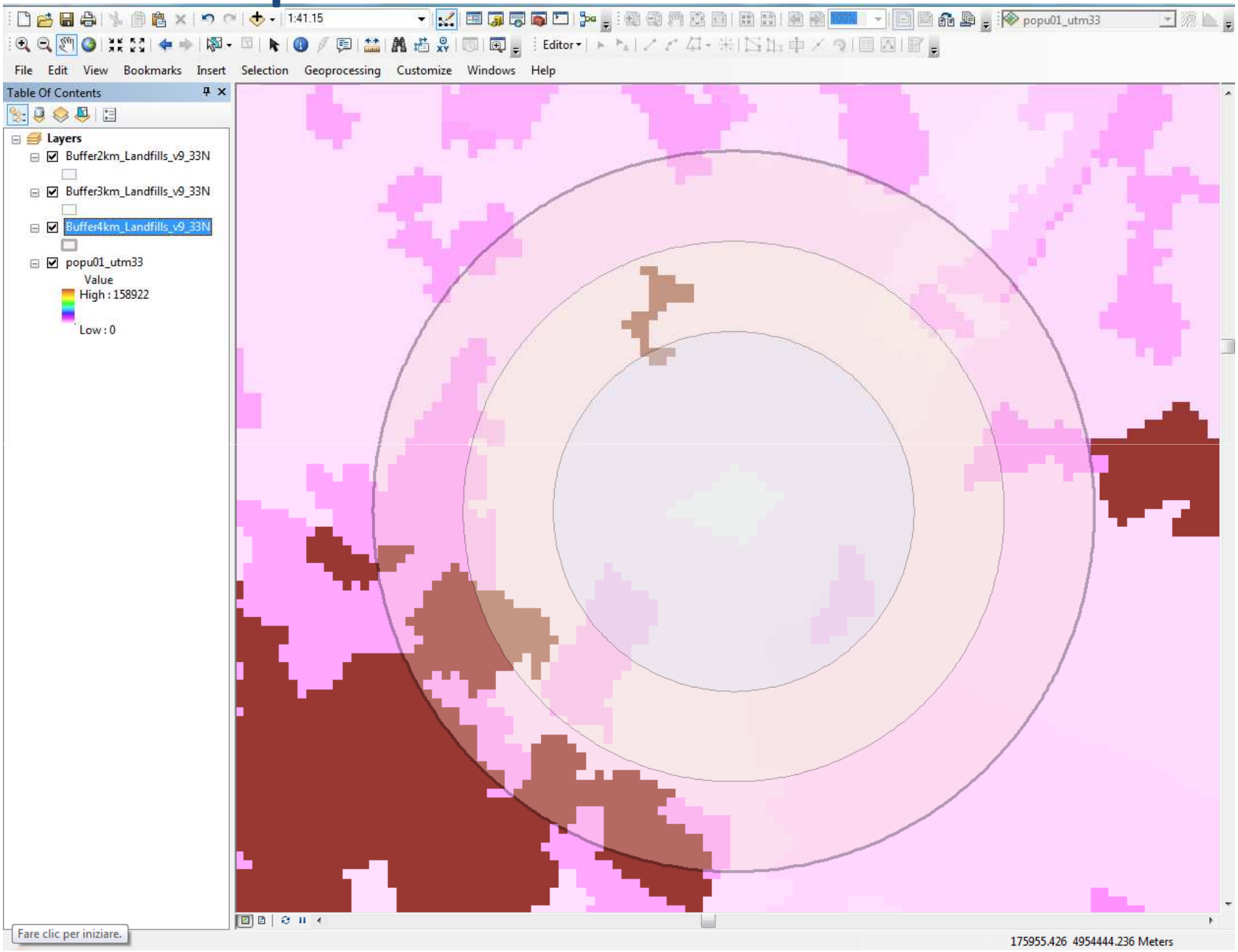
Population data

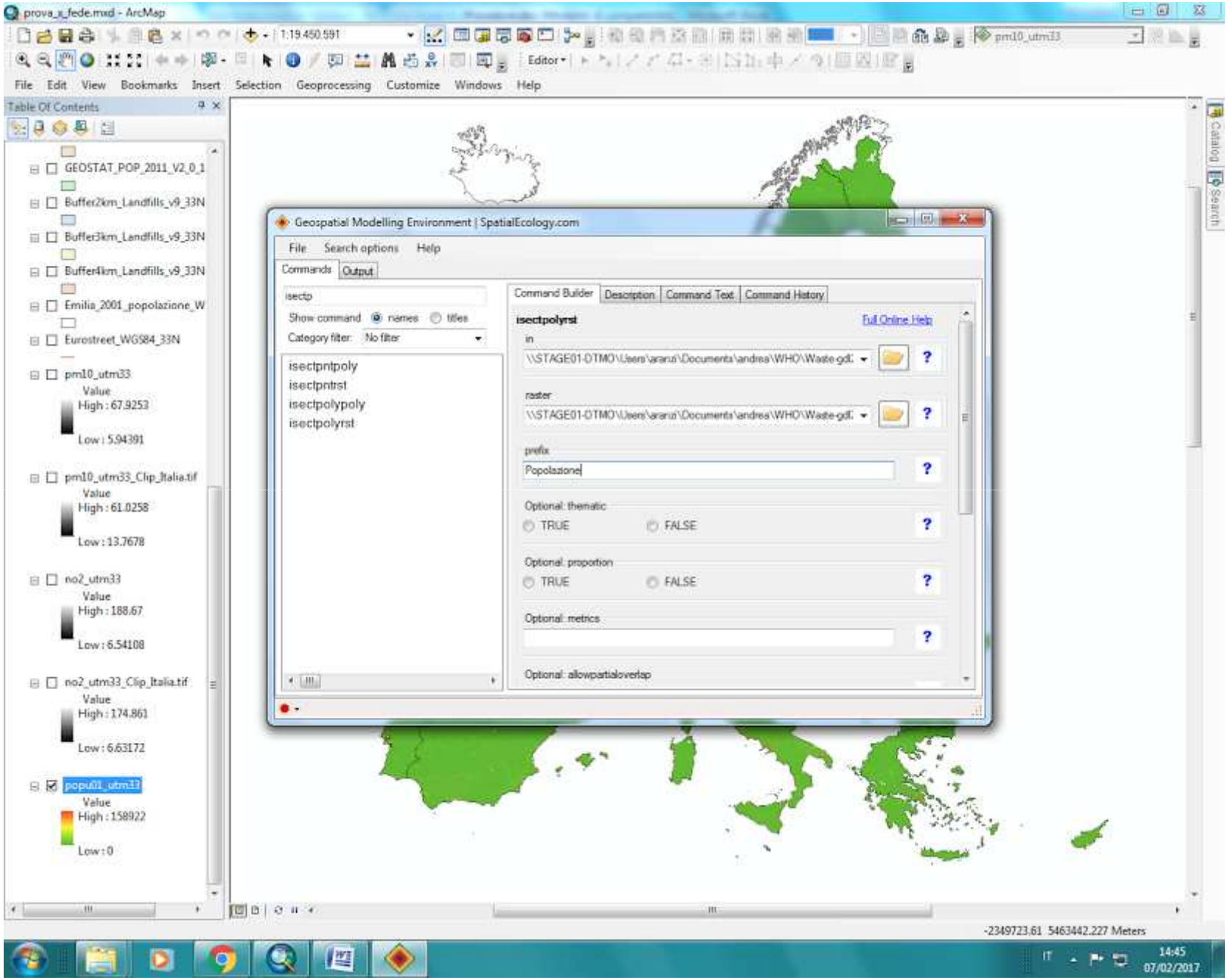


How to calculate exposed people

- ArcGIS function: “Clip” raster to select squares, then calculation of sum of values

- GME free package (http://www.spatialecology.com/gme/, ArcGIS and R are required in your PC)
  - Function: isectpolyrst(in=*polygon shapefile with buffers*, raster=*rasterfile with population*, prefix="Pop", metrics=c("CNT","SUM","MEAN","STD"), allowpartialoverlap=TRUE);

At the end, each population number has to be divided by 100 (as it represents 1x1 km density on 100x100 m, see Gallego et al.)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Buffer4km_Landfills_v9_33N
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Geospatial Modelling Environment | SpatialEcology.com
File Search options Help
Commands Output
isectp
Show command names titles
Category filter: No filter
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isectpntrst
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Command Builder Description Command Text Command History
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Full Online Help
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TRUE FALSE
Optional: metrics
Optional: allowpartialoverlap
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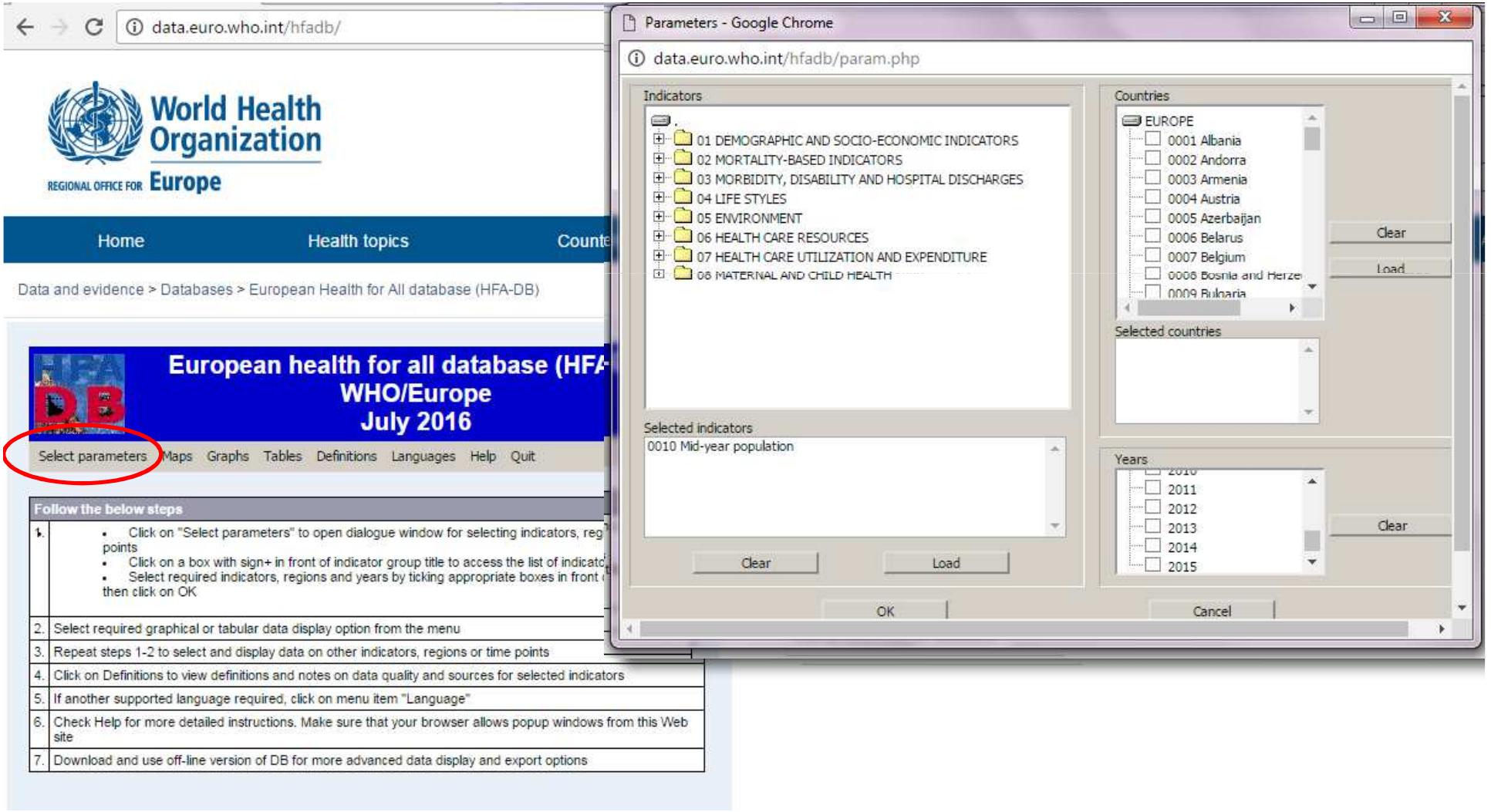
07/02/2017

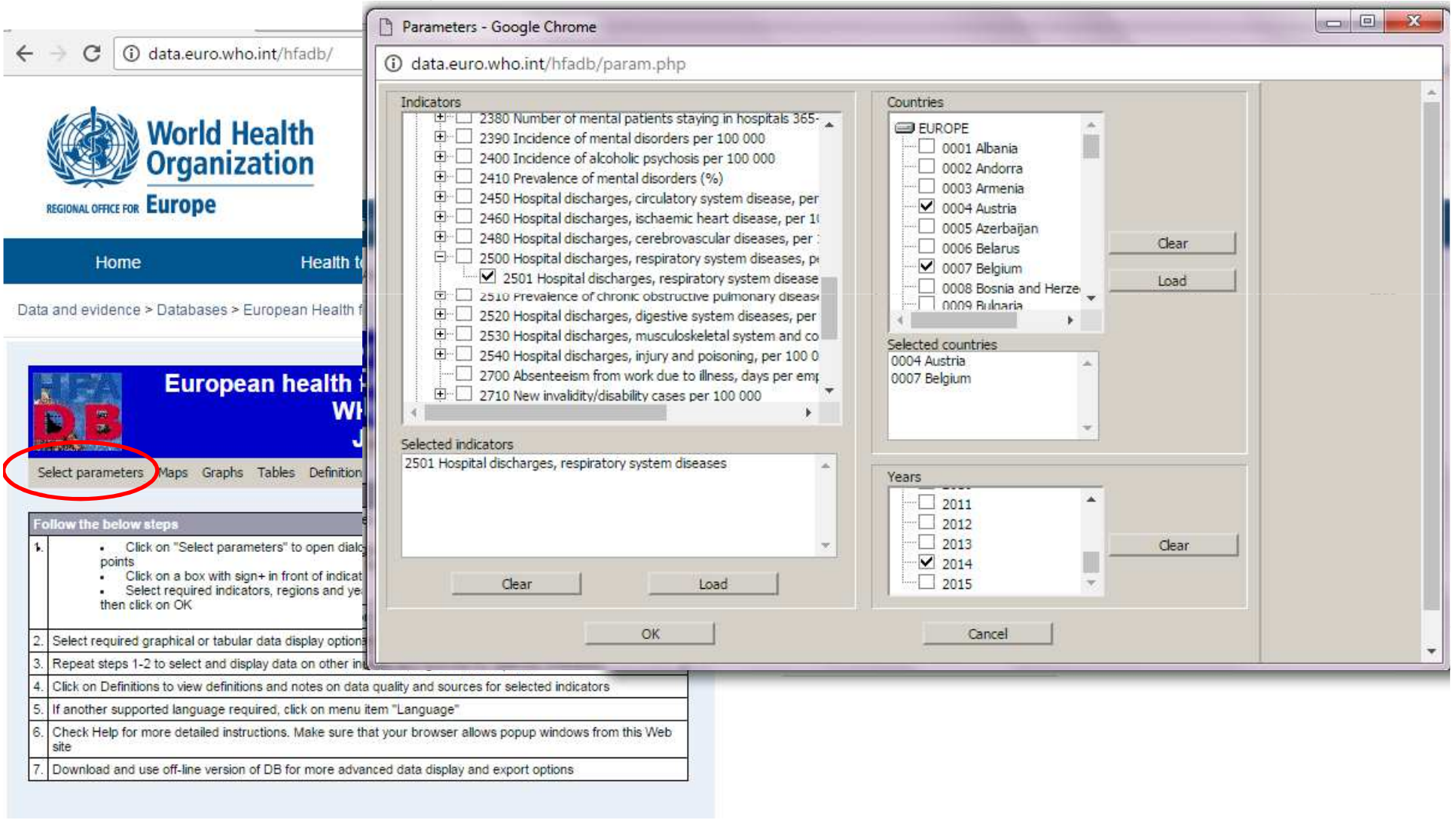
Health for All Database

(http://data.euro.who.int/hfadb/)

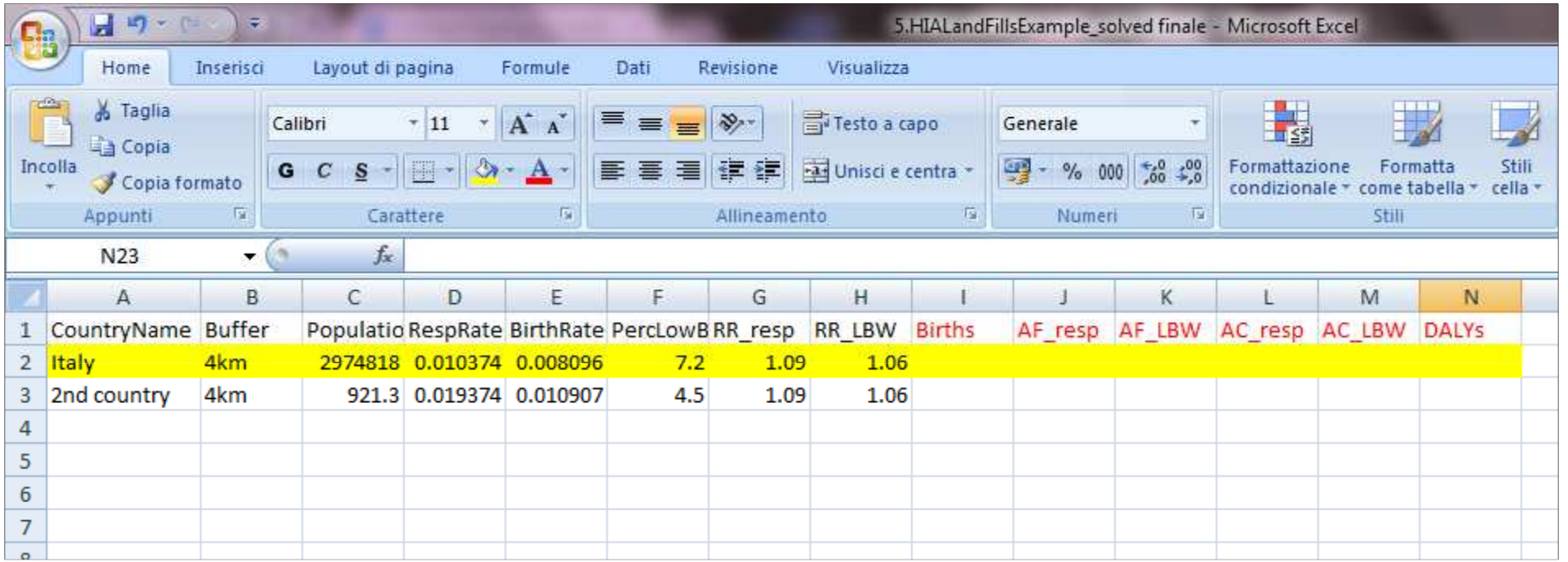


Health for All Database

(http://data.euro.who.int/hfadb/)



Input file



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	CountryName	Buffer	Populatio	RespRate	BirthRate	PercLowB	RR_resp	RR_LBW	Births	AF_resp	AF_LBW	AC_resp	AC_LBW	DALYs
2	Italy	4km	2974818	0.010374	0.008096	7.2	1.09	1.06						
3	2nd country	4km	921.3	0.019374	0.010907	4.5	1.09	1.06						
4														
5														
6														
7														

Istruzioni per l'esercizio

- Calcolare almeno le stime per l'Italia e un altro stato
- Creare una nuova colonna e calcolare il totale dei nati, usando le informazioni sul birth rate
- Calcolare i 2 AF usando i rischi relativi riportati (RR)
- Creare nuove colonne per AC_lbw e AC_resp
- Calcolare AC_lbw e AC_resp usando la formula:

$$AC = AFexp * Ratepopgen * Popexp$$

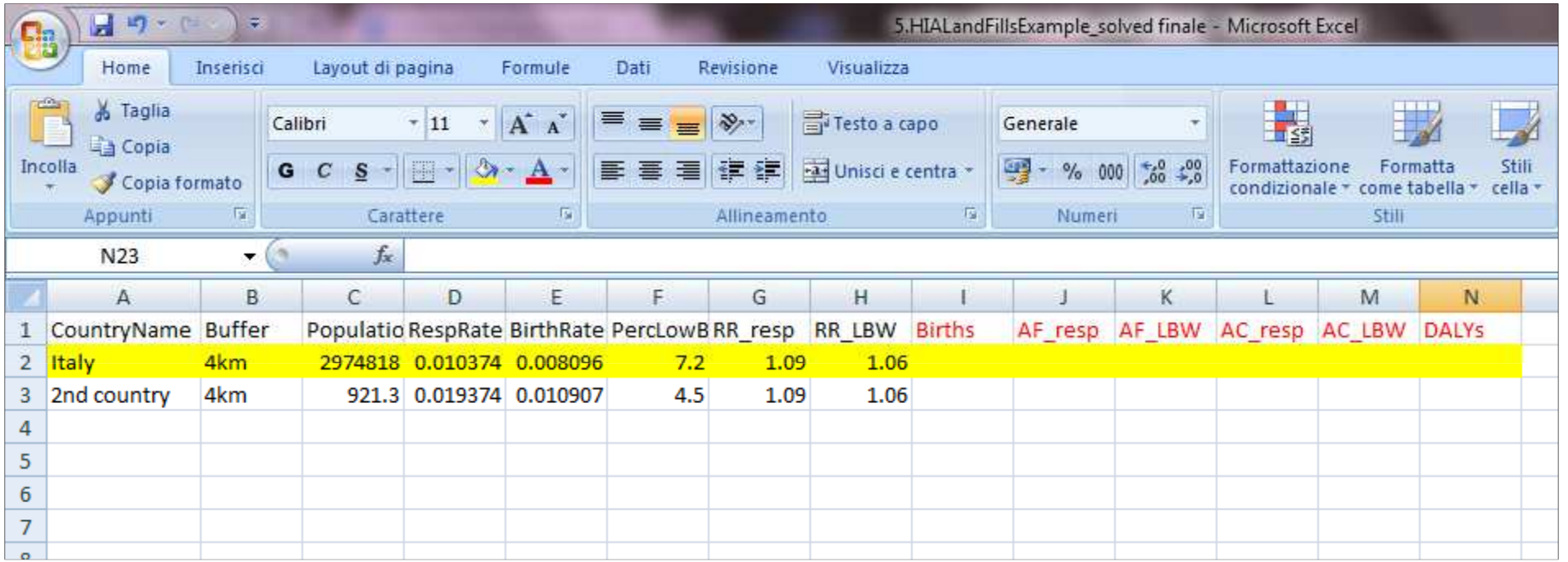
- Creare una nuova colonna per i DALYs
- Calcolare i DALYs usando la formula:

$$DALYs = AC * DW * L$$

Variables you have to create

Decription	Formula
Births: popolazione esposta per l'outcome LBW	total population * birth rate
AF_resp: frazione attribuibile per le malattie respiratorie	(RR_resp – 1)/RR_resp
AF_LBW: frazione attribuibile per basso peso alla nascita	(RR_LBW – 1)/RR_LBW
AC_resp: casi attribuibili per le malattie respiratorie	AF_resp*Resprate* population
AC_LBW: casi attribuibile per il basso peso alla nascita	AF_LBW*(perc_LBW/100)*Births
DALYs: numero totale di DALYs per entrambi gli outcome di salute	$\sum_{i}^{resp,lbw} AC_i * DW_i * L_i$ Resp: DW=0.08 ;L=1 LBW: DW=0.106;L=79.6

Risultati



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	CountryName	Buffer	Populatio	RespRate	BirthRate	PercLowB	RR_resp	RR_LBW	Births	AF_resp	AF_LBW	AC_resp	AC_LBW	DALYs
2	Italy	4km	2974818	0.010374	0.008096	7.2	1.09	1.06						
3	2nd country	4km	921.3	0.019374	0.010907	4.5	1.09	1.06						
4														
5														
6														
7														

Exp_LBW	AF_resp	AF_LBW	AC_resp	AC_LBW	DALYs
24083	0.082569	0.056604	2548	98	1032

Towards an assessment of the health impact of industrially contaminated sites: waste landfills in Europe

Gavin Shaddick,[1] Andrea Ranzi,[2] Matthew L. Thomas,[3] Roman Aguirre-Perez,[1] Maria Bekker-Nielsen Dunbar,[4] Federica Parmagnani,[2] Marco Martuzzi[5]

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[2] Environmental Health Reference Centre, Regional Agency for Prevention, Environment, and Energy of Emilia-Romagna, Modena (Italy)
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[4] Emergency Response Department, Public Health England, Porton Down (UK)
[5] World Health Organization, European Centre for Environment and Health, Bonn (Germany)

Table 1 below shows the outcomes that can be considered in the assessment for landfills:

Exposure buffer	Exposure index	Health outcome	Health risk	Metrics*	Ref.
2 km	Distance	- congenital anomalies	Relative risk (RR) = 1.02 (99%CI = 1.01-1.03)	I.C.	Elliott et al. 2001
		- annoyance from odour	5.4%**	P.	Herr et al. 2003
		- low birth weight	RR = 1.06 (99%CI=1.052-1.062)	I.C.	Elliott et al. 2001
5 km	H_2S (disp.model)	- respiratory diseases	RR = 1.09 (95%CI 1.00-1.19)	P.	Golini et al. 2016

* I.C. = cumulative incidence on the simulation period (2004-2020); P. = annual prevalence
** Confidence intervals are not available, because this value refers to data from questionnaires

Table 1. Exposure and health outcome metrics used for health impact assessments for landfills

The general formula of attributable cases (AC) can then be applied:

$$AC = AFexp \cdot Ratepopgen \cdot Popexp$$

where $AFexp = (RR - 1)/RR$ is the attributable fraction in exposed people, $Rategenpop$ is the background population incidence rate (proxy of rate in unexposed people) and $Popexp$ is the exposed population.

AC can also be converted to Disability Adjusted Life Years (DALYs), using the formula:

$$DALY = AC \cdot DW \cdot L$$

where AC is attributable cases, DW is the disability weight and L is the disease duration.

E-PRTR: DATI DISPONIBILI

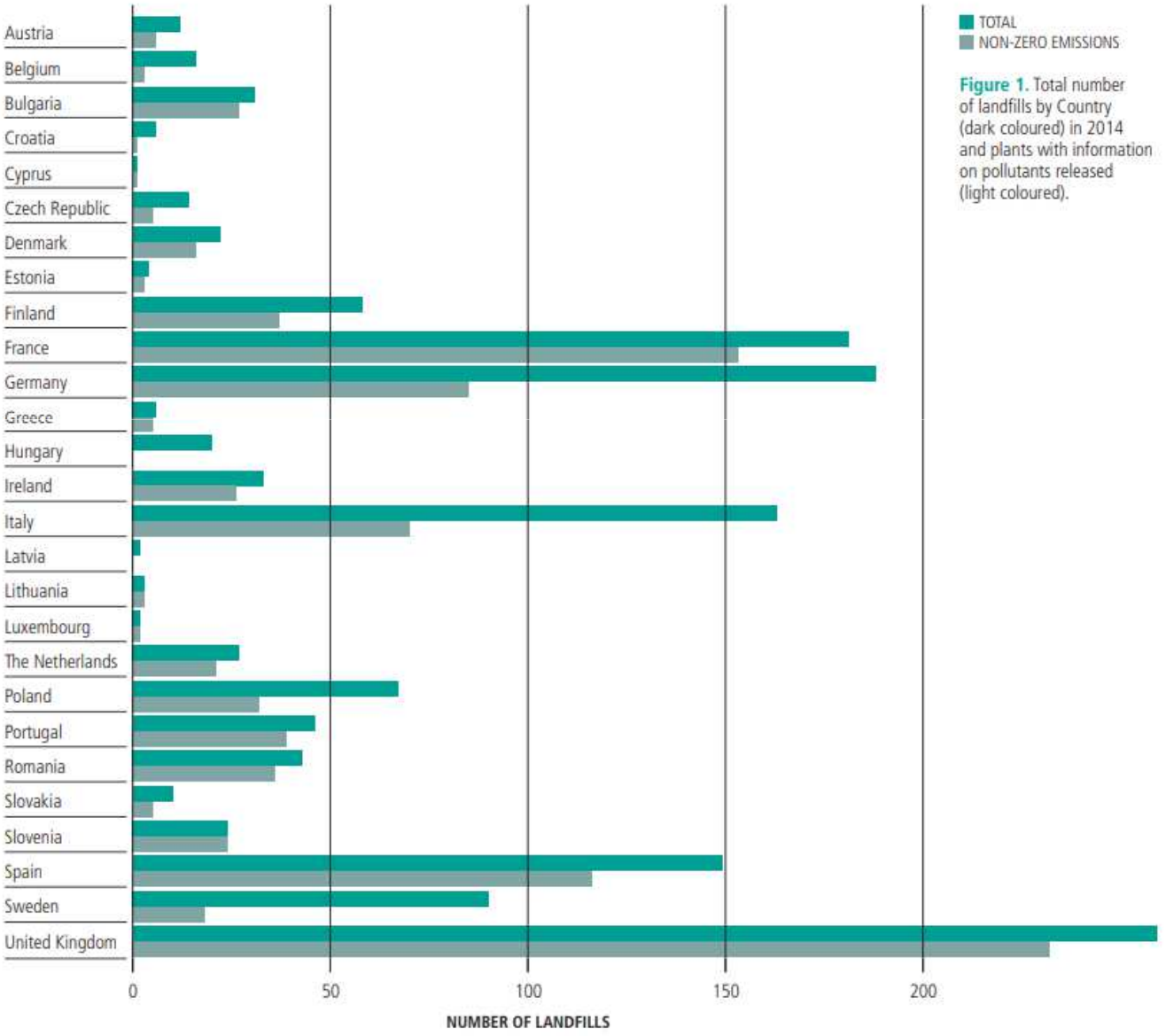

Figure 1. Total number of landfills by Country (dark coloured) in 2014 and plants with information on pollutants released (light coloured).

Towards an assessment of the health impact of industrially contaminated sites: waste landfills in Europe

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HEALTH OUTCOME	RISK MEASURE	DISABILITY WEIGHT	DURATION (YEARS)
Low birth weight	RR: 1.06 (99% CI: 1.052-1.062)*	0.106	79.6
Congenital anomalies	RR: 1.02 (99% CI: 1.01-1.03)*	0.170	79.6
Respiratory diseases	RR: 1.05 (95% CI: 1.01-1.08)**	0.080	1.00
Annoyance from odour	Prop: 5.4%^	0.030	1.00

RR: relative risk; Prop: proportion of affected * Exposure represented by 0-2 km ** Exposure represented by 0-5 km ^ Proportion based on data from questionnaires, confidence interval not available

Table 1. Risks, disability weights, and duration of disease for four health outcomes used in calculations of the health impacts associated with landfill sites. (See Ranzi et al. for details)[6]

It is estimated that 29,308,192 people in the EU (approximately the 6% of the total population) live within 4 km of the 1,476 waste landfill sites here considered.

HEALTH OUTCOME	ACs (95%CI)	DALYs (95%CI)
Low birth weight	1,239 (1,110-1,307)	10,192 (9,371-11,030)
Congenital anomalies	70 (36-106)	958 (496-1,437)
Respiratory diseases	33,039 (0-63,829)	2,688 (0-5,106)
Annoyance from odour	1,582,624 (1,455,545-1,720,710)	47,505 (43,666-51,621)
Total	1,616,972 (1,487,370-1,759,540)	61,325 (56,618-66,265)

ACs: attributable cases; DALYs: disability adjusted life years

Table 2. Estimated health impacts (excess cases and DALYs) for the four health outcomes: medians and 95% confidence intervals from Monte Carlo simulations.

DISCUSSIONE

- Punti di forza

- Punti deboli