WASABY

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WAter and Soil contamination and Awareness on Breast cancer risk in Young women

D7.2 Report on environmental data available for spatial analysis

Alessandro Borgini, Martina Bertoldi, Andrea Tittarelli and Paolo Contiero

V1 – 31 October 2019

Co-funded by the Health Programme of the European Union

EU funding disclaimer: This project has received funding from the 3rd European Union Health Programme 2014-2020 under Grant Agreement PP-2-5-2016 (# 769767)

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1. Introduction

The aim of the Wasaby project is to link water and soil pollution to the breast cancer diagnosis in young women, in the setting of epidemiological studies for public health.

The specific aim of the report D7.2 is to evaluate the availability and the usefulness of environmental electronic databases, to quantify the exposure of people to pollutants, in this case young women.

The availability of environmental databases is primary useful to investigate possible associations between environmental exposure to pollutants and population health status.

Data estimated by the EEA (European Environment Agency, Progress in management of contaminated sites (CSI 015), 2007) suggest that the number of sites where potential toxic substances have been heavily released by human activities in the EU is approximately 2.5 million. Of these sites, 342,000 might be in very critical conditions, and effective measures of ecological remediation should be urgently implemented [Wcisło E, Environ Int, 2016].

The main sources of chemical contamination of soils and water are industry, agriculture, oil refineries, power stations, mining, road transport, domestic activities, waste-disposal, incineration and other waste treatments. Interestingly, chemical contamination of the environment can also occur through natural processes, such as corrosion, atmospheric deposition, soil erosion, leaching, sediment re-suspension and evaporation of many chemicals. Moreover, events such as weathering and volcanic eruptions have also been reported to significantly contribute to promote hazardous exposures to chemical pollution, for example to metals [Tchounwou PB, EXS, 2012].

The dispersion of these pollutants from their anthropogenic sources or natural reservoirs to soil and groundwater is one of the most difficult processes to explore. One of the most important problems about natural and anthropogenic contamination is that it frequently moves from one environmental compartment into another: a process called “cross-media transfer”.

For this reason, soil and water pollutants are highly connected, so that the toxicants found in both matrices are qualitatively and quantitatively overlapping.

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Heavy metals and organic compounds are the most frequent contaminants found both in soils and groundwater [JRC, EEA, The State of Soil in Europe, 2012].

In the first phase of the WASABY WP7 activity we reviewed the most important epidemiologic articles related to the relative risk of breast cancer and exposure to environmental pollutants identified as mammary carcinogens or compounds that alter the endocrine system, especially contaminants that persist for a long period in the different environmental matrices (air, water, soil and sediments), usually defined as POPs (Persistent Organic Pollutants), such as PCBs, DDT, dioxins, PAHs, heavy metals.

WP7.2 is focused on the identification of specific databases useful for epidemiological analysis containing European environmental monitoring data of the main environmental contaminants that persist in water and soil matrices, in particular POPs and heavy metals.

Many environmental data (monitoring, concentration of the specific contaminant, etc.) are fortunately often made available to the public through various national and international databases. Many regional, national and governmental environmental agencies (EPA, EEA, etc.) regularly collect each year data on air, water and soil contamination. If they are collected together with the relevant spatial references, most of these data can be modelled using Geographic Information Systems tools and methods.

Moreover, databases collecting emission values due to the presence of point sources, such as industrial sites, landfills and other productive activities, are available through the Environmental European Agency.

In this report we show the main and most important databases on environmental data available for spatial analysis via GIS.

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2. Environmental databases available

In order to identify possible environmental data sources already available we have found several online local, national and international open source databases visible in table 1. In this report we will describe and analyze in brief characteristics about all the considered databases.

These databases can be divided in two categories:

- databases collecting water and soil quality measures;
- databases collecting pollution emission values due to the presence of point sources, such as industrial sites, landfills and other productive activities.

Furthermore, we have identified a European platform (IPCheM) that provides a systematic collection of environmental databases produced at local, national and European level, in the context of European projects or in compliance with national or European environmental regulations.

The data collected from all the databases that we are going to analyze are to be considered net of a tolerance interval (error) that is explained for each measure and each contaminant.

Both the databases collecting measured concentration data or measured emission data also contain exposure maps to contaminants obtained through the use of statistical-mathematical models described each time in each database.

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Tab. 1 – Principal Environmental Databases

Name	Argument	Web address	Organization	Countries* included	Years covered
Waterbase - Water Quality	Water quality data	https://www.eea.europa.eu/data-and-maps/data/waterbase-water-quality-2	EEA's databases	38	2000 - 2016
FOREGS Geochemical Atlas of Europe	Soil quality data	http://weppi.gtk.fi/publ/foregsatlas/	FOREGS	26	1998 - 2002
LUCAS TOPSOIL	Soil quality data	https://esdac.jrc.ec.europa.eu/content/lucas-2009-topsoil-data	JRC	28	2009-2012
E-PRTR	Emission Data of Industrial sites	https://prtr.eea.europa.eu/#/home	EEA's databases	33	2007-2017
IPCHEM Information Platform for Chemical Monitoring	Air, Water, soil, quality data	https://ipchem.jrc.ec.europa.eu/RDSIdiscovery/ipchem/index.html	Different EEA's databases and other databases	38	1980- 2017

*All the Wasaby countries (France, Germany, Italy, Lithuania, Poland, Portugal, Spain, Northern Ireland, Slovenia) are covered by the different databases.

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Table 2 shows the available data regarding the main organic and inorganic persistent contaminants that we considered as prior in the relationship with breast cancer through articles visible in the following link:

http://www.wasabysite.it/material/D7.1_WASABY_Literature_Review.pdf

Tab. 2 – Principal pollutants indicators available

Pollutants	Unit of measurement	Database	Environmental Matrix	Measure periodicity	Spatial resolution
PCBs pcb total (congeners 28, 52, 101, 118, 138, 153, 180)	µg/l, point concentration	Waterbase groundwater **I**PCHEM	Water	annual	Sample points
DDT, DDD, DDE	µg/l, point concentration	Waterbase groundwater **I**PCHEM	Water	annual	Sample points
DDT	Kg/year	E-PRTR industrial point emissions	in Air, Water and Land threshold for releases 1 kg/ year	annual	Emission points
Alachlor	Kg/year	E-PRTR industrial point emissions	Water and Land threshold for releases 1 kg/ year	annual	Emission points
Aldrin	Kg/year	E-PRTR industrial point emissions	in Air, Water and Land threshold for releases 1 kg/ year	annual	Emission points
Gamma-hch (Lindane)	µg/l, point concentration	Waterbase groundwater **I**PCHEM	Water	annual	Sample points
	Kg/year	E-PRTR industrial point emissions	in Air, Water and Land threshold for releases 1 kg/ year	annual	Emission points
Hexachlorobenzene (hcb)	µg/l, point concentration	Waterbase groundwater **I**PCHEM	Water	annual	Sample points
	Kg/year	E-PRTR industrial point emissions	in Air threshold for releases 10 kg/ year	annual	Emission points
			in Water and in land threshold for releases 1 kg/ year	annual	Emission points
Chlordane	µg/l, point concentration	Waterbase groundwater **I**PCHEM	Water	annual	Sample points
PAH benzo(a)pyrene benzo(a)anthracene	µg/l, point concentration	Waterbase groundwater **I**PCHEM	Water	annual	Sample points

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Pollutants	Unit of measurement	Database	Environmental Matrix	Measure periodicity	Spatial resolution
Anthracene	Kg/year	E-PRTR industrial point emissions	in Air threshold for releases 50 kg/ year	annual	Emission points
			in Water threshold for releases 1 kg/ year	annual	Emission points
			in Land threshold for releases 1 kg/ year	annual	Emission points
Triazine atrazine desethylatrazine desisopropylatrazine	µg/l, point concentration	Waterbase groundwater **I**PCHEM	Water	annual	Sample points
Atrazine	Kg/year	E-PRTR industrial point emissions	in Water threshold for releases 5 kg/ year	annual	Emission points
		E-PRTR industrial point emissions	in Land threshold for releases 5 kg/ year	annual	Emission points
Cadmium	µg/l, point concentration	Waterbase groundwater **I**PCHEM	Water	annual	Sample points
	mg/kg, area concentration	Geochemical Atlas of Europe	Soil	2008	4.700 km²
	mg/kg, area concentration	LUCAS topsoil database	Soil	2009 and 2012	200 km² for one sample
	Kg/year	E-PRTR industrial point emissions	in Air threshold for releases 10 kg/ year	annual	Emission points
		E-PRTR industrial point emissions	in Water threshold for releases 5 kg/ year	annual	Emission points
		E-PRTR industrial point emissions	in Land threshold for releases 5 kg/ year	annual	Emission points
PCDD (dioxins	Kg/year	E-PRTR industrial point emissions	in Air, Water and land threshold for releases 0,0001 kg/ year	annual	Emission points
Trihalomethanes (THMs) bromoform bromo-dichloro-methane dibromochlorometha ne chloroform	µg/l, point concentration	Waterbase groundwater **I**PCHEM	Water	annual	Sample points

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2.1 Waterbase - Water Quality

General description

Waterbase Water Quality is the generic name given to the EEA's databases on the status and quality of Europe's rivers, lakes, groundwater bodies and transitional, coastal and marine waters, on the quantity of Europe's water resources, and on the emissions to surface waters from point and diffuse sources of pollution.

The dataset contains time series of nutrients, organic matter, hazardous substances and other chemicals in rivers, lakes and groundwater, as well as data on biological quality elements (BQEs) such as phytobenthos and macroinvertebrates in rivers and lakes. A list of monitoring site identifiers with selected attributes, reported through WFD (EU Water Framework Directive) and WISE (Water Information System for Europe) spatial data reporting, is added to the dataset as spatial reference. The data have been compiled and processed by EEA.

Sampling methods are strictly standardized. This standardization is very important because it allows to perform environmental spatial analyses in different territories at local, national and European level.

The data concerning deep waters at European level provide geo-referenced GIS (Geographic Information System) maps that indicate the concentration of the organic and inorganic contaminant required, the specific site for the detection of the contaminant, and the sampling period. The entire database is available at the following link:

https://www.eea.europa.eu/data-and-maps/data/waterbase-water-quality-2

The data series are calculated as the average of the annual average concentrations in Europe for underground water bodies / river stations / lake stations.

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Monitoring Reasons

Waterbase contains data on nutrients, organic matter, hazardous substances and other chemical substances in surface water and groundwater. It also includes biological data in rivers and lakes, which is reported as ecological quality ratios (EQRs). The data was delivered between 2000 and 2016 by EEA member countries and cooperating countries, in the scope of the current WISE SoE - Water Quality (WISE-4) reporting obligation and River quality (EWN-1), Lake quality (EWN-2) and Groundwater quality (EWN-3) reporting obligations. The national data deliveries are compiled by ETC/ICM into a European-wide Waterbase. The data are used for EEA core set indicators that assess the state, trends in water related pressures and that monitor the progress of European policy objectives.

Sampling and Analytical data info

Within the Waterbase Water Quality we also find a list of organic and inorganic chemicals that we can select in interactive and georeferenced maps, together with sampling point, sampling period and values expressed in concentration (unit of measure µg/l and/or mg/l).

Number of environmental contaminants

In this specific Waterbase Water Quality we have a data set of almost 860 pollutants between organic and inorganic.

Uses for epidemiologists and cancer registries

This database, responding to the Water Quality (WISE-4) reporting obligation, through periodic and systematic sampling, collects a considerable amount of data with an excellent geographical coverage in many areas of the European Union and it represents a valid instrument to conduct epidemiological studies. However, the sampling point geographic distribution is not uniform and some areas may be lacking information.

Waterbase also contains several maps describing pollutants' dispersion in aquifers and soils, with a resolution of 1 km^2. These maps are created using validated and explicit dispersion models in the metadata documents present for each map.

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2.2 Geochemical Atlas of Europe

General description

The FOREGS Geochemical Baseline Mapping Programme's main aim is to provide high quality, multi-purpose environmental geochemical baseline data for Europe. The FOREGS geochemical basic mapping program was launched in 1998 to supply high quality environmental geochemical background data in Europe. Geological surveys and related institutions from 26 european countries took part in the mapping program. During five working years (1998-2002), several data archives were created at European level.

The FOREGS database and materials archives include:

- ✓ archived sampling materials (soil, subsoil, flood plains and sediment of streams and humus) preserved at the Geological Service of the Slovak Republic;
- ✓ field observation sheets;
- ✓ work maps;
- ✓ Microsoft Access database for field observations;
- ✓ analytical data files;
- ✓ databases of combined fields and analytical data;
- ✓ GIS levels;
- ✓ maps and work tables;
- ✓ collections of photographs in the field and a digital photo archive.

The Geological Survey of Finland (GTK) was responsible for database management and map production for the FOREGS group. The methods of data management and map production were selected in the seminars of the database management group.

The verification and validation of the data was carried out by each participating country.

In total, 360 geochemical maps were prepared showing the distribution of elements throughout Europe. All results and field observations are organized in a common database and the maps are published as the Geochemical Atlas of Europe. All sampling sites were photographed and the photo archive is also available. The samples were archived in the Slovak Republic for possible future use. Initial results show that the distribution patterns of both water samples and solid samples are related to factors such as large-scale tectonic provinces, the geochemical variation of large lithological units, the extension of the Weichselian glaciation and reflecting contamination, industrialized areas and regions of intensive agriculture.

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Monitoring Reasons

Data on geochemical baselines are urgently needed in Europe, because environmental authorities in most countries define limits for contaminants in soils for different land use purposes. At the same time, the Commission of the European Union (EU) is preparing the Soil Protection Directive. As geochemists know, the natural concentrations of elements are different in the different constituents of overburden, and they also vary markedly between geologically disparate areas. State authorities, however, are not always aware of such significant natural variations which should be taken into account in defining action limits. There are already examples of action limits that are lower than natural concentrations.

The choice of sample monitoring media was taken in accordance with the recommendations of the IUGS/IAGC Working Group on Global Geochemical Baselines (Darnley et al. 1995). Such media, described below, are considered to be the most representative of the Earth's surface environment, and they are the most commonly used in past and current environmental geochemical investigations, as follows:

- Stream water (filtered and unfiltered);
- Stream sediment - mineral sediment (<0.150 mm);
- Residual soil - upper 0-25 cm horizon (topsoil) without the top organic layer (<2 mm);
- Residual soil - lower (C) horizon (subsoil); a 25 cm layer within a depth range of 50-200 cm (<2 mm);
- Humus (where present);
- Overbank sediment - upper 0-25 cm horizon (<0.150 mm, optional);
- Overbank sediment - bottom layer (<0.150 mm, optional);
- Floodplain sediment - upper 0-25 cm horizon (<2 mm);
- Floodplain sediment - bottom layer (<2 mm, optional).

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Sampling and Analytical data info

A wide range of sampling densities were employed across the FOREGS region, reflecting different survey objectives. Stream sediment survey densities range from 1 sample per < 1 sample per 2.5 km^2 in Albania, Germany and the UK) to very low densities in Finland and Romania (1 sample per 290 km^2 and 1 sample per 2000 km^2 respectively). In general, soil survey sampling densities follow similar trends to those of stream sediments ranging from 1 sample per < 1 km^2 in France and Portugal to 1 sample per 3500 km^2 in Estonia. Most soil surveys were conducted in the range 1 sample per 5 km^2 to 1 sample per 25 km^2

Over 50 elements and other parameters (such as pH and granulometry) were determined on the particle size fraction <2 mm of the minerogenic samples and the total concentrations of organic soil samples were measured after using a strong acid digestion. Nine European geological survey laboratories carried out the analytical work.

Number of environmental contaminants

In this FOREGS database we have a data set of 60 inorganic pollutants and heavy metals.

Uses for epidemiologists and cancer registries

In total, 360 geochemical maps have been produced and spatial correlations have been found between the underlying geology and element abundances in the sampled media. The aim of the Geochemical Atlas is to document background/baseline chemical element variation at the national scale. It is found to be a suitable tool to investigate the possible correlation between soil composition and health outcomes.

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2.3 LUCAS topsoil database

General description

LUCAS topsoil database is part of the wider European Soil Data Center (ESDAC) https://esdac.jrc.ec.europa.eu/ i.e., the thematic centre for soil-related data in Europe, and it is its ambition to be the single point of reference for European soil. It contains a number of resources that are organized and presented in various ways: datasets, services/applications, maps, documents, events, projects and external links.

Monitoring Reasons

The LUCAS Topsoil Survey of the European Union opened new possibilities to acquire detailed monitoring information on the soil cover in Europe, including heavy metal content. With its 1 site/ 200 km^2 sampling density, it allows modelling and monitoring of soil resources on a finer scale than any other previous attempt. This detail of sampling is adequate to create continuous maps for reliable spatial representation at 1 km resolution (Hengl, 2006) of heavy metals in topsoil of Europe.

Sampling and Analytical data info

Over 23,000 topsoil samples (upper 20 cm) were collected from the land of the European Union (EU) Member States (EU-28 except Croatia) with the aim to produce the first coherent baseline topsoil database for continental scale monitoring (Tóth et al., 2013). Sampling was performed in two campaigns, in 2009 and in 2012. The soil sampling was undertaken within the frame of the Land Use/Land Cover Area Frame Survey (LUCAS), an EU wide project that monitored changes in management and character of the land surface (Eurostat, 2015).

Number of environmental contaminants

The LUCAS topsoil database includes a data set of the following heavy metals: As, Cd, Cr, Cu, Pb, Zn, Sb, Co and Ni.

Uses for epidemiologists and cancer registries

With its 1 site/ 200 km^2 sampling density, LUCAS allows modelling and monitoring of soil resources on a finer scale than any other previous attempt. This detail of sampling is adequate to create continuous maps for reliable spatial representation at 1 km resolution.

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2.4 European Pollutant Release and Transfer Register E-PRTR

General description

The European pollutant release and transfer register (E-PRTR) is the European register (*https://prtr.eea.europa.eu/#/home*) providing key environmental data that are easily accessible from industrial facilities in EU Member States and Iceland, Liechtenstein, Norway, Serbia and Switzerland. E-PRTR has replaced and improved the previous European pollutant emission register (EPER).

The new register contains data reported each year by over 30,000 industrial facilities covering 65 economic activities across Europe.

For each facility, information is provided on the amounts of pollutant emissions to air, water and land, as well as off-site transfers of waste and pollutants to wastewater from a list of 91 key pollutants including heavy metals, pesticides, greenhouse gases and dioxins for the years starting in 2007.

Some information is also available on versions from diffuse sources that will be gradually improved. The register contributes to transparency and public participation in environmental decision-making processes. It implements for the European Community the PRTR protocol of the UNECE (Economic Commission for Europe of the United Nations) of the Aarhus Convention on access to information, public participation in decision-making processes and access to justice in environmental matters.

Monitoring Reasons

In 2006 the E-PRTR Regulation N° 166/2006 established a register (see the link: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:033:0001:0017:EN:PDF#page=8 which requires that the database must include releases of pollutants from diffuse sources, where available. Article 8 of the Regulation establishes that the Commission will include data on releases from diffuse sources which have already been reported by Member States, and will disaggregate the information to an adequate geographical level whilst including information on the methodology used.

When no data on releases from diffuse sources are available, the Commission is required to take action for the initiation of and initiate reporting on diffuse sources.

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The European Commission launched the project. In the E- PRTR project available data on diffuse emissions to water were collected, estimation methods to quantify diffuse emissions were developed and forty maps were prepared, covering the EU Member States and the EFTA countries on a River Basin District sub-unit scale for a selection of key sources and substances. The maps will be integrated in the E-PRTR website (http://prtr.ec.europa.eu/) by the European Commission. In this document, the maps, map descriptions and the fact sheets are put together as a complete background document. In a separate document, the project report and the project results are described.

Sampling and Emission data info

The register contains annual data reported by over 30,000 industrial facilities covering 65 economic activities within the following 9 industrial sectors:

1. energy
2. production and processing of metals
3. mineral industry
4. chemical industry
5. waste and waste water management
6. paper and wood production and processing
7. intensive livestock production and aquaculture
8. animal and vegetable products from the food and beverage sector
9. other activities

Data are provided in the register for 91 pollutants falling under the following 7 groups:

- ✓ Greenhouse gases
- ✓ Other gases
- ✓ Heavy metals
- ✓ Pesticides
- ✓ Chlorinated organic substances
- ✓ Other organic substances
- ✓ Inorganic substances.

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A facility has to report data under E-PRTR if it fulfils the following *criteria*:

- ✓ the facility falls under at least one of the 65 E-PRTR economic activities listed in Annex I of the E-PRTR Regulation N° 166/2006 and exceeds at least one of the E-PRTR capacity thresholds
- ✓ the facility transfers waste off-site which exceed specific thresholds set out in Article 5 of the N° 166/2006 Regulation.
- ✓ The facility releases pollutants which exceed specific thresholds specified for each media - air, water and land - in Annex II of the E-PRTR N° 166/2006 Regulation.

Data are reported by individual facilities to the relevant competent authorities on an annual basis. The respective authorities in the countries compile and check the quality of the reported data. The data are then provided to the European Commission and the European Environment Agency for compilation and dissemination on this E-PRTR website. Detailed information on the reporting procedures and content is available in the E-PRTR Guidance Document.

The model allows to visualize interactive maps using Geographic Information System (GIS) to identify releases of different atmospheric pollutants, allowing them to enlarge their neighbourhood.

This include, for example, emissions of nitrogen oxides (NO_X), sulfur oxides (SO_2), carbon dioxide (CO_2), ammonia (NH_3) and particulate matter (PM_{10}). The maps integrate the existing data on the emissions of the individual industrial plants from the European register of emissions and transfer of pollutants (E-PRTR).

Number of environmental contaminants

We have 91 pollutants between organic and inorganic in the E-PRTR.

Uses for epidemiologists and cancer registries

Data interpolation models allow the construction of pollutant emission maps. In E-PRTR the emissions maps are allocated using GIS overlay techniques for distribution into grid cells with a spatial resolution of 5x5km².

The dataset is then transformed into vector polygons and projected into the E-PRTR WGS84 standard projection.

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2.5 – IPCheM - Information Platform for Chemical Monitoring

General description

The European information platform for chemical monitoring (IPCheM https://ipchem.jrc.ec.europa.eu) is the reference point of access to discover collections of chemical monitoring data that are managed and available for European Commission bodies, Member States, international organizations and national and research communities.

In particular, IPCheM receives data from the Water Information System for Europe (WISE: https://water.europa.eu/freshwater) where, inter alia, monitoring data on PS produced by the EU Member States are collected.

The platform aims to support a more coordinated approach to collecting, storing, accessing and evaluating data on the occurrence of chemical substances and chemical mixtures, in relation to humans and the environment. This would help identify the links between exposure and epidemiological data in order to explore potential biological effects and lead to better health outcomes.

IPCheM is not a centralized database platform but a distributed infrastructure. This means that data owners / suppliers remain responsible for their data. The "Technical Survey" collects the preliminary information necessary to integrate a data collection in IPCheM and it identifies the best solution to access or host the data in IPCheM.

The main objectives of the IPCheM platform are:

- ✓ to assist policy makers and scientific communities to discover and access existing and future chemical occurrence data through various matrices and media;
- ✓ hosting of data currently not easily accessible (e.g. results of EU research projects, off-line archived monitoring data, etc.), including data on new, emerging and less studied chemicals that will be accessible through the platform;
- ✓ to provide chemical quality monitoring information defined on spatial, temporal, methodological and metrological traceability. Taking these objectives into account, IPCheM was designed and implemented as a distributed infrastructure (web portal and related tools) providing remote access to existing chemical monitoring data whenever possible. At the same time, it offers data hosting capabilities if requested by data providers / data owners.

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Data collections in IPCheM are grouped into four thematic modules, which represent the main media in which it is possible to find chemicals.

These modules are:

- ✓ Environmental monitoring data
- ✓ Indoor air and product monitoring data
- ✓ Human biomonitoring data
- ✓ Food and feed monitoring data

Monitoring Reasons

The European information platform (IPCheM) defines and formulates the principles and conditions that govern the supply, management, access, use and reuse of chemical monitoring data and metadata recoverable through the IPCheM platform, to increase accessibility and facilitating wider use and recombination, through and beyond the thematic modules of IPCheM in order to better understand the general exposure of the environment and people to chemicals and chemical mixtures. It establishes rules for effective and efficient implementation of these principles and conditions applicable to chemical monitoring data and metadata recoverable through the IPCheM platform. It promotes transparency and good governance practices in order to enable and facilitate a coordinated and integrated approach to access, use and re-use of chemical monitoring data and metadata. It promotes and implements the general principles of free, complete, open and timely access to all types of chemical substance monitoring data where possible, recognizing and respecting the legislative provisions and government guidelines relating to the ownership of the data and the rights of intellectual property that apply to such data.

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Sampling and Analytical data info

The IPCheM platform is designed to allow the search, retrieval and comparison of sampling and chemical monitoring data that can be hosted in one or several databases. In a specific area, a specific chemical pollutant (organic or inorganic) may be searched for and with it the selection of a specific international, national and / or local database (containing measures of concentration of the chemical substance of interest) that contains all the parameters of the required chemical sampling (place, sampling period, concentration detected, environmental matrix of the sampling and legal limits). Furthermore, one may also access the information page on the metadata of the selected databases for an overview of the content (e.g. data monitoring, the methods used for sampling and data analysis, the point of contact, etc.).

Number of environmental contaminants

In IPCheM - Information Platform for Chemical Monitoring we have a data set of hundreds of organic, inorganic pollutants and heavy metals.

Uses for epidemiologists and cancer registries

IPCheM is an invaluable tool for cancer registries that want to quickly assess the feasibility of an epidemiological study in an area of their territory. The opportunity of filtering all data sources by environmental matrix and especially by geographic location, allows to quickly identify the presence of data that can be useful for epidemiological studies. The possibility of selecting databases, including local ones, the result of ad hoc monitoring campaigns or financed studies to investigate particular situations allows to verify if there are sufficient data to perform an epidemiological study.

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3 - Use of E-PRTR (emission database) in the literature

In this paragraph we describe different scientific articles that explain the correlation of some environmental databases, especially emission database, with estimates of population exposure data and possible correlations with health outcomes.

For example, in the study research of **Navarro et al. (2017),** data on industrial pollutant sources (2007-2010) of European pollutant emissions and transfer register (E-PRTR) were used to study cancer exposure to industrial pollution and to describe industrial emissions in the vicinity of Spanish cities. The exposure of the population was estimated using distance between cities and industry structures. They calculated the amount of carcinogens emitted in the air near (<5 km) the cities, showed them on municipal maps and summarized the most relevant results and conclusions reported by ecological E-PRTR based on mortality studies for cancer and industrial pollution in Spain and limits and results interpretations of these types of studies.

The results of the study suggest that those Spanish regions exposed to pollution caused by some types of industrial plants have about 17% cancer mortality in excess compared to those not exposed. Furthermore, excess mortality focuses on digestive system and respiratory tract tumors, leukemia, prostate, mammary and ovarian cancer. Despite their limitations, ecological studies are a useful tool in environmental epidemiology, not only to propose etiological hypotheses on the risk of living near sources of industrial pollutants, but also to provide data to identify specific areas with higher mortality.

The research of **Pistocchi et al. (2019)** built a preliminary inventory of dissolved water emissions of 36 of the 45 chemical priorities substances under the EU Water Framework Directive, 60/2000/EC using the European pollutant emissions and transfer register (E-PRTR) containing the emissions reported by the main industrial sectors. This study estimated the average European chemical emission factors from the available measurements of the dissolved phase concentrations, assuming simple emission patterns such as population and agricultural land.

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In another research, **Shaddick et al. (2018)** developed an assessment method on the health impact of pollution from sites contaminated by the presence of landfills in Europe using the register (E-PRTR) for emissions data for the period 2007-2014. They then combined data on landfill geo-referencing with population density data and disease frequency data in Europe, including available and scientifically proven data such as low birth weight, congenital anomalies, respiratory diseases, the discomfort caused by the smell. 1,544 landfills in Europe were considered, 29.3 million people (6% of the total population) living within 4 km of one or more of these sites. The number of attributable annual cases associated with low birth weight is 1,239 (95% CI 1.110-1.307), the congenital anomalies found are 70 (95% CI 36-106), respiratory diseases are 33.039, (95% CI 0-63.829) and the discomfort caused by the smell was estimated at 1,582,624, respectively (95% CI 1,455,545-1,720,710). These estimates indicate a significant impact on health, the largest due to the discomfort of odours, given the high frequency of the result and despite its lower severity than the others. The present research offers a first approximation of the impact on health of waste landfills in Europe and can be further applied to other contaminated sites.

In another research, **Abente et al. (2012)** designed an ecological study with data on death from the records of the National Statistics Institute and using the data taken from the E-PRTR register. The cause of death studied was that encoded as malignant neoplasm of two points, rectum and anus, ICD-IX codes 153-154, 159.0. They examined the colorectal cancer mortality at a municipal level (8098 Spanish towns), over the period 1997–2006 and conducted an exploratory analysis to estimate the relative risks (RR) of towns situated at a distance of less than 2 km from industrial installations. Statistically significant RRs were detected in the vicinity of mining industry (RR 1.258; 95% CI 1.082-1.463), paper and wood production (RR 1.071; 95% CI 1.007–1.140), food and beverage sector (RR 1.069; 95% CI 1.029-1.111), metal production and processing installations (RR 1.065; 95% CI 1.011–1.123) and ceramics (RR 1.050 ; 95% CI 1.004–1.099).

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Diaz et al. (**2018)** analyzed mortality due to motor neuron disease (MND) and explored the associations of MND to heavy metals released in Spanish river basins. MND deaths were extracted from the Spanish national register for the period 2007-2016. Standardized mortality ratios (SMRs) for MNDs were estimated at the municipal level. The sites that issued quantities of heavy metals above the regulatory thresholds were obtained from the E-PRTR database from the 2007-2015 period. The relative risks for unexposed and exposed municipalities (considering a river downstream of the 20 km section) by type of heavy metal were analyzed using a log-linear model. SMRs were significantly higher in central and northern municipalities. SMRs were higher (1.14; 95% CI 1.10-1.17) in areas exposed to heavy metals compared to unexposed areas (0.95; 95% CI 0.92-0.96). Considering the different metals, we found the following major risks of death from MND in the exposed areas: 20.9% risk for lead, 20.0% for zinc, 16.7% for arsenic, 15.7% for chromium, 15.4% for cadmium, 12.7% for copper and 12.4% for mercury. This study provides associations between risk of death for MND and heavy metals in exposed municipalities. To progress, further studies on exposure to heavy metals are needed to understand MND.

Another ecological study by **Abente et al. (2012)** examined mortality from pleural cancer at municipal level (8098 Spanish cities) in the period 1997-2006 among the populations residing in the vicinity of Spanish industrial facilities conducting an exploratory analysis "near or far" to estimate the relative risks (RR) of the cities located <2 km from the plants. This analysis was repeated for 24 industrial groups. The analysis showed statistically significant RRs in both sexes in the vicinity of 7 of the 24 industrial groups studied (RR, 95% CI), i.e. structures for biocides (2.595, 1.459–4.621), shipbuilding (2.321, 1.379-3.918), production of glass and mineral fibers (1.667, 1.041–2.665), treatment of non-hazardous waste (1.737, 1.077–2.799), zinc plating (1.637, 1.139-2.347), organic chemistry plants (1.386, 1.075–1.782) and the food sector (1.255, 1.006–1.562). These results support the fact that residing near IPPC-registered industries that release pollutants into the air is a risk factor for pleural cancer.

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