



LIFE PHOENIX

Perfluorinated compounds HOlistic ENvironmental Interinstitutional eXperience

LIFE16 ENV/IT/000488

1. ACTION B.4: INNOVATIVE AND INTEGRATED FORECAST TOOLS TO SUPPORT DECISION-MAKING

B.4.1 - NUMERICAL FLUX MODEL

The development of a forecast tool to predict PMOC diffusion on rivers and groundwater (Persistent Mobile Organic Contaminants, PFASs in the present case) for the risk assessment represent one of the main goals of the LIFE PHOENIX project.

Since PFASs diffusion occur mainly through groundwater and runoff flow, the implementation of both hydrological flow and transport models represent an important part of the project; such powerful tool could allow the analysis of the pollutants space-temporal evolution and provides full scientific support for the decision makers.

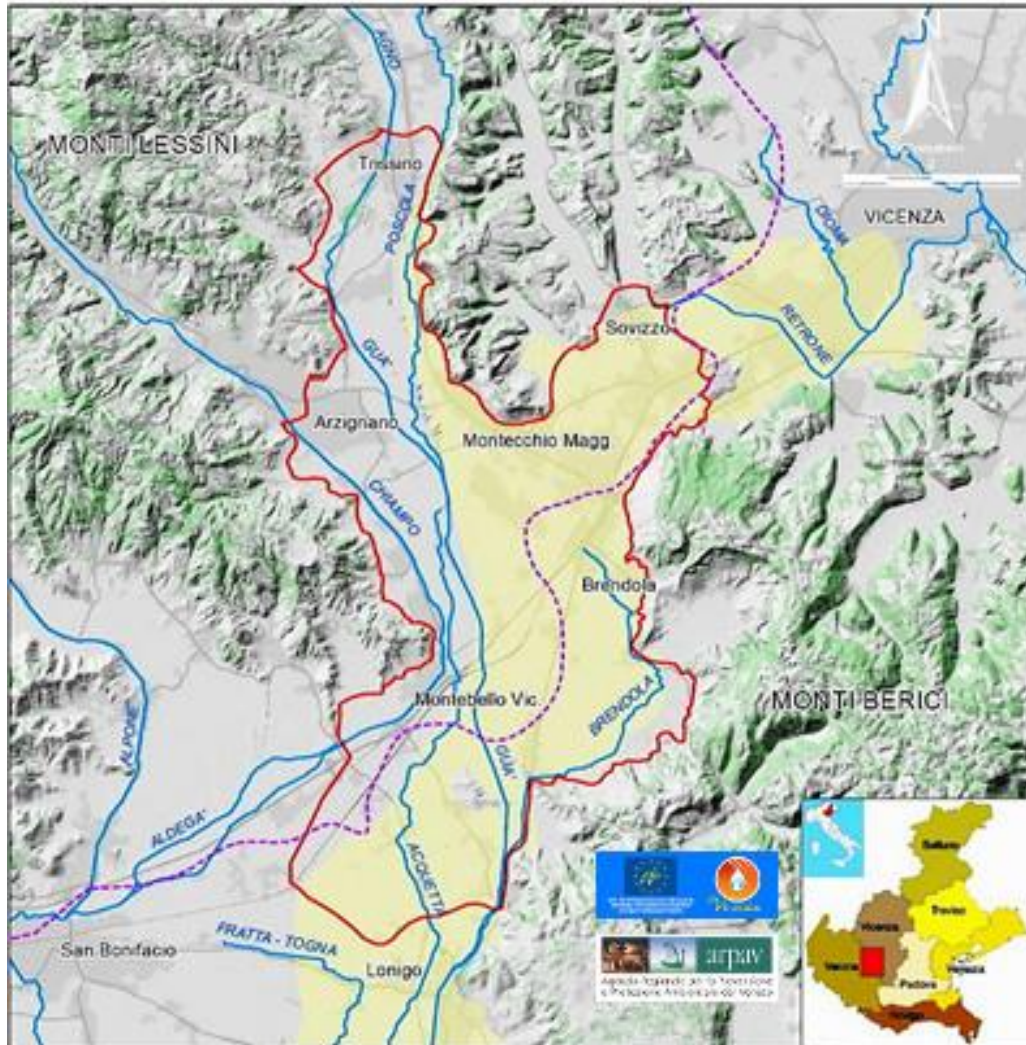
This model drives the understanding of all those processes which are related to water quantity and quality. The main aspects that are going to be simulated are related to advection, diffusion, hydrodynamic dispersion and absorbing processes. Finally, the model is going to support the prediction and distribution fate of PFASs; more attention is demanded for short-chain PFAS. The model aims to create different scenarios in order to support the best environmental and mitigation actions for human water supply, industry and agriculture purposes.

In order to build up a coupled flow and transport model (two different Equation of State have to be considered), two main steps are necessary. First, the groundwater numerical has to be implemented and then the transport one is going to be developed on it. Thorough this full process, model calibration, validation and sensitivity analysis are going to support the final numerical simulation tool.

The area of interest is located in Vicenza province (Northeast of Italy) in the medium, low Agno river valley where an extensive PFAS contamination affected both aquifers and rivers (fig.1).

From a numerical model point of view, the model domain, which is marked by the red continuous line, is located between Trissino and Lonigo towns which represent the Northern and Southern boundaries domain, according to the available phreatimatic maps; the Western and Eastern boundaries are delimited, respectively, by volcanic and calcarenitic hills (Lessini hills). The alluvial plain is stretched up to Sovizzo town, at the East side (fig. 1), by the alluvial spring line (dashed line).

Fig.1 Framework of the 3D model domain, marked in red. The yellow area indicates the PFASs plume



Geological data, extensive bibliographic studies, stratigraphic information from water wells drilled so far in the area, geophysical surveys supported the development of a 3D geological and hydrogeological conceptual model. Moreover, paleoriver beds (Poscola, Agno, Chiampo Rivers) have been identified according to isopach maps which has been obtained from the gravel and sand thickness analysis provided by the National Research Center (CNR, IRSEV).

The effective infiltration rate, evaluated according to the Kennesey's methodology, has been used and integrated to the water irrigation supplies data. Moreover, river discharges have been also considered, according to bibliography studies (Antonelli natural vulnerability map, 1993).

Groundwater withdrawals, within the PFAS study area, have been categorised in three main groups: withdrawals for public services purposes (real data are available from Public Water Authority); local withdrawals where the flow rate is larger than 10 l/s; finally, widespread withdrawals with a flow rate lower than 10 l/s, which are related to small and private groundwater exploitations.

Fig. 2 highlights the outcomes of the first not calibrated, flux model obtained using the FeFLOW numerical code (fig. 2).

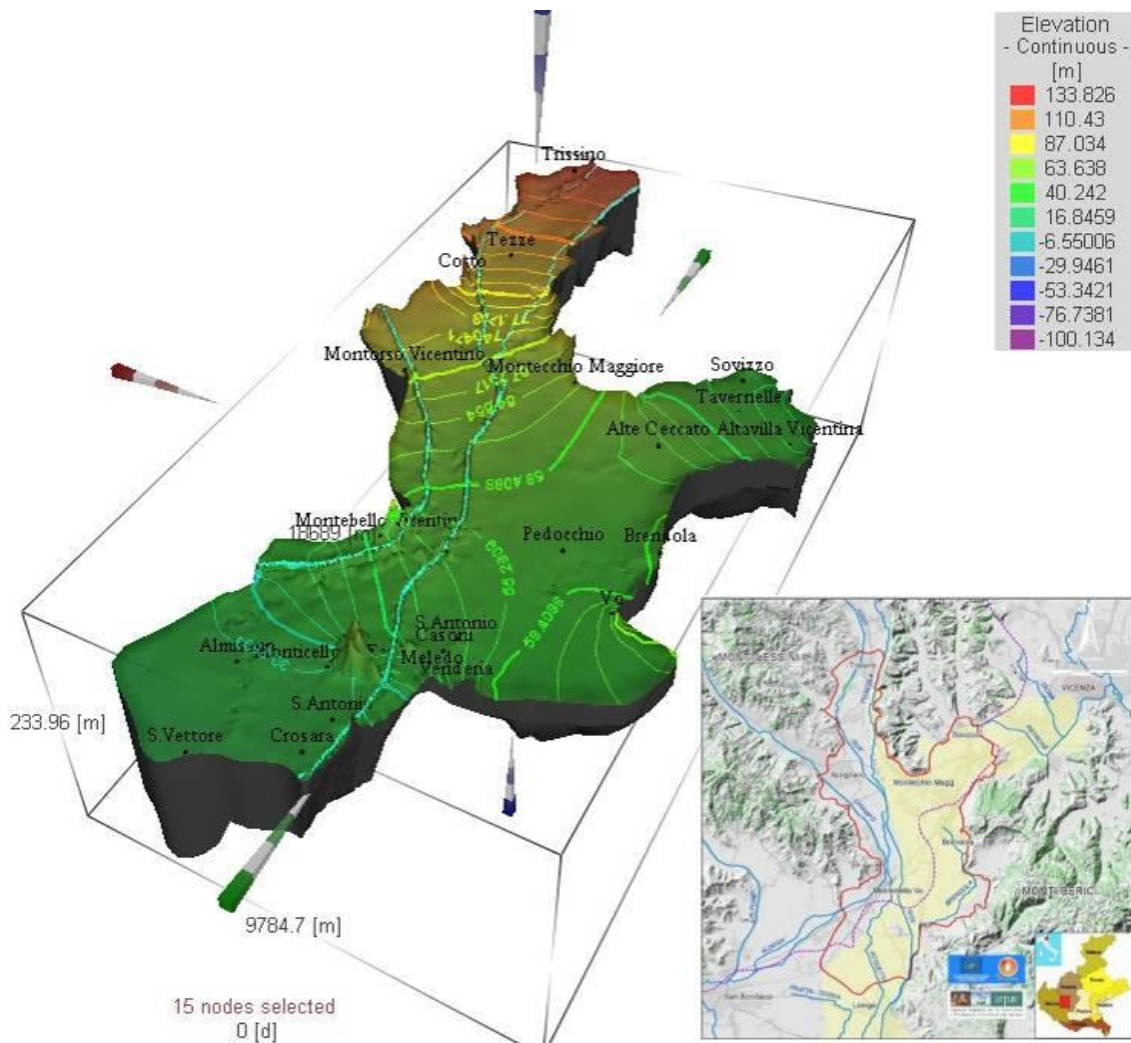


Fig.2 First numerical Flux model NOT Calibrated

2. FIRST DELIVERABLE OF THE ENVIRONMENTAL MONITORING ACTION

The first report of Action C.1 (Environmental Monitoring of the project) has been completed. The document summarizes the actions taken to develop and make available the Standard Operating Procedures (SOPs) for the analytical determination and quantification of PerFluoro Alkyl Substances (PFAS) in the different environmental matrices involved in the Project PHOENIX LIFE 16 ENV/ES/000488. The SOPs, one of the deliverables of PHOENIX, are considered essential documents to produce reliable results in support of the project. The partners involved are *Agenzia Regionale per la Prevenzione e la Protezione Ambientale del Veneto* (ARPAV) and *Consiglio Nazionale delle Ricerche – Istituto di Ricerca Sulle Acque* (CNR-IRSA) with their respective laboratories. The specific environmental matrices considered in PHOENIX Project are: water, soil, vegetable and animal organisms.

In details, to study the effectiveness of the technological tools (forecast and of mitigation) adopted in the operative Actions B.3 and B.4, reliable analytical methods are needed to determine the quantity of PFAS, the specific class of Persistent Mobile Organic Compounds (PMOC) considered as case study in PHOENIX Project. General analytical methods on PFAS were already available, known in literature and partially in use in the laboratories of ARPAV and CNR-IRSA. However, for the purposes of PHOENIX Project, it was necessary to adapt the protocols to the aims of the Project, hence obtaining *fit-for-purpose* and validated procedures for the specific emerging contaminants involved and for the environmental matrices selected.

ARPAV and CNR-IRSA has improved and refined the methods for PFAS available in literature in all kind of waters, in sediment and different soils, and in vegetable/animal tissues. In general, methods for the analysis of PFAS include an extraction step from the matrix, eventually a cleanup step on reverse phase according to the complexity of the same matrix and the final analysis and quantification with liquid chromatography coupled with mass spectrometry (LC/MS) technique. The results obtained are shared with the other partners through the common platforms provided by the Project.

The produced report explains briefly the development of each analytical procedure obtaining as final outcome a specific detailed SOP for every matrix.

3. PHOENIX PROJECT INVITED IN BRUSSELS AT THE ENSOR EVENT

Project LIFE PHOENIX has been presented at the ENSOR “*International workshop on Emerging challenges on New SOil contaminants*” event, hosted in Brussels on the 19 and 20 of November 2018.

The topic of emerging contaminants and the growing concern of their environmental presence, have attracted attention not only of the scientists and insiders, but also of institutions for the complexity

and the great relevance of the problem. Consequently, the policy makers at national, regional and local level are being challenged to set the right priorities and create an adequate regulatory framework in the short and medium-long period.

This first edition of the workshop organized by OVAM – the principal authority in the Flanders Region of Belgium for sustainable management of waste, materials and soils – has been a fruitful moment of networking focused on International cooperation, combined with a multi-stakeholder bottom-up approach.

The two-day workshop has been focused on emerging contaminants in soil and groundwater proposing different case studies and mitigation strategies. During the first day different plenary sessions were presented focusing on sharing knowledge, experiences and challenges between researchers, policy-makers, experts and stakeholders. The second day, divided in parallel sessions, was useful to draft a methodology as first step toward a common policy that can be benefit for the community.

The LIFE PHOENIX Project, introduced during the first day of works, has found considerable interest for its pragmatic and interinstitutional approach proposing an effective and prompt strategy regarding environmental emergencies, in particular from short-chain PFAS. The exchange of experiences with other international realities with their different approaches toward the emerging contaminants issues, in particular PFAS, was very interesting and useful. Moreover, the presence of the European Commission, represented by DG Environment, has underlined the need of an action at community level.

For more info: <https://www.2mpact.be/ensor>

4. INTRODUCTION OF A NEW PARTNER: AZIENDA ZERO

The Project LIFE PHOENIX has expanded its partnership to a new beneficiary associated named Azienda Zero to achieve its administrative and technical objectives.

Azienda Zero is an Agency body/company of the Veneto Regional Health System, with legal status, as well as administrative, organisational, technical, managerial and financial autonomy.

The corporate regulation of Azienda Zero has been introduced by the DGRV No. 733 of 29 May 2017 entitled 'Guidelines to enact the corporate regulation and to approve the organisational structure of Azienda Zero. Attribution to Azienda Zero of the functions envisaged at article 2, comma 2, of the regional law No 19 of 25 October 2016 and of the function of aggregational body. DGR No 31/CR of 6 April 2017 (article 2, commas 2 and 6, of the regional law No 19 of 25 October 2016). This regulation identifies its mission and organisational structure.

With the DGRV No 3 of 5 January 2018 some changes have been introduced to the normative framework described above. In particular, some offices/resources and personnel of the regional

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government have been transferred to Azienda Zero. Among these, the Purchasing Department of the Veneto Region (CRAV) and the information system of the Health and Social Department of the Region (DGRV 3/2018).

These structures in the project are necessary to buy the services for Veneto Region – Lead Partner and in the case of the Information system of the Health and Social Department to develop the action B.2 - Implementing an informative and statistic system, one of the most important project action.

At the end, the partner with the monitor's approval, decided to propose an amendment to EU Commission to introduce Azienda Zero as beneficiary associated and to postpone of the end of the project by 6 months (from 30 September 2020 to 31 March 2021).

In the new organization chart of the project, Azienda Zero is the organization responsible for the implementation of the B.2 action as laid down in the project and has the function and competence for procurement external assistance and the purchasing of all the relevant and needed items, while Veneto Region, as Lead Partner, provide to manage the whole project's activities.

5. PUBLICATION OF THE 'ZÜRICH STATEMENT ON FUTURE ACTIONS ON PER- AND POLYFLUOROALKYL SUBSTANCES (PFASs)'

On November 9-10, 2017 the Safety and Environmental Technology Group at ETH Zurich in Switzerland hosted an international workshop to support dialogue between scientists and regulators on per- and polyfluoroalkyl substances (PFASs). Over 45 invited participants attended the two-day event, including academic and government scientists from a wide range of fields and regulators from many countries and organizations. The workshop started with presentations from participants to summarize the current state of the science and policy regarding PFASs. Among the invited scientist there was also dr. Sara Valsecchi from CNR-IRSA, partner of LIFE-PHOENIX project, who presented the project aims and first results.

This expert group have jointly outlined a set of needs, goals, and actions to help assess and manage the diverse and widely used group of per- and polyfluoroalkyl substances (PFASs) in the future. The Statement has been [published in the open access journal Environmental Health Perspectives](https://ehp.niehs.nih.gov/doi/10.1289/EHP4158) (<https://ehp.niehs.nih.gov/doi/10.1289/EHP4158>).

The Statement stresses that, while well-known legacy PFASs such as perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) have been investigated extensively and regulated over the past two decades in response to their identified hazardous properties, very little information exists regarding the current uses and potential hazards of many other PFASs.

Specifically, the Statement calls for increased collaboration in efforts such as gathering information to fill critical data gaps, developing novel schemes to focus on highly (or very highly) persistent chemicals, and conducting joint assessments for groups of PFASs.

The Statement builds upon earlier calls made by scientists regarding PFASs in the [Madrid Statement](#) in 2015 and in the [Helsingør Statement](#) in 2014. In these statements, a precautionary approach is promoted for the use of PFASs as well as a transition towards the development and use of less persistent or non-chemical alternatives.

The Zürich Statement is currently open for signatories. More information on how to do this is provided on the [project page of the IPCP's website \(https://www.ipcp.ch/activities/zurich-statement\)](https://www.ipcp.ch/activities/zurich-statement).

6. PERSISTENT, MOBILE, TOXIC AND VERY PERSISTENT, VERY MOBILE (PMT AND vPvM) SUBSTANCES UNDER REACH: A REPORT ON THE UBA WORKSHOP

The German Environment Agency (UBA) and the Norwegian Geotechnical Institute (NGI) hosted a workshop on "PMT and vPvM substances under REACH" in Berlin, Germany on the 13-14th of March, 2018. Over 120 people from 16 countries attended, including dr. Sara Valsecchi from IRSA-CNR, partner of the LIFE PHOENIX project

The UBA has proposed criteria and an assessment procedure to identify Persistent, Mobile, Toxic and very Persistent, very Mobile substances that pose a hazard to the sources of drinking water, and invited the chemical industry, drinking water suppliers and regulatory bodies to participate in a discussion of voluntary measures and regulatory options to protect the sources of drinking water.

The criteria proposed by UBA in the assessment of REACH substances are:

- P/vP: Persistence is defined in REACH Annex XIII in the context of PBT/vPvB substances.
- M/vM: Mobile/(very mobile) substances are defined as having a lowest log K_{oc} ≤ 4.0/(3.0) over the environmentally relevant pH range of 4-9; or in the absence of log K_{oc} data, having a lowest log D_{ow} ≤ 4.0/(3.0).
- Toxicity: the T criteria controversially does not correspond with the definition of T as defined in REACH Annex XIII in the context of PBT/vPvB substances. It starts with the NOEC/EC10, CMR, and STOT criteria laid out in Annex XIII, but extends the definition to also include:
 - Carcinogenic category 2 and germ cell mutagenic category 2;
 - Additional category for effects on or via lactation;

- Derived-No-Adverse-Effect-Level (DNEL) is $\leq 9 \mu\text{g}/\text{kg}/\text{d}$ (oral, long term, general population);
- Endocrine disruptor criteria.

Based on the defined criteria, 240 substances are listed in the technical note on the NGI preliminary assessment (NGI Technical Note *Preliminary assessment of substances registered under REACH that could fulfil the proposed PMT/vPvM criteria*, <https://www.ngi.no/download/file/11567>)

- vPvM and not T: 30 substances
- vPvM and PMT: 23 substances
- PMT (but not vPvM): 35 substances
- High Potential to be PMT/vPvM: 152 substances

“High potential” implies that no experimental half-life data is available so a weight-of-evidence approach applied.

Discussion between industry and regulatory bodies regarding the equivalency of mobility in PMT with bioaccumulation in PBT was very lively: the concentration of PB substances in the food chain or the concentration of PM substances in the environment from which we and other critical species get drinking water lead to the same result, exposure by the oral intake pathway to concentrations of chemicals that may pose a risk.

The project LIFE PHOENIX partnership contributed to the discussion sharing his experience in managing a critical case study of pollution from a class of vPvM substances, i.e. short chain perfluorinated compounds.

7. LESSONS AT THE MOSCOW UNIVERSITY STUDIES

The Research Unit "Environmental Physiology and Experimental Zoology" (DiBio) is a partner of the LIFE PHOENIX project which main objectives are:

- the check of the possibility of "early warning", by evaluating the intake of PMOC (in particular short-chain PFAS) dispersed in the environment, in animal bioindicators both terrestrial (such as earthworm, ubiquitous in agricultural and natural environments) and aquatic, and in plants;
- the development of a smart methodology to provide a correlation between biodiversity levels in the agricultural area and environmental stress levels;
- the implementation of mitigation strategies, by using innovative and natural technologies

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A further important objective of the project is the dissemination of the knowledge of PFAS related problems in other European and extra-European contexts.

As part of the Bilateral Agreements and of Erasmus+ Internationalization actions with European and non-European countries, promoted by the University of Padua (Italy), the Research Unit "Environmental Physiology and Experimental Zoology", of the Department of Biology (DiBio), keeps an agreement dating from 2008 with the State University of Penza (Russian Federation). From the beginning, the focus of this cooperation project has been on biodiversity issues, that has significant interest at European and national level.

In fact, as defined by the Convention on National Strategy for Biodiversity Conservation (Rome, 2010) <<The richness of species and the complexity of the forms of life that surround us have an intrinsic importance, not only ecological, but also economic, social and ethics.>>.

Moreover, it is necessary to point out the importance of the analysis of the risks connected to the depletion of the water resource that can derive both from an indiscriminate use and from pollution with persistent pollutants, with unclear effects on the trophic and ecological chains, such as Perfluorinated Alkyl Substances (PFAS), which can cause elevated "irreversible" exposure (Ian Cousins, Madrid Declaration, September 2014).

With these premises, from October 23rd to November 1st 2018, the DiBio coordinator of the Phoenix project was invited to the "Lomonosov Moscow State University" of Moscow, first, and the "Penza State University" of Penza, then, to lecture a *Lectio Magistralis* to students, PhD students and Professors titled:

LIFE PHOENIX: an European project for the management of risks related to the diffusion of Persistent Mobile Organic Chemicals (PMOCs)

The topic attracted a lot of interest, especially from the Professors, among them there were also socio-economists, as they were not aware either of the characteristics of the PFASs or of the widespread use of these compounds. Many questions were then posed about the size of the area considered, the number of people involved and whether it was possible to make correlations between age, sex and PFAS levels, the major pathologies found, and which actions the Veneto region plans to implement in order to prevent health and environmental risks.

What has further motivated the discussion was the lack of knowledge of this important (worldwide) problem and the fact that, probably, it could also be present in Russia. This led to a formal commitment to work even more on issues related to the environmental protection, which took place on November 30 with the presentation of a project of "University Cooperation Initiatives - Year 2019", UNIPD, entitled " Biodiversity, pollution and climate change ", between the Department of Biology (Italy), Lomonosov Moscow State University and Penza State University (Russian Federation).

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