

# A novel holistic approach in the governance of environmental pollution events from PMOC

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## Abstract

Starting from the lesson learnt after a massive contamination by perfluoroalkyl substances (PFASs) discovered in 2013, an innovative approach to environmental and health emergencies is here suggested. The pollution episode affected a vast area (Figure 1) of groundwater recharge in the North-East of Italy (Veneto Region), with direct consequences on surface water, soil, subsoil, and on water for drinking purposes (WHO, 2017). The regional authorities faced the environmental and health emergency situation putting immediately in place mitigation actions effective for long-chain PFASs. However, the pollution event involved different fluorinated compounds, including the short-chain PFASs (i.e. < C<sub>6</sub>). Within the framework of the European LIFE Programme, the novel approach is proposed with the LIFE PHOENIX “Perfluorinated compounds Holistic Environmental Interinstitutional eXperience” Project (LIFE16/ENV/IT000488). Lead partner of the project is *Regione del Veneto* while associated beneficiaries are ARPAV, Azienda Zero, IRSA-CNR and *Università degli Studi di Padova*. The project aims at demonstrating how a new inter-institutional governance system could be able to manage efficiently risks related to the environmental contamination by persistent mobile organic contaminants (PMOC). PMOC are highly polar chemicals likely to persist in the water cycle, slowly degrade and are very mobile in aqueous medium, including water in biological tissues (Reemtsma et al, 2016). The most important subclass belonging to PMOC is PFASs and the short-chain ones are the main targets of the project. In general, exposure to PMOC can lead to serious health effects, which in many cases cannot be adequately assessed because of a lack of monitoring data as well as knowledge of physico-chemical, toxicological and eco-toxicological properties (Lamastra, Balderacchi & Trevisan, 2016).

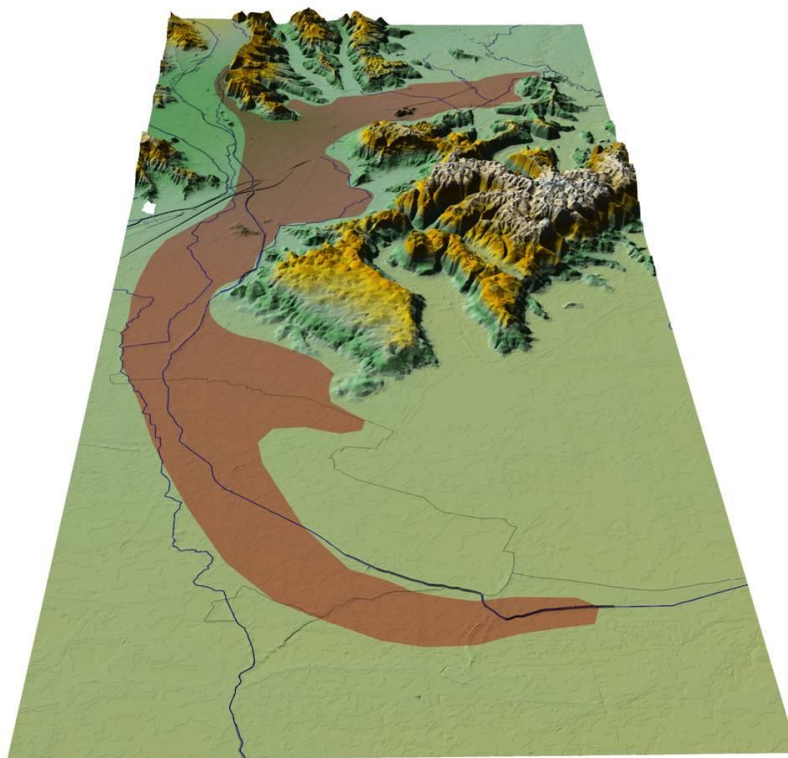
LIFE PHOENIX Project started in September 2017, will last until March 2021 and is adopting an integrated approach called “holistic” because plans to involve different bodies, authorities and stakeholders that play key roles in the assessment and management of the risks from the contamination. The outcomes hence will assist policy-makers in taking decisions and implementing effective prevention measures for the environment, human health and socio-economic context. The inter-institutional governance system started with the set up of a Permanent Regional Commission for emergencies supported by a Multidisciplinary Expert’s Panel in order to draft ready-to-use guidelines and prompt tools to support an effective action plan. An informative and statistic system based on a data warehouse that collects all crucial database and information available for the assessment will support the expert’s panel in order to implement the correct strategy and to improve the quality of data needed for local and regional policies.

At the same time two well-timed environmental forecast tools for the estimation of contaminant distribution were set. The first tool is based on a validated numerical model for the flow and transport of the examined contaminants in groundwater. The model allows understanding all processes related to water quantity and quality, predict the transport and distribution of PFASs along the aquifer and evaluate the interactions of different environmental and anthropogenic factors in the diffusion of the contamination. Moreover, a second developed tool is based on biological and eco-toxicological system of early warning to define correlation between biodiversity levels and environmental stress. The use of terrestrial organisms like *lumbricidae* to assess the health status of some important cellular components as biomarkers in hemolymph cells (i.e.: cell mortality, resistance of lysosomal membranes – NRRT test and Reactive Oxygen Species level) were evaluated.

The project is also proposing mitigation strategies based on sustainable technological and natural solutions. For the abatement of short-chain PFASs in drinking water the solution is based on physico-chemical treatment using ion exchange resins that are tested in a specific pilot plant. The resins are regenerable in situ and proposed as cheaper alternative to the off-site regeneration of activated carbon filters. Then the use of phytodepuration applied in a pilot plant and successfully obtained with *phtagmites* is tested for the abatement of PFASs in irrigation water. The constructed artificial wetland will be soon upscaled in three wetland systems already identified.

Finally, LIFE PHOENIX is aimed to transfer its solutions proposing the application of methodologies and approaches to other European geographical situations affected by similar episodes of environmental contamination from PMOC. The key points and the results of the first phase of LIFE PHOENIX Project are presented and discussed.

*Keywords: risk management, perfluoroalkyl substances (PFASs), forecast tools, mitigation strategies, early warning*



**Figure 1:** the plume of contamination from PFASs in the studied area.  
Source: Mazzola *et al.*, 2013

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