

# **HAZRUNOFF: Towards an earlier and more effective detection and response to oil and chemical pollution in rivers and transitional waters**

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## **Introduction**

Accidental and deliberate pollution at sea has been researched over many years, raising the awareness of the general public, but also improving the planning, prevention, preparedness and response to spills at sea. Both riverine and transitional areas (estuaries, lagoons, deltas and rias) are characterized by different hydrographic conditions, particularly in salinity/density and suspended matter (changing the behaviour of the pollutants), and with faster current velocities. These areas are often associated with major urban areas and ports in the vicinity, meaning that any contamination episode can potentially threaten a huge community and its related activities. Similarly, any volatile chemical or radiological contaminants in the air can also threaten a wider range of human lives and ecosystems.

Moreover, if not properly contained, such incidents may rapidly spread over the ocean under often undetermined conditions most of the time, with limited preparedness and response to understand and face these incidents under the mentioned conditions, in a timely fashion. As an example, since most of the nuclear power plants are connected to rivers and coastal waters, radioactive hazards represent a serious threat that can spread rapidly, impacting the air, transitional waters, coastal zones, urbanized areas, and ultimately, the ocean (e.g. Fukushima).

There are many different causes of hazmat incidents within the types of areas described. For example, they can arise from accidents due to inland/coastal shipping activities, or terrestrial infrastructures. Furthermore, hazmat incidents can also be part of certain cascading disasters in such areas: storms and flooding can trigger a hazmat incident. They can cause damage leading to exposure of historical contaminated sites such as landfills, and current coastal infrastructure such as power stations and refineries, resulting in pollution.

Extreme localized precipitation events are known for triggering devastating flash floods, however most of the early warning systems are still based on rainfall measurements or inadequate weather forecasting resolutions. In some of these situations, in-situ monitoring networks become useless because the stations may become damaged or inundated. Thus, alternative observing techniques like remote sensing and high-resolution modelling technologies become important for early warning, early detection, and follow-up of these situations. The development of new algorithms and their application to new sensor technology (hyperspectral, optical), combined with the recent increases of resolution in operational satellite imagery (e.g. Copernicus Sentinel constellation) or the proliferation of UAV's, makes both

airborne and space borne sensing technologies powerful instruments for effective and safe preparedness and response to some types of hazmat.

Furthermore, while social media networks and mobile technologies become more popular and widespread, many areas of environmental management and civil protection are still neglecting the potential of analysing social media information and ICT-enabled citizen observatories.

### **The solution**

HAZRUNOFF international project (DG-ECHO) aims to fill the gaps around knowledge, technology and preparedness involving early warning & detection, follow-up, and early response to flooding and hazmat contamination in inland and transitional waters, including urban areas. Many flood events in industrialized areas also cause pollution incidents, thus the project builds a continuum system to represent the processes occurring between rivers, transitional waters and coastal areas.

### **Pilot areas**

The activities on this project are studied and applied in 4 different European areas involving transitional waters, and in different participating countries.

The pilot areas are:

- Portugal: Tagus river (involving one nuclear powerplant installed in Almaraz, Spain) + Tagus estuary and Loures Municipality
- Spain: One of the Galician rias (coastal embayment), the estuary located on it and the river flowing into it (NW Spain)
- France: Loire river (involving 1 nuclear powerplant) and its estuary
- UK: Severn estuary and Severn river

### **Materials and Methods**

The implementation of HAZRUNOFF project builds a fast, reliable, flexible and comprehensive framework to face different or combined types of flooding and hazmat (oil, chemical, radioactive, floating objects) pollution in transitional waters, combining:

- in-situ sensing technologies (automatic stations, indicators, lab measurements, IoT approaches),
- airborne (UAV / drones) and satellite remote sensing (oil and chemical spills, water level monitoring, turbidity),
- holistic high resolution modelling (integration of meteorological, watershed, estuarine and pollutant dispersion models),
- operational tools for situational awareness and crisis management (new methods for interpreting social media, early warning, online dashboards and on-demand simulation tools),
- improved contingency planning and adapted protocols for response and communication.

### **Main Results**

Globally, the project expects to speed up and improve the process of early warning, early detection, follow-up and response to floods and multiple hazmat contamination in transitional waters. Specifically, this is achieved with the following results:

- Increased preparedness and knowledge on multiple types of floods (using a complex modelling strategy, capable of simulating flash floods, storm surges, riverine floods etc.) – beneficiaries: industries in flood-prone areas; civil protection
- Earlier detection of hazmat incidents (oil, chemical) in transitional waters (based on remote sensing techniques and IoT approach to identify anomalies in automatic stations) – beneficiaries: civil protection and environmental monitoring actors
- A more efficient follow-up of pollution incidents in transitional waters (combining UAV's and advanced and fast web-based pollutant dispersion modelling) – beneficiaries: civil protection, water pollution responders, port authorities

- Increased awareness on potential maritime pollution originated in inland waters or in estuarine environments - beneficiaries: marine pollution response authorities.
- Stronger and safer capacity for identification and monitoring of contaminated areas (using UAV's, avoiding human contact with contamination agents) – beneficiaries: civil protection, water pollution response
- Improved contingency planning (using model-based hazard mapping for multiple types of hazards; new response protocols; new communication planning) – beneficiaries: water pollution responders and civil protection
- Increased awareness on hazard identification and risk perception (by automatic data analytics on social media feeds): water pollution responders and civil protection.
- Improved knowledge on chemical properties and behaviour on transitional waters (by lab measurements in 20 chemical substances) – beneficiaries: scientists, modellers, civil protection and water pollution responders.
- Improved knowledge and awareness on multiple hazards as a consequence of new training materials, courses and exercising – beneficiaries: project partners, civil protection, water pollution responders.

### **Conclusion**

The project HAZRUNOFF focus on preparing and responding to civil / public health impacts as well as to acute environmental damages. The innovative operational high-resolution tools and methodologies for efficient monitoring, prediction and response to hazards involving different kinds of floods and pollutants in transitional waters, contributes directly for a better implementation of the EU Floods Directive in coordination with the WFD, and with MSFD.

Based on state-of-the-art technologies and testing in 4 pilot areas, HAZRUNOFF creates a holistic set of technologies and methodologies replicable and transferable worldwide.

The consortium includes 7 entities in 5 countries (Portugal, Spain, France, UK and Germany), including universities, private companies, research institutes, governmental agencies, and civil protection services, being supported by other national authorities.