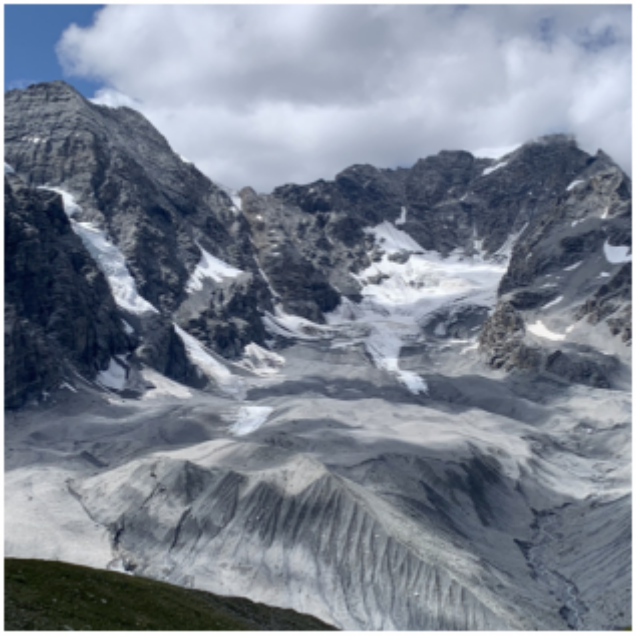
Project RainBO

Improvement of knowledge, methods and tools to increase the resilience of urban centers to extreme rainfall phenomena

adaptation | climate change | risk management

PROJECT DESCRIPTION

The risk of flooding of medium and large basins and small watercourses is a major problem in different Italian urban areas. In fact, urbanization processes have generated, over time, a decrease in soil permeability and a reduction in river- and streambed surfaces, increasing the probability of floods and the gravity of related damages. In addition, climate change is expected to cause more frequent extreme weather events in the future, such as heavy rainfalls, increasing the risk of flash floods. Despite its potential harmful effects, the risk of flooding from waterways in urban areas is often underestimated and few prevention and mitigation measures have been adopted to date.



OBJECTIVES

RainBO was developed on the basis of what emerged from the LIFE BLUEAP project (Bologna Local Urban Environment Adaptation Plan for a Resilient City), with the aim of improving knowledge, methods and tools to deal with extreme rainfall events and consequent **local flash floods** through the characterization and forecast of potential impacts of heavy rainfalls, with reference to medium-large as well as smaller basins, and to the vulnerability of the assets located in urban areas. To this end, RainBO has developed a **data platform** both for planning purposes and for monitoring small basins in urban areas in order to **predict sudden flood events** and **alert population**. In fact, the RainBO platform has two main functions: the planning and management of events (through the visualization of the territorial data and related risk and vulnerability maps) and the visualization of the data observed by the "traditional" sensors and that estimated and foreseen by "virtual sensors".

The test areas of the project were the Ravone torrent (Municipality of Bologna) and the Parma river (Municipality of Parma).

Notably the project actions were aimed at:

- enhancement of the monitoring infrastructure, through conventional and innovative systems;
- development of early warning systems based on hydrological simulation models and weather forecasts;
- simulation in "peacetime" of possible scenarios with the help of vulnerability models and hydraulic risk maps; and analysis as well as comparison with historical events;
- support to planning through detailed mapping of territorial data.

The project was aimed to support, through the actions developed, the implementation of the European Floods Directive (2007/60/EC), which requires all Member States to assess the flood risk for all watercourses and coastal areas in order to map

the extent and the risks for population and assets in these areas, as well as identify and undertake adequate countermeasures. It was also aimed to provide **tools to support the development and implementation of local plans for adaptation to climate change and action plans against flood risk**.

PROJECT PHASES

The main phases of the project were:

- ANALYSIS and SURVEY – identification of the Platform's technical requirements and functions.

This phase focused on:

- identification of the possible interested parties and/ or end users of the platform, and mapping of their needs with respect to the project outputs. Development of a sharing approach based on continuous involvement of the interested parties in order to share information and knowledge and work in sinergy, finding more efficient solutions to potential problems that could arise;
- exploration of the state-of-the-art hydrogeological models to be applied on a local scale for the assessment of sudden floods, adaptation criteria and the best practices to reduce damage and increase the resilience of the territories.

- INTEGRATION/ INSTRUMENTAL IMPROVEMENT of the MONITORING SYSTEM

This phase focused on:

- improvement of the network of monitoring sensors installed at the Ravone river basin in order to refine the calibration of the model and the flow scenarios for the RainBO platform. To this end, soil moisture measuring probes, webcams and hydrometers as well as additional rain gauges have been installed to obtain real-time information;
- implementation of an **innovative rainfall estimation system based on the evaluation of Microwave Links** (MWL);
- assessments of possible integrations between conventional and innovative monitoring networks (e.g. microwave);
- implementation of a crowdsourcing application in order to collect and view citizens' reports regarding observed weather phenomena.

- DEFINITION of the RAINBO PLATFORM'S STRUCTURE

This phase was focused on the study, design and implementation of the RainBO platform prototype, starting from the results of the first phase of collecting feedback from stakeholders. The structure of the RainBO platform consists of the following main elements:

- database that integrates the use of different data, such as monitoring data (including information collected in real time from networks), territorial data (regional maps, presence of hospitals, schools, etc.) and historical data (past events, hydrometric levels, etc.);
- conventional monitoring systems, including rain gauges, water level meters, radar;
- unconventional monitoring systems: systems based on the evaluation of microwave signals and a cooperative application of data collection and sharing;
- forecast data: forecasts of the hydrological response of the basins to heavy rainfalls (hydrological algorithms and statistical models), weather models;
- water balance data: e.g. water retention capacity index of the soil (maximum amount of water that can be retained in certain soil moisture conditions);
- "sensornet" web service: platform that collects all data relating to sensor configuration, data acquisition, standardization, etc.;
- "Business software" modules containing degree of vulnerability of elements exposed to the flood phenomena, data extraction and correlation (time series, real-time and forecast monitoring data) to identify the most probable scenarios, scenario analysis;
- "GUI" Graphical interface that allows interaction between the user, the database and the software modules through an integrated geographic information system capable of displaying geographical maps and spatial information and interfacing them with the data in the database.

PROJECT RESULTS

The main project result consisted in the development of the RainBO LIFE **monitoring platform**, capable of processing and integrating different types of territorial data in spatial and temporal dimensions, providing the user with useful and easily accessible information. The platform can be used both *on-line* and *off-line*. When used *on-line*, the Platform is able to continuously monitor hydrogeological phenomena and their evolution, and to forecast alerts for 12/24 hours, generating early warnings when certain threshold values are reached. The Platform is characterized by a configurable modular structure and an open architecture that allows interoperability with other systems.

With the aim of improving the quantity and quality of the data on which the operation of the platform is based, the project has developed a series of activities that have led to:

- definition and standardisation of the model of territorial data;
- integration of the observed monitoring data with estimated, as well as historical, real-time and forecast data;
- development of a hydrological simulation model for small basins, able to forecast the maximum water level in a critical measurement point of the river, carrying out a simulation through the water balance criterion and rain forecasts (for 72 hours) starting from the initial moisture conditions of the basin soil. As regards the medium and large basins, the project considers the use of already consolidated simulation models to be optimal;
- integration and improvement of the existing monitoring system through the installation of "traditional sensors" (soil moisture measuring probes, webcams and hydrometers to obtain real-time information, as well as additional rain gauges), as described in the document "**New water level data**" and an **innovative rainfall estimation system** based on the evaluation of microwave signals, traditionally used in commercial cellular communication networks (in the specific case of the Vodafone and Lepida networks project). As better explained in the document "**Rainfall data based on microwave links**", the intensity of the rainfall can be obtained by means of an algorithm starting from the attenuation of the radio signals. This system was developed through a modification of the "Rainlink" algorithm, specifically customised for the RainBO project
- development of the "Rmap4RainBO" application (with related **User manual**) which allows anyone to report an observed meteorological phenomenon and transmit information on the event (intensity, type, etc.), in order to share information updated in real time and distributed throughout the territory, using a shared platform.
- integration of the different developed (traditional and innovative) monitoring systems, as described in the document "**Rainfall data covering the test area**".

A **video** tutorial has been produced on how to use the Monitoring Platform.

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Acronym

RainBO

Number of reference
LIFE15 CCA/IT/000035

Reference Programme
LIFE

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EU contribution
677.656

Call Year
2015

Start Year
2016

End Year
2019

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Region
Emilia-Romagna

Description

EMILIA ROMAGNA