IMproving Preparedness and RIsk maNagemenT for flash floods and debriS flow events

Reporting

Project Information

IMPRINTS
Grant agreement ID: 226555
Status
Closed project
Start date 15 January 2009
End date 14 November 2012
Funded under
FP7-ENVIRONMENT
Overall budget
€ 4 460 191,36
EU contribution
€ 3 280 000
Coordinated by
UNIVERSITAT POLITECNICA DE CATALUNYA
Spain

Periodic Report Summary 3 - IMPRINTS (Improving preparedness and risk management for flash floods and debris flow events)

Project context and objectives:

The project IMPRINTS represents an integrated effort to establish a coherent, common methodology in Europe oriented to contribute to reduce loss of life and economic damage through the improvement of the preparedness and the operational risk management for flash flood (FF) and debris flow (DF) generating events, as well as to contribute to sustainable development through reducing damages to the environment.

The main scope of IMPRINTS is based on the conviction that implementation of active risk management strategies and FF/DF forecasting and warning systems are the most effective way to increase preparedness and mitigate FF/DF risk in the territory. Many previous projects have gone deep into the
understanding of the nature and dynamics of FF/DF from the phenomenological point of view, but, unfortunately, the application of the results has not conveniently reached the operational world up to now.

Under this premise, the challenge of IMPRINTS is to improve preparedness and risk management in FF/DF events through the implementation of operational tools, specifically designed to be used for the practitioners responsible for flood risk management and associated effects and damages.

To that end, IMPRINTS is organised in 9 main sub projects (SP) aiming at achieving five main objectives:

1. the improvement of short-term rainfall forecasts as the best way to increase anticipation in front of these FF/DF events (SP1).
2. the development of three methodologies of different complexities to provide FF/DF forecasting and warnings, namely an early warning FF/DF system based on simplified estimates of the probability exceedance (SP2), an integrated hydrometeorological probabilistic FF forecasting system (SP3) and a probabilistic FF/DF rule-based risk forecasting system (SP4).
3. the study of risk management and mitigation strategies by assessing the impact of potential plausible future changes (climate, land use and forest fires) in the test-bed areas and their effects on the hydrological response and their vulnerability in front of FF/DF generating events (SP5)
4. the development of a prototype of the operational platform including the IMPRINTS tools and methodologies developed under the project. This prototype has been designed (SP6) and developed (SP7) under the premise of its ultimate commercialisation and use around Europe.
5. the test of the tools and methodologies developed under the project in six selected test bed basins covering the main characteristics of the areas prone to FF/DF events (SP8).

The achievements obtained during the 46 months of the project have allowed the consortium to integrate in an early warning operational platform the developments produced by the 18 partners, including hydrological warnings based on the rainfall forecasted by meteorological models (few days in advance) and by weather radar networks (few hours in advance). The platform is able to transform the anticipation provided by the rainfall forecasts into hydrological forecasts, and also to combine these hydrometeorological forecasts with the available information about vulnerability and flooding risks, providing a full early warning system for FF and DF risk management.

Thus, the IMPRINTS platform is a major development to support the European Union’s (EU) Flood Directive implementation and, specifically, an advanced tool to support the development of the flood risk management plans required by the Directive.

It has been designed to be easily adapted to any basin in Europe over the coverage of meteorological models and radar networks and it has been tested on six river basins in Europe under the close collaboration between researchers and decision makers.

Finally, the IMPRINTS Project have made a huge effort to disseminate the results and produce audiovisual support for policy makers, risk managers, water enterprises and for the local authorities confronted to the risk of floods.

This material is accessible in the dissemination webpage of the project at http://www.imprints
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1. three IMPRINTS dissemination videos, which are accessible in YOUTUBE through Living with the risk, What can we do and Real time risk management: The IMPRINTS Platform of advanced tools.
3. two webminars in which the results of the IMPRINTS project have been showed, in collaboration with the Seventh Framework Programme (FP7) project STREAM
4. the fourth IMPRINTS International workshop on implementing the EU Flood Directive in FF prone areas held in Brussels, Belgium, on 27 September 2012 (see http://www.stream-project.eu/content/final-imprints-workshop-0)
5. the science-policy interfacing (SPI) water final conference ‘Facilitating water information exchange between science, policy and industry’, held in the European Parliament Brussels, Belgium, on 4 December 2012. (See the presentation of the video at the end of the session in the European Parliament at: 'http://stream-project.eu/content/water-science-reaching-policy-and-industry').

Project results:

SP1:

1. A novel technique for rainfall nowcasting in mountainous areas, NORA, has been fully developed and runs in real-time for rainfall forecasting over southern Switzerland.
2. The probabilistic short-term rainfall forecasting methodology, SBMcast, has been developed and its hydrological interest SBMcast rainfall nowcasts has been demonstrated. This technique has been integrated in the IMPRINTS platform.
3. The blending probabilistic forecasts combining radar based and numerical weather prediction (NWP) model based has been integrated in the platform.

SP2:

1. Development of a toolbox for pre determination of FF/DF risk areas, allowing potential users to friendly establish risk maps from generally available input data.
2. A specific module to include FF warnings between one to two days in the European flood awareness system for basins prone to FF events (EFAS-FF) has been developed. These forecasts are based on the European precipitation index climatology (EPIC). Critical thresholds for the EPIC at every river pixel of Europe have been calculated according to long-term data series. EPIC is being produced operationally on a daily basis for entire Europe based on Cosmo limited area ensemble prediction system (COSMO-LEPS) and is daily distributed within the EFAS network.
3. The EFAS-FF module has been integrated in the IMPRINTS platform and have forecasted with more than 24 hours of anticipation the major FF events occurred during the last year, including the Liguria floods on November 2012.
4. A probabilistic FF guidance system (PFFGS) using high resolution radar rainfall forecasts (up to 6 h)
4. A probabilistic FF guidance system (PFFGS) using high resolution radar rainfall forecasts (up to 6 h) have been developed to produce FF early warnings at the river scale (1 km²) in the selected test beds. The system has been integrated in the platform.

SP3:

1. New methodologies for assimilation of rainfall forecast ensembles in hydrological models when ground based data are available have been developed.
2. Three years of operational application of PREVAH model for the Verzasca and Glarus basins including assimilation of discharge (Verzasca) and consideration of hydropower management (Glarus) are available as result of the project.
3. A scenario based hydrological calibration approach and a framework for exploring the propagation of uncertainty arising from rainfall and parameter estimation in flow simulations has been developed.

SP4:

1. A knowledge base (KB) about the susceptibility of a sub-basin to register a DF event has been inferred for the Llobregat Basin (Spain) and the Sambuco Basin of Destra Sele (Italy). The methodology applied is based on critical rainfall thresholds, which depends on the static basin properties, obtained from a mathematical model through numerical simulations. It allows this decision support system (DSS) to be implemented not only in areas where historical events data are not available but also may take into account changing environments and climate.
2. A set of rainfall threshold curves (one for each considered value of antecedent rainfall) to be used as critical rainfall thresholds to control the time evolution of the dynamic variables in the rule based DSS have been obtained and related to the selected static variables of the system.
3. A final version of the fuzzy classifier to assess the DF hazard providing 'low', 'moderate' and 'severe' DF hazard warnings at the sub-basin scale has been developed based on the static and dynamic variables.
2. A verification test has been performed in two independent sub-domains in the Pyrenees (NE Spain), using radar rainfall information to dynamically monitor the DF hazard in the sub-basins.

SP5:

1. An approach to derive risk maps from hazard and vulnerability maps has been developed: Overlaying vulnerability maps developed using that different land use classes are related to a total economic value of its exposed assets, and the hazard maps for each future scenario, the future risk maps were created and the expected changes on risk depending on the different scenarios assessed.
2. A methodology using the Canadian drought code to take into account the risk of forest fires on the FF/DF probability of occurrence has been developed, and the future scenarios regarding forest fires were implemented in the Llobregat basin.
3. The analysis of DF susceptibility on the upper Llobregat basin using the rule-based system developed in SP4 on the selected future scenarios shows an increase in the DF occurrences, reflecting the tendency of the future scenario generator to predict an increase of the extreme rainfall.
4. The report providing guidelines for mitigation and adaptive management for the reduction of the risk associated to FF/DF based on the analysis of past events and on the analysis of the potential impacts due to future environment changes has been completed.
SP7: Development of practitioner tools

1. A final version of the operational prototype of the platform has been implemented in the test.
2. The prototype has been successfully used during the training course organised by the project in Brussels during September 2012.
3. An improved version of the prototype of the platform has been developed.

SP8: Testing the practitioners' tools on the selected test beds

1. The platform prototype has been implemented in the test-beds and the verification tests performed.
2. The limitations and challenges for building a real-time operation version able to effectively support the implementation of the EU Flood Directive in Europe have been identified.
3. The ideas for a follow up project to develop a full DSS to implement the platform in any region of Europe have been identified, and we are ready to proceed if the required funds become available.

SP9: Dissemination of project results

1. Production of three dissemination videos on FF and DF risk management, which are accessible in YOUTUBE.
2. Organisation of four international workshops to support the implementation of the EU Flood Directive in FF prone areas.
3. Organisation of the IMPRINTS training course on tools to support the implementation of the EU Flood Directive in FF prone areas (Brussels, Belgium, September 26th, 2012). The programme and the presentations are available at http://www.imprints-fp7.eu/course/.

Potential impact:

The achievements obtained during the 46 months of the project have allowed the consortium to integrate in an early warning operational platform the developments produced by the 18 partners, including hydrological warnings based on the rainfall forecasted by meteorological models (few days in advance) and by weather radar networks (few hours in advance). The platform is able to transform the anticipation provided by the rainfall forecasts into hydrological forecasts, and also to combine these hydrometeorological forecasts with the available information about vulnerability and flooding risks, providing a full early warning system for FF and DF risk management.

The new Flood Risk Management Directive is clear in the recognition of early warning systems as a key element in the reduction of FF/DF risk: ‘Flood risk management plans shall address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems and taking into account the characteristics of the particular river basin or sub-basin’ (Chapter IV, Article 7.3). The results obtained in IMPRINTS, improving quantitative short-term rainfall forecasts and making possible the implementation of a probabilistic forecasting system, are a tool to support the successful implementation of the Directive.
The study of the effects of future climate change in the evaluation of potential impacts carried out links directly to some important articles in the Flood Risk Management Directive: ‘an assessment of the potential adverse consequences of future floods for human health, the environment, cultural heritage and economic activity, taking into account as far as possible issues such as (...) long-term developments including impacts of climate change on the occurrence of floods’ (Chapter II, Article 4.2).

Thus, the IMPRINTS platform is a major development to support the EU Flood Directive implementation, and specifically an advanced tool to support the development of the flood risk management plans required by the Directive.

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4. the fourth IMPRINTS international workshop on implementing the EU Flood directive in FF prone areas held in Brussels, Belgium, on 27 September 2012

List of websites:
http://www.imprints-fp7.eu

Other report summaries

Periodic Report Summary 2 - IMPRINTS (Improving preparedness and risk management for flash floods and debris flow events)
Periodic Report Summary 1 - IMPRINTS (IMproving Preparedness and RIsk maNagementT for flash floods and debris flow events)