Flood Forecasting Systems - Europe

1. Policy Objective & Theme

- ADAPTATION TO RISK: Preventing and managing natural hazards and technological (human-made) hazards

2. Key Approaches

- Knowledge-based
- Technical

3. Experiences that can be exchanged

Provision of early flood warning is an important strategy in reducing flood damage and loss of life. To increase warning lead-time and mitigate impacts more efficiently, flood forecasting systems are increasingly becoming an essential step in the warning process.

4. Overview of the case

A flood warning system has been developed that has been applied nationally in the UK.

5. Context and Objectives

a) Context

Flood events across Europe, including the 1993 and 1995 events in the Rhine and Meuse basins, the summer floods of 1997 and 2002 in the Oder, Elbe and Danube basins, the UK floods of 2000/2001 and widespread flooding in the summer of 2005 in Southern Germany, Switzerland, Hungary, Rumania and Bulgaria have raised interest in the provision of flood warning in an effort to reduce losses of property and life due to large floods. Climate change predictions suggest that the frequency of large flood events in western Europe may be on the increase.

An increase of lead time in flood warning means its significance is becoming more and more relevant. This lead time can be effectively used to implement measures to reduce either the consequence of flooding through, for example, evacuation, or to reduce flooding itself through mounting of temporary defences.

b) Objectives

The main objectives have been to increase the warning time of a potential flood event and to standardise different, operational flood warning systems.

6. Implementation of the ICZM Approach (i.e. management, tools, resources)

a) Management

The Delft-FEWS flood forecasting platform has been developed by WL Delft (now Deltares) in the Netherlands.

b) ICZM tools

The elements of a flood forecasting system are; (i) a real time data acquisition system for observed meteorological and hydrological conditions, (ii) hydrological and hydraulic models for simulation, (iii) a system for forecast and meteorological conditions, and (iv) a system for updating and data assimilation. The architecture of the DELFT-FEWS system has been designed to provide an open framework that allows a flood forecasting system to be established to cater to the specific requirements of a forecasting authority. Through its modular structure it can, however, be easily adapted when requirements change. The modular approach has the advantage that many of the components used, such as the underlying models, can be exchanged without the need to change how the forecasting system is operated by its users. This allows for a much more rapid adaptation to advances in modelling techniques, without the added effort in organisational change. The system includes a wide range of modules that deal with generic processing of data in the context of flood forecasting, including data validation, data manipulation and spatial & temporal interpolation.

The National Flood Forecasting System (NFFS) of the UK is perhaps the most extensive application of DELFT-FEWS to date. Flood forecasting, both fluvial and coastal, is organised in eight regions in the UK, each providing forecasts for all fluvial and coastal sites within each region. DELFT-FEWS fulfils the aim of the Environment Agency to standardise flood forecasting practice across the eight regions. All data imported to NFFS is provided to the system in a standardised XML or GRIB form. such standardised formats have greatly eased integration of data from numerous sources (Telemetry, UK Meteorological Office etc.). The data used is primarily observed data from telemetry and precipitation forecasts from the NIMROD system but also includes surge forecasts at numerous sites around the coast. New developments, such as the use of precipitation forecasts derived from numerical weather prediction will also be included and the use of the standardised XML exchange formats makes adaptation to these sources very simple without the need of fundamentally changing the system. The eight regions responsible for flood forecasting have historically developed their flood forecasting systems independently. As a consequence, a wide range of forecasting models and methods is used. All modules have been integrated as a part of NFFS. This has again been achieved through use of the published XML exchange format between DELFT-FEWS and the third party models. These models include hydrodynamic models (ISIS & Mike11), hydrological routing models (KW, DODO), hydrological run-off models (PDM, NAM, MCRM, TCM), a number of transfer function models, as well as various look-up table type models used in coastal forecasting.

The wide range of forecasting methods reflects in part the range of response times found for the different river systems across the UK, or even across a single region. For faster responding systems on the western coast development has traditionally focussed on Transfer function type models (category 4 type forecasting points), while for the larger river systems such as the Severn, Trent and Thames the catchment model approach has been followed (category 2-3). The advantage of introducing these models to run under NFFS is that not only are these different models run using similar procedures across the eight regions, there is now much greater opportunity for using appropriate model techniques for different forecasting points depending how the response times and desired lead times compare. Such exchange of methods was not possible prior to the introduction of NFFS simply because of the technical constraint of adapting existing forecasting systems.

One of the initiatives in Europe has been the development of the European Flood Forecasting System based upon the Delft-FEWS flood forecasting platform. Its development took place over the period 2000–2003 with the objective of providing a flood forecasting platform that could be applied at a European scale. The data management platform of the EFFS has been equipped with generic tools providing a variety of data handling tasks, such as data validation, interpolation, aggregation and error correction in forecasts, including a variety of visualisation and forecast dissemination options.

FewsNL is the operational flood forecasting system used by the Dutch government to provide operational forecasts for the Rhine and Meuse rivers.

7. Cost and resources

No costs are available

8. Effectiveness (i.e. were the foreseen goals/objectives of the work reached?)

The flexibility which is needed to realise scalable, platform-independent, client-server installations that would guarantee sufficient resilience of the forecasting system to potential failure of individual components. Another important requirement has been the creation of a web-based dissemination of forecasting results through configurable reports.

9. Success and Fail factors

Through close cooperation of the hydrological/meteorological agencies of all countries involved the system is able to use on-line data from the different national hydrological and meteorological agencies. While cooperation in data exchange has been successful, standardisation of data exchange formats has had less success. To cater for this, for each of the formats to be imported, separate plug-in import modules have been developed. This is an example of the advantage of the open architecture approach, with plug-in modules/classes easily added to allow different formats to be imported.

10. Unforeseen outcomes

None so far

11. Prepared by

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12. Verified by

It has not been possible to verify this case.

13. Sources

- Developing Flood Forecasting Systems: Examples From The UK, Europe, And Pakistan (2005) M. Werner and M. van Dijk WL | Delft Hydraulics
- The Potential Of The Delft-Fews Flood Forecasting Platform For Application In The Mekong Basin (2006) A.Verwey, K. Heynert, M. Werner, P. Reggiani, R. van Kappel and J. Brinkman. WL | Delft Hydraulics.
- Update on Medium-term Flood Forecasting and Warning Functionalities and Applications of the Delft-FEWS System (2007) A. Verwey and K. Heynert WL | Delft Hydraulics
- www.deltares.nl

Developing Flood forecasting systems (728.2 KB)

The potential of the Delft-FEWS forecasting platform (257.59 KB)

Update on medium term flood forecasting (387.1 KB)