

the dissemination of forecasts. The forecast system can be considered in terms of information flow from the collection of data to the dissemination to the end-users. The design of the complete forecasting system needs to be considered starting from the point of view of the end-users. The design should identify these end-users and their requirements for forecasts in terms of the information to be provided at specific sites. It is only once these forecast requirements have been formulated and agreed by the users, that the technical people can start work to build the forecasting system.

The Yorkshire region of the United Kingdom Environment Agency operates a comprehensive flood forecasting system for protection of life and properties in its region. The rivers of Yorkshire, dominated by the River Ouse and its tributaries rising in the Pennines to the west and the North Yorkshire moors to the north, drain an area of 13,500 km². Snowmelt from the Pennines has been an important cause of flooding in the past and there is a risk of storm surges in the tidal reaches of the Ouse. In the region there are about 5,000 houses on unprotected flood plains and it has been estimated that the potential annual benefit of timely warnings exceeds £ 1 million (US\$ 1.7 million). A flood in January 1982 caused extensive damage in two towns, York and Selby, with 800 properties flooded. In addition, 18,700 ha of farmland were flooded. The forecasting system was set up to meet a general forecast requirement for a four-hour warning of flooding on the middle and lower reaches of the main rivers. The forecasting system makes forecasts at some 115 points in the region and a total of 208 detailed forecast requirements, for flood and low-flow forecasts, was identified. Rainfall forecasts are necessary to provide flood forecasts in time in the upper reaches, but their importance diminishes in the lower reaches where the natural lag in the river system response makes forecasts more accurate and reliable. The hydrological portions of the system use the United Kingdom Institute of Hydrology River Flow Forecasting System (RFFS); a modular, generic modelling system that can combine different hydrological and hydraulic models with multiple data sources.

The Yorkshire forecasting centre receives information from an extensive telemetry network as well as radar and satellite data and results from numerical weather prediction models from the United Kingdom Meteorological Office. Input data and model results can be displayed graphically for the use of the forecasters and telexes and faxes for sending forecast results to the end-users can be generated on-line.

Monitoring the performance of flood forecasting systems

There are many individual elements in a flood forecasting system linked to one another like the links of a chain (see box). All links in the chain are necessary for issuing forecasts.

Countries participating in WMO's Tropical Cyclone Programme have been using a simple three-part points scoring system, based on this chain, to monitor the performance of their flood forecasting systems. The Management Overview of Flood Forecasting Systems (MOFFS) is designed to allow a flood forecasting system to be quickly described and monitored on a single sheet of paper. The aim is to highlight the weakest links in the chain for appropriate management action.