

## The MINERVE project: a flood management model in a complex alpine catchment area (2003)

F. Jordan

Research funded by the Roads and Rivers Service Valais, the Hydraulic Resources Service Valais and the Swiss Federal Office for Water and Geology, in collaboration with the Laboratory of Hydrology and Land Use of the Swiss Institute of Technology and the Swiss Weather Services.

### Introduction

River floods have always represented a major natural risk in alpine regions, as recently confirmed by the disastrous August 1987, September 1993 and October 2000 flood events in Valais. The damages caused by such disasters are generally very high and may cause human losses. It is possible to mitigate floods by civil works such as river training works or development of defined flood zones, but such solutions can reveal expensive and difficult to manage.

The flood management model partially developed in the Laboratory of Hydraulic Constructions propose an original solution for the reduction of flood damages. By the help of existing hydropower schemes, the objective of the proposed method is to reduce the peak discharge by routing effect of reservoirs after preventive turbine operations. This can be a valuable solution for regions such as the Valais, where numerous major hydropower reservoirs exist. It is then necessary to integrate in the project multiple schemes in fields such as meteorology, hydrology, hydroelectric economy, hydropower scheme management as well as multi-objective optimization.

### Preliminary results and developments

#### Hydrological model

The MINERVE project first lead to the development of a hydrological model able to process continuous flow simulation in a complex catchment (model developed in the Laboratory of Hydrology and Land Use).

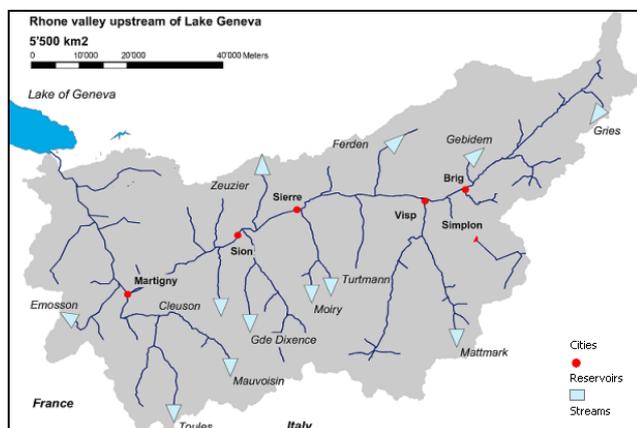


Fig. 1: The Rhone catchment upstream of Lake Geneva and its major hydropower schemes (total area: 5500 km<sup>2</sup>).

This one already uses precipitation and temperature forecasts in gauging stations as well as real-time measurements in order to provide the possibly most realistic flood forecast. The integration of hydro-meteorological forecasts provided by MeteoSuisse and the development of the computer infrastructure are currently worked out at the LCH.

#### Flood management model and expert system

The modeling and optimization of operations of the numerous existing hydropower schemes in the Rhone catchment upstream Lake of Geneva in Valais offer one of the greatest scientific challenges of this project. The most realistic modeling of the hydropower schemes management procedures during floods is currently undertaken. For this, numerous data relative to the hydropower schemes infrastructure and procedures have been collected, checked and classified in a database. Their conceptualization and integration in the hydrological model was achieved. The simulations will be undertaken by the help of *Routing System*, a software developed in the LCH, including the last hydrologic and hydraulic developments.

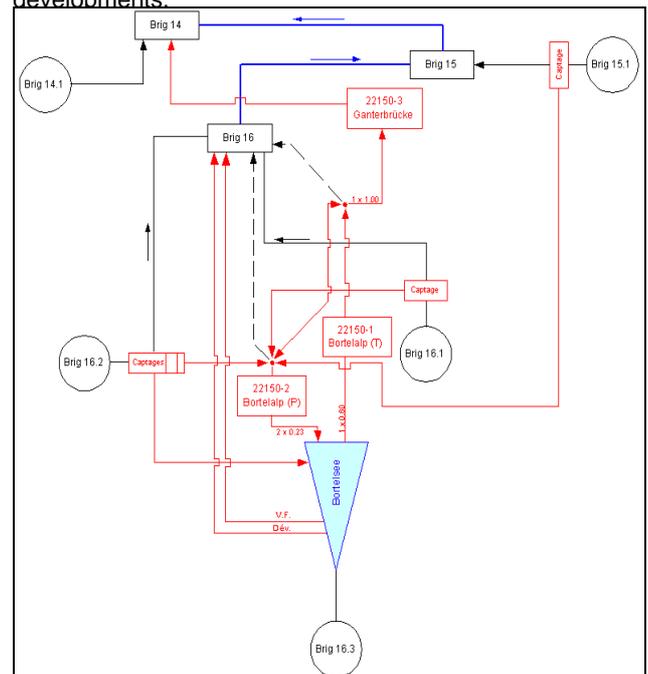


Fig. 2: Schematic representation of the hydraulic functions of a complex hydropower scheme: the Bortelalp hydropower scheme.

The optimal flood management procedure will be carried out on the bases of a hybrid expert system using case-based reasoning and expert rules. This will be developed after a systematic analysis of numerous hydrometeorological scenarios leading to defined near-optimal solutions. During its operational stage, the expert system will optimize the pre-defined solution to get a better adaptation to the real situation.

Finally, the computer infrastructure of the project will be developed around a central database located in Sion and collecting hydro-meteorological forecast, real-time measurements and operation policies of hydropower schemes during emergency situations.