Hydrology and Earth System Sciences, 7(6), *783* (2004) © EGU

Special Issue
Hydrometeorological processes and floods in the Alps

Preface

The present volume brings together the scientific papers resulting from the EU research project RAPHAEL (*R*unoff and *A*tmospheric *P*rocesses for flood *HA*zard for*E*casting and contro*L*). The objective of the project was to develop, implement and demonstrate the use of coupled meteorological and hydrological models at the regional scale to improve flood forecasting and management in complex mountain catchments.

The scientific community has increasingly devoted attention and research effort to coupling meteorological and hydrological models, as the only viable solution to the needs of more accurate and timely flood forecasts.

However, several issues remain, especially in relation to the accuracy of the forecasts in regions characterised by morphological, hydrological and meteorological complexity, such as the alpine environment. The papers collected in this volume investigate, on the one hand, the performance of existing meteorological models and their coupling with hydrological models and, on the other, basic problems related to their process representation.

By means of historical data relevant to major hazard events in the recent past, as well as data collected in specific field campaigns, the models have been investigated and their components tested in respect of their ability to reproduce a large variety of scenarios.

The inter-comparison of the accuracy of numerical weather predictions (NWPs) obtained by meteorological models based on different resolutions and mathematical modelling of the convection dynamics is one of the main aspects reported in this special issue. Not surprisingly, the results confirm the importance of the boundary and initial conditions in achieving quantitative forecasts that are both accurate and located correctly in space and time. Efficient data assimilation techniques, though not addressed explicitly, are thus recognised as critical.

An accurate knowledge of the initial conditions is equally important for hydrological models, as they control the time response of the catchment. However, their performance has been shown to be highly dependent on the accuracy of the precipitation forecasts, which drive the hydrological models towards under- or over-estimation of floods depending on the quality of the NWPs.

Finally, several papers focus on the predictive ability of modelling schemes that represent the soil-vegetation-atmosphere in both meteorological and hydrological models. This is also an important issue, both for what concerns the accuracy of these models and for the use of these modelling schemes in place of the chronic lack of adequate monitoring networks. The extensive tests carried out during special observation periods and illustrated in various papers in this volume show encouraging results.

In summary, this volume and the results of the RAPHAEL project are a valuable contribution to the advance of process understanding and to the improvement of modelling knowledge. However, considering the complexity of the alpine regions and the relevant wide variability of extreme event dynamics, additional research is needed also to analyse the effect of meteorological model errors, generally overlooked by meteorologists.

Finally, since the ultimate objective of forecasting is to improve the decision making capacity of authorities involved in the management of emergencies, additional research is essential to assess and quantify flood forecasting uncertainty to be used within the frame of uncertain decision schemes. Ways of obtaining this essential result, for instance by routing the forecast uncertainty through the cascade of meteorological, hydrological and hydraulic models, have been sketched and it is now time to concentrate new research programmes along these lines.

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