Uncertainty in flood forecasts and end-users’ perspectives: COST731 WG3 outcomes

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1. Introduction

A number of European projects, e.g. Carpe Diem, MAP D-Phase, COST717, COST731 have addressed the issues involved in communicating information on floods to both the public and to people responsible for protecting the public (i.e. end-users). These projects span a decade and contain a consistent message – that end-users do value and want uncertainty information but are still unclear if and how it should be presented to the public and how it should be incorporated into decision making processes and systems. The various issues involved have generated a considerable amount of research and debate and formed a central theme of Working Group 3 of COST731. This Working Group explored how uncertainty information could/should be presented and whether or not classical probabilistic methods, such as expected value, were appropriate for assimilating the uncertainties into formal decision methods. As befits such a multi-disciplinary topic, the group received inputs from a wide variety of experts, ranging from mathematical/economists to social scientists, considered a number of practical examples of operational flood forecasting platforms and were involved in a number of International workshops. In this paper, the work of COST731-WG3 is reviewed, overall conclusions are drawn and unresolved issues/future needs predicted by the chairmen of the working group.

2. Working Group 3 Tasks

The work of COST731 Working Group 3 was divided into a number of tasks, all focused on at adapting existing concepts of probabilistic forecast products from atmospheric modelling to flood forecasting;

- To review existing operational decision-making concepts e.g. using expected values of cost & benefits and adopt them for flood warning decisions.
- To critically evaluate these “classical” methods and their usefulness for truly operational situations.
- To collect information and input data on a number of case studies for demonstration purposes.
- To determine the practical limitations of ‘expected value methods’ for extreme and thus rare events (cf. St. Petersburg paradox).

3. Presenting uncertainty information / some operational demonstration platforms

The starting point was operational practice and the WG3 group identified a number of operational systems that could be used as case studies. These included (i) MAP D-Phase, (ii) the HYDROMET platform for the Canton of Zurich, (iii) the Finnish Environment Institute (SYKE) flood forecasting platform, (iv) the EU PREVIEW project forecasts for the Danube, (v) the Swedish platform WebHyPro, (vi) the European EFAS system, (v) the Besos river forecasting system in Catalonia and (vi) the Delft FEWS system. Many of these are described briefly in Bruen et al (2010), which gives some graphical examples of their outputs. The propagation of uncertainty in hydrological models is described in Zappa et al (2010). The list of platforms is not exhaustive and continues to expand as more operational systems are added to it.
Many operational platforms were demonstrated through live internet links at a workshop in Dublin in November 2008 after which end-users discussed how uncertainty information could be presented. Most agreed that it was desirable to have uncertainty information, but (i) there was a dissatisfaction and a genuine worry about presenting it in the form of “spaghetti” plots of all ensembles in case end-users felt obligated to respond to the worst case member of the ensemble; (ii) many end-users would like a past history of uncertainty information to evaluate its usefulness and training in its interpretation and (iii) there were many different ways to present uncertainty information, including:

- Some form of weighting of ensemble members, possibly including clustering
- Peak-Box method (see below)
- Quantiles and interquantiles - exceedence probability plot
- Consistency table
- Validation statistics
- Cumulative exceedence probability curve.

COST731 joined with HEPEX in a Special Workshop, held in Toulouse, France, June 15-18, 2009 on the topic of “Post-Processing and Downscaling Atmospheric Forecasts for Hydrologic Applications.” Working Group 3 was represented by M. Bruen, M. Zappa, Demuth, N., Krahe, P., Vehvilainen, B & J. Olsson. Kees Kok joined WG3 for some of its deliberations. Three COST731 related presentations were given and these were (see http://www.meteo.fr/cic/meetings/HEPEX09/ for the abstracts listed below)

1. A “Peak-Flow Box” for Supporting Interpretation and Verification of operational Ensemble Flood Forecasts, by Zappa M. & Jann S.,
2. Quantification and propagation of three sources of uncertainties in operational flood forecasting chains in mountainous areas, by Zappa M., Jann S., Germann U., & Walser A.,
3. Communicating uncertainty information with warnings of natural hazards : COST731, by Bruen M.,

While expected value methods are widely used and often promoted as a means of dealing with uncertainty information in a decision making context, there are concerns about its use in low-frequency, high impact, situations. WG3 addressed this topic, raising many issues, e.g. (i) the similarity of the problem with those of hedge funds in the commercial world, (ii) using expected utility instead of expected value and the (iii) the concept of “regret”. While there are many useful concepts, operational examples are extremely rare and this remains an important challenge.

4. Future directions / Issues for discussion

Many unresolved questions remain, which address future needs could be discussed at this ERAD 2010 meeting, e.g.

- What is the long-term vision ?
- How to use the Internet as the dissemination tool and is it secure/reliable during an emergency.
- SMS is an alternative but delays possible and what is the role of commercial warning services?
- How to communicate uncertainty information to the mass media (TV radio).

The latter issue was addressed at a recent workshop, held in Alkmaar, by the Commission for the Hydrology of the Rhine, in association with COST731, on the topic of “Advances in Flood Forecasting and the Implications for Risk Management” (http://www.chr-khr.org/en). For effective communication, it is extremely important to understanding how each type of mass media works and how each prioritises and presents information. It is also important to be clear about what the term “uncertainty” means to each end-user and there was much discussion of the concept of “predictive uncertainty”

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References
