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Hydrology and Earth System Sciences Discussions

Interactive comment on "The European Flood Alert System – Part 1: Concept and development" *by* J. Thielen et al.

J. Thielen et al.

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Response to anonymous referee # 1 received and published on 9th June 2008.

First of all the authors would like to thank the referee for the constructive comments on the paper that will help us to improve the final manuscript so that it is accepted as Part I of a paper and yet stand-alone publication.

We are pleased that both reviewers explicitly express that the paper is enjoyable and interesting to read, even though both reviewers suggest that Part I of this EFAS paper would be situated better in a scientific journal focusing more on flood management than in one focussing on hydrological sciences, as is the case of HESS. Before submitting the paper to HESSD the authors had discussed carefully to which journal a full paper on EFAS should be submitted to. We have decided that the development and the results

of a hydrological forecasting system like EFAS are really novel and very exciting. They merit therefore to be published in a scientific journal with high impact and which offers the possibility to open a discussion on the topic of i) coupling ensemble meteorological and hydrological forecasts for increased preparedness to extreme events and ii) scoring probabilistic flood forecasting to improve the decision making processes involved in flood forecasting and warning.

While Part I – concept and development – may appear less scientific, it is a novelty in the way it presents an enlarged view of all aspects that need to be considered in the successful development of a forecasting system, as well as in the way it addresses issues of communication of probabilistic information that are far from being solved in current practice. Communication of medium-range flood forecasting products and probabilistic results to end users in a way that better decisions can be based upon them is yet a major issue and one of the key objectives of the international HEPEX initiative (see Thielen et al., Atmos. Sci. Let. 9: 29–35, 2008).

Furthermore, as stated in our answer to the review published on 31 March 2008, we believe that joining the two papers into one would result in a lack of focus. It would either become very long and exceed by far the usual HESS page limits or it would oblige us to take out important aspects of either the concept and development phase or the verification of forecasts. We therefore still strongly think that it is necessary to keep the structure of a Part I and a Part II paper, separately, but we are going to take into account all the suggestions made by the reviewers to improve the scientific aspects of the paper.

In the following, we answer specifically to the different points the reviewer #1 has raised. With R is denoted the text of the referee we refer to and with A the answer of the authors.

R1: as a stand-alone contribution (i.e. without taking into account Part 2 of Bartholmes et al.), I would rather see this paper published in a practitioner’s journal that is

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dedicated to issues that are of interest for stakeholders in flood management.

A1: We fully agree that the paper cannot be considered as a stand-alone paper and must be read together with Part II for a full overview on the EFAS system. While Part I could indeed be well suited in a flood management scientific journal, Part II shows novel results at a scientific level in hydrological sciences that would probably exceed the scope of a journal addressed basically only to practitioners. For this reason, the authors proposed Part 1 and Part 2 together for publication in a scientific journal such as HESS. In each Part, the reader can find references to the other in order to explicitly indicate where he/she can find the complementary information and we have made clear throughout both parts that the two papers have to be evaluated together. Also we note that, as stated in the HESS webpage (http://www.hydrology-and-earth-system-sciences.net/index.html), the journal "encourages (…) fundamental and applied research (…)", as well as "multi-disciplinary" approaches. It is also stated that "HESS (…) has the ambition to serve not only the community of hydrologists, but all earth and life scientists, water engineers and water managers, who wish to publish original findings on the interactions between hydrological processes and other physical, chemical, biological and societal processes within the earth system, and the utilization of this holistic understanding towards sustainable management of water resources, water quality and water-related natural hazards."

Therefore, within this scope, we think that our paper (Parts I and II) fits well the scope and the scientific editorial line of the journal, as stated by the Editors.

R2: The basic elements of EFAS have already been presented in more detail in a series of papers.

A2: Other papers already published about EFAS, and mentioned in the references, do not exploit the full concept and development of the study.

R3: in some parts reads more as a technical report than a scientific paper […] a quantitative assessment of EFAS is given by Bartholmes et al. in Part 2, which is, in

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my opinion, the far more interesting paper.

A3: The authors are aware that the style of Part I is rather descriptive compared to Part II which is a much more mathematical paper. We will make efforts to adapt style and contents to a more scientific level and also include quantification of results not covered by Part II, e.g. the overall success rate of EFAS warnings during flood-prone periods like summer 2005 and spring 2006.

R4: The authors could therefore highlight the potential of their approach as a standard methodology for flood warning in Europe rather than mentioning apparent benefits of EFAS over other (regional) systems.

A4: The authors very strongly reject his comment. Throughout the paper the authors have made very clear that EFAS has been developed – in close collaboration with the national flood forecasting centres – to produce added value (paragraph 2, line 4). “Added value” does not mean "greater value" but information IN ADDITION to what already exists, to complement the local information with products that most forecasting centres do not have available operationally. These additional products are a catchment based view on the forecasted flood situation, extension of the leadtimes up to 10 days, probabilistic flood information that most operational centres do not have available, comparable regional information based on 1 model, and access to frontier research on flood forecasting which is shared across the EFAS partner network, training of operational forecasting staff on probabilistic products. It is contribution that has been offered by the system and not substitution. We believe that there is a misinterpretation of the text in this aspect.

R5: Also, the authors claim that Part 1 deals with the scientific approach adopted in the development of EFAS whereas especially the last part (from 3.5 onward) deals with administrative issues like the communication of results and the collection of users’ feedback which are of limited interest for the scientific community."

A5: Considering a multi-disciplinary view of research activities, the authors believe

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that Social and Human Sciences are aspects that should be also considered in more mathematic-based sciences. In hydrological sciences, and specifically when dealing with natural hazards that are often at the origin of extreme events and consequent human life losses, the study on the perception of uncertainty and the communication of uncertain results are, according to the authors, topics of increasingly importance. Communication of medium-range flood forecasting products and probabilistic results to end users in a constructive way is yet a major issue that is being identified as a key issue in leading international scientific initiatives such as HEPEX. The challenge is not only to produce the results but also to make them lead to better decisions regarding flood forecasting. This whole concept of development of products according to end user needs and communication of results to end users should also be of interest for the scientific community of applied research to ensure that the products have impact on practical applications. We propose to make this point clearer in the paper and also to complement the paper with some less descriptive results on the interpretation of forecasts and communication to endusers.

R6: The apparent advantages of EFAS that the authors list in comparison to local forecasting systems are not very convincing (paragraph 3.1.)."

A6: Paragraph 3.1 does not deal with "advantages of EFAS". There the authors only report the study of feasibility. We believe that there must be a misreading at this point. The objectives of the system are listed in paragraph 2, where it is also explicitly indicated how (and under what aspects) the system aims at complementing the activities of the national services.

R7: The authors argue that EFAS could provide added value with respect to extended lead times of prediction and interpretation of probabilistic weather and flood information. However, one could argue that using the 51 EPS runs, the same kind of forecasting products could be provided with any regional model that, on the other hand, may be more carefully calibrated to local characteristics (e.g. with better knowledge of site specific warning thresholds and with the availability of better data sets for calibration

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and evaluation)?

A7: As described in the paper, EFAS started its development in 2003 based on a survey what products the regional flood forecasting offices would consider added value products. The two issues that could be identified were a) flood forecasting results for the entire catchment to get a better overview as well as bordering catchments and b) producing EPS based flood forecast results that are first processed and interpreted BEFORE communicating them to the end users.

In 2003 there was not one operational flood forecasting centre in Europe that processed EPS operationally and even today there are only few centres that have EPS fully operationally implemented. There are a number of reasons for this: first, computing power: many flood forecasting centres would not have the capacity to extract 50 EPS members twice a day and process them; b) mismatch in spatial and temporal scale: many operational flood forecasting centres issue flood warnings for administrative units rather than catchment units. These may be very small contrasting comparatively large grids from the meteorological model with small hydrological sub-catchments; c) validation of results: as is elaborated in Part II of the paper, probabilistic forecasting needs to be assessed statistically over a sufficient long time period and a sufficient number of events. In single (sub)catchments it may not be possible to obtain sufficient number of events covered by consistent weather forecasts to produce significant statistics. End-users have confirmed that only running the EPS through the model and obtaining 50 hydrographs is not useful for making better decisions. Correct interpretation of the probabilistic results is essential. The development of a forecasting system does not concern only "computing and issuing flood warnings". Scientifically, there are still many challenges, for instance, related to issuing probabilistic forecasts for any location and extreme events, mapping flood inundation areas with uncertainty, as well as modelling setup and updating. The use of probabilistic flood forecasting for risk assessment and risk-based decision-making in flood warning is one of the greatest challenges for the scientific community. In cases where decisions may depend on simulated outcomes,

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the topic is considered to be more important than just an implementation of modelling tools. The responsibility of the modellers (in research or operational centres) is even greater, which stresses the need of efficient use and communication of probabilistic forecasts (model outcomes) and strong implication of end users in the whole process. These challenges are present in the majority of European operational forecasting centres, as can be seen in the recent report of the initiative EXCIFF (2005). We propose to make these points clearer in the paper and put it in a scientific context.

R8: "Since these weaknesses are rather unavoidable in such large scale forecasting systems, it is still not very clear to me what is the point in having EFAS unless there is no regional system available. Hence, I believe that EFAS is not complementary to regional systems but "only" represents an alternative in data poor regions across the world. Why having EFAS if there is a site-specific forecasting tool that can make use of ECMWF’s data sets? By insisting less on the "added-value"; of their system with respect to local systems and by focussing more on the fact that the EFAS approach could serve as a general blueprint for operational flood warning, the authors would increase the scientific relevancy of their work."

A8: The authors are conscious of the weaknesses of the current system and explicitly refer to them in many parts of the paper: e.g. page 266, line 20, p 270, line 16, etc. The weaknesses have been identified and will be addressed step by step, e.g. calibration of the input data through bias correction of the ensemble prediction systems, post-processing of discharge data at stations where measurements are available, improved input maps set, etc. For matters of clarity, we propose to refer to them all together in paragraph 4 "Discussion and way forward".

However, despite the current weaknesses of the system – which are being addressed while the system is still in research phase - EFAS is clearly considered as a step forward in probabilistic flood forecasting by the operational flood forecasting community which is clearly demonstrated by the expanding EFAS network. Also, as stated in paragraph 3.5, lines 22-23, our experience has conducted to a fairly different conclu-

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sion: as we wrote, "Feedback on EFAS results so far has been very positive". Here, we made reference to reports published on the topic, where the reader can obtain more detailed information. At paragraph 3.3.4, lines 7-9, we also note that EFAS forecasting diagrams "have also been considered as very useful and informative by the users of EFAS forecasts at the national forecasting centres". Therefore, the added-value is in fact recognized by the users.

We can explicitly add in the reviewed paper some results from the feedback of users to provide more elements to these evidences and make the statements clearer in a revised version of the paper.

Finally, EFAS is a major flood forecasting system that has been developed over the past to fill acknowledged gaps in operational hydrological forecasting. It is both novel in its extent and scope as well as in the probabilistic products, their interpretation in terms of quantified uncertainty and their communication of EARLY flood warning, in the medium-range- to endusers and stakeholders. As such we believe that it is NOT a good example for a blueprint for operational flood warning which typically operate on much shorter leadtimes.

R9: Finally, I recommend to skip some parts that are not relevant for the scientific community (e.g. 3.1, 3.5, 3.7).

A9: 3.1 deals with the scientific feasibility study; 3.5, with communication of forecasts to users; and 3.7, with transfer to operational system. As stated earlier, the authors think that traditional pure modelling of the natural system, without participation of the users of research results, do not contribute to sharing visions and knowledge and, hence, to efficient decision making processes. These parts are very briefly described in the paper, but we think that they are essential to the ensemble conceptualisation of the system, as illustrated in Fig. 1.

When adapting the manuscript to a more scientific style, we will look closely into paragraphs 3.1 and 3.5 and on how to present their relevance for the system. Section 3.7 is

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very short and was included to complete the discussion of Figure 1. The authors agree, however, that this section is not of direct scientific interest and propose to summarise the content in a sentence in the closing discussion.

Specific comments: C: "p. 263 l.7: EPS ensembles could be used by any regional forecasting system as well thereby eventually increasing the lead-times of these systems. EFAS is not the only system that can make use of the EPS ensembles. Hence, the added value may come from EPS (i.e. ECMWF) rather than EFAS."

The authors fully agree with the reviewer that weather ensembles could be used by regional forecasting system and do not state that EFAS is the only system to use EPS data. For reasons explained in Comment Nr 7, however, not all operational flood forecasting centres have the means to run all EPS through their model, perform the necessary statistics and research to make effective use of the information. The part that the reviewer refers to, the paper mentions the outcome of the survey held in 2003, where none of the participants of the survey used EPS quantitatively but qualitatively only. We can make this point clearer in the text.

C: "p. 263 l. 17: delete "in Europe". Ok.

C: P 265, l1: ECMWF and DWD run different meteorological models and EPS are only produced by ECMWF. We will make this clearer in the text.

C: yes, but not based on high resolution meteorological data but a coarse meteorological network. A study for the Elbe river basin has shown that higher resolution meteorological data can yield much better Nash coefficients. Data collection on European scale are ongoing (EU-FLOOD-GIS and ETN-R) to improve the quality of the forecasts across Europe. We are going to incorporate some results on the differences in the performance in the paper.

C: 270: yes. The model is calibrated by subcatchment. The paper will expand on the set-up and calibration of the model. This part will be better explained in the text.

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C: P272: A communication strategy of probabilistic results is crucial (first sentence of the section). However, the authors will adapt the descriptive style and highlight the scientific challenges.

C: Fig 4 and legends will be addressed in the reviewed version to clarify the content of the figure.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 257, 2008.