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Hydrology and Earth System Sciences Discussions

Interactive comment on "A pilot operational flood warning system in Andalusia (Spain): presentation and first results" *by* P.-A. Versini et al.

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Dear Editor,

Please find enclosed the revised version of the manuscript "A pilot operational flood warning system in Andalusia (Spain): Presentation and first results". All the comments and suggestions made by Referee #1 have been taken into account and inserted in a new version of the manuscript. Also, clarification of the scientific interest of the manuscript has been provided to answer the issue arisen by Referee #2. Also, we have included the analysis of the performance of the GFWS for a new event (less intense) to demonstrate the interest of using radar rainfall estimates. This analysis also illustrates the performance of the GFWS over a minor event, and shows how the GFWS did not

overestimate the hazard.

Referee #1

(1) SCS Model: We agree with the reviewer on the arbitrariness of some of the decisions made in the implementation of the rainfall-runoff model (including the 24-hour moving window used for continuous runoff simulation).

Michel et al. (2005) underlined some of the inconsistences in implementations SCS-CN. Among other aspects, the authors discussed about the differences between intrinsic model parameters and initial conditions through the initial abstractions, Ia. They proposed a change of the model parameterization and a new formulation to solve this problem and keep the efficiency of the original method.

Although the formulation of Michel et al. (2005) has not been implemented, in our study Ia is taken independent of the parameter S (the frequent approximation Ia=0.2S has not been used). Ia is calculated at the beginning of the event (using previous precipitation and evapo-transpiration) to characterize the soil moisture. However, this value is limited by the model structure: unlike Michel et al. (2005) the version of Ia used in our study cannot be negative or higher than S. In our basin, these hypotheses are reasonable and we think this is not a major limitation of the model (comparable to other assumptions discussed in the manuscript): instead of allowing negative values of Ia we have assumed that the initial flow can be represented by the base flow model, and Ia values larger than S are not necessary for the physical characteristics of the basin. These limitations are now explicitly discussed in the description of the model (lines 211-216).

(2) Model calibration: The model has been calibrated on 8 events using only Bobadilla stream gauge. The other 2 stations have not been used because no significant discharges were measured and/or the data were not available. The results of this calibration are presented in Table 1. This has been better clarified in lines 275-285.

The results presented in Table 2 correspond to the scores obtained for the 3 stream gauges for the 2 case studies of January and February 2010. For these events, the stream gauges worked correctly and a comparison between observed and simulated discharge was possible. This validation is not mentioned in Section 3.3, which introduces the calibration of the model. However, Table 2 is referred to Sections 5.1.1 (lines 397) and 5.2.1 (lines 445).

Concerning the procedure used to extend the calibration to the ungauged basins, only the 5 calibrated parameters were extrapolated (i.e. the curve number correction factor, FCN; the base flow parameter, α, and the three routing parameters -hillslope velocity, vh, river velocity, vr, river weighting factor, Xr-). That is, the values of these parameters found in Bobadilla were assumed in the remaining (ungauged) part of the watershed. The remaining variables are deduced from the geographical information (curve number, CN, from slope, geology and land cover data, and the number of river/hillslope cells, Nr, were deduced from the digital elevation model). An additional paragraph has been added to provide further details on this aspect (lines 311-313).

(3) Other comments:

- The abstract has been sharpened to better introduce the motivation of the paper.

- The terms “calibration a priori” have been replaced by “transfer of the parameters” (line 22). It is true that the parameters on ungauged basins were not deduced from the local characteristics of the watershed but directly transferred from a gauged basin.

- “prevent” has been replaced by “provide” in “provide a flood forecast several days in advance” (line 28).

- The term “quality” has been removed as suggested (line 35).

- Fixed.

- The term “risk” has been replaced by “hazard” all throughout the paper as required (line 97).

- “lager” has been replaced by “larger” (line 154).

- “soil drying” has been replaced by “soil drainage” (line 203).

- The text has been rephrased for better clarity. It now reads “Base flow is (. . .) is initialized with the initial flow Qini measured in gauged cells at the beginning of the event, and extrapolated to the rest of the basin proportionally to the drainage area of each cell.”. See line 225-227.

- The Spanish Ministry of Public Works is now introduced when the acronym MOPU appears for the first time in the text (line 248).

- The sentence has been rewritten (line 279-28).

- The reference to Borga (2008) has been added in the reference list.

- Nash (1969) has been replaced by Nash and Sutcliffe (1970).

- The term IDF (Intensity-Duration-Frequency) is introduced in line 165.

- Spatially averaged over the area upstream of each point. This extent has been included in the text (line 343)

Referee #2

The manuscript presents a study on the performance of a Flood Warning System adapted to the unfavourable conditions of the Guadalhorce basin: scarcity of historical hydrological measurements, ungauged basin framework. In our opinion, these constraints justify the implementation of the chosen simple approach. In this context, the study focuses on what, in our opinion, are the main points of interest:

- The complementarity of the different types of warnings (based on local and spatially integrated rainfall, and on simulated flows) and the discussion explaining their differences in terms of warning intensity. The current version of the manuscript (in Section 5.3 and in the conclusions, lines 592-605) emphasizes more on the interest of the warnings based on point rainfall to alert of urban or flash floods, and on the advantage of using simulated discharges by considering the rainfall-runoff transformation and antecedent soil moisture conditions.

- How the use of EFAS (using an uncalibrated hydrological model LISFLOOD) can provide valuable information several days in advance in an operational context. In this sense, the manuscript analyses its complementarity with a local high-resolution system (GFWS) and its limitations depending on the type of event that can be forecasted with the NWP ensemble (see Section 6 and the conclusions, lines 606-617).

- The discussion on the different lead times provided by both warning systems from an operational point of view. It has been demonstrated that EFAS is able to provide warnings several days in advance whereas the GFWS is limited to few hours (for the larger basins), allowing emergency services to improve the preparedness of their actions (Section 6.3 and conclusion L.652-665). In this sense, the manuscript now includes further discussion on alternatives to fill the gap between the lead times addressed by very-short term rainfall forecasting (nowcasting) and by NWP precipitation forecasts (lines 689-695).

These extents have been analysed for two intense rainfall events occurred short after the system started operating (unfortunately the radar was not operating in any of the cases). Since then, no major events have occurred. The text has been sharpened to emphasize on the issues mentioned above.

Also, the use of radar rainfall estimates has been demonstrated with the GFWS for a minor event occurred in April 2011, included in a new Appendix. For this event, 10 mm of rainfall were accumulated over the basin (with totals locally reaching up to 25 mm), and the GFWS did not issue any risk warnings. It illustrates the benefit of using radar-based QPE because there was no rain gauge at the location where the most intense precipitation occurred. Second, it can thus be considered a successful performance of the system, provided that no flooding was reported for this event.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/8/C6131/2012/hessd-8-C6131-2012-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 10425, 2011.

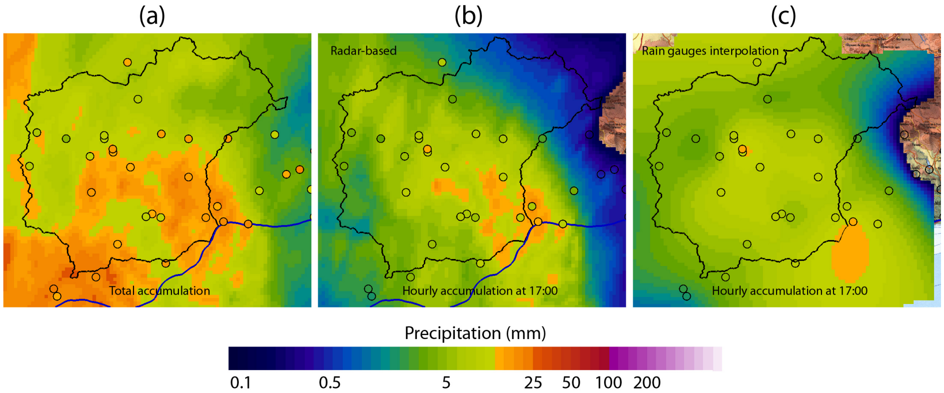

Fig. 1. Figure A1. Results obtained for the 21 April 2011 event: (a) total precipitation accumulated from radar-based estimates, (b) hourly rainfall field at 17:00 UTC computed by using radar-based estimates,