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Interactive Comment

Interactive comment on "Using globally available soil moisture indicators for flood modelling in Mediterranean catchments" *by* C. Massari et al.

Anonymous Referee #2

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Evaluation

The work describes the use of different soil moisture estimates for the initialization of a relatively simple conceptual event-based hydrological model. The model soil moisture routine is based on the SCS Curve Number approach; the runoff propagation routine is based on the geomorphological unit hydrograph. Observations from the 109 km2 wide Rafina catchment, in Greece, are used to drive the model and to evaluate the initial soil moisture estimates for fifteen rainfall-runoff episodes characterized by generally low flow peak magnitude. Four different methods are used to provide soil moisture estimates: two remote sensing products, the ECMWF-based soil moisture reanalysis, and ground-based soil moisture measurements carried out at 25 cm depth. These estimates are supplemented with soil moisture estimates obtained at the start of the

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events by using a continuous hydrological model.

The novelty of the work is represented by the development and verification of a modelling chain that permits the incorporation and the evaluation of external soil moisture estimates. The work is very interesting, significant and well suited to the readership of HESS. However it needs a careful re-organisation and attention to a number of issues to be acceptable for a major scientific journal.

General comments

1. The overall purpose of the paper is to provide soil moisture estimates at the start of flood events for flood prediction and flood risk management. However, the data used in the manuscript concerns low-to-moderate rainfall-runoff events. For the selected events, the max peak discharge is around 40 m3/s, i.e. 0.4 m3/(s km2), with 8 events less or equal than 6.7 m3/s. These magnitudes should be contrasted with the intensities of flood events of some relevance for risk management in the region (as a reference, the 500-yr return period peak discharge is estimated around 250 m3/s (Karagiorgos et al., 2012 and references therein)). The gap between the 'real' flood conditions in the basin and the analyzed rainfall-runoff events is totally understandable: the period considered in the study (from March 2009 to December 2012), was probably too short to capture significant flood events. Nevertheless, the gap should be identified by the authors, and the implications should be discussed. On the one hand, I think that the value of the technical analysis is not affected by the use of low-magnitude events, since the impact of the initial soil moisture conditions is (generally) expected to be more important for low magnitude events and to decrease with the magnitude of the event (however, Marchi et al., 2010, identified that the impact of initial wetness condition is still important for extreme flash flood events). On the other hand, it should be borne in mind that some assumptions used in the modelling chain may be less realistic when low-magnitude events are considered. This is the case of the lumped approach and the rainfall estimation procedure: small scale events are usually more affected by rainfall spatial variability than extreme events are. As a further and necessary step, the

authors should identify how the findings from this analysis can be extrapolated to more severe events.

2. The initial soil moisture status is not the only subsurface water state variable which may affect the hydrologic response. The water content of the bedrock system may be relevant as well, particularly in Mediterranean catchments where partially karstified aquifers are common (karst areas make up more than half of the Mediterranean drainage basin – Ganoulis 2003). This is the case of the Rafina basin, where geological formations such as limestones and shists, prone to fracturation and cave formations, form a good portion of the basin. It is likely that model-based soil-moisture simulations account for an overall 'wetness state' of the basin (including both soil and bedrock moisture content), whereas remote-sensing – based soil moisture estimates reflects more properly only the moisture status of the soil layer. This ambiguity is particularly relevant for the CN-SCS model used here, which does not consider the groundwater contribution to the runoff formation. The authors should identify and clarify adequately this ambiguity.

3. One main point in the modelling chain is the integration of two different models: one (termed RR) is used to describe the flood processes, whereas a continuous hydrological model (termed SWB) is used for the simulation of the hydrological cycle. There are both presentation, practical and theoretical issues which must be accounted for here. PRESENTATION: The presentation of the two models is bad and ambiguous, making it hard to understand how the two models are considered and linked. The ambiguity starts with Section 3.1, where a event-type flood model is presented as a continuous model. To this reviewer, a continuous model is a model which is able to account for the soil moisture balance over a long-term period, and which is able to describe the relevant hydrologic physical processes such as evaporation, transpiration and groundwater flow. This is certainly not the case for the model presented in Section 3.1. The ambiguity grows with Section 3.3, where the SWB model is presented. The SWB includes five parameters to be estimated (i.e., calibrated). Apparently, the SWB

model parameters are estimated based on comparison with FDR soil moisture measurements. This is reported in a cursory way in Section 4.1. The part concerning the model calibration should be moved to Section 3.3. PRACTICAL ISSUES: 1. At Section 4.3, it is said that the SWB model parameters are optimized by using the discharges measured in Rafina. How is this calibration carried out, with a model lacking any runoff propagation routine? Moreover, this is conflicting with the model parameter calibration described in Section 4.1. THEORETICAL ISSUES: The authors should clarify how the model states obtained from SWB model can be used to surrogate the value of S in RR model, in view of the different model structures and model calibration procedures. The manuscript doesn't provide any detail on this step.

4. The above "Presentation" ambiguities are not sorted out with the Answer provided by the Authors to Reviewer1 (Point 9, 10 and 11 in the Interactive Comment). In that answer, the Authors continue to present RR as a continuous model, which is not the case. To this reviewer, RR is an event model able to exploit soil moisture estimates from external sources.

5. Representativeness of the single site FDR soil moisture measurement. 25-cm depth, FDR measurements of soil moisture from a single site are used to supply ground based catchment-scale soil moisture estimates. These estimates are contrasted with satellite measures representative of different soil depths and characterized by different support area. The obvious jump of scale and the relevant implications should be adequately commented in the manuscript.

Details: There is a large number of instances which are in needs of improvement and correction. Most of these have been already identified by Reviewer 1.

References

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