Interactive comment on “Forest cover influence on flood assessment in Italian catchments” by F. Preti, G. Forzieri, and G. B. Chirico

Authors’ reply to the three Anonymous Referees

We are grateful to the three Anonymous Referees for their useful comments, which will help us in clarifying some of our results and statements as well as improving the readability of the text to the benefit of a wider readership.

All three Referees wrote a general favourable appraisal of the paper, but they also highlighted the need for a major revision to be focused on a deeper discussion of the results. We agree with this critic and we are now going to expand the paper with several careful considerations, which we missed to include in the first version of the paper. We are also sorry for many typos and editing errors, which certainly we could avoid with a careful proofreading and editing of our paper.

Please find below our preliminary reply to the three Referees.

Reply to Referee #1 (R#1)

R#1. *The paper analyses the influence of forest cover on flood peak for 75 Mediterranean catchments in Italy. The authors proposed a correction for the runoff coefficient estimate which accounts for the effect of forest cover. This appears to be the main point of the paper and I believe the method used is justified. The paper is well written, methods and results are adequately presented, however it is regrettable that no discussion of the interesting results was presented. Consequently, the interpretation of the results is weak, and the originality of the study is not sufficiently highlighted. For these reasons, I recommend major revisions for this paper before its acceptance in HESS. Below I list my suggestions for this paper.*

A. We agree with this general comment, as already discussed above. A specific session will be devoted to the discussion.

R#1. *I suggest that the term ’Mediterranean’ should appear in the title, maybe instead of (or in addition to) ’Italian’.*

A. We used “Italian” as we examined Italian catchments only. However, we agree that the term “Mediterranean” might be fine as well, as the examined catchments are representative of a broad range of climatic regimes within the Mediterranean region.

R#1*. I suggest that authors add additional international references from Mediterranean hydrology in order to better justify the need to improve the knowledge of forest influence on catchment hydrology in this context (all catchments used in this study are located in a Mediterranean context). The originality of the paper is the modification of an estimate of annual flood peak by adding a loss factor as a function of forest fraction. Thus, readers need a reference or a justification of the use of the Eq.1 as a reference of QT estimate for ungauged basins.*

A. We will add some specific references, although we would maintain the reference list to an acceptable number with respect to the very extensive literature on the topic.

R#1. *For more readability, Eqs. 2 & 3 should be presented in the same section than Eq. 1. What is the validity of the CL and Cobs variables? Give more details on the assessment of such parameters. Since the data processing is based on these variables, it would be interesting to give absolute values of CL and Cobs in Table 1.*

A. We will verify the opportunity to move equations 1, 2 & 3 to improve the readability. Details of

parameters C_L and C_{obs} will be provided as well as their range of variability will be reported in a table.

R#1. *3 Data mining. At the beginning of this section, I would expect a short explanation of the choice of statistical method (Spearman ranking and cluster analysis)*

A. We agree that an explanation is required also to clarify the choice of the methods employed in the following analyses.

R#1. *p 4901 L 12: the storage capacity of forest soil is one explanation among others, but I think that considering the data set they used, authors cannot differentiate soil storage from canopy storage or interception losses. It should be discussed here or in a separate section.*

A. Yes, other factors might contribute and the data analysed are not fully representative for exploring this issue. On the other hand, we believe that storage or interception losses, although being important in the water balance at large temporal scales, have a minor impact on the discharge during extreme flood events, as those examined in this paper.

R#1. *I think that a general discussion of the results is missing.*

A. As anticipated above, we will integrate the paper with a discussion section.

*Other **R#1** specific comments*

A. We thank Referee #1 for evidencing several technical and editing errors for providing technical correction for improving the quality of the paper. We will follow the suggestions in the revised paper.

Reply to Referee #2 (R#2)

R#2 *The manuscript proposes to modify the rational formula with a corrective factor to include the forest cover information that apparently could affect the runoff coefficient. The topic is interesting and potentially useful for the peak runoff estimation in ungauged basins. My evaluation is generally positive and I suggest major revision.*

A. Please, refer to our general comment.

R#2 *1) The rational formula, in my opinion, is dated since event-based procedures and continuous models can be currently applied also in ungauged basins using similar empirical parameters included in the rational formulas. So a first general suggestion is to try to apply the same approach on more advanced rainfall-runoff model. This is just a comment and not a specific request to the authors.*

A. We agree that several models can be currently applied for simulating catchment response. However, the rational formula is probably still the most favoured approach used by practitioners for flood peak estimation and hydraulic engineering, despite the numerous criticisms regarding its over-simplification of the complex hydrological processes, probably because it is easy to understand and simple to use. We will provide some comments on this specific aspect in the introduction.

R#2 *One of the most important conditions of the rational formula is that the rainfall should be homogeneous in space. This condition restricts its applicability to small basins for which, in addition, there are not accessible runoff observations and consequently simple and empirical formulas are reasonable solutions. Authors selected 75 basins and many of those are quite large (>5'000 Km^2) and for which probably it is not appropriate to apply the rational formula. Looking the figure 4 it seems that limiting the attention on basins with contributing area < 500km^2 still authors have a good sample on which they can apply the proposed approach.*

A. Rainfall spatial variability at catchment scale can certainly be one of the main sources of uncertainty for catchment response predictions, particularly when catchment is modelled as lumped. In fact, rainfall spatial variability can be interpreted as a source of apparent non stationarity of catchment behaviour in lumped models (Viglione et al., 2010a,b). In the rational formula, the effects of the intra-catchment variability are treated by statistical and empirical terms, such as by means of the rainfall areal reduction factor.

R#2 *3) Other "dangerous" assumptions are related to use the Giandotti formula to estimate the concentration time and the formula (3) to quantify the Cobs. In both cases we do not have a clear idea of the error source. Are there other methods to estimated these parameters using observed data? if not, I understand that to make spatial analyses we need to find a compromise.....but probably this problem should be considered in the manuscript. For instance when the authors hypothesize the reasons of the differences between Cobs and CL they should mention that probably this difference is not exclusively due to the forest cover fraction but also to the variability induced by the adopted estimation procedures.*

A. There are several error sources that contribute to the overall prediction uncertainty. Namely, all parameters required for the application of the rational formula are subjected to uncertainty. The aim of our study is to assess to what extent the spatial variability of the runoff coefficient can be explained by forest cover fraction. Beside this, it is also important to mention that forest cover fraction is also uncertain because is subjected to temporal variability. Anyway, the Referee rose an important point that deserves a deeper discussion in the paper.

*Other **R#2** specific comments*

A. As for Referee #1, we thank Referee #2 for evidencing several technical and editing errors for providing technical correction for improving the quality of the paper. We will follow the suggestions in the revised paper.

Reply to Referee #3 (R#3)

R#3 *The manuscript proposes an analysis of the influence of forest cover on the runoff coefficient of Italian catchments. This is an interesting subject to understand runoff behaviour and can be useful to the research question of PUB. Unfortunately the study is based only on six parameters describing catchment characteristics without discussing the selection of parameters and results. Therefore I recommend major revision for this paper.*

A. The motivation underlying the parameter selection will be carefully illustrated. Herein, we briefly remind that the selected parameters are those directly or indirectly involved in the computation of the flood peak with the rational formula.

R#3 *The rational formula is usually limited to small catchments, less than 50 or 100 km^2. Please give reasons for the use of this method for the studied much larger catchments and discuss advantages and problems of the method.*

A. As highlighted in the reply to Referee #2, the rational formula is probably still the most favoured approach used by practitioners for flood peak estimation, even for large catchments. Following also the suggestion of Referee #1, we will add more references on this point.

R#3 *Why is only forest cover responsible for deltaC?*

A. In fact, other factors might contribute, but we have been exploring to what extent the forest cover can explain deltaC and what is a possible strategy form improving the estimation of the runoff coefficient, by a better combination of the forest cover with other factors, such as h_c.

R#3 *What about other catchment characteristics with an influence on runoff, e.g. climate, topology, geology, soils, drainage density, other land uses than forest, type of forest . . ..? Please discuss the choice of parameters. Bear six parameters (A, Zm, hc, Q, SP and Sb) comprehensive information to calculate the influence of forested areas? (All other parameters are calculated from the six parameters!)*

A. As anticipated above, we employed those parameters directly or indirectly involved in the computation of the flood peak with the rational formula and thus were available for a large number of catchments. Other parameters, such as those climatic indices employed by Fiorentino and Iacobellis (2001) might be explored in further studies, but keeping in mind the fact that there might be a strong cross–correlation.

R#3 *A discussion of the result and their significance is missing.*

A. As replied to the other tow Referees, we will add a discussion section.

R#3 *The reader gets no information about the studied catchments. Are there different catchments characteristics between catchments concerning catchment size, topology, geology, soils, drainage density, land use, degree of urbanization or climate? This information is important to assess catchments and differences/similarities between them.*

A. We will illustrate these details.

*Other **R#3** specific comments*

A. As for Referees #1 and #2, we thank Referee #3 for evidencing several technical and editing errors for providing technical correction for improving the quality of the paper. We will follow the suggestions in the revised paper.