**Natural Hazards
and Earth System
Sciences**

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Discussions

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Interactive comment on "Estimation of flood design hydrographs using bivariate analysis (copula) and distributed hydrological modelling" *by* A. Candela et al.

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The manuscript describes a procedure for design hydrograph estimation and provides an application on a small Italian watershed.

The proposed methodology is interesting and the topic is surely appropriate for NHESS.

While I am glad to suggest to publish the manuscript, I have some comments to share with the authors and specific suggestions to try to improve the manuscript.

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General Comments

1) In general, I would suggest to better explain in the introduction the aim of the paper. In the present form it is not fully clear and the reader could be confusing since the paper includes several hydrological modules and the original contribution could be not so evident. In my view, a major point provided by the paper is the effort to include the volume information in the design hydrograph estimation procedure. Indeed this latter, while it is pivotal for hydraulic hazard mapping is too often misevaluated. We recently published a couple of papers on similar topic:

Grimaldi S, Petroselli A, Serinaldi F (2012). Design hydrograph estimation in small and ungauged watersheds: continuous simulation method versus event-based approach. HYDROLOGICAL PROCESSES, vol. 26, p. 3124-3134, ISSN: 1099-1085, doi: 10.1002/hyp.8384

Grimaldi S, Petroselli A, Serinaldi F (2012). A continuous simulation model for design-hydrograph estimation in small and ungauged watersheds. HYDROLOGICAL SCIENCES JOURNAL, vol. 57, p. 1035-1051, ISSN: 0262-6667, doi: 10.1080/02626667.2012.702214

and I found interesting that the event-based approach proposed by the authors is able to provide volume information similarly to the continuous modelling. As a consequence, a question naturally raises, why do not use a continuous model? It could provide information on the antecedent moisture condition in the CN model and could avoid several methodological choices in the rainfall event analysis. So, maybe this kind of comments and answer could enrich the paper and give a more exhaustive overview to the reader.

2) The conceptual fully distributed model proposed by the authors is based on the CN approach. I agree with them in promoting the CN method above all in Sicily where it is widely applied, i.e. the latest paper:

D'Asaro, F., Grillone, G., and Hawkins, R. (2014). "Curve Number: empirical evaluation and comparison with Curve Number handbook tables in Sicily." J. Hydrol. Eng., 10.1061/(ASCE)HE.1943-5584.0000997 (Mar. 15, 2014).

However, I think it is important to recall some well known concerns on which we recently investigated:

Grimaldi S, Petroselli A, Romano N (2013). Green-Ampt Curve Number mixed procedure as an empirical tool for rainfall-runoff modelling in small and ungauged basins. HYDROLOGICAL PROCESSES, vol. 27, p. 1253-1264, ISSN: 1099-1085, doi: DOI: 10.1002/hyp.9303

Grimaldi S, Petroselli A., Romano N. (2013). Curve-Number/Green–Ampt mixed procedure for streamflow predictions in ungauged basins: Parameter sensitivity analysis. HYDROLOGICAL PROCESSES, vol. 27, p. 1265-1275, ISSN: 1099-1085, doi: 10.1002/hyp.9749

It is relevant to underline that the CN approach can not be used at hourly resolution, indeed underestimations could be provided by the CN method when the hyetograph peak occurs at the beginning of the storm.

3) Language, structure of the text, references, and equations should be improved. Some equations could be removed and other ones better explained or included in the text. References should be checked since some are present in the text but are not included in the reference list.

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Specific Comments

1) (minor comment) The title could be improved. I do not have good suggestions however in the present form is too long and the "(copula)" sounds strange.

2) Abstract. lines 2-5. It is not necessary to explain here the meaning of copula, so

these lines can be removed.

3) lines 18-19. These two lines should be rewritten. I suggest to not conclude the abstract with "etc."

4) Introduction page 28 lines 21-26 and page 29 lines 1-6. These first two paragraphs can be removed. Authors could include the "(European Union, 2007) reference in the first two lines (page 29 lines 7-10).

5) page 29 lines 24-29 page 30 lines 1-15. Here it should be underlined the aim of the paper in a more appropriate way.

6) page 29 line 25. I am not sure if (Hosking and Wallis 1997) is an appropriate general reference for FFA.

7) page 29 line 28. "hydrograph project"...maybe "hydrograph design"

8) page 30 line 3. "under the basin" is not clear.

9) page 30 line 5. FFC?

10) page 30 line 15. Maybe here instead of (Grimaldi and Serinaldi 2007) are more appropriate : Grimaldi S, Petroselli A, Serinaldi F (2012). Design hydrograph estimation in small and ungauged watersheds: continuous simulation method versus event-based approach. HYDROLOGICAL PROCESSES, vol. 26, p. 3124-3134, ISSN: 1099-1085, doi: 10.1002/hyp.8384 Serinaldi F, Grimaldi S (2011). Synthetic design hydrograph based on distribution functions with finite support. JOURNAL OF HYDROLOGIC ENGINEERING, vol. 16, p. 434-446, ISSN: 1084-0699, doi: 10.1061/(ASCE)HE.1943-5584.0000339

11) page 30 lines 22-30. Since the first paper on copula in hydrology was published 10-11 years ago, in order to provide an useful short reference review I would include the latest papers on copula. In any case as representative of hydrological applications I would not mention the first five listed in the line 23.

12) I would suggest to conclude the introduction with a short summary of the paper.

13) Section 3.1.1 I would not give too much details on copula, above all about equations, like 7 and 8. Since this is not a paper on copula function but on its application, I would add more details on how it was used in the model and I would give some suggestions for a correct application (choice of the copula function, R package used, etc).

14) The end of the section can be improved. The list of common distributions is not so appealing.

15) Section 4.2 & 5 I agree with the comments of reviewer 3 concerning calibration (1 event) and on the JRP selection.

16) page 45 - line 18-20 it is figure 15 not figure 8.

17) Section 6 conclusions can be improved.

18) Figures Figures 10 and 8 could be merged.

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