Hydrology and
Earth System
Sciences
Discussions

Interactive comment on "Multivariate Statistical Modelling of Compound Events via Pair-Copula Constructions: Analysis of Floods in Ravenna" by Emanuele Bevacqua et al.

Anonymous Referee #2

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The paper by Bevacqua et al presents a very comprehensive assessment of a compound event by discussing floods in Ravenna. In a way the paper is a bit academic, as it cannot be expected to model return periods of annual maxima very accurately with only 6 years of data (e.g., section 5.3). This is reflected in the large uncertainties that prohibit clear conclusions such as that considering the dependence between drivers of the floods does not necessarily improve the predictions of more extreme return levels. However, the authors show that by including the relevant dependencies at much higher temporal scale, substantial reductions in uncertainty can be obtained. In particular the consequent propagation of uncertainties is a valuable contribution to the community working on compound events and other multivariate problems, and demonstrates how

large those uncertainties are in higher dimensional problems dealing with extremes. This is an often-ignored topic in this type of analysis. I thus consider the paper suitable for publication in HESS after some amendments which mostly refer to the presentation of the results as listed below.

Major comments: The structure of the paper could be improved quite a bit. Currently, large parts of the results are actually explanations of methods, selection and evaluation of model etc. For instance, the beginning of the result section would fit better into the methods section. Actual results are only presented from section 5.3 onward. And even later on, descriptions that belong to the methods part can be found throughout the text. Separating methods from results more clearly would improve the readability of the results section substantially. A discussion section missing although some points are discussed are in the conclusion section. I suggest renaming section 6 "Discussion and Conclusions" and also here more clearly separating the discussion from the conclusions.

Minor comments:

Page 1

L6: "CEs" has not been defined yet as an acronym

L7: "downscaling of compound events"

L20: "obstructed" not sure what this word means here

Page 2

L1: "recent report": the IPCC report was published 5 years ago, would not call that recent anymore

L 14: "Leonard et al., 2013": the year should be 2014

Page 6

L5: avoid one-sentence paragraphs

L12 : this type of downscaling can be very useful, however, it can only be used at locations where at least some impact data is available and a model can be fitted since usually the fitted models are very context specific, which is also the case in this paper. I suggest omitting the sentences explaining the general usefulness of the downscaling of make it more specific for the applied case.

Page 7

L3: I'm not convinced that the prior selection of parametric models generally reduces the uncertainty of the estimated quantity of interest. The uncertainty of selecting the right parametric model is just not considered in the final uncertainty estimates.

L25: I wouldn't say that copulas increase the number of available multivariate distributions. They only simplify the modelling of those.

Page 9

L13: Maybe state that you will go through the 5 steps in detail in the next sections

L22: Maybe repeat the time period where impact data is available

Page 10

L7: Is it reasonable to assume that the model has Gaussian noise?

L13: "Considering the two models...": "Omitting one of the variables as predictor leads to worse model performance, underlining the compound nature of the impact h"

L15: "The relative contribution...": omit and start the sentence with the part that comes afterward: "The sum of the relative contributions of the rivers..."

Page 13

"red spot": "red dot"

C3

Page 14:

L2: Specify which model you talk about

Page 13

L13 and following: This should be moved to the methods section

Page 16

L21: maybe also state the actual maximal value of h

Page 17

L2: "is affected by uncertainties": "is affected by large uncertainties"

Page 18

L3: this reads as if the model were not specifically designed for the floods in Ravenna. The discussed model can only be used for this specific case and location. For other places, new models would have to be designed and fitted to do downscaling (the number and location of rivers may be different, the mapping from the meteorological predictors X to Y might have a very different structure). Through this strong context dependence, compound events and models thereof are inherently difficult to generalize.

Page 32

L14: delete "Environ. Res. Lett."