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Comment

## ***Interactive comment on “Future hydrological extremes: the uncertainty from multiple global climate and global hydrological models” by I. Giuntoli et al.***

### **Anonymous Referee #4**

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#### General comments:

The authors present a study that investigates the projected changes in hydrological extremes from 6 global hydrological models. The study is robust, both in terms of the statistical techniques used and the size of the ensemble (although the authors can easily extend the number further). The results of the study further our understanding of uncertainties global climate and hydrological models in simulating in future hydrological extremes.

My main concern is with the authors' use of multi-model ensemble mean. Although effort has been made to provide some information on the inter-model spread (e.g.

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variance), the manuscript can make a significant contribution to our understanding of the projections and modelling uncertainty of each GHM-GCM combination. In these respect, Figures 1, 3 and 4 can be provided as added illustration in the manuscript (or as appendix) by showing the changes in frequency of days under high and low flows from every GHM-GCM combination. In addition, given the focus of the study, I have strong recommendation on the use of winter half-year and summer half-year periods which is more representative of the relationship between rainfall and runoff, instead of climatologically defined seasons such as DJF and JJA.

Specific comments:

The authors should also address the following comments for added clarity to improve the manuscript.

3:13-15 : The authors cited several studies which assessed future changes in the global water cycle and argued that the lack of GHMs in these studies presents a limitation. The authors went on to say that GHMs provide more uncertainty. What is the authors' point on the relationship between the utility of more GHMs and uncertainty? Are the authors referring to the range of uncertainty (i.e. ensemble spread) that is produced given the use of large number of GHMs? This should be made clear. In addition, the authors should explain: the types uncertainties by GHMs and if there are merits in using GHMs (with input from GCMs) compared with using solely GCMs for assessment of future hydrological extremes.

4:12-13 : The cited studies – Dankers et al. (2013), Schewe et al. (2013), Davie et al. (2013) and Prudhomme et al. (2014) – do not amplify how “GCMs and GHMs uncertainty contribute to the spread in projected changes in hydrological cycle”. Reference to these studies should describe the regions where there is consistency as well as uncertainty in the projected changes of hydrological extremes.

5:9 : Is there any reason why the authors use the Koppen-Geiger climate classification over other classifications such as Giorgi-Francisco regions (2002) or Mahlstein-Knutti's

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(2010) cluster analysis-based regions?

5:19 : What variables from GCMs were used as inputs to GHMs?

5:22 : There should be a description on how well the climates of CMIP5 GCMs have been bias-corrected. For example, can the authors identify regions where there is high confidence in the simulation of climate after bias correction? The same can be said for regions which still suffer from poor simulation of climate after bias correction. (cf. 6.26)

6:21-24 : The binary assignment – 0 or 1 – to no low/high flows and low/high flows is confusing. In the example of high flows, if the runoff value of the cell exceeds the Q95 value, then the cell is assigned either 0 or 1. There should be separate criteria to distinguish a 0 flag from a 1 flag.

6:26 : On the aspect of “screened-out” areas – While the screened-out gridcells are located in arid or frozen regions, could they also be regions where there is considerable modelling uncertainty GHMs and/or GCMs? (cf. 5:22)

8:13 : Referring to Figure 2, the authors state that “the mean change vary spatially in magnitude”. However, there is no information in Figure 2 to highlight spatial differences. In addition, it is not clear how the mean changes are derived. Are these spatially averaged changes? Can the authors clarify these two points?

8:14-19 : The description in the lines 14-19 should be referenced to Figure 1.

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Interactive comment on Earth Syst. Dynam. Discuss., 6, 1, 2015.

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