

## ***Interactive comment on “Impact of climate change on freshwater ecosystems: a global-scale analysis of ecologically relevant river flow alterations” by P. Döll and J. Zhang***

### **Anonymous Referee #1**

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### Summary

The paper compares river flow alterations caused by anthropogenic forces with potential river flow alterations resulting from climate change and consecutively compares to what extent freshwater ecosystems may be affected by these two sources of alteration. Effects on ecosystems are quantified with a relation between changes in long-term average river discharge and number of fish species (Xenopolous, 2005). Furthermore changes in five selected ecologically relevant river flow characteristics are qualitatively related to potential changes in ecosystems.

General comments

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The effect of climate change related hydrological changes on freshwater ecosystems has been quantified by Xenopolous (2005) before by the method described in section 2.3. They used the same model (WaterGAP /WGHM) to quantify changes in discharge for the A2 and B2 scenario with data from the GCM HadCM3 as well. The new and for HESS interesting point of this paper is the use of the ecologically relevant river flow characteristics and the changes in these quantities. However the changes in these characteristics are only very briefly and qualitatively related to changes in ecosystems (page 1322, line 11-14, line 27-29).

The results of the study provide mainly information on the difference between anthropogenic river flow alterations and climate change related flow alterations and is not very interesting from an ecological point of view, although the title suggest differently.

I feel that the following points still need to be addressed:

1. Especially for the three basins that have been selected for a more detailed analysis, the authors should provide information on the freshwater ecosystem and the number and kind of fish species present. Are the expected flow alterations and resulting ecosystem changes in the ecosystems relevant for the species present and what will be the impacts? Please describe in more detail. It might as well be possible to relate the global scale flow alterations very roughly to a world map of ecosystems.

2. Does equation 1, derived for zero order basins, also apply to upstream areas of grid cells. Discharge quantities for upstream areas may vary from maybe 1 m<sup>3</sup>/s up to 200.000 m<sup>3</sup>/s, is it in these cases still valid to apply the equation? Furthermore the equation has been derived for river basins located between 42°N and 42°S, while the authors apply the equation for the whole world (Fig. 6). Does this introduce additional bias? What is the authors opinion on the validity of the equation outside 42°N and 42°S. It is shocking to see how far of the number of species calculated with this equation is from the number of species observed (Amazone 561 iso 1800, Orinoco 279 iso 88). Is there an explanation for these deviations? Is it possible to derive one equation for the

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whole world, keeping in mind the variety of ecosystems and species present?

Minor comments:

3. For the historic precipitation time-series the monthly number of wet day from the CRU TS 2.1 are combined with the monthly precipitation quantities of the GPCP dataset. Why were these datasets combined?

4. Section 2.1.1, line 5: a definition of consumptive water use is given. It is “the withdrawn water that does not return to the river but is evaporated”. Is it correct that evaporation is the only reason why the water does not return to the river?

5. Section 2.1.2, line 20: What method has been used to interpolate the GCM data to the WGHM resolution?

6. Section 4: Results and regime curves (Fig. 7) are given for the Danube, Volga and Missouri because large anthropogenic flow alterations have been made in the past in all three rivers. However, are these river also most interesting from a climate change point of view?

7. Conclusion, page 1327, line 10-13: Is it really possible to conclude that the calculated river flow alterations will result in strong alteration of genetic levels?

8. Table 2: In the second half of the table the median indicator values for the land areas (in %) are given. Differences between ECHAM4 and HadCM3 are large, is it possible to say something about the reliability of the two climate models or to give an explanation for the difference?

9. In the figures results are more often given for the HadCM3 model, is there a reason for this?

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