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Hydrology and Earth System Sciences Discussions

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 #2

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This paper provides an important and interesting modeling analysis of the effects of climate change on river flow regimes, and posits a comparison of climate effects with flow regime impacts caused by dams and water withdrawals.

The results in this paper summarizing the influences of climate change are certainly worthy of publication. However, there are some serious issues with the comparison between climate effects vs. dam/withdrawal effects on flow regimes. First, only a subset (6553) of the more than 50,000 large dams have been included in this analysis. This creates a spatially incomplete representation of dam impacts on flows. Second, reservoir operating rules, which strongly dictate the degree to which dam operations will

alter natural flow regimes, are represented in a highly simplified fashion, on a monthly time step, that greatly obscures (attenuates) real dam effects on river flows on shorter (e.g., hourly or daily) time intervals. Third, it is known that the model used for this analysis underestimates the magnitude of alteration caused by dams and water withdrawals, based on comparisons with actual river flow data. However, the accuracy of the climate predictions is unknown.

Each of these shortcomings make it unreasonable to draw conclusions such as "Climate change will have a more widespread and stronger impact on ecologically relevant river flow characteristics than dam construction and water withdrawals have had up to now" (page 1326).

My recommendation would be to instead focus on the potential for climate change to exascerbate the dam and water withdrawals effects reported in an earlier paper by these authors. Additionally, the authors make the important point (on page 1325 and in Figure 8) that climate changes will in many regions present opportunities to improve environmental flow conditions, particularly for rivers that have been altered by dams and water withdrawals. This point should be retained and perhaps given even greater emphasis in the final paper.

Additional Points:

1. In the opening paragraph, the authors state that "...with one exception, transferable quantitative relations between flow alterations and ecosystem responses have not yet been derived." This statement should be clarified and qualified. It is true that globally-applicable linkages between flow alteration and ecological outcomes remain elusive. However, such linkages have been widely developed for specific rivers, and even for large regions (e.g., Tennant Method developed from hundreds of rivers in US). Additionally, there are numerous "ecosystem responses" that are of a chemical or physical nature that are well-understood and universally applicable, such as known relations between freshwater inflows and estuarine salinities, or the relationship between flow

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magnitudes and streambed particle sizes. The authors should clarify that they are using one particular relationship – describing the apparent influence of river discharge with freshwater species richness – to illustrate possible ecological consequences.

2. Has the relationship developed by Xenopoulos et al (2005) been tested for its predictive capability? My understanding is that it is based on a regression relationship linking discharge and species richness, but its ability to accurately predict how species richness would decline in rivers experiencing flow depletion has not been tested to my knowledge. Therefore, the authors use of this equation in a predictive manner is questionable.

3. In the Abstract, emissions scenarios are referred to as "A2" or "B2", which may be recognized by scientists familiar with climate models, but may require more explanation upon first mention in this paper.

4. The authors begin a number of sentences with "Besides,...." where other words such as "Additionally, ..." may be more grammatically correct or preferable.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 1305, 2010.