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Hydrology and Earth System Sciences Discussions

Interactive comment on "The influence of constrained fossil fuel emissions scenarios on climate and water resource projections" *by* J. D. Ward et al.

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We thank Anonymous Referee #1 (AR1) for his/her positive and constructive comments.

AR1 notes that we have devoted a considerable portion of the paper to our criticism of IPCC emissions scenarios, and suggests that we could have made this point by simply taking our "favoured scenario" (low emissions) as the basis for further analysis. However, we feel that such an approach would be left open to criticism as our selection of a low emissions pathway would appear subjective and unjustified; indeed, by the

same method of choosing a "favoured" emissions scenario, other authors could (and frequently do) subjectively select either a medium or high emissions scenario as the basis for further analysis. We feel it is very important to include the history of both the IPCC emissions scenarios and the more recent revisions to fossil fuel production estimates, in order to justify a refinement to the range of likely emissions scenarios used in long-term projections. We strongly believe that the current approach to emissions scenarios assigns unrealistically high probability to high emissions pathways and that the recent published literature suggests that it is reasonable to constrain estimates to the lower end of the IPCC's emissions scenarios.

AR1's "main technical comment" is that in our hydrological case study, we should not only look at the projected shift in mean, but also the projected shift in extremes under low and high emissions. This is a good recommendation and we have re-interpreted the results from the GWLF model. In our revised paper, we will now include a graph showing the median, 10th percentile (dry) and 90th percentile (wet) streamflows for the baseline ("current") conditions and the perturbed 2070 climate under low and high emissions. Even in our simple catchment model, the results show that under a high emissions scenario, extreme (modelled) situations can theoretically arise; in this case the confluence of a significant increase in evaporation and a significant decrease in precipitation yields an extreme-case modelled scenario in which the streamflow apparently drops to nearly zero in the driest 10% of years. This would typically be interpreted as "a potential increase in extreme events". On the other hand, under the low emissions scenario, while the projected trend in streamflow is still downward, the worst-case modelled results are far less extreme, and the stream does still flow substantially during dry years. It must be remembered that this is an extremely simple hydrological model with a crude approach to climate change scenarios. However, we believe the results are useful and informative, and AR1's recommended extension to consider extreme scenarios in this way has added to the usefulness of the case study.

AR1 also suggests that our brief inclusion of resource limits and economic disruption does not add to the paper. AR1 does not recommend deletion of this section, and we feel that it should be retained. The reason for this is that the IPCC's emissions scenarios included projections of significant economic and population growth worldwide, which have sometimes been used to model adaptive capacity under various climate change impacts. On the other hand, the prospect of a near-term peak and decline in energy availability is at odds with the expectation of ongoing growth. We feel that it is important for such issues to be discussed openly when considering other long-term concerns (such as climate change) facing humanity and the natural world. In particular, given the abundance of literature now pointing to fossil fuel shortages, the potential for over-estimation of both greenhouse emissions and future economic wellbeing (under a business-as-usual growth scenario) is counterproductive when attempting to mitigate large-scale, long-term risks.

Once again, we thank AR1 for their constructive comments on our manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 2627, 2011.