Response to Brian Richter

We thank Brian Richter for the profound evaluation of the paper and the helpful comments. Accordingly, the following revisions were made (our response is highlighted in blue and italic type):

This is well-executed study with conclusions that should be highly relevant to water management and policy-making in Europe. The methods applied are scientifically sound and the design of this study reflects the authors' strong familiarity with biodiversity conservation, ecological flow management and aquatic ecological theory, ecosystem services, global hydrology modeling, and climate change. This paper also very well demonstrates the potency and flexibility of WaterGAP3 for addressing the implications of changes in hydrological driving forces, e.g., the capability of generating both natural and climate-modified flow regimes.

This paper is very well written and enjoyable to read. The logical structure of the analysis is well described and easy to follow. In setting up the context for the study, the authors have done an excellent job of summarizing the state of our understanding of river flow infuences on biota and ecosystem functions, and appropriately emphasized the economic and other social values tied to ecosystem services that could be lost with changes in flow regimes.

The conclusions of the study are easily understood and supported by modeling results. The only substantive shortcoming is that I wanted to see some comparisons between climate change-induced flow changes and what has already taken place due to anthropogenic water uses. I realize that a comparison with current conditions is somewhat outside the scope of the study's intent, but I know that WaterGAP has been used to describe anthropogenic impacts on flow regimes previously (i.e., Doll et al 2009 in HESS). I wonder if these authors might consider the possibility of adding some results from anthropogenically-altered model runs, as a point of comparison with natural and climate-changed flow regimes? It would be really interesting to at least plot the monthly flow regimes for natural, existing, and future climate conditions in Figures 8-13, for example. Without such a comparison, the reader is left wondering whether future climate effects are greater or less than existing anthropogenic impacts on flow regimes, and whether climate effects will be additive or offsetting with anthropogenic influences.
Response: We totally agree on this and our first intention actually was to compare the impacts of the various anthropogenic impacts (water abstractions, dam operation, land-use change and climate change) with each other in this study by means of a sensitivity analysis. However, the quantity of results produced was too large for one paper. So, we would like to keep the scope of this paper to the impact of climate change on flow regimes in different climate zones. However, a follow up analysis/paper is already in progress in order to evaluate the impacts of water abstractions and dam management on natural flow regimes in Europe. We apply the Hanasaki et al. 2006 algorithm in WaterGAP3 for dam operation and we aim to extend this approach by implementing further dam types (i.e. with the purpose for hydropower generation and flood control) to be more accurate in our comparisons.

The authors need to be careful about the assymetry of percentage changes when comparing low versus high flows. A relatively small change in low flows can produce a large percentage change, with the opposite result for high flows. This does not affect most of the conclusions, tables, or figures in this paper, but it does have some implication for Figure 3, in which changes in individual flow characteristics were added together.
Response: This issue is mentioned now in the text for total flow regime modification: "For our analysis of total flow regime modification, results for individual flow characteristics were added together and the same threshold was applied for all flow characteristics. It has to be considered that a relatively small change in low flows can produce a large percentage change, with the opposite result for high flows. Hence, more research on individual thresholds is required for the different flow characteristics."

Caution should also be exercised in comparing smaller vs. larger rivers for this same reason – for example, the authors might want to run a quality-control check for any significant differences in their results when rivers are parsed into different size classes.
Response: According to this valuable suggestion, a quality-control check was conducted for rivers of different size classes. We distinguished rivers of small (Qbf = 100 – 300m3/s), medium (Qbf = 300 – 600m3/s) and large size (Qbf >= 600m3/s) and results are provided in the Supplement of the paper. The results show that smaller rivers are slightly stronger impacted then rivers of medium or larger size. However, no substantial differences were found and the statements made in our analysis can be applied for all three river size classes.

Finally, a small but important suggestion: try to use the same vertical scaling in Figures 8-13 to the extent possible. When you use different vertical scales it can give misleading impression of magnitude of differences between natural and climate-affected flow regimes.
Response: Done. Figures 8-13 were adjusted by using the same vertical scaling (i.e. 500m3/s). An exception was made for the Chirko-Kem river (raised to 300 m3/s only) in the boreal climate zone as it is of much smaller size.

All in all, very nice work!