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## ***Interactive comment on “How will climate change modify river flow regimes in Europe?” by C. Schneider et al.***

**Anonymous Referee #3**

Received and published: 27 September 2012

Schneider et al presented an interesting study with the WaterGap Model. The results of projected changes in streamflow and analyses for different climate zones in Europe are of interest. This is a well-written paper and I recommend it for publication, pending further explanations from the authors and the following revisions.

Remarks: - Introduction: please provide an overview of previous studies that focussed on climate change impact on streamflow and flow extremes in Europe. References to relevant studies are missing (e.g. Dankers and Feyen, 2009; Feyen and Dankers, 2009)

- While the Watergap model simulations were performed on a high spatial resolution 5' x 5' (which is about 6 x 9 km<sup>2</sup> for Central Europe as mentioned in 9199 line 12) the

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authors decided to use output from GCMs rather than RCMs to force the hydrological model. I am really wondering why the authors used GCM data and not RCMs data. I think that use of RCM output (as available for example from the ENSEMBLES project) would be more logical choice, so the authors need to explain why they used GCM rather than RCM data.

- On page 9200, line 17 they mention that they simply disaggregated the climate forcing to 5', but does this mean that 0.5° grid with climate forcing were simply split up to 5' climate forcing? Please explain this, as it does not seem the most elegant approach for producing high resolution streamflow projections for Europe.

- The authors use output of three GCM experiments to account for some uncertainty. They explain why they focussed on experiments for SRES A2. However, it would be good to explain the choice of the three GCMs in their study and why they didn't select a larger number of climate models.

- Please explain why the baseline was performed with the WATCH-forcing data (pag 9200 line 13).

- While the authors mention that the WaterGap model is calibrated for Europe using 221 GRDC gauging stations (page 9200 line 1-3) I think it would be good to explain briefly how this calibration was performed (which data set used, which period, which parameters). It is also necessary to include results (an extra figure or table) to summarize the quality of the streamflow simulations by the WaterGap model for the historical (baseline) period or otherwise to refer to a paper/report that shows an evaluation of the WaterGap modelling performance on 5' with this reference dataset.

- Overall, I think the selected hydrologic parameters of the IHA are a good choice. However, I was wondering why a 1-day minimum flow and Julian data in 1-day minimum flow are selected and how meaningful these parameters are for this assessment. I would expect that a minimum flow for certain duration would be more relevant for analysis of changes in low flow than 1-day minimum flow.

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- Döll et al. (2009) and Döll and Zhang (2010) also used indicators of ecologically relevant flow using the WaterGap model on a global scale. Please include these studies as references.

Minor remarks: - Page 9194, line 26: what do you mean with “validation on robustness”? Please rephrase.

- Page 9195, line 17: increase in evap is not only due to higher temperatures.
- Page 9196, line 15: Do you mean “thermoelectric cooling”?
- Page 9201, line 13 and header in Table 3: explain what you mean with ensemble median results. (you used only three GCMs).
- Page 9203, line 2: “threshold exceedance” is a difficult term to understand as reader and I think this term needs more explanation in this sentence.
- Pag 9204, line 22: for consistency I would suggest to use “snow cover”, which is presented in Fig 2.
- Pag 9207, line 22: “In the following section,”
- Pag 9208, line 5: check capital “central location”
- Pag 9208, line 20: I would recommend to use the word “increases “ rather than “elevates”
- Pag 9210, line 17: replace “they” by “these events”
- Pag 9212, line 11: decreasing by 8.0% in the ensemble median (is this an average for the whole region)?
- Pag 9214, line 4-6: “Our results show that besides other anthropogenic factors, climate change may severely alter natural patterns of flow. I miss the reference to Döll and Zhang (2010) who focussed on impacts of both climate change and anthropogenic impacts on streamflow (see reference below).

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- Fig 5: This figure is not very well readable. Perhaps you could increase the contrast in colours (e.g. dark green or white background for European continent) to increase readability of the figure.

- Fig 8-13: Would be interesting to include also observed annual flow to show how simulated flow corresponds with observed flow.

References Dankers, R., Feyen, L., 2009. Flood hazard in Europe in an ensemble of regional climate scenarios. *Journal of Geophysical Research-Atmospheres*, 114. Döll, P., Fiedler, K., Zhang, J., 2009. Global-scale analysis of river flow alterations due to water withdrawals and reservoirs. *Hydrology and Earth System Sciences*, 13(12): 2413-2432. Döll, P., Zhang, J., 2010. Impact of climate change on freshwater ecosystems: a global-scale analysis of ecologically relevant river flow alterations. *Hydrology and Earth System Sciences*, 14(5): 783-799. Feyen, L., Dankers, R., 2009. Impact of global warming on streamflow drought in Europe. *Journal of Geophysical Research-Atmospheres*, 114.

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Interactive comment on *Hydrol. Earth Syst. Sci. Discuss.*, 9, 9193, 2012.

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