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Hydrology and Earth System Sciences Discussions



# *Interactive comment on* "The hydrological response of the Ourthe catchment to climate change as modelled by the HBV model" *by* T. L. A. Driessen et al.

**Anonymous Referee #3**

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This paper is about the impacts of climate change on different hydrological responses (fluxes, stores, droughts, flood peaks). A conceptual hydrological model (HBV) is forced with bias corrected high resolution RCM results for three SRES scenarios. The paper is well written and structured and within the scope of HESS. General comments, specific comments and some technical corrections are given below.

General comments

- An important issue in the paper is the bias correction of RCM (REMO) outputs using correction parameters obtained by comparing precipitation and temperature observed

at a station and precipitation and temperature from a re-analysis data set (ERA 15). It is thus assumed that the correction parameters can be used to correct the RCM outputs as well. It is not clear to me whether this assumption is reasonable or not. Moreover, why did the authors not compare the station observed and REMO climatologies directly to obtain bias correction parameters. It is clear that station observed and REMO simulated time series can not be compared, but climatologies can be compared. This seems to be a much more direct approach for bias correction. In the current setting, differences between ERA 15 and the reference climate of REMO may necessitate another bias correction in order to get a realistic simulation of the hydrological responses under current climate conditions.

- Another important point is the novelty of this study. Although the authors did an interesting study which is a nice contribution to the climate change impact literature in hydrology, it is not completely clear to me what exactly are the novel points in this study. Therefore, first it is important to clearly state the research objective in the introduction. Furthermore, the added value of this study should be clearly indicated. Is the novelty of this study in the use of high resolution RCM results in a hydrological climate impact study? Is the comparison of four different bias correction methods the most important issue (but then the paper needs to be revised according to this objective)? Is the impact analysis for different responses (including different stores within the catchment) the most important contribution? Finally, this study should be placed in a wider context than just the Rhine and Meuse basins. For instance, have other studies also used this type of high resolution RCMs in hydrological impact studies (e.g. in the US or Japan), including the bias corrections?

Specific comments

* Introduction

- p7145, l4-6: The evacuation of several hundreds of thousands of people in the Netherlands took place in 1995 as a result of the near flood in the Rhine (not the Meuse).



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- p7145, l16: Which alternative methods can be used to downscale coarse scale GCM information and why has this dynamical downscaling method (i.e. a RCM) been used in this study?

- p7146, l1-2: The fast response of the Ourthe is not only due to its hydraulic gradient, but also due to its limited groundwater storage and steep sandstone slopes (see p7147, l114-16).

- p7146, l6-17: Please try to complete the outline of the paper, e.g. only sub-section 2.2 and sub-section 3.1 are mentioned.

* Study area, model and data

- p7147, l27-28: What is the difference between HBV Light Version 2.0 (Seibert, 2005) and the commonly used HBV96 model version (see Lindström et al., 1997, Journal of Hydrology, vol. 201, p272-288)? And why can the HBV Light Version 2.0 be used in this study?

- p7148, l4-6: It is questionable whether all HBV model parameters are either measurable or significantly correlated to easily measurable catchment characteristics, see e.g. previous regionalisation studies using HBV such as Seibert, 1999 (Agricultural and Forest Meteorology, vol. 98-99, p279-293) and Merz and Blöschl, 2004 (Journal of Hydrology, vol. 287, p95-123).

- p7148, l21-22: Why has only one meteorological station been used? Although apparently only one station is available in the Ourthe catchment, stations from adjacent areas could have been used for comparison and interpolation purposes.

* Methodology

- p7150-7155: Given the length of section 3.1, it could possibly be divided into some sub-sections.

- p7150, l20-22: Are the methods of Shabalova et al. (2003) and Hay et al. (2002)



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similar to the method of Leander and Buishand (2007)? And why has the method of Leander and Buishand (2007) been chosen for bias correction in this study?

- p7151, l9: Why 73 blocks?

- p7151, l18-20: Was the method as applied to the Rhine basin also successful for temperature?

- p7151, l26-27: How are the different bias correction parameters per grid cell calculated in method 1?

- p7152-7154: The methods and results are mixed here, please try to separate these two parts and put the relevant results in the results section (additional sub-section about bias correction?).

- p7152, l10-12: Figure 3, shouldn't the period be 1979-2003 instead of 1979-1996?

- p7152, l25-29: Is this part again about precipitation or still about temperature?

- p7153, l1-2: Has the goodness-of-fit of the Gumbel distribution statistically been tested?

- p7153, l2: What is shown in each of the four subplots?

- p7153, l11: Is the GEV distribution also used for the annual maximum daily precipitation amounts?

- p7154, l9: What is the relative difference for 15 mm?

- p7155, l16: In HBV96 (see Lindström et al., 1997) besides elevation also land use is included in the zones. Did the authors also include land use?

- p7155, l17-19: Why are these lapse rate values used? Are they default values in HBV?

- p7155, l23: The number of calibration parameters is substantial. Did the authors consider the use of a subset of this number, e.g. based on previous HBV studies or a



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sensitivity analysis?

- 7155, l24: Are the parameter ranges of Seibert (2000), who applied the HBV model to two Swedish catchments, representative for the Ourthe catchment? Why not using parameter ranges based on former Meuse and Ourthe studies?

- p7155, l24-28: Has the calibration been carried out using a local or global optimisation algorithm?

- p7156, l5-7: How are the two single objective functions combined into a multi-objective function?

- p7156, l14-17: It is remarkable that the validation results are better than the calibration results. Please comment on this.

- p7156, l16-17: Is the correlation coefficient an additional, third, single objective function?

- p7157, l13: What is reasonable in this context?

- p7157, l13-15: Why hasn't the potential evapotranspiration not been corrected for biases directly?

* Results and discussion

- p7159, l7-12: What happens with the range between the 25th and 75th percentile in the future?

- p7161, l1-2: What is the definition of the annual maximum cumulative deficit volume?

- p7161, l3-4: Has the goodness-of-fit of the Generalised Pareto distribution statistically been tested?

- p7161, l25-26: Figure 9, has the goodness-of-fit of the GEV distribution statistically been tested?

* Summary and conclusions



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- p7164, l5-7: These comparisons probably have been done at a global scale. Is the same true at regional scales, in particular for North-western Europe?

Technical corrections

- p7153, l10: “precipitation” instead of “discharge”

- p7155, l3: second “the” should be removed at the end of the line

- p7157, l2: “the slope of the saturated water vapour pressure as a function of temperature curve” instead of “the slope of the saturated water vapour pressure curve”

- p7158-7161: the sub-section numbers should be corrected

- p7158, 10: “hydrology” instead of “climatology”?

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 7143, 2009.