

**Manuscript:** Discharge simulations performed with a hydrological model using bias corrected regional climate model input

### **Major remarks**

The authors tested the applicability of one temperature and two precipitation bias correction methods over the Meuse basin. The bias correction is conducted for RCM data of the RACMO2 model. Here, a control period is considered as well as the impact of the bias correction onto the climate change signals of precipitation, temperature and discharge. For the latter, the HBV model was used to simulate discharge using (corrected and uncorrected) daily data of precipitation, temperature and PET as forcing. The topic of bias correction is currently a hot topic in hydrological research considering future climate change, and thus worth publishing. But the present paper has several shortcomings, which should be corrected.

- There are many smaller inconsistencies and slips of the pen. Please read the paper carefully to get rid of them. Some of them are already noted in the minor remarks.
- There is a sloppy use of references, as several references cited in the text are not listed in the list of references. Please carefully control that the list of references comprises all references cited in the text (and not more or less).
- Please avoid filling sentences with no real information. Some examples that can be directly eliminated are: p. 4592, line 24/25 “This research showed that it is challenging to project low flows for the future.”, p. 4593, line 21/22 “In this paper important details of non-linear bias correction methods will be shown.”, p. 4596, line 22/23 “The table shows a number of relevant statistics.”, p. 4600, line 7/8 “Some statistics of daily precipitation are shown for comparison of both methods with the uncorrected data.”
- The lack of information on the WD method prohibits the real understanding of the method itself. It is unclear, which simulated wet days are deleted, and also how new ones are created in the simulated time series. Thus, fundamental issues of the method are not explained.
- Very often, figure or table captions are partially or fully repeated in the main text. This is largely redundant and should be avoided if content is not necessary to understand the main text. Examples that can be directly eliminated are: p. 4599, line 8-10 “In Fig. 3 ... .. after correction.”, p. 4600, line 6 “Only the ... are shown.”, p. 4602, line 7-9 “The HBV-CTL ... .. corrected statistics.”
- In the concluding section 6, I miss a clear conclusion drawn from the results of using the two bias corrections. Which bias correction is better suitable for the use in climate change impact studies? Or can you name specific applications where the WD method is recommended, and other cases where the MV method is more adequate?

In summary, I recommend acceptance of the paper after some revisions are conducted.

### **Minor remarks**

In the following suggestions for editorial corrections are marked in *Italic*.

Abstract – par. 1 - p. 4590 – line 8  
... forced by *ECHAM5/MPIOM* under ...

Sect. 1 – par. 1 - p. 4590 – line 24-26  
... 2007), *winter precipitation is projected to increase over Northwest Europe. This applies to the mean, but also to the increase in frequency* ...

Sect. 1 – par. 1 - p. 4591 – line 1  
... winter and *increasing extreme precipitation amounts* (van den Hurk et al., 2006).

Sect. 1 – par. 2 - p. 4591 – line 4  
...aquifers, *lakes and artificial reservoirs, from which water is released*...

Sect. 1 – par. 3 - p. 4591 – line 21  
As different *models show* the

Sect. 1 – par. 3 - p. 4591 – line 28  
STOWA (2004) is missing in the list of references.

Sect. 1 – par. 4 - p. 4591 – line 29 to p. 4592 – line 4-...  
This paragraph seems misplaced, as it is not implemented in the content flow of the text. The two adjacent paragraphs deal with observed and projected changes, while par. 4 gives more technical information on the use of HBV model.

Sect. 1 – par. 5 -  
In this part about previous studies on regional climate change projection, I miss a reference to the PRUDENCE project (Christensen and Christensen 2007) where several studies focused on the Rhine catchment whose results are very likely also valid for the Meuse (e.g. Graham et al. 2007, Hagemann and Jacob 2007, van den Hurk et al. 2005). Later in Sect. 3, PRUDENCE is mentioned (as well as van den Hurk et al. 2005), but just for a note that RACMO2 has been applied previously, and not for results about climate change.

Christensen JH, Christensen OB (2007) A summary of the PRUDENCE model projections of changes in European climate by the end of this century. *Climatic Change (Prudence Special Issue) 81, Supplement 1*, doi: 10.1007/s10584-006-9210-7: 7-30.

Graham LP, Hagemann S, Jaun S, Beniston M (2007) On interpreting hydrological change from regional climate models. *Climatic Change (Prudence Special Issue) 81, Supplement 1*, doi: 10.1007/s10584-006-9217-0: 97-122.

Hagemann S, Jacob D (2007) Gradient in the climate change signal of European discharge predicted by a multi-model ensemble. *Climatic Change (Prudence Special Issue) 81, Supplement 1*, doi:10.1007/s10584-006-9225-0: 309-327.

van den Hurk B, Hirschi M, Schär C, Lenderink G, van Meijgaard E, van Ulden A, Rockel B, Hagemann S, Graham LP, Kjellström E, Jones R (2005) Soil control on runoff response to climate change in regional climate model simulations. *J Climate* 18: 3536-3551.

Sect. 1 – par. 6 - p. 4592 – line 19/20  
... range of *GCM* projections, ...

Sect. 1 – par. 7 - p. 4593 – line 2  
... results of a new ...

Sect. 1 – par. 7 - p. 4593 – line 3

... forced *by a transient* ...

Sect. 1 – par. 7 - p. 4593 – line 4

... the GCM *ECHAM5/MPIOM* (Roeckner et al. 2003, Jungclaus et al. 2006) using ...

Roeckner E, Bäuml G, Bonaventura L, Brokopf R, Esch M, Giorgetta M, Hagemann S, Kirchner I, Kornblueh L, Manzini E, Rhodin A, Schlese U, Schulzweida U, Tompkins A (2003) The atmospheric general circulation model ECHAM5. Part I: Model description. Max Planck Institute for Meteorology Rep. 349, 127 pp.

Jungclaus JH, Botzet M, Haak H, Keenlyside N, Luo J-J, Latif M, Marotzke J, Mikolajewicz U, Roeckner E (2006) Ocean circulation and tropical variability in the coupled model ECHAM5/MPI-OM. J Climate 19: 3952-3972.

Reference of Roeckner et al. (2003) has to be corrected in the list of references accordingly.

Sect. 2 – par. 1 - p. 4594 – line 21

The model *was developed* ...

Sect. 3 – par. 1 - p. 4594 – line 24

Van den Hurk et al. (2005) is missing in the list of references.

... et al., 2005) ...

Sect. 3 – par. 1 - p. 4594 – line 26

... with *the coupled atmosphere/ocean GCM ECHAM5/MPIOM* (member 3), under ...

Sect. 3 – par. 1 - p. 4595 – line 1

*ECHAM5* is ...

Sect. 3 – par. 1 - p. 4595 – line 2

... *Planck Institute for Meteorology* (Roeckner et al., 2003). *ECHAM5* is coupled to the ocean model *MPIOM*, which is based on the previous *HOPE* model (Jungclaus et al.; 2006).

Sect. 3 – par. 2 - p. 4595 – line 4

... river *discharge* are ...

Sect. 3 – par. 2 - p. 4595 – line 5

... from *RACMO2* to force ...

Sect. 3 – par. 2 - p. 4595 – line 14

... of *the correction* methods ...

Sect. 3.1 – par. 1 - p. 4595 – line 17

Delete first sentence “ For this ... input.”

Sect. 3.1 – par. 2 - p. 4596 – line 5

*RACMO2* at 25 km resolution covers ...

Sect. 3.1 – par. 1 - p. 4596 – line 10

... observed *data*. *The daily* input ...

Sect. 3.1 – par. 1 - p. 4596 – line 13  
... in the *analysis of results*.

Sect. 3.1.1 – par. 3 - p. 4596 – line 26/27  
*It also can be seen that discharge is overestimated during spring and summer.*

Sect. 3.2.1 – par. 1 - p. 4597 – line 7  
...1969-1998 as for the observations) of ...

Sect. 3.2.1 – par. 2 - p. 4597 – line 15  
... from RACMO2.

Sect. 3.2.2 – par. 1 - p. 4597 – line 22  
For precipitation, observational records ...

Sect. 3.2.2 – par. 1 - p. 4597 – line 23  
... was taken from ... . The precipitation bias was ...

Sect. 3.2.2 – par. 1 - p. 4598 – line 3  
It is written:  
... by decreasing of increasing ...

I don't understand! See also major remark according the description of the WD method.

Sect. 3.2.2 – par. 3 - p. 4598 – line 9  
The parameters *a* and *b* ...

Sect. 3.2.2 – par. 4/5 - p. 4598  
It does not become totally clear, which PET is used when HBV is forced by RCM data. I assume, eq. 3 is used to derive PET that is consistent with bias corrected temperature values of RACMO2. But this should be stated and explained more clearly in the text.

Sect. 4.2 – par. 1 - p. 4599 – line 21-23  
Delete “The MV method ... .. period 1969-1998.”, as this is redundant information already stated before.

Sect. 4.2 – par. 6 - p. 4601 – line 2  
It is written:  
... of the reduced Gumbel variate.

A reader unfamiliar with statistics has no idea what this means. Please explain more thoroughly.

Sect. 5 – par. 1 - p. 4601 – line 24  
It is written:  
... “calculated observed values ...”

This is contradictory in itself. Either you have observed values or calculated values!

I suggest to write:

... discharges calculated *from* observed values and ...

Sect. 5 – par. 4 - p. 4603 – line 2

... higher *for both* RACMO2 runs.

Sect. 5 – par. 4 - p. 4603 – line 6

For low *flow*, *the* threshold ...

Sect. 5 – par. 4 - p. 4603 – line 6-7

It is written:

A sensitivity ... ...with days.

I don't understand. Please clarify what you mean!

Sect. 6 – par. 1 - p. 4603 – line 17

Jacob et al. (2007) is missing in the list of references.

Sect. 6 – par. 2 - p. 4604 – line 7

... in *discharge due* to ...

Sect. 6 – par. 6 - p. 4605 – line 2

Leander et al. (2005) is missing in the list of references.

Figure 1

The figure would improve if the main river path will also be shown.

Figure 2 caption

**Fig. 2.** *Mean annual of HBV simulated discharge ... for the period 1969-1998.*

Note that the last sentence is deleted from the caption, as this is obvious from the caption and the figure.