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Hydrology and Earth System Sciences Discussions

Interactive comment on "Anomaly in the rainfall-runoff behaviour of the Meuse catchment. Climate, land use, or land use management?" *by* F. Fenicia et al.

Anonymous Referee #3

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General Comments

The paper examines a possible cause of a rainfall-runoff anomaly that was previously identified for the Meuse River. The work is definitely within the scope of HESS. The modelling approach used is novel, and the results raise interesting questions for future research (both within and outside the Meuse basin). However, the following serious issues need to be addressed in depth.

1. My main major concern is with regards to the method used in the hydrological modelling. Firstly, the model is evaluated based on the GLUE framework of Beven and

Binley (1992) but using a moving time window rather than evaluation simultaneously over the entire observation period. The authors find that by allowing the model parameters to vary over time, the performance of the model can be improved, and state that time varying parameters can correct most of the modelling error (pg. 1801, lines 8-9). However, is this not logical since the best parameter set is chosen for each 4-yr time-window, the aim of which is to improve performance for each time-window? An assumption is then made as to which parameters should be allowed to vary over time, one of which is alpha, a calibration parameter which accounts for the fact that forest transpiration may vary with forest age. It is found that by varying this parameter over time the model performs better over the entire period, and it is suggested that this provides evidence that the change in the water balance (as identified by the rainfall-runoff anomaly) may be the result of the change in forest age. However, the use of the model does not prove this, as it seems logical that by allowing this parameter to vary over time that the model performance can be improved. If the model is sensitive to changes in this parameter then by allowing it to vary will consequently lead to large changes in the results. Given these points it seems very optimistic to state that land use and land management provide a more likely explanation (page 1804, line 1) than climate change for the observed changes in runoff. At the least these issues need to be discussed, and I would suggest presenting results of the sensitivity analyses so that the reader can assess the sensitivity of the model to the various parameters.

2. The description of the model set up is unclear. For example, what are the spatial and temporal resolutions? Also, the description of the model parameters needs improving. For example, why were the interception thresholds all multiplied by the same calibration parameter (Ci)? This may allow the interception of the various land use classes to vary proportionally, but what is the reason for doing this? A discussion of such issues is needed. Please expand on the model description and make the parameter descriptions clearer.

3. The authors use climate data for De Bilt in The Netherlands to calculate evapo-

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transpiration (ET) over the entire Meuse basin. This seems to be one of the major weaknesses of the study. On page 1795 (lines 3-6) it is stated that these provide an acceptable agreement with observations within the catchment area. However, which observations are being referred to here? And moreover, what is meant by a reasonable agreement? Please show this evidence, for example some graphs and/or statistical tests showing the agreement between the estimates and the observed data. Also, have any measures been taken to account for the spatial variability in ET within the basin? If so, which? If not, please discuss the implications of this.

4. It is stated that a similar anomaly was found in the Moselle catchment, and that this provides evidence that the anomaly cannot be attributed to data errors. However, can you be sure that this is the case? Perhaps changes in the measuring method were implemented in both stations at the same time? It may be useful to examine the metadata of both stations to check this.

5. In a number of places in the text the authors make substantive statements without providing evidence or references. For example: pg. 1789 (5-7), pg. 1794 (20-21), pg. 1795 (21-22), and pg. 1804 (6-9). Please ensure that such statements are supported.

6. The authors refer to the work of Ward et al. (2008) on page 1790 (line 27), saying that they found a negligible effect of land use change on Meuse discharge. In fact, they found that land use change had a huge effect on Meuse discharge over the last millennium, but that the climate signal was more important over the last century. This should be addressed more carefully.

7. The paper would benefit greatly from a discussion of the limitations of the method and the results, and what implications these could have for the results and conclusions. At the moment this is lacking, and the conclusions seem to be given with too much certainty.

Next to these major issues, a few minor comments are as follows: 1. In the abstract (line 1) it sounds as though the authors have identified the rainfall-runoff anomaly them-

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selves, whilst this is not the case: this should be reformulated.

2. The aims and objectives could be somewhat clearer. At present they seem to be distributed throughout the introduction (which is quite long). For example on pg. 1791 (line 2), pg. 1793 (line 6), page 1793 (line 16). This makes it confusing to identify the key aims. Perhaps it would be useful to restructure the introduction and group the aims and objectives together? Perhaps using bullets or numbering?

3. Please indicate De Bilt on Fig. 1. Also, what is the source of this map? Finally, I find the text too small. Perhaps this is only on the review copy, but it may be worthwhile increasing the size of the place names.

4. A general comment relates to the English. Whilst the paper is generally well structured and well written, it would benefit from proofreading by a native English speaker to remove the minor language errors.

Technical Corrections 1. Pg. 1789 (line 15): delete at

2. Pg. 1792 (line 23): replace where with were?

3. Pg 1795 (line 13): replace Historical land use change… with Data on historical land use change…

4. Pg. 1795 (line 19): artificial coniferous forest …due you mean coniferous plantation?

5. Pg. 1795 (lines 19-20). Replace Historical land use change is not… with Historical land use change data are not….

6. Pg. 1796 (line 14): Replace Brown et al., 2005 with e.g. Brown et al., 2005

7. Pg. 1804 (line 11) replace of with or

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 1787, 2008.