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Hydrology and Earth System Sciences Discussions

Interactive comment on "Prognostic simulation and analysis of the impact of climate change on the hydrological dynamics in Thuringia, Germany" *by* P. Krause and S. Hanisch

P. Krause and S. Hanisch

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First we like to thank the reviewer for his or her critical evaluation of our paper. We have considered the reviewer's suggestions thoroughly and will integrate most of them in the revised version of the paper.

Response to the general comments: Parts of the paper will be rewritten according to the suggestions of the reviewer.

Response to the specific comments: The reviewer gave a lot of helpful and interesting advices how to improve the paper. We will consider them thoroughly and integrate them if appropriate. But, we like to answer to some of the statements directly.

The reviewer argues about the term 'hydrological dynamics' because in his or her understanding this term indicates only short-term processes like floods. We do not agree to this interpretation as the term 'dynamics' is also very common to describe daily, monthly, seasonal, or even annual variations.

The reviewer is right with his or her statements that we hadn't included an investigation of flood and drought frequency or change in precipitation intensities. He or she is also right that the more frequent occurrence of floods and droughts, which we had concluded from our investigations, is somewhat speculative. To make that clearer we will reformulate the relevant statements in such a way that it is more obvious that they represent more or less likely future conditions only.

S 1831: The argument that the two 'UBA' references are not publicly available is not true. Everyone can access them directly and free of charge via the internet. For more details concerning WettReg and its underlying methodology two more references will be given in the revised paper. In addition, we will integrate a section about validation of the WettReg data for a couple of climate and precipitation stations in Thuringia to demonstrate the quality of the data.

S1831: We did mean temporal resolution as we wrote it. The temporal resolution was long-term annual mean values as indicated in the text (page 4043, line 6).

Description of J2000g: The first reviewer wanted us to shorten this paragraphs this reviewer likes more information. Because J2000g is our product, we are more than happy to provide more information: p4044, line 7 the important hydrological behaviours we had in mind were mostly the good reproduction of the general waterbalance (Q = P - ET +- DS). More cannot be expected from this simple modelling approach. Examples and more information of validation and calibration will be given in the revised version. Potential ET was calculated according to Penman-Monteith.

Reviewer asks: "how do you explain the relative simplicity of your model with the subdivision on an area of ca. 16,000kmˆ2 into more than 220,000 modelling units?" Answer:

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We don't understand the argument of the reviewer. We did the subdivision in such a way that we obtained homogenous regions and did preserve as much information as possible. The delineation of the modelling units was done with respect to elevation, slope, aspect, landuse type, soil type, and hydrogeological formation. All such information is considered by the model in the respective process descriptions. Any coarser resolution would have resulted in a loss of already available information. We don't really understand the problem of having lots of spatial model entities as long as the model is able to deal with them.

Reviewer asks: "... the high spatial variability of TMF, FCA and ETR requires more description". Answer: It is not that much an effect of spatial variability it is simply an effect of the low sensitivity of these parameters on the Nash-Sutcliffe efficiency (NSE) used as objective function for the automatic model calibration as indicated in the paper (p4047, line 8).

The selection of the subcatchments for the model calibration was based on former experience in these catchments in terms of modelling and field observations. The representativeness of the calibration in terms of lowland basins is given by catchment 7 and 8, but we will show some more examples in the section about model validation of the revised version. The reviewer was right with the three Gera basins. Actually 2 and 3 are the headwater basins of 4, but this had no direct consequences for the calibration. Table 1 shows that the sensitive model parameters are pretty similar for these three basins which can be taken as an indication for model robustness and transferability.

The fact that the averaging of the model parameters from the eight not five calibration catchments (this is wrong in the manuscript) did deliver reasonable estimates for the uncalibrated areas will be more precisely demonstrated and discussed in an own section about model validation.

Reviewer asks: "Tbase: Does this mean that snow accumulation starts only at a temperature of below at least -3.9°C? Is this realistic? Discuss the physical meaning!"

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Interactive Comment

Answer: No it does not mean that snow accumulation starts only at a temperature of below at least -3.9°C in general. But we are talking of a model working with monthly time steps. Under these circumstances snow accumulation has only impact on the runoff if water is stored as snow for a longer period than one time step. Practically this means that it needs a pretty low monthly mean temperature to be relevant. When the model is applied in daily time steps Tbase is fairly close to 0°C as one would expect. The extreme high variability of TMF can be explained because of two reasons. First, TMF proved to be not very sensitive for NSE and second, values of TMF beyond a specific threshold cannot be very precisely determined because they do not show influence on snow melt. In other words if the entire snow pack melts with a TMF value of let's say 5 it does also melt with a TMF value of more than 5. To answer the other question the reviewer had concerning the parameter values we will integrate more information about parameter sensitivity and model uncertainty in the revised version.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 4037, 2007.