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Geoscientific
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Discussions

Interactive comment on "A pragmatic approach for the downscaling and bias correction of regional climate simulations – evaluation in hydrological modeling" *by* T. Marke et al.

T. Marke et al.

thomas.marke@uni-graz.at

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THE AUTHORS THANK REVIEWER#2 FOR ALL THE FRUITFUL COMMENTS AND SUGGESTIONS AND FOR CONTRIBUTING TO THE IMPROVEMENT OF OUR MANUSCRIPT - THANK YOU VERY MUCH FOR YOUR ENDEAVORS, THEY ARE HIGHLY APPRECIATED!
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——————— Reviewer#2 comment: ———————

The method is based on the availability of a high resolution climatology for the area

of study and depends crucially on the quality of this climatology. For the case study this quality appears quite high but this may not be so for other areas. A more detailed presentation of the high resolution climatology used would be useful, together with a short discussion of the applicability of the method when fewer observations are available (it is conceivable that for areas not well covered by observations, the applied methodology may lead to no or negative improvement in the results of the hydrometeorological chain). In particular, figure 4 presents the downscaling function used to downscale temperature, which is rich in detail, conceivably because the PROMET preprocessor uses orographic information. It would be interesting to present also the downscaling function for precipitation (obviously the most important variable for determining the daily discharges presented in fig. 5), which, being based on observations from measurement stations will be probably less detailed.

——————— Authors comment: ———————

The reviewer is right in suggesting that our statistical downscaling approach largeley depends on the availability and quality of station observations. We have updated the respective section in our manuscript including a short discussion of the problem. Of course, the downscaling function for precipitation is very important for the current study. We have followed the reviewer's suggestion and have added illustration and information on the downscaling factors for precipitation to the paper.

——————— Reviewer#2 comment: ———————

The application and verification of the model presented are 'in-sample': both the observation climatology and model verification are computed on the same time period (1970-2000) and using the same measurement sites. Long-term variability in the climatology combined with the particular period used to define the climatology or insufficient spatial coverage of the measurement stations could worsen the effectiveness of the method when applied out of sample for future scenarios. Both issues could be explored for example by splitting in two the observational period or the measurement stations and using one half for defining the climatology and the other half for validation.

——————— Authors comment: ———————

We have updated the manuscript concerning a discussion of the effect of sparsely available station recordings on the performance of the presented downscaling approach. The generation and hydrological application of the presented downscaling functions in our study requires a database of station observations over climatological time periods. This is why splitting the time period into two halfs is not really applicable in our case. However, a meteorological cross-validiation of the downsclaing approach has been carried out in the past by Schipper et al. (2010). These authors have yielded good performance when systematically leaving out individual years for the generation of the downscaling functions that are later used for performance evaluation. Information on previous meteorological evaluations including the related references has been added to the manuscript.

——————— Reviewer#2 comment: ———————

The paper actually presents two different methods: one where a multiplicative and another where an additive correction is used. The latter is used only for temperature, the former for other variables (precipitation, wind speed, humidity). It would be good to discuss more in detail which method should be chosen for a particular variable. One observation is the following: the two alternative methods correct actually different aspects of the statistics of the field on the fine grid. While an additive correction is only able to adjust the temporal mean at each gridpoint of the small-scale interpolated field, the multiplicative correction will change also its higher moments in time, inparticular variance. For variables which are positive definite and have an exponential-like distribution, like precipitation, a multiplicative correction will change both mean and variance in time. The difference will be important for the statistics of extremes in the downscaled fields and for the applicability of the method also for downscaling on small basins. There may exist also physical reasons for preferring one method to another:

while for precipitation small scale variability may be introduced by multiplicative processes, small scale variability of temperature is more related to additive processes such addition of the lapse-rate correction due to orography. - Note: the paper often mentions the term 'variability': it would be better to distinguish clearly when variability (i.e. variance) in space and when variability in time is meant.

——————— Authors comment: ———————

The description of the downscaling approach and the choice of multiplicative or additive correction has been updated in the manuscript. The authors know about the different statistical consequences of a multiplicative and additive correction, however, our approach is rather pragmatic and physically orientated. We try to avoid negative values and the generation of precipitation whenever no precipitation is found in the RCM simulations by applying the multiplicative approach for the downscaling of precipitation. The effect of a multiplicative correction of RCM-simulated precipitation on discharge extremes is now adressed in the updated manuscript. In case of temperature, we are following a lapse-rate orientated approach, which from our perspective better reflects the nature of the systematic relation between temperature and elevation. The term "subgrid-scale variability" in our paper is always related to the spatial variability of a given meteorological parameter within the area covered by a coarse grid cell (here 45 x 45 km) and not to a temporal variability. This has been made more clear in the updated version of our manuscript.

——————— Reviewer#2 comment: ———————

The authors verify the hydrometeorological chain for a very large basin. While the applicability of the method for smaller basins can be clearly the subject of other studies, it would be interesting to at least address this issue in the discussion.

——————— Authors comment: ———————

Thank you very much for this suggestion, we have updated the discussion accordingly.

——————— Reviewer#2 comment: ———————

Please add a sentence to explain briefly the NSME score, to facilitate readers from a broader audience and make it easier to quickly follow the discussion.

——————— Authors comment: ———————

The suggested information has been incorporated in the manuscript.

——————— Reviewer#2 comment: ———————

According to the description in the text, figure 5 reports daily discharges in the period 1972-2000. That would amount to 29*365 data points in the figures, while the number of points in fig 5 appear to be much less. Please clarify.

——————— Authors comment: ———————

The reviewer is right, the illustration was showing not all data points, the manuscript has been updated accordingly.

Interactive comment on Geosci. Model Dev. Discuss., 4, 45, 2011.