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Earth System Dynamics
Discussions

Interactive comment on "Large scale atmospheric forcing and topographic modification of precipitation rates over High Asia – a neural network based approach" *by* L. Gerlitz et al.

Anonymous Referee #2

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This paper presents a statistical downscaling framework for generating spatially high-resolution precipitation fields for a target area in Central Asia, including the Tibetan Plateau, that can be utilized for the development of local-scale climate change scenarios.

The statistical approach employed in this study is based on the implementation of an Artificial Neural Network (ANN) used to develop the transfer functions that explain the relationship between large-scale predictors and local scale precipitation. The ANN is trained making use of synoptic dynamical fields from the ERA-Interim reanalyses and local geographical data from high-resolution digital elevation models.

Of course, the study area is one in which a better understanding of the fine-scale precipitation distribution is particularly important for assessing present and future water availability and developing effective adaptation strategies; the study is particularly relevant in this context.

The proposed procedure is well validated and some examples are provided; I consider this approach as a valuable one and, in my opinion, the paper deserves publication on this journal after minor issues, outlined below, are addressed.

1. Overall comments

- Evaluation/validation procedure: the validation procedure is based on the use of 18 independent in-situ stations, for which the data in the period 2000-2011 have been considered. On the contrary, 157 stations in the period 1989-2000 have been used for the analysis of local-scale precipitation rates as an essential part of the downscaling/ANN framework (i.e., for calibration purposes). I would like to find in the paper more explanations about the choice of those specific 18 stations used in the evaluation procedure. In addition, I suppose the observed datasets include missing data and gaps. How are these gaps (if any) handled by the ANN?

- Why the authors did not use a cross-validation strategy in order to better exploit information from all the available stations? Is the reason related to the computational time that is required for such an "exercise"?

- The proposed method is very interesting and effective for obtaining high spatial resolution (1 km) precipitation fields. However, as the authors also highlight in the conclusions, the achieved monthly temporal resolution is really too coarse to be of use for impact and assessment studies requiring, at least, a daily resolution. Therefore, the method is interesting but it does not seem to be really (fully) effective for practical application purposes, or unless another temporal downscaling is applied. Please suggest some "solutions" to this drawback or discuss it better.

- The vertical gradient of precipitation is still a poorly understood phenomenon (e.g., Barry, 2012, Rangwala and Miller, 2012). Several studies in the literature reported increasing precipitation with altitude. However, some works found a precipitation increase up to the highest elevations, while others indicated a limiting elevation above which precipitation amounts saturate. Please at least mention this issue somewhere in the paper (e.g., Section 2), since the elevational precipitation gradient is discussed, for example at page 1294. At the same time, I found Section 2 a bit too long and maybe repetitive in some parts.

References:

- Barry RG. 2012. Recent advances in mountain climate research. Theoretical and Applied Climatology 110: 549-553. DOI: 10.1007/s00704-012-0695-x

- Rangwala I, Miller J. 2012. Climate change in mountains: a review of elevation-dependent warming and its possible causes. Climatic Change 114: 527-547.

2. Specific comments

Section 2

Page 1281, Line 22: Please add in this section the following reference (Filippi et al., 2014, see below), since it discusses another important aspect of the role of western weather patterns in the western stretches of the area and associated precipitation, i.e., the mechanisms that can explain the well-known relationship between the NAO teleconnection pattern and winter precipitation in that region.

Reference:

- L Filippi, E Palazzi, J von Hardenberg, and A Provenzale, 2014: Multidecadal Variations in the Relationship between the NAO and Winter Precipitation in the Hindu Kush–Karakoram. J. Climate, 27, 7890–7902. doi: 10.1175/JCLI-D-14-00286.1

Section 3

- Page 1285, lines 7-11: I do not understand very well the two sentences reported at those lines and their causal relationship. To my knowledge, estimates of precipitation associated with the ERA-Interim reanalysis are produced by the forecast model, based on temperature and humidity information derived from the assimilated observations. That it, there is no direct assimilation of precipitation observations in the reanalysis system. Please explain better/rephrase the sentence in order to avoid confusion. The reanalysis system does assimilate the large scale fields indeed, which is good for the approach employed in this study. Again, specify better.

- Page 1285, lines 14-21: The authors use the ERA-Interim monthly mean fields of humidity at two atmospheric levels (500 and 200 hPa) and of wind at 500 hPa. These fields are resampled (interpolated) at 1 km spatial resolution, much finer than the original resolution of the reanalysis. To what extend does the interpolation introduce error/uncertainties in the procedure? Has this issue been addressed/taken into account by the authors?

- Page 1286, Line 7 (the same: Page 1290 line 27; Page 1302 line 17): While its meaning is clear, I don't like very much the expression "precipitation-genetic"

3. Figures

Figure 8: Could you please specify the difference between left and right panels in the figure caption?

Interactive comment on Earth Syst. Dynam. Discuss., 5, 1275, 2014.