Geosci. Model Dev. Discuss., 6, C1806–C1811, 2013
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Geoscientific Model Development Discussions

Interactive comment on "TopoSCALE: deriving surface fluxes from gridded climate data" *by* J. Fiddes and S. Gruber

Anonymous Referee #2

Received and published: 29 October 2013

1 General comments

The manuscript with the title "TopoSCALE: deriving surface fluxes from gridded climate data" presents an approach to obtain high-resolution driving data for land-surface-models (LSM) from a coarser-scale climate data set in combination with digital elevation model (DEM) data at high horizontal resolution. Input data are the coarse-scale variables at the nearest pressure levels to the subgrid-scale elevation (temperature, relative humidity, wind), or, if no pressure-level data is available as for the shortwave and longwave radiation fluxes and precipitation. The method makes use of a simple interpolation according to topographic height between the upper and lower next pressure level and some additional methods from literature for variable-specific adjustments

(such as topographic corrections for wind speed and radiation fluxes). For precipitation an additional precipitation climatology is needed to disaggregate the precipitation from the coarse grid according to local effects (shading etc.). The proposed methods are tested for a large number of stations within Switzerland and evaluated against reference methods. From my point of view, the method is a useful tool to obtain high-resolution driving data for land surface models in regions of complex terrain. The detailed analysis of the performance of the presented approach over Switzerland is comprehensive and shows additional skill compared to the coarse-scale climate data and also to some simpler reference methods. There are, however, a number of aspects that need to be considered before publication, see below.

2 Specific comments

1. The title is somewhat misleading. The manuscript is not about the computation or derivation of the surface fluxes, but about disaggregating gridded coarse-scale climate data to the desired scale under consideration (which can be in turn used to obtain surface fluxes on the subgrid-scale)
2. I would include the keywords "disaggregation" or/and "downscaling" (rather than "scaling", which is more general) in the text, that the article is found if people search for such methods
3. Topography is not the only source of horizontal heterogeneity. Others might be land cover / land use, subgrid-scale water pixels, soil characteristics... These are not considered in the manuscript, this however should at least be mentioned somewhere.
4. Please give the period over which the evaluation has taken place

5. In my point of view it is very important/interesting how the pressure-level values for levels below the ERA model topography are obtained. I checked the cited IFS-documentation for that, however it might be very helpful to list the methods for the different variables at least briefly, this helps a lot in understanding the concept

6. In principle the number and quality of references are appropriate. There are however also quite a few studies from the atmospheric sciences community, which also provide a more or less physical-based downscaling of near-surface variables which are used to obtain the surface fluxes at a higher resolution. For completeness it might be worthwhile to cite some of them too (e.g. Seth and Giorgi (J. Geophys. Res., 1994); Arola (J.Atmos. Sci.,1999), Dimri (Clim Dyn.,2009); Schomburg et al. (Tellus, 2010))

7. Structure of manuscript: When reading the manuscript the first time, the structure of the article leads to some confusion, because limitations of the approach(section 2) are discussed before the data and methods are introduced. The manuscript should be re-structured such that 1) Introduction, 2) Data, 3) Methods 4) Experiments 5) Results and discussion 6) Conclusion. The section "Background" should be renamed and split up. The description of "pressure levels below model surface" should be placed in the data section, the limitations of the presented approach should be given in the discussion section.

8. You method for precipitation relies not on climate data and elevation alone, additionally a precipitation climatology is needed. You should state that early enough in the article.

9. For me it is suspicious that TopoSCALE outperforms ERA for the GRID surface level (see Figure 12 and text p3402, line 10-15). This means the interpolation performs better than the explicit model? This is really strange.

10. The abstract should contain at least some information on the method that is used

to obtain the fine-scale information

3 Technical corrections

- Generally: run a spell-check. There are several typos that can be detected by a standard spellchecker
- p3382: even if DEM is a standard abbreviation, write it out where you use it first!
- p3382, line 17/18: change to ..."when statistical methods are not applicable due to a lack of observations, i.e. for remote areas of future periods
- p3383, line 5: Verb missing
- p3385, line 9: Replace by "Reanalyses assimilate a large number of observations in spatially and temporally varying quantities and densities.
- P3385, line 10: Reformulate "It is important to understand..."
- p3385, line 19: What do you mean with "In general, assimilated observations are not scaled"? Scaled how/by what?
- P3386, line 20 and following: But are these effects not at least partly simulated by the model?
- P3387, line 10: verb missing
- P3388, line 1/2: refer to the section where this interpolation is described (currently it is section 3.3)
- P3389, equation (3): this should be LW_{sub} and not LW_{grid}!?!

- generally: check all references to the appendix. Almost everywhere you refer to appendix A, although Appendix B.x would be the correct reference!
- P3390, line 5: leave away the (δ). You use a δ on the next page, but I think it is a different δ!
- P3391, line 12: Please re-formulate this sentence. The main source for precipitation is still the large-scale forcing. You refer here to the sources of precipitation patterns or heterogeneity.
- P3391, line 16: typo, it should be “dataset”
- P3391, line 23: typo, it should be “disaggregation”
- P3391, line 19: remove the “then”
- P3392, line 18: You refer to the appendix for converting RH to Td, but actually the appendix does not contain any information on this
- P3392, line 21: what are c/b?
- P3393, equation (14): brackets missing!?!
- P3394, line 26: what are SLF IMIS stations?
- P3395, line 8: what you mean here are probably 3-hourly timesteps?
- p3395, line 25: change to “... was used in the study and makes error-prone gap-filling unnecessary.”
- Section 6.1: it is somewhat confusing that you talk about the wind in the third paragraph, then about the longwave radiation in the fourth paragraph, and then about the wind again in the last paragraph. Please move the last paragraph to the former wind paragraph.

- P3400, line 12: add a comma and leave out the station abbreviations: “A subset of OBS stations is presented, representing an elevation range of 370-3580 m a.s.l.
- P3402, line 17: you refer here to the point scale. But actually the scheme works very well for high resolution gridded data, I suppose, not only for single points/stations.
- P3402, line 27: Change to “Specifically, in terms of variables computed in this study, strong improvements in the subgrid radiation fluxes would likely result from ...”
- P3405, line 15 and 17: typo: interval
- Figure 4: This Figure is never referenced?
- Figures 5,7, 11, 12: please enlarge them, it is hard to read the axes
- Figure 11: leave out the last sentence in the caption. This should be contained in the text.

Interactive comment on Geosci. Model Dev. Discuss., 6, 3381, 2013.