

Geosci. Model Dev. Discuss., referee comment RC3  
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## Comment on gmd-2021-60

Anonymous Referee #3

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Referee comment on "TopoCLIM: rapid topography-based downscaling of regional climate model output in complex terrain v1.1" by Joel Fiddes et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-60-RC3>, 2021

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### Code:

The provided methods could be highly useful for many people requiring downscaled climate model data for running impact models. Unfortunately, the source code in its current form is in my opinion not yet usable for the community.

First, there is no manual. The GitHub repository only contains a very short Readme explaining how to download the model and run the examples, but no information whatsoever on how to apply the methods for one's own purposes.

Also, the code is quite messy. Most importantly, the parameters of the methods should not be set directly in the source files (parameters and code should always be separated (not only) for reusability and reproducibility reasons). Ideally, the code should be provided in the form of a Python package e.g. with individual functions for each method which accept their respective parameters as arguments. This would allow to run the methods from Python directly instead of having to manually execute a number of Python scripts in a particular sequence.

Finally, even getting the example to run is not straightforward with the provided instructions. Running it seems to require an installation of R including the packages `ncdf4` and `qmap` (which I found out by trial and error), but I still could not get it to run. It crashes when trying to run the R script `qmap_hour_plots_daily_12.R`:

```
Error in cordex_dates_cp : object 'cordex_dates_cp' not found
subprocess.CalledProcessError: Command '['Rscript',
'./rsrc/qmap_hour_plots_daily_12.R', './examples/', '_1D', '_1D.csv', '9.809', '46.83',
```

'../examples//cordex']' returned non-zero exit status 1.

I would encourage the authors to rework the code and to provide a proper manual (or extended Readme) containing at least a description of the individual methods and how to run them, their parameters, as well as the required prerequisites apart from the Python libraries (R + packages, cdo etc.) and the supported Python versions.

### **Paper:**

### **General comments:**

- The paper is concise and well-written. My only major remark is that in several parts of the paper it is not immediately clear which parts are "hardcoded" in the TopoCLIM methods and which are only exemplarily used for the particular snow modeling application. E.g., does the scheme currently only allow to use CORDEX and ERA5 data or is it already possible to use other data sets (as mentioned in the conclusions)? It would be very helpful to the reader if this would be made more specific (see also my individual remarks below).
- Remembering the several schemes/data sets and their acronyms (CLIM, T-MET, T-CLIM, QM, QM\_MONTH, ...) can get quite challenging; maybe consider adding a table listing all of the acronyms and their meaning.
- Both "snow height" and "snow depth" are used throughout the paper, ideally this should be consistent.

### **Specific comments:**

- Title: is the first dot in "v.1.0" intentional or should it be v1.0?
- Abstract: references should be avoided in the abstract.

### **Section 2.1:**

- When reading this, it is not really clear if the procedure refers to a single CORDEX grid point or if the method considers all grid points within a specified region.

## Section 2.2:

- It would be helpful to list exactly which preprocessing steps are performed with the CORDEX data instead of providing only some examples. This could be done in the text and/or integrated in Fig. 1 (i.e., listing all the steps instead of the generic "Preprocess CORDEX" block).
- "The CDO tools are incorporated into ..." is a little ambiguous – I assume the tools are not directly integrated into the package but have to be pre-installed and are called from within the package?

## Section 2.4:

- Again, here it is not clear if the two time periods (1980-1995 and 1996-2006) are fixed in the method or if these are only used for this particular study.

## Section 2.5:

- Please consider adding some more detail about the used disaggregation functions for the different variables (as these can likely have considerable impact on the impact modeling results).
- "An adapted version of the Melodist package" - adapted in which way?

## Section 2.6:

- Again here it is not clear if this is part of the TopoCLIM method or only part of the example application for using TopoCLIM-generated data in an impact model. Since I assume the latter is the case, this section (along with 2.7) should probably be moved e.g. to section 4?
- "Typical setups use ..." - perhaps add some more details about a typical setup (region size, resolution).

## Section 3.2:

- What does "globally" (L172) mean in this context?

#### Section 5.1:

- Last paragraph: the agreement seems to be good for only some of the years in the mentioned periods. However, individual years should probably generally not be compared to observations for both the historical and the scenario period.

#### Section 5.2:

- If I understand correctly, DOY is used here as "days since September 1"? If so, this is really confusing, since the term DOY has a very specific meaning (with 1 being January 1). I suggest to either use the actual DOY in Fig. 6 or use another term instead of DOY.

#### Section 5.3:

- The section title is confusing, since the previous results also already included TopoCLIM results and climate change impacts on the Alpine snow cover (albeit on the point scale).
- "by coupling TopoCLIM with the TopoSUB spatial framework" - and with FSM in between, correct?

#### Fig. 1:

- As stated above, this figure contains some very specific terms and dates (CORDEX, ERA5, 1980-2100, 1980-2020, 90 m, 1980-2100). Since the figure should be a general overview of the TopoCLIM method I would remove all terms and dates which are not "hardcoded" in TopoCLIM.
- There is a typo in "Qantlle map".

#### Fig. 2:

- "with CORDEX grid overlaid" - please specify which grid (44 km?).

Fig. 6:

- The term TSCALE appears only in this figure. Probably this should be T-MET?

Fig. 7:

- The figure has a very poor resolution.
- Figure caption: "Example TopoCLIM climate change maps" - maybe rephrase, since the maps are not a direct TopoCLIM result but a combination of TopoCLIM, FSM and TopoSUB.

Table 1:

- The table is very useful, but as far as I see it is not referenced from the paper. Consider adding a reference e.g. at the beginning of the results section.
- What do the timesteps of 3 and 6 hours mean?

### **Minor remarks:**

- P3 L65: Add reference to ERA5 here (currently in section 3.3) if this is the first mention.
- P3 L69: Either write "a subgrid clustering scheme" or "the subgrid clustering scheme TopoSUB".
- P4 L118: Add a colon at the end of the line.
- P5 L130 and P8 L228: replace QMAP\_MONTH by QM\_MONTH as in the rest of the paper (assuming this does not actually refer to a different variant).
- P5 L145: Remove the second "model".
- P6 L173: Capitalize "python".
- P7 L202: Adding "(cm)" is probably not necessary.
- P7 L207: Replace 2031-60 and 2070-100 with 2031-2060 and 2070-2100.
- P8 L219: The term "QM\_QM" appears only here and in the caption of Fig. 3, I assume this is what is referred to as only "QM" in the rest of the paper?
- P8 L225: Typo ("erro").

- P10 L283: "25 km" -> not 30 km (as stated in section 3.3)?
- P10 L293: The acronyms (TA, ILWR, ISWR) appear here for the first and only time; please write the full variable names.