Reviewer #3

A global dataset of daily near-surface air temperature at 1-km resolution (2003-2020)

Review Comments

General comments:

Near-surface air temperature (Ta) has extensive applications in climate and environment studies. This study, based on a newly developed Spatially Varying Coefficient Models with Sign Preservation (SVCM-SP) algorithm, generated a global dataset of daily maximum and minimum Ta (Tmax and Tmin) at 1 km from 2003 to 2020 by integrating ground Ta observations from weather stations and gridded LST and DEM data. The assessment shows that the employed algorithm can effectively capture the negative relationships between Ta and elevation and the positive relationships between Ta and LST. The cross-validation indicates the estimated Ta show satisfactory accuracies, and the RMSEs of Ta estimates range from 1.20 to 2.44 ºC for Tmax and 1.69 to 2.39 ºC for Tmin.

The study designed a global maximum and minimum Ta estimation scheme and developed an applicable time-series (2003-2020) daily Ta dataset. I think this work is important because the generated datasets are of great demand and value in practical applications (e.g., urban climate research). However, some issues in the manuscript still need to be addressed before being ready for publication. The specific comments are given as follows.

Response: Thank you very much for your comments and suggestions. Below please find our responses to your comments in detail.

Specific comments:

Comment #3-1: Line 18, Please add the unit for '2.44'.

Response: Done.

Comment #3-2: Line 20, There is ambiguity in the expression. The positive and negative relationship is suggested to be expressed separately.

Response: Thank you for pointing it out. We have improved the description in the revised manuscript.

"Our dataset correctly represents a negative relationship between Ta and elevation and a positive relationship between Ta and land surface temperature" (lines 20-21)

Comment #3-3: Line 30, Why is the LST mentioned here?

Response: LST has been removed.

Comment #3-4: Line 70, What does 'these' refer to?

Response: Thank you for your question. We have clarified it in the revised manuscript.

"To overcome such drawbacks, we recently proposed a class of Spatially Varying Coefficient Models with Sign Preservation (SVCM-SP) (Kim et al., 2021; Zhang et al., 2022b), which can capture and preserve relationships between Ta and explanatory variables." (lines 67-69)

Comment #3-5: Line 88, It is recommended to add the region name represented by each color boundary, or to label the region name directly in Figure 1.

Response: Thank you for your suggestion. We have explained the name of regions in the caption of Figure 1 in the revised manuscript.

"Specifically, polygons of red, purple, orange, blue, and black represent the boundaries of North America, Latin America, Africa, Australia, and Europe & Asia, respectively." (lines 90-91)

Comment #3-6: Line 90, Do these ground measurements provide hourly Ta observations?

Response: Thank you for your question. No, the ground measurements we obtained only contain maximum and minimum Ta observations in each day. We clarified it in the revised manuscript.

"Ground station-based Tmax and Tmin were compiled from a total of 103,156 weather stations from 2003 to 2020." (line 92)

Comment #3-7: Line 96, What are the DEM data years used?

Response: Thank you for your question. We clarified it in the revised manuscript.

"The DEM layer we used is the SRTM30_PLUS product at 1-km resolution (Becker et al., 2009), which has been generated from the combination of the Shuttle Radar Topography Mission (SRTM30) topography (collected in 2000) (Hennig et al., 2001; Rosen, 2000) within a latitude of ±55 degrees, ICESat derived topography (collected from February 1st, 2003 to June 30th, 2005) (Dimarzio et al., 2007) in Antarctica, and the GTOPO30 topography (completed in late 1996) (Danielson and Gesch, 2011) in the Arctic." (lines 96-100)

Comment #3-8: Line 136-137, What does this sentence mean?

Response: Thank you for your question. This sentence means the interannual variations of the accuracy are smaller than spatial variations of the accuracy across regions. We have clarified it in the revised manuscript.

"Meanwhile, the variation of accuracy across years in each region is smaller compared to the spatial variation of accuracy across regions (Tables S1-S2)." (lines 154-155)

Comment #3-9: Line 216-227, There are too many introductions about previous studies, which are already discussed in the Introduction. It is suggested to simplify these contents.

Response: Thank you for your suggestion. We have simplified the description in the revised manuscript.

"The gridded Ta data in this study have advantages regarding spatiotemporal resolutions (i.e., 1-km and daily maximum and minimum) and its global coverage (Table S3). The spatial resolution of existing global Ta datasets with daily frequencies and long-term coverage is generally low (e.g., 0.25°) (Hersbach et al.,

2018; Kalnay et al., 1996). Ta datasets with improved spatial resolutions (e.g., 1 km) are usually only available at the continental or national scales (Chen et al., 2021; Fang et al., 2021; MacDonald et al., 2020; Oyler et al., 2015; Thornton et al., 2021).” (lines 239-243)

Comment #3-10: Line 227-239, Some contents (e.g., Line 228-232) that have been mentioned similarly in the Introduction are also suggested to be simplified.

Response: Thank you for your suggestion. We have simplified relevant descriptions in the revised manuscript.

“The gridded Ta in this study can effectively capture the spatial variation of Ta by preserving physical relationships between Ta and response variables (Fig. S7). In other Ta datasets, such physical relationships (e.g., positive relationship between Ta and LST) cannot always be preserved in some situations because these datasets were created using methods without explicit constraints on the relationships between Ta and response variables. Efforts have been made to build vertical lapse models to estimate gridded Ta according to Adiabatic Lapse Rate (ALR) (Dodson and Marks, 1997; Rhee and Im, 2014; Thornton et al., 2021; Zhu et al., 2017), but the generalization of these models is limited because it is difficult to accurately capture ALR due to its spatial change.” (lines 244-249)

Comment #3-11: Line 228, What does the “which is not always true in other gridded Ta datasets” mean?

Response: Thank you for your question. It means that, in most cases, there is a negative relationship between elevation and Ta and a positive relationship between LST and Ta in other gridded Ta datasets. However, in some cases, there are opposite relationships. We have clarified it in the revised manuscript.

“In other Ta datasets, such physical relationships (e.g., positive relationship between Ta and LST) cannot always be preserved in some situations because these datasets were created using methods without explicit constraints on the relationships between Ta and response variables.” (lines 245-247)

Comment #3-12: Line 244, Why is the UHI effect mentioned here? The previous description of the Ta dataset does not seem to refer to UHI.

Response: Thank you for your question. We mentioned the UHI effect for a weakness of Daymet in capturing the spatial variation of Ta in urban areas, although its overall accuracy is comparable to our dataset. We have clarified it in the revised manuscript.

“Therefore, Daymet has difficulties in capturing the spatial variation of Ta in urban areas, although its accuracy is comparable to our dataset.” (lines 256-257)

Comment #3-13: Line 278-281, This is more appropriate for the discussion section than for the conclusion.

Response: Thank you for your suggestion. We have moved these descriptions to strengthen the discussion section, and simplified the description in the revised manuscript.

“Second, we only used two covariates in the SVCM-SP algorithm although the potential of generalization of our framework is large. Additional covariates (e.g., other surface characters such as GLAS-derived

canopy height and vegetation parameters) can be explored in the SVCM-SP algorithm to further improve the model performance." (lines 268-270)

"Future work can focus on improving the accuracy of the gridded Ta dataset using the SVCM-SP algorithm by exploring more explanatory variables which are available over large areas." (lines 290-291)