Data Article

A long-term 0.01° surface air temperature dataset of Tibetan Plateau

Lirong Ding, Ji Zhou, Xiaodong Zhang, Shaomin Liu, Ruyin Cao

A School of Resources and Environment, Center for Information Geoscience, University of Electronic Science and Technology of China, Chengdu 611731, China
b Faculty of Geographical Science and State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing Normal University, Beijing 100875, China

ABSTRACT

The surface air temperature ($T_a$) dataset of the Tibetan Plateau is obtained by downscaling the China regional surface meteorological feature dataset (CRSMFD). It contains the daily mean $T_a$ and 3-hourly instantaneous $T_a$. This dataset has a spatial resolution of 0.01°. Its time range for surface air temperature dataset is from 2000 to 2015. Spatial dimension of data: 73°E–106°E, 40°N–23°N. The $T_a$ with a 0.01° can serve as an important input for the modeling of land surface processes, such as surface evapotranspiration estimation, agricultural monitoring, and climate change analysis.

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Specifications Table

| Subject area                  | Earth and Planetary Sciences |
|-------------------------------|------------------------------|
| More specific subject area    | Atmospheric Science, Earth-Surface Processes. |
| Type of data                  | image                        |
| How data was acquired         | Downscaling model            |

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* Correspondence to: No. 2006, Xiyuan Ave, West Hi-Tech Zone, Chengdu 611731, Sichuan, China. Fax: +86 28 61831571.
E-mail addresses: dlryouxiang@163.com (L. Ding), jzhou233@uestc.edu.cn (J. Zhou), bobtennis@sina.com (X. Zhang), smliu@bnu.edu.cn (S. Liu), cao.ruyin@uestc.edu.cn (R. Cao).

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Data format
Experimental factors
Experimental features
Data source location
Data accessibility
Related research article

Raw and examples of analyzed data
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University of Electronic Science and Technology of China, Chengdu, China
This data has a high temporal resolution and a medium spatial resolution; thus, this dataset is huge. In order to maximize the sharing of this data, we can only provide a link to download this dataset.
Resource link: https://pan.baidu.com/s/1SaD3gafyGJRYXjW8k8Cs7g
L. Ding, J. Zhou, X. Zhang, S. Liu, and R. Cao, “Downscaling of surface air temperature over the Tibetan Plateau based on DEM,” Int. J. Appl. Earth Obs. Geoinformation, vol. 73, pp. 136–147, 2018.
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Value of the Data

- It can contribute to better modeling the radiation balance and energy budget and water cycle over the Tibetan Plateau.
- It can serve as an important input parameter for the modeling of land surface processes, such as surface evapotranspiration estimation.
- It can provide long-term $T_a$ dataset with acceptable accuracy and medium spatial resolution for climate change study.

1. Data

As the highest plateau in the world, the Tibetan Plateau has the largest glaciers except the Arctic and Antarctic. Due to complex natural environment, the Tibetan Plateau has significant impacts on climate change of the surrounding areas and even the whole world. Because of its special geographical location and topography, the radiation balance and energy budget and water cycle examinations of the Tibetan Plateau are particularly important. Thus, the scientific communities is requiring a long-term $T_a$ dataset with acceptable accuracy and medium spatial resolution.

We use the China regional surface meteorological feature dataset (CRSMFD) [1,2] as the basis dataset. We develop a practical method to downscale the CRSMFD from 0.1° to 0.01°. The temporal resolution of this dataset is consistent with CRSMFD. It have better consistency with the ground measured $T_a$ than original CRSMFD in Tibetan Plateau. It has higher spatial resolution than most of the current long-term $T_a$ dataset for the Tibetan Plateau. In addition, $T_a$ with a 0.01° resolution can reflect more spatial details of $T_a$ when compared with the original CRSMFD. The $T_a$ at some time is shown as an example in Fig. 1, and the 0.01° $T_a$ of local areas is shown as an example in Fig. 2 (area A and area B are shown in Fig. 1). Thus, this dataset is able to meet the ever-increasing demand for related studies and applications.

2. Experimental design, materials, and methods

The linear relationship between $T_a$ and its influencing factors, $T_a$ can be expressed as:

$$T_{a,daily} = f_{daily}(H,X_1) = \lambda H + aX_1 + c$$

$$T_{a,ins} = f_{ins}(H,X_1,X_2) = \lambda H + aX_1 + bX_2 + c$$

where $T_{a,daily}$ and $T_{a,ins}$ are the daily mean and instantaneous $T_a$ in K, respectively; $f_{daily}$ and $f_{ins}$ are the statistical functions for the daily mean $T_a$ and instantaneous $T_a$, respectively; $H$, $X_1$, $X_2$ are the elevation, latitude, and longitude, respectively; $\lambda$, $a$, and $b$ are the corresponding coefficients; and $c$ is
Fig. 1. Examples of the $0.01^\circ \, T_a$ data over the Tibetan Plate.

Fig. 2. Subsets of the $0.01^\circ \, T_a$ data.
the intercept. It is evident that \( \lambda \) is the lapse rate (LR) of \( T_a \) [3, 4]. Note that the longitude is not contained in Eq. (1) due to its ignorable ability in explaining daily mean \( T_a \).

Based on Eqs. (1) and (2), the flowchart of the proposed method for \( T_a \) downscaling is shown in Fig. 3. The first stage for \( T_a \) downscaling is to calculate LR. The DEM data at 90-m is aggregated to 0.01°. The mean elevation of the 10 \( \times \) 10 pixels is calculated and used as the elevation of the pixel at 0.1° that containing these 10 \( \times \) 10 pixels. The spatial distribution of LR can be divided into eight regions, i.e. Region 1: 73–90°E, 35–40°N; Region 2: 90–100°E, 35–40°N; Region 3: 100–105°E, 35–40°N; Region 4: 78–95°E, 27–35°N; Region 5: 95–100°E, 27–35°N; Region 6: 100–107.5°E, 30–35°N; Region 7: 100–105°E, 25–30°N; Region 8: 100–105°E, 23–25°N [5]. In this division scheme, each region has similar regional climatic characteristics and a range of elevation changes. This division scheme is utilized by this method. To better address the intra-annual variations of LR, the LR values of instantaneous \( T_a \) at every 3 h and the daily mean \( T_a \) on every day are calculated.

The second stage is to determine and optimize the initial value of \( T_a \) at the target resolution. The \( T_a \) value at the native resolution (i.e. 0.1°) is taken as the initial value of the pixel at the target resolution (i.e. 0.01°). At the target resolution, a moving window approach is employed to refine the initial \( T_a \) of the central pixel. For each pixel at the target resolution, the window size is set to 11 \( \times \) 11 pixels and the current pixel under consideration is the center of the window. If the current pixel is on the edge of the image, the window is not complete and the existing pixels are selected. Pixels with valid \( T_a \) and elevation in the moving window are selected as valid pixels [6]. Then the mean \( T_a \) of the valid pixels in the moving window is calculated as the optimized \( T_a \) of the central pixel as follows:

\[
T_a^0 = \frac{\sum_{i=1}^{m} T_a\text{-initial}(i)}{m}
\]

where \( T_a^0 \) is optimized initial value of the \( T_a \); \( T_a\text{-initial}(i) \) is the initial \( T_a \) the i-th pixel at the target resolution within the window; and \( m \) is the number of valid pixels in the window.

The third stage is to determine the final value of \( T_a \) at the target resolution. According Eqs. (1) and (2), the \( T_a \) difference between the central pixel and the mean \( T_a \) of moving window can be expressed as:

\[
\Delta T_a\text{,daily} = \lambda (H - H_{\text{win}}) + a(X_{1\text{-win}} - X_{1\text{-i}}) + X_{2\text{-win}} - X_{2\text{-i}}
\]

\[
\Delta T_a\text{,ins} = \lambda (H - H_{\text{win}}) + a(X_{1\text{-win}} - X_{1\text{-i}}) + b(X_{2\text{-win}} - X_{2\text{-i}})
\]

where \( \Delta T_a\text{,daily} \) and \( \Delta T_a\text{,ins} \) are daily mean \( T_a \) difference and instantaneous \( T_a \) difference in K; \( H \), \( X_{1\text{-i}} \) and \( X_{2\text{-i}} \) are the elevation, latitude, and longitude of the central pixel of the moving window, respectively; \( H_{\text{win}} \), \( X_{1\text{-win}} \) and \( X_{2\text{-win}} \) are the mean elevation, latitude, and longitude of the moving window, respectively. \( X_{1\text{-i}} \) and \( X_{1\text{-win}}, X_{2\text{-i}} \) and \( X_{2\text{-win}} \) can be considered to be approximately equal.

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**Fig. 3.** Flowchart of the method for \( T_a \) downscaling.
Thus, Eqs. (4) and (5) can be simplified as:

$$\Delta T = \lambda (H - H_{win})$$

where $\Delta T$ is the $T_a$ difference in K.

Then the final $T_a$ of the central pixel is:

$$T_a = T_{0a} + \Delta T$$

Finally, the 0.01° $T_a$ data of Tibetan Plateau was obtained by this downscaling method.

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**Transparency document. Supporting information**

Transparency data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2018.08.107.

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