Land surface temperature (LST) is one of the most important essential climate variables for climate change studies. Given the cloud contamination and discontinuous satellite observations, it is challenging to analyze the trend of LST for a specific region and time frame by solely relying on a satellite product. To tackle this issue, the study targets to provide a temporal-consistent LST dataset for China in 2003-2017 by utilizing both MODIS LST product and local LST measurements from meteorological stations. The authors applied their data reconstruction method and validated their dataset. The validation suggests that the accuracy of reconstructed LST is reasonable well for the long-term trend analysis.

Response: We would like to thank you for the comprehensive summary and constructive comments of the manuscript. A detailed response to each comment is given as follows.

I am particularly interested in the imbalanced temperature-trends for different regions and seasons in China from this study. I would have the following suggestions and look for the authors responses.

From Fig. 1, we can see that the distribution of weather stations is sparse in the western China. Can you discuss how the non-uniform distribution of weather stations affects the dataset accuracy and your potential method for improvement?

Response: Thank you for the valuable comment. There are relatively fewer meteorological stations in western China. Under the same conditions, the accuracy in western China is lower than that in areas with dense weather stations when using the surface meteorological station to reconstruct LST values under the cloudy cover conditions. As shown in Fig. 3-4, there are more clouds in the eastern China than in the western China. In this case, the number of days for LST values can be obtained from the remote sensing image in a month is very smaller in the eastern part of China than in the western China. In this study, accuracy evaluation is based on the monthly scale. The accuracy is mainly determined by the number of days of effective pixels on the monthly and annual scales, and our analysis indicates that the more days of available pixels corresponding to the pixels on the monthly scale, the higher the accuracy. No matter how cloudy or not, the higher accuracy can be achieved by increasing the number of weather stations and satellite observations.

The authors have made significant contribution in analyzing the historical temperature changes in China. The imbalanced LST trends in China are revealed. The authors have made an amount of discussions on the reasons.

First, can the author add the significance of trends to the maps (or in the supplementary materials)?

Response: Thank you for the valuable comment. To some extent, the correlation coefficient can be used to reflect the reliability of the surface temperature trend over time. In order to more clearly express the significance of the trend, student’s t-test was performed for different time scales. The significance maps has been added to the revised manuscript and can be seen in supplementary material.

Second, the authors mentioned that the increase in aerosol may reduce the “cooling effect”, while I think that the aerosol is recognized for the cooling effect. Can the authors clarify that?

Thanks for this comment. The effect of aerosol climate forcing is complex, because aerosols both reflect solar radiation to space (a cooling effect) and absorb solar radiation (a warming effect) (Hansen et al., 2011).

The warming effect is mainly caused by the absorption of solar radiation by black carbon aerosols. As Ramanathan and carmichae (2008) pointed out, black carbon aerosols may be the second strongest contribution to climate warming. Kühn et al. (2014) also found that recent changes (1996–2010) in aerosols forcing over China are a warming effect due to increasing black carbon concentrations, especially in the north. In this part of the manuscript (Summary and conclusions), we emphasized the contribution of human factors to climate warming, so only the warming effects of black carbon aerosols was discussed.

As Dr. He has pointed out, scattering aerosols, such as sulfate aerosols and nitrate aerosols, are expected to produce cooling effects by absorbing and scattering solar radiation. We also make a supplementary explanation for this part in the revised version of the manuscript.

Third, the authors attributed the cooling trend in Northeast China to negative Arctic oscillation; while I found that the cooling trends are mostly located in cropland; the increasing agriculture and irrigation may contribute to increased evapotranspiration and therefore, the lower LST; more discussion is expected in this regard. I look forward to seeing your peer-reviewed and refined revision.

Response: Thanks for this constructive comment. We agree with Dr. He that the evaporation and irrigation of vegetation have a cooling effect. In our analysis, we emphasized the possible causes of temperature changes from a macro perspective, while ignoring the possible impact of changes in local land use types. In recent years, the area of unused land converted to cultivated land in the Northeast has continued to increase. Transpiration caused by increased crops and irrigation is one of the important reasons to produce a cooling effect on surface temperature. This part will be added in the revised version of the manuscript.

Some specific comments:

Fig. 1 and table 1: it is unclear from the captions what is the difference between key zone and region?

Response: Thank you for the valuable comment. We agree that the original description of the key zone is not quite clear and needs further clarification.

The study area is divided into six regions to describe the temporal and spatial characteristics of China's LST. They are: I Northeast Region, II North China Region, III Central - South China Region, IV South China, V Northwest Region, VI Qinghai-Tibet Plateau Region.

To further understand the credibility of the data and clarify the limitations of the use of our method, we further assess the performance by some meteorological station data at different sub-climate regimes and topography situations. Six key zones which shown in Fig. 1 and Table 1 are determined by interannual change trends of LST from the slope map (Fig. 6(a)), including the three most significant regions for warming (b, d, f), the two most significant regions for cooling (a, c) and the zone located in Xinjiang Province (see Fig. 6a for details), and special attention was given to area around the Taklamakan Desert (e) in Xinjiang, which has complex terrain and extensive heterogeneity.

Figs. 3 and 4: Areas of invalid data are in 'blank'.

Response: Many thanks for your attentions. We have revised the word as suggested in the revision.

Fig. 5: need more information in the caption: is the linear trend derived from "National average", is the "National average" derived from the corrected MODIS LST time-series?

Response: Many thanks for your attentions. We apologize for the insufficient description of Fig. 5. We have revised the caption statement in Fig. 5. The caption information is also presented below for the ease of reviewing.

Time series of annual mean LST (unit: ℃) for the period of 2003-2017 from the corrected MODIS LST of China. The solid blue line indicates its linear trend. The orange dashed line shows its five-year running average trend.

Fig. 6: it is desirable to show a separate map for each pixel if the correlation is significant.

Response: Thanks for this comment. The significance map of annual mean LST change trend has been added to the revised manuscript and can be seen in Figure. S1.

Table 2: for some records, the RMSEs after corrections are increased.

Response: Thanks a lot for pointing this out. The accuracy for each pixel should be improved in the ideal situation if the region is divided into small enough. However, affected by complex sub-climate regimes and topography situations, it is difficult to use limited strategies to significantly improve the accuracy of each pixel for such a large area.

In this study, we reconstruct the surface temperature under the cloud cover by combining MODIS daily, monthly and meteorological station data, which can effectively ensure the quality of the reconstructed data. Then, we built calibration models for subregions with different climatic conditions and topographical characteristics, which can further improve the data accuracy. As Shown in table 2, about 83% of the data accuracy is improved and a small amount of accuracy is slightly decreased after the reconstructed data is corrected by the verification model.

L607: examine “Sahara Desert region”.

Response: We appreciate Dr. He for the careful reading of our manuscript and are very sorry for the carelessness. We have replaced “Sahara Desert region” with “Taklamakan Desert” in the revised manuscript. Thank you.

References

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