Response to second comments of reviewer #1

We appreciate a lot for your efforts in providing detailed comments and recommendation. They are very helpful to improve the quality of the manuscript. We have revised the manuscript according to your comments. The comments from the reviewers are kept in regular font, our responses use blue highlighting, and the revised sentences or words in the revised manuscript are highlighted with red color.

Thank you for your response which resolved many of my concerns. However, I am still wondering if you have addressed some key issues of the AVHRR GAC data:

Q1. As the archived historical data, the AVHRR GAC raw data have a serious geolocation issue that has been criticized by Wu et al. (2020), especially when the view zenith angle is larger than 40-deg, thus I would suggest the authors deal with this issue or at least quantify the impact. Please double-check previous literature and collect such data issues and give a comprehensive discussion.

Response: Thanks for your valuable suggestion. Indeed, Wu et al. (2020) provides a preliminary geolocation assessment for AVHRR GAC data of NOAA-17, MetOp-A, and MetOp-B, which present shifts that stay within the range of 4 km for satellite zenith angles smaller than 40° and can reach 6 km when the satellite zenith angle is larger than 40°. To be more clearly for readers, we have added the detail of the geolocation issue according to the work of Wu et al. (2020) in Line 105-107 as follows:

"*Therefore, AVHRR Level-1b GAC data are generally treated as having a coarse resolution of 4 km at the nadir, and the pixel size increases with the satellite zenith angle (VZA). Furthermore, as the VZA increases, the geolocation accuracy of the AVHRR GAC scene become lower, particularly when VZAs larger than 40° (Wu et al., 2020).*".

In addition, considering the influence of geolocation issue, we used an open-source package, Pygac, to pre-process AVHRR GAC data. Pygac, which is based on ephemeris data, orbit model and time of onboard clock, uses correction of satellite location method, correction of scanline timestamps method, correction of geolocation method to improve the geolocation accuracy of the AVHRR GAC data. After the GAC data are treated through above methods, we believe that their geolocation accuracy basically meets the demand of global applications at 0.05° spatial resolution. However, if users need high geolocation quality GAC data, we suggested that the GAC data less than 40° should be preferred. We have clarified this point in Line 473-476 with the expression as follows:

"*…A variety of factors such as cloud cover, orbital gaps, and instrument failure are responsible for this limitation. And finally, the geolocation accuracy of GT-LST product basically meets the demand of global applications at 0.05° spatial resolution. However, if users need very high geolocation quality GT-LST data, we suggested that the GT-LST data with VZAs less than 40° should be preferred.*"

Q2. It still doesn't make sense that the data ended in 2005 artificially and the other reviewer also agreed with my suggestion.

Response: Thanks for your comment. We are sorry for the previously unclear explanations. As emphasized in the introduction section, this study aims to fill the data gap of global satellite-derived twice-daily LST before 2000. However, considering global meteorology and climatology-related applications urgently need more than 30 years of daily LST products, there are two ways of satisfying that requirement based on GT-LST. One way is to combine GT-LST (1981-2000) with the existing satellite-derived daily LST product (2000-present), which depend on different products with the same observation period to eliminate or limit the bias between different sensors. Therefore, we extend the time span of GT-LST to 2005. Benefiting from the same observation period (i.e., 2000-2005) with MODIS LST, we will produce a global long-term (1981-present) LST data record according to the method of Liu et al. (2012), which will be primarily from the AVHRR (1981-2000) and MODIS (2000-present).

Indeed, as you mentioned, extending the time span of GT-LST to present is another way to address this issue. We have already started working on generating GT-LST products (2006-present). Although we have proposed a framework for generating GT-LST product, we still need spend a lot of time downloading global AVHRR GAC L1B data, handling large amounts of original Level-1B data, generating huge amounts of process variable data, and so on. After all data have been processed, we will upload GT-

LST (2006-present) to previous URL (https://doi.org/10.5281/zenodo.7134158).

Q3. The monthly mean LST still has an overall bias of 1.3 K compared to site observations, please double-check the code or provide a discussion and comparison with previous work.

Response: Thanks for your suggestion. According to your suggestion, we have double-checked the code but not found problems. In addition, we have added the discussion of positive bias between monthly mean GT-LST and in situ LST in Line 439-441 as follows:

"*…This result is similar to that of Chen et al. (2017), who compared MMLST from MODIS day and night instantaneous clear-sky LST with actual MMLST from 156 flux tower stations, and reported RMSE value of approximately 2.7 K. However, it should be noted that a positive bias of 1.3 K between GT-LST MMLST and in situ MMLST. One possible reason is that in situ MMLST of some sites does not represent the MMLST over the 0.05°×0.05° pixel.*"

References for the above responses are listed below:

Liu, Y., Liu, R., and Chen, J. M.: Retrospective retrieval of long-term consistent global leaf area index (1981–2011) from combined AVHRR and MODIS data, J. Geophys. Res-Biogeo., 117, 1-14, https://doi.org/10.1029/2012JG002084, 2012.

Wu, X., Naegeli, K., and Wunderle, S.: Geometric accuracy assessment of coarse-resolution satellite datasets: a study based on AVHRR GAC data at the sub-pixel level, Earth Syst. Sci. Data, 12, 539–553, https://doi.org/10.5194/essd-12-539-2020, 2020.