

Responses to Comments Made by Reviewer #2:

The manuscript (MS) provides a long-term ET dataset over the Tibetan Plateau, a region that is known as “Asian Water Tower” because it is the source region of a few large Asian rivers. For this reason, accurate information of ET is particularly important. I very much appreciate the considerable efforts made by the authors to the ET community, as shown by not only this gridded dataset but also the eddy-covariance flux observations in Tibetan Plateau. The latter was published by these authors in also ESSD in 2020 (<https://doi.org/10.5194/essd-12-2937-2020>), which has been widely used by the community to improve the understanding of hydrological and climatological processes in the Tibetan Plateau. The present MS is an obviously big step forward upon the previous one, which is also definitely significant for understanding the land surface processes in the Third Pole Region.

Minor Revision:

- The authors stated their new ET dataset is at 0.01 degree. However, the best resolution of the inputs (Table 1) is just 0.05 degree and this is only for albedo and NDVI, others are even coarser. Usually, for any models (not only ET models), the resolution of model’s output cannot exceed the best resolution of inputs, otherwise it becomes simple “resampling” of the data (e.g., nearest neighbor or bilinear interpolation). This does not make sense since it cannot bring new spatial information. Therefore, I think the best resolution of this new ET dataset from their model can only be 0.05 degree.

Thank you for your suggestion. We agree to that resampling does not provide us with more information. Hereby, we fixed our objective from 0.01 degree to 0.05 degree product. Hereby, we have modified the title and other places which mentioned the spatial resolution in the revised manuscript.

- There have been a great number of studies that reported Tibetan Plateau is greening. This is not surprised because warming and wetting in recent decades may promote vegetation growth in such a cold and dry region. However, the NDVI significantly decreased after 2000 in Fig 9a, while warming (Fig 9b) and wetting (Fig 9e) are

still seen for this period. This seems different with the NDVI reported in Wang et al. (2022). Because NDVI is a key input of the model that determines both canopy transpiration and soil evaporation (fc in the Equations 1 and 2), I would suggest the authors to test if other NDVI datasets (perhaps even other leaf area index data?) also show similar interannual variations and how ET varied if they are also used in the modeling, otherwise the trends in transpiration and soil evaporation in the MS should be interpreted with caution.

Thank you for your constructive suggestions. We found that both the NDVI products from AVHRR and MODIS showed great consistency in time series. AVHRR-NDVI has a longer time series. Therefore, in this study, the AVHRR-NDVI product was used as the model input without obtaining more driver data. Although the existing studies have done a more realistic study of NDVI performance on the Tibetan Plateau, to compare more NDVI product maybe a deviation from the focus of this study. In addition, NDVI significantly decreased after 2000, is because of the extremely high NDVI values in the year of 2001 and 2004. When we remove these two years, the trends from 2000 to 2018 is still increasing. Hereby, the two years NDVI data might not be stable. We will do a deeper study on the influences of different NDVI product in future.

- Ln61: Here the Immerzeel et al. 2010 Science paper should be cited since this paper is perhaps the first one that proposed Asian Water Tower concept?

We have cited Immerzeel et al. 2010 in the revised manuscript.

Immerzeel, W. W., Van Beek, L. P. H., Bierkens, M. F. P.: Climate change will affect the Asian water towers. *Science*, 2010, 328(5984), 1382–1385.
<https://doi.org/10.1126/science.1183188>

- Ln75: Please delete the “pan evaporation” studies here since they are not really relevant to the present topic—ET.

“Pan evaporation” studies were removed in the new manuscript.

- Ln76-77: Please do not combine EC and reanalysis into one sentence. I would

suggest moving reanalysis to the previous sentence since it belongs to “dataset”. However, EC is a kind of ground observation and is much more valuable/reliable than above “datasets”, which should be specially highlighted.

Yes, this is a very good suggestion. We have modified the sentence in the revised manuscript as: Some investigations have used reanalysis datasets (Shi et al., 2014; Dan et al., 2017; Yang et al., 2019; De Kok et al., 2020), eddy-covariance measurement (Shi et al., 2014; You et al., 2017; Yang et al., 2019; Ma et al., 2020) to study the ET on the TP.

- Ln144: Please show how f_c is derived from NDVI.

Thanks. We have added the equation in the revised manuscript as:

$$f_c = \left(\frac{NDVI - NDVI_{min}}{NDVI_{max} - NDVI_{min}} \right)^2 \quad (4)$$

- Ln195: Prec is not shown in Tabel 1?

Thank you for your suggestion. We have added the precipitation information in Table1.

- Ln199-201: Please show the source reference and website of the NDVI dataset.

Thank you for your suggestion. We have added the sentence in the revised manuscript as: A long-term normalized difference vegetation index (NDVI) dataset with a 0.05° spatial resolution and daily temporal resolution were download from the National Oceanic and Atmospheric Administration’s National Centers for Environmental Information (NOAA-NCEI) (<https://www.ncei.noaa.gov/products/climate-data-records/normalized-difference-vegetation-index>) and was used to calculated the canopy height and LAI (Chen et al., 2013).

- Ln205: The emissivity data is not shown in Table 1? Please also show the resolution for it.

Emissivity is calculated following the method of Sobrino et al. (2004). That’s why we did not list emissivity data in table 1. Its resolution is 0.05 degree.

Sobrino, J. A., Jiménez-Muñoz, J. C., and Paolini, L.: Land surface temperature retrieval from LANDSAT TM 5, *Remote Sens. Environ.*, 90(4), 434–440, <https://doi.org/10.1016/j.rse.2004.02.003>, 2004.

- Table 2: I suggest adding the reference for each EC flux observation station in the Table 2. Also, the land cover type is not clear for BJ, does it belong to grassland?
Thanks. References for each EC flux observatory are added in table 2 now. The land cover type of BJ is the alpine meadow. We have updated all the land covers to alpine meadow and alpine steppe, which is more professional.

- Ln297-298: This point is important, but different precipitation products may produce different ratios of ET to precipitation. Did you test other datasets? I am not fully convinced by the reanalysis Prec product (especially in TP). Please also consider other Prec data, e.g., CMFD, TPHiPr (Jiang et al., 2022), and the latest gauge-satellite merged product GPCP Version 3.2 released in this year, etc. This suggestion also applies to Figure 9f because the lakes in TP continued to rapidly expand after 2000, but Prec from the current Figure 9f even decreased. Please see Fig 4e and Fig 6 in Zhang et al. (2020).

Thank you for your suggestion. We have used the precipitation product to give a more reliable estimation. The sentence is revised in the manuscript as follows: The average annual rainfall on the TP is about 1.8×10^3 Gt/year, estimated from the data of ERA5-Land, CMFD, and TPHiPr in Jiang et al., 2022. About 53% of the precipitation on the TP returns to the atmosphere through ET.

- Ln330: What is the difference between “wetting” and “increased precipitation”? The “wetting” occurs many times throughout the MS.... I assume you mean the increased soil moisture? Please state clearly.

Thank you for your suggestion. We have modified the sentence in the revised manuscript: Since the 1980s, the TP has experienced overall greening, warming, and wetting (increased soil moisture and precipitation).

- Figure 9: Please show the specific periods for different slopes shown in the Figure 9?

Thanks. There are two periods in the figure. We specify the two slope values for the two time periods in Figure 9.

- Ln430: “evaporated” from the entire TP.

We have modified the sentence as you suggested in the revised manuscript.

- Ln432: Please add the p value also for the significant decreasing trend.

Thank you for your suggestion. We have added the p value in the revised manuscript.

- Appendix A: I do not know whether ESSD allows Online Supplementary Materials. If so, I suggest moving all tables and figures in Appendix to Online Supplementary Materials. There is no need to show them (some are even out of TP) in this MS.

Thank you for your suggestion. It is possible to use Appendix for ESSD journal.