Responses to Comments Made by Reviewer #3:

The Tibetan Plateau is the birthplace of Asia's major rivers and is also essential to the Asian energy and water cycles. This manuscript aims to produce a long-term (1982-2018) evapotranspiration product to accurately monitor and understand the spatial and temporal variability of the ET components. The intent of this study is meaningful, and the scope is suitable for publication in Earth System Science Data. However, I also have some concerns about the method and results presented in this study. So I suggest a major revision is needed before publication.

Major comments:

- The Introduction is generally well written, but the scientific problem of lacking longer-term remote sensing ET products in TP needs to be more evident. It would help readers know why you did this study, the problem of ET products in TP, and how to solve these problems. In addition, the characteristics of TP and required model improvements for TP should be explained in the Introduction.

  Thank you for your suggestion. We have modified the introduction in the revised manuscript to describe the ET products problem and how to solve the problem.The poor performance of the MOD16 Penman–Monteith model (Mu et al. 2011) in the arid to semi-arid areas of the TP is due to the fact that the algorithm does not take into account the dominant role of the topsoil information (topsoil texture and topsoil moisture (SM)) in controlling the evaporation processes (Yuan et al., 2021). TP land covers is dominated by the short and sparse vegetation. Soil moisture may play an important role on the ET estimates for the TP region. The Penman–Monteith algorithm has been used to test the performance of the ET estimation on the TP (Wang et al., 2018; Ma et al., 2022). However, the effects of the SM on the evaporation resistance and stomatal conductance are not included in these studies. The enhanced Penman–Monteith model, MOD16-STM (MOD16 soil texture model), redefines the Es and Ec module to take into account the impacts of SM on soil evaporation resistance, with the help of eddy-covariance observations on the TP (Yuan et al., 2021). Hereby, MOD16-STM may provide us with a high chance to accurately estimate ET`s components.

- MOD16-STM is utilized in this study, but readers don't know the abbreviation of STM, please give its full name. Three ET components are considered in Eqs. (1) to

(3), but the surface resistance rs in Ec, Es, and Ei should be designed reasonably for dry vegetation, wet vegetation, and bare soil, respectively. Eq. (5) is the soil heat flux calculation, but the final term equation should be Is – Ic. Eq. (7) is the calculation of aerodynamic resistance, but the zero plane displacement (d0) is not included in the equation, more details please find in Liu et al. (2007). Shaomin Liu, Li Lu, Defa Mao, and Li Jia. Evaluating parameterizations of aerodynamic resistance to heat transfer using field measurements. Hydrology and Earth System Sciences, 2007，11（2）： 769-783.

Thank you for your suggestion. We give the explanation of STM in the new version. We made a mistake in equation 1 which cause the reviewers' misunderstanding. We use different resistance for Ec, Es, and Ei. Please check the revised equations. "Is – Ic" was used in Eq 5 now. Zero plane displacement was added in the equation. Liu et al. 2007 was also cited in the manuscript.

- Section 3.4 presented the comparison of MOD16-STM products and other ET products in TP, but readers don't know the spatial pattern difference among different products.

Thank you for your suggestion. We added new figure A4 to show the spatial difference among different products. It is also included in the following.

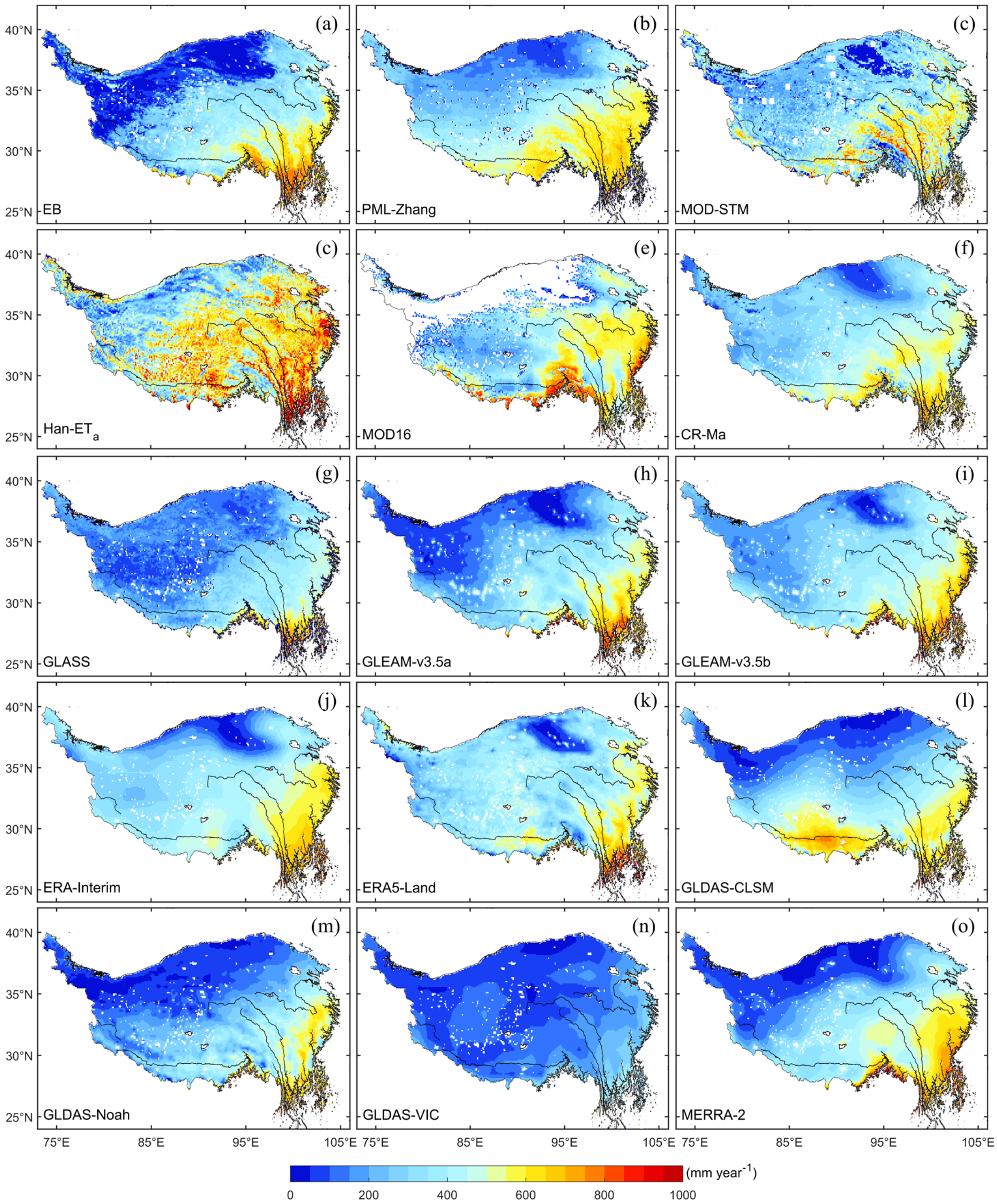

Figure A4 Spatial distribution of 15 annual mean evapotranspiration on the Tibetan Plateau from 2000 to 2014.

- The improvements of the proposed model compared with the MOD16 algorithm should be discussed in-depth.

  Thank you for your suggestion. We have added the following figure to demonstrate the difference between MOD16 and MOD16-STM in the revised manuscript:

Symbol	Description	MOD16	MOD16-SMT
C_L	The mean potential stomatal conductance per unit LAI	0.007	0.0038
h_c	Vegetation height	Not used	In situ
v	Kinematic viscosity of the air	Not used	$1.328 \times 10^{-5} \times \left(\frac{P_0}{P}\right)\left(\frac{T_{air}}{T_0}\right)^{1.754}$, $P_0 = 101.3$ kPa and $T_0 = 273.15$ K
u_*	Friction velocity	Not used	In situ
L	The Obukhov length (m)	Not used	In situ
T_*	Friction temperature	Not used	$\frac{T_{air} u_*^2}{\text{kgL}}$
z_{0h}	Heat roughness length	Not used	$\frac{70v}{u_*}\exp\left(-7.2u_*^{0.5}\lvert T_*\rvert^{0.25}\right)$
z_{0m}	Momentum roughness length	Not used	$h_c/8$
r_s^s	Surface resistance of bare soil	r_{tot}	$\exp\left(A + B \times \frac{\theta}{\theta_{sat}}\right)$
r_a^s	Aerodynamic resistance of soil surface	$r_a = \frac{rh \times rr}{rh + rr}$	$\frac{\ln\left(\frac{z_h}{z_{0h}} - \psi_h\right)\ln\left(\frac{z_m}{z_{0m}} - \psi_m\right)}{k^2 u}$
θ_{sat}	Soil porosity	Not used	$\left(1 - V_{SOC} - V_g\right) \times \theta_{sat,m} + V_{SOC} \times \theta_{sat,sc}$
$\theta_{sat,sc}$	The porosity of the SOC	Not used	$0.489 - 0.00126 \times \%\text{sand}$
V_{soc}	Volumetric content of the SOC	Not used	$\frac{\rho_p \times \left(1 - \theta_{sat,m}\right) \times m_{SOC}}{\rho_{SOC} \times \left(1 - m_{SOC}\right) + \rho_p \times \left(1 - \theta_{sat,m}\right) \times m_{SOC} + \left(1 - \theta_{sat,m}\right) \times \frac{\rho_{SOC} \times m_g}{1 - m_g}}$
V_g	Volumetric content of gravel	Not used	$\frac{\rho_{SOC} \times \left(1 - \theta_{sat,m}\right) \times m_g}{\left(1 - m_g\right) \times \left(\rho_{SOC} \times \left(1 - m_{SOC}\right) + \rho_p \times \left(1 - \theta_{sat,m}\right) \times m_{SOC} + \left(1 - \theta_{sat,m}\right) \times \frac{\rho_{SOC} \times m_g}{1 - m_g}\right)}$

Figure A5 Comparison of Improved Parameters or Intermediate Variables in the MOD16-SMT Model and the MOD16 Model (Yuan et al., 2021).

Minor comments:

- Line 40, 'During the study period, the ET exhibited a significant increasing trend, with rates of about 1–4 mm/year ($p < 0.05$), over most parts of the central and eastern TP and a significant decreasing trend, with rates of −3 to −1 mm/year, over the northwestern TP'. Please reorganize this sentence.

  Thank you for your suggestion. We have rewritten the sentence in the revised manuscript as: The results of this study indicate that the ET in most of the central and eastern parts of TP showed a significant upward trend with a rate of about 1-4 mm/year ($P<0.05$) during the period from 1982 to 2018.

- Lines 118-119, how to determine the climate zones, please provide necessary references.

  The climate zone is based on FAO drought index dataset. We have added the sentence in the revised manuscript as: Based on FAO drought index dataset, it is the largest landform unit in Eurasia and mainly includes hyper-arid, arid, semi-arid, and sub-humid climate zones (Fig. 1b).

- Figure 1, all these figures belong to the classification diagram, so the color bar should not be continuous.

  Thank you for your suggestion. But, to keep consistency with Fig.1a in the figure, Fig.1b-1d these figures belong to the classification figure, and the legend is kept uniform.

- Line 144, how to calculate F_{wet}? Are any empirical parameters that need to be calibrated following the studies of Mu et al. (2011, RSE)? How to calibrate these parameters? Mu, Q., Zhao, M., Running, S.W., 2011. Improvements to a modis global terrestrial evapotranspiration algorithm. Remote Sensing of Environment. 115, 1781-1800.

  The detailed equation for F_{wet} and all the other variable in the MOD16-STM model have been listed in Yuan et al. 2021. That`s why we did not repeat it in this paper. F_{wet} was calculated with relative humidity. We did not change it from Mu et al. 2011

$$F_{wet} = \begin{cases} 0.0, RH^4 < 70\% \\ RH^4, 70\% \leq RH \leq 100\% \end{cases} \quad (3)$$

- Line 155, what does "surface model" mean?

  The "surface model" means the 'land surface model'. We changed 'surface model' to 'land surface model'.

- Some grammar mistakes are included, e.g., Line 200, 'domwnload' should be 'download'; Line 330, 'increase' should be 'increased'.

  Thank you for your correction. We have modified the sentence in the revised manuscript.

- Line 210, the URL and necessary references should be added in Table 1.

  Thank you for your suggestion. URL and references for each input data have been included in section 2.2.2 Input data., Such as, CMFD is downloaded from TPDC (https://data.tpdc.ac.cn/). 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).

- Table 1, the spatial resolution of model input data and auxiliary data is greater than 0.05°. Can the 1km ET products provided in this study capture more spatial details after resampling?

  Yes, this is a very good suggestion. Thank you for your suggestion. We have adjusted the spatial resolution accuracy to 0.05° for the optimal data set for this study.

- Line 225, ECR is calculated in Eq. (18), why not use ECR in Eq. (19) ?

  Thanks. Eq. 19 has been revised as you suggested.

- Line 231, accuracy evaluation may be more appropriate.

  Yes, this is a very good suggestion. Thank you for your suggestion. We have modified the title in the revised manuscript.

- Line 265, the legend needs to be added to Figure 4.

  Thank you for your suggestion. We changed the caption of Figure 4 to include legend information. Please check the revision in the revised verion.

- Lines 292-293, the Es in Ma et al. (2022, AFM) is nearly 226, and Ec is almost 110, please explain the differences. Ma, N., Zhang, Y., 2022. Increasing Tibetan plateau terrestrial evapotranspiration primarily driven by precipitation. Agricultural and Forest Meteorology. 317.

  Thank you for your suggestion. The results of this study assume mainly NDVI $<$ 0.25 as a screening condition when classifying bare soil. Therefore, the simulation results of this study are dependent on NDVI data. The difference with the results of Ma et al. (2022) depends solely on the difference in NDVI-driven data. the NDVI true values used in the model of Ma et al. (2022) have a wider spatial distribution, while the NDVI of AVHRR has a narrow spatial distribution style. This results in why Ec in Ma et al. (2022) is higher than ours.

- Line 353, are you sure their RMSE values are under 0.006 mm/d?

  RMSE values was revied from “0.006mm/d” to “14 mm/month”.

- It is quite strange why the NDVI and wind speed have different trends after 2000? Detailed explanations need to be provided into the manuscript.

  Thank you for your suggestion. This is not out of expectation when a different trends exhibit. We agree that the Tibetan Plateau is turning green. The warming and wetting of recent decades may have promoted vegetation growth in such a cold and dry region. The NDVI declined after 2000. This is caused by quite high NDVI values in the year of 2001 and 2004. The short period from 2005-2018 still shows an increasing trend. Therefore, it is possible that 2001 and 2004 has a poor data quality. Wind speed trend changes have been reported by other scientists. The explanation is out of focus of this paper.

- The conclusion is too long to understand, please shorten them to make it more readable.

  Thank you for your suggestion. We have simplified the conclusions of the manuscript, as detailed in the revised manuscript.

  1. The ET product generated using MOD16-STM exhibited a good performance on the TP. Compared to the flux tower observation data, the R^2 and IOA values of the modeled ET reached 0.83 and 0.93 for 782 samples, with the RMSE of 13.48 mm/month and an MB of 2.58 mm/month. The actual ET and can be used in research in water resource management, drought monitoring, and ecological change.
  2. The combined effect of the atmospheric demand and water supply resulted in spatial heterogeneity of the ET and the changes in the ET. The annual ET generally decreased from southeast to northwest on the TP. The Es accounted

for more than 84% of the annual ET. The estimated multiyear (1982–2018) mean annual ET on the TP was 346.5±13.2 mm, resulting in approximately 0.93 ± 0.037 Gt/year of total water evapotranspiration from the entire TP.

3. The ET exhibited a significant increasing trend, with rates of about 1 to 4 mm/year ($p<0.05$), over most parts of the central and eastern TP and a significant decreasing trend, with rates of −3 to −1 mm/year, on the northwestern TP. Averaged across the entire TP, the ET increased significantly during 1982–2018, with a rate of 0.96 mm/year. The increase in the ET over the entire TP from 1982 to 2018 can be explained by the warming and wetting of the climate during this period.