Response to Thomas Van Niel:

Dear reviewer, we sincerely appreciate your time and effort in reviewing our manuscript and providing valuable feedback to help improve our work. In the reply, the reviewer's comments are in black, our responses are in blue, and quotes from the revised manuscript are in *orange italics*.

Overview

The study introduces a global terrestrial evapotranspiration (ET) dataset (2001–2019, 0.1° resolution) using the Remote Sensed Non-Parametric (RSNP) model, which avoids complex parameterization by leveraging nonparametric (NP) and Surface Flux Equilibrium-Nonparametric (SFE-NP) approaches with remote sensing and reanalysis data. Validation against FLUXNET and water-balance ET showed comparable accuracy to existing datasets (ETMonitor, PML_V2, PEW). RSNP offered more complete global coverage by reducing missing values, especially in arid regions. I personally learned a great deal from my own research into the Hamiltonian approach used and came away inspired to test new ideas. However, almost none of this understanding came directly from the paper, which largely glosses over, arguably, the most compelling reason to publish the work. Because of the novelty of the approach used to generate the dataset, I would very much like to see this paper published. However, it would require a substantial effort to make it ready for publication, in my opinion. I describe 5 major comments/concerns that I have about the manuscript in its current state. These should be explicitly addressed in the author's response. The intent of my comments is only to help improve the manuscript. I then provide a list of minor issues.

Major Comments/Concerns:

1.) Insufficient Explanation of the Hamiltonian Approach: The manuscript does not provide sufficient detail on the Hamiltonian microstate approach, making it unclear why this method was chosen over a standard deterministic model. The novelty of this approach is underemphasized, despite it representing a fundamental departure from traditional surface energy balance (SEB) modelling. The lack of explanation makes it difficult for readers to fully understand the rationale behind this choice and assess its advantages. I only realized the significance of the approach after questioning the formulation of Eq. (1-1) and (1-2) and conducting my own research. The authors should provide a much clearer and more detailed explanation of the Hamiltonian (variational) method and explicitly highlight how it differs from conventional deterministic SEB modelling approaches. Strengthening this discussion would better justify its use and emphasize the novelty of the study.

Response: We sincerely appreciate your suggestion regarding the Hamiltonian approach. In response, we have substantially expanded the Introduction and Section2.1 to provide a more detailed explanation of the assumption of Hamiltonian's principle and theoretical foundations of the original NP methods, the limitations in the original NP method, as well as the improvement of the SFE-NP method. In the revised manuscript, we also upload supplements (Appendix A and B) to include the derivation of each parameter followed the Hamilton's principle, and we hope this revision can enhance the clarity of independent of resistance parameterization.

a. Introduction:

"Evaporation is the phase change process where water molecules transition from liquid to vapor, and thermal driving is the primary mechanism governing terrestrial evaporation. Hamilton's principle offers a physical insight into the macro-state processes to mechanics and describe

thermodynamics. The original nonparametric (NP) method is based on the Hamiltonian principle that terrestrial ET follows in the macroscopic state, with surface temperature as a generalized coordinate of the Hamiltonian, and combining with the equilibrium ET (Liu et al., 2012), the original NP method is in a simple analytical form without parameterization of aerodynamic resistances. To address NP method's applicability in arid areas, the surface flux equilibrium (SFE) with relative humidity was introduced to develop the SFE-NP method (Pan et al., 2024)." (Line 74-82)

b. Section2.1:

"According to Hamilton's principle, net radiation (R_n) represents the potential energy in a macro-state system, while soil heat flux (G_s), latent heat flux (LE), and sensible heat flux (H_s) collectively constitute the kinetic energy. In a macro-state system, terrestrial ET can be treated as a mechanical and thermodynamic process following Hamilton's principle, and temperature (T_s) is an intensive thermodynamic indicator of a macro-state system. By adopting T_s as generalized coordinate within the Hamiltonian system and incorporating equilibrium evaporation, the original NP method expresses LE as a function of R_n, G_s, T_s and air temperature (T_a), which eliminates the need for parameterizing resistance terms (Liu et al., 2012)" (Line 97-104)

"The application of the NP method in remote sensing retrieval has shown high accuracy in humid regions, however, its effectiveness appears to be limited in arid regions (Hsieh et al., 2022; Yang et al., 2016). The primary limitation is that the conventional equilibrium ET employed in the original NP method is limited to the wet situation and loss the applicability to arid region. To address this limitation, the SFE-NP method has been introduced by replacing the conventional equilibrium ET with an equilibrium ET estimation based on the relative humidity (RH) budget, aiming to enhance ET estimation from unsaturated surfaces (Pan et al., 2024)." (Line 108-114)

2.) Further thinking/justification of the surface partitioning constraint:

The function, ln(Ts/Ta), that is in both Eq. (1-1) and (1-2) would seem to me to be very insensitive to change within a realistic range of naturally occurring terrestrial land surface and air temperatures. I feel like it would, thus, fail to effectively scale energy partitioning. For example, when I calculate the output for temperatures in Kelvin for a few realistic terrestrial temperature examples, I get:

- Ts = 308.15 K (35°C), Ta = 298.15 K (25°C) → ln(Ts/Ta) ≈ 0.033
- Ts = 288.15 K (15°C), Ta = 298.15 K (25°C) → ln(Ts/Ta) ≈ -0.034

As can be seen from the two examples above, the function's output is very small. The reason for this is that if the temperatures are in Kelvin, then the difference between Ts and Ta is relatively very small compared to either of Ts or Ta, resulting in values only negligibly different from unity. When the ln is taken of values near one, they are always small. This would, subsequently make it behave almost linearly and prevent the function from capturing the expected nonlinear shift in energy partitioning from latent heat to sensible heat as the surface dries. Additionally, if temperatures are expressed in degrees Celsius, the function becomes physically invalid, as it involves taking the logarithm of a ratio that can include negative values or be divided by zero. These issues suggest to me that ln(Ts/Ta) is not a suitable scaling function for partitioning surface energy fluxes within the Hamiltonian framework. Apologies if I've got this wrong. I'd appreciate to hear from the authors specifically if I've made a mistake in my interpretation. If I am right, then at the very best, this function is doing almost nothing to partition the sensible and latent heat fluxes. The authors may be better off looking into a more appropriate function of Ts and Ta, which might improve the partitioning of latent and sensible heat fluxes. If this function has nearly no impact on the model, then what does it say about the reason the model outputs very reasonable ET estimates? Is it because the ERA5 data are doing most of the work? I discuss this more below.

Response: Thank you very much for your feedback on the NP method. Our response according to these comments contains three aspects:

(1) The NP method was derived based on both the Hamilton's principle and the conventional equilibrium ET. When T_s serves as a generalized coordinate of the system, we can obtain Eq. A4, and obviously we can have $\partial(G_s + H + LE + R_n)/\partial T_s = 0$. Among them, the partial derivative of R_n with respect to T_s is $\frac{\partial R_n}{\partial T_s} = -4\varepsilon\sigma T_s^3$. The partial derivative of LE with respect to T_s is $\partial LE/\partial T_s = 0$ (Wang et al., 2004; Wang et al., 2007) . According to the Lagrangian multiplier method, and the energy conservation equation and Fourier's law, further incorporating $\partial G_s/\partial T_s = G_s/T_s$ (Magyari et al., 1999). Consequently, we can obtain the partial derivation of H to T_s as Eq. A5, and when $T_s > 0$, $\partial H/\partial T_s$ is evidently a continuous function which can be expressed as Eq. A6 (where H_{T_0} is the heat flux referenced to surrounding environment when $T_s = T_0$). Integrating from T_0 to T_s, we can obtain Eq. A7. Consequently, the logarithmic term $ln(T_s/T_a)$ is not chosen as a scaling function, but a term from the derivation and integrating of G_s. And details of derivation are included in the supplement (Appendix A) and research papers of the original NP and SFE-NP method (Liu et al., 2012, Pan et al., 2024).

$$\frac{\partial HA}{\partial T_s} = \frac{\partial\left(\int_{t_1}^{t_1}\int_A (G_s+H+LE+R_n)dAdt\right)}{\partial T_s} = 0, \tag{A4}$$

$$\frac{\partial H}{\partial T_s} = 4\varepsilon\sigma T_s^3 - \frac{G_s}{T_s}, \tag{A5}$$

$$\int_{T_0}^{T_s}\frac{\partial H}{\partial T_s}dT_s = H_{T_s} - H_{T_0}, \tag{A6}$$

$$H_{T_s} = H_{T_0} + \varepsilon\sigma(T_s^4 - T_0^4) - G_s ln\left(\frac{T_s}{T_0}\right), \tag{A7}$$

(2) The land surface temperature and air temperature are in Kelvin in this paper. In addition, Hsieh had conducted the validation of the three terms in NP method (Hsieh et al., 2022), and indicated that the first term $\frac{\Delta}{\Delta+\gamma}(R_n - G_s)$ is the major component contributes to LE, the second term $\varepsilon_s\sigma\left({T_s}^4 - {T_a}^4\right)$ accounts about ±10%, and the third term $G_s ln\left(\frac{T_s}{T_0}\right)$ is close to zero. Therefore, no matter the unit of temperature is K or C°, the Ts/T0 affected the ET insignificantly. In addition, prior to the development of the proposed RSNP model, which utilizes GLASS and ERA5-Land data as inputs, the NP method had already been successfully applied with Moderate Resolution Imaging Spectroradiometer (MODIS) and China Meteorological Administration Land Data Assimilation System (CLDAS) in the Lower Mekong River basin and the Poyang Lake basins. The selection of ERA5-Land data for current study was driven by its global coverage and comprehensive inclusion of relevant parameters.

(3) Since the first term of NP method accounts for the majority of the LE results, the improvements to the non-parametric approaches based on Hamiltonian principles and equilibrium evapotranspiration primarily focus on refining the first term. For instance, the SFE-NP approach

introduces an equilibrium state based on relative humidity to enhance its applicability over non-saturated underlying surfaces (Pan et.al, 2024). We will also continue to explore the improvement of the accuracy of NP method in the future.

Reference:
Hsieh, C.-I., Chiu, C.-J., Huang, I.-H., and Kiely, G.: Estimation of Latent Heat Flux Using a Non-Parametric Method, Water, 14, 3474, http://doi.org/10.3390/w14213474, 2022.
Pan, X., Yang, Z., Liu, Y., Yuan, J., Wang, Z., Liu, S., and Yang, Y.: A non-parametric method combined with surface flux equilibrium for estimating terrestrial evapotranspiration: Validation at eddy covariance sites, J. Hydrol., 631, 130682, http://doi.org/10.1016/j.jhydrol.2024.130682, 2024.

3.) Justification for a New Global ET Model:
One of the key questions that arises is whether a new global ET model is truly needed, particularly given that the proposed dataset appears to perform similarly to existing models. The primary stated advantage of the dataset is that it is gap-free, but this claim is not inherently compelling, as the seamless nature of the data appears to be a result of gap-filling through averaging rather than a fundamentally new methodological breakthrough. The authors should clarify what specific advancements their approach offers beyond convenience, particularly in relation to existing global ET datasets. After a very quick web search I found several existing global datasets, see below. The list of datasets in not intended to be comprehensive. The authors should, in my opinion, include a more comprehensive summary of the current global ET datasets and then justify the need for a new one. A table that summarises the available datasets and classifies them into groups by some relevant criteria would be very helpful.

- Global land surface evapotranspiration monitoring by ETMonitor model driven by multi-source satellite earth observations https://www.sciencedirect.com/science/article/pii/S0022169422010149
- A global dataset of terrestrial evapotranspiration and soil moisture dynamics from 1982 to 2020 https://www.nature.com/articles/s41597-024-03271-7
- On the divergence of potential and actual evapotranspiration trends: An assessment across alternate global datasets https://doi.org/10.1002/2016EF000499
- A global terrestrial evapotranspiration product based on the three-temperature model with fewer input parameters and no calibration requirement Earth Syst. Sci. Data, 14, 3673–3693, 2022 https://doi.org/10.5194/essd-14-3673-2022
- A Comprehensive Evaluation of Five Evapotranspiration Datasets Based on Ground and GRACE Satellite Observations: Implications for Improvement of Evapotranspiration Retrieval Algorithm https://www.mdpi.com/2072-4292/13/12/2414
- Multi-scale evaluation of global evapotranspiration products derived from remote sensing images: Accuracy and uncertainty https://www.sciencedirect.com/science/article/pii/S0022169422005571
- Global Evapotranspiration Datasets Assessment Using Water Balance in South America https://www.mdpi.com/2072-4292/14/11/2526
- GLEAM4 https://repository.kaust.edu.sa/items/0980d173-e356-48b9-9bae-19c81d830eb7

Response: We sincerely appreciate your thoughtful comments regarding the justification for our new global ET model. We have made below revisions to highlight the importance of our study regarding your valuable suggestions:

(1) We have carefully revised the manuscript to better highlight the necessity of establish the RSNP model, particularly its foundation in Hamiltonian principles that provide clear physical meaning to the derived ET estimates, which is a key distinction from existing datasets. Regarding the need for a new dataset, while many studies rely on multi-dataset integration, most input global ET datasets share similar basic methodology (e.g., PM method, PT method, and surface energy balance residual method) that may introduce correlated systematic errors. Our physics-based RSNP global ET dataset offers an independent alternative that could help mitigate such issues in future synthesis studies. The relative statements are as follows:

"By evaluating 25 global ET datasets with site observations and their spatial patterns. Tang et.al refer that ET dataset produced based on similar algorithms tend to have high consistency in annual magnitude and spatial distribution (Tang et al., 2024). Therefore, developing a global ET dataset based on well-defined physical mechanisms remains a critical need in ET research. Moreover, integrating datasets with reliable accuracy and clear physical significance can enhance the robustness of analytical results in global data synthesis." (Line 68-73)

(2) We have cited researches which have already compared existing global ET products, and theses reference could provide a much comprehensive intercomparison of global ET datasets (Zheng et al., 2019; Cheng et al., 2020; Elnashar et al., 2021; Ma and Zhang, 2022; Liu et al., 2023; Tang et al., 2024) (Line54-59). In addition, we have also added a table to summarize typical published global ET datasets (Appendix C. Table 1), including eight remote sensing datasets, two reanalysis datasets, two ensembled datasets, and one machine learning dataset. In addition, we have added GLEAM and ERA5-Land ET dataset for comparison according to your valuable suggestions. We hope these revisions could address the importance of proposing the RSNP model for global ET estimation.

Table S1 Summary of typical global ET datasets.

Type	ET Datasets	Time span	Spatial/Temporal resolution	Method	Reference
Remote sensing dataset	BESS	2001-2015	1km/8-day	Breathing Earth System Simulator process model	(Jiang and Ryu, 2016; Ryu et al., 2011)
	PML-V2	2002-2019	0.5 km/daily	PML model coupled with gross primary products via canopy conductance theory	(Zhang et al., 2019)
	PEW	1982-2018	0.1°/monthly	PT-JPL algorithm considering available water capacity	(Fu et al., 2022)
	GLEAM4	1980-2023	0.1°/daily	GLEAM model	(Miralles et al., 2025)
	VISEA	2001-2024	0.05°/daily	Variation of the Standard Evapotranspiration Algorithm	(Huang et al., 2024)

	ETMonitor	2000-2021	1 km/monthly	Estimating ET components with a multi-process parameterization model	(Zheng et al., 2022)
	3T	2000–2020	0.25°/daily	The Three-temperature Mode	(Yu et al., 2022)
	SSEBop	2003-now	1km/monthly	Simplified Surface Energy Balance model	(Senay et al., 2020)
Reanalysis dataset	ERA5-Land	1950-now	0.1°/monthly	Hydrology-Tiled ECMWF Scheme for Surface Exchanges over Land (H-TESSEL)	(Muñoz-Sabater et al., 2021)
	GLDAS	2000-now	0.25°/monthly	GLDAS NOAH Land Surface model	(Rodell et al., 2004)
Ensembled datasets	Synthesized ET	1982-2019	1km/monthly	Ensemble the global ET products	(Elnashar et al., 2021)
	GLASS	1982-2018	1km/8-day	Bayesian model averaging method	(Yao et al., 2014)
Machine learning datasets	FLUXCOM	2001-2015	0.1°/monthly	Multiple machine learning methods	(Jung et al., 2019)

Refences:

Elnashar, A., Wang, L., Wu, B., Zhu, W., and Zeng, H.: Synthesis of global actual evapotranspiration from 1982 to 2019, Earth Syst. Sci. Data, 13, 447-480, http://doi.org/10.5194/essd-13-447-2021, 2021.

Jiang, C. and Ryu, Y.: Multi-scale evaluation of global gross primary productivity and evapotranspiration products derived from Breathing Earth System Simulator (BESS), Remote Sens. Environ., 186, 528-547, https://doi.org/10.1016/j.rse.2016.08.030, 2016.

Ryu, Y., Baldocchi, D. D., Kobayashi, H., Van Ingen, C., Li, J., Black, T. A., Beringer, J., Van Gorsel, E., Knohl, A., and Law, B. E.: Integration of MODIS land and atmosphere products with a coupled-process model to estimate gross primary productivity and evapotranspiration from 1 km to global scales, Global Biogeochem. Cycles, 25, https://doi.org/10.1029/2011GB004053, 2011.

Zhang, Y., Kong, D., Gan, R., Chiew, F. H., McVicar, T. R., Zhang, Q., and Yang, Y.: Coupled estimation of 500 m and 8-day resolution global evapotranspiration and gross primary production in 2002–2017, Remote Sens. Environ., 222, 165-182, http://doi.org/10.1016/j.rse.2018.12.031, 2019.

Fu, J., Wang, W., Shao, Q., Xing, W., Cao, M., Wei, J., Chen, Z., and Nie, W.: Improved global evapotranspiration estimates using proportionality hypothesis-based water balance constraints, Remote Sens. Environ., 279, 113140, http://doi.org/10.1016/j.rse.2022.113140, 2022.

Miralles, D. G., Bonte, O., Koppa, A., Baez-Villanueva, O. M., Tronquo, E., Zhong, F., Beck, H. E., Hulsman, P., Dorigo, W., and Verhoest, N. E. C.: GLEAM4: global land evaporation and soil moisture dataset at 0.1 resolution from 1980 to near present, Sci. Data, 12, 1-14, https://doi.org/10.1038/s41597-025-04610-y, 2025

Huang, L., Luo, Y., Chen, J. M., Tang, Q., Steenhuis, T., Cheng, W., and Shi, W.: Satellite-based near-real-time global daily terrestrial evapotranspiration estimates, Earth Syst. Sci. Data Discuss., 2024, 1-37, https://doi.org/10.5194/essd-16-3993-2024, 2024.

Zheng, C., Jia, L., and Hu, G.: Global land surface evapotranspiration monitoring by ETMonitor model driven by multi-source satellite earth observations, J. Hydrol., 613, 128444, https://doi.org/10.1016/j.jhydrol.2022.128444, 2022.

Yu, L., Qiu, G. Y., Yan, C., Zhao, W., Zou, Z., Ding, J., Qin, L., and Xiong, Y.: A global terrestrial evapotranspiration product based on the three-temperature model with fewer input parameters and no calibration requirement, Earth Syst. Sci. Data Discuss., 2022, 1-33, https://doi.org/10.5194/essd-14-3673-2022, 2022.

Senay, G. B., Kagone, S., and Velpuri, N. M.: Operational global actual evapotranspiration: Development, evaluation, and dissemination, Sensors, 20, 1915, https://doi.org/10.3390/s20071915, 2020.

Muñoz-Sabater, J., Dutra, E., Agustí-Panareda, A., Albergel, C., Arduini, G., Balsamo, G., Boussetta, S., Choulga, M., Harrigan, S., and Hersbach, H.: ERA5-Land: A state-of-the-art global reanalysis dataset for land applications, Earth Syst. Sci. Data, 13, 4349-4383, 2021.

Rodell, M., Famiglietti, J., Chen, J., Seneviratne, S., Viterbo, P., Holl, S., and Wilson, C.: Basin scale estimates of evapotranspiration using GRACE and other observations, Geophys. Res. Lett., 31, https://doi.org/10.1029/2004GL020873, 2004.

Yao, Y., Liang, S., Li, X., Hong, Y., Fisher, J. B., Zhang, N., Chen, J., Cheng, J., Zhao, S., and Zhang, X.: Bayesian multimodel estimation of global terrestrial latent heat flux from eddy covariance, meteorological, and satellite observations, Journal of Geophysical Research: Atmospheres, 119, 4521-4545, https://doi.org/10.1002/2013JD020864, 2014.

Jung, M., Koirala, S., Weber, U., Ichii, K., Gans, F., Camps-Valls, G., Papale, D., Schwalm, C., Tramontana, G., and Reichstein, M.: The FLUXCOM ensemble of global land-atmosphere energy fluxes, Sci. Data, 6, 74, https://doi.org/10.1038/s41597-019-0076-8, 2019.

4.) Unclear Justification for Chosen Comparison Datasets:

Following on from the previous comment, the study evaluates their ET dataset against three other global products, but the rationale for selecting these particular datasets is not provided. The omission of GLEAM, which is a widely used and well-validated ET dataset, is notable. The authors should justify their dataset choices of evaluation datasets —do they represent distinct modelling approaches or different data sources? Establishing a clear logic for dataset selection is necessary to ensure that the validation is robust and meaningful. A clear justification of the global ET dataset comparison would strengthen the study and make its need and value more obvious.

Response: We sincerely appreciate your insightful suggestion regarding the rationale for dataset selection. We have added the widely used and well-validated GLEAM ET product for comparison according to your suggestion, which could strengthen the robustness of our validation. The introduction of GLEAM ET datasets and its validation results have been added into the revised manuscript. And there are revisions we made with this comment. The scatter plot of validated sites at the site scale showed RSNP (R2=0.65, RMSE=23.19mm/month, bias=-3.81mm/month) has comparable accuracy with GLEAM (R2=0.66, RMSE=22.70mm/month, bias=-3.06mm/month). The validation results at the basin scale demonstrate that RSNP exhibits a higher coefficient of determination and lower error (R2=0.89, RMSE=113.04 mm/yr, RE=0.16) when compared to GLEAM (R2=0.84, RMSE=129.63 mm/yr, RE=0.17) in relation to water-balanced ET (WBET).

The results suggest that the RSNP ET dataset may offer greater accuracy than the GLEAM ET dataset for regional studies, and RSNP is response for regional hydrology studies. To further clarify our dataset selection, we note that the evaluated ET products represent distinct algorithmic approaches: *"Among them, ETMonitor and PML-V2 developed from the PM algorithm, PEW and GLEAM are based on the Priestly-Taylor (PT) algorithm, and ERA5-Land is a reanalysis dataset derived from land surface model."*. Additionally, in Section2.3.3, we have expanded on basic algorithms of each dataset to facilitate clearer evaluation. The varying spatial resolutions among the datasets are also for their comparability. The differing spatial resolutions among the datasets also affect their comparability.

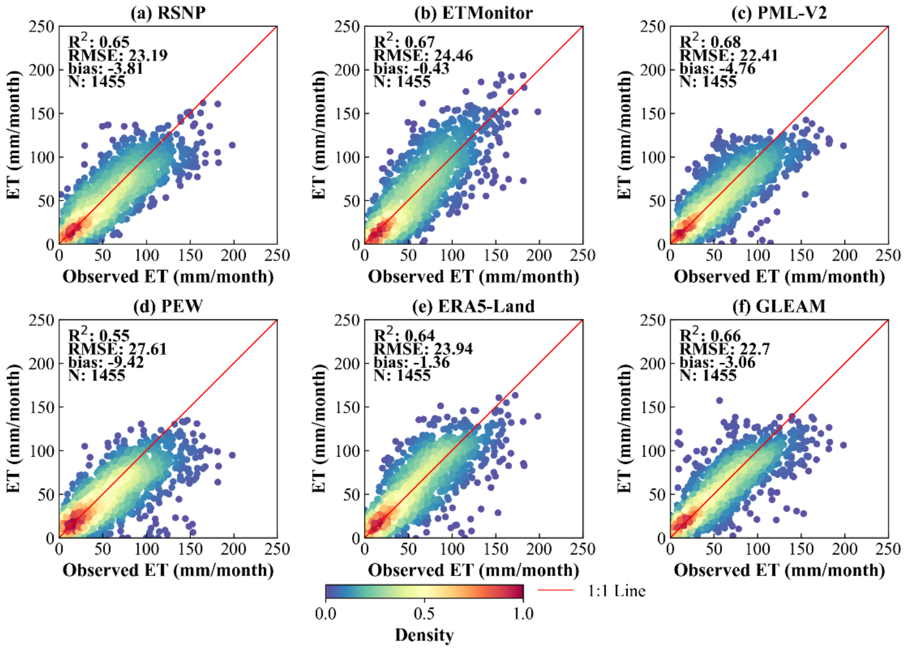

Figure 4: Comparison of estimated ET and observed ET over FLUXNET2015 sites. The relative mean square error (RMSE) and the bias are both in mm/month.

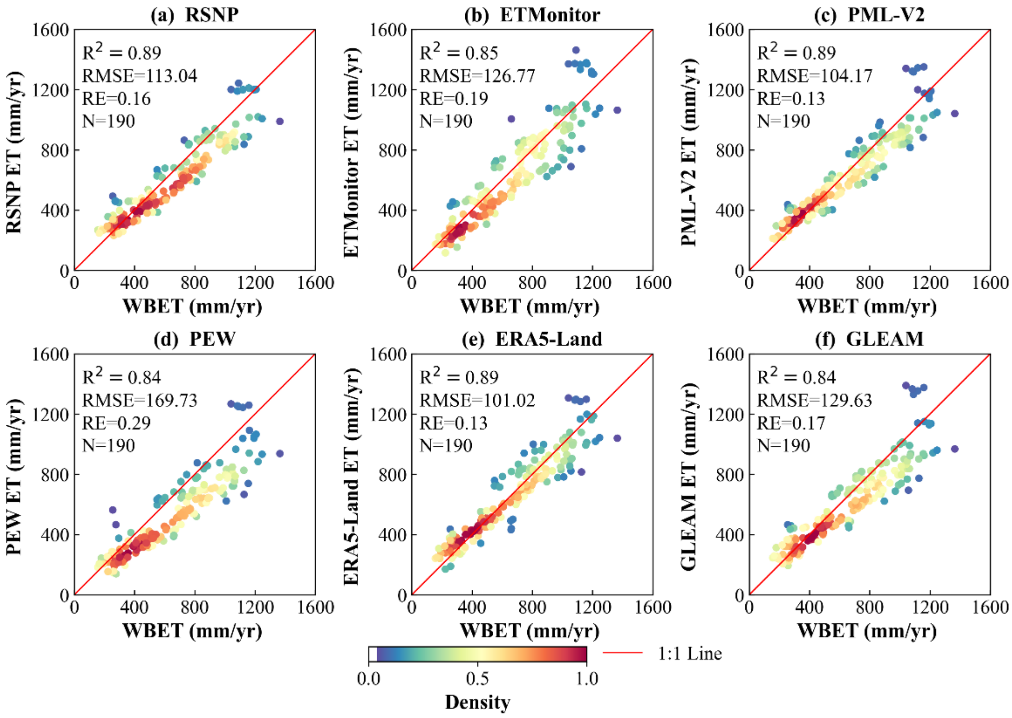

Figure 6: Comparison of estimated ET and WBET over 38 basins. The relative mean square error (RMSE) and bias are both in mm/yr.

5.) Heavy Reliance on ERA5 Reanalysis Data:

The model's substantial dependence on ERA5 reanalysis data is a concern, as it suggests that the ET estimates may be heavily influenced by the input data rather than providing a new contribution to the scientific community. Additionally, ERA5-Land already provides a latent heat flux product, which raises an important question: How different is the new model's ET output from ERA5's latent heat flux? A direct comparison between the study's ET dataset and ERA5's latent heat flux should be included to assess the degree of similarity and potential redundancy.

Response: We sincerely appreciate your insightful comment regarding the model's reliance on ERA5 reanalysis data and the need to clarify its added value compared to ERA5-Land's latent heat flux product. This study primarily focuses on global terrestrial ET estimation using the NP methods, which eliminates the need for resistance parameterization. The NP methods require land surface temperature, air temperature, net radiation, soil heat flux, and relative humidity as inputs. At the global scale, ERA5-Land provides seamless long-term observations of key meteorological variables (e.g., land surface temperature, air temperature, dew point temperature) and has been widely validated as a reliable data source for driving ET models in numerous studies (Huang et al., 2024). However, as you rightly pointed out, since the RSNP model relies heavily on ERA5-Land-derived input parameters, and given that ERA5-Land's ET product itself is generated through the ECMWF land surface model. In the revised manuscript, we have added ERA5-Land ET to the comparison dataset.

(1) We added the ERA5-Land to the validation and comparison: The revise scatter plot of model validation shows that RSNP has a more concentrated scatter density distribution than ERA5-Land, especially less underestimations (Fig.4). For different land covers, RSNP shows higher in situ accuracy than ERA5-Land for vegetated land covers, and the accuracy improvement at

the wetland sites is significant, with RMSE reducing from 65.21 mm/month to 20.6 mm/month (Fig.5). At the basin scale, statistical comparisons reveal that RSNP's RMSE, bias and R^2 values fall within similar ranges as other global ET products, suggesting equivalent capability in capturing ET dynamics at the basin scale.

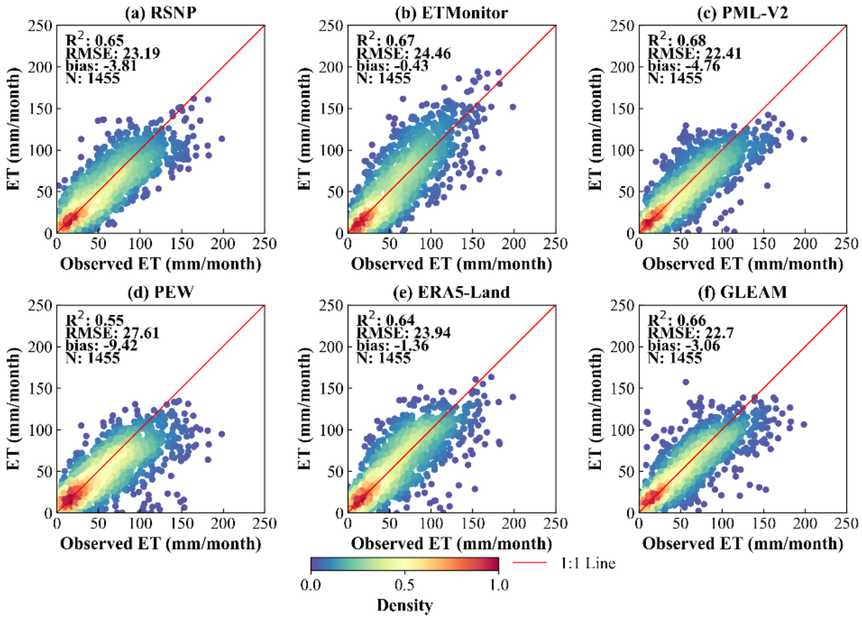

Figure 4: Comparison of estimated ET and observed ET over FLUXNET2015 sites. The relative mean square error (RMSE) and the bias are both in mm/month.

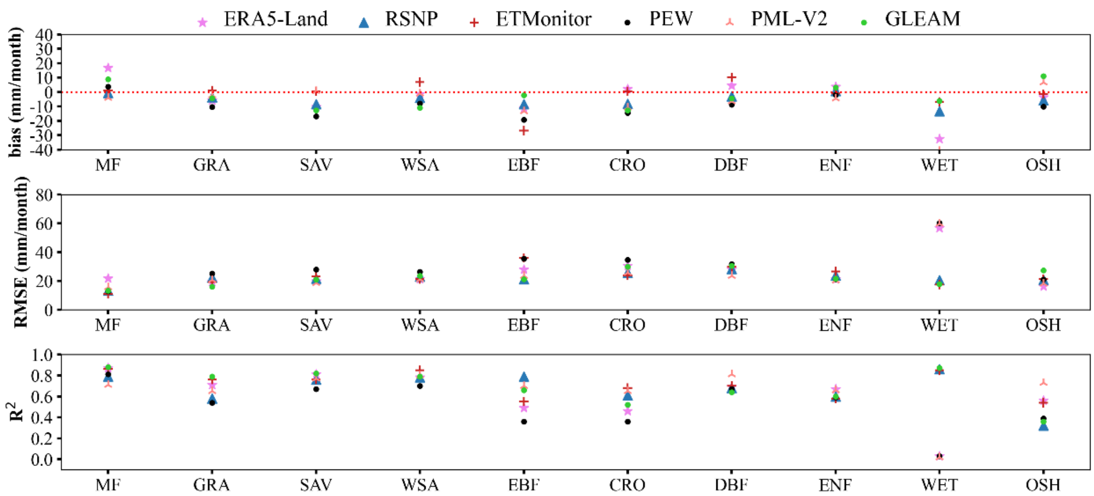

Figure 5: Comparison of estimated ET and observed ET over FLUXNET2015 sites at ten types of land covers, including MF (Mixed Forest), GRA (Grassland), SAV (Savanna), WSA (Woody Savanna), EBF (Evergreen Broadleaf Forest), CRO (Cropland), DBF (Deciduous Broadleaf Forest), ENF (Evergreen Needleleaf Forest), WET (Wetland), OSH (Open Shrublands). The relative mean square error (RMSE) and bias are both in mm/month.

(2) We added the ERA5-Land to the comparison of spatial distribution: Through spatial comparison of global ET datasets, we specifically incorporated an intercomparison between ERA5-Land and RSNP. Notably, despite sharing identical input parameters, their

fundamentally different algorithmic principles, which lead to distinct spatial patterns in estimated terrestrial ET. We have expanded the discussion with the comparison between RSNP and ERA5-Land at reginal scales, *"When compared to ERA5-Land ET dataset, which shares the same data sources and spatial resolution as the RSNP ET dataset, RSNP demonstrates superior capability of ET variations. For instance, in South America, ERA5-Land shows minimal spatial differentiation in ET between low and high vegetation areas, whereas RSNP successfully captures the gradual variation of ET, better reflecting the actual surface heterogeneity."* (Line381-385)

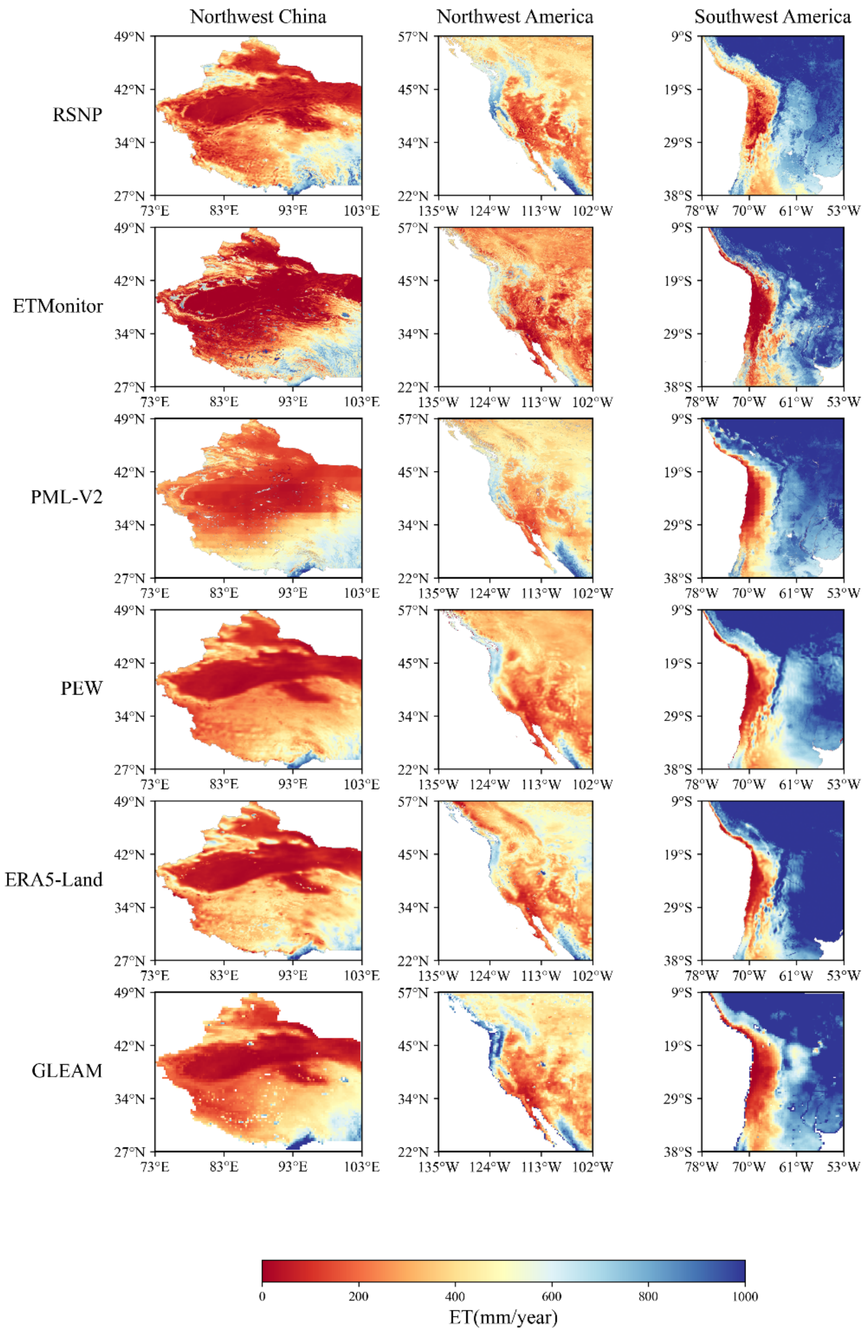

Figure 13: Spatial pattern of global ET datasets in typical regions in 2014. Columns from left to right: (a) Northwest China; (b) Northwest America; (c) Southwest America.

Reference:

Huang, L., Luo, Y., Chen, J. M., Tang, Q., Steenhuis, T., Cheng, W., and Shi, W.: Satellite-based near-real-time global daily terrestrial evapotranspiration estimates, Earth Syst. Sci. Data Discuss., 2024, 1-37, https://doi.org/10.5194/essd-16-3993-2024, 2024.

Minor comments

6.) Title: “Seamless” is probably not the right word for what you mean. Something like gap-free might be easier to immediately understand. I didn’t know what you meant by seamless until several pages into the document.’

Response: We sincerely appreciate your valuable suggestion of the word ‘gap-free’ to replace ‘seamless’, and the revised title is “A Gap-free Global Terrestrial Evapotranspiration Dataset Estimated by the Nonparametric Approach with Remote Sensing and Reanalysis Datasets”.

7.) Line 18: "hydrology cycle" → "hydrological cycle"

Response: Thank you very much for your careful reading and valuable suggestions. We have revised the manuscript according to your comments. We have changed "hydrology cycle" to "hydrological cycle" to ensure the accuracy and professionalism of the terminology. (Line 18)

8.) Line 35: "metrological" → "meteorological"

Response: Thank you very much for pointing out the grammar error of our writing. We have changed "hydrology cycle" to "hydrological cycle" to ensure the accuracy of the terminology. (Line 35)

9.) Line 61: "applicability and accuracy of them have not been incrementally improved" → "applicability and accuracy have not improved significantly"

Response: Thank you for your suggestion regarding the phrasing of this sentence. We sincerely appreciate your careful review and constructive feedback. However, since the original statement have not indicated the research gap between previous work and the proposed RSNP, we have revised this statement, thus the original statement has been removed. We thank you again for help us to improve English writing in our manuscript.

10.) Line 92: "access the accuracy of monthly ET retrieved by remote sensing method." → "assess the accuracy of monthly ET retrieved by the remote sensing method."

Response: Thank you very much for your detailed feedback. In the revised manuscript, we have reorganized the section of ‘Flux Tower Data’, and the sentence “access the accuracy of monthly ET retrieved by remote sensing method.” has been removed now. And we have changed the passive tense to active tense, the revised statement is “*The monthly in-situ EC observations used for evaluate RSNP model was from FLUNXET2015 (https://fluxnet.org/data/fluxnet2015-dataset/).*” (Line 173-175). If this expression still needs to be adjusted to a more professional form, we are pleased for your further suggestions.

11.) Line 116: "nearest-image resampling method." → "nearest-neighbor resampling method."

Response: Thank you for your insightful comments. We have changed "nearest-image resampling method" to "nearest-neighbor resampling method". Additionally, we have conducted a thorough review of the entire manuscript and have corrected all similar expressions to ensure consistency and accuracy throughout the text. We appreciate your attention to detail and are confident that these changes have improved the clarity and professionalism of our manuscript.

12.) Line 125: "regions(Hsieh et al., 2022; Yang et al., 2016)." → Missing space before citation.
13.) Line 137: "expressed as(Bisht et al., 2005)" → Missing space before citation

Response: (to both No.12 and No.13) Thank you for pointing out these formatting issues. We have carefully reviewed the manuscript and made corrections to ensure proper spacing before citations. We have also conducted a thorough review of the entire manuscript to ensure that all citations are formatted correctly with appropriate spacing. We appreciate your attention to detail and are confident that these changes have improved the overall quality and readability of our manuscript.

14.) Line 206: "valud" → "value"

Response: We sincerely thank you for pointing out these spelling errors. We have revised the word 'value'. (L245)

15.) Line 209 & 210: "retreival" → "retrieval"

Response: We sincerely thank you for pointing out these spelling errors. According to your comments, we have revised the word 'retrieval'. (L249) In addition, we have also conducted a thorough review of the entire manuscript to ensure that all similar errors have been corrected. We appreciate your attention to detail and are confident that these changes have improved the accuracy and readability of our manuscript.