

stoPET v1.0: A stochastic potential evapotranspiration generator for simulation of climate change impacts (Supplementary information)

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Nighttime PET analysis for selected locations in humid and arid regions

stoPET assumes the nighttime PET values to be zero. We assume this because the amount of PET during the night is very small, and it has little contribution in the crop or hydrological modeling. The nighttime PET amount is very small for humid regions compared to the daytime PET as it is shown in Fig. S1 by the PDF (nighttime PET median value is between -0.014- and 0.002-mm h⁻¹). Nighttime PET is more observed in Arid regions (Fig. S2) however, it is still small compared to the total daytime PET values (nighttime median value is between 0.001- and 0.076-mm h⁻¹) and the values also include negative PET indicating condensation.

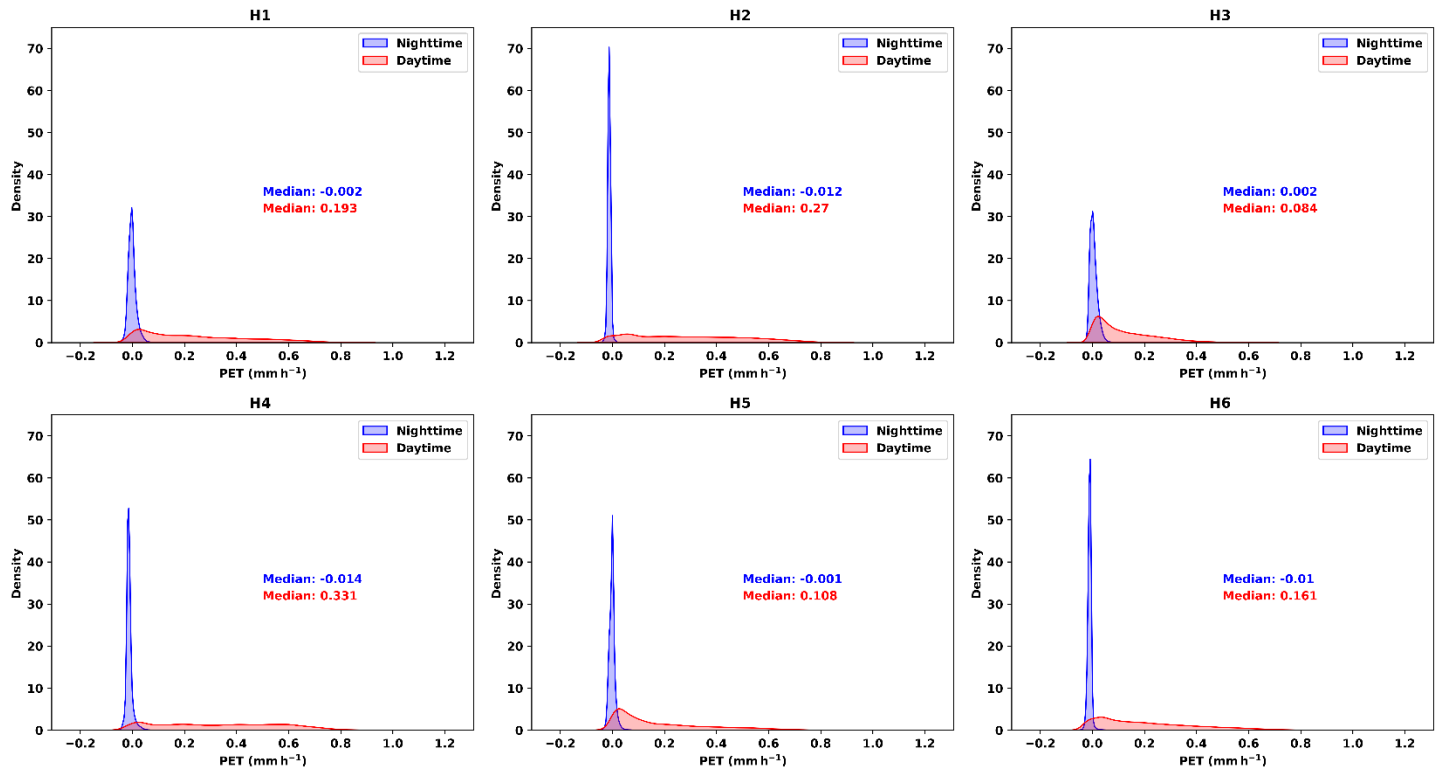


Figure S1: Probability density function for nighttime and daytime PET of the humid regions.

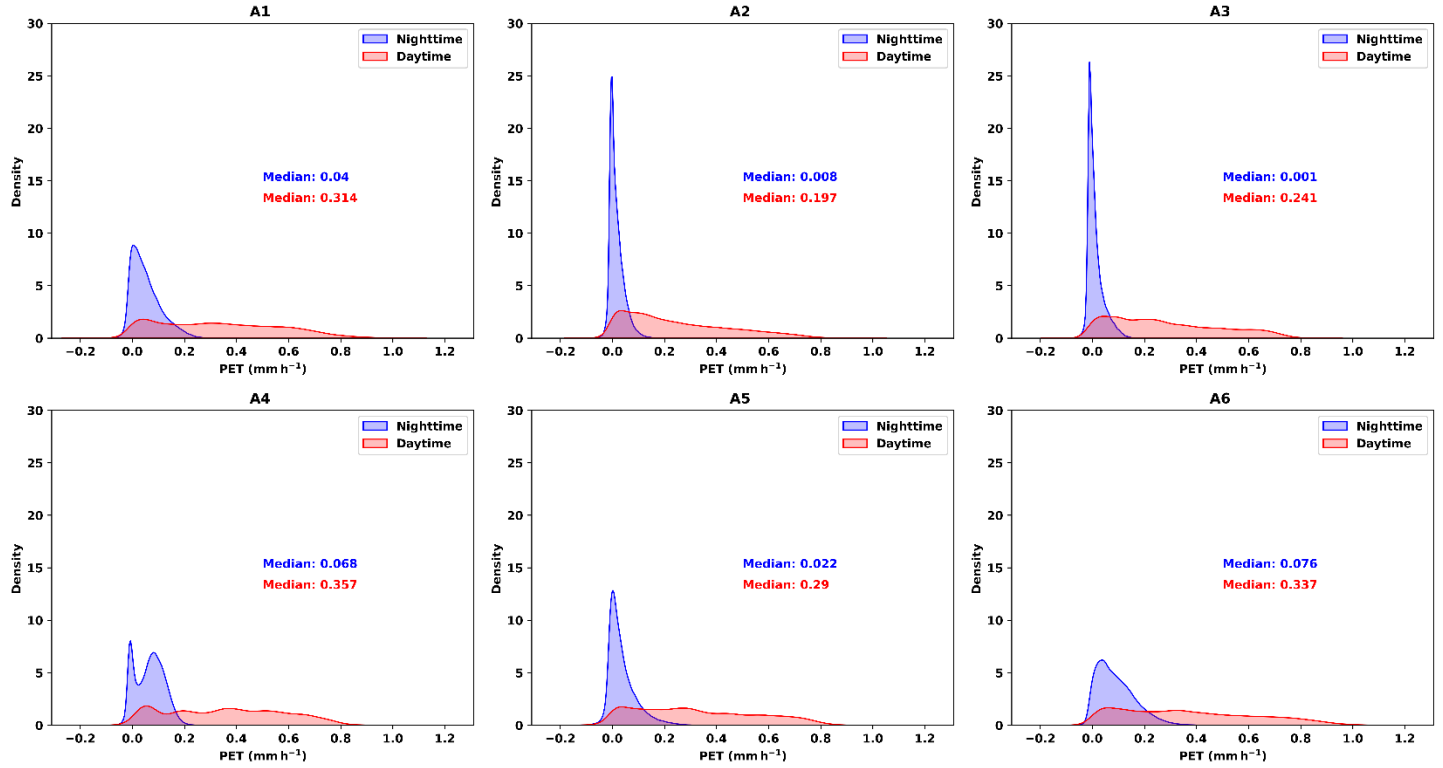


Figure S2: Probability density function for nighttime and daytime PET of the arid regions.

Regional comparison of stoPET with hPET (with nighttime PET removed)

The figures in this section show the comparison between the stoPET and hPET dataset, where the night-time PET is removed for six continental areas. We removed the nighttime PET values to make like-for-like comparisons, as the stoPET model considers nighttime PET to be zero. Figures S3, S4, S5, S6, S7 and S8 show that stoPET reproduces the hPET values well for all continents and regions across the globe, with the average annual PET being within a 5 % of difference margin compared to the hPET dataset (with nighttime PET removed).

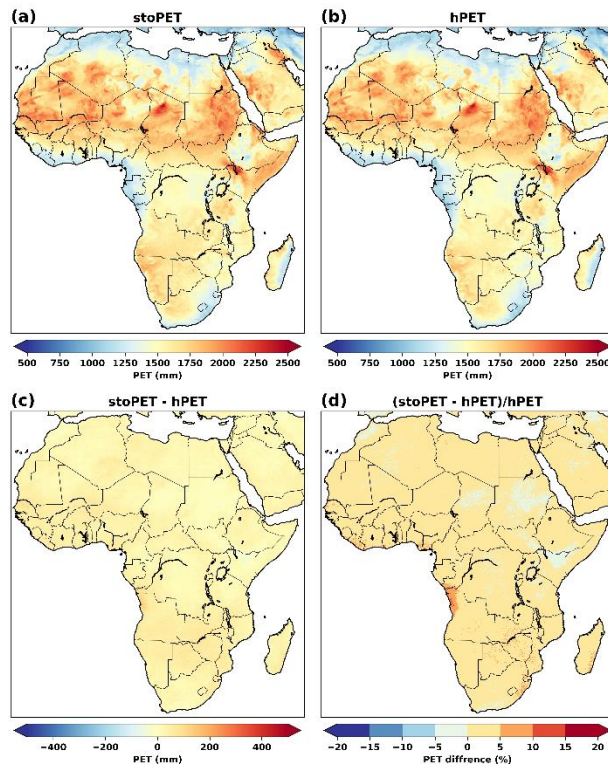


Figure S3: Average annual PET for five randomly selected years (a) stoPET, (b) hPET with night-time PET removed, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for Africa.

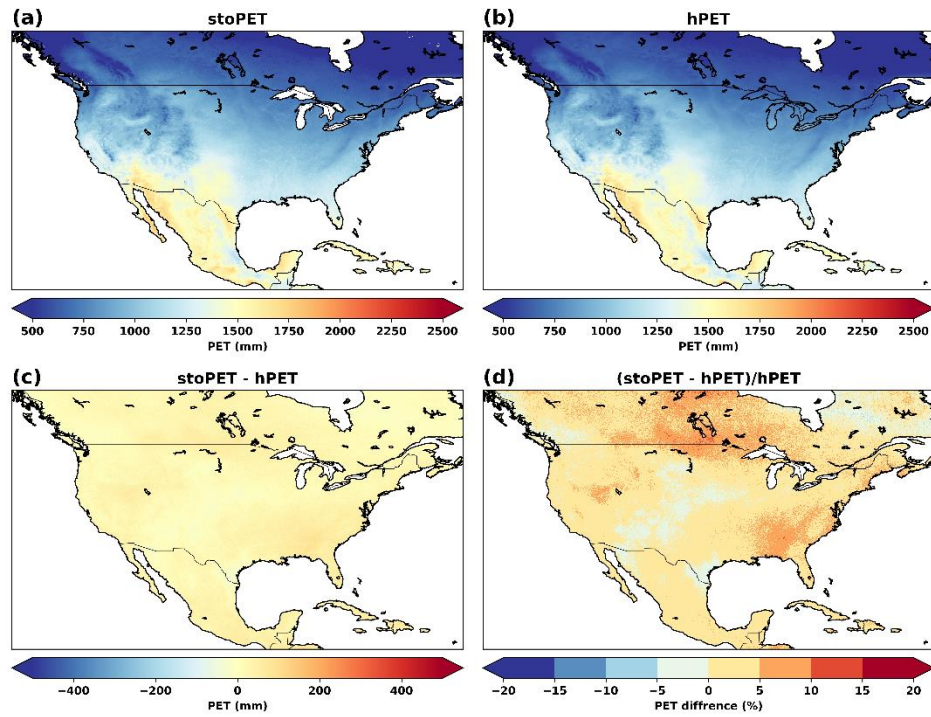


Figure S4: Average annual PET for five randomly selected years (a) stoPET, (b) hPET with night-time PET removed, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for North America

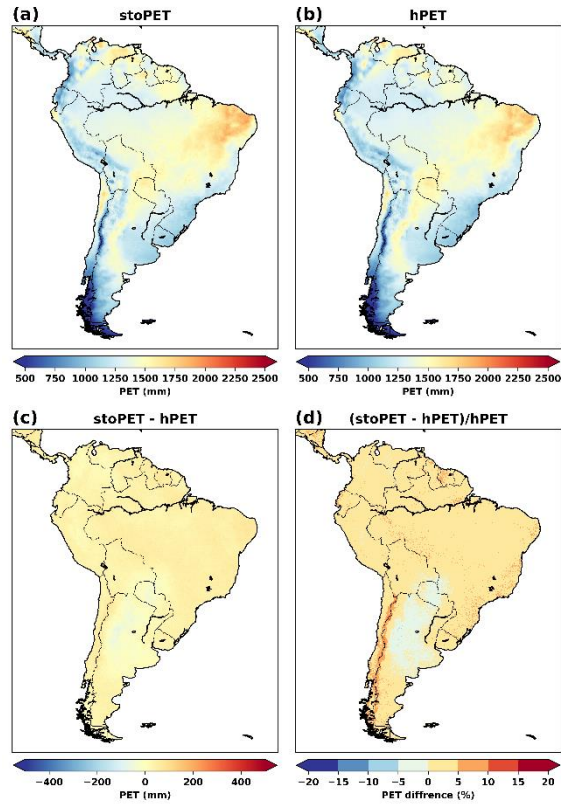


Figure S5: Average annual PET for five randomly selected years (a) stoPET, (b) hPET with night-time PET removed, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for South America.

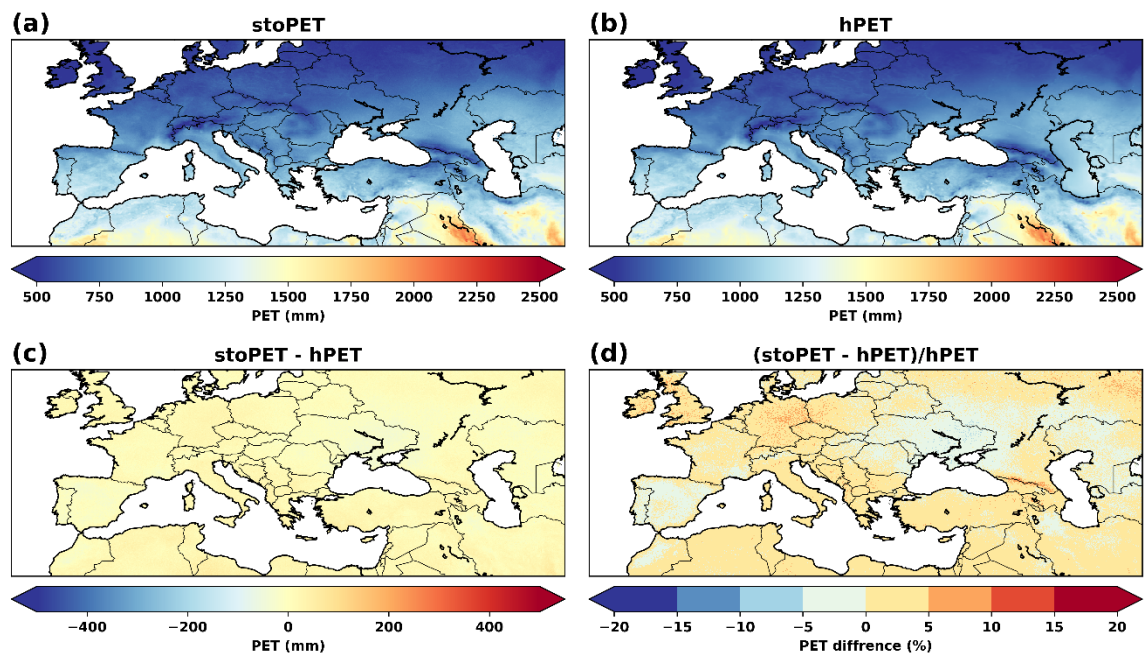


Figure S6: Average annual PET for five randomly selected years (a) stoPET, (b) hPET with night-time PET removed, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for Europe.

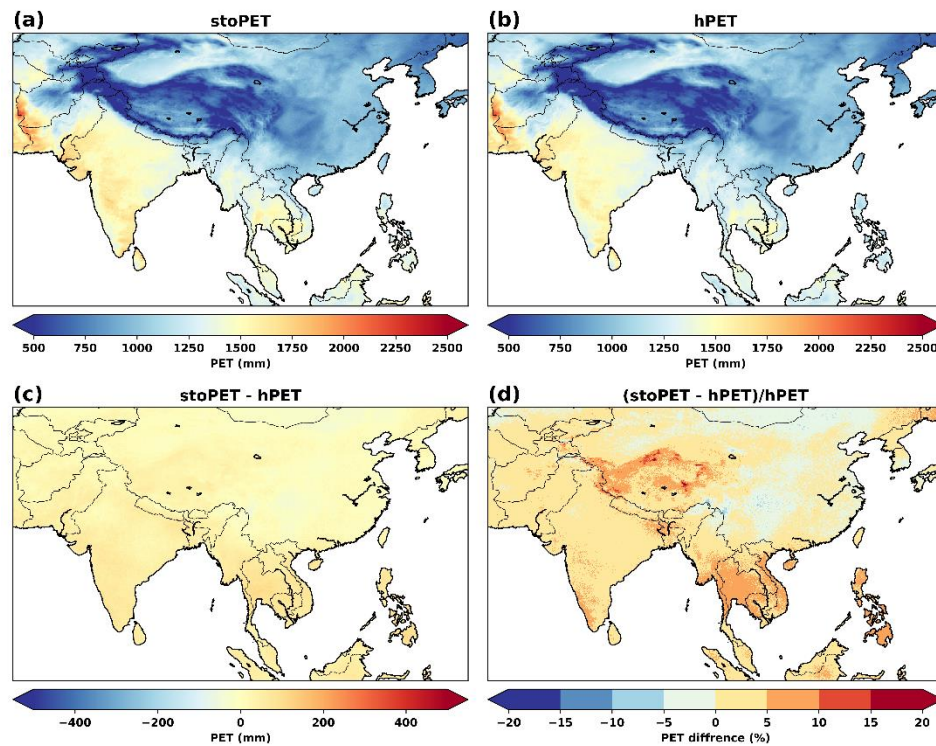


Figure S7: Average annual PET for five randomly selected years (a) stoPET, (b) hPET with night-time PET removed, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for Asia.

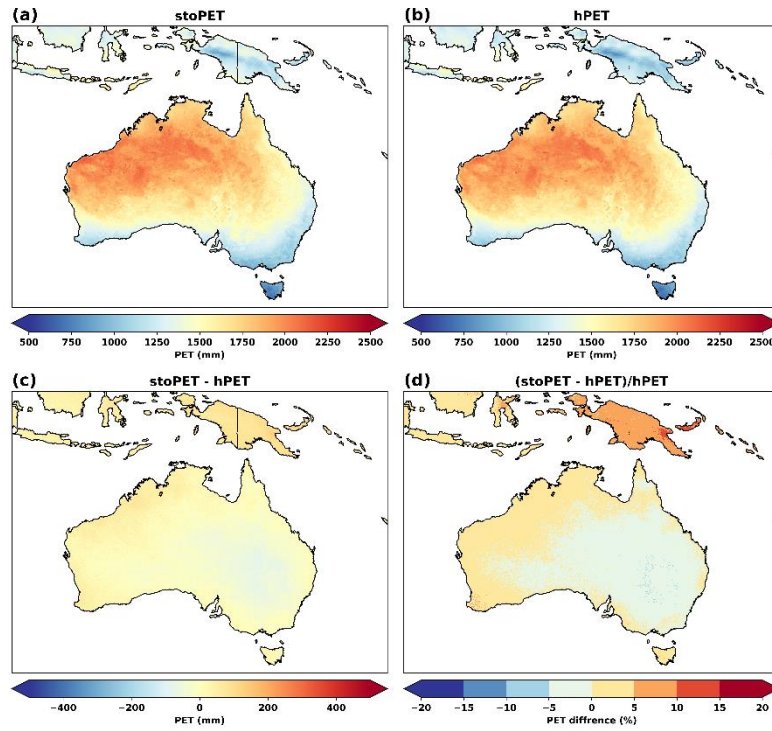


Figure S8: Average annual PET for five randomly selected years (a) stoPET, (b) hPET with night-time PET removed, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for Australia.

Regional comparison of stoPET with hPET (with nighttime PET included)

In this section we show the comparison between stoPET and the actual PET values from hPET. Figures S9, S10, S11, S12, S13 and S14 all indicate that stoPET underestimates the annual PET in arid regions compared to the hPET climatology. This is mainly a result of inclusion of nighttime hPET values above zero for these arid areas (Fig. S8 and Fig. S14). However, in the humid regions this nighttime hPET value is low (often below zero), so the differences between stoPET and hPET are minimal (Fig. S6 and Fig. S12).

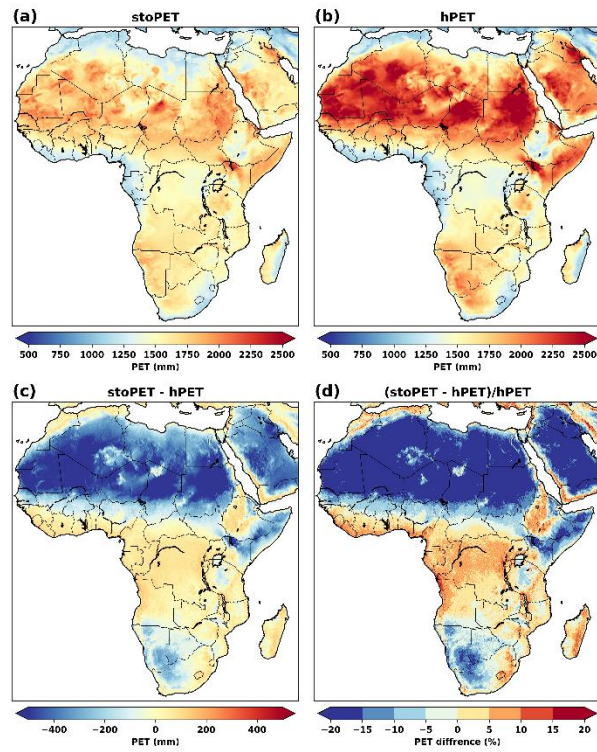


Figure S9: Average annual PET for five randomly selected years (a) stoPET, (b) hPET, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for Africa.

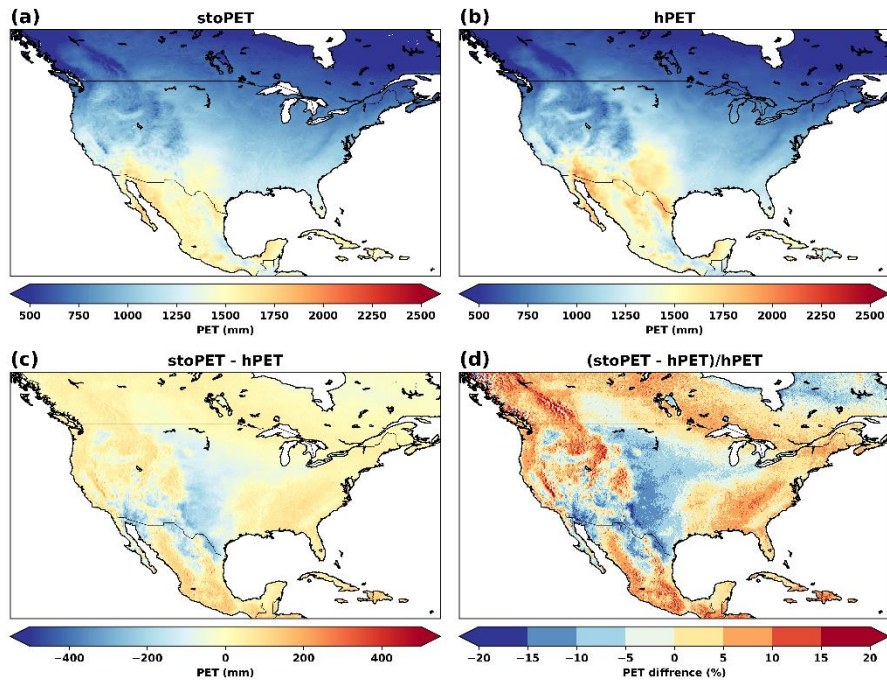


Figure S10: Average annual PET for five randomly selected years (a) stoPET, (b) hPET, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for North America.

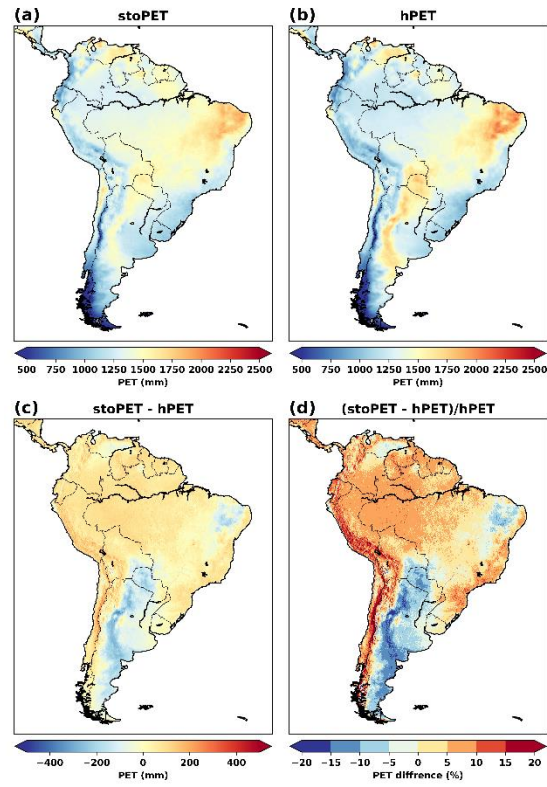


Figure S11: Average annual PET for five randomly selected years (a) stoPET, (b) hPET, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for South America.

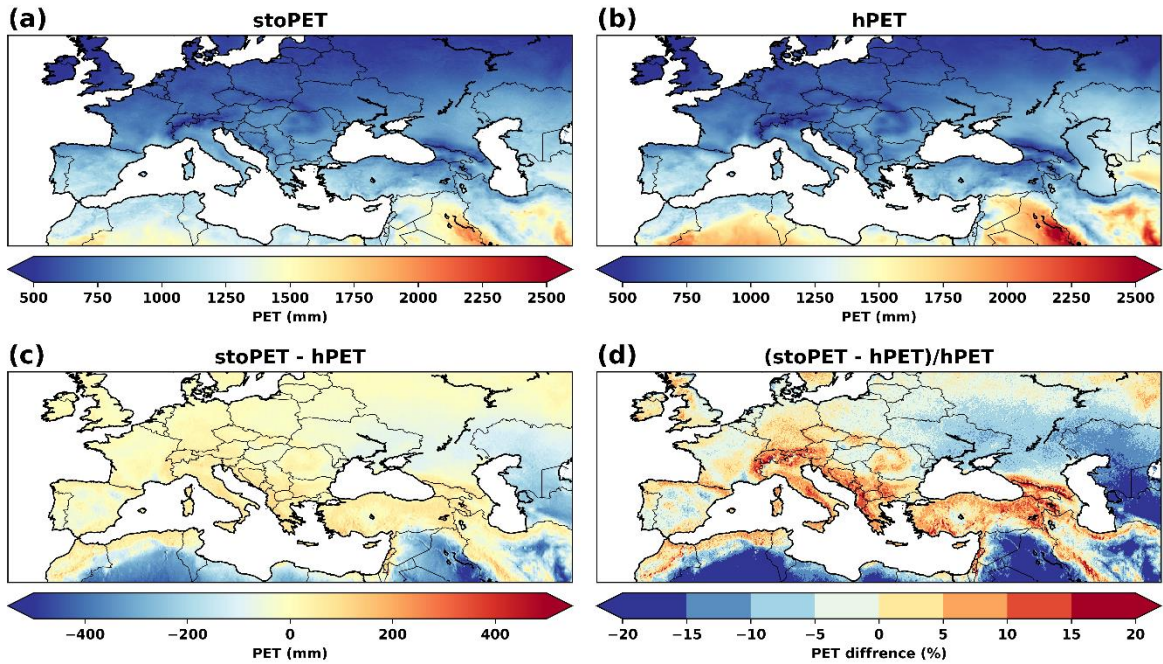


Figure S12: Average annual PET for five randomly selected years (a) stoPET, (b) hPET, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for Europe.

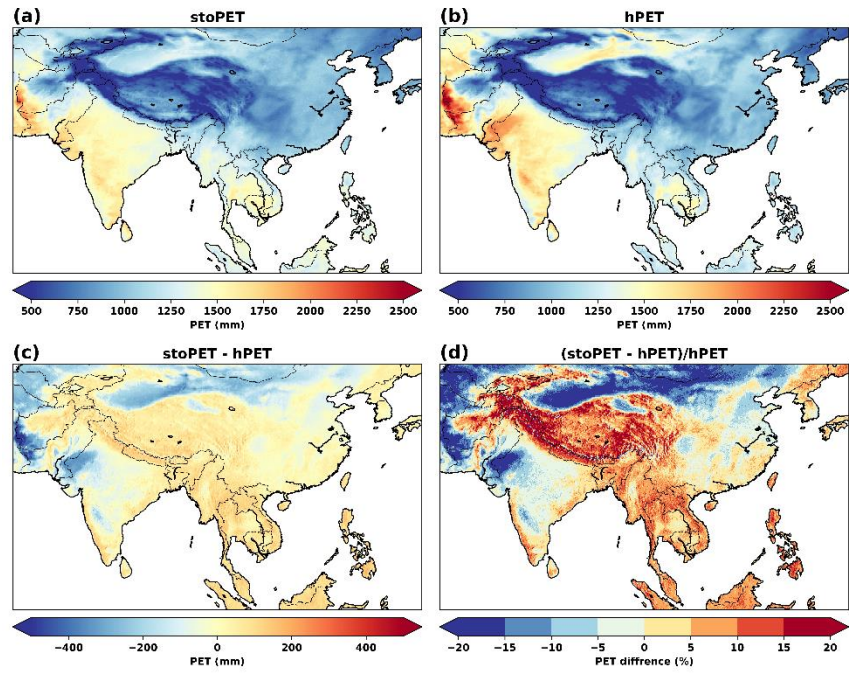


Figure S13: Average annual PET for five randomly selected years (a) stoPET, (b) hPET, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for Asia.

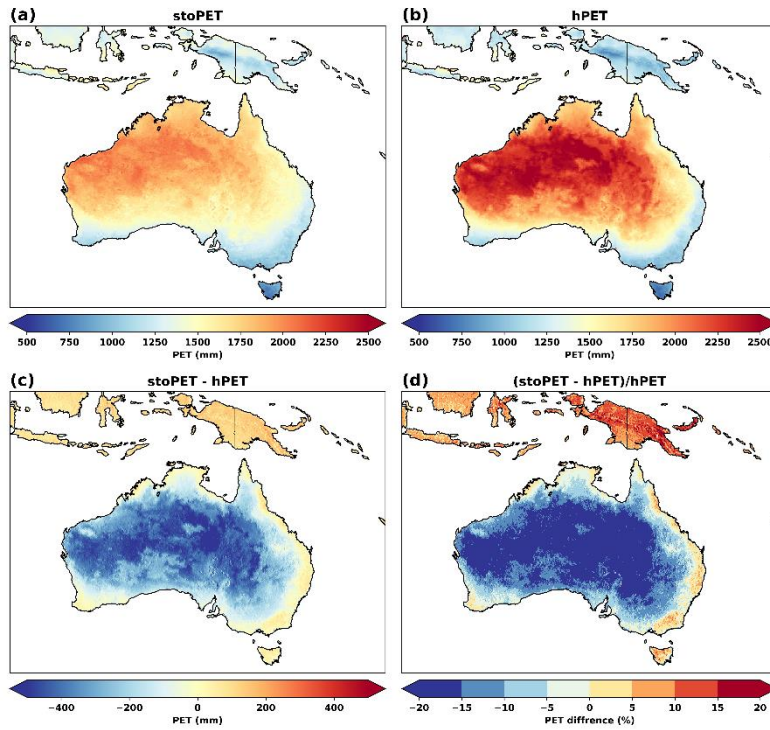


Figure S14: Average annual PET for five randomly selected years (a) stoPET, (b) hPET, (c) the difference between stoPET and hPET and (d) the percentage of the difference from the hPET for Australia.

Single point comparison of stoPET and hPET

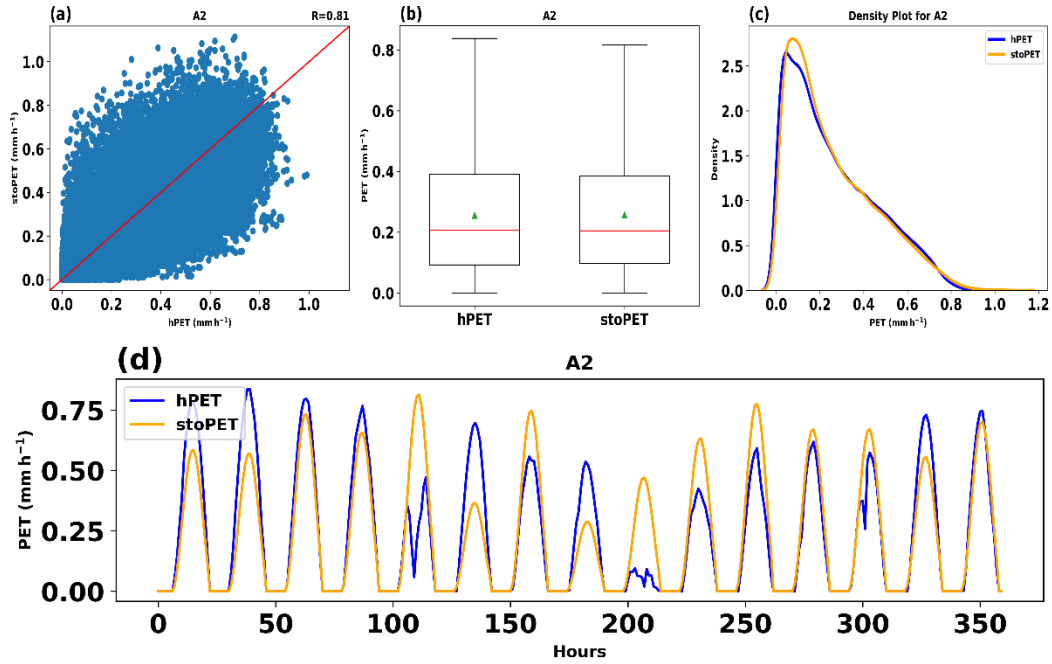


Figure S15: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for A2 (Arid climate point in South America in Fig. 7).

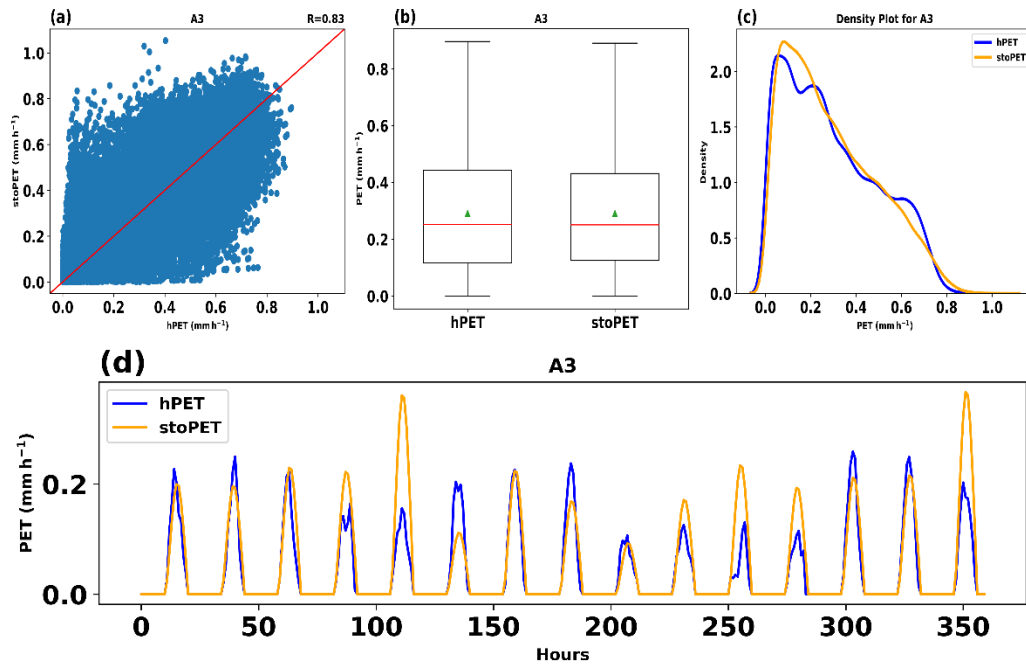


Figure S16: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for A3 (Arid climate point in Europe in Fig. 7).

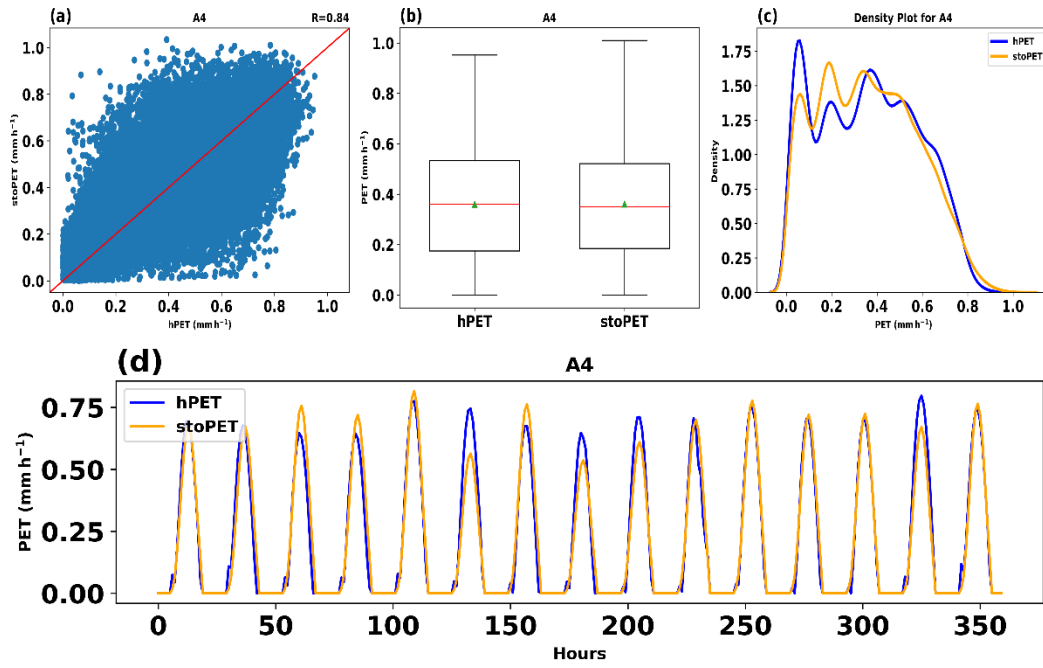


Figure S17: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for A4 (Arid climate point in Africa in Fig. 7).

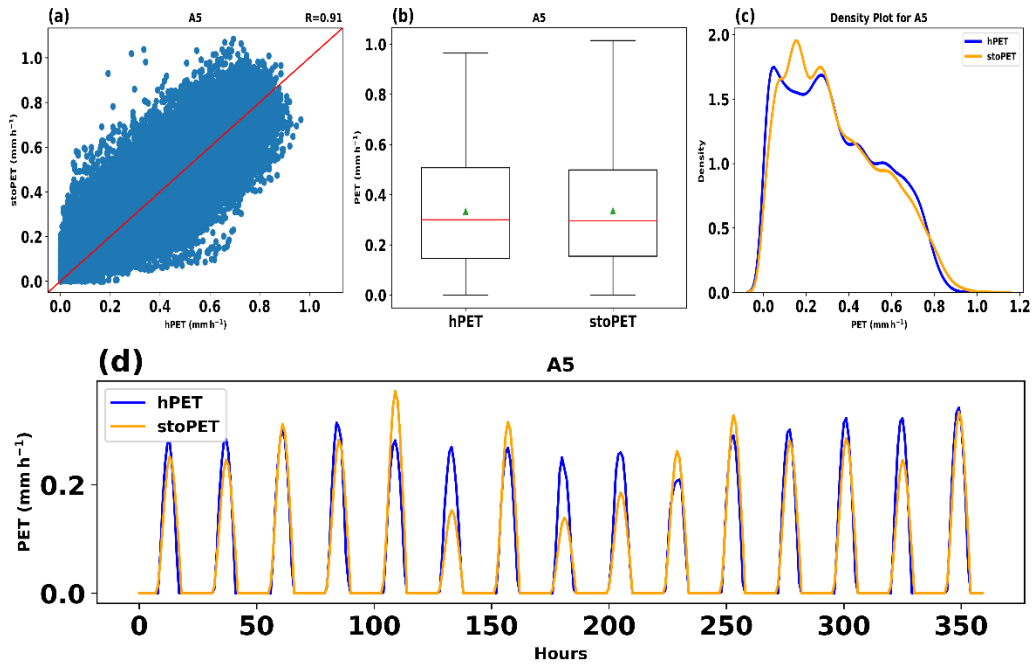


Figure S18: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for A5 (Arid climate point in Asia in Fig. 7).

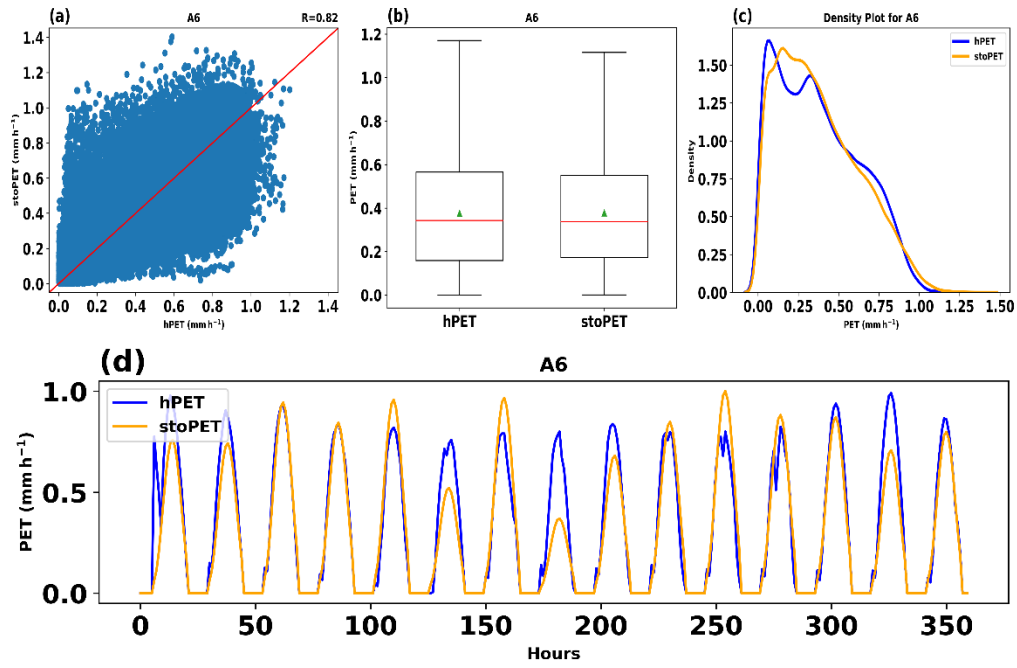


Figure S19: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for A6 (Arid climate point in Australia in Fig. 7).

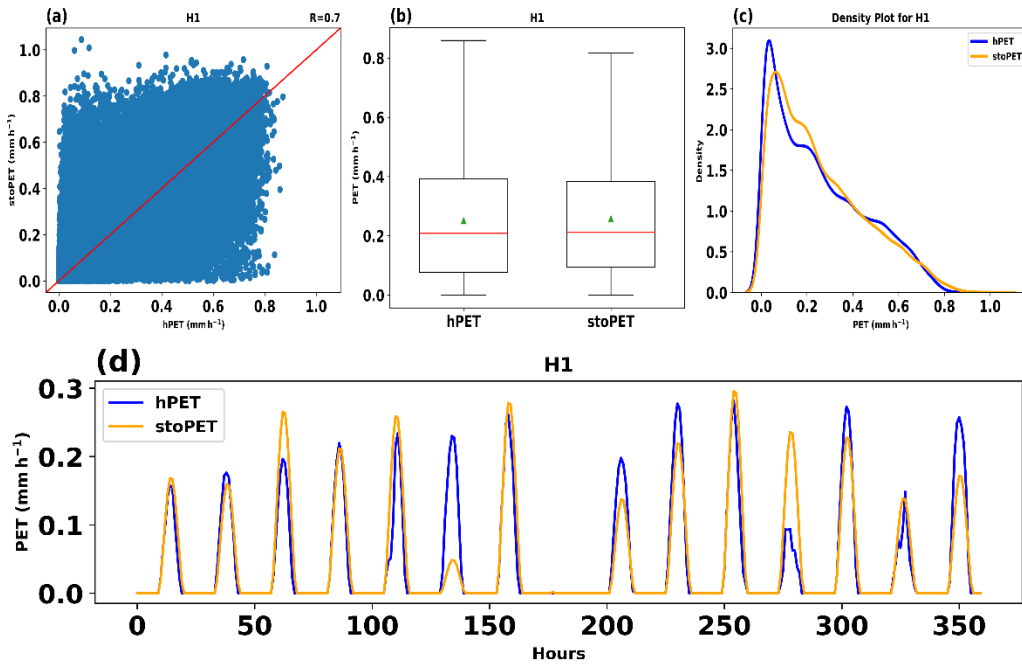


Figure S20: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for H1 (Humid climate point in North America in Fig. 7).

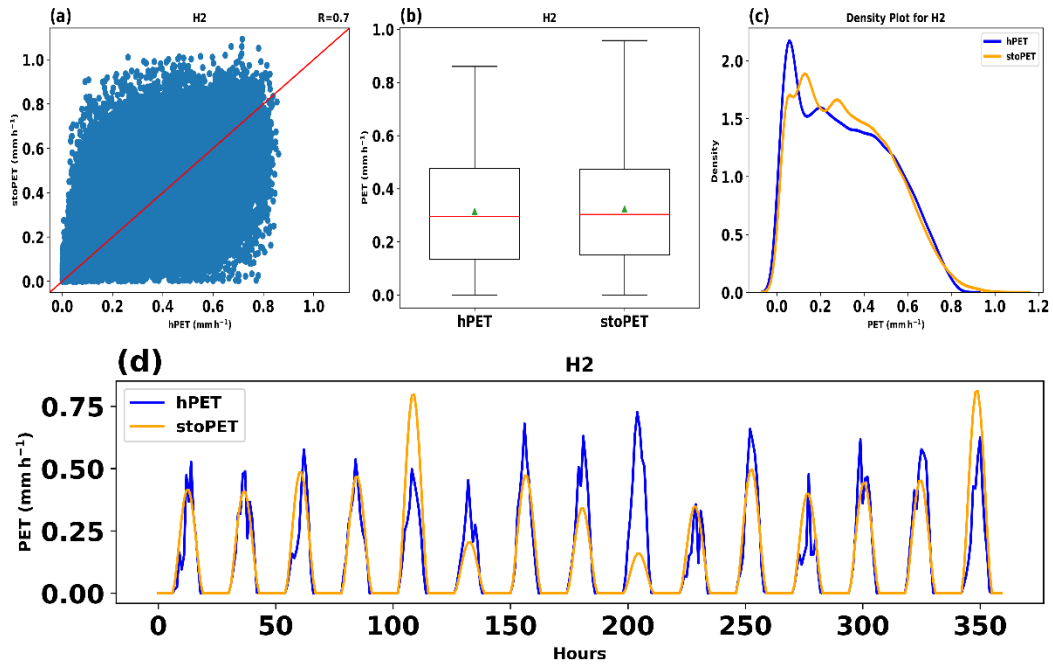


Figure S21: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for H2 (Humid climate point in South America in Fig. 7).

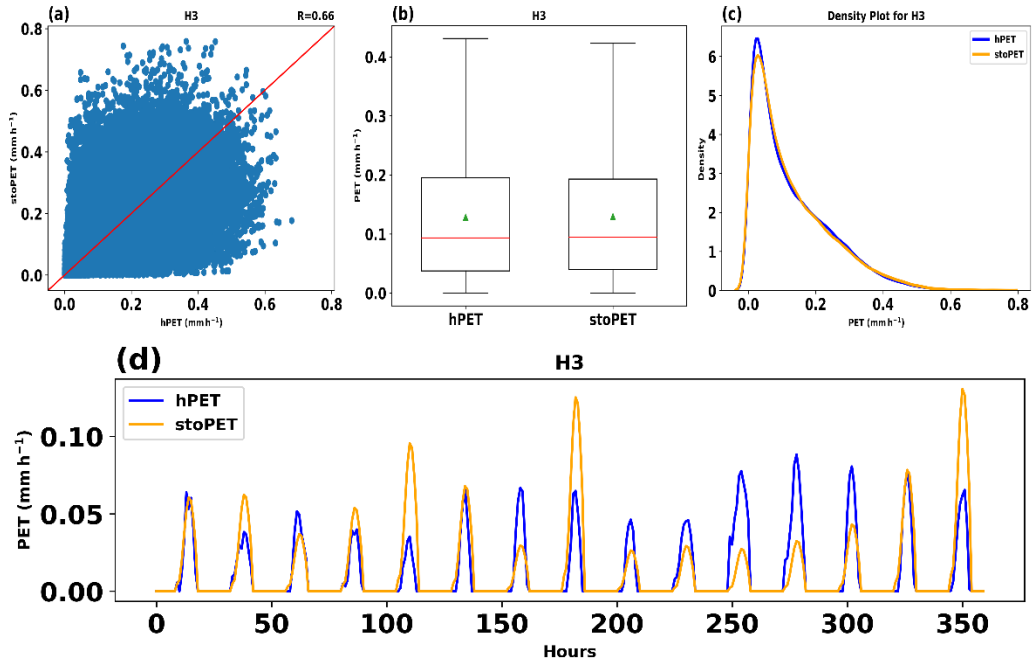


Figure S22: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for H3 (Humid climate point in Europe in Fig. 7).

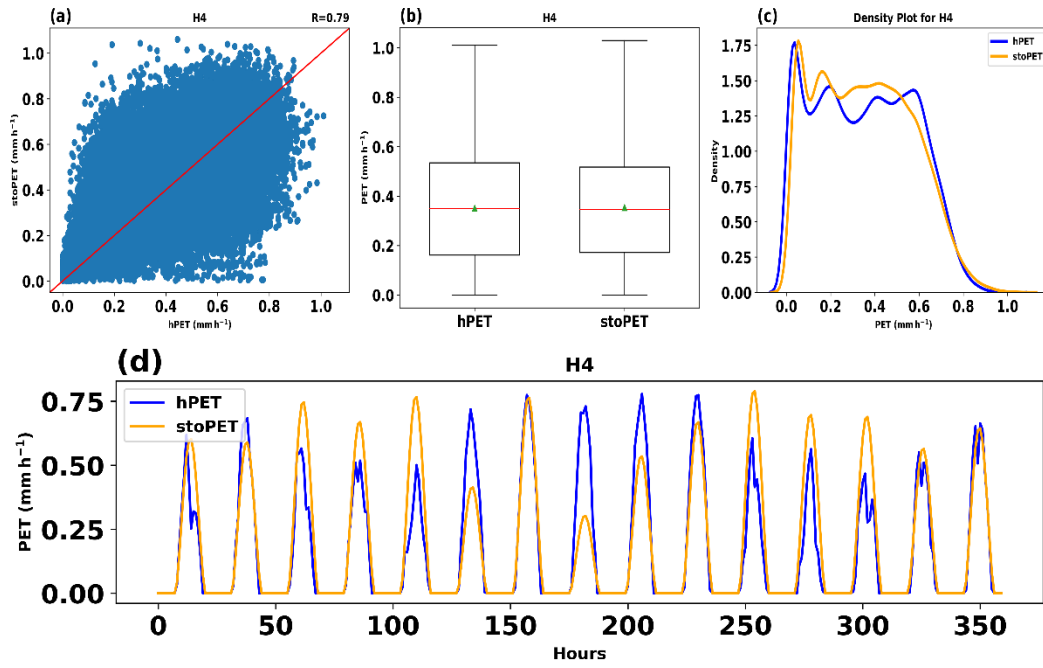


Figure S23: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for H4 (Humid climate point in Africa in Fig. 7).

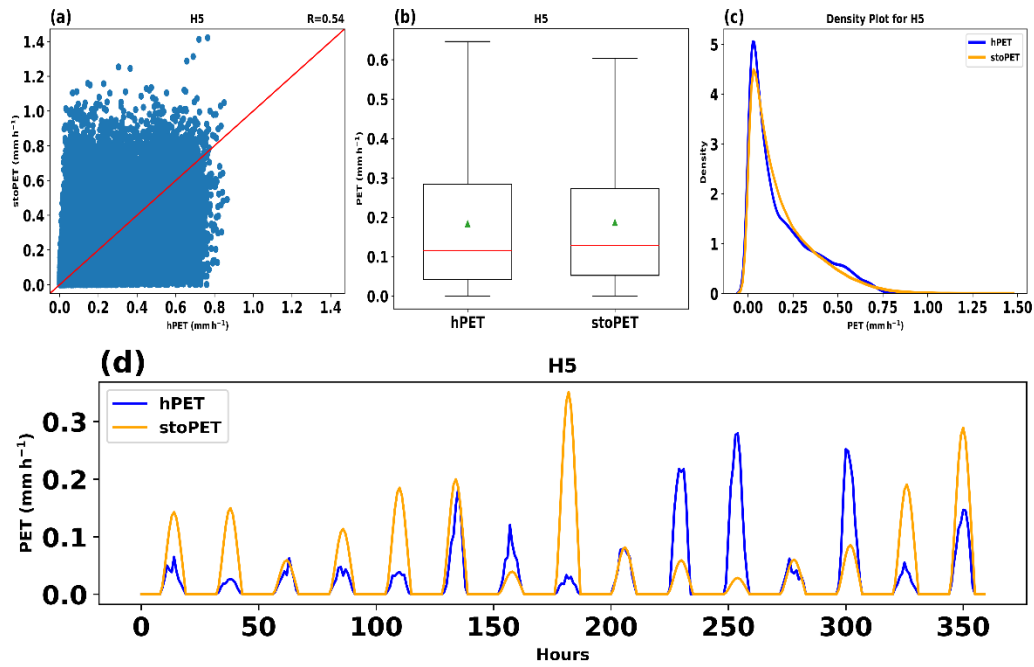


Figure S24: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for H5 (Humid climate point in Asia in Fig. 7).

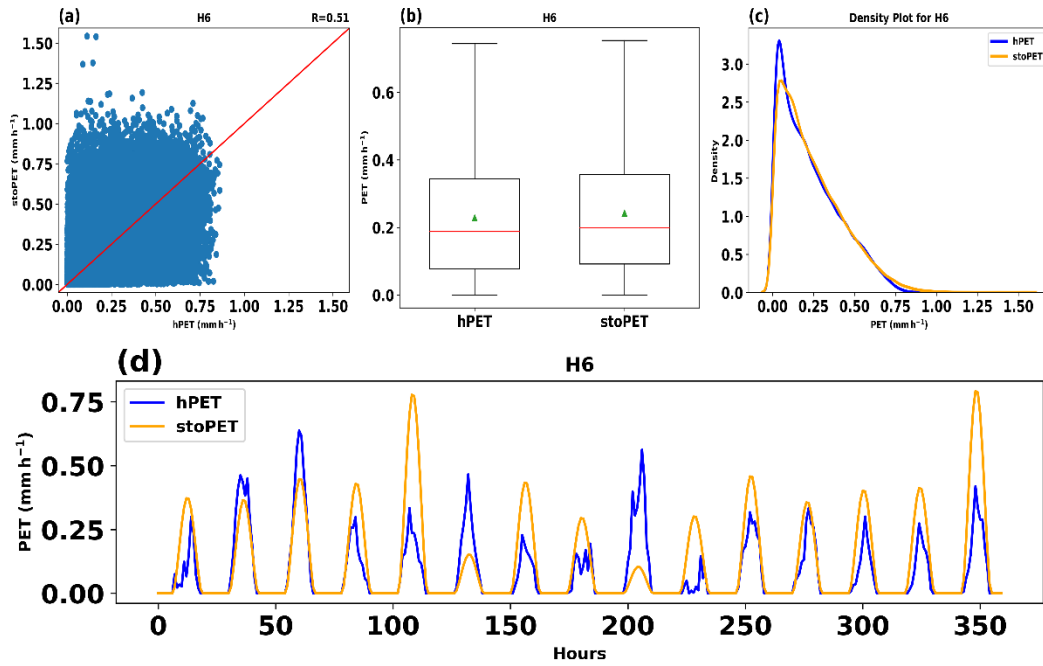


Figure S25: (a) scatter plot between hPET and stoPET, (b) box plots between hPET and stoPET data, (c) density plot and (d) hourly timeseries for the last 15 days of 2020. The data presented covers the period of 2001–2020 for H6 (Humid climate point in Australia in Fig. 7).

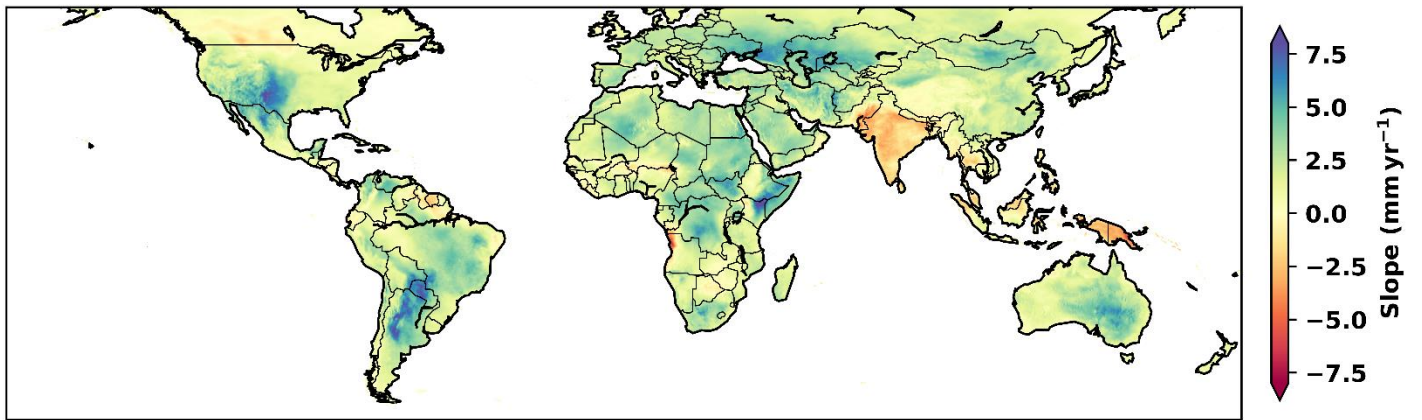


Figure S26: The slope of the linear trend of the historical annual PET from hPET (1981-2020) .

Examples of stoPET-generated PET under climate change by the three methods

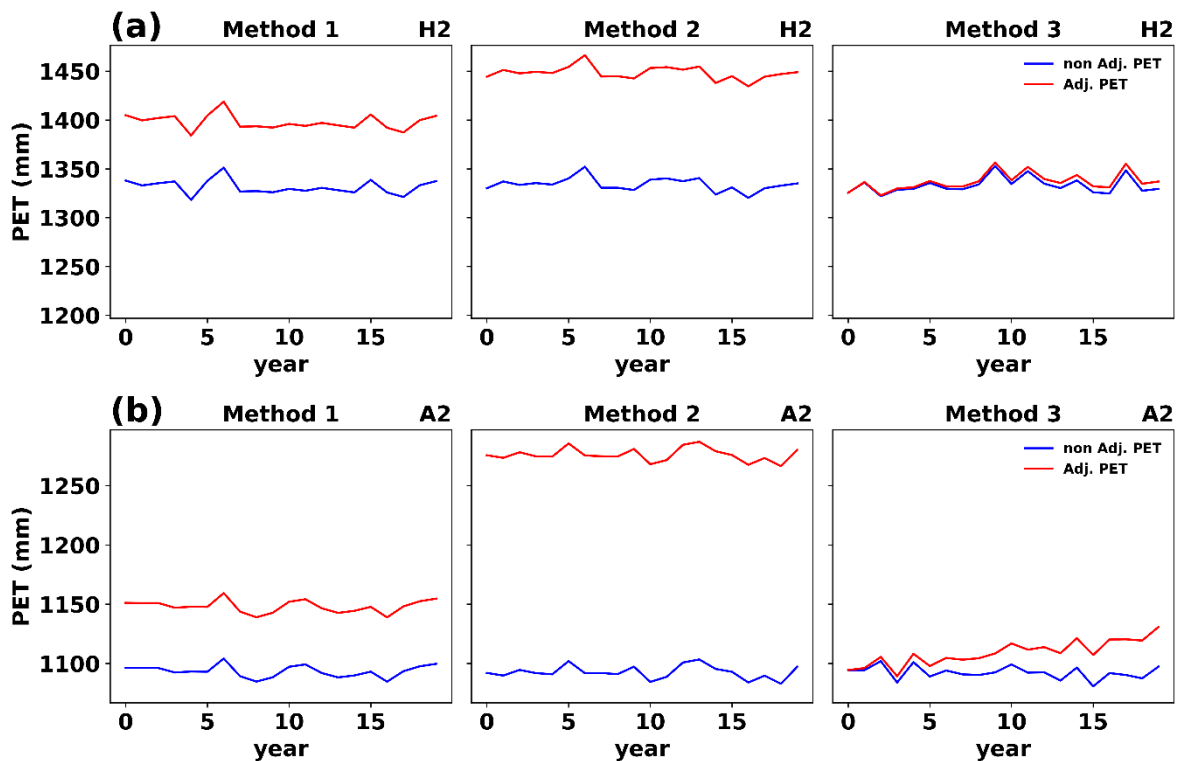


Figure S27: Annual PET estimated using stoPET with the four methods for (a) humid location and (b) arid location South America in Fig. 7.

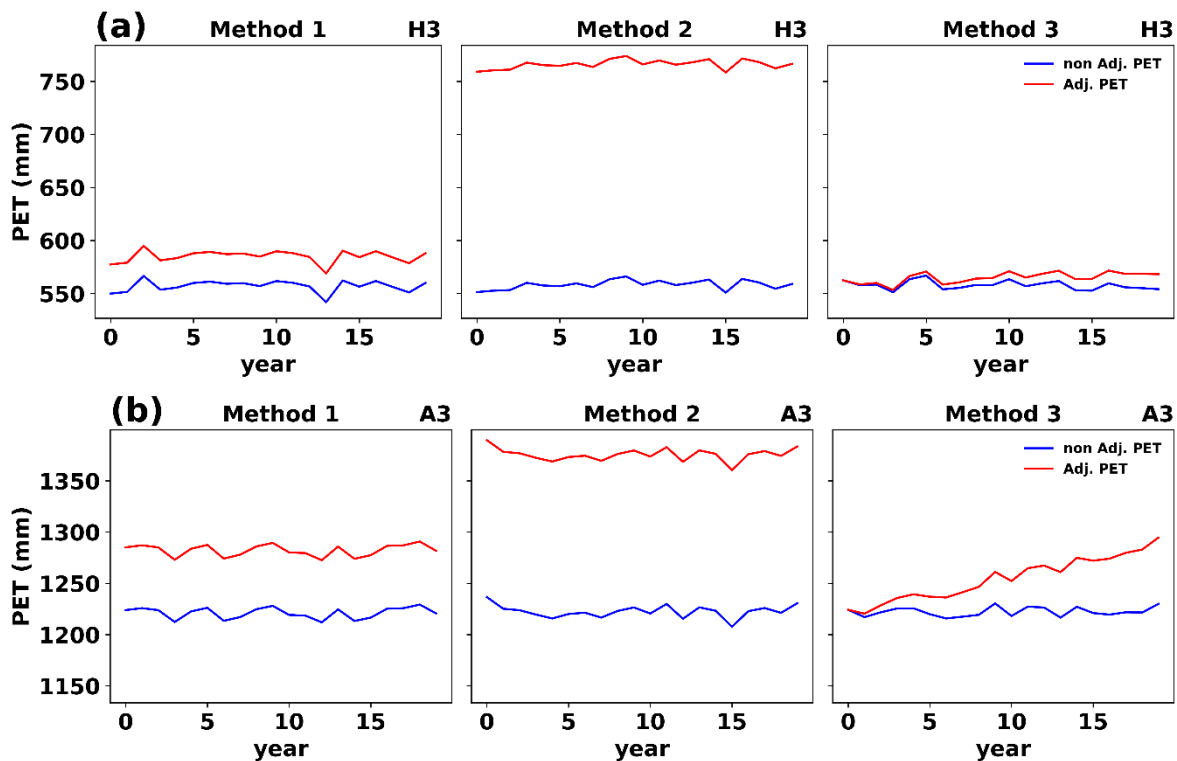


Figure S28: Annual PET estimated using stoPET with the four methods for (a) humid location and (b) arid location Europe in Fig. 7.

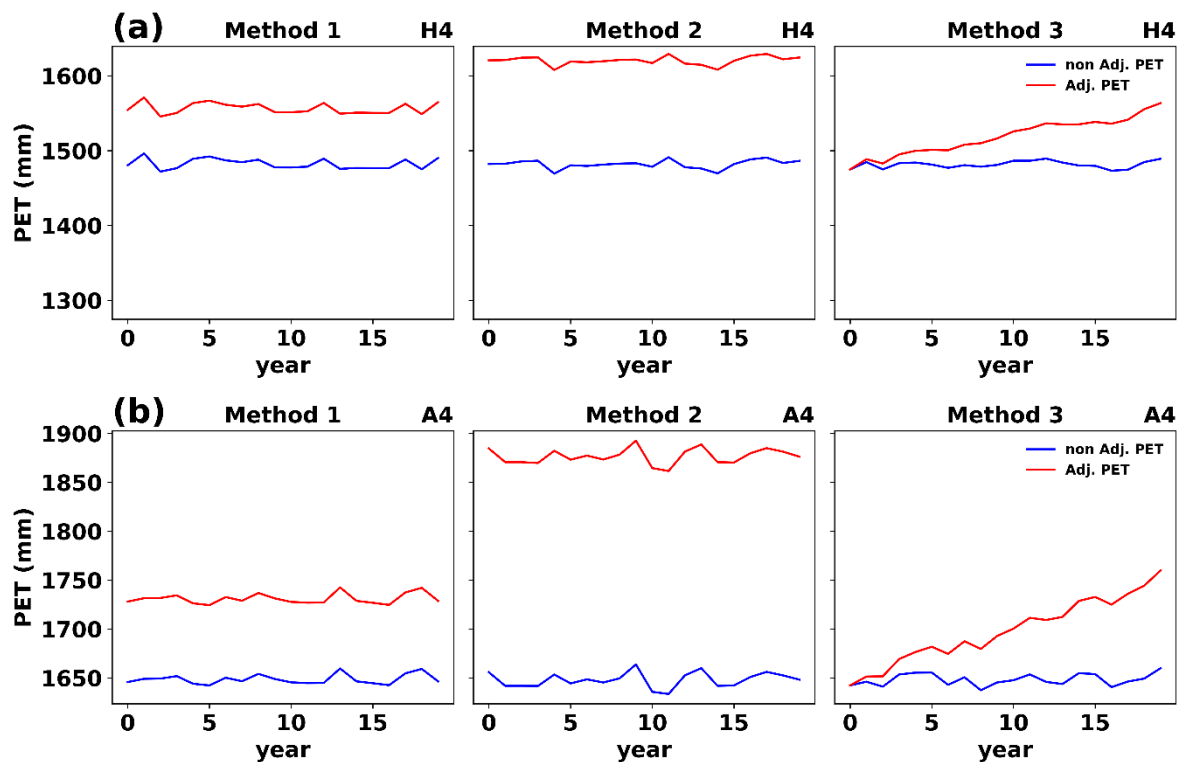


Figure S29: Annual PET estimated using stoPET with the four methods for (a) humid location and (b) arid location Africa in Fig. 7.

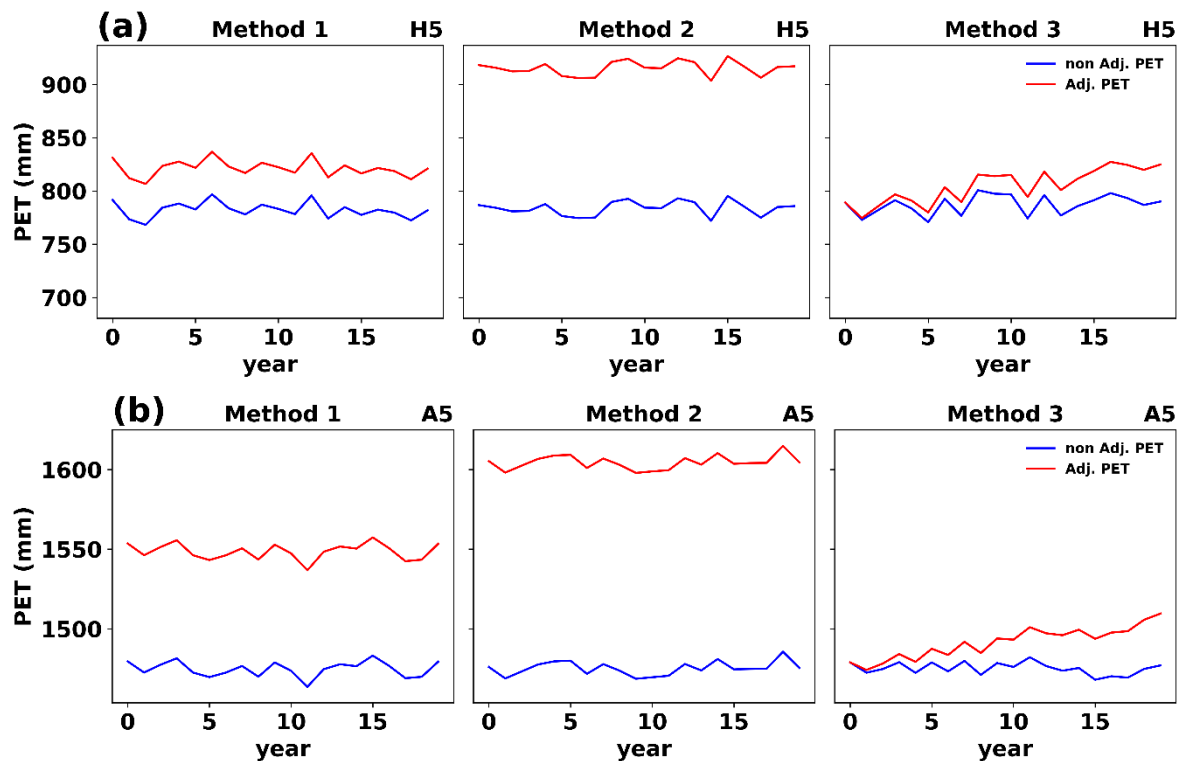


Figure S30: Annual PET estimated using stoPET with the four methods for (a) humid location and (b) arid location Asia in Fig. 7.

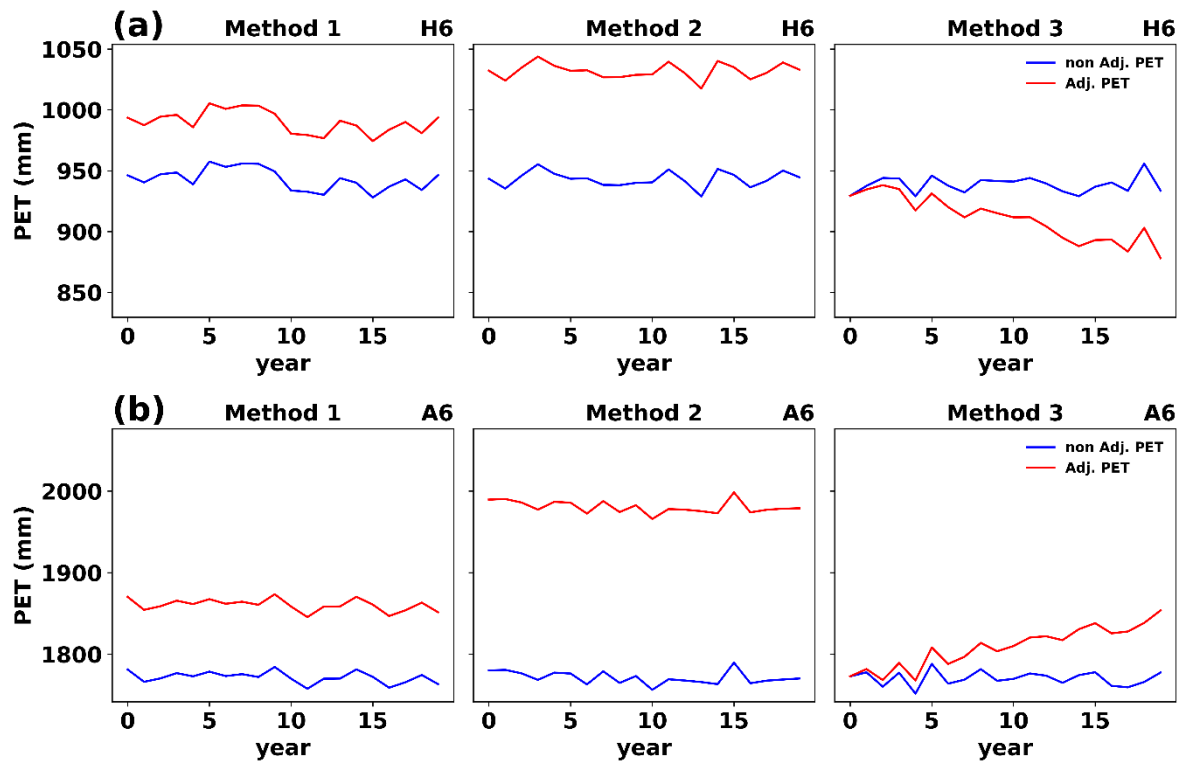


Figure S31: Annual PET estimated using stoPET with the four methods for (a) humid location and (b) arid location Australia in Fig. 7.