Evaluating Diverse Potential Evapotranspiration Methodologies and Databases for the Amazon River Basin

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1. Introduction:

Potential evapotranspiration (*PET*), is a highly relevant hydro-climatological variable since it takes part in the three fundamental laws of conservation: mass, energy and carbon. In the Amazon River basin, *PET* plays a fundamental role, given the ability of the forest to regulate climate at local, regional and worldwide scales. This is possible mainly because of its trees transfer every day around 20 billion tons of water to the atmosphere and about 17 billion tons of water to the ocean (Nobre, 2014).

2. Objetive:

The main goal of this work is to evaluate and test different *PET* estimation methodologies, based on the coupling between water and energy balances, using diverse combinations of databases. Specifically, we aim at determining which methodology, which database and which record length of the hydrological variables yields the most accurate estimate of *PET* in the Amazon River basin.

3. Databases:

Variable	Database	Spatial Resolution	Period of record
Actual evapotranspiration (*AET*)	GLEAM	0.25°x0.25°	1984-2007
	MPI	0.50°x0.50°	1982-2008
Precipitation (*P*)	CHIRPS	0.05°x0.05°	1981-2014
	TRMM 3B43	0.25°x0.25°	1998-2013

4. Models:

- **Budyko (1958):** $$AET = \left[P\left(1-\exp\left(\frac{P}{PET}\right)\right)PET\tanh\left(\frac{P}{PET}\right)\right]^{0.50}$$
- **Choudhury (1999):** $$AET = \frac{P}{\left[1+\left(\frac{P}{PET}\right)^{1.80}\right]^{1/1.80}}$$
- **Yang, et al. (2008):** $$AET = \frac{PET \cdot P}{\left[P^{1.58}+PET^{1.58}\right]^{1/1.58}}$$
- **Carmona, et al. (2015):** $$AET = \frac{0.66 \cdot P}{\left(\frac{P}{PET}\right)^{0.83}}$$

5. Results:

5.1. PET estimation and sensitivity to the record period of the hydrological variables:

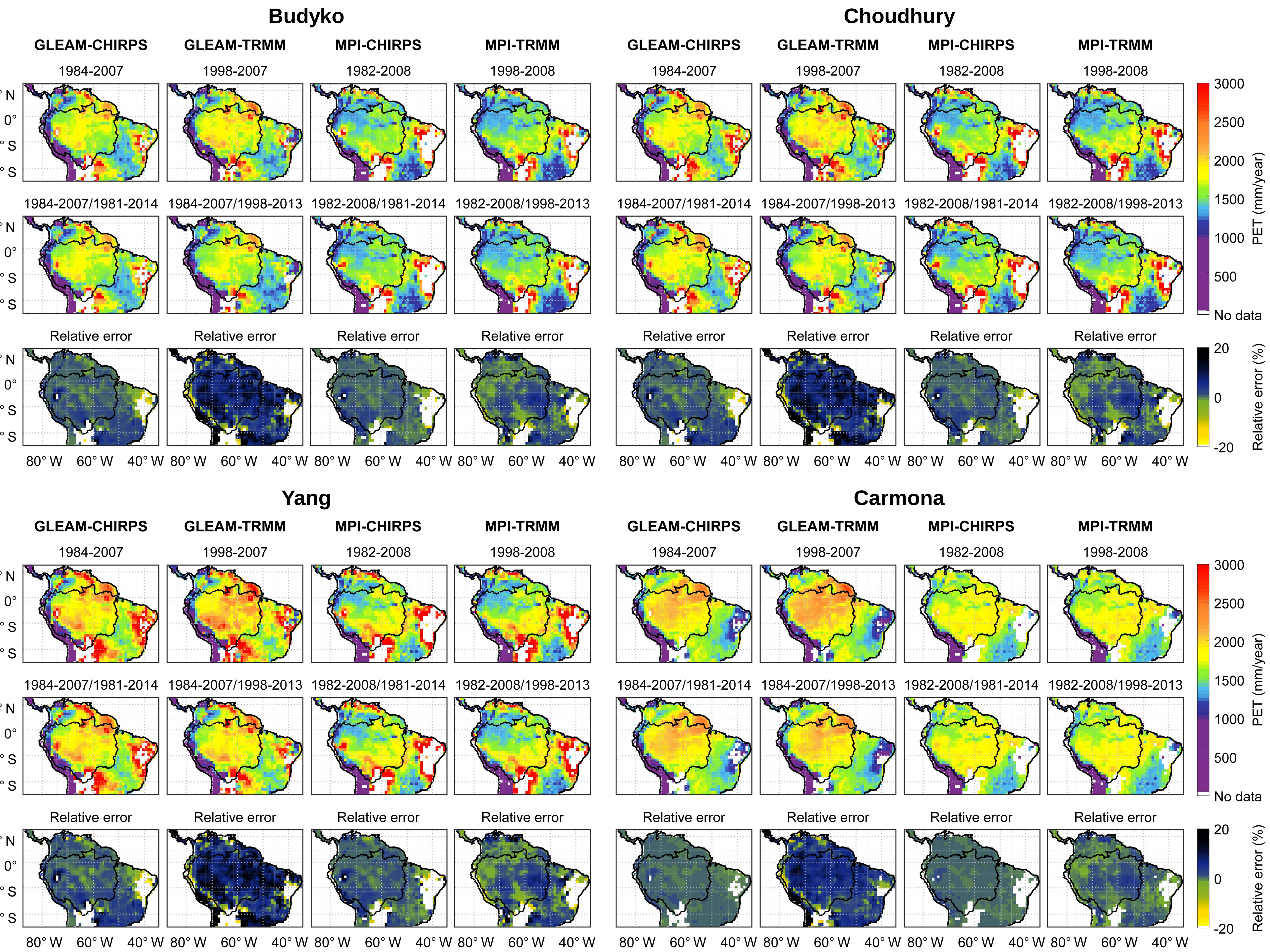

Figure 1. Estimation of the long-term mean *PET* in the Amazon River Basin, with both coincident and discordant periods of record of *AET* and *P*.

5.2. Models and databases evaluation:

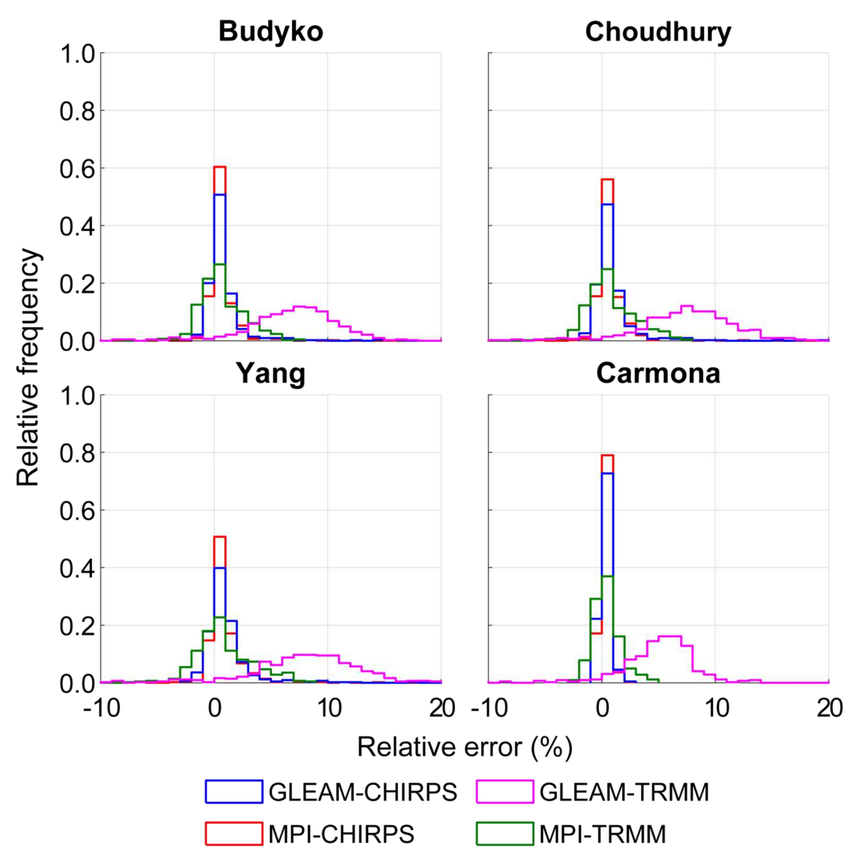

Figure 2. Relative error between *PET*, calculated both with coincident and discordant periods of record of *AET* and *P*.

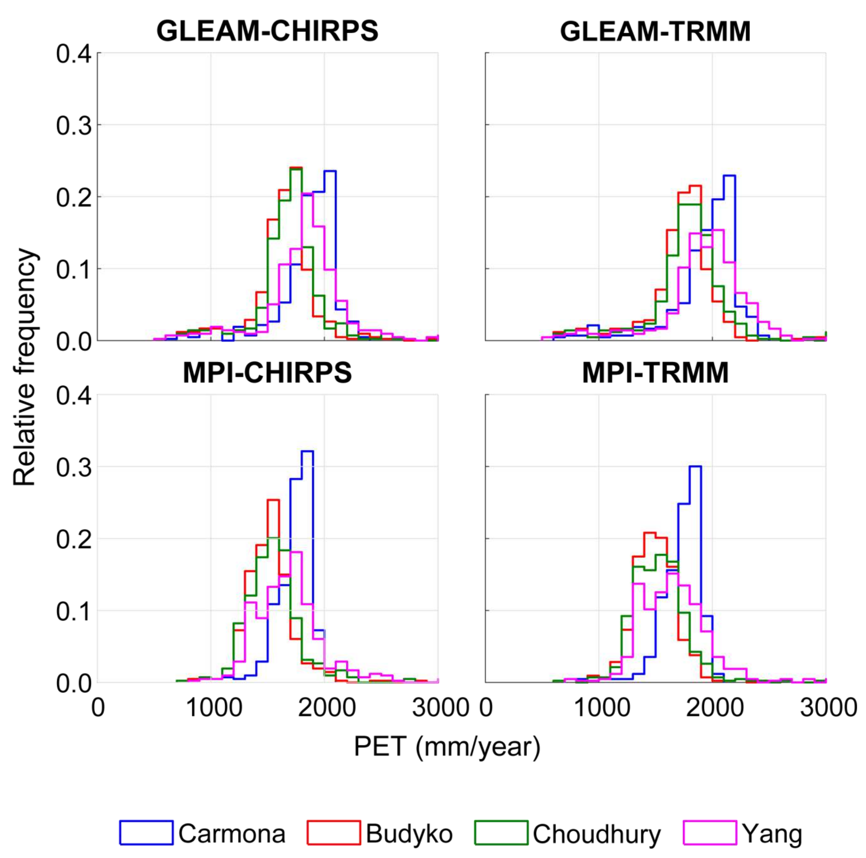

Figure 3. Probability density functions of the long-term mean *PET* estimated with coincident periods of record of *AET* and *P*.

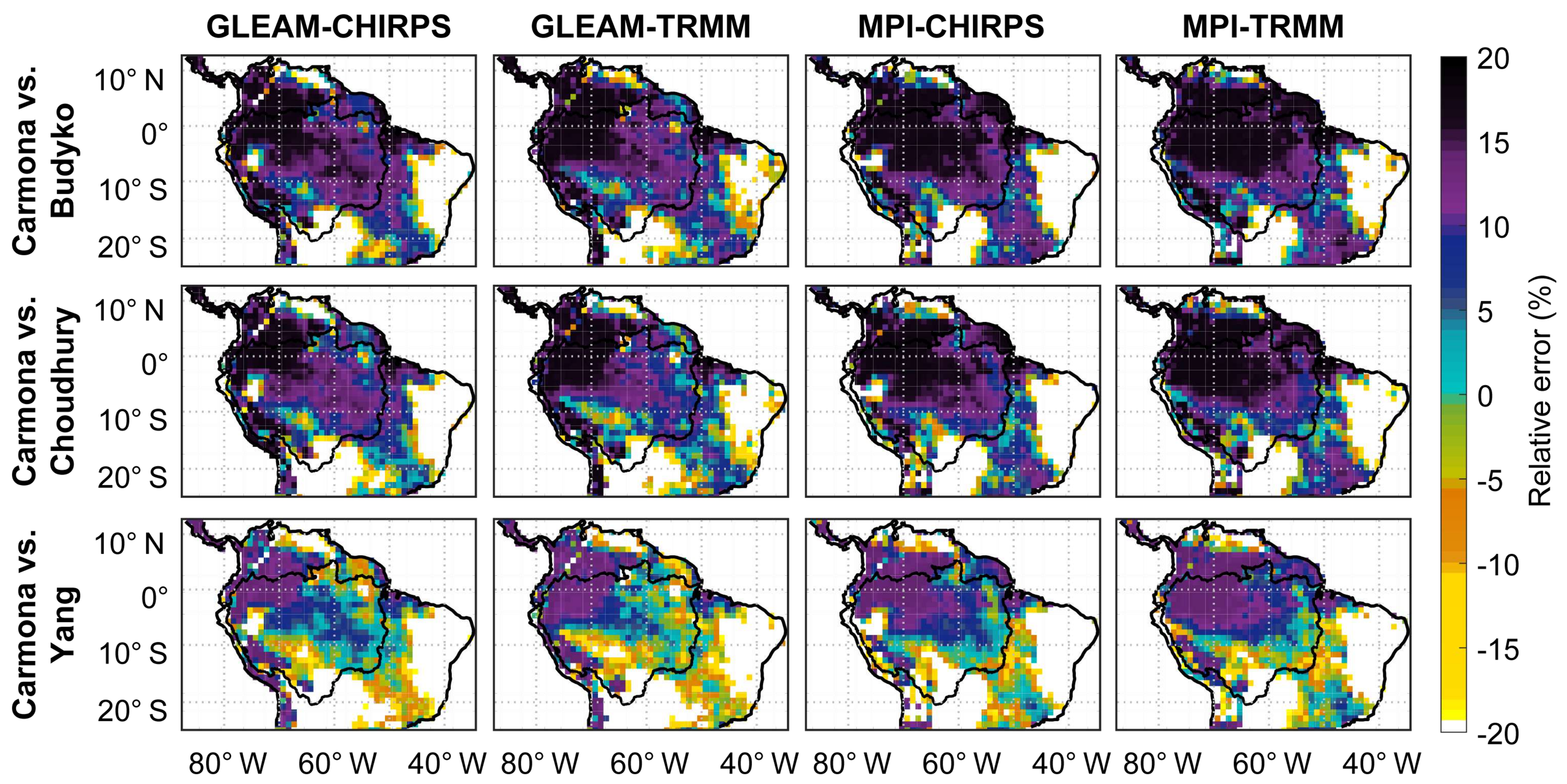

Figure 4. Relative errors obtained when comparing *PET* estimation with Budyko, Choudhury and Yang models, using Carmona's model as a reference.

6. Conclusions:

- The relative error obtained when comparing the estimation of *PET* with both coincident and discordant periods of record of *AET* and *P*, is not negligible for all data sets and models used in the calculations. Moreover, we obtained considerably high relative errors when using GLEAM and CHIRPS regardless of the model.
- Although the four evaluated models are based on the same fundamental hypothesis of coupled water and energy balances (Budyko, 1958), estimates for *PET* obtained with Budyko, Choudhury and Yang et al's equations have probability distribution functions with significant differences with respect to the one from the equation by Carmona et al., (2015).
- Our results suggest that there are some databases and Budyko-type equations (Budyko, Choudhury and Yang et al., 2008) that are not entirely adequate to estimate *PET* in wet environments such as the Amazon River basin.

7. References:

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