Global estimates of rainfall interception loss from satellite observations: recent advances in GLEAM

Feng Zhong[1,2,3], Brecht Martens[3], Albert van Dijk[4], Liliang Ren[1,2], Shanhu Jiang[1,2], Diego G. Miralles[3]

[1] State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, Hohai University, Nanjing, China
[2] College of Hydrology and Water Resources, Hohai University, Nanjing, China
[3] Hydro-Climate Extremes Lab, Ghent University, Ghent, Belgium
[4] Fenner School of Environment and Society, Australian National University, Canberra, Australia

Context

Motivation

The estimation of interception loss in the Global Land Evaporation Amsterdam Model (GLEAM) has not been updated since its original release (Miralles et al., 2010).

Two main drawbacks:
– Only tree interception is considered.
– The algorithm is not directly sensitive to temporal changes in LAI.

Current Method

Based on the revised Gash analytical model (Valente et al., 1997), in which the storage capacity per unit of canopy area and mean wet canopy evaporation rate are both considered constants in both space and time.

Recent Advancements

➤ **Global benchmarking of the model outputs against in situ data.**
– Published results from past interception field campaigns have been reviewed.
– Those with a duration over half a year and taking place within the 40 year record of GLEAM (1980–2019) have been retained for validation.
– This yielded 98 different in situ sites corresponding to 122 field campaigns.

➤ **Exploration of the magnitude and variability of global interception loss during 1980–2019.**

Results: Field Validation
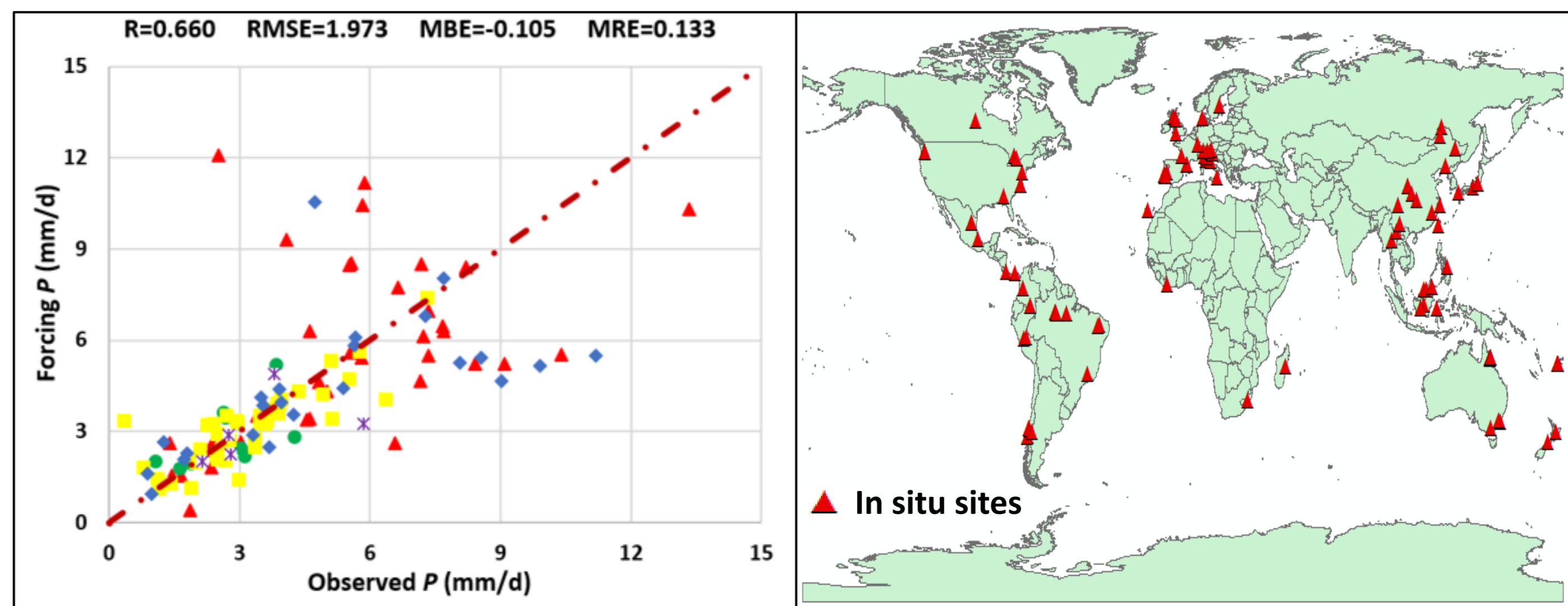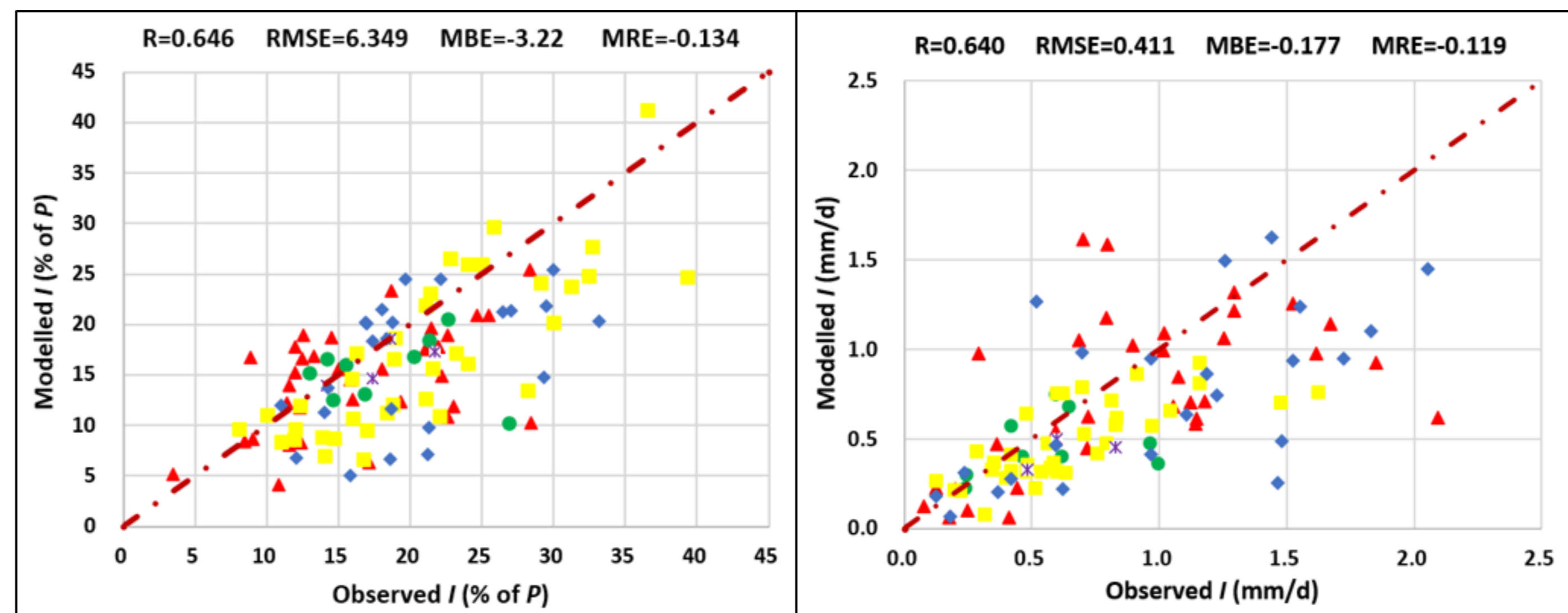
Summary of Current Findings
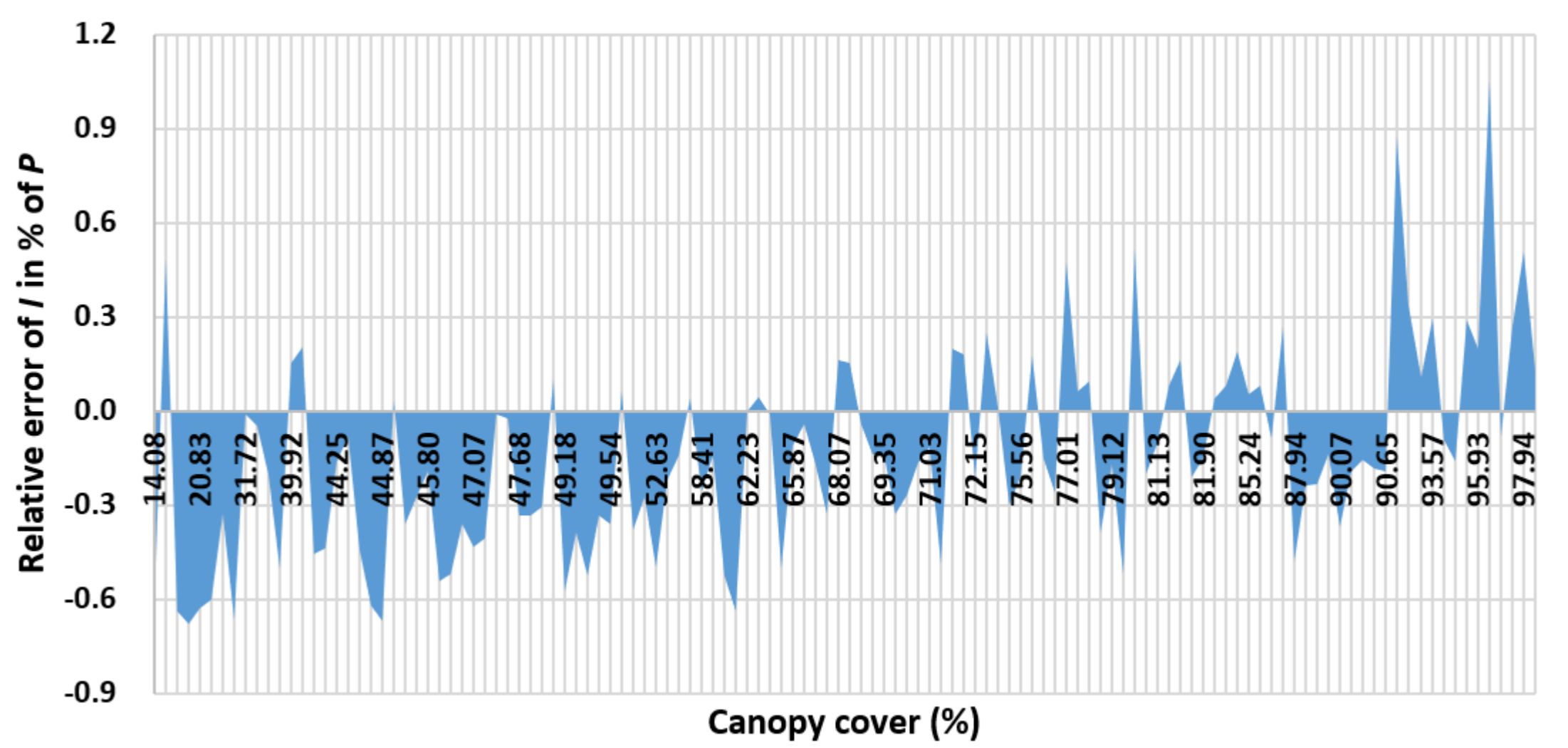
◆ Overall underestimation by GLEAM, and mostly under low canopy cover conditions.

◆ Higher canopy interception loss (mm/year) and uncertainty in broadleaf forests, which can largely be explained by errors in precipitation.

◆ Positive trends in most of the land area, except for the Congo rainforest, the Pampas region and the Amazon deforestation belt.

Results: Global Interception Loss (1980–2019)
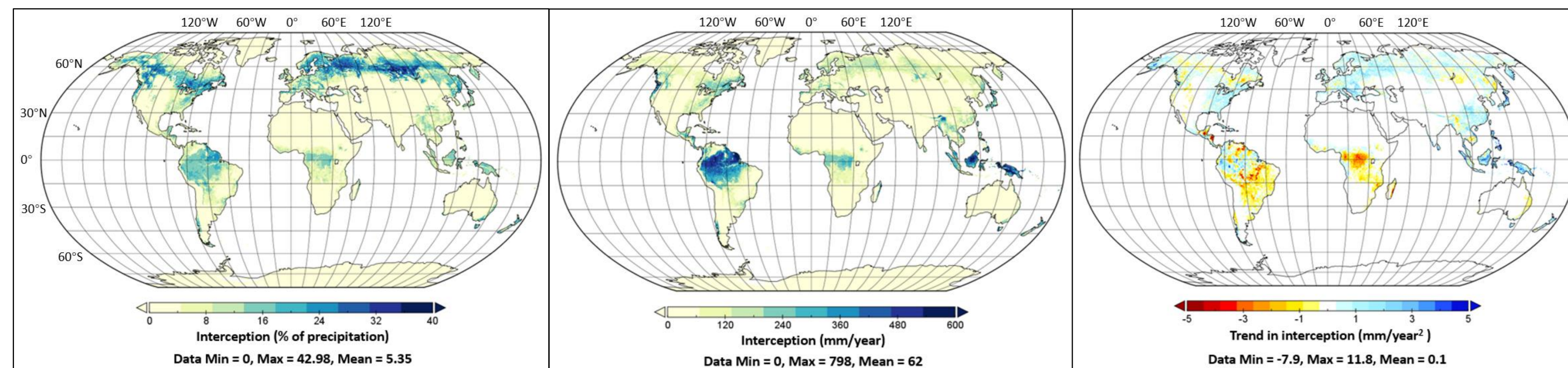
Ongoing Work

◆ Explore the potential of the modified Gash's model by Van Dijk and Bruijnzeel (2001).

➤ Canopy cover fraction, $c_j = 1 - e^{-\kappa L_j}$
➤ Canopy capacity, $S_{v,j} = L_j S_L + S_{s,j}$
➤ Mean wet canopy evaporation rate, $\overline{E}_j = \left(1 - e^{-\alpha L_j}\right)\overline{E}_a$

➤ Incorporating leaf area index (L_j).
➤ Allowing to estimate short vegetation interception loss.

References

● Miralles D.G., Gash J.H., Holmes T.R.H., et al. (2010) DOI: 10.1029/2009JD013530.
● Valente F., David J.S., Gash J.H.C. (1997) DOI: 10.1016/S0022-1694(96)03066-1.
● Van Dijk A., Bruijnzeel L.A. (2001) DOI: 10.1016/S0022-1694(01)00392-4.