Integrated Land Ecosystem - Atmosphere Processes Study

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# Land-atmosphere-climate dynamics KEY GAPS

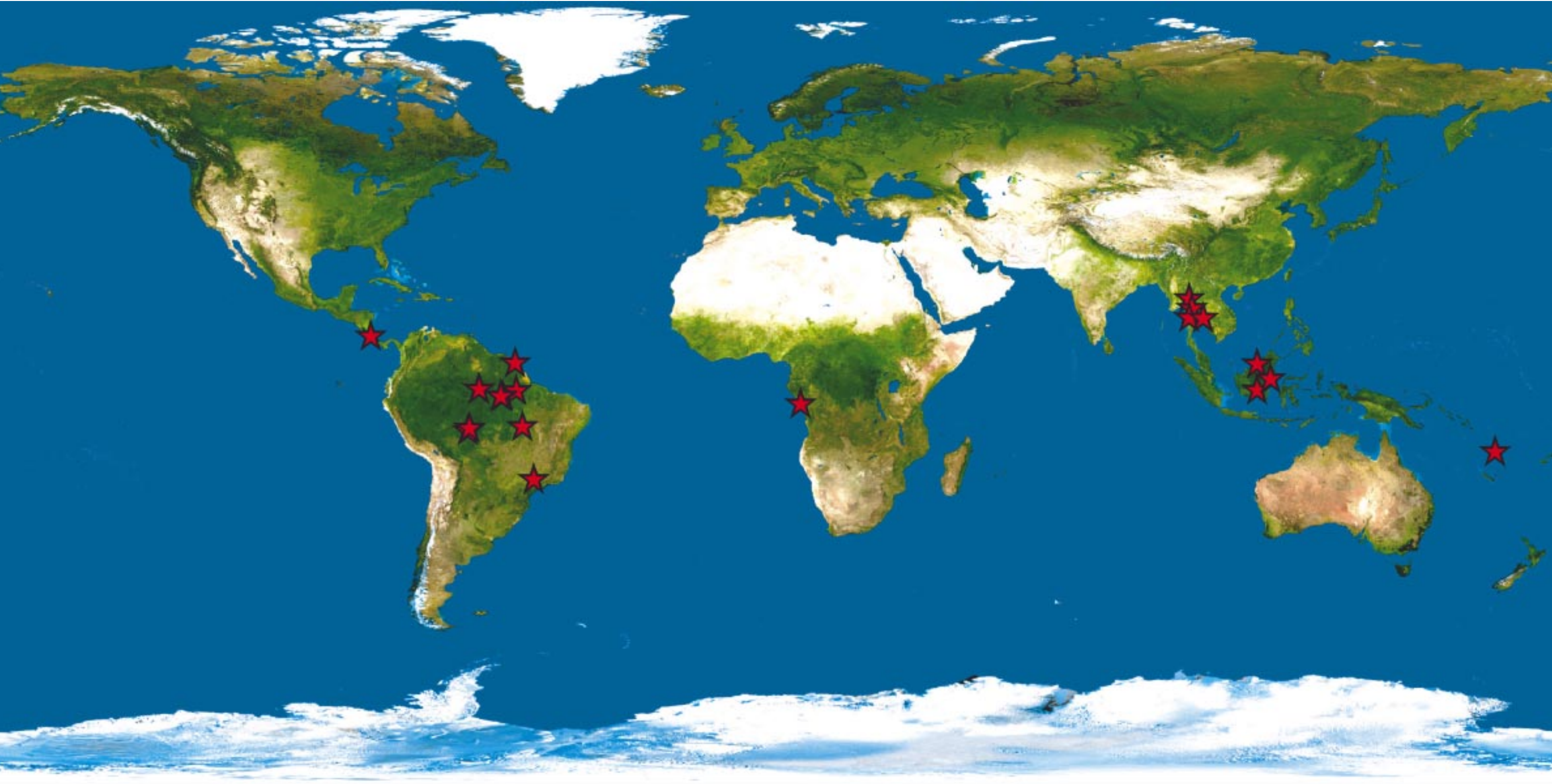

**Figure 1.** The 21 tropical eddy-covariance measuring sites.

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# Evapotranspiration from tropical vegetation

Tropical vegetation is a major source of global land-surface evapotranspiration, and can thus play an important role in global hydrological cycles and global atmospheric circulation [1, 2, 3]. Accurate prediction of tropical evapotranspiration (evaporation from surfaces and transpiration by plants) is critical to our understanding of these processes under the changing climate.

We examined the controls on evapotranspiration in tropical vegetation at 21 pan-tropical eddy-covariance sites (Fig. 1), conducted a comprehensive and systematic evaluation of 13 evapotranspiration models (based on radiation, temperature, or atmospheric transfer/resistance) at these sites, and assessed the ability to scale up model estimates of evapotranspiration for the test region of Amazonia.

Net radiation turned out to be the strongest determinant of evapotranspiration (average evaporative fraction, the ratio of evapotranspiration to net radiation, 0.72) and explained 87% of the variance in monthly evapotranspiration across the sites. Vapour-pressure deficit was the strongest predictor (14%) of the residual variation that net radiation could not predict, followed by the Normalised Difference Vegetation Index (NDVI, 9%), precipitation (6%), and wind speed (4%).

Overall, the radiation-based evapotranspiration models performed best for three reasons:

1) evapotranspiration was largely unaffected by atmospheric turbulent transfer, especially at the wetter sites;
2) the difficulty of characterising canopy and stomatal resistance (water vapour transfer in canopy and at leaf surface) consistently in the highly diverse vegetation hindered the resistance-based models;
3) the temperature-based models captured the variability in tropical evapotranspiration inadequately.

Finally, we evaluated the potential to predict regional evapotranspiration for one test region: Amazonia. We estimated the evapotranspiration for the whole Amazonia to be 1370 mm $yr^{-1}$. ■

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2. Numaguti A 1993. Dynamics and energy balance of the Hadley circulation and the tropical precipitation zones: significance of the distribution of evaporation. Journal of Atmospheric Science 50, 1874–1887.
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