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An R tool for Capturing Dynamics of Actual Evapotranspiration with MEP model and its application in Amazon

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Abstract: It is challenged to get an accurate estimate of surface energy budget for the investigation of land atmosphere and global ecosystems. In this study, we established a novel tool based the maximum entropy production (MEP) method for the simulation of global energy flux as well as evapotranspiration (ET) processes. This tool (named as RMEP) was built in R for its great convenient for open-source and the feature of easy-use. As only three variables (net radiation, surface temperature, and specific humidity) are need for MEP model, it shows great advantages in simulation for both global or site scales. **Firstly,** we compare the performances of RMEP in two flux sites, BR-Sa1and BR-Sa3 of Amazon basin, with the simulation of heat fluxes. Although the substantial bias of G flux exist, both the latent and sense heat flux show high R^2 in hourly temporal scale. **Then,** the RMEP was test in large scale by employing the global scale dataset. Since the Global Land Data Assimilation System (GLDAS) product integrates satellite data and ground-based observations at global scale, the variables of radiation, surface temperature, as well as specific humidity of GLDAS were used as inputs for RMEP and the outputs of RMEP were validated with the variables of fluxes and evapotranspiration in GLDAS. The MEP model shows a high performances in simulating surface energy budget in global scale and Amazon basin area of 3-hourly temporal scale. The performances of MEP model using GLDAS data are superior to that of EC data, with higher R^2, lower RMSE and higher, positive NSE. In addition, the MEP accurately estimated ET over regional or global scale. **Especially for Amazon area,** MEP simulated results of heat fluxes and ET are used in comparisons at their original (3-hourly and daily) and aggregated monthly temporal scales. Generally, the original 3-hourly simulations had a higher accuracy and smaller bias than daily simulations, take the aggregated monthly ET for example, the monthly 3-hourly ET (R^2=0.91, NSE=0.85) outperformed than that of daily scale (R^2=0.29, NSE=-0.98). **Results indicated** the excellent performances of the MEP model in estimating ET with 3-hourly temporal scale in Amazon area. **In summary,** the RMEP shows great performances in both site and global scale. It also can deal with the input file with both site measured table and global netcdf types. The resulted figures, global ET values (in netcdf file), source code, and R package can be shared by the request to the first author.

Appendix. List of figures and tables.

Table 1. Information for two flux sites

Site name	Lat/Lon	Canopy height (m)	Biome type	Study period (hourly)
BR-Sa1	2.85S/54.97W	35-40	Tropical rainforest	07/01/2004-07/31/2004
BR-Sa3	3.01S/54.58W	35-40	Selectively logged tropical	07/01/2000-07/31/2000

Figure 1.