Reconciling Canopy Interception Parameterization and Rainfall Forcing Frequency in the Community Land Model for Simulating Evapotranspiration of Rainforests and Oil Palm Plantations in Indonesia

Mar 15, 2019

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Abstract

By mediating evapotranspiration processes, plant canopies play an important role in the terrestrial water cycle and regional climate. Substantial uncertainties exist in modeling canopy water interception and related hydrological processes due to rainfall forcing frequency selection and varying canopy traits. Here we design a new time interpolation method “zero” to better represent convective-type precipitation in tropical regions. We also implement and recalibrate plant functional type-specific interception parameters for rainforests and oil palm plantations, where oil palms express higher water interception capacity than forests, using the Community Land Model (CLM) versions 4.5 and 5.0 with CLM-Palm embedded. Reconciling the interception scheme with realistic precipitation forcing produces more accurate canopy evaporation and transpiration for both plant functional types, which in turn improves simulated evapotranspiration and energy partitioning when benchmarked against observations from our study sites in Indonesia and an extensive literature review. Regional simulations for Sumatra and Kalimantan show that industrial oil palm plantations have 18–27% higher transpiration and 15–20% higher evapotranspiration than forests on an annual regional average basis across different ages or successional stages, even though the forests experience higher average precipitation according to reanalysis data. Our land-only modeling results indicate that current oil palm plantations in Sumatra and Kalimantan use 15–20% more water (mean 220 mm or 20 Gt) per year compared to lowland rainforests of the same extent. The extra water use by oil palm reduces soil moisture and runoff that could affect ecosystem services such as productivity of staple crops and availability of drinking water in rural areas.

Read the article in *Journal of Advances in Modeling Earth Systems* [1].

Associated Project:
Supply-Chain Commitments [2]
DOI for citing:
https://doi.org/ 10.1029/2018MS001490

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[1] https://agritrop.cirad.fr/592211/1/Fan%20JAMES%202019%20Reconciling%20Canopy%20Interception%20Parameterization%20and%20Rainfall%20frequency%20CLM%20Evapotranspiration%20Rainforests%20Oil%20palm.pdf
[2] https://www.sesync.org/project/propose-a-pursuit/supply-chain-commitments