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ABSTRACT TITLE: Exploring the influence of time and spatial resolution on the prediction of latent heat fluxes

ABSTRACT: Predicting latent heat flux in forests is essential to understanding the hydrological cycle. However, this is not an easy task. Plant transpiration constitutes a considerable fraction of the water vapor flux above canopies and it depends not only on soil and atmospheric conditions, but also on how different species respond to environmental stimuli. In this work we explore the influence of time and spatial resolutions on the quality of the predictions of latent and sensible heat fluxes using OLAM, a global land-atmosphere model with powerful local mesh refinement capabilities. Our evaluation of simulation results against eddy covariance tower measurements showed that, despite difficulties on predicting the daily variation of the latent heat flux, the big leaf approach employed in our runs successfully estimated monthly evaporation totals for the studied period, which ranged from July 2009 to 31 October 2009.

Our sap-flow observations displayed features at daily and intra-daily time scales that are currently not well represented by OLAM. Among them, we emphasize the diurnal dynamic patterns of transpiration, in which the vegetation adjusts its transpiration rates to decreased soil moisture by shifting towards the morning and increasing stomata resistance at the afternoon. While some species, such as red maple show a next-day response to precipitation and strong morning-bias when soil is dry, other species such as red oak take longer to respond to increased soil moisture (4 days) and show diurnal transpiration dynamics that is less sensitive to soil moisture. We suggest that the simplified stomata parameterization employed in the big leaf approach which does not include the mechanics of water transport through the tree system is not capable of predicting the morning-time bias of intra-daily patterns of evaporation, nor is it able to differentiate between the species' specific response to environmental conditions, such as declining soil moisture. We show encouraging results obtained with Finite Element Tree Crown Hydrodynamics (FETCH) model, which, upon coupling with an ecosystem model such as ED2 could be used to reduce the gap between our predictions and observations of daily and intra-daily latent heat flux at local scales.