Testing stomatal models at stand level in deciduous angiosperm and evergreen gymnosperm forests using CliMA Land (v0.1)

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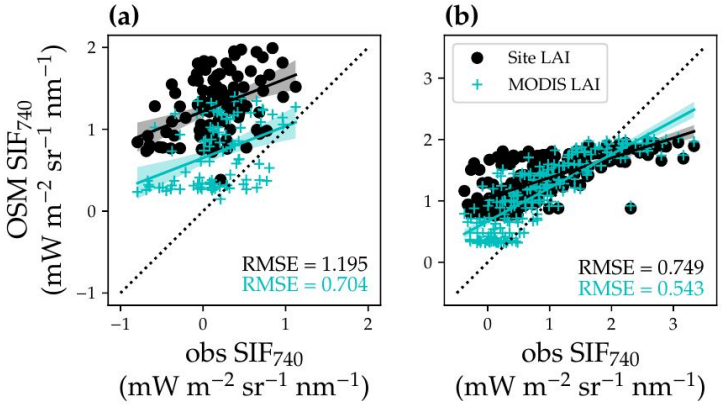

Fig. 1 The CliMA Land model captures the seasonal patterns of solar-induced fluorescence compared to the TROPOMI SIF retrieved at 740 nm, showing great potential in constraining land models using remote sensing data.

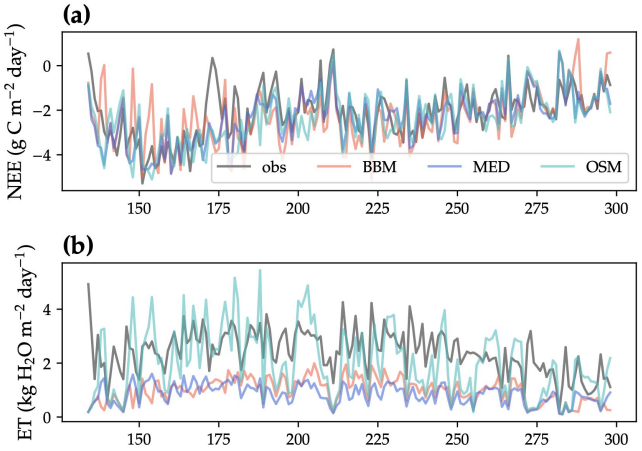

Fig. 2 The CliMA Land model embeds (i) 4 empirical stomatal models along with 2 types of ad-hoc tuning function and (ii) 5 optimality-based stomatal models. This figure shows the comparison in seasonal and diurnal patterns of carbon and water fluxes for 2 empirical models (BBM and MED) and 1 stomatal optimization model (OSM) vs. the observation from a flux tower located at Niwot Ridge (US-NR1).

Scientific Question: How well does the new land model within the Climate Modeling Alliance (CliMA) perform in terms of carbon and water fluxes as well as canopy level solar-induced chlorophyll fluorescence (SIF) at site level?

Data & Results: We implemented highly modularized plant hydraulics, photosynthesis, canopy radiative transfer, and stomatal control modules into the new CliMA Land model along with the recently developed stomatal optimization theory. We tested our modeled carbon and water fluxes using data from two flux tower sites in the USA (one gymnosperm forest at Niwot ridge, US-NR1, and one angiosperm forest at Ozark, US-MOz). We also tested our model predicted SIF using data from TROPOMI and MODIS LAI.

Significance: The CliMA Land model is the first land surface model that simulates stomatal behavior using stomatal optimization theory along with a complex canopy radiative transfer model that can predict canopy reflectance and fluorescence spectra. Bridging of the two allows for better evaluating land plant processes using remote sensing data.

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