Accounting for canopy structure improves GPP estimation from SIF

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Introduction

Statistical models that correlate solar-induced chlorophyll fluorescence (**SIF**) with vegetation gross primary productivity (**GPP**) have been an invaluable approach for retrieving information about terrestrial ecosystems. However, the impacts of canopy structure on escaped SIF are often roughly proxied using the near-infrared reflectance of vegetation (NIRv), potentially leading to biased estimation of global GPP patterns. In the presented work, we ask

1. how the canopy structural parameters—LAI and CI—impact the ratios of GPP vs. SIF and GPP vs. NIRv;
2. whether including LAI and CI in the statistical GPP∼SIF and GPP∼NIRv models help improve their predictive skills.

Materials & Methods

We run CliMA Land at the site-level and global-scale, and compared the model results to data-driven GPP/NIRv/SIF products:

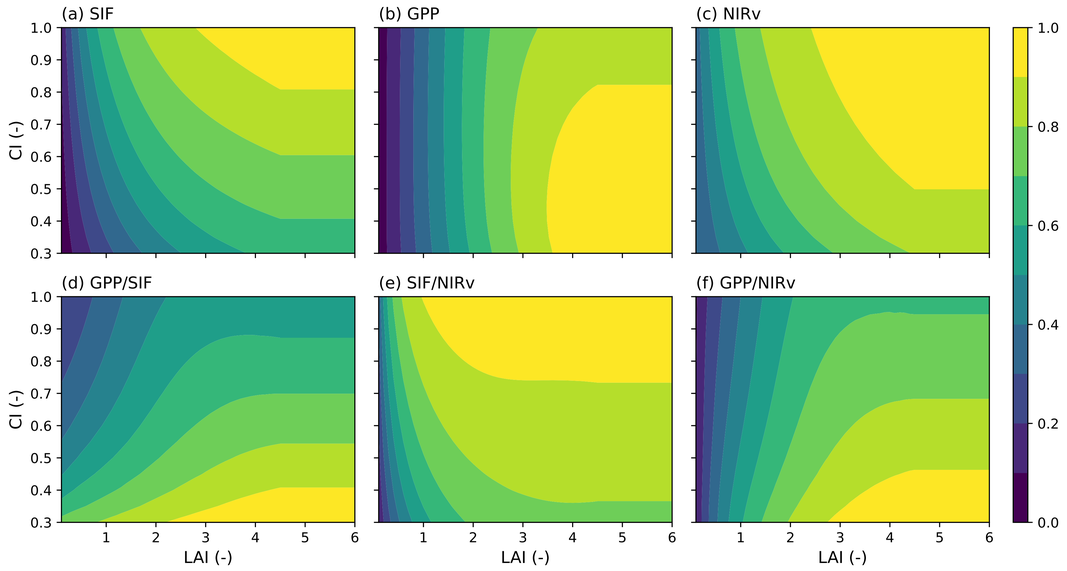
- ran site-level sensitivity analysis;
- ran global-scale CliMA Land;
- compared the model against data products;
- improved statistic model performance.

We used the following data products for statistical analysis:

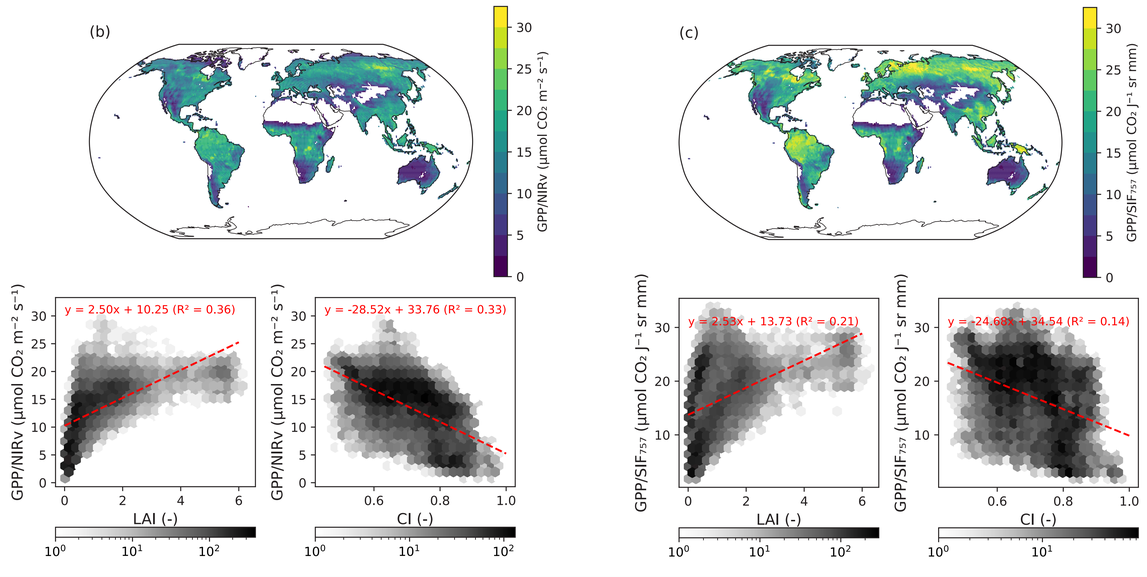
- OCO-2 SIF at 757 nm;
- OCO-2 SIF at 771 nm;
- TROPOMI SIF at 740 nm;
- MPI RS GPP.

Data are available through **GriddingMachine.jl**.

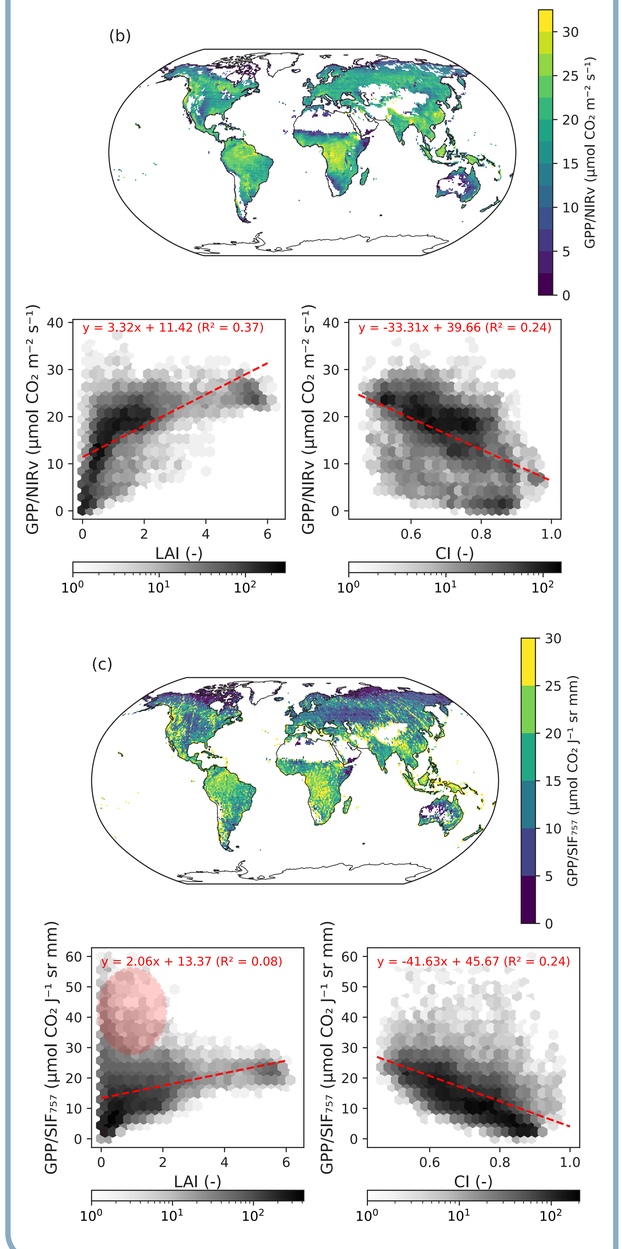
Model 1—Sensitivity Analysis



Model 2—Global Simulation



Comparison with Data



Conclusions

- Statistical models must account for canopy structure when estimating GPP from SIF and NIRv;
- Mechanistic models help identify and explain key results.

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