# A multi-year gridded data ensemble of surface biogenic carbon fluxes for North America: evaluation and analysis of results

## Background:

Currently available data products from flux towers and model-intercomparison models struggle to adequately represent spatiotemporal dynamics of surface biogenic carbon fluxes and to quantify their uncertainties.

## Methods:

- This paper introduces a new perturbed-parameter model ensemble, based on the CASA model, to estimate surface biogenic carbon fluxes at monthly and 3-hourly scales for North America at ~500 m and 5 km resolutions over a time frame between 2003 and 2017.
- Datasets used included MODIS ~500-m (MCD15A2H) and 1-km (MCD15A2) spatial resolution ƒPAR datasets, high-resolution forest maps, AmeriFlux and FLUXNET2015 datasets.
- This ensemble was compared with other model datasets at biome type level, ecoregional scale, and continental scale.

## Results:

- The new ensemble outperforms diverse data products at diurnal to annual scales and seasonality agrees well with other models for most biome types.
- The mean of the new ensemble outperforms other model products in comparison to flux tower data.
- Seasonal net carbon exchange shows consistency with other model products in high- and mid-latitude regions and at continental scales.
- Inconsistencies are found in subtropical and tropical ecoregions and for annual totals over North America.

## Significance:

- The CASA ensembles introduced in this study offers several improvements on most other currently available model products, including a finer spatial resolution, better performance on the Taylor skill score at diurnal, monthly, and annual temporal scales, and provides an up-to-date retrospective of carbon flux anomalies at monthly and 3-hourly time scales since 2003.
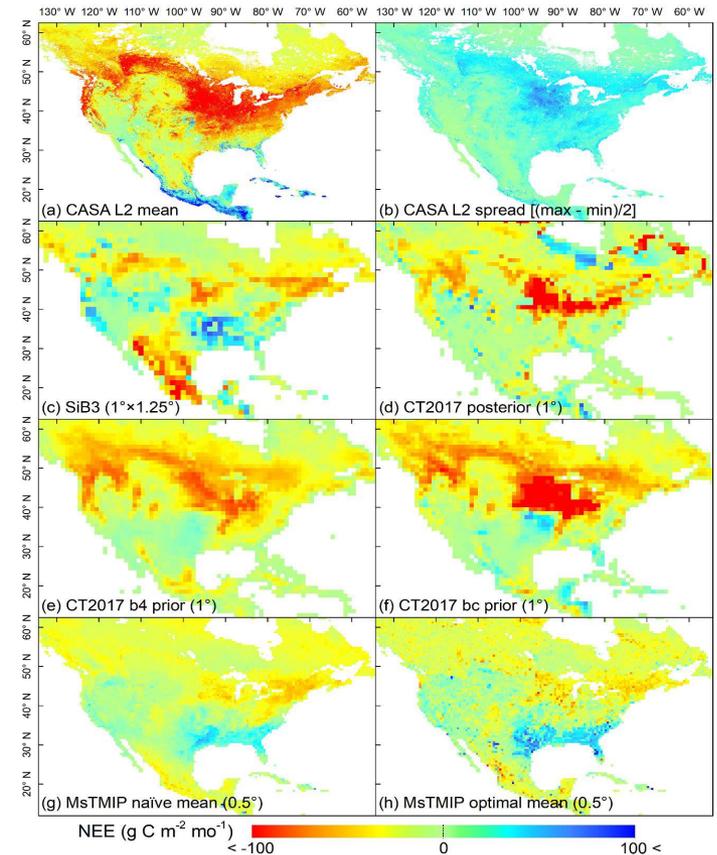


**Figure.** Spatial maps of NEE in August 2010 across the North American domain from (a) CASA L2 mean and (b) spread which is the half of the difference between maximum and minimum values, (c) SiB3CSU, (c) posterior and two priors (d) b4 and (f) bc estimates from CT2017, (g) naïve and (h) optimal means from MsTMIP.odel