# How does the ability to recover $CO_2$ flux anomalies scale with observational coverage?

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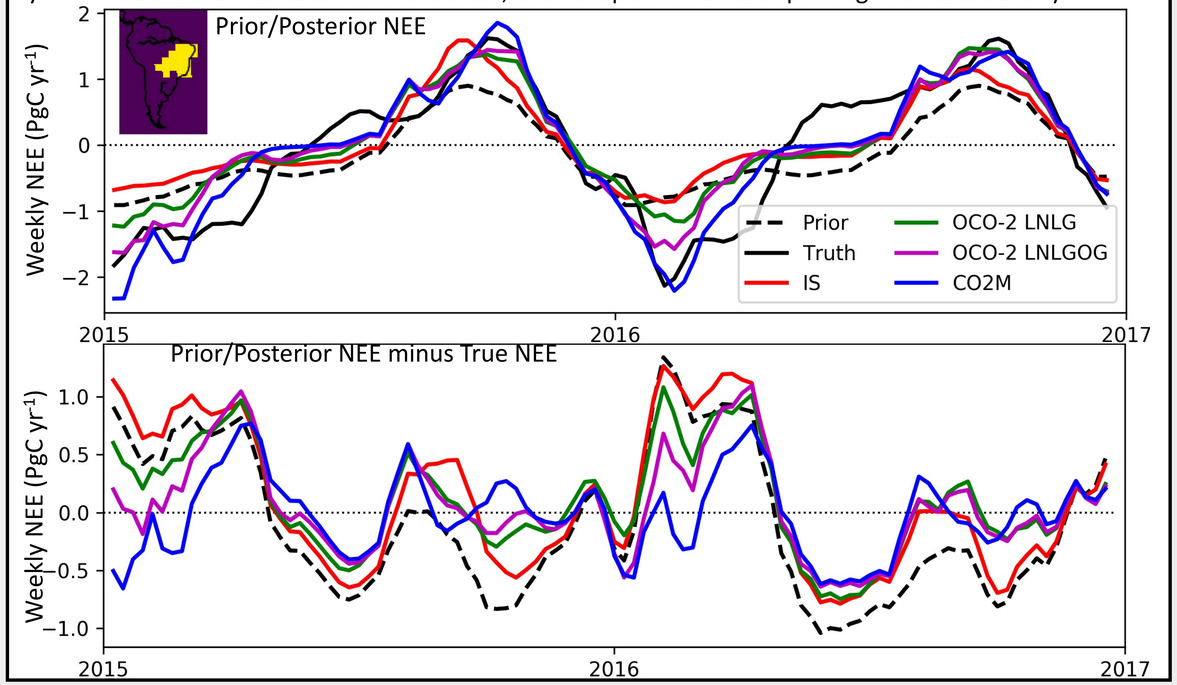
## Introduction

We investigate how well CO2M, OCO-2, and in situ (IS) data can recover weekly NEE fluxes using Observing System Simulation Experiments (OSSEs). For these experiments, we perform two year OSSEs optimizing weekly NEE on a 4x5 degree grid with CMS-Flux. CO2M sampling was simulated and cloud/aerosol filtering was applied to the data. For OCO-2 and in situ measurement, real observational coverage was employed. The NEE fluxes imposed were:

- True fluxes were obtained by combining climatological NEE fluxes from a GOSAT inversion with interannual variations in NEE from FLUXCOM.
- Prior Fluxes are taken to be the ensemble mean from TRENDY, with the spread among the TRENDY models giving the prior uncertainty.

## Results: Regional fluxes

We examine the ability of the observing systems to recover NEE over southern Brazil. All the observing systems reduce the mismatch from the truth, with the performance improving with data density.

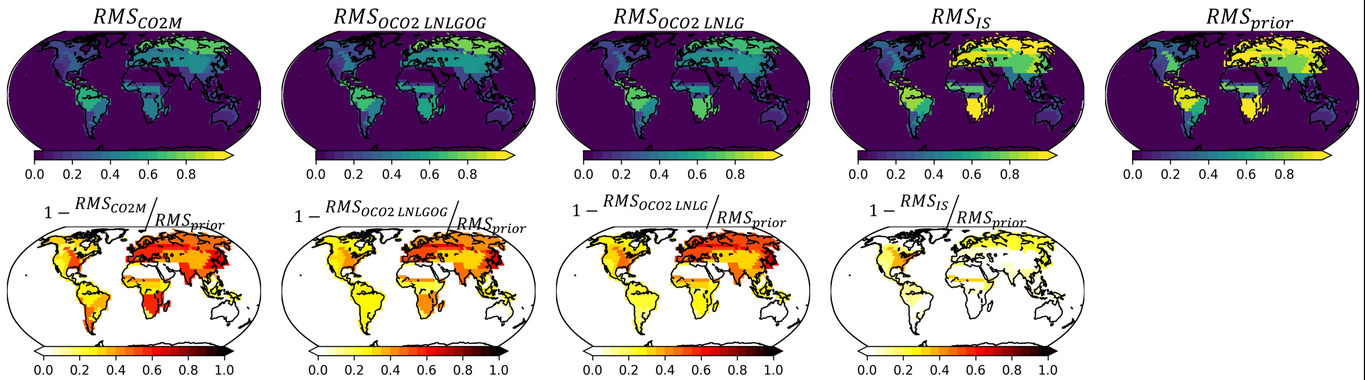



## Results: Root-mean-square errors

We quantify the ability of different observing systems to recover the true flux for 28 ecoregions based on the root-mean-square (RMS) error against the true fluxes. This is calculated separately for the mean seasonal cycle and interannual variability. We find that increased data density improves agreement of weekly fluxes with the true fluxes for both the mean seasonal cycle and anomalies. However, the denser sampling from CO2M seems to be particularly useful for capturing interannual variations in weekly fluxes over ecoregions.

$$RMS_{exp} = \left( \frac{1}{52} \sum_{week=1}^{52} \left( NEE_{exp} - NEE_{truth} \right)^2 \right)^{1/2}$$

RMS for mean seasonal cycle: $\frac{NEE_{2015}+NEE_{2016}}{2}$




RMS for anomalies: $NEE_{2016} - NEE_{2015}$