Geophysical Research Abstracts
Vol. 21, EGU2019-11701, 2019
EGU General Assembly 2019

Net Biosphere Exchange in Recent Past: Uncertainty Comparison Between Model-data Fusion and Earth System Models

Gregory Quetin (1), Anthony Bloom (2), Kevin Bowman (2), and Alexandra Konings (1)
(1) Stanford University, Earth System Science, United States (gquetin@stanford.edu), (2) NASA Jet Propulsion Laboratory

Net biosphere exchange (NBE) integrates the different components of the terrestrial carbon cycle. At global scale, data-driven constraints on NBE are only available in recent years, and simulations are needed to provide further insights into the mechanisms and long-term evolution of the carbon cycle. Estimations of the uncertainty in NBE are critical in projecting long-term changes in the carbon cycle. In this work, we compare the mean and uncertainty of NBE estimated by a model-data fusion approach (through CARDAMOM) and a more conventional ensemble-of-opportunity from Earth System Models (ESMs, here TRENDY and CMIP5). CARDAMOM uses remotely sensed spatially explicit observational constraints including mean leaf area, solar induced fluorescence, and NBE from the Carbon Monitoring System-Flux (CMS-Flux). Uncertainty in the data-fusion model is empirically estimated through an ensemble of thousands of parameter iterations for the underlying carbon cycle model. The single model used by CARDAMOM is relatively simple compared to ESMs, which may lead to relatively large structural uncertainties. However, the model-data fusion allows for systematically estimated parametric uncertainty constrained by available observations.

In this project we compare the estimated gross primary productivity (GPP) and NBE predicted by CARDAMOM with the spread of outcomes from an ensemble of CMIP5 ESMs (parametric, structural, and meteorological differences) and land models in TRENDY (parametric and structural differences). The comparison is for the recent past – 1997 to 2009 – to include more than a decade of overlap, while being outside of the observational periods used to constrain CARDAMOM.

The ensemble of CARDAMOM simulations is generally able to reproduce seasonal climatology of observed NBE and contiguous solar induced fluorescence (CSIF) – shown to be proportional to GPP - in regions where we expect the observations to have skill. Additionally, the match of regional fluxes from TRENDY and CMIP5 ESMs with observations is qualitatively similar to that of the CARDAMOM ensemble members. These results are encouraging for the use of model-data fusion products for global carbon cycle studies with empirically estimated uncertainty.