Toward integrated seasonal predictions of land and ocean carbon flux: lessons from the 2015-16 El Niño

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Seasonal Forecasts Beyond Climate
Coupled atmosphere-ocean GCMs increasingly provide skillful forecasts of climate 3-9 months into the future (Fig. 1). With advances in the complexity of model components, skillful seasonal predictions of carbon cycle flux may one day be possible.

GEOS Predictions of the 2015-16 El Niño
We examine the predictability of the carbon cycle response to the 2015-16 El Niño using NASA’s GEOS modeling system. Figure 2 shows SST anomaly forecasts while Figure 3 shows temperature and precipitation z-scores for forecasts beginning in Dec., 2015.

Prediction of the 2016 Carbon Flux Anomalies
Next, we use the predicted climate anomalies to estimate land and ocean carbon flux anomalies. Ocean flux anomalies (Fig. 4) were calculated by the NASA Ocean Biogeochemical Model (NOBM) driven by forecast meteorology. Land flux anomalies (Fig. 5) were computed using a statistical model of NBP trained using a 38-year simulation by the Catchment-CN terrestrial biosphere model and driven by 9-month forecast meteorology.

Atmospheric CO2 Impact
Finally, we integrate the predicted climate anomalies in the GEOS AGCM and compare to observed anomalies from OCO-2 (Fig. 6).

Next Steps
Ongoing work is focused on: developing bias correction techniques for forecast meteorology; defining skill metrics; quantifying skill in other initialization months and time periods (neutral, La Niña); and better understanding the potential user needs of such forecasts.

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