(47-210426-A) **Global Land GPP from the Terrestrial Photosynthesis State Estimate**

A.R. Jacobson[1,2], A. Kaushik[1,3], A. Schuh[4], I. Baker[4], and D. Munro[1,2]

[1]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309; 303-497-4916, E-mail: andy.jacobson@noaa.gov
[2]NOAA Global Monitoring Laboratory (GML), Boulder, CO 80305
[3]University of Colorado, Department of Atmospheric and Oceanic Sciences, Boulder, CO 80309
[4]Colorado State University, Fort Collins, CO 80523

We have developed a Bayesian state estimation system for terrestrial global gross primary production (GPP). This system, called the Terrestrial Photosynthesis State Estimate (TPSE) represents GPP as the weighted sum of global basis functions. Its unknowns are the time-varying magnitudes of these spatial patterns. A key feature of TPSE is that uncertainties are fully characterized. This allows us to put confidence limits on results for individual grid cells, used to represent point measurements, or on arbitrary collections of grid cells, representing political entities, ecosystems, or other regions of interest. TPSE is intended to serve as a prior for CarbonTracker, in which its unbiased estimate and explicit uncertainties will allow better use of limited atmospheric observations.

TPSE has been tested in a OSSE framework in which it is challenged to retrieve a 20-year time series of Simple Biosphere Model Version 4 (SiB4, Haynes et al 2019) GPP from a modest number of noisy synthetic measurements. TPSE successfully reproduces this artificial truth condition, finding predicted uncertainties that are consistent with actual performance. This system was designed to exploit eddy covariance and satellite observational measures of GPP, and we will report on results from a TPSE trial assimilating Flux Network 2015 (FLUXNET2015, Pastorello et al. 2020) eddy covariance data, and a trial also assimilating satellite estimates of Solar Induced Fluorescence (SIF). These are both imperfect constraints on globally-distributed GPP, and while TPSE does not extract more information from them than other mapping techniques, it does provide a unique alternative to those efforts. Its ability to represent error bounds also allows us to determine the statistical significance of TPSE results.

References

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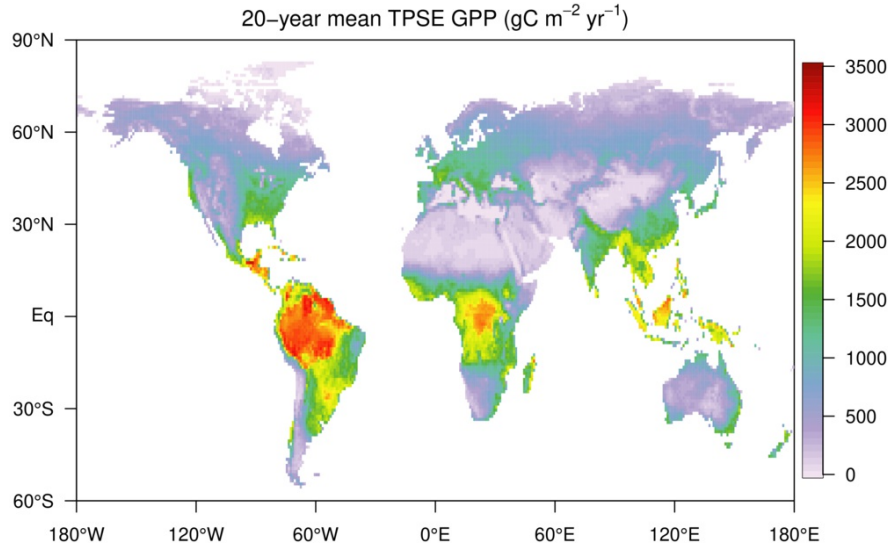

Figure 1. Long-term mean terrestrial global primary production (GPP) retrieved by the Terrestrial Photosynthesis State Estimate (TPSE) in an observing system simulation experiment using 200 noisy measurements per month from a SiB4 (Haynes et al., 2019) simulation.