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Water Constraint is Limiting Global Gross Primary Productivity

Nima Madani[1], Nicholas Parazoo[1], John Kimball[2], Ashley Ballantyne[2], Marco Maneta[2], Sassan Saatchi[1], Paul Palmer[3], Zhihua Liu[2], and Torbern Tagesson[4]

[1]Jet Propulsion Laboratory, United States of America (nima.madani@jpl.nasa.gov)
[2]University of Montana
[3]University of Edinburgh
[4]Lund University

We use a light use efficiency model (LUE) to describe gross primary productivity (GPP) from 1982 to 2016 using the GIMMS-3g FPAR record and NASA MERRA-2 reanalysis, and explore how GPP trends and anomalies can be explained using annual changes in temperature and hydrology. The GPP model uses optimum LUE (LUE_{opt}) inferred from the global FLUXNET network and extrapolated using solar induced chlorophyll fluorescence observations. We find that increasing trends in GPP at mid to high latitudes over the 35-year study period are due to reduced cold temperature of plant growth constraints. Our results suggest a persistent and increasing negative carbon-climate feedback at mid to high latitudes. We also find an increasing atmospheric vapor pressure deficit trends over the tropics, which represents an emerging positive climate feedback that results in a negative trend in GPP after the early 2000s. We expect that further warming, increasing water constraints, and disturbance events will significantly reduce global ecosystem productivity.