

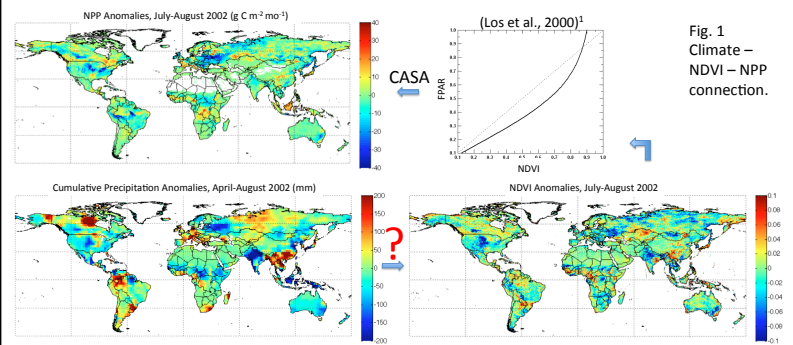
Analysis of the relationship between climate and NDVI variability at global scales

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1. Introduction: interannual variability in modeled (CASA) C flux is in part caused by interannual variability in NDVI (FPAR) (Fig. 1).



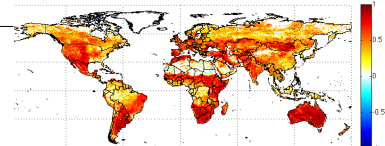
2. Justification: Is interannual variability in NDVI explained by climate? Here we examine the sensitivity of NDVI to interannual variability in precipitation and temperature.

3. Data:

Table 1. Data sets used.

	Resolution		Period
	Spatial (°)	Temporal	
GIMMS 3g NDVI ²	0.08	Semimonthly	1981-2010
GPCP precipitation ³	2.5	Monthly	1979-2009
CRU climatology ⁴	0.5	Monthly	1961-1990 (base)
GISS temperature anomaly ⁵	2	Monthly	1880-2010

Fig. 2 GIMMS - MODIS Aqua NDVI⁶ (0.25° monthly, 2003-2010) anomaly correlations significant ($p < 0.05$) in 76% of land pixels.



- Data sets used: long record; global coverage; consistent with data sets of higher quality (Fig. 2);
- Use of TRMM precipitation (40°N-40°S, 0.25°, semimonthly, 1998-2010)⁷ gives the same result.

4. Methods:

4.1. Conducted Pearson's correlation analyses at pixel level with varying lags (of NDVI response to climate) on:

- 1982-2009 NDVI - precipitation anomaly time series (monthly, $1^\circ \times 1^\circ$);
- 1982-2010 NDVI - temperature anomaly time series (monthly, $0.5^\circ \times 0.5^\circ$);

4.2. Accounted for first-order temporal autocorrelation following Dawdy and Matalas (1964)⁸. Only significant correlation coefficients (r values with corrected p values < 0.05 , two-tailed t -test) are shown.

5. Results:

5.1. NDVI - precipitation anomaly correlations:

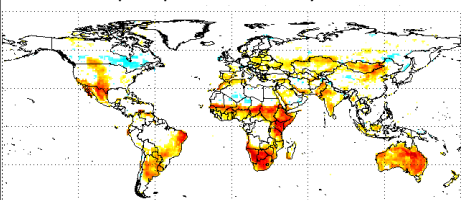


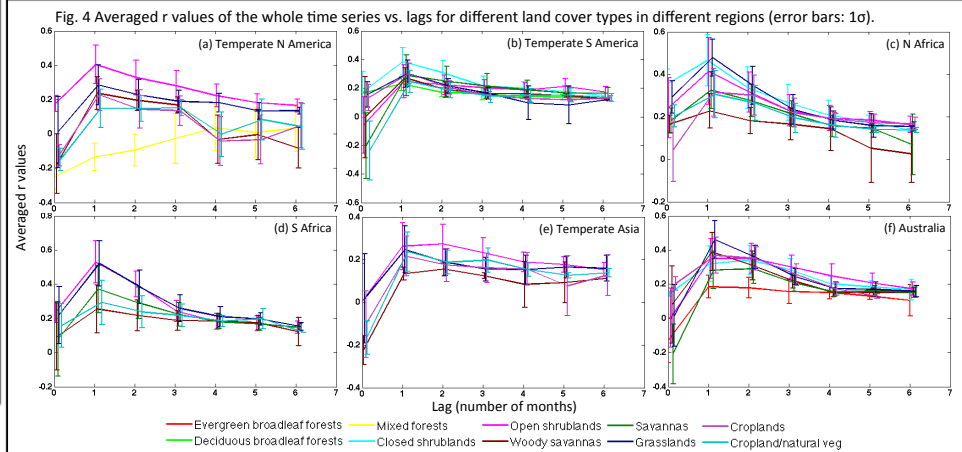
Fig. 3 NDVI - precipitation correlations for the whole time series (1 month lag). (Results using monthly precipitation here were consistent with those using accumulative precipitation (not shown).)

- Strongest for 1-month preceding precipitation;
- Significant in 36% of land pixels;
- Positive in arid and semiarid areas where grasslands and shrublands are the dominant land cover types.

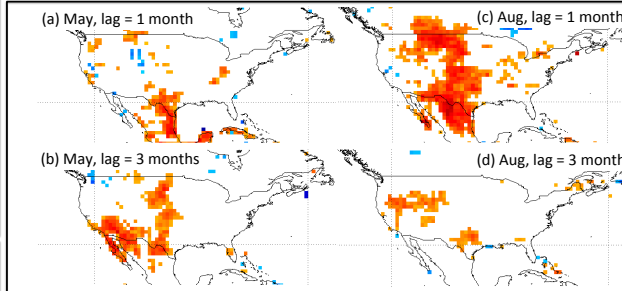
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Acknowledgements: This work is supported by NASA's Carbon Monitoring System project and Carbon Cycle Science element of the Terrestrial Ecology Program.



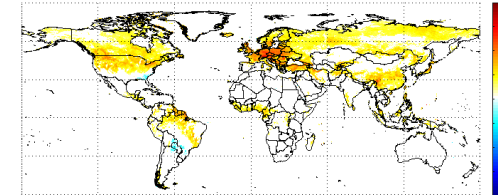
- Higher herbaceous cover (forests \rightarrow woody savannas \rightarrow savannas \rightarrow closed+open shrublands & grasslands): stronger correlations and clearer 1-month peak lag pattern.



- Early growing season (May): NDVI most sensitive to precipitation during winter and spring;
- End of growing season (August): NDVI most sensitive to more recent precipitation.

5.2. NDVI - temperature anomaly correlations:

Fig. 6 For the whole time series (no lag).



- Strongest for current month temperature (Fig. 6&7);
- Significantly positive in 40% of total land pixels, and 77% of these pixels are north of 35°N (Fig. 6);
- Not associated with land cover types.

Fig. 7 Averaged r values vs. lags for different regions.

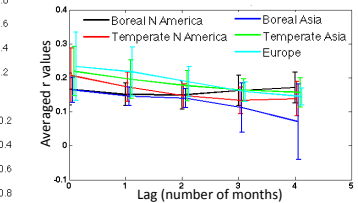
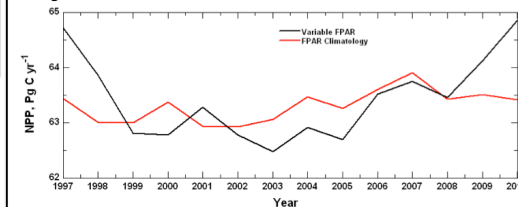


Fig. 8 Annual NPP modeled from variable FPAR vs. from FPAR climatology.



6. Conclusion:

- This study confirms a mechanism producing variability in modeled NPP:
 - NDVI (FPAR) interannual variability is strongly driven by climate;
 - The climate driven variability in NDVI (FPAR) can lead to much larger fluctuation in NPP vs. the NPP computed from FPAR climatology (Fig. 8).