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Supporting Online Material for

Response to Comments on "Drought-Induced Reduction in Global Terrestrial Net Primary Production from 2000 Through 2009"

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SOM Text S1)

We processed the Collection 5 MODIS 1-km NDVI, EVI (S*1*) and FPAR (S*2*) by following exactly the same method as used by Samanta *et al.* (S*3*) to filter unreliable pixels contaminated by cloudiness and heavy aerosols. Following Samanta *et al.*'s method, we also used aerosol information from 16-day quality assessment field in MODIS NDVI and EVI to further filter out aerosol-contaminated FPAR; additionally, we aggregated 8-day reliable FPAR into 16-day (S*3*) before calculating growing season average. The differences in our data and Samanta *et al.*'s (S*3*) are: i) we used the original 1-km NDVI and EVI instead of the Climate Model Grid (CMG) 0.05˚ NDVI and EVI; ii) we aggregated 1-km reliable data into 0.05˚ by averaging reliable values in a 6 by 6 1-km MODIS window rather than into 8km; iii) instead of calculating annual average of NDVI, EVI and FPAR, we first used 0.05˚ CMG MODIS snow cover data (Fig. S1) (MOD10C2, S*4*) to define average snow-free period over 2000-2009 as the growing season, and then calculated annual growing season average vegetation indices (S*5*).

Our growing season average NDVI, EVI and FPAR are more scientific to address vegetation activity than Samanta *et al.*'s (S*3*) because i) the direct use of the CMG 0.05˚ global MODIS NDVI and EVI data by Samanta *et al.* (see S3.1 in S*3*) may introduce inconsistency to their cleaned NDVI and EVI datasets since information from some 1-km pixels can be missed and the original CMG may use a different quality screen method; ii) more importantly, simply averaging annual reliable NDVI, EVI and FPAR can introduce noises for quantification of vegetation dynamics because land with or without snow cover during dormant seasons can change annual averages of these vegetation indices, though they further screened out low values of vegetation indices, some values above the thresholds may still be in dormant seasons, especially for evergreen needle leaf forests.

For the spatial pattern of significant changes in growing season average NDVI, EVI and FPAR from 2000 through 2009, we used $p = 0.1$ as the threshold for significant linear trends (Table S1 and Fig. S2).

SOM Text S2)

In response to the comments of sensitivity of our NPP model to temperature from both comments (S*3*, S*6*), four sensitivity tests were performed by lessening the sensitivity of respiration to temperature and by weakening constraints from vapor pressure deficit (*VPD*). For the first two sensitivity tests, we set two different constant Q_{10} values (2.0 and 1.4, respectively) for all organs (leaf, fine root and livewood) across all biomes; for the last two sensitivity tests, we set a constant 1.4 of Q_{10} but two different levels of daily maximum *VPD* ($VPD_{max,}$ 5,000 and 10,000 Pa, respectively) at which stomatal conductance reduces to zero and photosynthesis halts. The Q_{10} value, 1.4, is from a study of total ecosystem respiration based on data from 60 FLUXNET sites (S*7*). However, this lower Q_{10} value includes heterotrophic respiration from dead tissue, while we compute only autotrophic respiration of live tissue. For all four sensitive tests, we ran the global MODIS NPP at 1-km from 2000 through 2009. Q_{10} and VPD_{max} for the control results are without modification and from a Biome-Property-Look-Up-Table (BPLUT) (Table S1 in S*5*).

Table S1. Percentage (%) of vegetated land areas with significant changes (*p* = 0.1) in the Collection5 MODIS growing season average FPAR, NDVI and EVI from 2000 through 2009 (Fig. S2). "Tropical-rainforest" refers to areas with evergreen broadleaf forests as in MOD12Q1 (S*8*) land cover type 2 within the Tropic of Cancer and of Capricorn (23.5°S-23.5°N). "Not tropical-rainforest" refers to all vegetated land areas excluding the Tropical-rainforest. The sign "+" refers to significant upward trends whereas the sign "–" denotes significant downward trends. The method is detailed in SOM Text S1. **Both NDVI and EVI always have a much higher percentage of vegetated areas with significant decreased trends than that with significant increased trends in contrast to FPAR results except in the Southern Hemisphere.**

	FPAR -	FPAR +	NDVI -	NDVI +	EVI -	EVI +
Global	8.41	8.91	17.85	7.52	12.94	6.66
South of 70˚N	8.34	8.98	17.79	7.59	12.85	6.70
Southern Hemisphere	12.11	6.97	26.43	5.15	16.49	4.33
Northern Hemisphere	6.81	9.75	14.11	8.55	11.40	7.68
Amazon rainforests	5.88	6.89	46.53	0.68	17.88	1.48
Tropical-rainforest	6.82	6.52	40.58	1.35	16.69	1.86
Not tropical-rainforest	8.66	9.28	14.33	8.48	12.37	7.41

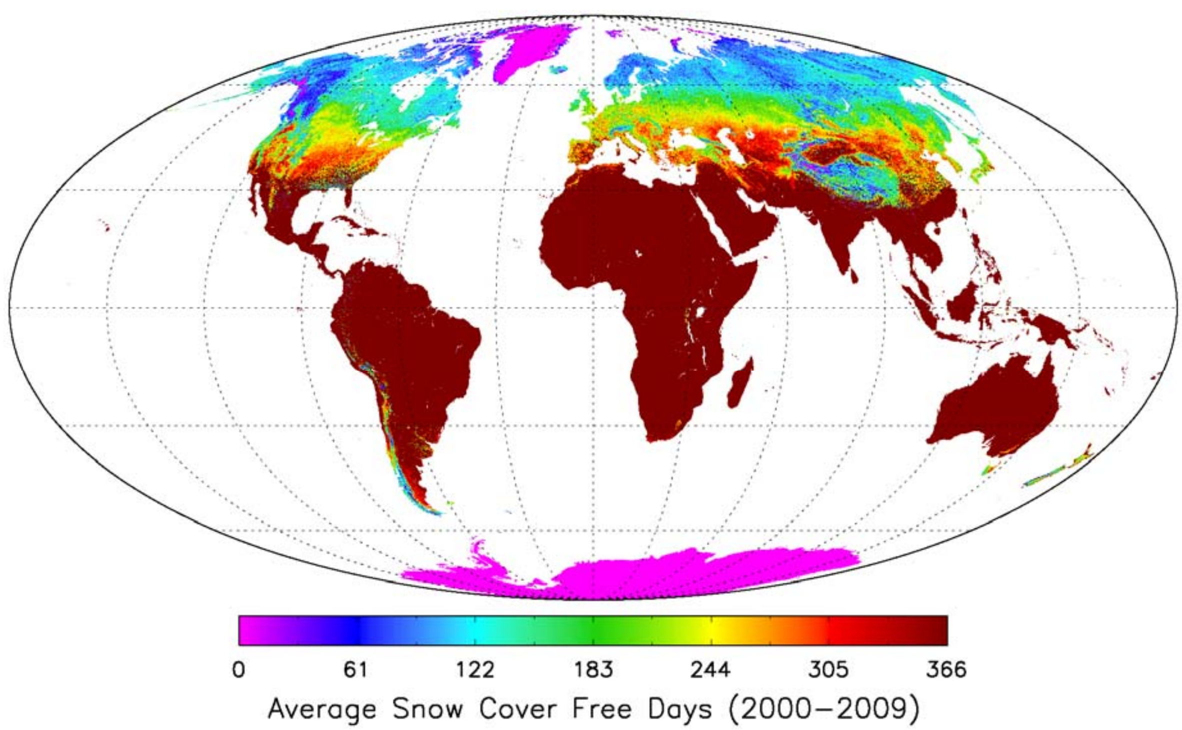

Fig. S1. Average snow cover free days derived from 8-day MODIS snow cover data from 2000 through 2009, which is use to calculate growing season average FPAR, NDVI, EVI (S*5*).

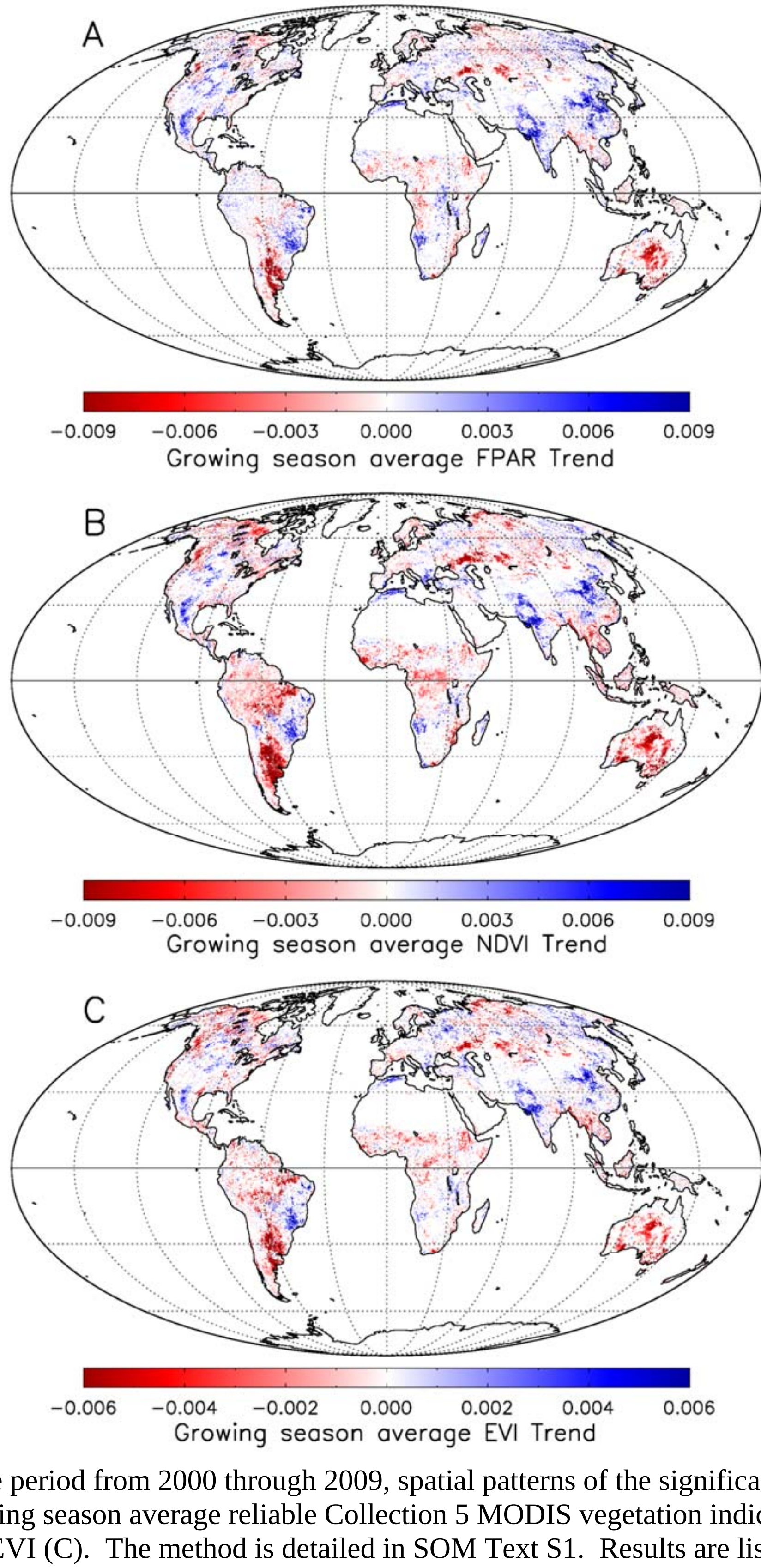

Fig. S2. For the period from 2000 through 2009, spatial patterns of the significant trends (p = 0.1) in the growing season average reliable Collection 5 MODIS vegetation indices, FPAR (A), NDVI (B) and EVI (C). The method is detailed in SOM Text S1. Results are listed in Table S1.

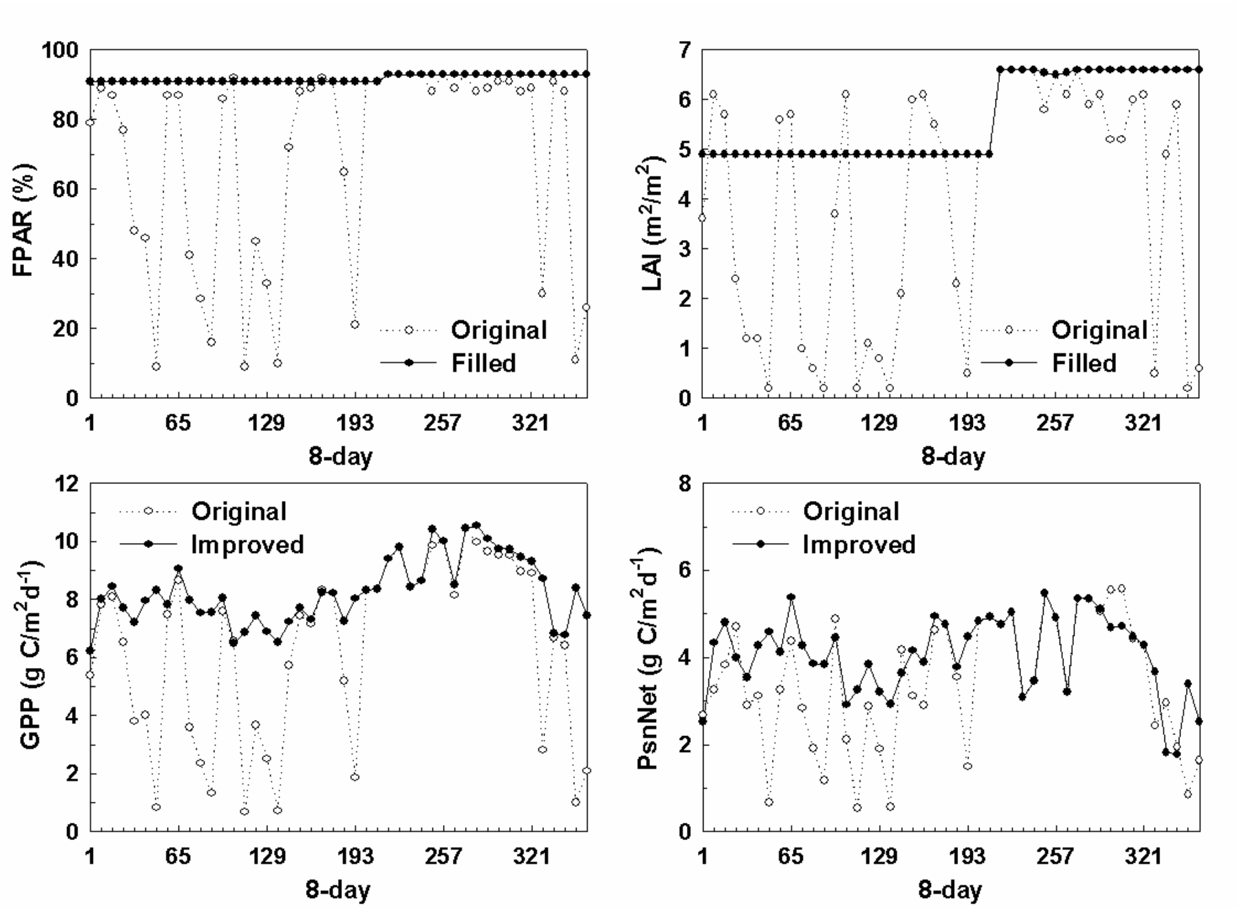

Fig. S3. An example on how temporal filling unreliable 8-day Collection 4 FPAR/LAI, and therefore improved 8-day GPP and PsnNet for one MODIS 1-km pixel located in Amazon basin (lat = -5.0, lon = -65.0). In 2002, the improved annual GPP and NPP are 2759 g C/m^2/yr and 914 g C/m^2/year, respectively, in comparison to the corresponding original annual GPP and NPP of 2252 g C/m^2/year and 871 g C/m^2/yr (Figure 5 from S*9*). The higher and unreliable LAIs before 8-day 193 were derived by the empirical MODIS FPAR/LAI algorithm, which is employed under unfavourable atmospheric conditions and tends to overestimate LAI (S*10*). Empirically derived LAI should not be used (S*10*).

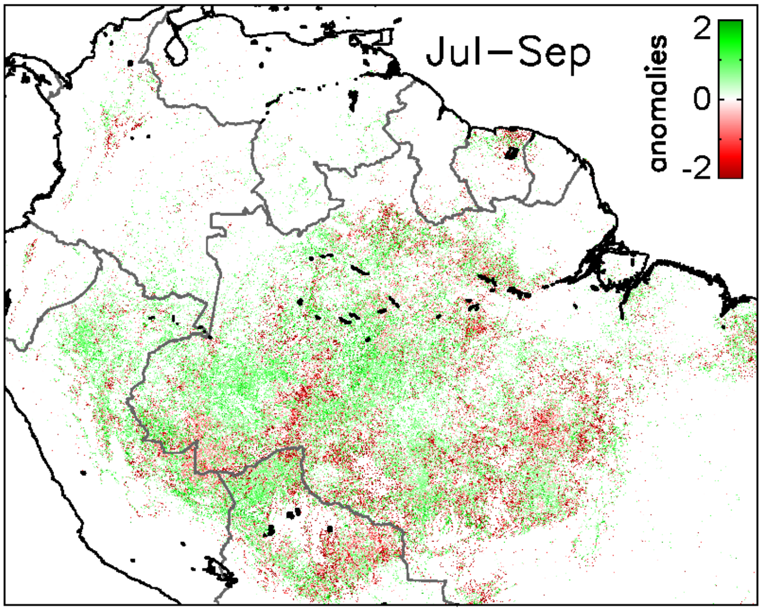

Fig. S4. Standardized anomalies of the Colleciton5 MODIS 1-km FPAR over dry season (July to September) in 2005. Anomalies are calculated relative to dry season from 2000 to 2004, but excluding 2005. We followed exactly the same method as used by Samanta *et al.* (S*3*) to screen out these contaminated FPAR by cloudiness and aerosols without temporal filling of reliable FPAR, and also aggregated 8-day reliable FPAR into 16-day in a way same as Samanta *et al.*(S*3*) (SOM Text S1). For this figure, we didn't spatially aggregate 1-km data into CMG grid. These 16-days within July to September are Julian dates of 193, 209, 225, 241 and 257. We also screened out these no rainforest (rainforests are defined as evergreen broadleaf forests) pixels based on MODIS land cover dataset, MOD12Q1 (S*8*). For all areas south of the equator with rainforests (evergreen broadleaf forests), 28.5% area was greener while 16.8% was browning, and the rest had no change. Overall, the updated results are consistent with our previous report that "green-up" Amazon in the 2005 drought as expressed by MODIS FPAR (S*5*).

References and Notes

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