



# Supplement of

## Vegetation greenness and land carbon-flux anomalies associated with climate variations: a focus on the year 2015

Chao Yue et al.

Correspondence to: Chao Yue (chao.yue@lsce.ipsl.fr)

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**Figure S1** Rank of seasonal mean NDVI for the four seasons of 2015 (Q1 = January to March, Q2 = April to June, Q3 = July to September and Q4 = October to December) over the period 2000–2015. Larger numbers correspond to higher NDVI ranks, with 16 (magenta colour) indicating grid cells where NDIV reached the highest in 2015.



**Figure S2** Seasonal distributions of land areas where 2015 shows the highest NDVI since 2000 as a function of latitude. Shaded areas represent different seasons stacked on top of each other.



**Figure S3** Annual NDVI anomalies for different latitudinal bands. The trend line is shown for regions where significant simple linear regression over time is obtained.



**Figure S4** Relationship between de-trended land uptake anomalies and air temperature anomalies for different seasons and regions. Solid dots indicate the year of 2015. Numbers on the plots show the estimated slopes using an ordinary least square simple linear regression, with the asterisk indicating a significant regression (p<0.05). n = 34 (i.e., 1981–2015 except 1993).



**Figure S5** Relationship between de-trended land uptake anomalies and precipitation anomalies for different seasons and regions. Solid dots indicate the year of 2015. Numbers on the plots show the estimated slopes using an ordinary least square simple linear regression, with the asterisk indicating a significant regression (p<0.05). Also note indicated slopes are for 10 mm per season. n = 34 (i.e., 1981–2015 except 1993).

## (a) CAMS



(b) Jena04



**Figure S6** De-trended seasonal anomalies of land carbon uptake for the four seasons of the year 2015  $(\text{kgC m}^{-2} \text{ season}^{-1})$  by the two inversion systems, **(a)** CAMS and **(b)** Jena04.



**Figure S7** Relationship between de-trended land uptake anomalies and NDVI anomalies for different seasons and regions. Solid dots indicate the year of 2015. Numbers on the plots show the estimated slopes using an ordinary least square simple linear regression, with the asterisk indicating a significant regression (p<0.05). n = 16 (i.e., 2000–2015).



**Figure S8** Anomalies of land carbon uptake linearly de-trended for 1981–2015 for different seasons in 2015, estimated by the CAMS (blue) and Jena04 (orange) inversion data. Data are shown for: (a) boreal Northern Hemisphere (BoNH, latitude > 45°N), (b) temperate Northern Hemisphere (TeNH, 23.5° < latitude < 45°N) the two sub-regions of (c) BoTeNH defined in the main text. Dots indicate seasonal values with solid dots indicating that the anomaly is below the 10th or above 90th percentile over 1981–2015. Vertical bars indicate the annual sum.

### (a) air temperature



(b) soil water content



**Figure S9** De-trended seasonal climate anomalies for 2015: (a) air temperature and (b) volumetric soil water content from ERA interim reanalysis. Hatched regions indicate <10th or >90th percentile over 1981-2015.



**Figure S10** The evolution of El Niño events during 2014–15 and comparison with that of 1997–98, and its influence on climate and carbon uptake variations over land in the tropics and extratropical Southern Hemisphere (TroSH, latitude < 23.5°N). The state of ENSO in warm (El Niño) or cold (La Niña) phase is indicated by the Multivariate ENSO Index (MEI) and the Oceanic Niño Index (ONI, http://www.cpc.ncep.noaa.gov/products/analysis\_monitoring/ensostuff/ONI\_change.shtml). Positive values of MEI indicate a warm phase, and negative a cold phase. For ONI, warm or cold periods of ENSO are often judged based on a threshold of +/- 0.5°C. All other variables are shown as monthly anomalies

with linear trends being removed for each month over 1981–2015 except for fire carbon emissions for which the de-trending time window is 1997–2009. Fire emissions are derived from GFED4s data. For fire emissions, TroSH is further divided into three sub-regions: northern tropics ( $0^{\circ}$  < latitude < 23.5°N), southern tropics ( $0^{\circ}$  < latitude < 23.5°S) and southern extra-tropics (latitude > 23.5°S). Antarctica is excluded when making the analysis. Data are shown for 1997–98 and 2014–16. The shaded area indicates Q4 (October to December) of 2015. Note the different Y-axis scales for subplots of fire emissions.

#### (a) CAMS



(b) Jena04



Figure S11 Measurement sites for 2015 used in (a) CAMS and (b) Jena04 inversions.