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The impact of the 2018 summer drought on Europe's terrestrial biospheric carbon exchange from combined remote sensing, crop and forest modeling, and atmospheric inversions

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High temperatures, low relative humidity, and reductions in soil moisture available to plants under intense drought conditions leads to reductions in photosynthetic activity in many plant functional types. During the summer of 2018, we see this across central and northwestern Europe in our sun-induced fluorescence (SIF) remote sensing product SIFTER [1], suggesting that the terrestrial biosphere took up less carbon from the atmosphere that year than it does under typical summer conditions.

We use a variety of atmospheric drivers to generate multiyear soil moisture fields using the 5x5 km hydrological model PCR-GLOBWB, which is subsequently used along with SIF in the biosphere model SiB4 to drive simulations of gross primary production (GPP), following the method of van Schaik et al. 2018 [2] . We optimise the biosphere fluxes first using reported crop yields after Combe et al. 2017 [3] and secondly with observed atmospheric CO_2 mole fractions in the atmospheric inverse system CarbonTracker Europe [4].

We will quantify the impact of the drought on the carbon fluxes of Europe's biosphere using these optimised values, and illustrate the dominant pathways across forests, grasslands, and croplands. The severity, spatial extent, and onset- and recovery-timing of the anomaly in GPP will be compared to other recent notable drought events in EurAsia, such as that of 2003 and 2010.

[1] Koren, Gerbrand, et al. "Widespread reduction in sun-induced fluorescence from the Amazon during the 2015/2016 El Niño." Philosophical Transactions of the Royal Society B: Biological Sciences 373.1760 (2018): 20170408.

[2] van Schaik, Erik, et al. "Changes in surface hydrology, soil moisture and gross primary production in the Amazon during the 2015/2016 El Nino." Philosophical Transactions of the Royal Society B: Biological Sciences 373.1760 (2018): 20180084.

[3] Combe, Marie, et al. "Grain yield observations constrain cropland CO_2 fluxes over Europe." Journal of Geophysical Research: Biogeosciences 122.12 (2017): 3238-3259.

[4] der Laan-Luijkx, Van, et al. "The CarbonTracker Data Assimilation Shell (CTDAS) v1. 0: implementation and global carbon balance 2001-2015." Geoscientific Model Development10.7 (2017): 2785-2800.