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Sensitivity of tropical and extratropical land carbon to variations in water and temperature

Johannes Winckler (1), Ana Bastos (1,2), Frédéric Chevallier (1), Martin Jung (3), and Philippe Ciais (1)

(1) Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, France, (2) Ludwig Maximilian University of Munich, Germany, (3) Max Planck Institute for Biogeochemistry, Jena, Germany

Variations in the land carbon sink are driven by variations in water availability and temperature, but the contribution of each factor to the global land-sink variability and the atmospheric CO_2 growth-rate are still unclear. There is an ongoing debate about to what extent the sensitivities to variations in water availability and temperature differ between the tropics and the extratropics, and how much each region contributes to the global-scale sensitivities. The role of productivity versus decomposition and their sensitivities to water and temperature is also an open question. In this study we want to revisit this topic by merging different sources of data that can provide further insights about these questions. Atmospheric CO_2 inversions provide gridded estimates of land-atmosphere carbon fluxes by combining atmospheric CO_2 measurements and transport models. These inversions allow an observation-based split-up of variations in land carbon into contributions from the tropics and the extratropics. However, inversions do not provide further insight to whether productivity or decomposition drive the response of the land-sink. Land-surface models and data-driven products based on eddy-covariance flux measurements, on the other hand, allow partitioning the net land-atmosphere flux into productivity and respiration components. Land-surface models are also now able to reproduce most of the variability in the land-sink [Le Queré et al., 2018].

Here, we use statistical methods to quantify the sensitivity of net land-atmosphere fluxes to temperature and water availability and temperature based on atmospheric CO_2 inversions, and compare the results with the models from the latest TRENDY intercomparison [v7, Le Queré et al., 2018]. We explore the dependence of the land carbon variability on variations in water availability and temperature, separately for tropics/extratropics and for different seasons. Furthermore, we analyze the contributions of productivity and decomposition separately. Finally, we discuss the challenges of using the inversions in such an approach.

Le Queré et al. (2018): Global carbon budget 2017, Earth Syst. Sci. Data, 10, 405–448, https://doi.org/10.5194/essd-10-405-2018