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Reviewing the role of precipitation and soil moisture in driving the terrestrial carbon cycle variability in Europe: recent advances and known unknowns

Gabriele Messori[1,2,3], Guiomar Ruiz-Pérez[4], Stefano Manzoni[3,5], and Giulia Vico[4]

[1]Dept. of Earth Sciences, Uppsala University, Uppsala, Sweden (gabriele.messori@geo.uu.se)
[2]Department of Meteorology, Stockholm University, Stockholm, Sweden
[3]Bolin Centre for Climate Research, Stockholm, Sweden
[4]Department of Crop Production Ecology, Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden
[5]Department of Physical Geography, Stockholm University, Stockholm, Sweden

The terrestrial biosphere is a key component of the global carbon cycle and is heavily influenced by climate. This interaction spans a wide range of temporal (from sub-daily to paleoclimatic) and spatial (from local to continental and global) scales and a multitude of bio-physical processes. In part due to this complexity, a comprehensive picture of the physical links and correlations between climate drivers and carbon cycle metrics at different scales remains elusive, framing the scope of this contribution. Here, we specifically explore how precipitation, soil moisture and aggregated climate variability indices relate to the variability of the European terrestrial carbon cycle at sub-daily to interannual scales (i.e. excluding long-term trends). We first discuss broad areas of agreement and disagreement in the literature. For example, while most carbon cycle proxies tend to correlate positively with precipitation, responses to soil moisture and climate indices are more variable. In fact, soil moisture often correlates positively with productivity in water-limited environments, and negatively in light limited ones, or can exhibit nonlinear relations with the carbon cycle proxies. We then conclude by outlining some existing knowledge gaps and by proposing avenues for improving our holistic understanding of the role of climate drivers in modulating the terrestrial carbon cycle.