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Ecosystem carbon and radiative fluxes: a global synthesis based on the FLUXNET network.

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Solar radiation is the most important environmental factor driving the temporal and spatial variability of the gross primary productivity (GPP) in terrestrial ecosystems. At the ecosystem scale, the light use efficiency (LUE) depends not only on radiation quantity but also on radiation "quality" both in terms of spectral composition and angular distribution. The day-to-day variations in LUE are largely determined by changes in the ratio of diffuse to total radiation. The relative importance of the concurrent variation in total incoming radiation and in LUE is essential to estimate the sign and the magnitude of the GPP sensitivity to radiation. Despite the scientific relevance of this issue, a global assessment on the sensitivity of GPP to the variations of Phar is still missing. Such an analysis is needed to improve our understanding of the current and future impacts of aerosols and cloud cover on the spatio-temporal variability of GPP.

The current availability of ecosystem carbon fluxes, together with separate measurements of incoming direct and diffuse Phar at a large number of flux sites, offers the unique opportunity to extend the previous investigation, both in terms of ecosystem, spatial and climate coverage, and to address questions about the internal (e.g. leaf area index, canopy structure) and external (e.g. cloudiness, covarying meteorology) factors affecting the ecosystem sensitivity to radiation geometry.

For this purpose half-hourly measurements of carbon fluxes and radiation have been analyzed at about 220 flux sites for a total of about 660 site-years. This analysis demonstrates that the sensitivity of GPP to incoming radiation varies across the different plant functional types and is correlated with the leaf area index and the local climatology. In particular, the sensitivity of GPP to changes in incoming diffuse light maximizes for the broadleaved forests of the Northern Hemisphere.