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Year-to-year variability of ecosystem CO_2 and H_2O exchange of European forests inferred from eddy covariance flux data: patterns, factors and driving processes

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In this analysis we are trying to characterize the year-to-year variability of carbon fluxes, and identify the driving processes (e.g. assimilation versus respiration) as well as the climatic versus biological controls at European forest sites. Overall, between-year differences in annual NEP can be largely be attributed to variability in GPP and less in TER. Sometimes even positive correlations of NEP with TER are found, which is counterintuitive and shows that high TER is indicative of high productivity under most conditions. Moreover variability of year-to-year NEP seems to be largely caused by summer-time variability, except in some Boreal sites. No simple climate index could be identified that explains interannual variability, but it became evident that changes in GPP are largely due to variation in radiation-use and less by radiation absorption, i.e. ecophysiological control exceeds biophysical control. An analysis of light-response curves throughout the seasons also reveal a strong control of NEE variability by changes in ecosystem properties (e.g. assimilatory capacities identifiend from light response curves) than climatic trends. It is discussed, whether these changes are related themselves to climatic variability and rising CO_2 or intrinsic forest dynamics. Finally the site-level findings are up-scaled data-adaptive modeling approaches. The dominance of GPP versus TER in controlling IAV is confirmed in this spatial application, but exceptional regions are identified where accordings to the data-derived model TER dominates variability of annual NEP. These regions might include low-productivity ecosystems and ecosystems with large soil carbon stocks.

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