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Trends in long-term carbon and water fluxes - a case study from a temperate Norway spruce site

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In this study we analyse eddy-covariance flux measurements of carbon dioxide and water vapour from 18 years at Waldstein-Weidenbrunnen (DE-Bay), a Norway spruce forest site in the Fichtelgebirge, Germany. Standard flux partitioning algorithms have been applied for separation of net ecosystem exchange NEE into gross ecosystem uptake GEE and ecosystem respiration R_{eco}, and gap-filling. The annual NEE shows a positive trend, which is related to a strong increase in GEE, while R_{eco} enhances slightly. Annual evapotranspiration increases as well, while atmospheric demand, i.e. potential evapotranspiration, shows inter-annual variability, but no trend. Comparisons with studies from other warm temperate needle-leaved forests show, that NEE is at the upper range of the distribution, and evapotranspiration in Budyko space is in a similar range, but with a large inter-annual variability. While this trends are generally in agreement with findings from other locations and expectations to climate change, the specific history at this site clearly has a large impact on the results: The forest was in the first years very much affected due to forest decline and convalesced after a liming. In the last ten years the site was much affected by beetles and windthrow. Thus the more recent positive trends may be related to increased heterogeneity at the site. As FLUXNET stations, built 10-20 years ago, often started with “ideal forest sites”, increasing heterogeneity might be a more general problem for trend analysis of long-term data sets.