



Sensitivity of water balance and water use efficiency to climate and crop type at an agricultural site

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The effects of climatic factors and crop type on evapotranspiration (E) and water use efficiency (WUE) were analyzed using tower-based eddy-covariance data for an agricultural site in Thuringia, Germany. During ten years of observation, winter wheat (five times) and winter barley (once) were alternately planted with potato (twice), rapeseed (once) and sugar beet (once). The seasonal pattern of E was closely linked to growing-season length and rainfall distribution. Although annual precipitation (P) was highly variable (380-700 mm), minimum annual E was not less than 250 mm and was limited to 380 mm. However, a positive correlation between annual P and annual E with E plateauing at high P as was usually found at forest, grassland and peatland sites could not be observed. Winter wheat tended to limit annual E and was found to be relatively insensitive with changing annual P and solar irradiance. A hysteretic relationship between monthly mean values of E and net radiation (R_n) indicated that E lagged behind the typical seasonal progression of R_n . Annual means of daytime dry-foliage Priestley-Taylor α much less than the theoretical maximum of 1.26 for extensive well-watered vegetation showed that E on an annual basis was either water limited and/or stomatal control of transpiration must have been prevalent. In all years, a strong linear correlation between monthly mean values of gross primary production and E resulted in WUE being relatively constant between 2.5 and 3.5 g C kg⁻¹ H₂O. Our study shows that crop selection has a major impact on the water balance of an agricultural site with the influence of climatic factors being significantly different than usually found for natural ecosystems.