



Compensating effects cancel out single climate drivers on European ecosystems' carbon balance

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The paradigm that primary production is strongly related to climate control and hence future climate changes could significantly affect terrestrial carbon sink is widely accepted and vegetation growth has empirically related to climate variables like temperature and precipitation. However, terrestrial carbon sink at ecosystem level is depending on the net balance between photosynthesis (gross primary production, GPP) and respiration (both, autotrophic and heterotrophic), defined as net ecosystem production (NEP). Both parts of the carbon balance have been shown to be very sensitive to climate recently, in the context of heatwaves or gradual temperature increases. Here we

present an analysis of nearly 100 annual pan-European eddy covariance carbon and water flux data sets and come to the conclusion that the common climate relationships for primary production do not hold for NEP. We can explain this behaviour by a strong limitation of GPP and respiration by water availability instead of temperature over large parts of Europe and by the parallel decrease of respiration when climatic factors become limiting gross primary production. Part of the pattern is due to the suppression of the apparent temperature response of ecosystem respiration in dry conditions, a behaviour that is opposite to what the output from a typical biogeochemical model reveals. Hence, ecosystem carbon balance modeling approaches should abandon the convenient climate-NPP analogy and better account for carbon-water cycle interactions and non-climatic factors affecting respiration in order to successfully estimate NEP under current and future climates.