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Impacts of climate variability on the European carbon cycle – a bottom-up approach from in-situ model-data-fusion to continental-scale modeling

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Regional climate models project a substantial alteration of European's climate, for instance a mean air temperature increase of more than 2 degrees Celsius. However, despite such projected trends, the annual variance is being suggested to increase, too. In the EU FP7 project CARBO-Extreme we therefore ask about the response of land-atmosphere interactions to a changing climate variability and frequency of extreme events, such as the 2003 heatwave. This question will be addressed by several observation-based and modeling approaches alone. However, the combination of both approaches has the potential to overcome current limits of models to adequately diagnose inter-annual variability in ecosystem fluxes. There are doubts on the ability of the current modeling structures to hold in a context of climatic variability – particularly sensitivities and response functions. Therefore, the bottom-up approach followed in the CARBO-Extreme project spans from in situ appraisal to regional application of current state of the art ecosystem models.

The in situ consideration of both ecosystem manipulation experiments (EMEs) and of long term observations of ecosystem state and function focuses on two key aspects: ecosystem responses to changes in climatic regimes (trend, variability) and processes driving inter annual variability, respectively. Model evaluation and improvement are attained through formal in situ model-data fusion exercises. Then, continental modeling experiments considering ¬model structures and parameterizations consistent with observations aim at understanding the role of expected and reduced climate variability in the carbon and water cycles of terrestrial ecosystems during the 21st century. Overall, concerted initiatives that allow the tractability of changes in ecosystem responses from local to continental scales increase our understanding of land-atmosphere interactions and confer robustness on prognostic modeling.