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Interactive comment on "A probabilistic risk assessment for the vulnerability of the European carbon cycle to extreme events: the ecosystem perspective" *by* S. Rolinski et al.

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Specific comments

Item 1:
We will definitely rewrite the manuscript and include native speakers. We like the idea to formulate a few ideas and follow them through the manuscript and will include it in the revision.

Item 2:
In the current manuscript, only model derived data are handled which should be made clearer in the revision. We considered to use a data set such as MTE by Jung et al.

2011, which has ironically been proved plausible by comparing it with modelled data (Jung et al. 20111). However, the author advised us for data quality reasons not to use the entire NEE data, but only anomalies from annual averages, and this wouldn't allow the application of our method. Thus, there is no spatially explicit data set readily available for calculating ecosystem vulnerability in order to prove that our approach can be applied also to long-term observation data. Nevertheless, the model itself and most of the implemented processes are validated against data. Responses to climate extremes are compared to remote sensing products for the European heat waves 2003 in Reichstein et al. 2007. In particular GPP results of 4 different vegetation models were compared with remote sensing data and it was found that 55% of the pixels exhibit a standard deviation of less than 25 gC/m^2/month. These previous evaluations of LPJmL performance especially in relation to climate extremes will be better included in the revision. We also refer to recent investigations of climate extremes on the carbon cycle combining data and vegetation models (Zscheischler et al. ERL 2014, Zscheischler et al. BG 2014). We will update the discussion accordingly.

Item 3:
We think that the probabilistic approach proposed here is exactly suitable for the evaluation of the responses of ecological systems to climatic drivers with their variability and extremes. Truly, the study has to rely on the representation of ecological processes in LPJmL that reflect plant responses to drought. LPJmL simulates physiological processes depending on the current climate conditions and their history which is reflected in the composition of the plant community and their carbon stocks accumulated so far. Thus, the response of the model to a certain extreme event is not always the same. Biological mechanisms responding to extreme events include net primary productivity driven by climate conditions and by atmospheric CO_2 concentration which changes the amount of leaf biomass simulated for each Plant Functional Type (PFT). Under rising atmospheric CO_2 concentrations, stomatal resistence increases, leading to higher water-use efficiency which can buffer increasing drought impacts. Another example of physiological adaptation is carbon allocation to new roots, which is an adap-

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tive response to increasing soil water limitations. Unproductive individuals with a low growth rate are very likely to die because of bad performance. The resulting model response is therefore a combination of the climate condition and of the performance of the present PFT. Competition between PFTs due to differences in their performance under given climate conditions, can lead to changes in vegetation composition as less adapted PFTs can be out-competed and replaced. This is then also quantifiable in the productivity and respective carbon fluxes in the simulation years after this change in vegetation composition. This applies to long-term climate trends as well as interannual climate variability, including the impact of extreme events. Therefore, the LPJmL model is indeed capable of capturing dynamic responses to, e.g., single or consecutive drought events. It does not have a pre-defined set of ecosystem responses.

We will therefore revisit our model description to include these aspects of the model behavior and thus open the manuscript to a wider readership. As we have learnt from the reviewer, this is essential for the reader to understand and follow our interpretation of the model-based results.

Technical corrections

Rewording and corrections will be included in the revision.

Interactive comment on Biogeosciences Discuss., 11, 10167, 2014.