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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.

Anonymous Referee #1

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The manuscript entitled "A probabilistic risk assessment for the vulnerability of the European carbon cycle to extreme events: The ecosystem perspective" by S. Rolinski et al. aims at applying the risk analysis framework of van oijen et al. 2011 to carbon fluxes at the European level. The authors use a dynamic vegetation model including NPP, respiration and disturbance fluxes for a final assessment of NBP extreme responses to climate indices. Definitely we have to acknowledge the effort in applying this framework to the carbon balance and include a large panel of processes including disturbances. However I am very concerned with some methodological issues and the way the results and conclusions are presented.

1. The study uses a dynamic vegetation model (LPJml) coupled with a fire risk model

SPITFIRE to capture the carbone fluxes arising from photosynthesis, soil respiration and emissions from combustion and the decomposition of resulting debris. I have no major concerns with the use of this tool for continental scale assessment of carbone fluxes, which definitely remains convenient and fairly validated as explained in the manuscript. My concern is to use it for quantifying the impact of extreme climate events. In this sense, this manuscript is kind of disappointing as none of the processes of the recent climate extreme experiment in the field have been incorporated, tested, nor even cited or discussed. The 'Acknowledgements' part of the manuscript should not be considered for evaluation but it's surprising to figure out that the authors have been financed by two projects related to climate extremes, with a tremendous amount of information from data acquisition (http://www.carbo-extreme.eu/index.php/Publications/Project) and that only a few of these results have been cited or considered. In turn, as the analysis has been performed, it appears as a model's sensitivity to climate extreme, within an outstanding conceptual framework. This can be interesting per se, but the goals and discussion should be rewritten in this sense. Neither new processes, nor model's testing under extreme events have been provided, to conclude on the actual carbone fluxes under extreme events. In turn, the discussion is very difficult to read, and doesn't provide fruitfull information. Again, no link with observations are given, as for exemple with observed (or simulated by experiments) processes.

2. My second concern is methodological. The future climate scenario is descrbied with the few lines: "MPI-REMO results have been bias corrected by applying the 1970–2010 mean and standard deviation of the WATCH-ERA-Interim climate data". No reference for the method is mentionned. This is critical here. Numerous bias correction for climate scenarios exist, with differential accounting for the number of rainy days (Mean rainfall anomalies vs quantile methods for exemple, Deque et al. 2007). As the number of consecutive dry days is a key variable, the authors should more precisely describe their climate scenario. There are confusing references to this variable (C or CDD) which should be homogeneized. In addition, the sensibility of these climate predictions for

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extreme events based on the different reanalysis dataset should be discussed (Bedia et al. 2012).

3. Fires are part of NBP, as modeled by the SPTIFIRE module. How well this module performs for extreme events? Long term fire reconstructions have been delivered (again within the projects financing the study) (Koutsias et al. 2012) and extended burned area in Europe are available (EFFIS, Mc Inerney et al. 2013) and have been analyzed (Loepfe et al. 2012, San Miguel Ayanz 2013). It would be worth mentioned all this in the discussion, and provide some results.

In conclusion, I was convinced with the conceptual framework and value the effort to apply it to NBP based on a combined assessment of carbone fluxes and disturbances, but I remain skeptical on the ability of these models to capture the conclusions mentioned in the manuscript for the belowmentionned reasons. To me, this is a sensivity analysis to extreme events, from a model validated on the current climate variability. The results should be discussed in terms of comparisons and identification of model's caveats with processes obtained from experiments rather than brought up as concluding statements as it is provided in the present version.

Some additional details to be improved: P10169 l14 : Âń negative impact Âż is a pessimistic/dramatic point of view that should be balanced as some areas of the world would benefit from climate change. L15: ecosystem degradation: again, balance your statements 10171 l 4: you mean 'probability' instead of probility? 10175 l1-l4: no reference for the bias correction method? Provide here either a reference or a more comprehensive procedure. As CDD is an environmental variable used for the analysis, we have to know if the number of rainy days been corrected or only rain amounts? Different bias correction methods exists so we wonder which one has been used. C or CDD for consecutive dry days?

I present here a list of studies arising from the carbo extreme project (http://www.carbo-extreme.eu/index.php/Publications/Project):

Burri, S., Sturm, P., Prechsl, U., Knohl, A., Buchmann, N. (2014): The impact of extreme summer drought on the short-term carbon coupling of photosynthesis to soil CO2 efflux in a temperate grassland. Biogeosciences, 11, 961–975. doi:10.5194/bg-11-961-2014

Limousin J.-M., Rambal S., Ourcival J.-M., Rodríguez-Calcerrada J., Pérez-Ramos I.M., Rodríguez-Cortina R., Misson L. and Joffre R. (2012) Morphological and phenological shoot plasticity in a Mediterranean evergreen oak facing long-term increased drought. Oecologia 169 (2): 565-577.

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Selsted, M., van der Linden, L., Ibrom, A., Michelsen, A., Larsen, K., Kongstad, J., Mikkelsen, T., Pilegaard, K., Beier, C. and Ambus, P., 2012. Soil respiration is stimulated by elevated CO2 and reduced by summer drought: Three years of measurements in a multifactor ecosystem manipulation experiment in a temperate heathland (CLIMAITE) Global Change Biology 18, 1216-1230.

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