I reviewed for the revised manuscript from Rolinski et al. about ‘A probabilistic risk assessment for the vulnerability of the European carbon cycle to climate extremes: The ecosystem perspective’. I acknowledge the correction provided and the gain in clarity of the manuscript.
However, I am still concerned by a lack of understanding of underlying processes in this nicely presented conceptual risk assessment. In turn, after reading the manuscript, I cannot conclude if the framework captured the actual functioning of the system with ecological meaning or just provides evidences within a bunch of statistical analysis. We definitely lack clarity in the ecological explanations of observed fluxes, particularly how much anomalies are due to NPP, respiration or disturbances, the three components of the NBP. I mentioned few key papers, among other which try to stick a little more to ecological evidences of ecosystem functioning.

I am also concerned with a last point on SPEI calculations over long periods (century) with climatic trends. In explain below potential biases which would benefit from clarifications.

In turn, I am convinced by the potential benefits of this conceptual approach, but frightened about conclusions not supported by an extensive literature review of observations and intermediate informations as NEP, Resp , disturbance that would help to understand the results. I pointed out some potential bias in SPEI that would benefit to be clarified.

Detailed informations below(document):

L123-L126: references to add

Baudis et al. 2014. Intraspecific differences in responses to rainshelter-induced drought and competition of Fagus sylvatica L. across Germany. Forest Ecology and management 330: 283-292.

Barbeta A. Ogaya R. Penuelas J. 2013. Dampening effects of long-term experimental drought on growth and mortality rates of a Holm oak forest. Global change biology 19(10): 3133-3144

Martin Stpaul et al. 2014 The temporal response to drought in a Mediterranean evergreen tree: comparing a regional precipitation gradient and a throughfall exclusion experiment. Global Change biology 19(8): 2413-2426

L 300-320: very sad again to have not even a single reference on observations and conclude ‘Therefore, the LPJmL model is indeed capable of capturing dynamic responses to, e.g., single or consecutive drought events’.

L342-345 L346-351

Biomass burnt (BB) result from dead and live fuel consumption in surface fires and from crown scorching (Thonicke et al., 2010) and is included in the carbon balance NBP (Eq.

4) => do we have necromass assessment and tree mortality as reviewed in Mcdowell et al. 2013.

McDowell N.G. et al. 2013. Evaluating theories of drought induced vegetation mortality using a multi model experiment framework. News Phytol 200(2): 304-321

L402-404:"The border region of Ukraine, Belarus and Russia is most pronounced with positive V_E values of more than 0.4 where fire has a large impact on the carbon balance." => no information/result/graph on simulated fire activity illustrates this point. All along the manuscript, we never know if changes occur in NPP, heterotrophic respiration or fire modify NBP… it's kind of a black box.

L473-474: why only a 12 months period? Leaf life span in evergreen forests can last up to 3 years, while in grasslands it's only 6 months. We might expect different impact delays of a 3 months drought (SPEI3) depending on leaf life span of the ecosystem. Please discuss this point and ^potential weaknesses of this single 12 months value in your approach.
Also, how much LAI adjustment to icreasing drought is actually simulated in LPJmL and fits the Carnicer Results (figure and reference below)?
Carnicer J. et al. 2011. Widespread crown condition decline, food web disruption, and amplified tree mortality with increased climate change type drought. PNAS 108(4): 1474-1478
This might be crucial for understanding drought effects, highly balanced by an hydro ecological adjustment of LAI along increasing drought trend which could mitigate drought impact on NPP.

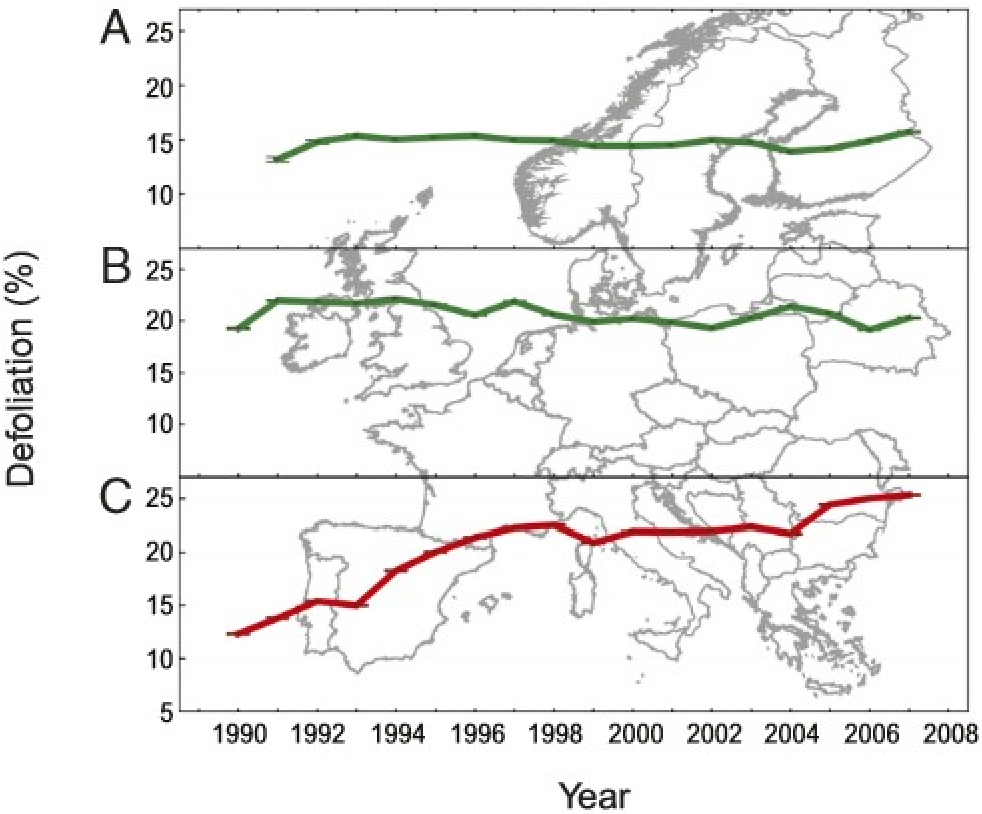


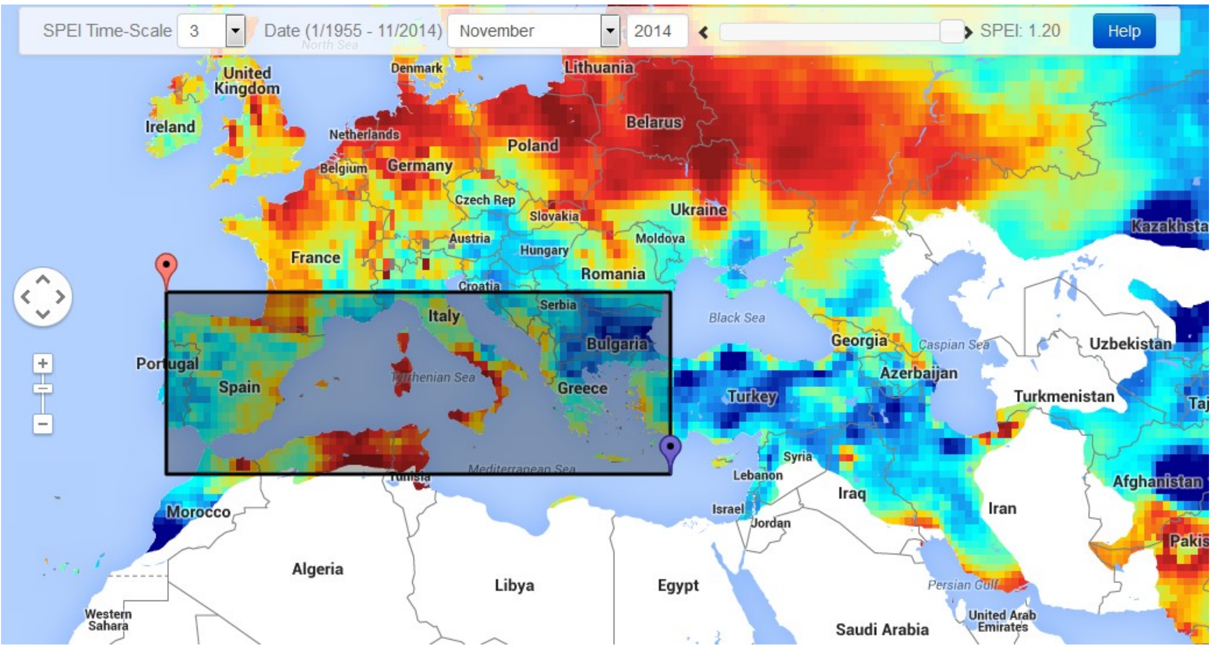
Fig. 1. A comparison of crown defoliation trends in northern, central, and southern European forests during 1990–2007. Annual trends in averaged defoliation per plot (for all species grouped) are plotted for three latitudinal bands: (*A*) northern European forests (>58°N of latitude); (*B*) central European forests (46°N < latitude < 58°N); and (*C*) southern European forests (<46°N of latitude).

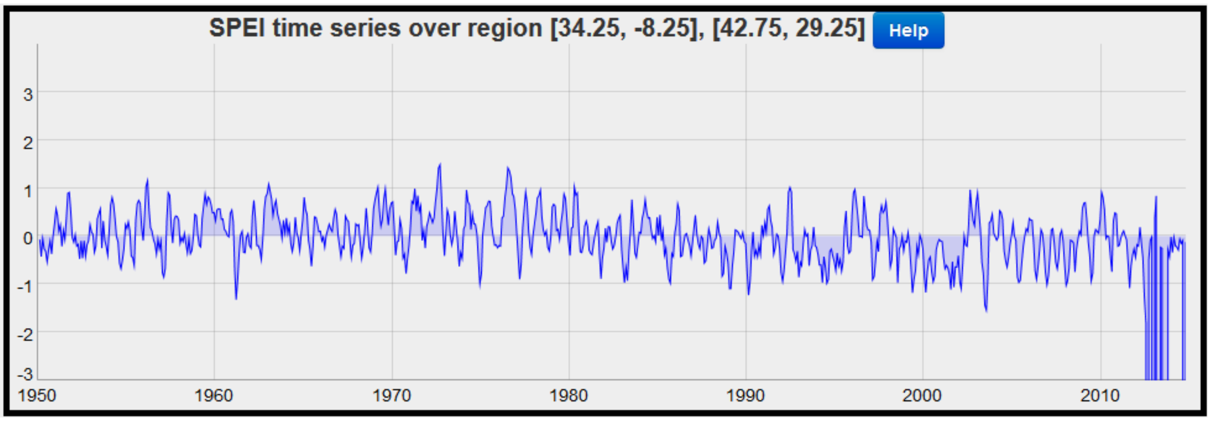
Figure from Carnicer et al. 2011.

L 485-495: we appreciate this point.

Last concern regarding SPEI:

I have a last question about SPEI3 calculations: the authors mention SPEI calculations over the 1901-2010(L206-L208). Then analysis are performed over the 1981-2010 period. I am here concerned about the climate trend over the SPEI3 calculation. SPEI calculations, by construction, fit a normal distribution over the whole dataset to identify deviation for this distribution. In turn, SPEI values for a given month are dependant on the normal distribution of the whole reference dataset. It means that calculating SPEI3 over the 1981-2010 or the 1901-2010 might lead to different values for the monthly SPEI3 over the 1981-2010 period if the distributions for the two periods are different. They actually might be different considering recent observed climate changes and as is illustrated in the MED SPEI3 trend from the vicente-serrano database.





We might wonder if the continental scale analysis on vulnerability might not be biased by the continental heterogeneity in climate trends and the subsequent bias in SPEI3 calculations. To clarify this point, I suggest the authors to provide continental pixel trend analysis on SPEI3 and the regional values of SPEI3 trend for MED, NEU, CEU for the 1901-2010 period.

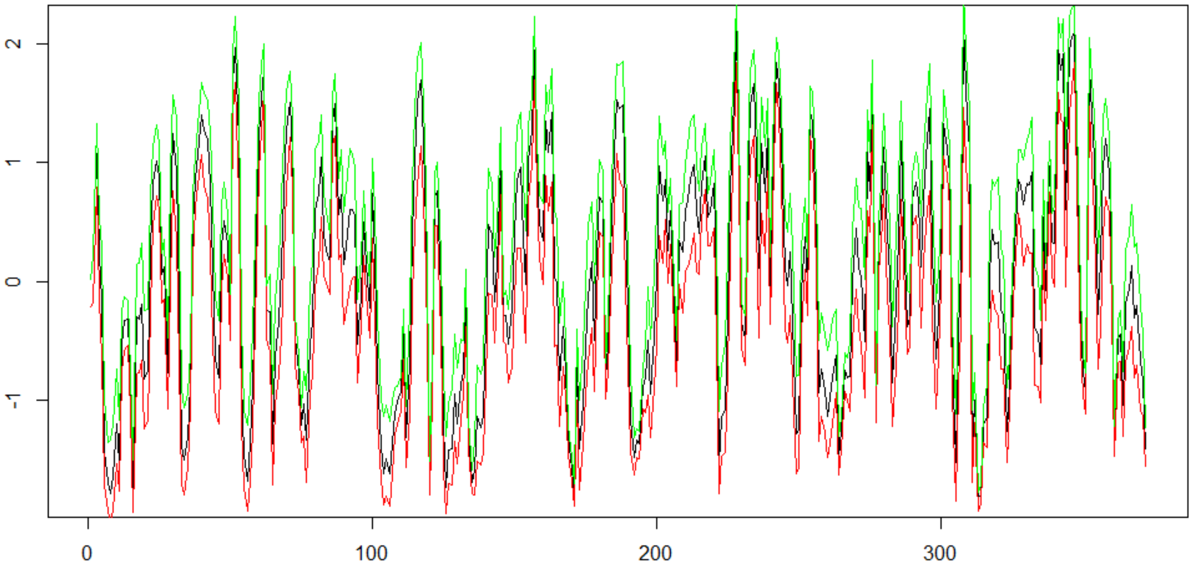
I illustrate my concern with some calculations I just performed with the SPEI R package using the default Wichita climate database. I computed SPEI3 for the period provided by the default dataset (1980-2011) and I built a theoretical increasing and decreasing trend by replicating the default time serie 3 times and artificially increasing/decreasing PET and decreasing/increasing Precipitation.

Here is the R code:

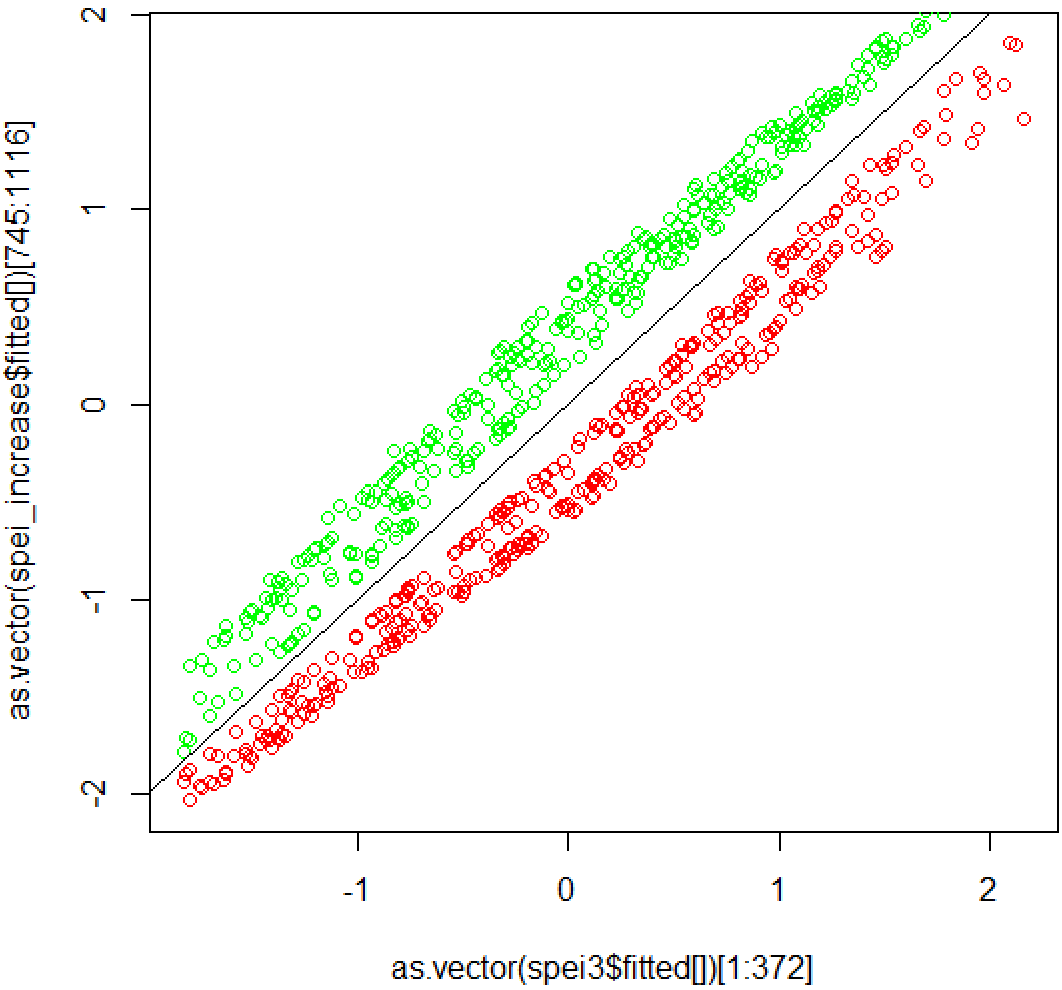
```
library(SPEI)

data(wichita)
wichita$PET <- thornthwaite(wichita$TMED,37.6475) # PET calculation
spei3 <- spei(wichita$PRCP-wichita$PET,3) # SPEI reference calculation 1980-2011

# climate scenario with increasing PET and decreasing Precipitation => increasing SPEI
```

```
vecpetincrease<-
c(0.8*wichita$PET[1:372],0.9*wichita$PET[1:372],wichita$PET[1:372])
vecpptincrease<-
c(1.2*wichita$PRCP[1:372],1.1*wichita$PRCP[1:372],wichita$PRCP[1:372])
spei_increase<-spei(vecpptincrease-vecpetincrease,3)

# climate scenario with drecreasing PET and increasing precipitation
=>decreasing SPEI
vecpetdecrease<-
c(1.2*wichita$PET[1:372],1.1*wichita$PET[1:372],wichita$PET[1:372])
vecpptdecrease<-
c(0.8*wichita$PRCP[1:372],0.9*wichita$PRCP[1:372],wichita$PRCP[1:372])
spei_decrease<-spei(vecpptdecrease-vecpetdecrease,3)

#
plot(as.vector(spei3$fitted[])[1:372],type='l')
points(as.vector(spei_increase$fitted[])[745:1116],type='l',col='red')
points(as.vector(spei_decrease$fitted[])[745:1116],type='l',col='green')
x11()
plot(as.vector(spei3$fitted[])[1:372],as.vector(spei_increase$fitted[])
[745:1116],col='red')
points(as.vector(spei3$fitted[])[1:372],as.vector(spei_decrease$fitted[])
[745:1116],col='green')
abline(0,1)
```

here below are the SPEI3 monthly values for the 1980-2010 period with no climate trend(black), increasing SPEI trend (red) and decreasing SPEI trend (green) in the previous decades.



Below are the Monthly comparisons between reference (no trend) SPEI for the 1980-2010 period and SPEI for the same period with increasing or decreasing trends.


as.vector(spei_increase$fitted[])[745:1116]
as.vector(spei3$fitted[])[1:372]
-2
-1
0
1
2
-1
0
1
2