Biogeosciences Discuss.,
doi:10.5194/bg-2016-319-AC1, 2017

Biogeosciences
Discussions
Open Access

Interactive comment on "Modelling Holocene peatland dynamics with an individual-based dynamic vegetation model" *by* Nitin Chaudhary et al.

Nitin Chaudhary et al.

nitin.chjj@gmail.com

Received and published: 25 January 2017

We thank the reviewer for these helpful comments.

The time series we adopted to force our model lack decadal and centennial scale variability, but capture inter-millennial trends (Figs. 1 and 2), as they were constructed by applying anomalies relative to present day from millennium time-slice experiments with the UK Hadley Centre Unified Model – HadSM3 (Pope et al., 2000). These reconstructions were evaluated and found broadly in line with proxy data for the mid-Holocene (6kyear cal. BP) in northern Europe and Canada (Muri, 2009). Detailed information is available here - http://www.climateprediction.net/projects/completed-project/mid-holocene/. The peat profile in both simulated localities, and across the northern

Printer-friendly version

Discussion paper

high latitudes in general, is a product of accumulation over millennia, and decadal to centennial-scale climatic variations may be assumed to have a minor influence on peat depth and density today.

The amplitude and variability in the millennial-scale temperature and precipitation smoothed out due to 10-year running mean, therefore we have included new figures here (see below Figs. 3 and 4). We found the applied temperature forcing is quite similar in magnitude and variability to Esper et al. (2014) (their Fig. 2 and 5c) for the last 2000 years (see Figs. 5 and 6 in this document) even though decadal and centennial variability is not captured.

Stordalen

The source of the discrepancy between proxy-based annual temperatures and the model-based data used as forcing in our study is due to errors in the modelled winter (October-March) temperatures (Fig. 7 b and d). While this could have some impact on our simulations, summer temperatures (Figs. 7 a and c) are more important than winter temperature for the peat growth in our model. This is evident from Fig. 8 (in this document) where winter anomalies from October-March were not added to the observed surface temperature and a very limited effect was noticed on the peat accumulation trajectory compared to STD experiment. In contrast, when we set the summer temperature anomalies to zero, the peat accumulation differs compared to STD experiment. Although the upward trend in mean annual temperature is influenced by winter anomalies (Oct-Mar), that discrepancy didn't affect the overall peat growth. Hence we would argue that the climate data used as forcing in our study are sufficiently realistic in terms of their influence on modern peat amount.

Mer Bleue

Mean annual temperature has been relatively stable for the last 8500 years in Ontario region. There was no warming and cooling trend in the proxy-based climate reconstruction (Muller et al. 2003, Page 65 of their paper) and the same dataset was used to model peat accumulation at Mer Bleue by Frolking et al. (2010) (see Page 8 of their paper). Kaufman et al. (2004) showed (in their Fig. 7) that the Holocene Thermal Maximum (HTM) initiated around 6-7 kyears cal. BP and terminated around 3-4 kyears cal. BP near Hudson Bay and this is reflected in the Holocene time-series of temperature used as forcing in our study (Fig. 2b in this document). The HTM was delayed in this region due to remnants of Laurentide ice sheet and the period was warmer than today by 1-2 degree C which coincides with vegetation density and northern advance of arctic tree line (Page 238, Rolland et al. 2008).

While we maintain that the climate forcing data used in our study are defensible and adequate for representing the main climatic drivers of peatland development at our study sites, there are obviously uncertainties in reconstructions of past climate, whether using proxy data or models. We have added some more explanation on the potential effects of climate uncertainty on the model simulations around Line 467-476 of our paper.

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-319, 2016.

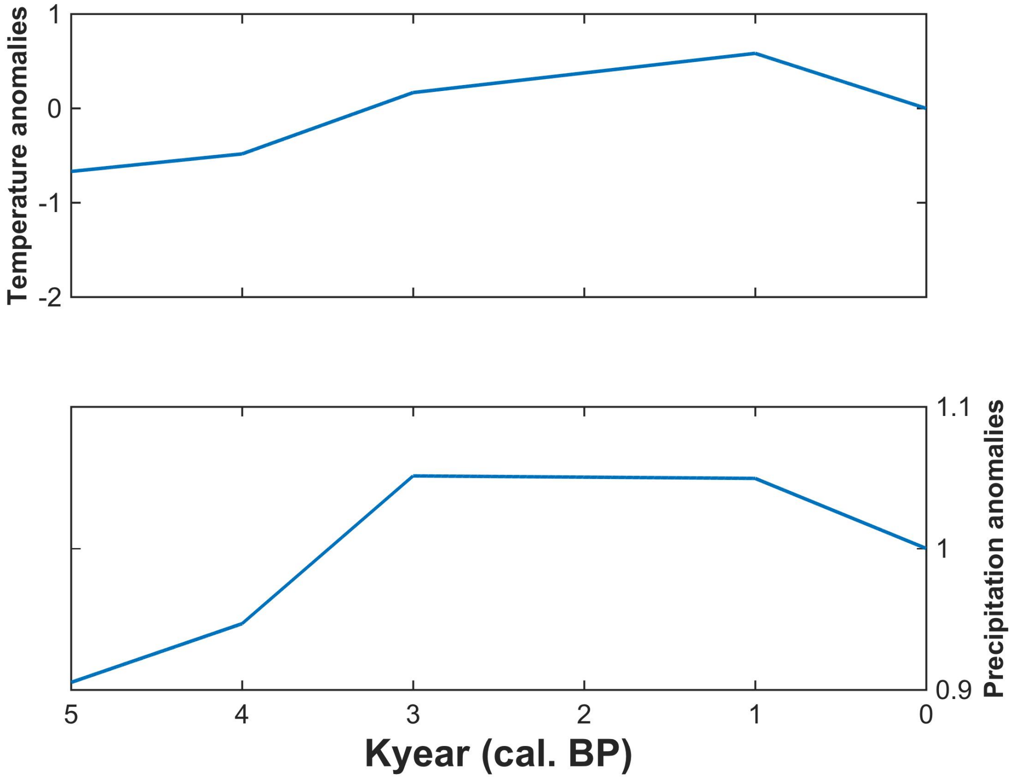

Fig. 1. Applied annual temperature (additive) and precipitation (multiplicative) anomalies for the Stordalen.

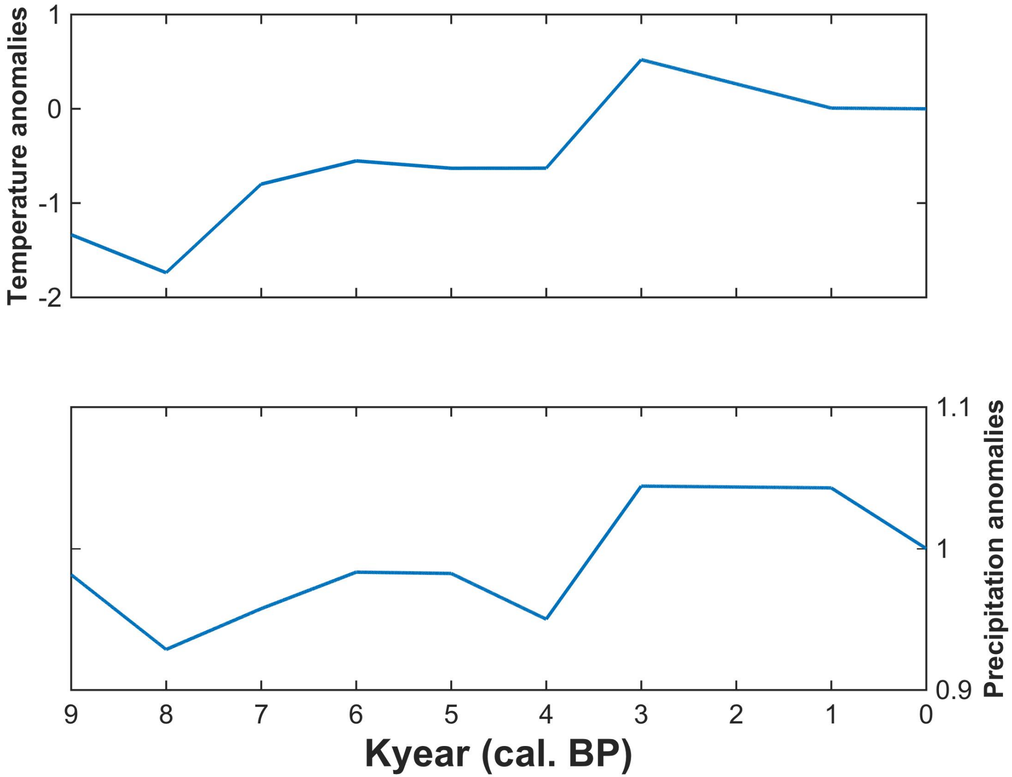

Fig. 2. Applied annual temperature (additive) and precipitation (multiplicative) anomalies for the Mer Bleue.

Printer-friendly version

Discussion paper

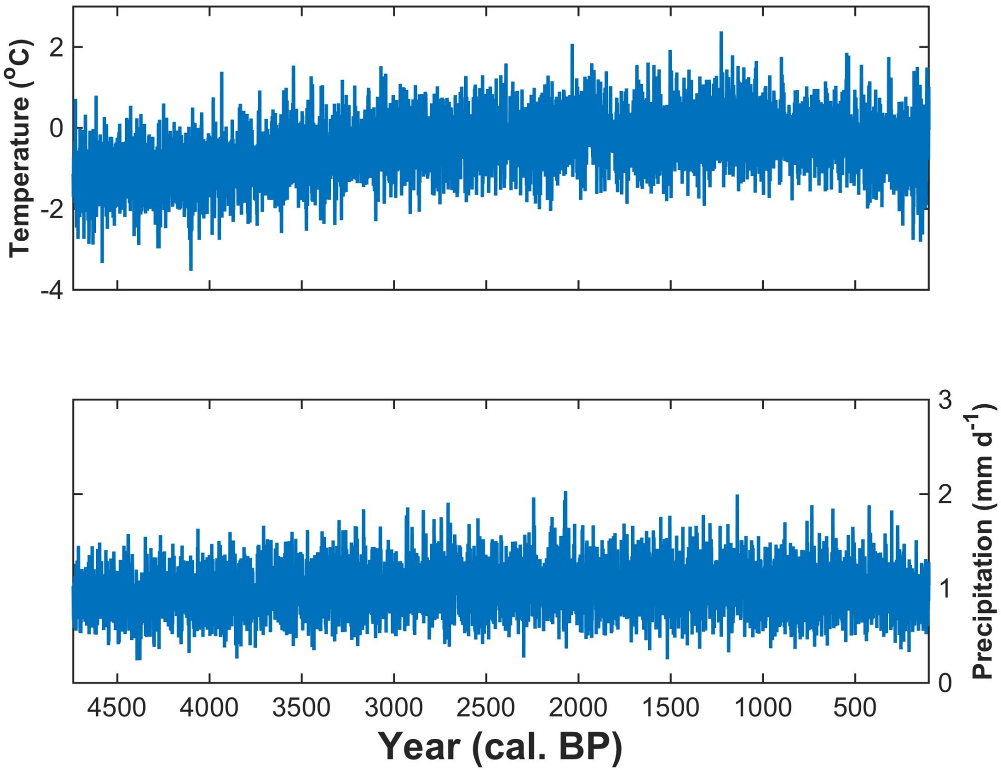

Fig. 3. Applied temperature (°C) and precipitation (mm/day) forcing for the last 4700 years at Stordalen

Printer-friendly version

Discussion paper

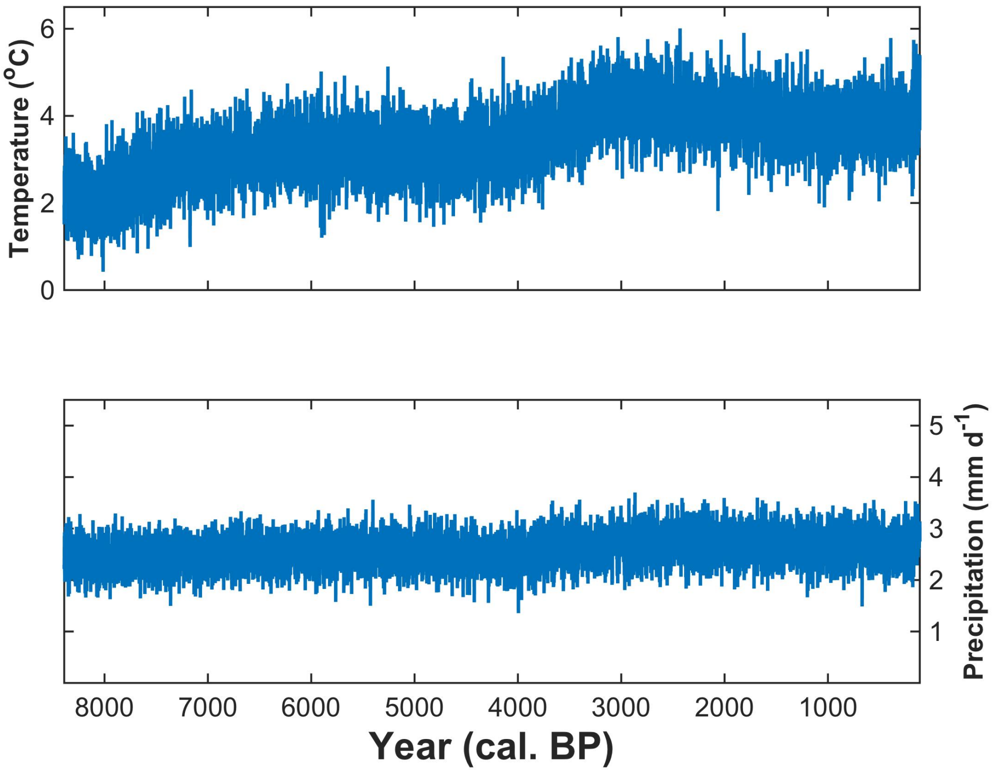

Fig. 4. Applied temperature (°C) and precipitation (mm/day) forcing for the last 8400 years at Mer Bleue

Printer-friendly version

Discussion paper

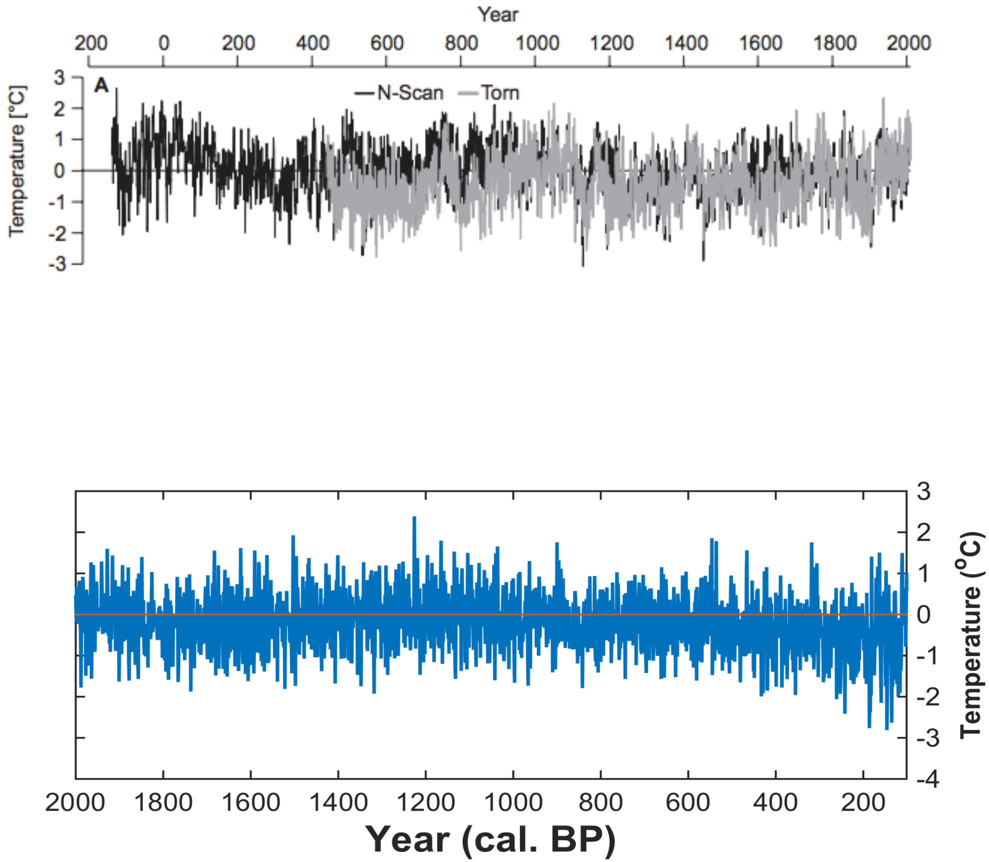

Fig. 5. Comparison between Esper et al. 2014 (Fig. 2a - N-Scandinavia/Finnish Lapland) and applied temperature (°C) forcing for the last 2000 years at Stordalen.

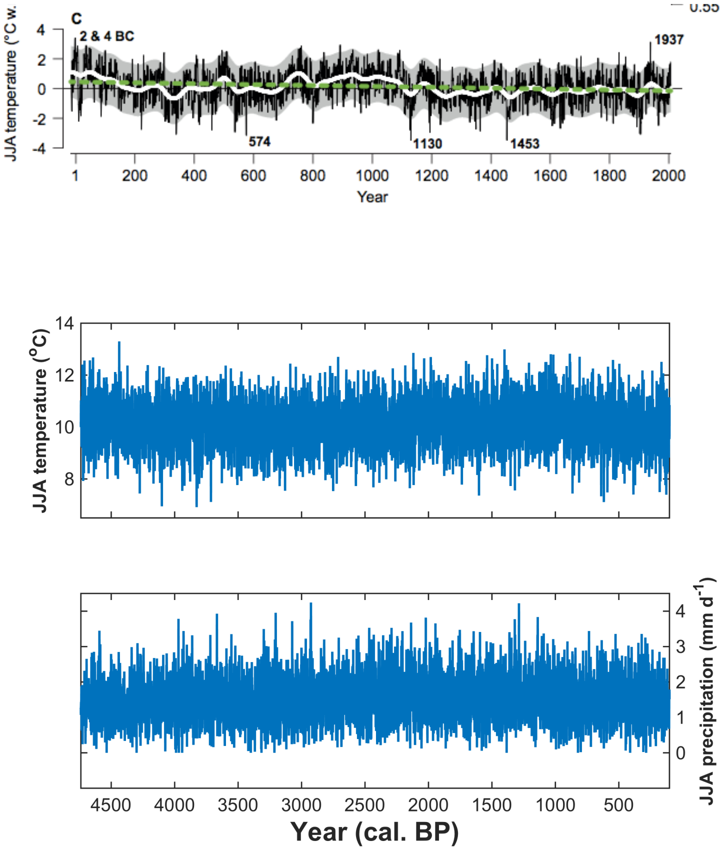

Fig. 6. Comparison between Esper et al. 2014 (Fig. 5c - northern Europe) and modelled June-July-August (JJA) temperature (°C) and precipitation (mm/day) at Stordalen

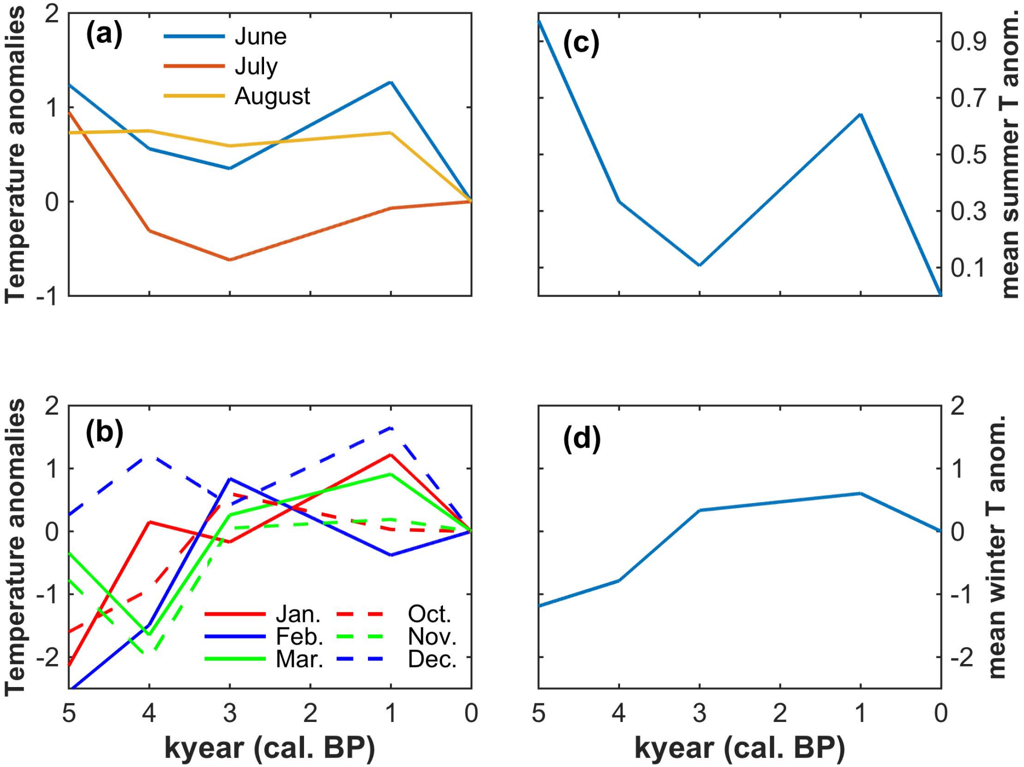

Fig. 7. Applied annual temperature anomalies for (a) summer months (June-August) and (b) winter months (October-March) and mean annual (c) summer and (d) winter temperature anomalies for the Stordalen.

Printer-friendly version

Discussion paper

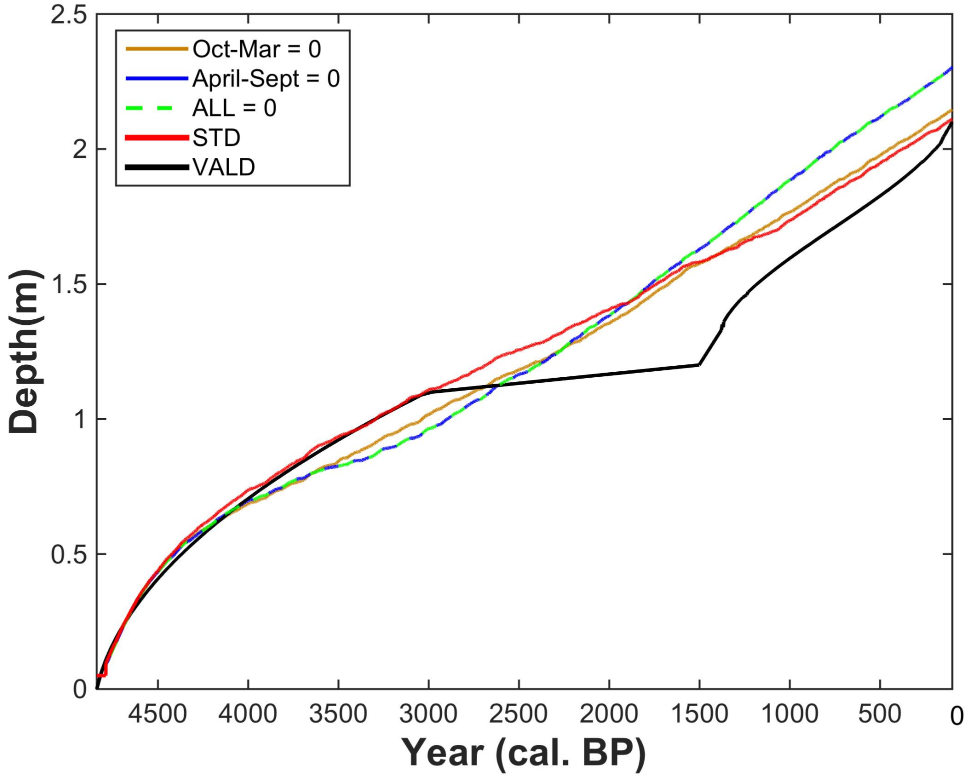

Fig. 8. Peat depth sensitivity to applied temperatures anomalies. No anomalies added to the mean monthly-observed temperature (1913-1942) (ALL = 0), no winter temperature anomalies applied (Mar-Oct = 0) and n

Printer-friendly version

Discussion paper