

Anonymous Referee #1 - Received and published: 20 June 2013

● *The aim of the manuscript is first of all reconstruct atmospheric dust composition detected from peat layers, secondly determine the origin of the dust and thirdly to define the relationship between dust deposition patterns and climate. Unfortunately the authors seem to fail in their third aim which I understand should be the most interesting part of this study.*

The first aim of the manuscript is to reconstruct dust flux over the Holocene, in agreement with the title. The second aim is to trace the dust sources using isotopic and geochemical signatures. The third aim cited in the ms, i.e. the relationship between dust deposition patterns and climate, is discussed in the last section of the ms as a potential interesting perspective. Our approach is based on a comparison between dust flux and other climate-relevant proxies like humification, testate amoeba that have been measured on the same peat record. This comparison indirectly allows evidencing the sensitivity of dust flux in regard with climate changes. We evidence three periods characterized by higher dust flux. We observe that those periods are coincident with global cold climate suggesting an influence of climate on dust record in the Misten bog.

● *It appears that the authors cannot make up their minds whether their scope is local, regional or global*

REE composition and Nd isotope signatures have been used to track for the origin of the dust. The Saharan dust signal is well constrained in literature. Its Nd isotope ratio is significantly different than the local and regional signal. However it is difficult to decipher between the local and regional sources. As they are both influenced by the European loess cover they are characterised by a similar range of Nd isotope ratios, with an upper crust signature.

● *Dust transported from Sahara and Canadian dust events are reflecting environmental conditions far away and European climate phases should not be connected straightforwardly.*

Our dataset evidences dust-rich layers in Misten bog. The Nd isotopic composition in Misten record is interpreted by a mixing between local/regional and distal sources. We propose as an interpretation that local moist conditions favor the distal contribution from Sahara. Local supplies is promoted during local dry conditions (more soil erosion).

● *The authors for instance refer to cold periods (page 2901, line 11) but it remains unclear where - references are missing.*

We agree with the reviewer. We must precise in the text that we refer to the main cold periods identified in Northern hemisphere by Wanner et al. (2008, 2011).+ http://www.oeschger.unibe.ch/research/projects/holocene_atlas/

● *Further confusion is created by a comment "influence of dust on climate remains poorly quantified (Page 2893, line 14)".*

This statement is taken from Maher et al., 2010. It is reported in the introduction of the ms to show that the relationship between dust flux and climate has not been mainly investigated.

● *In addition my opinion is that it is an old-fashioned way to refer to climate phases as Atlantic and Subatlantic etc.; it is possible that the younger generations do not even recognize this terminology anymore.*

Changed

● *Moreover the manuscript seems to be relatively badly designed and written: it is full of spelling mistakes and the language needs to be improved. Some words are misused such as flux and evolution.*

There is quite a lot of repetition. The manuscript cannot be accepted to be published before it has been drastically changed and amended.

Ok, we improved the text to avoid spelling mistakes, repetition, ... In particular the English was carefully edited by a native geoscientist English speaker to read and correct the last version of the ms.

● It can also be speculated if the *Climate of the Past* is the right forum for this material because eventually climate as such seems to play only a minor part in this manuscript.

Several recent papers dealing with dust reconstruction has been published in *climate of the past*, see for instance (e.g., Lambert et al., 2012. *Clim. Past*, 8, 609-623, 2012; Preunkert and Legrand, 2013. *Clim. Past*, 9, 1403-1416, 2013). We are aware that, in regard with ice record, peat is a non classical archive to trace dust.

● Below I list some issues that should be considered when writing the next version. It is actually quite impossible to go into very details because the current version is relatively chaotic. The authors use BC not BP ages for their own data. This is quite annoying because all climate data the authors use for comparisons are presented as BP ages.

Ok all ages were reported as BP in the revised version.

● In Introduction the authors list proxies and archives that have been used to reconstruct climate. The list is random and in many ways incomplete and neglects many important biological proxies (Note: they are not measured! and for instance macrofossils etc. are not organic but biological proxies) and many important northern European records and climate reconstructions are basically missing. Actually I am not convinced that this kind of (intended) profound listing is necessary at all when the forum is *Climate of the Past*.

OK we have completed and corrected this section.

● It appears that perhaps the author(s) are not at their strongest area in discussing past climate because the topic is introduced in a very confusing way. And it should be noted that the view of the Holocene climate patterns is also changing. Increasing amount of data (other than pollen-derived) is suggesting warm early Holocene temperatures.

This section was rewritten.

● Because the authors are working with peat layers and dust deposition, in the Introduction these elements and previous studies on these subjects as related to climate should be introduced and get the main attention. Some important references are missing of studies where dust deposition has been used to infer past climate (Kylander et al. *QSR* on line) and where quantitative climate reconstructions have been carried out from bogs showing prominent changes in moisture conditions for the late Holocene (Väliranta et al. 2007 *Holocene*; 2012 *QI*).

The recent relevant references were added in this section

● I wonder why the authors did not carry out proper plant macrofossil analysis on their record even though plant remains were searched for radiocarbon dating. Plants reflect moisture conditions at least as well as testate amoebae. Such an extended multiple proxy approach could have provided the authors robust tools to perform environmental reconstructions for their own study site. This would have been an interesting addition to the data available from elsewhere in Europe.

In our study the moisture conditions are already reconstructed using two proxies, i.e. humification level and testate amoebae. Regarding Macrofossils, we had sufficient material only for the Wardenaar core (i.e. the first upper meter) and not for the Bielorrussian corer (i.e., the section presented in this

study). Note macrofossils data from the Wardenaar section are available online, see De Vleeschouwer et al., 2010:

[http://etat.environnement.wallonie.be/index.php?page¼ etudes-detaillees](http://etat.environnement.wallonie.be/index.php?page¼%20etudes-detaillees)).

• *Now they seek support from pollen records (perhaps not the best proxy to reconstruct moisture conditions) from adjacent locations. In Material and methods chapter it should be stated why different analyses were carried out – what is their purpose in this study.*

In the discussion, available pollen data from Damblon (1994) are mainly used to give information about the vegetal cover changes, pointing to soil degradation/erosion, and/or climatic changes. The comparison of our data derived from humification level and testate amoebae with pollen records from the Hautes-Fagnes Plateau (including the Misten bog) improves our interpretation in term of the evolution of dust deposition during the Mid and Late Holocene. Palynological analysis on the Misten 01 core is under progress within the framework of a PhD thesis.

• *I wonder why fen phase is included to this study even though the authors mention that it is influenced also by catchment processes, not only atmospheric load.*

We need to refer to the bottom part of the peat to define the baseline.

• *In Results chapter ages should also be displayed when presenting data, not just cms.*

done

• *My opinion is that some of the text in Discussion should be removed to the Results. Discussion of climate linkage is on quite vague grounds. Supporting data are fetched randomly: sometimes from Greenland, sometimes from Spain, sometimes from nearby pollen record etc. Moreover the impression is that the Misten bog data are overinterpreted in terms of climate. Based on figures there seems to be no consistent pattern between the proxies or between the different sediment records. Perhaps this could even be statistically tested.*

We rewrite the discussion. The discussion is subdivided in 4 main sections: 1) REE distribution pattern; 2) Dust source; 3) Evolution of dust deposition during the Mid and Late Holocene and; 4) Comparison of dust deposition records from peat bogs and ice cores. For the last two points we compare our results with available data derived from any continental archives over Europe. Each archive being characterised by its own sensitivity to environmental changes it is crucial to compare our peat record with other continental archives to validate our interpretation. First we propose an interpretation of our Misten data in term of either local or regional environmental changes, second we compare our interpretation with available environmental information, starting from local to global scale. A statistical approach is not obvious. For instance a wavelet approach has been tested to check if the Misten dust-flux variability is on the same order than other climate proxies such as sunspot number and cosmogenic nuclide production (^{14}C). At this stage the different resolutions between the proxies do not allow to establish a significant correlation.

• *Testate amoebae species record should be displayed; it is not enough just to indicate “major taxa”.*
modified

• *Some of the figures use Depth scale, some Age scale. Age is more relevant.*

modified

• *The Reference list is far too long and should be reduced. Yet some relevant references are clearly missing.*

The reference list was updated to integrate the recent publications like Kylander et al. We tried to reduce the number of references.

● *I can agree that the manuscript potentially includes some important achievements as related to identifying origin of the dust but the link between dust deposition(s) and climate remained ambiguous.*

We take into account the remarks of the reviewer. We presented the relationship dust-climate as a perspective rather than an aim. More data are requested to better understand those interesting but complex relationships of the Earth's system.