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Climate of the Past Discussions

Interactive comment on "Periodic input of dust over the Eastern Carpathians during the Holocene linked with Saharan desertification and human impact" *by* Jack Longman et al.

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Interactive comment on "Periodic input of dust over the Eastern Carpathians during the Holocene linked with Saharan desertification and human impact" by Jack Longman et al. N. Fagel (Referee) nathalie.fagel@ulg.ac.be Received and published: 1 March 2017 The ms presents a very interesting and complete dataset on Holocene dust reconstruction from East European peat record. The ms is well organized with clear aims. The text is too the point. The approach is quite innovative. See the attached pdf with several remarks and/or suggestions on the text and the figures. For my point of view, two mains points should be completed. First on the methodological approach I suggest to present the calibration between ITRAX and ICP-OES data

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to better constrain the proposed approach. I will also discuss the potential influence of porosity/humidity changes in the measured peat section on the number of ITRAX counts. Indeed elemental ITRAX data are often normalized, for instance by the number of measured counts in order to take into changes in peat density/porosity but also on surface irregularities. I would explain why this approach is not useful.

R1: We thank Dr. Fagel for the comprehensive review of our work. We fully agree, and have addressed both comments in the revised manuscript. Firstly, we now present the correlation, and significance of said correlation, between ICP-OES and ITRAX. Secondly, we have normalised our ITRAX data (by incoherent + coherent scattering) with respect to the scattering effect of density, porosity and organic matter changes. As such, all data is now presented as normalised counts per second, and all corresponding further analysis has been performed on such data. Please see the comments below for exact location of added text, and adapted figures.

Second I would complete the text about the relationships between the identified dust events, the wet/dry, cold/warm conditions and the related figures.

R2: We have also addressed these issues; see below for text additions, and figure adaptations

Hoping the review will be helpful to improve this interesting manuscript. Sincerely, Nathalie Fagel Please also note the supplement to this comment: http://www.clim-past-discuss.net/cp-2017-6/cp-2017-6-RC2-supplement.pdf Specific comments from attached Supplement: Line 26 unclear older or younger than 6,1 kyr?

R3: “Since” 6100 yr BP; manuscript has been adapted to reflect this

Lines 125-126 For my pint of view those data must be more exploited in the ms. Why do you not present the calibration between ITRAX and ICP data?

R4: This is a valid point and we have performed such measurements. Due to the differences in resolution of the data sets, we have performed a Gaussian interpolation

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at 100 yr steps, with a window of 300 years in order to put both records on the same timescales. The correlation (Pearson's R, n=105) of this is 0.2649, with a p-value of 1.416×10-8, indicating a significant relationship between the two methods. The apparent weakness of the correlation is likely a function of the early half of the record, where low values are observed in both methods, and so the correlation is simply noise, and so we do not expect a perfect correlation. We have attached a graph to display this here: Such correlation data has also been added to the manuscript on lines 203-206: "To facilitate comparison, we bring both records on the same timescale using a Gaussian interpolation with 100 year time steps and a 300 year window. Pearson's r=0.2649, with a p-value of <0.001, indicative of a significant correlation (See SI 4)."

Lines 164-165 You should give the age of the lithological transition. I would suggest to add a schematic lithological column in regard with Fig 3.

R5: The age of the lithological transition has been added to the manuscript on line 173: "transition from a wetland into a bog, at approximately 10,330 yr BP" A lithological description, and full core image was included in the supplementary information: SI1 & SI2

Lines 175-176 (1) The identification of the D events must be precise. It is not clear why you merge some peaks into one D event (e.g., D1, D8).

R6: Dust events were identified based on the increase in two or more of the ITRAX-derived element concentration profiles (see caption on Fig. 3). For each element, a cutoff point was identified, with K=0.001, Si= 0.001 and Ti= 0.004. There are two exceptions, the very earliest section of the core, close to the minerotrophic-ombrotrophic transition, and in the most recent 1000 years, where the noise is higher. Some dust events do indeed appear to merge peaks, this is because we believe they are related to the same event, as they are very close to each other chronologically. An explanation of the denotation of dust events is now included on lines 183-187: "Such zones are identified as an increase in two or more of the elements above the background deposition

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(K > 0.001, Si > 0.001 and Ti > 0.004, see dashed line on figure 3). These intervals are further discussed as reflecting major dust deposition events, and are referenced in the remainder of the text using the denotation D01-D10 (Fig. 3). Two exceptions, at the base of the core, close to the transition from lake to bog, and the last 1000 years, due to high noise, are not highlighted."

(2) What is the age uncertainty for each interval according to your age model? It is important to precise since some events cover less than 200 years.

R7: The age model uncertainties range from approximately 20 years at the uppermost sections of the core, to around 150 years by the base of the core (See Fig. 2 and Table 1). As such, events lasting 200 years should be discernible at this resolution. This has been added to the manuscript on lines 175-176: "Age model uncertainties range from 20 years in the uppermost sections to 150 years at the base of the core."

(3) On figure 3, I would suggest to add a secondary scale for dust flux in order to check for smaller peaks.

R8: We have added such a figure to the supplementary information- see SI 3.

Line 192 You must give more arguments to support this assumption. Do you calculate the correlation coefficient between the two datasets? I would add the figure, even as supplementary data. See also notes on fig. 3 and 4.

R9: Such data has been added to lines 203-206. See above for our description of the process, and a simple graph of said comparison (also added to the manuscript as SI 4).

Line 204 add a synthetic lithological column on Fig; 4 to indicate the transition

R10: See SI 2 for lithological column

Line 225 text unclear.

R11: Text has been altered on lines 246-247: "These persist only for the period in

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which each element is enriched, with such cycles particularly evident within the last 6000 years."

Line 230 Text unclear. Indeed the similar profiles in the three elements emphasize that there is no post-depositional elemental mobility: all elements behave as conservative in the studied peat. I would reorganize the paragraph.

R12: We have inserted the following into line 254: " indicating the conservative behaviour of such elements in the studied peat."

Lines 247-248 For your record I would suggest to describe deeper the relationships between air temperature and/or humidity and dust flux. In the Misten dust record most dust peaks coincide with cold events.

R13: We agree such a discussion improves the manuscript, and so we have adapted lines 268-276 to reflect this: "For example D8, between 3450-2800 cal yr BP falls Europe-wide cold period (Wanner et al., 2011). Such cold-related dust deposition has been observed previously in western Europe. However, within Mohos such a compassion may not be drawn for the majority of dust events. For example, event D9 (860-650 cal yr BP) occurs during the Medieval Climate Anomaly, a period of generally higher European temperatures (Mann et al., 2009) but also one of intense human impact on the environment through deforestation and agriculture (Arnaud et al., 2016; Kaplan et al., 2009). Furthermore, such events within the Misten record (Allan et al., 2013) were also linked to low humidity, whereas the Mohos TA (Fig. 4) record indicates locally wet conditions. This suggests that dust depositional events in this region are a result of a complex interplay of environmental conditions in the dust source areas, rather than simply reflecting locally warm or cold, or even wet or dry periods."

Lines 260-261 also observed in other bog records (misten, EGR)

R14: We have revised the text on lines 284-285 to reflect this: "a major shift in the controls of dust production and deposition at this time, a shift observed in peat-derived

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dust records from Western Europe (Allan et al., 2013; Le Roux et al., 2012)."

Line 299 it could reflect the minerotrophic stage of the peat, with no meaining on dust flux.

R15: Type 1 deposition only occurs within D10- the most recent dust event, not D0, the event close to the minerotrophic stage of peat. We agree however, that D0 may therefore not be a dust event, but related to minerotrophy, and the transition to ombrotrophy, and so we now do not discuss it as a dust event.

Line 344 not clear with double (.

R16: Text adapted line 372: "(Gradient of samples pre-10,500 yr BP = 0.7429, D10= 1.0637)."

Lines 353-356 D10 is older or very close to the minerotrophic/ombrotrophic transition. I would not give to much interpretation in term of dust flux for this first D event. The peat at that time may be affected by surface runoff.

R17: As mentioned above, we agree with the reviewer's interpretation regarding D0, and so we do not discuss it as a dust event.

Line 373 you must first remove signal from volcanic eruption observed in EGR record (see Le Roux et al., 2012).

R18: Text has been adapted to reflect this in lines 401-403: "with a large dust flux peaks identified in Switzerland between 9000-8400 cal yr BP with other volcanic eruption-related peaks (See Fig. 5), when there is little evidence of dust input into Mohos."

Lines 414 and 418 Fig .7 - But there are still several meter variations in water table: it is significant, no? Moreover most D events during this interval coincide with shallower water table. Such wetter conditions may limit local erosion and favor distal input. We observe the same relationship for the Misten bog (see Allan et al., 2013).

R19: The DWT values are in cm, something which has now been indicated on the

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figures. As such, the variations in this period only indicate changes of roughly 2-5 cm change at most. The second point regarding such wet conditions favouring distal deposition is valid, however, and so we have adapted the text accordingly on lines 448-449: "Such wetter conditions also limit local drought-related erosion, and so may be further evidence of distal dust input at this time (Allan et al., 2013)."

Lines 427-428 you may add that the local input erase any distal input in that case.

R20: The text has been adapted lines 458-459: "local dust mobilisation, with K-rich dust present at this time, with local input potentially erasing some distal signals."

Line 436 The time interval is quite short to evidence cyclcity > 1 kyr. i would suggest to keep "millenial cyclicity".

R21: Text has been adapted in lines 467 and 470 to reflect this

Lines 460-463 I would suggest to rewrite point 2. Here it overlaps with the point 3. I would say that two intervals are identified wit different major dust control: 1) dust input over the older interval reflects more local conditions; 2) distal input for the younger interval .

R22: In order to improve the clarity , we have re-written this point, on lines 492-494: "The two intervals before and after this shift are indicative of a change in major dust controls. For the period prior to 6100 yr BP, dust input is reflective of more local controls, whilst the most recent 6100 yr BP of deposition may be linked to more distal forcings."

Comments on Figures Figure 3: any influence of density changes in the measured counts? see note for figure 4.

R23: As mentioned above, we have normalised all ITRAX data (relative to scattering) to take into account density shifts.

Figure 4: Do you calculate ash content after 950° calcination? It could also be a good

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indicator for mineral matter in your peat.

R24: Unfortunately, we did not measure LOI after 950°, as we were primarily interested in organic matter, not CaCo3 content.

Since ITRAX was performed on the fresh core section how do you take into account the density and/or porosity changes in the measured counts? I suggest to discuss this point in the ms. What could be the influence of the average 20% variation of the bulk density on the elemental counts? How could you normalize each ITRAX elemental profile?

R25: As outlined earlier, in order to circumvent these issues, we have normalised to the scattering values of the ITRAX, after Kylander et al., 2011.

What is the correlation between ITRAX counts and ICP measurements?

R26: The correlation has been calculated, and is presented in lines 203-206: "To facilitate comparison, we bring both records on the same timescale using a Gaussian interpolation with 100 year time steps and a 300 year window. Pearson's r=0.2649, with a p-value of <0.001, indicative of a significant correlation (See SI 4)"

Figure 5: I would suggest to improve this figure. Add the dust events as grey bars as identified in the two ms of Allan et al. 2013 and Le Roux et al. 2012. Some volcanic events are reported in EGR record: they have to be indicated.

R27: In our opinion adding the dust events as indicated by the other two manuscripts clutters the figure. The data is still presented, and so it is hopefully still clear when those studies indicate increased dust. The volcanic events have been added.

Figure 6: add arrows on the vertical scale trend to indicate wetter or dryer local conditions as identified by the reconstructed water table.

R28: These have been added to all figures displaying the TA record.

Table 2: ? add digits

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R29: All issues relating to digits here have been resolved

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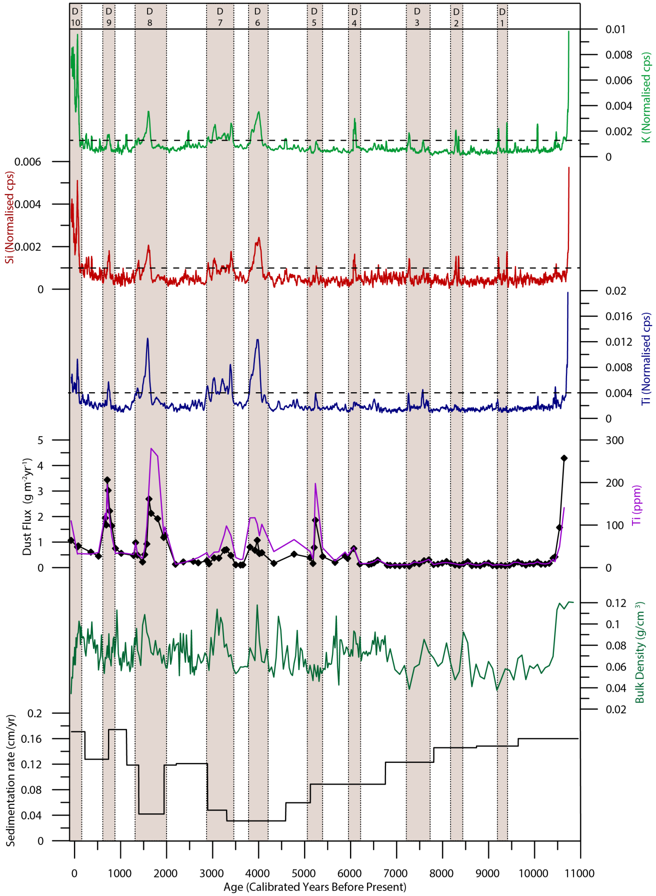

Fig. 1. Updated Figure 3

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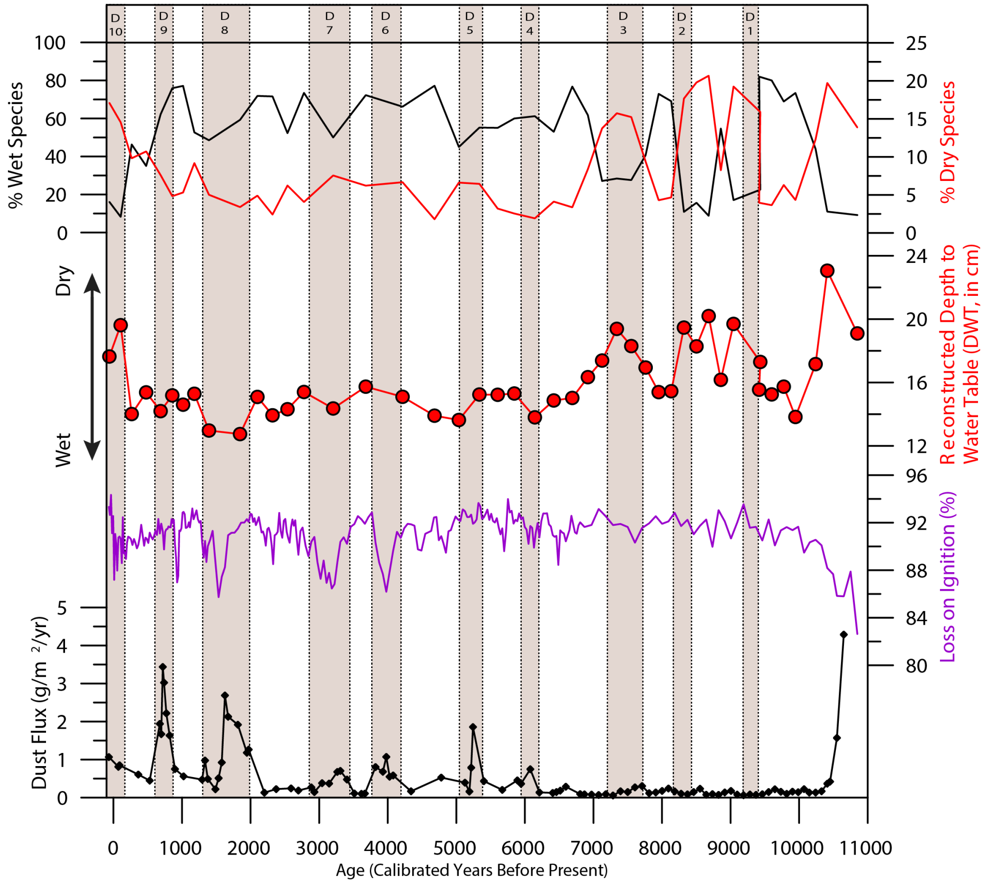

Fig. 2. Updated Figure 4

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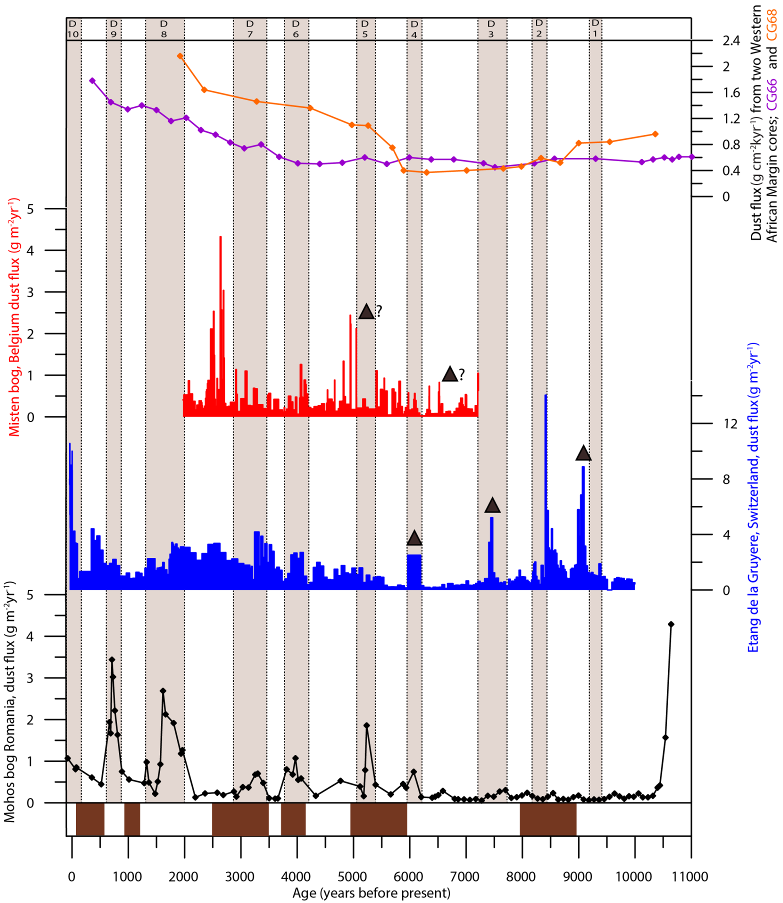

Fig. 3. Updated Figure 5

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