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Climate of the Past Discussions

Interactive comment on "Temperature variability at Dürres Maar, Germany during the migration period and at high medieval times, inferred from stable carbon isotopes of *Sphagnum* cellulose" *by* R. Moschen et al.

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Responses to the interactive comments of the anonymous referee #2:

1-3) Anonymous referee #2 depicts that the topic of this manuscript is very relevant for the palaeoclimate community because a palaeoclimate reconstruction based on a relatively new and independent proxy is presented. As the referee states, the stable carbon isotope composition of Sphagnum cellulose and its relationship to ambient temperature is not fully understood. Our results however show the potential of this proxy.

We hope that our results stimulate the palaeoclimate community to set more work on this proxy, to establish additional Sphagnum d13Ccellulose time series, and to perform substantial plant-physiological studies on the genus Sphagnum.

4) Referee #2 states that our age depth model below a depth of 5 m appears arbitrary and, thus, proposes to exclude the section below 5 m from our interpretation, or requests more 14C data to exclude considerable human impact on the peat during Roman times. The referee's remark on this important issue is appropriate; however, the age depth model shown in figure 4 (given for the youngest approximately 2000 years of core DM-01) is a bit mistakable since it ends with the calendar age of 129 $\pm$82 BC of the sample from a depth of 520-522 cm. Core DM-01, retrieved in Dürres Maar in 2007 has a total length of $\sim$7.5 m and is dated from the top to the bottom. The entire age depth model of core DM-01 displays the time window from presence to $\sim$2000 years BC and is published in Moschen et al. (2009) and Kühl et al. (2010). The bottom of core DM-01 was dated to $\sim$2000 years BC. The peat growth rate during the following two millennia was $\sim$0.9 mm/yr. This growth rate is supported by 5 14C ages. Regarding the manuscript presented here, we have decided just to show the age depth model from presence to the turning point AD/BC. This is because the last 2000 years depict the relevant time window for which reliable tree ring based palaeotemperature reconstructions and historical data are available to compare these with our high resolution stable carbon isotope time series (only for this upper part of the core material continuous Sphagnum d13Ccellulose values have been determined so far). Since the age depth model given in figure 4 could be misunderstood we have addressed on that issue in the description of table 1. We have also included the sample from a depth of 572-574 cm into table 1 to depict that the peat growth rate during the first four centuries AD is similar to its growth rate during the two millennia BC. We additionally refer to Moschen et al. (2009) and Kühl et al. (2010) where the age depth model of the entire core DM-01 is published.

5) As a consequence of point 4, referee #2 states that the title of the manuscript is

misleading, because convincing results are just given for Medieval Times. We do not agree with the reviewer's annotation and feel that despite a less precise age depth model than at Medieval Times, the age depth control from the 1st to the 5th century AD is sufficient to attempt an interpretation of the temperature development during the European Migration Period (additionally see reply on comment 4)).

References:

Kühl, N., R. Moschen, S. Wagner, S. Brewer and O. Peyron: A multiproxy record of late Holocene natural and anthropogenic environmental change from the Sphagnum peat bog Dürres Maar, Germany: implications for quantitative climate reconstructions based on pollen, Journal of Quaternary Science, 25, 675-688, 2010.

Moschen, R., N. Kühl, I. Rehberger and A. Lücke: Stable carbon and oxygen isotopes in sub-fossil Sphagnum: Assessment of their applicability for palaeoclimatology, Chemical Geology, 259, 262-272, 2009.

Interactive comment on Clim. Past Discuss., 7, 535, 2011.

Table 1: Results of radiocarbon dating: *Sphagnum* plant material is used for radiocarbon dating to avoid admixture of plant material relocated from the bog's vicinity. In one case (*) plant fragments from *Vaccinium* spec. were used for ^{14}C dating, because *Sphagnum* plant material was not available in an adequate amount. The standard deviation for the calendar ages is given as 2σ. The sample from a depth between 502 and 504 cm has been omitted from the model, since its ^{14}C age is obviously too young. These results depict the radiocarbon dating of the upper approximately 5.5 m of core DM-01 with a total length of ~7.5 m. The age depth model of the entire core is shown in Moschen et al. (2009) and Kühl et al. (2010).

depth [cm]	Lab. no.	^{14}C age	age cal. BP	**calendar age (2σ)**
20–22	Poz-22240	130.27 ± 0.39 pMC		**1960-61 AD**
84–86	Poz-24702	640 ±30 BP	610 – 544	**1368 ±28 AD**
132–134	Poz-23191	890 ±30 BP	834 – 733	**1167 ±51 AD**
172–174	Poz-22243	1075 ±30 BP	1015 – 930	**978 ±43 AD**
228–230	Poz-20797	1140 ±30 BP	1142 – 968	**895 ±87 AD**
292–294	Poz-22244	1270 ±30 BP	1286 – 1167	**724 ±60 AD**
356–358	Poz-20798	1490 ±30 BP	1416 – 1305	**590 ±56 AD**
428–430	Poz-22246	1570 ±30 BP	1530 – 1393	**489 ±69 AD**
422–424	Poz-20799	1585 ±30 BP	1538 – 1405	**479 ±67 AD**
472–474	Poz-20773	1650 ±30 BP	1622 – 1508	**385 ±57 AD**
502–504	Poz-24706	1350 ± 30 BP	1314 – 1235	**676 ±40 AD**
520–522*	Poz-23192	2125 ±35 BP	2160 – 1997	**129 ±82 BC**
570–572	Poz-20800	2585 ± 30 BP	2766 – 2701	**784 ±33 BC**

Fig. 1. revised table 1