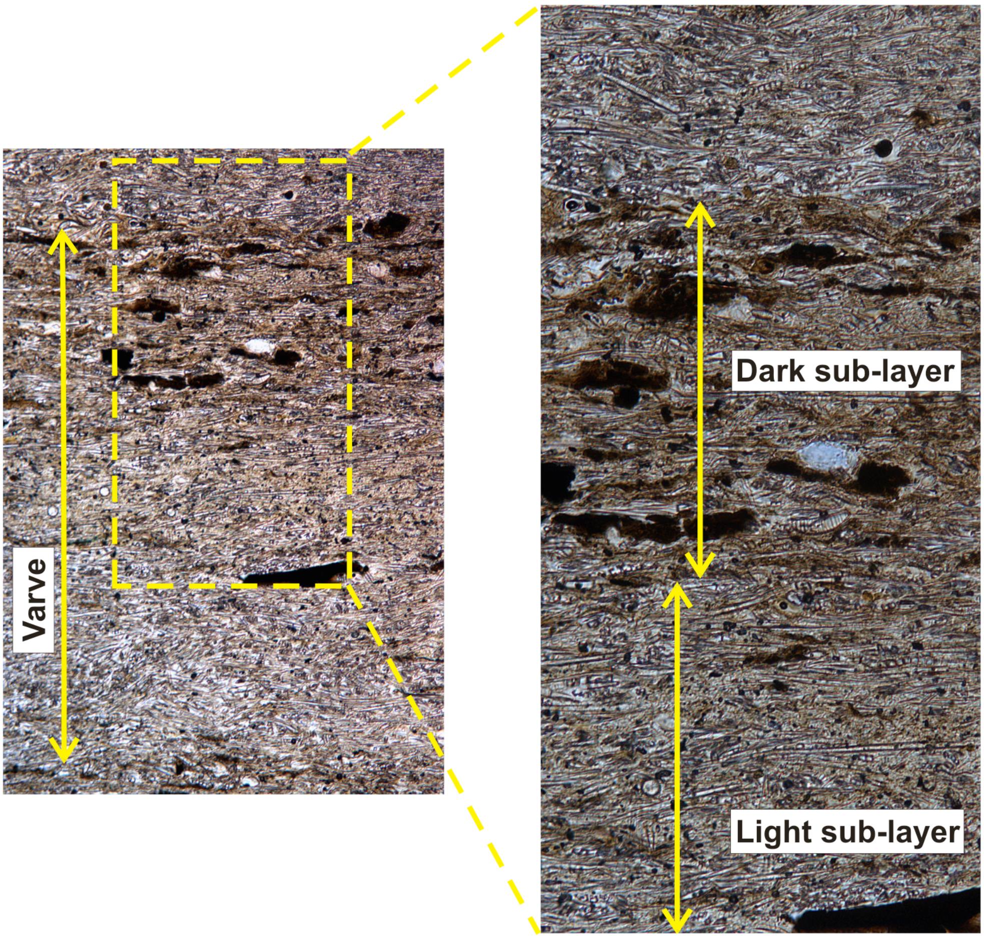
We thank the two anonymous referees for their positive and constructive reviews. Below, we provide a point-by-point response to their comments.

Referee #1

- We appreciate Referee's #1 comment regarding the definition of the boundary between the top of a light sub-layer and the overlaying dark sub-layer on a routine basis under the microscope as it gives us the opportunity to clarify a methodological point that is critical for the accuracy of our data. This boundary was defined by the distinct change in the composition of the two individual sub-layers. The light sub-layers are formed by very well preserved diatom frustules. The dark sub-layers are predominantly composed by amorphous organic matter and broken diatom remains; reworked periphytic diatoms, remains of littoral origin, clay and minerogenic material are present. As shown in the figure below, the compositional change from a fine diatom sub-layer (light) to an organic-detrital sub-layer (dark) can be efficiently defined under a petrographic microscope.



Left: Photograph of a typical varve from the Dethlingen core. Right: Close-up photograph of the boundaries between the light and dark sub-layers that can be defined by changes in the sub-layer composition from fine diatom to organic-detrital layers.

In a few cases of low varve preservation and less clear boundary between the light and the dark sub-layer the thickness measurements were taken at the mid-point between the two distinct sub-layer compositions. The varves of the Dethlingen record are very well preserved and thick enough (1.5-2 mm) to allow precise measurements of the individual layer thicknesses under a petrographic microscope. The statistical analyses were employed only on well preserved and precisely measured varves. Varve interpolation was only used to establish a floating chronology for the Dethlingen record and not in statistical analyses. Varve interpolation was applied on short core intervals with 80 % of them being interpolated with less than 5 varves. The varve counting error is estimated to ±2%.

In the revised manuscript the description of the boundaries between the individual light and dark sub-layers are rephrased in order to achieve greater clarity for the readers regarding our methodological approach and accuracy of the varve thickness measurements.

- We appreciate Referee's #1 suggestion to employ a low-pass filter to the sub-layers thickness datasets prior to spectral analysis as it may allow a better assignment of the sub-decadal-scale periodicities to the ENSO and NAO cycles. However, this appears not to be necessary in our study as the spectra, on which our discussion is based on, are linear superpositions, and thus no additional information would be gained by the employment of a low-pass filter. We fully agree, however, that other statistical approaches may prove useful in the interpretation of the data, so we intend to make the varve thickness measurements of the Dethlingen record accessible to the scientific community through a web-based database in order to facilitate any future analyses of this varve record.
- All minor/technical corrections suggested by Referee #1 will be incorporated in the revised manuscript.

<u>Referee #2</u>

- Referee #2 suggests to explain how the sediments of this study have been attributed to MIS 11. A decadal-scale palynological analysis of the varved sediments from Dethlingen has revealed a unique vegetation succession allowing a bio-stratigraphic assignment of these lake deposits to the Holsteinian interglacial (Koutsodendris et al., 2010). The Holsteinian is a Middle Pleistocene interglacial period, for which absence of continuous terrestrial records spanning several interglacial periods in northwestern Europe and lack of reliable absolute dates have precluded a direct correlation with the marine isotope stratigraphy. However, a substantial body of research accepts that the

Holsteinian interglacial is the terrestrial equivalent of MIS 11 in central Europe (e.g., Turner, 1998; de Beaulieu et al., 2001; Nitychoruk et al., 2005; see also Koutsodendris et al., 2010, for a discussion). This correlation is achieved by palynostratigraphic correlations between pollen records from lowland central Europe, a long terrestrial sequence from Massif Central (France), and a marine core. The lowlands of central Europe, from the British Isles to Poland, are characterized by very distinct vegetation dynamics during the Holsteinian interglacial (e.g., Geyh and Müller, 2007; Urban, 2007). Based on characteristic tree associations, e.g., expansion of *Taxus* and *Picea* during the older stages of the interglacial, strong expansion of *Abies* and *Buxus* during the younger stages, and the last occurrence of *Pterocarya* in central Europe, the Holsteinian pollen profiles from lowland settings have been correlated with mountainous records (e.g., de Beaulieu et al., 2001). In the mountainous pollen record from Praclaux (Massif Central, France), which extends over the last five interglacial periods (Reille et al., 2000), the distinct Holsteinian vegetation dynamics are recorded during MIS 11 (Reille et al., 2000; de Beaulieu et al., 2001). A land-sea correlation off Iberia (core MD01-2447) revealed the characteristic Holsteinian vegetation succession during MIS 11 in the marine realm, thus supporting the correlation of terrestrial records at Praclaux and providing a direct correlation of the Holsteinian interglacial with the marine isotope stratigraphy (Desprat et al., 2005).

- We respectfully disagree with Referee #2 that the “dropstone-like sand grains” may not confirm the seasonal interpretation of the laminations at Dethlingen. The “dropstone-like” grains in our record lay on the boundary between the dark and light sub-layers. They cause a local deformation of the dark sub-layers and they are always covered by the diatom frustules that compose the light sub-layers (see Figure 2F in the manuscript). The position of these grains suggests that they were deposited after the formation of the dark sub-layers, i.e., after the sedimentation break in winter, and before the onset of the massive diatom blooms in spring that lead to formation of the light sub-layers. As a result, the deposition of these grains appears to be related with the melting of the lake ice-cover shortly after the onset of warmer conditions in spring. Hence, these grains mark a very distinct time interval of the annual sedimentation processes. Similar single grains have been previously observed in central European varve records from the Holocene (e.g., Brauer and Casanova, 2001) and MIS 11 (e.g., Brauer et al., 2008)
- Determination of thickness measurements / interpolation of varve counting: see reply to Referee’s #1 comment above
- We fully agree with Referee #2 that the prominent 207-year solar cycle is absent from the statistical results and this needs to be mentioned in the revised manuscript. In

addition, Referee #2 argues that one of the two peaks at 25 and 10.5 years in the Dethlingen varve thickness power spectra is not most likely related to a solar cycle, either the 22- solar cycle or the 11-yr sunspot. Referee's argument is based on the fact that the 11-year Schwabe solar cycle is the sunspot expression of the 22-year Hale magnetic cycle, and therefore the Hale cycle should have the double period of the Schwabe cycle. We fully appreciate this comment. It has to be noted, however, that the 11 and 22 years are mean values and the periods of these two prominent solar cycles vary in length, between 8 and 17 years for the 11-year sunspot and between 20 and 25 years for the 22-year solar cycle (Hoyt and Schatten, 1997). The observed 10.5- and 25-years periods in our record are found well within these boundaries. Considering the fact that these two periods are significant on the light sub-layer spectrum, which represents the diatom productivity that is strongly influenced by solar activity, we suggest that the 10.5- and 25-years periods may be attributed to the prominent 11- and 22- year solar cycles, respectively.

- We respectfully disagree with Referee #2 that most of the identified cycles in our record, particularly the 11-year sunspot and the QBO, relate to patterns that are not prominent in Central European climate at the moment. Recent studies on modern instrumental datasets suggest that there is a significant influence of solar variability on atmospheric circulation over central Europe (e.g., Gray et al., 2010; Woolings et al., 2010). Particularly, based on analyses of a 40-year-long meteorological dataset (European Centre for Medium-Range Weather Forecasts) and satellite observations, the planetary wave amplitude in the mid-high latitudes, i.e., 55-75° N, appears to be closely related to the 11-year solar cycle (Powell and Xu, 2011). In addition, the QBO variability influences central European climate and is strongly related to the 11-year sunspot (e.g., Labitzke, 2005). Combinations between the two different phases of the QBO and the solar maxima and minima phases affect the planetary waves and temperature over the Acrtic and the middle latitudes in the northern hemisphere making an impact on midwinter climate.
- We agree with Referee #2 that additional µ-XRF data should be presented in Figure 8 to better show that the OHO was not associated with any significant changes in the geochemical composition of the sediments. We have, therefore, added µ-XRF data spanning ~90 years before and ~150 years after the onset of the OHO in the revised manuscript to support our interpretation.
- We fully agree with Referee #2 that the statement "In contrast, when the cyclic signals are absent from all seasonal spectra, the external climate forcing controlling varve formation was altogether weakened and/or ceased completely" (p: 1408, lines: 2-4)

excludes a weak sensitivity of the climate system to external forcing as a possible reason for the absence of cyclic signals from the power spectra; hence, the sentence is rephrased in the revised manuscript.

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