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Interactive comment on "The transformation of the forest steppe in the lower Danube Plain of south-eastern Europe: 6000 years of vegetation and land use dynamic" *by* Angelica Feurdean et al.

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Interactive comment on "The transformation of the forest steppe in the lower Danube Plain of south-eastern Europe: 6000 years of vegetation and land use dynamic" by Angelica Feurdean et al. Natalie Schroeter (Referee) nschroet@bgc-jena.mpg.de Received and published: 20 August 2020. The manuscript titled "The transformation of the forest steppe in the lower Danube Plain of south-eastern Europe: 6000 years of vegetation and land use dynamic" by Feurdean et al. presents a multi-proxy approach to investigate the history of European forest expansion in the Lower Danube Plain over the last 6000 years. It is a well written and encompasses a detailed comparison to

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other regions and a comparison to the output of the REVEALS model. Generally, there are no major issues with this manuscript as it is already well organized. I have only minor suggestions and comments which will hopefully help with the data interpretation, particularly of the n-alkane results.

R: Thank you for the positive appreciation of our work.

Line 68: It would be interesting to know how far in time human occupation in this area has been detected.

R: We have revised this paragraph to fit to the story of Potential Natural Vegetation as requested by Rev 2- (see Rev 2 point 2 and lines 92, 96). It now reads “Since the Lower Danube Plain represents one of the oldest areas of continuous human occupation from the Neolithic onwards i.e., 8000 cal yr BP (http://ran.cimec.ro; Balasescu and Radu, 2004; Weininger et al., 2009; Wunderlich et al., 2012; Nowacki et al., 2019) and one of the most important agricultural areas in Europe (European Environmental Agency, 2016), the current vegetation is likely very different from its natural state, though exactly how different is not known”.

Line 178: “To determine the climate conditions and the predominant vegetation type. . .”. I would suggest to rephrase this sentence and be a little bit more careful with the interpretation value of n-alkanes. n-alkanes are commonly used to distinguish different origins of organic matter sources based on their chain-length and their delta Deuterium values can help to identify past environmental conditions.

R: We have rephrased this sentence to more accurately show that the chain-length of n-alkanes are commonly used to distinguish among sources of organic matter. The relation between the n-alkanes chain length and the type of organic material and plant source is also detailed in 3.2.2. Additionally, to accommodate Rev 2 suggestion (l. 286) on the occurrence of n-alkanes of aquatic origin, we have added Paq =aquatic index, which quantifies the abundance of submerged vascular macrophyte. This subsection now reads :“3.2.2 Leaf wax n-alkanes based vegetation reconstruction. To determine

the source of organic matter and the predominant vegetation type (Eglinton and Calvin, 1967; Ficken et al., 2000; Diefendorf et al. 2015), we measured the concentration of higher-plant derived n-alkane homologues of 60 sediment samples selected along the composite core. n-Alkanes are an integral part of higher-plant leaf epicuticular waxes, highly resistant to degradation and among the most stable lipid components of the protective waxes coating terrestrial plant leaves (Eglinton and Eglinton, 2008; Sachse et al., 2012). They are commonly used to distinguish sources of organic matter based on their chain-length (....). In this study, we calculated the ratio of straight-chain n-alkanes of different chain (homologues) lengths as these have been previously used as proxies for the relative contribution of various types of plants in lacustrine sediments (e.g. Ficken et al., 2000; Zhou et al., 2005). Average chain length (ACL) is an indicator of the relative abundance of short (C16-C20) vs long chain n-alkanes and may be linked to the predominance of higher taxonomic plants over lower taxonomic plants including algae (Ficken et al., 2000; Eglinton and Calvin, 1967). Within the long chain n-alkanes, the abundance of n-alkanes with n-C31 and n-C33 may be indicative of grass predominance, whereas n-C27 and n-C29 may indicate a predominantly tree covered landscape (Aichner et al., 2010; Meyers, 2003). The aquatic index (Paq) quantifies the abundance of submerged and floating vascular macrophytes, which are characterised by medium chain length n-alkanes (n-C23 and n-C25), relative to emergent aquatic and terrestrial plant types that are characterised by long chain n-alkanes (Ficken et al., 2000). It should be noted that n-alkanes are less successful in detecting coniferous than angiosperms (Diefendorf et al. 2015) and that some overlap within the mid chain length alkanes n-C23 and n-C25 is possible (Aichner et al., 2010; Meyers, 2003)".

Line 183: N2 subscript Chapter 3.3 Regime disturbances by fire and herbivores: Since you aim to reconstruct past fires, have you considered analyzing levoglucosan as a proxy for biomass burning?

R: We could not reliably detect levoglucosan in any of the trial samples. Levoglucosan peaks detected in a few samples were very small relative to the high background,

meaning a high degree of uncertainty in the analysis result.

Line 280: Please explain how shorter chain lengths of n-alkanes correlate to moister climate conditions.

R: To avoid confusion (see also comment l.282 of Rev 2), we have removed the interpretation of the shorter chain length as a direct proxy for moist conditions and retained only that the (C27+C29)/(C33/C31) ratio primary reflect changes in major vegetation type. However, indirectly, increases in the (C27+C29)/(C33/C31) ratio typical for the dominance of trees may indicate wetter conditions, as trees required higher amount of moisture than the grasslands, especially steppic one. This sentence now reads: "Coeval with the maximum extent in tree cover, the n-alkanes were dominated by the shorter chain lengths (ALC) and a higher n(C27+C29)/(C33/C31) ratio, indicative of increased contribution of tree-derived n-alkanes (Meyers, 2003; Aichner et al., 2010). However, the concentration of n-alkane varied with that of detrital elements (high between 6000 and 4200 cal yr BP; low between 4200-25000 cal yr BP; Fig.3) suggesting their enhanced deliver into the lake by runoff of floods".

2. Study area. 290: Since you discuss climate dynamics in your study region, you should add a short paragraph about the current climate regime/atmospheric systems effecting the studied lake in section

R: This and the suggestions of Rev2_114 we have revised the information about the climate type in this region. This reads: "The climate in the study region is wet-warm temperate continental (Koppen-Geigger class Dfa), also termed excessive with the prevalence of harsh winters and hot summers (Posea et al., 2005), due to the influence of air masses from continental Asia. The mean annual temperature is of ca. 11°C, mean January temperature of ca. -1 °C and a mean summer temperature 25°C. Annual precipitation is about 400 mm (Adamclisi Meteo station)."

Line 317: "As climate conditions remained relatively moist during this decline, anthropogenic rather than climatic causes are likely" How did you infer moist conditions?

R: We have removed the climatic hypothesis from this place, and only discussed pollen-based evidence of anthropogenic land cover changes. In the second part of this sub-chapter (5.2), we discuss local climate conditions based on P aq, and geochemistry as well as published regional climatic records and conclude that climate conditions remained relatively moist during this decline in tree cover, therefore anthropogenic impact was likely the main cause of tree cover loss.

Line 326: “The proportion of Cerealia is significantly greater in the REVEALS estimate (40%) than in the raw pollen percentages (5%)” Interesting, why is that?

R: To accommodate this and at the suggestion of Rev2 (line 329) we have introduced a paragraph discussing the implication of uncertainties in the REVEALS model on the pollen-based vegetation reconstruction. This reads: “Our Cerealia pollen includes Triticum, Zea, Hordeum and Secale cereale, for which we have used productivity estimates obtained from calibration of local surface pollen samples with vegetation inventory (Grindean et al., 2019). These productivity estimates are considerably lower than the average for Europe (0.22 vs. 1.85; Mazier et al., 2012), which is the main cause for the high proportion of Cerealia cover reconstructed by REVEALS and for the difference in outcome from this study and elsewhere in Europe. The crop species included in Cerealia also varied among regions and with time, which may also introduce differences when applying the PPEs for landscape reconstruction back in time. Lastly, the occurrence of wild grass species with pollen that fall in the Cerealia pollen type (all Poaceae grains larger than 40 μm), may have led to an overestimation of proportion of Cerealia at certain times in the past”.

Line 367: “Our quantitative record of vegetation indicates a higher than present tree cover across the landscape of the eastern Lower Danube Plain between 6000 and 4200 cal yr BP with an absolute maxima of 50% (60% raw pollen percentages) between 4200 and 2500 cal yr BP (Fig. 6, see Table 3 for reference and Fig. 1 for locations).” Does the concentration of n-alkanes also increased between 6000 and 4200 cal yr BP?

R: We have extended the discussion on the n-alkane concentration See reply l. 280.

You compare your results to a various other locations. However, did you also consider altitude variations?

R: All sites are located at low elevation (less than 300 m asl). To illustrate this, in Table 3, we have added elevation of each site.

Figures Figure 3: I would suggest to delete the number 850 and possibly 950 from the y axis of the depth [cm] since they are too close to the previous and subsequent depth numbers and thus nearly illegible.

R: For a better readability, we amended depths on this figure.

Figure 4: The numbers on the x axis and y axis are a little bit hard to read due to the small font size.

R: For a better readability, we enlarged the numbers on this figure.

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