

# ***Interactive comment on “Opportunities and limitations related to the application of plant-derived lipid molecular proxies in soil science” by Boris Jansen and Guido L. B.***

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Final author response:

We are grateful for the time and effort of the two referees. We are very glad to see the paper is deemed ‘an important and essential contribution to the SOIL community’ (referee 1). Upon the final verdict of the Topical Editor we will of course give a detailed response to all points raised by the two referees. For now in our final author response we shall give a more general response on the emerging issues and topics raised by the referees:

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In response to Referee 1: - We agree there is potential for further condensation / sharpening of the focus of the paper. - Assessment of the chemotaxonomic potential of the molecular proxies as transferred to the soil is indeed very important. Therefore, we dedicated an entire section to it: section 4: "transformations and turnover in soils". We will more clearly link the results there to the chemotaxonomic potential at the source as discussed in section 2. Specific studies where the chemotaxonomic potential in soils is explored are already included (e.g. Jansen et al. *palaeo-3*, 2013), but will be highlighted more explicitly. Also the precise origin of the chemotaxonomic distinction (or lack thereof) will be more clearly explained. - The quantity and quality of extractable lipid patterns in leaf waxes vs. root waxes is indeed a topic of debate. We tried to capture this in section 3.2, but will make it even more explicit.

In response to Referee 2: - Our emphasis on straight-chain lipids is due to the fact that the vast majority of the work of molecular proxies, at least in the sense of chemotaxonomic application, has been on this compound class. We agree that this should be more clearly explained. - We do not agree that biodegradation and microbial synthesis are overemphasized. Both are important issues that should be considered when applying molecular proxies in soils. - The description of the ester-bound lipids is indeed somewhat imprecise. We will amend this in line with the suggestions of the referee. - The referee mentions various points with regards to transformation/degradation/preservation of lipids as part of soil organic matter (SOM) dynamics. We agree that the description of processes of transformation could benefit from further specification and we will critically re-read and amend/expand this section accordingly. However, it is explicitly not the aim or scope of the present article to enter a detailed discussion of molecular SOM dynamics. This is part of a separate on-going debate in the soil scientific community (e.g. Schmidt et al. *Nature*, 2011; Lehmann & Kleber *Nature*, 2015). For instance, the referee mentions molecules may remain intact as 'a constituent of humic-type macro-molecules'. The importance and even existence of such macro-molecules is currently under debate (Lehmann & Kleber, *Nature*, 2015). It is explicitly not our aim to contribute to this debate in our paper, as that issue alone



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would be grounds for an entire review paper on its own. However, we will more explicitly mention the debate. - The referee asks for inclusion of more of the classical work on lipids. As can be seen in our reference list, we already went through great efforts to retrieve older and/or less accessible work. As a result we included a large body of older works including several publications in books (e.g. Eglinton et al., 1962; Herbin and Robins, 1968; Tulloch et al., 1973; Jambu et al., 1978; Tissot et al., 1984; Chaffee et al., 1986; Dinel et al., 1990).. However, strong focus of the review lies on more recent findings that generally helped to significantly change and improve our mechanistic understanding of processes influencing lipid composition in soil. Most of the relevant literature has been published during the last 2-3 decades, whereas older literature is often more descriptive on the one hand and on the other hand processes that were thought to be of high significance in the past and highlighted e.g. by Stevenson (1966, 1994) are now under debate, e.g. the concept of recalcitrance (Marschner et al., 2008; Dungait et al., 2012). Therefore, we focus more on the current state of knowledge. Nevertheless, we will carefully evaluate the references suggested by the reviewer and include them where they are relevant. - The referee mentions a large number of other applications of molecular proxies in soils and the importance of other classes of components and additional forms of application than already mentioned in our review. For the sake of completeness we will carefully consider this. At the same time, focus is also needed (and specifically requested by referee 1!) to allow for in-depth discussion and to keep the review paper within acceptable page limits. Initially the review paper was substantially longer, but as per the request of the Editor was significantly reduced in length before it could be considered as discussion paper in SOILD. We cannot vastly expand the scope without concurrent vast reduction of depth and thoroughness. This is a fine balance that we wish not to disturb too much (but we will indicate our choices for delineation more clearly).

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