Grass leaf wax *n*-alkane distributions from a field experiment conducted in central Tibet

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Abstract:

The distributions of long chain *n*-alkanes can serve as plant biomarkers and, as such, are in valuable as paleoclimatological and paleoecological, as well as chemotaxonomical, proxies, but, as yet, we cannot discriminate the degree to which plant types, temperature (T) and/or hydrology drive the variations in *n*-alkane distributions. Seven co-occurring grass species, *i.e.*, *Poa pratensis L. Poaceae* (Pl), *Stipa purpurea* (Sp), *Potentilla bifurca Linn*. (Pb), *Potentilla saunder siana* (Ps), *Kobresia parva* (Kp), *Kobresia hunilis* (Kh), *Lagotis Gaertn* (Lg) (116 samples) and soils (14 samples) were studied in climate-controlled growing conditions in an open-top chamber located in Naqu, Tibet. We identified *n*-alkane concentrations and distributions using generalized *n*-alkane parameters, *e.g.* the carbon preference index (CPI), the average chain length (ACL), chain-length ratios (C_{31}+C_{33})/(C_{27}+C_{29}+C_{31}+C_{33}) subjected to increasing temperatures (rising *T*) and relative humidity (*RH*) (spanning a >4°C mean annual temperature (MAT) gradient with Plus 50% *RH*, and an ambient *RH* accompanied by arising *T* value). The *RH* experiments included using Plus 50% *RH*, ambient *RH*, and Minus 50% *RH* treatments under ambient and 2°C rising T conditions, respectively. Pl and Pb hydrogen isotopic compositions of leaf wax *n*-alkanes (*i.e.* the δD_{wax} and δD values of C_{31} and C_{33} *n*-alkanes, respectively) were also analyzed to determine the environmental controls on isotopic compositions. Our study found that: 1) plant *n*-alkane concentrations and distributions, along with δD_{wax} values, respond to both *T* and aridity in a nonlinear fashion; 2) consistent with other recent findings, the evidence we uncovered shows that the influence of aridity on δD_{wax} values and distributions is both complex and variable; 3) the often assumed increase in δD_{wax} values under drier conditions, and a increase in ACL values with rising *T* and aridity, cannot be fully confirmed; and 4) decreases in *n*-alkane CPI values under warmer conditions also need be reconsidered. Thus, our new findings further imply that plant species can gradually adjust to a regime of continuous warming by physiologically acclimatizing themselves whilst retaining their *n*-alkane concentrations and keeping their distributions invariant, and that any increased stress placed on plant growth by drought-like conditions may modify the sensitivity of *T* to *n*-alkane concentrations and distributions. Our results complicate the use of leaf wax distributions and δD_{wax} as paleoenvironmental proxies. Consequently, more accurately differentiated

experimental approaches and/or conditions need to be further investigated to confirm the threshold value. Further observational study may illustrate the respond of CPI and ACL of soil to *T* (altitude), and the impact of plant species and MAP on CPI and ACL in moister SE Tibet or/and in drier NE Tibet as a whole.