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Contrasting impacts of Dansgaard-Oeschger events over a western European latitudinal transect: Implications for the location of main sources of glacial CH_4

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Terrestrial and marine proxies (pollen, planktic and benthic oxygen isotopes, alkenone- and foraminifer-derived sea surface temperatures, ice rafted debris) from IMAGES deep-sea cores MD95-2042 (37˚N, 10˚W), MD99-2331 (42˚N, 9˚W) and MD04-2845 (45˚N, 5˚W) show that western European and offshore environments were strongly affected by Dangaard-Oeschger (D-O) oscillations and Heinrich events. These sequences reveal the latitudinal floristic variability of western Europe in response to D-O oscillations. In southern Europe, cold sea surface temperatures (SST) characteristic of D-O stadials whether related or not with iceberg discharges were contemporaneous with the expansion of semi-desert indicating a cold and dry climate while D-O interstadials were synchronous with the expansion of Mediterranean forest. Further north, above 40˚N, the alternation between D-O interstadials and stadials was synchronous with changes between deciduous *Quercus-Betula-Pinus* open forest (warm and humid climate) and steppic formations (dry and cold climate). In northwestern Iberia at 42˚N, heathlands and grasses dominated the herbaceous vegetation during cold D-O episodes while *Artemisia*, sedges and *Calluna* dominated in western France at 45˚N. Interestingly, our data reveal that the amplitude of Atlantic and

Mediterranean forest expansions differs for any given D-O warming during the glacial period (18-74 kyrs BP). In the western Mediterranean, D-O 17-16 and D-O 8-7 were associated with high forest cover contrasting with lower forest cover during D-O 14 and 12. This indicates that the Mediterranean climate was more strongly expressed, i.e. globally warmer and wetter with particularly dry summers, during D-O 17-16, 8 and 7 (corresponding to minima in precession) than during D-O 14 and 12. The opposite pattern is revealed by the Atlantic sites. In Greenland, the amplitude of the temperature changes is differet again when compared with climatic changes recorded in the lower latitudes: the strongest Greenland warmings are recorded for D-O 19, 11, 8, 12 and 16-17. The comparison of this contrasting latitudinal climatic scenario with the methane record shows that changes in the amplitude of Mediterranean forest cover during the full glacial are well correlated to those of methane, which have been previously shown to be strongly imprinted by precession. Moreover, the similarities observed between the Mediterranean vegetation profile and monsoon records of low latitudes in Asia, which are also strongly influenced by precession, suggest that glacial methane emissions were mainly controlled by this low latitude system through changes in the surface of wetlands. Monsoon-influenced glacial sources contrast with a higher contribution from northern latitudes during periods with limited ice-sheet development such as the present interglacial and Marine Isotopic Stage 5e (MIS 5e, $\sim$132-115 ka).