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Millennial- and sub-millennial-scale shifts in moisture availability for western Mediterranean forest development during the Deglaciation and Holocene

W.J. Fletcher (1), M.F. Sanchez Goñi (2), O. Peyron (3), and I. Dormoy (3)

(1) UMR 5805 CNRS - EPOC, Université Bordeaux 1, Talence, France (w.fletcher@epoc.u-bordeaux1.fr), (2) EPHE, UMR 5805 CNRS - EPOC, Université Bordeaux 1, Talence, France, (3) Laboratoire de Chrono-Environnement, UMR 6249, Université de Franche-Comté, Besançon, France

Pollen data for temperate Mediterranean forest development from marine core MD95-2043 (Alborán Sea, western Mediterranean) and pollen-based climate reconstructions using the modern analogue technique (MAT) for annual precipitation (PANN) and mean temperatures of the coldest and warmest months (MTCO and MTWA) provide evidence for abrupt changes in western Mediterranean climate between 20 and 1 cal ka BP. During the Deglaciation period (20 -6 cal ka BP), major climatic shifts with parallel precipitation and temperature changes occurred at the onsets of Heinrich Event 1 (equivalent to the Oldest Dryas), the Bölling-Allerød (BA), and the Younger Dryas (YD). Multi-centennial-scale oscillations in forest development related to regional precipitation (PANN) variability occurred throughout the BA, YD, and early Holocene, with drier atmospheric conditions in phase with Lateglacial events of high-latitude cooling including GI-1d (Older Dryas), GI-1b (Intra-Allerød Cold Period) and GS-1 (YD), and during Holocene events associated with high-latitude cooling, meltwater pulses and N. Atlantic ice-rafting (events at 11.4, 10.1, 9.3, 8.2 and 7.4 cal ka BP). The forest record also indicates multi-centennial variability within the YD interval with an intra-YD episode of forest recovery. A possible climatic mechanism for the recurrence of sub-millennial-scale dry intervals and an opposed regional precipitation pattern with respect to western-central Europe relates to the dynamics of the jet stream and the prevalence of atmospheric blocking highs. Comparison of radiocarbon and ice-core ages for well-defined climatic transitions in the forest record suggests possible enhancement of marine reservoir ages in the Alborán Sea by approx. 200 years (surface water age approx. 600 years) during the Lateglacial. During the (mid- to late-) Holocene, a significant millennial-scale oscillation in forest development is detected, centred at around 1750 yrs, which may reflect low frequency changes in the strength and latitudinal position of the westerlies related to a North Alantic Oscillation-like (NAO-like) pattern.