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CO_2 leads global temperature: Analysis of ice core and marine sediment data in combination with modelling of marine reservoir ages for the last deglaciation

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Data sets from ice core and marine sediments indicate a lead of CO_2 vs. global temperature. The global temperature is obtained by an EOF analysis of marine cores available, CO_2stems from ice core measurements including a methane synchronization, and climate sensitivity is estimated from climate models of different complexity. For the deglaciation it is shown that the question of leads and lags of CO_2 vs. temperature depends sensitively on the marine ^{14}C reservoir ages (MRA). A critical problem in radiocarbon (^{14}C) dating is the spatial and temporal variability of MRA. To assess the evolution of MRA during the last deglaciation, a numerical scheme is proposed in which existing ^{14}C chronologies can be re-adjusted by transient, three-dimensional simulations of marine and atmospheric $\Delta^{14}C$. The re-adjustment leads furthermore to enhanced variability of atmospheric $\Delta^{14}C$ and increases the mysterious drop of atmospheric concentrations between 17.5 and 14.5 cal ka BP. The simulations indicate also the effect of glacial ocean circulation and deglacial meltwater on MRA. Finally, the energy balance of radiation and temperature response are related to the latent heat from the melting ice sheets, indicating a delayed response of the ice sheets to deglacial global warming. The representativeness of marine and ice core data for the last termination is discussed.