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Possible pathways to a Dansgaard-Oeschger (DO) PMIP protocol

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The DO events of the last ice age represent one of the best studied abrupt climate transitions, yet we still lack a comprehensive explanation for them. There is uncertainty whether current IPCC-relevant models can effectively represent the processes that cause DO events. Current Earth system models (ESMs) seem overly stable against external perturbations and incapable of reproducing most abrupt climate changes of the past (Valdes, 2011). If this holds true, this could noticeably influence their capability to predict future abrupt transitions, with significant consequences for the delivery of precise climate change projections. In this task, the objectives of this study are (1) to cross compare existing simulations that show spontaneous DO-type oscillations using a common set of diagnostics so we can compare the mechanisms and the characteristics of the oscillations, and (2) to formulate possible pathways to a DO PMIP protocol that could help investigate cold-period instabilities through a range of insolation-, freshwater-, GHG-, and NH ice sheet-related forcings, as well as evaluating the possibility of spontaneous internal oscillations.

Although most abrupt DO events happened during MIS3, only few studies investigate DO events in coupled general circulation models under MIS 3 conditions (e.g., Kawamura et al., 2017; Zhang and Prange, 2020). Here, we thus propose that the MIS3 period could be the focus of such a DO-event modelling protocol. More specific sensitivity experiments performed under MIS 3 boundary conditions are needed in order to (1) better understand the mechanisms behind millennial-scale climate variability, (2) explore AMOC variability under intermediate glacial conditions, and (3) help answer the question: “are models too stable?”.