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Dansgaard-Oeschger events in climate models: A PMIP baseline MIS3 protocol

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Frequent well documented Dansgaard-Oeschger (D-O) events occurred throughout the MIS3 period. This study lays the ground-work for a MIS3 D-O protocol for CMIP-class models. We consider the over-arching question: Are our models too stable? In the course of laying out groundwork we review: necessary D-O definitions; current progress on simulating D-O events in IPCC-class models (processes and published examples); and consider evidence of boundary conditions under which D-O events occur. Greenhouse gases and ice-sheet configurations are found to be crucial and the effect of orbital parameters is found to be small on the important features of MIS3 simulations. Oscillatory D-O type behaviour is found to be more likely, although not guaranteed, when run with low-intermediate MIS3 CO₂ values, and reduced ice-sheets compared to the LGM. Thus, we propose performing a MIS3 baseline experiment centered at 38 ky (40 to 35 ky) period, which (1) shows a regular sequence of D-O events, and (2) yields the ideal intermediate ice-sheet configuration and central-to-cold GHG values. We suggest a protocol for a single baseline MIS3 PMIP protocol, alongside a preconditioned (kicked Heinrich) meltwater variant. These protocols aim to help unify the work of multiple model groups when investigating these cold-period instabilities. The protocol covers insolation-, freshwater-, GHG-, and NH ice sheet-related forcing. This addresses the currently gap in PMIP guidance for the simulation of a MIS3 state conducive to D-O oscillations under a common framework