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The Mid-Holocene and Last Interglacial Experiments in PMIP4/CMIP6

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Understanding the forcings and feedbacks that produced interglacial warmth and the outcomes from it can help us better project the future climate of our planet. CMIP6 will include two interglacial experiments to explore the responses of the models to the forcing by orbital variations: the Mid-Holocene (MH 6000 years ago [6 ka]) and Last Interglacial (LIG 127,000 years ago [127 ka]). The dominant orbital forcing changes from modern modified the incoming solar insolation at the top of the atmosphere, resulting in large positive anomalies in summer in the Northern Hemisphere. Greenhouse gas concentrations were close to those of the pre-industrial. This pair of simulations will allow an assessment of the scaling and thresholds of the Earth system to the magnitude of the solar insolation changes (larger seasonal anomalies at 127 ka than 6 ka). High latitude feedbacks from sea-ice, water vapor and clouds will be a focus, and the implications for the stability of the Greenland and West Antarctic (WAIS) ice sheets. This output will be used by the ice sheet modeling community, with an intercomparison being coordinated as a joint activity of PMIP4 and ISMIP6 for CMIP6. As well, these experiments will explore the relative changes of the low-latitude hydrological cycle and monsoons.

The MH and LIG are the most suitable of the warm interglacials for a CMIP6 assessment because of the wealth of data including: ice cores providing measurements of well-mixed greenhouse gases, aerosols including dust and sea salt, and stable water isotopes as a proxy for temperature, as well as for Greenland, ice sheet elevation and extent; marine records for ocean temperatures and geotracers that can be interpreted in terms of water masses and overturning strength; speleothems that provide indication of monsoon strength; fossil corals and sediments for interannual to multi-decadal variability; and terrestrial records that indicate temperature, vegetation, lake level, and hydroclimate changes. As well, new records are refining our knowledge of sea ice extent, fire, and biodiversity.

As part of PMIP4, some groups will perform additional, complementary time-slice simulations: LIG with freshwater forcing to explore Heinrich event 11, early LIG disintegration of the WAIS, glacial inception at 116 ka, and the early Holocene 9 ka; and transient coupled ice sheet-climate simulations.

We will discuss the overall setting, illustrating the experimental design and some of the expectations from preliminary experiments. Modeling groups and people interested in the final data are being invited to discuss the experimental design and most suitable output.