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Modelling the glacial cycles with 40 kyr cycle before MPT: Why and how different were the ice sheet and climate from the recent 100 kyr cycle world?

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Climate change with the wax and wane of large Northern Hemisphere ice sheet occurred with a periodicity of about 100,000 years. This followed a transition at about 1 million years ago (Ma) before which a 40,000 year cycle with smaller amplitude was dominant. Although the importance of insolation as the ultimate driver is now appreciated, the mechanism what determines the timing and strength of ice age termination as well as the amplitude of glacial cycles are not clearly understood. Here we simulate the glacial cycles of the last 1.6 Ma using a three dimensional ice sheet model with the input examined by the MIROC 4m GCM together with one dimensional ice model around the Dome Fuji area in Antarctica. The model is forced by astronomical parameters (Berger, 1978) and atmospheric CO_2 change obtained from ice cores (Vostok, EPICA and DomeF), where available. The simulations reproduced strong 40-kyr cycles with shapes similar to the proxy record especially between 1.6 and 1.2 Ma before MPT even with a constant Greenhouse Gas level. Deglaciation occurred once in two 20-kyr local maxima of insolation when the contributions from obliquity and precession were compounded. The local minimum of precession determined the onset of deglaciation in each cycle, whereas obliquity was important as a pacemaker for the cycles. The role of orbital parameters and CO_2 in determining ice sheet and climate is compared between the period 1.6-1.2Ma and recent 400 ka in order to understand the climate change before and after MPT. In the session, we will discuss the modeled New Dome Fuji ice core profile to preview how the 40-kyr cycle period would look like along depth assuming the possible conditions around Dome Fuji ice drilling cite.