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Astronomically-induced Mid-Brunhes Transition in the Southern and Deep Oceans

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The interglacials after 430 ka (ka: 1000 years) ago were characterized by warmer climates and higher atmospheric CO_2 concentrations than the interglacials before, but the cause of this climatic transition (the so-called Mid-Brunhes Event, MBE) is unknown. Based on model simulations, my results show that, in response to insolation changes only, feedbacks between sea ice, temperature, evaporation and salinity caused vigorous pre-MBE Antarctic Bottom Water formation and Southern Ocean ventilation. My results also show that strong Westerlies increased the pre-MBE overturning in the Southern Ocean via an increased latitudinal insolation gradient created by changes in eccentricity during austral winter and in obliquity during austral summer. The stronger bottom water formation led to a cooler deep ocean during the older interglacials. These insolation-induced differences in the deep-sea temperature and in the Southern Ocean ventilation between the more recent interglacials and the older ones were not expected, because there is no straightforward visible systematic difference in the astronomical parameters between the interglacials before and after 430 ka ago. Rather than being a real "event", the apparent MBE (i.e. the difference in the interglacial intensity before and after 430 ka BP) appears in my results to come from the complex response of the climate system to the astronomical and insolation forcings prevailing before and after 430 ka BP. This does not mean that nothing could have happened between MIS-13 and MIS-11 which might have amplified such difference. Given the important roles of the Southern and Deep Oceans on the carbon cycle, these findings are a first step towards understanding the magnitude change of the interglacial CO_2 concentration around 430 ka.

Reference: Yin Q.Z., 2013. Insolation-induced Mid-Brunhes Transition in the Southern and Deep Oceans. Nature, DOI 10.1038/nature11790.

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