Ice Sheet - Climate Interaction learned from modeling the past for the future

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Recent various observation sources show a substantial change in ice sheet mass (Antarctica, Greenland, Northern Hemisphere ice sheets) and its interaction with the high latitude climate. It is of great challenge to understand and predict the ice sheet response to climate change in the past both for near term and long term. The task is not easy since the ice sheet changes in various time scales from decadal to millennial, but not too unreachable thanks to the fruitful data related to ice sheet advance/retreat and sea level in the past and to ice core data providing information for the past climate change over ice sheet. I will show four examples by simulating the geological and recent past observation by models with various components and hierarchy in order to understand the ice sheet stability/instability, irreversibility and the ice sheets influence upon polar amplification and ocean circulation/stratification for different ice sheets and climate background. Above referring to several CMIP/PMIP results and ISMs (Ice Sheet Models), I use mainly MIROC GCM developed in Japan used for CMIP runs and IcIES (a thermo-mechanical coupled dynamical ISM) for climate and ice sheet experiments, respectively. Recent highlights on simulations of the glacial/interglacial change in orbital time scale, stadial/interstadial change in millennial scale, climate and ice sheet in the pre-Quaternary are introduced and evaluated to show how ice sheets are sensitive to small change of forcing.