Session: B8 Oral presentation

Ocean circulation of the Last Glacial Maximum: multiple quasi-steady states and their sensitivities

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The earth system model (COSMOS) was utilized to explore the climate response to various initial ocean states. Two distinctive states associated with the overturning circulation are generated under the same Last Glacial Maximum (LGM) boundary conditions and forcings. Only the one, which is initialized from a strongly statified ocean, possesses typical LGM characteristics. These characteristics include 1) the shoaling boundary between Glacial North Atlantic Intermediate Water (GNAIW) and Antarctic Bottom Water (AABW); 2) the relatively enhanced upper-level overturning rate. The existence of two stable states indicates that the ocean became well-stratified prior to the LGM. Further investigation remains essential to confirm the exact time when the formation of a well-stratified ocean occurred during the last glacial/interglacial cycle. Different hosing experiments have been performed to test how two model states respond to freshwater perturbations. The results indicate that 1) due to the relatively weak Atlantic Meridional Overturning Circulation (AMOC), the state with a well-stratified ocean is much more sensitive to freshwater perturbation; 2) the freshwater input is unable to trigger the transition from one state to another; 3) the in-phase or out-of-phase variations of the upper and lower overturning cell are related to the oceanic structure, i.e. in-phase variations are accompanied by a well-stratified ocean, and vice versa; 4) the occurrence of the AMOC overshoot is independent of the oceanic stratification, and is related to the enhanced mixing in the Arctic Ocean.