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Surface mass balance modeling of the Antarctic ice sheet: evaluating contributions of the main components and coupling to an AO GCM

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Earth system models (ESMs) are widely used at present for studying climate dynamics. Normally, a modern ESM must contain a cryospheric component, i.e. must incorporate ice sheet dynamics. Proper coupling of ice sheet models (ISMs) and a climate model is a challenging task because of impressive differences in spatial and temporal scales. Therefore elaboration of an effective coupling methodology of an AO GCM and an ICM is the key problem of an ESM construction and utilization.
In the modeling studies we use climate model INMCM developed in the Institute of Numerical Mathematics (Moscow, Russia). Its spatial resolution is 5°x4° and 21 vertical layers in the atmospheric block, 2.5°x2° and 33 vertical layers in the oceanic block. Our approach to solve the problem of coupling is to utilize rather simple effective buffer models assimilating «climatic» variables (surface air temperature, precipitation rate, etc.) generated by the INMCM for further calculation of surface mass balance (SMB) of ice sheets. Procecces forming SMB differ in Greenland and in Antarctica. SMB in Antarctica is driven mainly by solid precipitation, sublimation and transport of drifting snow. Surface melting is observed only on the margins of the Antarctic ice sheet and on ice shelves. We evaluate contributions of the main Antarctic SMB components for the steady-state model pre-industrial conditions and compare results with the similar model reconstructions and field observations.