様々な気候、境界条件下における南極氷床の変動

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Sensitivity experiments for the Antarctic ice sheet with varied climatic boundary conditions

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The mass balance of Antarctica and its changes are not so clear even now. Eighty percents of the ice flow towards the coastline is discharged through them. Recent observations have led to strong concerns that ice-dynamical processes. One of the impressive phenomena about ice shelves in recent years is the collapse of the Larsen ice shelves. It is discussed that only small changes of ice shelves changes upward ice region largely. The limited understanding of such processes was explicitly spoken out in the Fourth Assessment Report (AR4) of the United Nations Intergovernmental Panel on Climate Change (IPCC): Dynamical processes related to ice flow not included in current models but suggested by recent observations could increase the vulnerability of the ice sheets to warming, increasing future sea level rise. Understanding of these processes is limited and there is no consensus on their magnitude." (IPCC, 2007).

Sea-level Response to Ice Sheet Evolution (SeaRISE) is a community organized effort to estimate the upper bound of ice sheet contributions to sea level in the several 100s years. The ice sheet model SICOPOLIS (Greve, 1997) is applied to the Antarctic ice sheet using the forcings given by the project. The sensitivity of basal melting rates is simulated by forcings defined by SeaRISE (basal melt rates scenarios, accumulation rates; (1). Control run: The constant climate simulation which beginning at present and running 500 years holding the climate steady to the present climate. (2). Surface warming runs (experiments C): The surface temperature and precipitation changes with AR4 (IPCC 2007) future climate forcing. (3). Ocean-induced melting runs (experiments M): The sub-ice-shelf melt rates are increased; which will be caused by ocean warming. (4). basal sliding forcing (experiments S): The basal sliding under the ice sheet is changed.

The results of sea level changes show sea level rise caused by the Antarctic ice sheet is most sensitive experiments M, increased sub ice shelf melting. Velocities in ice shelves are higher than that in the ice sheet, since there is no friction under ice shelves. The disappearance of ice shelves mean reduction of the flux going away from the land ice. This effect and reduction of buttressing may cause the changes of land ice volume In general, under the influence of high basal melting, the Ross and Antarctic Peninsula ice shelves decay faster than the Filchner-Ronne and Amery ice shelves. In the M1 experiment (2m/a basal melting), the Ross ice shelf loses more than half of its area by 250 years and (Fig. 2) has almost disappeared by 500 years, while the Amery ice shelf does not lose much of its area. The vulnerability of the Ross ice shelf results from the fact that it is surrounded by the Transantarctic Mountains, so that the incoming flux from the ice sheet is smaller than for other ice shelves. On the other hand, the Amery ice shelf does not so much affected by in this run because of the large inflow from upward glacier is large enough.

The sea level equivalent ice volume also changes largely changes with changes of basal sliding rates. It enforces ice mass transfer from land to ocean and ice sheet to ice shelves. Increased velocities on grounded ice region increases ice flux of ice shelves, then ice sheet velocity field can increases. The sea level change caused by the surface warming is not so large as others. But if the change is large, it causes surface melting at margins of the ice sheet and ice shelves. It can also cause dynamical reduction of ice sheet.

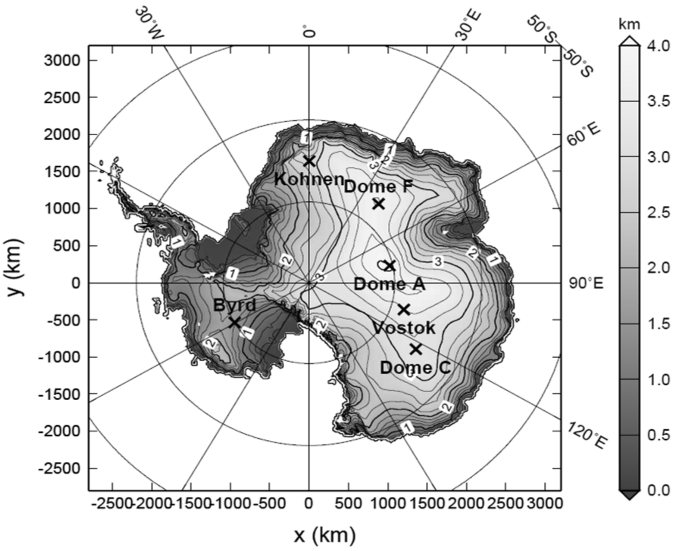

Figure1.　The snapshot of the ice surface topography in M1 experiment (2m/a sub-ice-shelf melt rate) at 250 year later .