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南極棚氷底面融解の氷期及び温暖気候下における変動メカニズム
Antarctic ice shelves' basal melting and its mechanisms under the LGM and a CO2 doubling climate

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Basal melting of Antarctic ice shelves is considered to be an important factor to the retreat of Antarctic ice sheet in the past or future, but little consensus exists on how the rate of basal melting changes against climatic forcing.

We investigate Antarctic Ocean and basal melting of Antarctic ice shelves under the Last Glacial Maximum (LGM) and an equilibrium CO2 doubling climate as well as present-day, using a circumpolar ocean model with ice shelf cavity component (Kusahara and Hasumi 2013). As the circumpolar ocean model requires atmospheric forcing at sea surface and oceanic forcing at lateral boundary of the model domain, we use outputs of a climate model (MIROC) simulations. To test the sensitivity to climate, we use present-day Antarctic ice sheet/shelf configuration in all experiments.

Although global radiative forcing of LGM and CO2 doubling climate are similar, change in basal melting amount under the CO2 doubling climate is more pronounced than the LGM. Change in background climate modifies basal melt rate of ice shelves through changes in water mass properties on continental shelves. Active sea ice production in the Antarctic Coast forms cold and dense water on continental shelves under a colder climate. Under a warmer climate, decreased sea ice production and dense water on continental shelves enable warm deep water in the Southern Ocean to intrude onto continental shelves and increase basal melting. This behavior of the water mass properties on continental shelves is not well represented in the climate model with a coarse resolution.

A series of sensitivity experiment shows that atmospheric heat-derived forcing is the most important to sea ice production and basal melt rate. These results suggest that basal melt rate of ice shelves is not simply parameterized from deep ocean temperature in the Southern Ocean, and that it is required to consider water mass formation process in the Antarctic Coast.

キーワード: 南極, 棚氷, 棚氷底面融解, 海氷, 海氷生成, 南大洋, 大陸棚, 海洋モデル, 気候モデル
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