The Heart of the East AnTarctic CRyosphere-Ocean Synergy System (HEAT-CROSS)

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The sum of glacier and ice sheet contributes to global mean sea level rise, which is rising and accelerating. Acceleration of ice flow and retreat has been observed in the West and East Antarctica. In recent years, mass loss of the Totten Ice Shelf in Wilkes Land has been revealed by satellite observations. Behind the Totten Ice Shelf, there is a huge ice sheet that raises the sea level by 4 meters when it melts. The monitoring of West Antarctica alone no longer can assess the contribution of Antarctic ice sheet melting to sea level rise. Accurate prediction of sea level rise requires elucidation of the actual state of mass loss in the Antarctic ice sheet with uncertain response to global warming. The main causes of the ice sheet mass loss are the calving and basal melting (Rignot et al., 2013; Depoorter et al., 2013). Basal melting is significant in the mass loss of ice sheet facing the West Antarctica, especially the Amundsen Sea and Bellingshausen Sea, where the Antarctic Circumpolar Current with warm Circumpolar Deep Water (CDW) approaches the continental shelf. In contrast, the continental shelf in the East Antarctica is generally considered as a cold shelf (Schmidtko et al., 2014), but the basal melting contributes more to the mass loss of Totten Ice Shelf, Moscow University Ice shelf, and Shackleton ice shelf than the calving. The driver of the basal melting is the CDW which is originally located offshore and is somehow carried to ice shelves. Our particle tracking study with satellite datasets suggests us that CDW accesses a specific coastal area, such as off Totten ice shelf. On the contrary, the basal melting induces the increase in the input of freshwater and shelf-originated materials (e.g., dissolved iron) to offshore. Freshening of the deep layer in the Indian Ocean sector is already evident, and shelf-originated materials may have an impact on the marine ecosystem and carbon cycle. We will work on 1) the heat transport process from offshore to the end of the ice sheet, which is the core of the Cryosphere-Ocean synergy system, and 2) the impacts of changes in the system on the carbon cycle and marine ecosystem in the downstream area.

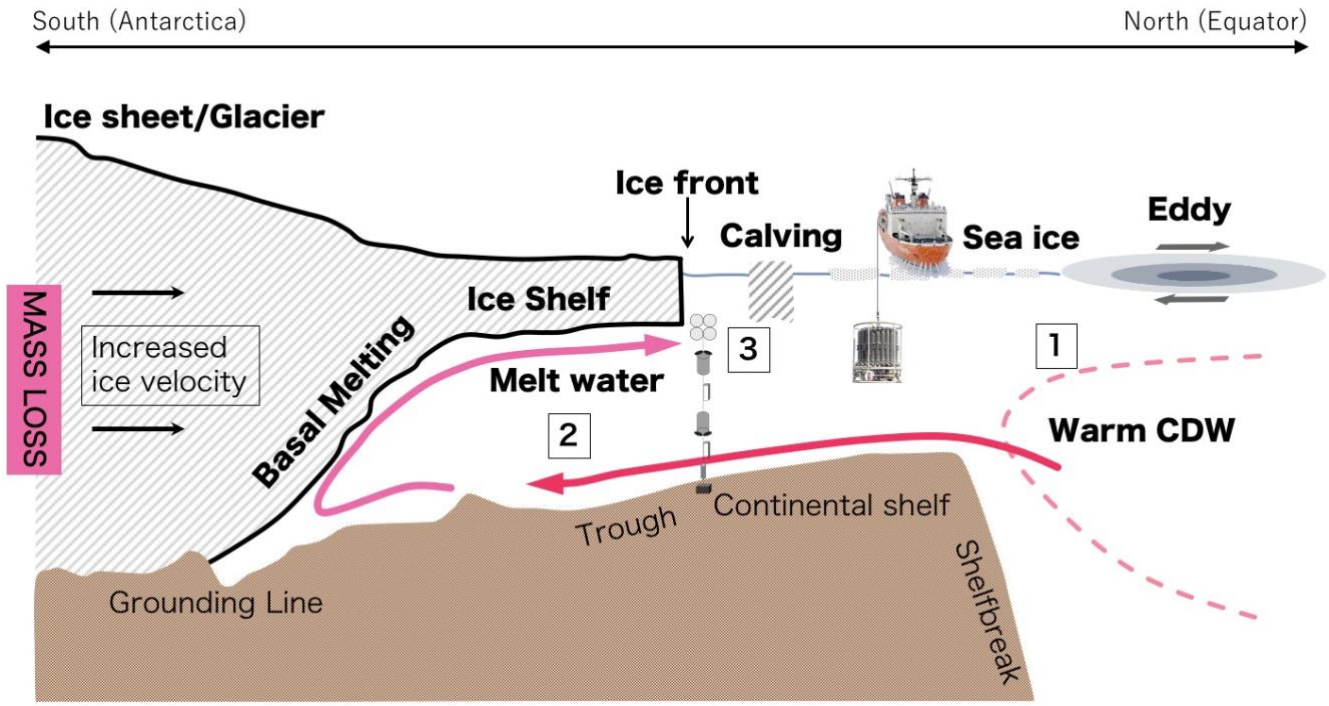

Figure 1. Conceptual diagram of ice sheet-ocean interaction. Each number indicates our target processes; 1) the transport process of CDW from offshore to continental shelf, 2) the transport process of CDW in continental shelf, and 3) the impact of meltwater input on the freshening and carbon cycle/marine ecosystem in the downstream area.