Icebergs refloat affecting the breakup of multi-year landfast sea ice

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The polar oceans have multi-year fast ice (MYFI) areas that have been maintained for several years to a decade or more. Such perennial ice has formed thickly due to downward growth through direct freezing of seawater and upward growth by snow-origined sea ice formation due to deep snow. An example of the MYFI region is Lützow-Holm Bay (LHB) of the Antarctic region. The ice condition in LHB has been monitored by satellite since 1980 and, in particular, the remarkable breakup and discharge of sea ice in wide area has attracted attention from the viewpoint of physical and biogeochemical processes as well as heat and mass exchange between the ocean and the atmosphere. Regarding the stability of ice shelves and glacier termini, the coverage of fast ice contributes to the buffer against ocean swells and the buttressing effect on ice sheet margins. Furthermore, since the ice condition greatly affects the field operations for expedition teams and navigation of the icebreaker, the knowledge of the characteristics of the fast ice variabilities are also used as information for the in-situ operation.

In order to understand how the collapse of the MYFI progresses spatially at LHB, the characteristics of the boundary between the ice and the remaining area at the time of collapse, i.e., the location of the fixed ice edge, have been investigated based on satellite imageries. Since variations in the position of icebergs trapped in the MYFI region are also helpful in determining whether or not the ice has collapsed and become pack ice, I used Synthetic Aperture Radar images, which can acquire information on the ice condition with high spatial resolution even in bad cloudy weather. In past cases of the MYFI breakup, I have compared the location of the iceberg's established ice edge with the bathymetry of the area, and found that in LHB, the MYFI broke up in areas with comparable bathymetry, indicating a trend toward the formation of an established ice edge. This process was discussed as follows: among the icebergs in the MYFI region, stranded icebergs hardly move in response to tidal changes, and thus act as ‘anchor points’ to hold the surrounding sea ice together (Giles, et al., 2008). In other words, grounded icebergs have the effect on stabilizing the surrounding ice. At the same time, as the icebergs continue to melt in seawater, they continue to move from stranding to refloating the icebergs. Here, qualitative interpretation is possible by assuming that the draft of each iceberg is almost equal to the water depth in the stagnant area of the stranded icebergs group, and that the icebergs run aground at about the same time. In the future, I will attempt a quantitative evaluation by using the melting of freshwater ice in salt water as an analogy for the melting of icebergs and estimate the timing of icebergs breakaway in an area where the water depth (≒ draft of icebergs) is equivalent.

References:

Giles, A. B., R. A. Massom, and V. I. Lytle, 2008: Fast-ice distribution in East Antarctica during 1997 and 1999 determined using RADARSAT data, *J. Geophys. Res.*, 113, C02S14, doi:10.1029/2007JC004139.