The Cryosphere Discussions

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Comment on tc-2020-352

Anonymous Referee #2

Referee comment on "Brief communication: The anomalous winter 2019 sea-ice conditions in McMurdo Sound, Antarctica" by Greg H. Leonard et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2020-352-RC2, 2021

A study regarding land-fast sea ice (fast ice) breaking/calving at McMurdo Sound like this brief communication seems to be valuable when taking into account field activities around the Ross Sea/Ice Shelf area, Antarctica. However, the breaking mechanism of fast ice was not discussed adequately in this manuscript, as described below.

The 2019 anomalous breaking of fast ice appears to be associated with KWI and sea ice concentration, as shown in Figure 3. However, this manuscript did not explain the mechanism of fast ice breaking.

The authors used KWI and southerly winds. I straightforwardly regarded these as due to katabatic wind. What mechanism do the authors consider for the fast ice break up by the katabatic wind? Figure 3 showed that the KWI increase coincides with the fast ice break up. When the KWI was large, strong winds were blowing from the south (continent). Again, how does the fast ice is broken by this wind? It is widely known that sea swells affect the breaking of fast ice. The swell effect was also discussed in Banwell et al. (2017), cited by the authors. It seems hard to destroy fast ice only by katabatic wind, even if it is a strong wind. Furthermore, since the wind blows from the shore to the offshore, it is expected not to generate swells that destroy the fast ice.

Since the katabatic wind is a strong wind from inside the continent, it is expected that the air temperature will drop during the period when the KWI is large. However, as is clear from Figure 3, the temperature rose when the KWI is large. Please explain the reason for this. Is this because of the breaking of fast ice or a coastal polynya formation? Both of them will increase heat flux from the ocean to the atmosphere.

Regarding the fast ice break up during June-July: The reviewer cannot know the details because the authors only show the southerly wind component, but wondering the influence of low pressure rather than the katabatic wind from the following facts: the wind speed increased, the temperature rose, and the atmospheric pressure decreased (Fig. 3). If so, the reviewer considers that fast ice could be collapsed by sea swell. The authors also described it as a "storm event" in their conclusion (P. 4, L. 108). Is this an atmospheric event due to the katabatic wind only? Otherwise, is it the effect of a low-pressure system? Please clarify this.

This study showed a relationship between a coastal polynya and KWI (section 4). By what mechanism does the polynya cause the fast ice break up? Is it just a description of a relationship between KWI (southern wind) and polynya? The air temperature was below -10 degrees Celsius during the period. Under such atmospheric conditions, even if an open water fraction appears by the divergent ice motion due to prevailing wind, the ocean surface will be immediately covered with thin sea ice. In winter, coastal polynyas should be considered as thin ice-covered areas with high ice concentration rather than low ice concentration areas under the passive microwave sensor's coarse spatial resolution. Many sea ice concentration algorithms used for passive microwave satellite data underestimate the concentration in thin ice-covered areas. It may be possible to regard the low ice concentration region as a coastal polynya signal due to this characteristic, but caution will be required. It does not detect coastal polynyas precisely. For the detection of coastal polynyas from passive microwave satellite data, Tamura et al. (2007; 2008) and Nihashi and Ohshima (2015) would be helpful.

Tamura,T., K. I. Ohshima, T. Markus, D. J. Cavalieri, S. Nihashi, and N. Hirasawa, (2007), Estimation of thin ice thickness and detection of fast ice from SSM/I data in the Antarctic Ocean. J. Atmos. Oceanic Technol., 24, 1757–1772, doi:10.1175/JTECH2113.1.

Tamura,T., K. I. Ohshima, and S. Nihashi (2008), Mapping of sea ice production for Antarctic coastal polynyas. Geophys. Res. Lett., 35, L07606, doi:10.1029/2007GL032903.

Nihashi, S. and K. I. Ohshima (2015), Circumpolar Mapping of Antarctic Coastal Polynyas and Landfast Sea Ice: Relationship and Variability, J. Clim. 28(9) 3650 – 3670, doi: 10.1175/JCLI-D-14-00369.1.