Interannual variability of sea ice formation for the Chukchi Sea Alaskan coastal polynya in the Arctic Ocean

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One of the largest Arctic polynya occurs along the Alaskan coast of the Chukchi Sea between Cape Lisburne and Point Barrow due to offshore wind of the Beaufort High. This coastal polynya is the largest sea ice producer north of Bering Strait. In the area which is covered by thick sea ice, active sea ice formation does not occur during the winter due to insulation of air sea interaction by sea ice. On the other hand in the coastal polynya, sea ice was moved to the offshore region by the wind and active sea ice formation occurs even in the mid winter. The Barrow-Cape Lisburne polynya forms over the pathway of Pacific Winter Water which flows into the Chukchi Sea via the Bering Strait. The large heat and salt fluxes associated with the polynya play an important role in modifying the Pacific Winter Water which becomes denser and spreads into the intermediate layer in the southern Canada Basin of the Arctic Ocean. In this study, we examine the interannual variability of Pacific Winter Water for the six winters of 2001-2006, using the following two approaches; (1) volume transport of Pacific Winter Water using mooring observations in the Barrow Canyon - the main gateway for Pacific Winter Water into the Canada Basin, and (2) estimation of sea ice formation in the Barrow-Cape Lisburne polynya using satellite and meteorological data.

From the mooring observations, volume transport of Pacific Winter Water is large in 2001, 2002, 2006 and small in 2003, 2004, 2005 by a factor of 1.5 to 2. From the estimation of sea ice formation, we expect the large sea ice formation occurs in 2001, 2002 and 2004. These results agree well except in 2004 and 2006. In 2006, in the southern Chukchi Sea, the salinity of Pacific Winter Water is higher than that of other years. This suggests that change in the upstream region also affects that volume of Pacific Winter Water. In 2004, volume transport of Pacific Winter Water is small, even though that polynya is often observed. During early winter for this year, the temperature of the subsurface layer is above the freezing point. This is because of the large heat input of Pacific Summer Water during summer. These results suggest that the typically latent heat Barrow-Cape Lisburne polynya would temporarily shift to a sensible heat polynya due to warming of subsurface water. Our results suggest that volume transport of Pacific Winter Water is mainly controlled by three factors; change in sea ice formation in the Barrow-Cape Lisburne polynya, change in salinity in the upstream region and change in heat flux of the Pacific Summer Water.