Influence of the interannual-scale Bering Sea ice variation on cold air outbreaks

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In the Northern Hemisphere winter, cold air outbreaks occur over East Asia and the eastern North America. Quantitative estimation of a cold air mass was developed recently and this allowed us to detect two climatological cold air streams (Iwasaki et al., 2014): the East Asian stream and the North American stream. Cold air incursions are strongly affected by the terrain and land–sea distributions, and the cold air mass is lost due to diabatic heating over the northwestern parts of the North Pacific and the North Atlantic, which are downstream regions of the two streams (Kanno et al., 2015). The East Asian stream passes over the Bering Sea covered by ice. It is expected that the Bering Sea ice would affect the path and formation/loss of cold air mass. However, the influence of sea ice, including the Bering Sea, on the cold air mass has been unclear. We investigate a temporal relationship between the Bering Sea ice and the cold air mass and discuss its cause from the view point of large-scale atmosphere patterns, by applying statistical methods. In addition, we try to describe an influence of cold air mass on ocean mixed layer temperature and depth. Following a pioneering work by Iwasaki et al. (2014), we calculate negative heat content (NHC), which is regarded as a cold air mass amount below potential temperature of 280K, by using ERA-Interim data. We use the Bering Sea ice concentration from NOAA OISST v2 dataset. Analysis period is 37 years of 1982-2018, and we focus on February because the Bering Sea ice concentration has the largest value and the largest variance. In order to extract the NHC and atmosphere patterns related to the Bering Sea ice variation, we perform a composite analysis. Here, we define two categories (high and low ice concentration years) based on the regional time series of Bering Sea ice concentration (160°E-150°W, 55°N-65°N); high (low) ice concentration years are defined as years in which sea ice concentration is above (below) plus (minus) one standard deviation from the long-term mean. In high ice concentration years, NHC is found in the Bering Sea and the Bering Strait, showing southward NHC flux. NHC loss is dominated over a region south of the Bering Sea. Composite maps of sea level pressure and geopotential height show remarkably large amplitude in the central North Pacific, indicating a change of the Aleutian Low intensity. We checked a relationship between the Bering Sea ice concentration and large-scale atmospheric patterns such as Pacific/North Atlantic pattern, West Pacific pattern, and El Nino. Interestingly, the Bering Sea ice concentration is not significantly correlated with climate indices representing the atmosphere patterns mentioned above. Our result implies that the Bering Sea ice concentration has a potential to affect the cold air mass outbreak and the NHC. In the presentation, we introduce an impact of the NHC loss on the underlying ocean.

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