A hemispheric extreme cold winter in 2017/18 enhanced by the lowest extent of Chukchi sea ice

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In East Asia 2017/18 winter, the seasonal mean temperature was the lowest recorded since 1985/86. The cold winter was influenced by the lowest extent of Chukchi sea ice (Tachibana et al. 2019). On the other hand, the sea ice decline in the Barents and Kara Sea (e.g., Honda et al. 2009), and La Niña (e.g., Wang et al. 2000) are also other factors of the cold winter over East Asia. Compared with other two factors or other cold winters, the influence of the sea ice decline in the Chukchi Sea needs detailed statistical analysis on interannual time scale. We examine relative importance of the sea ice decline in the Chukchi Sea among the three remote oceanic factors for the cold winters over East Asia by a linear regression. Considering the sea ice decline in the Chukchi Sea was important to explain the abnormally cold winter in 2017/18 (Figures 1a and 1b). In 2017/18, the ratio of the estimated anomaly by the Chukchi sea ice decline to the observed anomaly was higher than the ratios of the estimated anomalies by other two factors to the observed anomaly, and was the highest in cold winters. (Figures 2a and 2b). The estimated anomaly by the Chukchi sea ice in 2017/18 is the best explanation among the other cold winters. It is important to consider the abnormal sea ice decline in the Chukchi Sea, due to explain for extreme cold winter over East Asia.

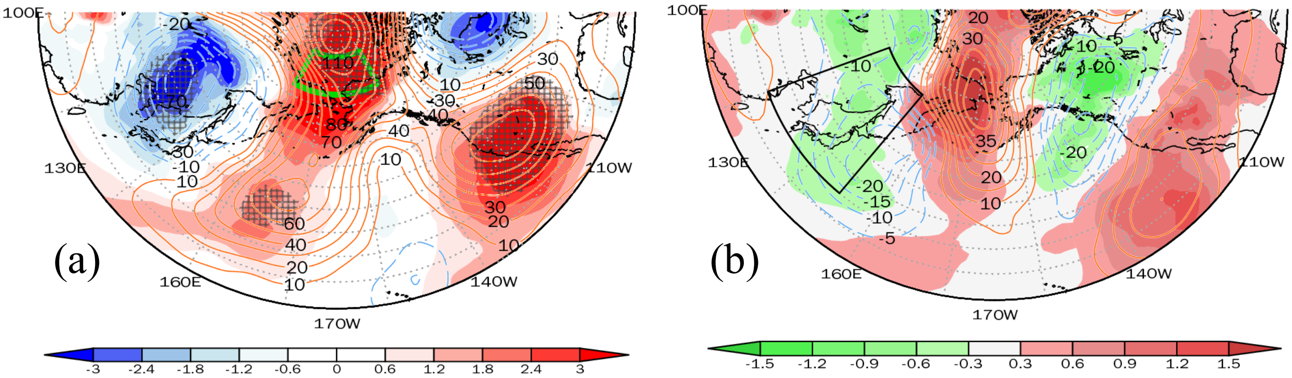

Figure 1. (a) Anomalies of Z500 (contours [m]; Hatching areas are larger than ±2.0σ) and T850 (color shading [K]) in 2017/18 from climatology. A green box indicates Chukchi Sea area. (b) Sum of the estimated anomalies of Z500 (contours [m]) and T850 (color shading [K]) in 2017/18 from three sets of simple regression analyses by Chukchi sea ice, La Niña, and Barents and Kara sea ice indices.

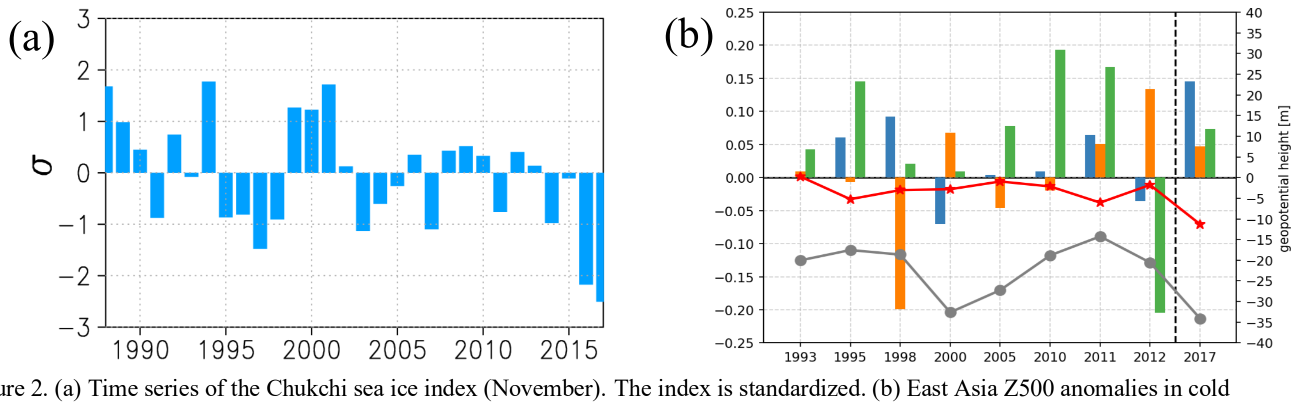

Figure 2. (a) Time series of the Chukchi sea ice index (November). The index is standardized. (b) East Asia Z500 anomalies in cold winters (areal average inside the black box in Fig. 1b). The blue bars indicate ratio of estimated anomalies by Chukchi sea ice index to the observed anomalies, the orange bars indicate ratio of estimated anomalies by Barents and Kara sea ice index to the observed anomalies, and the green bars indicate ratio of estimated anomalies by La Niña index to the observed anomalies. The red line indicates sum of the estimated anomalies by three factors [m]. The gray line indicates observed anomalies [m]. we defined cold winters as bottom 9 years out of 30 years (1988/89-2017/18) with observed Z500 anomalies over East Asia.

References

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