Interannual SST variability in the vicinity of Subpolar front and its impact on winter precipitation

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Abstract

East Asian winter monsoon affects climate around Japan. However, the role of interannual sea surface temperature (SST) variability on winter climate around Japan still has not been understood well. In the present study, therefore, the impact of the SST anomalies around Japan on the atmosphere on interannual time scales is examined by observational data analysis and numerical experiments. The remarkable interannual variability of SST is observed over the Subpolar Front (SPF) of the Japan Sea. The SST anomalies are positively correlated with the latent heat flux, suggesting the importance of oceanic process on the formation of the SST anomalies. Furthermore, the SST anomalies are also positively correlated with precipitation on the downwind side under the northwesterly East Asian winter monsoon.

The numerical experiments by the Weather Research Forecasting model by using two sets of SST data were also conducted to clarify the impact of SST anomalies on the atmosphere. The satellite based OISST with a spatial resolution of 0.25º was used in one experiment, while the other experiment used the same data in which the interannual variability is removed. The comparison shows that the interannual SST variability over the SPF regions affects the interannual variance of the local precipitation on the downwind side under the northwesterly East Asian winter monsoon. The response of the SST anomalies extends to the mid-troposphere up to around 500 hPa; this is accompanied by changes in the cloud ice. This suggests that the SST in the vicinity of SST fronts can affect the atmosphere above the planetary boundary layer.

The formation process of SST anomalies around the SPF is also examined, using the MRI ocean assimilation data. The mixed layer temperature anomaly begins to rise from June and rapidly increase from October, subsequently showing a peak in December. The heat budget analysis reveals that the SST warming during winter is mainly due to the anomalous horizontal advection process.