Atmospheric responses to sea surface temperature in the Bering Sea and Chukchi Sea

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Sea surface temperature (SST) fronts associated with the Gulf Stream and Kuroshio induces horizontal air temperature gradients, leading to low pressure anomalies, convergence, and ascent motion over the warm flank of the SST front. The effects of SST around the western boundary currents on the atmosphere have been intensively revealed for the last two decades. Seo and Yang (2013) indicated from model simulations that the pressure adjustment mechanism works even in the Chukchi Sea. Very large horizontal temperature gradients are produced around sea ice edges, however, there are only few studies on air-sea interaction in the high latitudes, probably due to lack of observations. The author further analyzed atmospheric reanalysis data to examine atmospheric responses to SST in the Bering Sea and the Chukchi Sea. In this study, the NCEP-CFSR data in 1979-2010 were used. “SST” means surface temperature of open water or sea ice hereafter.

In the Chukchi Sea, the convergence of the 10-m-height wind became very large in October and November, and nearly zero or negative from February to August. The seasonal cycles of the Laplacians of sea level pressure (∇^2SLP) and SST (∇^2SST) corresponded to the cycle of the convergence, indicating that the large convergence in autumn was caused by the pressure adjustment mechanism. The SST in the southern Chukchi Sea was highest in August, but its gradient peaked in November. In November, sea ice already existed in the Chukchi Sea, but its SST was still relatively high due to warm water coming from the Bering Sea. On the other hand, the SST in the northern region droped below minus 20°C, and as a result, the gradient and Laplacian became largest in November.
Over the shelf break region in the Bering Sea, the 10-m-height convergence was positive throughout the year except for July, and became larger in winter. The convergence well correlated with ∇^2SLP. ∇^2SST over the shelf break was negative throughout the year and especially large from February to April. On the other hand, the annual mean of the convergence was negative over the northern shelf region. The spatial distribution of the near-surface convergence clearly reflected water depth in the Bering Sea.
The contrast across the slope region also can be seen in low-level cloud water both in winter and summer. As a result, downward solar radiation at the sea surface became minimum along the continental shelf. Xie et al. (2003) indicated that the bottom topography affected the lower atmosphere. These spatial patterns in the Bering Sea suggest that the bottom topography affects incoming solar radiation through the regulation of SST and low-level clouds.

Keywords: Bering Sea, Chukchi Sea, air-sea interaction, sea surface temperature , bottom topography

