

Impacts of high-resolution sea surface temperature on atmospheric reanalysis; an example over the Sea of Japan in winter

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The JRA-55CHS is a member of the Japanese 55-year Reanalysis (JRA-55) “family”. The JRA-55CHS is the same as the JRA-55 Conventional (JRA-55C) in that both use the same data assimilation system and do not assimilate satellite observation datasets. Higher-resolution sea surface temperature (SST) dataset is, however, prescribed in the former. It has been reported that the JRA-55CHS reproduces more realistic meso-scale structures in the lower troposphere over the midlatitude western boundary currents like the Kuroshio-Oyashio extension where the SST gradient is large. The Sea of Japan is also characterized by the SST front around 40 deg. N, and by large latent and sensible heat fluxes from the ocean to the atmosphere in winter due to the cold and dry northwesterly monsoon. This study aims at evaluating impacts of small-scale SST structures on the wintertime atmosphere over the Sea of Japan based on the climatological-mean differences between the two reanalysis datasets. Compared with JRA-55C, the northerly wind is weaker (stronger) in association with the cooler (warmer) SST over the north (south) of the SST front in the JRA-55CHS. This suggests that these wind differences are due to the differences of vertical mixing of the horizontal momentum in the atmospheric boundary layer. These wind differences lead to stronger surface horizontal divergence just over the front in the JRA-55CHS. This enhanced divergence accompanies enhanced lower-tropospheric downward motion convergence aloft, which results in suppressed precipitation. Along the Japanese coast, the surface horizontal convergence is enhanced in association with the enhanced northwesterly wind over the warmer SST upstream in the JRA-55CHS. This convergence accompanies enhanced precipitation there. The enhanced evaporation over the sea also contributes to the increased precipitation. Our analysis suggests that the small-scale structure of the SST in the Sea of Japan can affect the lower tropospheric atmosphere and precipitation not only over the Sea of Japan, but also over Japan.

Keywords: atmospheric reanalysis, sea surface temperature, precipitation