An oceanic impact of the Kuroshio path on snowfall on the Kanto region of Japan in the cold season

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Abstract

Over the Kanto region of Honshu Island, Japan, in the northern fall, winter and spring the Japanese southern-coastal cyclones (extra-tropical cyclone) sometimes bring heavy rainfall and snowfall. These heavy rainfall and snowfall events induce traffic problem in the Kanto region of Japan. Previous researches showed that the two types of Kuroshio path (i.e., large meander and non-large meander paths) have a different impact on southern-coastal cyclone activity and snowfall in Tokyo (Nakamura et al. 2012 and Hayasaki et al. 2013). However, a relationship between the Kuroshio path and snowfall in the Kanto region is still unclear.

To understand an impact of Kuroshio path south of the Pacific coast of Japan during winter on heavy rainfall and snowfall on the Kanto region, this study conducted 5-km resolution experiments by a non-hydrostatic regional model ARW-WRF (Skamarock et al. 2008). A control simulations (CTL) driven by ERA-Interim reanalysis data and the monthly National Oceanic and Atmospheric Administration Optimum Interpolation sea surface temperature (SST) dataset was performed. We focus on a severe snowfall event in February 7th and 8th, 2014. In this case, the SST pattern is similar to that during the large meander path. We conducted 9-member ensemble experiments with the different initial time (00UTC February 1st, 06UTC, 12UTC, 18UTC, 00UTC February 2nd, 06UTC, 12UTC, 18UTC, 00UTC February 3rd). In addition, a series of Kuroshio non-large meander experiments (NLM) was performed. The numerical design of NLM experiments was the same as that of CTL, except that SST over the whole domain was replaced by the SST values in 2012. 2012 was not the large meander period of the Kuroshio. The difference between these two simulation sets is analyzed to determine the sensitivity of surface temperature and snowfall in the Kanto region to the SST difference.

Results showed that the CTL simulations represented spatial and temporal variations

in surface temperature well, yielding realistic surface temperature values with observations (not shown). In addition, the location and strength of the simulated extra-tropical cyclones are basically reproduced in both CTL and NLM experiments, which implies that there is no distinct modifications of the extra-tropical cyclone due to the SST changes.

The prescribed SST values south and east of the Kanto region are warmer in the NLM experiments, compared with those in the CTL experiments. As the result of sensitivity experiments, surface air temperature at Tokyo in the NLM experiments tends to be higher than that in the CTL experiments during almost snowfall period. We will discuss the changes in rainfall and snowfall.

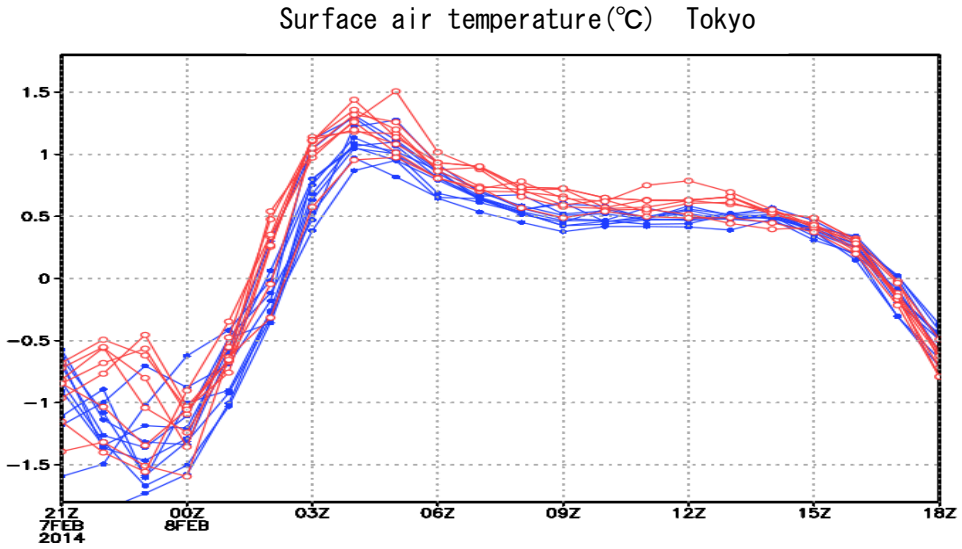

Figure. 1: Time-series of the simulated surface air temperature at Tokyo during the snowfall period from 21UTC February 7th 2014 to 18UTC Feb 8th 2014. 9 blue lines indicate CTL experiment. 9 red circles denote NLM experiments.

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