Predictability of the Arctic Cyclone in August 2012 in Medium-range Ensemble Forecasts

Akio Yamagami[1] and Mio Matsueda[2,3]
[1]*Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan*
[2]*Center for Computational Sciences, University of Tsukuba, Ibaraki, Japan*
[3]*Department of Physics, University of Oxford, Oxford, UK*

Arctic cyclones (ACs) have a long life-time and a wandaring tracking in the Arctic region. The structures of the ACs are characterized by the warm and cold cores at upper and lower levels, downward and upward drifts at upper and lower levels, and barotropic relative vorticity. ACs have large impacts on the Arctic systems like the sea water temperature and the sea ice (*Inoue and Hori*, 2011 (*GRL*); *Parkinson and Comiso*, 2013 (*GRL*)). ACs also have a social impact on the Northern Sea Route of a ship and an airplane. Therefore, accurate predictions of ACs are important for environmental and social concerns. In August 2012, one of the largest ACs on record occurred. The cyclogenesis was over the Siberia at 18UTC 2nd August 2012, and then the AC developed, moving to northeastward. The minimum sea level pressure (SLP) of 964 hPa was recorded over the central Arctic Ocean at 18UTC 6th August 2012. The AC stayed for 4-5 days around the north of the Beaufort Sea, and then the AC moved southeastward and disappeared over the Canadian Arctic Archipelago on 14th August 2012 (*Simmonds and Rudeva*, 2012 (*GRL*); *Aizawa and Tanaka*, 2016 (*Polar Science*)).

In this study, we have investigated the predictability of the AC, using operational medium-range ensemble forecasts provided by The Interactive Grand Global Ensemble (TIGGE). Figure 1 shows the predicted minimum SLP in the area of 70˚-90˚N and 90˚-270˚E from different initial dates. The development of the AC was well predicted by CMC, ECMWF, and JMA (NCEP and UKMO) members initialized at 12UTC 4th - 5th (3rd – 5th) August 2012. Some ECMWF and NCEP members initialized in late July 2012 also predicted the development of the AC. From 2nd August 2012, some JMA and UKMO members started to predict the development of the AC with central SLP of < 980 hPa. JMA members initialized on 2nd August 2012 had the largest ensemble spread of minimum SLP. Figure 2 represents the cyclone track for each ensemble member initialized at 12UTC 2nd August 2012. Most of ensemble members well predicted the observed AC moving toward the central Arctic Ocean. Some JMA and CMC members predicted ACs moving toward the Bering Sea with weak central SLPs (~1000 hPa) at 18UTC 6th August 2012. Based on the comparison with higher-skill and lower-skill JMA members, predicted horizontal wind at 500 hPa was significantly different (99% significance level, not shown). Thus, the wind difference was one of the reasons for the track difference. In addition, in the well-developed members, the AC over the Eurasia merged with a cyclone connected with the upper polar vortex over the East Siberian Sea in the previous day of minimum SLP. The merging was clearly seen as the merging of warm core at upper levels. In conclusion, the merging led by the accurate prediction of upper wind is necessary for accurate prediction of the AC development.

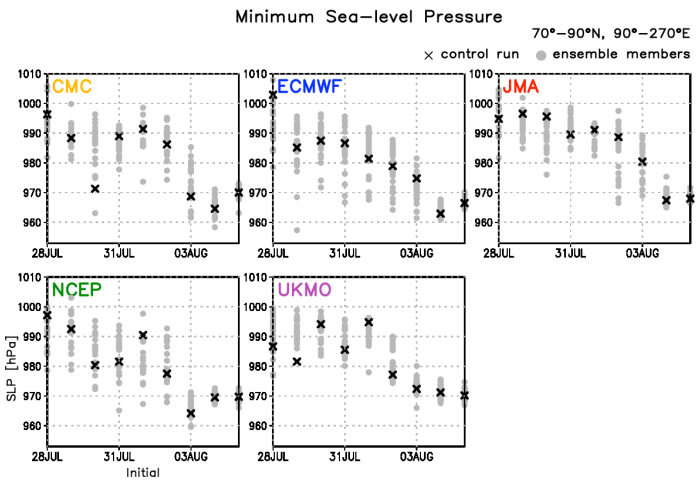

Figure 1. Predicted minimum SLP in the area of 70˚-90˚N and 90˚-270˚E from different initial dates (28th Jul. - 5th Aug. 2012). Black cross (gray circle) represents control run (each member).

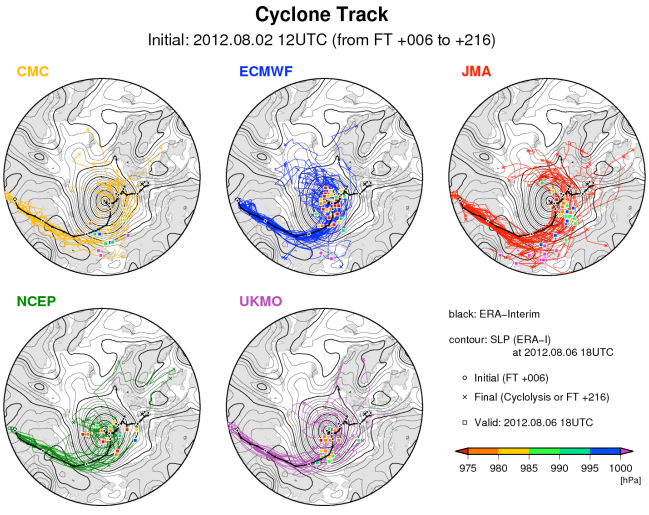

Figure 2. Predicted (colored) and Observed (black) cyclone tracks. Forecasts were initialized at 12UTC 2nd August 2012. Square symbols represent SLP at 18UTC 6th August.