Dynamical Downscaling of two typhoons Chanthu and Lionrock over Northern Japan in 2016 and their response to climate change

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The Typhoons are considered one of the major weather-related disasters which cause various social damages such as loss of lives and economics. Two typhoons viz. Chanthu and Lionrock recently hit Japan and devastated many lives and property across Northern Japan in August 2016. In our study, we investigated the track and intensity of these two typhoons and the associated features such as precipitation amount and wind speed in the target region after landfall by conducting dynamical downscaling experiments with Weather Research and Forecasting (WRF) model’ s Advanced Research dynamic solver (WRF-ARW). The model is configured with three nested domains with resolution of 9km for parent domain (covers Japan and mostly the western parts of the north Pacific Ocean), 3km for inner middle domain (covers Japan), and 1km for innermost domain (covers the northern part of Japan). The European Centre for Medium-Range Weather Forecasts (ECMWF) Reanalysis (ERA-Interim) with resolution of 0.75 degree and Japanese Reanalysis (JRA55) with resolution of 1.25 degree are forced to the model as initial and boundary conditions at 6-hour interval. The typhoon track, central pressure and wind speed in reanalysis datasets are first compared with Regional Specialized Meteorological Center (RSMC) best track datasets. We find that the typhoon tracks are well represented in both reanalysis fields (JRA55 and ERA-Interim) with high central pressure (by ~10hpa) and weak wind speed (by ~10knots). The downscaled simulations produced a large improvement in typhoon tracks, wind fields and central pressures with respect to the original reanalysis fields and are consistent with RSMC best track datasets. We find that the typhoon tracks in the model simulation with ERA-Interim slightly moved towards east/west after landfall. However, the typhoon tracks in the model simulation with JRA55 are well captured and follows the best track data. The associated precipitation amount and the wind speeds after landfall of the typhoons at target regions are also well captured by the model and consistent with Automated Meteorological Data Acquisition System (AMeDAS) station observations. The 24 hours accumulated rainfall after landfall of the typhoon Chanthu is significantly overestimated by the model with ERA-Interim, while that of with JRA55 is slightly underestimated. However, the 24 hours accumulated rainfall after landfall of the typhoon Lionrock is well captured in both simulations and consistent with Radar-AMeDAS observations (Figure 1). Their (these two typhoons) responses to climate change will be further discussed by conducting the Pseudo Global Warming (PGW) experiments on these two typhoons by using WRF model.

Keywords: Typoon, WRF-ARW model, Typhoon track and intensity, Dynamical downscaling

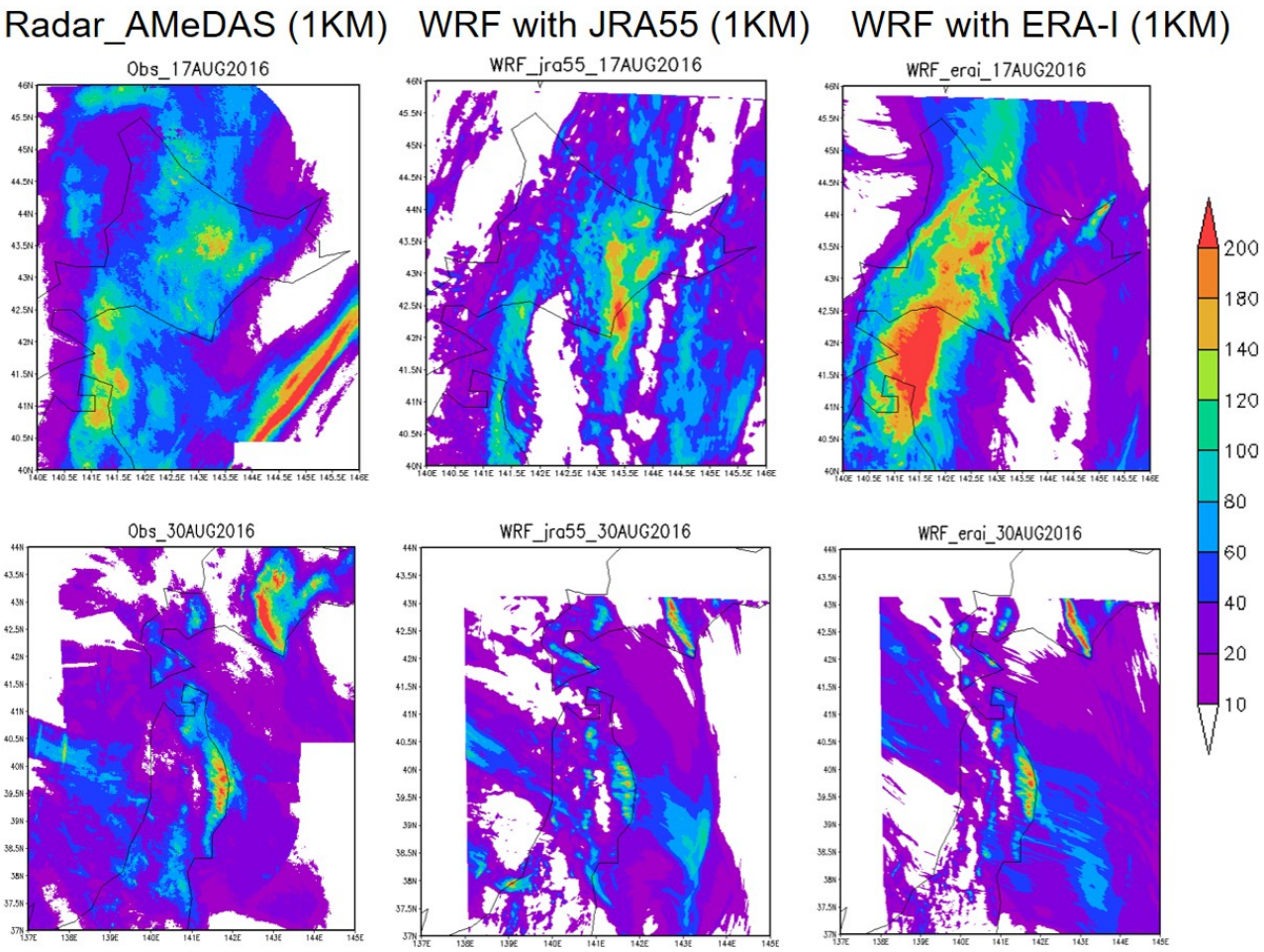

Figure 1: 24 hours accumulated rainfall (mm) on the day of landfall. First row corresponds to the typhoon Chanthu and second row corresponds to the typhoon Lionrock.

