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High resolution simulation of a tornadic convective storm in South Korea; a case study of the Goyang tornado on 10 June 2014

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Tornadoes are powerful vortices, ranging from a few meters to a few hundred meters in diameter, which occur over both the land and the sea, as a part of the tornadic convective storms (TCSs). In general, strong wind shear and atmospheric instability are essential for the formation of tornadoes. In Korea, the possibility of tornado occurrence is relatively low, especially over the land. It might be partly due to complex topography over the Korean Peninsula where approximately 70% of the land is covered by mountains; thus possibly discouraging development of TCSs in contrast to the Great Plains in the US. Although tornadoes are not likely to occur in Korea, once they happen, they can cause serious damages with potential loss of life and significant economic cost. In this study, we investigate an inland tornado case occurred in Goyang, Korea on 10 June 2014, focusing on the development mechanism of the TCS, by employing the Weather Research and Forecasting (WRF) model, version 3.6.1, with the dynamic core of Advanced Research WRF (ARW). The case TCS is well simulated by WRF with a 1 km resolution, in a triple-nested domain, in terms of various storm-related parameters, and distribution and intensity of storm cells, but with some phase errors. We further investigate the environmental conditions and local atmospheric circulation related to the TCS with a higher resolution (200 m) in a quadruple-nested domain, and check the model performance through the observational and the 1 km grid experiment data. We also investigate the impact of diversity in land cover composition on the development of this TCS by changing the land use types over the plain areas of the Korean Peninsula.