Turbulence at Narita Airport in a real case simulated by a numerical weather prediction model

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An aviation accident occurs when an airplane was about to land on Narita Airport at 1323 JST on 20 June 2012. No storm was reported, but strong environmental south-westerly winds were presented. In such a situation, convective turbulence organized as roll (roll-shaped convection) may occur in the atmospheric boundary layer. The rolls would align parallel to the environmental wind (south-westerly), and wind speeds may be significantly different between updraft and downdraft regions. The airplane would encounter highly fluctuated winds during landing. A Doppler-Lidar placed at the airport indeed observed patterns that are likely to be associated with the roll-shaped convection.

We conducted a numerical simulation of this case to reproduce detail turbulence structures. A reginal weather prediction model, JMA-NHM (Saito et al., 2006), was used. Numerical domains are centered at Narita Airport. The outer-run was performed with the horizontal resolution of 1 km wherein initial and boundary conditions were given by the Meso-Scale analysis provided by JMA. The inner-run is nested in the outer-run. It horizontal resolution is increased up to 100 m.

The south-westerly prevails on the ocean around the Kanto region due to a synoptic low in the north-east. The result of the outer-run reveals that the south-westerly is locally enhanced on the Tokyo-Bay. The Narita Airport is located only several ten kilometers away from the Tokyo-Bay in the south-west, and is exposed by the enhanced winds.

In the inner-run, the roll convection prevail (Figure) around the airport due to the sensible heat flux from heated lands. Its horizontal structure is comparable to that observed by the Doppler-Lidar. Appearances of local gusts associated with the small scale phenomena have been inferred by some environmental factors. In contrast, our study suggests a recent fine resolution simulation can directly resolve even the turbulence structures and gusts in a real case.

Keywords: Turbulence, Numerical weather prediction model , Gust, Convection