Tropopause inversion layer (TIL) is a persistent layer with high static stability (Birner, 2002). Formation mechanism of the TIL is not fully understood, although a dynamical mechanism (Wirth, 2004) and another radiative forcing mechanism (Randel et al., 2007) were proposed. We perform numerical experiments on a life cycle of an observed extratropical cyclone with an extended version of JMA Non-Hydrostatic Model. The model has 200 layers from the surface to 25 km, and the horizontal domain is 4140 km x 4000 km around Japan with a horizontal resolution of 20 km. The time integration period is 72 hours from 19th to 22nd in February 2009, during which a typical event of explosive cyclogenesis was observed. The TIL obtained in the control run has similar characteristics as observations, including dependence on local relative vorticity: stronger TIL in negative vorticity areas while weaker TIL in positive vorticity areas.

In some experimental runs, water vapour is removed above 300 hPa, 400 hPa, or 500 hPa level in the initial condition to investigate the temperature response to the radiative forcing by water vapour perturbations around the tropopause. The explosive development of the extratropical cyclone is not different from the control run very much, but the TIL becomes stronger in the experimental runs. The vertical profile of static stability becomes sharper due to weak cooling above the tropopause with decreased water vapour. Quantitative analyses on the formation of the TIL are done in detail to see the relative importance of dynamical and radiative forcing mechanisms.