Detection of a weakening of the polar night jet in early winter and its relation to cooling over Siberia

*Yuta Ando[1], Koji Yamazaki[2], Yoshihiro Tachibana[1], Masayo Ogi[3], Jinro Ukita[4]

1. Graduate School of Bioresources, Mie University, 2. Hokkaido University, 3. Centre for Earth Observation Science, University of Manitoba, 4. Faculty of Science, Niigata University

The polar night jet (PNJ) is a strong stratospheric westerly circumpolar wind at around 65°N in winter, and the strength of the PNJ is widely recognized to increase from October through late December. Remarkably, the PNJ temporarily stops increasing during late November. A detailed understanding of the weakening of the PNJ in late November is important in terms of the dynamic meteorology of intraseasonal variations in the stratosphere. No previous studies explicitly showed this weakening of the PNJ, nor have yet been addressed in terms of dynamic meteorology. We thus examined this weakening of the PNJ in terms of the atmospheric dynamical balance and the interannual variability. Examination of the atmospheric dynamical balance showed that an increase in upward propagation of planetary waves from the troposphere to the stratosphere in late November is accompanied by convergence of the Eliassen–Palm (EP) flux in the lower stratosphere, which brings about this weakening of the PNJ. The upward propagation of Rossby (planetary) waves over Siberia from the troposphere to the stratosphere is a dominant cause of the weakening of the PNJ. This upward propagation of planetary-scale Rossby waves at high latitudes is associated with amplification of eddy geopotential height and air temperature, that is, with a strengthening of the trough over Siberia. Further, we inferred that this strengthening of the trough is forced by the high-latitude land–sea thermal contrast caused by their different heat capacities. The interannual variability of the weakening of the PNJ is associated with that of the high-latitude land–sea thermal contrast.

The part of this presentation was published as the article, Ando et al. (2018).

Ando, Y., K. Yamazaki, Y. Tachibana, M. Ogi, and J. Ukita, 2018: Detection of a climatological short break in the polar night jet in early winter and its relation to cooling over Siberia. Atmospheric Chemistry and Physics, 18, 12639-12661, doi:10.5194/acp-18-12639-2018.

Keywords: Stratosphere, Rossby wave, Land–sea heating contrast, Interannual variability