Temporal evolution of minor species observed with ground-based FTIR at Syowa Station, Antarctica in 2007, 2011, and 2016

*Hideaki Nakajima[1], Isao Murata[2], Yoshihiro Nagahama[1], Masanori Takeda[2], Yoshihiro Tomikawa[3], Hideharu Akiyoshi[1]

1. National Institute for Environmental Studies, 2. Tohoku University, 3. National Institute of Polar Research

Vertical profiles of O_3, HNO_3, HCl, and $ClONO_2$ were retrieved from solar spectra taken with a ground-based Fourier-Transform infrared spectrometer (FTIR) installed at Syowa Station, Antarctica (69.0S, 39.6E) from March to December, 2007, September to November, 2011, and October to December, 2016. We analyzed temporal variation of these species combined with ClO data taken by Aura/MLS, and $ClONO_2$ data taken by Envisat/MIPAS satellite sensors at 18 and 22 km over Syowa Station. In early July, polar stratospheric clouds (PSCs) started to be formed over Syowa Station. With the return of sunlight at Syowa Station in early July, $ClONO_2$ and HCl showed depleted values while ClO showed enhanced values. At all three altitudes (18 and 22 km), when ClO concentrations started to decline in early September, HCl started to increase rapidly, while the increase in $ClONO_2$ was gradual. The Cly partitioning between HCl, $ClONO_2$, and ClO showed difference at different altitudes. At the altitudes of 18 km, where ozone was almost depleted, ClO and HNO_3 amounts are low, so conversion to HCl was favored rather than $ClONO_2$. Whereas, at 22 km, sufficient ozone still remained, at an amount that $ClONO_2$ formation from ClO and NOy species continued to occur at this altitude. This is the first in the world to observe O_3 destruction and recovery process of reservoir chlorine (HCl and $ClONO_2$) after disappearance of PSCs using ground-based FTIR in the Antarctic.

Keywords: FTIR, Syowa Station, Cly, ozone, ozone hole