

Chemistry within 2009/10 Arctic polar vortex observed by ISS/JEM/SMILES

SUZUKI, Makoto^{1*}, MANAGO, Naohiro¹, MITSUDA, Chihiro², IMAI, Koji³, SANO, Takuki¹, AKIYOSHI, Hideharu⁴, NAITO, Yoko⁵, SHIOTANI, Masato⁶, Douglas Kinnison⁷

¹JAXA/ISAS, ²Fujitsu FIP, ³Tome R&D Inc., ⁴NIES, ⁵Kyoto U., ⁶Kyoto U./RISH, ⁷UCAR

Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES) is a 4K cooled limb sounding instrument in the 625-650 GHz frequency region, onboard International Space Station (ISS). SMILES was jointly developed by Japan Aerospace Exploration Agency (JAXA) and National Institute of Information and Communications Technology (NICT). SMILES operated from Oct. 12, 2009 to Apr. 23, 2010, when sub-mm local oscillator was suddenly terminated operation by failure. SMILES measured O₃, H₃₅Cl, H₃₇Cl, ClO, HOCl, HO₂, BrO, HNO₃, CH₃CN and O₃ isotopes (17OOO, 18OOO, and O17OO). Precision (random error) of SMILES ClO product is about 0.01 ppb which is about 1/10 of Aura/MLS. SMILES measured 45 degree leftward from ISS forward direction, which gave latitudinal coverage of SMILES, 38S-65N.

It is well known that the chlorine chemistry (ClO_x) becomes dominant when the heterogeneous processes occurred during the polar winter season. SMILES observed O₃, HCl, and ClO during 2009/10 arctic winter season, as shown in Fig. 1. HCl is about 1.6 ppbt at outside polar vortex and it is almost entirely converted to the ClO (1.6 to 2.0 ppbt). O₃ destruction has occurred as much as 20% (from 4 ppmv to 3.2 ppmv) after 3 weeks of heterogeneous chemical process.

Fig. 2 (a) shows trajectory of observation points of SMILES (large circles) from 15:23UT to 15:47 in Jan. 23, 2009, and CALIPSO observation points which passed north of Europe. Fig. 2(b) shows SMILES ClO vertical section. Figs. 2(c) and (d) shows horizontally and vertically interpolated ClO of SMILES and SD-WACCM (specified dynamics-WACCM, reproduction run using GEOS-5 meteorological data), where slight difference is obvious at the region observed in 15:38-15:40UTC at 20-22 km. Figs. 2 (e) and (f) shows those of HCl observed by SMILES and calculated by SD-WACCM, and HCl has been converted fully to the reactive inorganic species. Figs. 2 (g) and (h) show O₃ and temperature observed by SMILES.

