

Sudden Stratospheric Warming event and its impact on mesospheric compositions in 2009-2010 Arctic Winter by JEM/SMILES

MAHANI, Mona E.^{1*}, Daniel Kreyling², Hideo Sagawa¹, Isao Murata¹, Yasumasa Kasaba¹, Yasuko Kasai²

¹Tohoku University, ²National Institute of Information and Communications Technology (NICT)

The final target of this research is to find out the potential response of the atmospheric compositions affected by Sudden Stratospheric Warming (SSW) in the upper stratosphere and mesosphere. A SSW is a dramatic middle atmosphere event where the polar vortex of westerly (eastward) winds in the winter hemisphere abruptly (i.e. over the course of a few days) slows down (Minor warming) or even reverses direction (Major warming). During such events, the polar stratosphere exhibits a warming of tens of degrees over a few days and polar mesospheric cooling has also been observed during SSWs. Over the past decades, satellite instruments have observed the impact of SSW events on minor constituents like carbon monoxide (CO), ozone (O₃), nitrous oxide (N₂O) and water vapor (H₂O). It is now clear that SSWs are dynamical disturbances affecting the entire middle and upper atmosphere, in addition to perturbing the tropospheric circulation (Kvissel, O.-K., et al., 2011).

We investigated the impact of SSW in the strato/mesosphere using newly obtained data with SMILES (Superconducting sub-Millimeter Limb Emission Sounder). SMILES is a highly sensitive radiometer with a few to several tens percent of precision from upper troposphere to the mesosphere. SMILES was developed by the Japanese Aerospace eXploration Agency (JAXA) and the National Institute of Communications and Technology (NICT) located at the Japanese Experiment Module (JEM) on board the International Space Station (ISS). From October 2009 to April 2010, SMILES has successfully measured the vertical distributions and the diurnal variations of various atmospheric species in the latitude range of 38S to 65N.

The analysis of temperature and ozone for the SSW during 1st January - 31 March 2010 was performed. Ozone increasing from January to March in the stratosphere has been confirmed. In the mesosphere, the diurnal variation structure of ozone was illustrated due to the variation in SMILES solar zenith angle. Night time ozone enhancement in the mesosphere has already been approved during this period, with respect to the temperature. SMILES observation approved the occurrence of SSW event in the end of January 2010 and the end of March 2010. SMILES observation of latitudinal, diurnal and seasonal variation of ozone in the mesosphere will be investigated in detail with the focus on discovering the impact of SSW on the mesospheric temperature and minor constituents such as O₃, HCl and HO₂.

Keywords: sudden stratospheric warming, SMILES, atmospheric compositions, ozone, mesosphere, diurnal variation