Analysis of the mesospheric ozone enhancement event in the Arctic winter with a new ISEE Chemical Lagrangian Model

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Mesospheric chemical composition largely varies caused by environmental changes from the earth inside and outside. Environmental changes are, for example, temperature changes, solar UV, a large event of energetic particle precipitation. To understand the atmospheric composition changes caused by natural phenomena, we have installed millimeter-wave spectrometers in Rikubetsu (Japan), Syowastation (Antarctic), Atacama (Chile), Rio Gallegos (Argentine), and Tromso (Norway), and have been observing atmospheric minor molecules such as ozone, NO_x, HO_x, and ozone-depleting substances in the stratosphere and mesosphere. In addition to these observations, we need to analyze model simulation results to understand the impact of these changes on the global. For this purpose, ISEE has developed a new chemical transport model which is a combination of two models, FLEXPART and KPP. FLEXPART is a Lagrangian transport and dispersion model that is extended so that the MERRA2 reanalysis data can be used as input. Also, a chemical reaction software KPP (Kinetic Preprocessor) can calculate chemical changes simultaneously with the transport model. In order to validate the model calculation results, we compared the model output with mesospheric ozone dataset measured with JEM-SMILES from December 2009 to January 2010. During this period, a sudden increase in the ozone concentration (1 to 5 ppmv) in the Arctic mesosphere occurred. The analysis of the trajectories and ozone distribution in the mesosphere revealed that the ozone increase over Alaska region was caused by the effect of the air mass passing through the low temperature region. On other hand, the air mass passing through a region where the temperature was high contains with low ozone concentration. Therefore, it was found that the ozone concentration in the mesosphere depends on the temperature on the transport route. In this presentation, we will present the results of the comparison between the simulation and the JEM-SMILES dataset as well as the analysis results of the event which mesospheric ozone suddenly increases in the Arctic winter in 2009/2010 season.

Keywords: Chemical Lagrangian model, Mesosphere, Composition change

