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Near Tropopause Halogen Heterogeneous Chemistry Indicators using SAGEIII / ISS Observations and WACCM Simulations

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Heterogeneous halogen chemistry on and in polar stratospheric particles (PSCs) is known to play a significant role in polar ozone depletion. This chemistry is seasonal, with most ozone loss occurring in late winter / spring. Near the altitudes of the mid-latitude tropopause, some studies suggest that similar heterogeneous chemistry might also occur on cirrus cloud particles. e.g., Solomon et al., JGR (1997). Further, this topic has been recently expanded by Anderson et al. Science (2012, 2017) to include the potential roles of liquid sulfate aerosols under cold tropopause conditions at mid-latitudes along with changes in water vapor associated with deep convection. Solomon et al. GRL (2016) presented evidence for heterogeneous halogen activation near the tropical monsoon regions as well. Significant activation of inorganic halogens may result in depletion of ozone, and heterogeneous processing can alter the chemical budgets not only of chlorine and bromine species, but also those of nitrogen compounds in the upper troposphere and lower stratospheres, broadening the scope of impacts associated with such chemistry. Among the uncertainties in heterogeneous processes in the vicinity of the tropopause are the detailed distribution of aerosols, water vapor, and other constituents. The initial focus of this study is on using Stratospheric Aerosol and Gas Experiment, version 3 (SAGE III) flown on the International Space Station (ISS) observations in conjunction with the National Center for Atmospheric Research (NCAR) Whole Atmosphere Community Climate Model (WACCM) to assess the importance of aerosols in the UTLS region on heterogeneous processing. The model will be “nudged” to the NASA Global Modeling and Assimilation Office (GMAO) Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA2) meteorological fields. We will examine whether the rich database of products from the SAGE III/ISS can be used to provide indicators of the role of heterogeneous halogen chemistry. Initially we will use the limited release SAGE III/ISS Solar Level v5 data. In addition, for this analysis, we will supplement this SAGE III/ISS data with previously released SAGE-II and SAGE-III Meteor data.