Quasi-biennial Oscillation and Solar Cycle Influences on Arctic O_3 Simulated by the WACCM4 Model

King-Fai Li [1,2] *[king-fai.li@ucr.edu], Ty L. Limpasuvan* [3]*, Varavut Limpasuvan* [4]*, Ka-Kit Tung* [1]*, and Yuk L. Yung* [3]

[1] *University of Washington, Seattle, WA, USA*
[2] *University of California, Riverside, CA, USA*
[3] *California Institute of Technology, Pasadena, CA, USA*
[4] *Coastal Carolina University, Conway, SC, USA*

Observations show that the quasi-biennial oscillation (QBO) and the 11-year solar cycle perturb the polar vortex via planetary wave convergence at high latitudes, a mechanism first proposed by Holton and Tan in 1980. These perturbations lead to an increase of stratospheric sudden warming events, and consequently observable increases in temperature and O_3 abundance at polar latitudes. However, these observations have not been studied in models definitively. Here we test whether the observed O_3 changes can be reproduced in chemistry-transport models. We constrained the Whole Atmosphere Community Climate Model version 4 (WACCM4) with the observed wind fields and 11-year UV variability and ran the model from 1979 to 2014. The simulation was diagnosed in four groups: westerly QBO phase and solar minimum, westerly QBO phase and solar maximum, easterly QBO phase and solar minimum, and easterly QBO phase and solar maximum. We showed that the simulated O_3 changes among these four groups agree very well with the observation. The linkage between the Holton-Tan mechanism and polar O_3 in the model are examined.