

## Lower-thermospheric circulation during the geomagnetically storm times

\*Jack Chieh Wang<sup>1,2</sup>, Jia Yue<sup>1,2</sup>, Wenbin Wang<sup>3</sup>

1. Goddard Space Flight Center, NASA, MD, USA, 2. Catholic University of America, DC, USA, 3. High Altitude Observatory, NCAR, CO, USA

In this study, the thermospheric meridional circulation pattern during geomagnetically active periods has been studied using the SD-WACCMX output. During geomagnetically quiet times, there exists a winter-to-summer meridional circulation stacked between two well-known summer-to-winter circulation in the mesosphere and middle-to-upper thermosphere. The vertical advection associated with the lower-thermospheric circulation is found to be a dominant mechanism in transporting atomic oxygen vertically, which would further impact the upper atmospheric variation on a wide range of time scales.

During geomagnetically active times, our model analysis suggests that pressure gradients due to the enhanced Joule heating and the enhanced ion drag induce clockwise and counterclockwise circulations between 105 km and 140 km in the Southern and Northern polar region, respectively. Dynamical tracers, such as CO<sub>2</sub> from SABER, are also employed in this work to validate the dynamics simulated by SD-WACCMX. Our results indicate vertical advection associated with the altered circulation pattern can effectively transport CO<sub>2</sub> into the thermosphere, which qualitatively agrees with observations. This mechanism acts as an efficient way to mix the atmosphere, which also impacts the vertical distribution of atomic oxygen during the storm times.

Keywords: Residual Circulation, Geomagnetically Storm, CO<sub>2</sub>

# Kp > 6, 2008-2017

