

Ionospheric Variability during the September 2019 Southern Hemisphere Sudden Stratospheric Warming

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A sudden stratospheric warming (SSW) is an extreme wintertime meteorological phenomenon occurring mostly over the Arctic region. Studies have shown that an Arctic SSW can influence the whole atmosphere including the ionosphere. In September 2019, a rare SSW event occurred in the Antarctic region, following strong wave-1 planetary wave activity (see attached figure). The event provides an opportunity to investigate its broader impact on the upper atmosphere, which has been largely unexplored in previous studies. Ionospheric data from ESA's Swarm satellite constellation mission show prominent 6-day variations in the dayside low-latitude region during the SSW, including 20-70% variations in the equatorial zonal electric field, 20-40% variations in the electron density, and 5-10% variations in the top-side total electron content. These ionospheric variations have characteristics of a westward-propagating wave with zonal wavenumber 1, and can be attributed to forcing from the middle atmosphere by the Rossby normal mode “quasi-6-day wave” (Q6DW). Geopotential height measurements by the Microwave Limb Sounder aboard NASA's Aura satellite reveal a burst of global Q6DW activity in the mesosphere and lower thermosphere at this time, which is one of the strongest in the record. These results suggest that an Antarctic SSW can lead to ionospheric variability by altering middle atmosphere dynamics and propagation characteristics of large-scale waves from the middle atmosphere to the upper atmosphere.

Keywords: sudden stratospheric warming, quasi-6-day wave, Swarm

