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About EPP-Driven Variability of Upper Atmospheric Nitric Oxide Over the Syowa Station in Antarctica

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In the polar middle and upper atmosphere, Nitric Oxide (NO) is produced in large amounts by both solar EUV and X-ray radiation and energetic particle precipitation (EPP), and its chemical loss is driven by photodissociation. As a results, polar atmospheric NO has a clear seasonal variability and a solar cycle dependency which have been measured by satellite-based instruments. On shorter timescales, NO response to magnetospheric electron precipitation has been shown to take place on a day-to-day basis. Despite recent studies using observations and simulations, it remains challenging to understand NO daily distribution in the mesosphere-lower thermosphere during geomagnetic storms, and to separate contributions of EPP forcing and atmospheric chemistry and dynamics. This is due to the uncertainties existing in the available EPP flux observations, differences in representation of NO chemistry in models, and differences between NO observations from satellite instruments. Nagoya University has operated a millimeter-wave spectroscopic radiometer at the Syowa station in Antarctica since 2012. In this paper, we use NO data from the Syowa radiometer measured in the period 2012 - 2017 to study both its long-term and short-term variability. Comparisons are made with results from the Whole Atmosphere Community Climate Model (WACCM) to understand the shortcomings of current EPP forcing in models and how the representation of the NO variability can be improved in simulations.

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