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Nitric oxide response to the April 2010 electron precipitation event - using WACCM and WACCM-D with and without medium energy electrons

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Energetic electrons from the magnetosphere deposit their energy in the atmosphere and lead to production of nitric oxide (NO) in the mesosphere and lower thermosphere. We study the atmospheric NO response to a moderate geomagnetic storm in April 2010 with the Whole Atmosphere Community Climate Model (WACCM). Modeled NO is compared to observations by the Solar Occultation For Ice Experiment instrument on NASA's Aeronomy of Ice in the Mesosphere satellite. We investigate the modeled NO sensitivity to change in energy and chemistry. The electron energy model input is based on WACCMs Kp-parameterization for auroral electrons as well as a full range energy spectrum (1-750 keV) based on NOAA/POES (National Oceanic and Atmospheric Administration / Polar Orbiting Environmental Satellites) and EUMETSAT/MetOp (European Organisation for the Exploitation of Meteorological Satellites / Meteorological Operational satellites). To study the importance of ion cluster chemistry for the production of NO, WACCM-D with more complex ion chemistry is used.Both standard WACCM and WACCM-D underestimate the storm time volume mixing ratio (VMR) in the main production region (90-100 km) using both electron energy model inputs. At and below 80 km including medium energy electrons (>30 keV) is important both for direct NO production and the indirect effect. By using WACCM-D the direct NO production in this altitude region is improved, but the contribution of the indirect effect likely remains insufficient, as a consequence of the NO underestimation aloft.