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Simulation of the October-November 2003 Solar Proton Related Events in the CMAM GCM

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The FTS instrument on SCISAT-I observed a very large NOx anomaly in mid February of 2004 near 80 N around 55 km. It has been proposed that this anomaly is the result of transport of high levels of NOx produced in the lower thermosphere or upper mesosphere by ionization associated with the massive solar flares and subsequent magnetospheric and auroral disturbances during October and November of 2003. Using a middle atmosphere GCM we investigate whether NOx produced directly by solar protons or indirectly via enhanced auroral ionization by magnetospheric precipitation can explain the observations. We find that the solar proton events produce insufficient amounts of NOx to account for the observed values. However, there is evidence that intense aurorae caused by the October-November 2003 solar storms produced sufficient levels of NOx in the lower thermosphere. This NOx rich air appears to have experienced descent with an unusual degree of polar night confinement. Part of this confinement was facilitated by the strong mesospheric vortex associated with a major warming event from mid January to mid February of 2004. The model simulations were initialized from a typical model state and do not reproduce this confinement. We conduct additional simulations to study the vortex response to the chemical-radiative effects of the solar proton events.