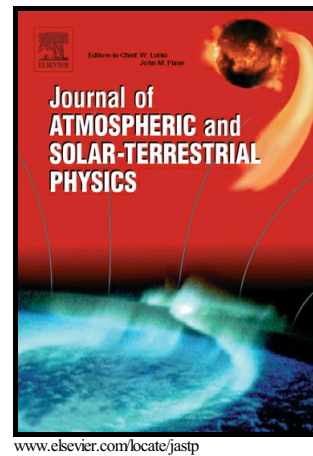


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## The Influence of Middle Range Energy Electrons on Atmospheric Chemistry and Regional Climate

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## Abstract

We investigate the influence of Middle Range Energy Electrons (MEE; typically 30-300 keV) precipitation on the atmosphere using the SOCOL3-MPIOM chemistry-climate model with coupled ocean. Model simulations cover the 2002-2010 period for which ionization rates from the AIMOS dataset and atmospheric composition observations from MIPAS are available. Results show that during geomagnetically active periods MEE significantly increase the amount of NO<sub>y</sub> and HO<sub>x</sub> in the polar winter mesosphere, in addition to other particles and sources, resulting in local ozone decreases of up to 35 %. These changes are followed by an intensification of the polar night jet, as well as mesospheric warming and stratospheric cooling. The contribution of MEE also substantially enhances the difference in the ozone anomalies between geomagnetically active and quiet periods. Comparison with MIPAS NO<sub>y</sub> observations indicates that the additional source of NO<sub>y</sub> from MEE improves the model results, however substantial underestimation above 50 km remains and requires better treatment of the NO<sub>y</sub> source from the thermosphere. A surface air temperature response is detected in several regions, with the most pronounced warming occurring in the Antarctic during austral winter. Surface warming of up to 2 K is also seen over continental Asia during boreal winter.

Keywords: MEE, mesosphere, ozone, chemistry, climate

## 1. Introduction

Energetic particles are one of the natural factors closely related to solar activity that can directly impact the chemical composition of the upper atmosphere. They can directly impact temperature and dynamics and can also have an indirect effect on polar surface temperatures (Seppälä et al, 2009; Rozanov et al, 2012). Their contribution to climate change is, however, not well established and typically not included in climate change assessments such as the 2014 Intergovernmental Panel on Climate Change (IPCC report, 2014).

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