EP 11: Near-Earth Space I

Time: Thursday 14:00–15:30 Location: ZEU/0160

Invited Talk EP 11.1 Thu 14:00 ZEU/0160

Energetic Particle Precipitation reflected in the Global Secondary Ozone Distribution — •Jia Jia[1,2], Lisa E. Murberg[1,3], Tiril Løvset[1], Yvan J. Orsolini[1,3], Patrick J. Espy[1,2], Jude Salinas[4,5], Jae N. Lee[4,5], Dong Wu[4], and Jiarong Zhang[6] — [1]Norwegian University of Science and Technology (NTNU), Trondheim, Norway — [2]Birkeland Centre for Space Science (BCSS), Norway — [3]NILU - Norwegian Institute for Air Research, Kjeller, Norway — [4]NASA Goddard Space Flight Center, Greenbelt, Maryland, USA — [5]University of Maryland, Baltimore County, Maryland, USA — [6]Coastal Carolina University, Conway, South Carolina, USA

The secondary ozone layer is a global peak in ozone abundance in the upper mesosphere-lower thermosphere (UMLT) around 90-95 km. The effect of energetic particle precipitation (EPP) from geomagnetic processes on this UMLT ozone has not been well studied. In this research we investigated how the secondary ozone response to EPP from the Microwave Limb Sounder (MLS) and the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument on the Aura and TIMED satellites, respectively. In addition, the Whole Atmosphere Community Climate Model with thermosphere and ionosphere extension and specified dynamics (SD-WACCM-X) was used to characterize the residual circulation during EPP events. By comparing ozone and circulation changes under High- and low-Ap conditions, we report regions of secondary ozone enhancement or deficit across low, mid and high latitudes as a result of circulation and transport changes induced by EPP.

EP 11.2 Thu 14:30 ZEU/0160

Comparison of D-region ion-chemistry in ExoTIC and EMAC with MIPAS observations — •Monali Borthakur[1], Miriam Sinnhuber[1], Thomas von Clarmann[1], Gabriele Stiller[1], and Bernd Funke[2] — [1]Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Instituto de Astrofísica de Andalucía, CSIC, Granada, Spain

Energetic particle precipitation (EPP) and ion chemistry affect the neutral composition of the polar middle atmosphere. For example, production of odd nitrogen and odd hydrogen during strong events like solar proton events can decrease ozone. However, the standard ion chemistry parameterisation used in atmospheric models neglects the effects on some important species. Studies have also shown that the increase of some species measured during solar proton events (SPEs) cannot be reproduced using the standard parameterisation of HOx and NOx production, while models considering D-region ion chemistry in detail agree better with the observations. Here we present results with D-region ion-chemistry in a 1D model ExoTIC and 3D model EMAC, which includes a set of lower ionosphere (D-region) chemistry: 413 reactions of 46 positive ions and 28 negative ions. Using AISSTORM ionisation rates, ExoTIC and EMAC simulations in the Northern polar region are compared with MIPAS satellite observations for the Halloween SPE of 2003. A focus is on the analysis of the chemical composition changes of different species due to the chlorine ion-chemistry in EMAC.

EP 11.3 Thu 14:45 ZEU/0160

Ring current electron precipitation during multiple geomagnetic storm events: the mechanism and the effect on the atmosphere — •Alina Grishina[1,2], Yuri Shprits[1,2,3], Miriam Sinnhuber[4], Michael Wutzig[1], Hayley Allison[1], Dedong Wang[1], Alexander Drozdov[3], and Matyas Szabo-Roberts[1] — [1]GFZ German Research Centre for Geosciences, Potsdam, Germany — [2]University of Potsdam, Potsdam, Germany — [3]University of California, Los Angeles, Los Angeles, CA, USA — [4]Karlsruhe Institute of Technology, Karlsruhe, Germany

The particle flux in the near-Earth environment can increase by orders of magnitude during geomagnetically active periods, which leads to intensification of particle precipitation into Earth's atmosphere and can further affect atmospheric chemistry and temperature. In this research, we concentrate on ring current electrons and investigate precipitation mechanisms using a numerical model based on the Fokker-Planck equation.

We investigate a time period that covers 4 corotating interaction region and 2 coronal mass ejection storms. Our results are validated against observations from the POES satellite mission, low Earth orbiting meteorological satellites, and Van Allen Probes. Maps of precipitating modeled fluxes for different energies allow us to understand in which regions on Earth precipitation is the most intensive. The output of the model is further used for calculation of ionization rates at different altitudes, allowing it to estimate effects of geomagnetically active periods on chemical and physical variability near the polar areas.

EP 11.4 Thu 15:00 ZEU/0160

A new approach to constrain space weather effects on the Earth's atmosphere — •Florian Haenel[1], Miriam Sinnhuber[1], Alina Grishina[2], and Yuri Shprits[2] — [1]Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany — [2]Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Potsdam, Germany

We investigate the impact of space weather on the Earth's middle atmosphere and its climate system using state of the art numerical models of the magnetosphere and atmosphere. In particular, we study the impact of electrons with medium-range energy, mostly from the Earth's radiation belts, lost into the atmosphere during geomagnetic storms. Previous studies, using ionization rates, based on electron fluxes measured by satellites show an underestimation of produced NOx ($NO+NO_2$) by comparison with satellite observations and exhibit a large uncertainty. NOx produced by electron precipitation in the mesosphere and lower thermosphere is the starting point of the so-called "indirect effect" altering stratospheric temperatures and winds, which even might impact surface climate. As consequence, this effect is consistently being underestimated in chemistry-climate models. We use a new approach to shed light on these uncertainties. We use precipitating electron fluxes simulated by the magnetospheric model VERB-4D, which will serve as an input for chemistry-climate simulations by the atmospheric model EMAC. Here, we will apply this combination of models in a case study of a geomagnetic active period in March/April 2010 and compare with previous data sets.

EP 11.5 Thu 15:15 ZEU/0160

Good timing — •David Wenzel — Deutsches Zentrum für Luft- und Raumfahrt, Institut für Solar-Terrestrische Physik, Neustrelitz

Several quantities observable on Earth follow day or year trends due to a significant impact of Sun light. The DLR Neustrelitz is for instance monitoring radio signals for reconstructing ionospheric properties in order to gain a deeper insight into the general coupling processes as well as developing warning systems for protecting technological systems from harm or malfunctioning by sudden disturbances like solar flares. The GIFDS (Global Ionospheric Flare Detection System) network of VLF receivers aims at issuing immediate alerts when possibly harmful flare events occur. The continously available VLF signals are heavily influenced by these. However, the measurements also experience a pronounced daytime variation, which has to be taken into account in designing warning algorithms. On the other side, the long-term observations moreover unveil annual characteristics. There is a sharp decrease of signal amplitudes during fall that is not symmetric to the increase in spring. This "October effect" is investigated in the project AMELIE. Grasping the year trends here will improve our view on the physics behind. Giving measurements an analytic representation is of interest for many reasons, but can turn out to be complicated. We will demonstrate that by adjusting the time scale in certain natural manner, modelling becomes easier with respect to appropriate ansatz functions and more accessible to relevant properties.