EP 3: Near Earth Space I

Time: Tuesday 11:00–12:30 Location: H8

Invited Talk EP 3.1 Tue 11:00 H8

Erforschung des Weltraumwetters am DLR Institut für Solar-Terrestrische Physik — •Jens Berdermann — DLR Institut für Solar-Terrestrische Physik, Kalkhorstweg 53, 17235 Neustrelitz

Das Weltraumwetter hat einen erheblichen Einfluss auf die Leistung und Zuverlässigkeit von weltraumgestützten und bodengestützten technologischen Systemen und kann hierdurch auch indirekt Menschenleben gefährden. Angesichts der wachsenden Bedeutung von Weltraumwetterinformationen ist 2019 die Gründung eines neuen DLR-Instituts am Standort Neustrelitz erfolgt. Das Institut für Solar-terrestrische Physik (SO) befindet sich aktuell in der Aufbauphase und forscht im Bereich Weltraumwetter von den Grundlagen bis zur Anwendung. SO untersucht zeitlich variable Bedingungen auf der Sonne und im Sonnenwind sowie deren Wirkung auf das gekoppelte Ionosphären-Thermosphären-Magnetosphären-System und analysiert Weltraumwettereffekte auf betroffene Technologien in den Bereichen Kommunikation, Navigation, Luftfahrt, Satellitenbetrieb, bemannte Raumfahrt, elektrischer Netzbetrieb und Landvermessung. SO wird mit seinen Forschungsergebnissen zu wissenschaftlichen und technologischen Anwendungen z.B. im Bereich der Satellitenkommunikation und Navigation, der Erdbeobachtung, des Krisenmanagements, der Kommunikation für die Luftfahrt und der automatisierten Mobilität beitragen. Im Vortrag wird ein Überblick über die existierenden und geplanten Aktivitäten zum Thema Weltraumwetter am DLR Institut für Solar-Terrestrische Physik, sowie deren Einbindung in internationale Weltraumwetteraktivitäten gegeben.

EP 3.2 Tue 11:30 H8

Exploring radiation belt electron precipitation — •Alina S. Grishina[1,2], Yuri Y. Shprits[1,2,3], Michael Wutzig[1], Hayley J. Allison[1], Nikita A. Aseev[1,2], Dedong Wang[1], and Matyas Szabo-Roberts[1,2] — [1]GFZ, Potsdam, Germany — [2]University of Potsdam, Potsdam, Germany — [3]University of California, Los Angeles, Los Angeles, CA, USA

The near-Earth space environment is filled with charged particles gyrating around magnetic field lines, bouncing between the two hemispheres, and drifting around the Earth. The particle flux in this region can increase by orders of magnitude during geomagnetically active periods, driven by plasma sheet injections. Additionally, particles can be lost from the magnetic trapping region via precipitation into Earth's atmosphere, potentially affecting atmospheric chemistry and temperature. To explore this relationship further, we require information about the energy spectrum and energy range of the precipitating particles.

In this research, we concentrate on ring current electrons and investigate precipitation mechanisms using a numerical model based on the Fokker-Planck equation. Chorus wave-particle interactions are included using diffusion coefficients from Wang et al. [2019], and interactions with plasmaspheric hiss waves are included via the diffusion coefficients of Orlova et al. [2016]. The precipitating flux is calculated for discrete values of energy values from 1 to 300 keV. Model output is compared with observations from the POES satellite mission, that allows us to validate the calculated precipitating fluxes at different MLTs, over the ring current energy range.

EP 3.3 Tue 11:45 H8

Validation of SSUSI derived auroral ionization rates and electron densities — •Stefan Bender[1,2], Patrick Espy[1,2], and Larry Paxton[3] — [1]Norwegian University of Science and Technology, Trondheim, Norway — [2]Birkeland Centre for Space Science, Bergen, Norway — [3]APL, Johns Hopkins University, Laurel, Maryland, USA

Solar, auroral, and radiation belt electrons enter the atmosphere at polar regions leading to ionization and affecting its chemistry. Climate models usually parametrize this ionization and the related changes in chemistry based on satellite particle measurements. Precise measurements of the particle and energy influx into the upper atmosphere are difficult because they vary substantially in location and time. Widely used particle data are derived from the POES and GOES satellite measurements which provide in-situ electron and proton spectra.

Here we use the electron energy and flux data products from the Special Sensor Ultraviolet Spectrographic Imager (SSUSI) instruments on board the Defense Meteorological Satellite Program (DMSP) satellites. This formation of currently three operating satellites observes the auroral zone in the UV from which electron energies and fluxes are inferred in the range from 2 keV to 20 keV. We use these electron energies and fluxes to calculate ionization rates and electron densities in the lower thermosphere (≈90–150 km), and validate them against EISCAT ground-based measurements. We find that with the current standard parametrizations, the SSUSI-derived auroral electron densities (90–150 km) agree well with the ground-based measured ones.

EP 3.4 Tue 12:00 H8

Dorman function of the DOSimetry TELescope (DOSTEL) count and dose rates aboard an aircraft — •Lisa Romaneehsen, Sönke Burmeister, Bernd Heber, Konstantin Herbst, Johannes Marquardt, Christoph Senger, and Carsten Wallmann — Christian-Albrechts-Universität zu Kiel, Institut für Experimentelle und Angewandte Physik, Abteilung Extraterrestrische Physik, Deutschland

The Earth is continuously exposed to high energetic charged particles of galactic cosmic rays. The flux of these particles is altered by the magnetized solar wind in the heliosphere and the Earth's magnetic field. If cosmic rays hit the atmosphere, the formation of secondary particles depends on the atmospheric density above the observer. Therefore, the ability of a particle to approach an aircraft depends on its energy and the position and altitude of the aircraft.

The radiation detector of the detector system NAVIDOS (NAVIgation DOSimetry) is the DOSimetry Telescope (DOSTEL) measuring the count and dose rate in two semiconductor detectors. From 2008 to 2011 two instruments were installed in two aircraft. The access for energetic charged particles to the current position of the observer is given by the so-called cut-off rigidity. To analyze the data we corrected them for pressure variation by normalizing them to one flight level. We found that the normalization parameters vary with the solar modulation parameter and the cut-off rigidity as expected. These corrected data were utilized to determine the cut-off rigidity dependence by fitting the so called Dorman function to the observation.

EP 3.5 Tue 12:15 H8

Dependence of the ISS DOSTEL Dorman function on the used external geomagnetic field — •Hanna Giese, Sönke Burmeister, Bernd Heber, Konstantin Herbst, Lisa Romaneehsen, and Carsten Wallmann — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, Kiel, Germany

The Earth is constantly hit by energetic particles originating from galactic sources. The flux of these particles is altered by the magnetized solar wind in the heliosphere and the Earth's magnetic field. For this reason, the ability of a particle to approach a spacecraft in Low Earth Orbit (LEO) depends on its energy and the position of the spacecraft within the Earth's magnetosphere, characterized by the so-called cut-off rigidity. This cut-off rigidity depends on the activity state of the heliosphere and magnetosphere that are described by models of different complexity. The DOSimetry TELescope (DOSTEL) aboard the International Space Station (ISS) monitors the radiation field within the European module Columbus, which varies with the geomagnetic positions. The correlation between the measured count rates and the corresponding cut-off rigidity is described by the Dorman function. In this contribution we compute cut-off rigidities along the ISS trajectory utilizing three Earth magnetosphere models during different solar and magnetospheric activity. As a result we find major differences between the resulting Dorman functions, which depend on and increase with the external solar wind pressure and exceed the uncertainty in intervals with a mean solar wind pressure of more than 3nPa.