EP 4: Near Earth Space II

Time: Tuesday 16:30–17:45 Location: H8

Invited Talk EP 4.1 Tue 16:30 H8

Using multiple radar stations to examine atmospheric tides and their variability — •Patrick Espy[1,2], Willem van Caspel[1,2], and Robert Hibbins[1,2] — [1]Norwegian University of Science and Technology, Trondheim, Norway — [2]Birkeland Centre for Space Science, Bergen, Norway

Atmospheric tides and planetary waves (PWs) play an important role in shaping the day-to-day and seasonal variability of the Mesosphere-Lower-Thermosphere (MLT). Measurements of tidal and PW variability in the mid-latitude MLT have however remained sparse. This study uses a new analysis technique on the meteor radar winds from a longitudinal array of SuperDARN radars. These provide hourly measurements of the meridional wind at ~95km altitude from which we are able to investigate tides and PWs in the MLT at 65 degrees North. Using the array of SuperDARNs, we can identify east and westward traveling S1, S2 and S3 wave components over a broad range of frequencies spanning tidal to planetary wave oscillations. We present a study of the variability of the migrating and non-migrating tides and the longitudinal variability resulting from their interaction. Additionally we examine the variability of the 2 and 5-day waves in the MLT, and their interaction with tides during stratospheric warming events.

EP 4.2 Tue 17:00 H8

The mid-to high-latitude migrating semidiurnal tide: Results from SuperDARN meteor wind observations and mechanistic simulations — •Willem van Caspel[1,2] and Patrick Espy[1,2] — [1]Norwegian University of Science and Technology, Trondheim, Norway — [2]Birkeland Centre for Space Science, Bergen, Norway

Meteor wind observations of the migrating semidiurnal tide (SW2) made by a longitudinal chain of high-latitude SuperDARN radars are compared against simulations made using a mechanistic primitive equation model. The model is a three-dimensional, non-linear and time-dependent spectral model. The modeled background zonal mean zonal winds and temperatures are nudged to daily mean data from the Navy Global Environmental Model - High Altitude (NAVGEM-HA) meteorological analysis system up to ∼95 km altitude. The SW2 tide is forced using 3-hourly temperature tendency fields from the Specified Dynamics Whole Atmosphere Community Climate Model With Thermosphere and Ionosphere Extension (SD-WACCMX). To compare the model to observation, the model is sampled according to the meteor echo distribution of the SuperDARN radars at the locations of available measurements for the year 2015. Our model accurately reproduces the observed seasonal variations in the SW2 amplitude and phase. Model experiments are performed to investigate the role of the background atmosphere, tidal forcing, and dissipation terms in establishing the simulated SW2 tide. Notably, the dissipation terms include a seasonally varying mesospheric eddy diffusion, and a surface friction layer.

EP 4.3 Tue 17:15 H8

Comparison of the chemical impact of extreme solar events with the Halloween solar proton event (SPE) in late October 2003 in the middle atmosphere using a 1D ion-chemistry model — •Monali Borthakur[1], Thomas Reddmann[1], Miriam Sinnhuber[1], Ilya Usoskin[2], Jan-Maik Wissing[3], and Olesya Yakovchuk[3] — [1]Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]University of Oulu, Oulu, Finland — [3]University of Rostock, Rostock, Germany

Strong eruptions in the Sun can accelerate protons to high energies, causing solar proton events (SPEs) and inducing geomagnetic disturbances. Such energetic particles can precipitate upon the Earth's atmosphere, mostly polar regions. We considered an extreme solar event combining an extreme SPE and a geomagnetic storm as derived from historical records of cosmogenic nuclides. The ionization rates (IRs) were calculated for strong directly observed events and scaled to represent extreme events. The chemical composition changes of different atmospheric components (Ozone, NOx, HOx, Cl) due to the extreme solar event and the Halloween SPE are compared in the middle atmosphere doing simulations in a 1D box model of the atmospheric neutral and ion composition. The motivation behind using this model is that it assumes canonical NOx/HOx per ion pair used in chemistry climate models (CCMs). Temperature, pressure and the initial state of the neutral atmosphere are input into the model that were obtained from the EMAC CCM using IRs from AIMOS. The IRs for the Halloween SPE were obtained from AISSTORM data.

EP 4.4 Tue 17:30 H8

synthetic aperture radar satellite imaging of Earth's upper atmosphere and its potential application for upcoming Venus missions — •Hiroatsu Sato[1] and Jun Su Kim[2] — [1]DLR Institute for Solar-Terrestrial Physics, Neustrelitz, Germany — [2]DLR Microwaves and Radar Institute, Wessling, Germany

Modern space-borne synthetic aperture radar satellite (SAR) can provide meter-scale resolution imaging of Earth*s ground surface. When SAR radio waves undergo propagation effects from the ionized atmosphere between the satellite and ground, the resulting SAR image contains information of the atmospheric plasma structures. Recent studies show that plasma density structures in Earth's ionosphere can be captured in L-band SAR images. Different SAR processing techniques using interferometry and sub-band data have been developed to extract the two-dimensional variation of plasma density irregularities We present case studies of SAR imaging of Earth ionospheric density and discuss its potential application for recently selected SAR missions for Venus whose ionosphere is not yet fully understood.