Geophysical Research Abstracts
Vol. 18, EGU2016-1463, 2016
EGU General Assembly 2016

Atmosphere-Ionosphere Coupling due to Atmospheric Tides (Julius Bartels Medal Lecture)

Jeffrey M. Forbes
University of Colorado, United States

Within the last decade, a new realization has arrived on the scene of ionosphere-thermosphere (IT) science: terrestrial weather significantly influences space weather. The aspect of space weather referred to here consists of electron density variability that translates to uncertainties in navigation and communications systems, and neutral density variability that translates to uncertainties in orbital and reentry predictions. In the present context "terrestrial weather" primarily refers to the meteorological conditions that determine the spatial-temporal distribution of tropospheric water vapor and latent heating associated with tropical convection, and the middle atmosphere disturbances associated with sudden stratosphere warmings. The net effect of these processes is a spatially- and temporally-evolving spectrum of waves (gravity waves, tides, planetary waves, Kelvin waves) that grows in amplitude with height and enters the IT system near $\sim$100 km. Some members of the wave spectrum penetrate all the way to the base of the exosphere (ca. 500 km). Along the way, nonlinear interactions between different wave components occur, modifying the interacting waves and giving rise to secondary waves. Finally, the IT wind perturbations carried by the waves can redistribute ionospheric plasma, either through the electric fields generated via the dynamo mechanism between 100 and 150 km, or directly by moving plasma along magnetic field lines at higher levels. Additionally, the signatures of wave-driven dynamo currents are reflected in magnetic perturbations observed at the ground. This is how terrestrial atmospheric variability, through the spectrum of vertically- propagating waves that it produces, can effectively drive IT space weather.
The primary objective of this Julius Bartels Lecture is to provide an overview of the global observational evidence for the IT consequences of these upward-propagating waves. In honor of Julius Bartels, who performed much research (including his habilitation thesis) on atmospheric and geomagnetic tides, this talk will emphasize the tidal part of the wave spectrum and its effects on the upper atmosphere.