Geophysical Research Abstracts
Vol. 15, EGU2013-10823, 2013
EGU General Assembly 2013
© Author(s) 2013. CC Attribution 3.0 License.

Penetration of Solar Wind Driven ULF Waves into the Earth's Inner Magnetosphere: Role in Radiation Belt and Ring Current Dynamics

Ian Mann, Kyle Murphy, Jonathan Rae, Louis Ozeke, and David Milling
Department of Physics, University of Alberta, Edmonton, Canada (imann@ualberta.ca)

Ultra-low frequency (ULF) waves in the Pc4-5 band can be excited in the magnetosphere by the solar wind. Much recent work has shown how ULF wave power is strongly correlated with solar wind speed. However, little attention has been paid the dynamics of ULF wave power penetration onto low L-shells in the inner magnetosphere. We use more than a solar cycle of ULF wave data, derived from ground-based magnetometer networks, to examine this ULF wave power penetration and its dependence on solar wind and geomagnetic activity indices. In time domain data, we show very clearly that dayside ULF wave power, spanning more than 4 orders of magnitude, follows solar wind speed variations throughout the whole solar cycle – during periods of sporadic solar maximum ICMEs, during declining phase fast solar wind streams, and at solar minimum, alike. We also show that time domain ULF wave power increases during magnetic storms activations, and significantly demonstrate that a deeper ULF wave power penetration into the inner magnetosphere occurs during larger negative excursions in Dst. We discuss potential explanations for this low-L ULF wave power penetration, including the role of plasma mass density (such as during plasmaspheric erosion), or ring current ion instabilities during near-Earth ring current penetration. Interestingly, we also show that both ULF wave power and SAMPEX MeV electron flux show a remarkable similarity in their penetration to low-L, which suggests that ULF wave power penetration may be important for understanding and explaining radiation belt dynamics. Moreover, the correlation of ULF wave power with Dst, which peaks at one day lag, suggests the ULF waves might also be important for the inward transport of ions into the ring current. Current ring current models, which exclude long period ULF wave transport, under-estimate the ring current during fast solar wind streams which is consistent with a potential role for ULF waves in ring current energisation. The combination of data from ground arrays such as CARISMA and the contemporaneous operation of the NASA Van Allen Probes (VAP) mission offers an excellent basis for understanding this cross-energy plasma coupling which spans more than 6 orders of magnitude in energy. Explaining the casual connections between plasmas in the plasmasphere (eV), ring current (keV), and radiation belt (MeV), via the intermediaries of plasma waves, is key to understanding inner magnetosphere dynamics.

This work has received funding from the European Union under the Seventh Framework Programme (FP7-Space) under grant agreement n 284520 for the MAARBLE (Monitoring, Analyzing and Assessing Radiation Belt Energization and Loss) collaborative research project.