IONOSPHERIC RADIO OCCULTATION MEASUREMENTS AND SPACE WEATHER

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GPS measurements carried out on board Low Earth Orbiting (LEO) satellites provide a unique opportunity for monitoring the entire electron density distribution from GPS heights down to the bottomside of the ionosphere.
Considering the Ionospheric Radio Occultation (IRO) technique it can be stated that no other profiling technique is able to unify profiling through the entire ionosphere with global coverage. Furthermore, GPS navigation measurements onboard LEO's may be used to reconstruct the electron density distribution of the topside ionosphere and plasmasphere with high resolution.
The talk addresses both techniques to demonstrate their capabilities for monitoring the global ionosphere on a routine basis that is of particular interest for space weather applications.
More than 20000 vertical electron density profiles are obtained since the beginning of ionospheric radio occultation measurements onboard the German CHAMP (CHAllenging Minisatellite Payload) satellite on 11 April 2001 by using a model assisted retrieval technique that will be discussed taking into account the rather low orbit of the CHAMP satellite ($h < 450$ km).
Validation studies reveal RMS deviations of the F2 layer parameters f0F2 and hmF2 of about 1 MHz and 40 km, respectively. Entire IRO derived electron density profiles were compared with corresponding profiles derived from vertical sounding measurements obtained at various ionosonde stations and incoherent scatter facilities. The absolute deviations from selected European ionosonde data computed as a function of altitude are generally less than 1 MHz (RMS < 1.5 MHz).
The topside electron density reconstruction, close to the CHAMP orbit plane, indicates a significant impact of complex space weather events on the shape of the geo-plasma environment. So the animation of the 2D electron density distribution in the CHAMP orbit plane reconstructed for the geomagnetic storm on November 6, 2001, indicates very dynamic and severe plasma enhancements near the Northern pole.
Generally speaking, IRO measurements carried out onboard LEO satellites have a huge potential to establish global data sets of electron density profiles for developing and improving global ionospheric models and to provide operational space weather information.