URSI GASS 2023, Sapporo, Japan, 19 – 26 August 2023

Estimating electron density on the CASSIOPE satellite using different methods

O. Grynyshyna-Poliuga [1], and C. Watson [1]
(1) University of New Brunswick, Fredericton, Canada; e-mail: o.grynyshyna@unb.ca; chris.watson@unb.ca

Radio occultation is a method used to estimate electron density in the ionosphere by analyzing the changes in radio signals transmitted from a satellite to the ground. The radio signals are transmitted through the ionosphere, and the ionosphere's electrons cause the signal phase perturbations. By measuring signal phase delay/advance during an occultation, the electron density in the ionosphere can be estimated. Radio occultation is a widely used method for estimating electron density in the ionosphere because it can provide high vertical-resolution information about the ionosphere's electron density with global coverage. However, it requires precise knowledge of the satellite's position and the atmospheric conditions along the signal path to obtain accurate results.

On 29 September 2013, the CAScade, Smallsat and IOnospheric Polar Explorer (CASSIOPE) spacecraft [1], now known as Swarm-E, was launched carrying the GPS Attitude, Positioning, and Profiling (GAP) experiment [2], offering the opportunity to perform ionospheric occultations with different sampling rates (20, 50 and 100 Hz). The high inclination, elliptical spacecraft orbit allows us to obtain vertical electron density profiles up to 1500 km altitude over a broad range of latitudes, including the polar regions. This research presents comparison of the electron density profiles derived from high-resolution GPS RO observations performed using a GPS receiver of the high inclination Swarm-E spacecraft during quiet and disturbed ionospheric conditions by Abel inversion and bottom-up methods.

Abel inverse method - this is a mathematical method that involves taking the integral of the measured data and inverting it to obtain the electron density profile. This method assumes a knowledge of the ionosphere's geometry and assumes that the electron density profile is smooth. Bottom-up approach - this method involves using multiple observations and measurements of the ionosphere to build up a picture of the electron density profile from the ground upward. This method is more empirical and does not require a priori knowledge of the ionosphere's geometry, but it can be more time-consuming and requires a larger amount of data. Both methods have their own strengths and limitations and can be used in combination to provide a more accurate estimate of the electron density profile in the ionosphere.

References

[1] A. W. Yau, and H. G. James, “CASSIOPE Enhanced Polar Outflow Probe (e-POP) mission overview”, *Space Sci. Rev*, **189**, 2015, 3–14, doi:10.1007/s11214-015-0135-1.

[2] D. Kim, and R. B. Langley, “The GPS Attitude, Positioning, and Profiling experiment for the Enhanced Polar Outflow Probe platform on the Canadian CASSIOPE satellite”, *Geomatica*, **64**(2), 2010, 233–243.