URSI AP-RASC, Sydney, Australia, 17-22 August 2025

A method to retrieve aeronomic parameters from noontime bottom-side equatorial Ne(h) and satellite neutral density observations

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The daytime ionospheric F2 region reflects the state of the surrounding neutral atmosphere, vertical plasma drift, and the intensity of solar ionizing EUV radiation. By solving the inverse problem of aeronomy, it is possible to derive a self-consistent set of key aeronomic parameters responsible for the formation of the ionospheric F2 layer. A method has been specifically developed for retrieving these parameters in the F2 region at the geomagnetic equator. This approach utilizes Digisonde DPS-4 daytime bottom-side (≥ 200 km) Ne(h) profiles combined with satellite-measured neutral density. By applying this technique, it is possible to estimate critical aeronomic variables, including neutral composition ([O], [O_2], [N_2]), exospheric temperature (T_{ex}), vertical ExB plasma drift, and total solar EUV flux (λ ≤ 1050Å) under various geophysical conditions.
The method has been validated using EUV observations from the TIMED mission spanning 2002 to 2010, as well as Jicamarca ISR hmF2 measurements. It effectively differentiates between various geophysical conditions by retrieving aeronomic parameters associated with specific events. This capability has been demonstrated through case studies, including a counter electrojet event and a severe geomagnetic storm. The accuracy of the retrieved ExB vertical plasma drifts has been confirmed through ground-based magnetic field H-component observations, further reinforcing the reliability of the method.
A major advantage of this approach is its ability to provide a comprehensive and consistent analysis of the equatorial thermosphere and ionosphere. By integrating ground-based and satellite observations, the method offers a robust framework for understanding the complex interactions between the ionized and neutral components of the upper atmosphere.
Overall, the proposed method represents a significant advancement in aeronomy, offering a powerful tool for investigating the equatorial ionosphere and thermosphere under varying geophysical conditions