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Global Measurements of the Ionosphere with the CARINA Satellite Flying Between the E- and F-Layers

Abstract:
An evolutionary step in ionospheric research is the Naval ResearchLaboratory CARINA mission where multiple spacecraft are put into limited life (45 to 60 day) earth orbits (LLEO) in the 150 to 250 km altitude range. Previous space missions have used either short-duration, sounding rockets in the 0 to 1000 km altitude range or long-duration, low-earth-orbit satellites with average altitudes above 300 km. The NRL CARINA satellites will explore the lower thermosphere with direct, in situ observations and will be able investigate both sporadic-E layers below the satellite and F-region structures above the satellite using radio propagation from ground and space based RF sources. The CORINA satellites look like torpedoes with have large mass (200 kg) and low drag area (0.05 sq-m). The sensors for the first CARINA mission are the orbiting GPS receiver (OGR), ram Langmuir probe (RLP) and an electric field instrument (EFI) covering the high frequency (2 to 15 MHz) range. The unique measurements with the CARINA satellite include:
(1) direct fly-through of the regions of the ionosphere modified by high power radio waves,
(2) tomographic mapping Sporadic-E layers using ground HF radio beacons,
(3) detection of the ionospheric coupling of extreme ocean storms using HF radar surface wave sea scatter to the CARINA receiver,
(4) monitoring of traveling ionospheric disturbances in the lower thermosphere by employing in situ plasma probes and orbiting GPS TEC receivers, and
(5) detecting electric field transients from terrestrial lightning that can drive space-plasma fluctuations.

Subionospheric satellite experiments will expand the knowledge of lower thermospheric science at all latitudes and enhance our understanding of the direct coupling between large scale terrestrial disturbances and bottomside ionosphere.