2015 Workshop: CARINA Science Mission

Long title
Global Support of the CARINA Science Mission to Study the Lower Thermosphere
Conveners
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Description

The Naval Research Laboratory is constructing two satellites to fly below the F-Layer ionosphere for a period of 45 to 60 days. The Space Plasma Mission will study (1) high power RF wave interactions in the Ionosphere, (2) sporadic-E layer characterization, and (3) global imaging of F-Layer ionosphere. The CARINA spacecraft will be launched in late 2015 to mid-2016 into a 51.6° inclination orbit that has in initial insertion of 178 km by 284 km. The instruments on CARINA are (1) Electric Field Receiver (EFI) measuring electromagnetic and electrostatic waves in the MF/HF Band (2 to 15 MHz), (2) Ram Langmuir Probe (RLP) measuring the electron concentration in the 102 to 106 cm-3 range and the (3) Orbiting GPS Receiver (OGR) to record TEC in the F-Layer above the satellite. The CARINA satellites are being delivered to Orbital Science in August 2015 for launched by one of the future Antares rockets as part of the CYGNUS flights to the space station.

The purpose of the CEDAR Workshop on CARINA is to build ground support and theory teams for the two-month mission. The six areas of research are (a) Sporadic-E/Intermediate Layers and TIDs with a focus on ionospheric structures below orbit and large scale bottomside fluctuations in the F-Layer, (b) global assimilation for using the CARINA OGR and RLP observations as drivers for data driven ionospheric models such as GAIM, IDA3D, etc., (c) HF propagation and radio scintillations to determine the impact of the bottomside ionosphere on HF ray trajectories for SuperDARN, ionosondes, etc., and to determine the effects of ionospheric irregularities and UHF/L-Band scintillation on GPS, etc., (d) lightning and ocean waves to directly measure lightning EM pulses and determine their impact on the ionosphere as well as derive ocean wave height spectrum from HF surface wave scatter, (e) high power HF modification from the Arecibo and SURA Heating Facilities with direct sensing of artificial irregularities and enhanced ionization, and (f) satellite

drag with thermosphere/mesospheric density updates determined by orbit measurements and reentry modeling of drag coefficients.

The global CEDAR community will be tapped to provide ground support with incoherent scatter radars (Millstone Hill, Arecibo, Jicamarca), ground based HF transmitters (ionosondes, TIDDBIT, HF Beacons), ground optical systems (imagers, interferometers, spectrometers), and other instruments. During the CEDAR mission, 90 separate experiments will be collecting data around the globe. This Workshop will be used to schedule individual sites that will support the CARINA mission. Those interested in the CARINA data will be responsible for acquiring their own financial support with proposals to NSF, NASA, AFOSR, etc. NRL will provide experiment data only for each ground team that has participated at a specified time and site location. The GPS TEC and RLP electron density data will be available to all experimenters after the completion of the CARINA mission. Data assimilator teams and theoretic modelers are encouraged to participate in the discussions for planning the CARINA mission.

Justification

The CARINA Mission Workshop has direct relevance to every Strategic Thrust of the CEDAR Strategic Plan. By staying in orbit for an extended period with an average altitude of 200 km, CARINA will observe the connections between the underlying troposphere (lightning and ocean waves) and mesosphere (E-layers) with overlying F-region ionosphere. Because, CARINA will fly “where no satellite has flown before”, there will be an immediate enhancement in the upper atmosphere knowledge base “to understand global connectivities and causal relationships involving space-atmosphere-interaction region (SAIR). After the demonstration of the CARINA concept, future missions flying near 200 km altitude will be conducted with unique observational and instrumentation strategies. CARINA will enable CEDAR experimenters to fuse the knowledge across the atmospheric disciplines of ITM, troposphere, and oceanography.

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