GEROS-ISS: Innovative Ocean Remote Sensing using GNSS Reflectometry onboard the International Space Station

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Abstract

The European Space Agency Directorate of Human Space Flight and Operations (H SO) released an announcement of opportunity in July 2011 in coordination with the preparing of an ESA’s Living Planet Programme Call for scientific experiments for the International Space Station relevant to global climate change. 7 Letters of intent were received from 237 science team members. After a peer-review of the received proposals and a scientific and technical evaluation, the GEROS-ISS proposal was accepted to proceed to Phase A feasibility studies.

Background

The mission goals are global atmosphere and ionosphere observations. Secondary mission objectives, which increase the scientific value of the GEROS data, but are not driving the instrument developments, are:

1. to further explore the potential of GNSS radio occultation data (vertical profiles of atmospheric bending angle, refractivity, temperature, pressure, humidity and electron density), particularly in the Tropics, to detect changes in atmospheric temperature and humidity (tropospheric humidity, soil moisture, vegetation biomass, and mid-latitudes snow/ice properties)
2. to retrieve scalar ocean surface mean square slope (MSS), which is related to sea roughness, wind speed and direction, with a GNSS spaceborne receiver to allow methodology testing, establishment of error budget and resolutions. As a secondary objective, 2D MSS (directional MSS) would be desirable.

Mission Goals

The primary mission objectives of GEROS are:

1. to measure the altimetric sea surface height of the ocean using reflected GNSS signals to allow methodology demonstration, establishment of error budget and resolutions, and comparison/synergy with results of satellite based nadir-pointing altimeters and
2. to retrieve scalar ocean surface mean square slope (MSS), which is related to sea roughness, wind speed and direction, with a GNSS spaceborne receiver to allow methodology testing, establishment of error budget and resolutions. As a secondary objective, 2D MSS (directional MSS) would be desirable.

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2. to assess the potential of GNSS scatteringometry for land applications and in particular to develop products such as soil moisture, vegetation biomass, and mid-latitudes snow/ice properties to better understand anthropogenic climate change.

Scientific Studies

Part of the preparation of the GEROS mission and the work of the Science Advisory Group are dedicated scientific studies and campaigns. One example is an initial Observation System Simulation Experiment (OSSE), which is described in [1] to investigate the GEROS capability for the observation of highly energetic mesoscale ocean currents (eddies) with changes of <30 cm sea surface within regions of <100 km. Knowledge on these eddies is important for the characterisation of nutrients and/or pollutants with many societal and scientific applications. Presently the tracking and forecasting of eddies is limited due to the capability of the current ocean altimetry missions. The OSSE used artificial GEROS measurements (only GPS, 50 cm accuracy, 1 month) and a regional ocean model. Initial results indicate that GEROS data, even with measurements from only one GEROS satellite and with conservative accuracy assumptions, could be used to improve current regional ocean topography forecasting with special focus on highly energetic mesoscale currents. The OSSE investigations will be continued with data from additional GNSS satellites and from classical radar altimetry missions.

Reference