

# **POLARIMETRIC GNSS RADIO OCCULTATIONS WITH THE SPANISH PAZ MISSION**

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A proposal to include a polarimetric Global Navigation Satellite System (GNSS) Radio-Occultation (RO) payload on board of the Spanish Earth Observation satellite PAZ, has been recently approved by the Spanish Ministry for Science and Innovation (MICINN). The PAZ mission, planned to be launched in Spring 2012, was initially designed to carry a Synthetic Radar Aperture (SAR) as primary and sole payload, and included an IGOR+ advanced Global Positioning System (GPS) receiver and corresponding antennas for precise orbit determination. After some modifications, the design of this GPS receiver allows the tracking of occulting signals. RO thermodynamical profiles are assimilated operationally into several global numerical weather prediction models (NWPM). Latest results at NCEP and ECMWF show that ROs improve anomaly correlation scores; they help reducing model biases; and the impact of their assimilated data in NWPM represents the fifth among 24 operational observational systems, in terms of forecast error reduction. To achieve these positive impacts, dense sets of RO data are required. One of the main sources of RO data is the constellation of 6 Low-Earth Orbiters (Taiwan/USA FORMOSAT-3/COSMIC mission), which will degrade from 2011 on. Therefore, the number of RO profiles risks to dramatically drop after the decommissioning of the COSMIC constellation. PAZ will contribute filling this gap. Although the frequency of the signals for the Global Positioning System were chosen such that they would suffer low attenuation by clouds or rain and enable all-weather operations, the de-polarization effect induced by the flattening of the heavy precipitation drops may exceed some measurable threshold. Work done for calibration and characterization of similar signals (GOES 11 L-band down-link at 1.5445 GHz and RHCP) have found strong correlation between the de-polarization ratio and heavy rain effects, when measuring a down-link at 14 deg. elevation angle (above the horizon). The same concept, in backscattering geometry rather than propagation, is used in the NEXRAD network of polarimetric weather radars across U.S.A, working at 3 GHz (compare to 1.5 GHz for GPS-L1). The de-polarization effect increases as the propagation line aligns with the plane of the drops' flattening (usually parallel to the local horizon). The Radio-Occultation signals cross the lower troposphere tangentially, i.e. along the local horizon, which maximize the de-polarization effect. PAZ will include RO capabilities with a new approach for the relatively small limb-oriented GPS antennas. The proposed RO antenna will use the GPS L-band Right Hand Circular Polarized (RHCP) transmitted signals to capture both co- and cross-polarized components of the GPS propagated signal for the first time in a space-based GPS receiver. This experiment will be a proof-of-concept to exploit the potential capabilities of polarimetric radio occultation towards detecting and quantifying heavy precipitation events. If successful, PAZ will provide a new application of GNSS Radio-Occultation observations by providing coincident thermodynamic and precipitation information with high vertical resolution within regions with thick clouds.