27th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Earth Observation Missions (4)

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OUTLINE OF THE HYDROGNSS GNSS-REFLECTOMETRY SCOUT MISSION

Abstract

HydroGNSS is an ESA Scout candidate consisting of a 40 kg satellite that addresses land hydrological parameters using the technique of GNSS Reflectometry, a form of bistatic L-Band radar using satnav signals as the radar source. The four targeted essential climate variables (ECVs) are of established importance to our understanding of the climate evolution and human interaction, and comprise of soil moisture, inundation / wetlands, freeze /thaw (notably over permafrost) and above ground biomass.

The technique of GNSS Reflectometry shows potential over all geophysical surfaces for low cost measurement of ocean winds, ocean roughness, soil moisture, flood ice mapping, and other climate and operational parameters. SSTL developed and flew the SGR-ReSI GNSS remote sensing instrument on the 160kg TechDemoSat-1 (TDS-1) in 2014 and, with sponsorship from ESA, collected data until TDS-1's drag-sail was deployed in May 2019. NASA's CYGNSS mission followed, using the SGR-ReSI on its 8-microsatellite constellation for sensing hurricanes. The datasets from TDS-1 have been released via the MERRByS website, and include ocean wind speed measurements and ice extent maps from National Oceanography Centre's C-BRE inversion. Researchers also recognised the benefits of GNSS reflectometry over land, including the unique capability to sense rivers under forest canopies to a high resolution.

HydroGNSS is proposed by SSTL and a team of partners with a broad range of experience in GNSS technology, GNSS-Reflectometry modelling and applications, and Earth Observation from GNSS-R measurements. The instrument takes significant steps forward from previous experiments by including capability in dual polarisation, dual frequency and coherent reflected signal reception, that are expected to help separate out ECVs and improve measurement resolution. The satellite platform is the 40 kg SSTL-Micro, which has improved attitude determination and a high data link to support the collection of copious quantities scientific data with a short time delay. HydroGNSS is anticipated to generate a new research data set in GNSS Earth Observation, specifically targeting land and hydrological applications.

State of the art missions targeting soil moisture, SMOS and SMAP, are highly valued, but are expensive to replace. HydroGNSS achieves radar performance on a small satellite. The forward scatter L-band measurements are complementary to other techniques, and HydroGNSS brings new measurement types. The small size and low recurring cost of the satellite design opens the door to a larger constellation to further improve spatial and temporal global hydrological measurements, invaluable for climate and weather forecast knowledge.