March 2025

Image credit: SSTL

HydroGNSS
Scout Mission

The ESA Scout HydroGNSS (Hydrology from Global Navigation Satellite Systems) mission comprises two small satellites. They use reflected satellite navigation signals to monitor the Earth's water systems, including presence and state of water in the soil as well as density of vegetation and ocean winds.

Opportunities HydroGNSS will offer

The presence or absence of water in or on land has a profound impact on agriculture, biodiversity, flood preparedness, climate and weather. HydroGNSS comprises two small satellites that use L-band signals from GPS and Galileo Global Navigation Satellite Systems as sources for bistatic radar measurements of the Earth's surface over land, ocean and ice.

Advanced GNSS Reflectometry (GNSS-R) measurements and techniques are used to separate and determine climate variables including:

- Soil moisture - important for climate, agriculture and weather forecasting.
- Freeze/thaw state – the timing of the freeze/thaw cycle of the permafrost active layer helps in understanding changes in methane release and CO_2 uptake.
- Inundation / wetlands – allows assessment of flood risk, wetland health and methane sources.
- Forest Biomass – influences climate, a vital parameter affecting CO_2 uptake.

Secondary products include ocean wind speed and sea ice extent over the ocean.

Mission Partners

- European Space Agency (ESA)

UK Expertise

- UK grants supported pioneering demonstrations of the GNSS-R remote sensing technique on Surrey Satellite Technology Ltd.'s (SSTL) satellites UK-DMC and TechDemoSat-1. SSTL's payloads enabled the NASA CYGNSS constellation that senses hurricanes and soil moisture from GNSS reflections.
- Surrey Satellite Technology Ltd (SSTL) developed the instrument, the satellite platform and ground segment. Martin Unwin is the industrial principal investigator for the mission, and executive officer of the HydroGNSS Science Advisory Group.
- Paul Blunt and colleagues at the University of Nottingham are working on GNSS signal processing, receiver design and RF (radio frequency) interference detection.
- Christine Gommenginger and Giuseppe Foti, of National Oceanographic Centre (NOC) in Southampton, are looking at calibration and ocean applications.

Other European team members

- ESA has GNSS-R expertise with Manuel Martin-Neira and Maria Paola Clarizia in the team.
- The science team includes Sapienza and Tor Vergata (University of Rome), IEEC-ICE, FMI, CNR-IFAC, TUW.

"Soil moisture has emerged as a critical climate and agricultural measure. Studies show that improved space observations, combined with models, could transform knowledge of today's water availability and future projections from droughts to soil saturation" – *Professor John Remedios Director National Centre for Earth Observation (NCEO)*

Mission Timeline

2003, 2014
SSTL launches UK-DMC and TDS-1 missions with early GNSS-R experiments demonstrating feasibility.

Summer 2019, 2020
HydroGNSS is shortlisted then selected as a Scout mission.

Oct 2021
HydroGNSS mission Kick-Off, design commences.

Feb 2024
First HydroGNSS satellite built, ready for test campaign, second satellite close behind.

Oct/Nov 2025
Rideshare launch of both HydroGNSS satellites

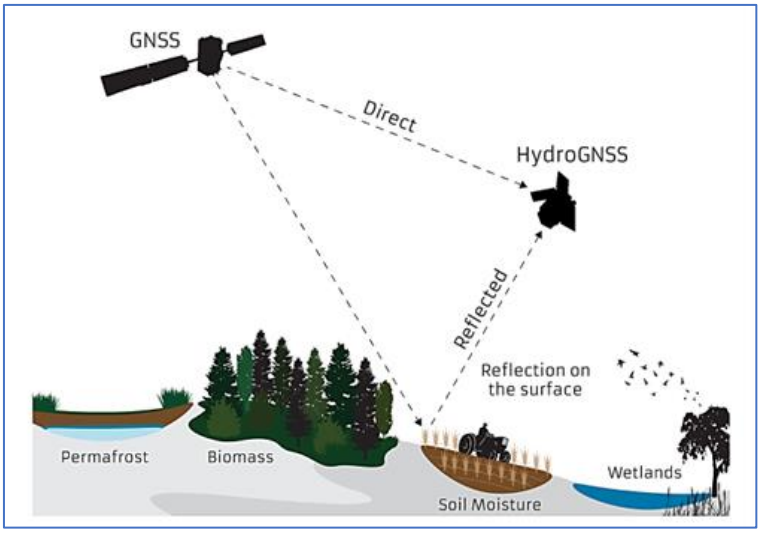
After 6 months, first data due to be released for users.

Mission and Instrumentation

The two HydroGNSS satellites will be launched into a sun-synchronous orbit at an altitude of 550 km. Following commissioning, measurements will be collected with a near 100% duty-cycle and processed in the Payload Data Ground Segment at Guildford. The collected data will be the property of ESA and will be disseminated via a web portal, according to ESA's free and open data policy.

- Level 1 data comprises GNSS-R Delay Doppler Maps and metadata, including calibrated reflectivity, sigma-0, and power estimates.
- Level 2 data comprises track-wise geophysical products
- Level 3 data aggregates measurements into gridded maps

Each HydroGNSS satellite has a mass of approximately 65kg, and includes star camera AOCS, xenon propulsion and X-band communications. The payload tracks GPS and Galileo satellites, and collects dual frequency (L1/E1, L5/E5a) dual polarisation (LHCP, RHCP) reflections, as well as high-rate coherent channel.



Further Information

- Watch the HydroGNSS animation
- ESA: HydroGNSS Twice as good
- Introduction to HydroGNSS doi: 10.1109/JSTARS.2021.3089550.
- Mission website and contact: www.hydrognss.org

Visit the HydroGNSS website hydrognss.org

Download this explainer

"As well as targeting important climate variables, GNSS Reflectometry continues to surprise. We are ready to expect the unexpected in uncovering new applications from the innovative measurements that will be taken"
- Dr Martin Unwin, Surrey Satellite Technology Ltd, HydroGNSS Industrial Principal Investigator