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# THE RADAR CLUSTER FOR EARTH REMOTE SENSING (RACERS) CUBESAT MISSION

**Abstract**

Spaceborne radar is central to Earth environmental monitoring and forecasting.

Space radars today include SAR imagers, altimeters and scatterometers, but no current operational systems combine SAR/Alt/Scat and no compact radar signal generator/processors offer multiple radar types or can alter their functions in flight.

Developed within the frame of European Space Agency's (ESA) OSIP Initiative, part of ESA's Preparation Element, the RaCERS (Radar Cluster for Earth Remote Sensing) study aims to fill this gap by designing a compact radar sensor that efficiently integrates all three functions.

The study project is led by GeoOptics Switzerland (GOS) as prime contractor, coordinating a consortium that includes Tyvak International (spacecraft bus design), the Italian National Interuniversity Consortium for Telecommunications (CNIT) and the University of Birmingham (responsible with GOS for developing the radar instruments and data analysis system). It pursues space radar innovations on two fronts: i) advanced instrumentation combining all radar signal generation and processing functions in a small, low-cost module, and ii) observing system architectures comprising swarms of cooperating smallsats to achieve new observation types and performance levels. Previously large platforms are "atomized" into swarms of simpler vehicles working together, exploiting today's smallsat technology and the versatility of satellite networks.

The RaCERS mission comprises a swarm of eight small satellites flying in formation below 500km, performing monostatic and bistatic altimetry and scatterometry, alternating with side-looking synthetic aperture radar imaging and multi-static interferometric SAR.

The mission has a nominal 2-year target lifetime with a goal of 5 years.

Based upon Tyvak International's low-cost 16U satellite platform, including OBDH, ADCS package and EPS, each spacecraft can accommodate the full suite of RaCERS science instrumentation, antennas and avionics. The Tyvak bus features deployable solar panels and power management system for radar functions and on-orbit formation maintenance via advanced electric propulsion.

RaCERS payloads consist of a three-frequency microwave radiometer for atmospheric moisture sensing, dual-band (C and Ku) radar antennas and single integrated signal generator/processor for all radar functions.

The concept seeks to demonstrate three main technical advances: i) Jason-class ocean altimetry with low-cost smallsats; ii) dramatic efficiency improvement by combining altimetry and scatterometry in a multistatic radar system; iii) forging a path to rapid global SAR/InSAR sensing with smallsat arrays.

The program started in October 2023 as a 6-month feasibility study, potentially leading to the launch of the eight-cell cluster within five years.