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G-CLASS: A GEOSYNCHRONOUS RADAR MISSION TO STUDY THE DIURNAL WATER CYCLE

Abstract

G-CLASS (Geosynchronous – Continental Land Atmosphere Sensing System) is a mission concept to advance our understanding of the diurnal water cycle. It overcomes the major limitation in temporal sampling of current missions by using radar imaging from geosynchronous orbit (GEO), and is expected to improve (a) understanding and forecasting for high resolution weather prediction, (b) water resource management in regions like southern Europe and Africa, and (c) protection of society from floods, landslides, earthquakes and volcanoes.

A feasible baseline mission design has been developed using current technology and is affordable as an agency mission. The orbit is designed to avoid the valuable geostationary orbit ring using modest inclination and eccentricity. The motion relative to Earth is up to 40 m/s, which allows useful synthetic apertures to be formed for radar imaging down to 20 m resolution. The orbit enables better coverage than conventional Earth observation missions for lower latitudes which could be particularly useful over Africa. The radar antenna diameter is 7 m, with dual polarisation and several overlapping spot beams which can be scanned to achieve good geographical and temporal sampling. The spacecraft is derived from OHB's standard SmallGEO bus, using electric propulsion to achieve a geosynchronous orbit from a Vega-C launch.

A major advantage of GEO imaging is that near-continuous image becomes possible. This allows direct observation of important processes (storm formation, flooding, diurnal snowmelt and soil moisture variations), with both atmospheric and surface changes detectable. The footprint is scanned by slewing the whole spacecraft, and only a few degrees of slew is needed to scan the full length of the Mediterranean or Sahel, for example. Beam steering uses no additional propellant and the beam can be scanned at will across the Earth disc visible from GEO: this gives unprecedented "software-defined" versatility and responsiveness in imaging modes and coverage so that a wide range of services can be provided. It should be particularly useful for disaster response, with images available within a few hours. G-CLASS also usefully complements conventional low Earth orbit (LEO) radar, e.g. using its temporal sampling to provide context for the high resolution LEO images, or its north-south viewing to add the 3rd dimension in surface displacement measurements.

G-CLASS has been proposed for ESA's Earth Explorer 10 opportunity. It is a revolutionary mission concept which is achievable with current technology and which offers significant new data and services.