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CARBONSAT: SPACE-BASED GREENHOUSE GAS MEASUREMENTS IN SUPPORT OF CLIMATE MODEL IMPROVEMENT

Abstract

Carbon dioxide (CO2) and methane (CH4) play a decisive role in climate change, and are the most important anthropogenic ("man-made") greenhouse gases.
The currently available mapping information shows significant weaknesses with respect to the global picture with respect to their variable natural and anthropogenic sources and sinks, which is a primary requirement for the creation of accurate climate models. Satellites can allow for relevant measurements on a global scale with high temporal resolution, which meet all requirements with respect to high accuracy of the CO2 and CH4 atmospheric measurements and sensitivity to near-surface concentrations. With this information, creation of appropriate inverse modelling schemes to convert the atmospheric concentrations into surface fluxes will be enabled.
The satellite missions SCIAMACHY mission on ENVISAT (ESA), and the Japanese TANSO mission on GOSAT have already demonstrated the benefits of satellite-based greenhouse gas observations in providing important information on regional CO2 and CH4 fluxes in global models.
The CarbonSat mission aims to address shortcomings of these missions by combining high spatial resolution and large swath widths, using measurements of reflected solar light in the NIR/SWIR band with an imaging spectrometer. Overall affordability and cost-effectiveness of the system are important drivers in order to ensure mission success.
The main objective of the CarbonSat mission is to provide XCO2 and XCH4 data for flux inversion models to quantify anthropogenic and natural sources of CO2 and CH4. The large scale biogenic sinks for CO2 over land and ocean and the atmospheric destruction of CH4 shall also be determined.
This paper will present the main characteristics of the CarbonSat mission, commencing with a discussion of the main requirements, with focus on the coverage characteristics, including revisit times and data latency. The instrument requirements are also investigated, which consist of requirements with respect to spatial resolution, spectral resolution, radiometry and co-registration.
The second part of the paper shortly discusses the main design characteristics. This includes a presentation of the mission and orbit design, including achieved coverage characteristics. This discussion is complemented by a high level description of the payload and associated satellite. Furthermore, the main design challenges of the mission will be presented, like the implementation of Sun-glint pointing.