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CarbonSat: ESA's Earth Explorer 8 Candidate Mission

Y.J. Meijer, P. Ingmann, A. Löscher, and the CarbonSat Mission Advisory Group Team
ESA, EOP-S, Noordwijk, The Netherlands

The CarbonSat candidate mission is part of ESA's Earth Explorer Programme. In 2010, two candidate opportunity missions had been selected for feasibility and preliminary definition studies. The missions, called FLEX and CarbonSat, are now in competition to become ESA's eighth Earth Explorer, both addressing key climate and environmental change issues.

In this presentation we will provide a mission overview of CarbonSat with a focus on science. CarbonSat's primary mission objective is the quantification and monitoring of CO_2 and CH_4 sources and sinks from the local to the regional scale for i) a better understanding of the processes that control carbon cycle dynamics and ii) an independent estimate of local greenhouse gas emissions (fossil fuel, geological CO_2 and CH_4, etc.) in the context of international treaties. A second priority objective is the monitoring/derivation of CO_2 and CH_4 fluxes on regional to global scale. These objectives will be achieved by a unique combination of frequent, high spatial resolution (2 x 2 km^2) observations of XCO_2 and XCH_4 coupled to inverse modelling schemes. The required random error of a single measurement at ground-pixel resolution is of the order of between 1 and 3 ppm for XCO_2 and between 9 and 17 ppb for XCH_4. High spatial resolution is essential in order to maximize the probability for clear-sky observations and to identify flux hot spots. Ideally, CarbonSat shall have a wide swath allowing a 6-day global repeat cycle.

The CarbonSat observations will enable CO_2 emissions from coal-fired power plants, localized industrial complexes, cities, and other large emitters to be objectively assessed at a global scale. Similarly, the monitoring of natural gas pipelines and compressor station leakage will become feasible. The detection and quantification of the substantial geological greenhouse gas emission sources such as seeps, volcanoes and mud volcanoes will be achieved for the first time.

CarbonSat's Greenhouse Gas instrument will exploit a passive observing technique measuring scattered solar light with imaging spectrometers. It will perform measurements of CO_2 and CH_4 in combination with O_2 to yield their dry column amounts. Spectral absorptions of CO_2 in the 1.6 μm and 2 μm bands, O_2 in the 760 nm and CH_4 in the 1.65 μm spectral ranges measured with high spectral resolution of the order of between 0.03 and 0.3 nm and a high signal-to-noise ratio. The CarbonSat mission concept builds on the heritage and lessons learned from SCIAMACHY, GOSAT and OCO(-2) to make strategically important measurements of the amounts and distribution of CO_2 and CH_4 in the context of Climate Change.