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NanoCarb Instrument Upgrades and Performance Enhancements for the Space Carbon Observatory Next Step

Contenu

SCARBOn (Space CARBon Observatory Next step) is an Innovation Action project funded by the Horizon Europe Programme and led by Airbus Defence and Space. The project brings together space industry partners, SMEs, and research institutes. It aims to mature the SCARBOn system, which is based on a constellation of small satellites equipped with a miniaturized static spectrometer (NanoCarb, Patent No.: FR16/56162) combined with aerosol sensors (SPEXone). These instruments will provide accurate daily global measurements to monitor diurnal variations in greenhouse gas (GHG) emissions. These data will contribute to the European Commission's efforts to combat climate change. The SCARBOn project focuses on the detailed technical definition of the NanoCarb instrument together with its industrial implementation. It also aims to validate the constellation concept. The overall objective is to achieve operational system availability before the end of the decade.

This paper primarily presents NanoCarb, a static Fourier transform spectral imager. Its compactness, robustness, and low mass make it a promising concept for greenhouse gas measurements from space. This concept represents a paradigm shift, as it acquires only portions of interferograms rather than spectral radiances. First, we present the upgraded design of the airborne prototype (NanoCarb-P), which led to a sensitivity increase of approximately a factor of 2 for CO_2 and a factor of 3 for CH_4. We also present the flight model design (NanoCarb-S), with a specific focus on the evolution of the interferometric core. Furthermore, we discuss how these upgrades enhance NanoCarb performance. The new design improves L2 (total column) performance, reducing random errors in CO_2 retrieval from synthetic data by up to 30% relative to the previous concept. In a case study with synthetic data with the improved and the previous design, we retrieved emissions from a large coal-fired power with improved precision (20% vs 35%) and similar accuracy (-15%).

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