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Performance assessment for total CO_2 and CH4 column monitoring using a miniaturized static spectrometer

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The SCARBO project (Space CARBon Observatory) aims at solving a key challenge of anthropogenic greenhouse gases (GHGs) monitoring from space: improving the temporal revisit over the various sites of interest while meeting the accuracy and spatial resolution requirements (as per the EU guidelines on anthropogenic GHGs monitoring). To do that a novel miniaturized static spectrometer concept called Nanocarb is currently being developed to be included on a constellation of Small Satellites and coupled with aerosol sensors and high-end reference instruments.

NanoCarb is an imaging interferometer dedicated to the measurement of CO_2 concentration in the atmosphere. It is based on the ImSPOC concept (invented by ONERA and by IPAG). This concept combines a multipath imager (lens array in front of single 2D detector) and an array of static Fabry-Perot filters (FP). The lens array forms a collection of thumbnail images of the scene at the focal plane, and each step of the interferometer is placed in front of a lens from the lens array. The specificity of NanoCarb is to measure only few optical path differences (as many as Fabry-Perot filters), that is only a partial interferogram. This specificity leads to a paradigm shift, since it is impossible to retrieve the spectrum from a partial interferogram. Therefore, the estimation of the CO_2 (and CH4) column concentration has to be done directly from these partial interferograms. Such a strategy implies that the spectral band and the optical path differences must be chosen very carefully. This is done through the development of an inversion algorithm, coupled with an optimization over instrumental parameters. This step is essential since on the one hand it includes a contribution to the SCARBO overall performance analysis tool: inversion from level 1 products (calibrated partial interferograms) to level 2 products (estimated geophysical parameters), and on the other hand it will also be used for the definition of the instrument and the prototype.

In this paper, after a presentation of Nanocarb and its inversion tool, first elements of performance analysis will be presented.