The Complete Data Fusion extended to two-dimensional products

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ABSTRACT

The large amount of data, now available from remote sensing missions, has stimulated the adoption of synergistic approaches to gain the largest amount of information from complementary measurements. The Complete Data Fusion (CDF) is an a posteriori method to combine atmospheric products from independent remote sensing observations of the same air mass into a single estimate with enhanced quality, ensuring a better characterization of the atmospheric state. For almost ten years, the CDF algorithm has been applied to one-dimensional (1D) products only (1D-CDF), such as vertical profiles of atmospheric species. In order to extend its application to two-dimensional (2D) products from remote sensing missions we implemented an extension of the CDF (2D-CDF), showing how to deal with 2D observations.

In this study, we present the extension of the CDF to 2D products: we describe its implementation and show the results of its first application to simulated 2D fields of CAIRT and 1D vertical profiles of IASI-NG for ozone.

The Changing-Atmosphere Infra-Red Tomography (CAIRT) mission, selected as one of the two candidates for ESA's Earth Explorer 11, proposes a limb imager capable of sounding the atmosphere simultaneously from the middle troposphere to the lower thermosphere with a horizontal sampling of 50 km along track, 25 km across track and vertical sampling of 1 km. From the simultaneous analysis of consecutive limb measurements, it is possible to retrieve profiles with a spatial resolution along track of the order of the measurements sampling. CAIRT is planned to fly on the same orbit of the MetOp-SG-A mission, hosting the Infrared Atmospheric Sounding Interferometer – New Generation (IASI-NG), to take advantage from measuring the same air masses and combine spatially resolved limb observations with horizontally resolved nadir measurements of IASI-NG.

The 2D data fusion of CAIRT and IASI-NG has been performed on the CAIRT 2D retrieval grid. On this grid, we combined multiple measurements of CAIRT (to simulate the 2D retrieval) and four measurements of IASI-NG for each along-track position, according to its expected spatial resolution. Furthermore, to evaluate the improvement attained by the two-dimensional combination, we compared the results with a 1D data fusion experiment, i.e considering only one CAIRT measurement in the combination study.

Results are presented for the 2D-CDF performance and for the improvement achieved with respect to the 1D-CDF in terms of total errors, degrees of freedom and Shannon information gain.