The Complete Data Fusion as a ready to use tool for the exploitation of atmospheric Sentinel ozone profiles

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Remote sounding of atmospheric composition makes use of satellite measurements with very heterogeneous characteristics. In particular, the determination of vertical profiles of gases in the atmosphere can be performed using measurements acquired in different spectral bands and with different observation geometries. The most rigorous way to combine heterogeneous measurements of the same quantity in a single Level 2 (L2) product is simultaneous retrieval. The main drawback of simultaneous retrieval is its complexity, due to the necessity to embed the forward models of different instruments into the same retrieval application. To overcome this shortcoming, we developed a data fusion method, referred to as Complete Data Fusion (CDF), to provide an efficient and adaptable alternative to simultaneous retrieval. In general, the CDF input is any number of profiles retrieved with the optimal estimation technique, characterized by their a priori information, covariance matrix (CM), and averaging kernel (AK) matrix. The output of the CDF is a single product also characterized by an a priori, a CM and an AK matrix, which collect all the available information content. To account for the geo-temporal differences and different vertical grids of the fusing profiles, a coincidence and an interpolation error have to be included in the error budget.

In the first part of the work, the CDF method is applied to ozone profiles simulated in the thermal infrared and ultraviolet bands, according to the specifications of the Sentinel 4 (geostationary) and Sentinel 5 (low Earth orbit) missions of the Copernicus program. The simulated data have been produced in the context of the Advanced Ultraviolet Radiation and Ozone Retrieval for Applications (AURORA) project funded by the European Commission in the framework of the Horizon 2020 program. The use of synthetic data and the assumption of negligible systematic error in the simulated measurements allow studying the behavior of the CDF in ideal conditions. The use of synthetic data allows evaluating the performance of the algorithm also in terms of differences between the products of interest and the reference truth, represented by the atmospheric scenario used in the procedure to simulate the L2 products. This analysis aims at demonstrating the potential benefits of the CDF for the synergy of products measured by different platforms in a close future realistic scenario, when the Sentinel 4, 5/5p ozone profiles will be available.

In the second part of this work, the CDF is applied to a set of real measurements of ozone acquired by GOME-2 onboard the MetOp-B platform. The quality of the CDF products, obtained for the first time from operational products, is compared with that of the original GOME-2 products.
This aims to demonstrate the concrete applicability of the CDF to real data and its possible use to
generate Level-3 (or higher) gridded products.
The results discussed in this presentation offer a first consolidated picture of the actual and
potential value of an innovative technique for post-retrieval processing and generation of Level-3
(or higher) products from the atmospheric Sentinel data.