

# Vertical grid of retrieved atmospheric profiles

Simone Ceccherini,\* Bruno Carli and Piera Raspollini

*Istituto di Fisica Applicata "Nello Carrara" del Consiglio Nazionale delle Ricerche, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Italy*  
[\\*S.Ceccherini@ifac.cnr.it](mailto:S.Ceccherini@ifac.cnr.it)

Measurements of the vertical profile of atmospheric constituents are often obtained with the inversion of remote sensing observations. In this case the observations are made in domains (spectral frequency and/or parameters of the geometry of observation) that do not coincide with the domain (either altitude or pressure) used for the representation of the profile. Accordingly, the vertical grid, made of the discrete points used for this representation, is a choice arbitrarily made during the retrieval process.

We discuss the choice of the vertical grid of atmospheric profiles retrieved from remote sensing observations considering the two cases of profiles used to represent the results of individual measurements and of profiles used for subsequent data fusion applications.

We compare the individual retrieval results and the data fusion results when the profiles are retrieved using different vertical grids: selected according to the vertical resolution of either the individual profile or the fused profile. We perform this comparison using the ozone measurements of the MIPAS (Michelson Interferometer for Passive Atmospheric Sounding) instrument onboard the ENVISAT satellite. The observations of a limb sounding sequence of the instrument are divided into two complementary sets, made of observations at different limb angles, and two profiles are independently retrieved from the two sets of observations. The two profiles are retrieved a first time on different vertical grids each one corresponding to the tangent altitudes of the observations included in the set and a second time on a common vertical grid corresponding to the tangent altitudes of all the observations of the full sequence. Therefore, the first time the vertical grids are each optimized for the retrieval of the single set and the second time the common grid is optimized for the simultaneous retrieval and for the data fusion. In both cases the complete fusion algorithm is used for the fusion of the profiles. The results of the individual retrievals of the single sets and of the data fusions performed using the two different vertical grids are compared in terms of values, errors, vertical resolutions and number of degrees of freedom.

In the case of individual retrievals no evident advantage is obtained with the use of a grid finer than the one optimized for the individual retrieval. Nevertheless, this instrument dependent vertical grid, which seems to extract all the available information, provides very poor results when used for data fusion. A loss of about a quarter of the degrees of freedom is observed when the data fusion is made using the instrument dependent vertical grid relative to the data fusion made using a vertical grid optimized for the data fusion product. This result is explained by the analysis of the eigenvalues of the Fisher information matrix and leads to the conclusion that the vertical grids of products used for subsequent data fusion operations must be chosen taking into account the expected quality of the fused profiles, rather than using the choices made for the representation of the results of the individual retrievals.

*Keywords:* Atmospheric Constituents, Atmospheric Profiling, Image Processing and Data Fusion, Synergy.

*Satellite and data used:* ENVISAT.