Spectral Representation of Spatial Correlations in Variational Assimilation Systems with Grid Point Models: Application to the Belgian Assimilation System of Chemical ObsErvations (BASCOE)

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One of the critical aspects of any assimilation system is the formulation of a background error covariance matrix (BECM) which is sufficiently compact to be implemented numerically and sufficiently complex to represent correctly the real error covariances of the first guess field. In the late nineties, meteorological centers have implemented relatively powerful BECM where the spatial correlation matrix is defined in the spectral space. In this configuration, the horizontal correlations are assumed to be homogeneous and isotropic. Moreover, non-separable vertical correlations can be implemented.

The goals of this study are numerous. First, it aims at presenting this method by focusing on a univariate assimilation and for global models. Usually, this method is implemented in meteorological spectral models with the physical grid being the (non-equally spaced) Gaussian grid. We will show that the method can be applied directly to equally spaced physical grid without operating a transformation from the Gaussian grid to the model grid, which necessarily degrades the analyses. This method has been implemented in the stratospheric chemistry data assimilation system BASCOE. Statistics of the background error correlations are estimated using the NMC method for separable and non-separable vertical correlations. Results from real test cases will be shown using Envisat MIPAS and EOS Aura MLS observations.