Application of a Spectral Transform on Cubed-Sphere Grids to Representation of Forecast Errors for Variational Data Assimilation

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The assumed lack of covariance between parameters has reduced the amount of statistical information needed to draw a background error covariance. The auto-covariance of each parameter between different positions in space needs to be handled. There are usually in excess of 10^6 components of a field and so the spatial error covariance cannot be dealt with explicitly [1]. The spatial transform is the next stage of the covariance model. Spectral transform achieves approximately the non-correlation of errors by assuming that errors between spectral modes are uncorrelated.

We commonly use spherical harmonics as a basis function for spectral transform [2]. To obtain the spectral coefficients, we conventionally take Fourier transformation and Legendre transformation which are line integrals on the sphere. In a cubed-sphere grid system based on an equi-angular coordinate, the unit vectors are not orthogonal [3]. If using that grid system, we should take a surface integral of the multiplication of spherical harmonics and a scalar function on the sphere. In this presentation, we show the detailed algorithm of the spectral transform on a cubed-sphere grid. We apply it to represent forecast errors for data assimilation. We present the resultant structure of forecast errors and the result of application to a three-dimensional variational system.

References

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