“Vertical Localization for EnKF Radiance Assimilation”

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Assimilation of satellite radiances has been proven to have positive impacts on the forecast skill, especially for regions with sparse conventional observations. Localization is an essential component to effectively assimilate satellite radiances in ensemble Kalman filters with affordable ensemble sizes. However, localizing the impact of radiance observations is not straightforward, since their location and separation from grid point model variables are not well defined.

Adaptive localization methods, like global group filter (GGF), can provide a theoretical estimate of vertical localization functions for radiance observations being assimilated for global numerical weather prediction. The GGF uses groups of climatological ensembles to provide an estimated localization function that reduces the erroneous increments due to ensemble correlation sampling error. When the GGF is applied to radiance observations, it can provide different localization functions for different channels, which indicates the complexity and large computational cost of tuning the localization scales for radiance observations. Verification to the conventional observations shows that the GGF outperforms the commonly used Gaspari and Cohn (GC) localization.

Besides the adaptive localization methods in observation space, model space localization for EnKF can be implemented through a modulation approach. The modulation approach generates the modulated ensemble from the raw ensemble and eigenvectors of the localization matrix. The modulated ensemble implicitly contains model space localization, thus the EnKF using the modulated ensemble without localization is equivalent to EnKF using the raw ensemble with model space localization. For radiance observations, only vertical localization in model space is needed, thus the size of the modulated ensemble is approximately 10 times more than the raw ensemble. The performance of EnKF assimilating radiance observations has been improved by use of the modulation approach, i.e., model space localization.