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A Local Data Assimilation Method (Local DA v1.0) and its Application in a Simulated Typhoon Case

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Integrating the hybrid and multiscale analyses and the parallel computation is necessary for current data assimilation schemes. A local data assimilation method, Local DA, is designed to fulfill these needs. This algorithm follows the grid-independent framework of the local ensemble transform Kalman filter (LETKF) and is more flexible in hybrid analysis than the LETKF. Local DA employs an explicitly computed background error correlation matrix of model variables mapped to observed grid points/columns. This matrix allows Local DA to calculate static covariance with a preset correlation function. It also allows using the conjugate gradient (CG) method to solve the cost function and allows performing localization in model space, observation space, or both spaces (double-space localization). The Local DA performance is evaluated with a simulated multiscale observation network that includes sounding, wind profiler, precipitable water vapor, and radar observations. In the presence of a small-size time-lagged ensemble, Local DA can produce a small analysis error by combining multiscale hybrid covariance and double-space localization. The multiscale covariance is computed using error samples decomposed into several scales and independently assigning the localization radius for each scale. Multiscale covariance is conducive to error reduction, especially at a small scale. The results further indicate that applying the CG method for each local analysis does not result in a discontinuity issue. The wall clock time of Local DA implemented in parallel is halved as the number of cores doubles, indicating a reasonable parallel computational efficiency of Local DA.