
Hongqin Zhang\(^1\) and Xiangjun Tian\(^2\)
\(^1\)Institute of Atmospheric Physics, Chinese Academy of Sciences, International Center for Climate and Environment Sciences, China (hqzhang1112@mail.iap.ac.cn)
\(^2\)Institute of Atmospheric Physics, Chinese Academy of Sciences, International Center for Climate and Environment Sciences, China (tianxj@mail.iap.ac.cn)

The system of multigrid NLS-4DVar data assimilation for Numerical Weather Prediction (SNAP) is established, building upon the multigrid NLS-4DVar assimilation scheme, the operational Gridpoint Statistical Interpolation (GSI)-based data-processing and observation operator and widely used numerical forecast model WRF (easily replaced by others global/regional model). The multigrid assimilation framework can adequately correct errors from large to small scales to achieve higher assimilation accuracy. Meanwhile, the multigrid strategy can accelerate iteration solution improving the computational efficiency. NLS-4DVar, as an advanced 4DEnVar method, employs the Gauss-Newton iterative method to handle the nonlinear of the 4DVar cost function and provides the flow-dependent background error covariance, which both contribute to the assimilation accuracy. The efficient local correlation matrix decomposition approach and its application in the fast localization scheme of NLS-4DVar and obviating the need of the tangent linear and adjoint model further improve the computational efficiency. The numerical forecast model of SNAP is any optional global/regional model, which makes the application of SNAP very flexible. The analysis variables of SNAP are rather the model state variables than the control variables adopted in the usual 4DVar system. The data-processing and observation operator modules are used from the National Centers for Environmental Prediction (NCEP) operational GSI analysis system, prominent in the various observation operators and the ability to assimilate multi-source observations. Currently, we have achieved the assimilation of conventional observations and we will continue to improve the assimilation of radar and satellite observations in the future. The performance of SNAP was investigated assimilating conventional observations used for the generation of the operational global atmospheric reanalysis product (CRA-40) by the National Meteorological Information Center of China Meteorological Administration. Cyclic assimilation experiments with two windows, which is 6-h for each window, are designed. The results of numerical experiments show that SNAP can absorb observations, improve initial field, and then improve precipitation forecast.