[EE] Evening Poster | A (Atmospheric and Hydrospheric Sciences) | A-AS Atmospheric Sciences, Meteorology & Atmospheric Environment

[A-AS01]High performance computing for next generation weather, climate, and environmental sciences

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A lot of advanced simulation studies are being conducted by high performance supercomputers such as K computer, Earth Simulator in various fields including meteorology. The high performance supercomputers enables us to conduct numerical simulations and data assimilation of observation big-data (huge high-density and high-frequency data) with an order of magnitude higher resolutions and ensemble numbers than those with previous supercomputers. In addition, the post-K computer will be available as a successor of K, and studies for the post-K computer was started. At the Atmospheric Science session co-organized by the Meteorological Society of Japan, we comprehensively pick up this topic in the Atmospheric and Hydrospheric Sciences Session of this 2018 Union Meeting that enables to comprise the atmospheric, oceanic and land sciences. This session aims to promote recent studies related to the issues on high performance computing in weather, climate, and environmental studies using the K computer and other supercomputers, and to enhance discussions on future directions of numerical simulations in meteorology.

[AAS01-P05]On the Ensemble Transform Perturbation: (2) NHM-LETKF

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Ensemble data assimilation methods are widely noticed as the analysis methods suitable for HPC which have potential to improve the accuracy of numerical weather prediction, substituting for or combining with the variational methods. Ensemble data assimilation methods have an advantage in terms of the development cost over the 4-dimensional variational method in that the adjoint models are not necessary, however, their performances are still arguable and likely have a room for further improvement.

In ensemble data assimilation, the forecast error, which is necessary in data assimilation, is estimated by perturbations of the ensemble forecast, while characteristics of the ensemble forecast strongly depend on how the initial ensemble was generated. The ensemble transform (ET), eigenvalue decomposition of the analysis error covariance matrix, is widely used as the initial ensemble perturbation generator for the most ensemble data assimilation including ensemble Kalman filter such as LETKF and the ensemble variational method (EnVAR). The ensemble transform has an advantage in that the magnitude of perturbations (initial ensemble spread) can reflect the magnitude of the analysis error, but on the other hand, it is known that the growth of the errors is slower than other methods such as the singular vector method and the BGM method. In the previous studies for the mesoscale ensemble system (e.g., Saito et al. 2011, 2012), perturbations from LETKF were not necessarily better than other methods as the initial perturbations, which may affect the accuracy of the analysis field. Non-diagonal components in the transform matrix likely contaminate the synoptic scale structure of the bred vectors in the ensemble forecast in the assimilation window when the localization is applied.

In the former presentation (Saito et al. 2017), we performed an OSSE experiment using SPEEDY-LETKF, and showed spatial structure and power spectrum of ensemble perturbations by diagonal and off-diagonal components of the transform matrix. Recently, we performed more realistic LETKF experiments using the JMA nonhydrostatic model with two horizontal resolutions (15 km and 2 km). In the presentation, we will show horizontal and vertical perturbation structures and their influences on the forecast.

References:

Saito, K., M. Hara, M. Kunii, H. Seko, and M. Yamaguchi, 2011: Comparison of initial perturbation methods for the mesoscale ensemble prediction system of the Meteorological Research Institute for the WWRP Beijing 2008 Olympics Research and Development Project (B08RDP). Tellus, 63A, 445-467.
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Saito, K., M. Kunii, L. Duc, T. Kurihana, 2017: Perturbation methods for ensemble data assimilation. AS12-05, Japan Geoscience Union Meeting 2017 (JPGU2017).