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How fast shall we go? Lessons learned from 30-second-update convection-resolving data assimilation experiments

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For local severe weather forecasting at 100-m resolution with 30-minute lead time, we have been working on the "Big Data Assimilation" (BDA) effort for super-rapid 30-second cycle of an ensemble Kalman filter. We have presented two papers with the concept and case studies (Miyoshi et al. 2016, BAMS; Proceedings of the IEEE). Since then, we have performed more experiments in multiple torrential rain cases, and all showed promising results. We were hoping that we could assume the Gaussian error distribution in 30-second forecasts before strong nonlinear dynamics distort the error distribution for rapidly-changing convective storms. However, using 1000 ensemble members, the reduced-resolution version of the BDA system at 1-km grid spacing with 30-second updates showed ubiquity of highly non-Gaussian PDF associated with convective activities. Since our results so far with multiple case studies were quite successful even with this strong non-Gaussianity, we performed additional experiments by denying observations in time, i.e. with observations assimilated every minute, every 2 minutes, and so on, to investigate what forecast degradation we get from less frequent updates. Here we aim to gain combined knowledge from BDA case studies with different cycle intervals (e.g., 30-sec, 1-min, 5-min), 1000-member experiments with 1-km grid spacing, 4D-EnKF experiments with different window lengths, and toy-model experiments with dense and frequent observations. In this presentation, we will show the most up-to-date results of the BDA research, and will discuss how fast is good for convective-scale data assimilation.