

NON-ASYMPTOTIC ANALYSIS OF ENSEMBLE KALMAN UPDATES: EFFECTIVE DIMENSION AND  
LOCALIZATION

**Daniel Sanz-Alonso**

University of Chicago, United States  
sanzalonso@uchicago.edu

Many modern algorithms for inverse problems and data assimilation rely on ensemble Kalman updates to blend prior predictions with observed data. Ensemble Kalman methods often perform well with a small ensemble size, which is essential in applications where generating each particle is costly. In this talk I will introduce a non-asymptotic analysis of ensemble Kalman updates that rigorously explains why a small ensemble size suffices if the prior covariance has moderate effective dimension due to fast spectrum decay or approximate sparsity. I will present the theory in a unified framework, comparing several implementations of ensemble Kalman updates that use perturbed observations, square root filtering, and localization. As part of our analysis, we develop new dimension-free covariance estimation bounds for approximately sparse matrices that may be of independent interest.

*Joint work with Omar Al Ghattas (University of Chicago).*