Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

**Hybrid Ensemble and Variational Estimation for Chaotic Systems** JOSEPH CESSNA, THOMAS BEWLEY, University of California San Diego — An estimate of a system is developed from knowledge of the model of the system along with a time history of noisy measurements. Unlike a filtered result, an estimate conditioned on both past and future measurements is said to be a smoothed estimate. For linear systems, computing the prior smoothed estimate trajectory appropriately has no bearing on the most recent filtered estimate. However, in chaotic systems, the estimate probability distribution is non-gaussian and must be computed through some form of linearization. As a result, one would expect that knowing a prior trajectory more accurately (through smoothing) could be beneficial in improving the most recent estimate via a reinterpretation of past measurements about this new trajectory. Unfortunately, for high-dimensional chaotic systems, typical smoothing approaches such as the Ensemble Kalman Smoother update the prior smooth trajectories upon receipt of a new measurement without altering the most recent filtered estimate. Using a new hybrid approach combining the EnKS with an adjoint variational method, we examine how the smoothed trajectories can be used consistently to improve the most recent filtered estimate. By appropriately defining a cost function, we can use the EnKS estimate as an initial condition for a well-posed variational iteration. It is shown that this technique reduces to the well known optimal Kalman Smoother result in the case of a linear system.

Joseph Cessna
University of California San Diego

Date submitted: 31 Jul 2009 Electronic form version 1.4