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# A Sequential Ensemble Prediction System at Convection Permitting Scales

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A Sequential Assimilation Method (SAM) following some aspects of particle filtering with resampling, also called SIR (Sequential Importance Resampling), is introduced and applied in the framework of an Ensemble Prediction System (EPS) for weather forecasting on convection permitting scales, with focus to precipitation forecast. At this scale and beyond, the atmosphere increasingly exhibits chaotic behaviour and non linear state space evolution due to convectively driven processes.
One way to take full account of non linear state developments are particle filter methods, their basic idea is the representation of the model probability density function by a number of ensemble members weighted by their likelihood with the observations. In particular particle filter with resampling abandons ensemble members (particles) with low weights restoring the original number of particles adding multiple copies of the members with high weights.
In our SIR-like implementation we substitute the likelihood way to define weights and introduce a metric which quantifies the "distance" between the observed atmospheric state and the states simulated by the ensemble members. We also introduce a methodology to counteract filter degeneracy, i.e. the collapse of the simulated state space. To this goal we propose a combination of resampling taking account of simulated state space clustering and nudging.
By keeping cluster representatives during resampling and filtering, the method maintains the potential for non linear system state development. We assume that a particle cluster with initially low likelihood may evolve in a state space with higher likelihood in a subsequent filter time thus mimicking non linear system state developments (e.g. sudden convection initiation) and remedies timing errors for convection due to model errors and/or imperfect initial condition.
We apply a simplified version of the resampling, the particles with highest weights in each cluster are duplicated; for the model evolution for each particle pair one particle evolves using the forward model; the second particle, however, is nudged to the radar and satellite observation during its evolution based on the forward model.