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# Ensemble data assimilation for systems with different degrees of nonlinearity with a hybrid nonlinear-Kalman ensemble transform filter

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The second-order exact particle filter NETF (nonlinear ensemble transform filter) is combined with local ensemble transform Kalman filter (LETKF) to build a hybrid filter scheme (LKNETF). The filter combines the stability of the LETKF with the nonlinear properties of the NETF to obtain improved assimilation results for smaller ensembles. Both filter components are localized in a consistent way so that the filter can be applied with high-dimensional models. The degree of filter nonlinearity is defined by a hybrid weight, which shifts the analysis between the LETKF and NETF. Since the NETF is more sensitive to sampling errors than the LETKF, the latter filter should be preferred in linear cases. It is discussed how an adaptive hybrid weight can be defined based on the nonlinearity of the system so that the adaptivity yields a good filter performance in linear and nonlinear situations. The filter behavior is exemplified based on experiments with the chaotic Lorenz-63 and Lorenz-96 models, in which the nonlinearity can be controlled by the length of the forecast phase.