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EnKF4DVar: Coupling ensemble Kalman filter with 4-D variational data assimilation

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We coupled the deterministic four-dimensional variational assimilation (4d-Var) to the ensemble Kalman filter (EnKF) to produce a superior hybrid approach to data assimilation.ă The hybrid assimilation scheme exploits the benefits of the state-dependent uncertainty provided by ensemble-based filters while taking advantage of the relative insensitivity of 4DVar to rank deficient background error covariance information.ă The deterministic analysis produced by the 4d-Var procedure provides an estimate of the minimum error covariance state about which the ensemble perturbations are transformed, and the resulting ensemble analysis can be propagated forward both for the next assimilation cycle and as a basis for ensemble forecasting.ăThe feasibility and effectiveness of this hybrid approach have been demonstrated in experiments with an idealized model. We will present the comparison of this full coupled approach with both EnKF and 4DVar in terms of accuracy and computational costs. The coupled scheme is found to give superior performance to both EnKF and 4DVar while retains comparable or even lowerăcomputational costs than standard 4Dvar. The coupled system is also found to be effective in both perfect model and imperfect model scenarios though some tuning of the configuration is necessary.ăThe proposed hybrid approach to data assimilation will leverage the strengths of 4d-Var and ensemble-based filtering, and may provide a means of bringing together these two data assimilation communities.