Data Assimilation by delay-coordinate nudging

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A new nudging method for data assimilation, delay-coordinate nudging, is presented. Delay-coordinate nudging makes explicit use of present and past observations in the formulation of the forcing driving the model evolution at each time-step. Numerical experiments with a low order chaotic system show that
the new method systematically outperforms standard nudging in different model and observational scenarios, also when using an un-optimized formulation of the delay-nudging coefficients. A connection between the optimal delay and the dominant Lyapunov exponent of the dynamics is found based on heuristic arguments and is confirmed by the numerical results, providing a guideline for the practical implementation of the algorithm. Delay-coordinate nudging preserves the easiness of implementation, the intuitive functioning and the reduced computational cost of the standard nudging, making it a potential alternative especially in the field of seasonal-to-decadal predictions with large Earth system models that limit the use of more sophisticated data
assimilation procedures.