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Stein-based preconditioners for weak-constraint 4D-Var

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State-of-the-art algorithms for data assimilation are very sophisticated schemes which try to predict the most likely state of a dynamical system by combining information from observations and prior models. The linearized weak-constraint four-dimensional variational assimilation problem (4D-Var) can be reformulated as a saddle point problem that needs to be preconditioned to ensure fast convergence in terms of number of iterations.

In this talk we illustrate novel preconditioning operators which involve the solution of certain Stein matrix equations. In addition to achieving better computational performance, the latter machinery allows us to derive tighter bounds for the eigenvalue distribution of the preconditioned problem.

A panel of diverse numerical results displays the effectiveness of the proposed methodology compared to current state-of-the-art algorithms.