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Preconditioning NAVDAS-AR Using Lanczos Connection

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A weak constraint observation-space four-dimensional variational atmospheric data assimilation system, NAVDAS-AR[a], is under development at NRL in Monterey. NAVADAS-AR is a four-dimensional extension of the current US Navy three-dimensional operation data assimilation system – NAVADAS[b]. Using a numerical weather prediction (NWP) model as a dynamic constraint, NAVADAS-AR minimizes a generalized nonlinear cost function that combines the errors in the initial background, forecast model, and observations within a given data assimilation window. The minimization is equivalent to solving a nonlinear coupled Euler-Lagrange (EL) system. Instead of directly solving the nonlinear EL system, we use an iterative method to partially account for the nonlinearities in both the NWP model and observation operators. This is done by solving a sequence of coupled linear EL systems that are decoupled using the accelerated representer method. In this talk, we start with some background material in the development of NAVDAS-AR and give a brief description of the basic design and formulation that can be applied for both mesoscale and global data assimilation. In the remainder of the talk, we mainly focus on a precondition algorithm to speed up the convergence of the inner loop conjugate gradient solver of NAVDAS-AR. Some preliminary results are also presented.

[a]NAVDAS-AR: NRL Atmospheric Variational Data Assimilation System – Accelerated Representer
[b]NAVADS: NRL Atmospheric Variational Data Assimilation System