A sequential variational algorithm for data assimilation in oceanography and meteorology

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The study theoretically establishes a sequential variational (S-VAR) method for the data assimilation. Requiring a significantly smaller amount of computer memory, theoretically S-VAR gives the same optimal model state estimate like the four-dimensional variational (4D-VAR) method. It is estimated that its computational cost is similar to that of the 4D-VAR and representer methods. S-VAR also computes an estimate for error covariances at the end of the assimilation window consistent with the optimal model state estimate. It is demonstrated that S-VAR applies the linearization around the non-linear model trajectory which is generally more accurate than that obtained by the incremental approach commonly used in oceanography and meteorology. These advantageous properties of the new algorithm are obtained by combining the sequential methodology with suitable definitions of several new l2-norms.