CENTRE FOR THE ANALYSIS OF TIME SERIES

The Role of Operational Constraints in Selecting Supplementary Observations

JA Hansen & LA Smith

J. Atmos. Sci., 57 (17): 2859-2871, 2000

Abstract

Adaptive observation strategies in numerical weather prediction aim to improve forecasts by exploiting additional observations at locations that are themselves optimized with respect to the current state of the atmosphere. The role played by an inexact estimate of the current state of the atmosphere (i.e., error in the ‘‘analysis’’) in restricting adaptive observation strategies is investigated; necessary conditions valid across a broad class of modeling strategies are identified for strategies based on linearized model dynamics to be productive. It is demonstrated that the assimilation scheme, or more precisely, the magnitude of the analysis error is crucial in limiting the applicability of dynamically based strategies. In short, strategies based on linearized dynamics require that analysis error is sufficiently small so that the model linearization about the analysis is relevant to linearized dynamics of the full system about the true system state. Inasmuch as the analysis error depends on the assimilation scheme, the level of observational error, the spatial distribution of observations, and model imperfection, so too will the preferred adaptive observation strategy. For analysis errors of sufficiently small magnitude, dynamically based selection schemes will outperform those based only upon uncertainty estimates; it is in this limit that singular vector-based adaptive observation strategies will be productive. A test to evaluate the relevance of this limit is demonstrated.