

Menu

amplitudes-vars-arti...

diagrama_hibrido_n...

figure_ei_new-crop...

main.tex

prec_artigo.pdf

precip_gpcp_3dvar_...

references.bib

skill_GL_SA-crop.pdf

skill_GL_SA_new-cr...

skill_NH_TR_SH-cro...

skill_NH_TR_SH_ne...

Artigo Híbrido - JAMC

SourceRich Text

www.overleaf.com/project/5a1ed93dbf2077395411ad57

AbReviewRecompile3

ShareSubmitHistoryChat

50

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\section{Introduction}
\label{sec:intro}
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51

52

53

54

55

56

57

Hybrid data assimilation systems using an ensemble Kalman Filter and a variational technique have been developed and applied (e.g., Hamill and Snyder 2000; Lorenc/2000, Lorenc/2003, Zupanski 2005) ; these systems focus on the sampling and the representation of the spatial-temporal variations of background error covariances and introduce the day-to-day statistical variations of the background error covariances and introduce the day-to-day statistical variations of the background error covariances. The representation of background error covariances is one of the main issues of operational data assimilation, and its specification for deterministic systems (e.g., variational systems) is of prime importance.

Variational systems such as 3DVar use a static background error covariance matrix, which means that its covariances are stationary in time and do not vary; the same error statistics are thus used for the entire assimilation process. A similar situation applies to a 4DVar system, which generally uses a pre-computed covariance background error matrix at the beginning of each assimilation window that is at least propagated in time during the assimilation of observations using the tangent linear version of the forecast model. Differences in the way that background error statistics vary with time because of variations in the background flow lead to what is called flow-dependence.

Flow-dependent covariances are a key feature of modern data assimilation systems; their specification either at the beginning or during the assimilation window allows the analysis to correctly account for the time and spatial dependency of the observation innovations being used in the analysis increments in both horizontal and vertical directions. Moreover, desirable features of the background error covariances also include anisotropy and inhomogeneity (non-uniform statistics - Rabier 2005).

1. Introduction

Hybrid data assimilation systems using an ensemble Kalman Filter and a variational technique have been developed and applied (e.g., Hamill and Snyder 2000; Lorenc 2003; Zupanski 2005) ; these systems focus on the sampling and the representation of the spatial-temporal variations of background error covariances and introduce the day-to-day statistical variations of the background flow (the so called "errors of the day" - Corazza et al. 2003) to the static part of the variational covariances. The representation of background error covariances is one of the main issues of operational data assimilation, and its specification for deterministic systems (e.g., variational systems) is of prime importance.

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4