ELSEVIER

Dynamics of Atmospheres and Oceans 29 (1999) 255–303

dynamics of atmospheres and oceans

www.elsevier.com/locate/dynatmoce

Estimation and study of mesoscale variability in the strait of Sicily

P.F.J. Lermusiaux *

Harvard University, 29 Oxford Street Cambridge, MA 02138 USA

Received 17 July 1998; received in revised form 13 January 1999; accepted 26 February 1999

Abstract

Considering mesoscale variability in the Strait of Sicily during September 1996, the four-dimensional physical fields and their dominant variability and error covariances are estimated and studied. The methodology applied in real-time combines an intensive data survey and primitive equation dynamics based on the error subspace statistical estimation approach. A sequence of filtering and prediction problems are solved for a period of 10 days, with adaptive learning of the dominant errors. Intercomparisons with optimal interpolation fields, clear sea surface temperature images and available in situ data are utilized for qualitative and quantitative evaluations. The present estimation system is shown to be a comprehensive nonlinear and adaptive assimilation scheme, capable of providing real-time forecasts of ocean fields and associated dominant variability and error covariances. The initialization and evolution of the error subspace is explained. The dominant error eigenvectors, variance and covariance fields are illustrated and their multivariate, multiscale properties described. Five coupled features associated with the dominant variability in the Strait during August–September 1996 emerge from the dominant decomposition of the initial PE variability covariance matrix: the Adventure Bank Vortex, Maltese Channel Crest, Ionian Shelf Break Vortex, Strait of Messina Vortex, and subbasin-scale temperature and salinity fronts of the Ionian slope. From the evolution of the estimated fields and dominant predictability error covariance decompositions, several of the primitive equation processes associated with the variations of these features are revealed, decomposed and studied. In general, the estimation of the evolving dominant decompositions of the multivariate predictability error and variability covariances appears promising for ocean sciences and technology. The practical feedbacks of the present approach which include the determination of data optimals and the refinements of dynamical and measurement models are considered.

Keywords: Mesoscale variability; Strait of Sicily; Error covariances

* Tel.: +1-617-495-0378; e-mail: pierrel@pacific.harvard.edu

0377-0265/99/$ - see front matter
PII: S0377-0265(99)00008-1