Abstract View

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An Objective Analysis of the POLYMODE Local Dynamics Experiment. Part I: General Formalism and Statistical Model Selection

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ABSTRACT

A formalism is presented for making estimates of a variety of mesoscale quantities—streamfunction, potential vorticity, and both linear and nonlinear terms in the dynamical balance equations for heat and potential vorticity—from measurements made during the POLYMODE Local Dynamics Experiment (LDE). The formalism is based upon the dynamical assumptions of geostrophic and hydrostatic balance and the methodology of multivariate optimal estimation theory. A particular novel result is the derivation of optimal estimators for quadratically nonlinear quantities, such as the advection terms in the dynamical balance equations.

Two statistical representations are formulated that are appropriate to different subsets of LDE data: a vertical *modal representation* for spatially extensive estimates of the most energetic mesoscale motion (for use during the two-month intensive phase of LDE), and a vertically *local representation* for the somewhat smaller scale motions that can be estimated from the thermocline moored array over a fifteen-month period. The empirical parameters for both statistical representations are estimated, primarily from the moored array over the full ocean depth. A hierarchy of statistical assumptions is considered in order to select estimators that are an appropriate compromise between an accurate depiction of observed mesoscale statistical structure and simplicity of the estimator formulae. This formalism is being used to make the estimates from LDE data, which are reported on in companion papers.

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