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The Kuroshio meandering south of Japan: prediction with the MRI Multivariate Ocean Variational Estimation (MOVE) System and a sensitivity study with an adjoint code

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The MRI Multivariate Ocean Variational Estimation (MOVE) System is an ocean data assimilation system developed for monitoring, analysis and prediction of the ocean state and climate in the Meteorological Research Institute (MRI). It will be used for the next-generation system of ocean and climate prediction in the Japan Meteorological Agency.

The Ocean General Circulation Model (OGCM) used in MOVE System is the MRI Community Ocean Model (MRI.COM). MRI.COM is a primitive equation model with z-coordinate developed in MRI. The analysis method is a Three-Dimensional Variational (3DVAR) method with coupled temperature-salinity empirical orthogonal function (EOF) modes. The merit of using the coupled EOF is that salinity can be estimated from temperature observation alone through the coupling information represented by the coupled EOF. Nonlinear constraints are also introduced in order to assimilate satellite altimetry and for variational quality control. Preconditioned Optimizing Utility for Large-dimensional analyses (POpULar), a descent scheme developed in MRI, is applied in MOVE System for handling the nonlinearity with considering horizontal correlations among analysis increments. The analysis result is employed for correcting the model temperature and salinity fields with the Incremental Analysis Updates (IAU).

In this presentation, we will show the results of prediction experiments of the Kuroshio path and its meandering south of Japan. A regional ocean model with the resolution of $0.1^\circ \times 0.1^\circ$ (nested in the model with the resolution of $0.5^\circ \times 0.5^\circ$) is adopted. Each

prediction starts from the assimilation fields in which in-situ (ship and ARGO float) temperature and salinity data and satellite altimetry data (TOPEX/Poseidon, Jason-1, ERS-1/2, ENVISAT) are employed. The predictive limit of our prediction system is roughly 40-60 day, which is much longer than the persistence. The meandering event occurred in 2004 was well predicted three months in advance using this system.

We are also examining the mechanism of the Kuroshio meandering with the model and its adjoint code as well as the analysis fields of the MOVE system. An early result points out that the eastward-propagating anticyclonic eddy below 1500m depths south of Kuroshio plays an important role in the meandering. We will show the result of sensitivity study with the adjoint code that supports the possibility.