Assimilation of high-resolution sea surface temperature into an eddy-resolving ocean model using a weak-constraint 4D-Var method

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Many ocean data assimilation systems use gridded sea surface temperatures (SSTs) produced by statistical interpolation methods such as optimal interpolation. Such gridded SSTs are however spatio-temporally smoothed. Therefore, in a high-resolution ocean data assimilation system, it is desirable to assimilate satellite Level-2 data directly, rather than the gridded data. In this study, we developed a method to analyze the SST field with high accuracy within the framework of the four-dimensional variational (4D-Var) method. In 4D-Var assimilation systems at eddy-resolving resolution, the assimilation window is usually set to about 10 days, and increments to the initial condition is optimized by minimizing the cost function. Although this setting is reasonable for analysis of ocean internal variations such as changes in ocean current and ocean internal temperature, it would not be appropriate for SST because the SST variability is influenced not only by the oceanic internal dynamics but also by the atmospheric forcing. In this study, we propose a new scheme based on weak-constraint 4D-Var to reproduce detailed spatial-temporal SST variations with guaranteed reproducibility of ocean internal variations. In the new scheme, daily SST increments within the assimilation window are added to control variables, and they are assumed to be independent from other control variables such as temperature and salinity increments to the initial condition. We implemented this scheme into the Meteorological Research Institute Multivariate Ocean Variational Estimation (MOVE) system and conducted an experiment to assimilate Himawari SST together with altimeter data and in-situ temperature and salinity. In addition to details of the developed scheme, early results of the assimilation experiment will be presented.

Keywords: Data assimilation, 4D-Var, Sea surface temperature

