Estimation of Subsurface Density Profile From Surface Dynamic Height in the Kuroshio Region

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Abstract

A method for estimating subsurface density profile in the region surrounding the Kuroshio from surface dynamic height is proposed. We provide a model of the statistical relationship between surface dynamic height relative to 1000-dbar reference level ΔD (0/1000 dbar) and subsurface density by deriving multiple regression relationships between ΔD, position (longitude and latitude) and amplitudes of the first three modes of empirical orthogonal functions (EOFs) of density profiles. This model is more complete than that proposed by Carnes *et al.* (1990), who employed the regression relationships between ΔD and the first two modes of EOFs of temperature profiles. Comparing these models indicates the advantage of applying multiple regression analysis in estimating density profile. The total rms error (consisting of EOF-related and regression-related rms errors) for the multiple regression model reaches a maximum of 0.3 kg m^{-3} in August and decreases to a minimum of 0.15 kg m^{-3} in February. In every month, the total rms errors in the upper 200 m are larger (0.2 ~ 0.5 kg m^{-3}) than those in the layer below 200 m where the errors at most standard depths are within 0.2 kg m^{-3}. Estimating geostrophic current profiles for one section consisting of eight hydrocasts shows the good agreement between geostrophic current profiles calculated from estimated and CTD-derived density profiles (rms difference is 0.04 m s^{-1}). These results demonstrate the feasibility of estimating density and geostrophic current profiles from ΔD and position using the modification of the derivation of Carnes *et al.* (1990).