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Effects of optimal initial errors on predicting the seasonal reduction of the upstream Kuroshio transport

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With the Regional Ocean Modeling System (ROMS), we realistically simulated the transport variations of the upstream Kuroshio (referring to the Kuroshio from its origin to the south of Taiwan), particularly for the seasonal transport reduction. Then, we investigated the effects of the optimal initial errors estimated by the conditional nonlinear optimal perturbation (CNOP) approach on predicting the seasonal transport reduction. Two transport reduction events (denoted as Event 1 and Event 2) were chosen, and CNOP1 and CNOP2 were obtained for each event. By examining the spatial structures of the two types of CNOPs, we found that the dominant amplitudes are located around (128°E, 17°N) horizontally and in the upper 1000 m vertically. For each event, the two CNOPs caused large prediction errors. Specifically, at the prediction time, CNOP1 (CNOP2) develops into an anticyclonic (cyclonic) eddy-like structure centered around 124°E, leading to the increase (decrease) of the upstream Kuroshio transport. By investigating the time evolution of the CNOPs in Event 1, we found that the eddy-like structures originating from east of Luzon gradually grow and simultaneously propagate westward. The eddy-energetic analysis indicated that the errors obtain energy from the background state through barotropic and baroclinic instabilities and that the latter plays a more important role. These results suggest that improving the initial conditions in east of Luzon could lead to better prediction of the upstream Kuroshio transport variation.