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Predictability study of Kuroshio path variation:Effects of initial error and model parameter errors on the prediction

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Conditional nonlinear optimal parameter perturbation (CNOP-P) method is used to investigate the effects of errors in model parameters on the prediction of the transition to the Kuroshio large meander (KLM) state in a barotropic shallow-water model. Because of their relatively large uncertainties, three model parameters were considered: the interfacial friction coefficient, the wind-stress amplitude, and the lateral friction coefficient. We determined the CNOP-Ps optimized for each of these three parameters independently, and we optimized all three parameters simultaneously using the Spectral Projected Gradient 2 (SPG2) algorithm. Similarly, the impacts caused by errors in initial conditions were examined using the conditional nonlinear optimal initial perturbation (CNOP-I) method. Both the CNOP-I and CNOP-Ps can result in significant prediction errors of the KLM over a lead time of 240 days. But the prediction error caused by CNOP-I is greater than that caused by CNOP-P. The results of this study indicate not only that initial errors have greater effects on the prediction of the KLM than errors in model parameters but also that the latter cannot be ignored. Hence, to enhance the forecast skill of the KLM in this model, the initial conditions should first be improved, the model parameters should use the best possible estimates.