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Reduction of initial shock in decadal predictions using a new initialization strategy

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Initial shock is a well-known problem occurring in the early years of a decadal prediction when assimilating full-field observations into a coupled model, which directly affects the prediction skill. For the purpose to alleviate this problem, we propose a novel full-field initialization method based on dimension-reduced projection four-dimensional variational data assimilation (DRP-4DVar). Different from the available solution strategies including anomaly assimilation and bias correction, it substantially reduces the initial shock through generating more consistent initial conditions for the coupled model, which, along with the model trajectory in one-month windows, best fit the monthly mean analysis data of oceanic temperature and salinity. We evaluate the performance of initialized hindcast experiments according to three proposed indices to measure the intensity of the initial shock. The results indicate that this strategy can obviously reduce the initial shock in decadal predictions by FGOALS-g2 (the Flexible Global Ocean-Atmosphere-Land System model, Grid-point Version 2) compared with the commonly-used nudging full-field initialization for the same model as well as the different full-field initialization strategies for other CMIP5 (the fifth phase of the Coupled Model Intercomparison Project) models whose decadal prediction results are available. It is also comparable to or even better than the anomaly initialization methods. Better hindcasts of global mean surface air temperature anomaly are obtained due to the reduction of initial shock by the new initialization scheme.