

# Multiyear climate prediction using 4D-Var coupled data assimilation system

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An initialization relevant to interannual-to-decadal climate prediction has usually used a simple restoring approach for oceanic variables. Here, we demonstrate the potential use of four-dimensional variational (4D-Var) coupled data assimilation on the leading edge of initialization approach particularly in multi-year (5-year-long) climate prediction. We perform full-field initialization rather than anomaly initialization and assimilate the atmosphere states together with the ocean states to an atmosphere-ocean coupled climate model. In particular, it is noteworthy that ensembles of multi-year hindcasts using our assimilation results as initial conditions exhibit an improved skill in hindcasting the multi-year changes of the upper ocean-heat-content (OHC) over the central North Pacific. The 4D-Var approach enables us to directly assimilate a time trajectory of slow changes of the Aleutian Low that are compatible with the sea-surface-height and the OHC. Consequently, we can estimate a coupled climate state suitable for hindcasting dynamical changes over the extratropical North Pacific as observed.

Keywords: Decadal prediction, 4D-Var data assimilation, Coupled data assimilation