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Transient, spurious and long-lasting ocean features resulting from the initialization of an ocean ensemble assimilation system

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At the National Center for Atmospheric Research, a 48-member ensemble adjustment Kalman filter (EnKf) is being used to assimilate daily subsurface temperature and salinity data into the POP 1^{o}x1^{o} global ocean model. EnKf systems are typically initialized with an ensemble of model states that represent a climatological distribution. Over many cycles of the assimilation system, the ensemble narrows into a distribution that is a function of the internal variability of the system and the observations that are constraining it. A well-equilibrated ensemble should not be strongly influenced by the choice of the initial ensemble. The POP/EnKf system was initialized in model-yr 1998, with the goal of having an equilibrated ensemble of ocean states by model-yr 2000. While the dynamic time-scales of the upper ocean support this choice of "burn-in" time, we show here that the deep ocean remains sensitive to the choice of initial ensemble for at least a decade. We illustrate this here with a case-study from the equatorial Atlantic ocean, where the choice of initial ensemble leads to spurious, transient behavior that impacts large-scale climate variables like the vertically integrated northward heat transport and the meridional overturning circulation.