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Full-field versus anomaly initialization in the MiKlip decadal prediction system

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We show how ocean initialization from full-fields instead of anomalies in the MiKlip decadal prediction system significantly reduces rediction skill of ocean heat content (OHC) in the northern North Atlantic. The MiKlip prediction system, which is based on the Max-Planck-Institute Earth system model (MPI-ESM), is initialized by assimilating selected state parameters from reanalyses. Here, we apply either full-field or anomaly nudging in the ocean. We apply full fields from two different ocean reanalyses. We show that nudging of temperature and salinity in the ocean modifies OHC and also induces changes in mass and heat transports associated with the Atlantic meridional overturning circulation. In the North Atlantic, the OHC tendencies from the ocean reanalyses are adopted quite well by our forecast system, regardless of using full fields or anomalies. The resulting ocean transport, on the other hand, reveals considerable differences between full-field and anomaly nudging. In the assimilations, the ocean heat transport together with the net heat exchange at the surface does not correspond to the induced OHC tendencies, the heat budget is not closed. Discrepancies in the budget in the cases of full-field nudging exceed those in the case of anomaly nudging by a factor of 2-3. The nudging-induced changes in ocean transport continue to be present in the free running hindcasts, a clear expression of memory in our coupled system. In forecast mode, on annual to inter-annual scales, ocean heat ransport appears to be the dominant driver of North Atlantic OHC. Thus, we ascribe a significant reduction in OHC prediction skill when using full-field instead of anomaly initialization to the poor initialization of the ocean flow.