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Arctic ocean models intercomparison using a water mass census

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The hydrographic output of two Arctic Ice-Ocean models and one global ocean model, for the simulation years 1998-2009, have been compared and evaluated using watermass census as a metric: the HYCOM ACNFS (Ref 1), NCOM (Ref 2) and POP (Ref 3, no active ice) models. Resolutions varied from .083 deg (HYCOM) to .10 deg (Global POP) to .125 deg (Global NCOM). The comparison studies concentrated on the global Arctic band (70N-90N) and the GIN Sea region (20W-20E, 60N-80N). The HYCOM and NCOM model simulations also included data assimilation starting in year 2008. The model results were also compared with the WOA05 climatology of the National Oceanographic Data Center (NODC), the PHC2 climatology of the University of Washington, and with all available casts from the World Ocean databases (WOD98, WOD05 and WOD09) from NODC. The cast data were supplemented with some additional local casts, particularly in the GIN Sea. Both the models, climatologies and the observations exhibited a significant presence of deep watermasses with T-S characteristics that do not fall into the 'named' deep water varieties (e.g. Norwegian Sea or Arctic Ocean deep waters). There were marked seasonal and interannual variations in the deep water sub-classes, more so than in the Atlantic Water (AW) water masses. There was reasonably good agreement between the models, but significant differences exist between model results, the climatologies, and the results of hydrographic census surveys. Some explanations for the differences include: (a) model resolution; (b) atmospheric forcing, (c) data assimilation and (d) sampling biases of the observations in space and time (near surface, near shelves, spring and summer, etc.).

Ref 1: Validation of the 1/12 deg Arctic Cap Nowcast/Forecast System
(ACNFS)
Pamela G. Posey et al, Tech. Report NRL/MR/7320—10-9287, Nov 4, 2010,
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Ref 2: User's Manual for the Global Ocean Forecast System (GOFS)
Version 2.6
Lucy F. Smedstad et al, Tech. Report NRL/MR/7320—10-9210, March 31,
2010, Naval Research Laboratory, Stennis Space Center, MS, 39529

Ref 3: An eddy resolving global 1/10 deg ocean simulation
Mathew E. Maltrud and Julie L. McClean
Ocean Modelling 8, pp. 31-54, 2005.