Print

Ice-Tethered Profiler: Ocean surface mixed layer

Variations in the Arctic Central Canada Basin mixed layer properties are documented based on a subset of nearly 6500 temperature and salinity profiles acquired by Ice-Tethered Profilers during the period summer 2004 to summer 2009 and analyzed in conjunction with sea ice observations from Ice Mass Balance Buoys and atmosphere-ocean heat flux estimates. The July-August mean mixed layer depth based on the Ice-Tethered Profiler data averaged 16 m (an overestimate due to the Ice Tethered Profiler sampling characteristics and present analysis procedures) while the average winter mixed layer depth was only 24 m, with individual observations rarely exceeding 40 m. Guidance interpreting the observations is provided by a one-dimensional ocean mixed layer model. The analysis focuses attention on the very strong density stratification at the base of the mixed layer in the Canada Basin that greatly impedes surface layer deepening and thus limits the flux of deep ocean heat to the surface that could influence sea ice growth/decay. The observations additionally suggest that efficient lateral mixed layer restratification processes may be active in the Arctic, also impeding mixed layer deepening.

Reference: Toole, J.M., M.-L. Timmermans, D.K. Perovich, R.A. Krishfield, A. Proshutinsky and J.A. Richter-Menge, 2010: Influences of the Ocean Surface Mixed Layer and Thermohaline Stratification on Arctic Sea Ice in the Central Canada Basin. Journal of Geophysical Research, accepted.

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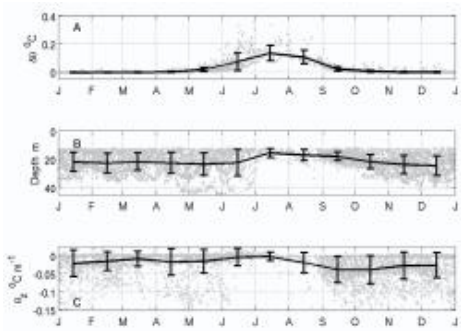

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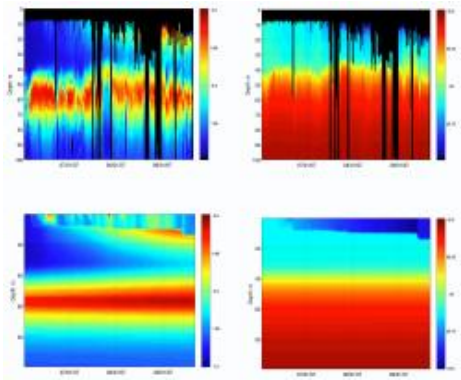
Mean seasonal cycle of central Canada Basin mixed layer temperature departure from the local freezing temperature (top), mixed layer depth (middle), and vertical potential temperature gradient in the 5 meter interval below the mixed layer base (bottom) based on approximately 5800 ITP profiles. Estimates from individual profiles are marked by gray dots. The black curves connect monthly-mean values (reported at the average time of the available estimates); the brackets mark the average plus and minus the estimated standard deviations. Mean estimates for July and August are likely biased estimates as the ITPs often failed to resolve the very shallow and warm mixed layers characteristic of summer.



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Depth-time contour plots of the observed and modeled upper ocean temperature and salinity for the Summer 2007 case study (ITP 6). The top two panels show the observations from ITP 6, the bottom two show the model output (the model was an extension to the Price-Weller-Pinkel [1986] 1-D model). The base temporal resolution of the ITP data was two profiles per day; the model output has 1-hr resolution. A black mask is used in the top panels to indicate depths/times that the ITP failed to sample.

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