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Fresh water transformations in the Beaufort Gyre in 2003-2008

A. Proshutinsky (1), R. Krishfield (1), M-L. Timmermans (1), E. Carmack (2), F. Mclaughlin (2), W. Williams (2), S. Zimmermann (2), M. Itoh (3), and K. Shimada (3)

(1) Woods Hole Oceanographic Institution, Physical Oceanography, Woods Hole, United States (aproshutinsky@whoi.edu, 508 457 2181), (2) Institute of Ocean Sciences, P.O. Box 6000, Sydney, B.C., CA V8L 4B2, (3) The Japan Agency for Marine-Earth Science and Technology, Yokosuka, Yokosuka, 237-0061, Japan

We investigate basin-scale mechanisms regulating anomalies in fresh water content (FWC) in the Beaufort Gyre (BG) of the Arctic Ocean using historical observations, data collected in 2003-2008 by the Beaufort Gyre Exploration Project, and measurements obtained from drifting Ice-Tethered Profilers. The major cause of the large FWC in the BG is the process of Ekman pumping associated with the climatological anticyclonic atmospheric circulation over the Canada Basin centered in the BG. The mechanically-forced seasonal variability of FWC in the central BG follows wind curl changes with its maximum in November – January and a minimum in June-August tracking seasonal changes in the atmospheric circulation. The atmospheric and oceanic thermal regimes regulate seasonal transformations of liquid FWC due to the seasonal cycle of sea ice melt and growth. Combination of the two mechanisms, reflected in the seasonal cycle of total BG FWC, has two pronounced peaks separated by approximately 3-4 months. The first peak (June-July) is observed when the sea ice thickness reaches its minimum (maximum fresh water release from sea ice to the ocean) and when the Ekman pumping is very close to its weakest. The second maximum is observed in November- January when the wind curl is strongest (maximum Ekman pumping) and the salt flux from the growing sea ice has not reached its maximum. One conclusion from this study is that the observational practice to sample the Arctic Ocean hydrography in August-September (when the sea ice coverage is at its seasonal minimum and the Arctic is accessible by research icebreakers) and April-May (using aircraft when the sea ice is sufficiently strong and there is adequate daylight) misses natural FWC seasonal variability and underestimates the seasonal variability of hydrographic fields, their gradients and circulation patterns.
UR: http://www.whoi.edu/beaufortgyre