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Distribution and circulation of Pacific Winter and Summer Waters in the Arctic Ocean based on historical data

M. Makhotin (1), L.A. Timokhov (1), R. Colony (2)

(1) Arctic and Antarctic Research Institute, St.Petersburg, Russia (m-makhotin@mail.ru/Fax: +7(812) 352 28 83), (2) Pacific Arctic Group (mcolony@wavecable.com)

Due to hydrostatic imbalance, water from the North Pacific flows through the Bering Strait, transits the upper levels of the Arctic Ocean, and finds its way to the North Atlantic. Waters recently originating from the North Pacific generally have a distinct temperature, salinity, and silicate signature. Summer and winter modification produces two forms of Pacific-origin water that comprise the upper and middle halocline of the upper layer, respectively. Using hydrographic and hydrochemical data (1950 - 1993), annual wintertime fields are estimated and used to delineate the boundary between the halocline of predominately Atlantic Water from the halocline of predominately Pacific Water. The horizontal extent of Pacific Winter Water is often sharply defined by a strong gradient in silicate. Examinations of the hydrographic/hydrochemical fields also suggest that temperature on the 33.1 psu isopycnal can also be used to estimate the boundary between halocline waters. We determined that the boundary lies at the intersection of 33.1 psu isohaline and -1.6oC isotherm. The interannual and decadal positions of the boundary are illustrated. Finally, we show data of the vertical and horizontal structure of the interface between the two haloclines. During summer and early fall, much of the Chukchi Shelf is ice free and surface waters are found to be several degrees above the freezing temperatures. This warm water flows off the shelf and subsides beneath the fresher surface water of the Canadian Basin. In subsequent winters, remnants of this warm shelf water can be identified by a slight temperature maximum, greater than -1.4oC, in the upper halocline. Data collected during the “Sever” (and other) expeditions are analyzed to determine the extent of this Pacific Summer Water (PSW). Annual spatial patterns of maximum temperature and thickness of the PSW are shown for selected years. Summaries of volume and heat content are estimated.

The transport of PSW is reconciled with patterns of geostrophiclly balanced flow in the upper halocline off the Beaufort and Chukchi Seas. We show time series of water volume and heat content of PSW with comparison to indexes of atmospheric circulation. Finally, we calculated the circulation of Pacific Water in the Arctic Ocean based on a model of Bernoulli equations.