THE PACIFIC GATEWAY TO THE ARCTIC – QUANTIFYING AND UNDERSTANDING BERING STRAIT OCEANIC FLUXES. Russian American Long-term Census of the Arctic

Rebecca Woodgate (UW), Tom Weingartner (UAF), Terry Whitledge (UAF), Ron Lindsay (UW), Kathleen Crane, (Arctic Research, CPO, NOAA, RUSALCA Mission Coordinator)

ABSTRACT

The Bering Strait, a narrow (~ 85 km wide), shallow (~ 50 m deep) strait at the northern end of the Pacific, is the only ocean gateway between the Pacific and the Arctic. Although the flow through the strait is small in volume (~ 0.8 Sv northward in the annual mean), due to its remarkable properties (high heat and freshwater content, low density, high nutrients) it has a startling strong influence, not only on the Chukchi Sea and the Arctic Ocean, but also on the North Atlantic overturning circulation and possibly world climate. Draining the Bering Sea shelf to the south, the Bering Strait throughflow is an integrated measure of Bering Sea change. The comparatively warm, fresh throughflow contributes ~ 1/3rd of the freshwater input and possibly ~ 1/5th of the oceanic heat input to the Arctic, and provides the most nutrient-rich waters entering the Arctic Ocean.

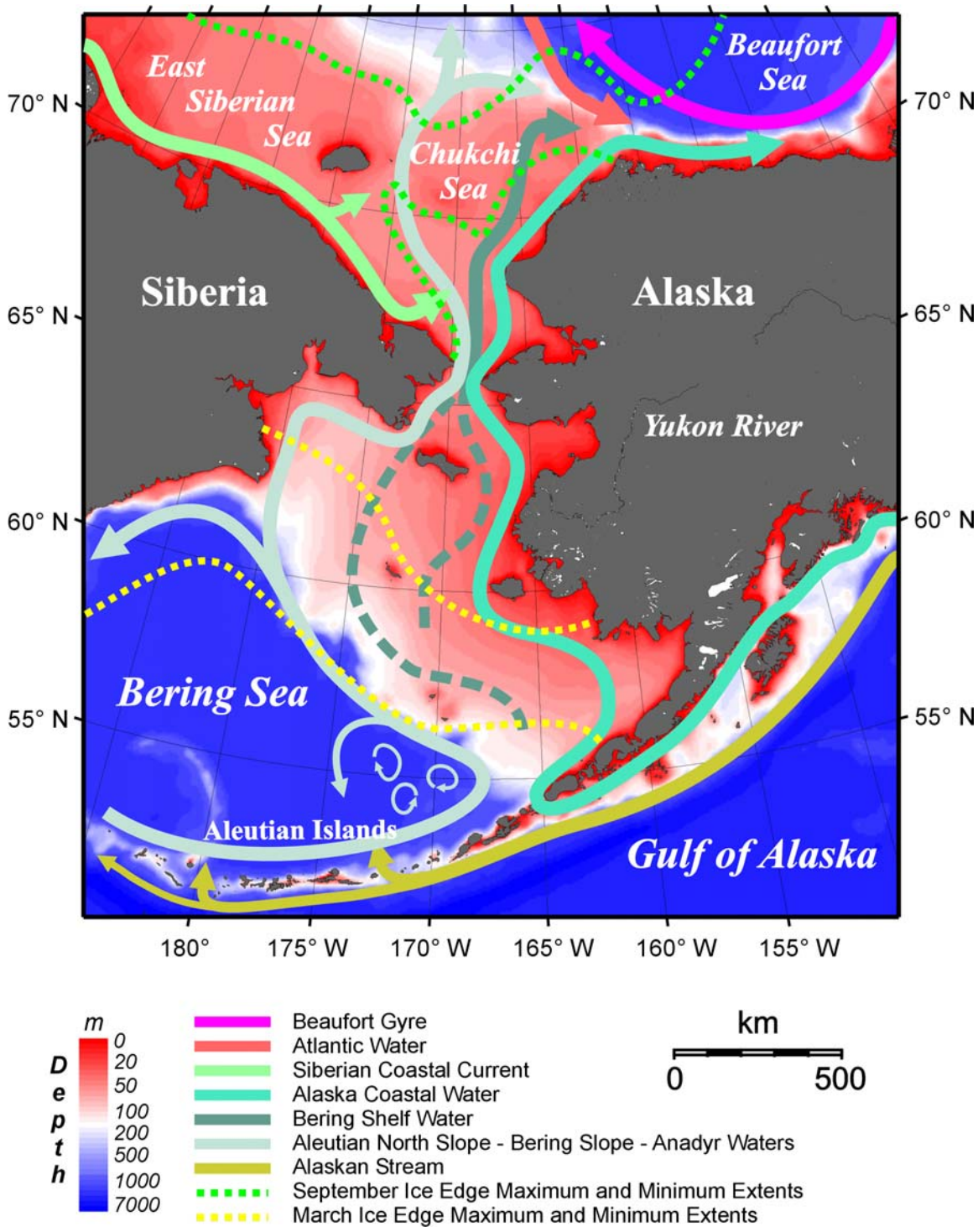
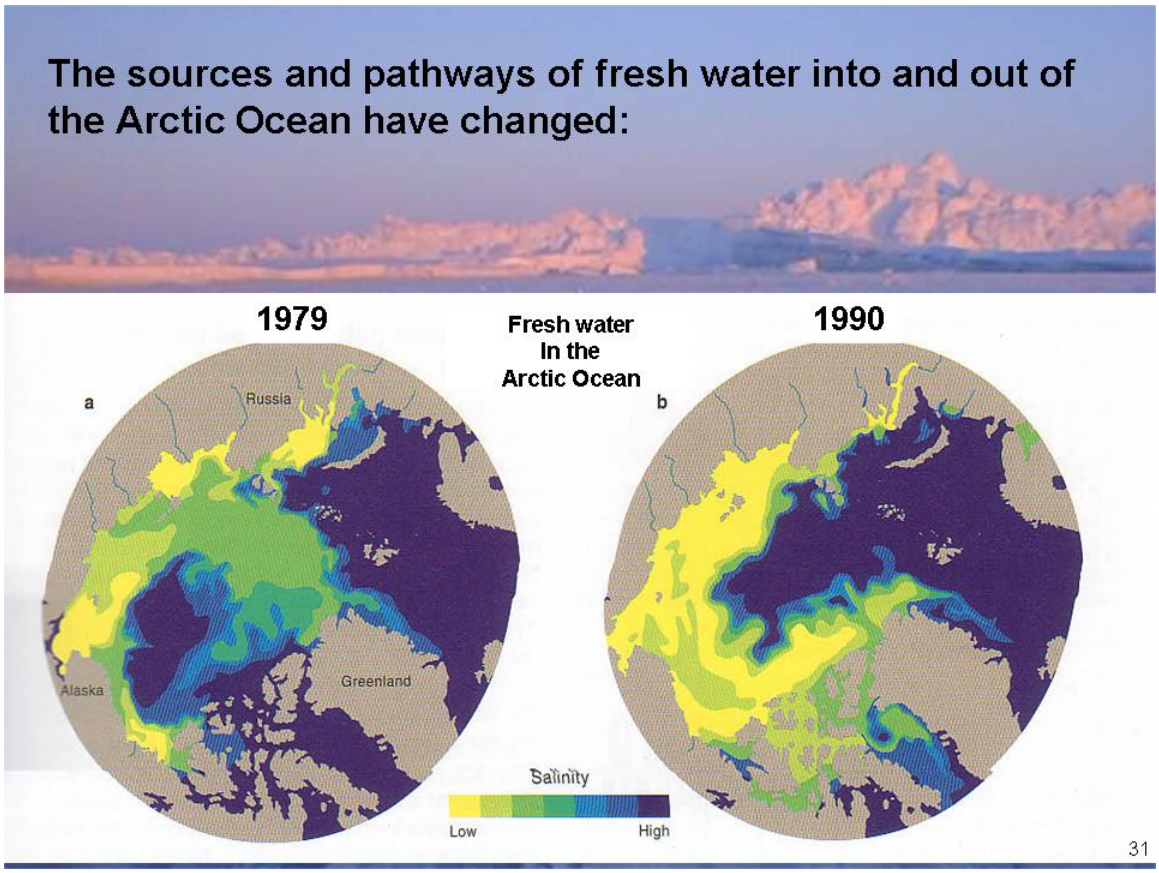


Illustration of the currents through the Bering Strait.

Furthermore, the low density of these waters keeps them high in the Arctic water column, giving them a key role in upper ocean ecosystems and physical

processes including ice-ocean interactions. At the time when dramatic change, especially the retreat of sea-ice, is observed in the Bering and Chukchi seas and the Arctic, we have measured significant increases of Bering Strait fluxes of volume, freshwater and heat, the heat flux in 2004 being the maximum recorded in the last 15 years.

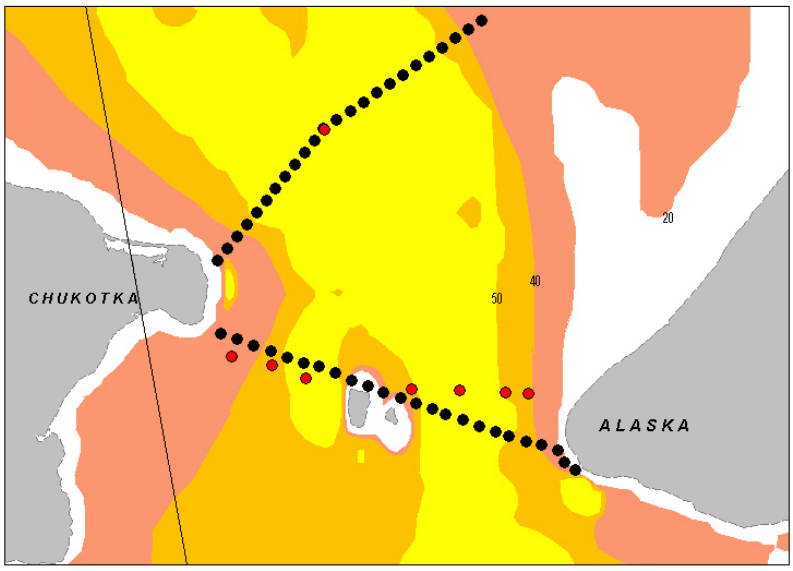
Yet, our understanding of what sets the properties and variability of the Bering Strait throughflow is still rudimentary. Indeed, our ability to measure these fluxes accurately has, in the past, been constrained by lack of data, both from the most nutrient-rich western half of the strait (which lies in Russian waters), and from the upper water column (due to potential ice-keel damage to instrumentation), where stratification and coastal boundary currents (especially the Alaskan Coastal Current in the eastern channel) contribute significantly to freshwater and heat fluxes.



More freshwater has been accumulating in the Pacific sector of the Arctic Ocean, particularly since the 1990's. Low salinity (yellow). Transport pathways of water and ice across the Arctic have also changed significantly. The Bering Strait is on the left middle of the image.

Furthermore, although recognized as a key ocean gateway by national and international global observing initiatives, there had still been no long-term

observing strategy for the Bering Strait until the development of the RUSALCA program (Russian-American Long-term Census of the Arctic). Building on US-Russian collaborations established in 2004 and NOAA- NSF collaboration to build the critical observing chain of moorings in this Pacific - Arctic Gateway, The RUSALCA program undertook the first ever deployment of instrumentation in both the Russian and U.S. waters of the Bering Strait in August-September of 2007 onboard the Russian Naval hydrographic vessel "SEVER".

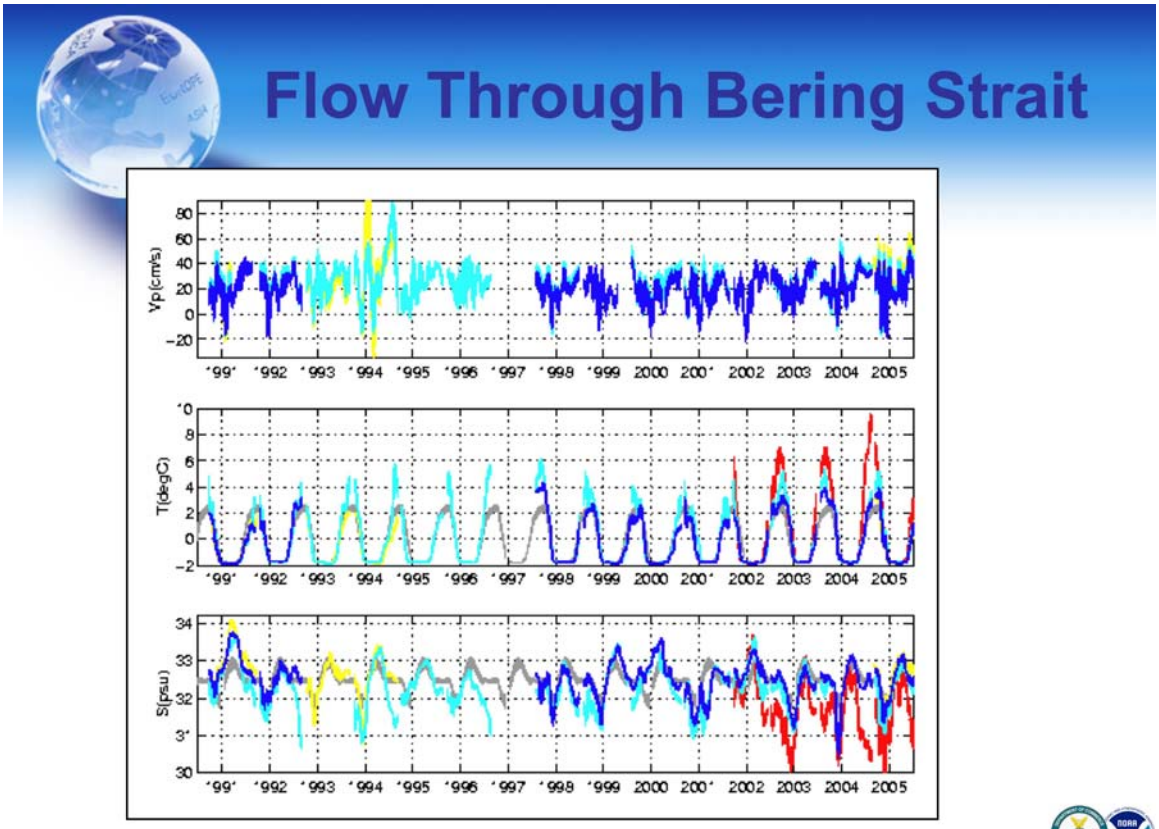


2007 mooring locations (red), CTD stations in black. Depth is in meters.

The science objectives are:

1) To measure the velocities and water properties of the Bering Strait throughflow;
2) To understand the physical processes influencing the properties of the Bering Strait throughflow, with special focus on mechanisms driving change, and impacts on the Arctic Ocean;
3) To quantify (or at least bound) oceanic fluxes of volume, freshwater, heat, nutrients, and chlorophyll biomass through the strait; and
4) To design an optimum monitoring system for oceanic fluxes through the

Bering Strait.



From Rebecca Woodgate - UW/APL

30-day running mean time-series of all available velocity, temperature, and salinity data from the Bering Strait mooring sites (Green) western channel, Russian Federation waters, (light blue) eastern channel (U.S. waters), (dark blue) north Bering Strait, (yellow) central Chukchi Sea and (red) base of the Alaskan Coastal Current. The background gray is a 15-year climatology for the central Chukchi Sea. Solid black lines are weekly averages of sea surface temperature from MODIS satellite data from the eastern channel. Prior to 2007 mooring operations in the western and eastern channels were not coordinated.

The hypotheses of the Principal Investigators in the RUSALCA program are that Bering Strait throughflow properties are set by global and regional oceanic and atmospheric processes, which are vulnerable to climate change; and that understanding the physical processes and scalings in the strait are key to quantifying current conditions, assessing future change scenarios, and designing an efficient observational scheme for this oceanic gateway.

Additionally, the RUSALCA Bering Strait moorings will provide an observational platform for other Bering Strait measurements; an annually- updated status of Bering Strait fluxes and potential Arctic impacts for the science community and the general public; and public dissemination of results and the importance of global oceanography to US schools and the general public, including via a Polar Science Weekend at the Pacific Science Center (Seattle's major science

museum).

By quantifying and understanding oceanic fluxes at this key Pacific-Arctic ocean gateway, this work contributes directly to NOAA's mission of documenting the climate system and detecting change. The work also directly fulfils RUSALCA goals and milestones, specifically by quantifying Bering Strait fluxes of freshwater, heat and nutrients, via annual mooring data; by maintaining climate CTD lines in the Bering Strait and Chukchi Sea; and by providing annual updated estimates of fluxes (including data and data products) via a public website and national data archives.