Status of the Bering Sea in 2008: COLD!

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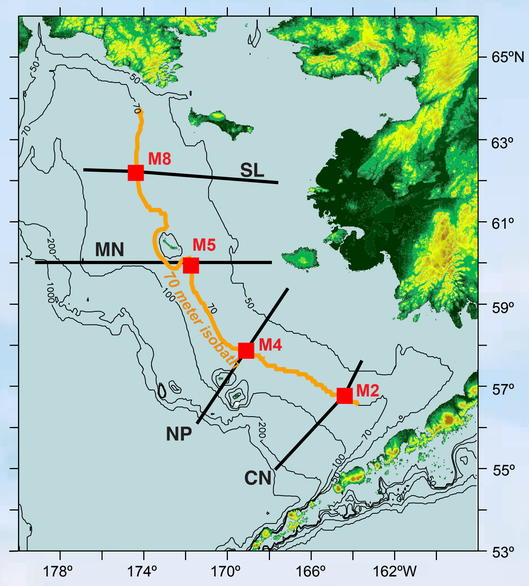
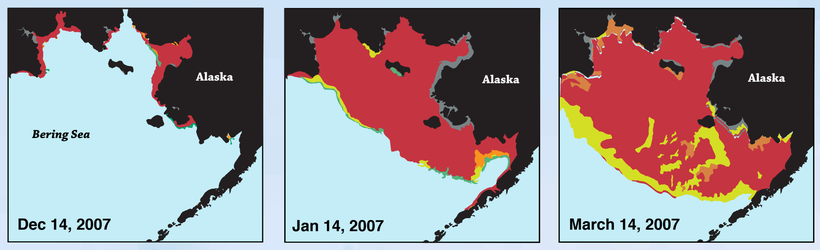
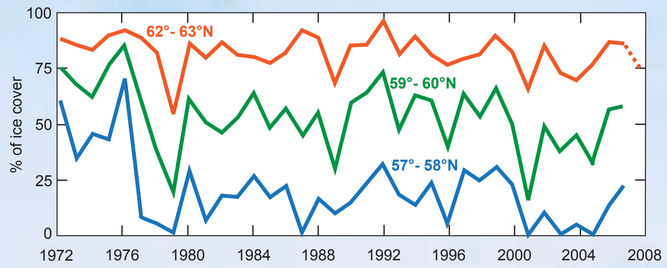


Sea Ice Extent 2008



In December the Bering Sea was largely ice free. Within 30 days sea ice covered most of the shelf with maximum ice extent occurred in late March.

Index of Sea Ice: Persistance and Extent



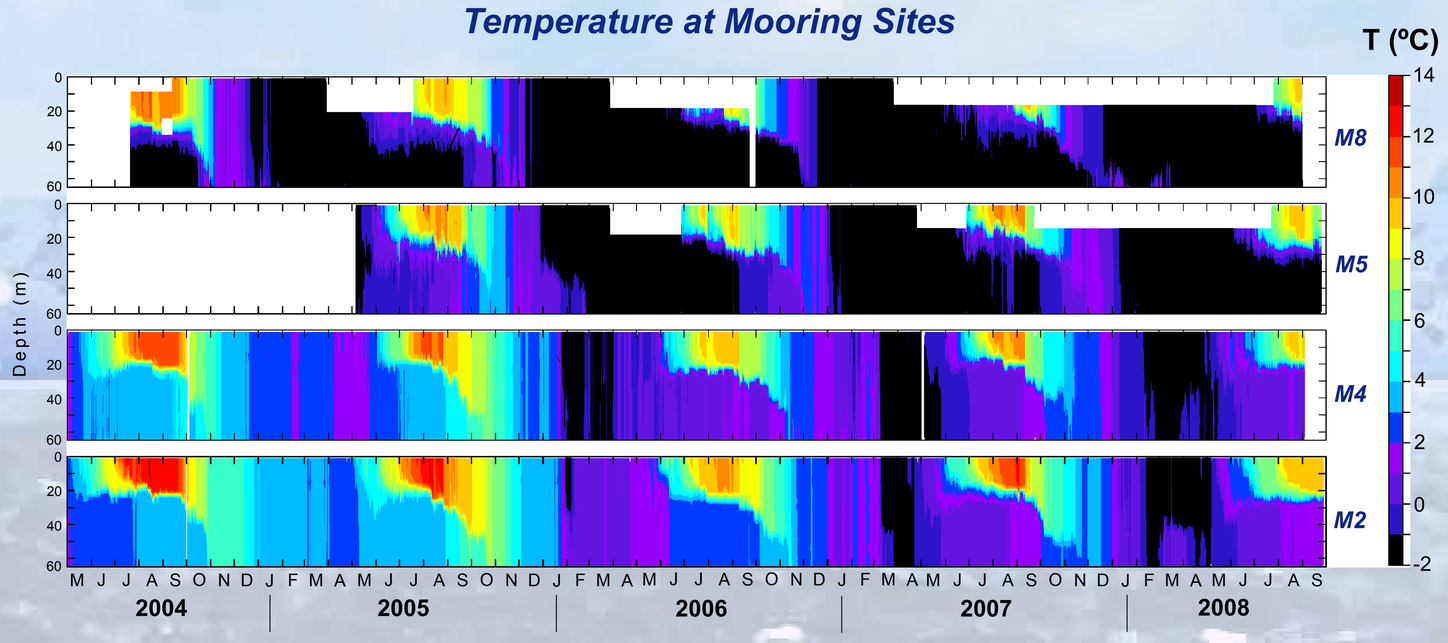
Average of sea ice concentration (Dec.-May) in 1° latitude bands.

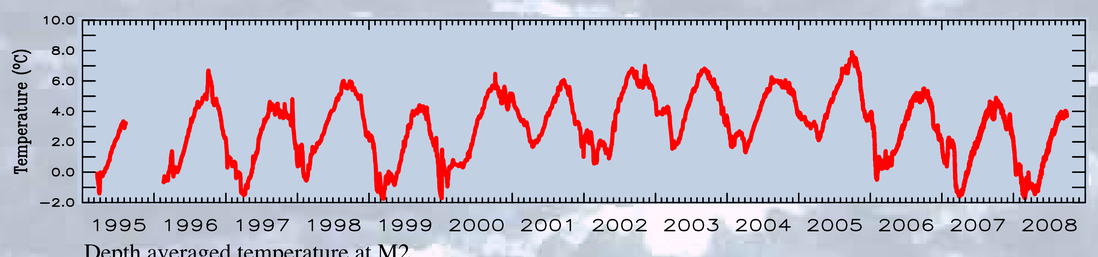
Southern: most extensive/persistent ice since 1976

Middle: average sea ice

Northern: below average

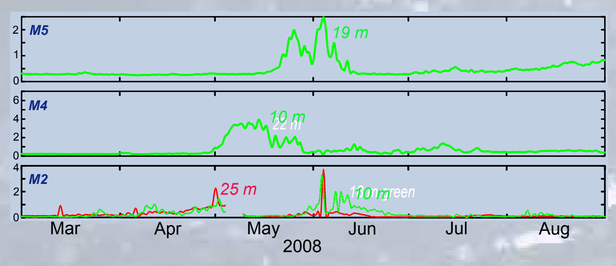
Temperature at Mooring Sites





Depth averaged temperature at M2

Normalized Florescence



Time series of fluorometers on the moorings.

Questions

Was the subsurface phytoplankton bloom in 2008 a result of a relatively thin mixed layer or is it a result of the more gradual pycnocline?

What causes the high ammonia concentrations on the southern shelf in contrast to low over the northern shelf?

In the spring, was the lower nutrients over the central region a result of a bloom in conjunction with melting ice, or does advection play a role?

Just as there are three cross shelf domains there are three along shelf regions: the southern shelf (M2 to north of M4); central or transition region; and northern region (M5 to M8 +). The regions vary in ice cover, temperature, salinity, currents (not shown), tides (not shown), timing and vertical location of phytoplankton blooms and nutrients (particularly ammonia).

Observations in 2008 along the 70-m isobath

Sea Ice

- Ice arrived late in the northern Bering Sea because of warm conditions in the Arctic Ocean (Paradigm: "The Arctic must freeze before the Bering Sea does.").
- Very rapid advance of ice southward over the shelf.
- Southern shelf: index of ice extent and persistence was the largest since 1976.
- Central and northern shelf: index of ice extent and persistence was average or below average, because of lack of ice early in the season.

Temperature, salinity and water column structure

- Scale of variability (~20 km).
- Cold surface temperatures (< 9.5°C) over the southern shelf.
- Extensive cold pool that persisted through September.
- Southern shelf characterized by sharp, temperature dominated two-layer structure.
- Northern shelf characterized by more gradual pycnocline approximately equal contributions from temperature and salinity.
- Spring: most saline water found in the north and least saline in central shelf near St. Matthew I.
- Summer: Least saline water was surface water in the north and most saline water was bottom in the north.
- Shallow mixed layer (~20 m).

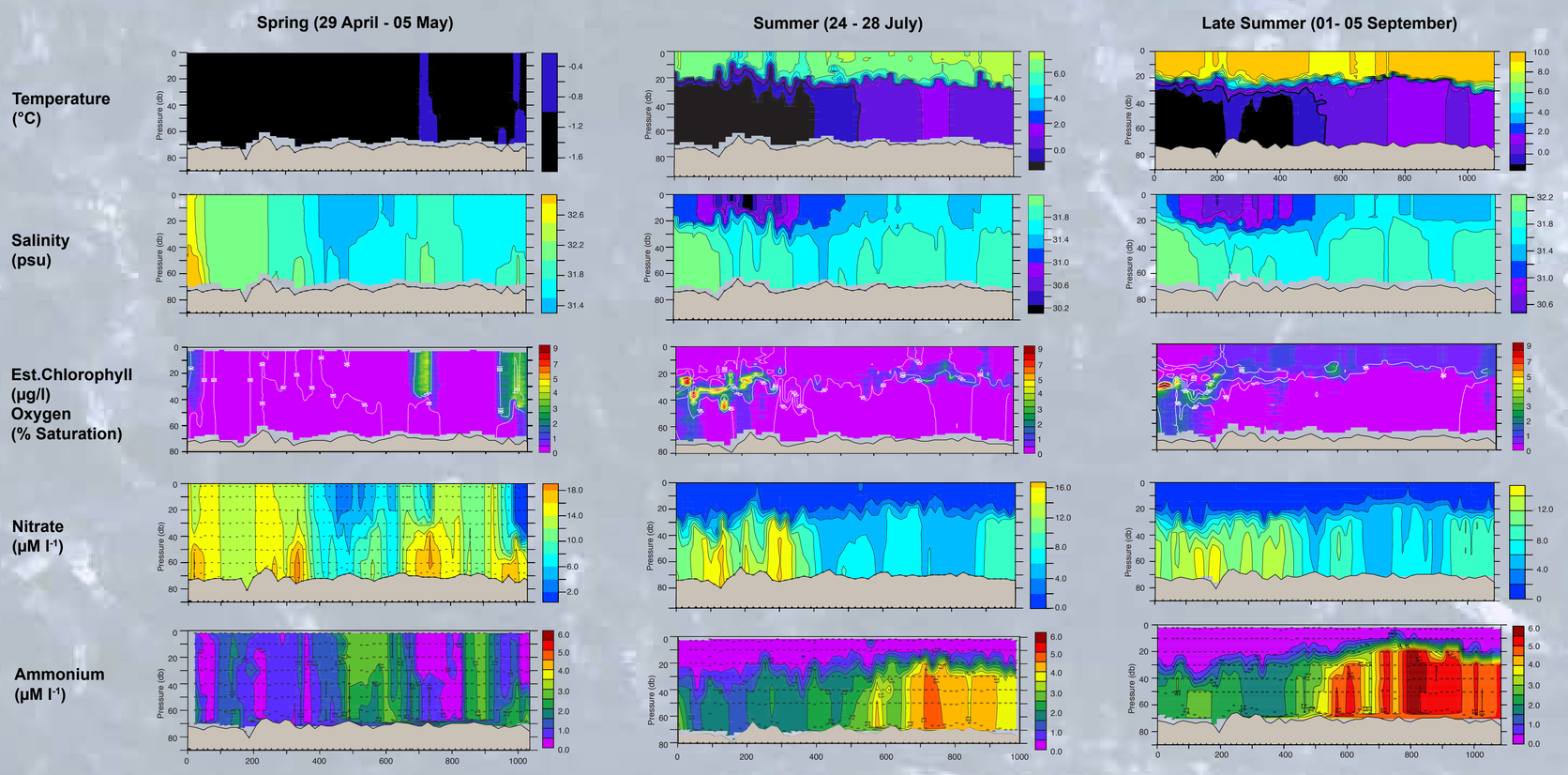
Phytoplankton blooms

- Timing: M2: began in April in association with ice, with an additional bloom in late May during mixing event;
  M4: began in early May when ice began to retreat;
  M5: began in late May with retreat of ice.
- Northern shelf had bloom in the pycnocline beneath the surface mixed layer during summer; southern shelf had no subsurface bloom.
- There had been no significant storms by mid September and there was little evidence of the fall phytoplankton bloom

Nutrients

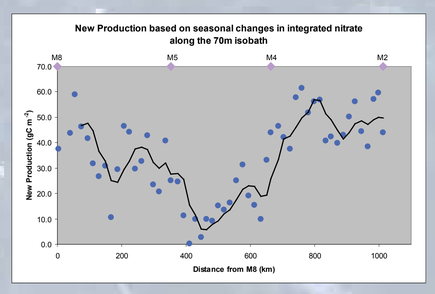
- In spring some depletion of nutrients evident on the southern shelf (near M2) and on central shelf between M5 and M4.
- Ammonium changed from low concentration over the entire 70-m isobath (spring) to high concentration on the southern shelf and continued low concentrations on the northern shelf (late summer).
- Production estimated from nitrogen suggests larger production in the south versus the north.

70 m Isobath



On three different cruises in 2008, water properties were measured along the 70-m isobath. Selected variables are shown in plots to the left.

Production estimate from Nitrate concentrations (Spring -Summer)



Integrated nitrate for the southern portion adjusted to pre-bloom concentrations. The region between M4 and M5 may be heavily influenced by advection. New production from M8 to M5 (36±11 g C m^{-2}) and from M4 to M2 (49±8 g C m^{-2}) match previous estimates of 30-50 g C m^{-2} on the middle shelf (Sambrotto, Walsh, McRoy,Whitledge and Dieterle).

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