CLIMATE VARIATIONS during the RUSALCA decade: 2004–2013

Main points:

- LOSS OF PERENNIAL SEA ICE NORTH OF 70° N A KEY FACTOR
- CHANGE IN SEASONAL CYCLE & LARGE INCREASE IN OPEN WATER
- MASSIVE INCREASE IN SOLAR ENERGY ABSORBED BY OCEAN
- INCREASED SENSITIVITY OF SEA ICE TO WIND FORCING
- MODEST CHANGES IN BERING STRAIT REGION & SOUTH

Loss of perennial sea ice north of 70° N



Fraction of Arctic Ocean multiyear (MY) sea ice coverage on 1 January derived from satellite data. [Adapted from Kwok & Untersteiner (2011).]

Change in seasonal cycle | increased open water



Top: Daily sea ice concentration du ring the melt season (1979-2013) in the Beaufort and northern Chukchi Seas (70–80° N x 175° E – 120° W) from satellite microwave radiometry.
Bottom: MODIS true-color/SST composites for 24-26 August 2006 and 22-24 August 2007

Increase in solar energy absorbed by ocean

⁴⁴Cumulative anomalies in total absorbed solar radiation (May–Sep) for the recent five years locally exceed 300-400 MJ m⁻² in the Beaufort, Chukchi and E. Siberian seas (Stroeve *et al.* 2014).

In 2007 absorbed solar radiation was 500% of normal due to increased open water area (Perovich et al. 2008).

Several sources of heat ≥ measured in Bering Strait.

-10123456789101112°C

Anomalous winds have played a role



Source of year-to-year variability



Modest changes in Bering Strait region



Daily microwave sea ice concentration (1979-2013) in the Bering Strait region (ocean area between 63–70° N). The black line shows the climatological mean (1981-2010) and the dashed/dotted lines are the mean for the decade 2004–2013 and 1981–1990 respectively.

Annual cycle of ice cover & temperature in the Bering Strait



Cycle of ice cover & temperature in 2010



-2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2 3 4 6 8 10 12 14 °C

What is this?



20-21 July 2002

29 July – 02 August 2013

Fresh surface layer warmed in transit?

What's next?

- High resolution cloud / surface exposure climatology
- Put oceanographic data in context with surface & atmospheric data
- Provide an initial draft & reference data to the RUSALCA community soon
- How will the data collected so far influence future operations?
 - 1. Need for more collaborative work early/late in season
 - 2. New instruments and techniques (radiosondes, radiation buoys, semiautonomous systems)
 - 3. Flexible cruise planning



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