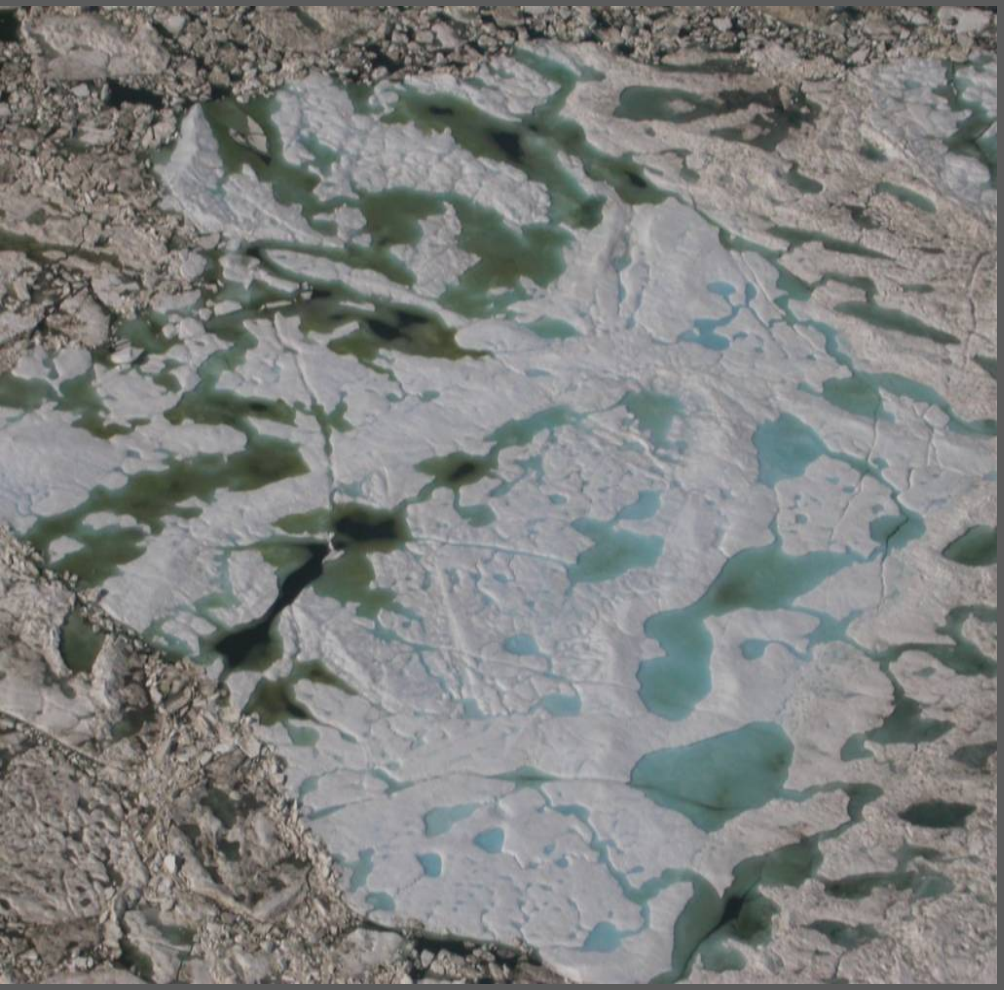
Alaska regional perspectives on the Arctic Sea Ice Outlook



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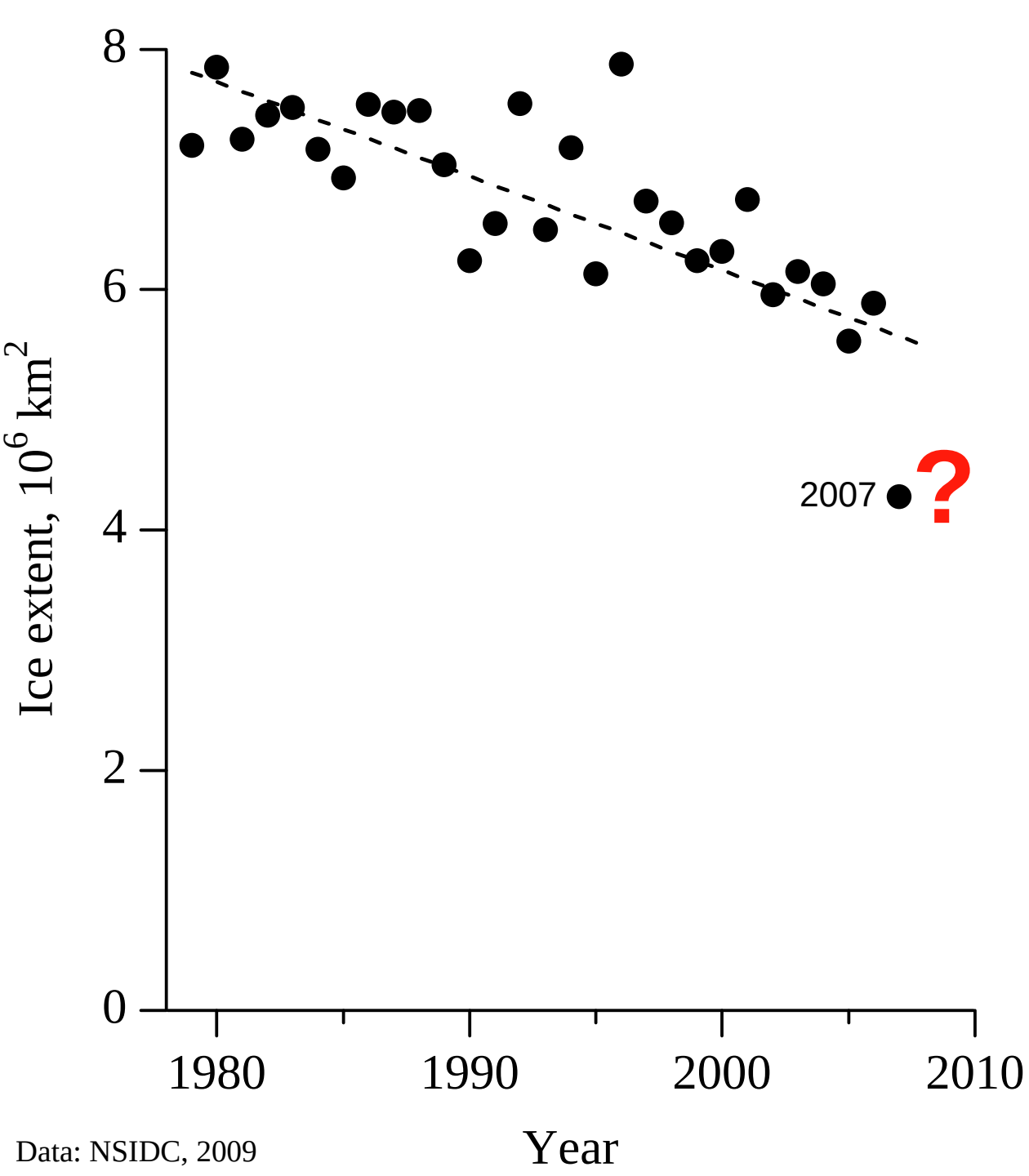
- Arctic Sea Ice Outlook
- Regional downscaling
- Predicting ice melt and break-up at Barrow



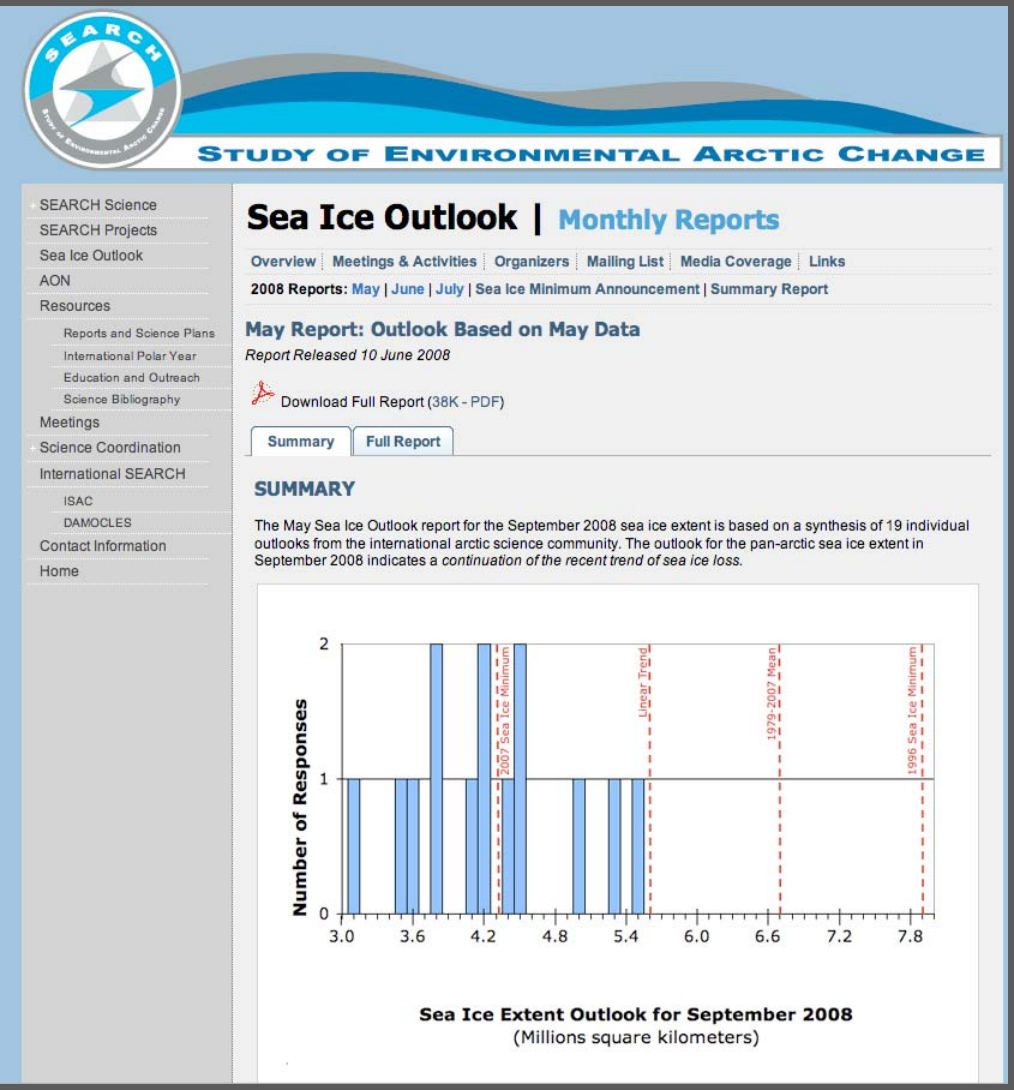
What did we expect for Sept. 2008 in May 2008?

- Keeping up with the ice: New approaches & responses required

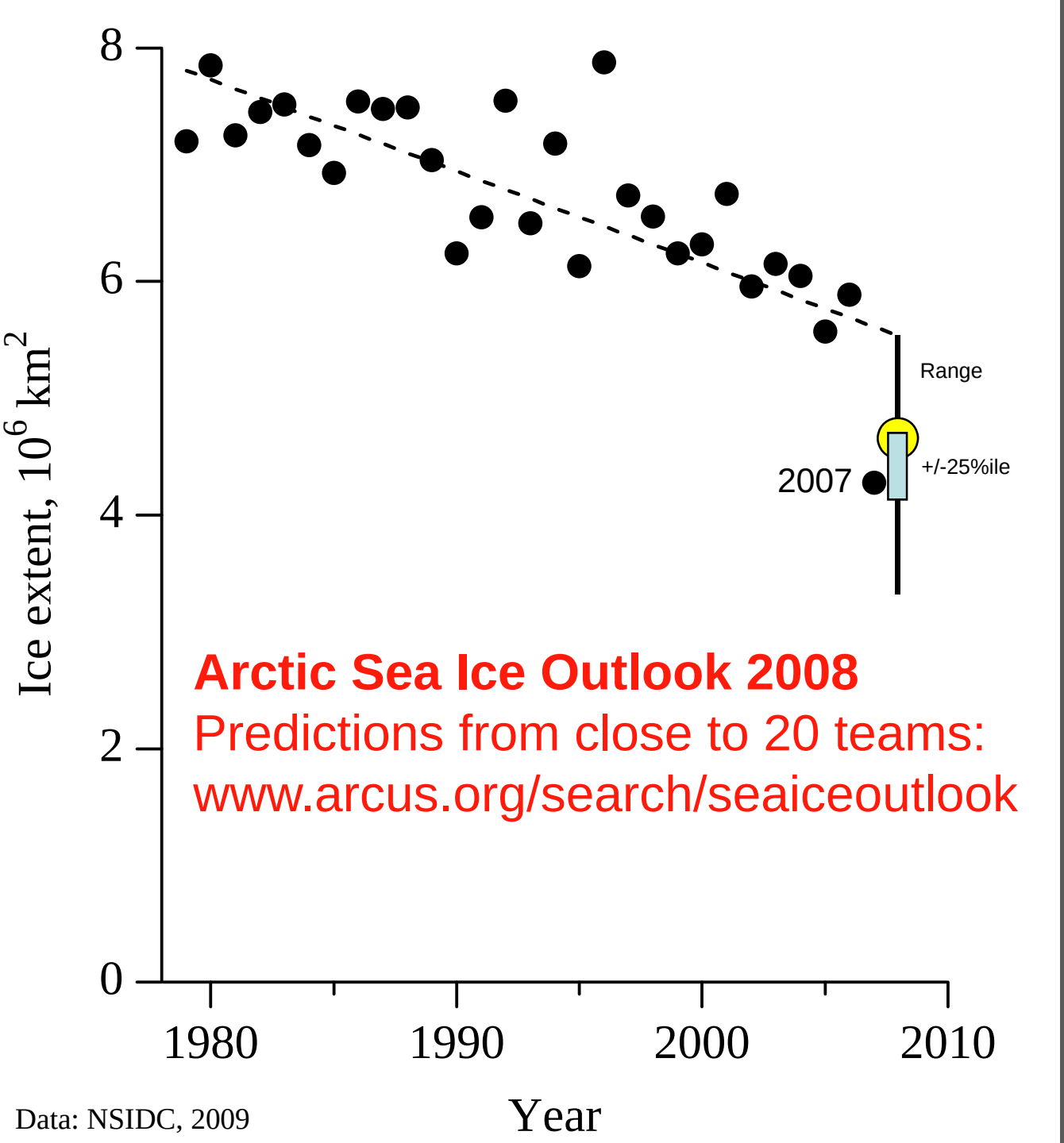
- IPY provided lots of measurement platforms, model output and expert input

2008 Arctic Sea Ice Outlook

www.arcus.org/search/seaiceoutlook



- International effort (led by EU DAMOCLES & US SEARCH programs, coordinated by Jim Overland) to anticipate, track and evaluate Arctic seasonal ice evolution in the summer of 2008
- Roughly two dozen contributors: statistical, heuristic, numerical and other models, discussion & integration of observations
- Continuation for 2009 underway - visit web site & contribute!



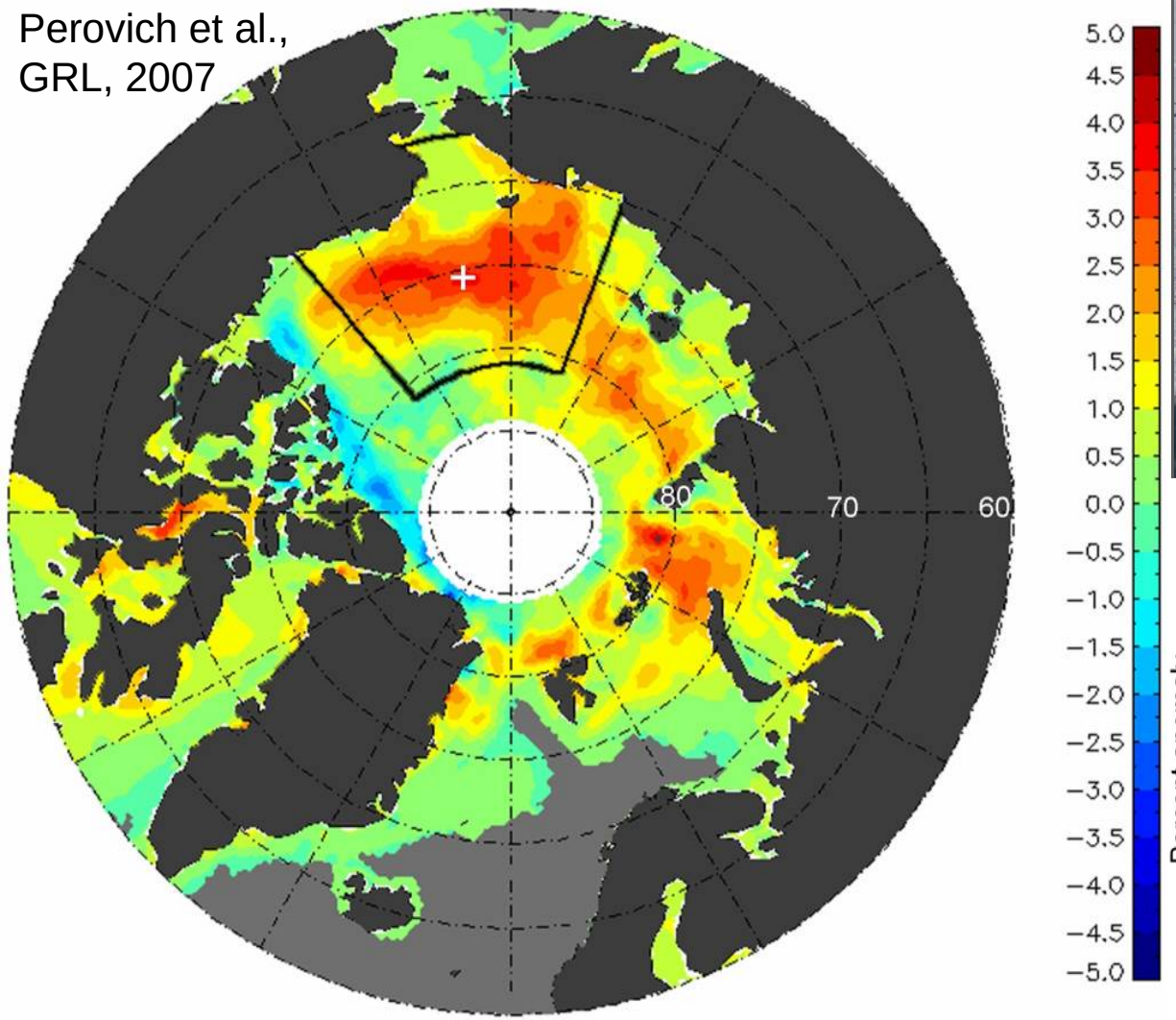
Key considerations of forecasters

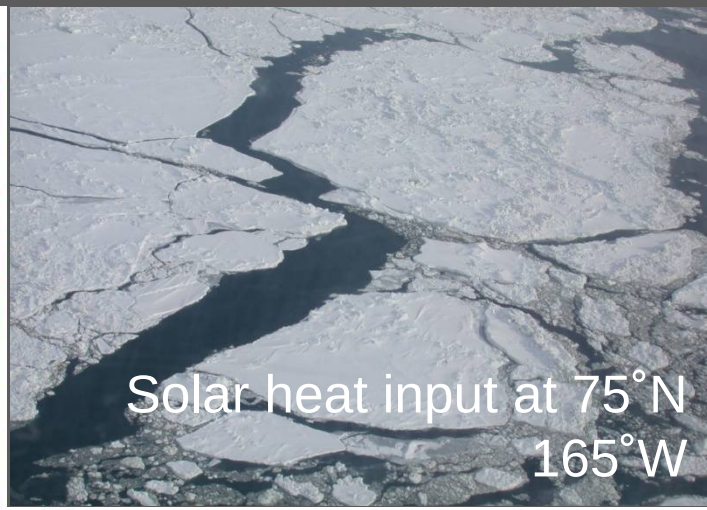
- Importance of preconditioning (heating of ocean in preceding year)
- Fate of first-year ice through melt cycle
- Vagaries of the weather: May through August

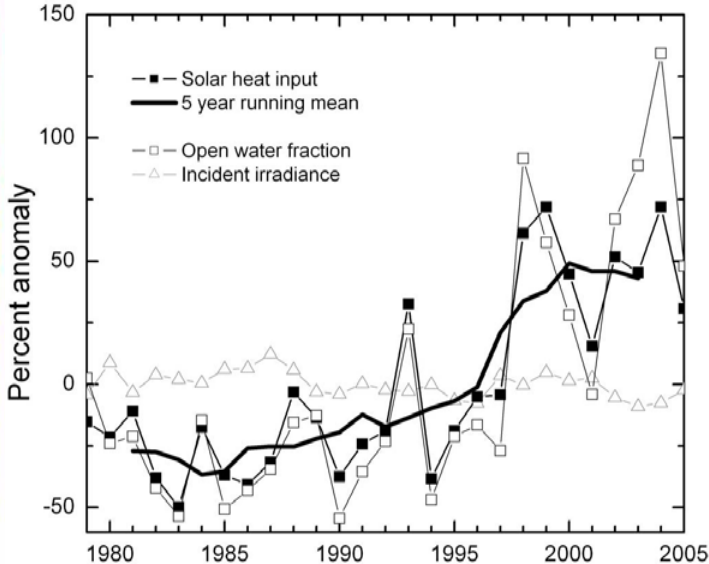
Solar heat into surface waters in pack ice: Ice-albedo feedback hard at work?

Solar heating linear trend (% yr^{-1}, 1979-2005)

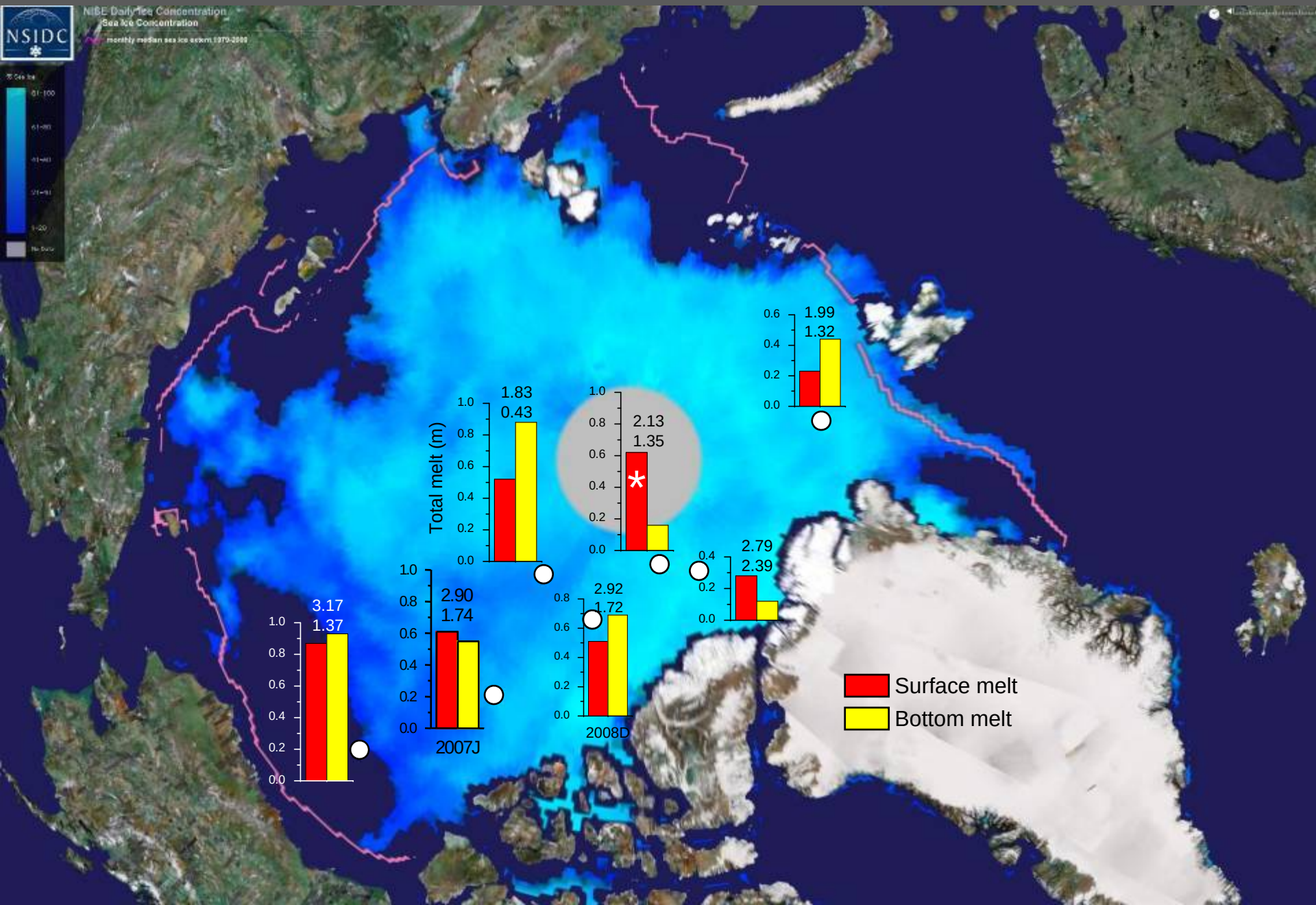
Perovich et al., GRL, 2007



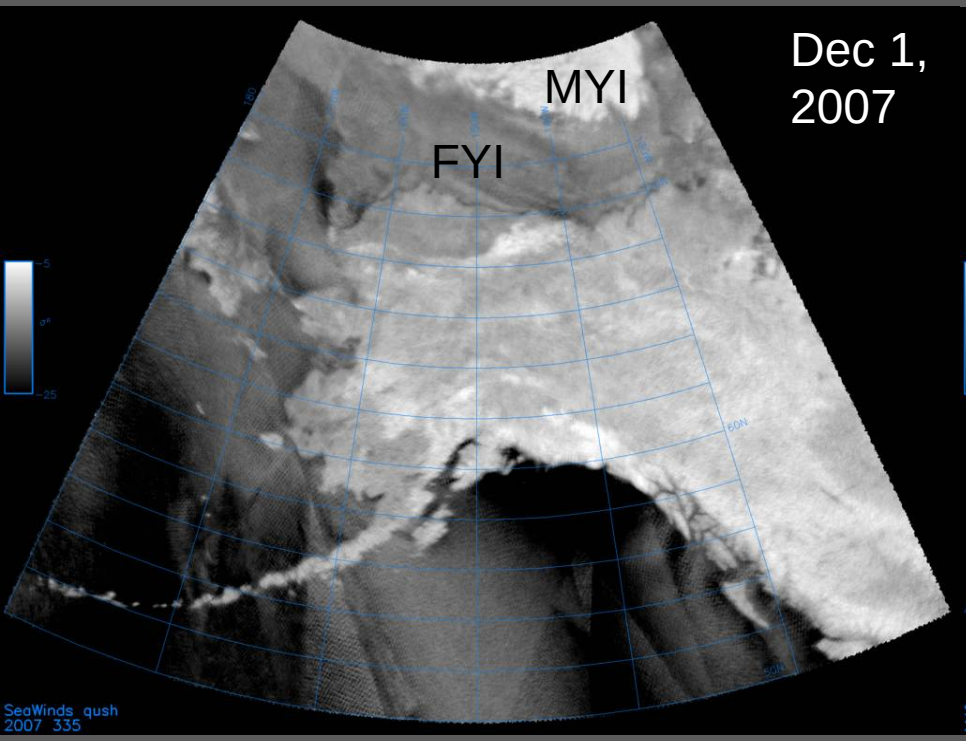


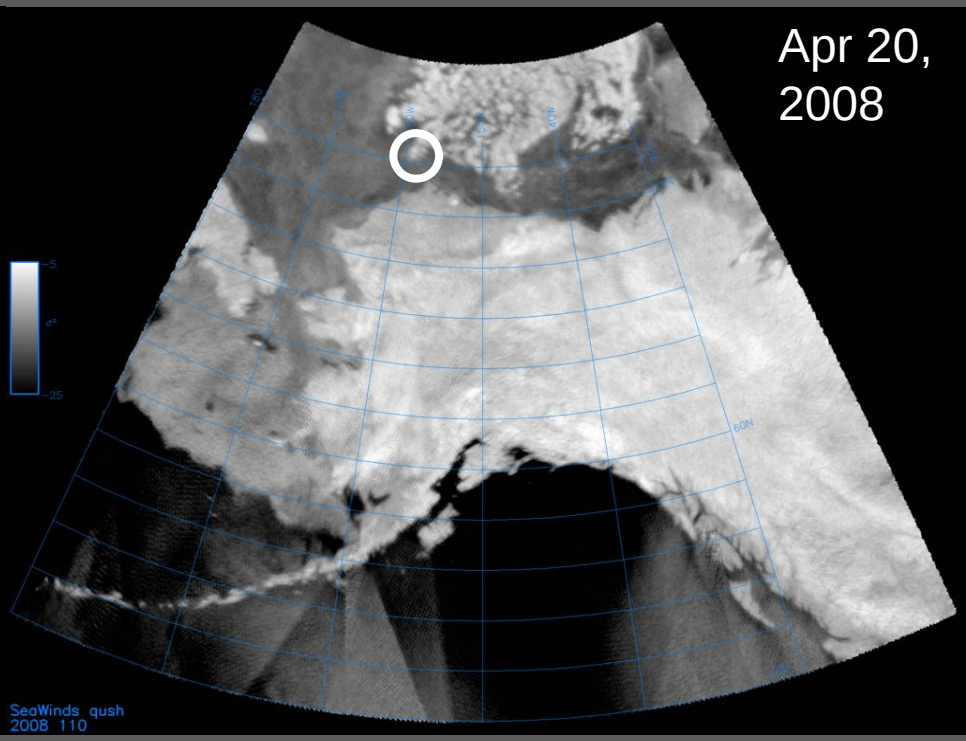


2008: Results from IPY mass-balance buoys (Perovich et al.)



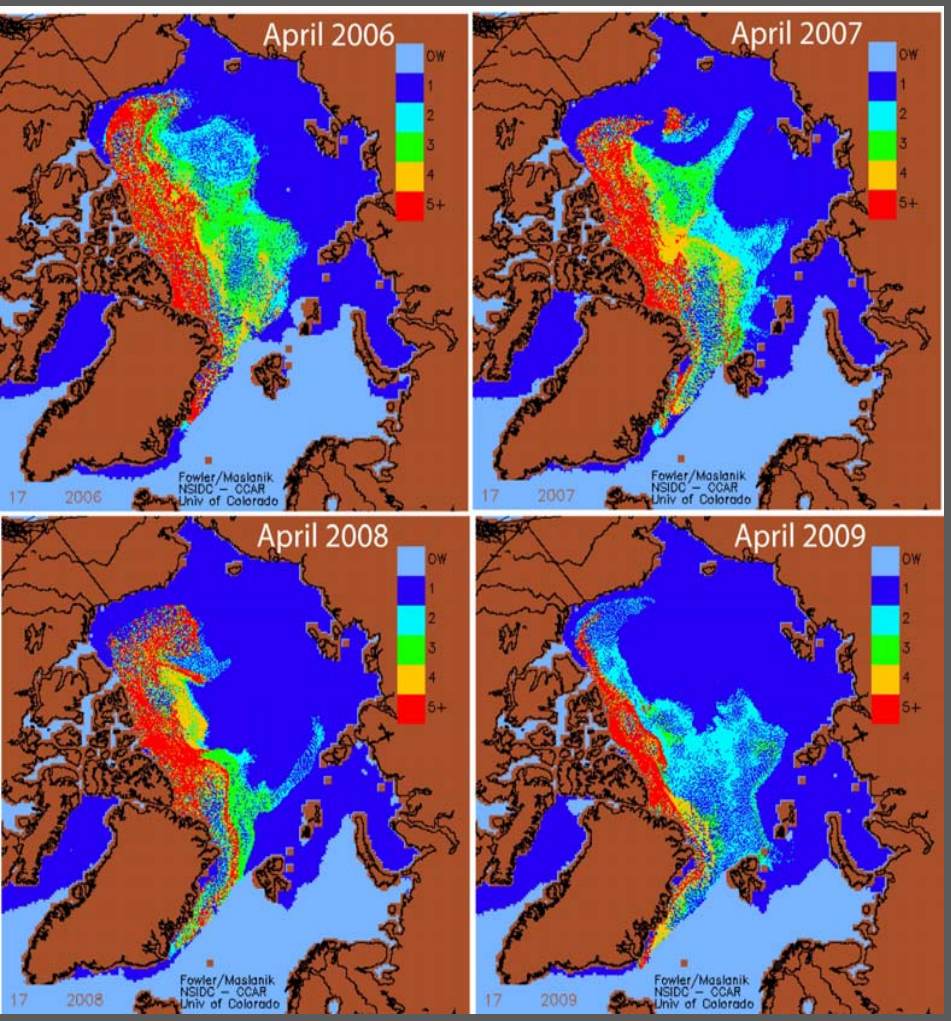
Faster ice movement still advects some thick, old ice north of Alaska





- Ice circulation patterns & increased ice velocities help bring old (multiyear) ice to Beaufort Sea coast
- Measurements off Barrow in April 2008: 5-7 year old, 3.5 m thick ice from High Canadian Arctic
- April 2009: First-year ice thicker than 2008, less multi-year ice of comparable thickness, though possibly younger age (to be confirmed)

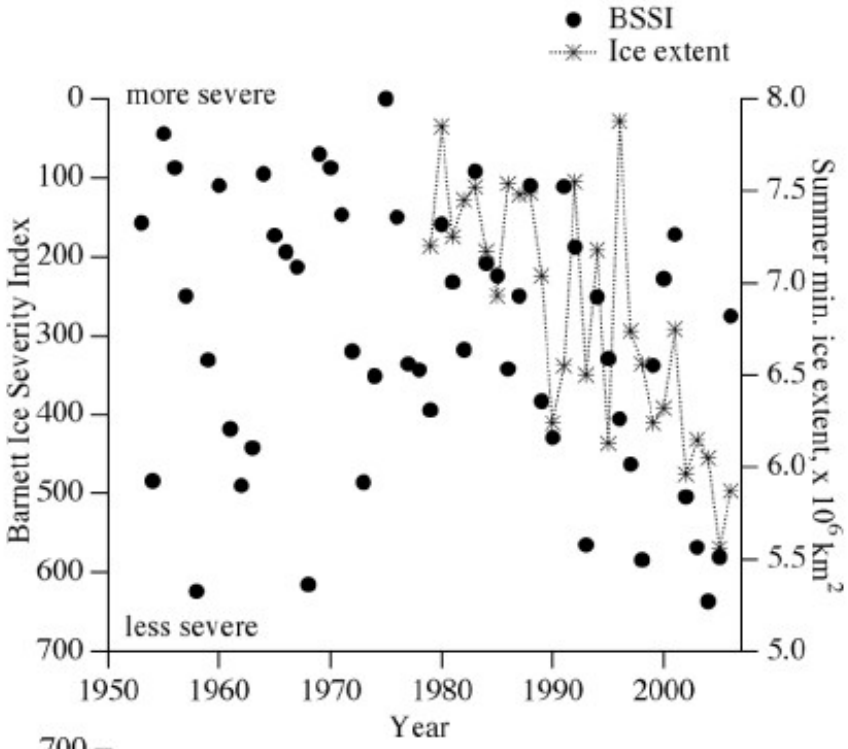
Sea Ice Outlook 2009: Ice age distribution

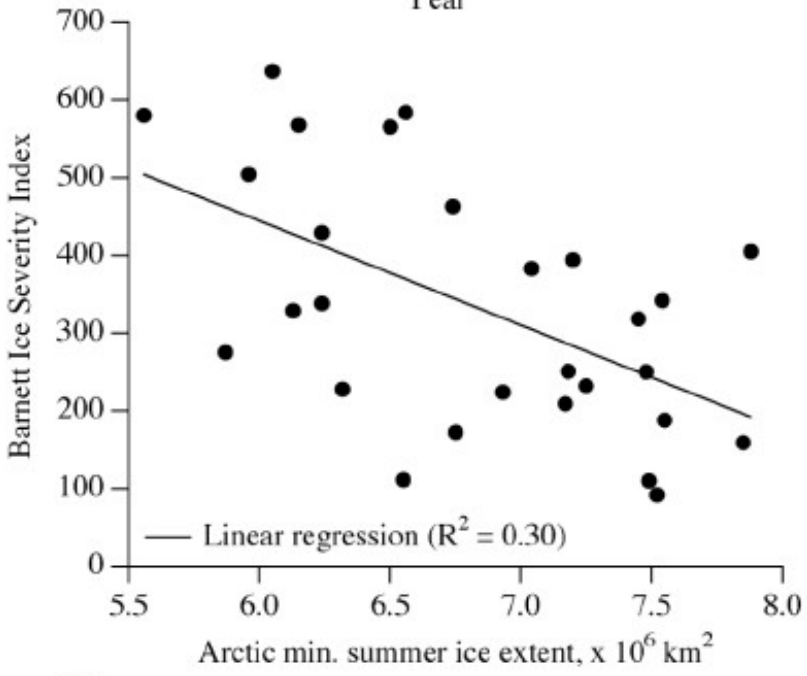


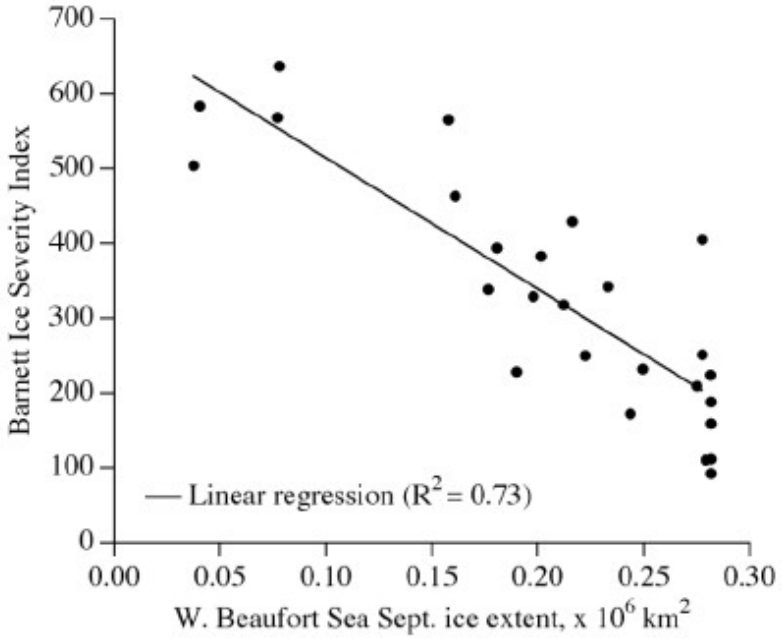
- Maslanik & Fowler: Age distribution derived from ice velocity fields (obtained from passive microwave data)
- 2009 has the smallest proportion of old ice since 1979
- Large variability and big reduction in ice age in Alaskan Arctic
- Reduction in multi-year ice impacts marine mammals and subsistence hunters

How do regional and local ice conditions scale with pan-Arctic ice variability?

- September minimum ice extent explains 30 % of observed variance in Barnett Ice Severity Index
- W Beaufort Sea Sept. ice extent explains 73 %







Eicken et al., *Arctic*, 2009

Correlation matrix for different Arctic and northern Alaska sea-ice variables

	Arctic annual minimum ice extent	**West Beaufort September Ice extent**	**Barnett Ice Severity Index (BSI)**
West Beaufort September Ice extent	**0.699**$^{+}$		
BSI	**-0.55**	**-0.853**	
First landfast ice at Barrow	0.246	-0.255	0.611
First stable landfast ice at Barrow	0.075	-0.032	0.257
Landfast ice break-up at Barrow	0.362*	0.642*	*-0.769**
First landfast ice at Prudhoe Bay	-0.078	-0.535	0.577
First stable landfast ice at Prudhoe Bay	-0.307	*-0.765*	**0.884**
Landfast ice break-up at Prudhoe Bay	0.221*	0.575*	-0.604*

+ Correlation coefficients r significant at 99%-level are shown in bold, those significant at 95%-level are shown in italics (two-tailed Student t test)

** evaluation for minimum ice extent in the subsequent rather than the preceding season*

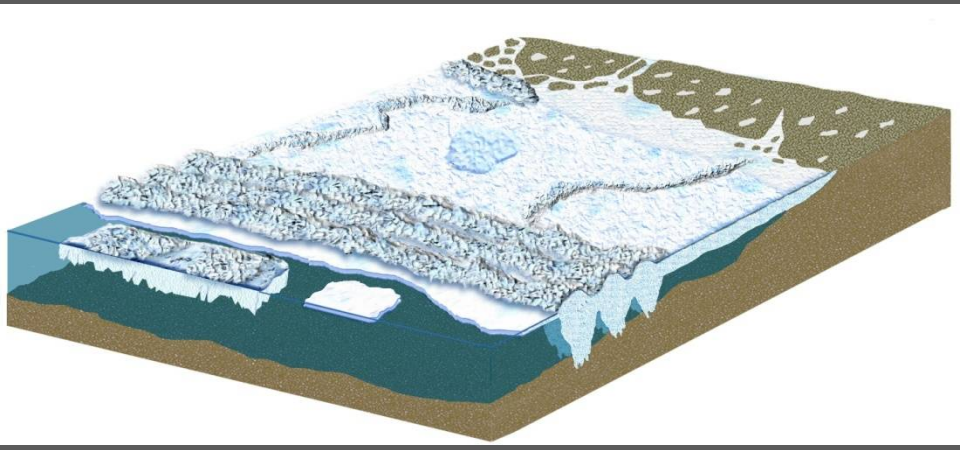
Photos: Winton Weyapuk Jr.

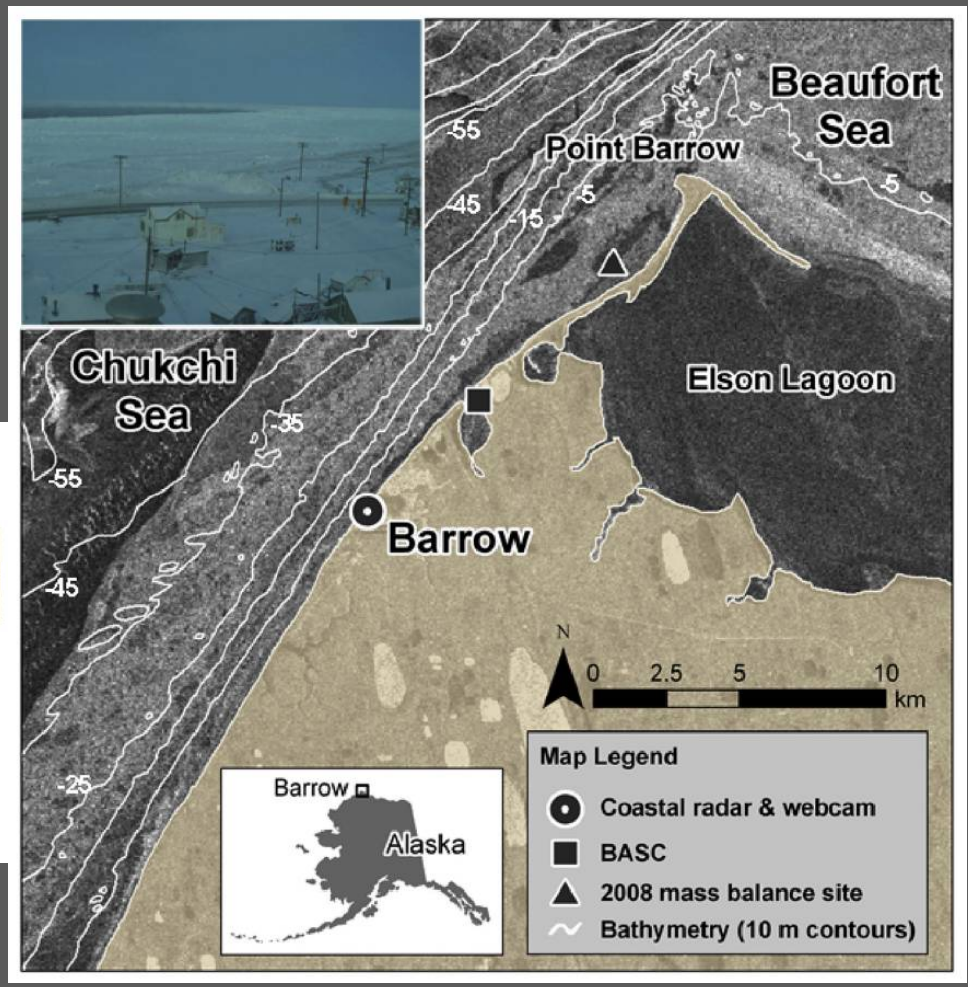
- Use of sea ice as platform by marine mammals (walrus, seals)
- Use of sea ice as a platform for hunting & butchering by Iñupiaq & Siberian Yupik hunters

Local conditions at Barrow, AK

- *Remote sensing* (km-scale)
- *Coastal radar* (sub-km scale)
- *Thickness and topography* (sub-km)
- *Ice mass-balance* site (10s m-scale)
- *Local Iñupiaq ice observations* (J. Leavitt, A. Brower Sr. and others)

www.sizonet.org



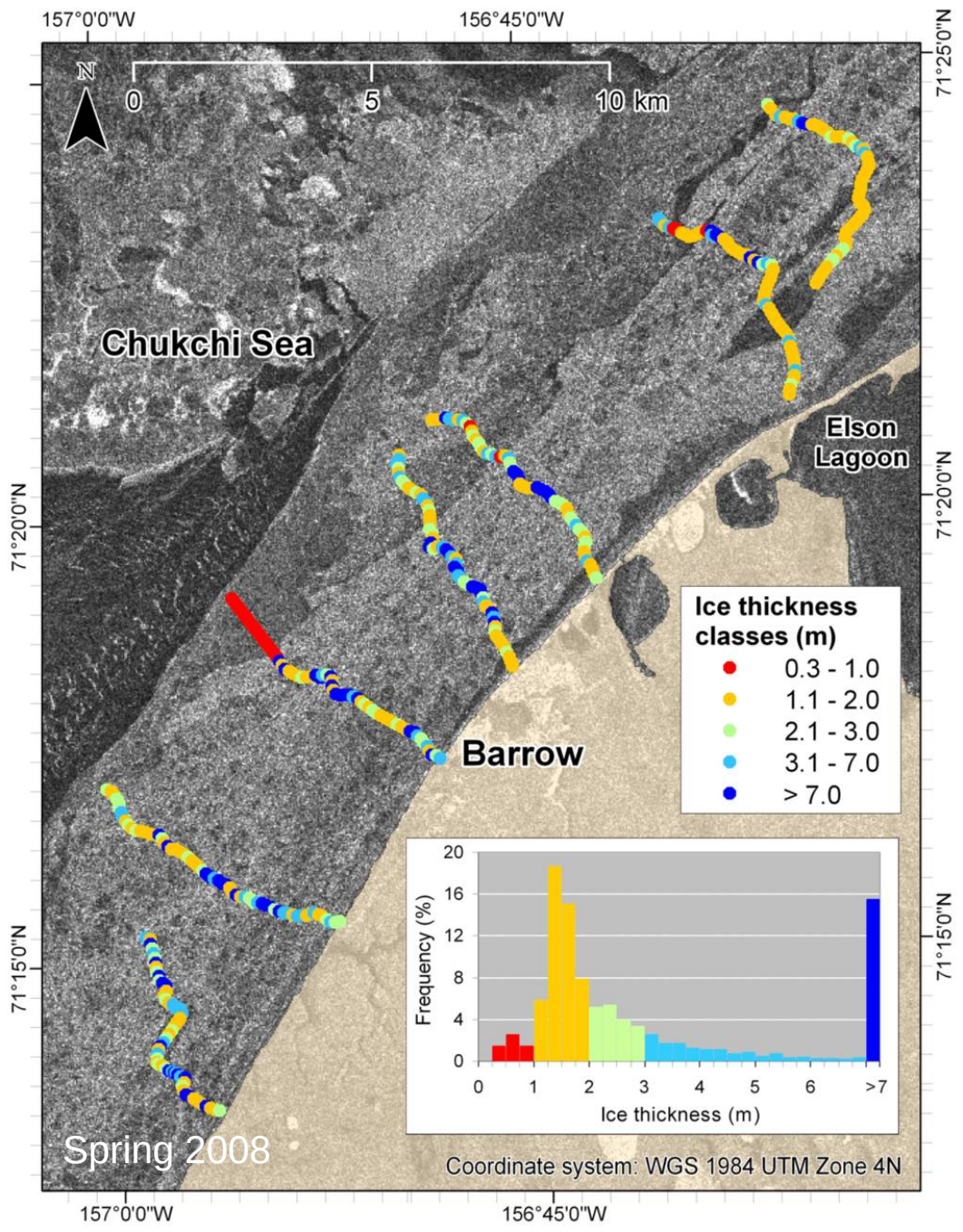


- *Seasonal Ice Zone Observing Network (SIZONet) IPY Project with support from NSF-AON and NOAA AK Ocean Observing System*

M. Druckenmiller et al.

Tracking ice use & ice stability

- Trails for hunting camps established annually
- Thickness (EMI) & surf. elevation (DGPS) data collected trail on system
- Interviews with hunters

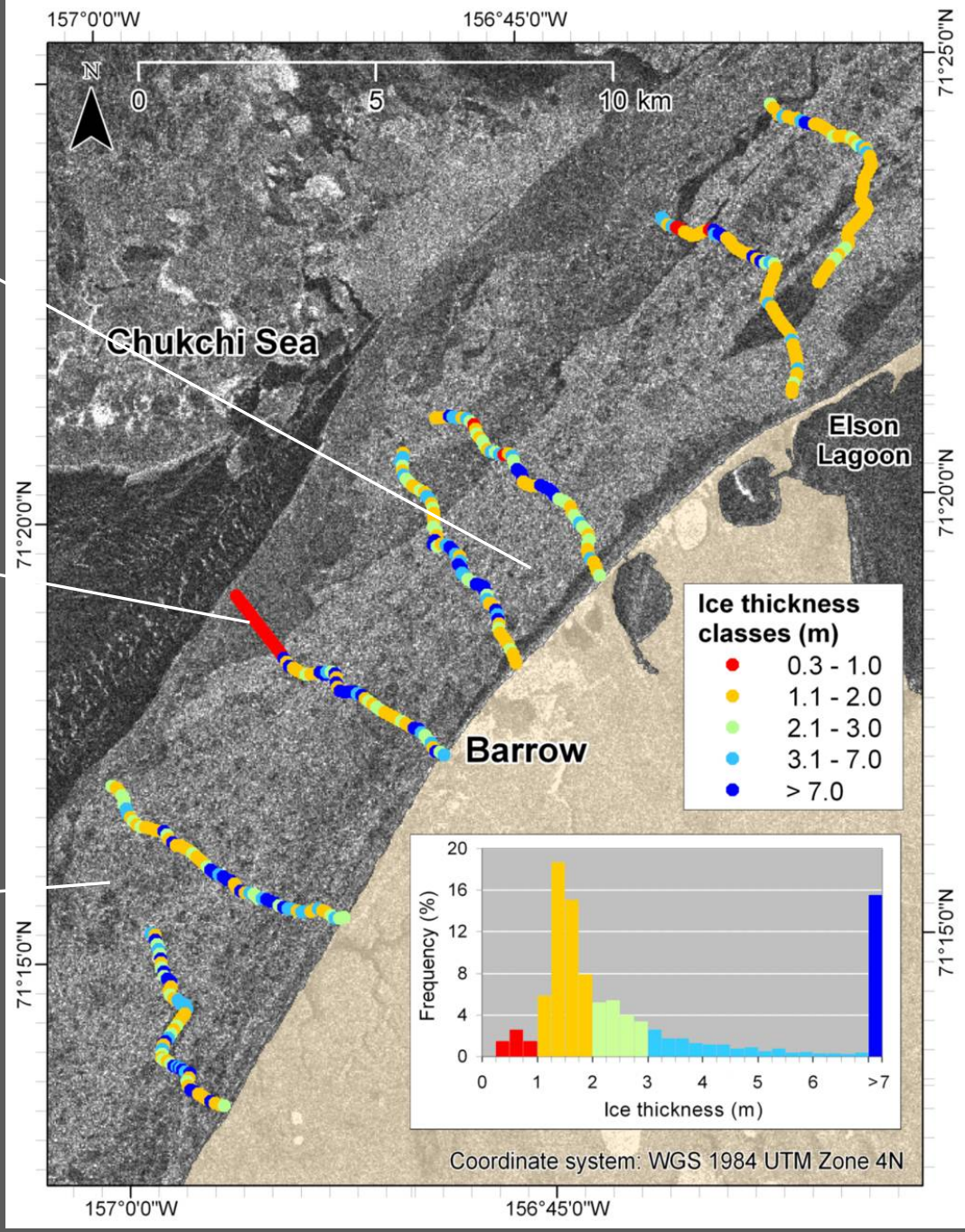


Coastal sea-ice change during past two decades

Ice is rougher but fewer large pressure ridges, reducing landfast ice stability

Thinner ice impacts load-bearing capacity & harvesting of whales

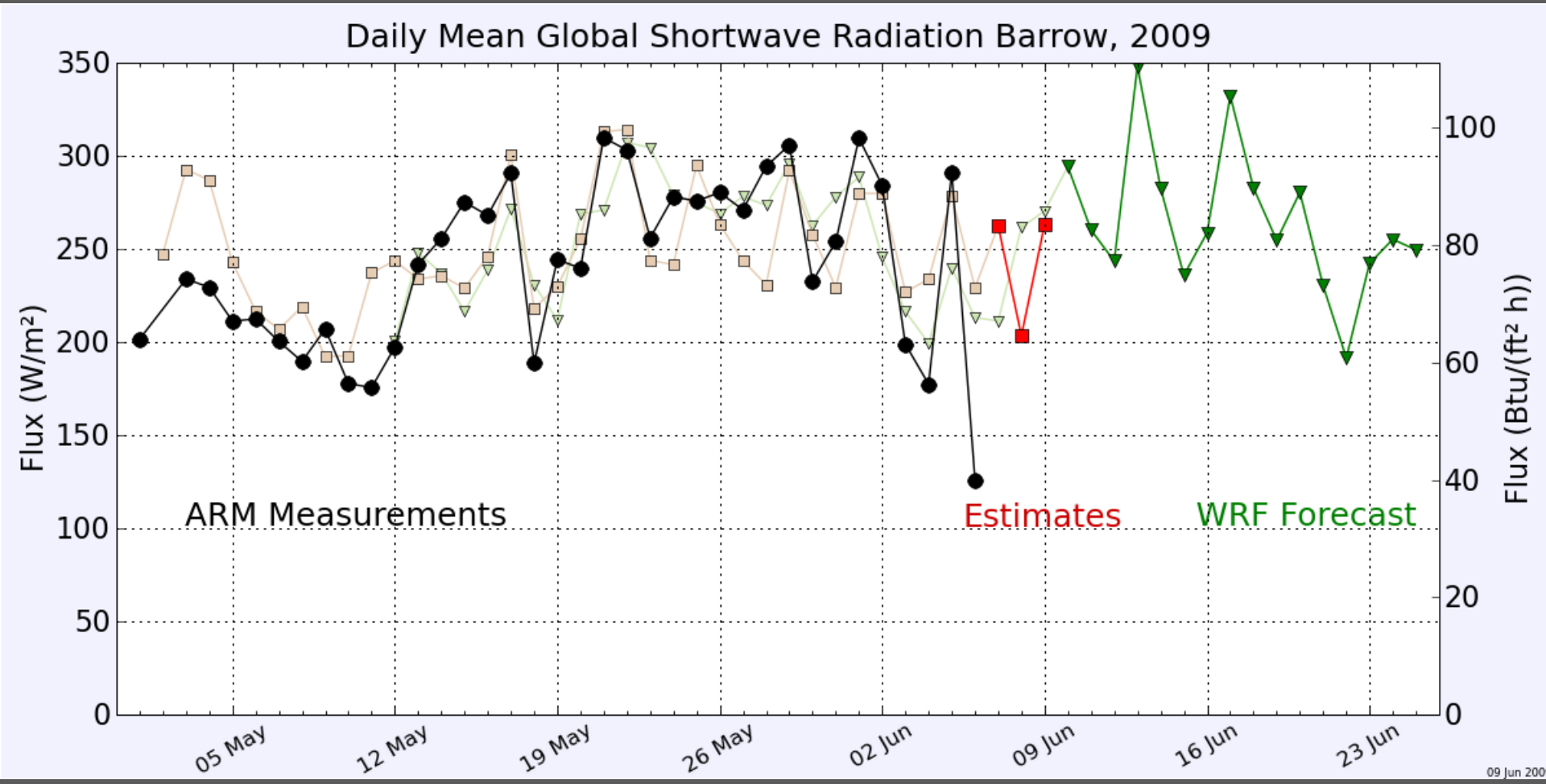
Lack of multiyear ice & more dynamic ice pack reduce landfast ice stability and impact access to marine mammals



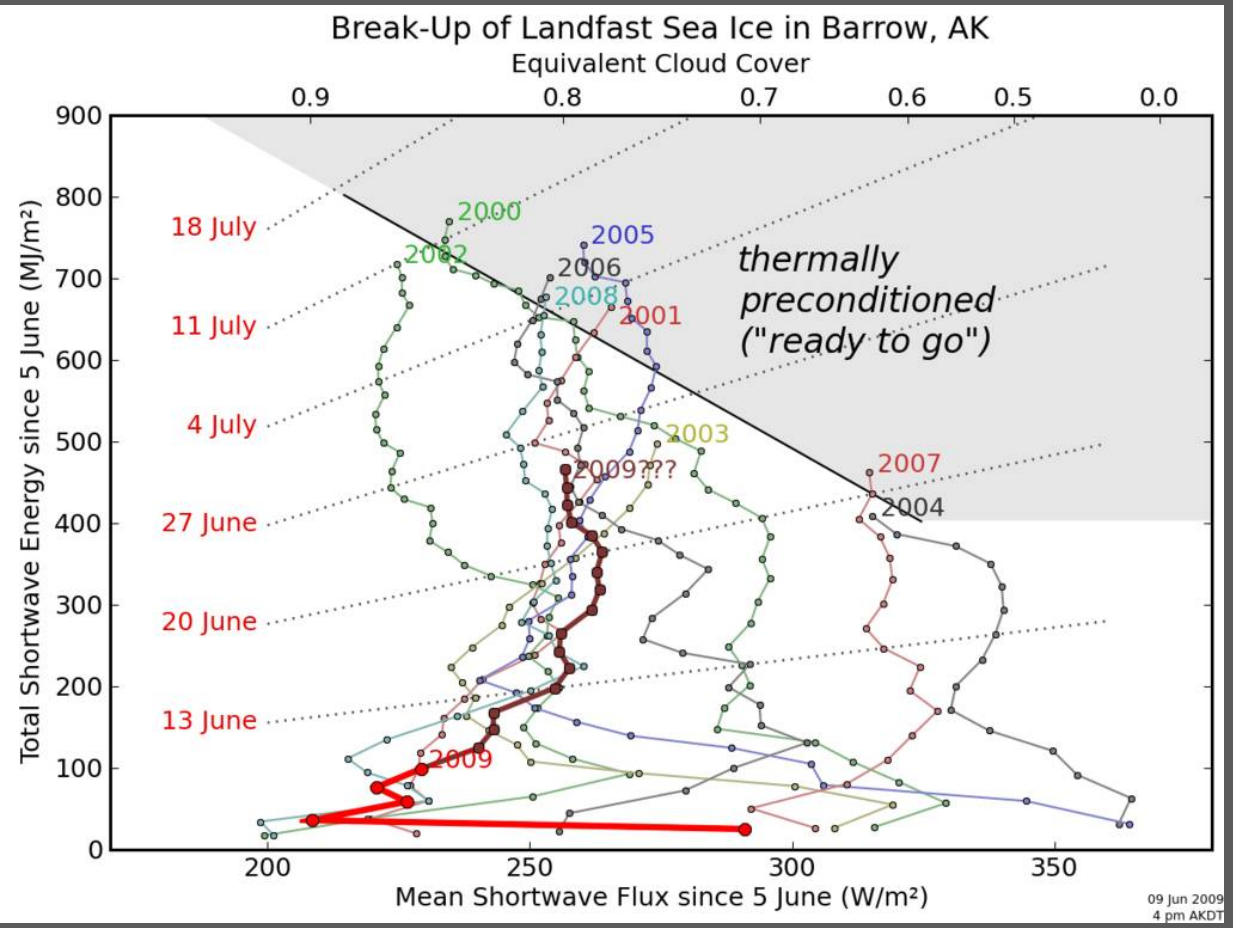
Can ice break-up be predicted?

- Case study at Barrow www.gi.alaska.edu/BRWICE
- Ice decay and melt-out driven by solar heat input melting level landfast ice matrix
- Ice break-up driven by sealevel variations and currents, dislodging and removing grounded pressure ridges

2009 Solar radiation at Barrow



Can ice melt-out be predicted?



- Case study at Barrow
- Ice decay and melt-out driven by solar heat input melting level landfast ice matrix

Petrich & Eicken:
www.gi.alaska.edu/snowice/sea-lake-ice/Brw09/forecast/

Sea ice predictability: present status

- Pan-Arctic minimum ice extent appears to have predictability several months in advance
  - -- ice age distribution
  - -- preconditioning

- Correlations between pan-Arctic extent and local conditions are not high

- Melt-out of coastal ice appears to have short-range (~weeks) predictability, with accumulated solar flux as a key predictor