Welcome

Sea Ice Prediction Network (SIPN) Webinar

"The 2015 Sea Ice Outlook: Post-Season Discussion "

Today's presenters:

Julienne Stroeve is a Senior Research Scientist at the National Snow and Ice Data Center (NSIDC) within the Cooperative Institute for Research in Environmental Sciences (CIRES). Her Arctic research interests have focused on the sea ice cover and include sea ice predictability, climate change, and associated local and large-scale impacts.

Larry Hamilton is Senior Fellow at the Carsey School of Public Policy, University of New Hampshire. He does research on human communities in the Arctic, and on public knowledge and perceptions of science.

Cecilia Bitz is a professor in Atmospheric Sciences at University of Washington, and she is part of the UW Program on Climate Change. Her research focus is on climate and climate change in the high latitudes, especially involving the cryosphere. She is currently working on Arctic sea ice predictability, the hydroclimate of Antarctica, and climate control of snow depths on sea ice.

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- **All participants have been muted upon entry to this webinar.**
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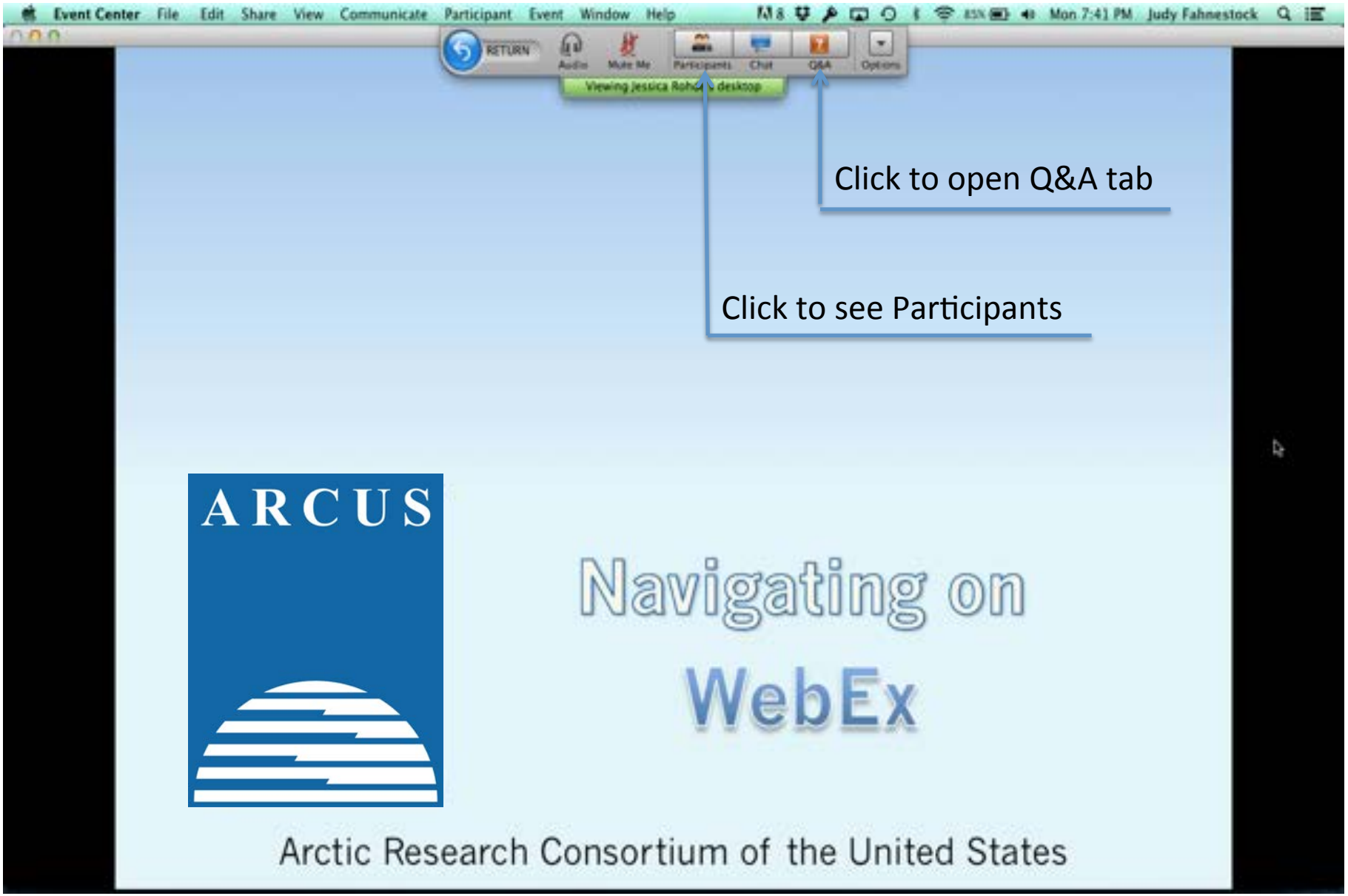
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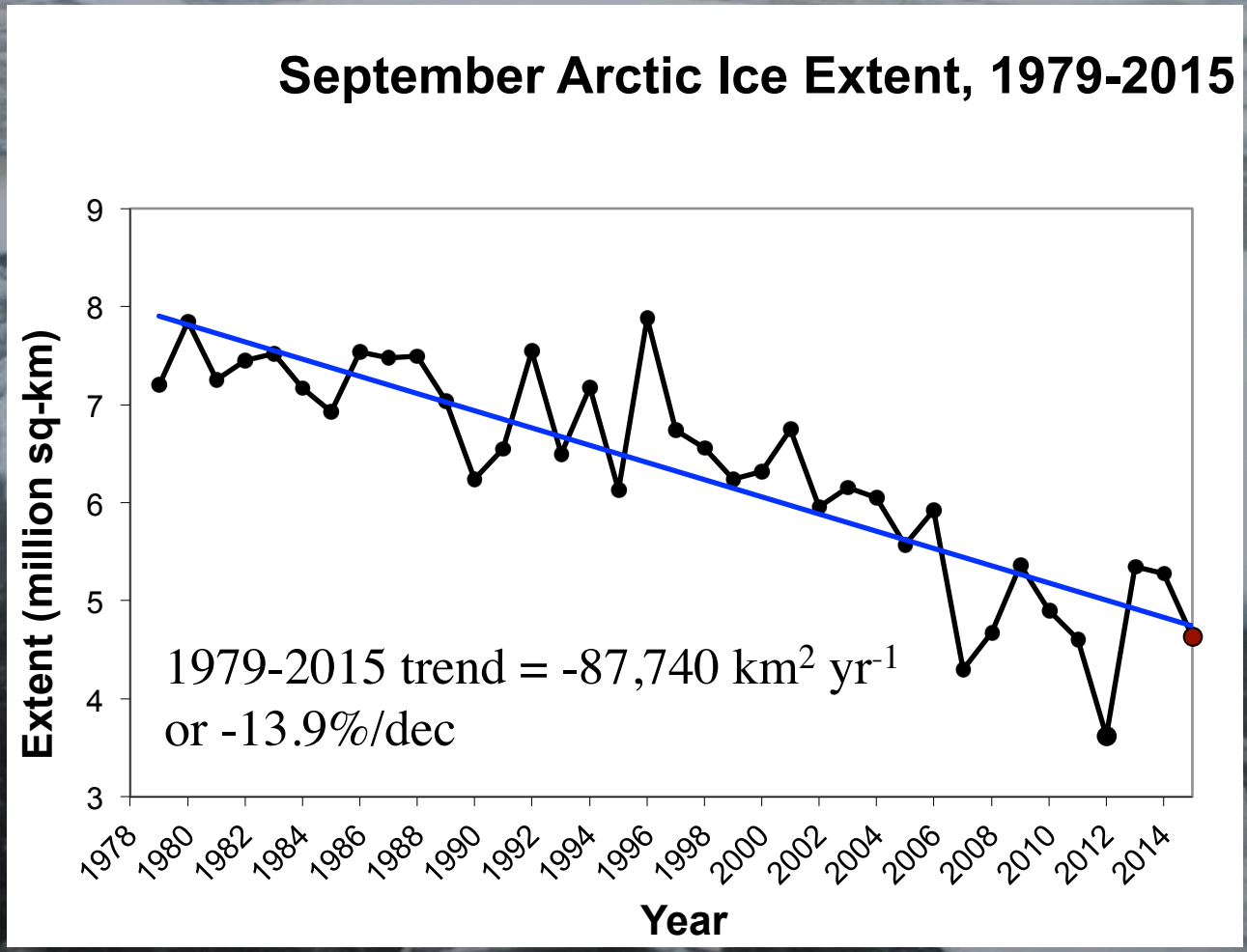
SIPN Webinar: Another Summer of Near Record-Low Sea Ice Conditions

J. Stroeve

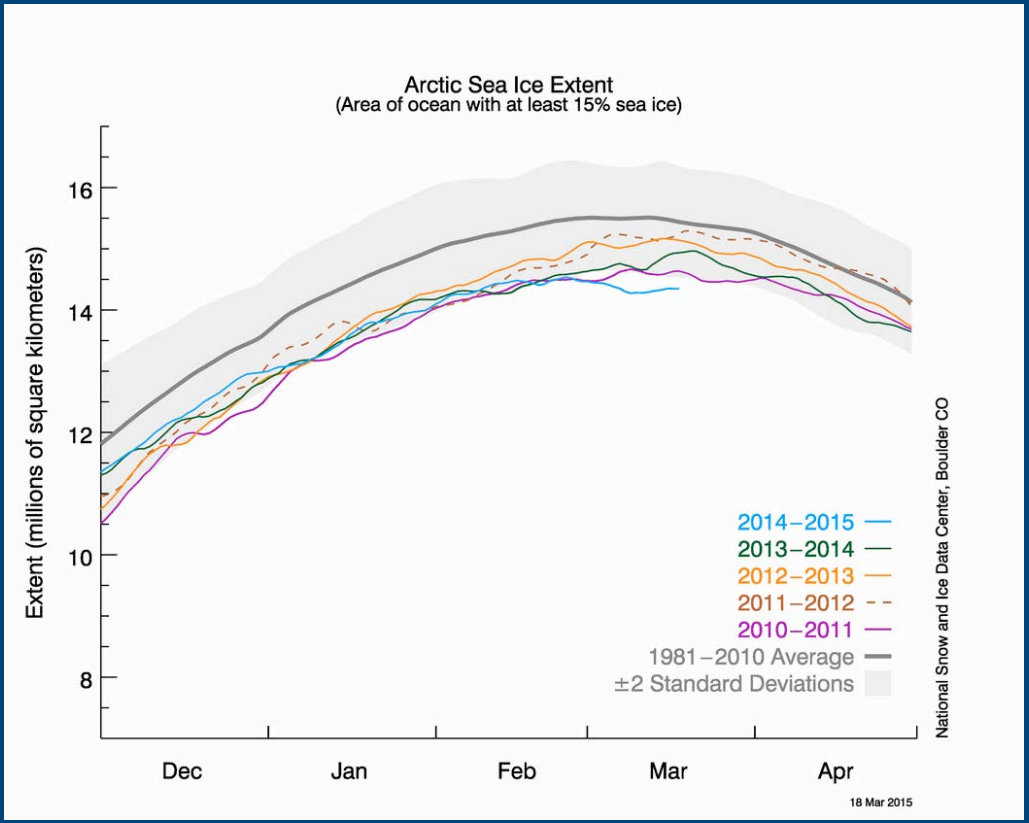
2015: Another year of near-record low sea ice

- 2015 ended up as the 4th lowest in the satellite data record.



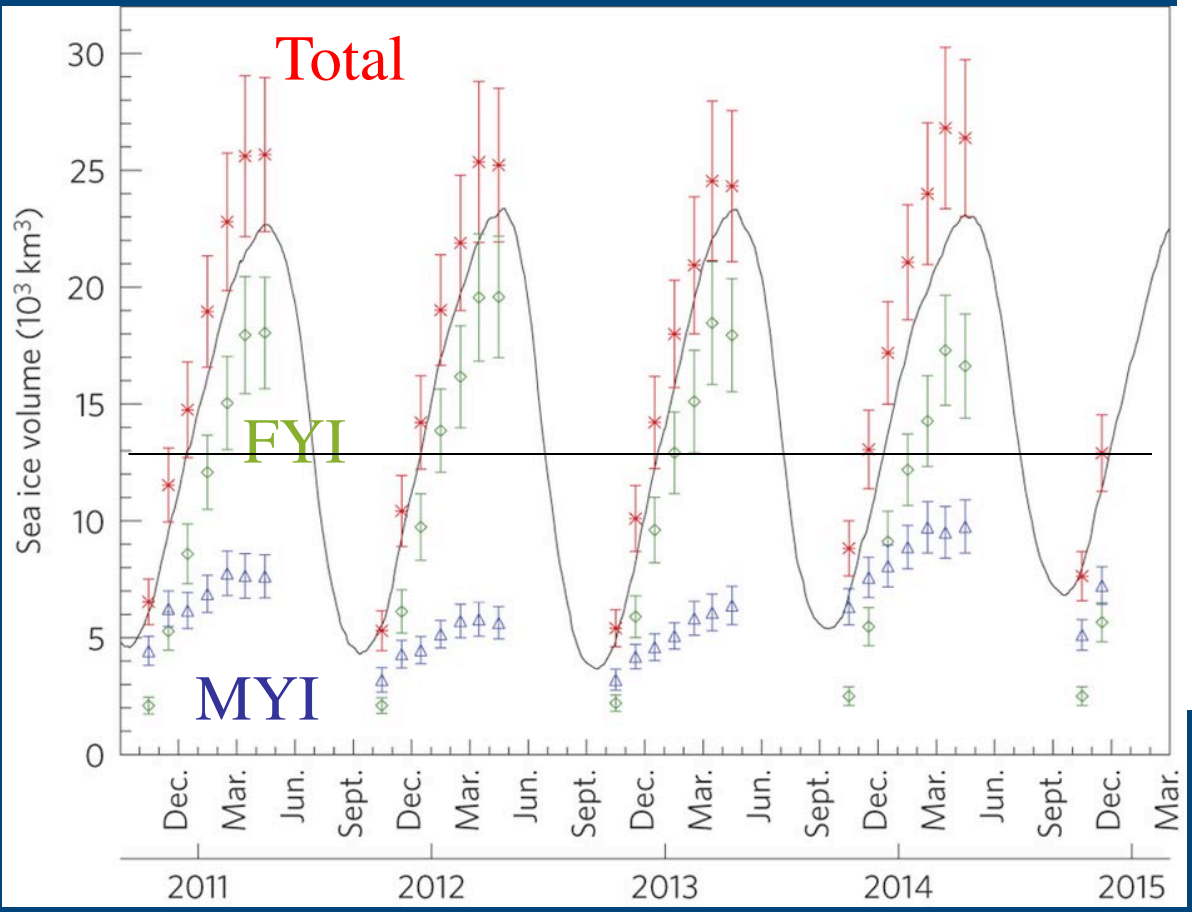
The Set Up: Record minimum Maximum

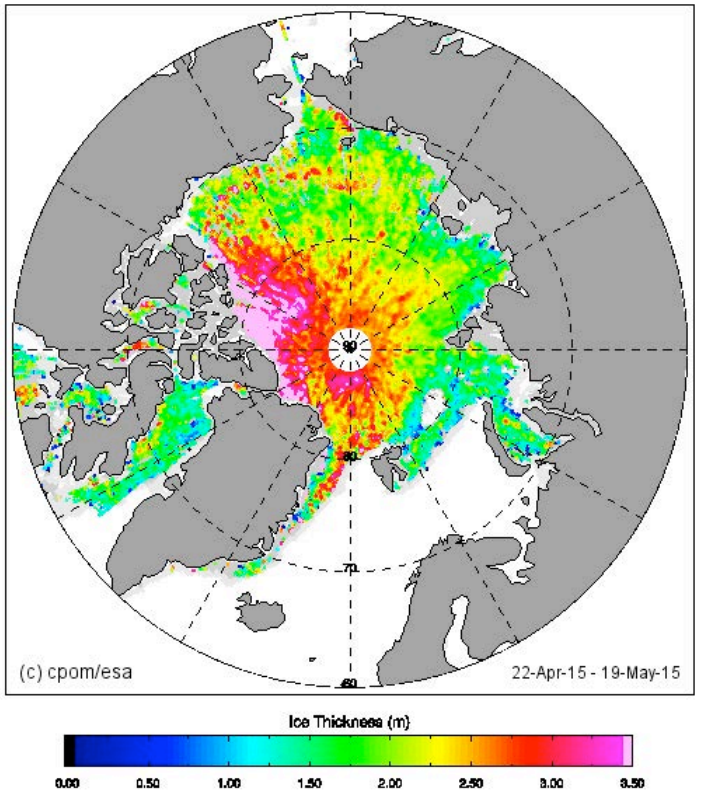
- This winter saw the lowest winter maximum, occurring on 25 February 2015, 1.1 $10^6 km^2$ below 1981-2010 average.
- Low winter ice extent was mostly a result of below normal sea ice conditions in Sea of Okhotsk and Bering Sea.



The Set Up: Thicker ice?

- Paper by Tilling et al. (2015) suggested a recovery of ice thickness in 2014.

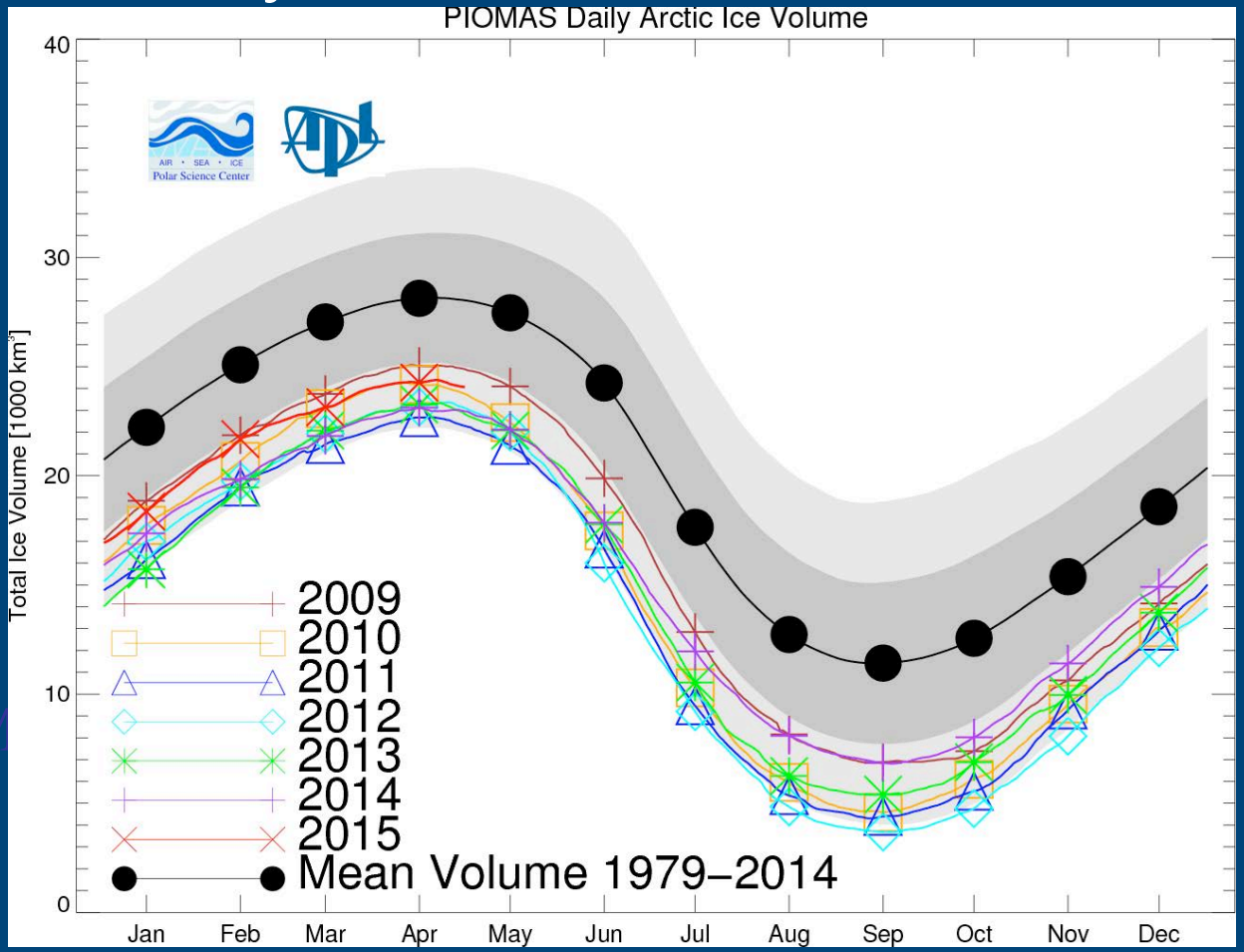




Total thickness in Dec 2015 about the same in 2014

The Set Up: PIOMAS volume

- PIOMAS also suggested higher spring ice volume than recent years.



The Set Up: Spatial pattern of MYI

- Both ASCAT imagery and ice age fields show advection of MYI into the southern Beaufort Sea

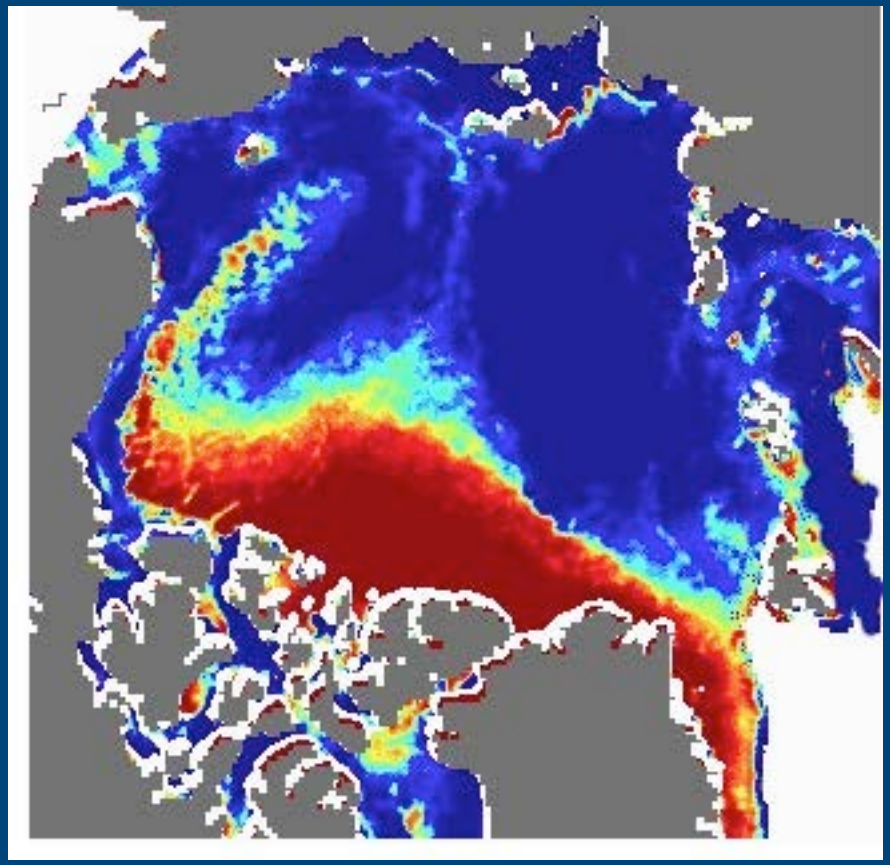
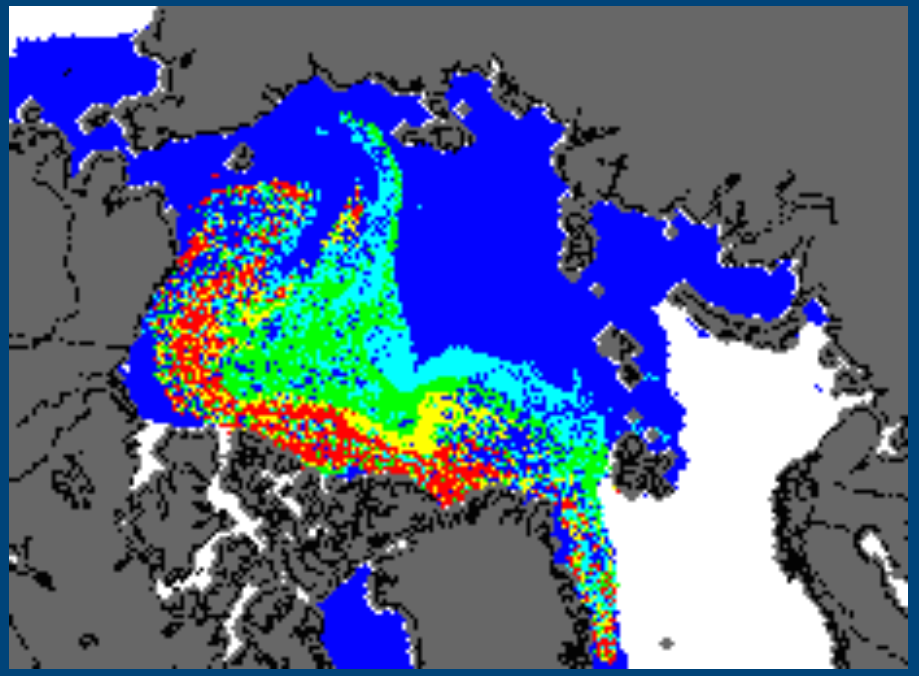
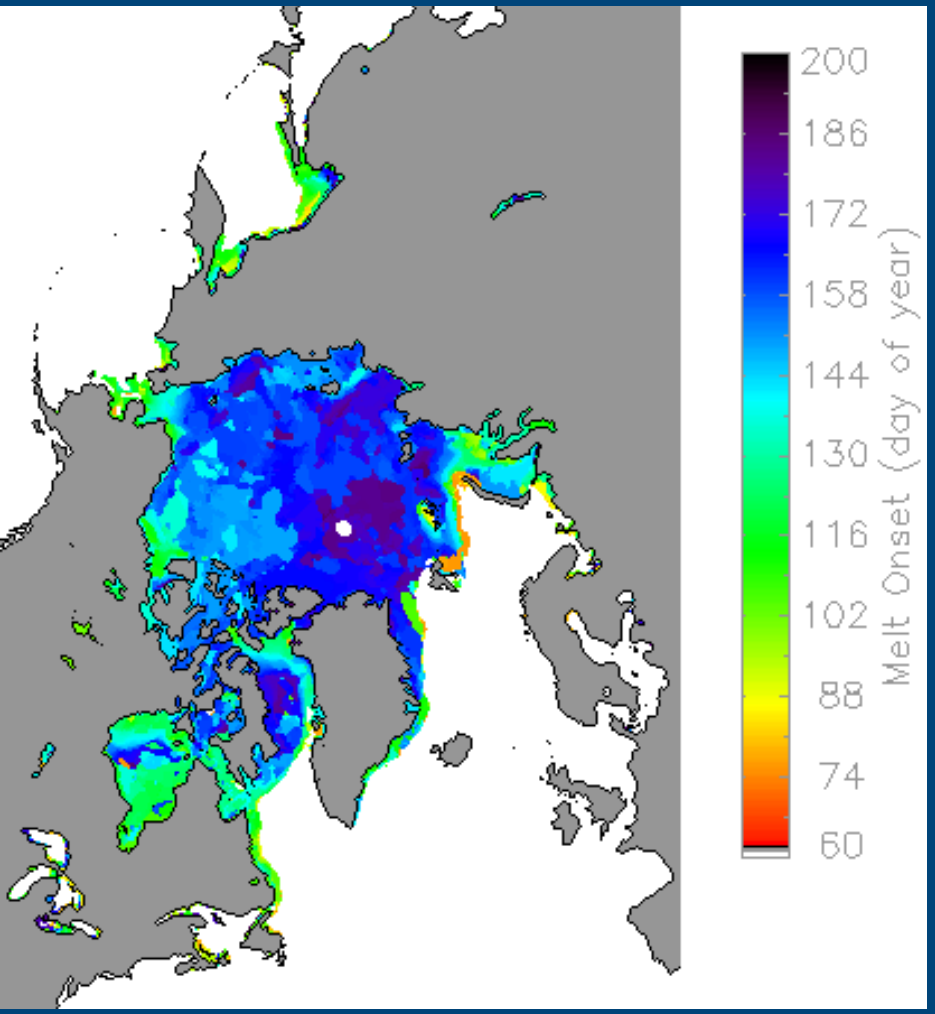


Image from R. Kwok

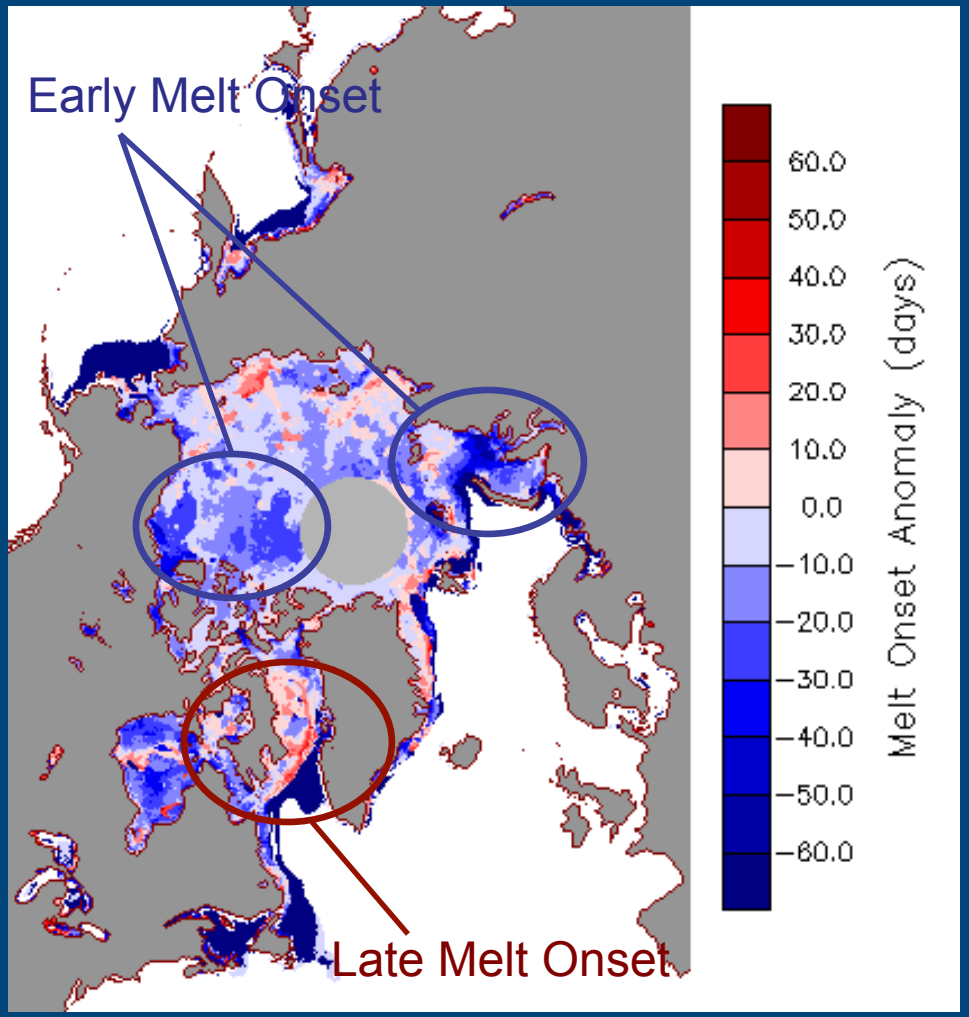


Timing of melt onset

Continuous Melt Onset



Melt Onset Anomaly



Early opening in Eastern Beaufort

- MODIS image from June 2

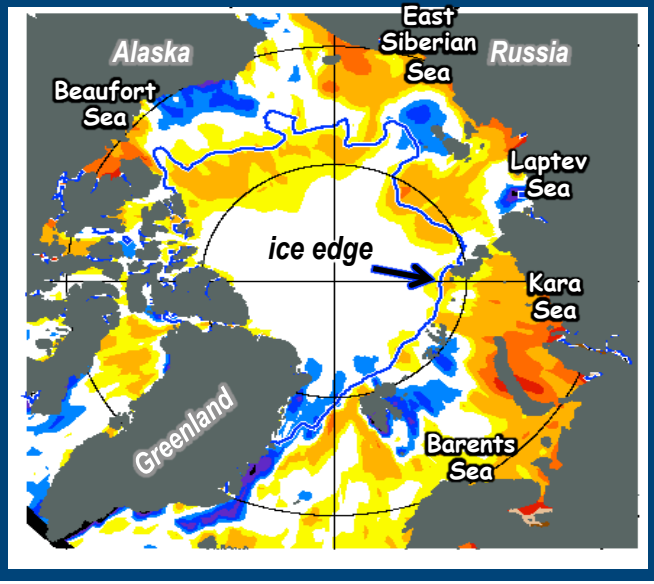
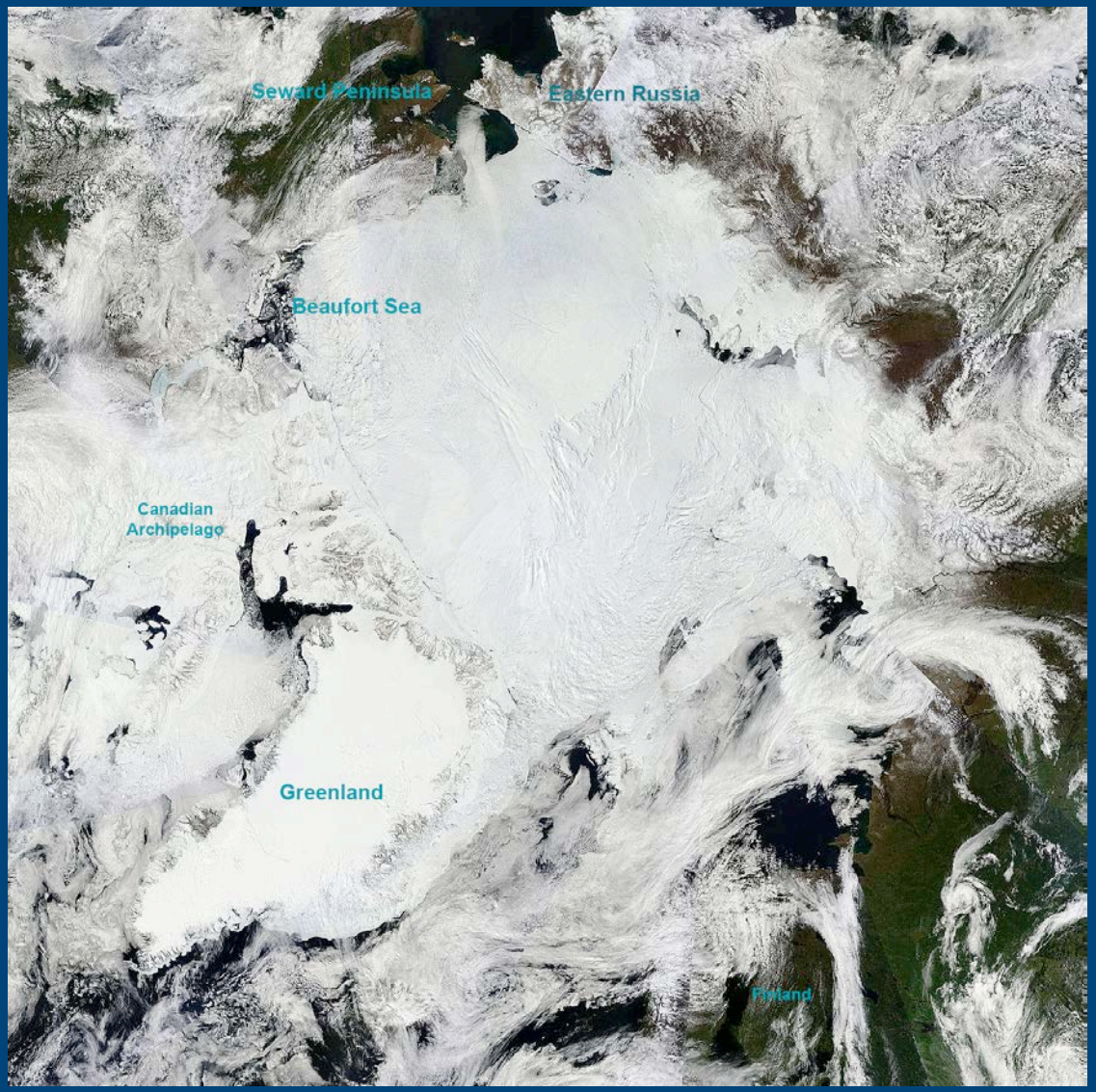
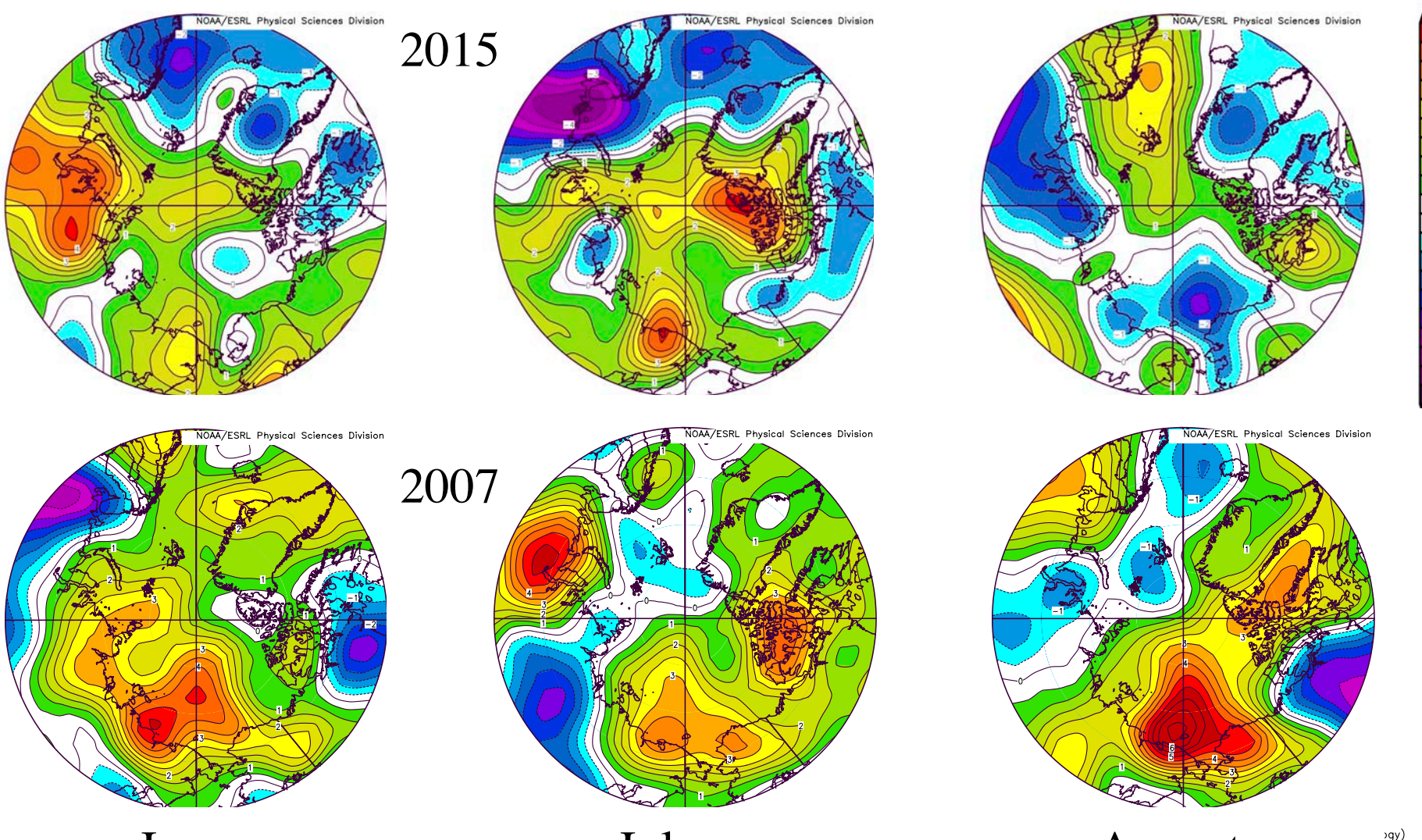


Image from M. Steele

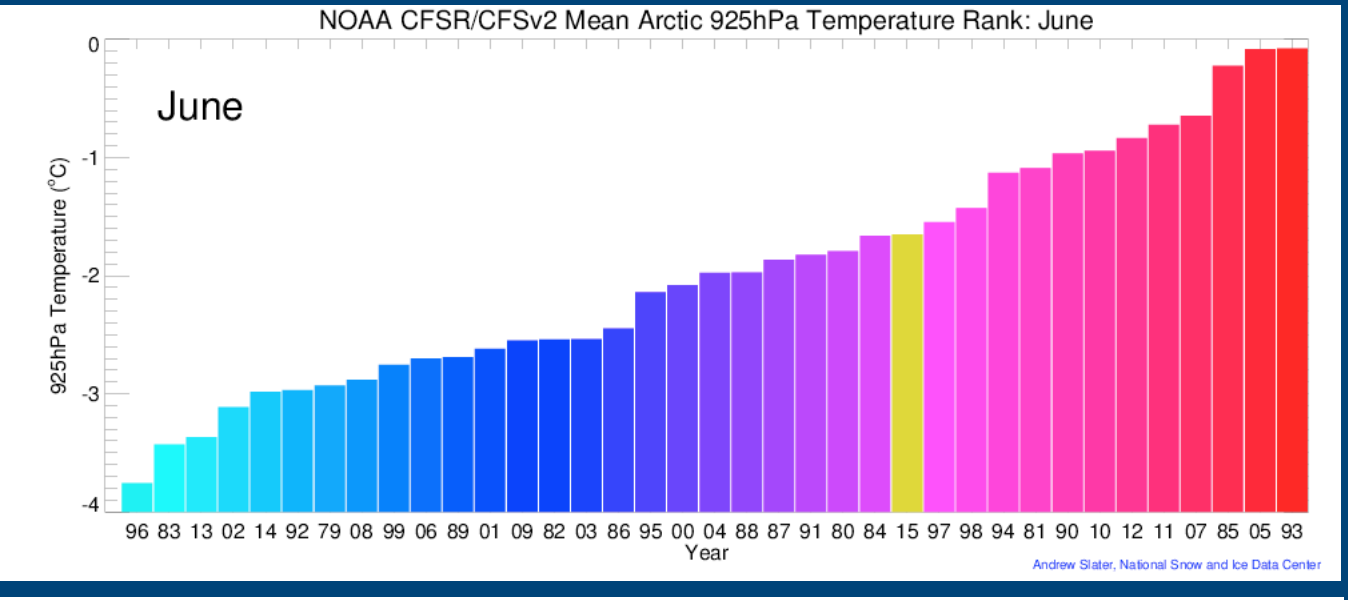


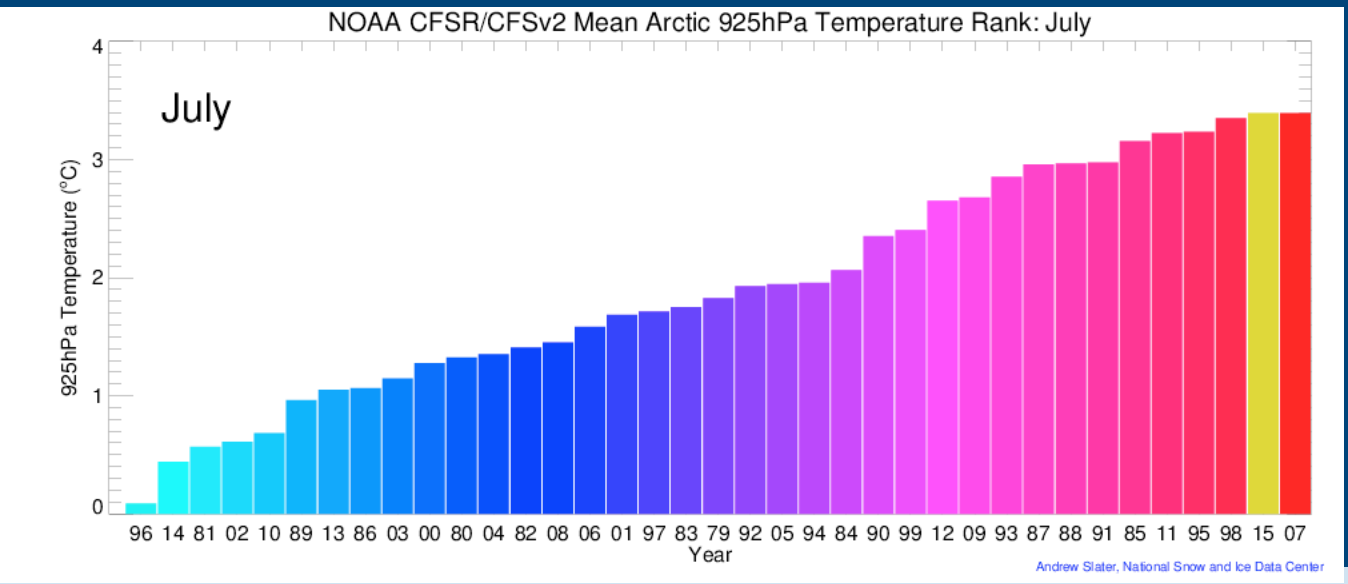
Summer weather patterns

925 hPa Air Temperature Anomalies
Relative to 1981-2010



Ranking of Arctic temperatures



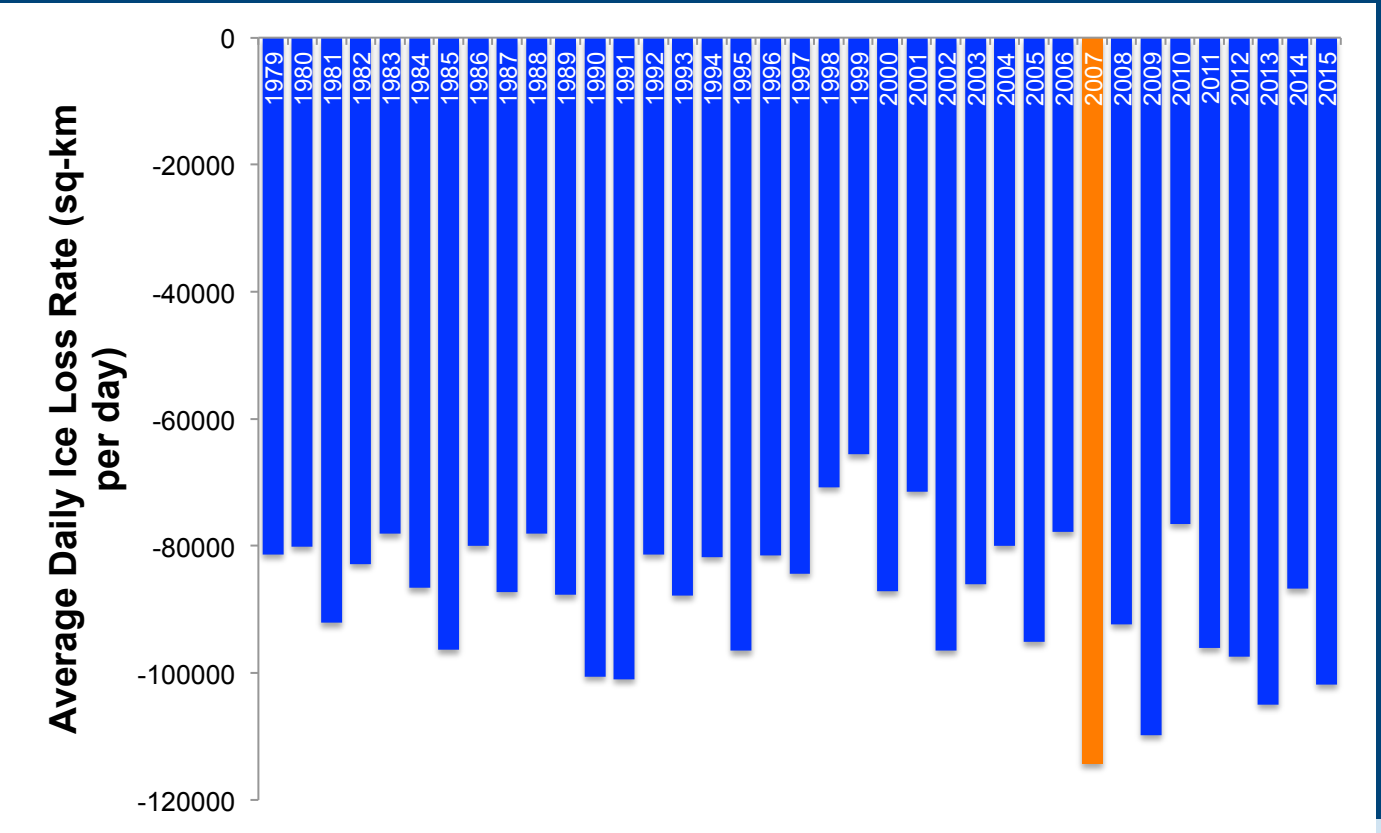


- June arctic-wide temperatures ranked 13th warmest
- July ranked 2nd
- August ranked 29th

Image from A. Slater

Near-normal rates of retreat in June, fast in July

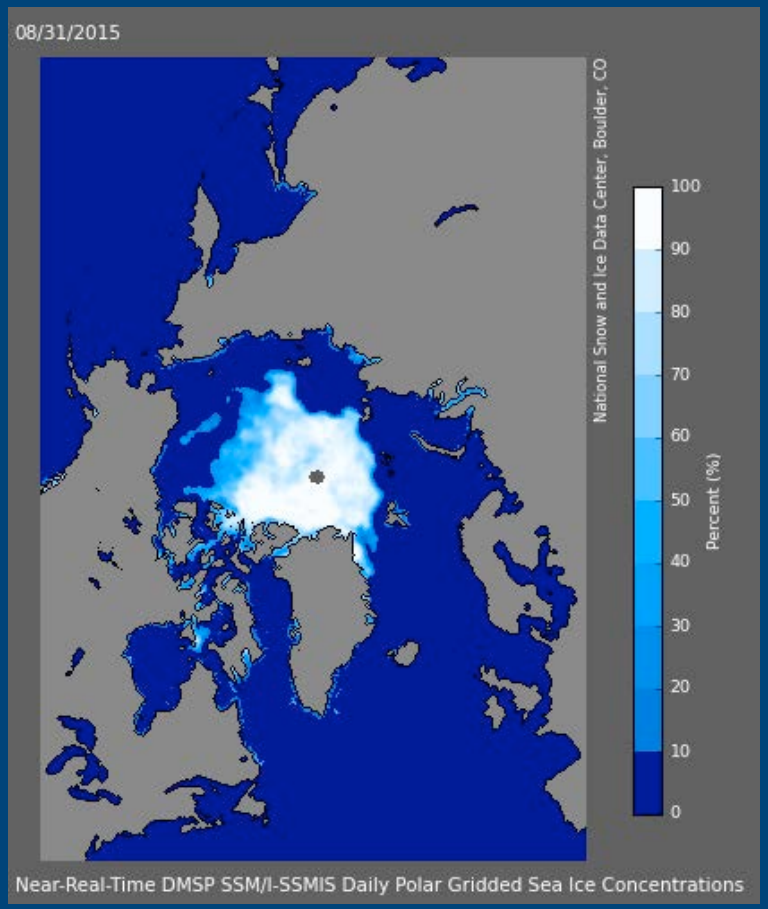
- Ice loss in July averaged 101,800 km^2 day^{-1}, compared to 97,400 km^2 day^{-1} in 2012 and a mean rate of 86,900 km^2 day^{-1} for the (1981-2010) long-term mean.
- In 2007, July ice loss averaged 114,200 km^2 day^{-1} the fastest on record.
- Despite fast pace of ice loss, July 2015 was only the 8th lowest extent on record.

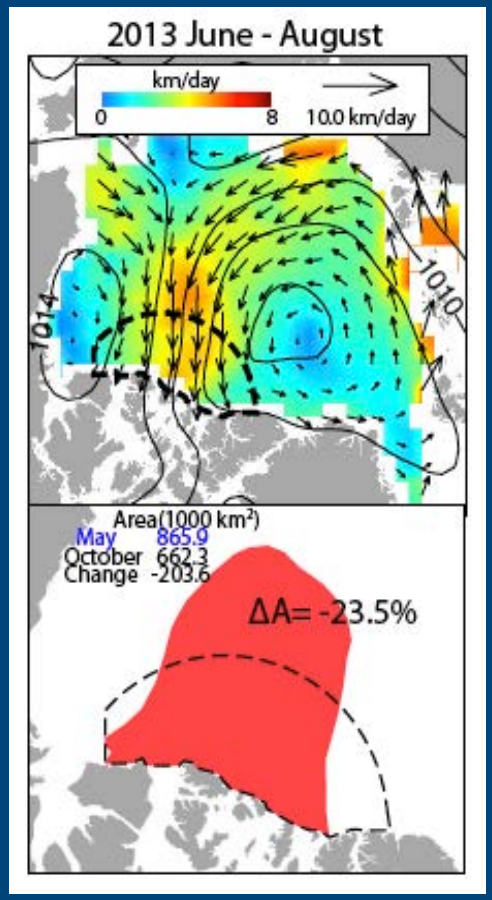


NSIDC National Snow and Ice Data Center

cpom

August





Onshore ice drift during summer of 2013.

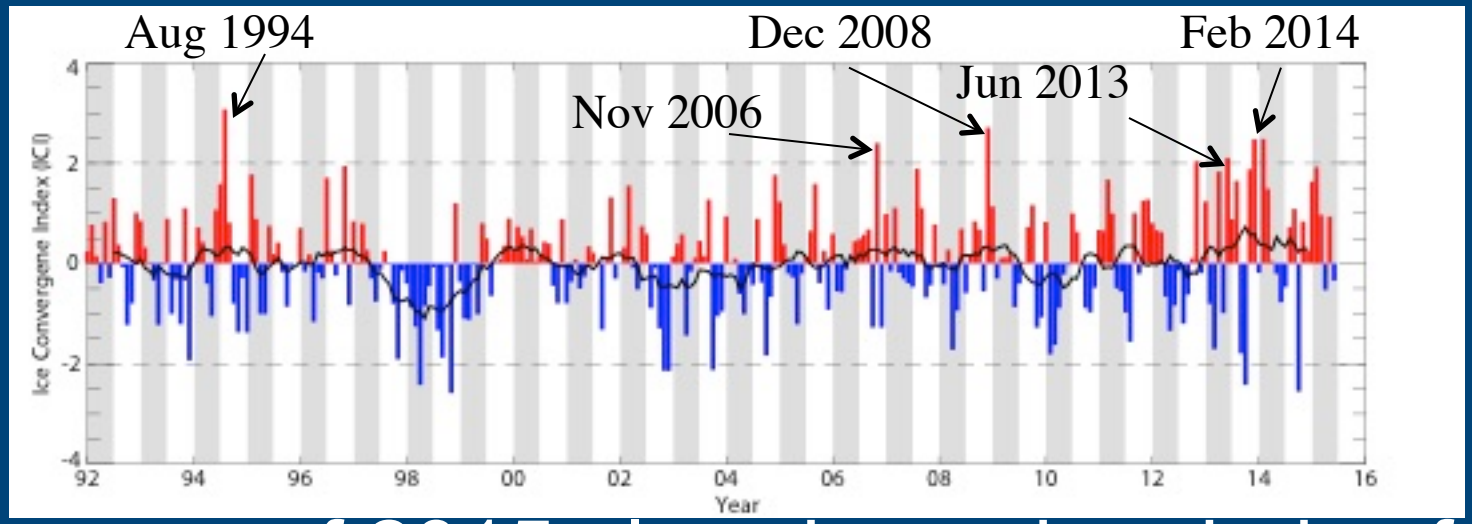
Due to convergence, ice area in May (in red) is compressed by ~23% by the end of the summer leading to thicker ice (from Kwok, 2015).

- Band of ice that hung on most of August likely a result of thicker/deformed ice (created in 2013/2014) that advected from CAA region.

Enhanced convergence in 2015?

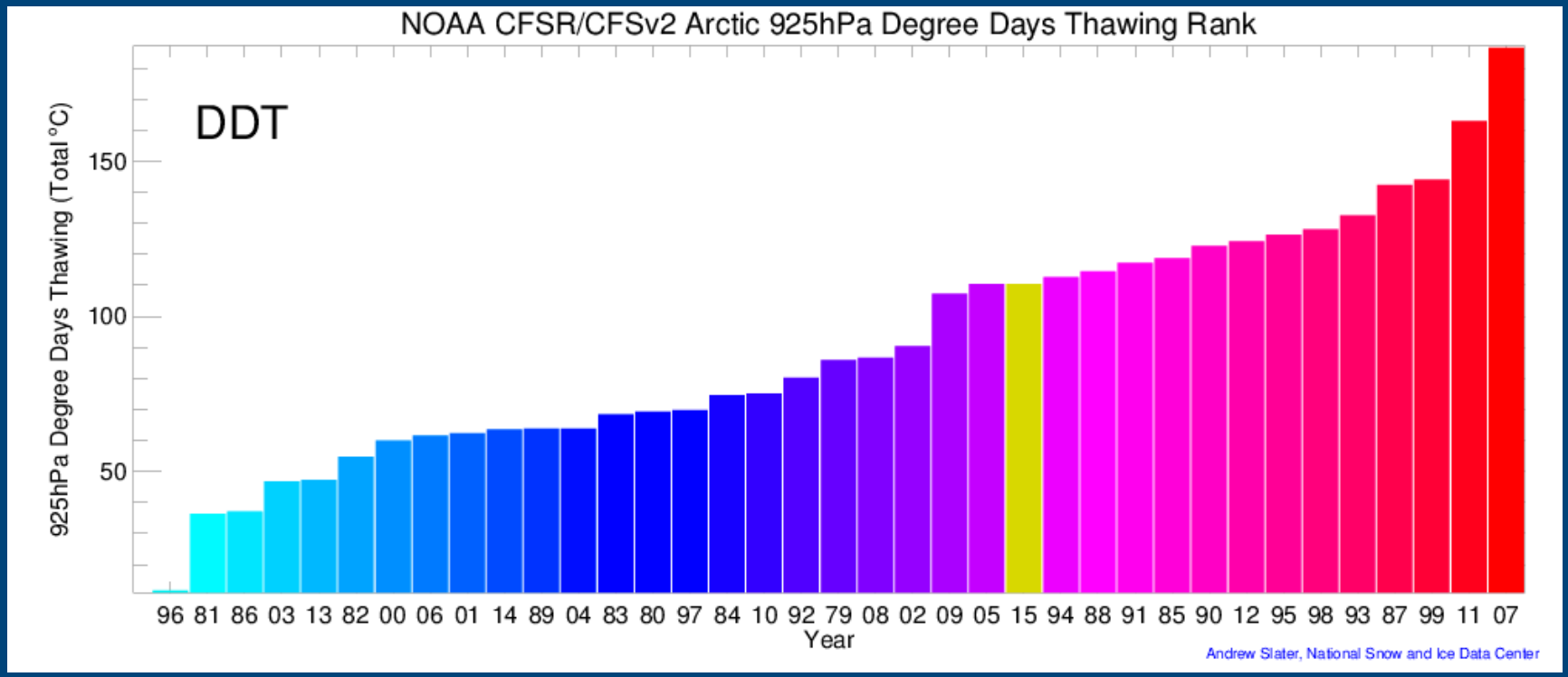
- Ice Convergence Index through flux gate parallel to CAA and Greenland:

$$ICI(t)=F(t)-F')/\sigma_F$$



- Summer of 2015 also showed periods of enhanced ice convergence, which may help to thicken ice north of CAA and Greenland

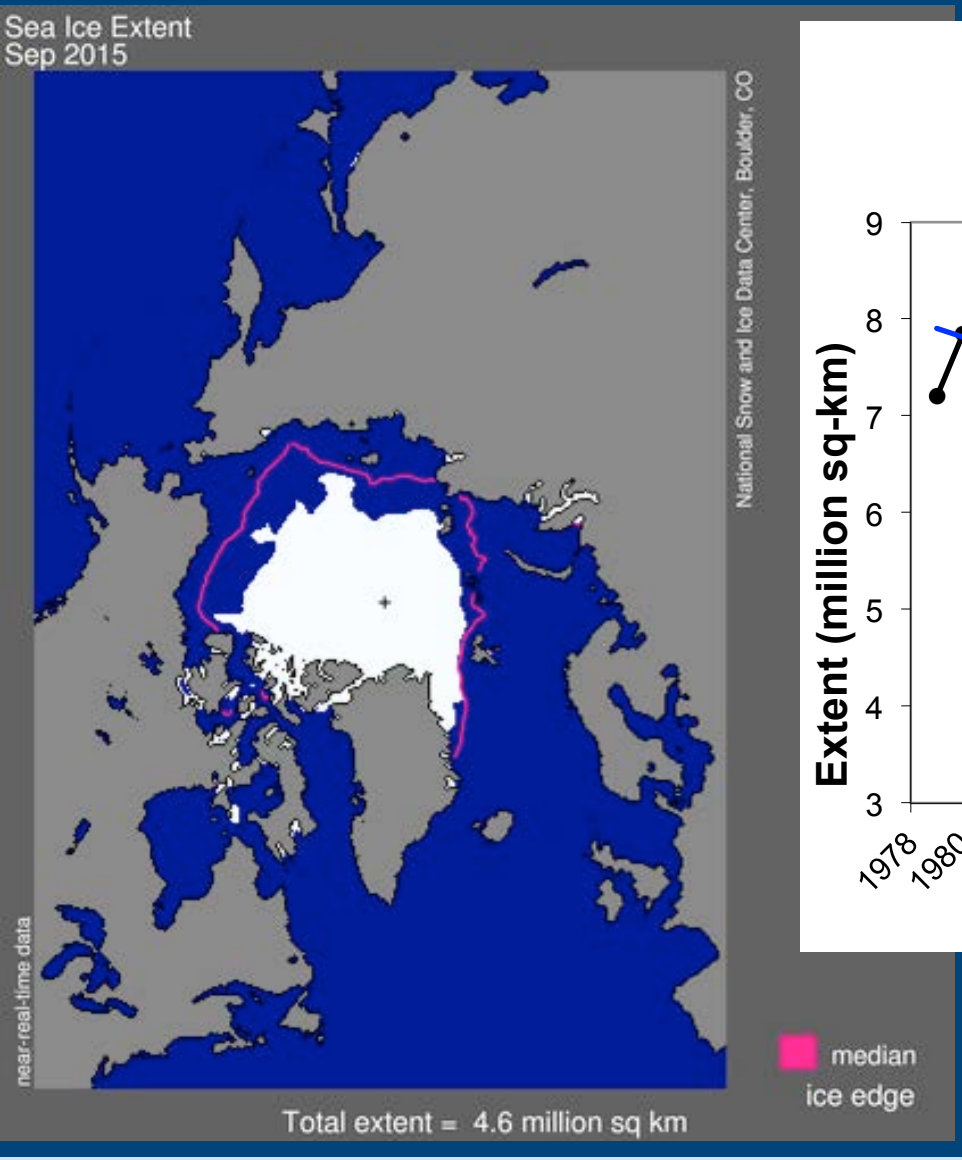
Little correlation with DDT

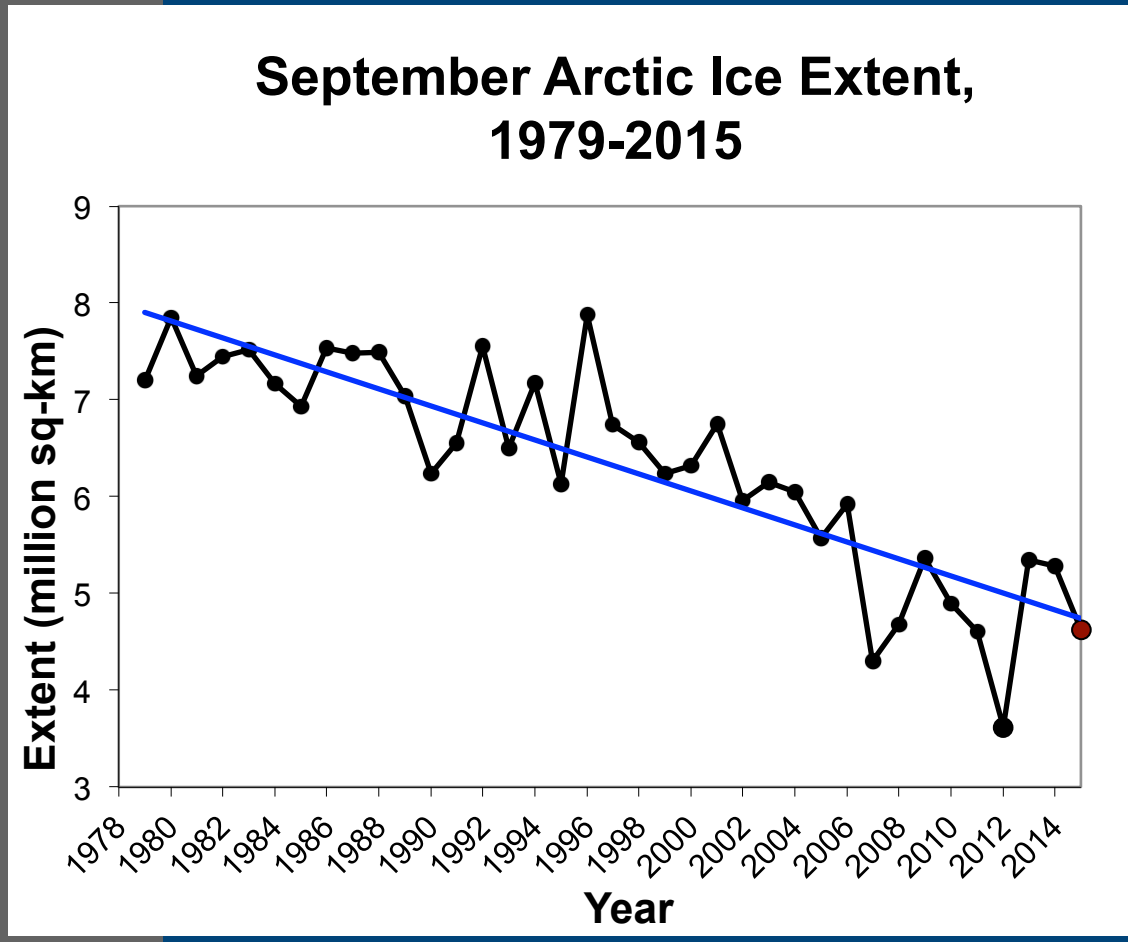


- While Tilling et al. (2015) suggested DDT a good predictor of ice volume, it does not appear to be a good predictor of extent, correlation for 2015 is only *r = -0.4*

Image from A. Slater

September (4th lowest)





A Look Back: Sea Ice Outlook Predictions 2008–2015

Larry Hamilton

Carsey School of Public Policy

University of New Hampshire

Sea Ice Prediction Network Webinar

October 6, 2015

Research supported by National Science Foundation

Sea Ice Prediction Network PLR-1303938

PoLAR Climate Change Education Partnership DUE-1239783

What Does the General Public Think About Sea Ice?

Polar questions asked on New Hampshire surveys, summer 2011 through fall 2015.

Seaice — Which of the following three statements do you think is more accurate? Over the past few years, the ice on the Arctic Ocean in late summer ...

Covers less area than it did 30 years ago (69%)
Declined but then recovered to about the same area it had 30 years ago (11%)
Covers more area than it did 30 years ago (8%)

Weather — If the Arctic region becomes warmer in the future, do you think that will have no effects (6%), minor effects (29%), or **major effects (60%)** on the weather where you live?

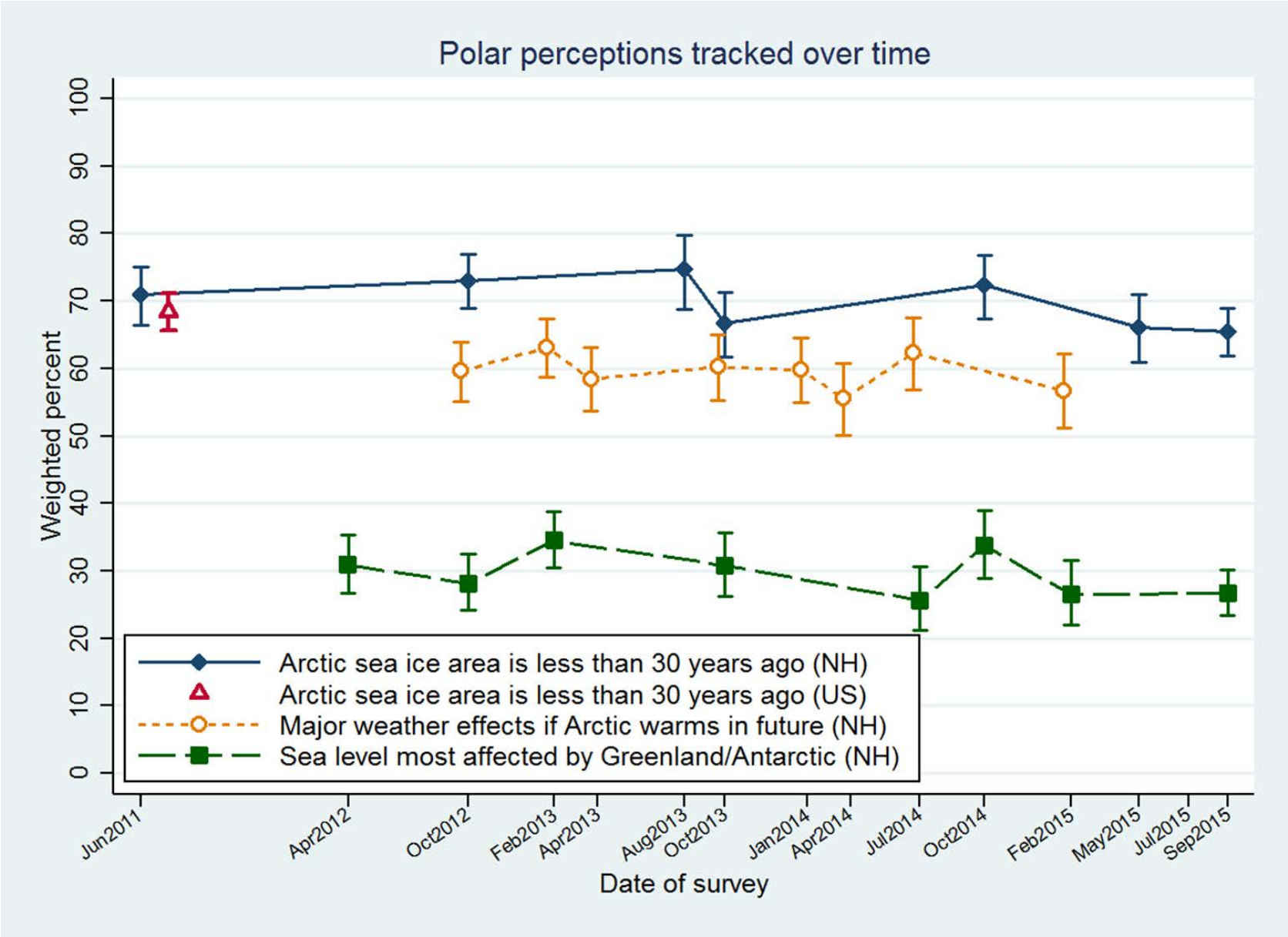
Sealevel — Which of the following possible changes would, if it happened, do the most to raise sea levels?
Melting of sea ice on the Arctic Ocean (32%)
Melting of land ice in Greenland and the Antarctic (30%)
Melting of glaciers in the Himalaya and Alaska (11%)

Northpole — Which of these best describes the North Pole?
Ice a few feet or yards thick, floating over a deep ocean (38%)
Ice more than a mile thick, over land (38%)
A mainly rocky, mountainous landscape (6%)

Southpole — Which of these best describes the South Pole?
Ice a few feet or yards thick, floating over a deep ocean (19%)
Ice more than a mile thick, over land (46%)
A mainly rocky, mountainous landscape (13%)

Surveys over past 5 years find *stable or slightly declining* public knowledge of Arctic sea ice

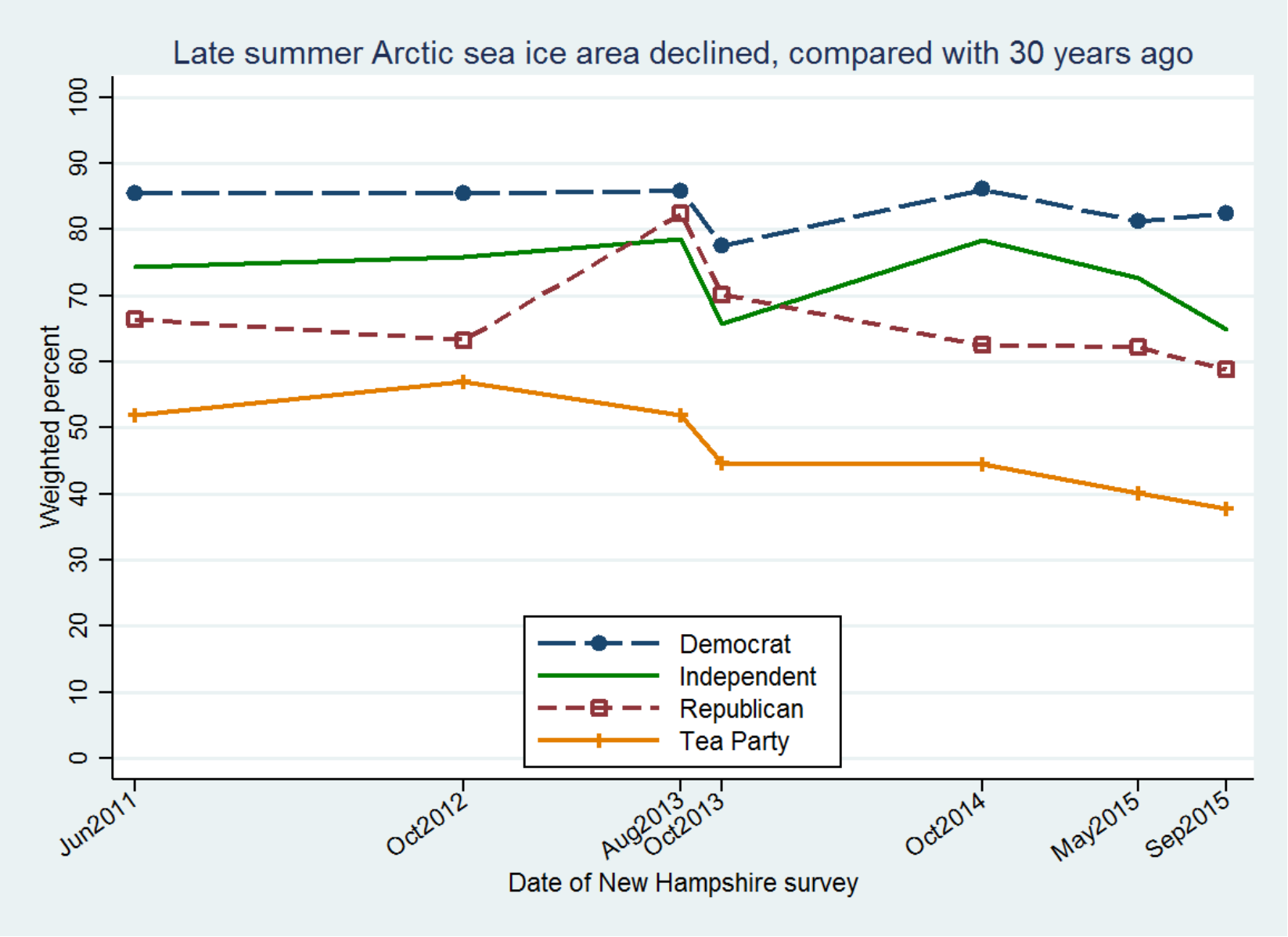
Arctic Sea Ice blog 10/4/2015



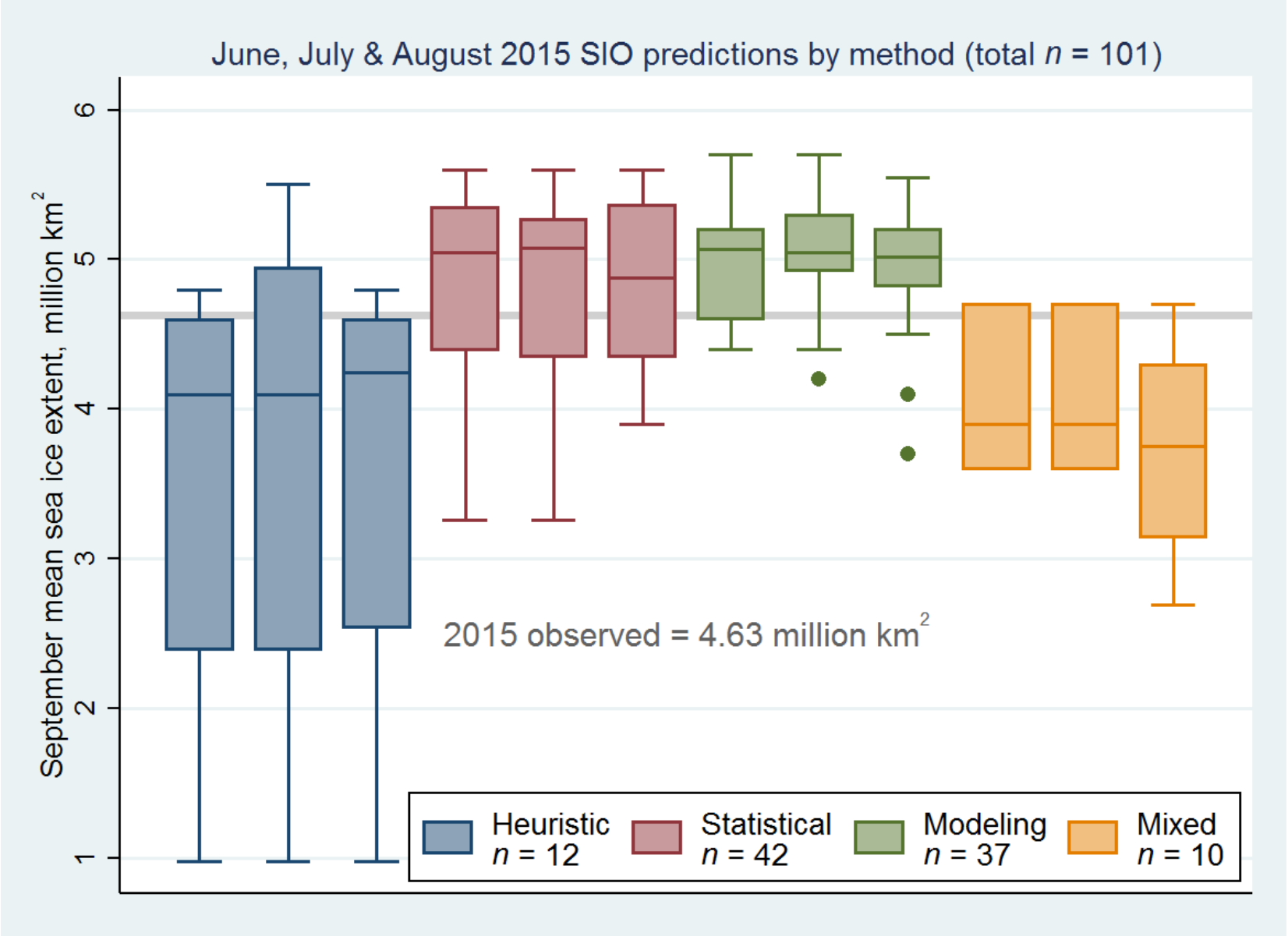
However there is an elephant in the room:

Perceptions of sea ice & Arctic change are *shaped by politics*

The problem is not just "science communication"

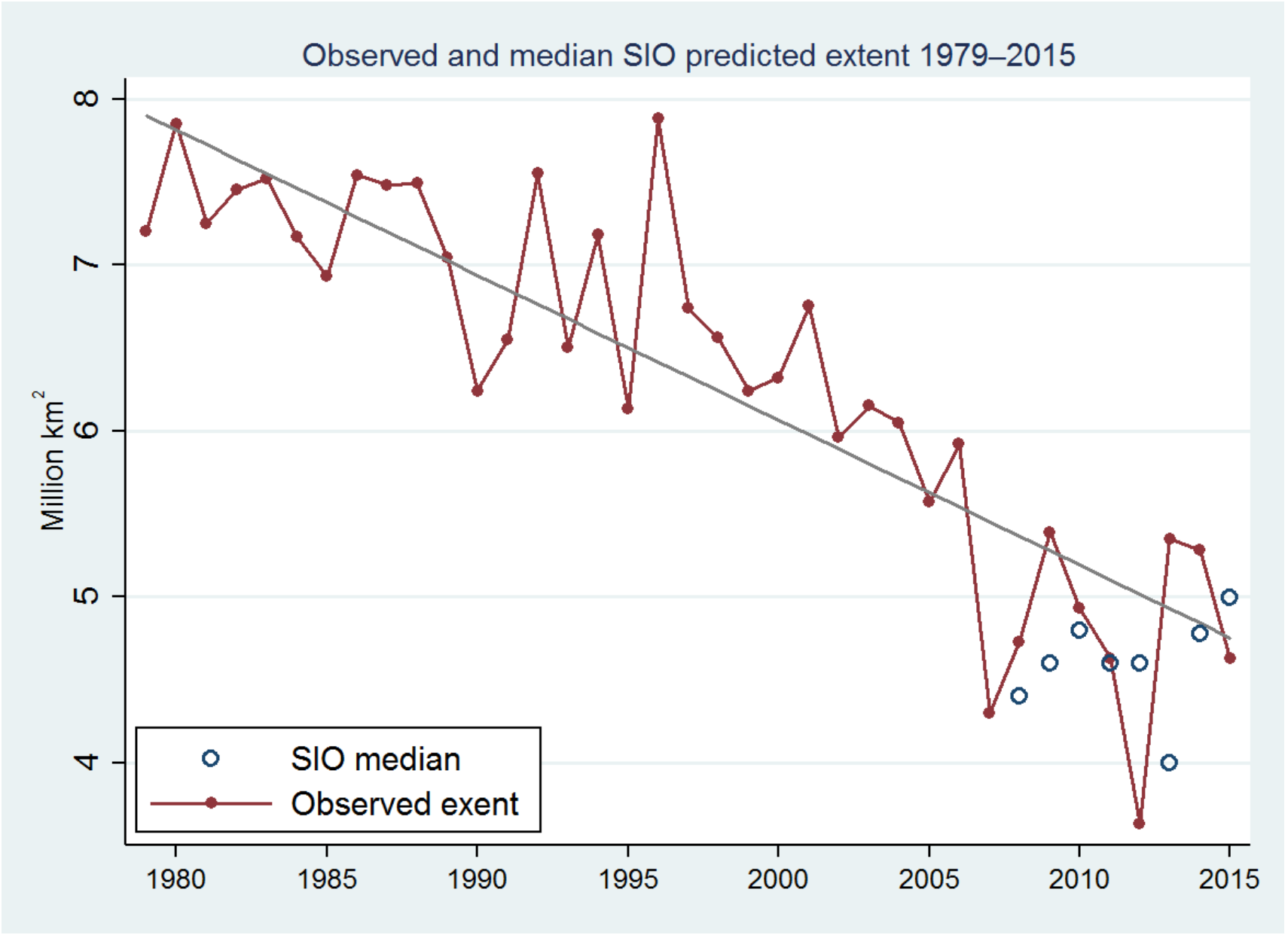


The SEARCH Sea Ice Outlook solicits contributions in early June, July & August each year, predicting September mean sea ice extent



GRL 2014, analysis of 2008–2013 SIO found there are easy and difficult-to- predict years

Difficult ones are those departing from the linear trend



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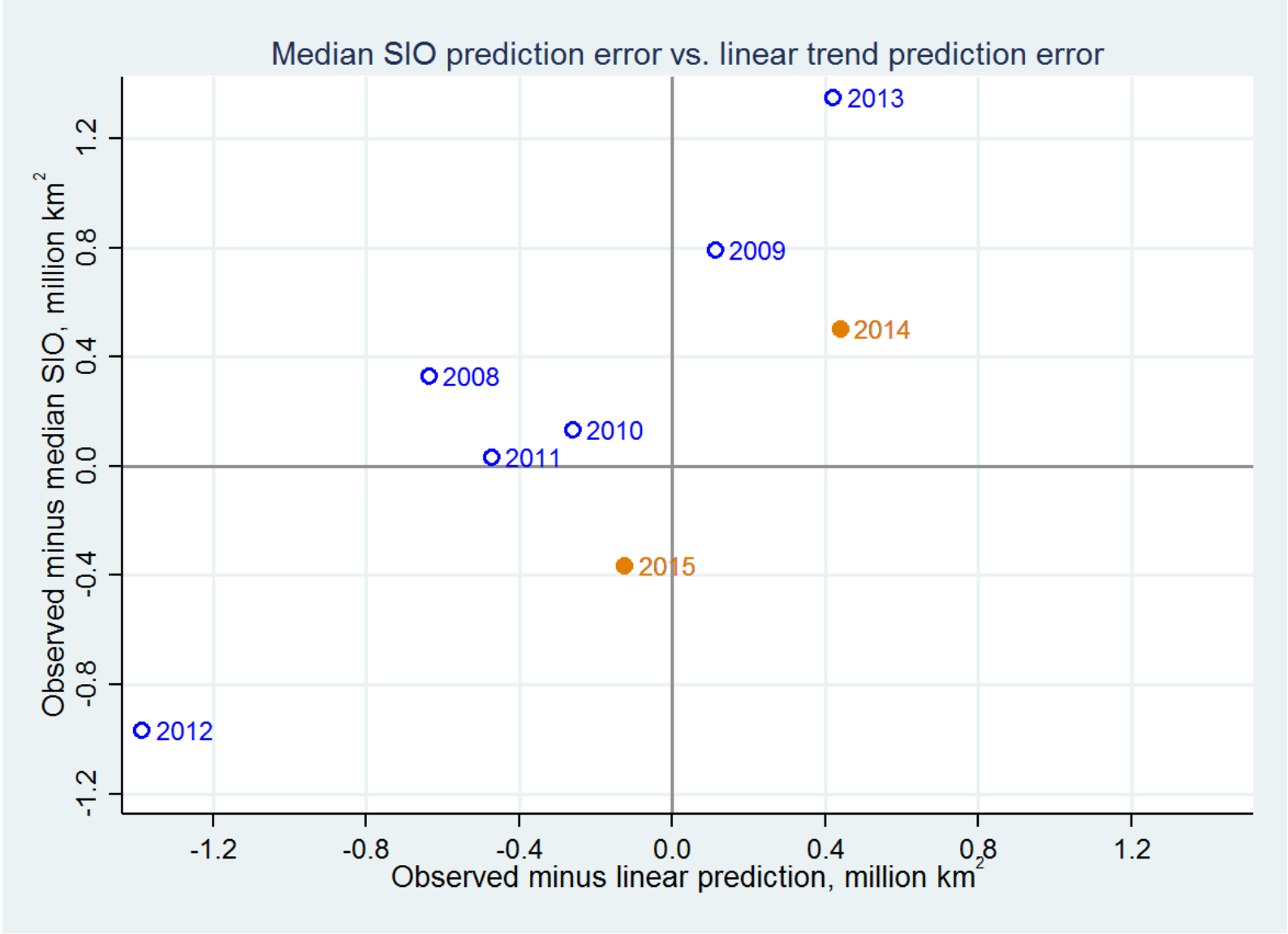
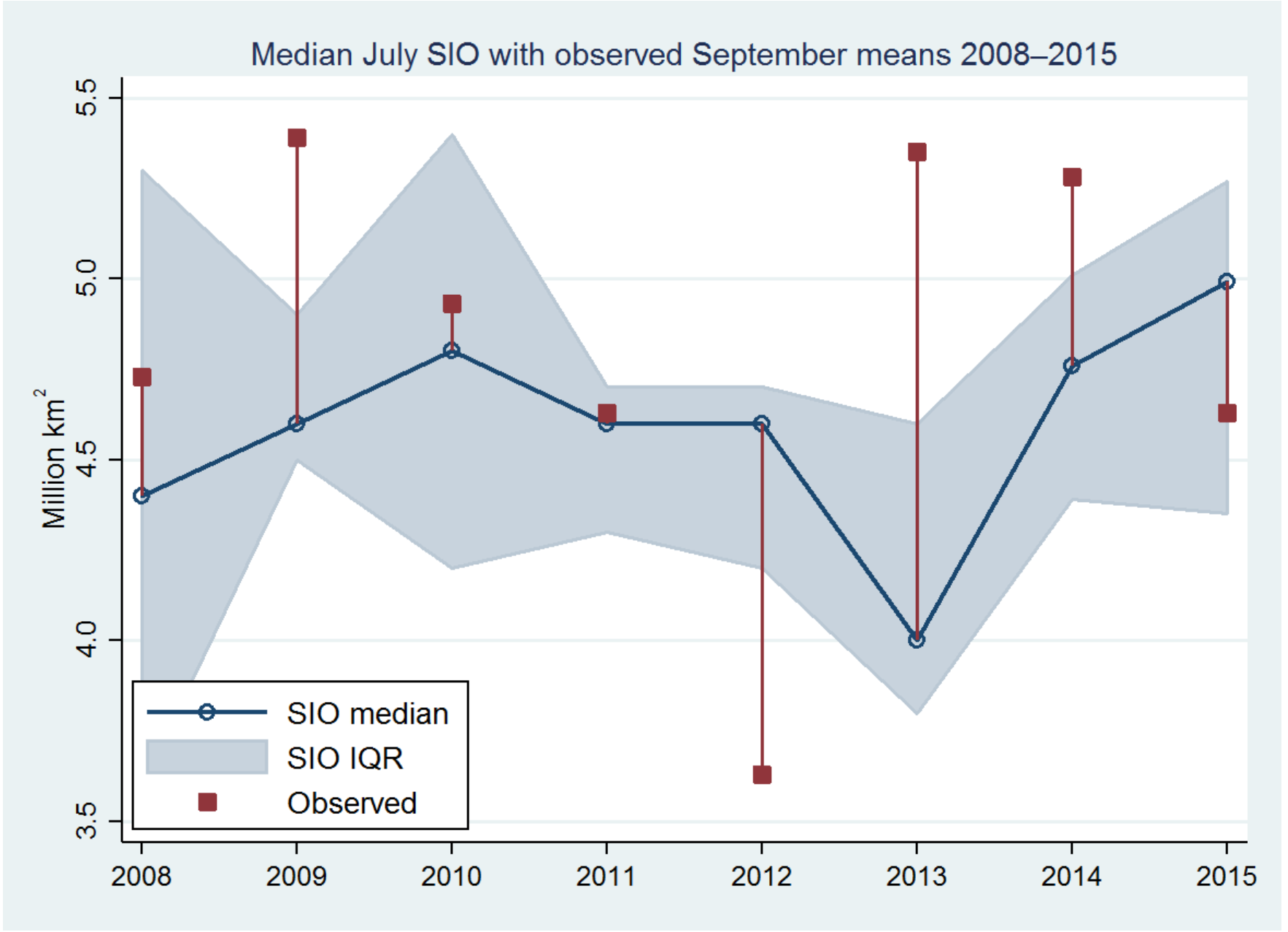


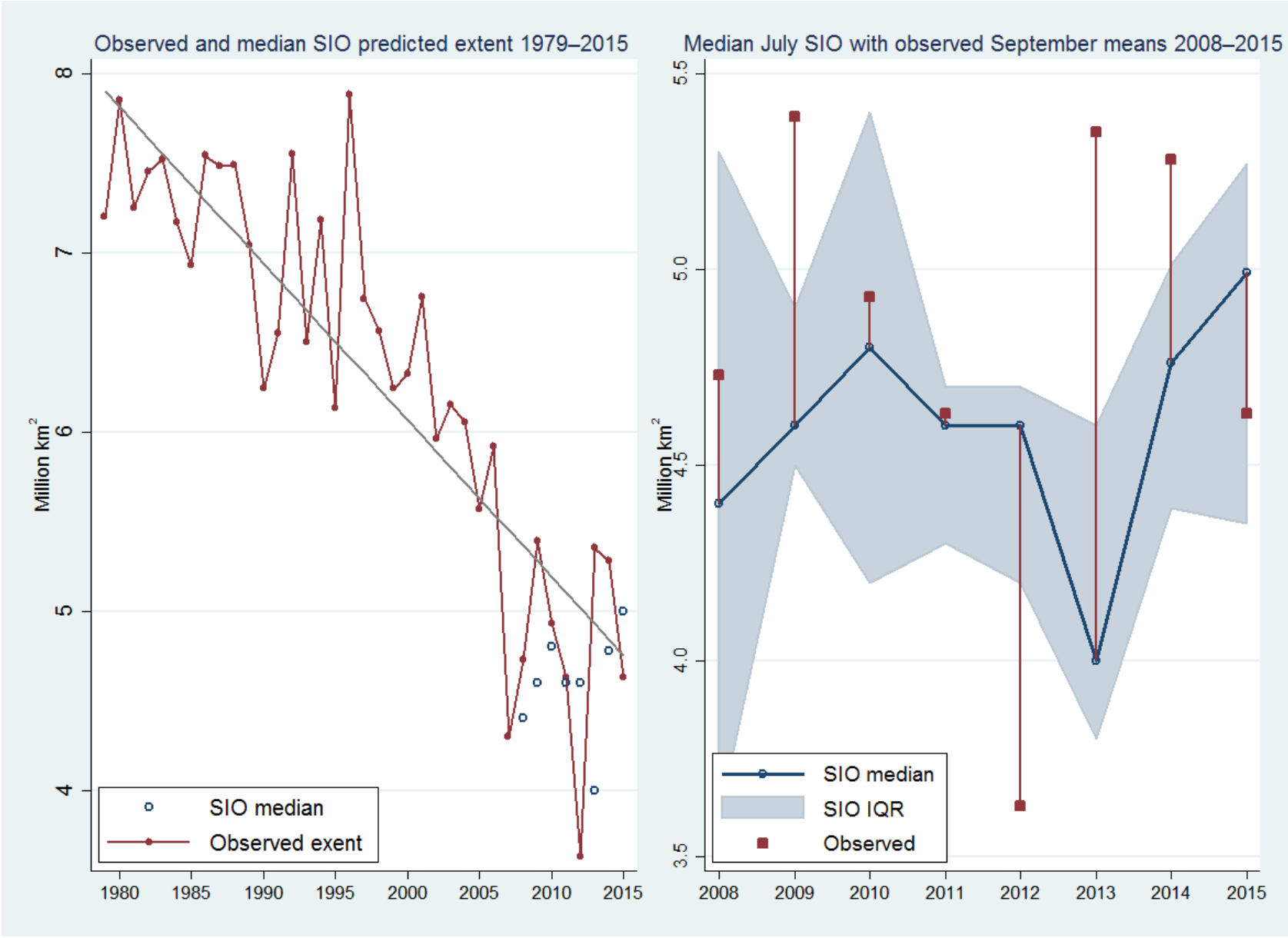
In difficult years, observed September sea ice fell well beyond interquartile range (IQR) of SIO, and outside most individual confidence intervals



Either 2015 predictions were better (we hope),

or this was not as difficult a year **(close to linear prediction)**

Next year may tell



```
. qreg abswrong ib2011.year ib6.month ib1.method2, nolog vce(robust)

Median regression                                       Number of obs =        445
  Raw sum of deviations   85.585 (about .5800004)
  Min sum of deviations    71.85                        Pseudo R2     =     0.1605

------------------------------------------------------------------------------
             |               Robust
    abswrong |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        year |
        2009 |         .46   .0668094     6.89   0.000     .3286891     .591311
        2010 |   .1299996   .1018671     1.28   0.203    -.0702158    .3302151
        2012 |   .5300002   .0909586     5.83   0.000     .3512249    .7087755
        2013 |   .9400001    .122816     7.65   0.000     .6986104     1.18139
        2014 |   .2700005   .0900716     3.00   0.003     .0929685    .4470324
        2015 |         .23   .0729581     3.15   0.002      .086604     .373396
             |
       month |
        July |         .02   .0435041     0.46   0.646    -.0655054    .1055054
      August |  -.1099997   .0500765    -2.20   0.029    -.2084229   -.0115764
             |
     method2 |
   Modeling  |  -.0999999   .0563087    -1.78   0.076    -.2106724    .0106726
Statistical  |  -.1700001   .0589356    -2.88   0.004    -.2858356   -.0541646
      Mixed  |   .1999998   .1862778     1.07   0.284    -.1661213    .5661209
             |
       _cons |   .4099998   .0780407     5.25   0.000     .2566141    .5633856
------------------------------------------------------------------------------
```

2008 represents a dummy variable coded 1 if year = 2008, 0 otherwise (***base* = 2011**)
July represents a dummy variable coded 1 if month = July, 0 otherwise (***base* = June**)
modeling represents a dummy variable coded 1 if method = modeling, 0 otherwise; etc.
Significant positive coefficients indicate median absolute errors greater than *base* (worse)
Significant negative coefficients indicate median absolute errors less than *base* (better)

```
. qreg abswrong ib2011.year ib6.month ib1.method2, nolog vce(robust)

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------------------------------------------------------------------------------
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- SIO predictions were “less wrong” (lower median absolute errors) in 2014 and 2015 than in 2012 and 2013.
- August predictions are better than June
- Statistical predictions performed better than heuristic
- As SIO continues we get more data for evaluation

References

Sea Ice:

Stroeve, J, L. Hamilton, CM Bitz & E Blanchard-Wrigglesworth. 2014. “Predicting September sea ice: Ensemble skill of the SEARCH Sea Ice Outlook.” *Geophysical Research Letters* 41:2411–2418. doi: 10.1002/2014GL059388

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Take-home points

- Many people do not know or accept that Arctic sea ice has declined, but confusion relates more to politics than education.
- Viewed as an ensemble, the median Sea Ice Outlook predictions have been close to observed September ice extent in “normal” years when extent was not far from its overall downward trend
- Median SIO predictions have been farther from observations in “strange” years when extent ended far above or below the linear trend.
- Ensemble predictions were better in 2014 and 2015 than the previous two years, but then again these years were not as strange as 2012 or 2013

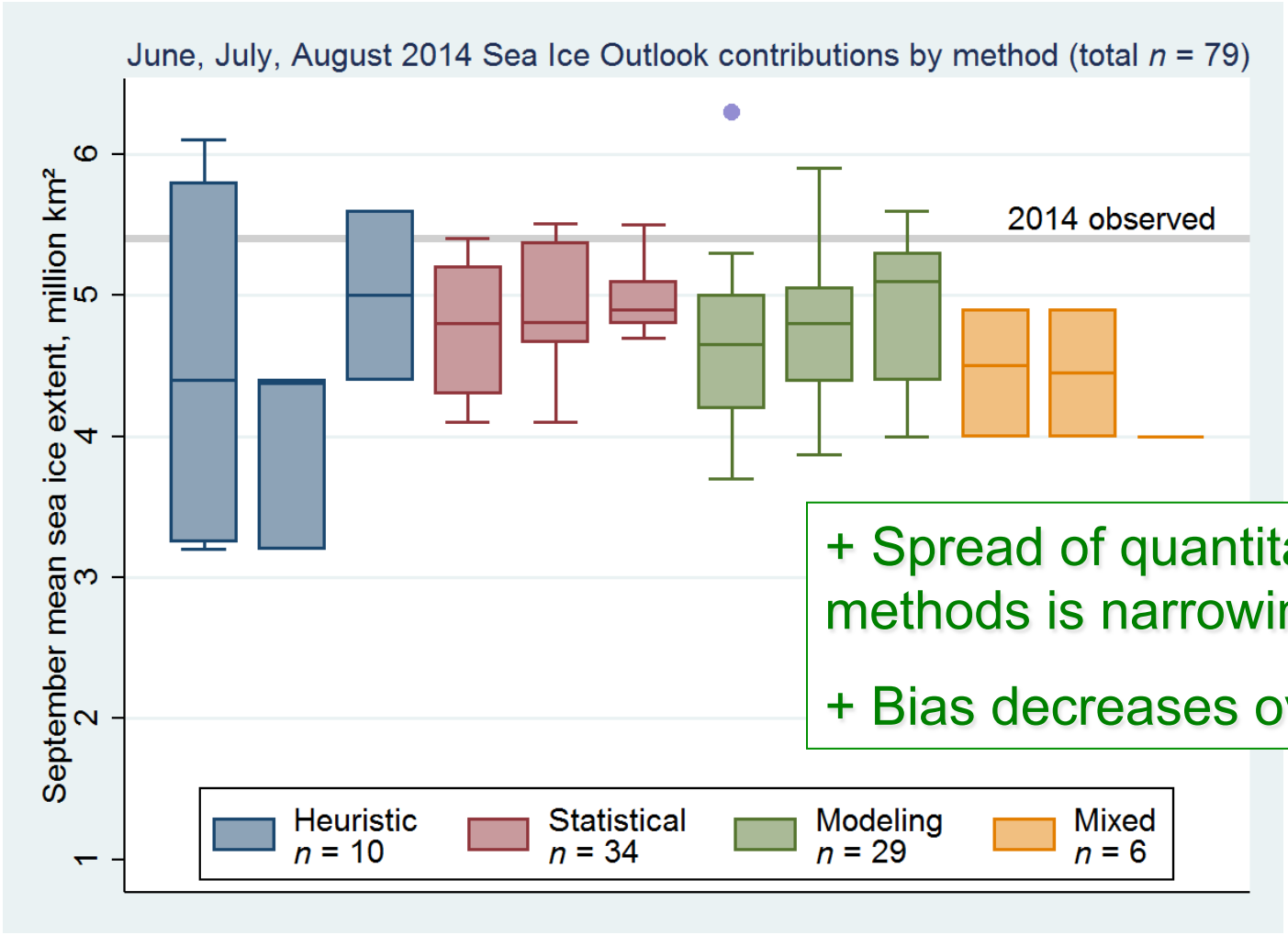
Arctic Sea-Ice Prediction at the Local Scale: Challenges and Successes

Cecilia Bitz Atmospheric Sciences
University of Washington

Sea Ice Prediction Network
Webinar – Oct 6, 2015

Photo by Matt Kennedy, 2012
Extreme Ice Project

Sea Ice Outlook and the Prediction Network



+ Spread of quantitative methods is narrowing

+ Bias decreases over time

Figure by
Larry Hamilton

Sea Ice Outlook and the Prediction Network

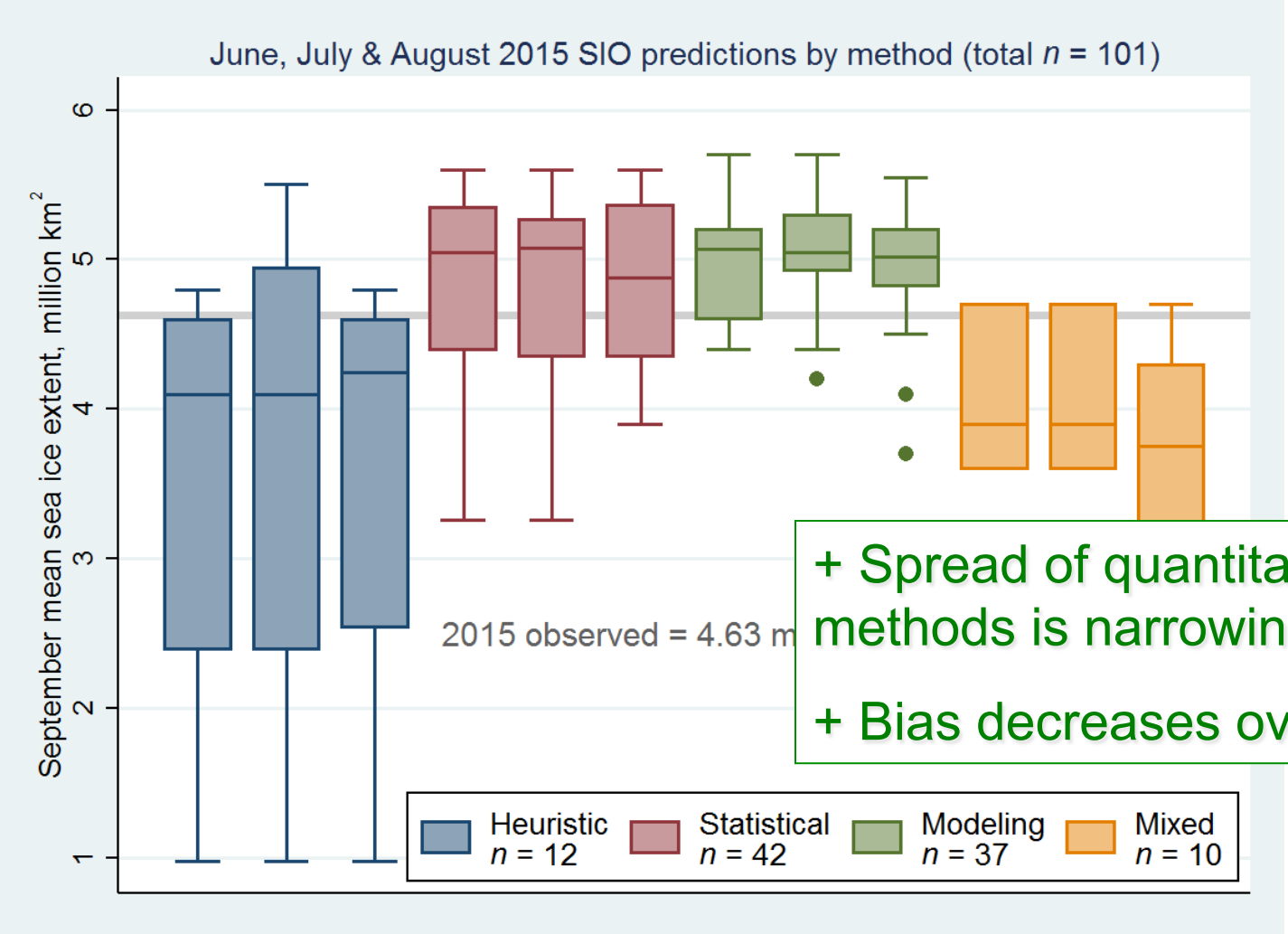


Figure by
Larry Hamilton

Sea Ice Outlook Spatial Distributions

Probability of Sea Ice Presence by Model in 2014

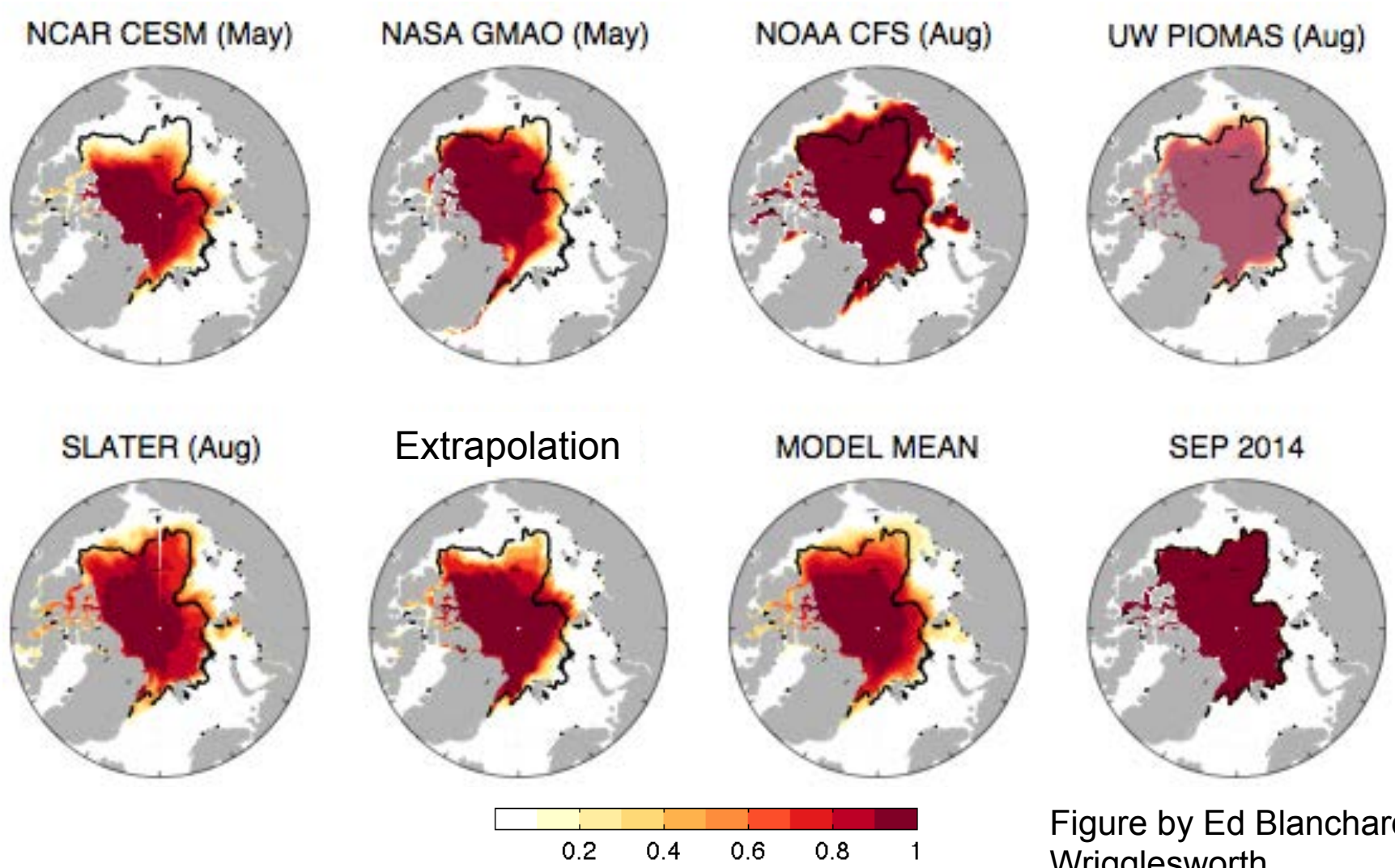


Figure by Ed Blanchard-Wrigglesworth

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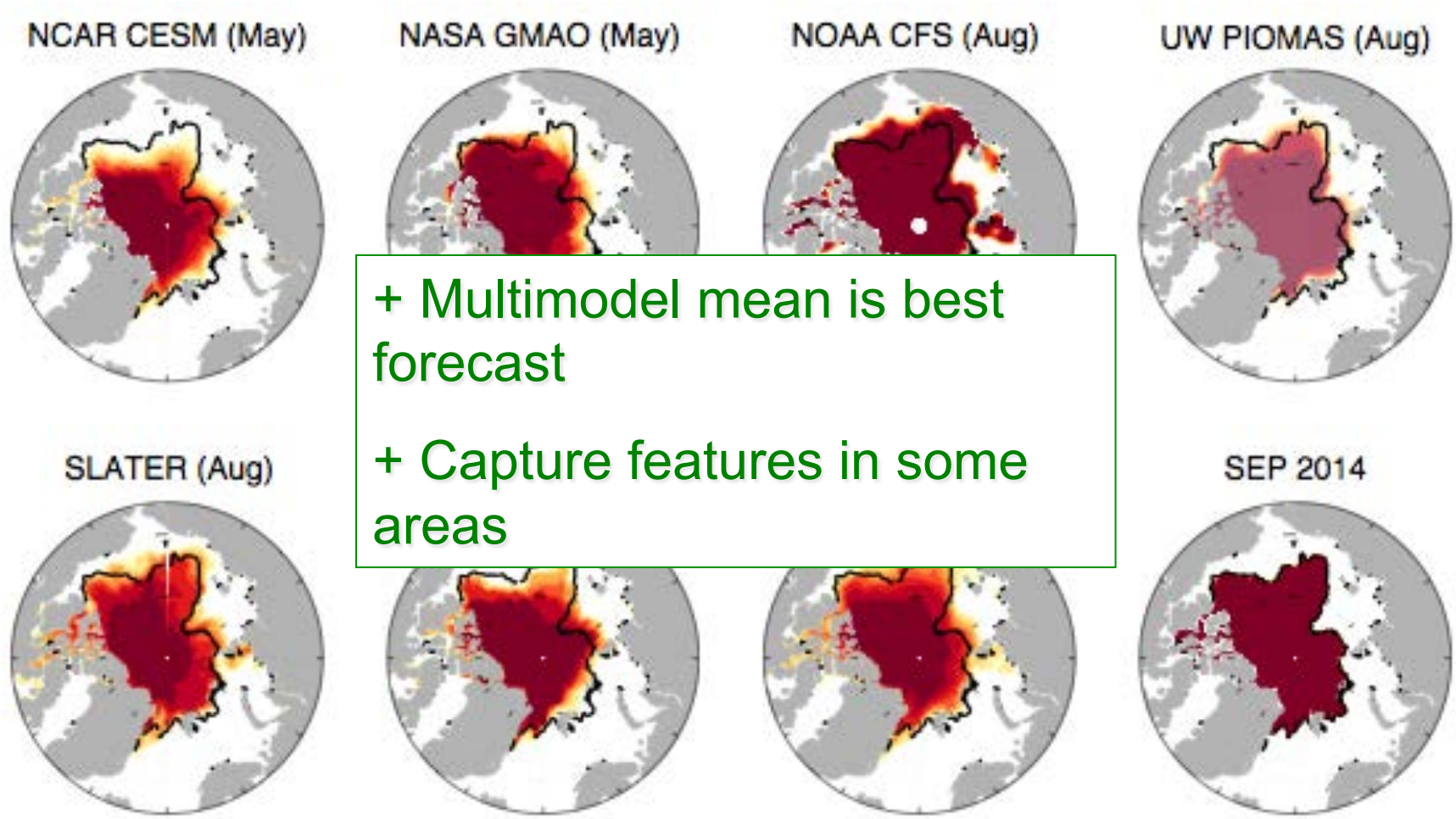


+ Multimodel mean is best forecast

+ Capture features in some areas

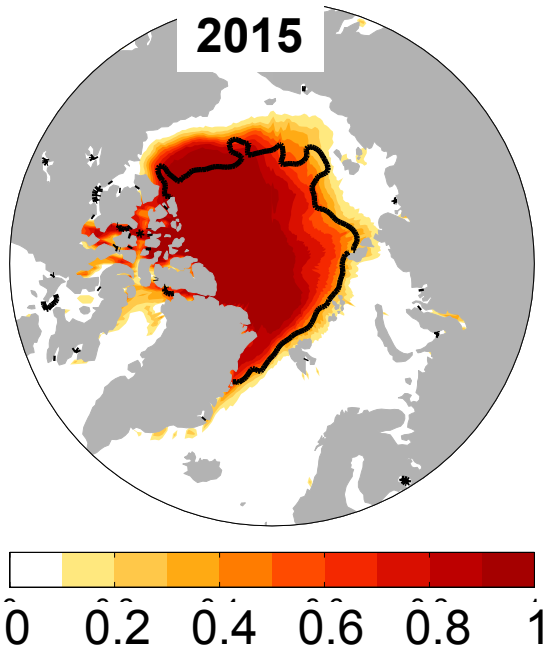
Figure by Ed Blanchard-Wrigglesworth

Sea Ice Outlook Spatial Distributions

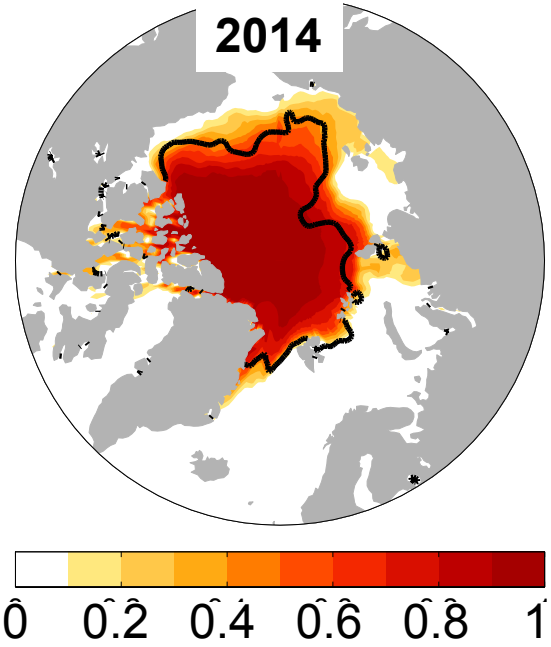
Probability of Sea Ice Presence in September in 2015 vs 2014

Multi-model mean forecast (colors)
with observed extent (black line)

May/June initialization



Mixed date of initialization



Forecast Difference

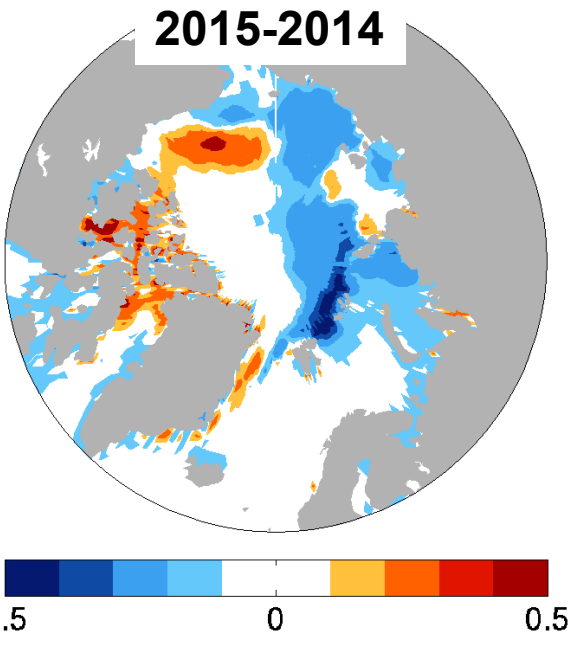


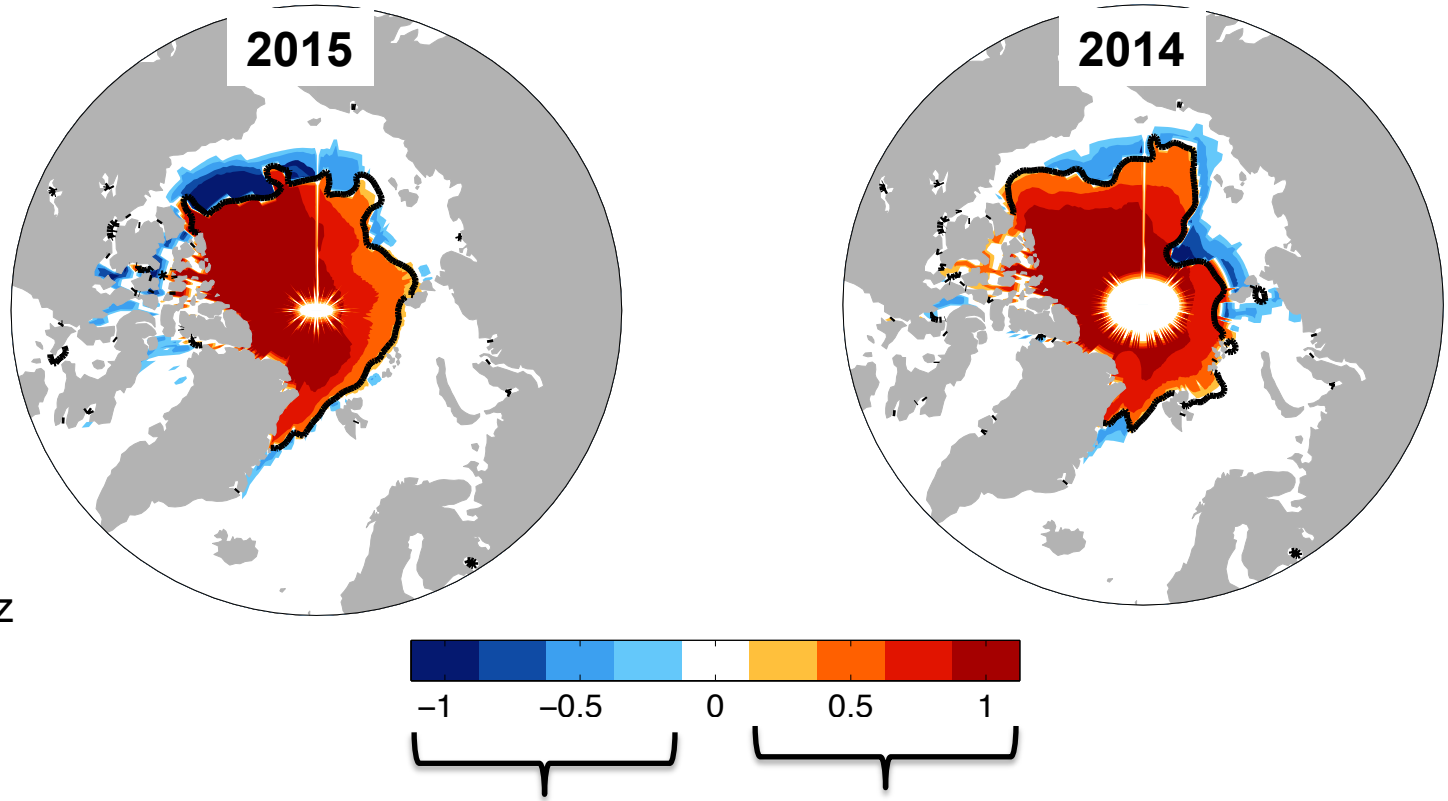
Figure by Ed Blanchard-Wrigglesworth & C. Bitz

2014 Forecasts: Slater, CFSv2, GMAO, PIOMAS, CESM
2015 Forecasts: GMAO, NRL, UCL-Belgium, MetOffice

Sea Ice Outlook Spatial Distributions

Probability of Sea Ice Presence in September in 2015 vs 2014

Forecast Agreement



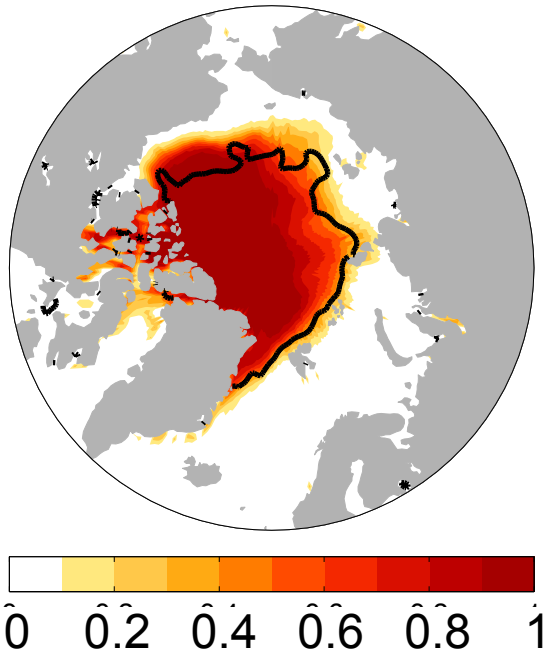
Figures C. Bitz

Sea Ice Outlook Spatial Distributions

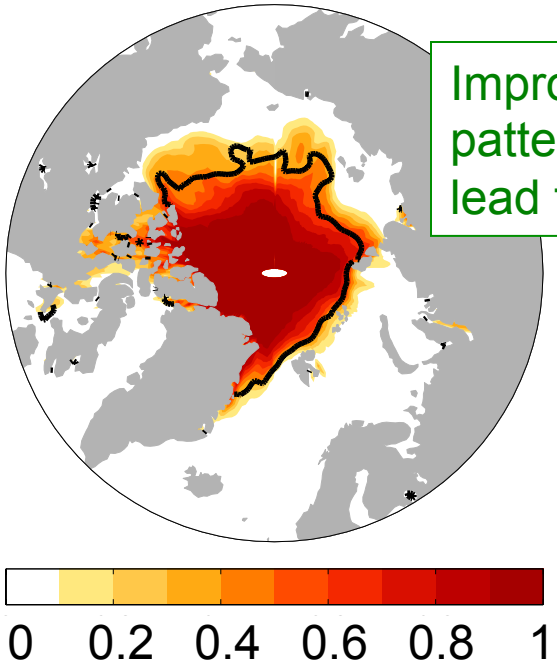
Probability of Sea Ice Presence in September in 2015

Multi-model mean forecast (colors)
with observed extent (black line)

May/June initialization



July/Aug initialization



Improved spatial pattern at shorter lead time

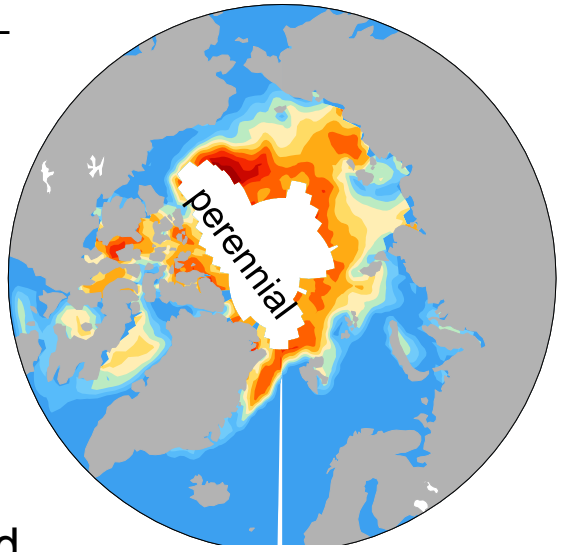
Figure by Ed Blanchard-Wrigglesworth & C. Bitz

May/June IC Forecasts: GMAO, NRL, UCL-Belgium, MetOffice
July/August IC Forecasts: SLATER, NRL, MetOffice

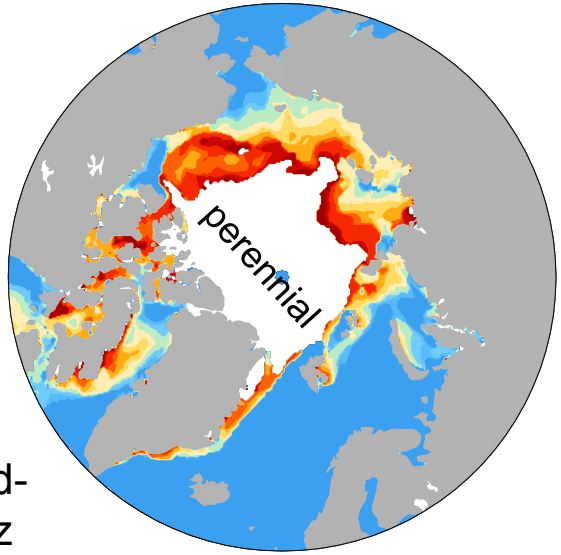
Sea Ice Outlook Spatial Distributions

First Ice-Free Day (IFD) in 2015, Forecast Initialized in June

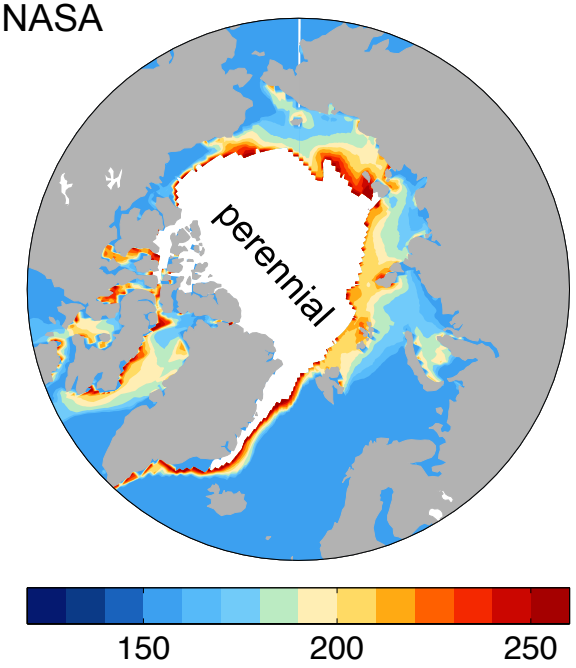
Posey/ NRL



Observed



Cullather / NASA GMAO

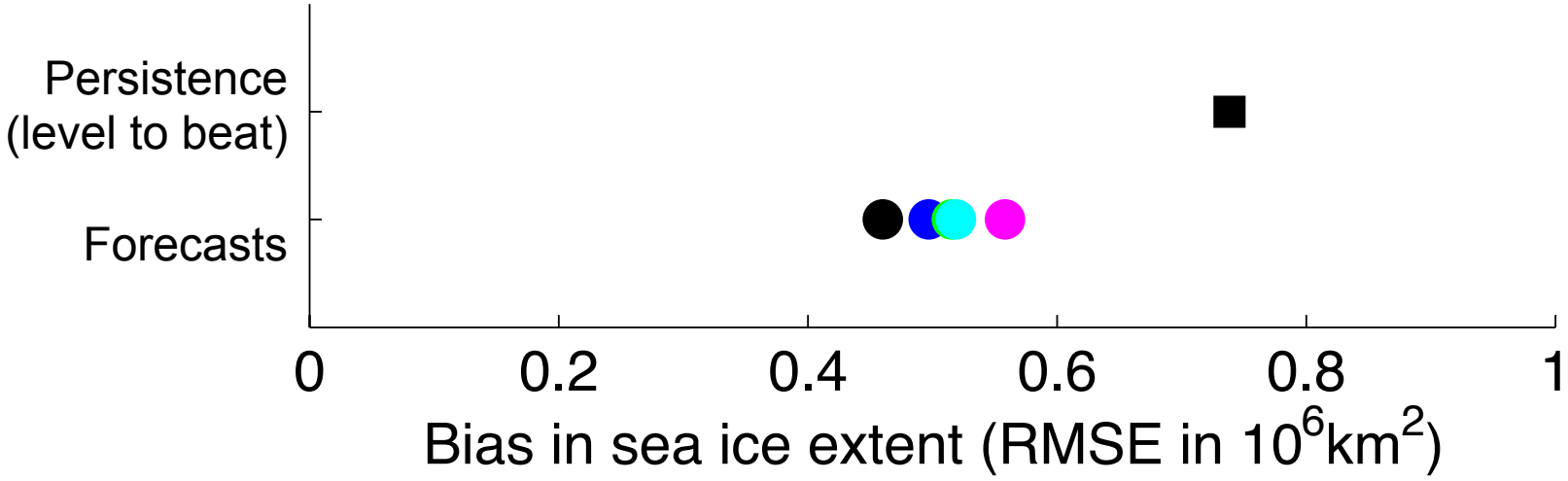


Julian Day

May 1= 121
June 1=152
July 1=182
Aug 1=213
Sep 1=244

Figure by Blanchard-Wrigglesworth & Bitz

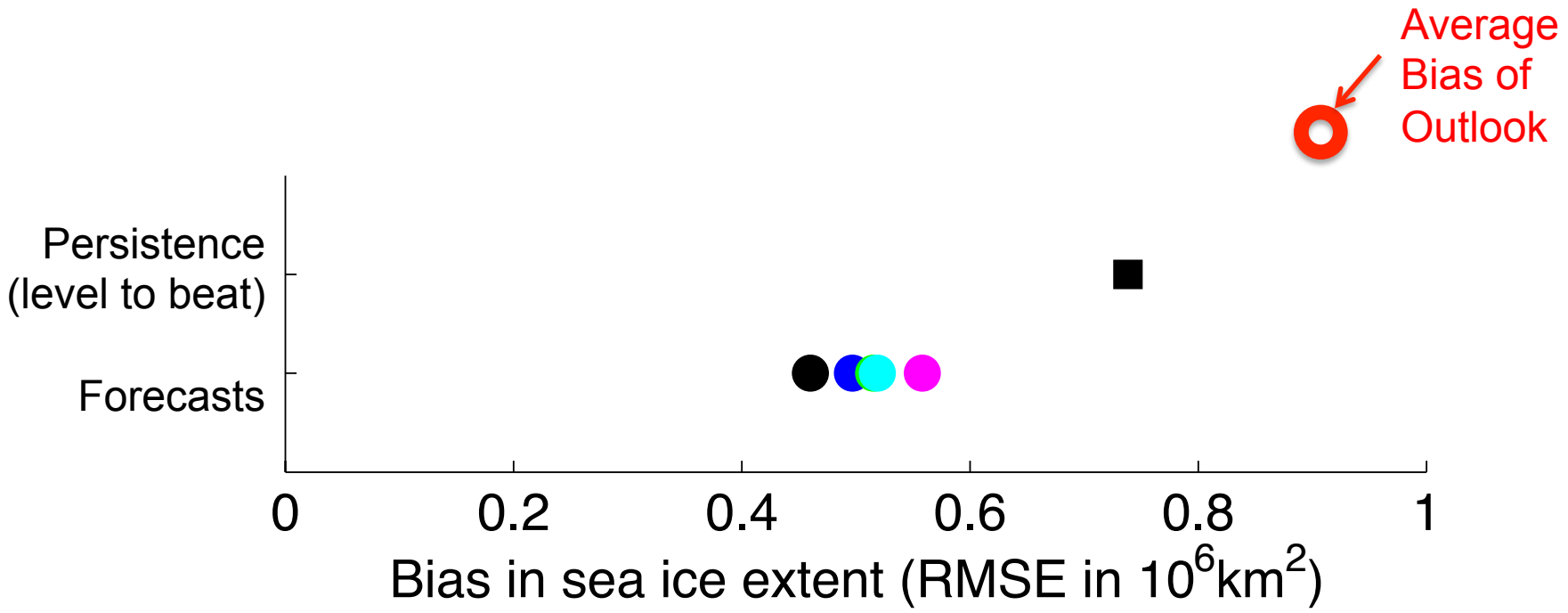
Forecast of September Sea Ice Extent at 4 Month Lead Time



+ Retrospective forecasts in these 5 models are skillful

Figure by E. Blanchard-Wrigglesworth

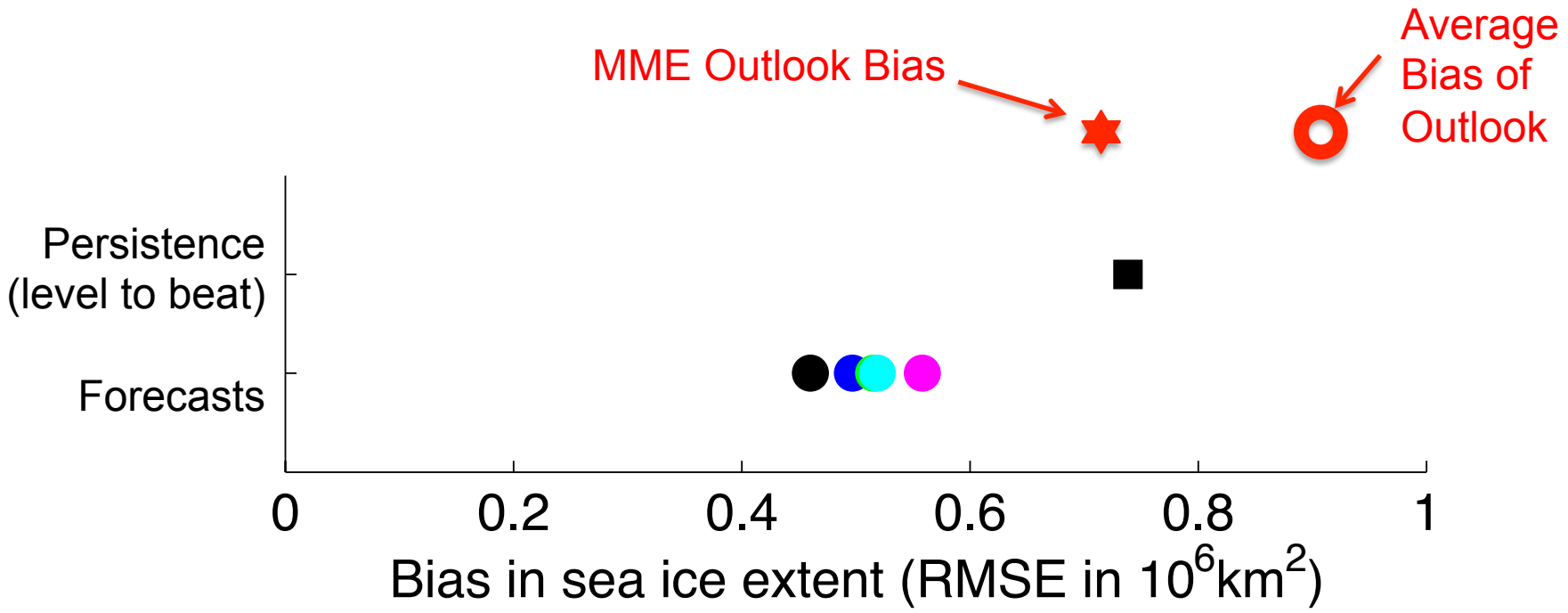
Forecast of September Sea Ice Extent at 4 Month Lead Time



Average bias of Outlooks from dynamical models 2007-2014 not skillful

Figure by E. Blanchard-Wrigglesworth

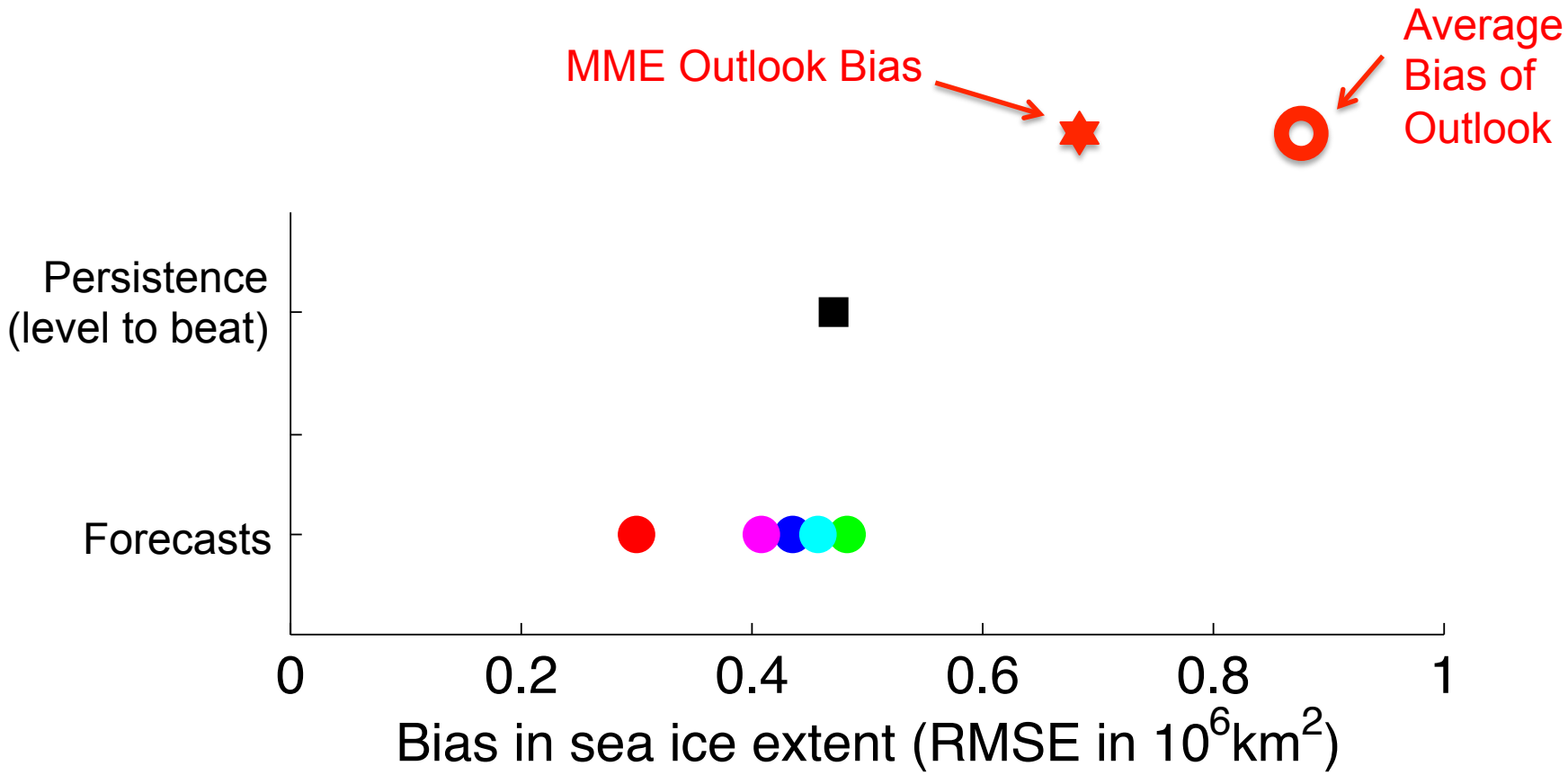
Forecast of September Sea Ice Extent at 4 Month Lead Time



Bias of the multimodel ensemble mean of Outlooks from dynamical models about equal to persistence

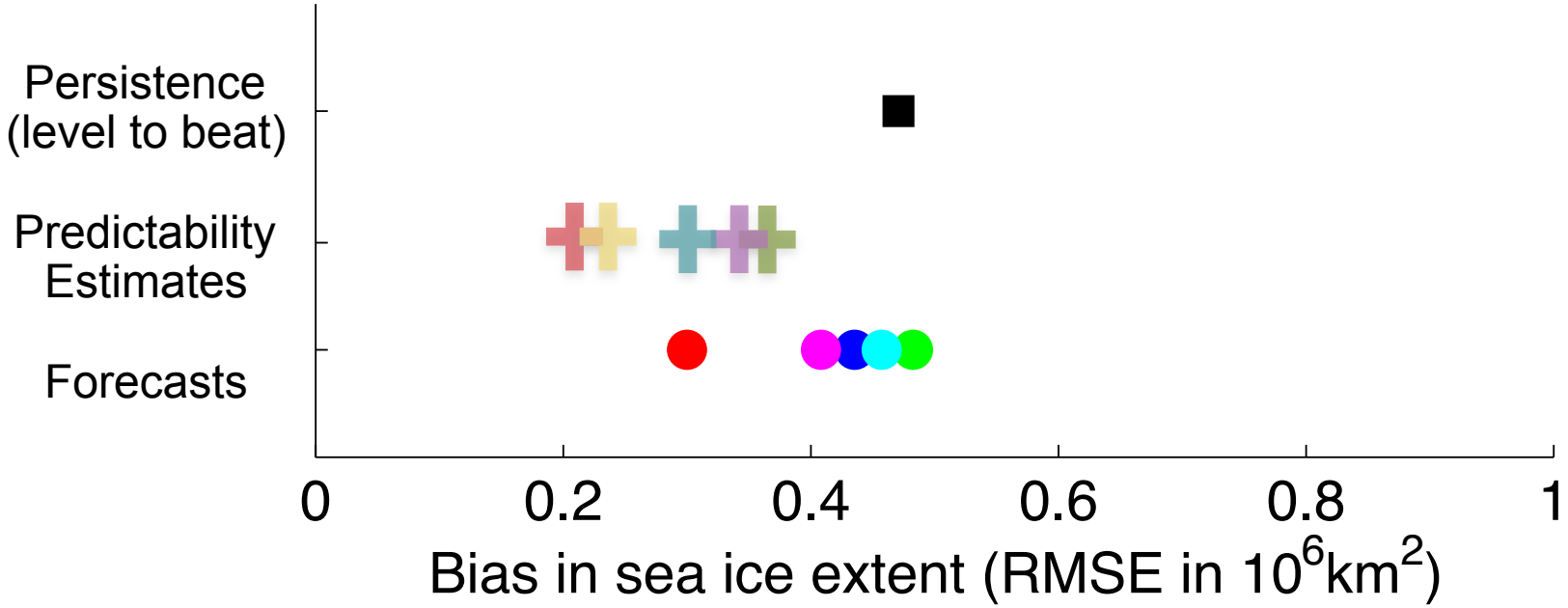
Figure by E. Blanchard-Wrigglesworth

Forecast of September Sea Ice Extent at 2 Month Lead Time



All forecasts here are relatively less skillful at shorter lead time.

Forecast of September Sea Ice Extent at 2 Month Lead Time



+ Predictability indicates room for improved forecasts

Summary

Forecast of sea ice extent …

- Bias decreases with shorter lead times in quantitative methods 2014 & 2015. Spread narrows too.
- Hindcasts are currently skillful at least 4 months in advance of September. Predictability is even longer. But forecasts are relatively less skillful at 1-2 month lead times.

At the local scale, skill in some regions, especially in MME at 1-2 month lead times. Our community is still learning how to produce and analyze these fields.

The local data are available, email bitz@uw.edu

Please plan to keep providing them and stay tuned for an expanded effort to collect, share, and analyze these and other fields

To Ask Questions or Share Comments

- **Please use the Q&A function to type your questions or comments.** *(A facilitator will read your question to the group.)*

- **To open the Q&A tab:** *hover your mouse over the green bar centered at the top of your screen titled "Viewing Julienne's Desktop." The Q&A tab should be one of menu choices. Or, Q&A is available under the "Options" tab.*

- **If you are having technical difficulties, please contact Judy Fahnestock (**judy@arcus.org**).**

- **Today's presentation will be archived and available on the SIPN Webinars webpage:** *http://www.arcus.org/sipn/meetings/webinars*

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Take home points

Stroeve:

- *2015 shows that any talk of recovery is premature.*
- *Opening of the northern sea route and northwest passage has become part of the "new arctic."*

Hamilton:

- *Many people do not know or accept that Arctic sea ice has declined, but confusion relates more to politics than education.*
- *Viewed as an ensemble, the median Sea Ice Outlook predictions have been close to observed September ice extent in "normal" years when extent was not far from its overall downward trend.*
- *Median SIO predictions have been farther from observations in "strange" years when extent ended far above or below the linear trend.*
- *Ensemble predictions were better in 2014 and 2015 than the previous two years, but then again these years were not as strange as 2012 or 2013.*

Bitz:

- *There are hints of predictive skill at the local scale in some regions, especially in MME, at one to two month lead times. Our community is still learning how to produce and analyze these fields.*

Today's presentation will be archived on the SIPN webpage: http://www.arcus.org/sipn

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