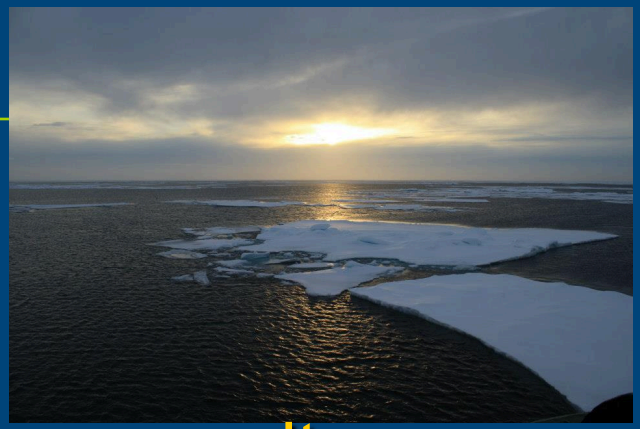
National Snow and Ice Data Center
Supporting Cryospheric Research Since 1976

Sea Ice Prediction Network (SIPN)

J. Stroeve, C. Bitz, E. Blanchard-Wigglesworth, H. Eicken, L. Hamilton, E. Hunke, J. Hutchings, P. Jones, W. Meier, J. Overland, A. Tivy, M. Wang and H. Wiggins

Introduction



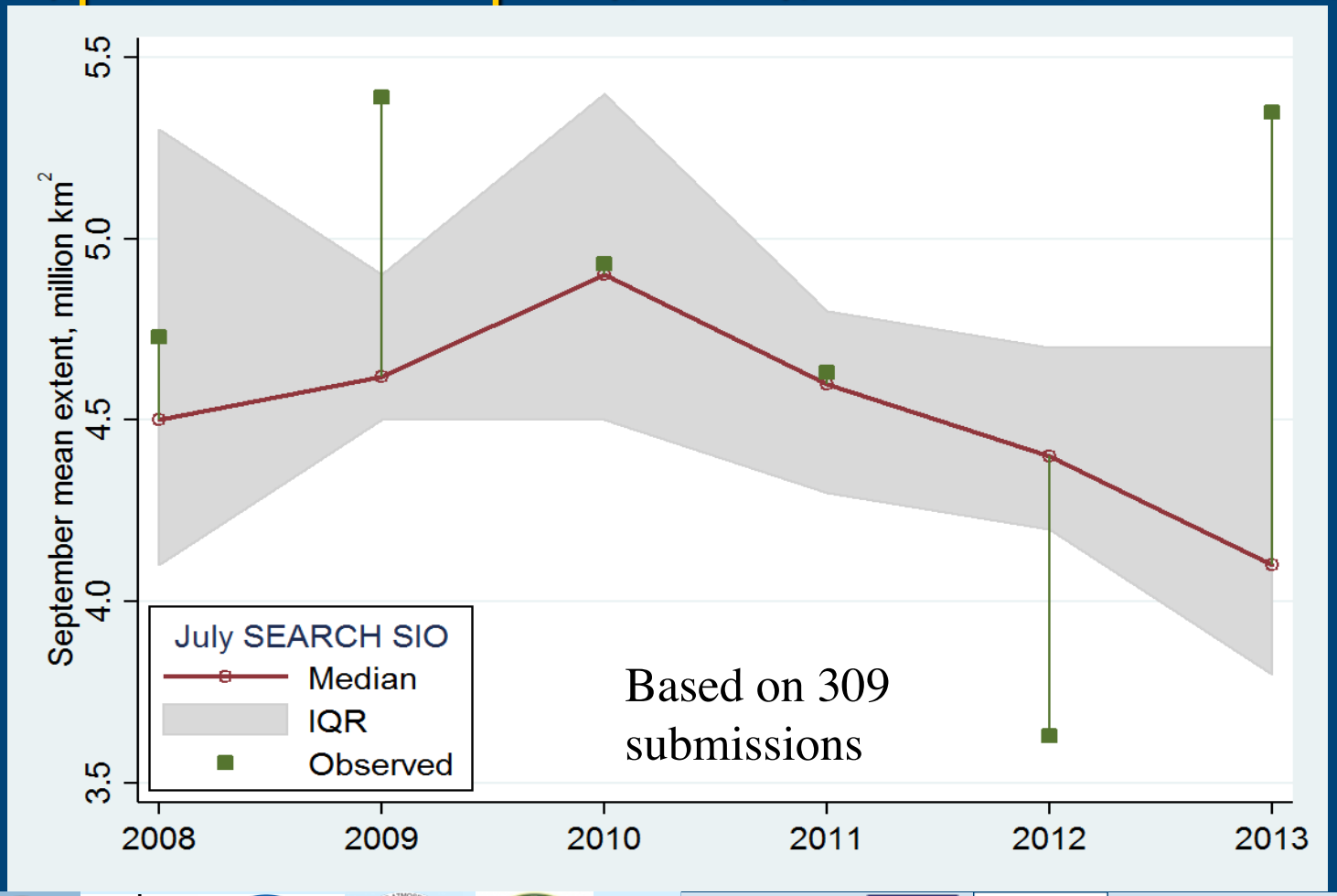
- Predicting Arctic sea ice a few months in advance has become a challenging priority.
- Since 2008 SEARCH has solicited community predictions of the September sea ice extent and disseminated results through the SEARCH Sea Ice Outlook (arcus.org/search-program/seaiceoutlook
- Individuals and teams employ a wide variety of modeling, statistical and heuristic approaches to make these predictions
- This informal network has received a total of 309 contributions for the years 2008 to 2013

Talk Outline

- First discuss how well the seasonal SIO predictions did over the last 6 years (*Stroeve et al., 2014; GRL*).
- Next, discuss implications for predictability.
- Finally, discuss efforts to turn this informal exercise into a more format network (SIPN) aimed at:
  - **Coordinating** and evaluating seasonal predictions
  - **Integrating, assessing and guiding observations**
  - **Synthesizing predictions and observations**
  - **Disseminating** predictions and engaging key stakeholders

July SIO predictions reveal Bimodal Pattern of Success

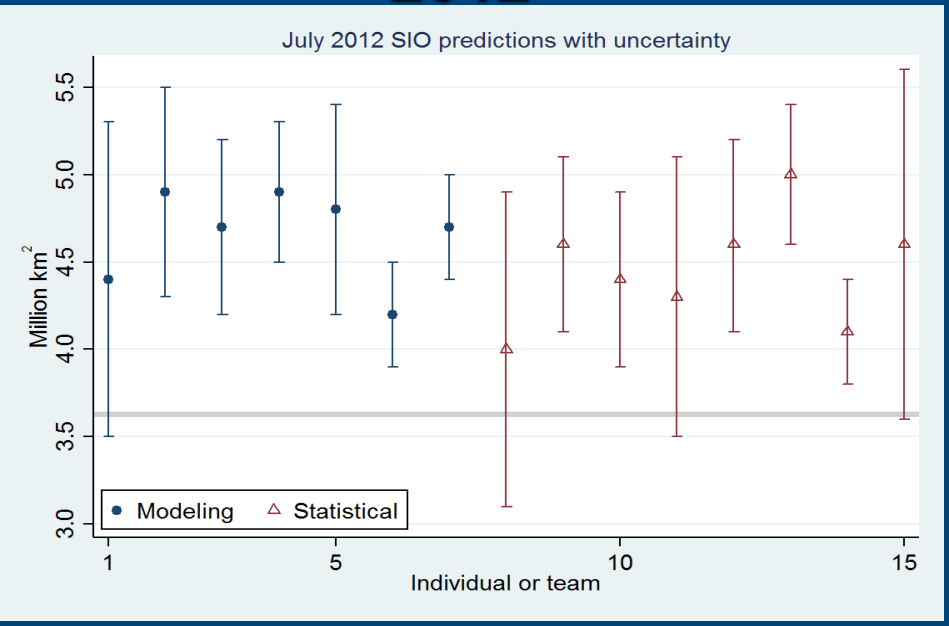
Median and interquartile range of July SIO predictions compared with September mean sea ice extent



Predictions by method

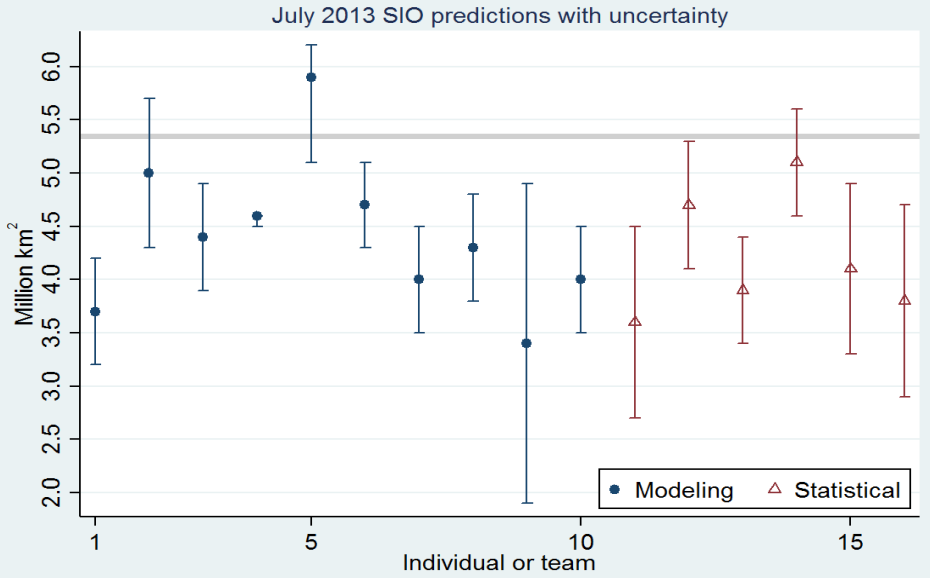
SIO predictions with contributor-supplied uncertainty

2012



Observed extent lies outside the intervals for 11 of 15 predictions, and barely inside the lower limit of 3. As a group, 2012 statistical predictions came closest to the unexpectedly low ice extent.

2013

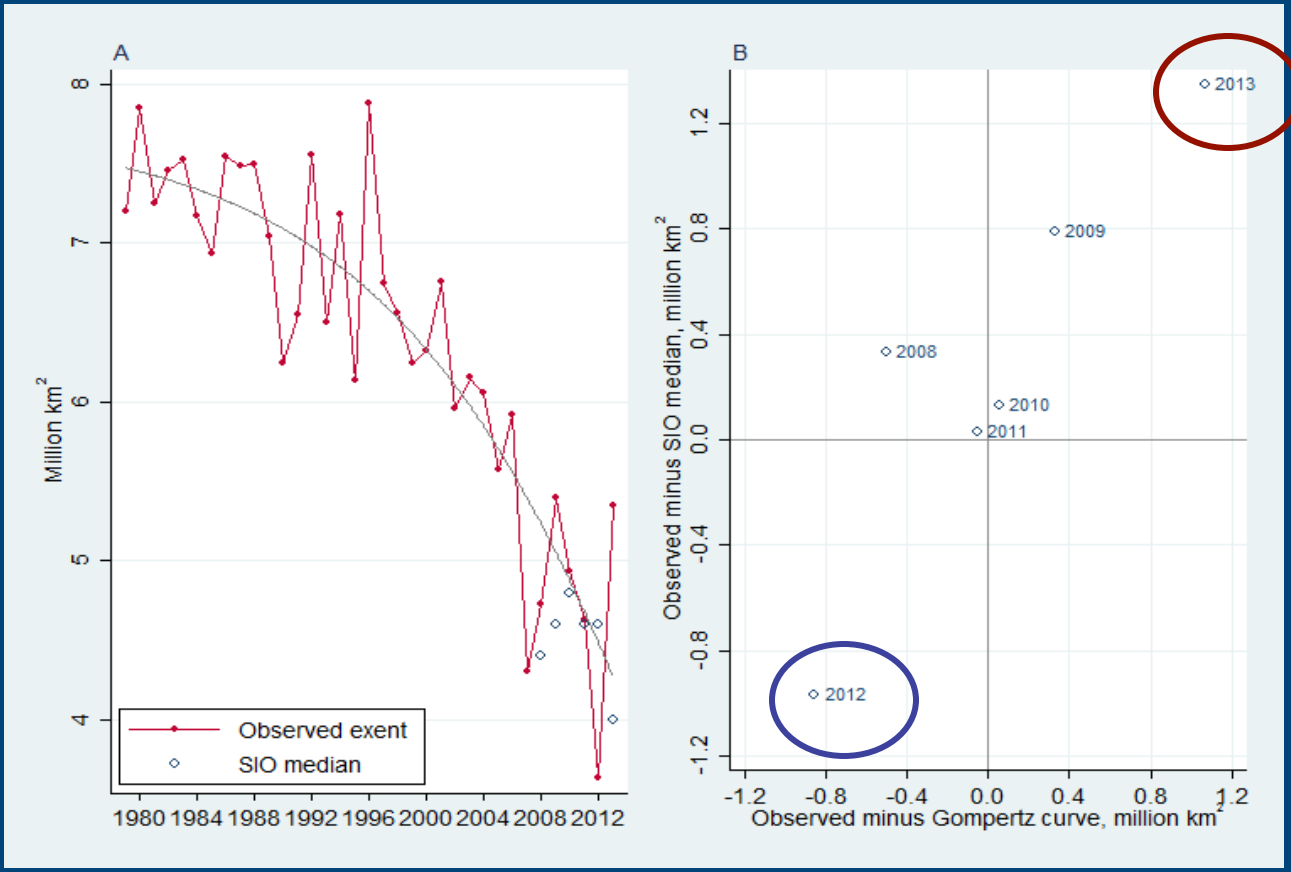


Observed extent lies outside the intervals for 13 of 16 predictions. As a group, 2013 modeling predictions came closest to the ice extent.

SIO Prediction Errors

Observed and Predicted Extent

Prediction Errors



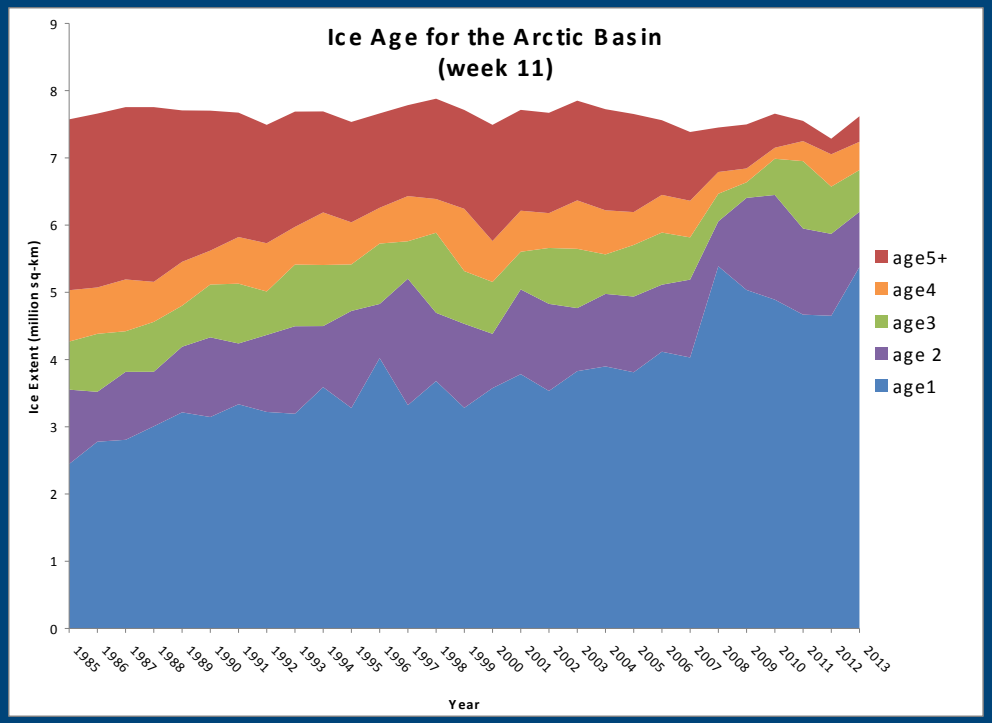
The downward trend is summarized by a Gompertz curve-an asymmetrical S-curve appropriate for the accelerating downward trend.

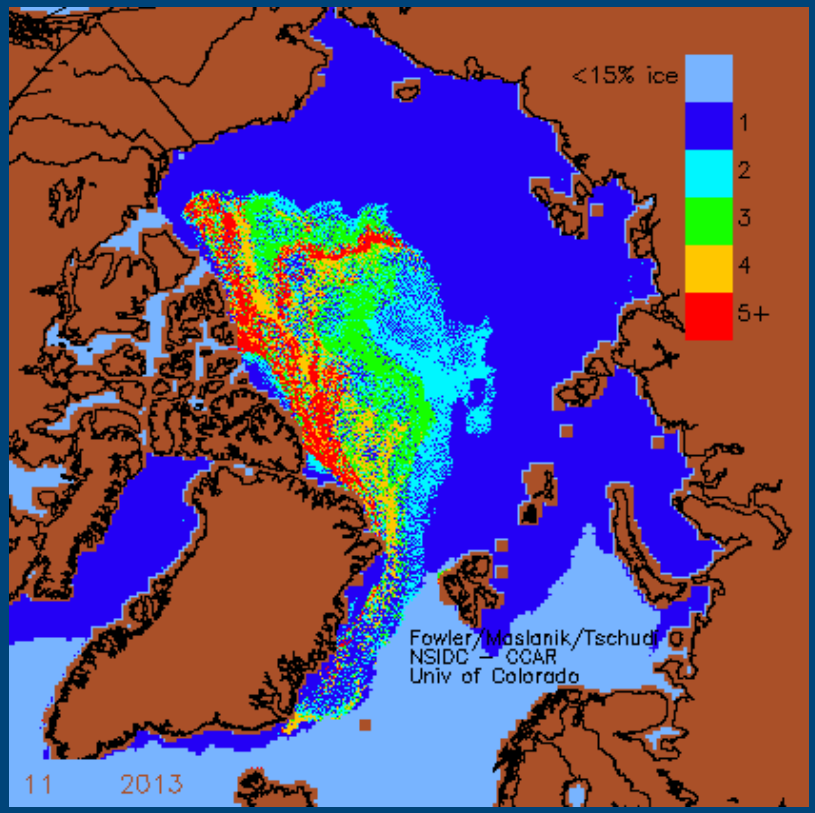
SIO prediction errors and Gompertz curve residuals have a strong positive correlation ($r=0.90$, $p< 0.05$)

MSE of SIO predictions is only slightly better than a series of linear-trend predictions (MSE = 0.58 vs. 0.65)

Limits on Predictability

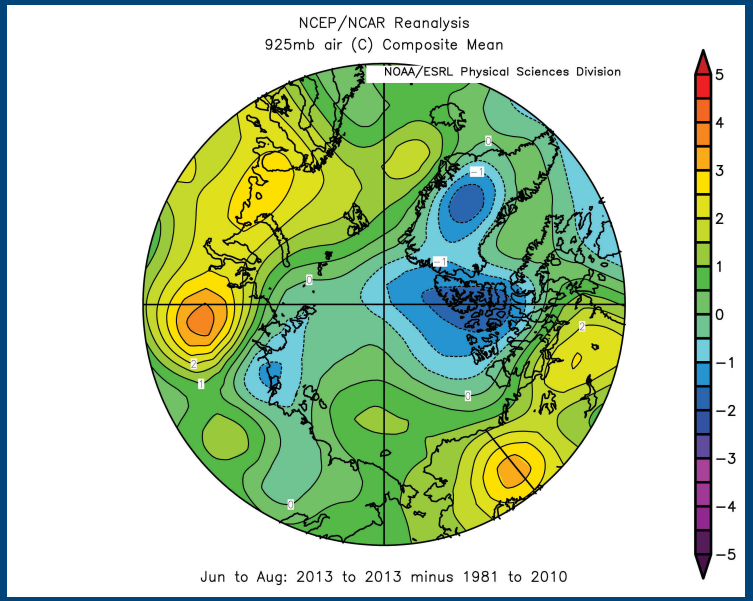
- The largest median error occurred in 2013.
- Yet the summer started out with a large fraction of thin, first-year ice and very little old ice (5+ yr).





Limits on Predictability

- 2013 was characterized by below normal SLP, limiting heat advection from the south, leading to cooler conditions over the Arctic Ocean.
- In this case, despite anomalous spring conditions, summer weather resulted in the September extent not being predictable from a spring initialization.



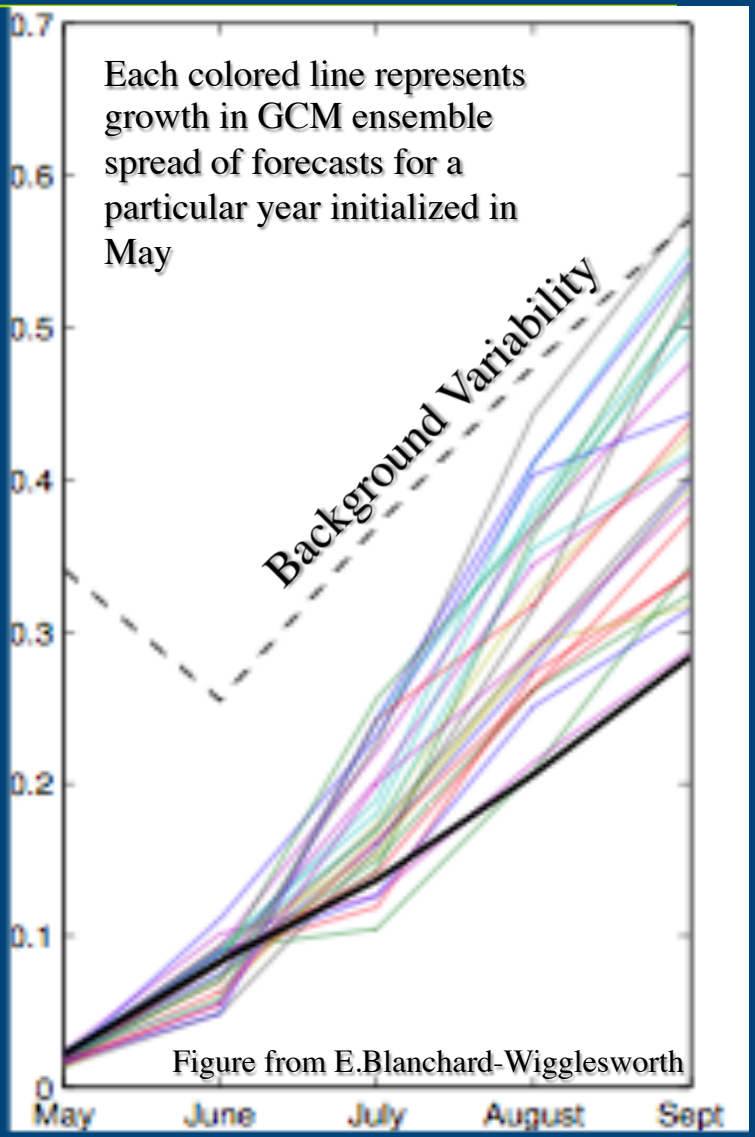
JJA 2013 925 mbar temperature anomalies

- On the other hand, some extreme Septembers could be the result of extreme spring preconditioning, which should be predictable to a degree (from a spring initialization with the right ICs and thickness.

Limits on Predictability

- Simulations from GCMs show that different years can show very different predictability skill – in some years the summer atmosphere gets rid of all predictability by Sep, in other years there still remains good predictive skill.

- SIO predictions show that regardless of method used, it remains difficult to predict Sep SIE when conditions depart from long-term trend, despite preconditioning (though they do beat persistence and climatology)

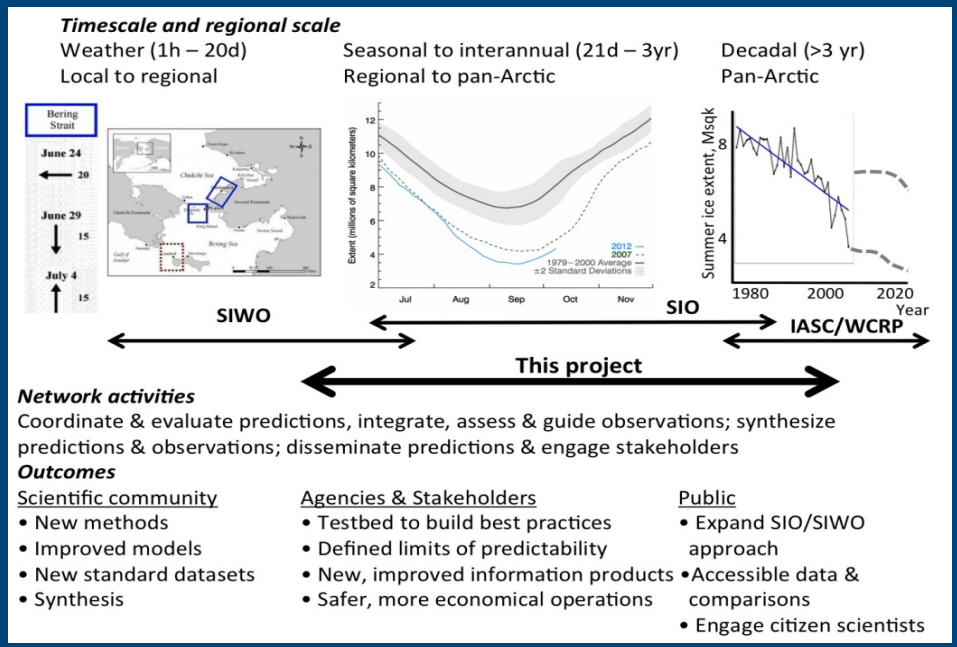


Sea Ice Prediction Network (SIPN)

- SIPN builds on the SEARCH SIO
- Goal of SIPN is to improve seasonal sea ice prediction on seasonal by developing a network of scientists and stakeholders to advance research on sea ice prediction and communicate sea ice knowledge and tools.
- Observations ⟷ Models
- SIPN team members: *J. Stroeve, C. Bitz, E. Blanchard-Wigglesworth, H. Eicken, L. Hamilton, E. Hunke, J. Hutchings, P. Jones, W. Meier, J. Overland, A. Tivy, M. Wang and H. Wiggins*

Towards a Sea Ice Prediction Network

- Coordinate and evaluate predictions (*C. Bitz*)
- Integrate, assess and guide observations (*J. Stroeve*)
- Synthesize predictions and observations (*J. Overland*)
- Disseminate predictions and engage key stakeholders (*L. Hamilton and H. Wiggins*)

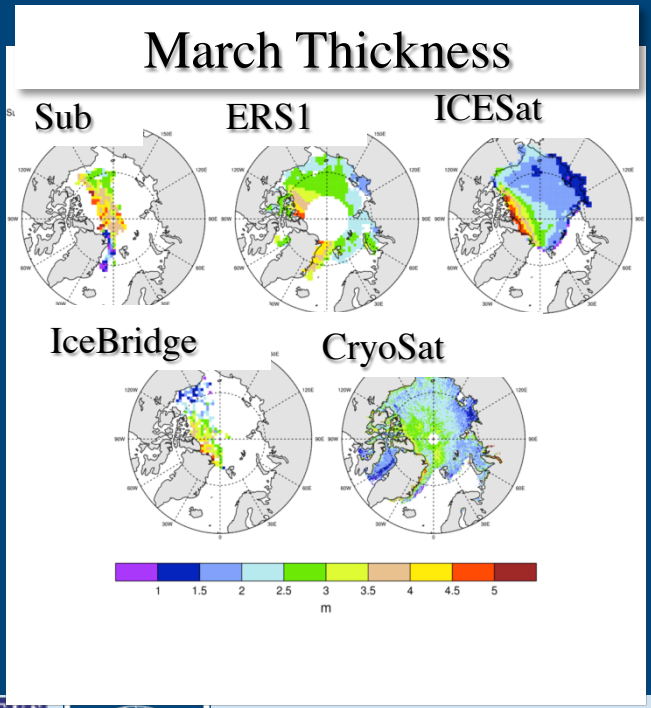


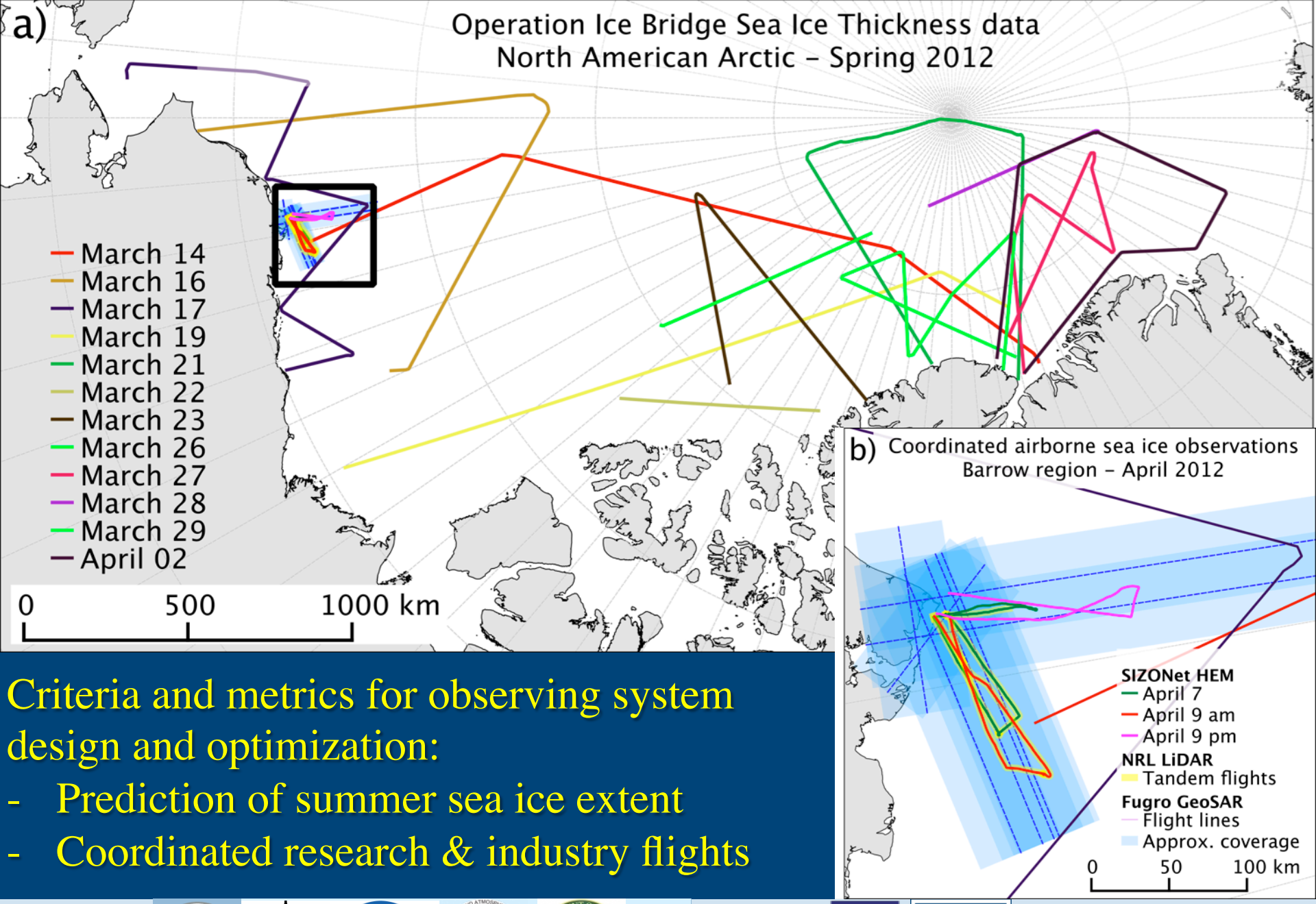
SIPN Workshop (1-2 April 2014, Boulder, CO)

- Overall goal was to plan for the 2014 SEARCH SIO
  - Provide sea ice forecasts with uncertainty estimates – move more towards probability maps;
  - Expand to include spatial pattern of sea ice;
  - Obtain guidance from the community as to how the SEARCH SIO can improve and become a more robust scientific tool.
- Secondary goal is to advance sea ice prediction by:
  - Coordinating experiments;
  - Defining data sets for initialization and validation;
  - Create better metrics for evaluation.
- In total we had about 67 participants, focused on different aspects of sea ice predictability.
  - Follow on workshop to take place in the UK in April 2015.

Observation Goals

- Good knowledge of initial sea ice state is necessary to produce skillful forecasts – especially NRT products.
- New website at NSIDC provides links to sea ice observations at pan-Arctic, regional and local level (http://nsidc.org/data/sipn/)
- Critical: need to obtain guidance from predictive models on best observing strategies (i.e. what data are needed and where) to provide measureable improvement in predictive skill, level of uncertainty, temporal/spatial resolution, data format requirements, etc.





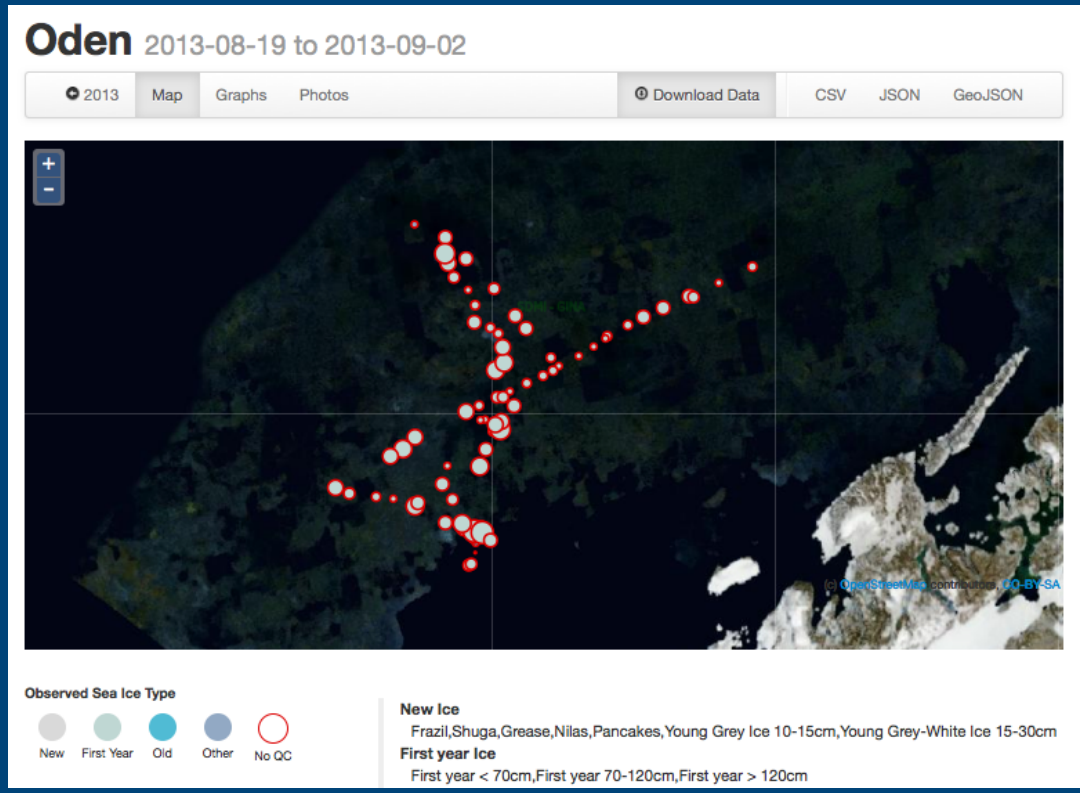
Criteria and metrics for observing system design and optimization:

- Prediction of summer sea ice extent
- Coordinated research & industry flights

ICE WATCH and ASSIST Programs (J. Hutchings)

Arctic Shipborne Sea Ice Standardization Tool (ASSIST)

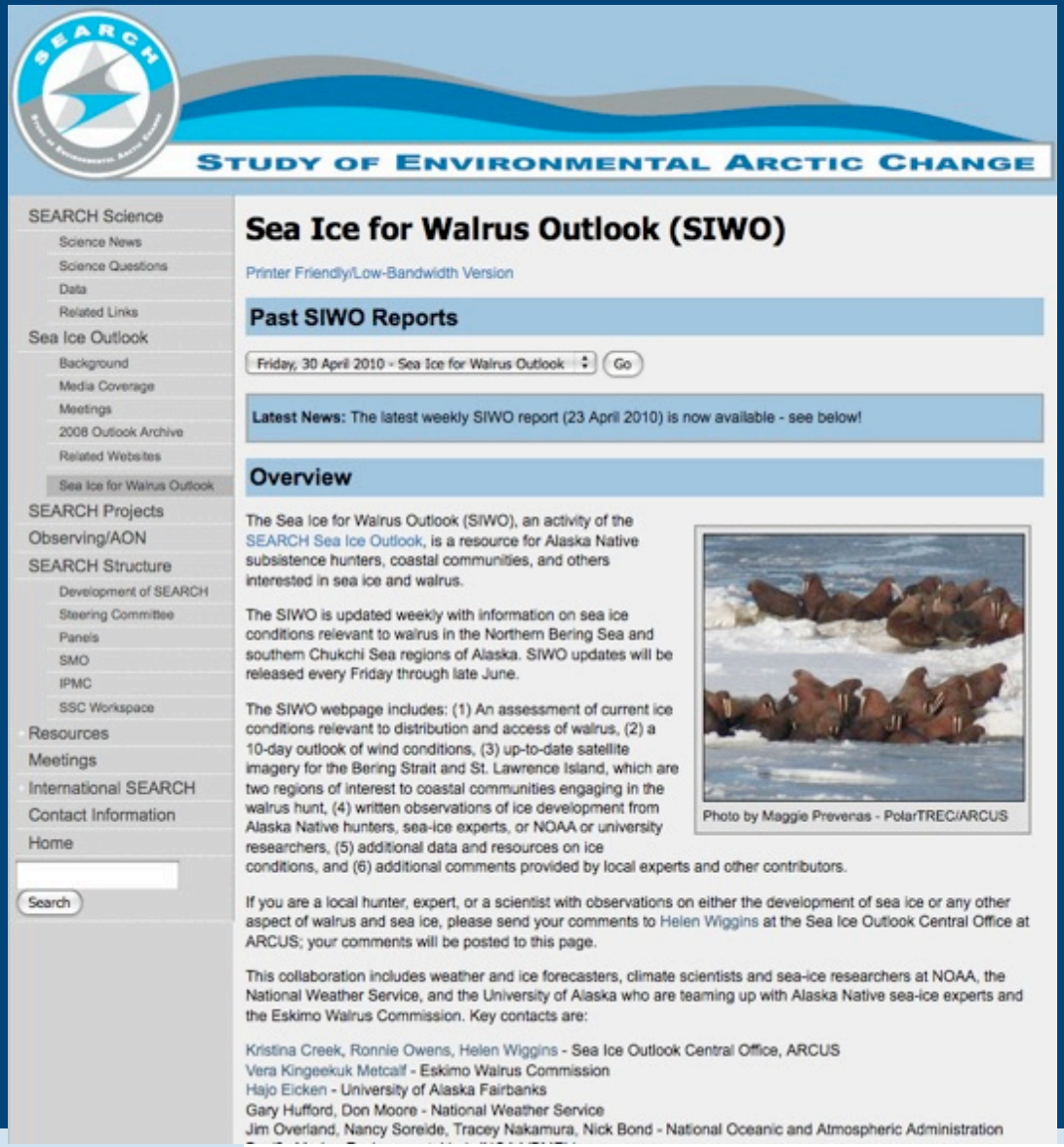
- Multi-media data collection tool to support standardi-zation of observation methods throughout the Arctic Ocean
- Observers on vessels from multiple nations use ASSIST to report near real-time visual sea ice observations
- Observation method follows the WMO (1970) convention, expanding categories to cover biological and geological features of interest



- Next step: Develop protocol & channels to support realtime submission of standardized observations into WMO reporting networks

Sea Ice for Walrus Outlook (SIWO)

- 10-day forecast for N Bering, S Chukchi Seas (NWS, PMEL)
- High-res. satellite images (UAF, NWS)
- Analysis of weather & ice patterns
- Observations by local experts (EWC, SIZONet)
- Input/review by scientists & indigenous experts
- Building a community of practice



www.arcus.org/search/siwo

Stakeholder engagement & information transfer

- Stakeholder information needs from existing reports, other workshops, own research
- Partnership with ACCESS (Northern Sea Route, Kara/ Barents Oil & Gas), Norwegian Research Council Project & AK Community observers

- Information transfer & analysis of sea ice blogs & broader public by L. Hamilton
- Is there any value in crowd-sourcing predictions?
- How does public interpretation of predictions depend on context?

For more information on SIPN:

http://arcus.org/sipn

Or email one of the action team leads

- **J. Stroeve – data**
- **C. Bitz – modeling**
- **J. Overland – synthesis**
- **H. Wiggins and L. Hamilton - stakeholders and dissemination**