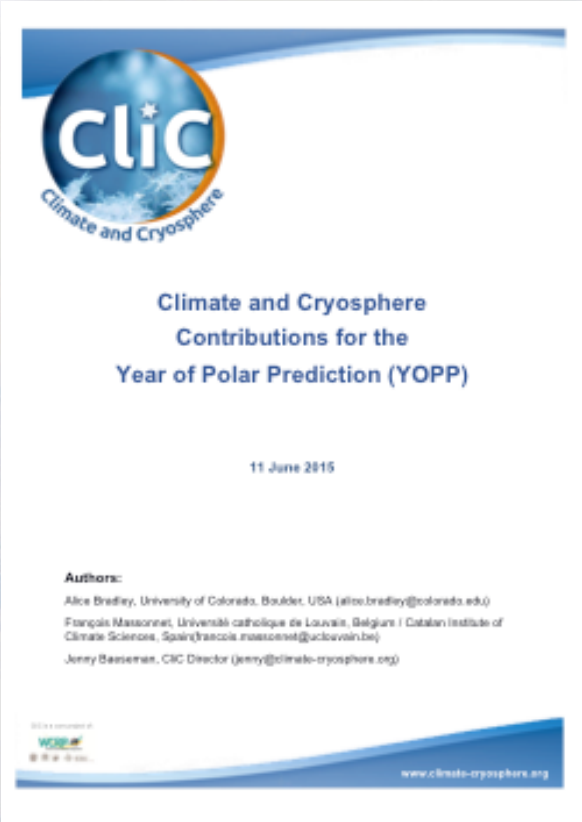
WCRP - Climate and Cryosphere – Polar Climate Predictability Initiative

Plans for the Year of Polar Prediction

G. Krinner, A. Bradley, F. Massonnet, J. Baeseman, C. Bitz and T. Shepherd

CliC Plans for YOPP

- Observations and process understanding
- Modeling, data assimilation
- Outreach and Community Building



Climate and Cryosphere
Contributions for the
Year of Polar Prediction (YOPP)

11 June 2015

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www.climate-cryosphere.org

http://www.climate-cryosphere.org/media-gallery/1521-clic4yopp

Observations and process understanding

- **Arctic and Antarctic Sea Ice Groups**
  - Standardized methods for collecting ship based sea ice observations
  - Arctic Sea Ice Flagship Observatories (with GCW)
- **Ice Plan – Arctic field expeditions**
  - SOOS is working on an Antarctic equivalent
- **Remote sensing**
  - **Identifying user needs & science priorities**
- **Potential: Sea-ice thickness**

- **Global atmospheric boundary layer study, phase 4 (GABLS4, WCRP GEWEX)**

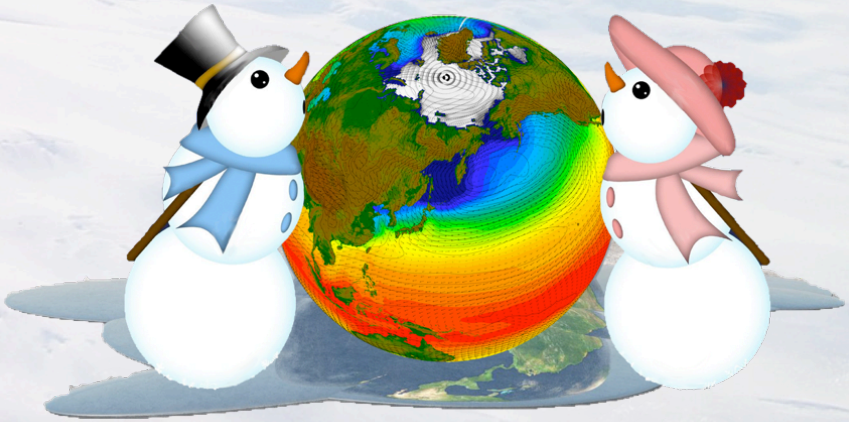
  Stable atmospheric boundary layer at Dome C

  YOPP plan:

participation from a whole suit of models ranging from LES, via limited area models to global weather and climate models. Another example is GABLS4, which focuses on a diurnal cycle in summer at Dome C in Antarctica, a case that was designed to meet a specific need identified at the ECMWF Polar Prediction Workshop. The interaction between the atmosphere and the snow-covered surface is of particular interest in this case besides the boundary layer that becomes strongly stably stratified and very shallow during the night. Transformation from marine to Arctic air

Modelling

- **Sea Ice and Climate Modeling Forum**
  - development and improvement of **dynamic-thermodynamic sea ice models**
  - **standardization of model outputs**: Diagnostic Sea Ice Model Intercomparison Project for CMIP6
- **List of variables for terrestrial, sea ice and ice sheet processes**
- **Next generation of process-oriented metrics for coupled climate models**
- **Regional modeling - Polar CORDEX**
- **Snow Model Intercomparison Project (Cryosphere GC)**
- **Permafrost (Cryosphere GC) – time scale relevant?**



Polar Cordex

- Arctic "bias"
- Hindcasts, historic runs, scenarios
- Possible links to prediction issues, not formalized

Arctic CORDEX modeling groups

Group ID	Contributor	Contact Person
SMHI	Rossby Centre Swedish Meteorological and Hydrological Institute (SMHI) Norrkoping, Sweden	Torben Koenigk
CCCma	Canadian Centre for Climate Modeling and Analysis Victoria, BC, Canada	John Scinocca
EMUT	Environmental Meteorology University of Trier Trier, Germany	Günther Heinemann
AWI	Alfred Wegner Institute Helmholtz Centre for Polar and Marine Research Potsdam, Germany	Annette Rinke
CU	University of Colorado Cooperative Institute for Research in Environmental Sciences (CIRES) Department of Atmospheric and Oceanic Sciences (ATOC) Boulder, CO, United States	John Cassano
ISU	Iowa State University Ames, IA, United States	Justin Glisan
DMI	Danish Climate Centre, Danish Meteorological Institute, Copenhagen, Denmark	Ruth Mottram
MGO	Voeikov Main Geophysical Observatory, St. Petersburg, Russia	Igor Shkolnik
UNI	Uni Research and the Bjerknes Centre for Climate Research, Bergen Norway	Stefan Sobolowski
ULg	University of Liège, Belgium	Xavier Fettweis

Antarctic CORDEX modeling groups

Group ID	Contributor	Contact Person
KNMI	Royal Netherlands Meteorological Institute De Bilt, Netherlands	Erik van Meijgaard
NMT	New Mexico Institute of Mining and Technology, Department of Earth and Environmental Science, Socorro, NM, United States	David Reusch
OSU	Ohio State University, Byrd Polar Research Center, Ohio, USA	Dave Bromwich
DMI	Danish Meteorological Institute, Copenhagen, Denmark	Ruth Mottram
KUL	University of Leuven, Department of Earth- and Environmental Sciences, Belgium	Nicole van Lipzig

ESM-SnowMIP

- Tightly linked to CMIP (Land Surface, Soil moisture and Snow intercomparison - LS3MIP)
- Coordination with SnowGLACE/WGSIP & GEWEX GLASS
- Transpose AMIP – Transpose CMIP for YOPP case studies?
  - Also for soil freezing/permafrost?
- YOPP plan:

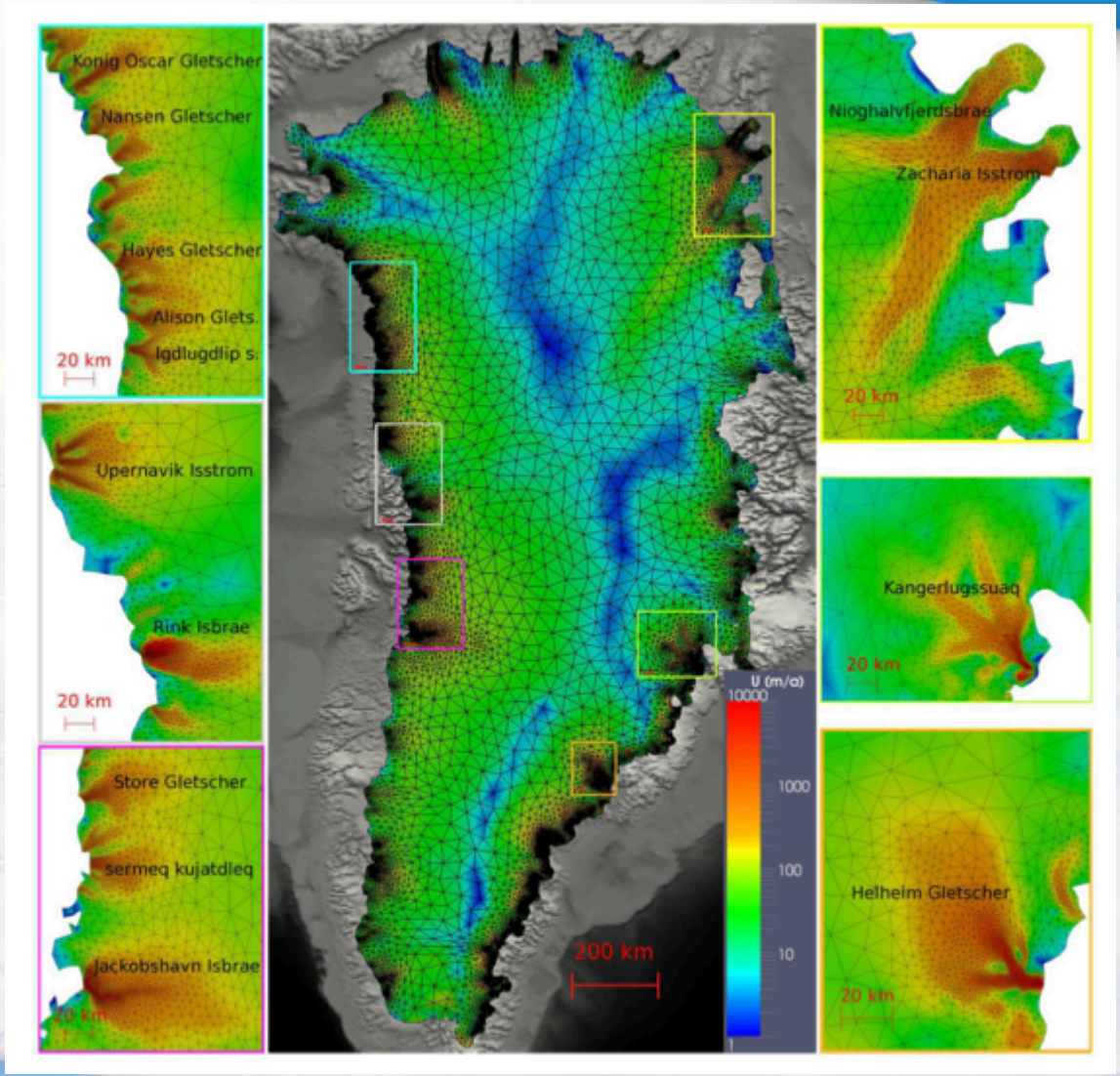
The sub-seasonal to seasonal prediction community, including through the S2S project, as well as the WMO Global Producing Centres for long-range forecasts, should be engaged to perform intensive real-time predictions during YOPP with frequent updates (once a day for sub-seasonal and once a week for seasonal) during interesting case studies. In coordination with WCRP PCPI coupled short-term forecasts with Earth System Models (ESMs), Transpose CMIP experiments, can be conducted to learn about biases in fast model processes that lead to systematic errors. This could become a contribution to the ESM-SnowMIP (Snow Models Intercomparison) initiative.

Assimilation

Strong YOPP focus on data assimilation

Data assimilation of interest for many cryospheric components of the climate system

e.g. decadal-scale predictions of ice-sheet outlet glacier flow variability?



Gillet-Chaulet et al., The Cryosphere, 2012

Outreach and community building

- CliC YOPP Fellows
- Polar Prediction Field School(s)
- Thousands via Twitter, Facebook, web
- YOPP Newsletter features
- YOPP FrostBytes

WCRP Polar Climate Predictability Initiative (PCPI)

http://www.climate-cryosphere.org/wcrp/pcpi

Co-leads: Cecilia Bitz (U. Washington, USA)

&

Ted Shepherd (U. Reading, UK)

THANKS to Jenny Baeseman for representing PCPI (& CliC) on the YOPP Summit organizing committee

PCPI Themes Joint with PPP & related to YOPP

1 *Improve understanding of polar climate predictability on seasonal to decadal timescales*

Co-leads: John Fyfe (CCCma, Canada) and Ed Hawkins (U Reading, UK)

2 *Assess reanalyses in polar regions*

Co-leads: Dave Bromwich (Ohio State U, USA) and Jim Renwick (Victoria University, New Zealand)

3 *Model error - identify processes & develop strategies to improve*

Co-leads: Markus Jochum (U Copenhagen, Denmark) & Gunilla Svensson (U Stockholm, Sweden)

PCPI Activities Related to YOPP

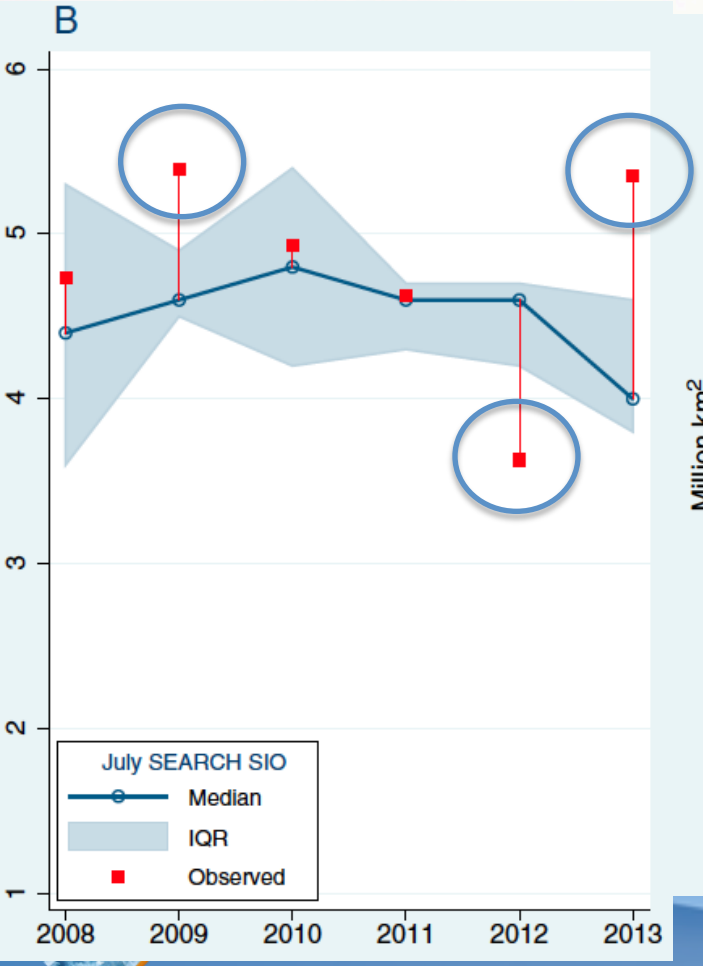
- Annual Sea Ice Prediction workshop (ongoing, rotating venue internationally) led to recommendations to Sea Ice Outlook
- Polar prediction sessions at AGU & EGU (ongoing) good participation and well attended
- Joint PPP/PCPI workshop on polar-lower latitude linkages (Barcelona, last December)
- Participating in the Polar Prediction School (Sweden, 2016)
- Various other workshops and several journal articles summarizing PCPI inspired research and reviews

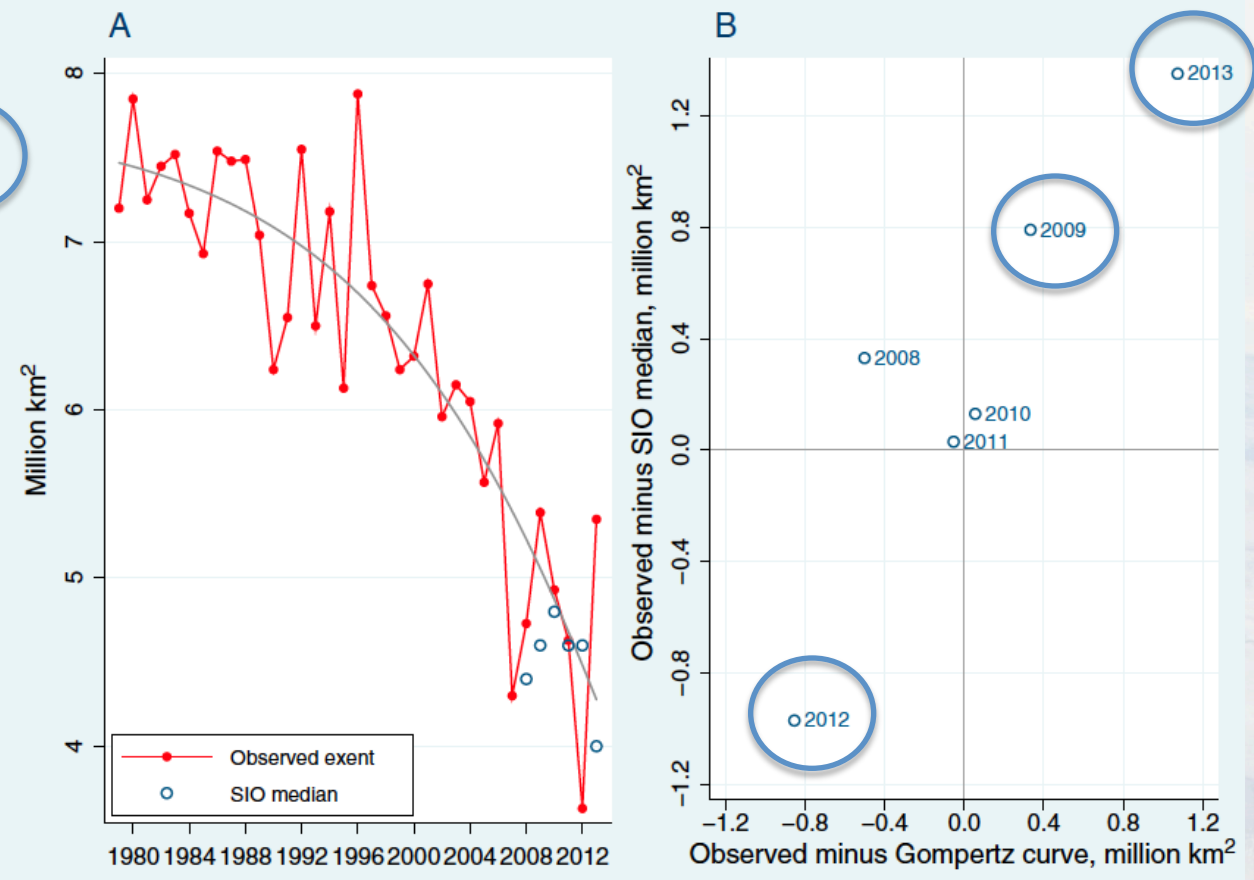
PCPI interests for YOPP

- Process studies for model development/improvements
- Observations that repeat process studies from IPY, to begin to identify baseline, variability & forced response
- Need to develop sea-ice (and coupled) data assimilation, especially with multivariate methods. Interested in doing transpose AMIP/CMIP experiments with YOPP reanalyses to evaluate methods

Thank you

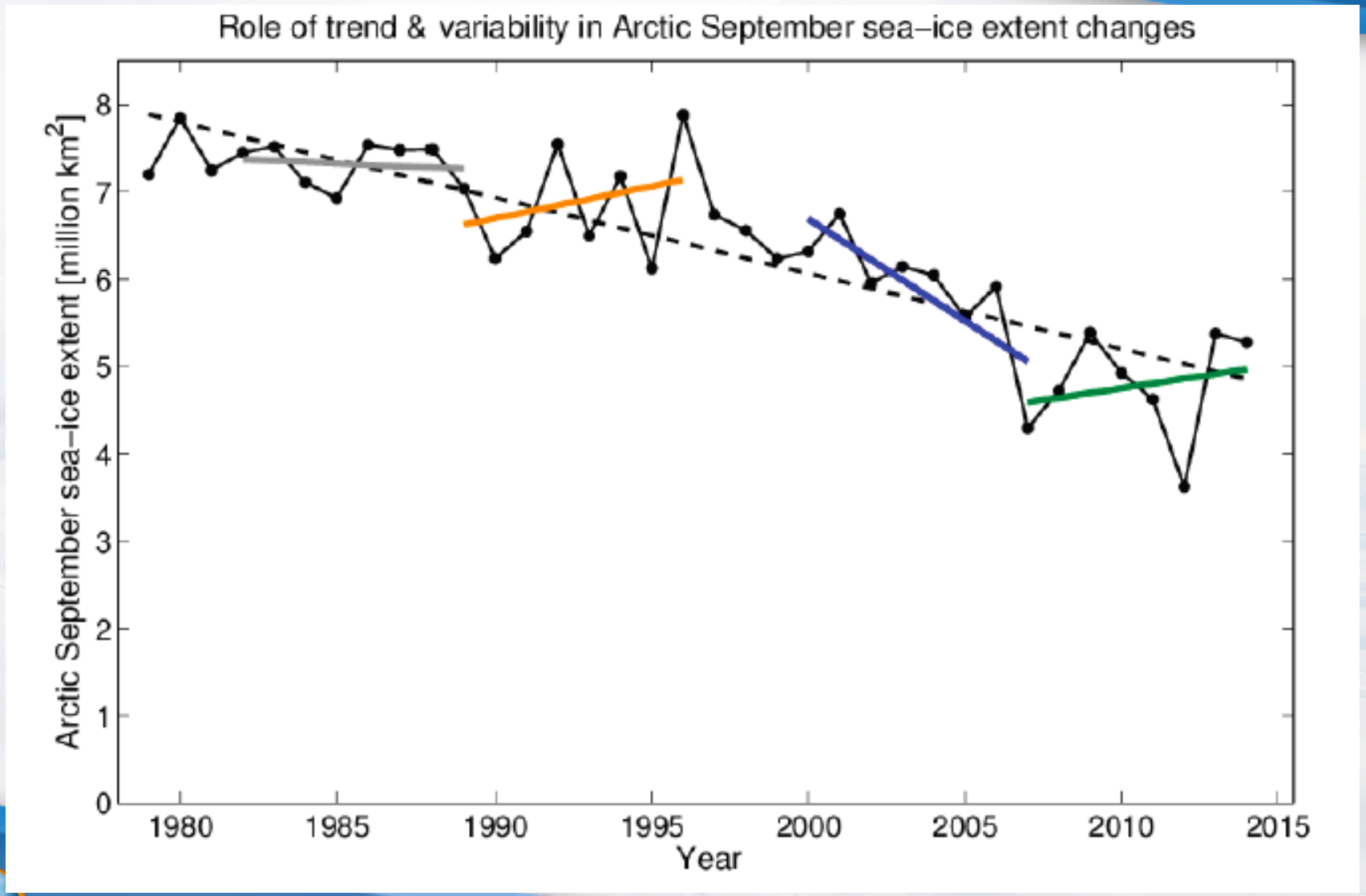
- Arctic sea-ice prediction is a new but rapidly growing area
- SEARCH Sea-Ice Outlook (SIO): any skill comes from the trend
- Anomalous years are more difficult to predict; need to determine where predictability may lie, e.g. in springtime sea-ice thickness





Stroeve et al. (2014 GRL)

- Arctic sea-ice trends over short periods can be highly variable



From Swart et al. (Nature CC, 2015); arose from PCPI workshop

Other PCPI Themes

4 *Assess performance of CMIP5 models in polar regions*

Co-leads: Hugues Goosse (UCL, Belgium) and Jennifer Kay (NCAR, USA)

5 *Improve knowledge and understanding of past polar climate variations (up to 100 years)*

Co-leads: Sarah Gille (Scripps, USA) and Julie Jones (U Sheffield, UK)

6 *Improve understanding of how jets and non-zonal circulation couple to the rest of the system in the Southern Hemisphere*

Co-leads: Gareth Marshall (BAS, UK) and Marilyn Raphael (UCLA, USA)

- Canziani, P.O., A. O'Neill, R. Schofield, M. Raphael, G. J. Marshall, and G. Redaelli, 2014: World Climate Research Programme Special Workshop on Climatic Effects of Ozone Depletion in the Southern Hemisphere. *Bull. Amer. Meteor. Soc.*, **95**, ES101–ES105.
- Swart, N. C., J. C. Fyfe, E. Hawkins, J.E. Kay and A. Jahn, 2015: Influence of internal variability on Arctic sea-ice trends, *Nature Climate Change*. 5, 86-89.
- Raphael, M.N., G.J. Marshall, J. Turner, R. Fogt, D. Schneider, D.A. Dixon, J.S. Hosking, J.M. Jones, and W.R. Hobbs, in press: The Amundsen Sea Low: Variability, change and impact on Antarctic Climate, *BAMS*.

- 2014
  - Collect and report more standardized information and provide it in the SIO monthly reports, such as uncertainty estimates, retrospective forecast skill, details about methods, etc
  - Collect and report regional-scale information, especially at 1-2 month lead time
  - Report more advanced analysis by contribution type
  - Report information to enhance understanding to public, such as how forecasts are made, meaning of skill metrics, predictability limits. Encourage all who are engaged in SIO to blog, tweet, make videos, etc.
  - Provide a post season report synthesizing annual activity
  - The workshop also generated recommendations for MIPS, observations, and developing metrics

- 2015
  - Collect Outlooks in other months, perhaps forecasts of January & April
  - Collect forecasts for the whole summer, so the June call collects forecasts starting the first week in June. Collect forecasts of weekly averages, not just monthly
  - Collect info about the uncertainty/width of ensemble in regional forecasts at each grid point
  - Clarify validation definitions in Outlooks and validation

WCRP World Climate Research Programme

WMO UNESCO IOC ICSU International Council for Science

GEWEX

CliC

SPARC Stratosphere-troposphere Processes And their Role in Climate

CLIVAR

Host Institute

NORSK·POLARINSTITUTT

Polar Climate Predictability Initiative