Data and Modeling Strategies eTown Meeting

Ad-Hoc ARCSS Committee Data and Modeling Working Group

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eTown Meeting of the Arctic Science Community

17 March 2006

ARCSS Move Toward Synthesis

- NSF Arctic System Science Program reformulating around synthesis and integrative research
- Aim: improved understanding of the Arctic as a system and of its particular role in the larger Earth system.
  - –scientific hypotheses on the Arctic system's inner workings and ultimate state (e.g. Overpeck et al. 2005, *Eos AGU Transactions*)
  - – the knowledge demands of an increasingly urgent policy debate (e.g. ACIA, IPCC).

Tradition of NSF Arctic Science

- History of ARCSS-funded research based largely on disciplinary study (i.e terrestrial ecosystems, ocean dynamics, ocean-atmosphere, and paleo-climatology, etc.)
  - –critical insights into the workings of major component processes
  - –broad array of scientific approaches and techniques, including process-level field experimentation, descriptive study, *in situ* and remote sensing monitoring, sophisticated time series and other statistical analyses, simulation modeling

Some Impediments to Info Flow

- This scientific knowledge not necessarily translated into accessible data sets or smooth information flow among these studies
- Discipline-specific, project-specific models/data sets employ highly specialized structures, resolutions, time/space domains
- Data restrictions/data policy impedes full access (e.g. human/social science data sets)
- Arguably, the typical PI focuses on his/her science; community framework for wide data & model dissemination lacking

The Consequence

- Opportunities missed to see
  larger-scale patterns and emergent
  system properties……which is
  the essence of synthesis

New Opportunities Building around Modeling and Data

- Major new observational and modeling initiatives:
  - –International Polar Year (IPY)
  - –International Conference on Arctic Research Planning (ICARP-II)
  - – SEARCH
  - –Coordinated Environmental Observational Program (CEOP)
  - –Global Environmental System of Systems (GEOSS)
- Unprecedented technical capabilities to create a coherent picture of the past, present, and future states of the pan-Arctic…. *using data to force models or in assimilation schemes*
- ARCSS could help catalyze and benefit immensely from a coordinated data synthesis strategy

What modeling and data integration methods, approaches or activities will best contribute to synthesis and uncover new insights into the workings of the Arctic system?

But before opening the dialogue…….
some examples of
pathways to synthesis

"WELL-POPULATED" SET of COMPONENT STUDIES

Cassano/Gutowski, Holland, Francis, Serreze

Cassano/Gutowski, Holland, Francis, Serreze

Hinzman/Cassano/ Gutowski, Lettenmaier, Liston, Semiletov, Yang, Zhang

Karabanov, Lettenmaier, Peterson, Semiletov, Smith, Vörösmarty

?

Hinzman

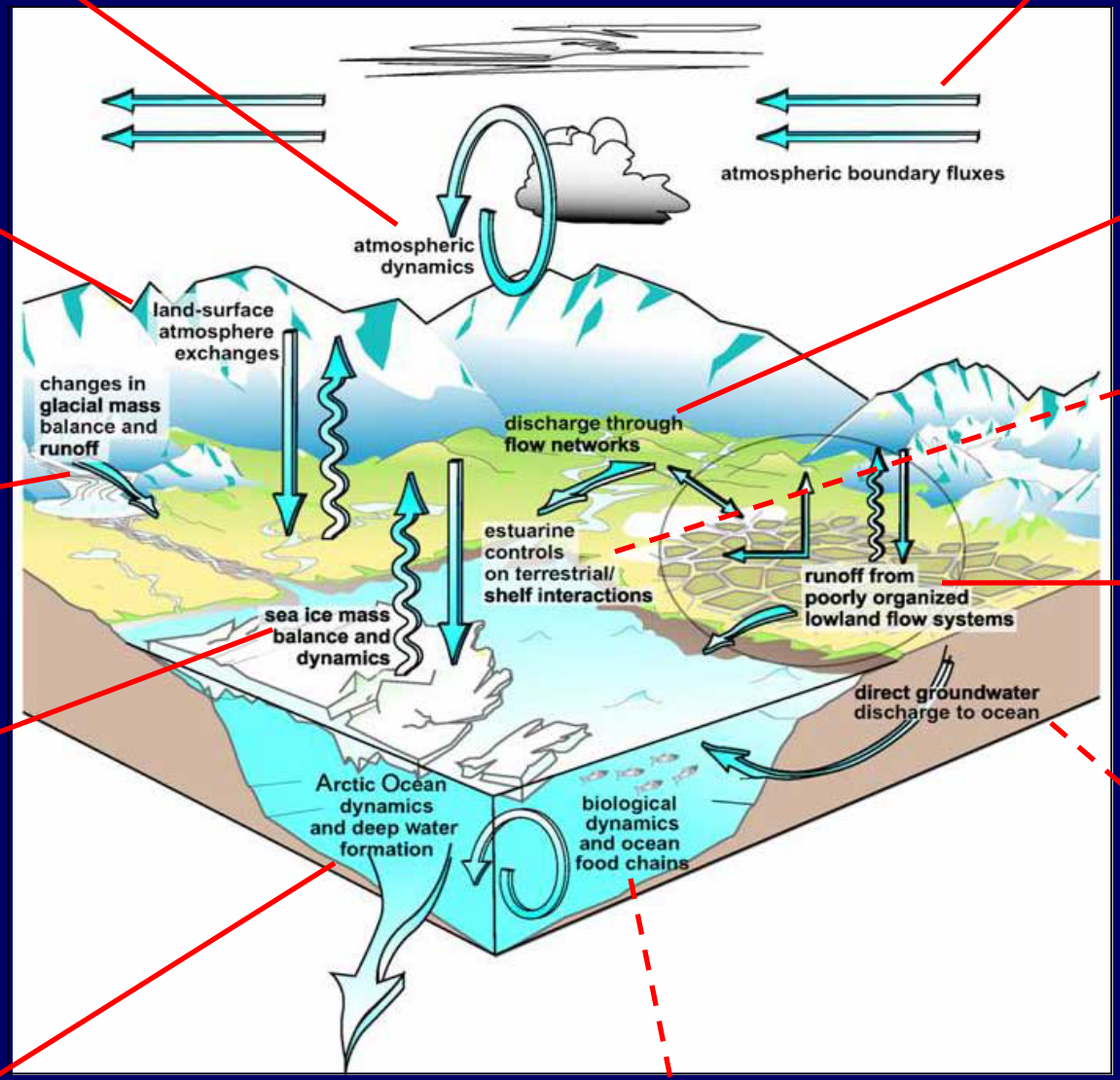
Semiletov, Zhang

Yu, Francis

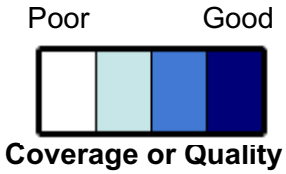
?

Falkner, Lee, Proshutinsky, Steele

?



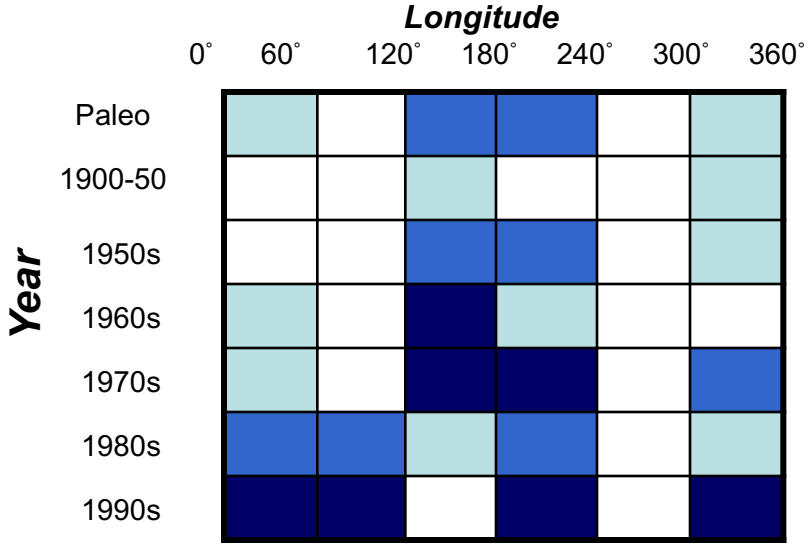
SYNERGY BETWEEN OBSERVATIONS AND MODELED OUTPUTS



SYSTEMIC UNDERSTANDING

INDUCTIVE PATH ⟷ *DEDUCTIVE PATH*

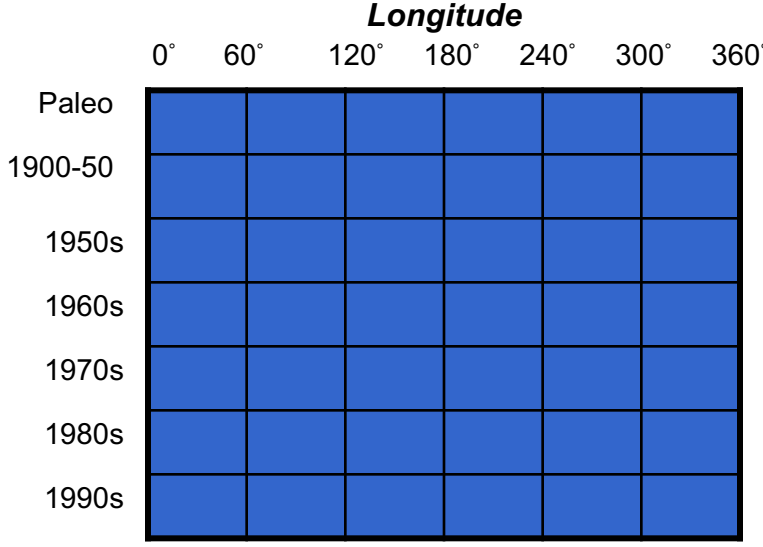
Specific to General



Observations

- Spatially/temporally patchy
- Quality: High to Low
- Challenging to explain in aggregate

General to Specific



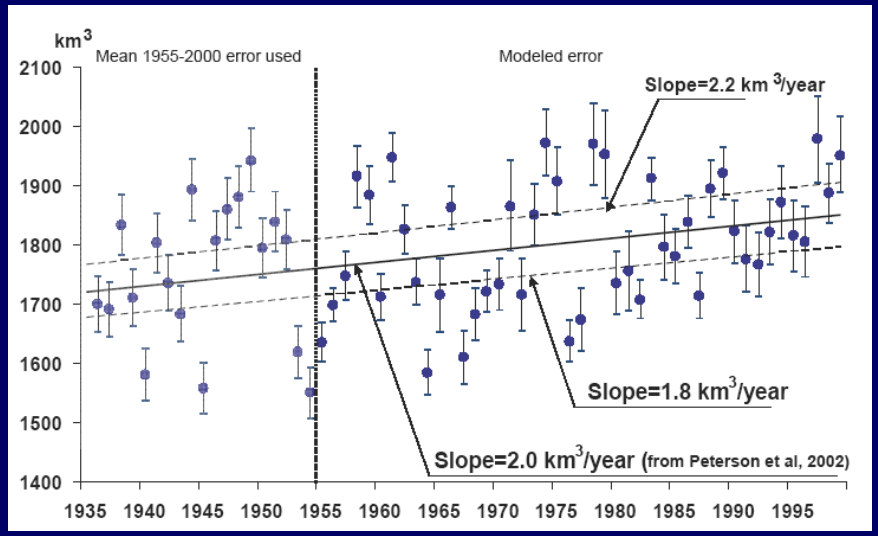
Modeled Outputs

- Spatially/temporally contiguous
- Physically-consistent but incomplete
- Gap-filling

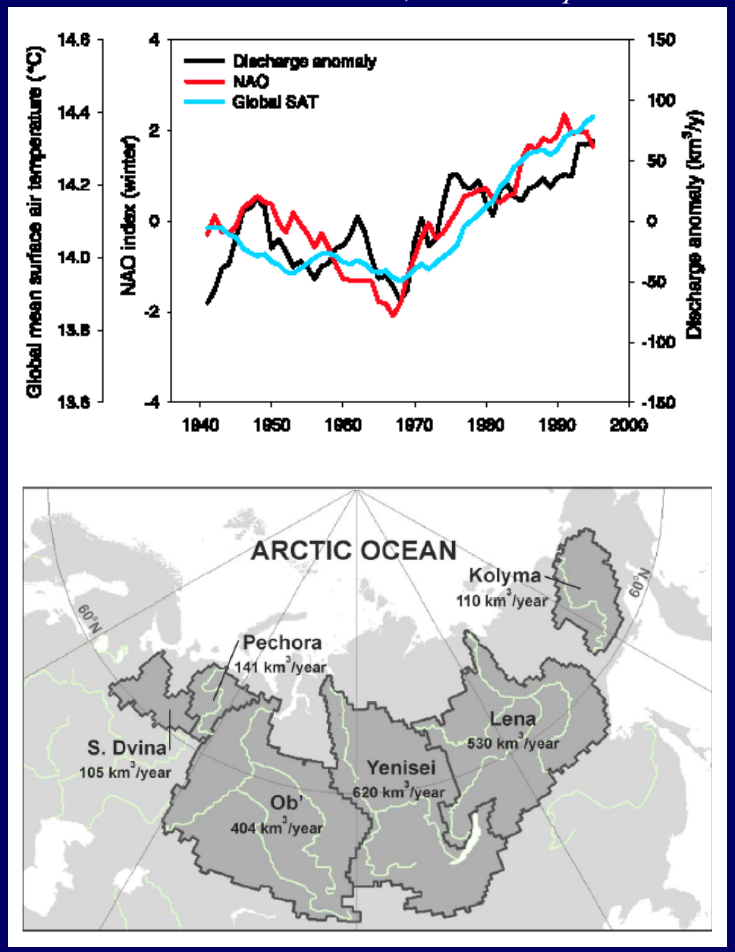
Hydrological Variables Sensitive to Environmental Changes over N. Eurasia:

Combined Annual Discharge 6 Largest Eurasian Arctic Rivers --- 7% increase over period of record

Peterson et al. 2002,, Shiklomanov et al. 2006



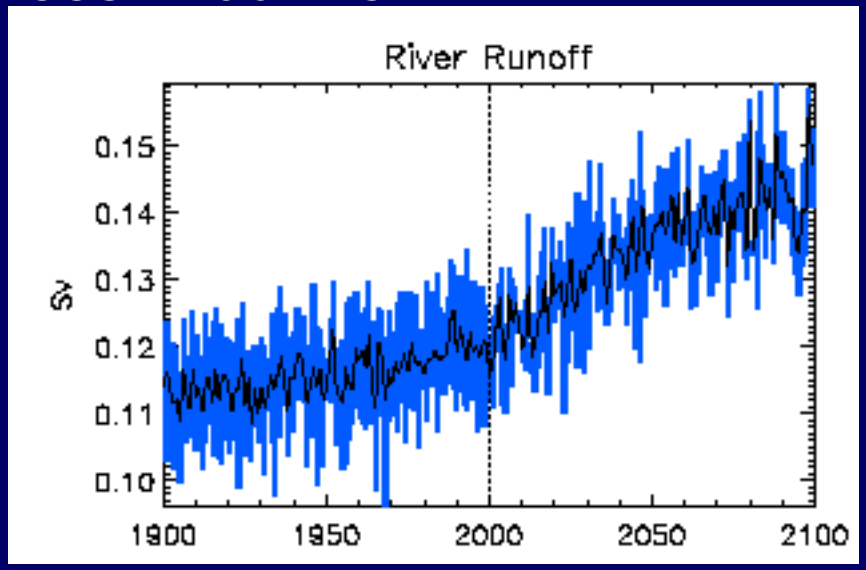
Lammers et al. 2001, *JGR-Atmospheres*

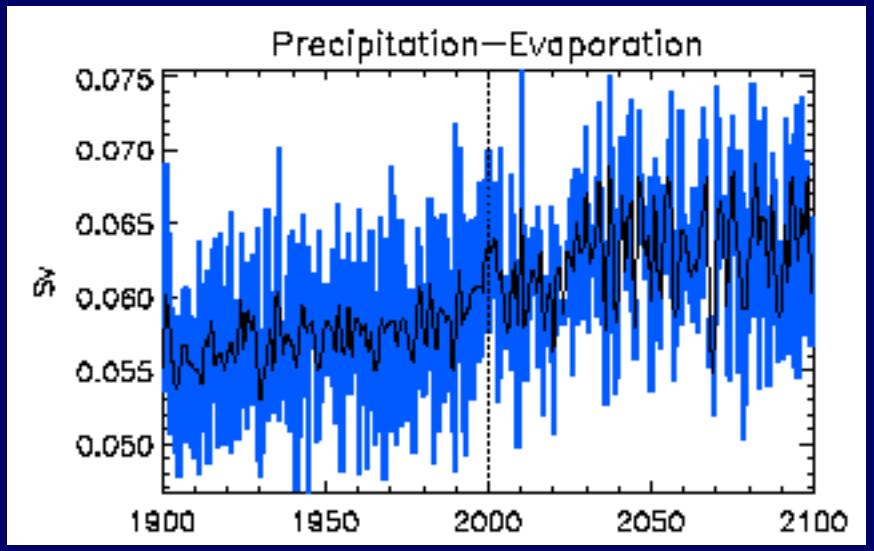


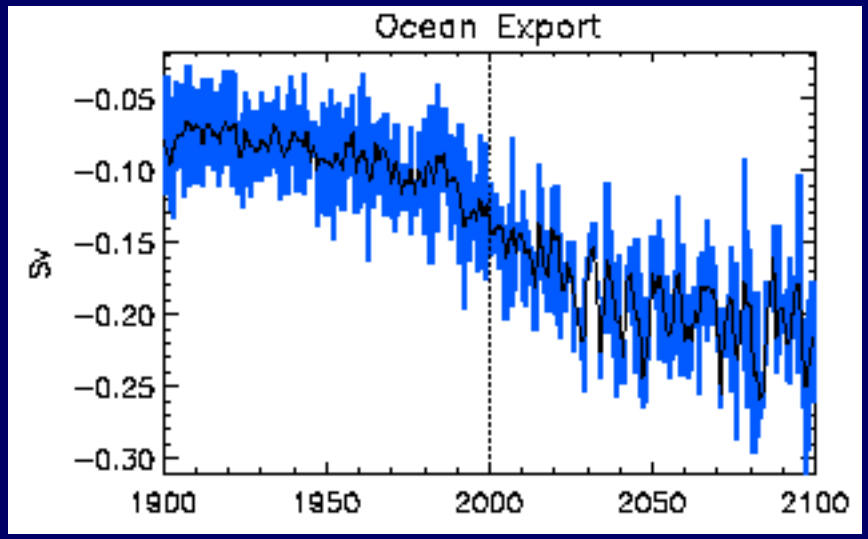
- Aggregate Trend Detectable for Arctic
  - -Temporal character complex
  - -Geography of Δ Complex
- Linked to NAO and global T rise
- 18-70% Increase in River Q to 2100

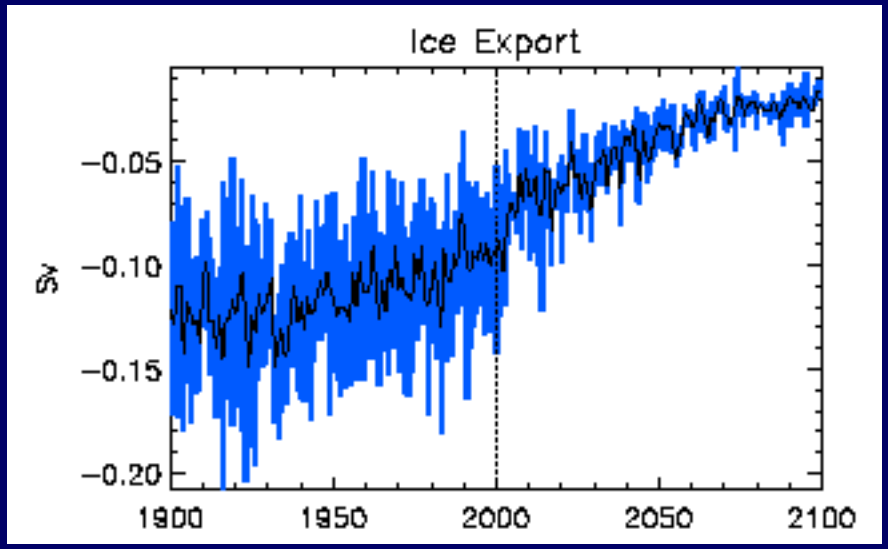
Synthesis through Earth System Modeling

CCSM-Polar WG



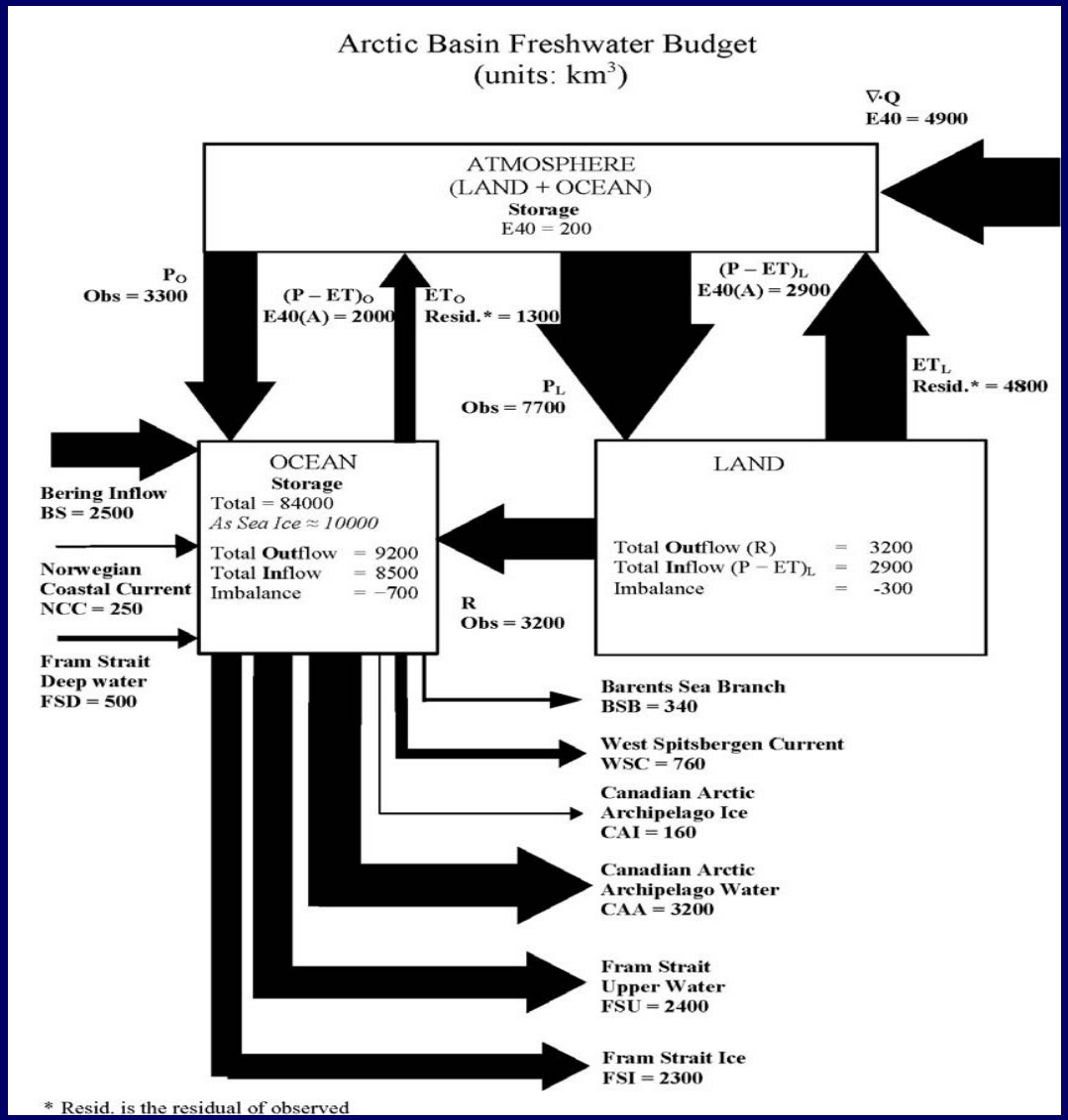


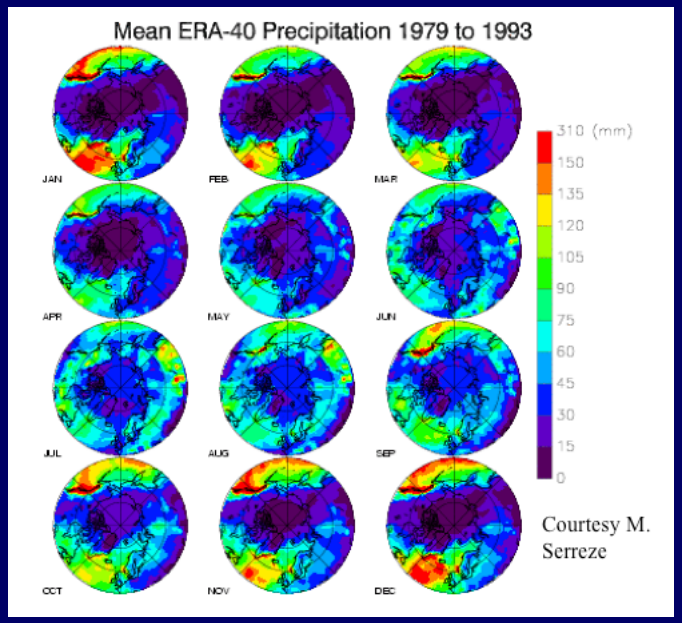




Slide courtesy Marika Holland, NCAR

FWI Budgeteers



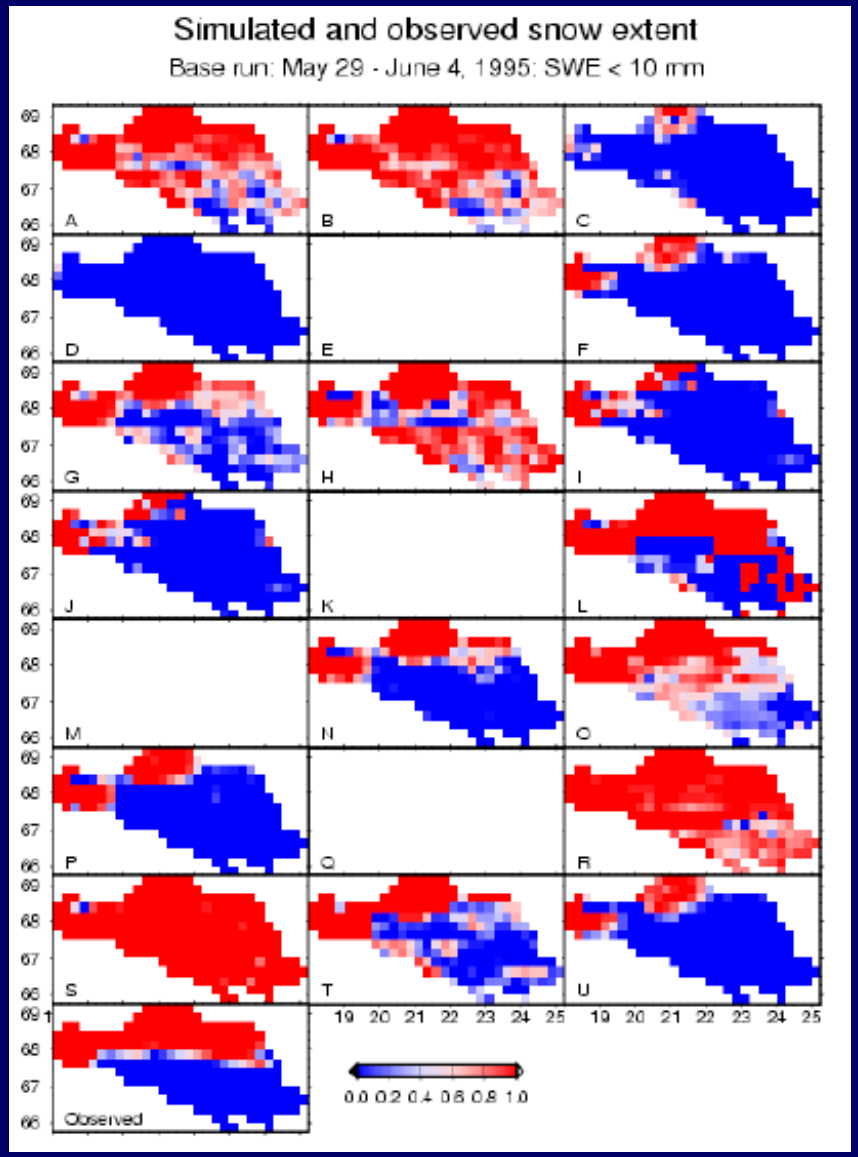


- Literature-based
- Distillations of FWI outputs, dedicated to this task
- New processing of data streams
- The “account” is physically meaningful

CHAIRS: Mark Serreze (Atmosphere), Richard Lammers (Land), Richard Moritz and Craig Lee (Ocean)

Synthesis through Intercomparison Experiments

- Broad disparities among models *(e.g. land surface hydrology)* of some of the basic building blocks of the pan-Arctic system
- Ongoing experiments for ocean *(AO-MIP)*, regional climate models *(ARC-MIP)*

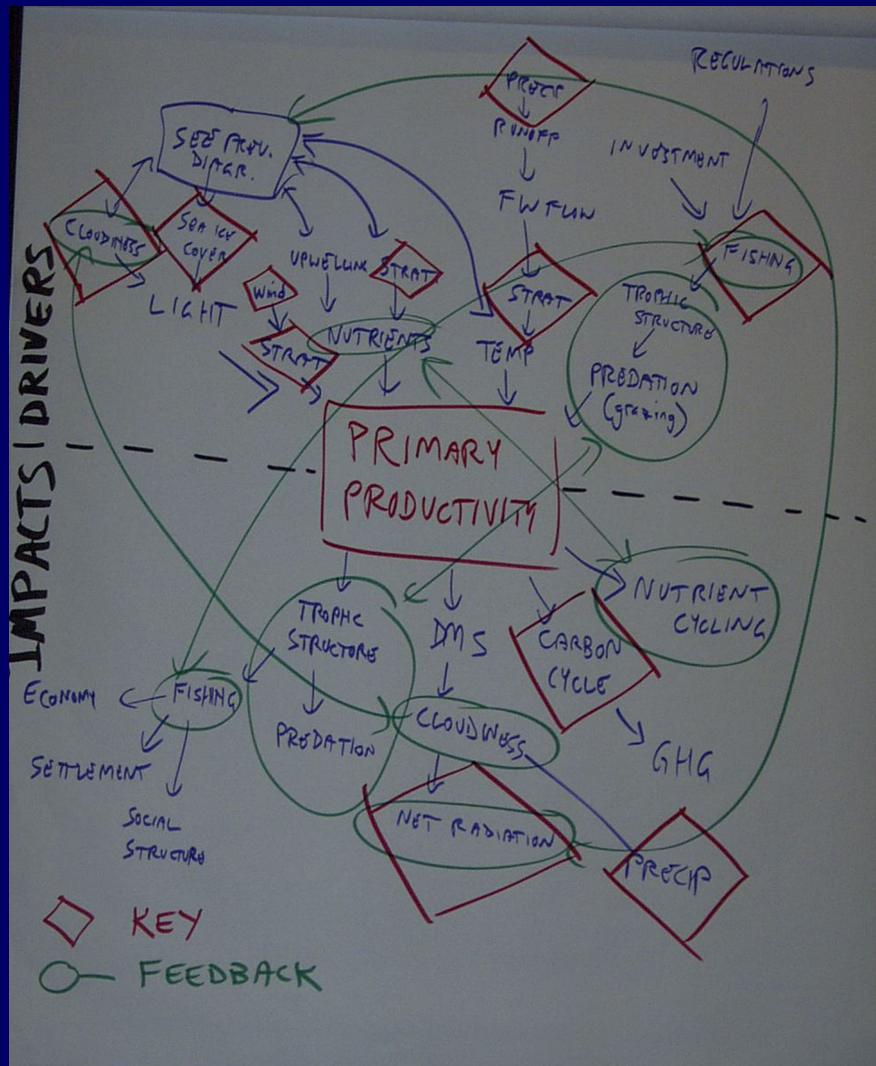


PILPS-2e (Lettenmaier et al.)

Synthesis through Heuristic Workshops

The 2003-04 ARCSS Arctic System Synthesis

- *An adaptive process* - the participants guided both the **goals** and the **process** (and soon, the final products…)



MOVING FORWARD: OUR QUESTION TO YOU……

What modeling and data integration methods, approaches or activities will best contribute to synthesis and uncover new insights into the workings of the Arctic system?

- *Workshops? Intercomparison projects? Community-based models? Community-based data set development? Reanalysis? Impact assessment? Arctic Analog for Earth System GRID?*