

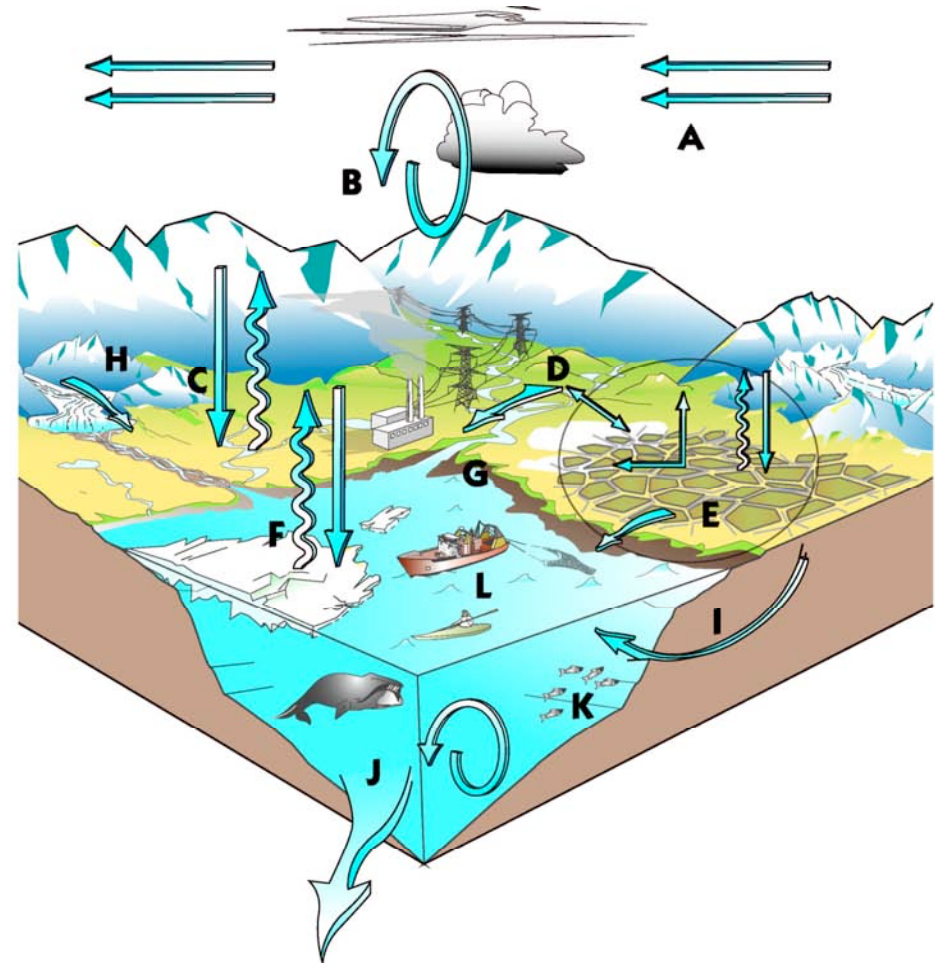
WIRING DIAGRAM APPROACH

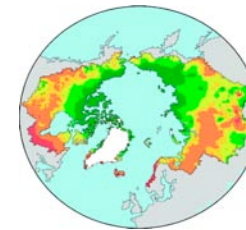
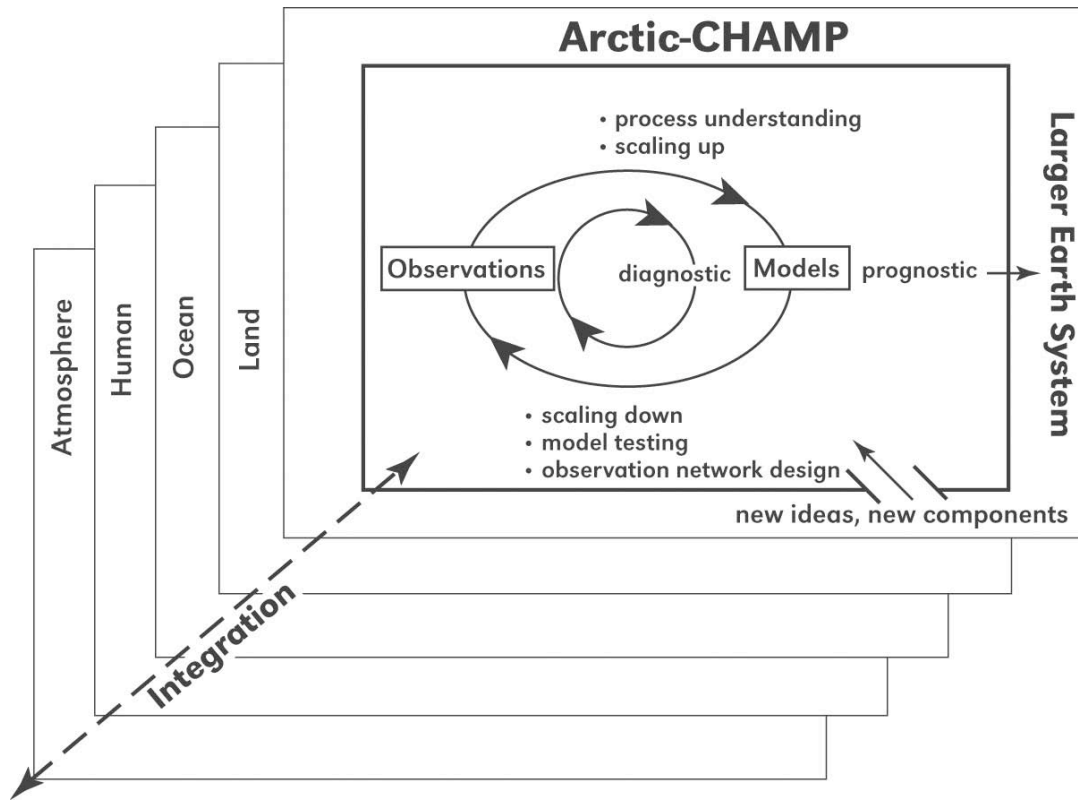
- Wiring Diagram in Broader Synthesis Context
- Example from CHAMP
- Character/Advantages of Such an Exercise
- Key Principles and Themes to Support the Approach

C. Vörösmarty
ARCSS Synthesis Meeting
Big Sky MT
11 August 2003

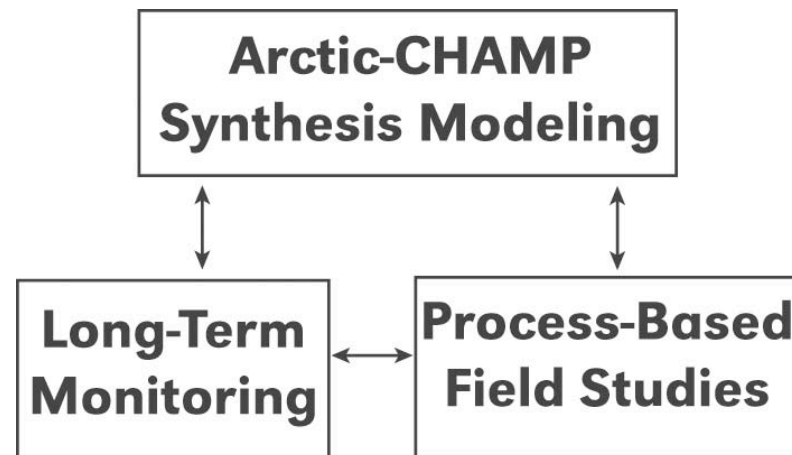
Key Processes and Linkages

- **Disciplinary research has studied many individual elements of the arctic water cycle**
- **These processes are linked and inter-dependent**
- **Major shortcoming of current science is the lack of integrative, inter-disciplinary synthesis**

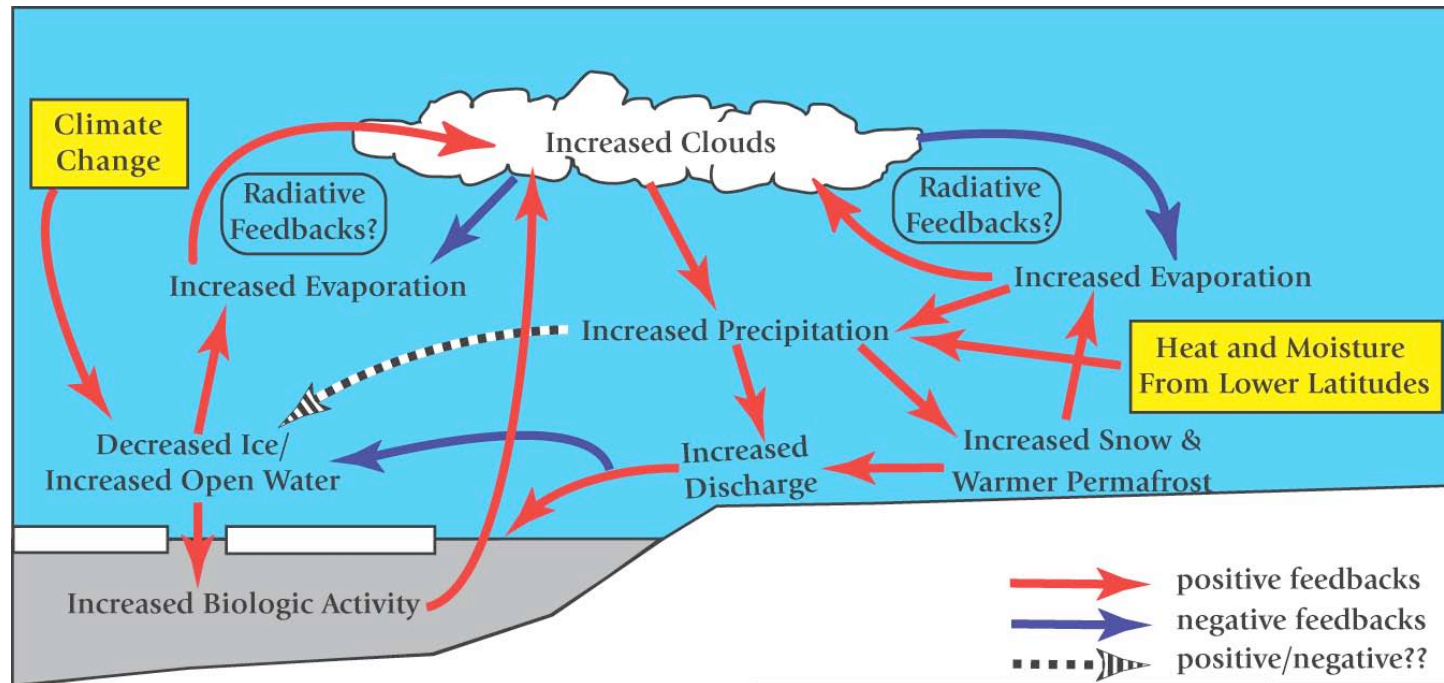




Arctic-CHAMP Approach to Synthesis

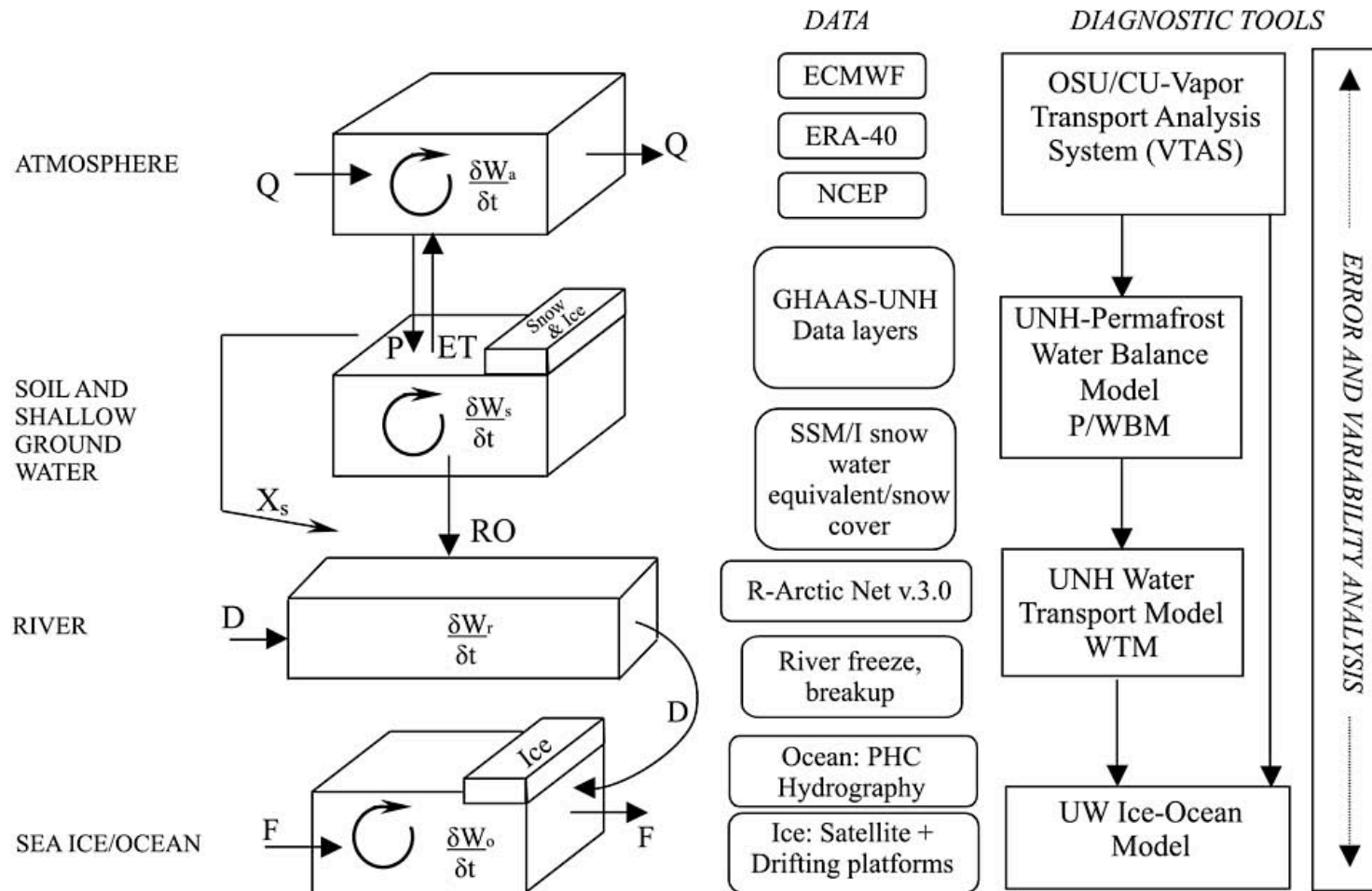


Q: What is the impact of climate change on sea ice? Feedback and System Sensitivity Studies (a la CHAMP)

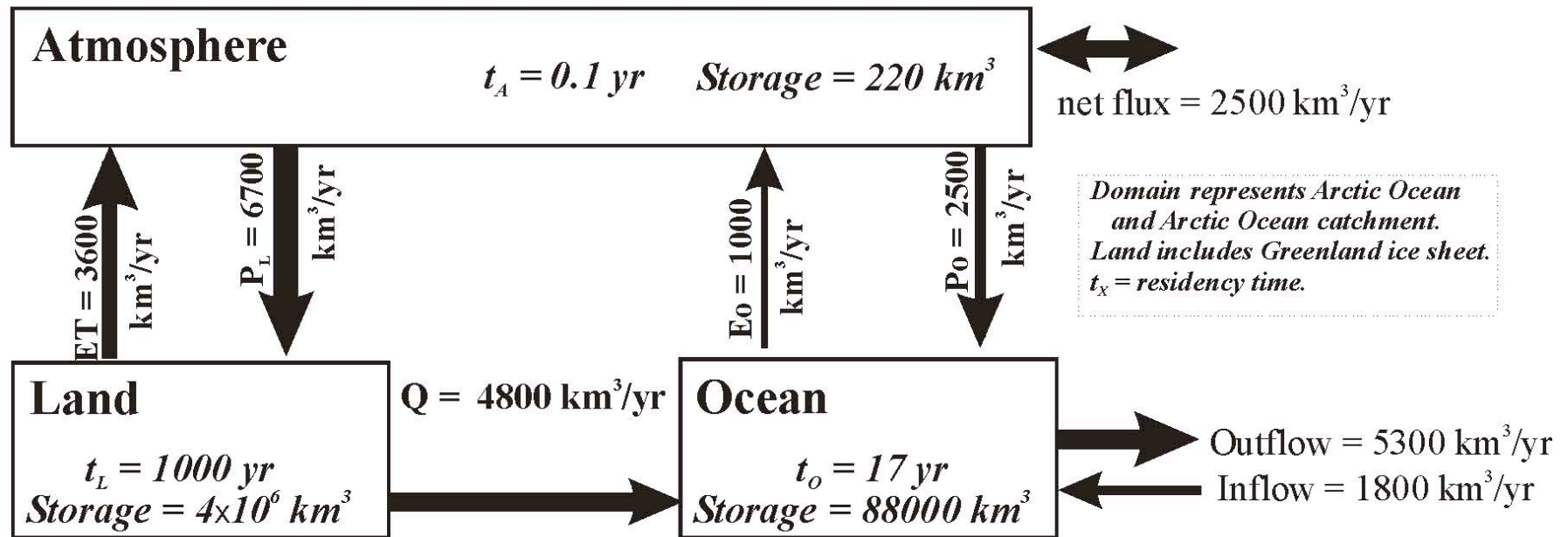


- “Simple” questions tested ---> complex interactions uncovered
- Gaps identified
- Playing field on which disagreements can arise
- Links physics, biochemistry, biology
- > 1 question can be addressed

COHERENT FRAMEWORKS ESSENTIAL



A FIRST-ORDER ATTEMPT AT WATER BUDGET CLOSURE



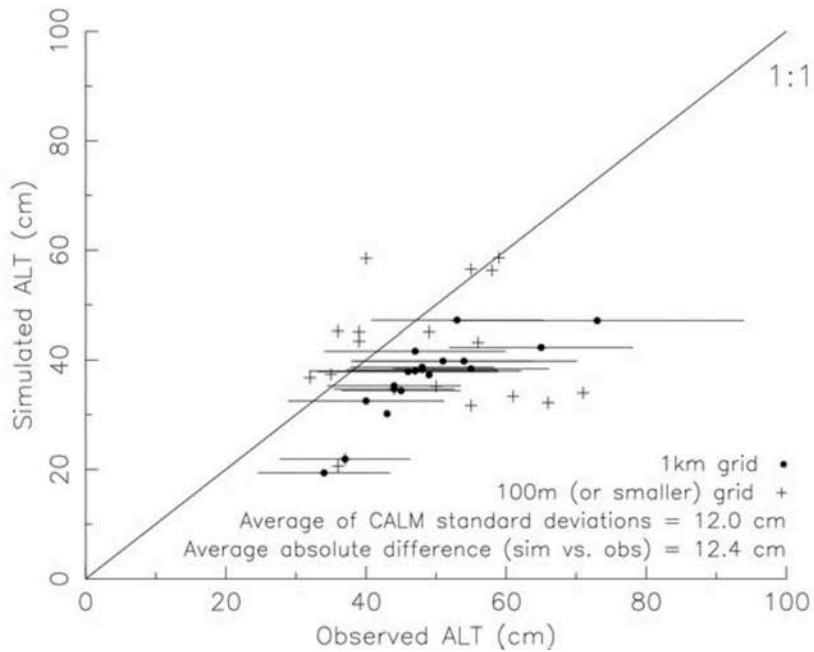
- Stocks, residence times
- Critical but Uncertain Pathway: Atmospheric
- Budget Closure Disparity Large
 - Land....1700 km³ y⁻¹
 - Ocean....2800 km³ y⁻¹

Pareto Principle

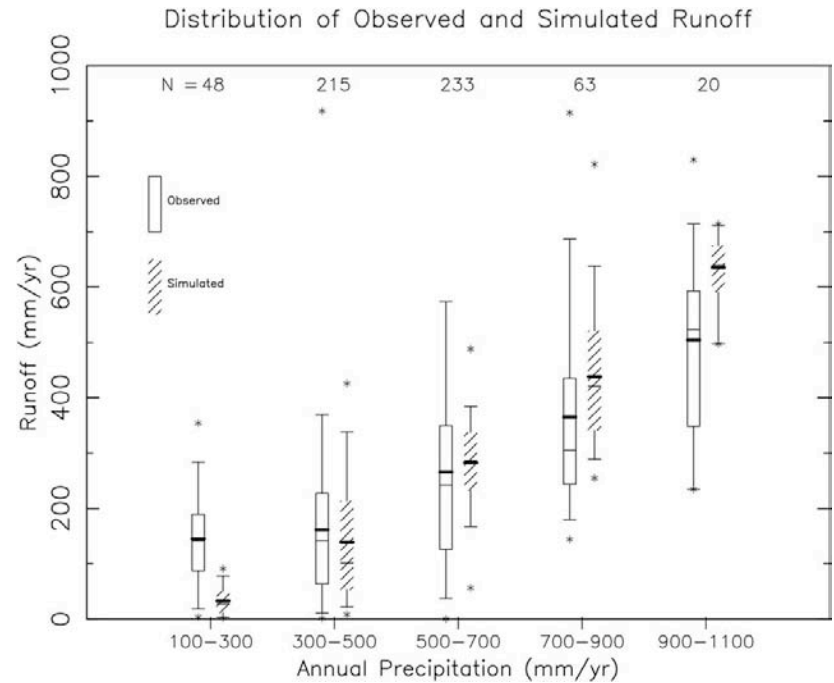
- 80/20 rule
- Early progress expected on “fundamentals”
- What is good enough?

Validation at “Correct” Scale: P/WBM Simulation

Point-scale (Calm Stations)



By Broad PPT Classes

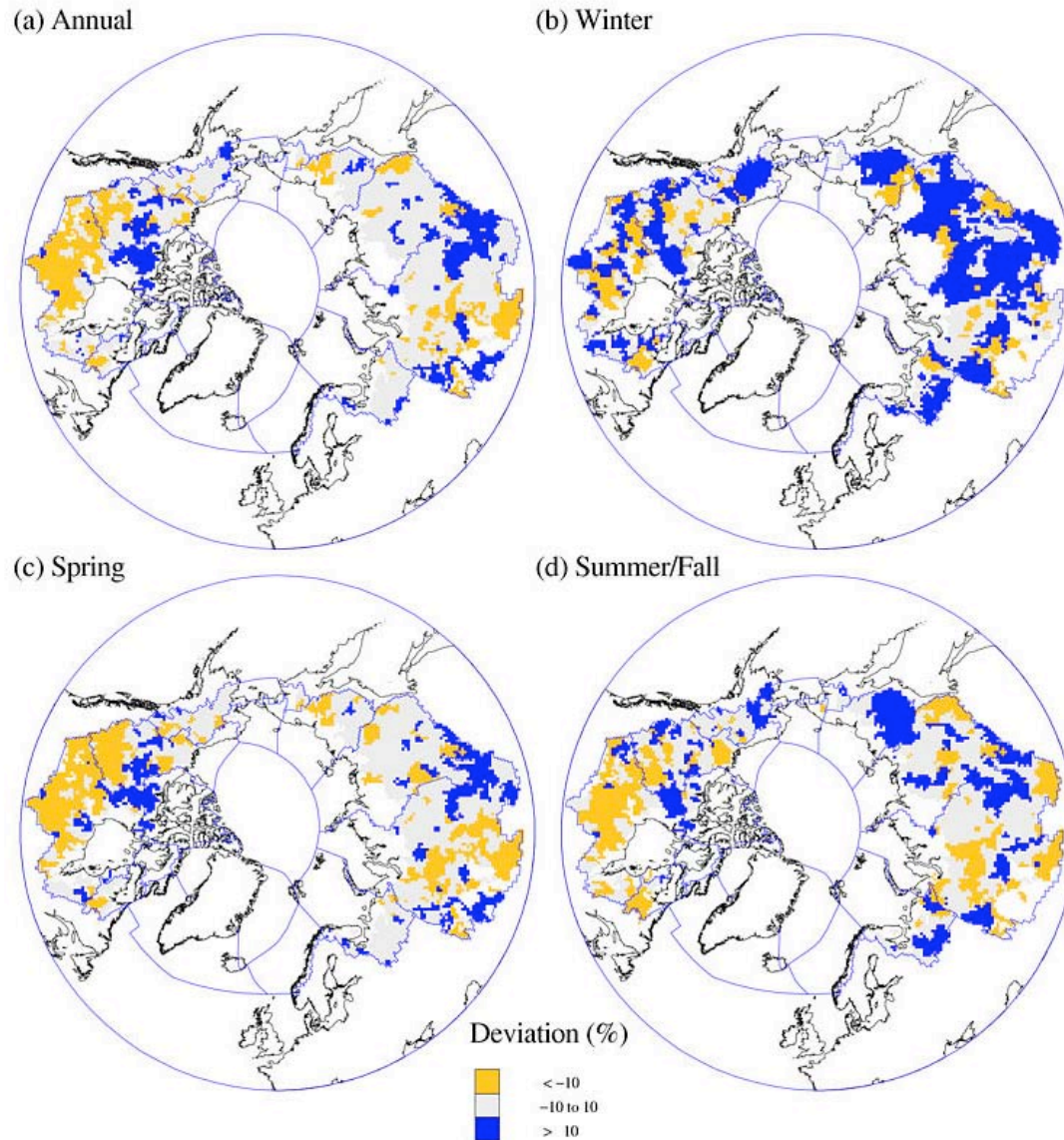


Validation: Focus on Integrative Measures

- Geospatial Fields
- Transects (McGuire et al. 2002)
- Discharge (Peterson et al. 2002; Yang et al. 2002; Ye et al., in press)
- Tree rings/ tree lines (Briffa et al. 1998, MacDonald et al. 2000), lake sediments (Rühland et al. 2003)
- Coordinated Suites of Measurements (Serreze et al. 2000, Overpeck et al. 1997)
- NWP, Atmospheric Models ---> potential bias but systematic computations

GEOGRAPHY AND TIMING OF CHANGE / VARIABILITY

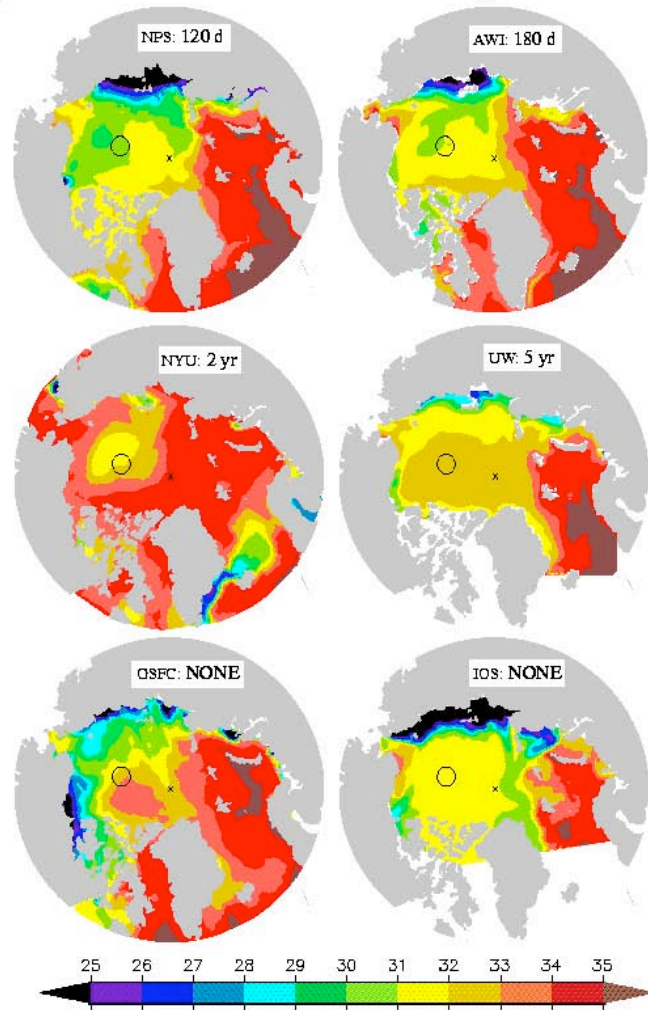
Deviation in Mean Annual and Seasonal Runoff



- Station-based, Observed Hydrography
- Decadal-scale Changes Recorded (1970s/80s vs 90's)
- Changes Complex over Space and Time

Lammers et al. 2001, *JGR Atmos.*

April mean sea surface salinity in 6 models



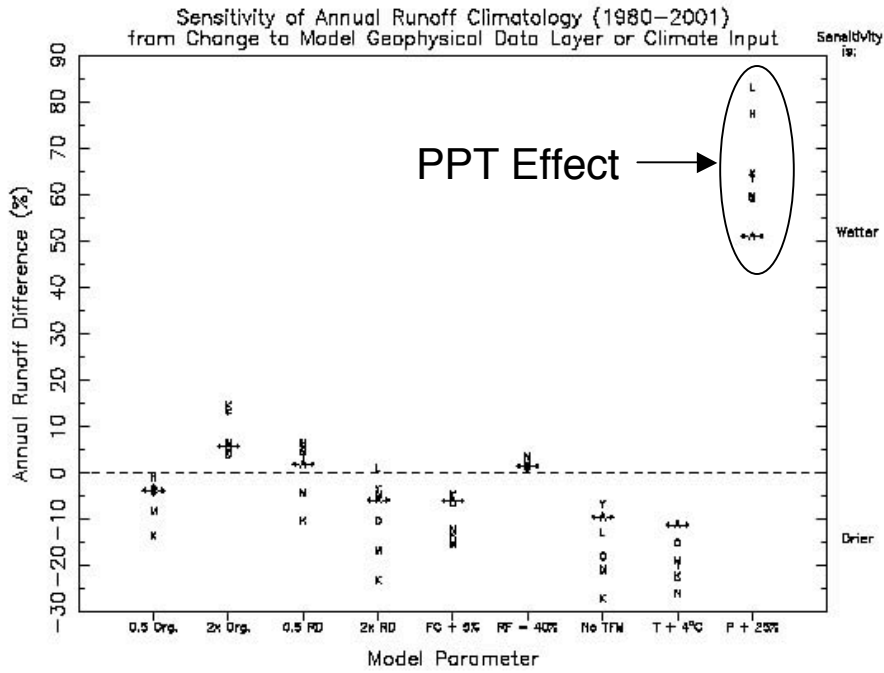
M. Steele et al.: Adrift in the Beaufort Gyre: A Model Intercomparison (*Geophys. Res. Lett.*, 28, 2935-2938, 2001)

**INTERCOMPARISONS
ARE USEFUL IN
BENCHMARKING OUR
UNDERSTANDING**

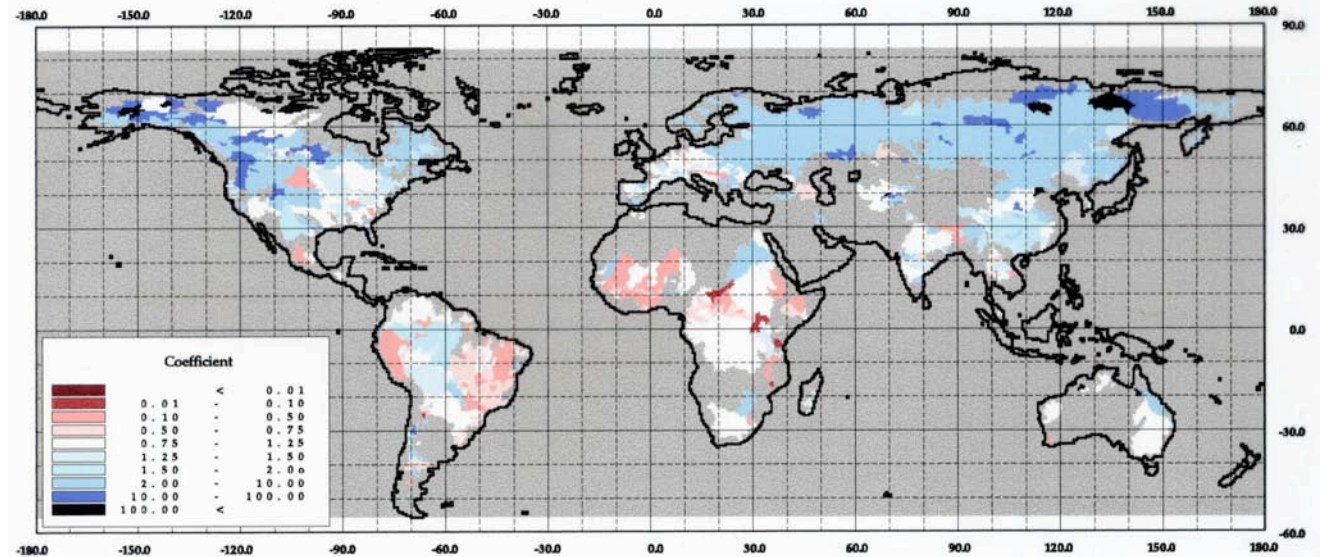
ARCTIC OCEAN SEA ICE MODEL INTERCOMPARISON

- Wide-ranging geography of results
- Most have implicit FW
- Differences in understanding immediately highlighted

THROTTLE POINTS: e.g. AMPLIFICATION OF PRECIPITATION UNCERTAINTY ON RUNOFF UNCERTAINTY



Substantial Pan-Arctic Bias in Budget Closure



KEY THEMES/PRINCIPLES

- Pose clear questions
 - An appropriate wiring diagram can be used to answer > 1 question
- Stocks and fluxes: closure, error analysis, physical consistency 1st
 - Integrative frameworks essential
- Validation: Look for integrative measures
- Articulate spatial and temporal variations
- Seek out potential throttles / attenuators
- Intercomparison efforts (models, field results, and data fields)