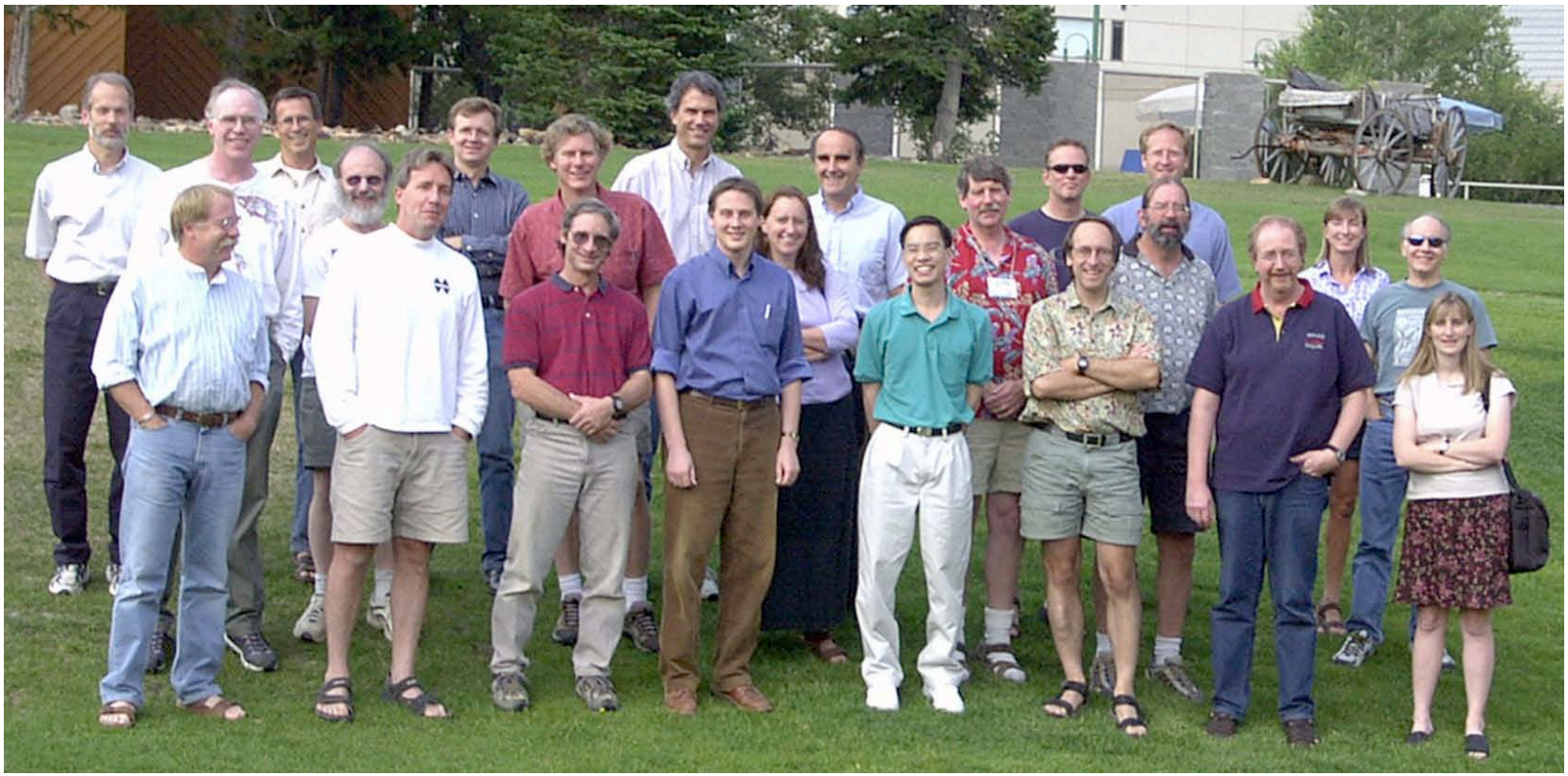
Arctic System Science (ARCSS) Program Synthesis Retreat 2004 (or retreat #2)

Welcome and Introduction…



(note the smiling faces near the end of retreat #1)

Arctic System Science (ARCSS) Program
Synthesis Retreat 2004 - Lake Tahoe
Overview of Presentation

- **Welcome and thanks for your time**
- **First (and LAST!) mention of programmatic framework**
- **A little on "synthesis" *versus* "analysis"**
- **Overview of first (Big Sky) retreat**
- **Intro to second (Lake Tahoe) retreat**
    - **starting point**
    - **participant-driven agenda**
    - **outcomes, goals & products**
    - **relaxed or family-friendly context**

Arctic System Science (ARCSS) Program Synthesis Retreat 2004 - Lake Tahoe

Welcome and thanks

This introduction on behalf of the organizing committee/team:

ARCSS Committee, Dan Ferguson, Julia McCarthy and Helen Wiggins

(with special thanks to Marika, Craig, Dan and Julia)

Arctic System Science (ARCSS) Program

Primary Overarching Goals

- to ***understand*** the physical, geological, chemical, biological, and social processes of ***the arctic system*** that interact with the total Earth system and thus contribute to or are influenced by global change, in order…

- to ***advance the scientific basis for predicting*** environmental change on a seasonal-to centuries time scale, and for formulating policy options in response to the anticipated impacts of global changes on human beings and societal support systems.

Arctic System Science (ARCSS) Program

The first 15 years…

LAII, ATLAS
OAII, SHEBA, SBI
GISP2, PALE, PARCS
HARC, RAISE, CHAMP
PACTS, LSI, SNACS

} ***Sub-system focused initiatives -- observation, process study, modeling, some synthesis***

SIMS

Arctic System Science (ARCSS) Program

The first 15 years…

LAII, ATLAS
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HARC, RAISE, CHAMP
PACTS, LSI, SNACS

SIMS - Synthesis, Integration, and Modeling Studies

- consider the interaction of the Arctic with the global system,
- span two or more of the ARCSS components,
- synthesis ARCSS data with results from other large global change programs
- Bring together (e.g., model) elements of different disciplines

Arctic System Science (ARCSS) Program

The NEXT X years…

An ARCSS Program that emphasizes ***the Arctic System*** and its roles in the global system

- continued focus on critical sub-system understanding (i.e., a proven ARCSS capability)
- but with stronger complementary focus on the system (including humans) as an interacting whole…

… integrated synthesis and analysis

Arctic System Science (ARCSS) Program

The NEXT X years…

And, hence, the experiments in ARCSS synthesis

- summer retreats (Big Sky in 2003, and Lake Tahoe in 2004)
- future ARCSS AO's

Arctic System Science (ARCSS) Program

The NEXT X years…

And, hence, the experiments in ARCSS synthesis

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- future ARCSS AO's

BUT DON'T FORGET - primary goal is not just to learn about how we do system science, but (more importantly) to ***learn about how the arctic system works*** *(and will work).*

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RULE #1

No more discussion, mention, etc. of programmatic issues (hooray!)

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Synthesis Retreat 2004 - Lake Tahoe
A little on "synthesis" *versus* "analysis"

Arctic System Science (ARCSS) Program
Synthesis Retreat 2004 - Lake Tahoe
A little on "synthesis" *versus* "analysis"

Tom Ritchey, based on a study by Bernhard Riemann:

*"**Analysis** and **synthesis**, as scientific methods, always go hand in hand; they complement one another. Every **synthesis** is built upon the results of a preceding analysis, and every **analysis** requires a subsequent **synthesis** in order to verify and correct its results."*

"There are, however, important situations in which one method can be regarded as more suitable than the other."

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Synthesis Retreat 2004 - Lake Tahoe
A little on "synthesis" versus "analysis"

And next on the agenda, everyone will provide some of their own insight into the issue of synthesis.

"In the context of this Arctic system workshop, scientific synthesis means…"

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"In the context of this Arctic system workshop, scientific synthesis means…"

but first, a Big Sky perspective…

The Big Sky Starting Point

"*known*" causes
(Ritchey/Riemann)

synthesis *noun* (plural: **-ses)**

1 the process of combining objects or ideas into a complex whole
Compare: **analysis**
2 the combination or whole produced by such a process

Source: The Collins English Dictionary © 2000 HarperCollins Publishers:

The Big Sky Starting Point

analysis *noun* (plural: **-ses**)

1 the division of a physical or abstract whole into its constituent parts to examine or determine their relationship or value
Compare: **synthesis** [1]
2 a statement of the results of this
…

7 (*Philosophy*) (in the writings of Kant) the separation of a concept from another that contains it
Compare: **synthesis** [6a]

The meaning of synthesis

The Concise Oxford Dictionary definition of 'synthesis' is

"the process or result of building up separate elements, especially ideas, into a connected whole, especially into a theory or system"

The definition is straightforward but the interpretation of the process can vary considerably.

Source: http://www.scenario-planning.com/define.htm

The Big Sky Starting Point

Synthesis:

The scientific method, of which synthesis is part, increases understanding about Nature and does so through successive approximation. The purpose of synthesis is to reduce diverse parts of a project or experiment into a coherent simplified statement for *practical* application and to set the stage for the next hypothesis and experiment.

Source: Patrick Webber, March 1997
ARCSS Workshop
(colors and italics, J. Overpeck)

The Big Sky Starting Point

Synthesis:

continued…

Synthesis is *not* the listing of data or research achievements; it is the abstraction of the best understanding of the fundamental characteristics, dynamics and controlling principles of the system. It is the critical last step before the design of the next experiment.

Source: Patrick Webber, March 1997
ARCSS Workshop
(colors and italics, J. Overpeck)

The Big Sky Starting Point

Synthesis:

"It is the abstraction of the best understanding - through the combining of ideas from disparate elements to gain new insight. It is that NEW INSIGHT - the *"AHA syndrome"* that is essential in my mind. That is what makes the whole more than the sum of the parts.

…you only achieve that *new insight by asking questions you cannot answer* with the understanding you currently have."

Source: Neil Swanberg, July 2003

(colors and italics, J. Overpeck)

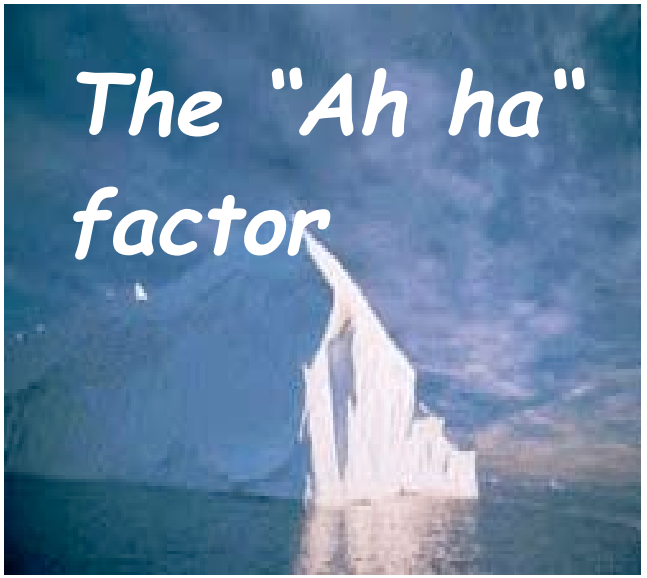
Arctic System Science (ARCSS) Program
Synthesis Retreat 2004 - Lake Tahoe

Overview of **first (Big Sky) retreat**

Arctic System Science (ARCSS) Program
Synthesis Retreat 2004 - Lake Tahoe

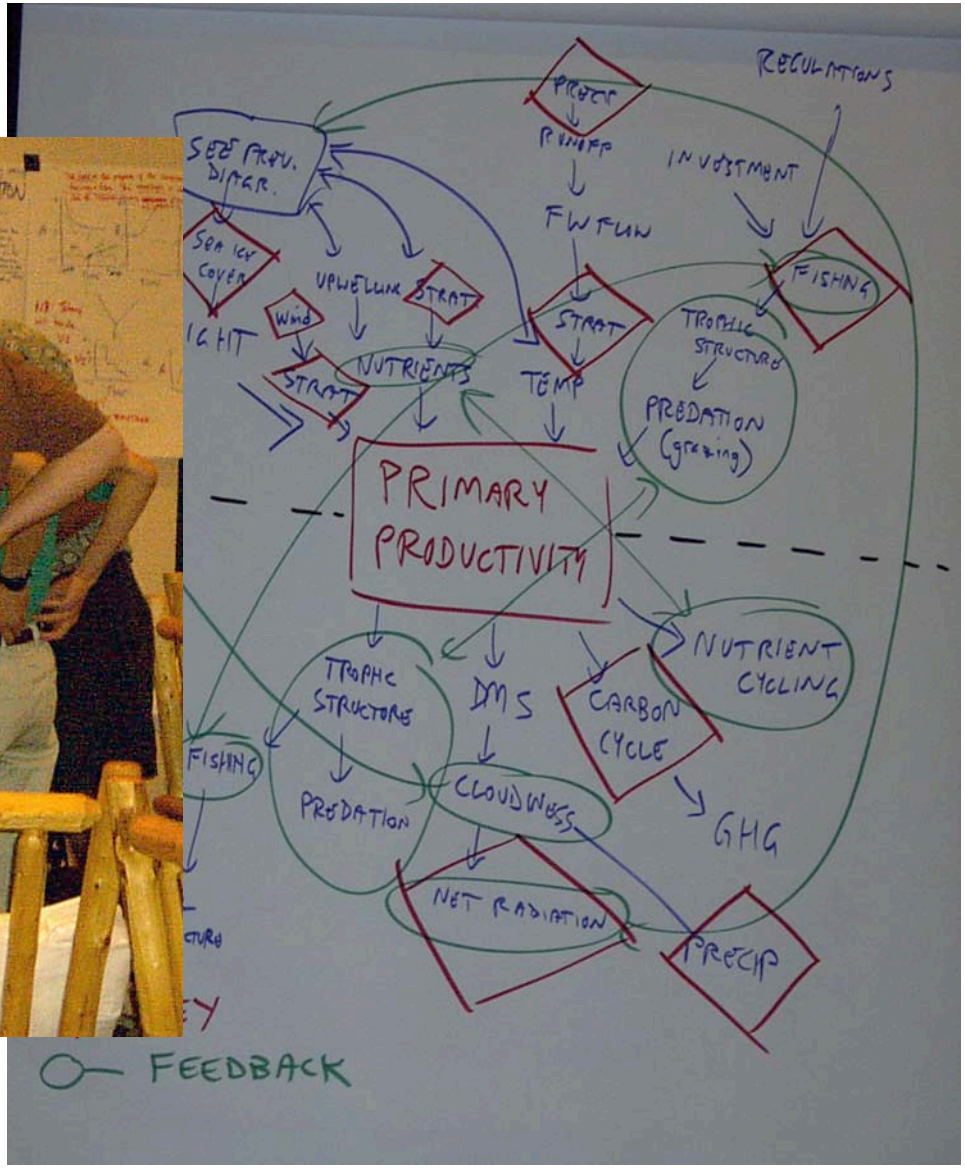
Overview of first (Big Sky) retreat

- The synthesis was designed to be non-programmatic, and is viewed as an experiment to:
  1) *determine the value of synthesis to arctic environmental science*
  2) *begin uncovering the best way to carry out **arctic system** synthesis*
  3) *identify key **arctic system** unknowns*
  4) *learn something new about how the **arctic system** works, and what it means for the future*



The 2003-04 ARCSS Arctic System Synthesis

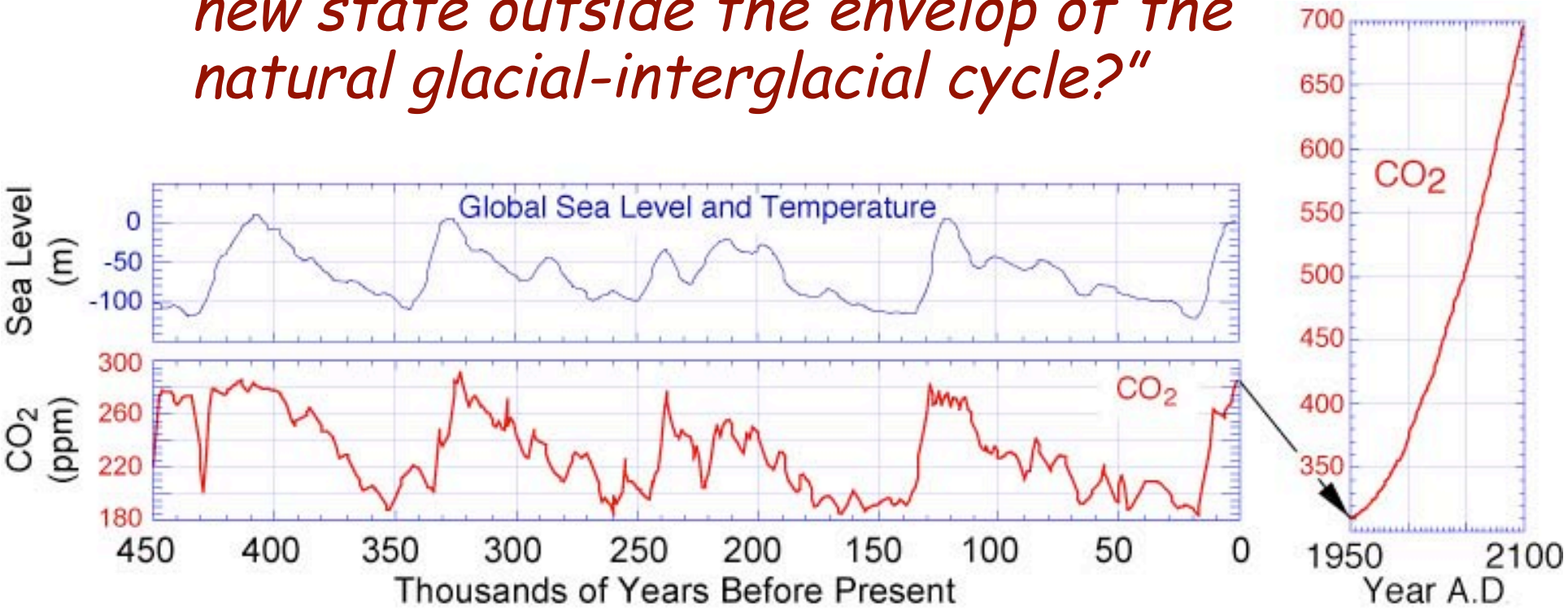
- *An adaptive process* - the participants guided both the **goals** and the **process** (and soon, the final products…)

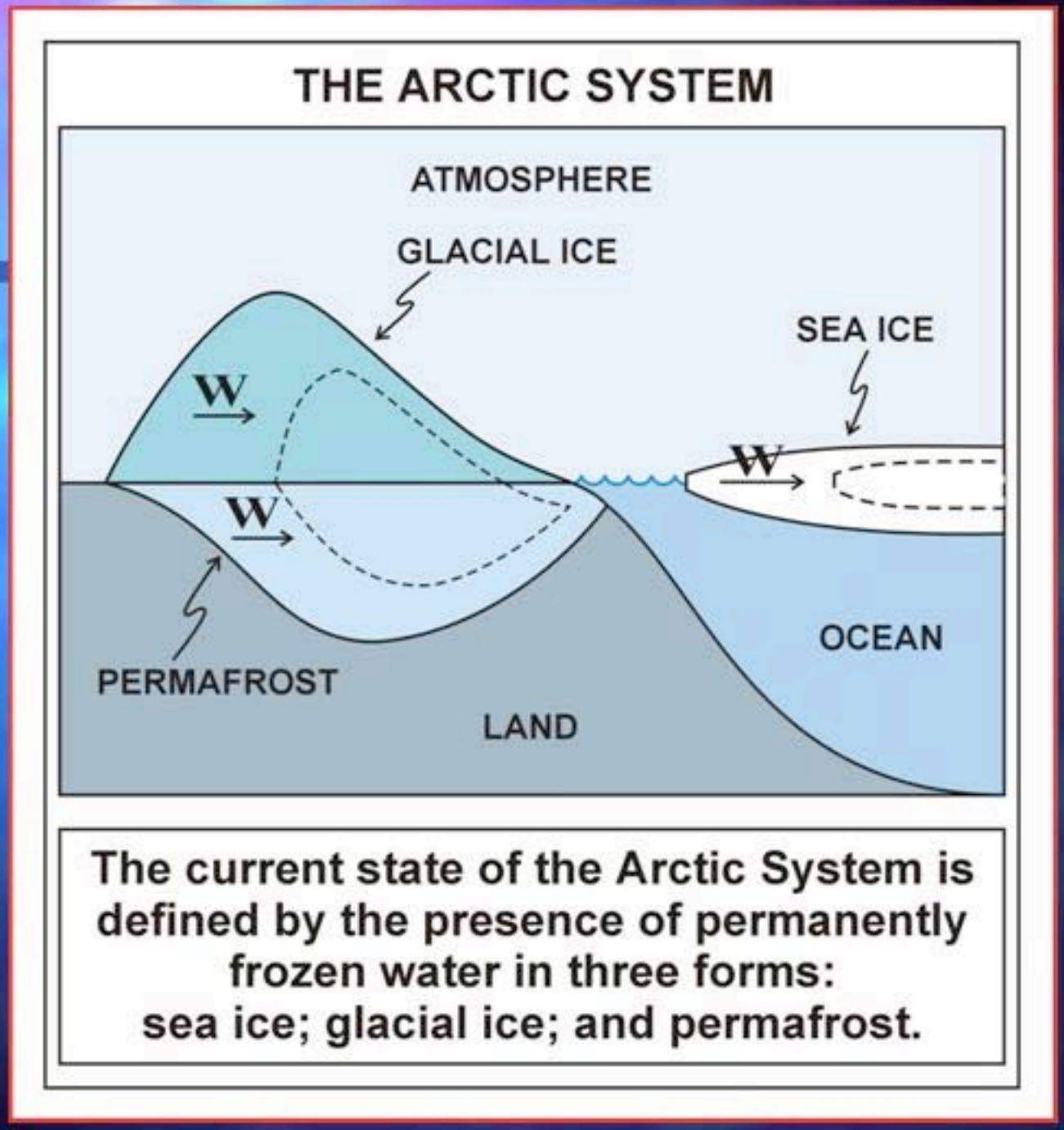


The 2003-04 ARCSS Arctic System Synthesis

- An adaptive process - the participants guided both the goals and the process (and soon, the final products…)
- Quickly converged on the value of **"the big question,"** which focused several days of plenary and breakout group discussions…

"Is the Arctic System moving to a new state outside the envelop of the natural glacial-interglacial cycle?"

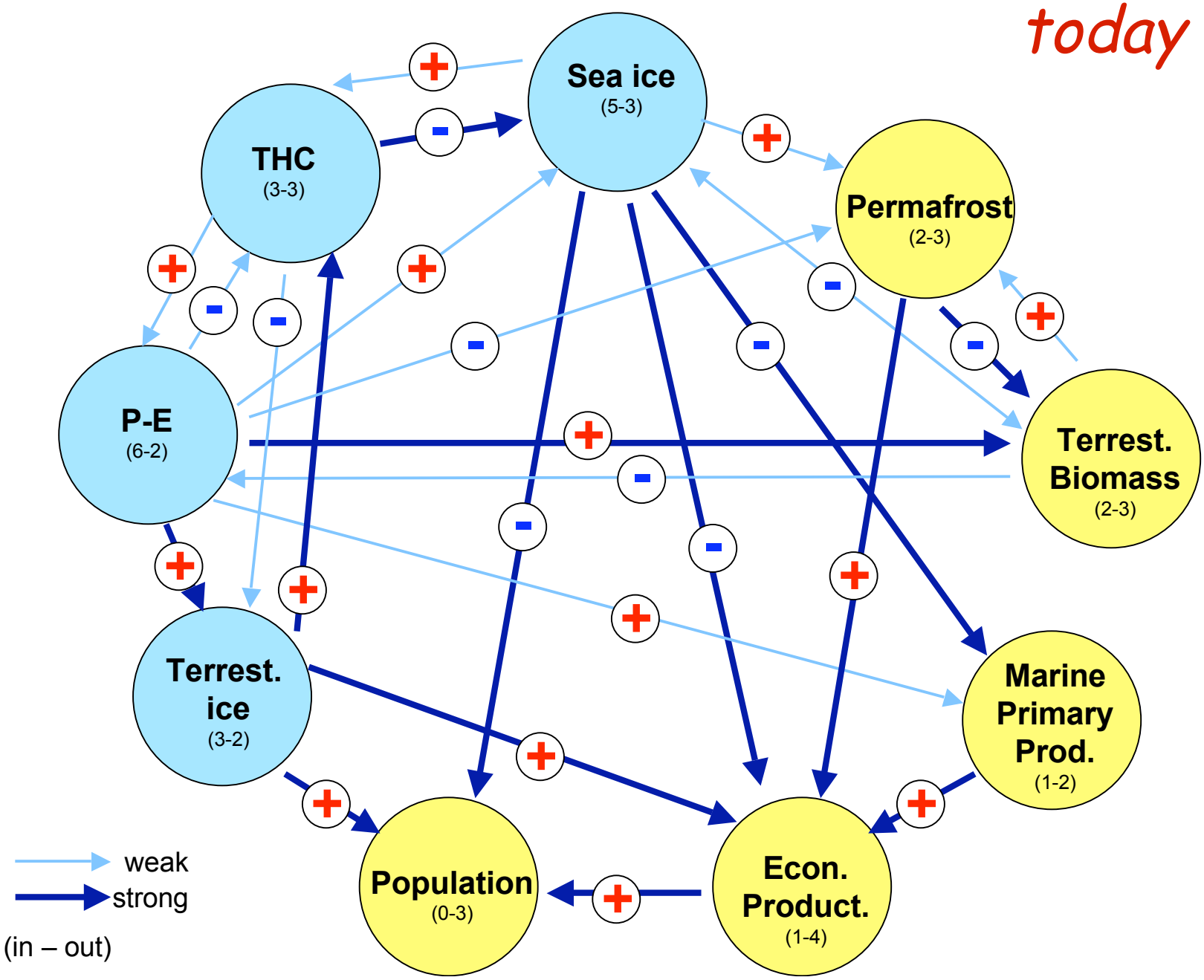




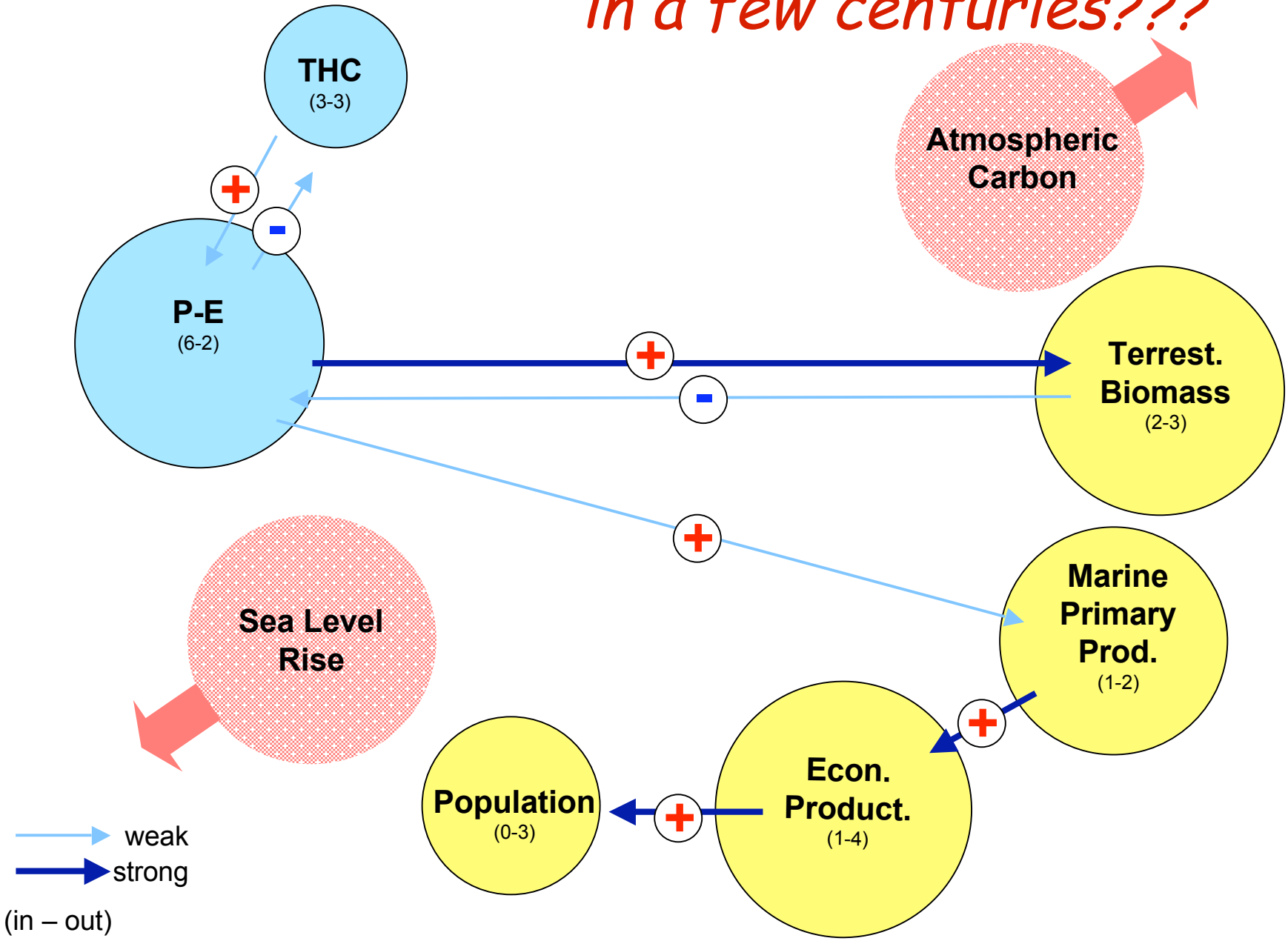
Includes the biosphere and humans too!

Cartoon drafted by E. Carmack

The Arctic System today



The Arctic System…
in a few centuries???



Arctic System Synthesis… the Ah ha's

- *arctic IS likely being driven to a new seasonally ice-free state*
- *current patterns of system change are likely a sign of things to come*
- *feedbacks generally positive in Arctic; cloud feedback are not likely to prevent state change*

These guys just didn't wait long enough…

Arctic System Synthesis… the Ah ha's

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  - *e.g., decreased poleward heat transport by atmosphere and/or oceans*

Arctic System Synthesis… the Ah ha's

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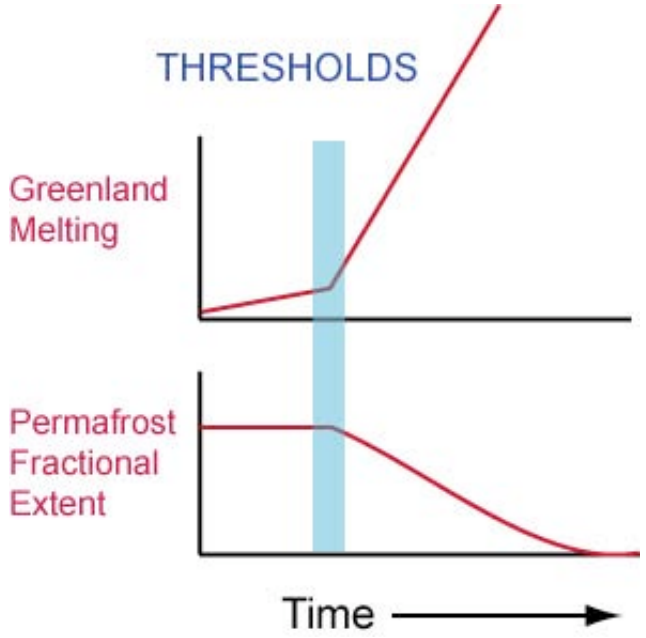
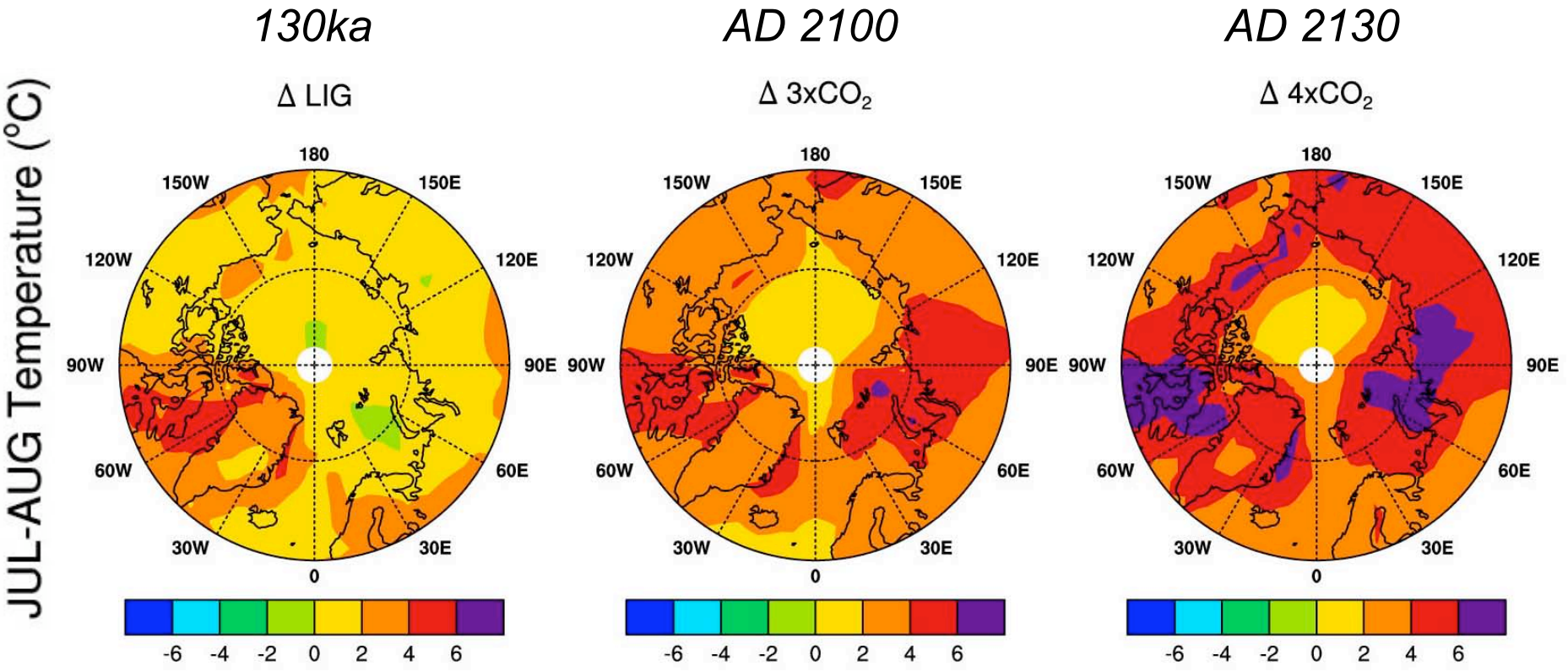
- must therefore look outside arctic for possible thermostats
  - e.g., decreased poleward heat transport by atmosphere and/or oceans
- **change likely to accelerate across poorly understood thresholds**



Simulated summer surface air temperature ***anomalies -***

130ka versus the future



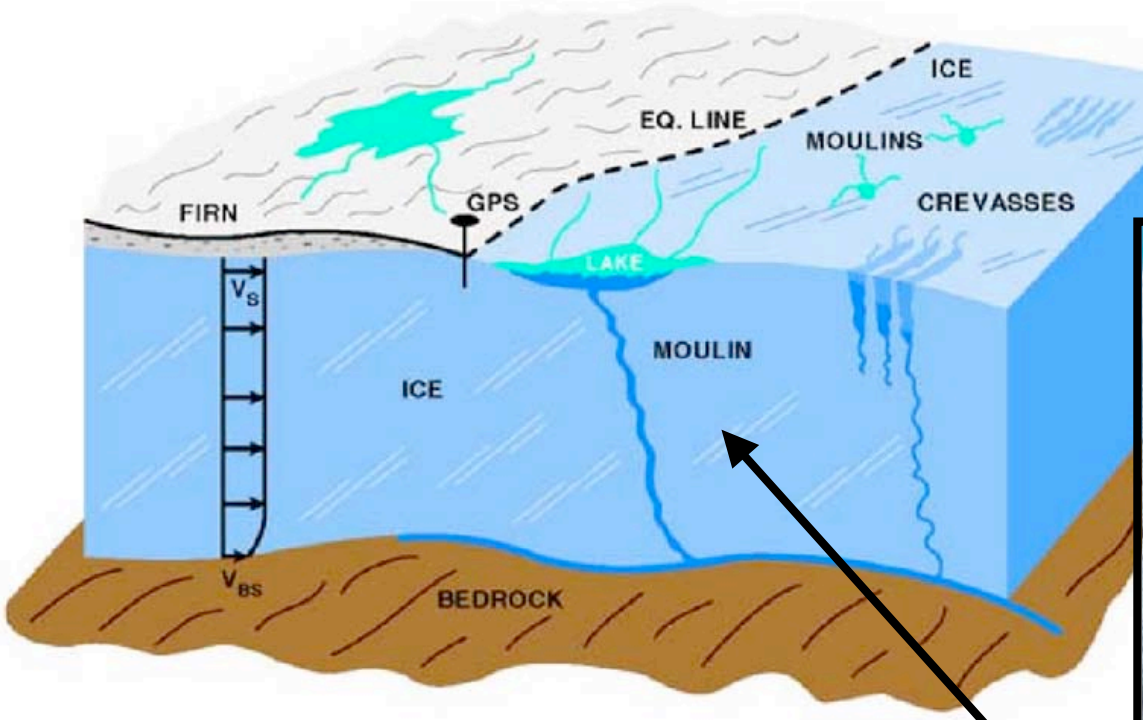
(Overpeck, Otto-Bleisner, Kiehl and Miller (in prep.)

Can sea level rise faster than previously estimated?

Time Period	Sea level Rise (cm/year)	Source
Next 100 to 1000 yrs. (model simulations)	**0.1 to 0.8** **(1990's observed = 0.25)** (0.1 to 0.8 m per century)	IPCC many **models**
Last Deglaciation 13,000 to 7000 yr B.P. (observations)	**Up to 1.1** (1+ m per century)	Bard et al., 1996 **coral dating**
Penultimate Deglaciation Ca. 130,000 yr B.P. (observations)	**2.0 to 5.0** (2 to 5m per century) + thermal expansion	Esat et al., 1999 McCulloch & Esat, 2000 **coral dating**

(Overpeck et al., in prep.)

New mechanisms for increased ice sheet sensitivity to surface warming



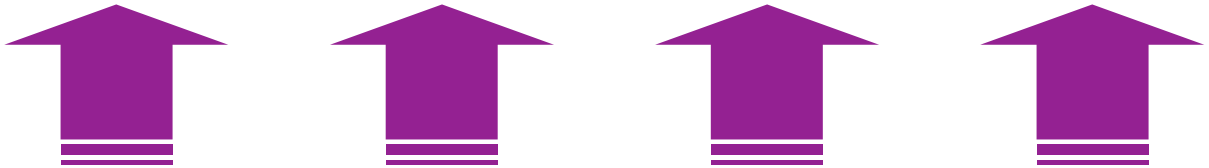
Zwally et al., (2002) *Science*
Parizek and Alley (2004) *QSR*

Arctic System Synthesis… selected impacts

- Northern lives/lifestyles/culture
- Costs to both existing and future infrastructure
- Biodiversity
- Global climate change - possibly abrupt
- Release of stored carbon to atmosphere
- Sea level rise - possibly abrupt

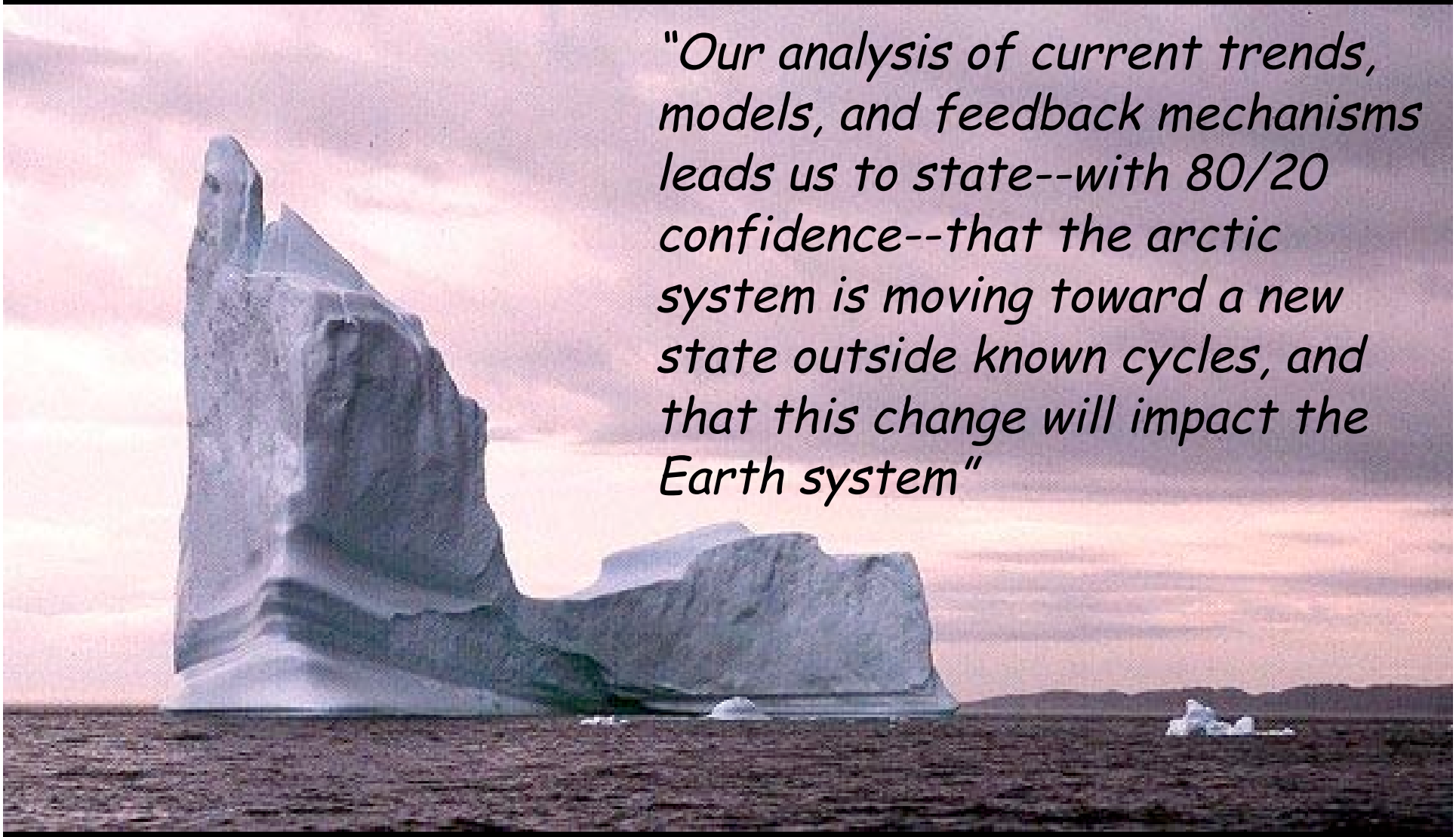
Arctic

Global



- Lack of predictability for all stakeholders

Arctic System Synthesis - conclusion



"Our analysis of current trends, models, and feedback mechanisms leads us to state--with 80/20 confidence--that the arctic system is moving toward a new state outside known cycles, and that this change will impact the Earth system"

Despite fact that much remains to be done

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Intro to second (Lake Tahoe) retreat

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With more of a starting point than Big Sky, but still intended to be *participant-driven*.

Starting questions:

"How realistic is the Big Sky conceptual model of a two-state (modern and future seasonally ice free) arctic system, and how well do we understand the mechanisms of possible state change?"

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- *what will trajectory look like? "*
- *what are the likely thresholds?*
- *any potential surprises?*
- *any way to slow or stop state change?*
- *is there a point of no return? changes irreversible?*

"sub-questions"

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… and how well are these key processes represented in state-of-the-art predictive models?

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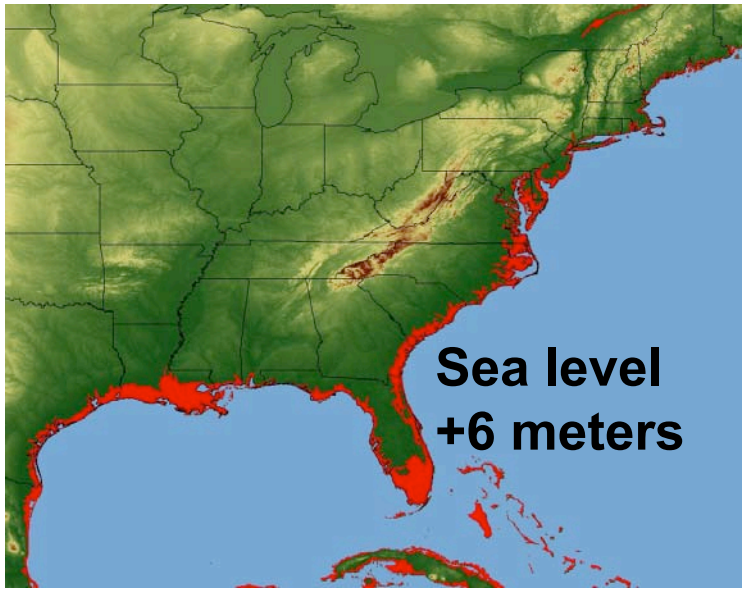
Intro to second (Lake Tahoe) retreat

Starting recommendation:

Can we guide our process-focus on the basis of what might be most important to society (i.e., by possible impacts of arctic system change)?

- *Rapid sea level rise*
- *Abrupt change to THC*
- *Accelerated release of carbon to atmosphere*
- *Opening of Arctic sea transport route*
- *Dramatic changes in high latitude fisheries*
- *Imperiled cultural integrity*
- *Threats to biodiversity*
- *Frozen-ground transformations*



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Outcomes, goals and products **(group discussion in afternoon)**:

- want to focus more on outcomes, goals & products at onset (with realization that we might adapt as the week progresses)
- build on, and/or complement, the Big Sky paper
- *ideas?*

  - paper focused on realism (or advance) of conceptual model from perspective of earth system models (e.g., AOGCMs)

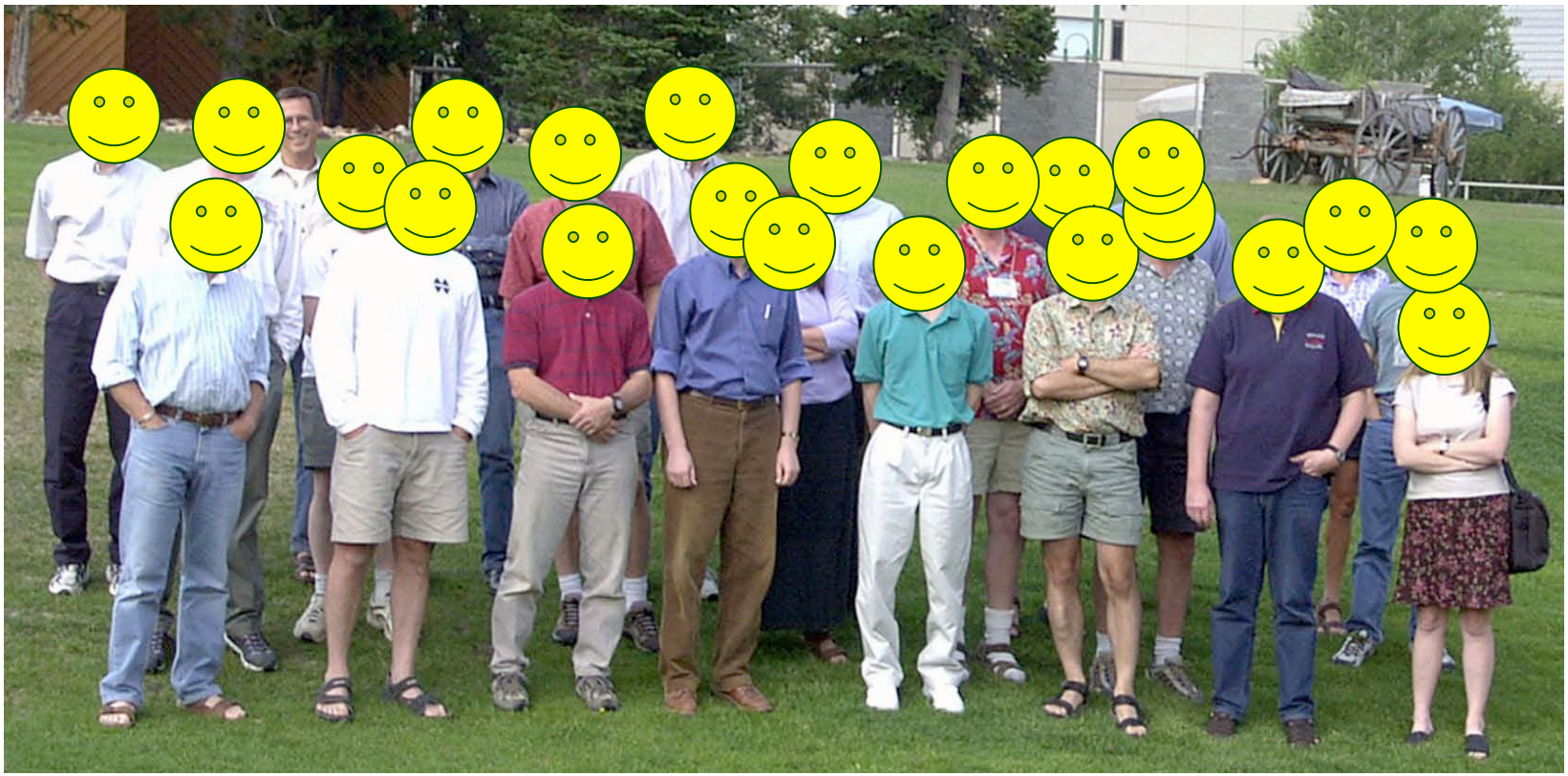
  - issue papers (e.g., focused on sub-questions; humans as part of system)

  - focus on role of the arctic in likely impacts

  - need to identify writing team(s) early

Arctic System Science (ARCSS) Program Synthesis Retreat 2004 (or retreat #2)

And don't forget - our objective is to have fun too!



(reminder to discuss logistics - including interest in wine/desert)