Biophysical & Biogeochemical Feedbacks and Transitions in the Arctic Regional System: *Biocomplexity* "Arctic biological and physical systems are inextricably linked because exchanges of energy, water, and elements between the geosphere, biosphere, and atmosphere are regulated by the thin layer of biota at the Earth's surface."



Land-surface state changes: What are the nonlinearities, thresholds, and "surprises" (i.e. *new assemblages*) that will result from the complex interaction of the biotic and abiotic systems (biocomplexity)? What will be the consequences of landsurface changes?

> Have we identified all important bioticabiotic feedbacks? (probably not)

Are we in a position to provide realistic predictions and assessments of the impact of changes in the biotic skin on ecosystems, animals, and society?

What are the marine counterparts?

Energy Fluxes: Moving beyond "simple"

Biotic response to more complex changes than ΔT:
Alterations in snow cover and growing season length
Changes in sea ice thickness and character
Changes in permafrost, thermohaline circulation, other biota

Consequences of biotic changes:
Climate feedbacks at many scales
Ecosystem function and sustainability

Trace Gases: An old problem but is it solved?

Do we know the current marine and terrestrial trace gas balance? Can we predict how the balance will change under future states? How well can we place current balance and potential changes in context of past changes and balance?

Thresholds & Response Times
Landscape control at the Pan-Arctic scale

Vulnerability & Sustainability: What will be the consequences of changes in the biotic system on the livelihood of arctic residents?

Speed of change
Speed of adaptation
Institutional responses

Hinzman

Technical Challenges: Spatialtemporal heterogeneity

How do changes in the arctic region biophysical systems propagate spatially and temporally?

Biogeophysical & Biogeochemical Feedbacks and Transitions in the Arctic Regional System

- Complexities associated with the biotic skin covering the arctic regional system.
- Non-linear response & emergent behavior across scales
- Assessment of vulnerability to change
- Interaction of humans with other components of the arctic and global systems
- Challenges (scaling, heterogeneity, feedbacks and response to change)







Ideas for Discussion



Can paleo-environmental studies constrain the set of possible future states, and how will better understanding of modern biocomplexity change our interpretations of the past?
What problems are common to both terrestrial and marine biogeophysics?

•Which impacts from the changing natural environment are important to society and which are not? With its focus on natural systems, what pressing societal questions is ARCSS best prepared to answer?

Which lessons learned in developing LAII interdisciplinary studies will be useful to future ARCSS studies?
How will a Biocomplexity Initiative best interact with SEARCH, CHAMP & others ARCSS programs?

