Biophysical and biogeochemical feedbacks & transitions

- Vulnerability & sustainability
- Transitions & thresholds of change
- Patchiness & heterogeneity
- Biogeochemical cycling

Vulnerability, sustainability, Human Society and the Arctic System

- 1. Effect of development and use of biological resources on the Arctic system
- 2. Interactions between resources, climate and society
- 3. Sustainability of food webs and cultures

Transitions and thresholds of change

- There are temporal transitions in system state that we anticipate will have circumarctic relevance.
- Factors that cause switches include changes in:
 - Vegetation
 - Woody plant abundance
 - Fire
 - Snow cover
 - Permafrost
 - Coccolith.
 - Sea ice & snow cover

Transitions and thresholds of change Questions:

- What induces switches in system state?
- How do switches alter local feedback loops and how do switches propagate spatially?
- How do interactions among switches affect reversibility of changes?
- How will switches interact with human systems?

Patchiness & heterogeneity

- What factors interfere in our ability to scale up and down in ways that capture the essential function of the system with spatial & temporal heterogeneity?
 - What can be remotely sensed?
 - Proxies?
 - Spatial & temporal undersampling?

Patchiness & heterogeneity, cont.

• How can we best use our understanding of patch dynamics and inter-patch transfer in order to project critical changes into the future, to guide our assessment of past changes, and to understand system function?

Patchiness & heterogeneity, cont.

• Which parts of the arctic biotic & surface system are we at risk of modeling and predicting incorrectly because of spatial and temporal heterogeneity?

Biogeophysicochemical cycling

• What are the processes controlling the biogeochemical linkages and exchanges within/among terrestrial, marine, atmospheric, & freshwater environments (*e.g., involving transport, mobilization, utilization of organic and inorganic N and impact on the C cycle*)?

Biogeophysicochemical cycling, cont.

• What are the impacts of structure of the physical environment on biological and chemical environment (*e.g., how does snow/ice cover impact on biological communities and how might this change*)?

Biogeophysicochemical cycling, cont.

• What are the impacts of the structure of the biological communities on biogeochemistry and physical structure of the environment (*e.g., impact of vegetation types & structure on snow cover*)?