Biophysical and biogeochemical cycles at the Arctic surface

Arctic system = $\int$ feedbacks

Questions:

- Functioning of individual feedbacks?
- How do they integrate over space and time?

4 working groups:

- Biogeochemical cycles
- Vulnerability/sustainability/resilience
- Heterogeneity/pattern
- Temporal state changes

Cycles of:
Water, energy, nutrients, contaminants

Major questions remain:

- e.g. Soil organic matter
- Snow photochemistry
- Links between biological and physical systems

Different areas have reached different levels of maturity in their understanding of cycles and feedbacks

Major themes for new science

1. Horizontal transfers: within systems, between systems
2. Changes in system state
3. Food webs
4. Human impacts on feedback systems

Horizontal transfer

Key for spatial scaling and for linking terrestrial and marine systems!

How does material move?
What controls movement?

Temporal changes

System state changes are likely
We can identify some of the likely triggers
  but, we don't necessarily know what the new state
    looks like and,
  we have very poor understanding of the trajectory.

Food Webs

We have inadequate understanding of food web dynamics in both terrestrial and aquatic systems

Yet- much shows they may be important in controlling the state of the system and form a core linkage to humans.

Human effects, feedbacks

Cumulative industrial impacts
Use of living resources: forests, wildlife, fish
Cultures: memory, language, and values of Arctic people