Arctic Nearshore Processes
Proposed Initiative

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The nearshore zone has been poorly studied, yet represents an absolutely dynamic boundary between arctic coastal plain watersheds and the arctic shelf and basin.

The nearshore zone is the site of:

- Most human activity, especially subsistence hunting
- Increased coastal erosion

Bowhead, Pt. Barrow (from D. Schell)

Camden Bay, July 1991

- Increased human and industrial activity
- Intense petroleum development, both onshore and offshore

Prudhoe Bay

Tern Island, Stefannson Sound, early July

TAPS, south of Prudhoe Bay

- Organic and inorganic input of materials from river discharge
- Substantial variations in ice-retreat and spring ice breakup
- Physical extremes of temperature, winds, and ice cover

Fast Ice, Stefansson Sound, late February

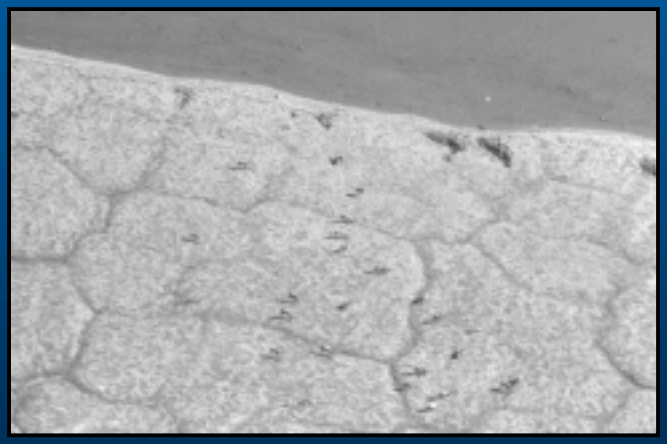
Ice break-up, near Cross Island, early July

Colville River, July

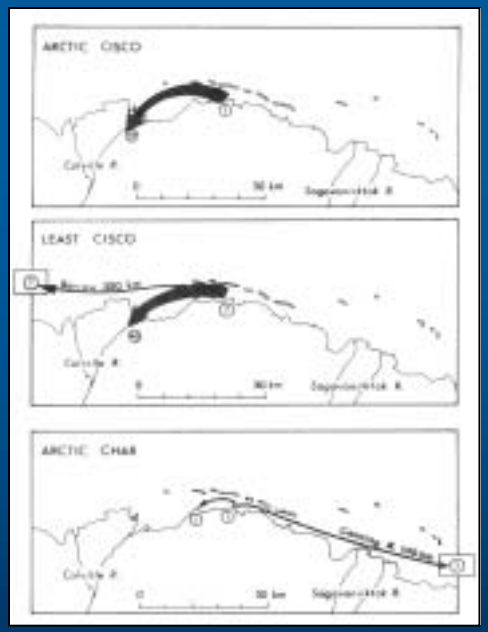
- Migrations of anadromous fishes, migratory water fowl, and large animals.

S.R. Johnson, 2000

Black Brant, Prudhoe Bay



Caribou, Camden Bay



P.C. Craig, 1980

- Consequently, the nearshore zone is characterized by considerable biogeochemical and hydrological cycling, identified as two major thematic approaches in the OAII Science Plan.

The absence of recent studies on the arctic nearshore zone is largely a result of:

- Extremely variable and unpredictable physical and climatic conditions
- High costs of performing arctic field research
- The absence of logistical support and infrastructure to support arctic coastal studies

The absence of recent studies on the arctic nearshore zone is largely a result of:

- Access to ice-strengthened and shallow draft research vessels
- Emphasis on shelf and basin research

R.V. Karluk, USGS

Overarching goal of an Arctic Nearshore Processes Initiative:

- To improve our understanding of the biogeochemical and hydrological processes that occur on the nearshore zone of the arctic shelf and coastal plain with respect to changes in global climate.

- However, the initiative must be focused on a specific set of questions that fall within the ARCSS themes of:
  - Arctic climate
  - Arctic ecosystems and societies
  - Biogeochemical feedbacks
  - Hydrological feedbacks
  - Detecting change

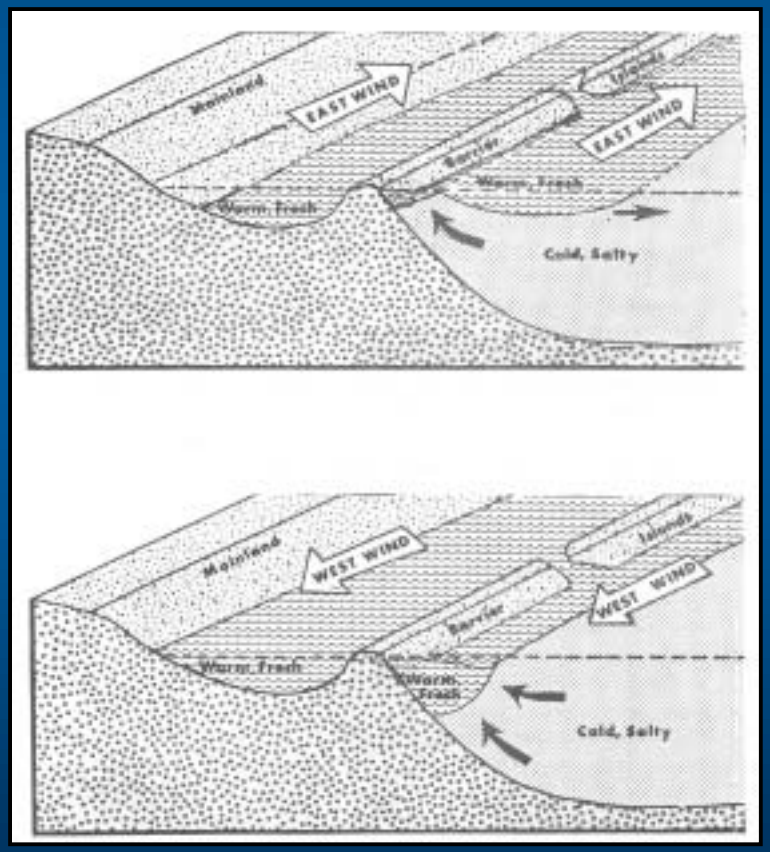
Arctic climate:

- What are the rates and magnitudes of erosion into the coastal zone? How will these inputs change as transgression along the arctic coast accelerates in response to climatic warming?

Flaxman Island, 1991

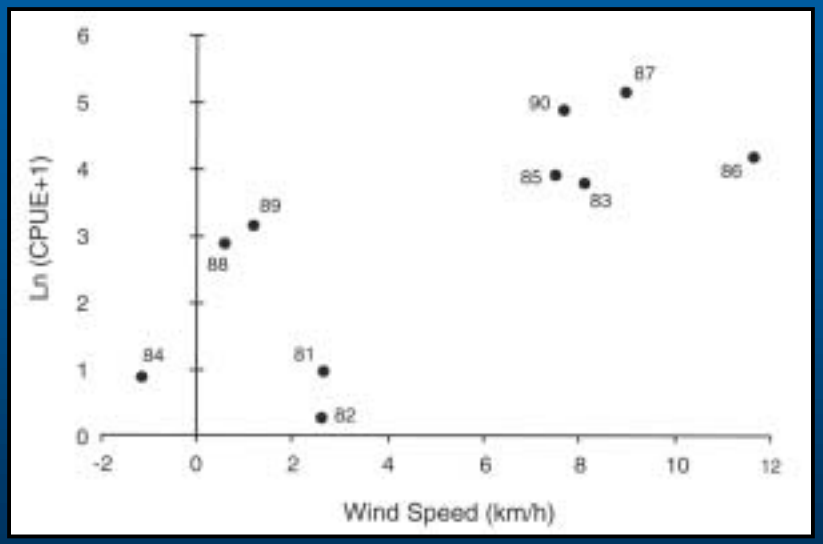
Arctic climate:

- Nearshore circulation patterns in the Arctic are poorly understood; how do frequent changes in wind direction and speed influence circulation and the advection of nutrients into the nearshore zone?



J.C. Truett, 1980

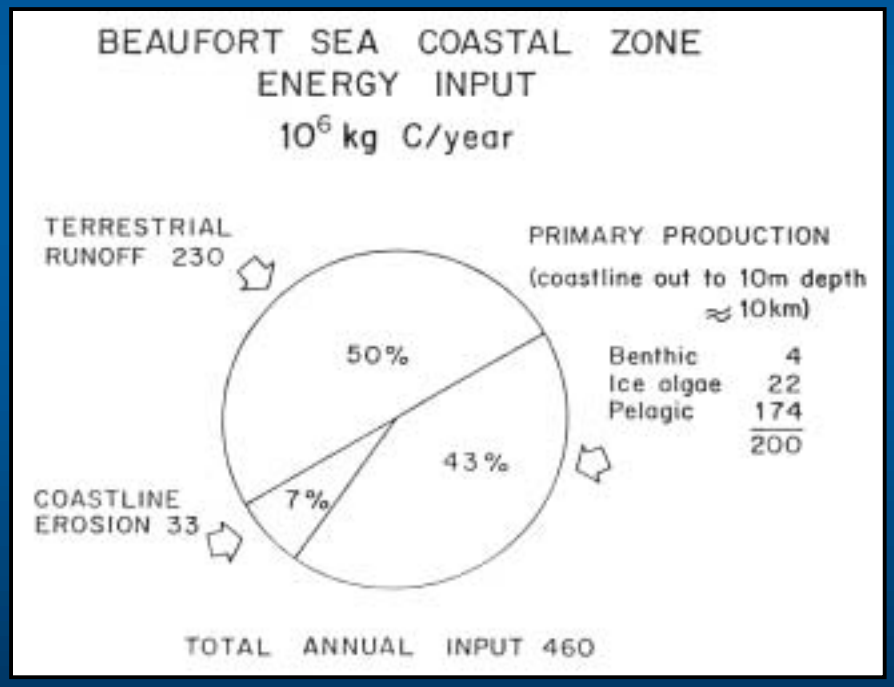
- How do variations in winds influence the dispersion of fast ice, rates of primary production, and the distribution of nekton?



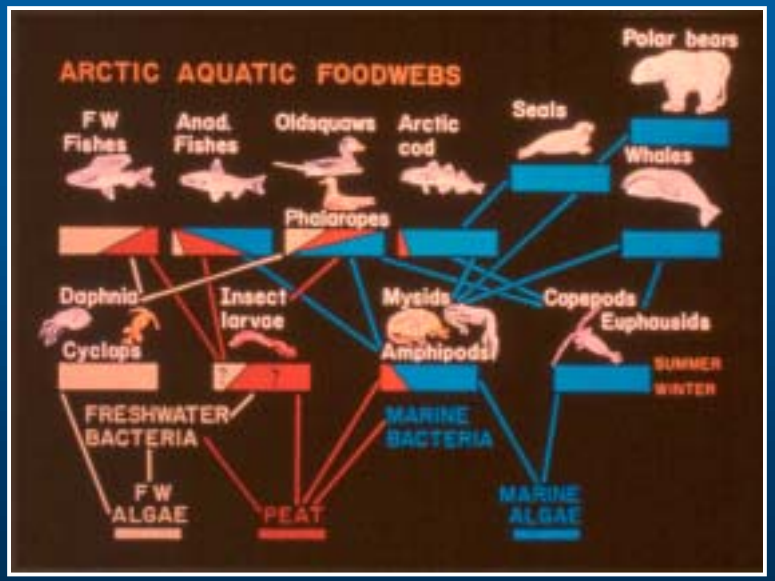
Catch-per-unit effort of arctic cisco in the Colville River as a function of average east/west wind component (B.J. Gallaway and R.G. Fechhelm, 2000).

Arctic ecosystems and societies:

- Is peat really a dead end carbon source on the nearshore shelf? What about other sources of terrigenous carbon and inorganic nutrients that enter the nearshore zone through erosion and river inputs?



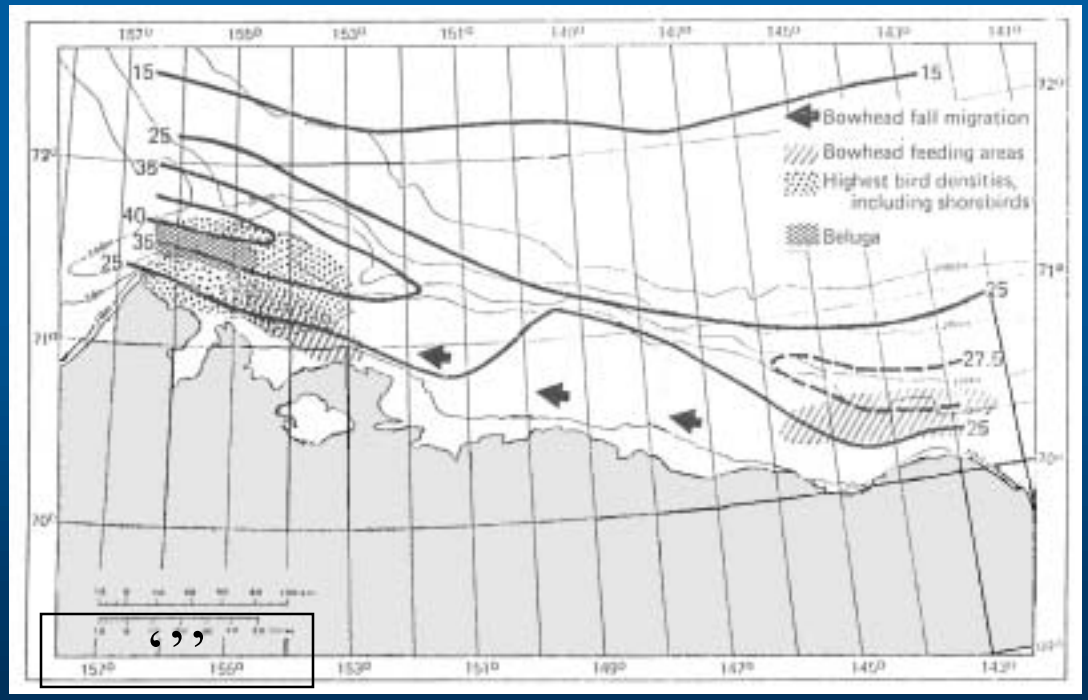
D..M. Schell et al, 1982



From D. Schell. unpub.

Biogeochemical feedbacks:

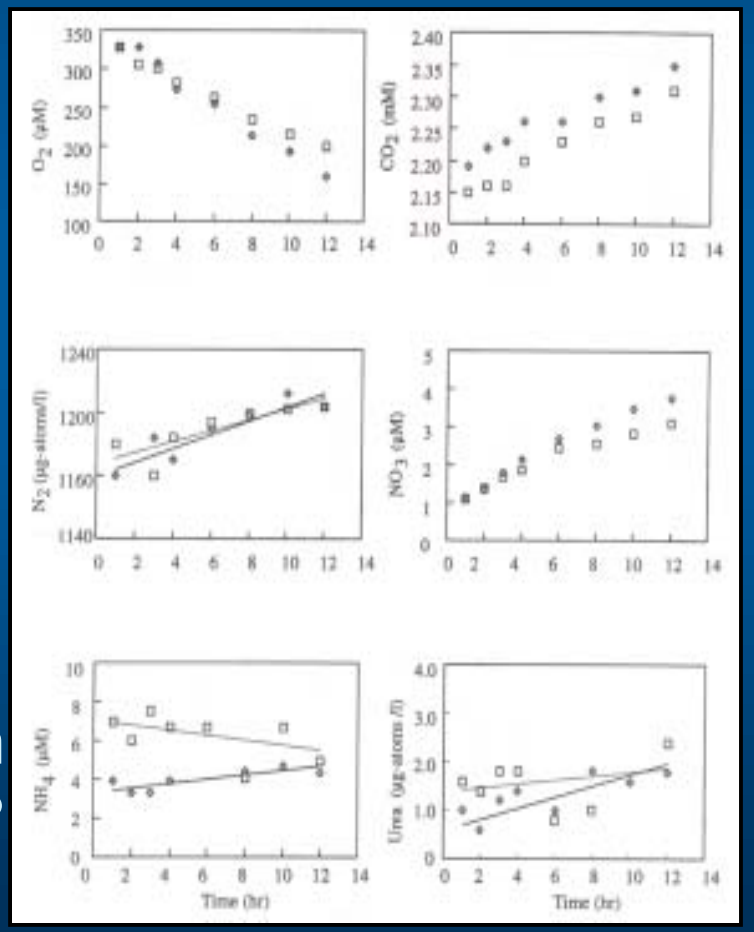
- Define the temporal and spatial scales of primary productivity along the nearshore arctic coast; how are these variations related to “hot spots” of secondary productivity, local hydrology, and nearshore/shelf circulation?



D..M. Schell et al, 1982

Biogeochemical feebacks:

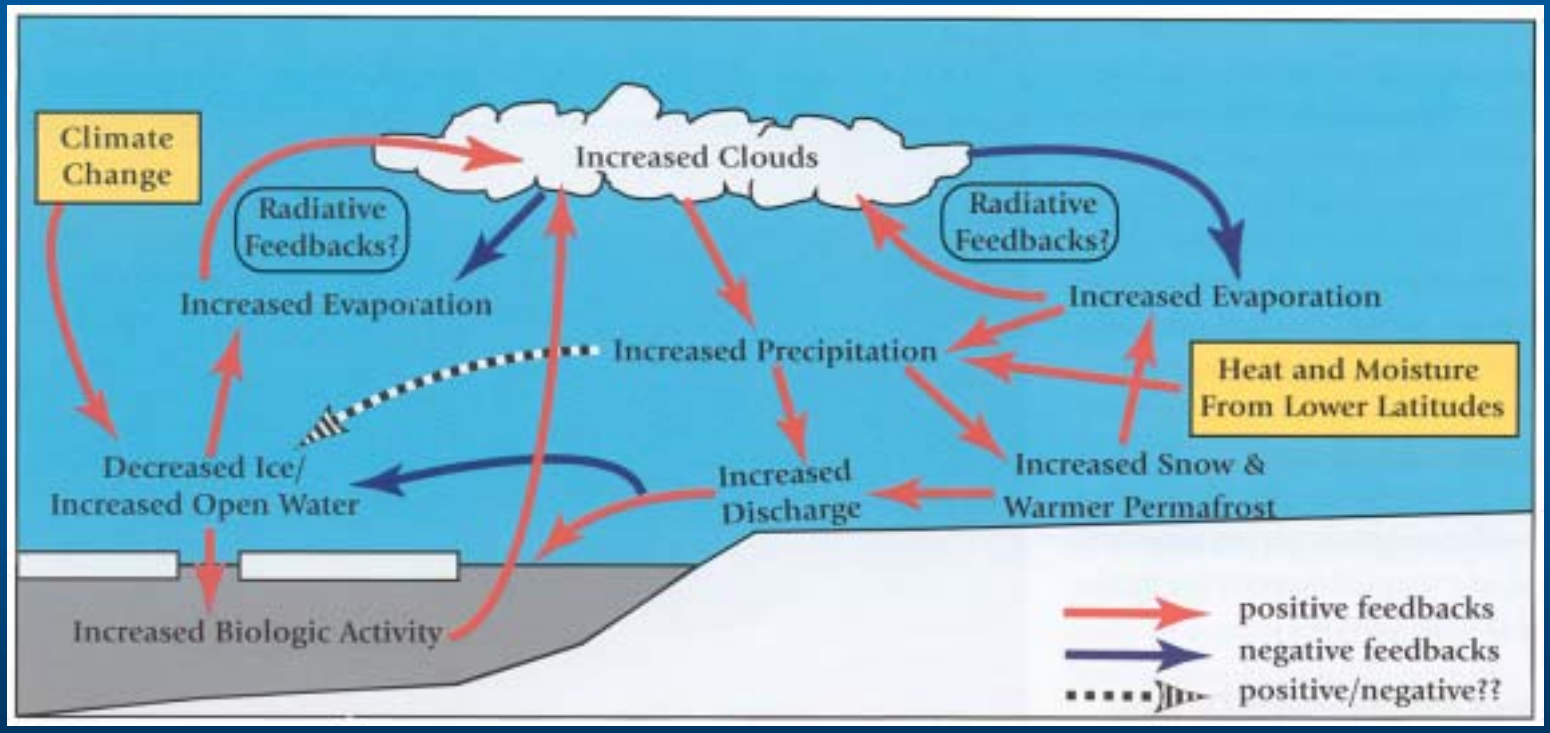
- Do nearshore sediments constitute an important source of marine denitrification and loss of contained nitrogen for arctic waters?
  - Do rate processes change during the 9-month ice-covered period?
  - Does the decomposition of organic matter from coastal watersheds contribute a significant source of new nitrogen for nearshore primary producers?



Devol et al., 1997

Hydrological feedbacks:

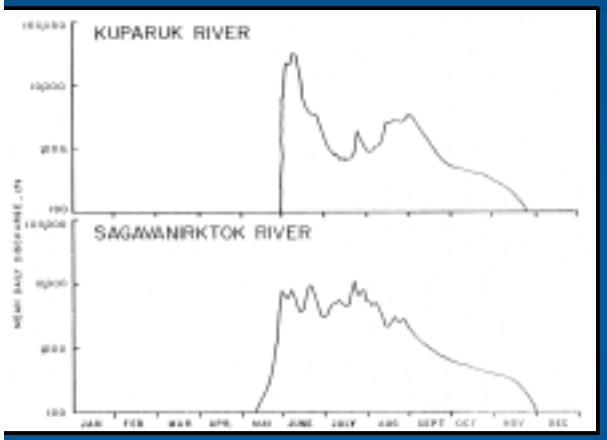
- What are the impacts of increased freshwater inflow on marine productivity in the nearshore zone?



Vorosmarty et al., 2001 NSF-ARCSS Hydrology Workshop Report

Detecting change:

- Some of the factors known to have significant impacts on nearshore processes, which are not well understood, include:



J.C. Truett, 1980

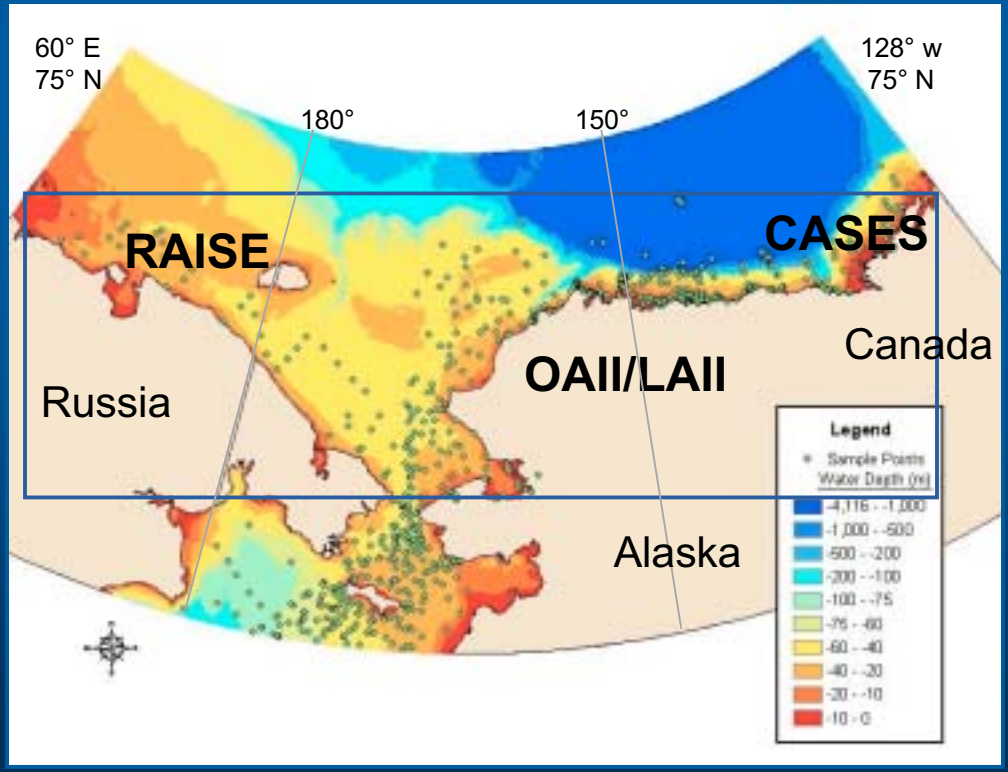
- Timing of the breakup of the nearshore fast ice and the duration and magnitude of fresh water discharge.
- Sediment transport by fast ice

Strudel scour formation during flooding of the fast ice, north of Sag River Delta, Stefannson Sound

Stefannson Sound

Proposed study area and linkages with other programs:

- RAISE: Eastern Siberian Shelf
- CASES: Mackenzie Delta
- HARC: Subsistence and native knowledge
- LAII: Rivers and watersheds
- ACD: International Program on Arctic Coastal Dynamics
- CHAMP: Pan-Arctic Hydrological Analysis and Momitoring



Major Uncertainty (Arctic climate):

- Will changes in ice concentrations have a significant impact on arctic water skiing?

K. Dunton near Narwhal Island