

# Linked Response to Rapid Climate Change and Land-Use Change in the Arctic

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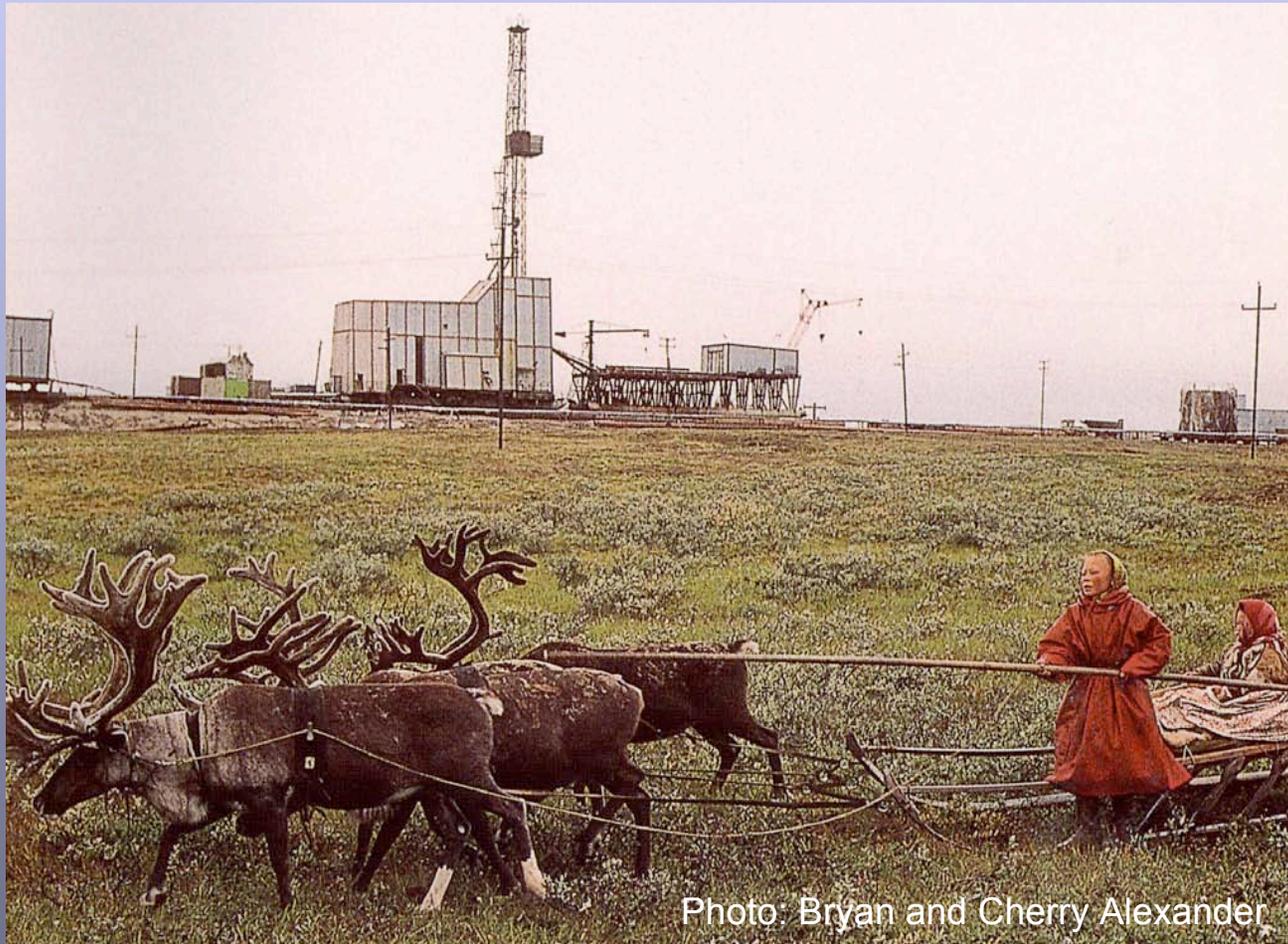
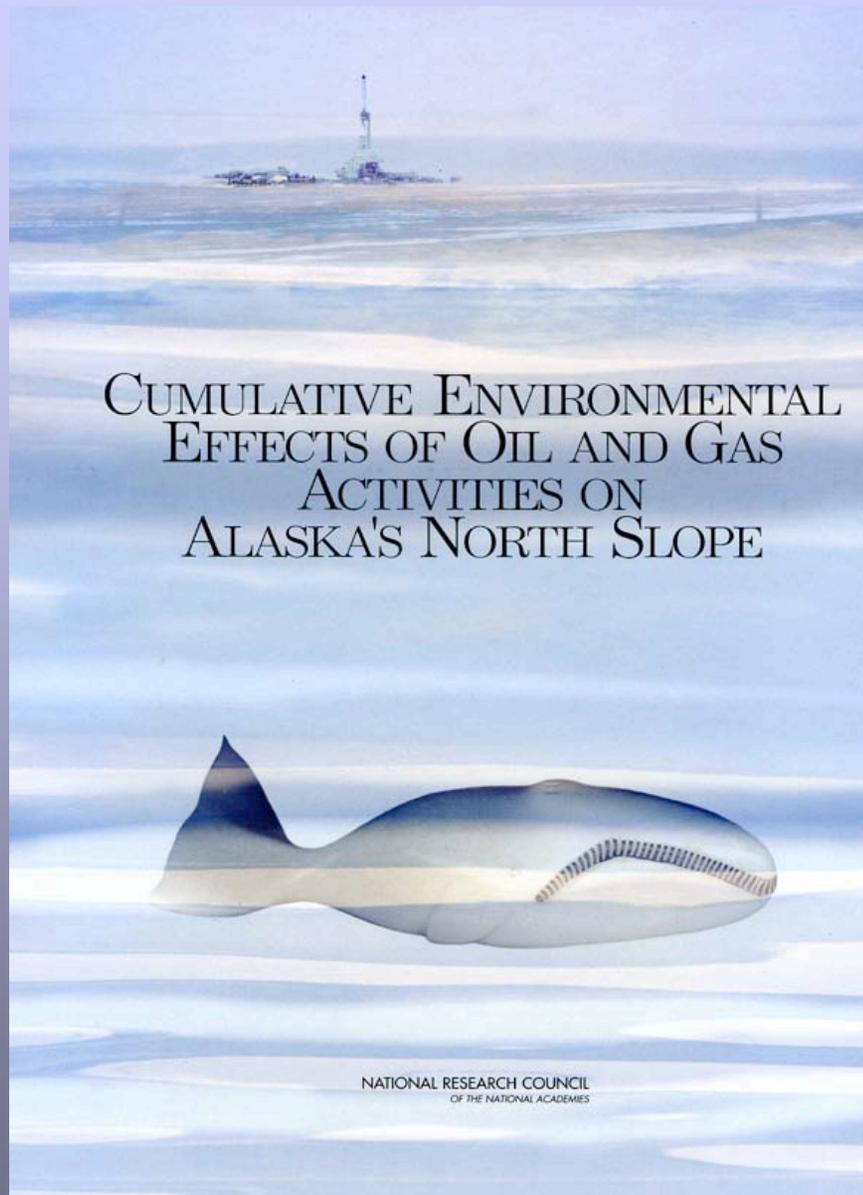


Photo: Bryan and Cherry Alexander

## **Rationale for an initiative to address linked human and terrestrial responses to rapid change in the Arctic**

- Precipitous drop in the extent of perennial Arctic sea-ice cover.
- Major undeveloped resources in the Arctic (hydrocarbons, diamonds, other mineral resources).
- Rapidly changing terrestrial and marine environments.
- Wildly fluctuating costs of oil.
- Worldwide concern regarding the combined environmental and social effects of oil and gas development and climate change in the Arctic.
- Complex interactions between climate change, expanding resource development, and the constantly changing social, economic and political environments.
- More sophisticated models and approaches are needed to help in planning possible futures for the Arctic and to help the indigenous people adapt to the impending changes.



CUMULATIVE ENVIRONMENTAL  
EFFECTS OF OIL AND GAS  
ACTIVITIES ON  
ALASKA'S NORTH SLOPE

NATIONAL RESEARCH COUNCIL  
OF THE NATIONAL ACADEMIES

## Comparative study with Alaska oil and gas development

2001: Congress charged the National Research Council with the task of examining the cumulative environmental effects of oil and gas activities on Alaska's Arctic Slope.

18-member committee: experts in geology, permafrost, economics, anthropology, marine and terrestrial mammals, birds, fish, vegetation, contaminants, arctic ecology, and the native people.

Included members of government agencies, private consultants, university professors, and non-governmental agencies.

2003: publication of the book.

## The NRC Report

- 288-page report published in 2003.
- The most comprehensive assessment of an arctic oil and gas development to date.
- Traces the history of development at Prudhoe Bay and addresses the interactions between climate change, oil development, and the social dimensions of the changes. Included a detailed quantitative assessment of the history and extent of the road and pipeline network.

## Where are we five years after the NRC report?

- Still no journal publications resulting from the study, so it is essentially an unknown study outside of Alaska.
- The report was initially denounced by the member of Congress most responsible for its funding (Ted Stevens), so there was reluctance to do follow-up publications and further research.
- Several new developments have occurred that have affected the focus of CE studies (e.g. rapid melting of the perennial sea ice, fluctuating cost of gas, new modeling tools, expanding development in NPR-A.)
- Cumulative effects of Arctic gas and oil development are being faced in several countries:
  - Russia: Yamal peninsula: ENSINOR project, Arctic Centre focused on human dimensions (Forbes et al.)
  - USA: NPR-A: NSSI, USFWS: infrastructure modeling (Bright, Fresco, et al.)
  - Canada: Mackenzie River delta: Scenario analysis using infrastructure models (Holroyd et al. 2005, 2007)
  - Norway: Barents Sea region: Impacts to Saami (Mathiessen et al. 2007)
- Different concerns and approaches in each region.

## US regulatory definition of “Cumulative Impacts”

*...an impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable-future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (CEQ 1978).*

- Resource development often proceeds in a piecemeal fashion — a process called “nibbling”.
- Likewise, climate change also occurs subtly and over long periods of time,
- ....as does population growth.

## **Need to expand the concept of Cumulative Impacts with a larger focus on effects to indigenous people**

- Adapting to the impending changes that are coming in the Arctic is a daunting prospect for the indigenous people.
- It is not possible for the people of the region to protect their interests without first gaining an understanding of what the future could look like.
- Need to expand the concept to include the impacts to the people and include the simultaneous and interactive effects of population growth and climate change, and the simultaneous effects of many developments regionally and world wide.

# Cumulative effects of rapid climate and land-use changes on the Yamal Peninsula, Russia

*D.A. Walker, M.O. Leibman, B.C. Forbes, H.E. Epstein*  
*AGU Meeting, 15-19 Dec 2008*



Photos: D.A. Walker

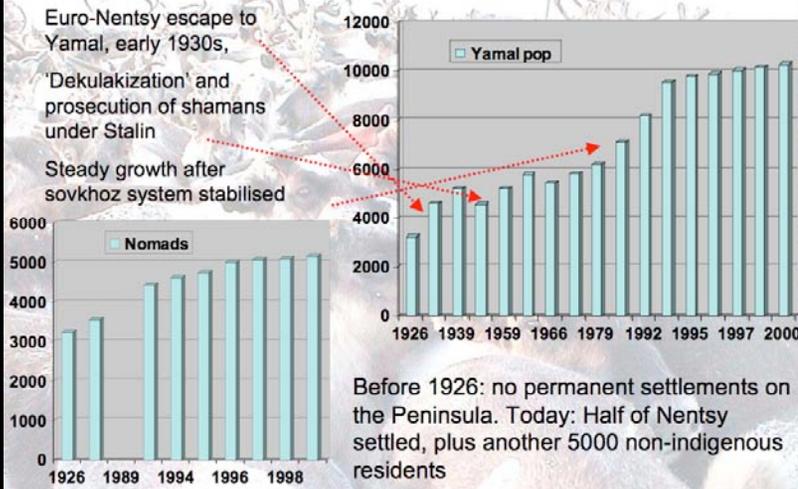
# The Nentsy use the entire Yamal Peninsula.



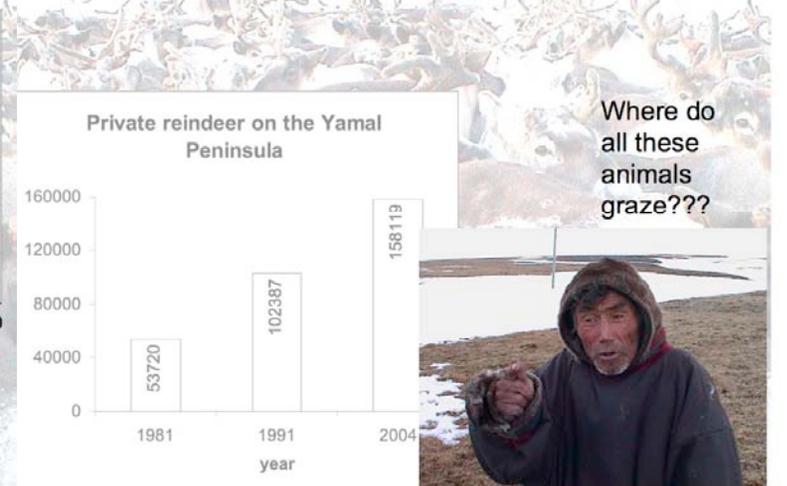


# The Nentsy and their reindeer

## Increase of humans on Yamal



## Increase of private reindeer



Graphics: Florian Stammner; Yamal LCLUC Workshop, Moscow, 28-30 Jan 2008.  
Photos: D.A. Walker

## High-ice Permafrost Landscapes

Extensive nutrient-poor surface sands with lichens that are easily overgrazed by reindeer.

Underlain by permafrost with massive pure ice.

Extensive landslides are rapidly eroding the landscape.

This exposes salt-rich and nutrient-rich clays.

Complex vegetation succession process that results in willow-shrub tundra in the interior parts of the peninsula.

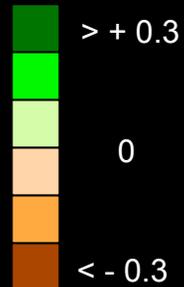
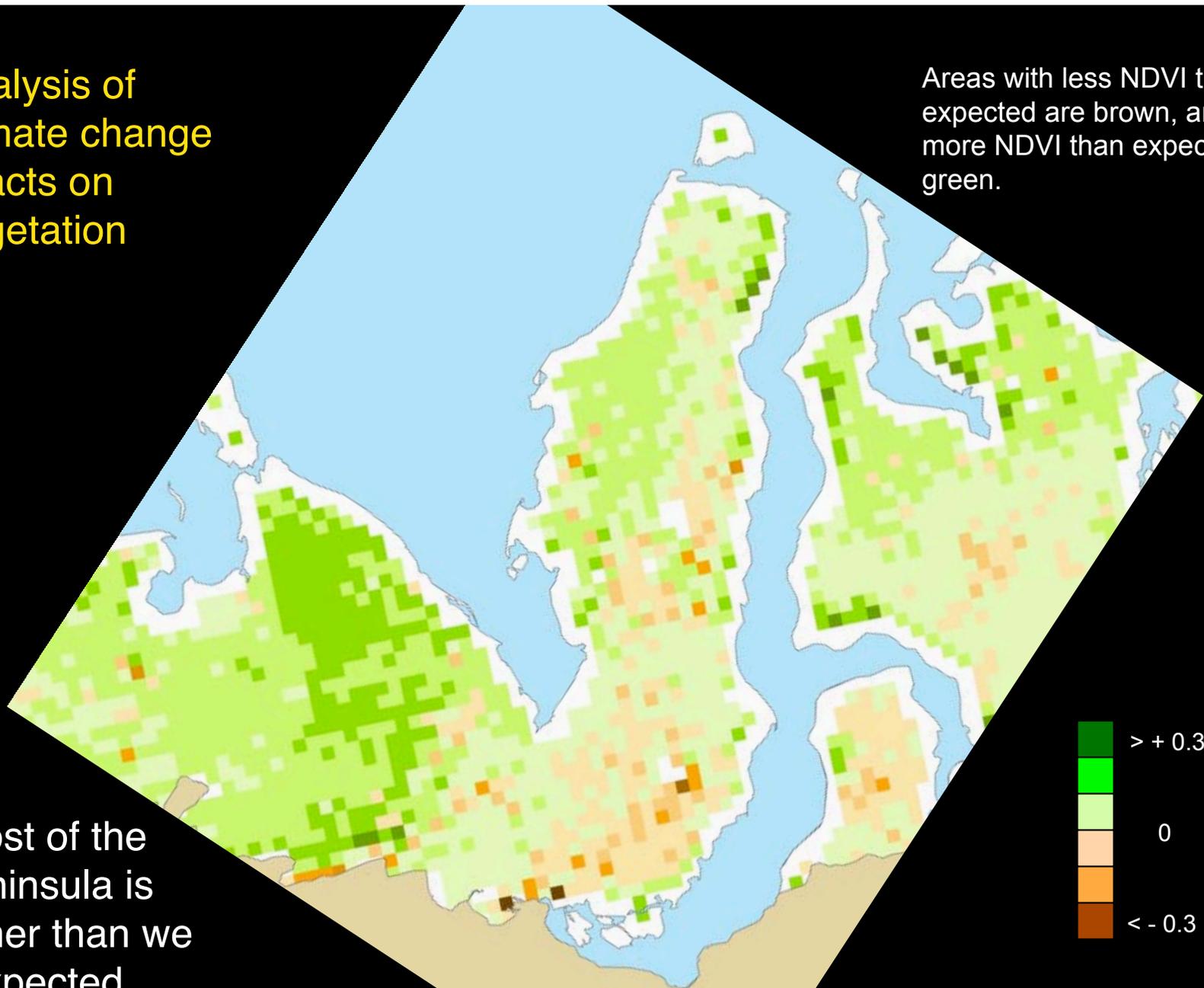
Photos: D.A. Walker  
and M. Liebman (upper right)



# Analysis of climate change impacts on vegetation

Areas with less NDVI than expected are brown, areas with more NDVI than expected are green.

Most of the peninsula is greener than we expected.



Extensive willow shrublands due to  
landslide disturbances



# Relaxed Regulatory Environment



Photos: D.A. Walker

# Environmental and Social Impacts of Industrial Development in Northern Russia (ENSINOR)



Bruce Forbes, Arctic Centre, Rovaniemi, PI of the ENSINOR Project.



**Florian Stammler interviewing members of Nenets brigade. Combining remote sensing and traditional knowledge.**

Photo: Bruce Forbes

## Herders view:



Photo: D.A. Walker

- Threats from industrial development much greater than threats from climate change.
- However, they currently generally view the gas development positively because of increased economic opportunities (e.g. markets for reindeer, some perks from the industry).
- Moderate demands:
  1. Complete and timely reclamation of lands used during the technical work that are not industrial and have no facilities on them.
  2. Establishing and protecting corridors for movement between camps by people and reindeer herders.(Zen'ko 2004, Stammler 2005).

Stammler, F. 2005. Reindeer Nomads Meet the Market: Culture, Property and Globalisation at the End of the Land. Litverlag-Halle Studies in the Anthropology of Eurasia, Muenster.

Zen'ko, M. A. 2004. Contemporary Yamal: ethnoecological and ethnosocial problems. Anthropology & Archeology of Eurasia 42:7-63.

However, there is a lack of equity in discussions regarding land-use.



**Pavel Orekhov and Nenets herder.**

Photo: D.A. Walker

- Despite an amazing ability to adapt to past climate, social, economic, and political upheavals in Russia, the Nentsy face difficult challenges with respect to adapting to industrial change because they lack title to their land.
- In Alaska and Canada, indigenous groups gained legal land claims. No such legal land rights exist for the Nentsy.

Bruce Forbes. 2008. Equity, vulnerability and resilience in social-ecological systems: A contemporary example from the Russian Arctic. *Research in Social Problems and Public Policy*, 15: 203–236.

# Cumulative effects on the Yamal

## Resource development:

- Indirect (unplanned) impacts (such as ORV trails, flooding from roads) are greater than the direct (planned) impacts (infrastructure).
- Roads and pipelines: serious barriers to migration corridors.
- Effects will increase as new fields are developed.

## Landscape factors and terrain sensitivity:

- High potential for extensive landscape effects due to unstable sandy soils, and extremely ice-rich permafrost near the surface.

## Reindeer herding:

- Land withdrawals by industry, increasing Nenets population, and larger reindeer herds are all increasing pressure on the rangelands.
- Herders view: Threats from industrial development much greater than threats from climate change. Big concern is lack of power during negotiations.
- They currently generally view the gas development positively because of increased economic opportunities.

## Climate change:

- Satellite data suggest that there has been only modest summer land-surface warming and only slight greening changes across the Yamal during the past 24 years. (Trend is much stronger in other parts of the Arctic, e.g. Beaufort Sea.)
- Kara-Yamal: negative sea ice, positive summer warmth and positive NDVI are correlated with positive phases of the North Atlantic Oscillation and Arctic Oscillation.

## Initial goal for this session

- *To initiate a discussion between US researchers to work toward better, more far-looking tools to predict the cumulative effects of resource development, climate-change, and traditional land use.*
- Initially wanted to invite international participants from Canada, Russian, Finland, Norway and the US who are working on new and innovative approaches to address the problem of cumulative effects of land-use change and climate change in the Arctic.
- Limited funds prevented us from doing this, so this goal is still in the future.

## **2008 Arctic Science Conference sessionAK, :** ***Terrestrial responses to rapid climate change and land-use change in the Arctic***

### **Yamal Peninsula, Russia**

- *Donald (Skip) Walker:* Cumulative Effects of Rapid Land-Cover and Land-Use Changes on the Yamal Peninsula, Russia
- *Bruce Forbes:* Cumulative Impacts of Petroleum Development on Reindeer Herding in Northwest Russia
- *Martha Reynolds:* Spatial patterns of NDVI distribution on the Yamal Peninsula

### **Alaska and North America**

- *Uma Bhatt:* Trends and Variability of Sea Ice, Land Surface Temperatures and Vegetation in Northern Alaska
- *Maribeth Murray:* Impacts of Shifting Sea Ice Conditions on Human Settlement and Land Use in Arctic North America
- *Larry Bright:* Developing a Decision-support Tool for Long-term Infrastructure Planning on the North Slope of Alaska

## **Proposed outcome:**

**Concrete proposal for an International Workshop:**

**“Advancing Understanding and Modeling of Rapid Change in Arctic Terrestrial Environments”**