Arctic LTER: Map Analysis

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• Change analysis using Landsat and Quickbird:
  – Natural Arctic ecosystems near Toolik Lake
  – Industrial complex at Prudhoe Bay.

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Toolik Lake vicinity:
Temporal analysis of Landsat-derived NDVI 1985-2009
30-m resolution, 7 peak summer scenes

Stripes are due to Landsat 7 scan line corrector failure
Landscape-level GIS: Hierarchy of Toolik Lake vegetation maps

- 3 scales of maps for the upper Kuparuk River and Toolik Lake region, AK.

Walker, D.A. and H.A. Maier. 2008 Biological Papers of the University of Alaska. No. 28
Analysis of NDVI trends 1985-2009

Entire map area

Vegetation types covering largest areas

Tussock-sedge, dwarf-shrub, moss tundra

\[ y = 0.0006x - 0.6864 \]
\[ R^2 = 0.1315 \]

Nontussock-sedge, dwarf-shrub, moss tundra

\[ y = -2E-05x + 0.5319 \]
\[ R^2 = 0.0002 \]
Changes 1985-2009

Positive changes along the Dalton Highway due to dust fertilization, thermokarst and enhanced shrub growth along buried pipeline north of road.

Negative changes (due to erosion) and positive changes (due to succession) along the Atigun River.

Plans:
2. Examine climate trends.
3. Use Quickbird for more detailed analysis, especially along roads and infrastructure.
Prudhoe Bay: Cumulative effects of oil and gas development

NRC Report

Only instance in the U.S. where the complete record of the transition from remote wilderness to extensive industrial complex is recorded in aerial photos and satellite imagery.
North Slope hydrocarbon fields and development units
Assessing the effects of oil development

Direct effects of infrastructure: Roads, facilities, pipelines, gravel mines

Indirect effects: Roadside dust, flooding etc.
Time series of development 1968-2001

- Maps and GIS database developed by Aeromap Inc. for BP
- 7 years of detailed maps of all infrastructure
  - Roads
  - Gravel pads
  - Pipelines
  - Gravel mines
  - Airstrips
  - Powerlines
  - Culverts, etc.
Analysis of maps

Length of roads

Gravel-covered Area

- Gravel roads and causeways
- Peat roads and tractor trails
- Total roads

Gravel mines
Other disturbed areas
Gravel covered areas

Year:
- 1968
- 1973
- 1977
- 1983
- 1988
- 1994
- 2001

Miles

Acres
Plan for coarse-scale analysis of Prudhoe Bay:

- Repeat NRC analysis using time series of Landsat imagery to determine what types and percent of the actual impacts can be detected.
- Update to the present.
- Possible application in new areas of development because methods used for the NRC report are not likely to be repeated because of the cost.
Analysis of indirect effects at fine scale (1:6000)

Vegetation

Time series of impacts
Plan for analysis of oil field infrastructure at fine scale:

- Use Quickbird imagery to update time series of areas mapped at Prudhoe Bay oil field.
- Needed for detailed analysis of roadside effects.
Planned road to Nuiqsut:

State DOT, oil industry and NSB planning construction road project that would accelerate:

- Oil and gas exploration and production in NPR-A and Foothills
- A new NPR-A staging area near Nuiqsut

The project would also provide Nuiqsut access to Dalton Highway for fuel and freight transport
Human Dimension Component and Synergies

• Relevance to residents of villages: Gary.

• Comparative studies with other MALS projects.

• NASA Land-Cover Land-Use Change Program
  – Similar issues in the gas fields of the Yamal Peninsula, Russia related to Nenets reindeer herders: Remote sensing and models for analyzing cumulative effects