#### Arctic Ice and Snow Roads 2010 Conference: Advancements and Future Needs



Alaskan North Slope Oil and Gas Transportation Support System

> Michael R. Lilly Geo-Watersheds Scientific

> > March 30, 2010





## **Project Partners**

- NETL/Arctic Energy Office
- ConocoPhillips Alaska
- Alaska Department of Natural Resources
- Bureau of Land Management
- Geo-Watersheds Scientific
- University of Alaska Fairbanks
- NOAA, National Weather Service
- Alaska Department of Transportation and Public Facilities
- Mineral Management Service
- North Slope Borough









# **Project Team**

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  - Jessie Cherry, International Arctic Research Center
  - Horacio Toniolo, Water and Environmental Research Center
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  - Chien-Lu Ping, Palmer Research Center
  - Vladimir Romanovsky, Geophysical Institute
  - Tom Heinrichs, Geographic Information Network
    for Alaska
  - Billy Connor, Alaska University Transportation Center
- Idaho National Laboratory
  - Gerald Sehlke





### **Benefits and Impacts to Industry**

- Better Management Tools to Plan Winter Transportation
- More Time During Winter Operations Season Though Quicker Decisions, Improved Management Objectives
- More Flexibility to React to Weather and Logistical Conditions







## **Arctic Transportation Background**

#### Ice and Snow Roads

- Exploration, Largest User
  - Safety, road construction speed is highest priority
- Operations and Maintenance of pipelines
- Hybrid Road Networks
  - Ice and gravel sections (Alpine Supply Road)
- Middle of Winter
- Short Seasons
- 6" snow on coastal plain, 9" in foothills
- -5°C Soil Temp at 12"







## **Arctic Transportation Objectives**

- Develop Analysis and Management Tools related to Arctic Transportation Networks
  - Snow Distribution
  - Soil Strength
  - Soil Temperature Forecasts
  - Water Use
  - Adaptive Management
  - Nowcast/Forecast Tools







### **Field Areas**







## **Task 2 – Field Data Collection Network**

- Project Data Stations
- Cooperator Station
- Multiple Data Uses







## Task 3 – Soil Analysis and Characterization

- Soil Measurements
  - Samples
  - Descriptions
  - Distribution
  - Frozen Strength Tests
- Questions?
  - Frozen Strength Needed?
  - At What Temperature is Soil at a Design Strength?
  - How Do Soils Vary Spatially?









Data: C.L. Ping and G.J. Michaelson UAF







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## **Task 4 – Snow Distribution Scaling**

- How does snow vary across different regions?
- How do you use single sites to manage areas?
- What standards are needed?







## **Task Examples – Snow Distribution**

- Snow Measurements
  - Depth, Density
  - Distribution
  - Standard Practices
  - Forecasts
  - Applicable to both tundra travel and lake recharge
- Questions?
  - How much is enough?
  - Does type matter?







## Task 5 – Water Use Tools and Adaptive Management

- Lake water use management evaluation
  - > Winter, Summer
- Adaptive permitting to fit usage needs and hydrologic cycles
- Lake ice thickness evaluation and tools
- Improved water use, reduced risks





























## Permitting, Water Use, Hydrologic Cycles







## Permitting, Water Use, Hydrologic Cycles







## **Typical Water Permitting, Actual Use**







## **Typical Water Permitting, Actual Use**

Over permitting is critical to allow adequate permit reviews, operational flexibility (due to weather, user need changes, etc.)





# **Types of Typical Use**







#### **Watershed Analysis – Landscape Scales**









### Watershed Analysis - Lake L9817, NPRA









## **Task 6 – Nowcast/Forecast Modeling Tools**

- Blowing Snow Modeling
  - > Snow redistribution When does it happen?
- Soil Temperature Modeling
  - > When will it be cold enough?





### **Snow Models Used for ATN Project**



Byam and Cherry, 2010





### Example of Spatially Distributed WRF Output –NOAH Model



## **Task 7 – Technology Transfer**

- http://www.arctic-transportation.org
  - Online Reports
  - Data Stations
  - Other Information
- > GINA
  - GIS Products





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- Map visualization of data layers
- Display of attributes, such as tundra travel status
- Choice of base layers (imagery, DEM, etc)



**Users** Portal

Data Layers Portal

DEMO site: http://atnportal.gina.alaska.edu/



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Users Portal Data Layers Portal									
Title	Source	Website	KML/KMZ	SHP	WMS	WFS	WCS	Layer	
NED WCS Two Arc Second Statewide USGS national elevation dataset, Two Arc Second	GINA/SDMI	> Website						> Layer	^
NED WCS One Third Arc Second (NPR-A) Statewide USGS national elevation dataset, One Third Arc Second (NPR-A)	GINA/SDMI	> Website						> Layer	
SDMI WMS Best Data Layer Statewide imagery collection, with the best available data being shown.	GINA/SDMI	> Website	> KML/KMZ		> WMS				
AA Track 2009.10.26 Complilation of state and federal oil and gas producing area tracks	AK DNR	> Website		> SHP					
AA Boundary 2009.10.26 Compliation of state and federal oil and gas producing participating boundary areas in Alaska	AK DNR	> Website		> SHP					
Active Leases - Shallow Natural Gas Feature class of active state shallow natural gas leases	AK DNR	> Website		> SHP					
STATSGO Soil Layers General soil association units developed by NRCS	NRCS	> Website			> WMS			> Layer	
2009 Ice Roads A collection of the ice roads constructed in the 2008-2009 winter season	ATN	> Website	> KML/KMZ	> SHP		> WFS			
2008 Ice Roads A collection of the ice roads constructed in the 2007–2008 winter season	ATN	> Website	> KML/KMZ	> SHP		> WFS			
2007 Ice Roads	ATN	> Website	> KML/KMZ	> SHP		> WFS			~

11+

- Catalog unified listing for convenient access, Listing and download of data
- Various GIS and CADD file formats **U.S. DEPARTMENT OF** NERGY

**DEMO** site: http://atnportal.gina.alaska.edu/





# Alaskan North Slope Oil and Gas Transportation Support System

#### **Project Recommendations On The Table!**

- Snow Measurement Methods and Data Reporting Standards
- Development, Validation, Training
- Leading to Earlier Opening? When Conditions are Right!

#### **Upcoming Project Recommendations!**

- Lake Ice Thickness and Water Level Surveys
- Permafrost Terrain Description Methods







#### Thank You Questions?

#### http://www.arctic-transportation.org