



UNMANNED AIRCRAFT SYSTEMS AND THE ARCTIC



The Small Unmanned Aircraft System (SUAS)

Less than 20 kg (55 lbs)

- Fixed Wing or Rotary Wing
- Battery or Gas Affects Endurance
- Multiple Launch & Recovery Options

On-Board Sensing Possibilities and Capabilities

- Visible and/or Thermal Imagery
- Video and/or Still Photography
- Hyperspectral and LIDAR
- Synthetic Aperture Radar
- Aerosols and Gasses; detection, characterization and classification
- Dropsondes



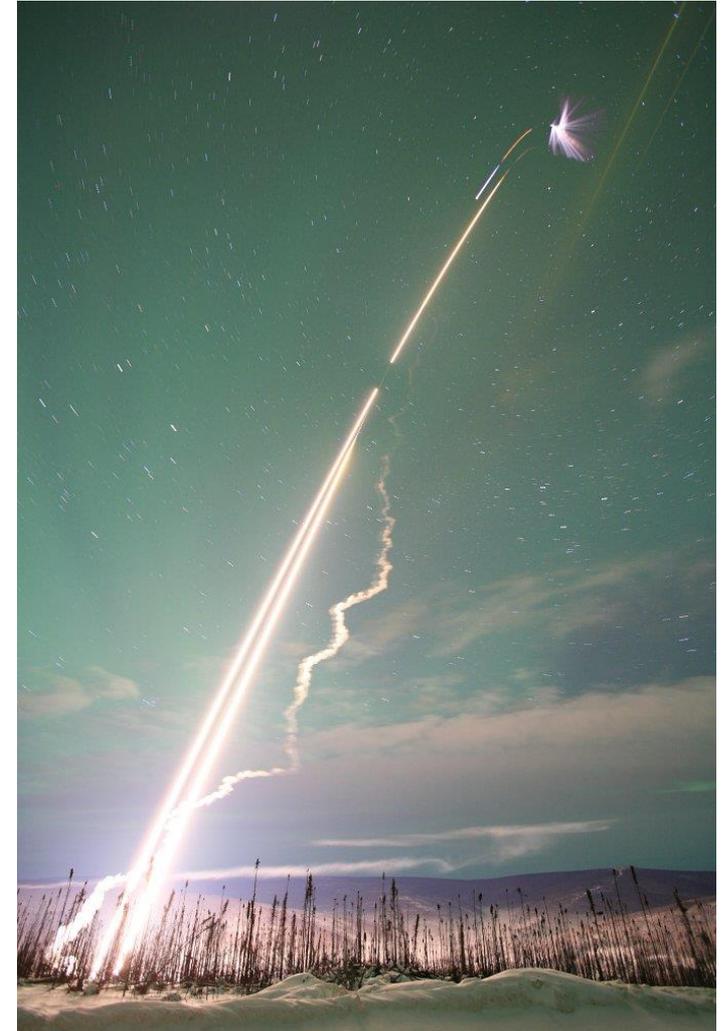
UAF Rocket History

Poker Flat Research Range

Largest land-based rocket research range in the world and the only high-latitude rocket range in the United States

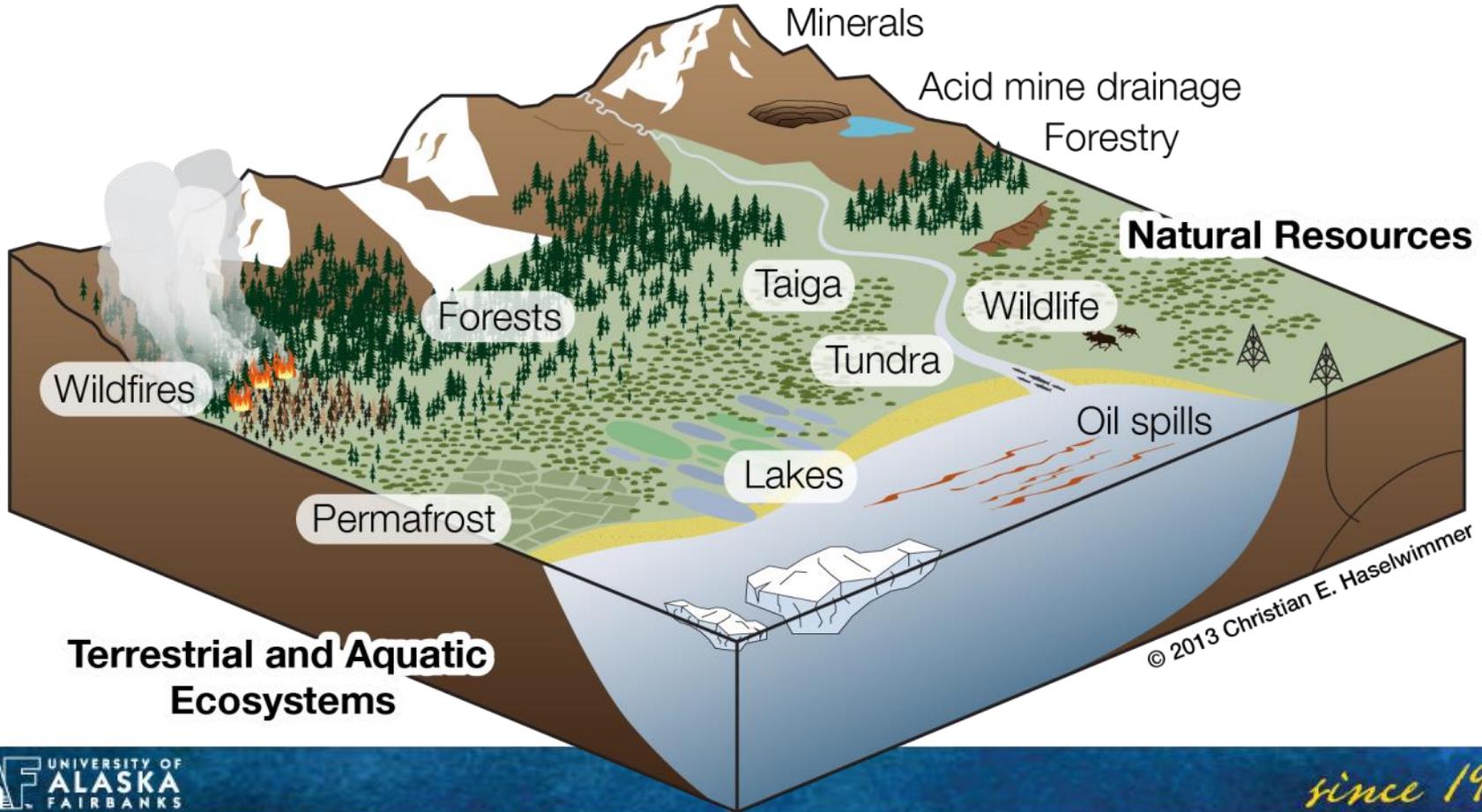
Safe-airspace legacy led to UAS operations

- UAS operations since 2001
- Military and civilian research partnerships



Arctic Applications

- Terrestrial and aquatic ecosystem applications
- Natural resource studies



Support to Science and Research

- Marine Mammal Monitoring
- Fisheries and Fish Population Management
- Sea Ice and Shore-Fast Ice Research
- Large Animal Research
- Sensor and Payload Development
- Sensitive Habitat Monitoring
- Erosion Management
- Agricultural Support
- Atmospheric Sciences
- Glaciology, Snow and Ice Studies
- Climate Change Analysis
- Hydrology and Floodplain Analysis
- Invasive Species

Support to Industry and Government

- Facilities and Infrastructure Monitoring
- Geospatial and Vegetation Mapping
- Roads & Pads Surveys; Build-up, Restoration and Repair
- Change Detection
- Satellite Data Truthing
- Shipping and Ice Piloting
- Volumetrics
- Precision Agriculture
- Pipeline Leak Detection
- Security

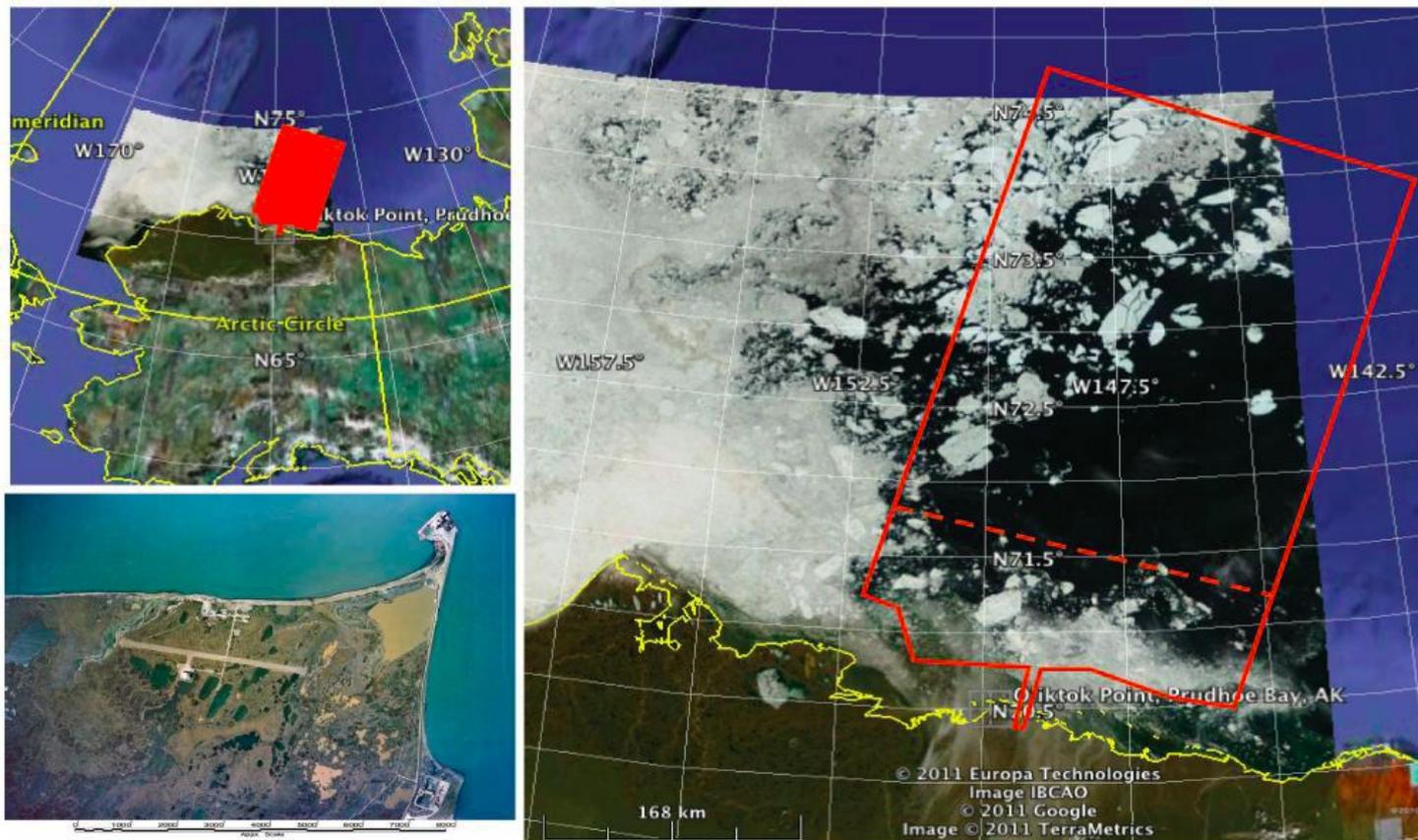
Support for Emergency Management

- Spill Response
- Wildfire Response
- Structural Fire Response
- Search and Rescue
- Accident Investigation (Aircraft, Train, Auto)
- Flood Monitoring and Response
- Storm Damage Assessment and Response
- Monitoring Sensitive Lands (4x4, ATV)

Sample of 2013 Missions

- Marginal Ice Zone Observations and Processes EXperiment (MIZOPEX)
- Arctic Shield
- Salmon Spawning Habitat
- Shipboard Operations
- Pilgrim Hot Springs
- Ugak Island
- Payload Development
- Iceland mapping flights (Spong)
- Bethel Aircraft Crash exercise
- Demo for DOT road mapping

Marginal Ice Zone Observations and Processes EXperiment (MIZOPEX) June 2013



Multiple aircraft simultaneously
Many new scientific payloads

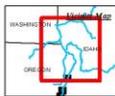
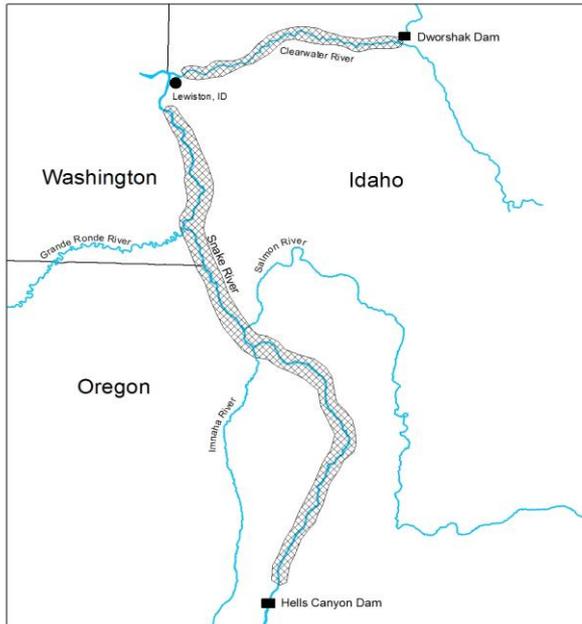
Marginal Ice Zone Ocean and Ice Observations and Processes EXperiment (MIZOPEX) June 2013

The main objectives of MIZOPEX are (were) to improve knowledge of how ocean surface and near-surface properties vary and evolve as a function of ice characteristics in and near the MIZ, and to quantify the performance of satellite-derived geophysical products and climate models in these areas.

The suite of measurements included skin temperature, spectral reflectance and albedo, sea ice freeboard and roughness, ice melt pond characteristics, atmospheric state variables, and wave height. These were obtained using infrared pyrometers, broadband and hyperspectral sensors, synthetic aperture radar, lidar, and electro-optical cameras.

Salmon Spawning Habitat Nov-Dec 2013

- Mapping Fall Salmon Nests along a 162 km of the Snake and Clearwater River in Idaho, Washington, and Oregon
- “THREATENED” under the Endangered Species Act



IDAHO POWER

IDAHO POWER COMPANY, BOISE, ID 2012
Date: 10/20/12





**Idaho Power Salmon Spawning Habitat
Raw Image**

26

A female on each nest

Salmon Spawning Habitat
After Analysis



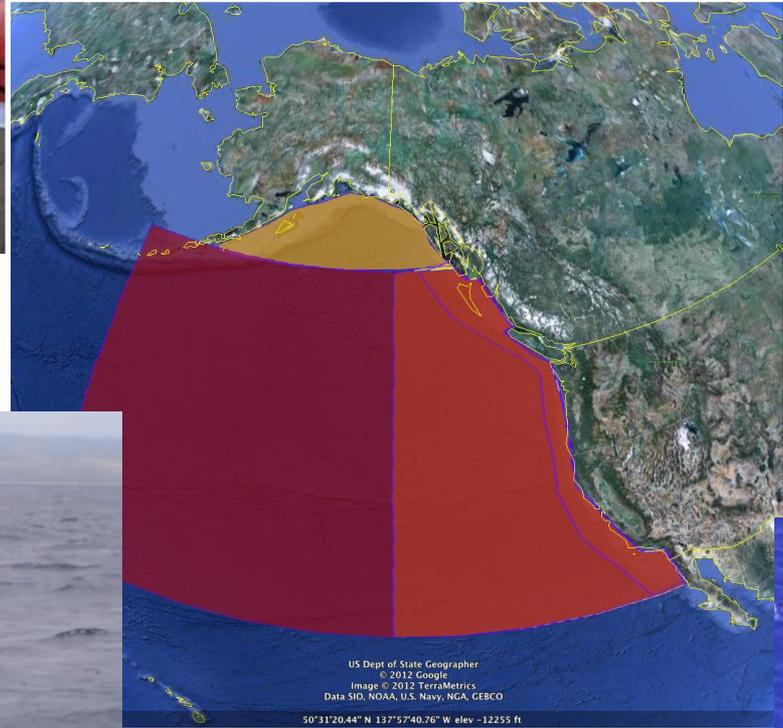
Oil and Gas Infrastructure - Pipeline (IR)

Nov 19, 2013



White is “hot”. Pilot sees hot spot on left then lowers camera and captures image on right. Temperature variations can be small but will show up vividly in IR.

Environment - Survey of Marine Debris



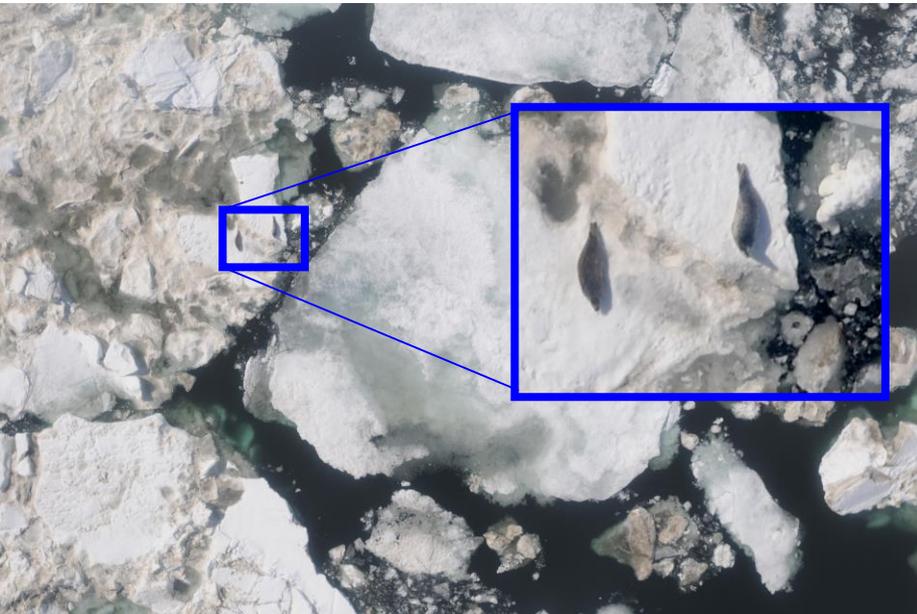
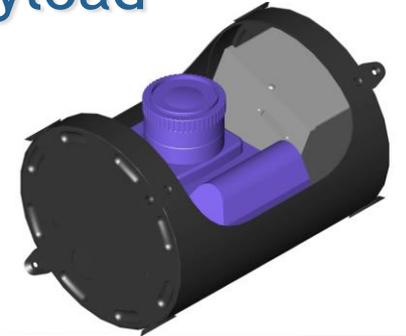
NOAA Funded Effort

Most recent missions flown 6 & 7 June, 2014



Marine Mammals

From University Built High Resolution Payload



500 ft AGL



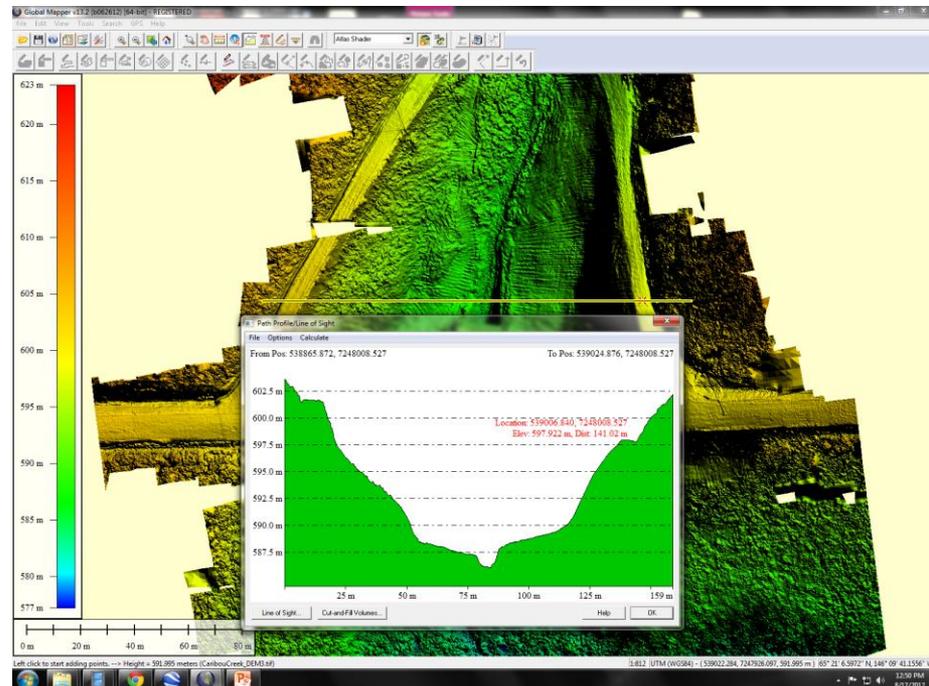
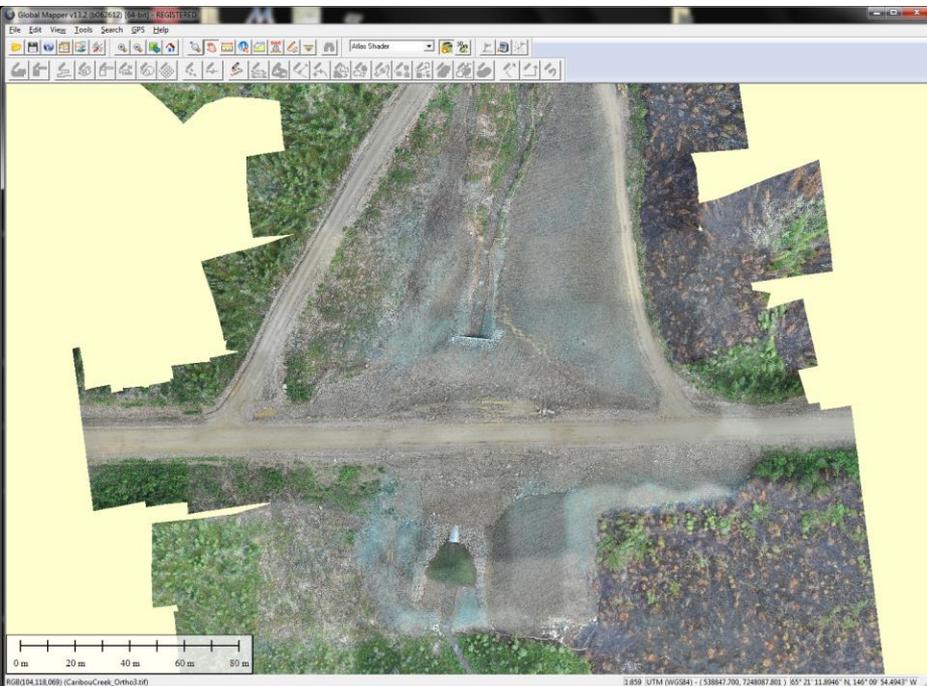
400 ft AGL

**Relaxed spotted and ribbon seals
(more accurate count potential than manned aircraft)**

Steller Sea Lion Counts



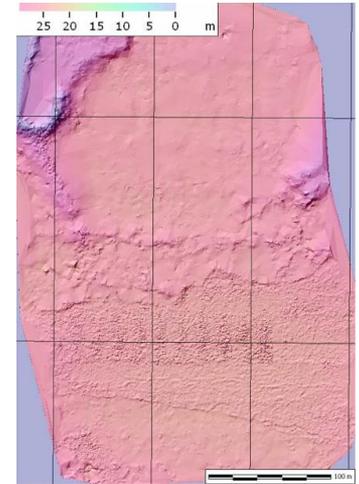
Infrastructure - Ortho Image and Surface Models



Culvert under road with elevation data

Nome Fuel Delivery

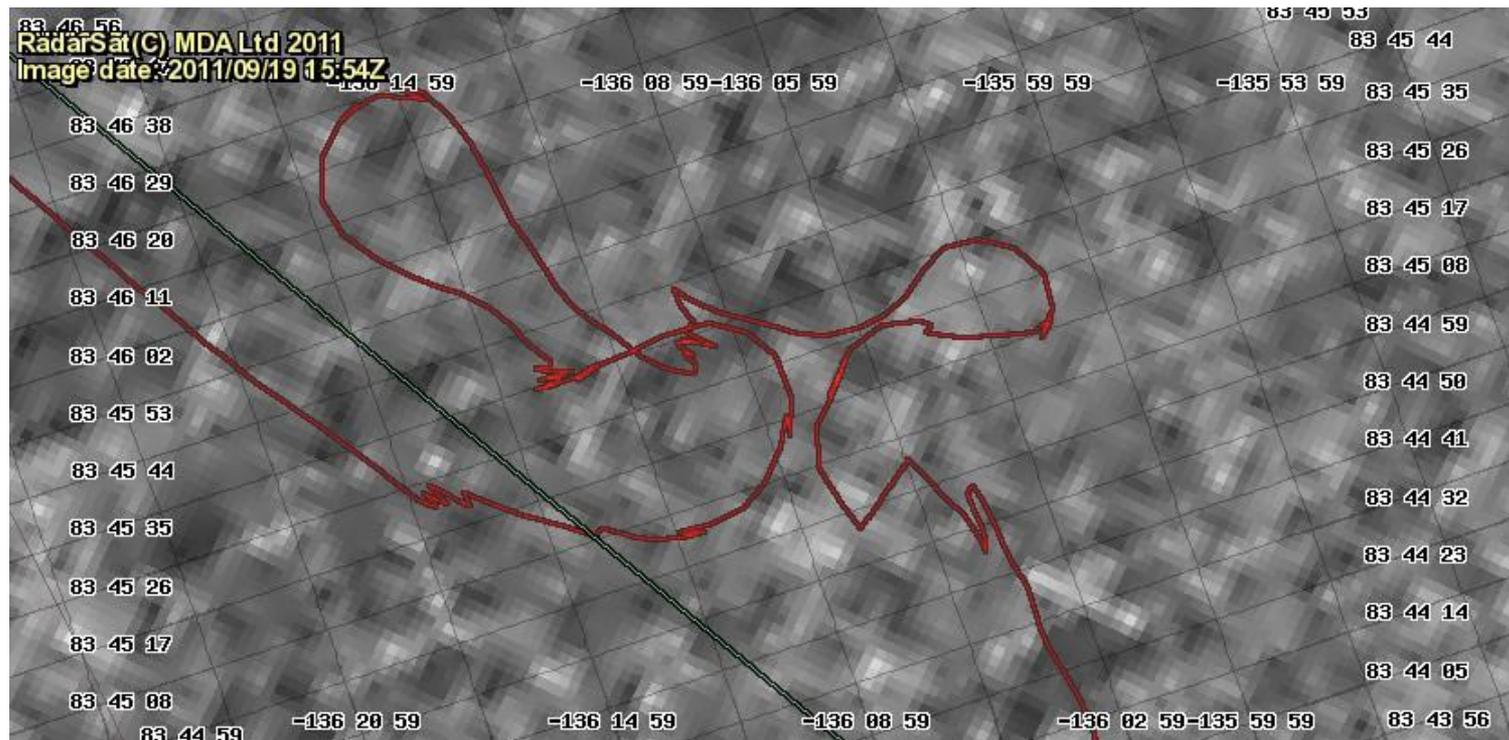
Ice Pressure-Ridge Mapping



Imagery For Ship Piloting in Ice Ship Tracks Superimposed

Background Image: National Ice Center highest resolution RADARSAT

- Desired icebreaker track (green)
- Actual navigation track (red)



Bear Bite - SAREX

Mass Casualty Exercise 7-10 February 2013

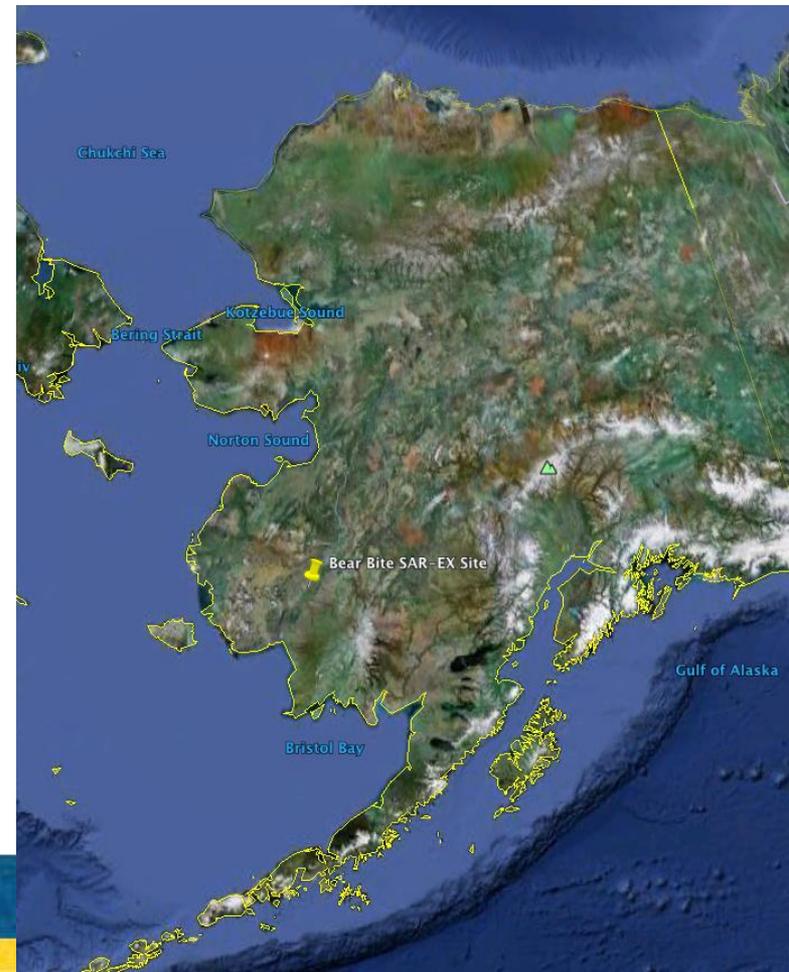
“An aircraft crashed in the tundra roughly 20 miles outside Bethel Alaska many died with some survivors”

Deployed two unmanned aircraft systems with support team

Coordinated with manned aviation on the scene

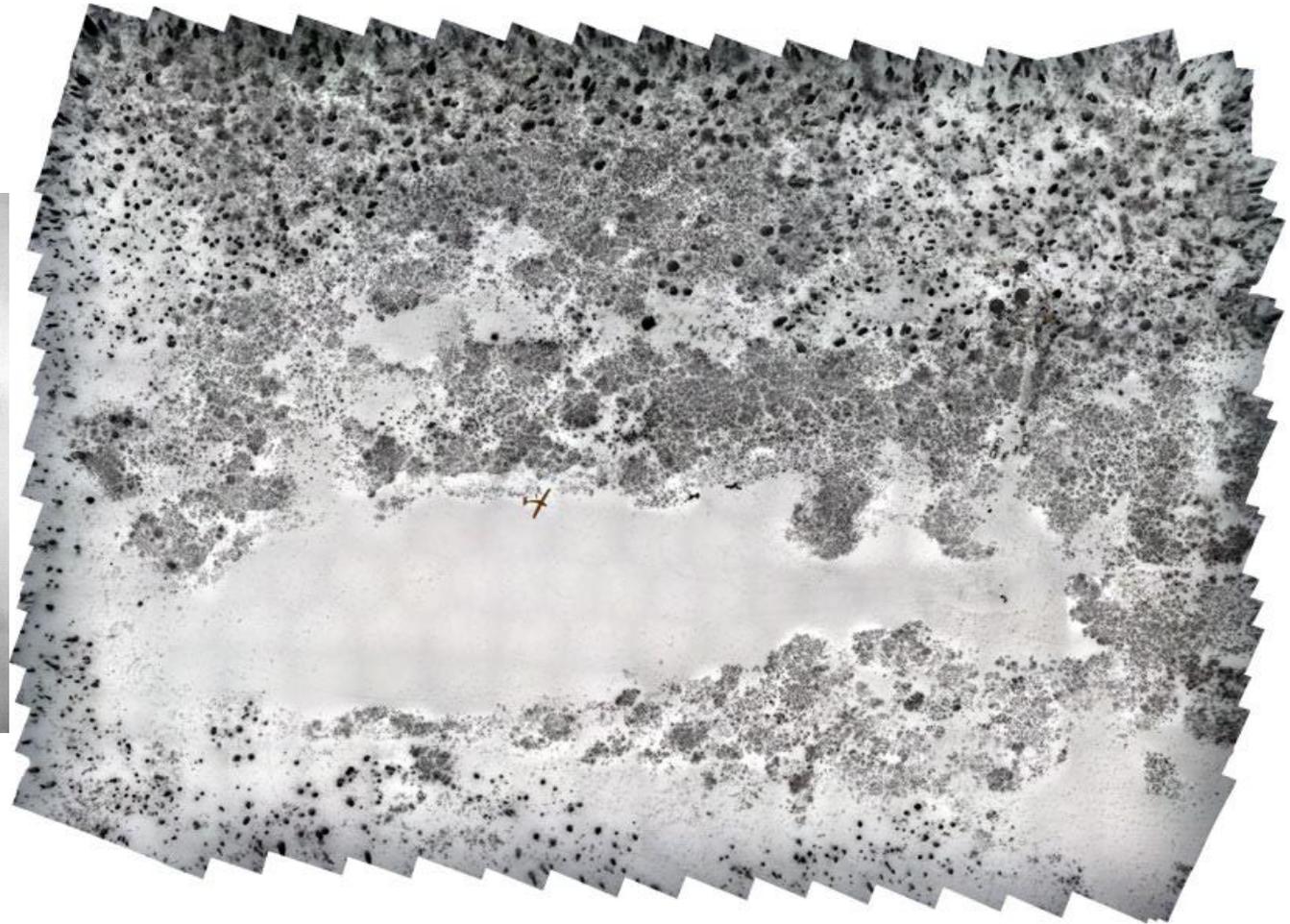
Mission:

- Map scene for event documentation
- Real-time SAR response

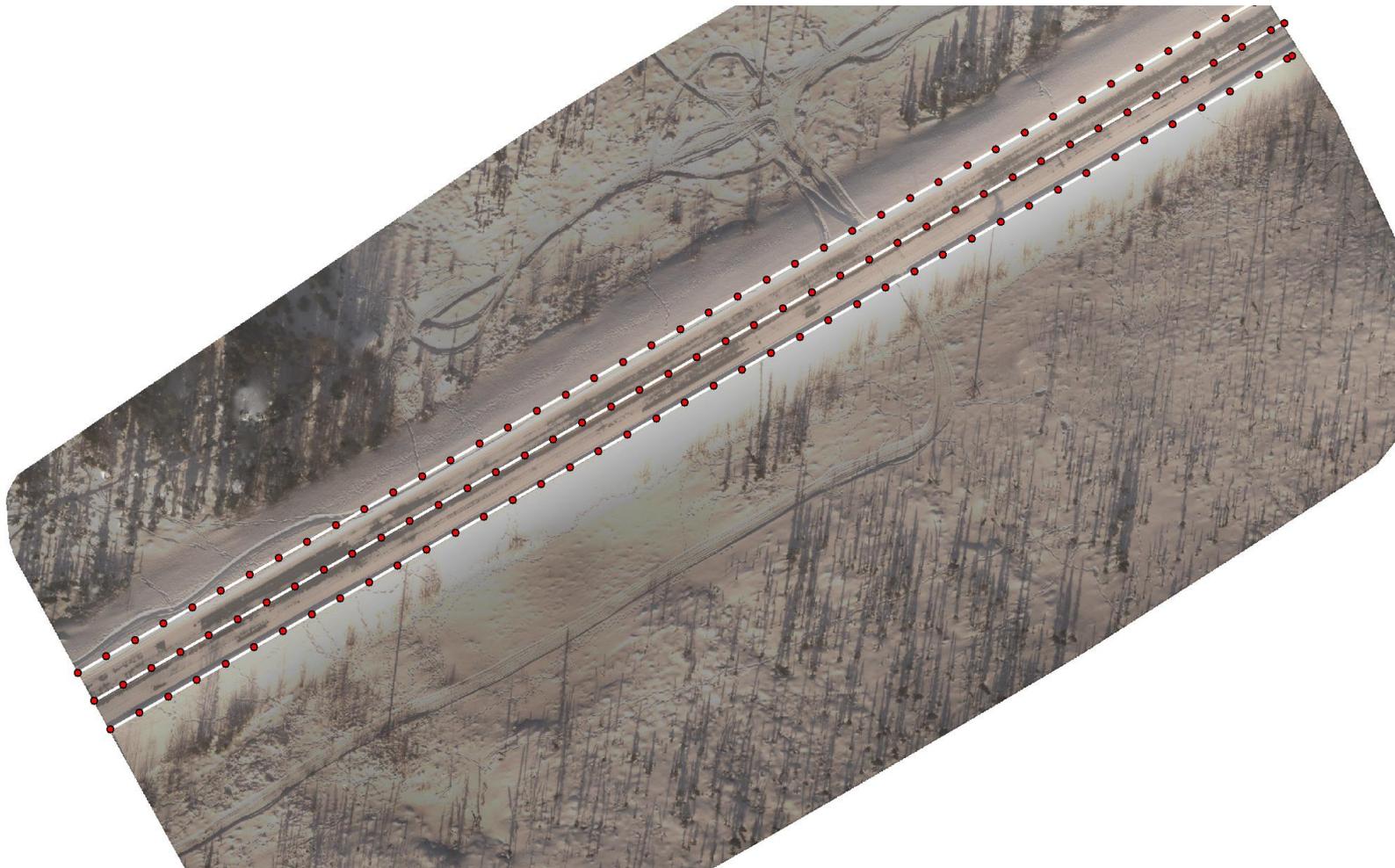


Bear Bite - SAREX

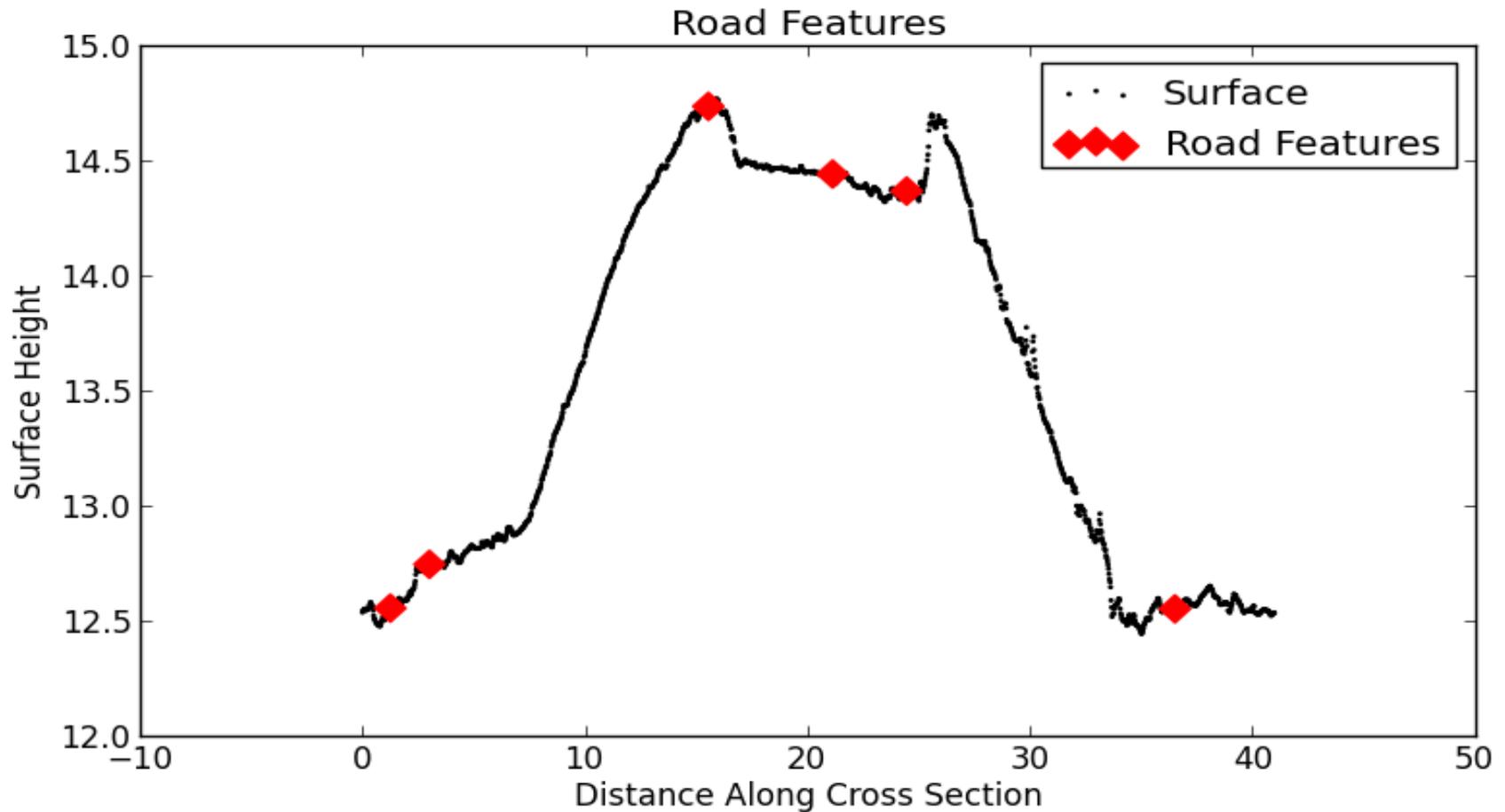
Mass Casualty Exercise 7-10 February 2013



Road Mapping (orthomosaic)



Feature Extraction with Neural Nets



Funny River Wildfire May/June 2014 Images



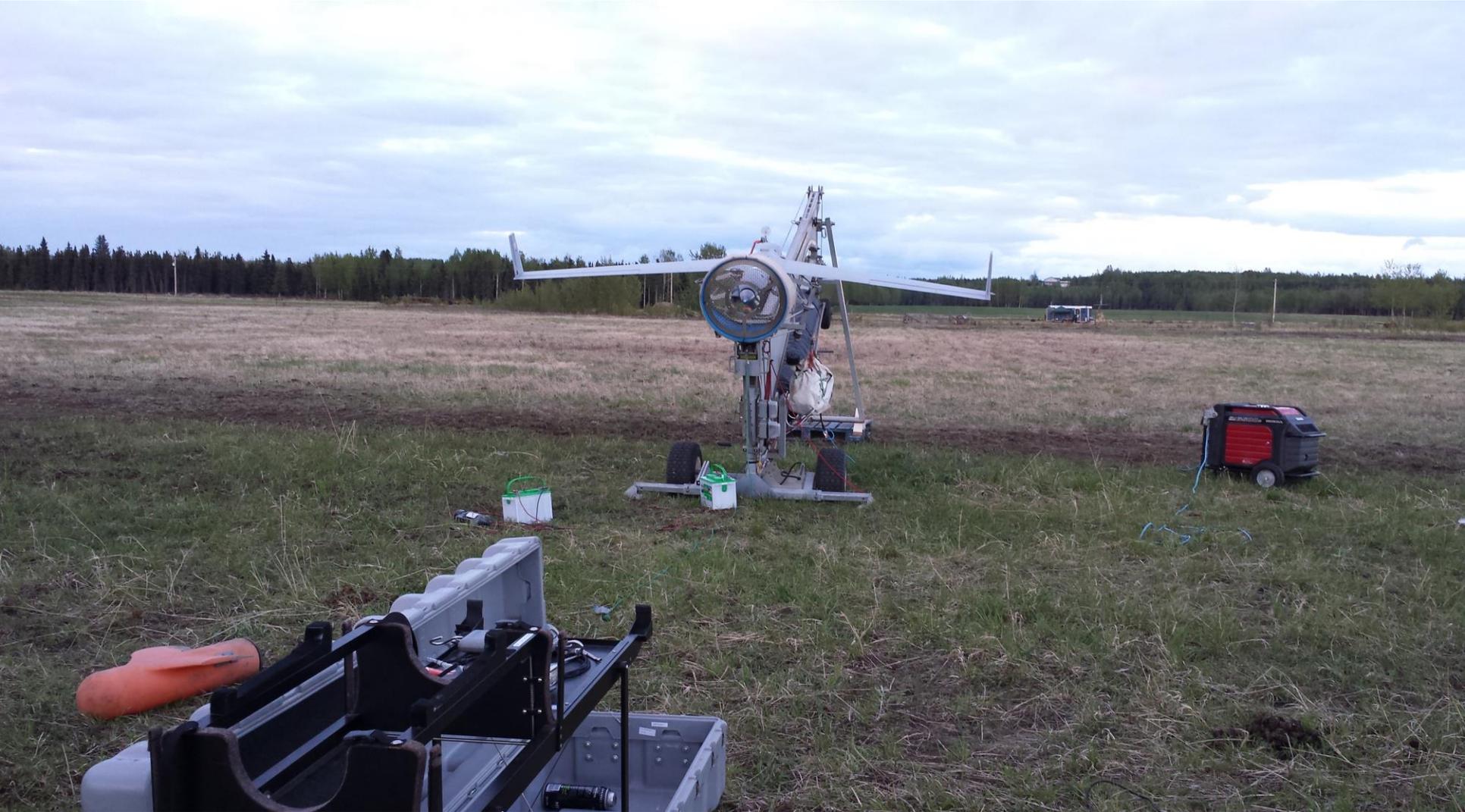
Funny River Wildfire May/June 2014 Images



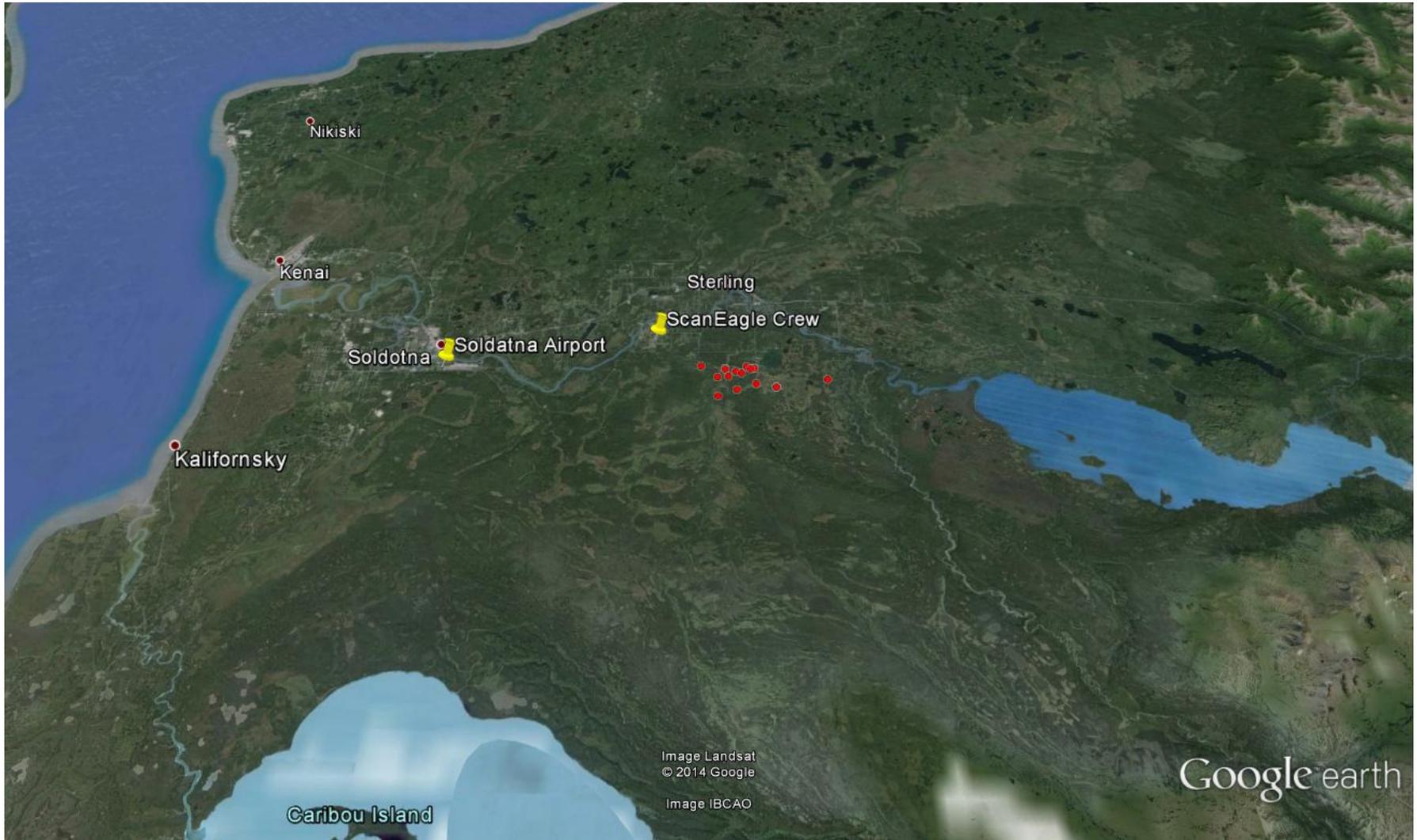
Funny River Wildfire May/June 2014 Images



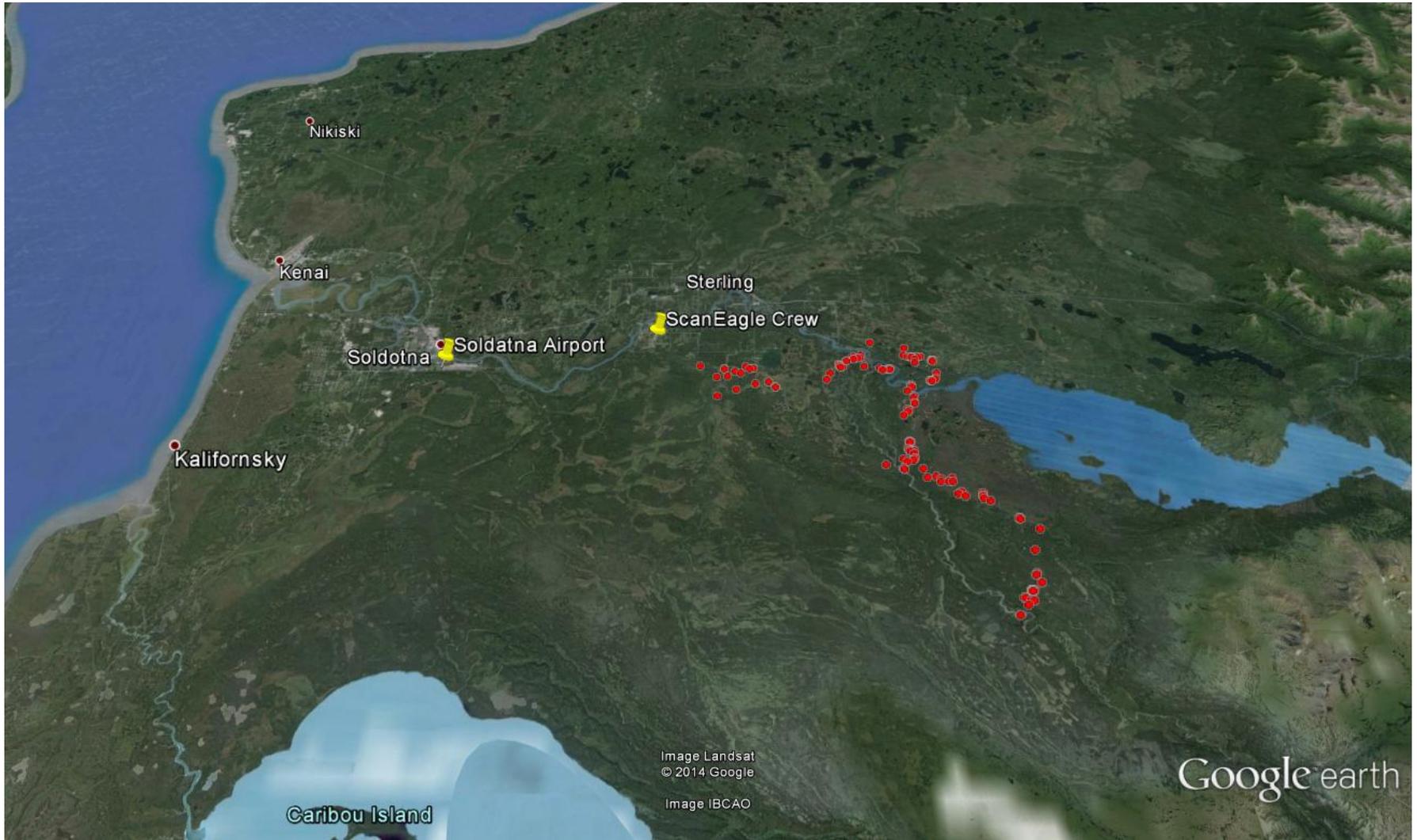
ScanEagle Just Before Launch



Funny River Wildfire Hotspot Data 30 May



Funny River Wildfire Hotspot Data 31 May



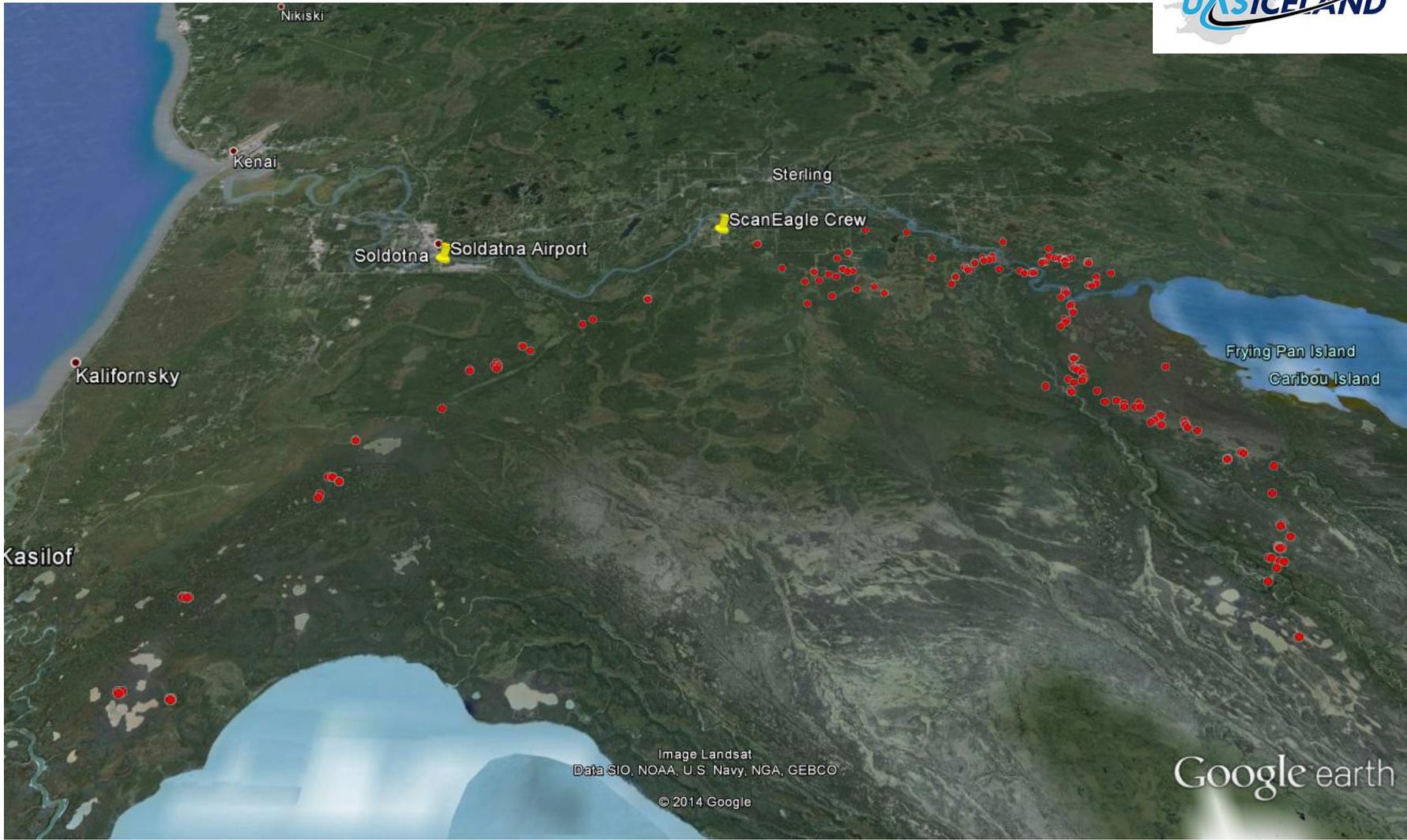


Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2014 Google

Google earth

Chukchi Sea Marine Mammal Research



Chukchi Sea Marine Mammal Research



Missions for 2014

- Vigilant Guard/Alaska Shield
- Iceland
- Test Missions for PPUTRC
- Sikuliaq Ice Trials
- Methane Emission Research
- Permafrost Research
- North Slope
- Marine Mammal Research
- Oil and Gas Infrastructure
- Sea Ice
- Invasive Species
- Airborne Ash and Particulates
- Moose, Caribou, and Dall Sheep Population Research

Pan Pacific UAS Test Range Complex (PPUTRC)



National and International Support



National and International Support



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National and International Support



Arctic UAS Nodes



Current Arctic Nodes

- Oliktok Point, Alaska
- Ny-Ålesund, Svalbard
- Tromsø, Norway
- Station Nord, Greenland

One Quarter of the Arctic is accessible through Greenland/Denmark/Norway



CryoWing UAS

CryoWing Micro (2012)

MTOW: 3-7 kg

Wingspan: 1.5-2.5m

Range: 30-100 km

Telemetry: UHF

Payload Capacity: 0.8-2 kg

Fuel: Li-Pol Battery

CryoCopter (2012)

MTOW: 6-7 kg

Range: 2 km

Telemetry: UHF and C-Band

Payload Capacity: 3 kg

Fuel : Li-Pol Battery

CryoWing Mk 1 (2007)

MTOW: 32 kg

Wingspan: 3.8 m

Range: 500 km

Telemetry:

3G/GSM Iridium, UHF

Payload Capacity: 10 kg

Fuel Capacity: 4.5 kg petrol

CryoWing Mk 2 (2012)

MTOW: 60 kg

Vingspenn : 5.2 m

Range: 2000 km

Telemetry:

3G/GSM, Iridium, UHF

Payload Capacity: 15 kg

Fuel Capacity: 15 kg petrol



Snowmobile tracks on tundra in Advent Valley



Assessing the Technology

University of Alaska Fairbanks and UAS Iceland

- 14 years experience flying UAS with FAA/CAA approvals
- Very experienced in Arctic UAS operations
- Broad experience nationally and internationally
- As members of the UAS Expert Group under Arctic Council, knowledgeable of world CAA rules
- UAS agnostic, focus is on mission, data, and payload.
- ICAO/FAA SMS Certificated UAS Staff Members
- Eight different fixed and rotary wing configurations (ScanEagle, Nanook, Scout, Ptarmigan, Stalker, Puma, Raven, & Aeromapper) New medium payload (8 lbs), medium endurance (3 hours) BLOS system in service within 6 months.

Summary

Considerations

- UAS adds possible options
- Cost; manned vs unmanned
- Complex FAA and ICAO airspace laws
 - National and Oceanic Laws differ worldwide
- UAS to perform the Dirty, Dull, Difficult and Dangerous





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