Navigating Sea Ice for the Nome Fuel Delivery:

University Engagement and Decision Support

Sponsored by the National Center for Island, Maritime, and Extreme Environment Security (CIMES)

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Background and Timeline

Nome fails to get fuel delivery by barge during fall ...
Ice-class tanker Renda chartered for wintertime fuel delivery
Plans laid for USCGC Healy to escort tanker through sea ice

- 12 DEC
  - Contacted by Alaska DEC regarding over-ice fuel delivery
  - Begin acquiring data to examine extent and stability of landfast ice near Nome
- 22 DEC
  - Contacted by NWS Ice Desk about a pressure ridge blocking entrance to harbor
- 23 DEC
  - Requested to by USCG to drill pressure ridge and analyze the conditions
- 3-4 JAN
  - UAF sea ice survey in Nome (Andy Mahoney & Josh Jones)
- 4 Jan
  - Requested by ADEC to deploy unmanned aircraft
- 8 – 16 JAN
  - UAF unmanned aircraft survey in Nome (Walker, Giessel, & Cherry)
- 14 JAN
  - Renda (Russian tanker) arrive with CGC Healy escort

Unmanned Aircraft Mission
Nome Winter 2012 Fuel Delivery

1. Identify potential safety concerns for those working on the ice
2. Document the site for mission response activity
3. Collect imagery for the USCG Public Affairs Officer (PAO) to disseminate
   - to help satisfy the press's interest in the activity
   - to alleviate the potential for independent activities on the ice

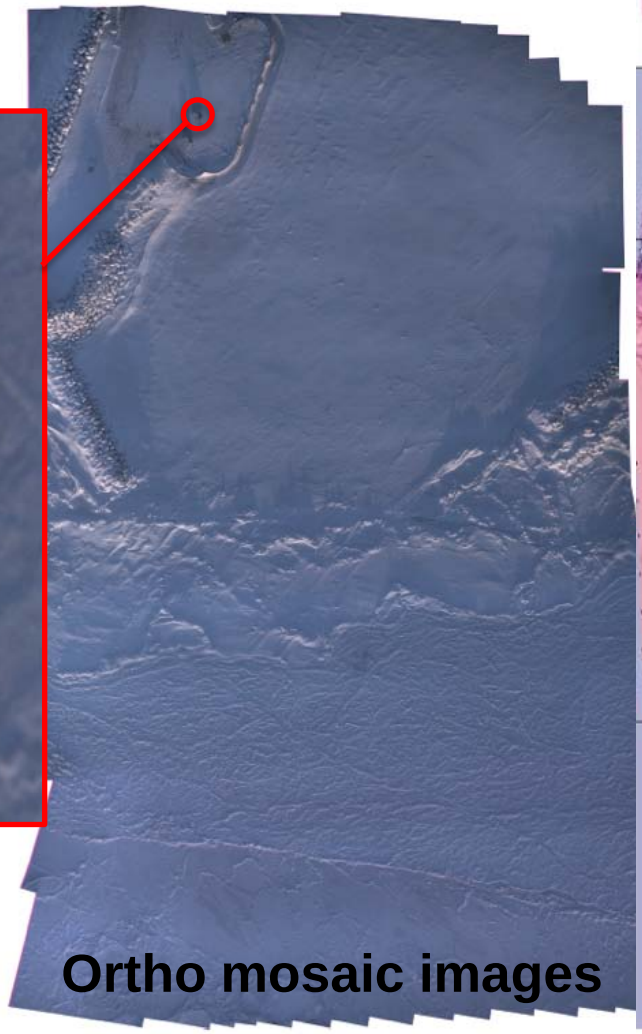
International Press Attention

UAF leased from BP Exploration (Alaska) Inc. the aircraft

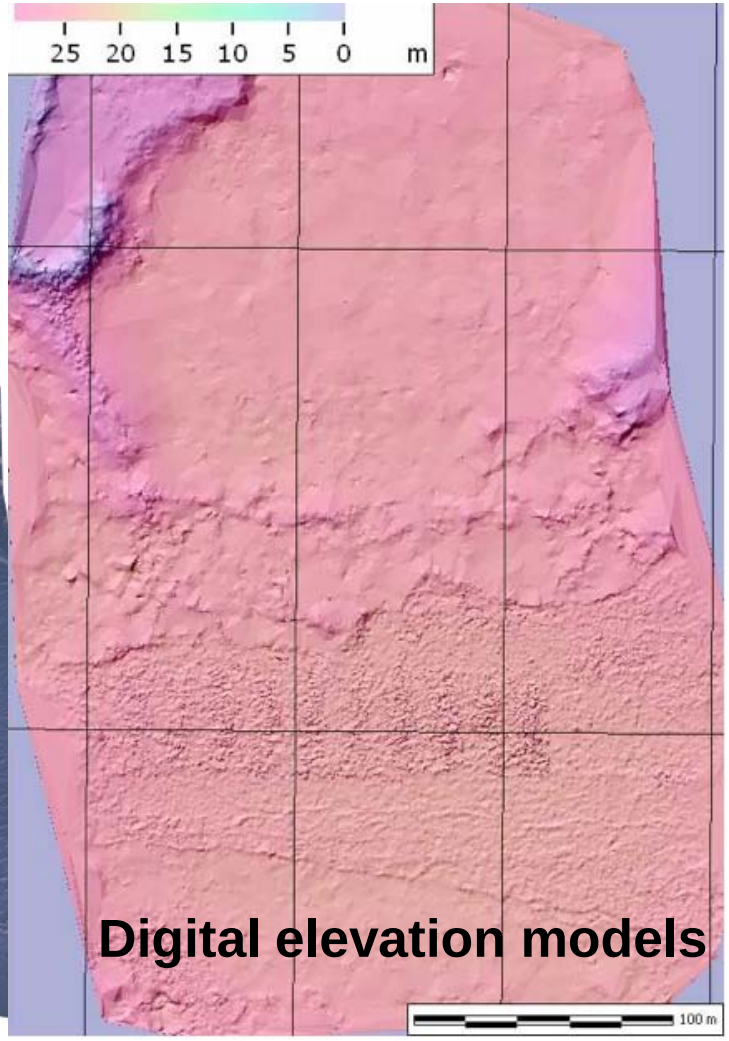
Flight Log

Date	Number of Flights	Number of Mapping images	Number of Surveillance images	Weather
January 9, 2012	6	0	60	Clear, -20F, 20 knot winds
January 10, 2012	4	48	5	Clear -20F, 15 knot winds
January 11, 2012	4	79	2	Clear -15F, 5 knot winds
January 12, 2012	4	144	30	Clear -25F, 5 knot winds
January 13, 2012	10	328	5	Clear -25F, 10 knot winds
January 14, 2012	9	0	58	High clouds, -5F, 25 knot winds
January 15, 2012	4	371	6	Low clouds, 0F, calm
Total	41	970	166	

Nome 2012 Imagery Products



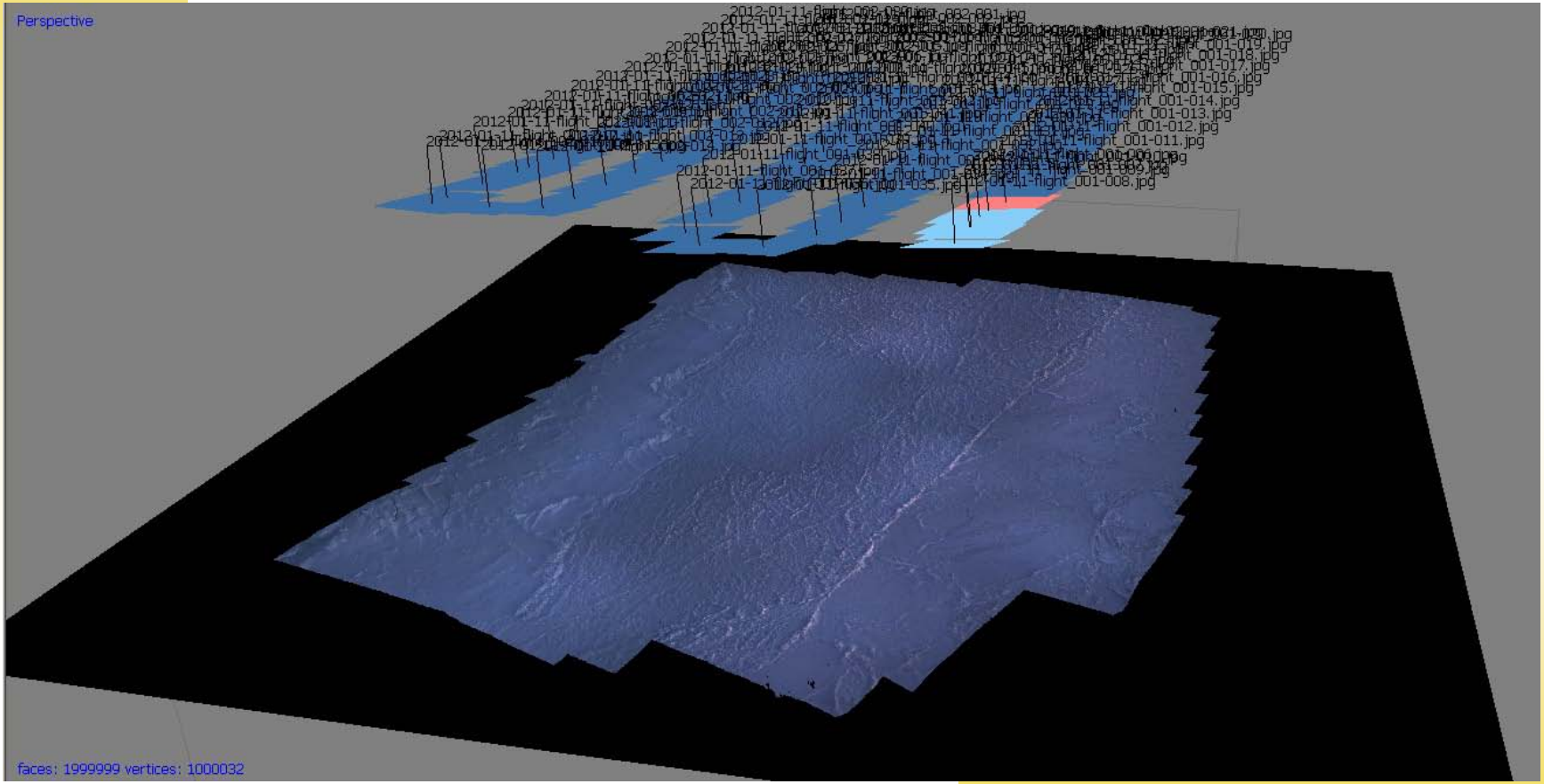
Ortho mosaic images



Digital elevation models

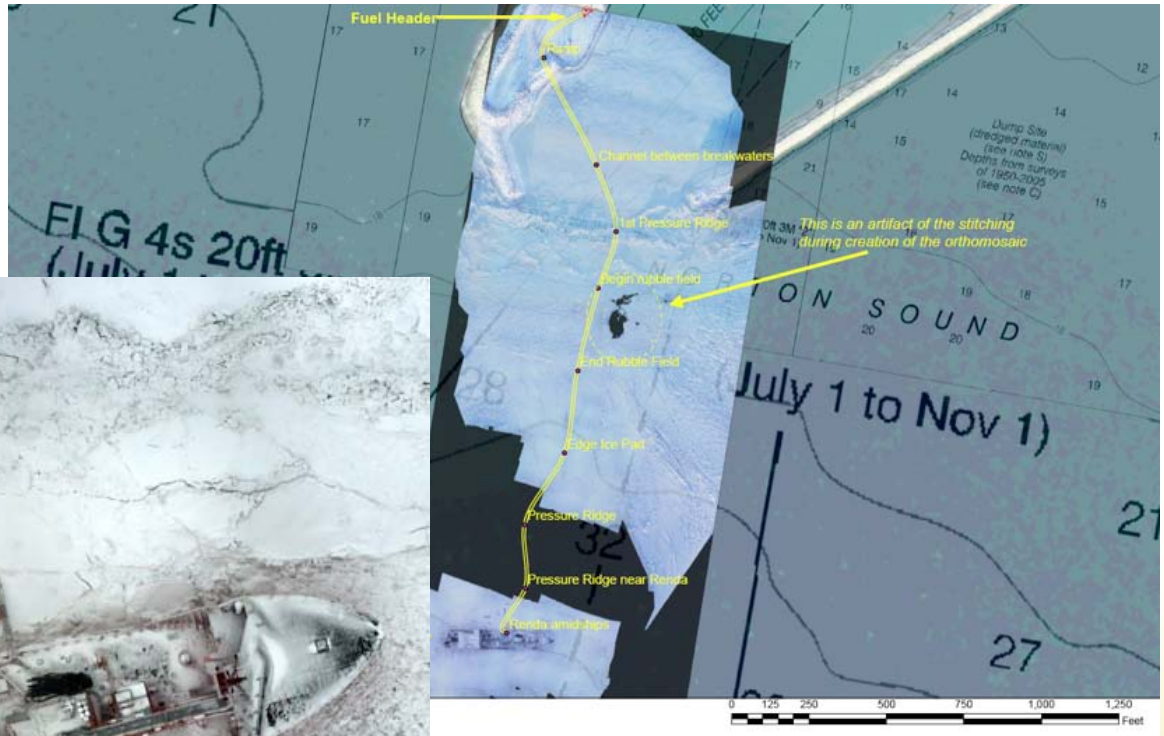
MOSAIC and DEM Development Processing From Image Only Data

Structure from Motion (SfM) Algorithm



Operational Overlays

Mark on ice where Renda was to locate headers



We Were Not "The Drone That Saved Nome"

It was a pleasure working with you. Thanks for your contributions to FOB Nome; the UAV piece of this mission was a key component to the overall success.

Commander Scott Johnson
Chief, Prevention Department
Coast Guard Sector Anchorage

This was a fantastic workout for the drone and provide some great site intel. Appreciate your joining us in Nome!

Mark L. Smith
CEO Vitus Marine LLC
Anchorage, AK

This is fantastic. Thank you for the superb effort. It certainly indicates the importance and high level of usefulness of UAVs for Arctic endeavors including within the response partnership that UAF and NOAA have entered.

John Whitney
NOAA Science Support Coordinator for Alaska
Anchorage, AK

The stills for that first mosaic attempt are amazing…

This still looks great and is very useful…

Great working with you and your team, hope to do it again soon.

John W. Engles
Environmental Program Specialist III *State of Alaska*
Dept. of Environmental Conservation
Prevention and Emergency Response Program
Valdez AK

Other positive comments from FAA leadership

Les Smith
Division Manager, AFS-400
Federal Aviation Administration

Dennis E. Roberts, Director
ATO Airspace Services, AJV-1

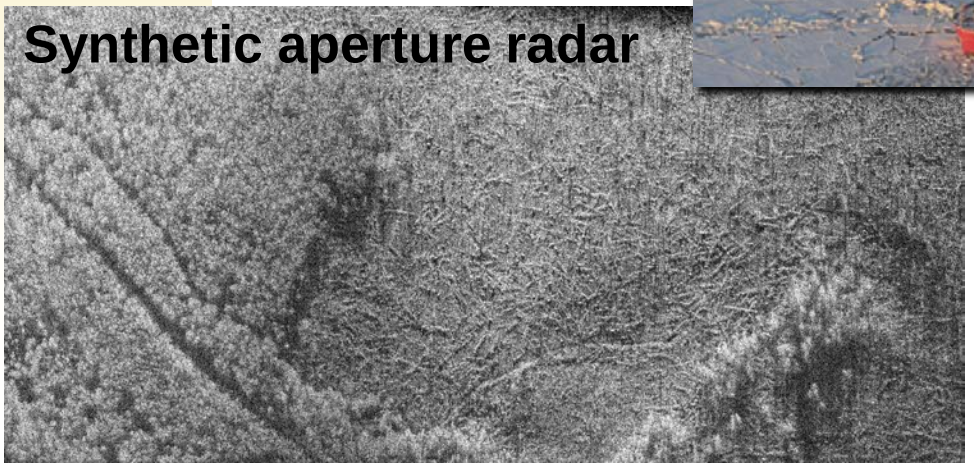
Improvement of Space-Based Sea Ice Retrievals

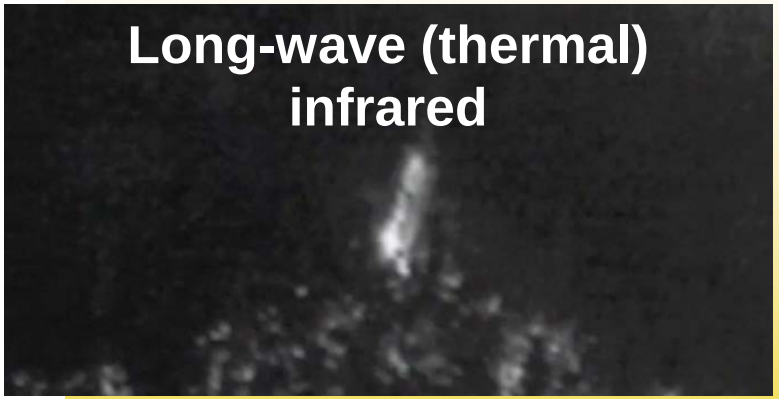
With Low-Altitude *in-situ* Observations

- Fly ScanEagle from the USCGC Healy during a late-summer cruise in the high Arctic
  - Goal: Work with USCG on process to integrate small UAS on a cutter
- Collect imagery to validate and investigate ways to improve satellite retrieval algorithms
  - Goal: Improve satellite images data products
- Evaluate improvement in icebreaker pilot's situational awareness when in ice
  - Goal: Improve navigation speed, reduce damage risk, reduce maintenance, extend equipment life, and improve fuel consumption

Ship Based Sea Ice Aerial Studies

- Dedicated Ship Ice Piloting
- Satellite Imagery Improvement
- Sea Ice Studies





Roles/Responsibilities

Investigative Team Leads

- Gregory Walker - UAF
  - Lead the ship integration efforts and the UAS ship deployment
- John Walsh - UAF
  - Evaluate the consequences of the corrections to the satellite imagery
- Lawson Brigham - UAF
  - Develop metrics to evaluate the enhancements for navigating sea ice
- Larry Mayer - UNH
  - As Principal Investigator for the scientific cruise of the CGC Healy
  - Coordinate opportunities to fly the missions needed
- Walter Meier - UCB
  - Compare the airborne imagery with space imagery and identify methods to improve the interpretive quality

Relevant Maritime UAS Experience

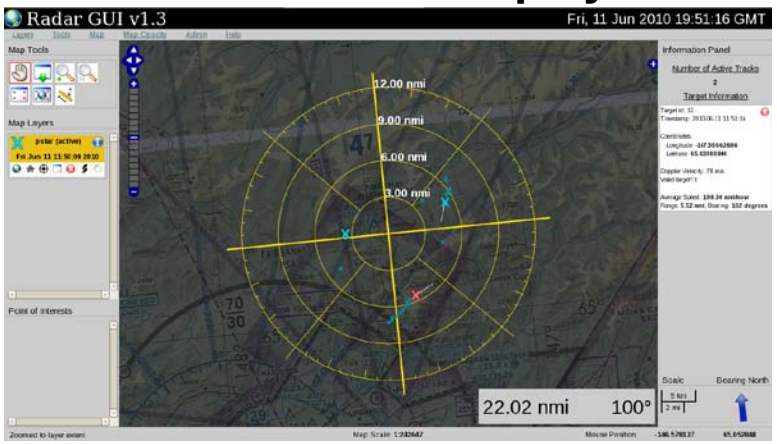
The UAF Portable Airspace Surveillance System

Enhancing situational awareness during aircraft or spacecraft operations:

Provides real-time position and track data on local airspace activity to assist in traffic avoidance

Status: Operational, approved use in Canada and NASA Certified

Web-Based Display



Primary RADAR (2D and 3D)
Cooperative Target Interrogation

This system could be integrated into an unmanned aircraft operation to provide an acceptable technical “sense-and-avoid” technology suitable for compliance with CFR 91.113 “see-and-avoid”

2012 FAA Authorization

Unmanned Aircraft Language

1) Develop a Comprehensive Integration Plan within 9 months of passage
2) Sets a 9/30/2015 deadline for integration
3) Requires a 5-year roadmap (updated annually)
4) Requires a small UAS Final rule within approximately two years
5) **Requires 6 UAS test sites (the test site language is identical to the already-passed defense bill language)**
6) **Requires within one year, a process for flying in the U.S. Arctic, 24 hours a day, and beyond line-of-sight (to at least 2,000 feet AGL)**
7) **Expedited access for public UAS use**
8) **Requires with 90 days, public users of aircraft weighing less than 4.4 lbs to get a one-time COA approval of similar operations.**
9) Includes an exemption for Model Aircraft. It prohibits the FAA from promulgating a rule on modelers if they fly for recreation and use community-based set of safety standards, and fly models less than 55lbs.
10) **Requires to FAA to study UAS human factors.**

Questions/Comments