Uncrewed Aerial Systems Support of the Arctic Operator

Using UAS to Validate and Visualize Alaskan Geographic Response Strategies

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Land Acknowledgement

My home and office are located on the traditional land of the *Lower Tanana Dene* people in an area that is now known as Fairbanks, Alaska.

Geographic Response Strategy (GRS)

GRSs are pre-approved response equipment deployment strategies for specific geographic locations that first responders use to immediately prevent and/or mitigate environmental damage following a spill.

- **Developed in early 2000s as PDFs**
- **Limited validation by stakeholders**
- **Converted to GIS by SofAK and USCG 2021-2022**

Geographic Response Strategy (GRS) Validation and Visualization

- Objectives
- Data Collection
- Data Processing
- Archive and Visualization
- What's next

GRS Validation and Visualization:

Objectives

1. Validate GRS in Alaska using UAS observational flights and GRS Field App
2. Visualize results in online interfaces – SofAK and NOAA

- 2D map GRS sites with UAS
  - electrooptical sensor (i.e. RGB digital camera)
  - Commercial-off-the-shelf-technology (COTS)
- Leverage GRS Field App
  - Validate GRS tactical recommendations in Ipad app
- Create GIS-consumable data for incorporation into SofAK and NOAA archive & visualization interfaces
  - Raw data formats
  - Orthomosaics
- Integrate approved validations into GRS online interfaces (SofAK and NOAA)

GRS Validation and Visualization:
Data Collection

Collaborative effort to validate GRS sites across Alaska

- **University of Alaska Fairbanks** (UAF), *International Arctic Research Center (IARC)*
- **Native Village of Unalakleet** (NVU)
- **United States Coast Guard** (USCG), *Sector ANC*
- **National Oceanic and Atmospheric Administration** (NOAA), *Office of Response and Restoration (ORR)*
- **Alaska Department of Environmental Conservation** (ADEC), *Spill Prevention and Response (SPAR)*

GRS Evaluation Team at Kalsin Bay, Kodiak, Alaska, 2021. Image credit: ADEC

GRS Validation and Visualization:
Data Collection

- Validated all road-accessible GRS sites on Kodiak Island (2021)
  - Seven GRS sites flown with UAS (UAF IARC)
  - Digital updates via GRS Field App
- Validated key road-accessible GRS sites on Seward Peninsula (2022)
  - Five GRS sites flown with UAS (UAF IARC and NVU)
  - Digital updates via GRS Field App

GRS sites validated on Seward Peninsula August, 2022.

NOTE: All GRS sites were validated through a combination of UAS data, boots-on-ground surveys, marine vessel-based surveys and information updated in the GRS Field App.

GRS Validation and Visualization:
Data Collection *NVU and IARC UAS Team*

- **Native Village of Unalakleet (NVU)** UAS inspection team developed under DHS funding from ADAC (2020-2022)
- Trained to fly UAS by UAF's **International Arctic Research Center (IARC)** for
  - Bulk fuel facility/infrastructure inspection
  - Flood delineation
  - Oil spill detection and monitoring
  - Search and Rescue support
- Trained to process 2D and 3D data as orthomosaics and models in DroneDeploy
- Contracted by USCG via UAF to fly GRS 2022 validations

NVU and IARC UAS team November 2021. Photo courtesy of J. Garron

GRS Validation and Visualization:

Data Collection

Skydio

Designed, assembled and supported in the USA

2D scan for linear and area mapping

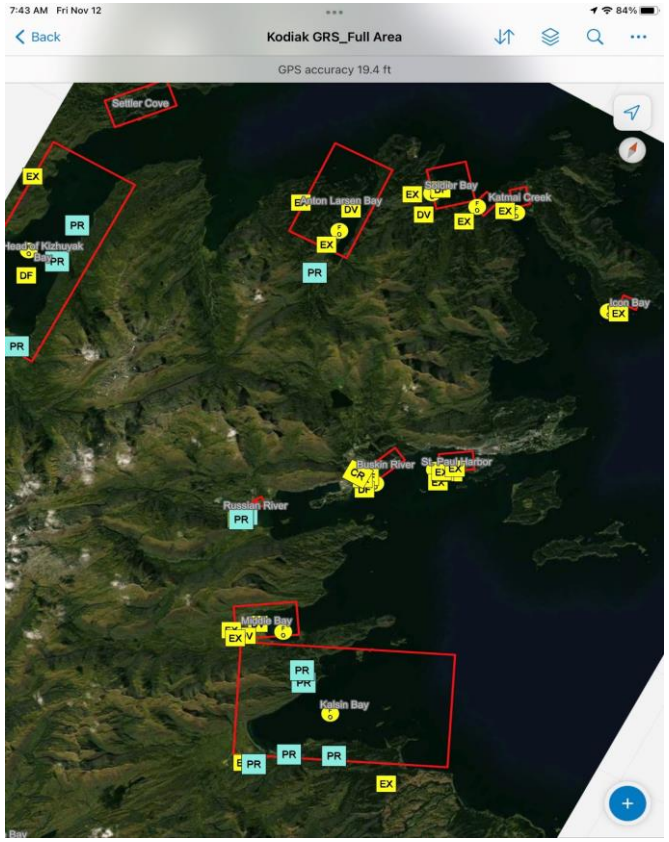
3D scan for infrastructure inspections

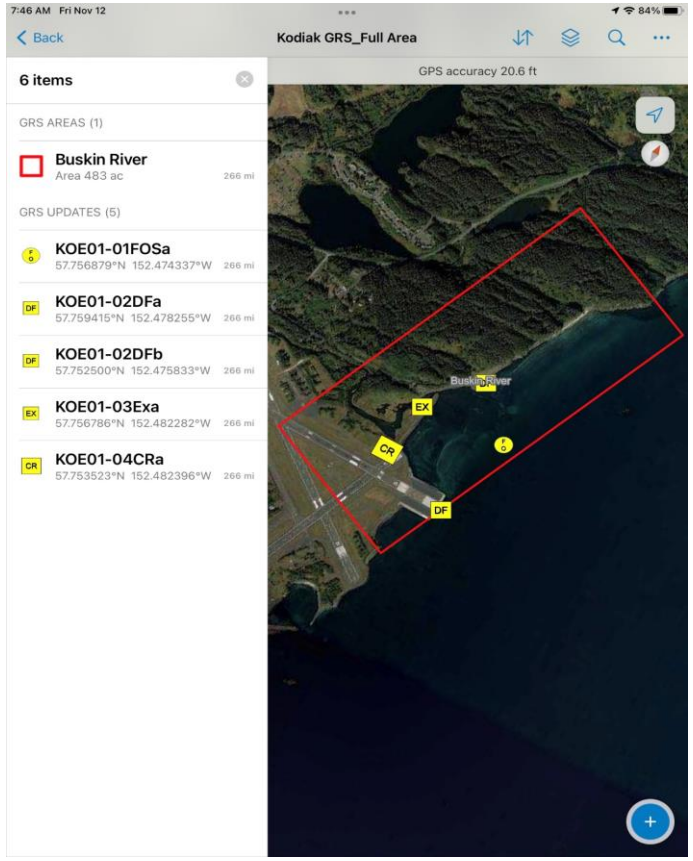
360° obstacle avoidance via AI powered autonomy

- **S2** – Training/operational aircraft with electro-optical (RGB) sensor
- **X2E** - Operational aircraft with electro-optical and longwave infrared (thermal) sensors

The Skydio Fleet - X2E with electro-optical and infrared sensors, X2E with electro-optical sensor, S2 with electro-optical sensor. Photo c/o R. Marlowe, AKDOT.

GRS Validation and Visualization:
Data Collection





Screenshots of GRS Collector App on an Ipad. Images c/ of Catherine Berg, NOAA OR&R

GRS Field App

-Visualization of GRS for area

-Supports editing in the field

-Upload of approved and validated information into GIS (SofAK and ERMA)

GRS Validation and Visualization:
Data Processing

- Orthomosaic Creation (UAF IARC & NVU)
  - Pix4DMapper and DroneDeploy
    - GeoTIFF and Shape files

- GRS Field App Updates (NOAA ORR)
  - GRS sites with tactical recommendations loaded on field Ipad
  - Boots-on-ground tactical validation on Ipad
  - Upload approved validation to GRS GIS layer

GRS Validation and Visualization:

Archive and Visualization

Version October 2022

UAS Data Collection
- *-Skydio X2E*
- -RGB and thermal images and video

Orthomosaic Creation
- *-DroneDeploy & Pix4DMapper*

GRS Site Validation Support
- -Integrate approved GRS Collector App validation results
- -Integrate approved validated hard copy GRS updates (backlog)

Archive

Open Data Geoportal

Orthomosaic & GRS Tactical Visualization

ERMA®

DIVER Explorer

Archive

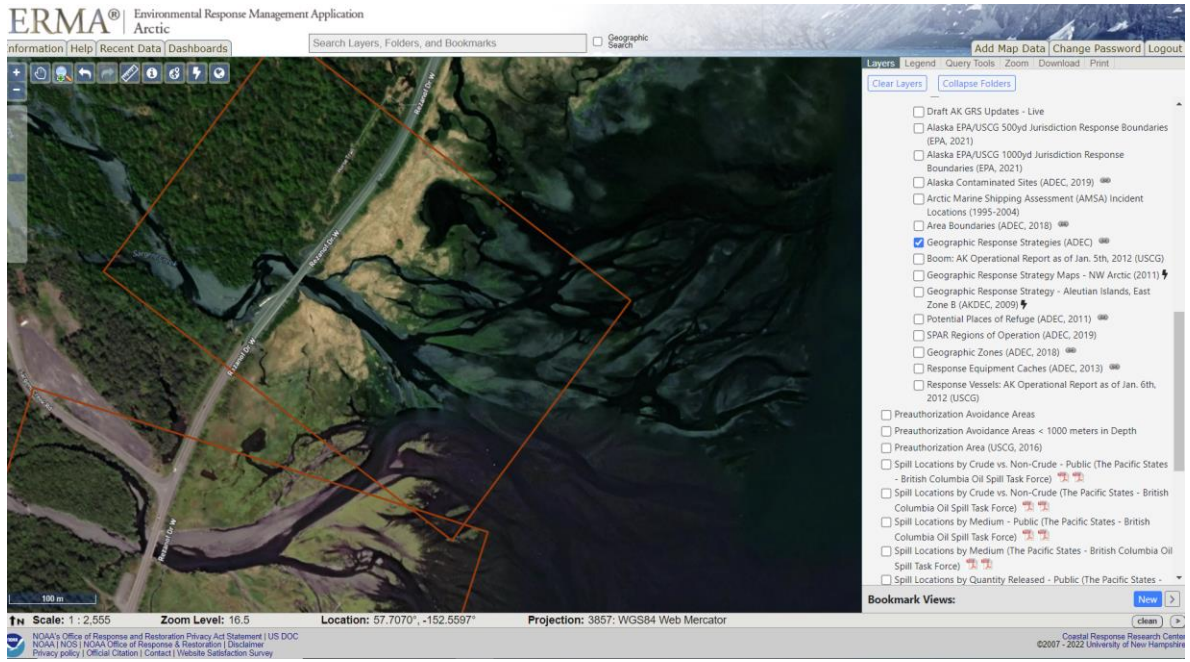
GRS End Users

Operators

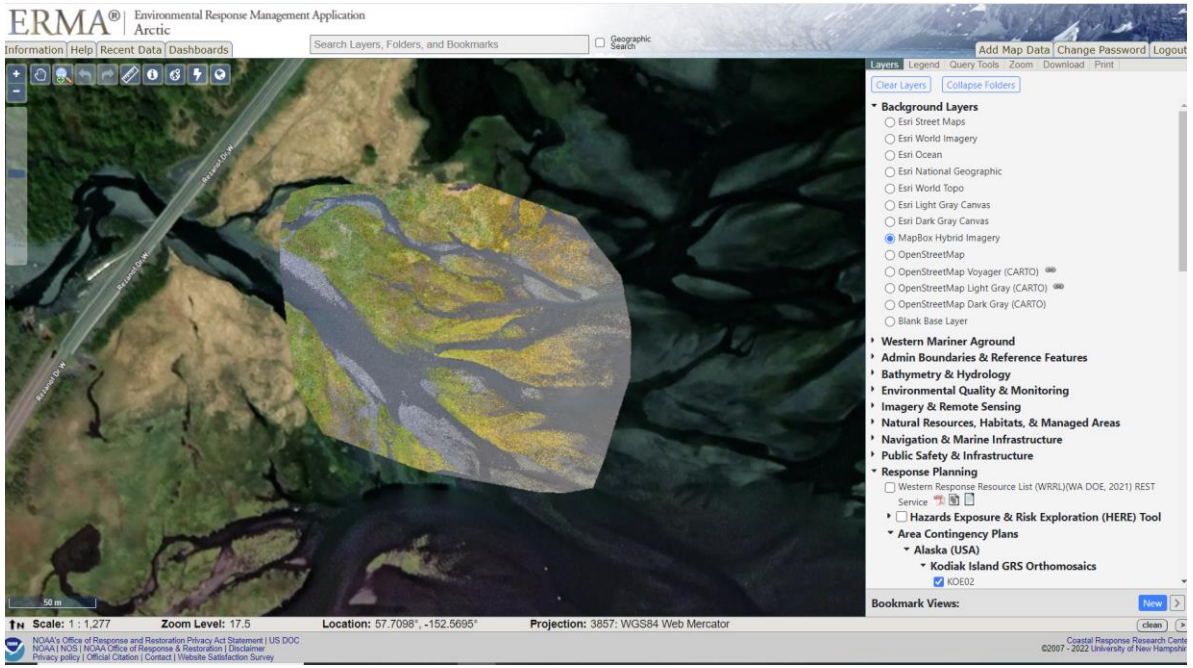
Planners

UAS GRS Validation Support: **Archive and Visualization**

NOAA Arctic ERMA CURRENT



NOAA Arctic ERMA BETA



Typhoon Merbok

Norton Sound, Alaska
September 17, 2022

- 35 Alaska Native communities along Bering Strait and Yukon-Kuskokwim Delta impacted
- Flooding, fuel spills, water source contamination, homes/camps/connexes washed away, **COASTAL EROSION**
- GRS validations provided pre-storm high resolution data for pre- and post-storm assessments
  - UAF, NVU & USCG 1° UAS assessments
  - UAF, AVCP & FEMA 2° UAS assessments

GRS Validation and Visualization:
Leveraging Assets and Partners During a Response

- Contracted NVU and AVCP through UAF for UAS collections
- Applied GRS UAS protocols for response and recovery assessments
- Collected imagery of 15 storm impacted communities*
- Identified consumable data formats for multiple end users
- Leveraged prototypical state and federal data delivery pathways
- Identified lessons learned for UAS applications during, 1) response and 2) recovery efforts

***UAF/NVU/AVCP UAS team only UAS team performing community assessments until mid-October**

GRS Validation and Visualization: **What's Next?**

- Continue integration of UAS-based Orthomosaics into GRS Field App
- Codify long-term raw data delivery & storage to AK Geospatial Office
- Revision of UAS collection, processing, archiving protocol for GRS sites in Alaska
- Train USCG team to fly UAS for GRS validation and inspection support
- Edit and update GRS GIS layer with SofAK and NOAA
- Exercise and implement protocol in 2023

Golovin, AK post-Merbok UAS assessment.

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Questions?
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