Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR)

DOI Users Group
June 2016

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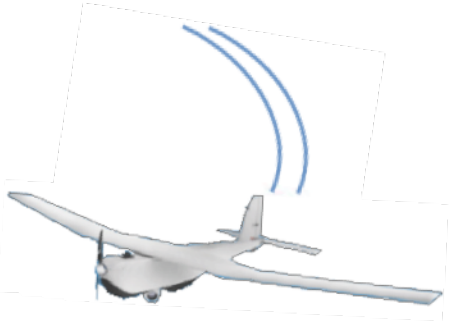
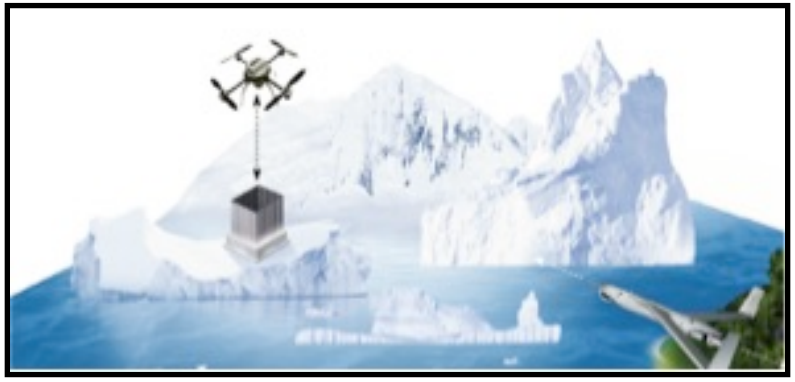


Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR)

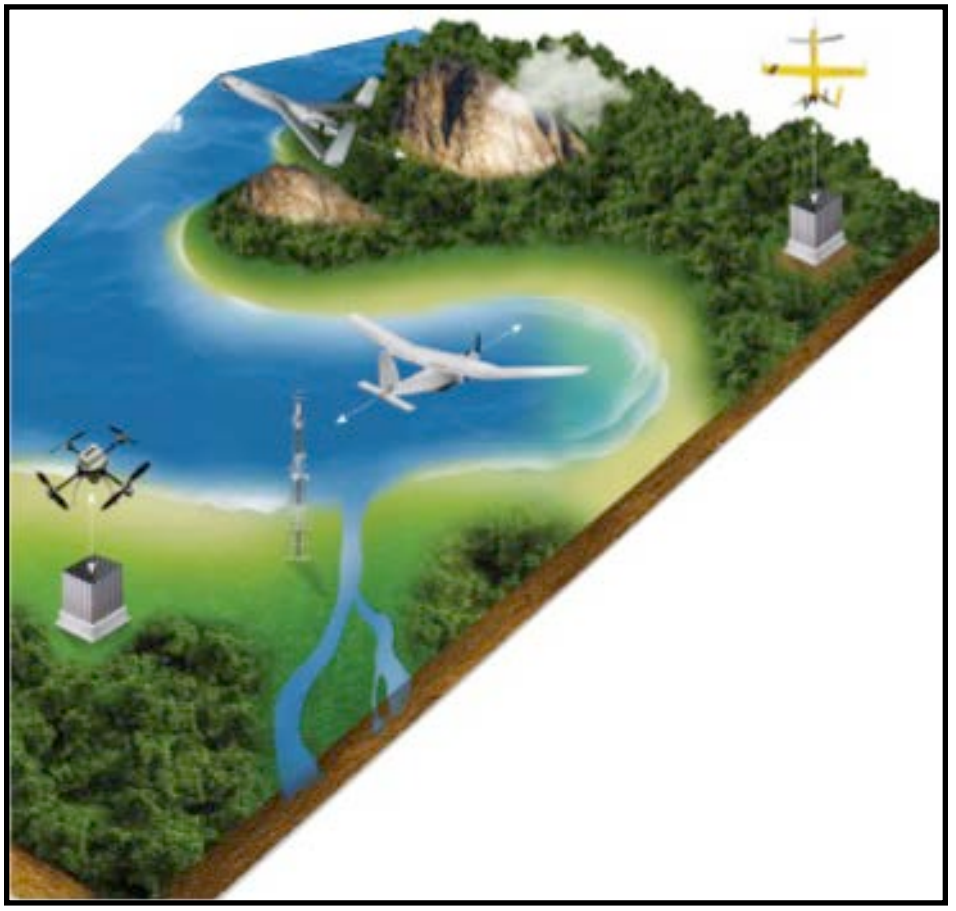
Deployable over a wide range of different regions

Every emergency starts as a local one!



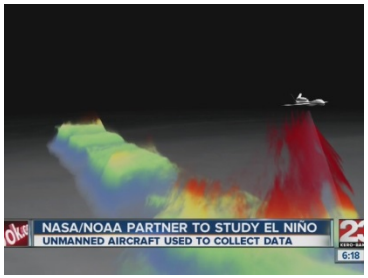
Polar

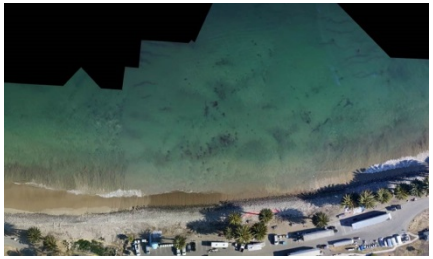
Marine



Inland and Coastal

UAS for Rapid Response





Data Product Complexity/ Potential Benefit

Time

Take off

Photos/
Full Motion Video

Orthomosaic

3D Digital Surface Model
(Hours--~1 Day)

Lidar/
Hyperspectral

Potential to soon provide all of this in "real time"…

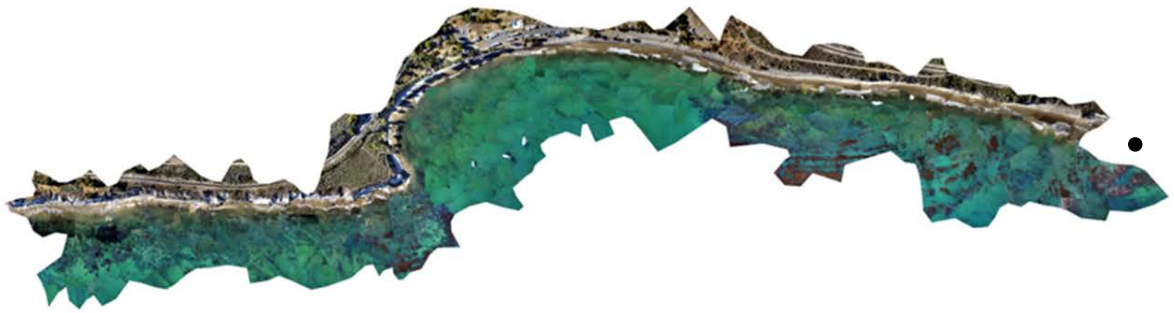
Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR) - Polar

Operation Arctic Shield 2013-15

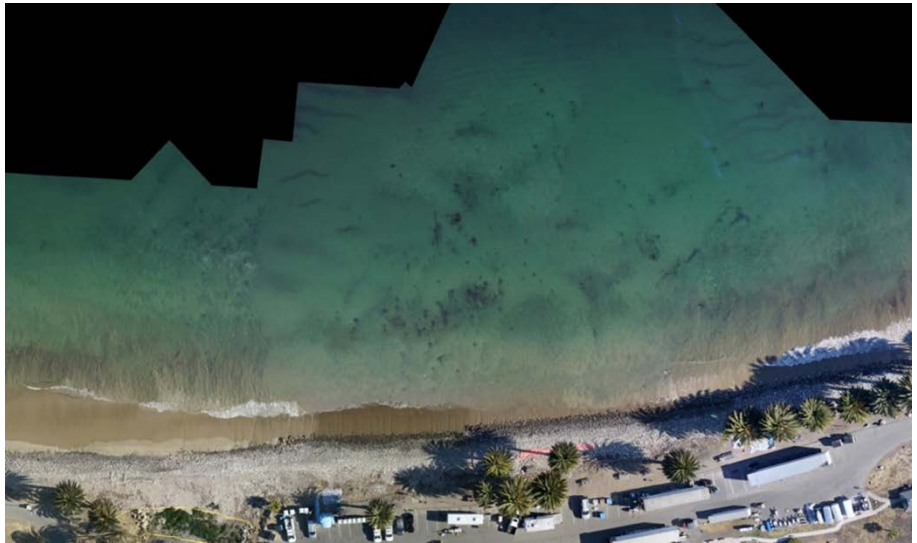
- **Collected high-resolution data for ice mapping, oil spills and SAR**
- **Common Operating Picture**
  - ✓ **Data ingested into ERMA**
- **Real-time data distribution**
  - ✓ **Ship-wide**
  - ✓ **Off-ship smartphone**
  - ✓ **Manned-Unmanned Teaming**

Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR) - Marine

Refugio Oil Spill – May 2015



- Collected high-resolution data from shore
- Produced stitched ortho-rectified image of Refugio bay at 2.5 cm per pixel.
- Data ingested into ERMA



Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR) - Inland

Hazardous Weather Events – Dec 2015

Charleston, SC

•The NWS Eastern Region UAS Team (ERUT) was established during the spring of 2015 to investigate the possibility of using Unmanned Aerial Systems (UAS's) to enhance post-storm damage assessments with localized aerial imagery. Teaming with the NOAA UAS Program and local Emergency Management Teams (EMT), they have recently been able to exercise the Rapid Response (RR) component of Targeted Autonomous Insitu Sensing and Rapid Response (TAISRR) with UAS concept of operations.

•On December 24th, aerial imagery from a UAS platform was provided by a local UAS operator (SkyView Aerial Solutions) to the Berkeley County EMT and NWS Charleston, SC. The information was used to properly identify weak "tornado damage" that would have otherwise been classified as "straight-line wind damage", had it been based on ground surveys, alone. SkyView provided Full Motion Video and Electro-Optical Imagery (see below) which included a mosaiced image that shows fire damage to a barn and wind damage to the field. The data was used in the NWS report below. The overhead imagery was instrumental in correctly classifying the damage as tornadic.

Imagery provided courtesy of SkyView Aerial Solutions

Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR) - Inland

Wildfire – Feb 2016

Grand Bay National Estuarine Research Reserve, MS

- **Over the past year, the Grand Bay National Estuarine Research Reserve (GBNERR) has partnered with NOAA's Northern Gulf Institute (NGI) and the Geosystems Research Institute (GRI) at Mississippi State University to utilize Unmanned Aircraft Systems (UAS) for a variety of missions. These missions include: high resolution vegetation mapping along GBNERR Sentinel Site research infrastructure, monitoring a simulated disaster response exercise, and mapping the extent of a marsh wildfire. These missions were possible through the support of the NOAA UAS Program Office and the NERR UAS working group.**
- **The most recent mission was flown in response to a wildfire that burned from February 11, 2016 to February 18, 2016 across 4,246 acres of marsh and upland habitat within the Grand Bay National Estuarine Research Reserve, Grand Bay National Wildlife Refuge, and adjacent lands. GBNERR wanted to obtain imagery of the fire for the purposes of mapping the effected marsh/upland habitats and analyzing vegetation regeneration. Efficient coordination between GBNERR, NGI, and GRI at MSU allowed for a mission to be coordinated quickly, funding identified, and the flight vetted through the U.S. Fish and Wildlife Service. On February 25 and 26, an Altavian Nova Block III was flown over the wildfire carrying a Micasense RedEdge payload.**
- **Imagery from: Northern Gulf Institute (NGI)**

Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR) - Inland

Hazardous Weather Events – Feb 2016

Appomattox, VA

Rapid Response / Storm Damage Assessment

UAS-based aerial imagery of storm damage from 26 Feb 2016 near Appomattox County, VA.

The UAS camera was able to see deep into areas of tangled debris not safely accessible from the ground. Good for determining damage extent, but also good for Search and Rescue efforts.

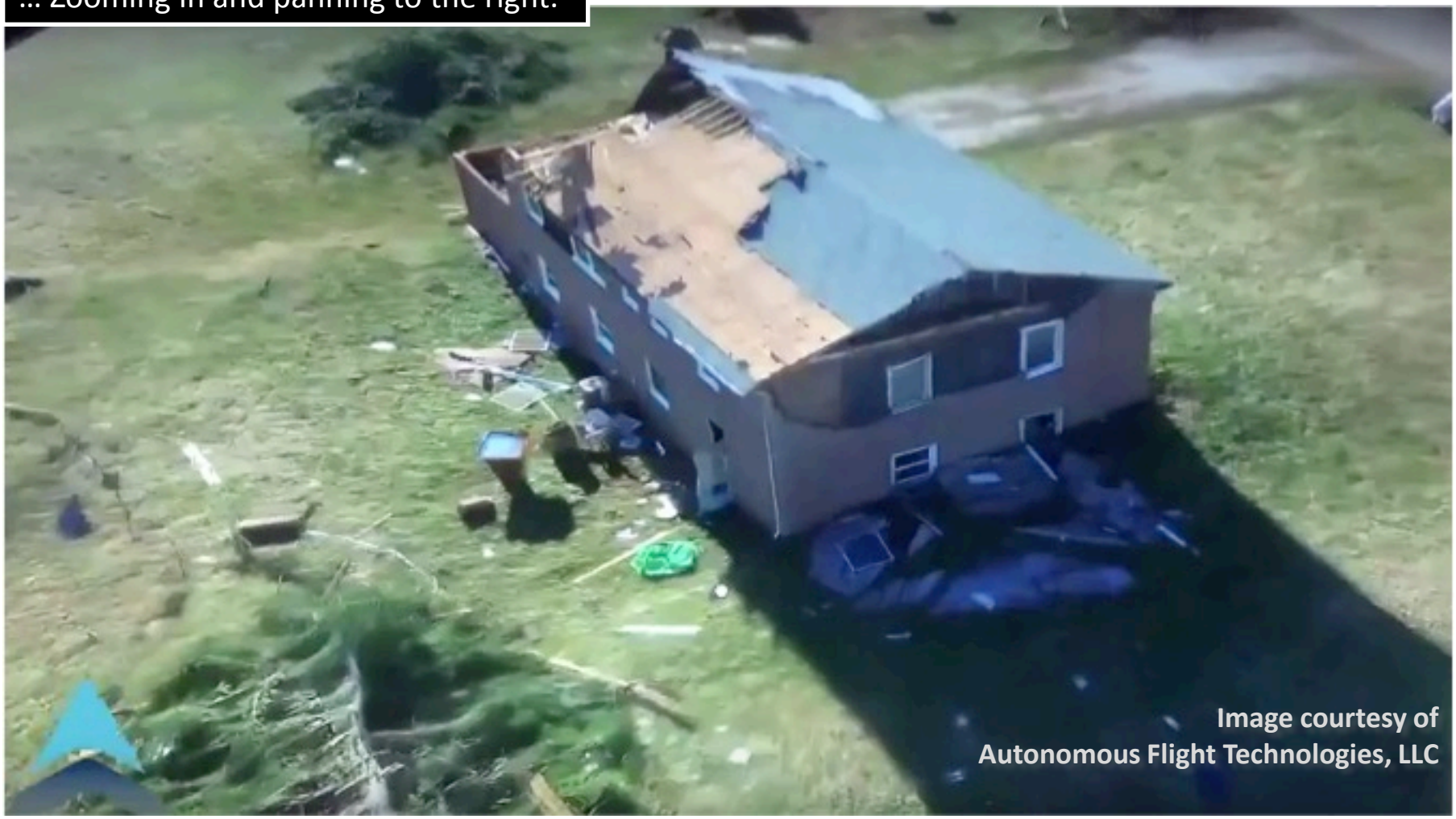
Imagery provided courtesy of "Autonomous Flight Technologies, LLC".

Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR) - Inland

Hazardous Weather Events – Feb 2016

Appomattox, VA

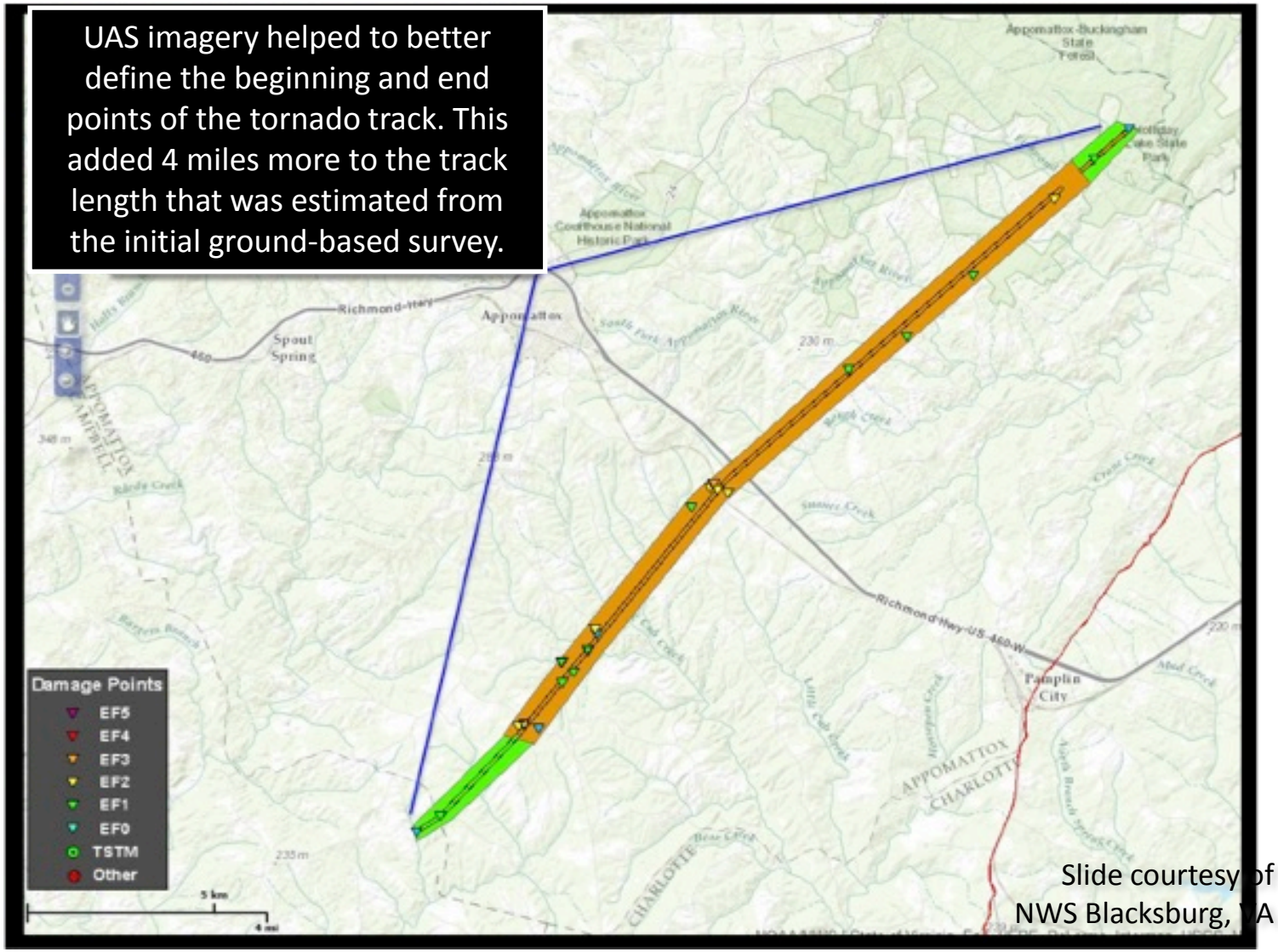
… Zooming in and panning to the right.



Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR) - Inland

Hazardous Weather Events – Feb 2016

Appomattox, VA



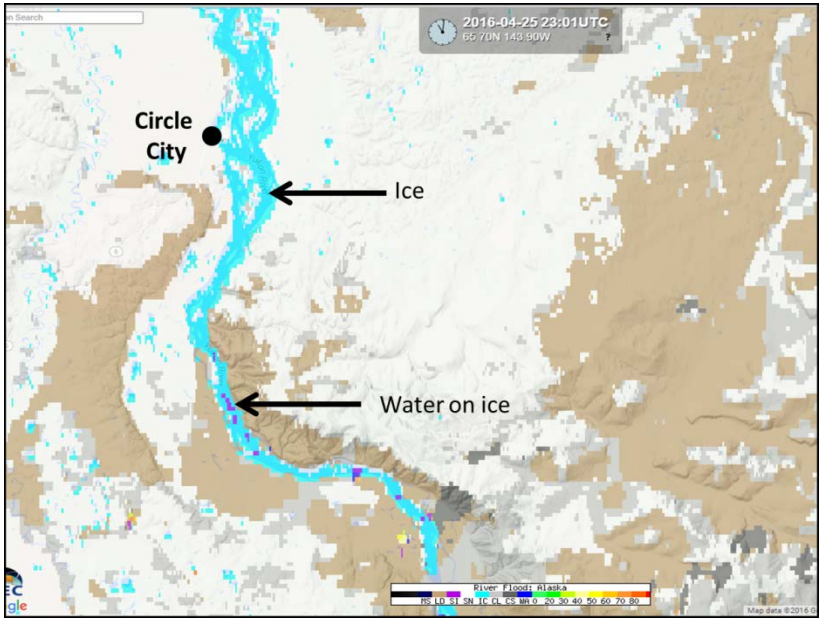
Slide courtesy of NWS Blacksburg, VA

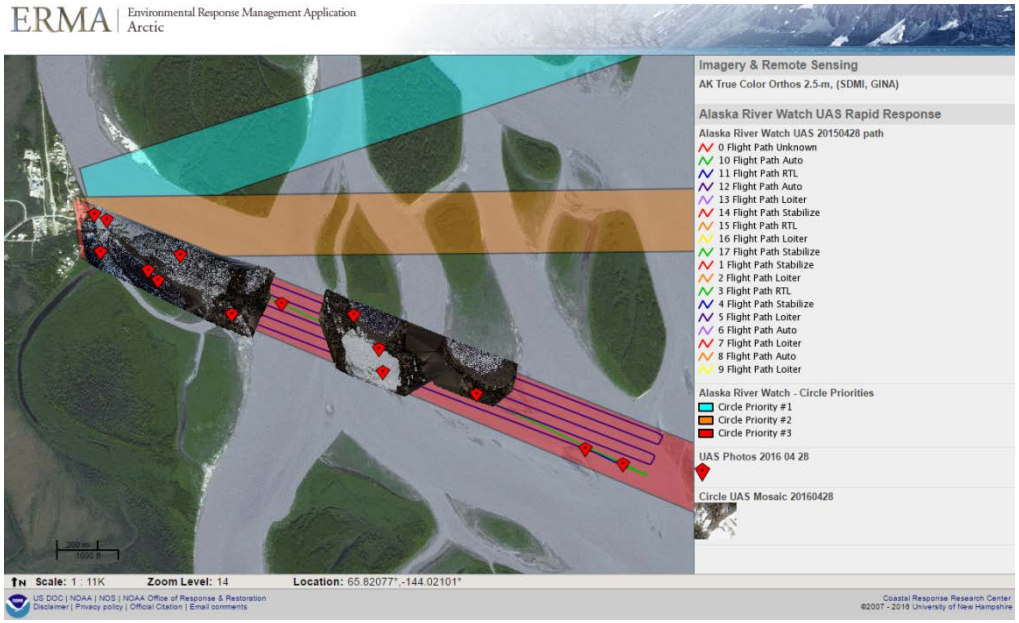
Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR) - Inland

Hazardous Weather Events – April 2016

Circle, AK

In April 2016, NOAA's NWS and UAS Program Office, two Cooperative Institutes and the Alaska Center for UAS Integration (ACUASI) partnered to evaluate the use of UAS to monitor ice conditions and breakup with significantly higher temporal and spatial resolution than presently available from satellite imagery. The objectives of this proof of concept was to examine near real-time operational forecaster Decision Support Service (DSS), provide rapid response surveillance of river ice and/or flooding, and to validate and calibrate satellite derived river ice and flood products.





Data Services Checklist

Section 1

Government
Data Services - End Product / Best Value Determination Tool

Purpose: This worksheet provides decision-making guidance when there is a need for a product, such as an aerial photograph, that could be obtained by a commercial company that uses unmanned aircraft systems (UAS). This worksheet should be used to make a best value determination by comparing UAS-obtained products and costs with alternative methods of obtaining the needed product. Contact the Government UAS Program for additional UAS platform or sensor guidance.

Directions: For each option, place a check in the box that applies (Yes or No). Do not fill out the grayed-out boxes. To fill out the "Cost" column, you must obtain a quote from commercial companies. Contact the controlling Government aircraft office for additional guidance.

All Options Should be Considered:	Will the Government Have Operational Control?		Take-Off/Landing Operation Within Park Boundaries		Complies with All Relevant Legal and Policy Requirements[3]		Data Captured Meets Projected Need		Provider for this Option is Available		Cost
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
Ground-Based Options (e.g. elevated structures, land masses)											
Manned Aircraft	[1]		[2]								
Unmanned Aircraft	[1]		[2]								
Other (e.g. kites, balloons, satellites)											

If Unmanned Aircraft meets all requirements and represents the best value to the Government, go to Section 2.

[1] If your answer is "Yes" for the "Operational Control" column, either the flight services must be procured through Government approval is required and the agency's internal approval process for UAS operations must be completed. For definition purposes, "*Operational Control*, with respect to a flight, refers to the exercise of authority over initiating, conducting, or terminating a flight." (14 CFR 1.1)

[2] If the answer is "Yes" for "Take-Off/Landing Operation Within Park Boundaries" for manned aircraft, superintendent approval is required. For UAS operations, approval is required and the Government internal approval process for UAS operations.

[3] Examples include but are not limited to requirements associated with the Wilderness Act (including a Minimum Requirements Analysis), Endangered Species Act, National Historic Preservation Act, Marine Mammal Protection Act, Migratory Bird Treaty Act, National Environmental Policy Act, and other applicable legal or policy requirements.

- Every Emergency is Local
- Data Buy of Airborne Imagery
- Affordable – Nation-Wide
- Numerous Government Agencies
- Real-Time Data Available

Section 2

Government Simplified Acquisition Procedures for
UAS End Product Contracts

From all legal and policy aspects, the Federal Aviation Administration (FAA), UAS are considered aircraft. While government agency policies may require that all *aviation services* must be obtained through an aviation oversight office, an "End Product Contract" or "Data Buy" is used to acquire a product for the Government. The intent of this type of procurement is for the contractor to supply all personnel and equipment in order to provide an "end product" or "end result."

Generally, if the cost of the supply is over the micro-purchase threshold, a Government contracting officer must issue a solicitation. Otherwise, in general, if the cost of the supply is under the micro-purchase threshold (currently $2,500-5000), a purchase charge card may be used. Refer to the site's specific policy regarding procurement. In either case, some or all of the following will apply:

1. Supervisory approval must be obtained.
2. An authorized Government credit card holder with purchase authority must make the purchase. **Note:** the vendor must invoice for the supply or product, not "services provided."
3. Verify the vendor meets all FAA requirements.
4. A written agreement with the vendor must be signed by both parties and will include, at a minimum:
   a. A detailed description of the product desired, the date of delivery, and note all products are the property of Government.
   b. Windows of opportunity to achieve best results for obtaining the product(s).
   c. Vendor's responsibility for complying with all local, state, and federal regulations, such as minimum altitudes above area commensurate with Federal Aviation Regulations and including FAA certification and Section 333 Exemptions.
   d. Areas to be avoided, measures to avoid impacts on natural resources and personnel.
   e. A vendor-provided operational safety plan.
   f. Procedures for data management and processing.
   g. Procedures and responsibility for recovering a downed aircraft and any associated damage to resources.
   h. Representations that the operator is properly insured and adequately indemnifies the Government (as applicable).
5. The written agreement **shall not** include:
   a. Specified aircraft type
   b. Pilot requirements
   c. Point(s) of departure
   d. Any authorization for take-off, landing, or operation.
6. The Government may need to coordinate with the vendor to restrict areas of operations for public/resource protection.

Targeted Autonomous In-situ Sensing & Rapid Response" (TAISRR)

Questions?

Contact Information:

Robbie Hood: Robbie.Hood@noaa.gov
JC Coffey: John.J.Coffey@noaa.gov
John Walker: John.R.Walker@noaa.gov

NOAA UAS SHOUT in Lower Atmosphere

Rapid Response / Storm Damage Assessment:
Current List of Experienced NWS WFOs (Valid: April 2016)

Charleston, SC (CHS): Ron Morales (WCM)
Ron.Morales@noaa.gov

Blacksburg, VA (RNK): Mike Sporer
Michael.Sporer@noaa.gov

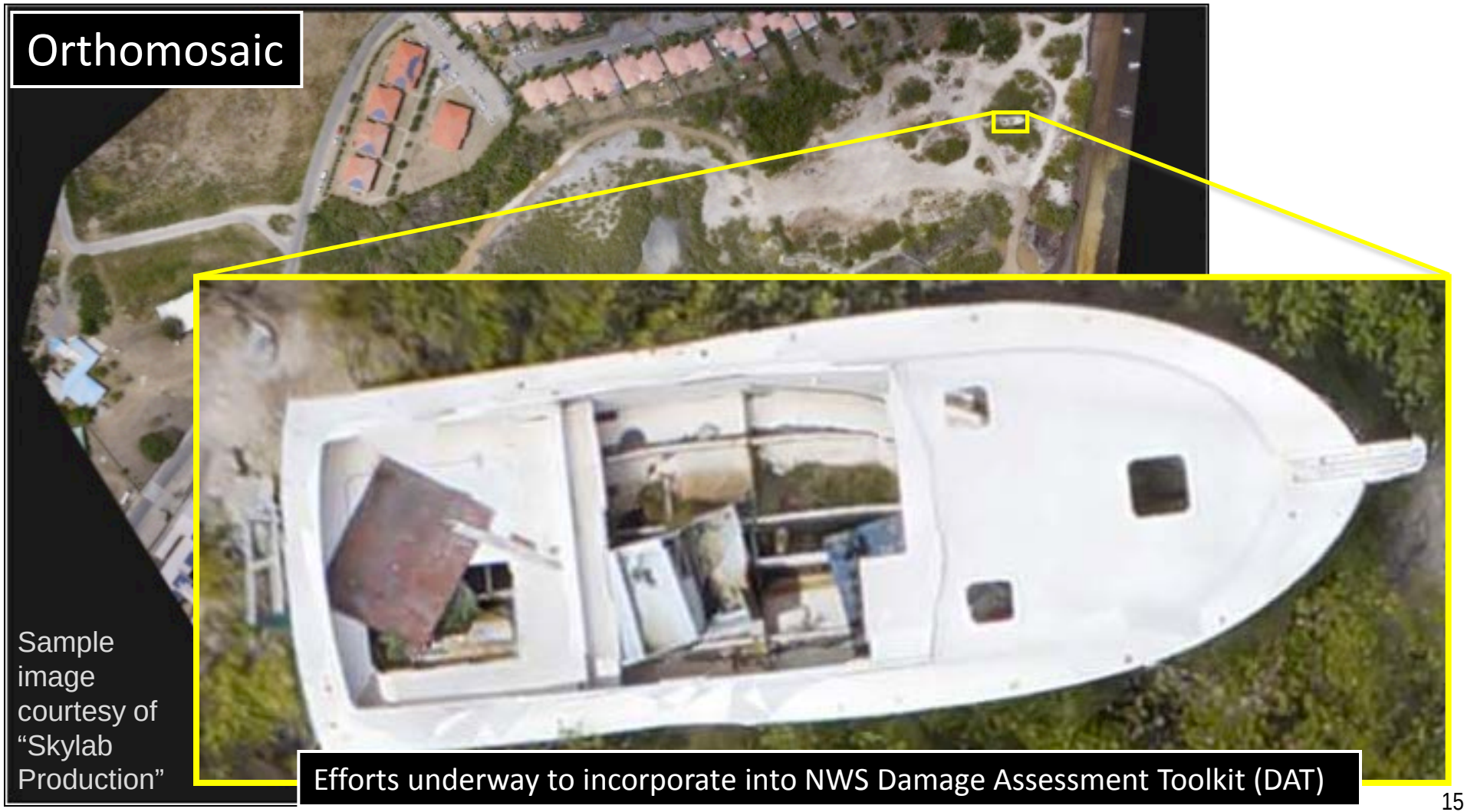
Huntsville, AL (HUN): Chris Darden (MIC), Todd Barron (WCM)
Chris.Darden@noaa.gov, Todd.Barron@noaa.gov

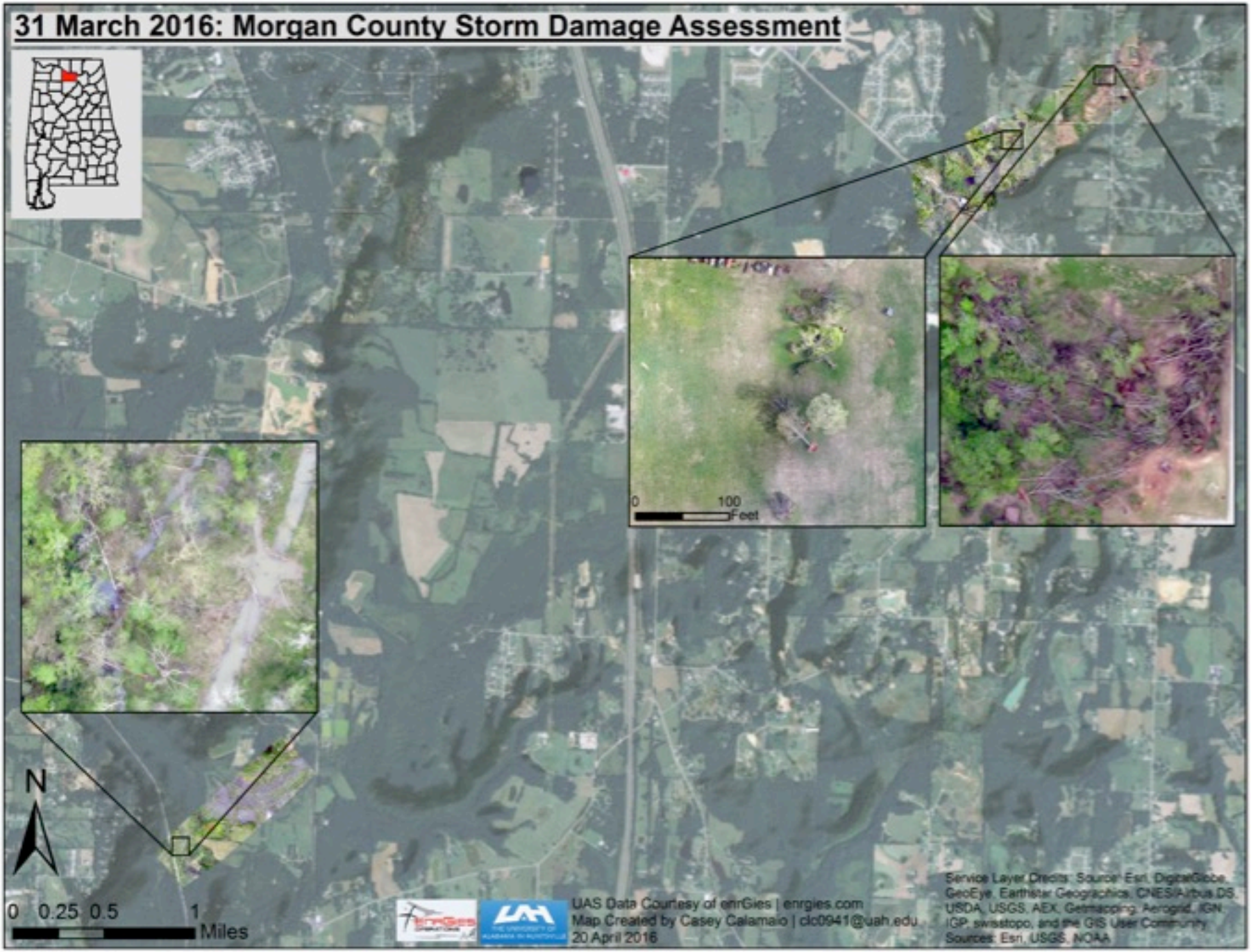
Jackson, MS (JAN): Chad Entremont (Acting MIC), Eric Carpenter, David Cox
Chad.Entremont@noaa.gov, Eric.Carpenter@noaa.gov,
David.Cox@noaa.gov

Alaska WFO (AK): Carven Scott (Acting Director)
carven.scott@noaa.gov

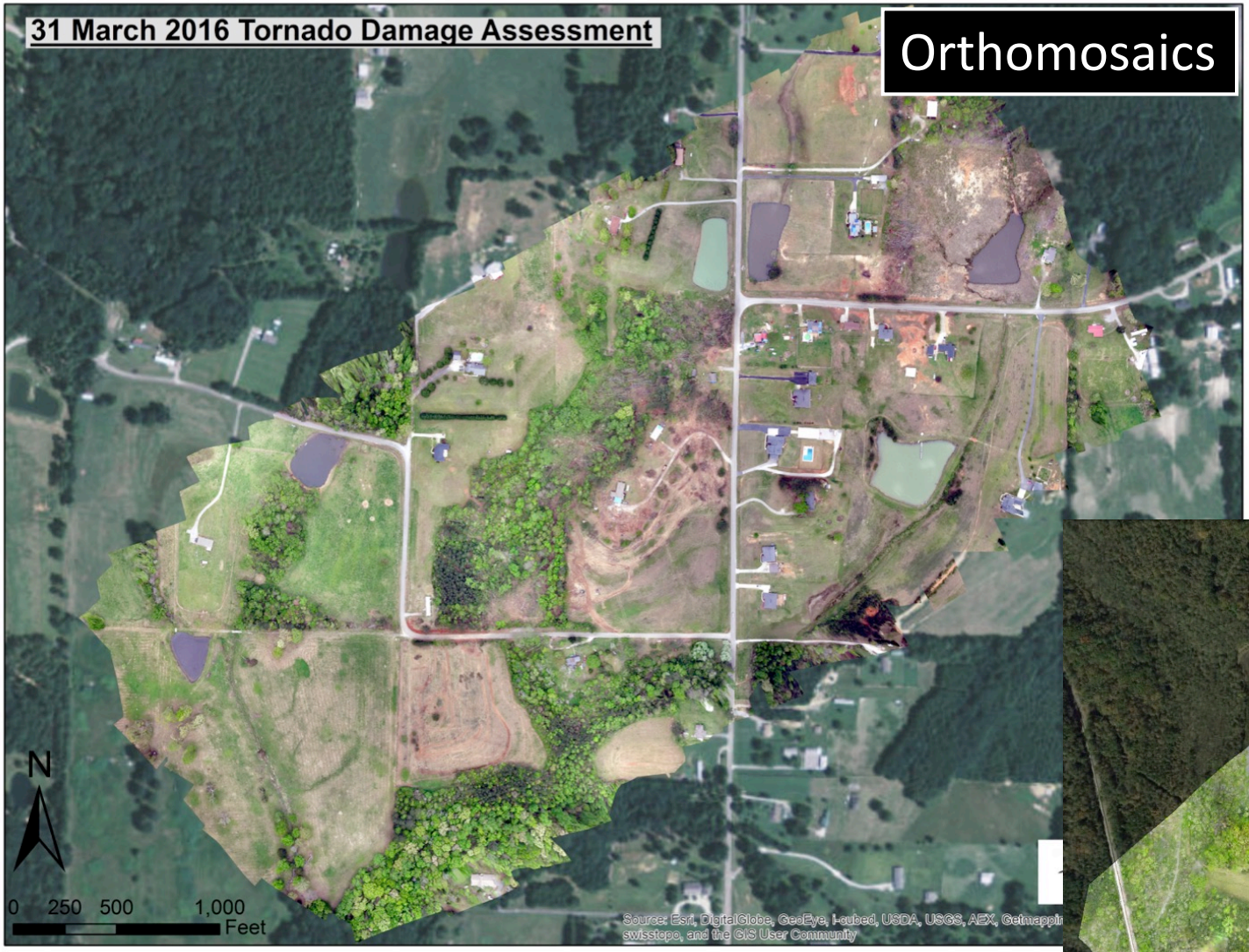
UAS for Rapid Response

Rapid Response / Storm Damage Assessment




31 March 2016: Morgan County Storm Damage Assessment
0 100 Feet
N
0 0.25 0.5 1 Miles
UAS Data Courtesy of enrGies | enrgies.com
Map Created by Casey Calamaio | clc0941@uah.edu
20 April 2016
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Sources: Esri, USGS, NOAA

Imagery Sample Output



UAS-based imagery from tornadic damage on 31 March 2016 in Morgan County, AL. Operations were coordinated through the Morgan County EMA Office.

Imagery provided courtesy of "enrGies" UAS engineering and operations company ("Section 333" exempt).

UAS for Rapid Response

Rapid Response / Storm Damage Assessment

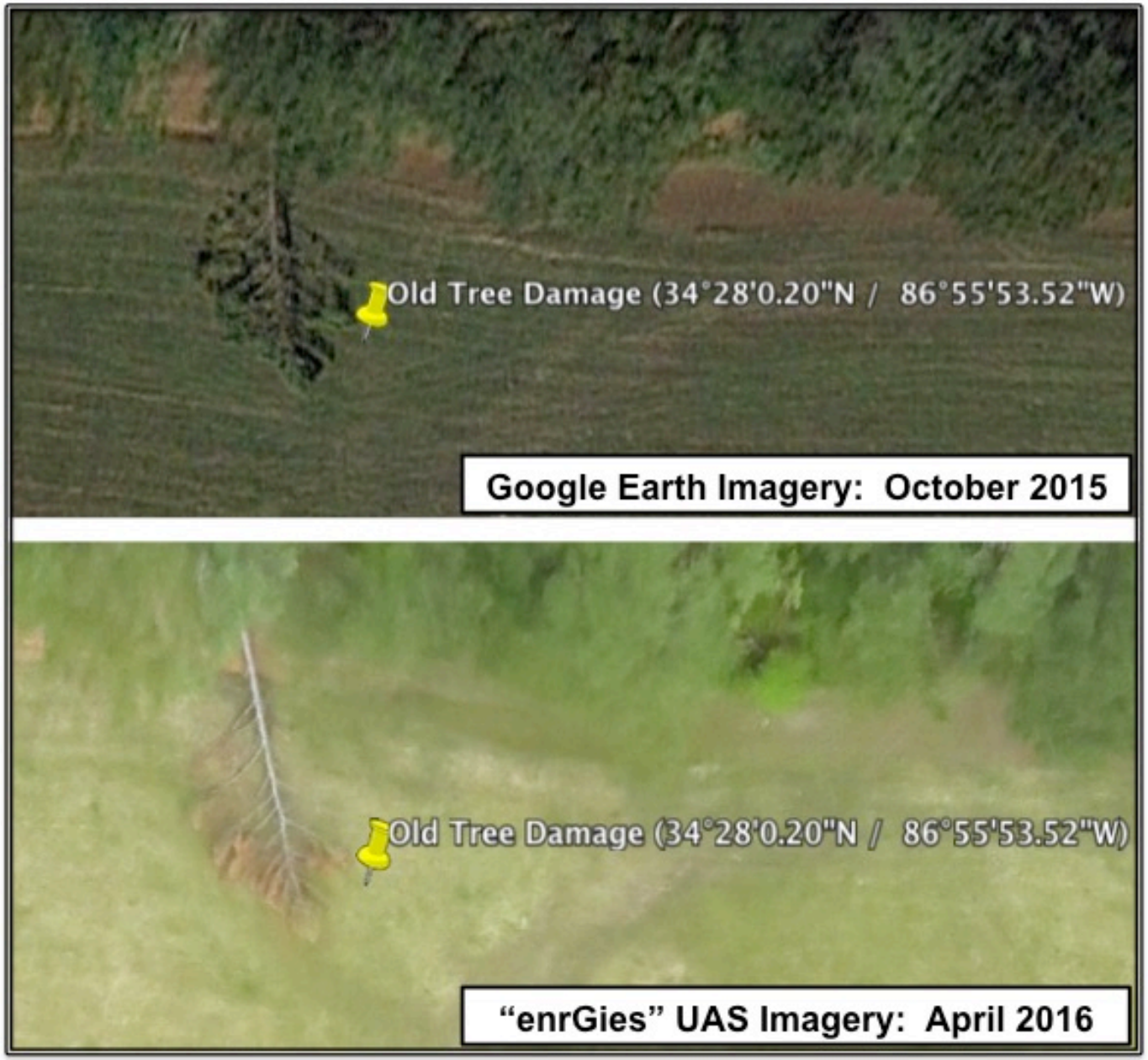
Orthomosaic “Change Detection”:
Pre- and Post-Damage Comparison Overlays

UAS for Rapid Response

Rapid Response / Storm Damage Assessment

Orthomosaic “Change Detection”:
Pre- and Post-Damage Comparison Overlays

Imagery Sample Output



Orthomosaic: Change Detection Capability

Imagery Sample Output

Orthomosaic: Change Detection Capability

Landsat 8 OLI (30m) Resolution

ASTER (15m)

ISERV (4m)

UAS (0.05m / 5 cm)

UAS for Rapid Response

Rapid Response / Storm Damage Assessment

3D Digital Surface Model (DSM) screenshots; Developed from Appomattox County, VA tornado damage that occurred on 02/24/16.

UAS for Rapid Response

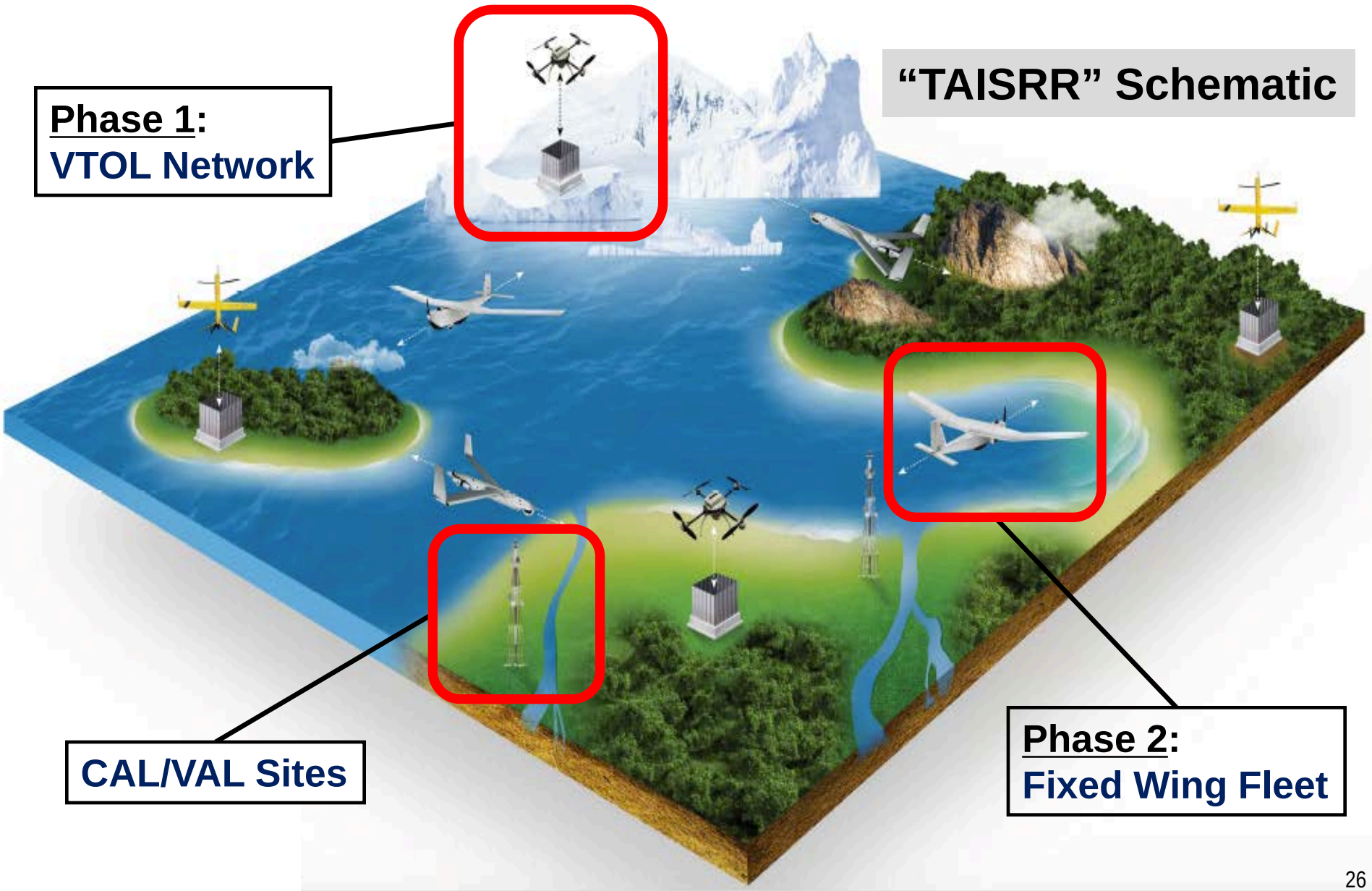
Sample Imagery: Rapid Response / Storm Damage Assessment

NOAA UAS SHOUT in Lower Atmosphere: Mission Examples

Missions (Regionally dependent in some cases):

- Severe/Winter weather situational awareness and prediction
- Rapid Response / Severe Storm damage assessment
- Hurricane damage assessment
- Pre-land falling tropical system sampling and prediction
- Enhanced “sea breeze” thunderstorm prediction
- River Forecasting Center (RFC) assessments
- Coastal erosion monitoring
- Lake Effect Snow Forecasting / Lake Influences
- Marine Layer prediction / Energy forecasting
- Fire weather prediction (mixing heights)
- Land slide and burn scar assessment
- Air quality observation and forecasting
- Sea ice monitoring
- Oil spill & marine debris monitoring
- Etc…

NOAA UAS SHOUT in Lower Atmosphere



SHOUT Lower Atmosphere Early Testing