

# Flight to Recovery

Using Innovative Drone Technology to  
Map the Impact of Natural Disasters

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NWS Guam Regional Climate Conference | May 23, 2024  
Presented by Romina King, Ph. D



Partner



# Overview

UOG Drone Corps  
Drone Applications  
Program Overview  
Natural Disaster & Damage Mapping  
Mawar Mission: Key Sites  
Access Data



The second cohort of UOG Drone Corps pose for a group photo during their first day of class.



UOG Drone Corps pilots observe a drone mid-flight during a practicum session of their Knowledge Course.

# UNIVERSITY OF GUAM DRONE CORPS

The **University of Guam Drone Corps** is the university's first-ever drone certification and training program. The program aims to build a cadre of responsible FAA-licensed pilots who can provide support to research projects and local organizations in the region.

# DEVELOPMENT WORKFLOW MILESTONES



## Knowledge Course

Students are enrolled in a Knowledge Course that prepares them for the exam. The course consists of a ground school and practicum.



## Certification

Upon completing the Knowledge Course, students apply their knowledge to take the FAA Part 107 Remote Pilot exam.



## Flight Hours + Beyond

Members complete 40 hours of flight time by pursuing missions and internships, where they can provide drone services.

### STIPEND BREAKDOWN (COHORT 3)

STIPEND 1: **250 USD**

STIPEND 2: **250 USD**

STIPEND 3: **1000 USD**

# Eligibility Requirements

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## ***18 years or older***

*Students must be 18 years or older to operate UAVs for Drone Corps.*



## ***UOG or GCC Student***

*Graduate and undergraduate students; must be currently enrolled.*



## ***US Citizen***

*Citizenship as required by Space Grant.*





Collaboration with Experts

# Knowledge Course

A key component of the UOG Drone Corps is partnering with a local drone company to administer the knowledge course portion of the program, where students prepare for the exam and gain hands-on experience.



A Hands-on Experience

# Practicum Training

Members gain hands-on experience with drones through simulator training and participating in specialized drone missions.





Take to the skies with  
UNIVERSITY OF GUAM  
**DRONE CORPS**



- GET FAA-LICENSED**  
Students can earn their FAA Remote Pilot License via a knowledge course & exam
- FLY UAV**  
Members learn to fly drones through hands-on opportunities & discussions
- DRONE SERVICES**  
Need aerial imagery or an area mapped? Our pilots offer services to agencies and researchers seeking drone support



SCAN THE CODE TO VISIT  
[WWW.BITLY/DRONECORPS](http://WWW.BITLY/DRONECORPS)

UNIVERSITY OF GUAM

LOOKING TO APPLY OR REQUEST A MISSION? CONTACT  
[DRONECORPS@TRITON.UOG.EDU](mailto:DRONECORPS@TRITON.UOG.EDU)

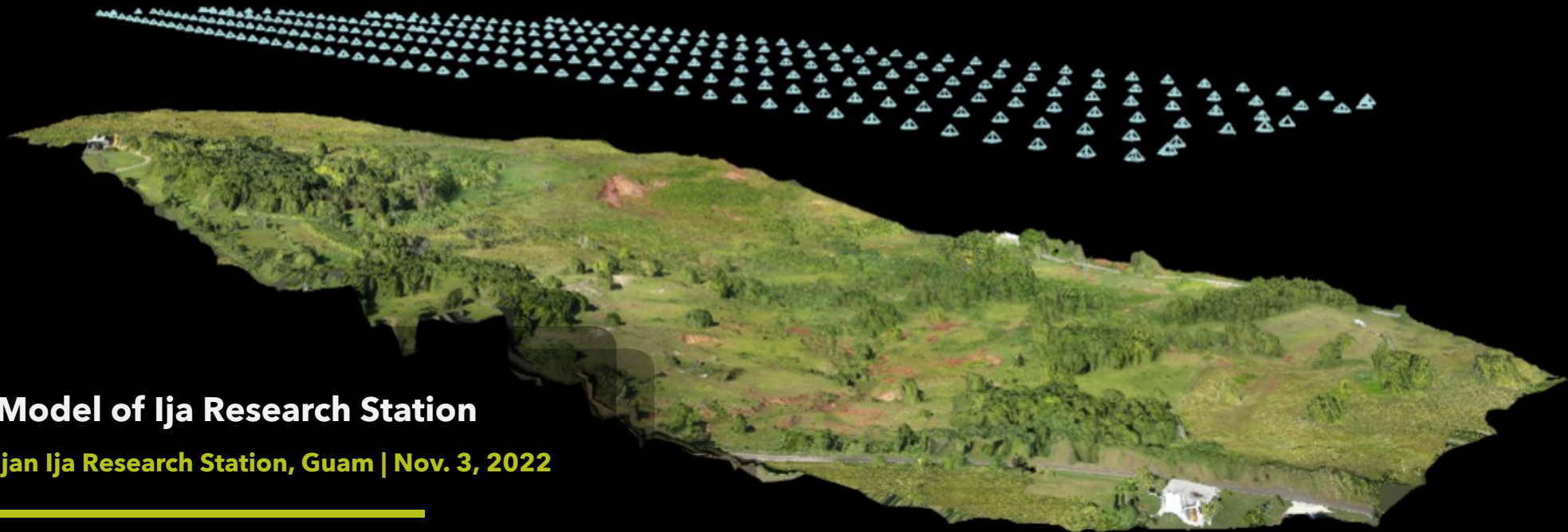


Technical & Research Capacity

# Collaborative Missions

Upon licensure, students earn flight hours by pursuing drone flight missions to assist **research partners**. This service provides the student with practice and the partner with valuable mapping data.





## 3D Model of Ija Research Station

Inarajan Ija Research Station, Guam | Nov. 3, 2022

A 3D model map of the Ija Research Station Farm in Inarajan, Guam.

The image was captured with a DJI Phantom 4 Multispectral RTK Drone.

*Courtesy of Christopher Salas and Kaya Taitano.*



# DRONE APPLICATIONS IN DISASTER & DAMAGE ASSESSMENT

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POST-FIRE MONITORING



EROSION



VEGETATION HEALTH

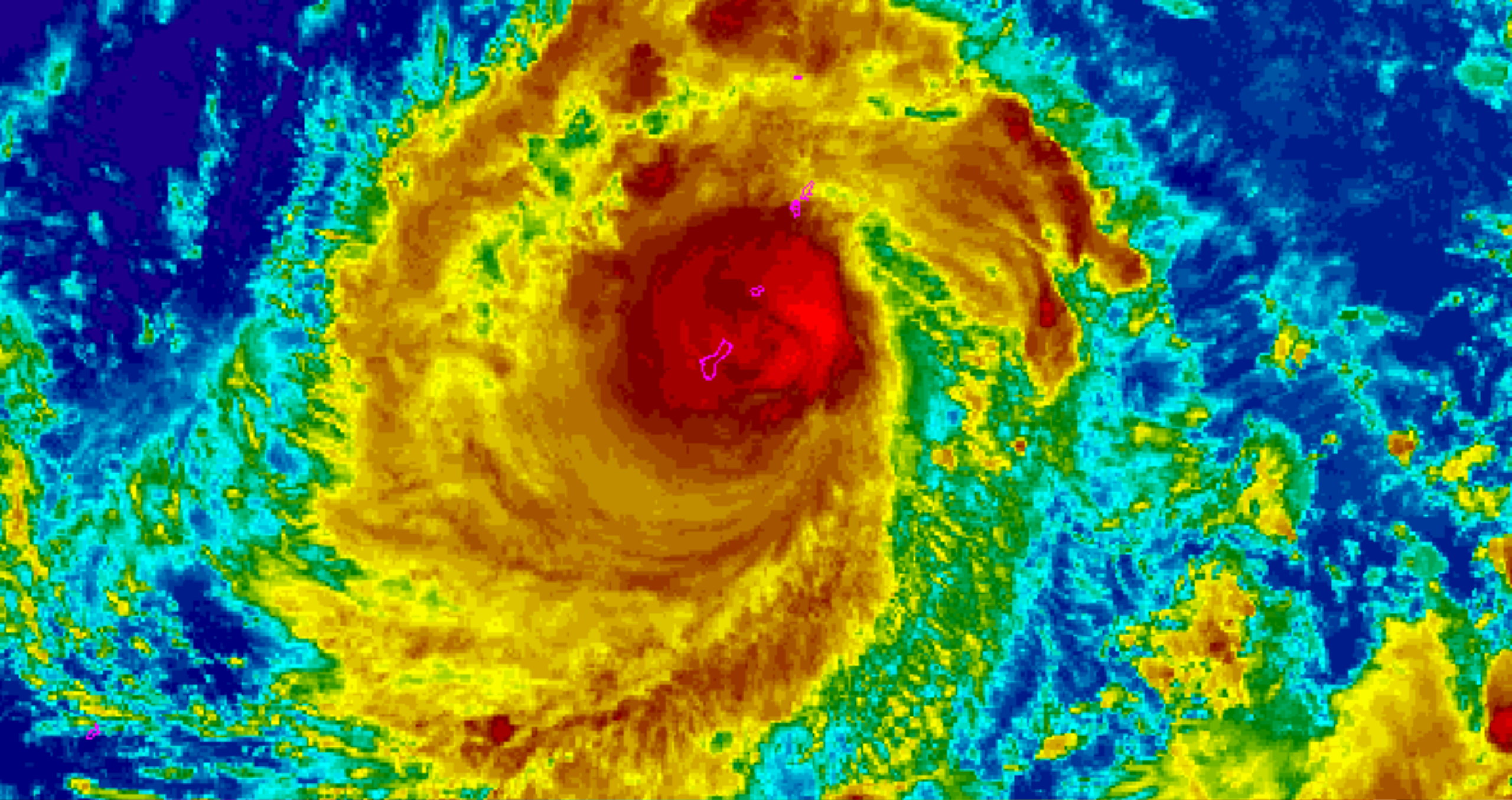


FLOOD MAPPING



CORAL HEALTH





# Mission Overview

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In a multi-agency collaboration between the National Weather Service Guam and various University of Guam programs, drone pilots assessed the damage of Typhoon Mawar at key sites on Guam from May 27 to June 8.

## Disaster response through drones

With approximately 60 hours spent on drone flight, set-up, and processing, the mission amassed **11,758 photos** that will be stitched together to produce high-precision orthomosaic maps.





# Equipment & Software

## DJI Matrice 300 RTK

Max Speed: 23 m/s  
Max Flight Time: 55 mins  
Weight: 6.3 kgs (with batts)

*\* Depending on weather and airspace*

## DJI Zenmuse P1 Sensor

Effective Pixels: 45MP  
Aperture: f/2.8-f/16  
Photo Size: (8192×5460)



## DJI RTK-2 Mobile Base Station

Provides real-time differential data for drones to achieve centimeter-level positioning accuracy



## Software

Google Earth  
UgCS  
Drone Deploy

ArcGIS  
Zenodo

## Other Equipment

Radios  
Duracell Batteries  
Safety Vests

Binoculars  
Gaming Laptops  
Pilot Team



# The Benefits

## Drones for Damage Assessment

Compared to traditional assessment methods, drones offer revolutionary benefits for resource managers in assessing the aftermath of the storm:

**Hard-to-reach areas**

**Accurate data**

**Worker safety**

**Quicker turn-around**







# The Insights

## Drones for Typhoon Assessment

With these extremely high-resolution orthomosaic maps, researchers will be able to make detailed analyses regarding:

**Coastal Inundation**

**Vegetation Loss**

**Wave Run-up**

**Structural Damage**

75 m



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# Key Areas

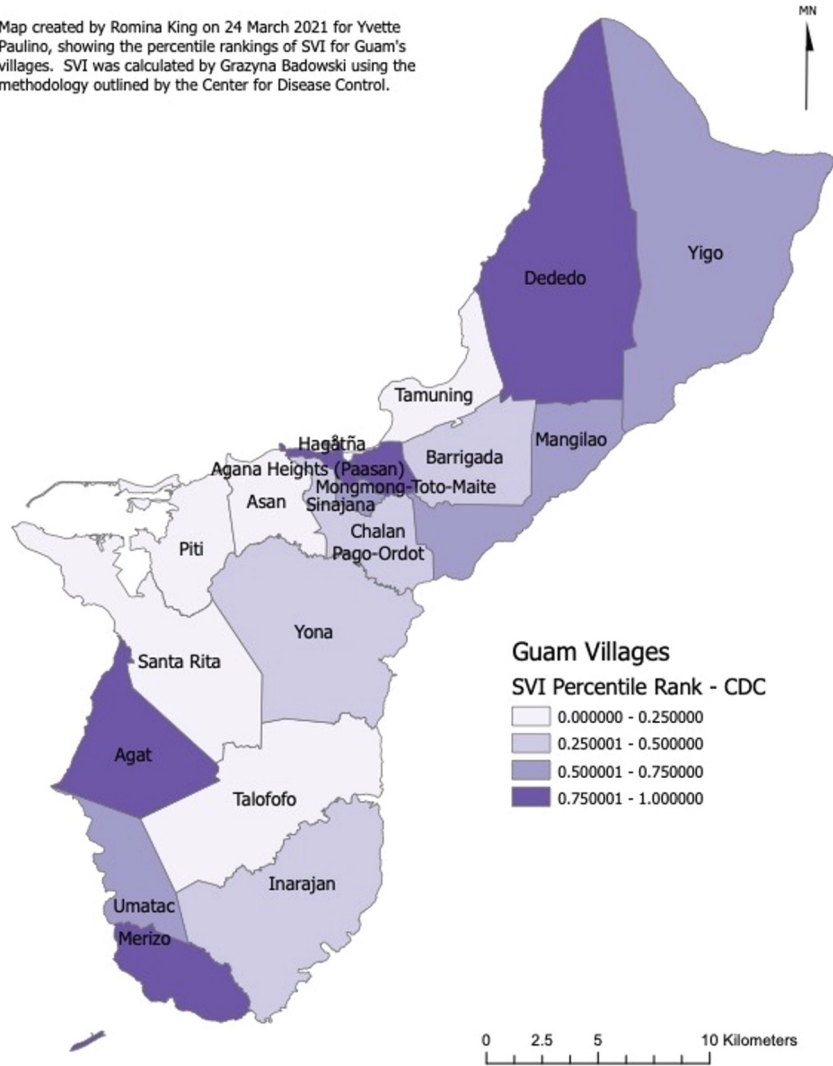
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- Ritidian
- Dededo (Astumbo, Okkodo, BMS)
- Hagåtña
- Tumon Bay
- Piti
- Agat
- Pago Bay
- Mangilao (UOG)

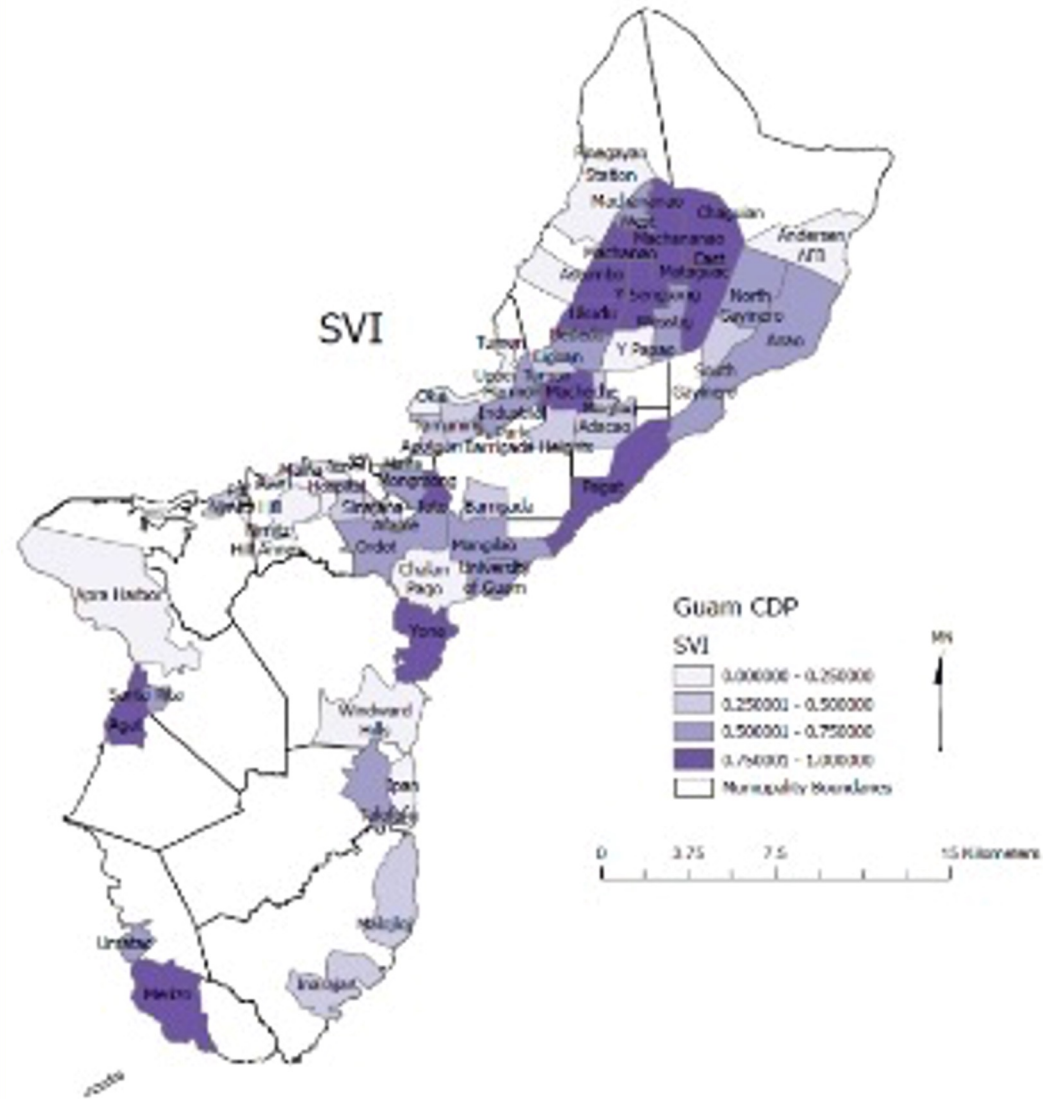



# Guam - Social Vulnerability Index (CDC methodology)

Map created by Romina King on 24 March 2021 for Yvette Paulino, showing the percentile rankings of SVI for Guam's villages. SVI was calculated by Grazyna Badowski using the methodology outlined by the Center for Disease Control.



# Social Vulnerability - Guam

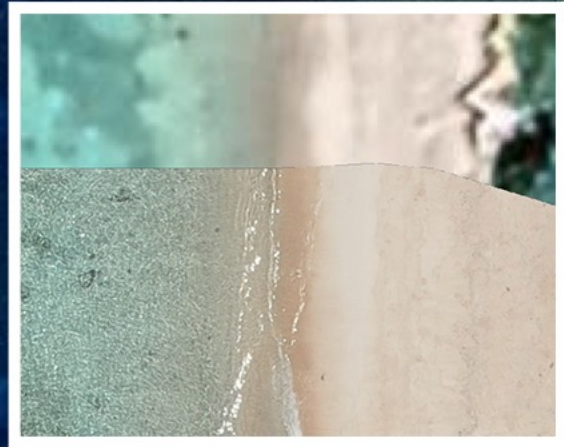


A group of people are gathered under a green canopy tent on a rooftop. In the foreground, a drone is on the ground. The background shows a cityscape and a car with its trunk open.

“The end product was an extremely high-resolution orthomosaic map that spans thousands of acres, with a ground sampling distance (GSD) of **2.64cm**. Having such a high-resolution GSD, which measures the distance between two consecutive pixel centers, enables scientists to delve deep into the smallest details, such as examining small cracks on the road.”

**Dong Won Lee, Co-Remote-Pilot-in-Command**

# Satellite Imagery (Pre-Mawar)



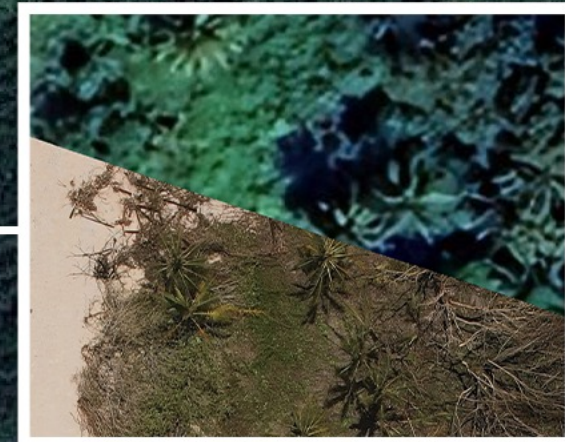
33 m



33 m



47 m



47 m



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## RGB Orthomosaic of Tumon, Guam

Tumon, Guam | May 27, 2023

## Drone Imagery (Post-Mawar)





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27 m



40 m

## RGB Orthomosaic of Astumbo, Guam

Dededo, Guam | June 7, 2023

An orthomosaic map displaying the destruction of a home in Astumbo, Guam. The image was captured with a DJI Matrice 300 drone and Zenmuse P1 sensor.





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76 m



17 m



## RGB Orthomosaic of Astumbo, Guam

Dededo, Guam | June 7, 2023

An orthomosaic map displaying the destruction of a home in Astumbo, Guam. The image was captured with a DJI Matrice 300 drone and Zenmuse P1 sensor.



# Earth Science: **Agriculture**



26 m

26 m



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## RGB Orthomosaic of Yigo Triton Farm

Yigo Triton Research Farm, Guam | December 2022

An orthomosaic map of the Yigo Triton Research Farm in Guam. The image was captured with a DJI Matrice M30T drone.

Courtesy of Kaya Taitano





26 m

26 m



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## RGB Orthomosaic of Yigo Triton Farm

Yigo Triton Research Farm, Guam | June 2, 2023

An orthomosaic map of the Yigo Triton Research Farm in Guam. The image was captured with a DJI Matrice M30T drone.

Courtesy of Kaya Taitano



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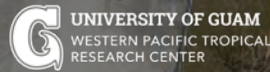
22 m

22 m

## RGB Orthomosaic of Ypao Beach Park

Tumon, Guam | May 27, 2023

An orthomosaic map displaying the destruction at Ypao Beach Park in Tumon, Guam. The image was capture with a DJI Matrice 300 drone and Zenmuse P1 sensor.



27 m



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Paseo Loop



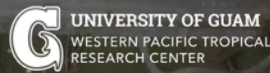
54 m

Rte 1

## RGB Orthomosaic of Hagåtña, Guam

Hagåtña, Guam | May 27, 2023

An orthomosaic map displaying the destruction at the Fishermen's Co-op in Hagåtña, Guam. The image was capture with a DJI Matrice 300 drone and Zenmuse P1 sensor.





2017



2023



"Thank you for your time, talent, and expertise you and your team have given to the Guam Power Authority for assisting in the recovery efforts following the recent Typhoon Mawar. Your continued commitment to providing unmanned aerial vehicle (drone) imagery has played a significant role in helping us assess the damage and plan our recovery strategies effectively."

**John Benavente, Guam Power Authority**



Scorched Landscapes

# Post-Fire Mapping

In collaboration with the **Guam Department of Agriculture's Forestry team**, our drone pilots were deployed to map the post-fire landscapes at the Quinene and As Gadao reforestation sites in Malesso'.





## RGB Orthomosaic of Quinene Burn Site

Malessos, Guam | February 19, 2024

An RGB orthomosaic map displaying the burn site after the Quinene wildfire; captured at 400 ft AGL.

The image was captured with a DJI Matrice 300 UAV and DJI P1 Zensor.

Courtesy of Jonelle Sayama and Andrea Velasquez



Aubrey Moore, University of Guam





20 m

20 m

## RGB Orthomosaic | Coconut Trees (100ft)

**Chalan Pago, Guam | March 29, 2023**

An orthomosaic map of coconut trees alongside an apartment complex.

The image was capture with a DJI Matrice 300.

*Pilot Team: Jonelle Sayama, Keanno Fausto / Dr. Aubrey Moore*



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# The Challenges & Overcoming Them

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**Inclement Weather:** To ensure the safety of the operations, pilots diligently adjusted their flight schedules and monitored NWS weather forecasts to identify windows of favorable conditions for drone flights.



**Power Limitations:** With no electricity on campus, the pilots relied on their partnership with NWS Guam, who generously provided charging facilities for their drone batteries.

# The Challenges & Overcoming Them

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**Time Constraints:** With a limited time window to capture relevant data, the pilots had to plan their flight routes and prioritize key areas.



**Higher Altitudes:** To cover larger areas in a shorter period, the pilots applied for a special Certificate of Authorization from the FAA to operate the drones at an altitude of 699 feet (compared to 400 feet)

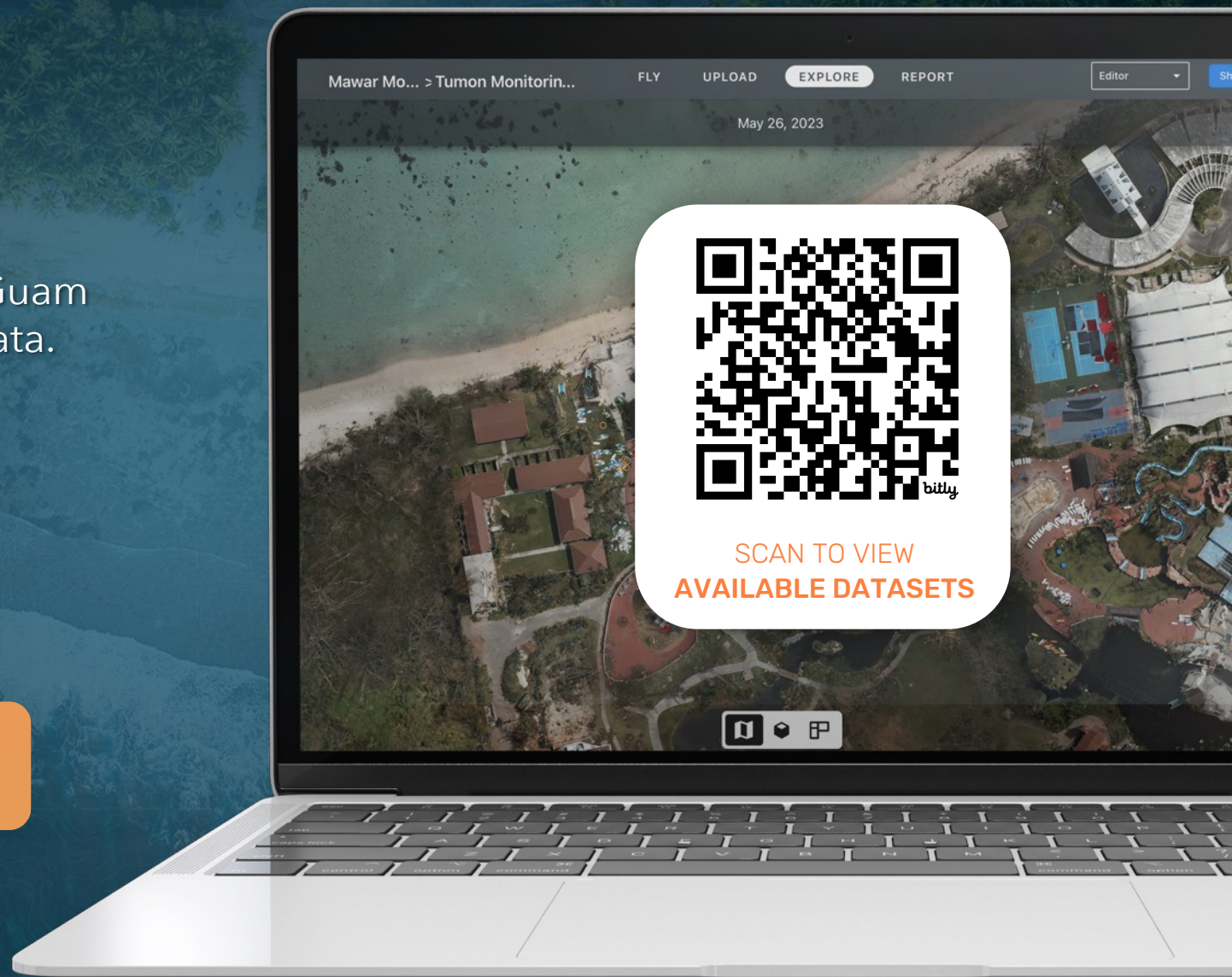
# Open-Source Data

Access Data for Research!

View aerial datasets of key areas across Guam and the region, including relevant metadata. Access to these images is granted for educational and research purposes. Each request will be carefully reviewed and approved to ensure responsible usage.

LEARN MORE AT

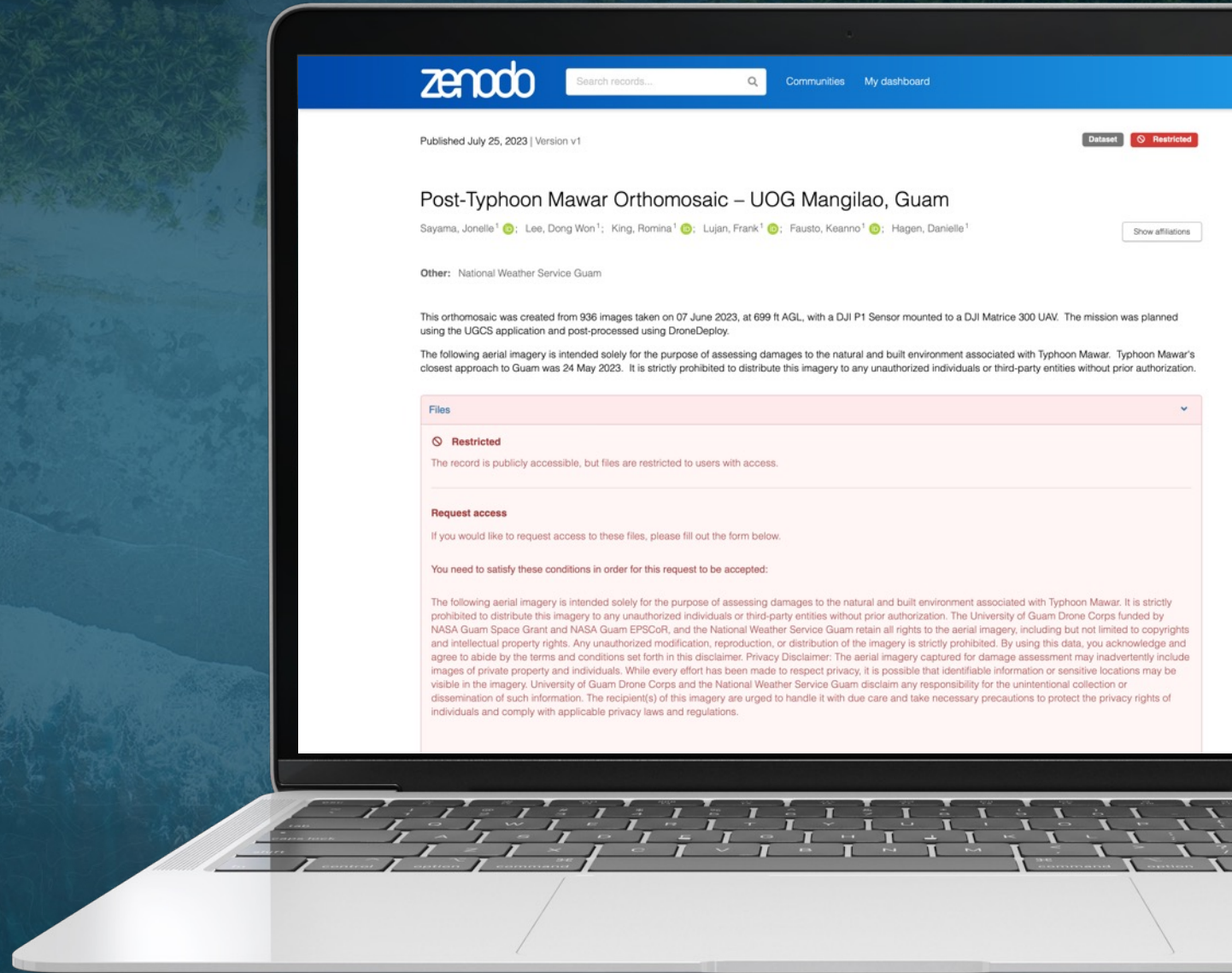
[www.bit.ly/nasagudata](http://www.bit.ly/nasagudata)



# Data on Zenodo

## Key Metadata Details

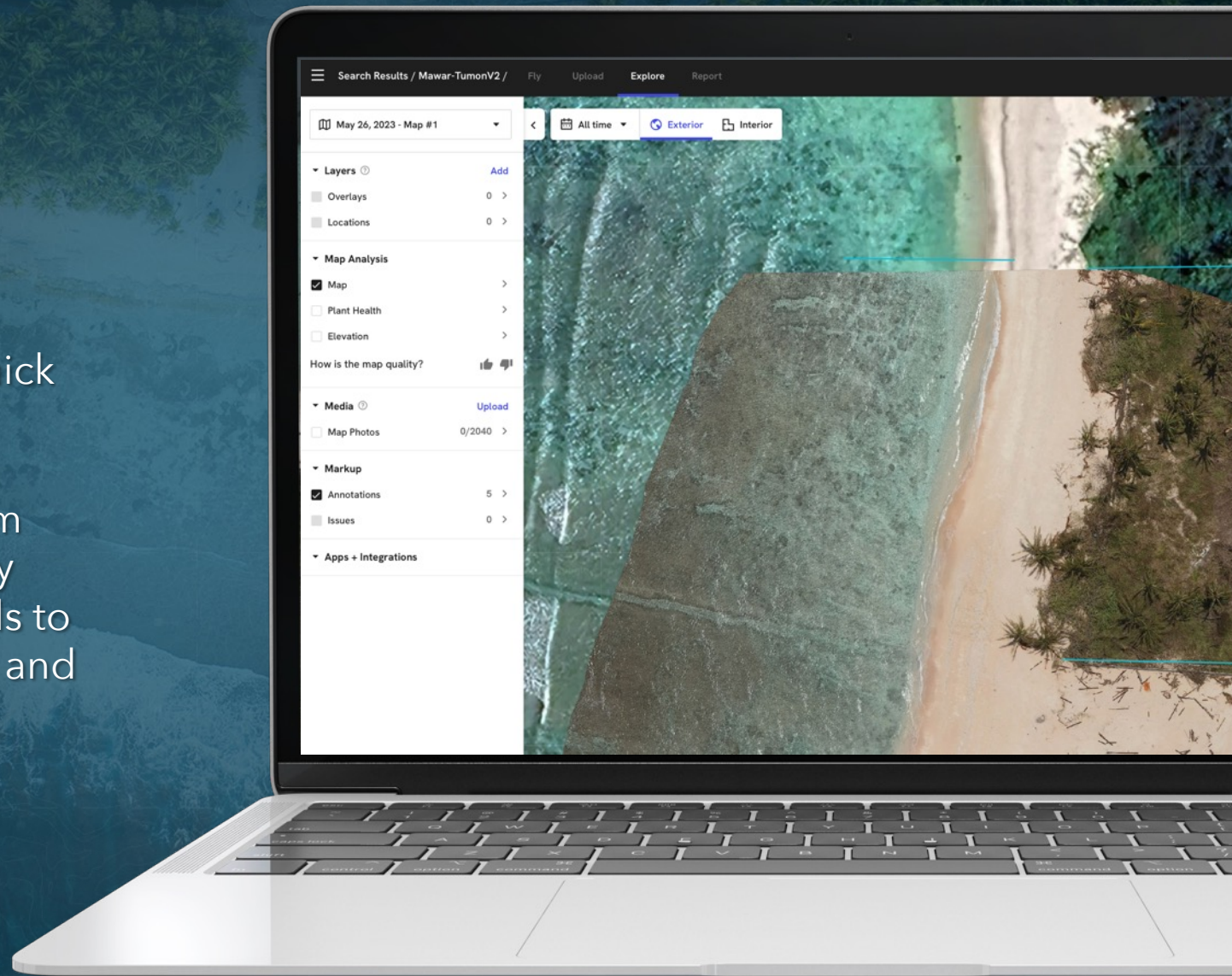
- Pilot Team
- Attribution
- Equipment Used
- Data
- Site(s)
- Height Flown



# Drone Deploy

## High-resolution data viewer

To give research partners and agencies quick access to captured imagery, stitched orthomosaic imagery is also available on Drone Deploy. This cloud software platform gives authorized users the ability to quickly view high-resolution imagery, and use tools to calculate key information such as distance and area size.



Video



IN THE NEWS

# UOG Remote Pilots Map Typhoon Mawar Aftermath with Drones



# Program Directors



**Dr. Leslie J. Camacho Aquino**

Associate Professor of Mathematics  
Executive Director, NASA Guam EPSCoR  
Chair, Division of Mathematics and  
Computer Science

 [aquinol8112@triton.uog.edu](mailto:aquinol8112@triton.uog.edu)



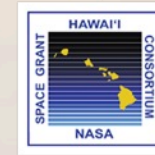
**Dr. Romina King**

Associate Professor of Geography - WPTRC  
Associate Director, NASA Guam Space Grant  
Lead, PICASC  
Vice-chair, MSc SAFNR

 [roking@triton.uog.edu](mailto:roking@triton.uog.edu)



# Partners





# Questions?

[www.bit.ly/dronecorps](http://www.bit.ly/dronecorps)  
WEBSITE

✉ [dronecorps@triton.uog.edu](mailto:dronecorps@triton.uog.edu)

