Applications of high-resolution aerial imagery and a small unmanned aircraft system in Everglades science

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Acronyms and Terminology

UA, UAS, *or* **RPV** = **U**nmanned **A**ircraft, *or* **U**nmanned **A**erial **V**ehicle, **R**emotely **P**iloted **V**ehicle:

-Strictly the physical flying component of a remotely flown aircraft

UAS, *or* **RPAS** = **U**nmanned **A**ircraft **S**ystem, *or* **R**emotely **P**iloted **A**ircraft **S**ystem:

-The physical flying component ***+***

-The manned ground control station ***+***

-The uplink/downlink communications between them

Drone:

-A stingless male bee that mates with the queen

-A continuous, low, dull, humming sound

-A pilotless 'dumb' object used for combat target practice

-A term that applies to UASs of the shooting military

-'A deadly flying robot raining terror'

-'A pilotless flying robot used for spying'

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Brief Overview of the UFUASRP

-In our 15th year of existence
-Natural resource-based applications from the very beginning
-Approach from the natural resource scientist point of view; simplicity of use and budget
-Over last seven years, interest in sUAS for natural resources has grown exponentially
-Truly interdisciplinary research program
-As of April 17, 2015, we have 14 active FAA Certificates of Authorization; three additional pending

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Airframe/Payload Considerations

-What is your *SCIENTIFIC QUESTION*? Define your target!

-What is your desired *END PRODUCT*? Individual images (samples), a mosaic (contiguous map or layer), a video (documentation of behavior), etc.

-What *KINDS OF DATA* do you need to collect to produce your end product? Identify the sensors that can deliver those data.

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Airframe/Payload Considerations

-Based on your sensor or sensor suite, select a *SUITABLE AIRFRAME* as a platform for your sensors. Capacity, runtime, sound, area, etc.

-What is your plan to collect *SCIENTIFICALLY SIGNIFICANT DATA?* Consult your statistician before you head out into the field!

-What is your plan for *POST-PROCESSING* the data collected? Do it yourself, contract it out to an expert, have a student do it, etc.

-What do you intend to do about *ARCHIVING* the data? File sizes are getting bigger…

Airframe Considerations

1) Design
    - -Fixed-wing
    - -Rotor-wing

2) Power Source
    - -Liquid (wet) fuel
    - -Battery

3) Physical Size
    - -Micro UAS
    - -Large UAS

4) Operating Environment
    - -Terrain
    - -Temperature

UFUASRP Airframe Evolution

UF Tadpole
(2004-5)

MLB Fold Bat
(2002-3)

UF Polaris / Nova
(2006-8)

UF Nova 2
(2008-9)

UF Nova 2.1 sUAS

-9 ft. wingspan
-14 lbs. fully loaded

-Hand launchable
-Built in-house

-Amphibious
-65 min. runtime

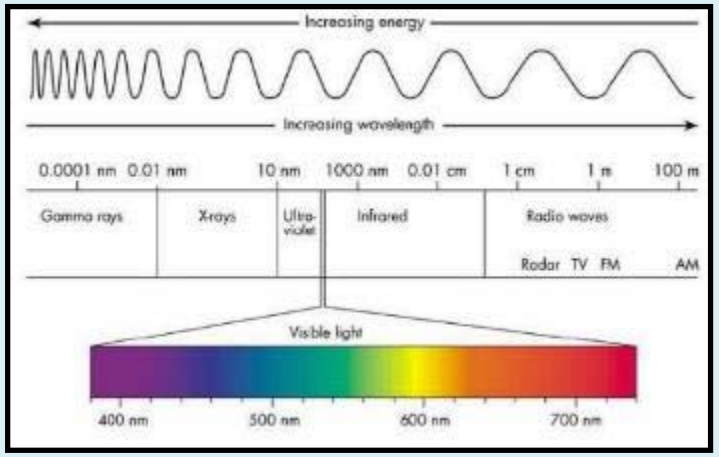
DJI Spreading Wings S1000+ Octocopter Rotor-wing sUAS

-3.5 ft. diameter
-10→24 lbs. takeoff

-Portable
-Off-the-Shelf

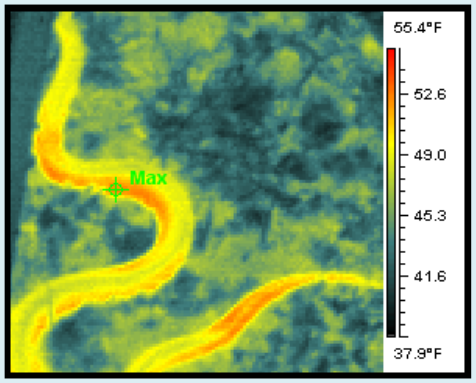
-Autonomous
-25 min. runtime

Payload Considerations



1) RGB and NIR
   - -Resolution
   - -Triggering

2) Multispectral and Hyperspectral
   - -Spectral Range
   - -Triggering
   - -Cost



3) Thermal
   - -Resolution
   - -Georeferencing
   - -Cost

UFUASRP Optical Payloads – Evolution

Canon Elura 2 MC

Canon PowerShot A640

Olympus E-420

Optical Sensor RGB and NIR – Evolution

Olympus E-420

Canon EOS 2Ti

Sony A7R

Canon EOS-M

Sony A6000

Canon EOS SL1

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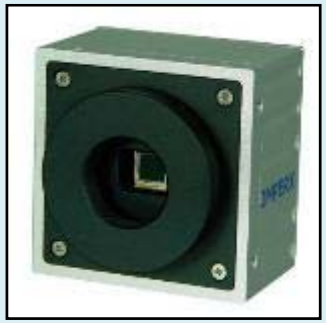
Optical Sensor—Thermal, Multispectral and Hyperspectral, and HD Video

FLIR Photon
Thermal

FLIR A65 SC
Thermal



Imperx B6640
Multispectral

Rikola
Hyperspectral

GoPro Hero 3

GoPro Hero 4

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Authorizations/Regulations/Approvals

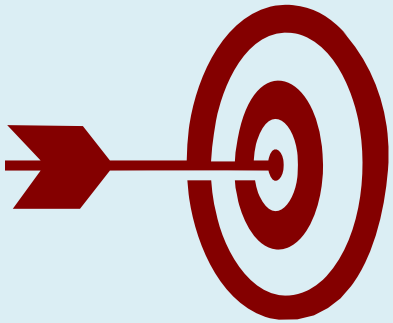
www.faa.gov/uas
www.modelaircraft.org
www.auvsi.org

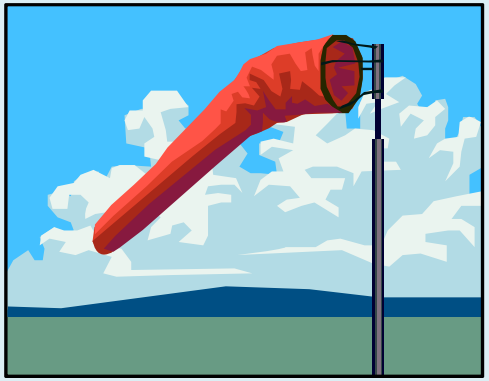
-Certificate of Authorization
-Aircraft Airworthiness
-Crew Certification
-Local Permission
-Notice to Airmen
-Flight Restrictions
-Failsafe Approvals
-Institutional Rules

-International Traffic in Arms Regulations (ITAR)
-Export Administration Regulations (EAR)

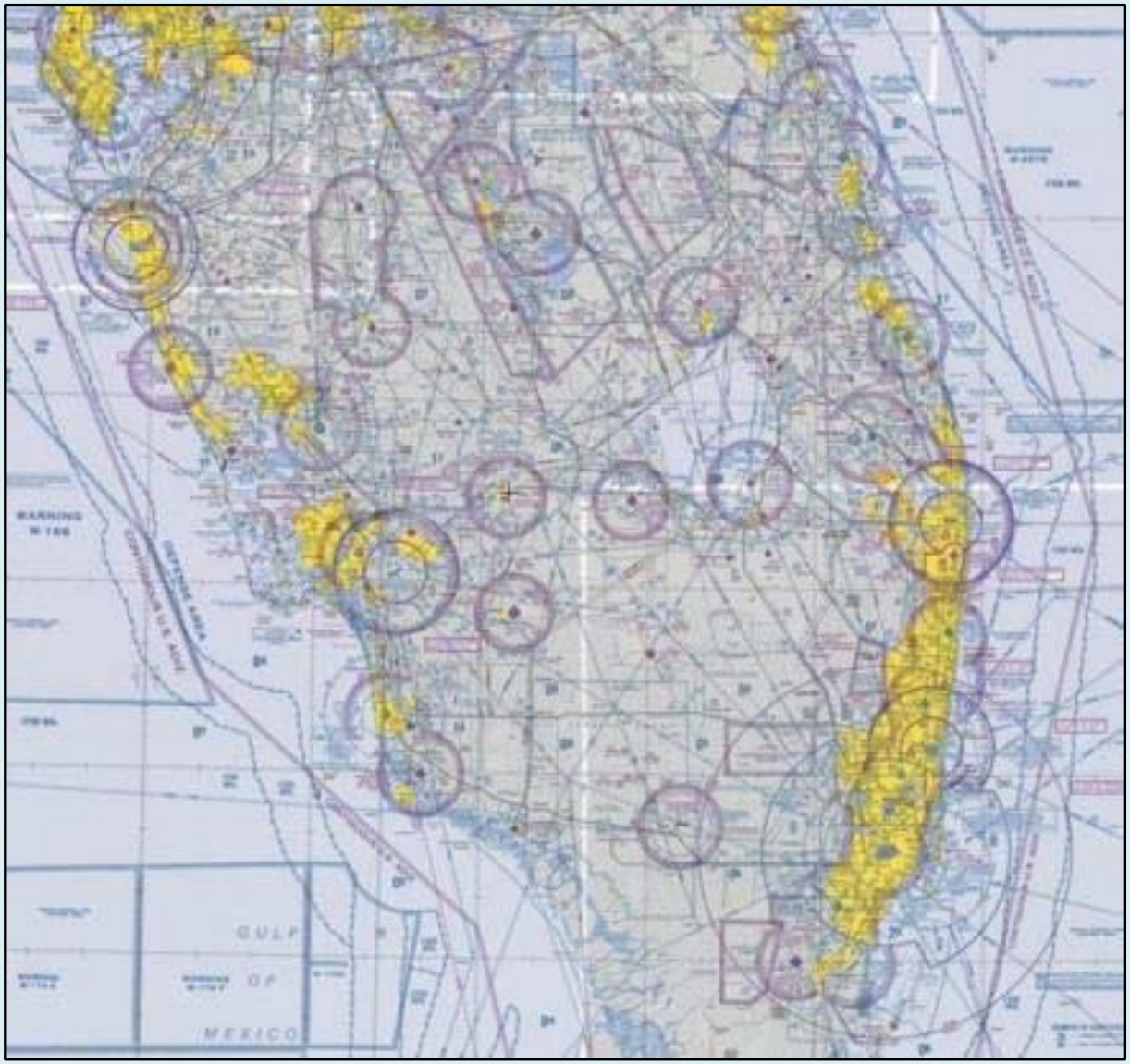
» United States Munitions List; Commerce Control List

The Flight Planning Process

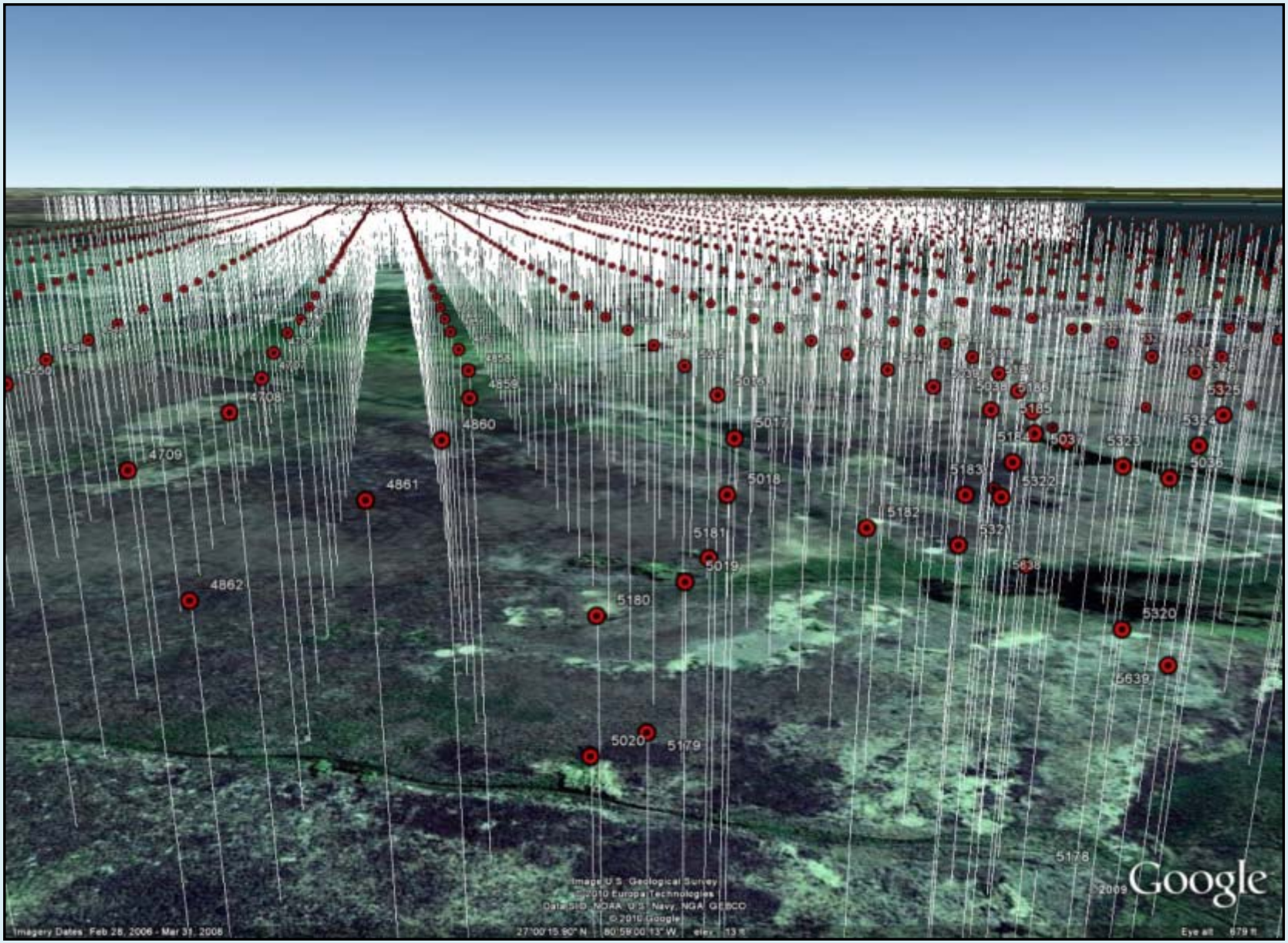




Flight Planning: Who, Where, and When?



Flight Planning: Complete Coverage



Wetland Vegetation Classification

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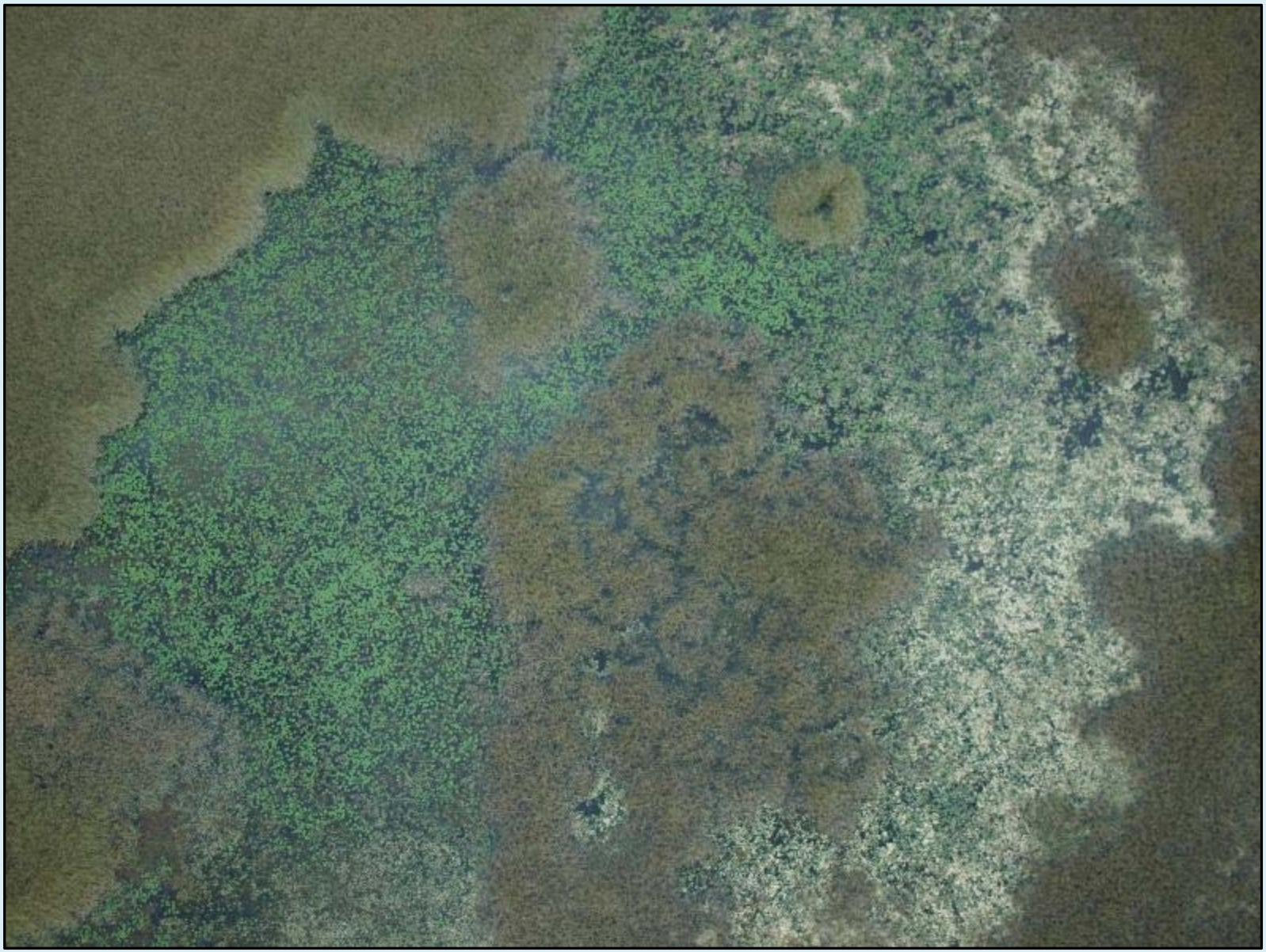
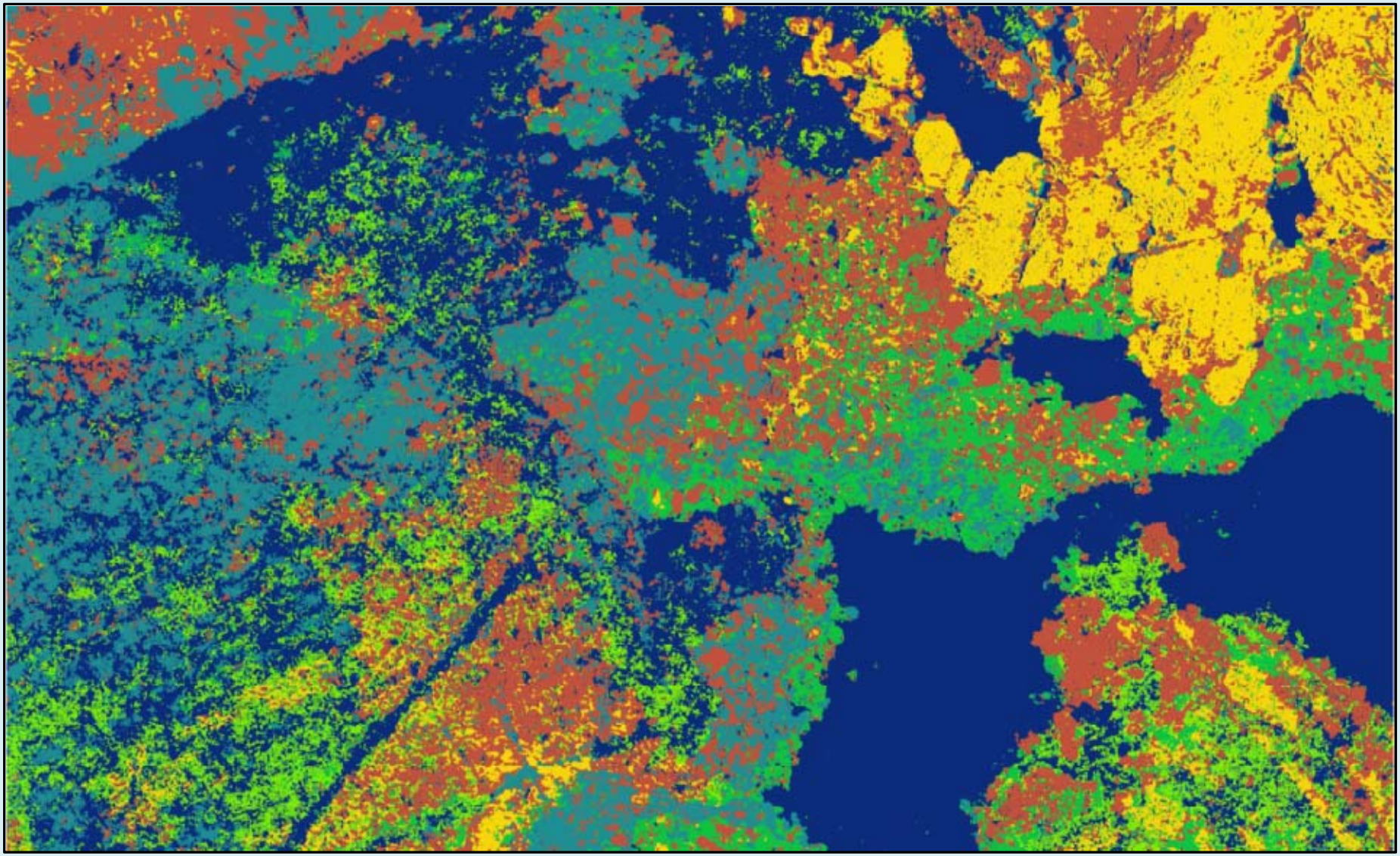
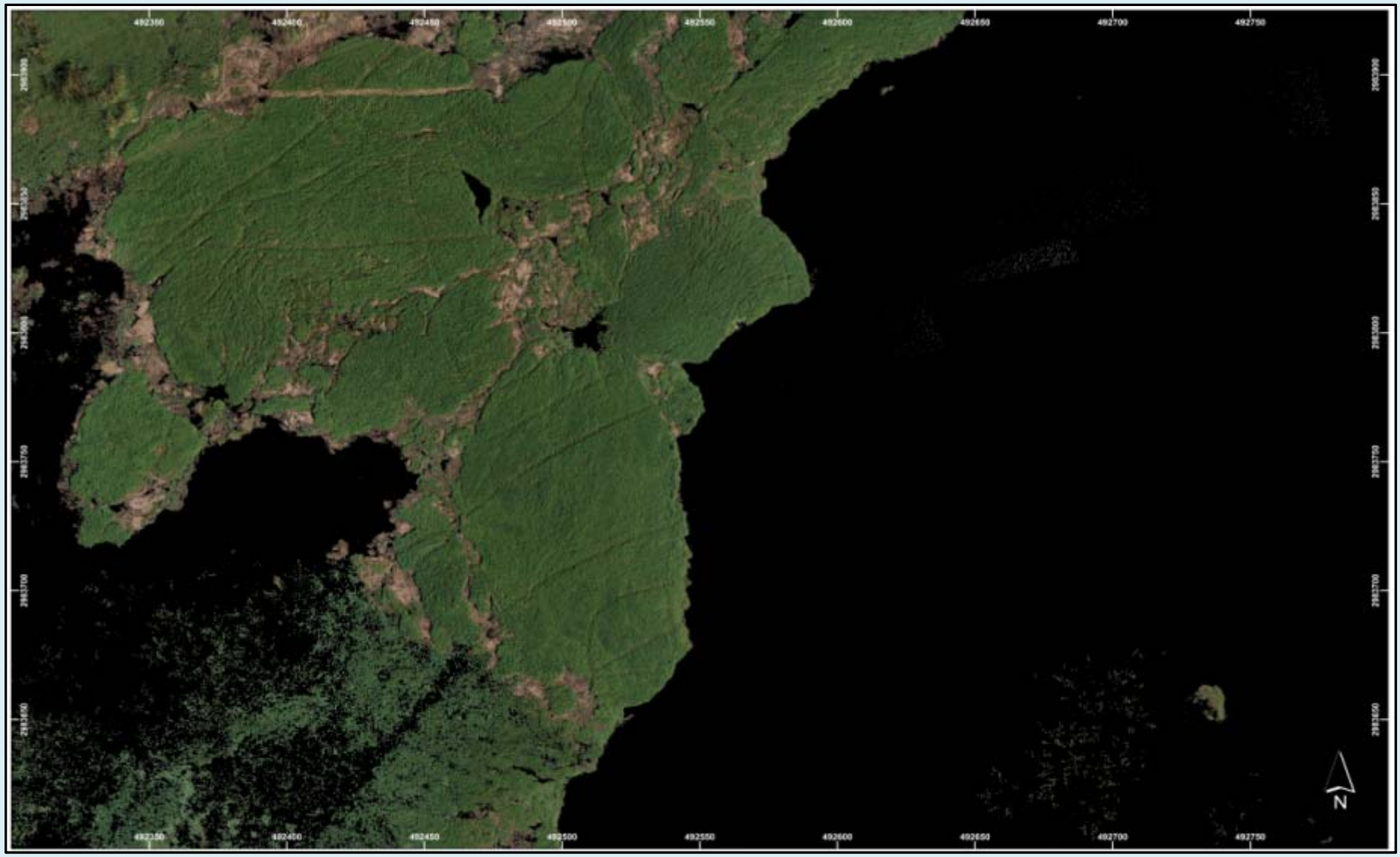


Veg. Pre-treatment Mosaic

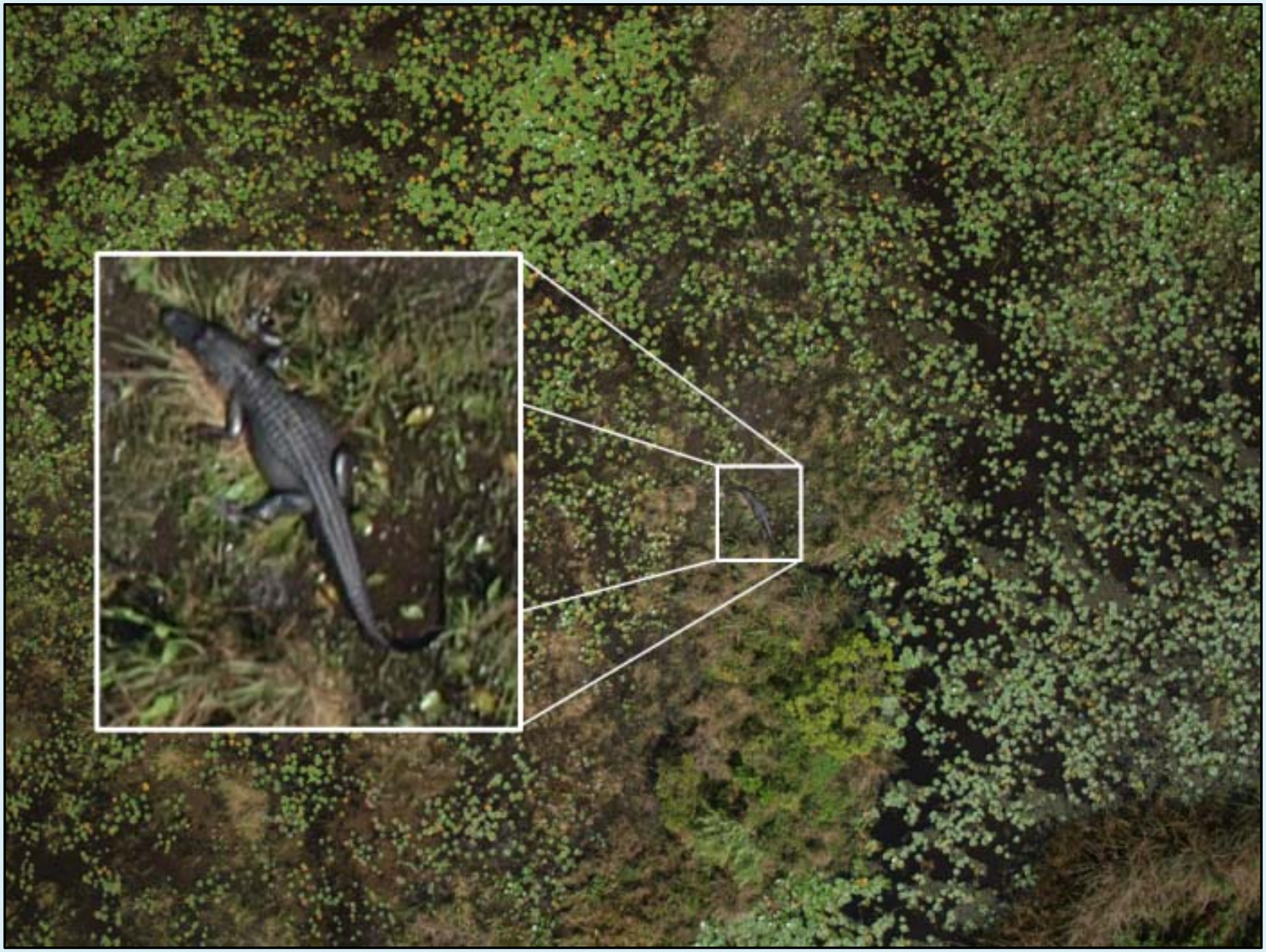
Veg. Classified Mosaic



Veg. Post-treatment Mosaic



Aerial Advantages

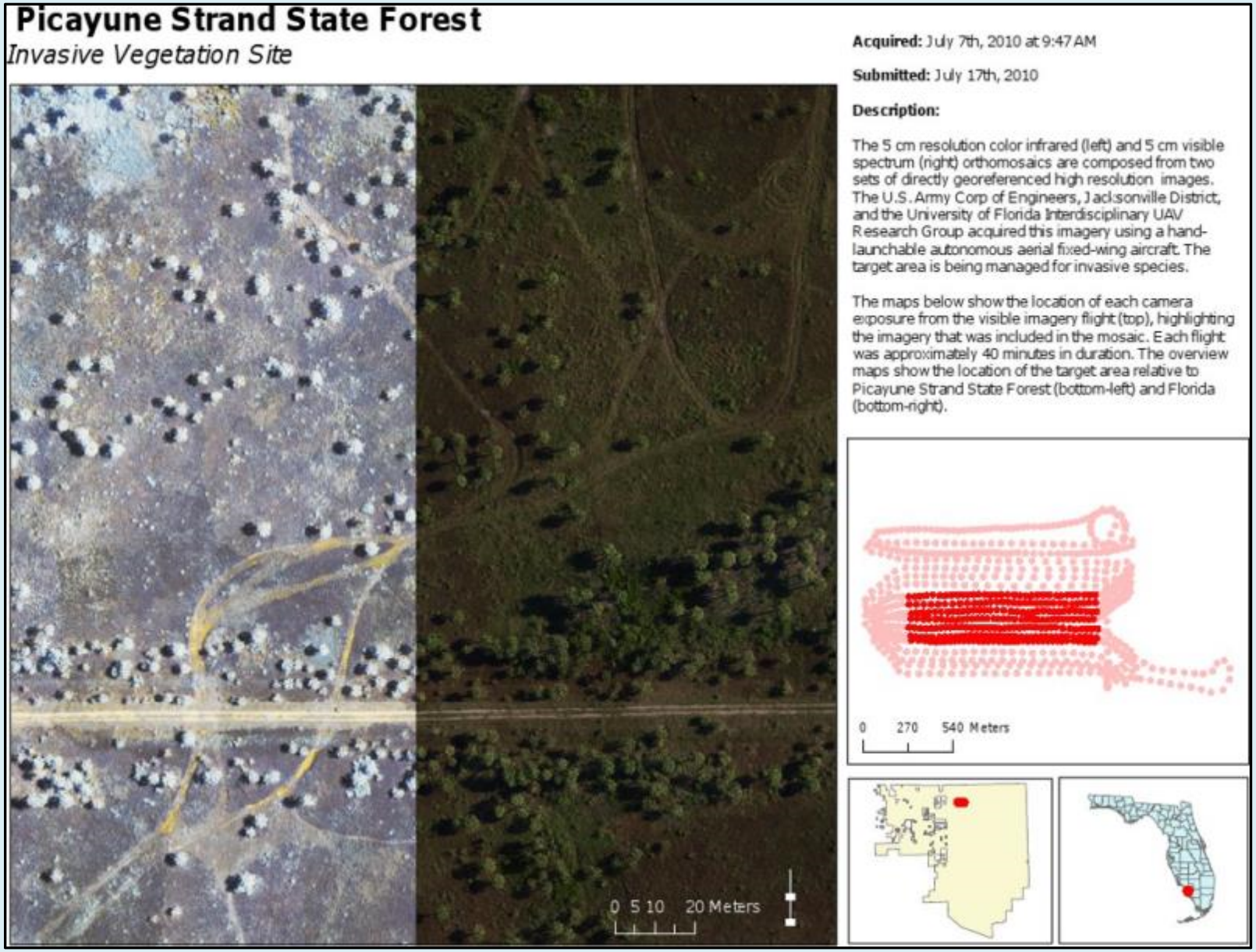


Nesting Wading Bird Colony Assessments

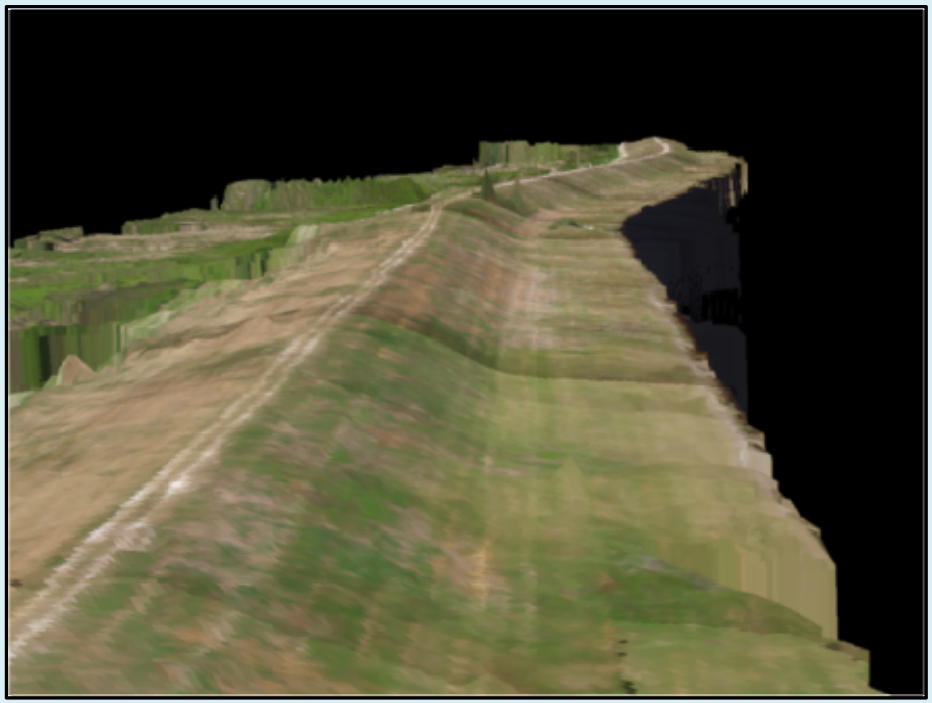
Nesting Wading Bird Colony Assessments

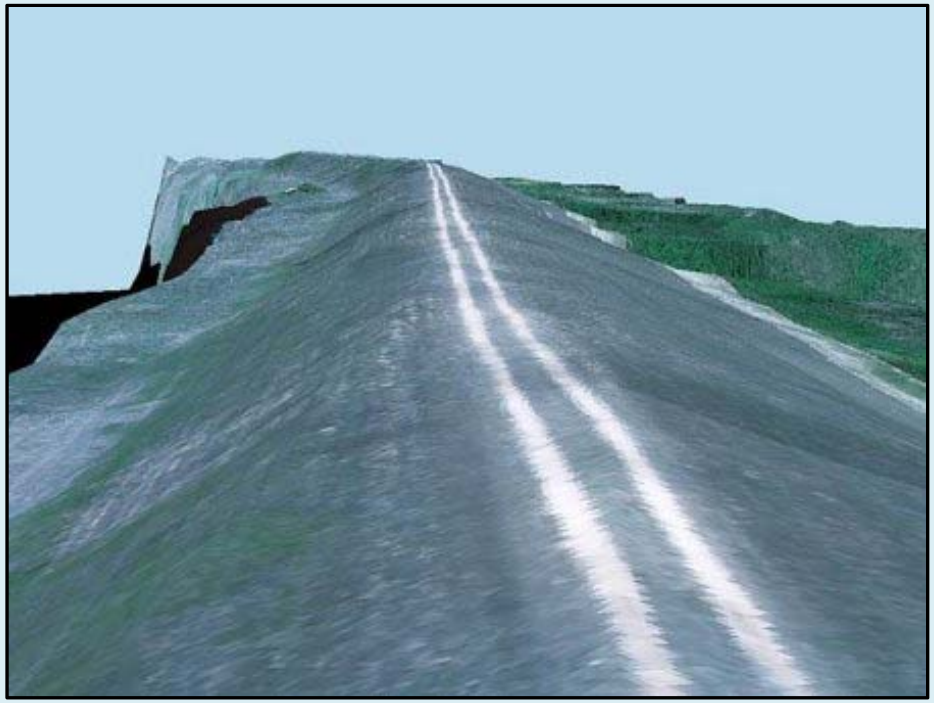
Infrastructure Monitoring

UFUASRP Multispectral Mosaics



UFUASRP – 3-Dimensional Mosaics

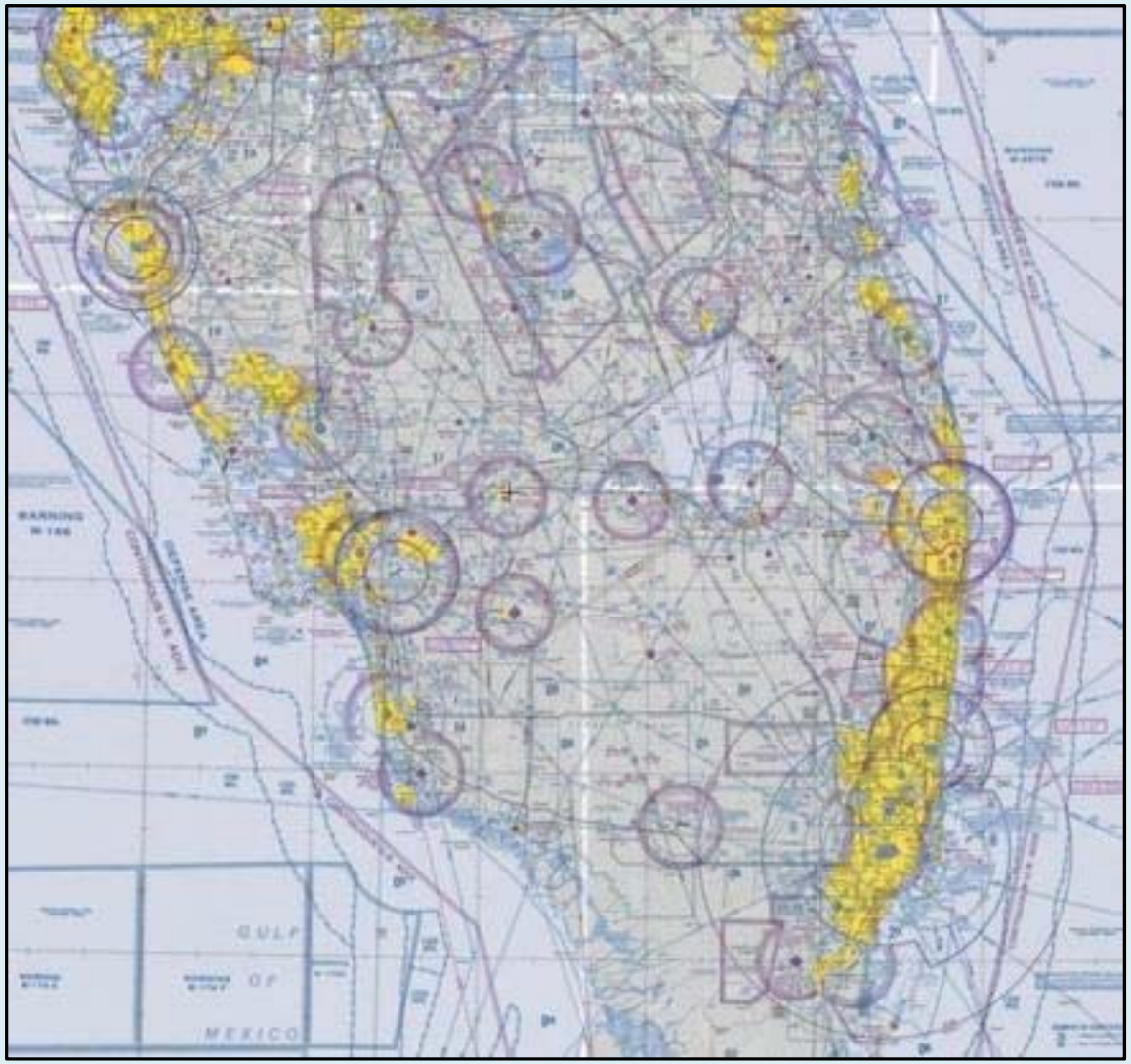




UAS Technology is Now Prolific:

Airspace Integration is Lagging

Be Patient…

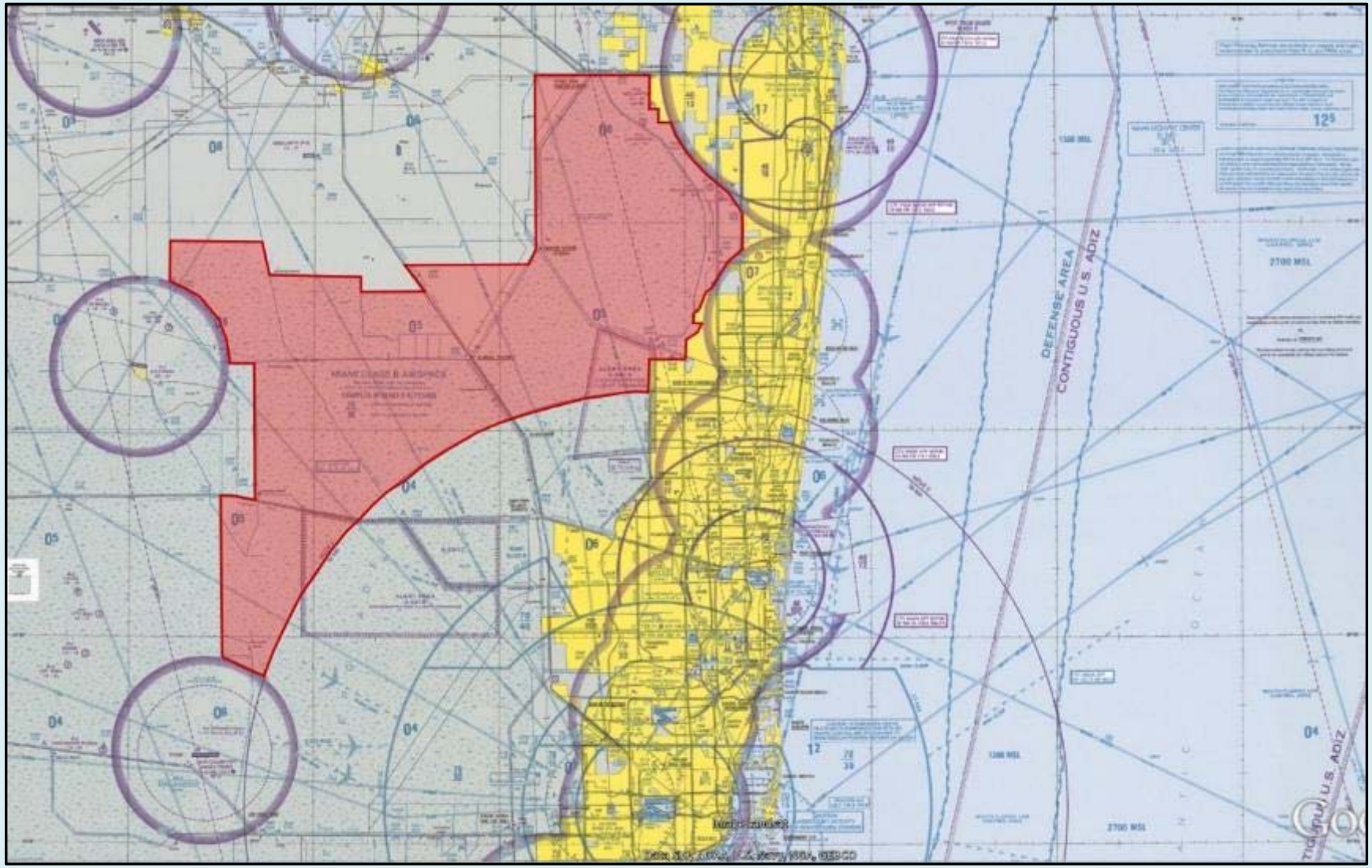


Be Patient…

Be Patient…

Thinking About Using UAS as a Tool?

Gaining Airspace Permission Can be a Significant Limitation



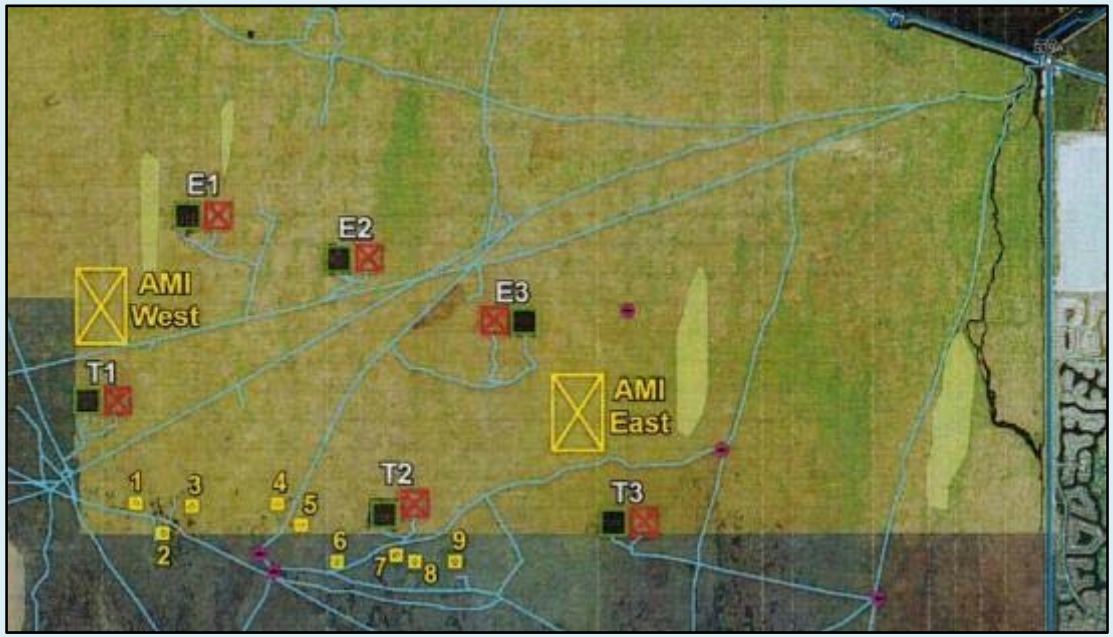
Unmanned Aircraft Systems and their Sensors Have Potential to be a Great Tool for Natural Resource Users

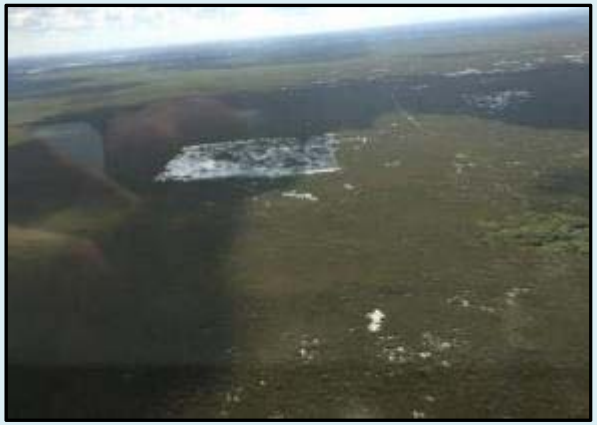
UFUASRP is Patient AND Adaptive…

Be Patient…

Active Restoration Project Monitoring

WCA-2





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Active Restoration Project Monitoring

S-152 – L-67 Sheetflow Restoration

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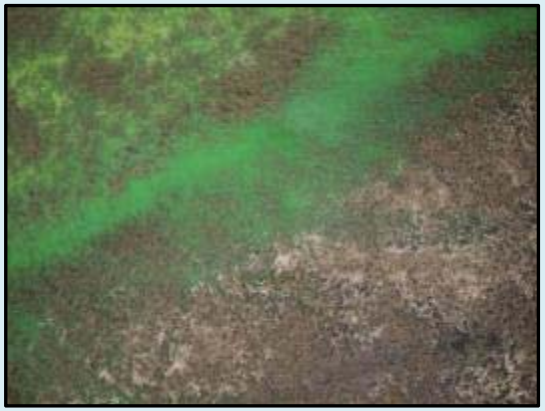
Active Restoration Project Monitoring

S-152 – L-67 Sheetflow Restoration





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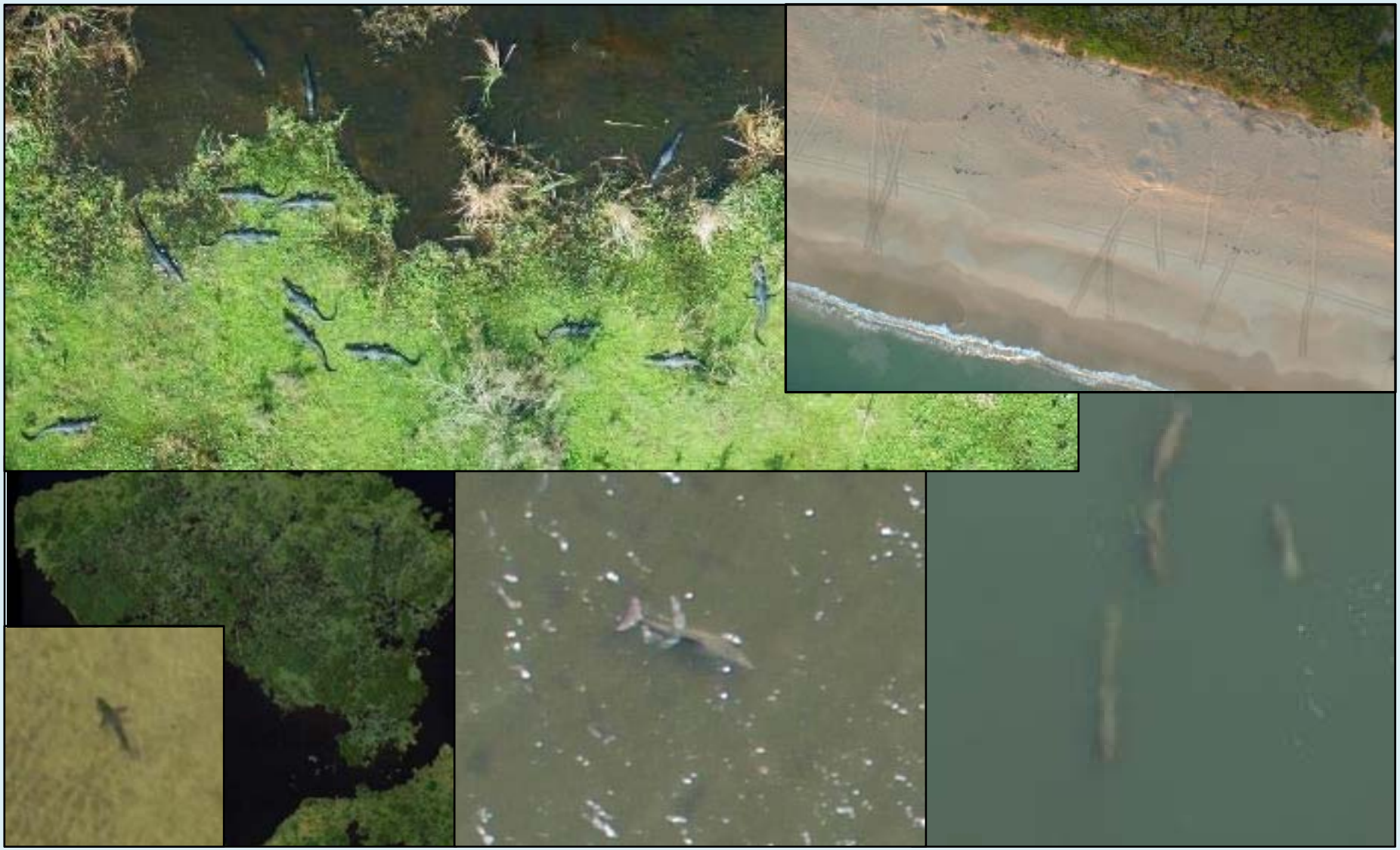
What is Your Target?



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Questions?

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