

# Unmanned Aerial Systems Technology & Applications

RS&GIS Research and Outreach Services  
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- Drones
- Remotely Piloted Aircraft System (RPAS)
- Unmanned Aerial Vehicles (UAV)
- Unmanned Aerial Systems (UAS)
- Autonomous Underwater Vehicle (AUV)
  - Drones are a tool in our tool belt. Part of a network of location based sensors
- Geographic information Systems
- Internet of Things (IoT) – Network of connected devices and smart devices
  - Devices embedded with electronics, software, and sensors connected to collect and exchange data
- Scale – What Geographic Data is right for your project?
  - Base maps, Infrastructure, landuse, ortho-photography, LiDAR

# The landscape of location-based data:

Opportunities for government to collect digital exhaust

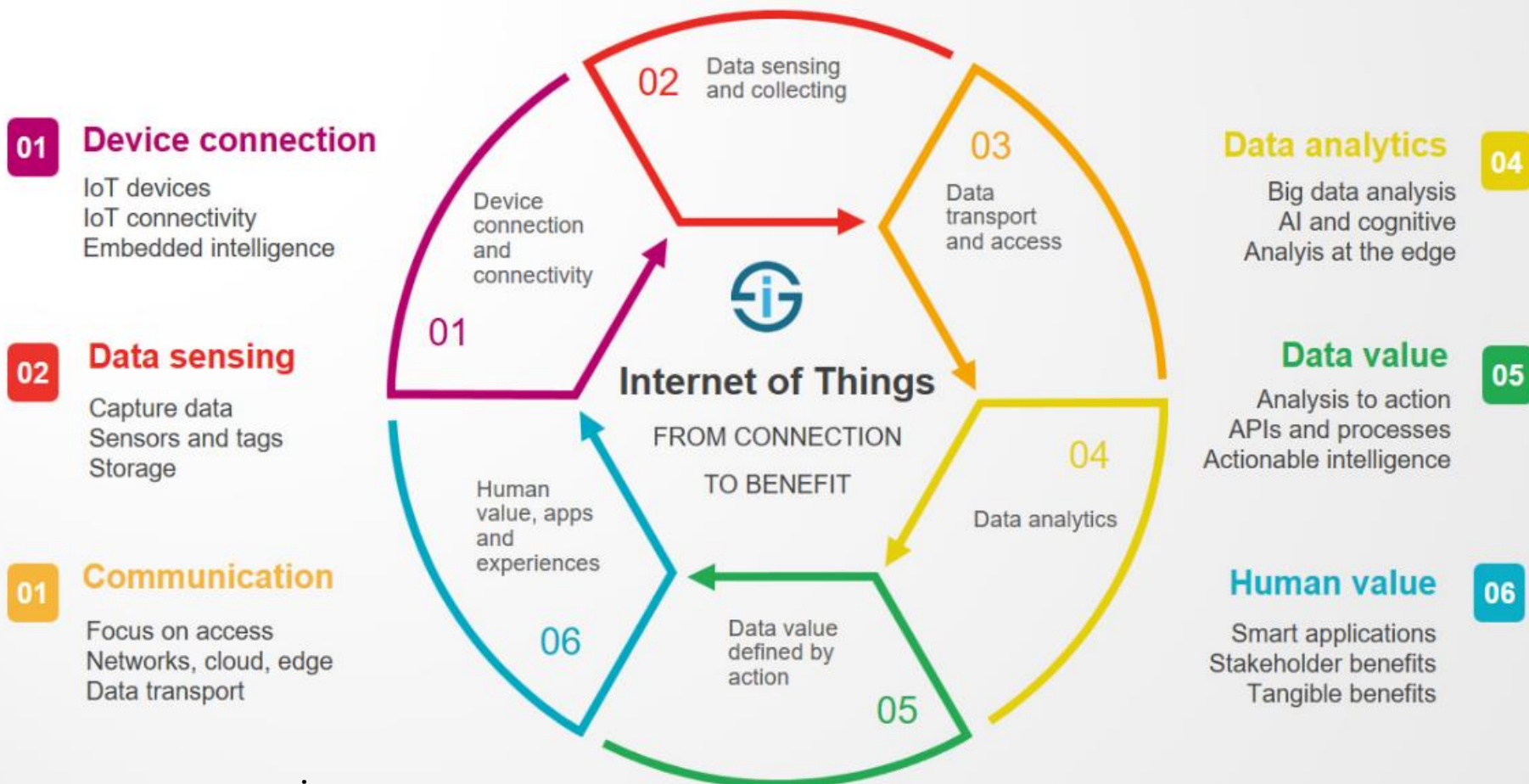


## Technologies accelerating the use of location intelligence



# The Internet of Things

From connecting devices to human value



- RS&GIS provides UAS services in the context of platform research
  - FAA-certified pilots-in-command (PIC) and Observers
  - FAA certificate of authorization (COA) application process
  - Sensor integration and project flight planning
  - Ground reference data collection (GPS)
  - Training
  - Imagery acquisition
  - Image processing



# So, you want to fly drones?

- You **must** possess a Remote Pilot Certificate from the FAA (unless you are flying strictly as a hobby)
  - Adhere to Part 107 of the Federal Aviation Regulations
  - Register your aircraft with the FAA
- <https://www.faa.gov/uas/>

Under 400'  
AGL

Outside restricted  
airspace

Etc.

Line of Sight

Drone < 55 lbs.

# What is a Drone?

- In the context of this talk, Drones are aerial platforms that either fly semi-autonomously or manually
- Extra-small → Small → Large → Extra Large
- Commercial, Prosumer, Recreational
- Size is determined by application

FAA says OK  
≤ 55 lbs.

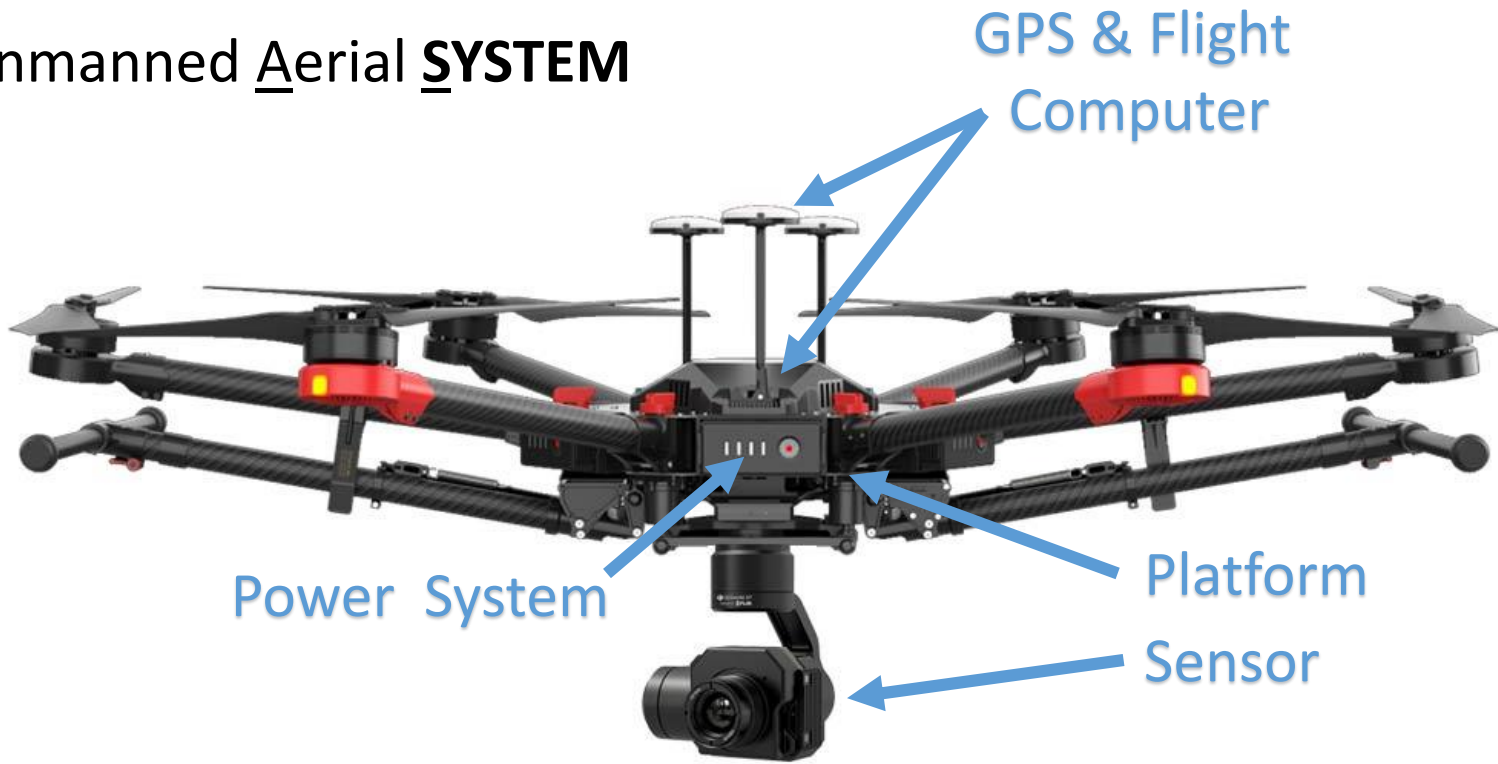






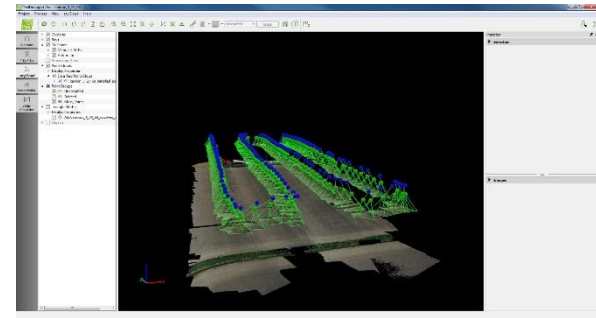
# What is a UAS?

- Unmanned Aerial SYSTEM



Ground Station / Planning Software

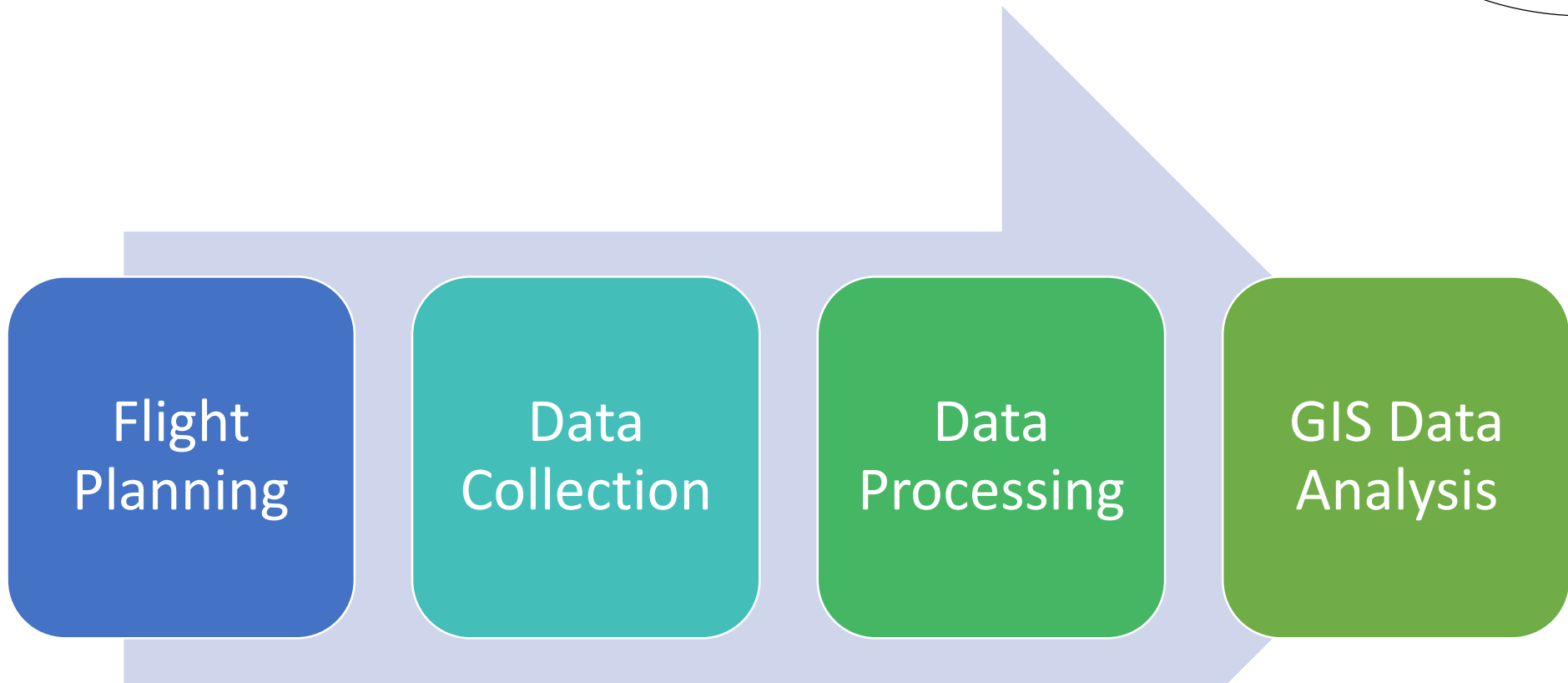
Data Processing Software GIS/RS



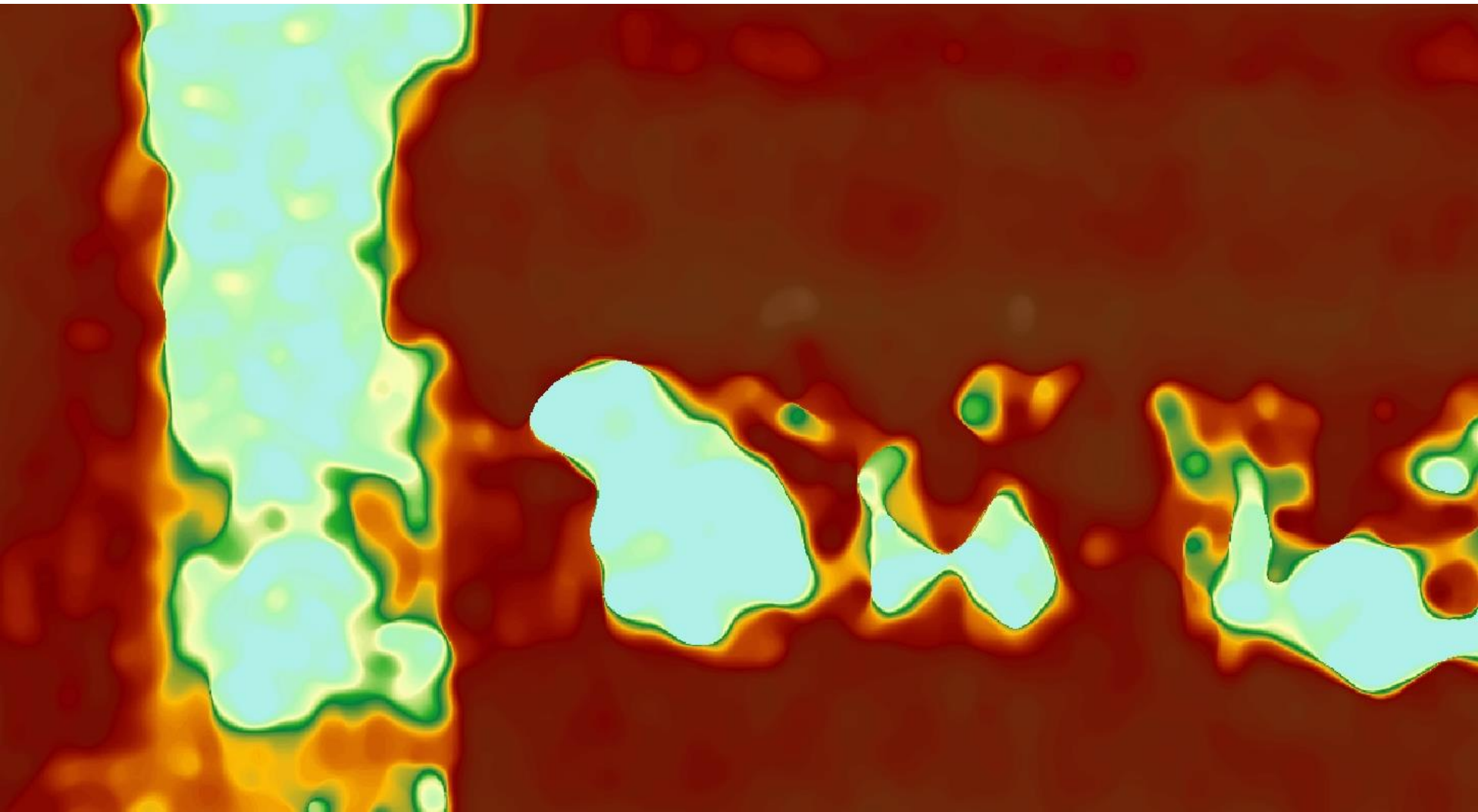
# UAS Sensors (a sampling)

- Standard point-and-shoot & SLR
- Action video cameras (GoPro)
- Multi-spectral cameras
- Thermal sensors
- Custom Video cameras
- Laser Scanners

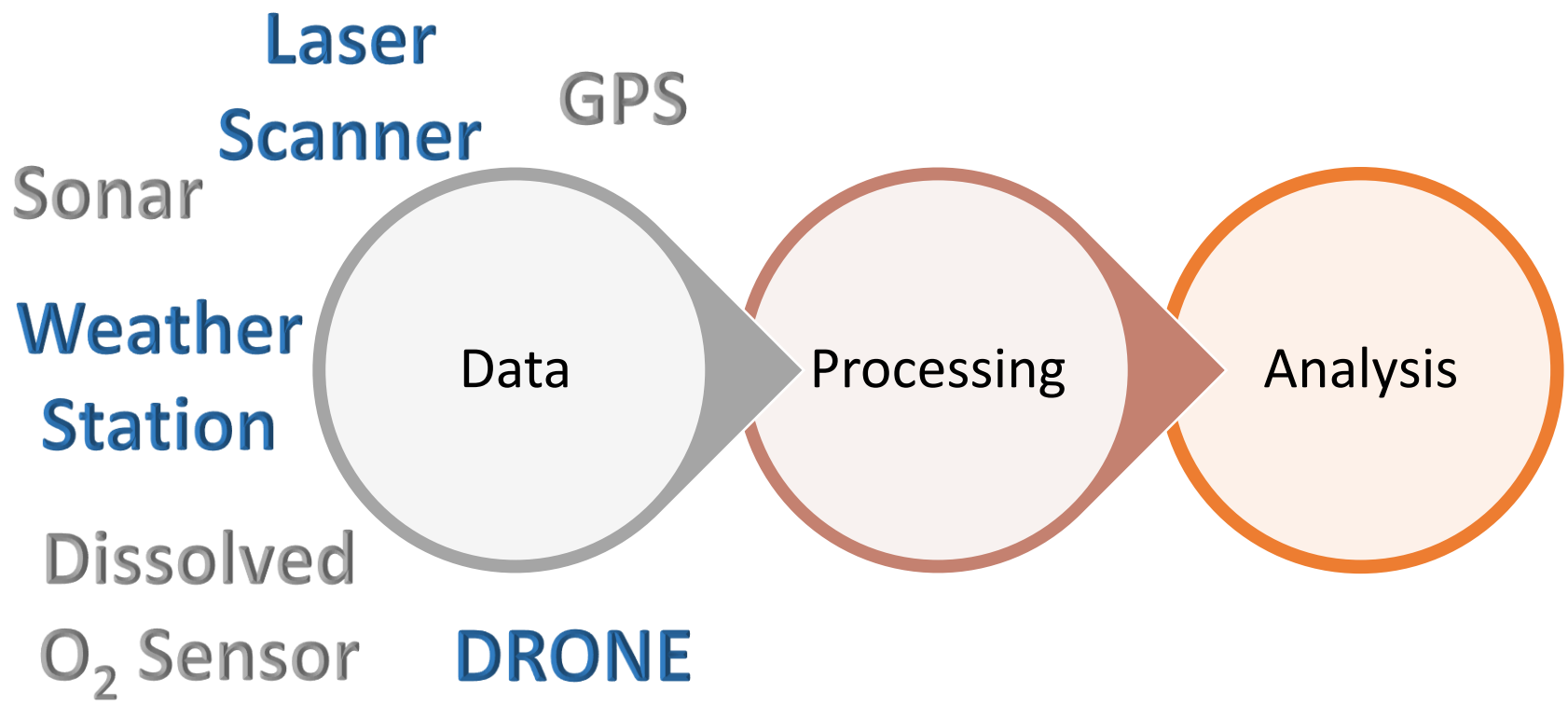




Hands-On Drone to GIS Training from RS&GIS  
and Northwestern Michigan College  
April, May, June, August, September  
[www.rsgis.msu.edu](http://www.rsgis.msu.edu)

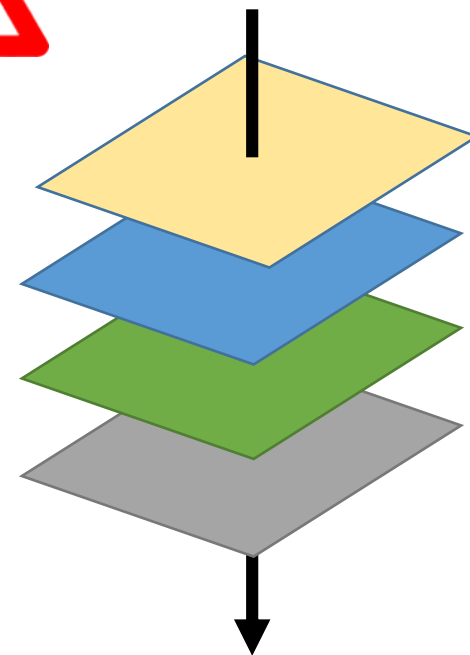


# Drones are just a tool for collecting data



# When are UAS most useful?

- Get data NOW!
- Get data Often – Multi-temporal
- Difficult or Limited Access
- Need a Different Perspective
- High Resolution





Engineering  
Surveys

Site Management  
and Progress Reporting

3D Surface  
Compilation

Crop Health

Utility Inspection

Stream, River &  
Drain Inspection

Reconnaissance

Point-Source  
Pollution ID

Vegetation  
Sampling

Aquatic Vegetation  
Mapping

Emergency  
Services

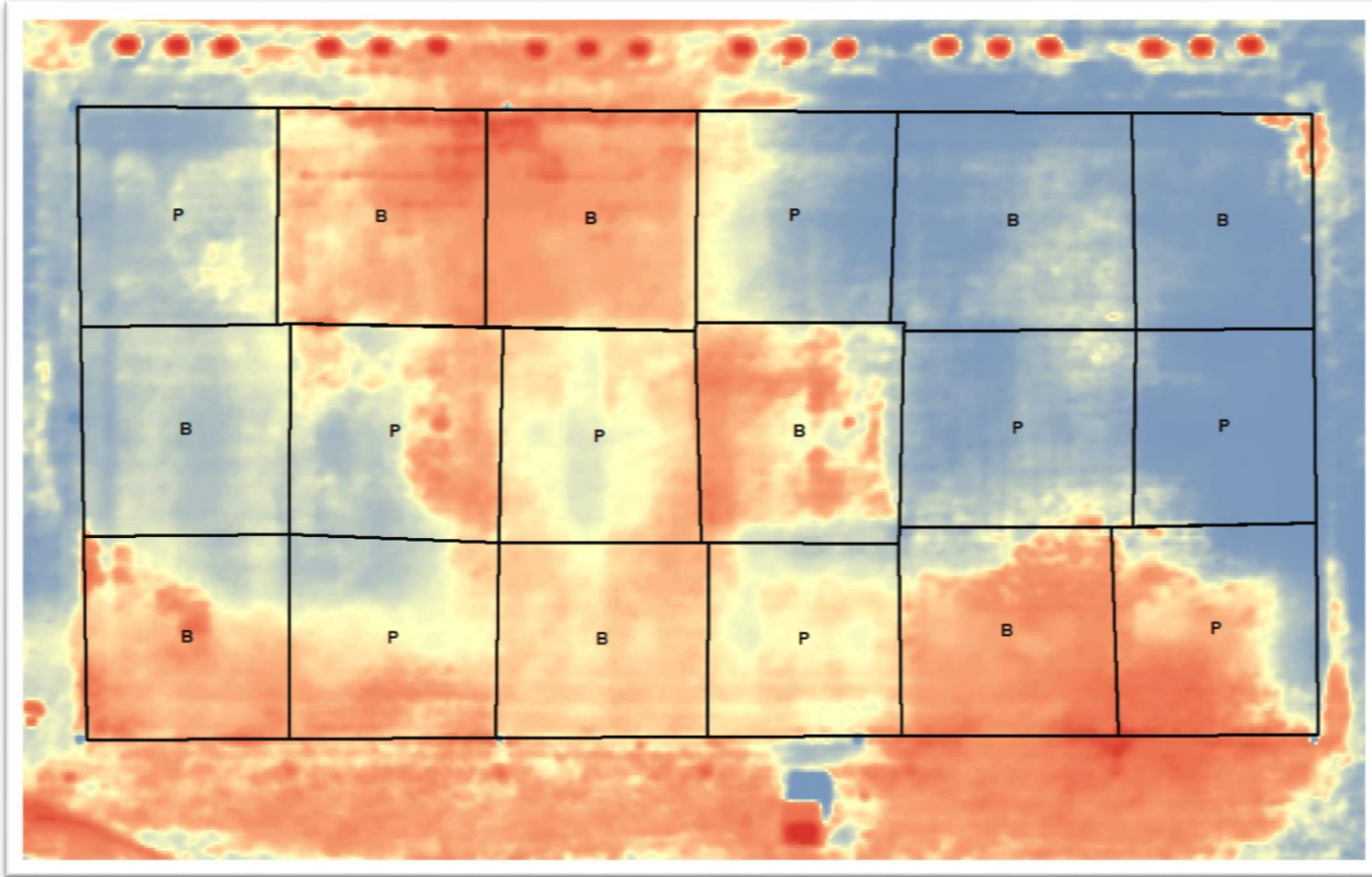
Marketing

Asset  
Collection or  
Identification

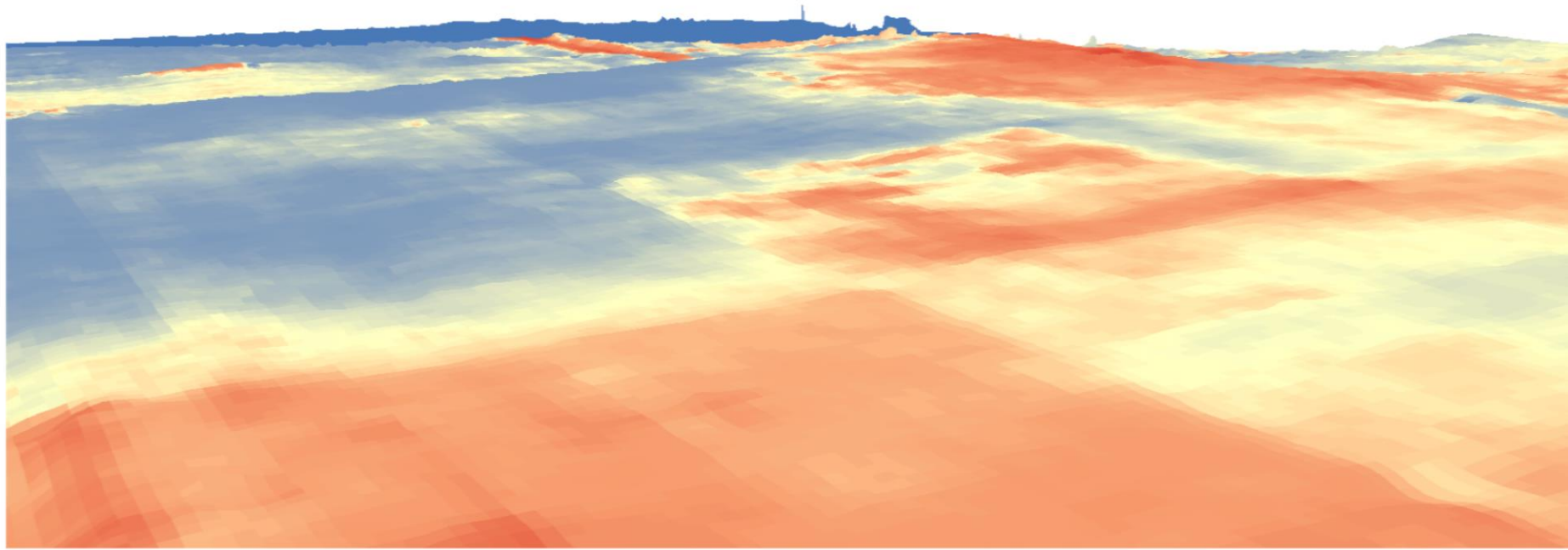
Wildlife  
Surveys



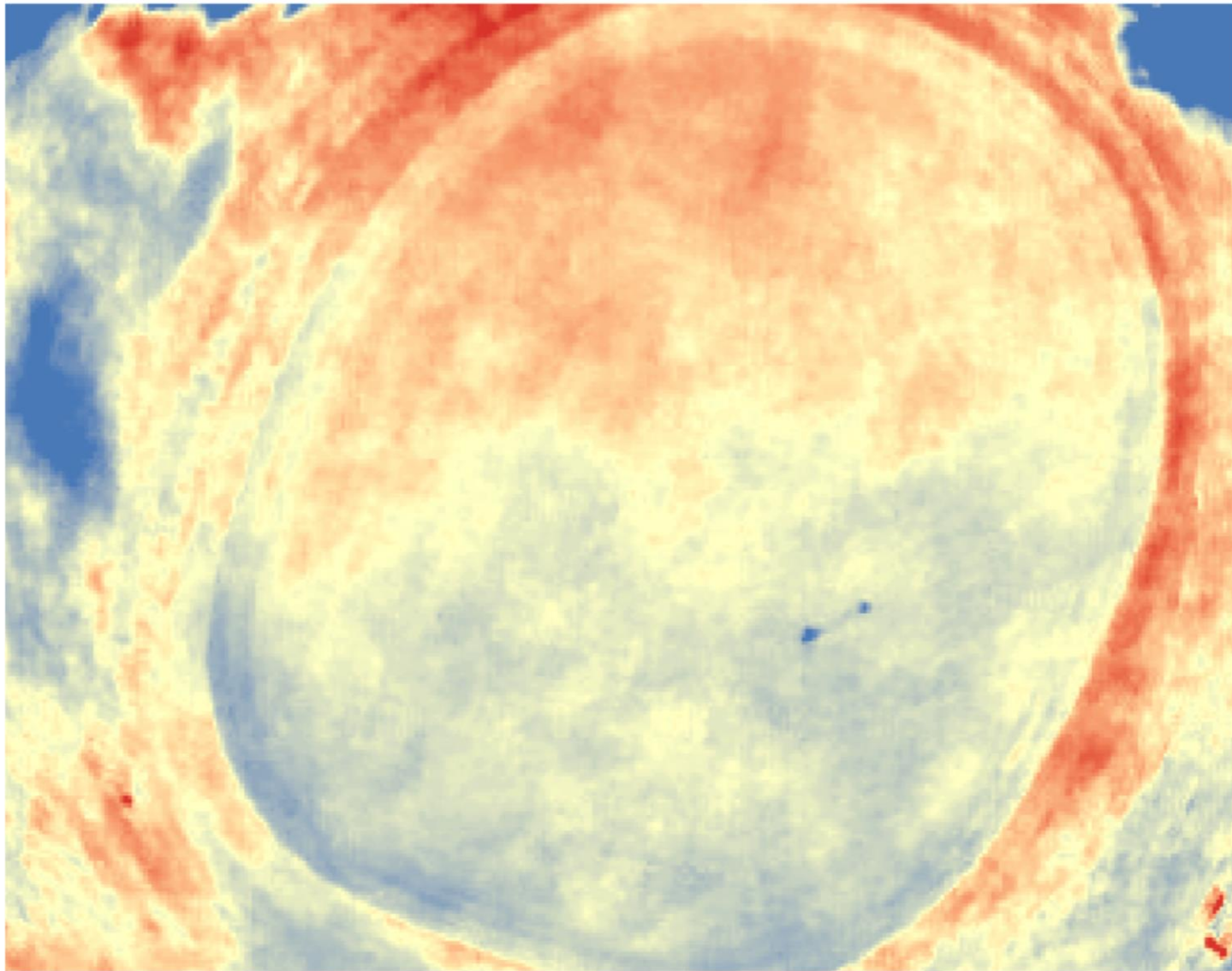
- Studying the relationship between moisture content and turf temperature

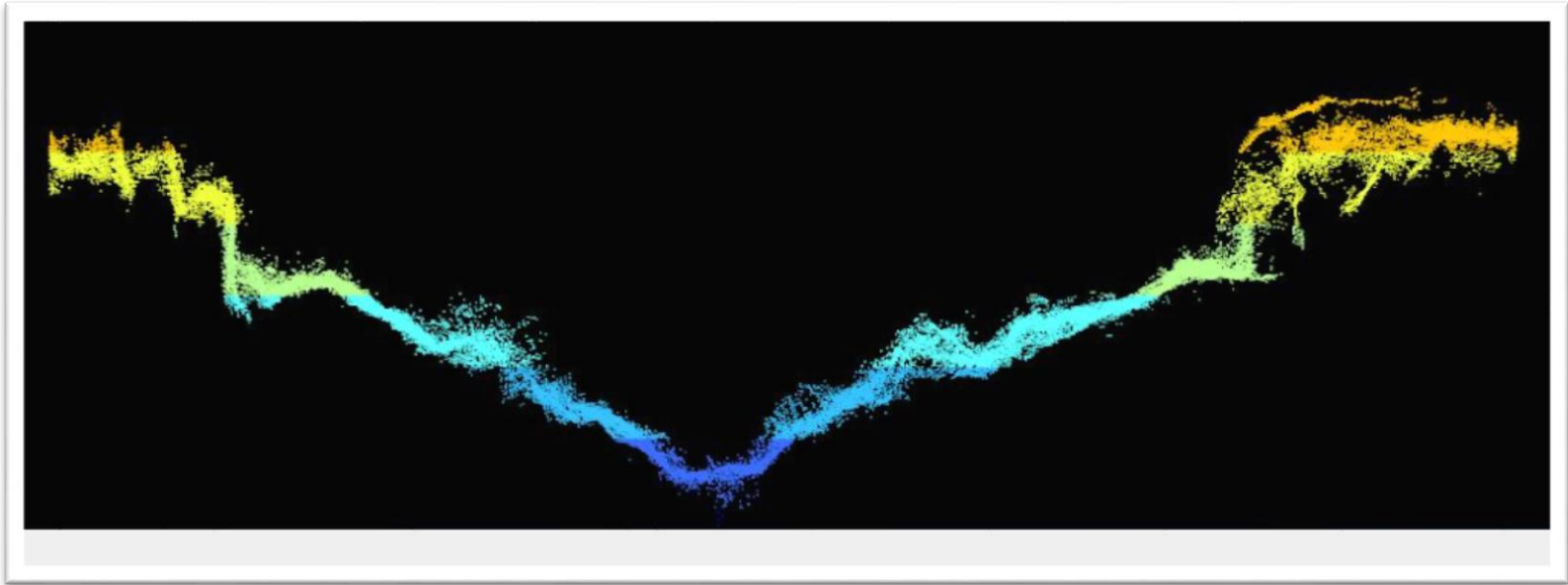


Elevation differences of a few inches show differences in temperature

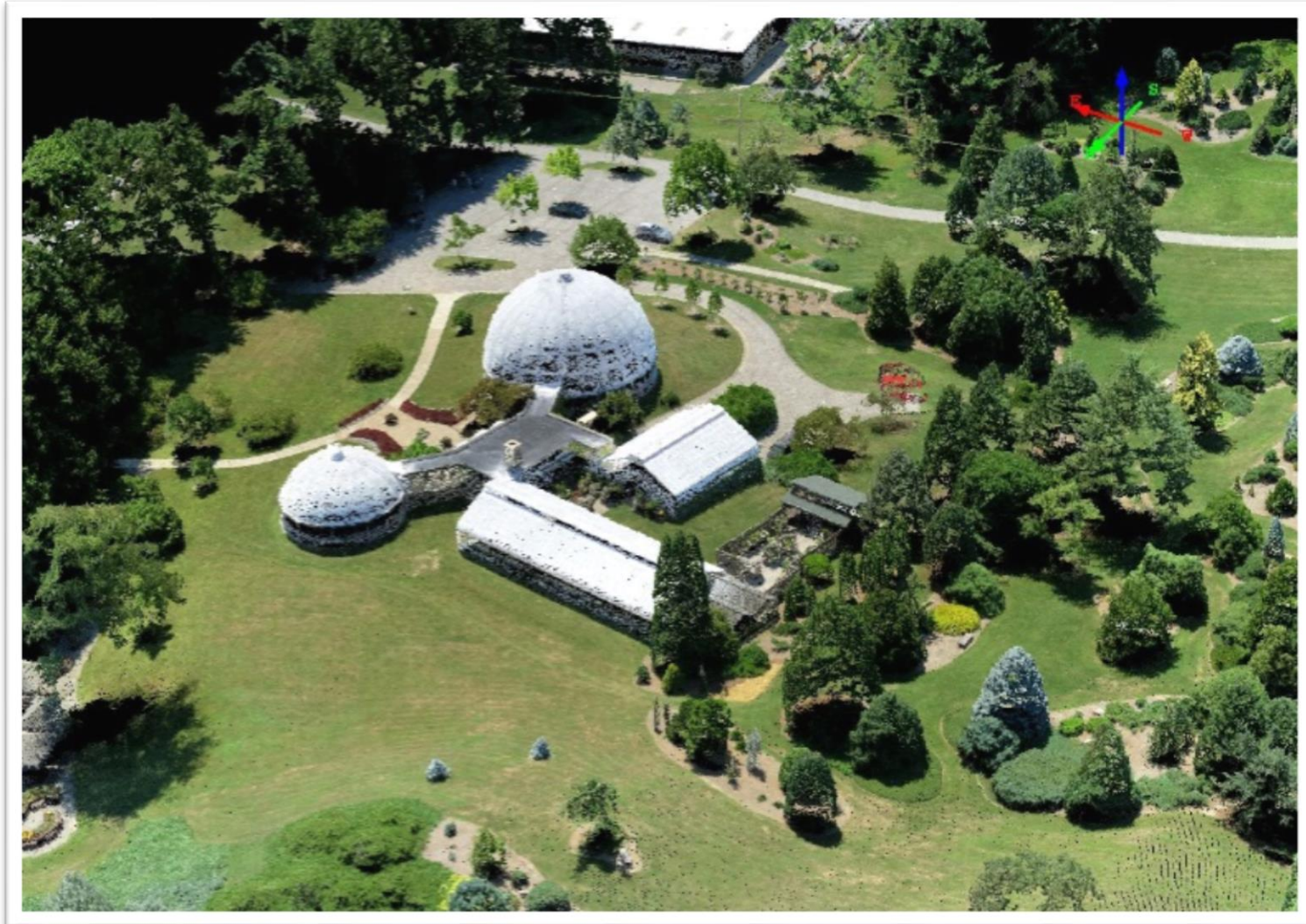


# Turf Research – UAS + Thermal IR



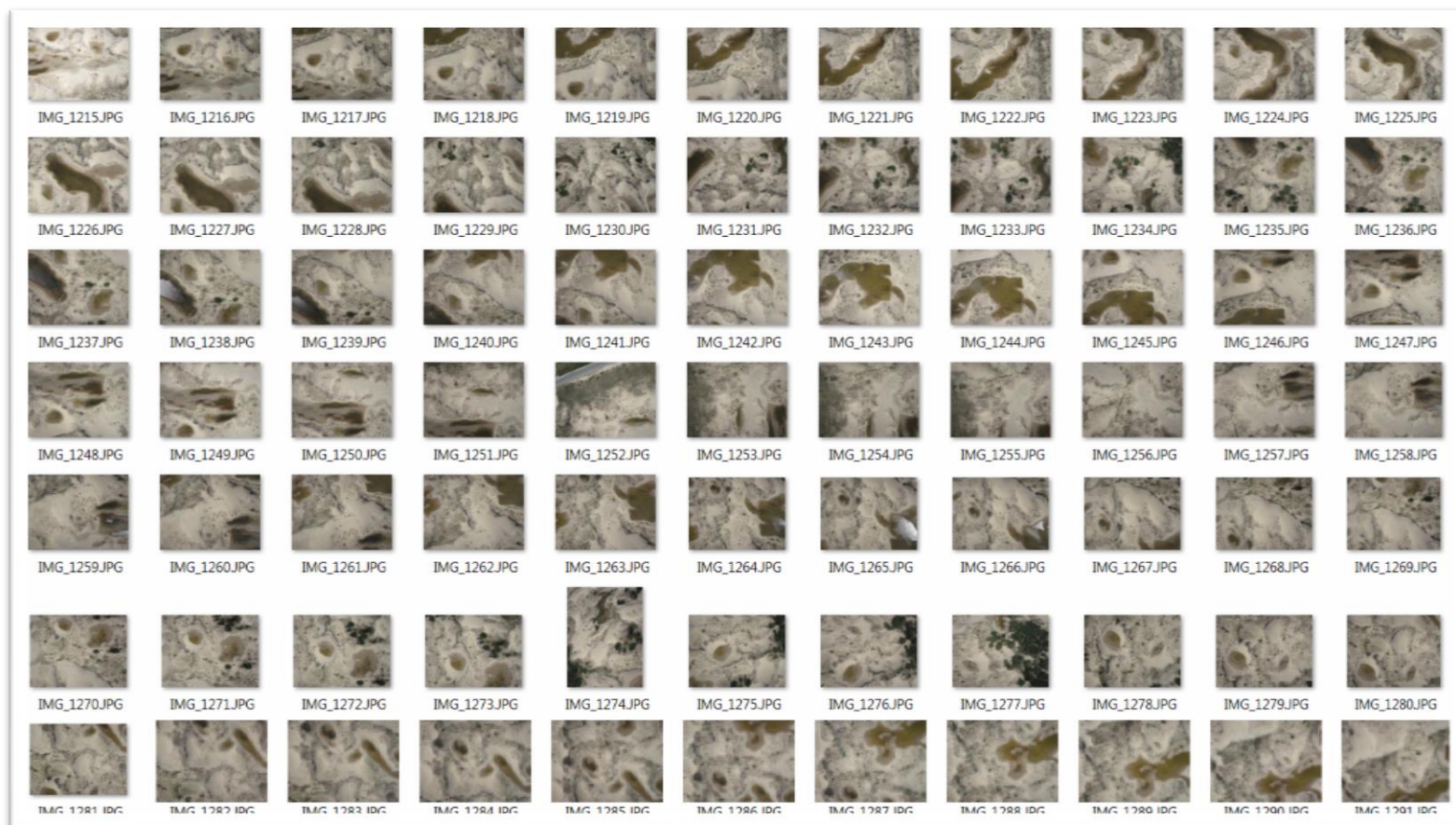


# 3D Analysis & Modeling

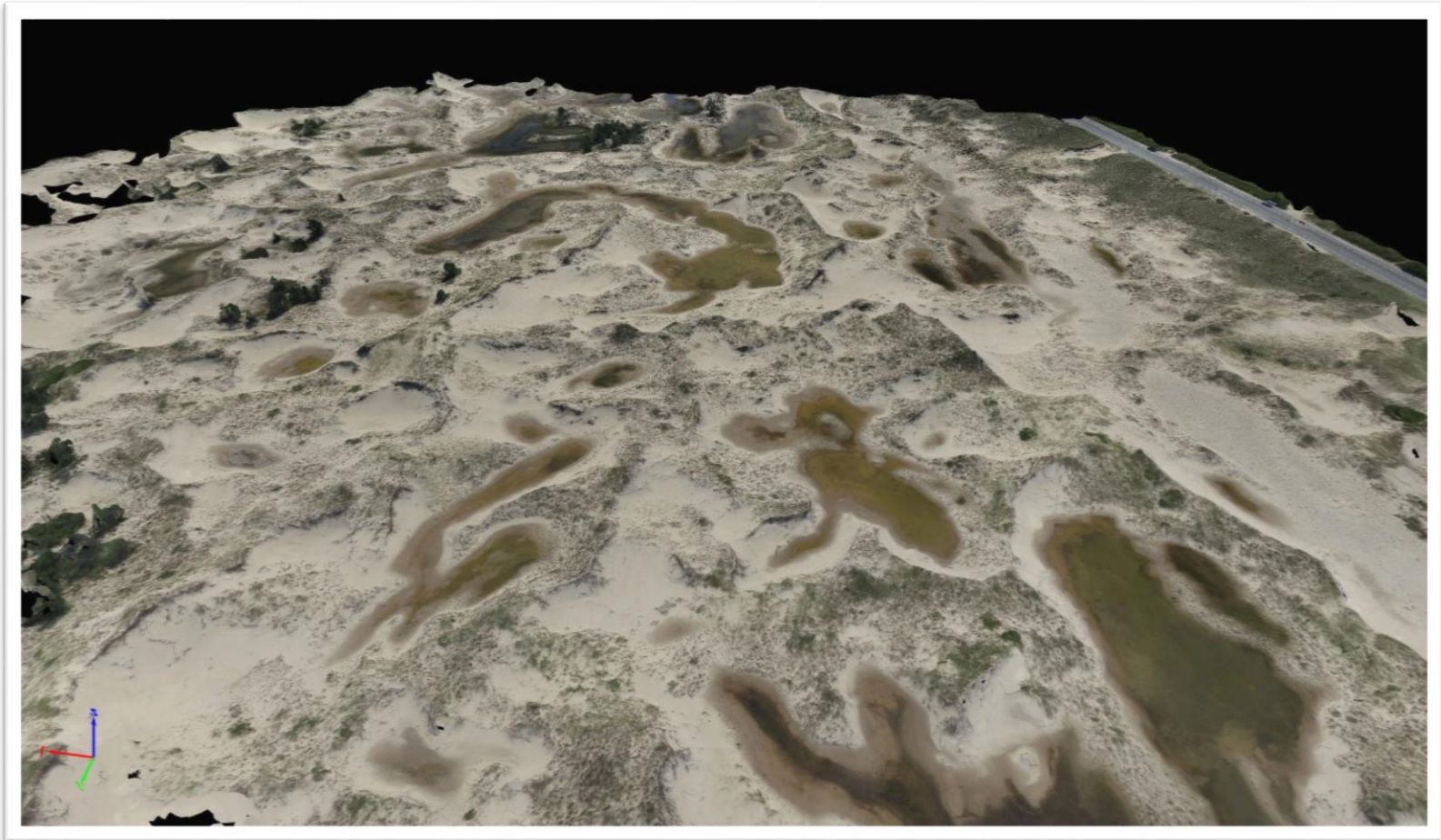


# 3D Modeling of Sand Dunes

- Generating Mosaics and Point Cloud Data for Dune Systems from Overlapping Photographs (PhoDAR)



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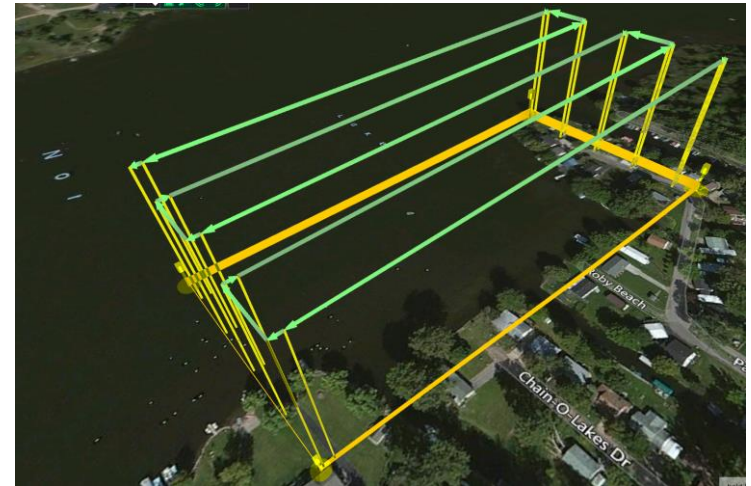


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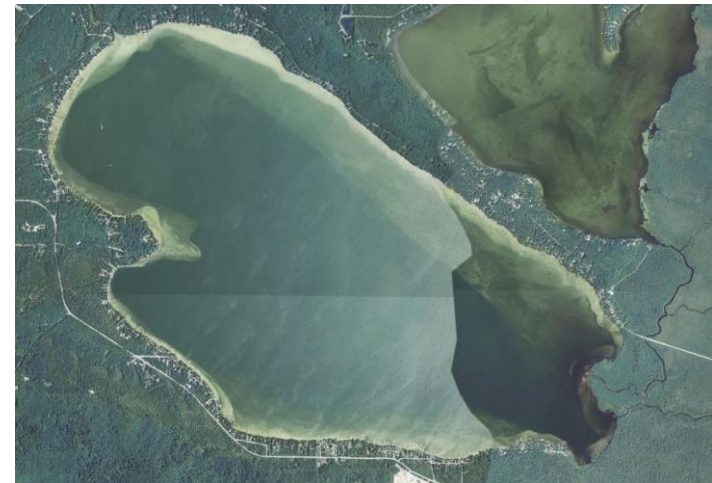




- Stream Inspections
- Water Sampling
  - [Water Sampling Drone](#)
  - [Splash Drone Video](#)
- Macrophyte and Algal Bed Mapping
- Locating septic failures
- Bathymetric Mapping
- Precise chemical application (laws may prevent this currently)



- Lack of recognizable points
  - To reference imagery of earth objects, it is necessary to have recognizable points visible on the imagery – VERY difficult over large water features
  - Points are used for tying/mosaicking images together
  - Buoys could be used as “Tie Points” but they would need to be made stationary both horizontally and vertically
  - Water color is highly variable, making image color-balancing difficult

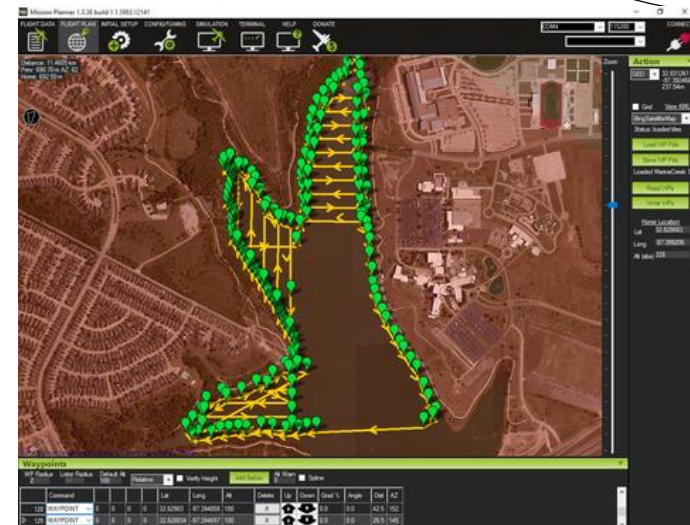


# Mapping Macrophyte or Algal Beds

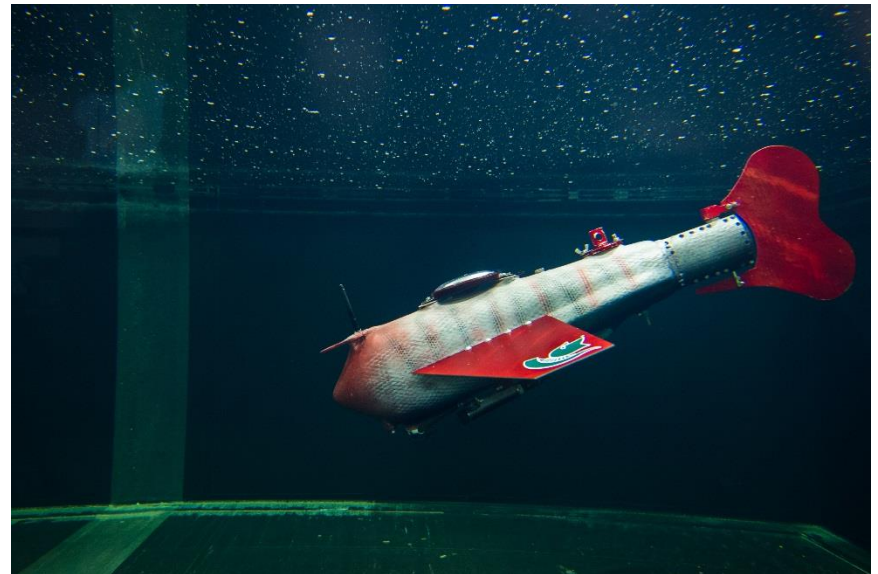
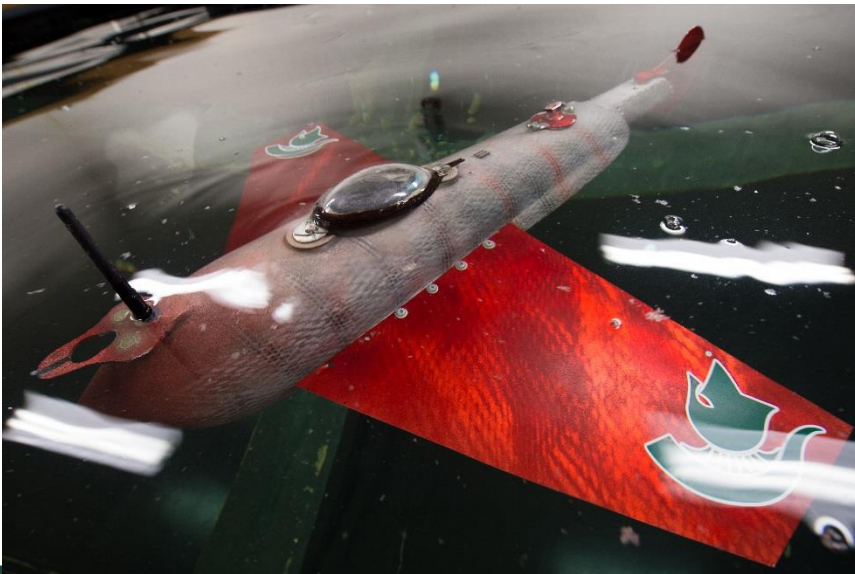


# Water Drones

- Drones may also be boats or submarines
  - No need to be airborne
  - Long collection intervals
  - Sea-worthy
  - Integrate Water Quality payload, sonar, video and more



- Collaboration between Engineering and Zoology
  - Xiaobo Tan and Elena Litchman
  - Sensors record temperature, dissolved oxygen, pollutants and harmful algae to name a few
  - Also is developing electronics so the devices can navigate and communicate in their watery environment.



An aerial photograph of a river winding through a lush, green forest. The river is the central focus, with dense trees on both banks. In the background, rolling hills are visible under a cloudy sky. The overall scene is a natural, scenic landscape.

# Questions?

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