

Project for the Strengthening of Spatial Data Infrastructures in Member States and Territories of the Association of Caribbean States

Capacity Building Program

Geographic Information Systems

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Topic 4: Augmenting Data Acquisition using sUAV

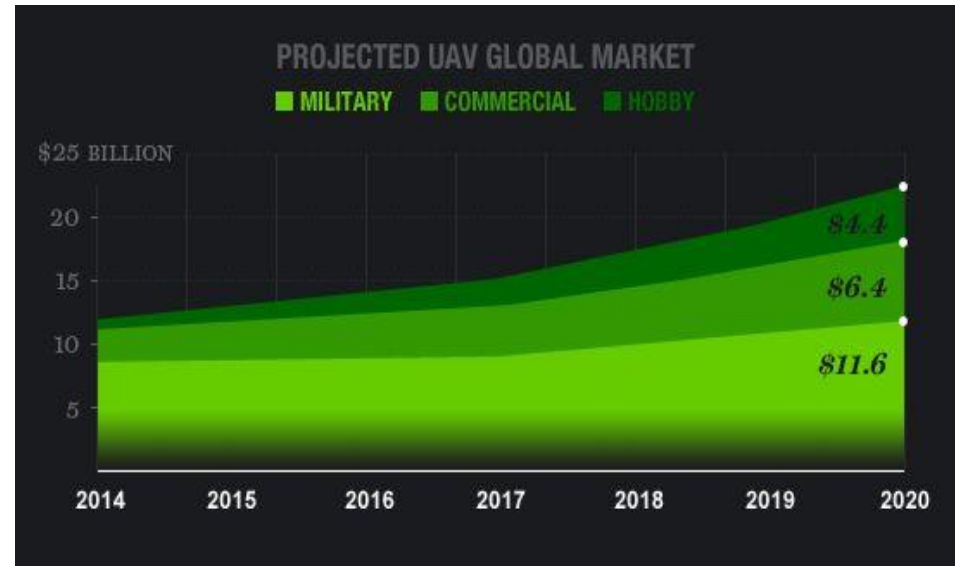
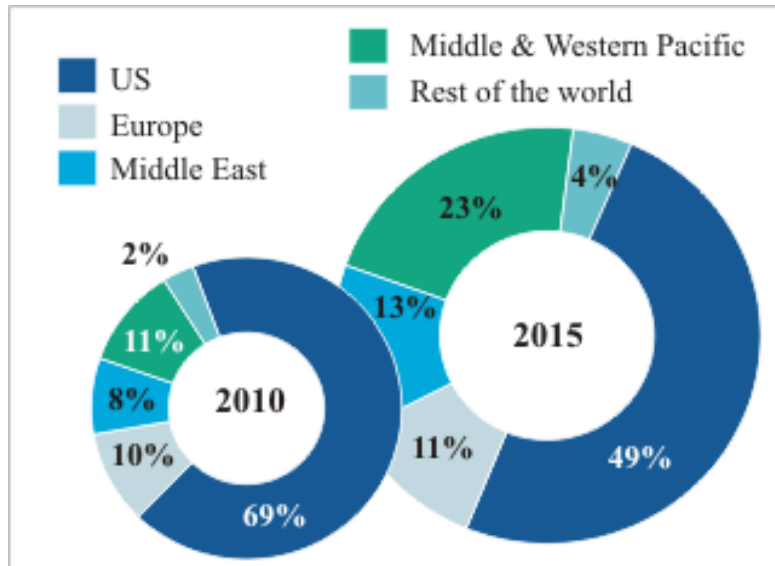
Topic Outline

- Introduction to Unmanned Aerial Vehicles (UAVs)
- UAV Components
- Which UAV is Right for me?
- UAV Applications
- Mapping Workflow
- Regulatory Aspects
- Using sUAV: Caribbean Examples
- Demo: UWI Campus Imagery

Unmanned Aerial Vehicle (UAV)

- They are known to most as **Drones** but in Geomatics they are referred to as **UAVs**.
- **Other names:** Remotely operated Aircraft; Micro Aerial Vehicles; Unmanned Combat Air Vehicle (UCAV); Small UAV; Low Altitude deep penetration UAV; Low Altitude Long Endurance UAV; and Medium Altitude Long Endurance UAV.
- A **UAV**, however, is a generic aircraft designed to operate with no human pilot onboard -(<http://www.uvs-international.org/>).
- There are also more complex systems known as **UAS** which are **Unmanned Aerial Systems** . They are composed of the aerial vehicle or platform UAV and the Ground Control Station.

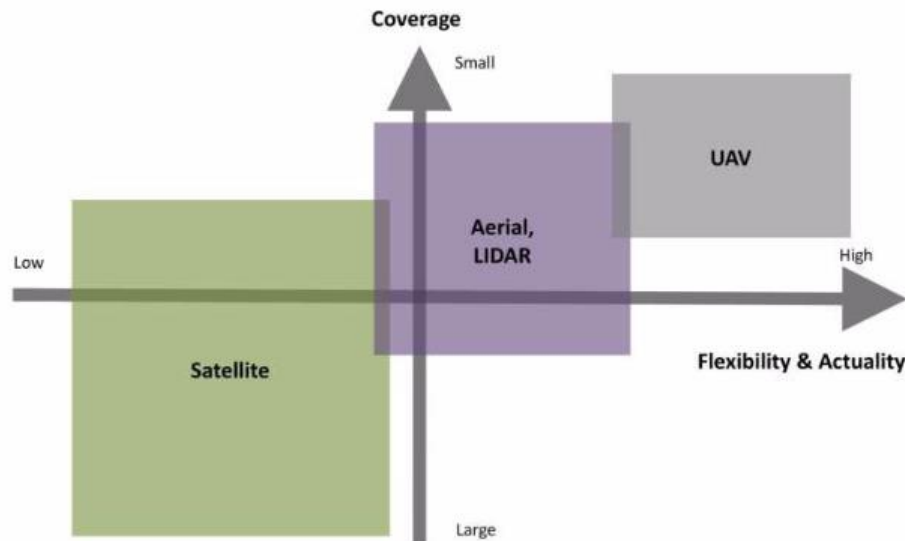
Global UAV Market



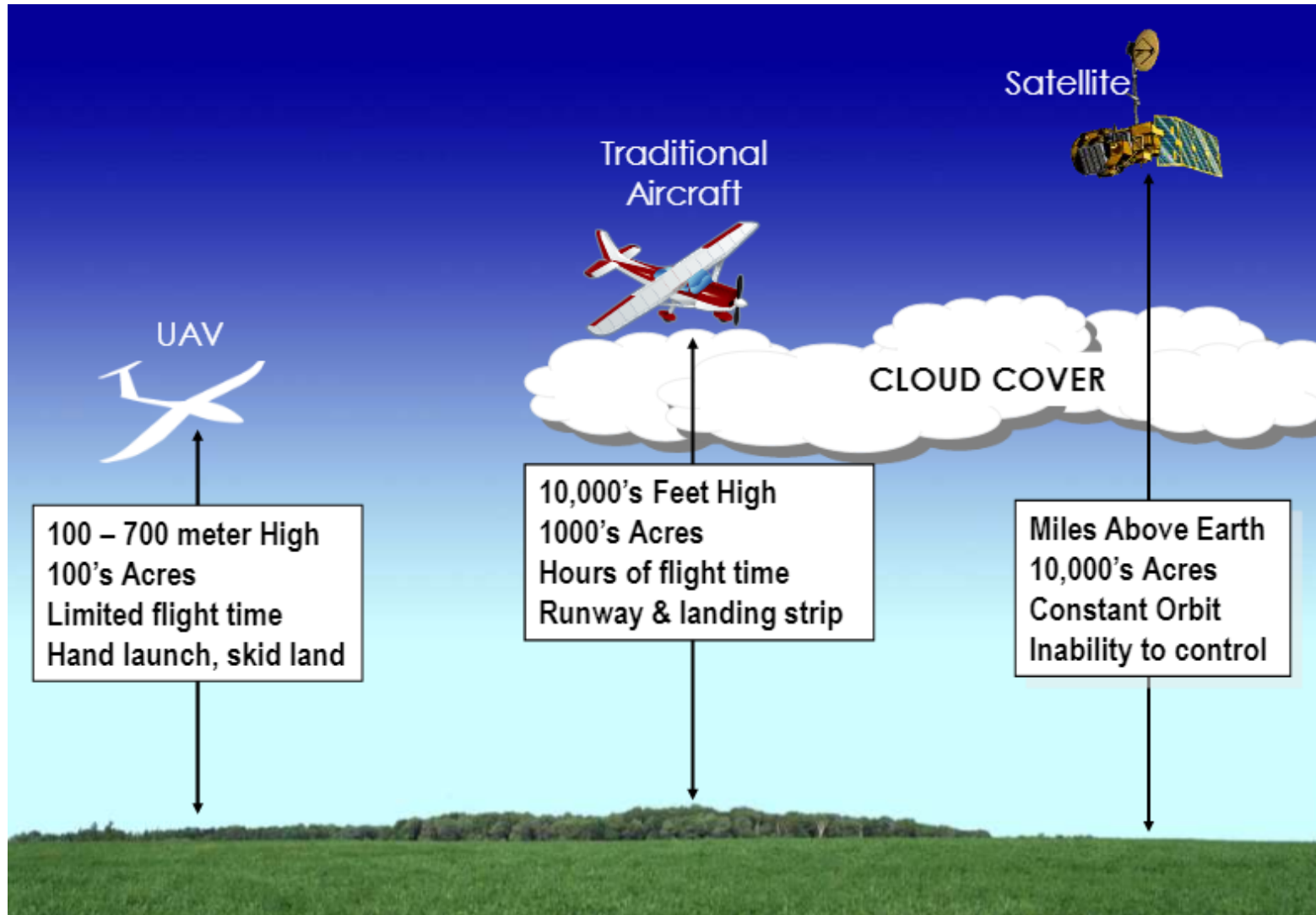
UAV Classification

Category	Weight(kg)	Altitude (ft)	Endurance (hr)	Range (km)
Micro	< 1	300	1	< 5
Mini	< 25	< 10,000	1-6	< 25
Close range	< 200	< 15,000	4-8	< 75
Small range	< 750	< 25,000	8-24	< 200
Male	> 1,000	< 30,000	> 24	> 1,000
Male +	> 3,000	> 30,000	> 24	> 1,000
Hale	> 3,000	> 45,000	> 24	> 1,000

Where does it fit?



Where does it fit?



Where does it fit?

- New emerging Technology well suited for Surveyors
- Complementary to Traditional Surveying technologies and to Traditional Photogrammetry
- Lower cost of entry into the Photogrammetry solution
- Rapid deployment
- Instead of years between data sets it can be Days!

Benefits

- UAVs offer the unique ability for users to capture their own data, in their own time frame
- Battery and optical technologies have evolved, allowing for larger areas to be captured at higher resolutions.
- Turnaround time is a few hours, instead of days, weeks, or months when compared to traditional delivery times.
- The user also controls the process rather than working with an outside vendor.

UAS Components



Platform

UAV (unmanned aerial vehicle or drone, on which the system is built)



Sensor

To capture data
Digital camera, Laser scanner



Software

Mission control
Data processing

UAS

GPS Receiver

For navigation and positioning



Operator

Flight plans and control



Output/Products



- Orthophoto mosaics
- Digital surface model (DSM)
- Planimetric map products
- Change detection
- Volumetrics
- 3D modelling

UAV Platforms

Fixed Wing



Multi-Rotor



Controllers



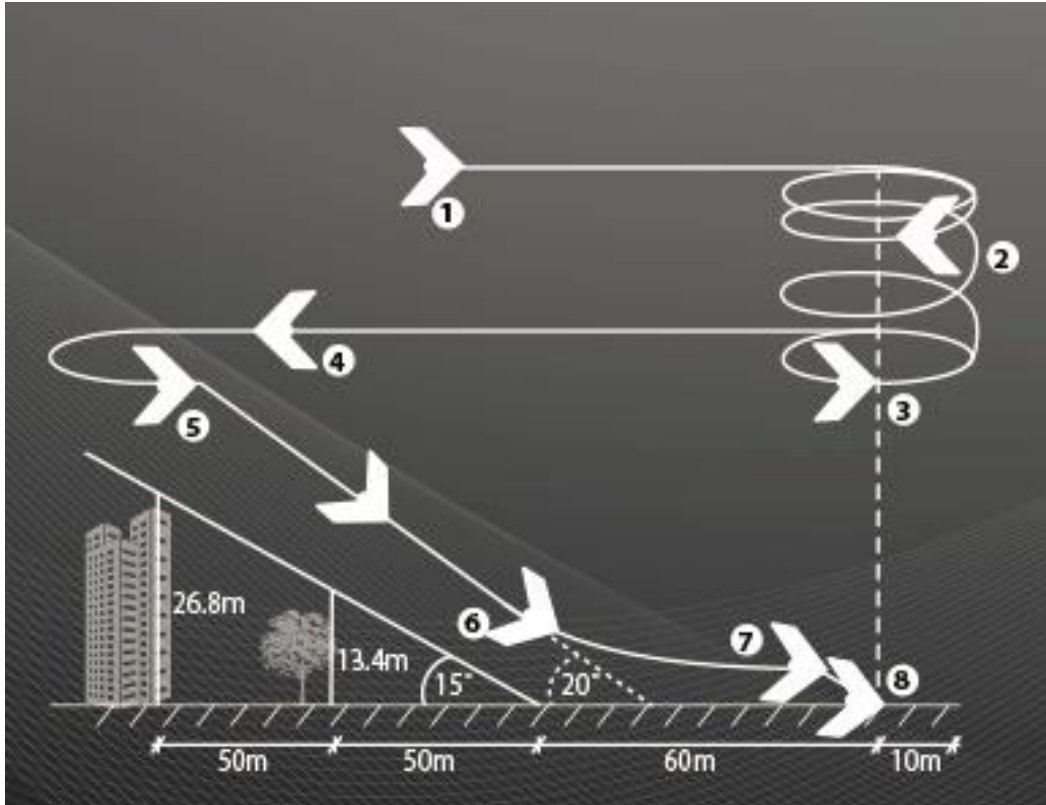
Common Controllers



Take Off

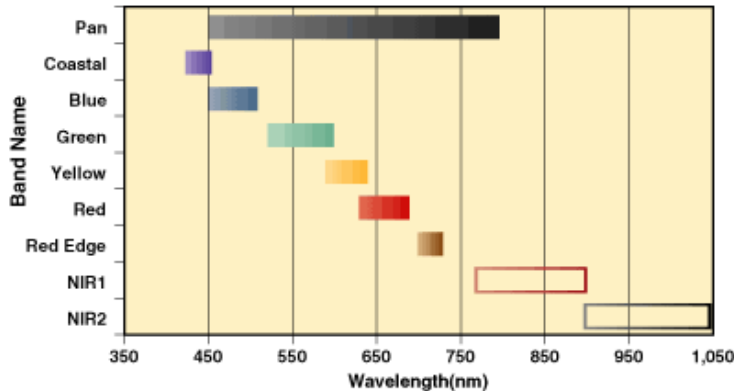


Landing



Sensors (payload)

- Still Photography
- HD Video
- LiDAR
- Etc.....



SICK LMS-291



Mini MCA Tetracam



Sony DSC-V1



Micro-Hyperspec VNIR

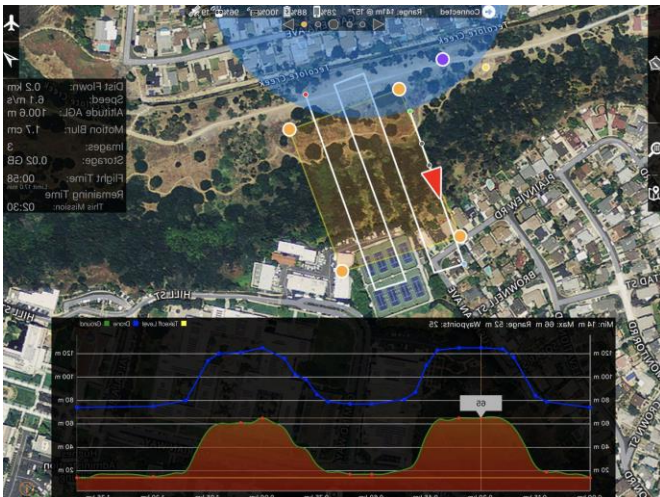


Tetracam-ADC



FLIR ThermoVision A40M

Software



Planning & Execution



Data Processing



Cloud Services

Which one is right for me?



Which one is right for me?



Which one is right for me?

- Budget
- Payload/sensors
- Flying time/Endurance
- Height above ground
- Size of project area
- Application
- Features/options
- Training/Support
- Etc...

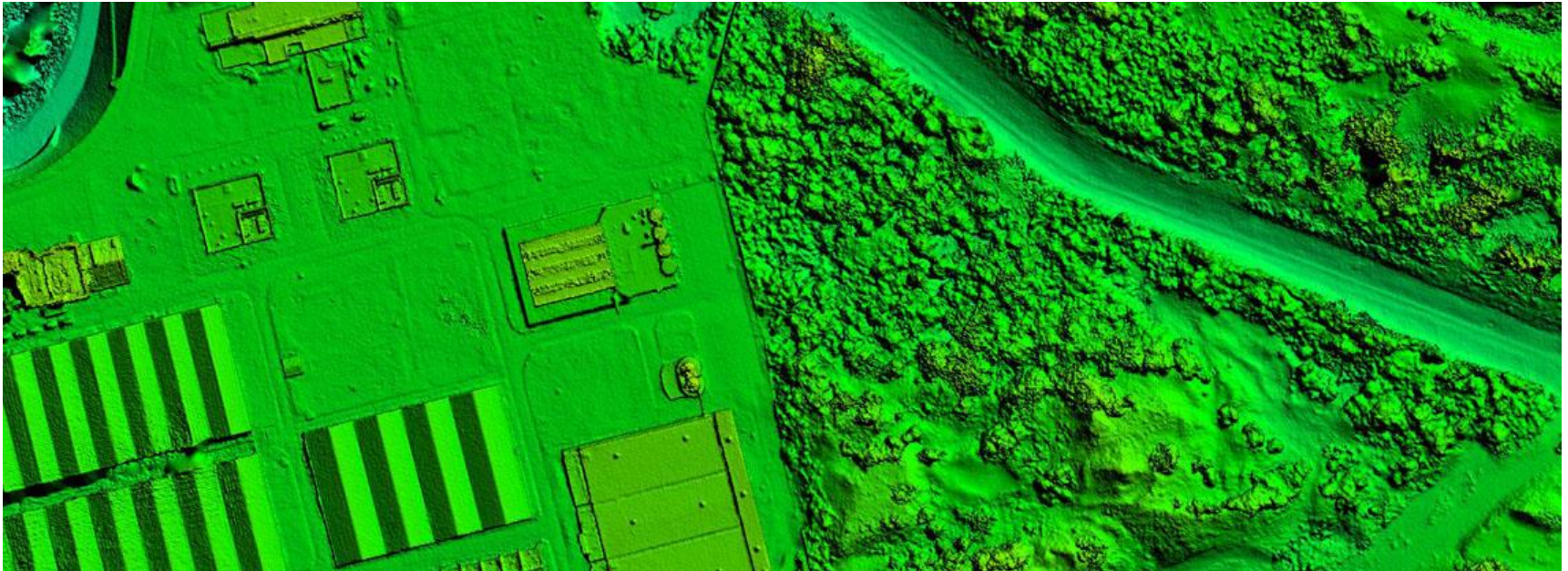
Applications



Mapping



Digital Elevation Modelling



Disaster Response

- UAVs are capable of surveying large areas very quickly to provide imagery to other types of remotely-sensed data. Satellite data is always valuable and desirable, but satellites cannot always be overhead at the right times on demand.
- UAVs can be deployed very quickly and can be easily directed toward different areas as the situational picture develops

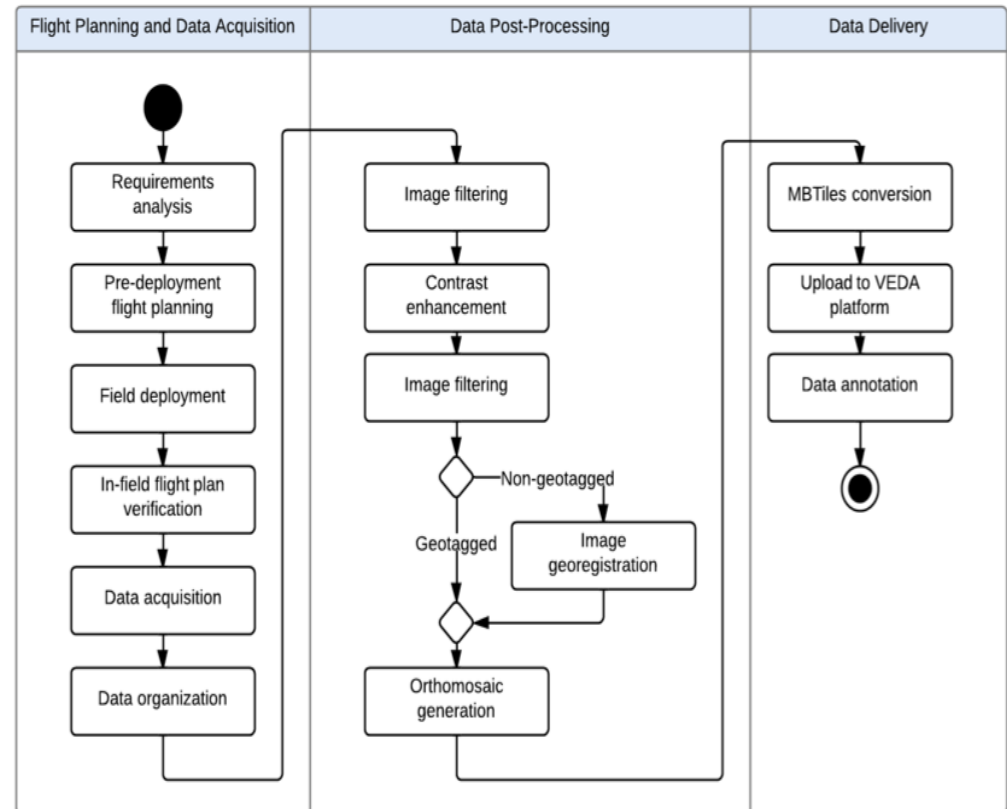


Dominica



UAV Mapping Workflow

- Requirements Analysis
- Mission Planning
- Image Acquisition
- GCP Measurement
- Image Processing
- Aerial Triangulation
- DSM Generation
- Orthophoto/Mosaicking
- Feature Extraction



Regulatory Aspects

- The Regulatory Landscape: Recreation, Commercial Use, Educational Use, Authorizations and Exemptions
- The US Congress has seen the benefits of UAVs for professional use and has ordered the FAA to produce the "rules of the skies" for incorporation into the National Airspace
- Most of the UAVs that would be used for mapping are small, lightweight airframes that fly far below the normal air traffic.
- Collision avoidance is a concern, as is impact with objects on the ground
- Everyone wants safe skies. But the uses and demand for UAV-collected data for GIS is becoming overwhelming.
- Taking an exam, obtaining a license, or registration of airframes, are all possibilities for consideration.

Regulatory - Jamaica

Operating Restrictions:

1. Recreational (Hobbyists)

Unmanned Aerial Vehicles shall not be operated:

- a. at a height exceeding **400 feet (122 metres)** above ground level
- b. beyond the maximum range of **1640 feet (500 metres)** from the operator
- c. at a distance beyond unaided visual range of the operator(s) of the aircraft
- d. using **First Person View (FPV)** or computer aided visuals of the UAV
- e. over or within **500 feet (152 metres)** of an organized open-air assembly of people
- f. over or within **165 feet (50 metres)** of any person. However, during take-off and landing, the aircraft may be flown within **165 feet (50 metres)**, but no less than **100 feet (30 metres)** of any person. These stipulations do not apply to the person in control of the aircraft
- g. over private or public property or dwellings without prior permission;
- h. within **16500 feet (5000 metres)** of any aerodrome or rotorcraft designated landing zones, such as helipads
- i. if **not** equipped with fail-safe mechanisms that will cause the aircraft to land in the event of loss of radio communications for control and the person in charge of the aircraft has been satisfied that the mechanisms are in good working order before flight
- j. if the aircraft has **not** been verified to be able to complete its intended flight, taking into consideration the payload, wind and propulsive power availability for the duration of the flight
- k. autonomously or on pre-programmed automatic flights
- l. at night or during low visibility conditions
- m. with the intention dropping or discharging any items to the ground
- n. within or over **restricted and prohibited** airspace.

Regulatory - Jamaica

2. Professional (Commercial and Non-Commercial Operators)

All commercial operators must apply to the Jamaica Civil Aviation Authority for a **Special Aerial Work Permit** before each flight.

All entities or persons wishing to operate a UAV, as referenced in this paragraph, shall:

- apply to the JCAA in writing for approval, providing all details of the intended operation
- not fly the aircraft, unless written permission has been received from the Authority, stating any applicable restrictions or conditions.

Having received approval, the professional operator must observe and comply with all the conditions included in the permit, in order to exercise the authority provided to operate a UAV.

Penalties

The safe operations of aircraft in Jamaica's airspace are a priority for the Jamaica Civil Aviation Authority. Non-compliance to the Civil Aviation Regulations may lead to

Using sUAV: Caribbean Examples

Resources

DJI Phantom 4



Trimble R2 GNSS
iPad mini 4
VRS connectivity

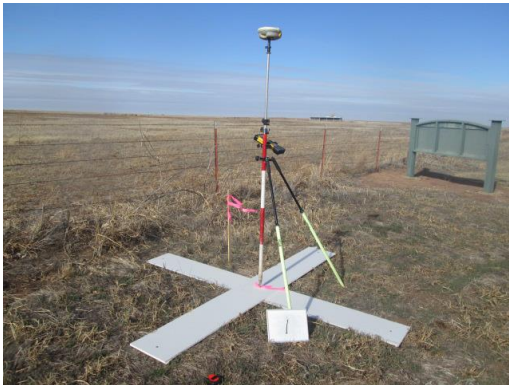


Apple iPad mini 4 running:

- DJI Go
- Map Pilot



GCP Targeting & Measurement



Traditional GCP Targets



GCP Targets More Suitable for use with UAVs



Flight Planning and Execution

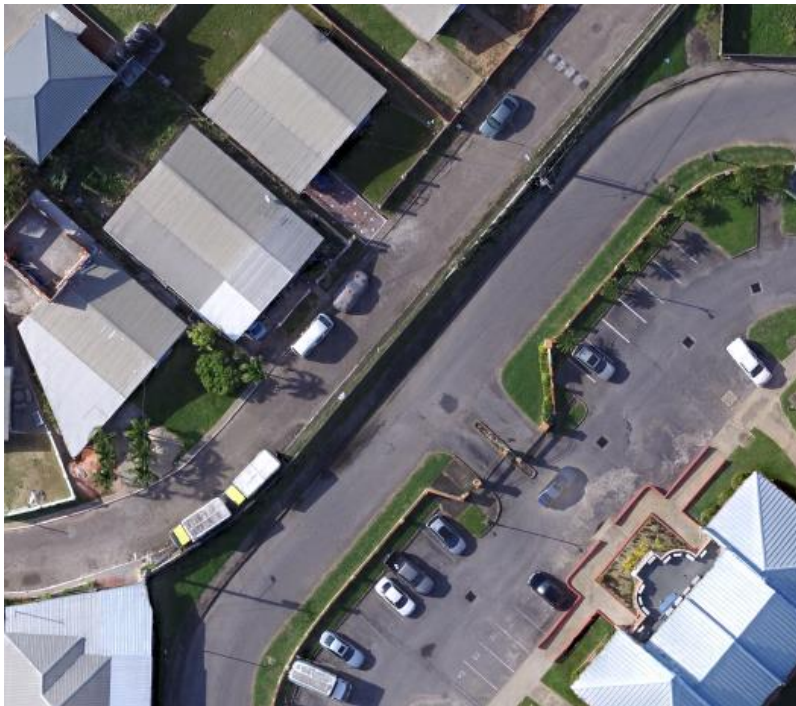


Trinity
Trinidad & Tobago

Map Pilot by Maps Made Easy

Image Acquisition

- Fly lower to get more detail. Fly higher to cover more area



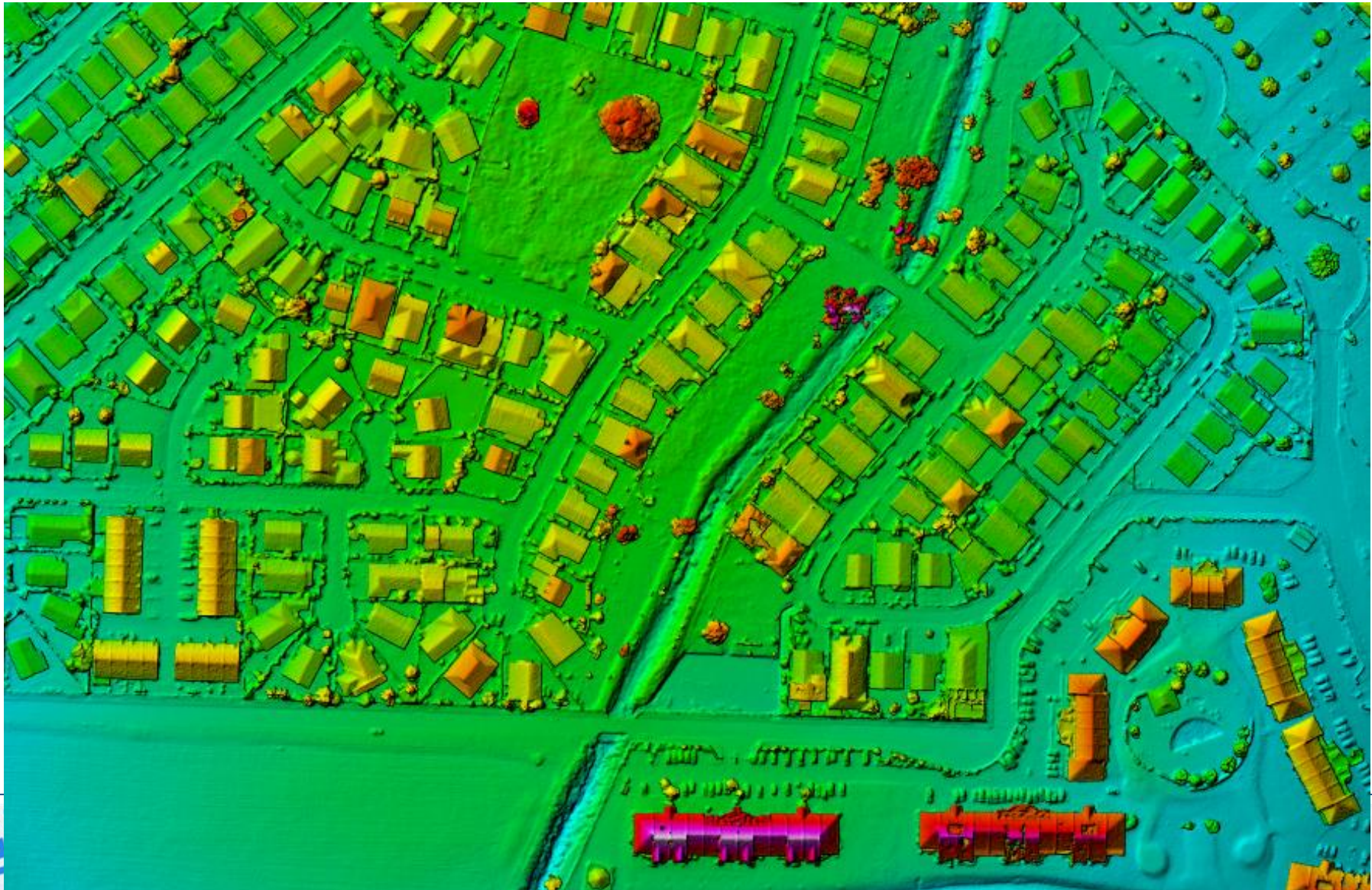
Data Processing - Orthophoto

Orthophoto 3.5 cm Resolution

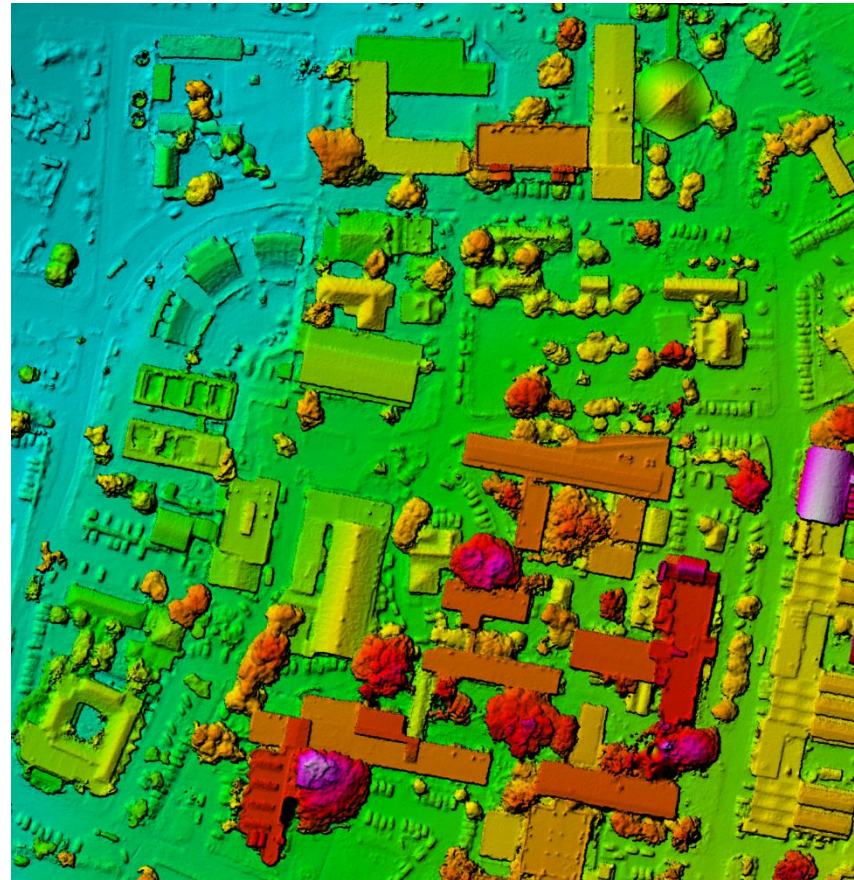




Data Processing – Digital Surface Model



University of Technology, Jamaica



UN-GGIM:Américas
COMITÉ REGIONAL DE LAS
NACIONES UNIDAS SOBRE
LA GESTIÓN GLOBAL
DE INFORMACIÓN GEOSPACIAL
PARA LAS AMÉRICAS



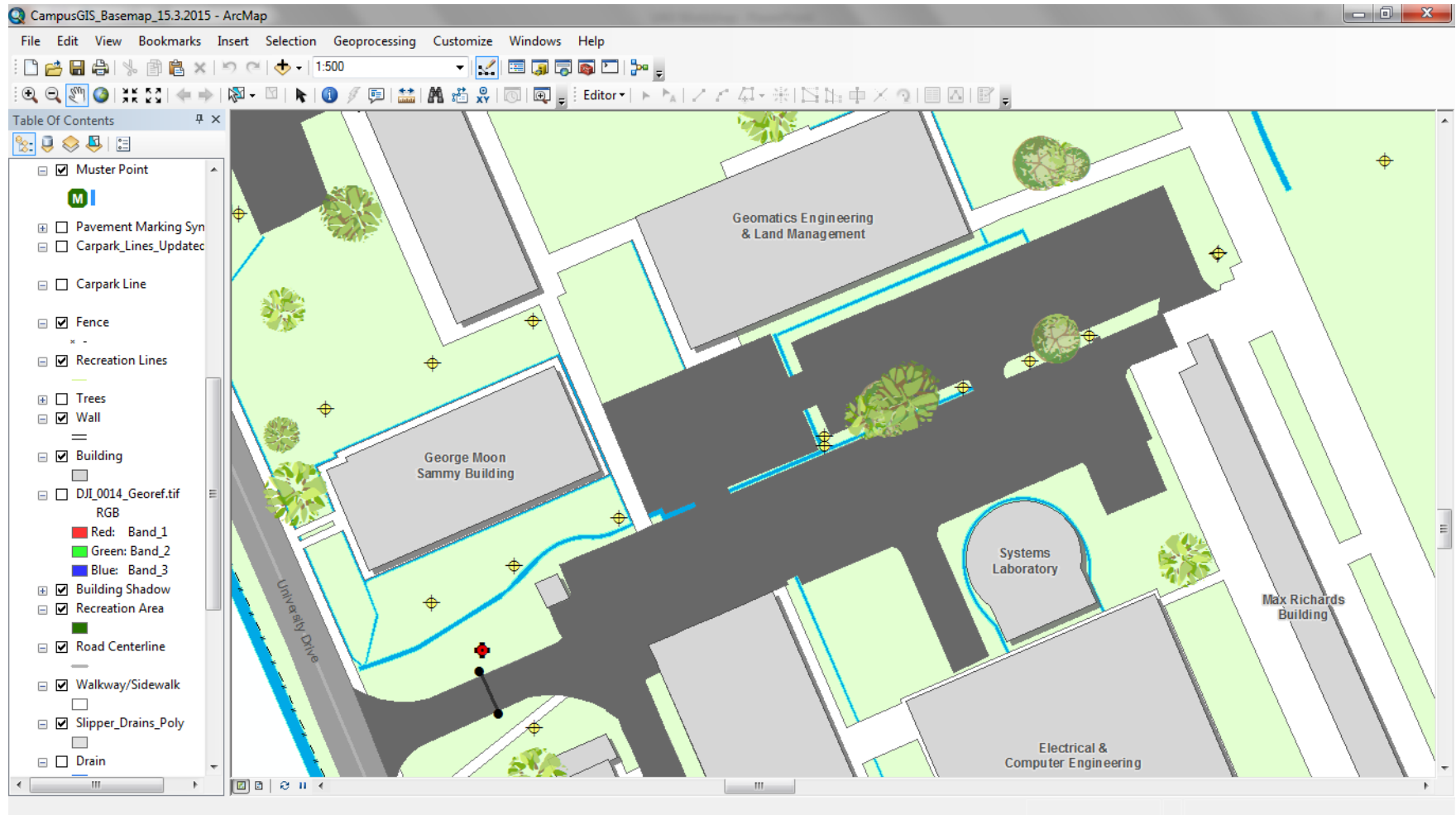
Association of Caribbean States
Asociación de Estados del Caribe
Association des Etats de la Caraïbe

AMEXCID
AGENCIA MEXICANA
DE COOPERACIÓN INTERNACIONAL
PARA EL DESARROLLO

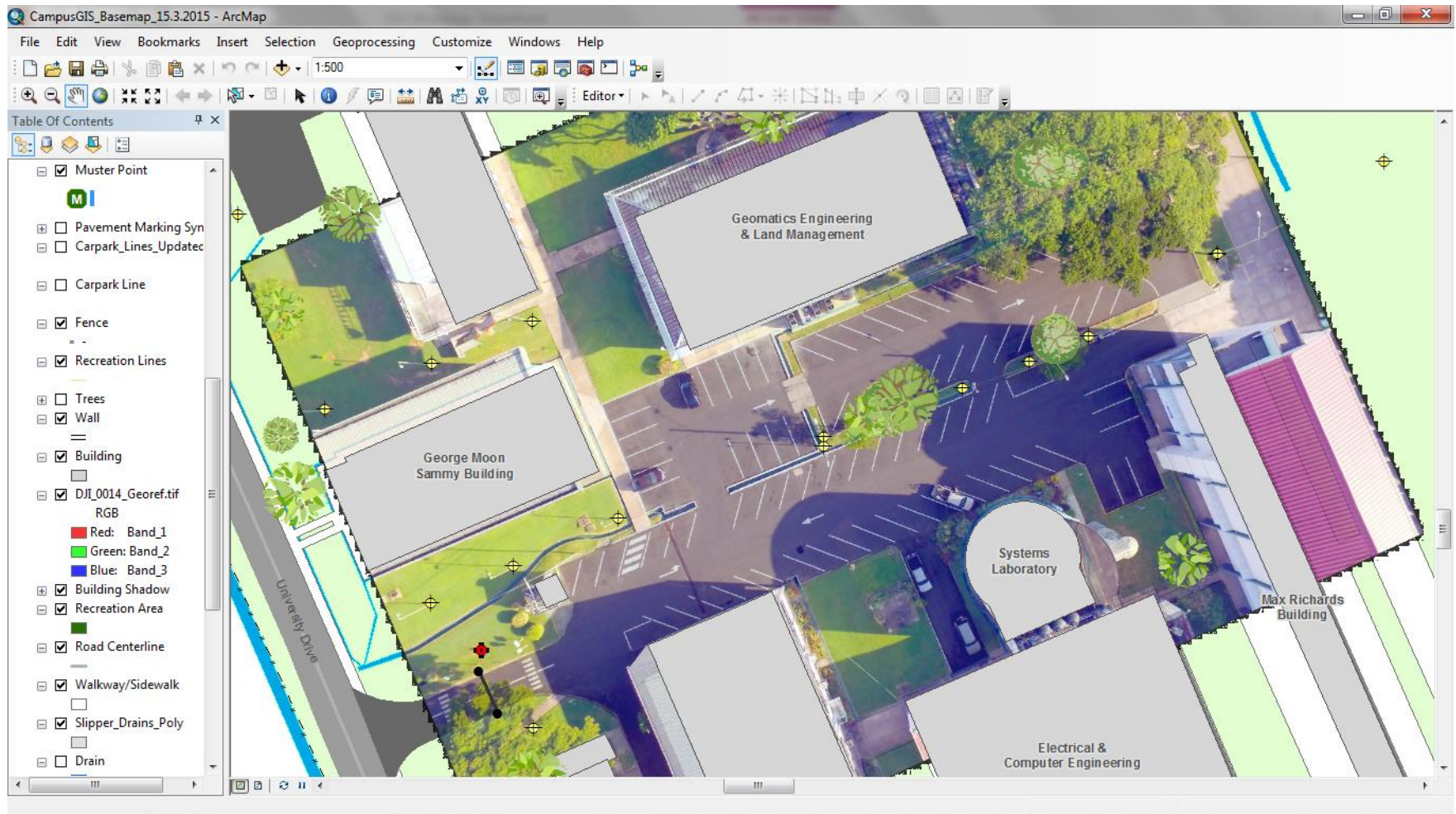


INSTITUTO NACIONAL
DE ESTADÍSTICA Y GEOGRAFÍA

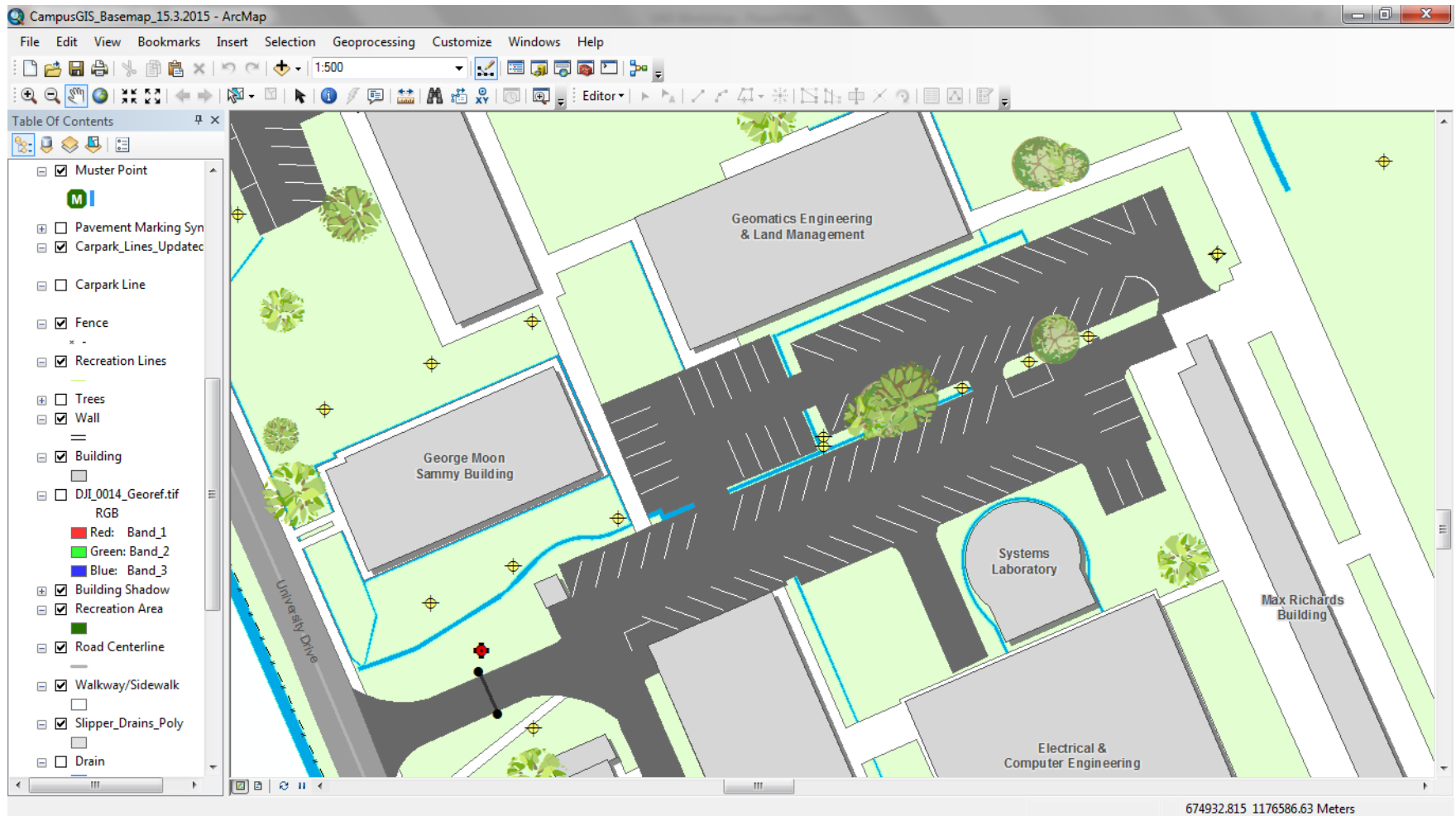
Updating UWI GIS Database(1)



Updating GIS Database(2)

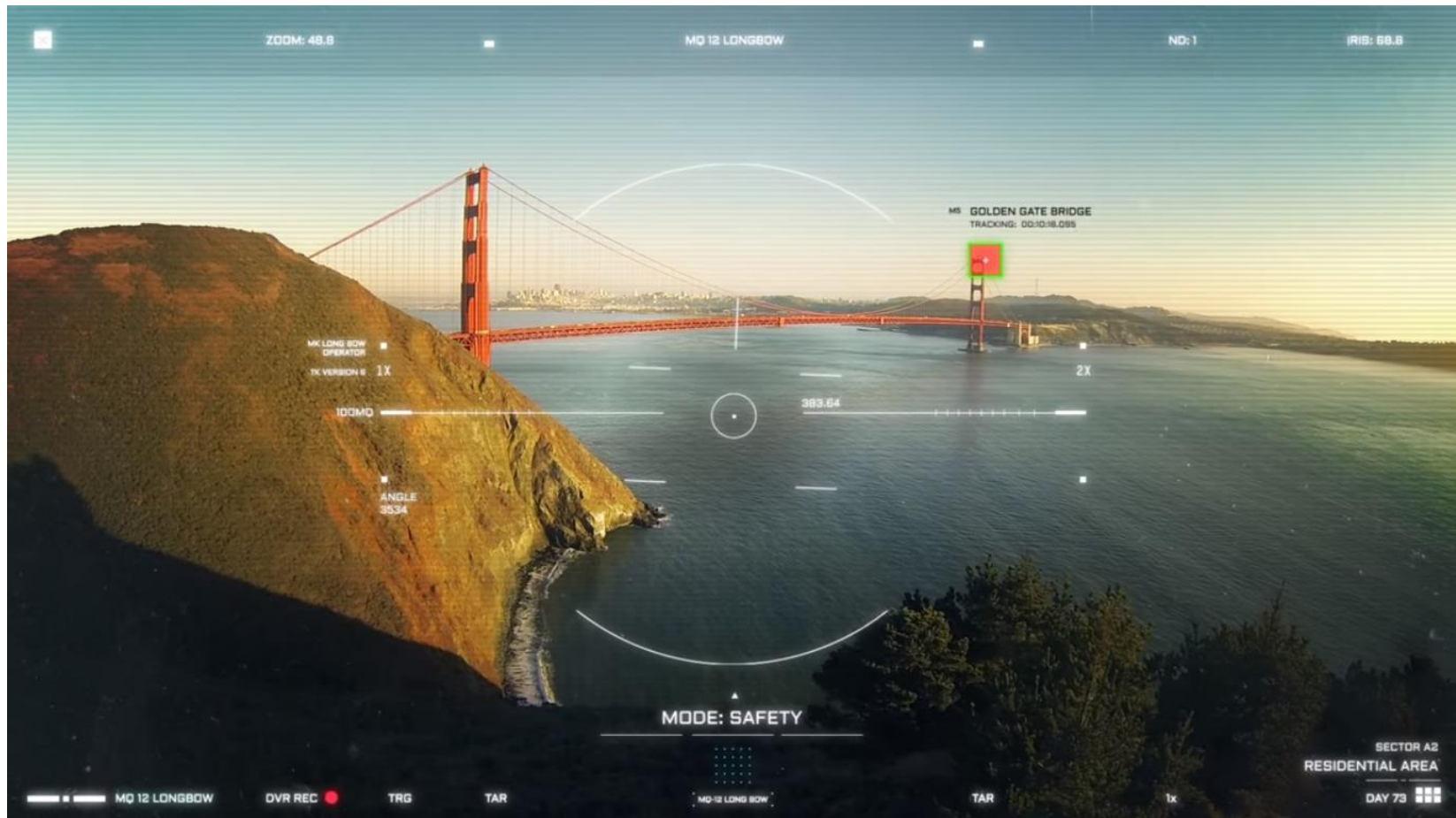


Updating GIS Database(3)



Futuristic Role of UAVs ??

<https://youtu.be/CgLkWT246qU>



DEMO

[UAV Imagery of UWI](#)

Show Orthophoto and
DSM

Concluding Remarks

- Places like Canada, Australia, New Zealand, Mexico, South Africa, China, and other locations, have already adopted the tool, and it is following the adoption curve of GPS in the 1990s. In other words, explosive growth.
- “Within the next five years, every survey company and many GIS organizations will own and operate small UAVs for mapping. It is a no-brainer. And it's fun, if done safely” --- Devon Humphrey, Waypoint Mapping (2014)

Concluding Remarks

- Follow the rules
- Fly Responsibly !!



UP NEXT

Activity: Creating geospatial data from low-cost UAV imagery