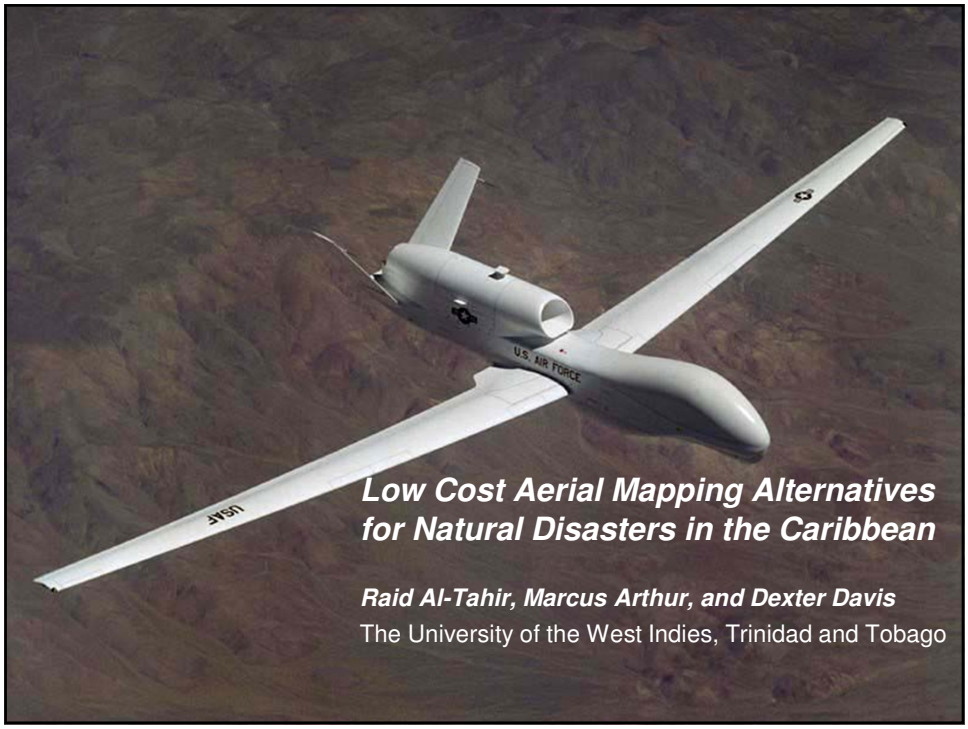

Low Cost Aerial Mapping Alternatives for Natural Disasters in the Caribbean

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Presentation Outline:

- The Caribbean region.
- Regional vulnerability to natural disasters.
- Role of Geoinformatics.
- Geo-data acquisition alternatives.

Key words:

- Aerial Mapping,
- Natural Disaster Management,
- Small Island Developing States.

The Caribbean

Primarily consists of an arc of islands

- Spans a large geographical area.

The climate is tropical;

- 'Dry' and 'Wet' seasons.
- Rainfall varies with elevation, size and currents.

Generally flat terrain with some rugged landscapes (mountain-ranges).

The Caribbean

Small island developing states (SIDS);

- Unique biodiversity and highly fragile ecosystems,
- Highly dependent on marine and coastal resources,
- Development challenged by financial constraints.

Susceptible to disasters and external impacts.

Regional Vulnerability

Natural hazards are common to the region due to geographical location and characteristics;

- Seismic activity,
- Volcanic eruptions,
- Landslides,
- Floods,
- Droughts,
- Hurricanes,
- Forest fires.

Regional Vulnerability

The Caribbean states are more vulnerable to disasters:

- Low-lying small land masses,
- Intensive land development and high population density in coastal zones,
- Poorly developed coastal infrastructure,
- Socio-economic dependence on coastal zone activities.
- Inadequate respond due to limited technological resources.

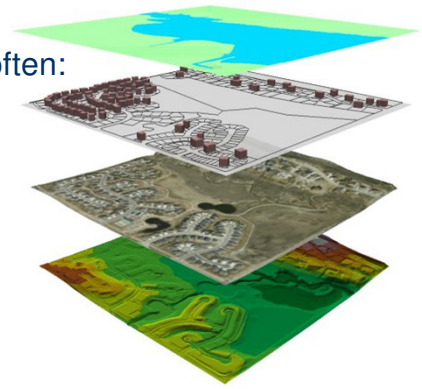
Role of Geoinformatics

Investigation of disaster susceptibility and the formation of proper national planning and management policies require wide range of factors.

- Most of which are of a spatial nature.

Needed spatial information is often:

- Outdated,
- Non-comparable,
- Non-existent.



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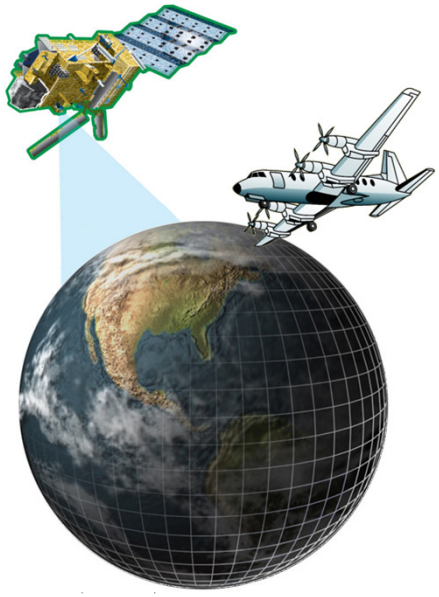
Role of Geo-imaging Technologies



Remotely sensed imagery has become key tools in assessing vulnerability to natural disaster and the damages.

Remote sensing guarantee:

- Data currency,
- Accuracy,
- Uniform and comprehensive coverage.

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Constraints and Alternatives

In the Caribbean, geospatial technology has not been meaningfully utilized in disaster management:

- Insufficient experienced personnel
- Economic constraints affect the availability of experienced personnel, hardware, software and necessary data

As such, and considering their sizes, none of the individual Caribbean states possess the indigenous capacity and means for acquiring aerial photography.

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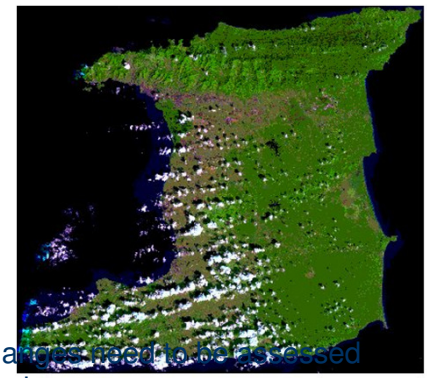
Constraints and Alternatives

A persistent cloud cover is a hindrance specific to tropical environments.

It poses a major challenge to the use of optical wavelength satellite images.

- Clouds directly obscure surface beneath them
- Their shadows mask surface information.



Problem compounded when changes need to be assessed using images from two different dates.

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Airborne and Satellite Imagery

Disadvantages

- The quality and resolution of data and imagery obtained may not be sufficient for accurate diagnostics.
- Data obtained can be easily affected by bad weather conditions like clouds or rain.
- Non availability of data when and where required.
- Data can be obtained only at regular intervals.
- Very expensive.

Piloted aircraft and satellites images may not be a valid choice for delivering on short notice critical information specific to natural disaster mapping and management.

Low Cost Aerial Mapping Alternatives for Natural Disasters

Unmanned Aerial Vehicles

Alternative: Unmanned Aerial Vehicle

UAVs are the fastest growing sector in the aerospace market.

Advantages of UAV

- Low capital and operational costs
- Quick deployment
- Elimination of the risk to pilots' lives in difficult missions
- Image capture at low altitude, reducing cloud problems
- Availability of data and imagery immediately after the flight
- Flexibility to user's particular needs
- Repeatable performance

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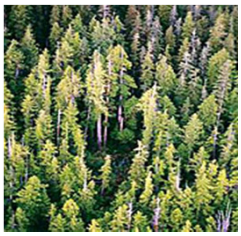
Non-Military Applications

- Fire-fighting;
- Disaster assessment and management;
- Life search and rescue;
- Border surveillance;
- Police surveillance;
- Large scale public outdoor events surveillance;
- Ground and sea traffic surveillance;
- Environmental control and monitoring (e.g., air and sea pollution);
- Crop monitoring;
- Animal surveillance;
- Mineral exploration;
- Ground mapping and photography;
- Meteorological observation;
- Pipeline and power line monitoring;



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Categorization of UAV Systems

Range and Altitude

UAV Categories	Range (km)	Altitude (m)	Endurance (hours)	Mass (kg)
Nano (η)	< 1	100	< 1	< 0.025
Micro (μ)	<10	250	1	<5
Mini	<10	150/300	<2	< 30
Close Range	10-30	3000	2-4	150
Short Range	30-70	3000	3-6	200

(UAV International 2010)

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Categorization of UAV Systems

Flight Performance and Navigation

Sensors	Geo-referencing	Real-time Capability	Application Requirement	UAV Category
No GPS/INS	Post	lowest value	Low accuracy	OM-class
GPS and consumer-grade INS	Post/direct	middle value	Moderate accuracy [dm-m]	M & L-class
DGPS/ navigation- and tactical-grade INS	Post/direct	best value	High accuracy [cm]	M- & L-class

(Eisenbeiß 2009)

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General Considerations

System:

- Size and weight of payload
- Stability and vibration
- Low cost and portability
- Resolution and accuracy of imaging/positioning sensor

Operational:

- Number of people needed for launch and control
- Level of piloting skills
- Flight time and range
- Minimum airspeed
- Minimum size of takeoff and landing area
- Safety

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The ideal UAV in the Caribbean

- Readily available, easily deployable, and transportable
- Limited operator skills
- Autopilot and way point navigation
- Modular payload facilitating multiple sensors and multiple use.
- Extensive range with low and medium altitude flight
- Linked to a global coordinate system
- Cost effective allowing adoption by government and private agencies.

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Short-listing Suitable UAV Systems

UAV Model	Type	Range (km)	Altitude (ft)	Endurance (mins)	Resolution (MP)	Navigation	Price USD
Draganflyer x8	Multicopter	-	8000	20	10	Manual	39,670
Gatewing x-100	Fixed Wing	5	2460	45	10	Autonomous	53,880
CropCam	Fixed Wing	3	2200	55	10 to 12	Autonomous	7,000
MD4-200	Multicopter	0.5	-	20	10	Manual or Waypoint	34,173
MD4-1000	Multicopter	0.5	-	50	12	Manual or Waypoint	53,700
LP960	Fixed Wing	5	1400	35	14	Autonomous	12,937
Pixy 26.40	Paraglider	10	1640	50	12 or 21	Autonomous	8,620
Rover	Fixed Wing	5	2000	60	-	Autonomous	55,000

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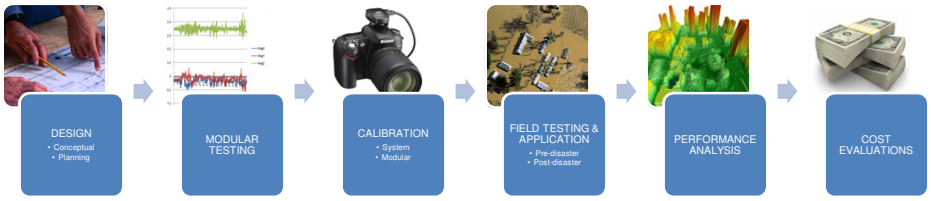
Project Stages



Conclusion

UAVs represent:

- Alternative to traditional challenges
- Improvements to disaster management

In light of the requirements for the Caribbean SIDS, the operational nature and cost factors make this an applicable technology to build a low cost mapping system upon.

With a continuing trend of miniaturization in electronics and other components, the UAVs can be made much smaller and cheaper.

Limitations

- UAV Operating Environments
  - Including national airspace