

Drones and Its Applications

Manzul Kumar Hazarika, Ph.D.

Director (Project Operations), Geoinformatics Center
Asian Institute of Technology (AIT)

Thailand

manzul@ait.asia



This learning material was not prepared by ADB. The views expressed in this document are the views of the author/s and do not necessarily reflect the views or policies of the Asian Development Bank or its Board of Governors, or the governments they represent. ADB does not guarantee the accuracy of the data included in this presentation and accepts no responsibility for any consequence of their use. The countries listed in this presentation do not imply any view on ADB's part as to sovereignty or independent status or necessarily conform to ADB's terminology.

What is a Drone?

Drone is a relatively small size remote controlled or automatic pilotless aircraft.

Advantages	Disadvantages
<ul style="list-style-type: none">• Cheap and cost effective• High spatial resolution• High accuracy• Easier to deploy• No hindrances from clouds• A great tool for surveillance	<ul style="list-style-type: none">• Limited capabilities and coverages• Care required to use in populated areas• Chances of misuse due to easy operation

Types Drones and Their Uses

Multicopter

- Flying height: Up to 500 m
- Flying time: 20-30 mins.
- Coverage: 0.4-0.8 km² per flight
- Range: 5 km



Fixed-wing

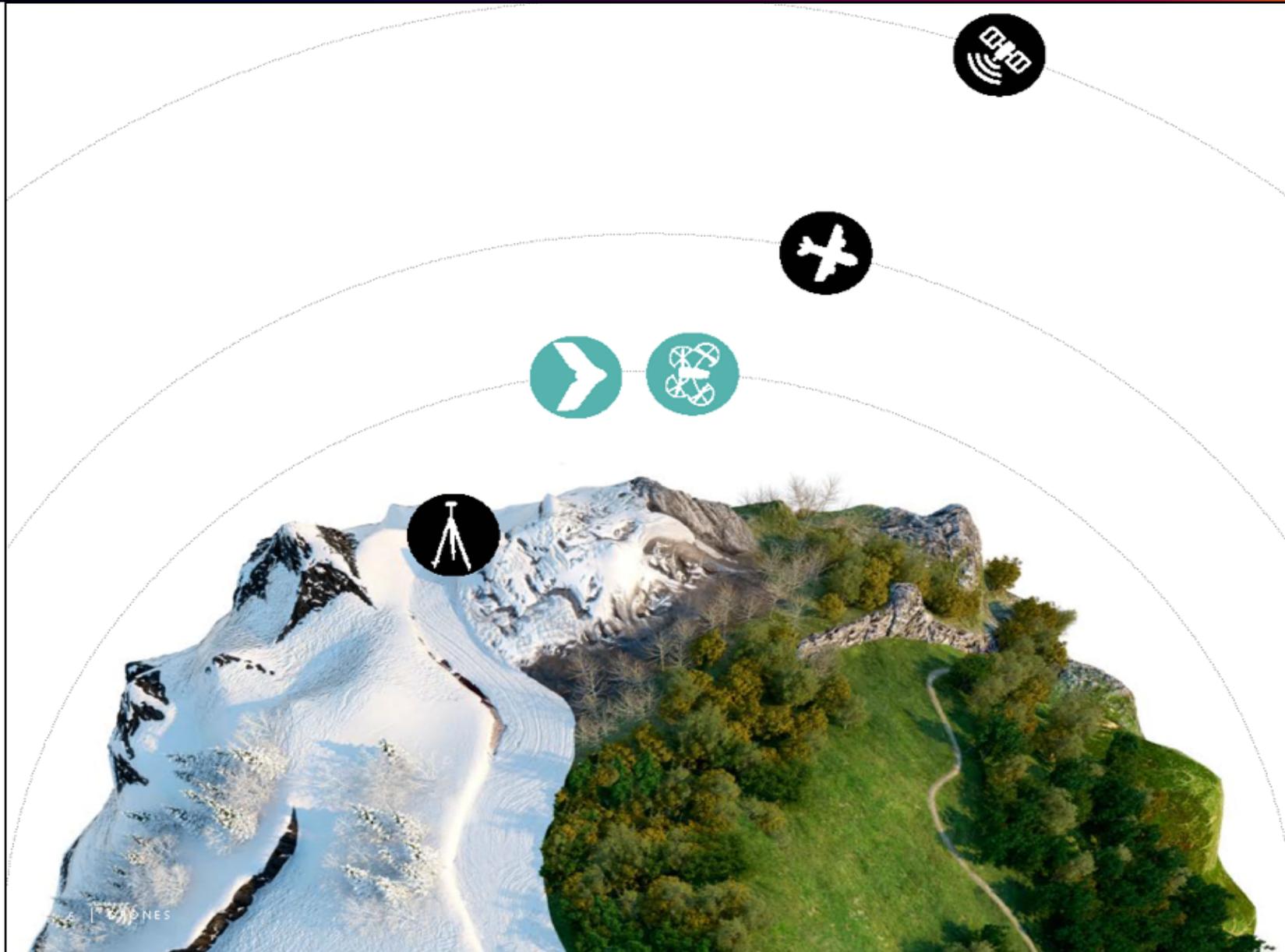
- Flying height: Up to 1,000 m
- Flying time: 50-60 mins.
- Coverage: 10-40 km² per flight
- Wing span: 1-2 m
- Range: 30-60 km



Multi-rotor Vs. Fixed-Wing Drones

Multi-rotor	Fixed-wing
<ul style="list-style-type: none">• Cheap• Easier to operate• Vertical and easy landing• Short flights and low coverage• Suitable for local mapping• Comply with aviation regulations	<ul style="list-style-type: none">• Relatively expensive• Need experienced operators• Horizontal landing and need sufficient space• Long flights and high coverage• Suitable for large area mapping• Often needs permission to fly

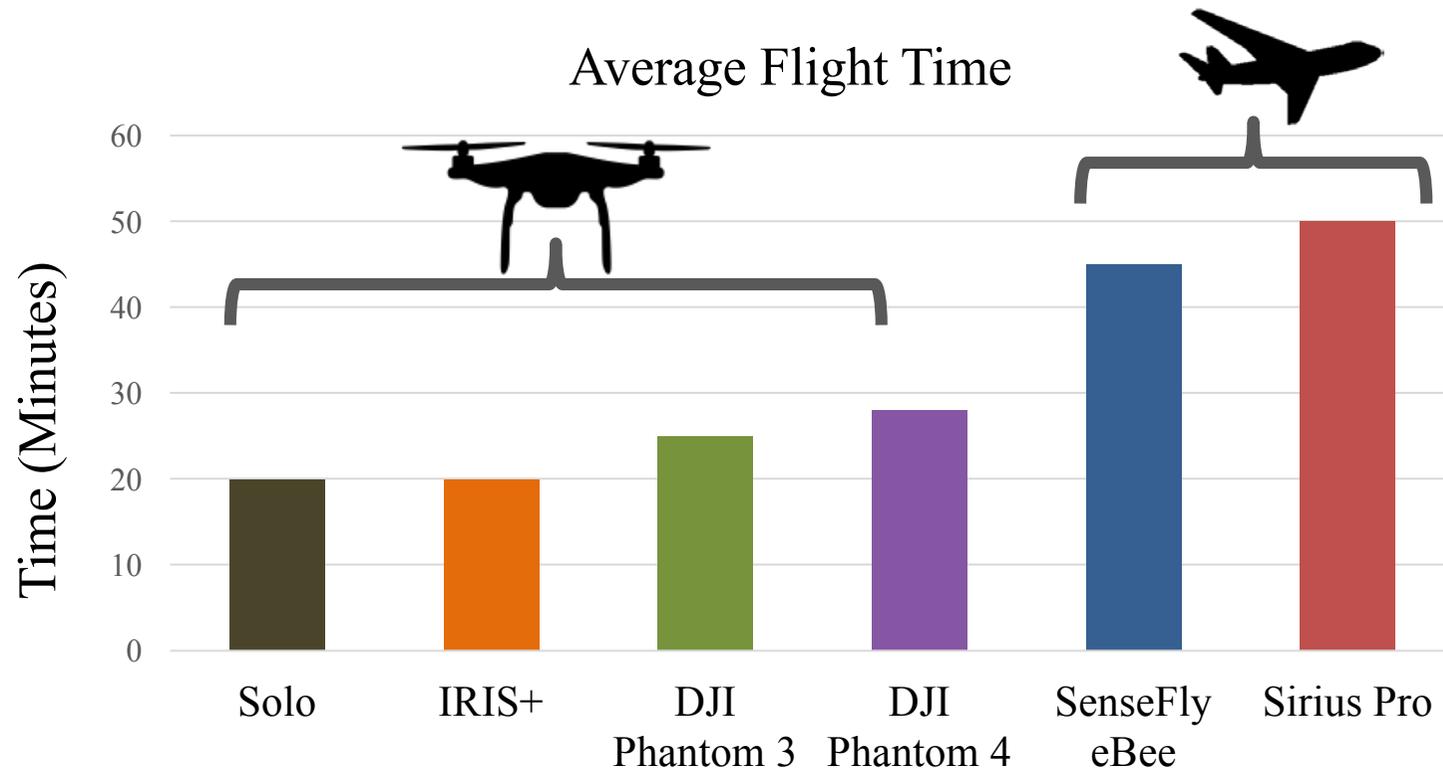
Data Acquisition Platforms



Data Acquisition Platforms - Pros and Cons

Platforms	Pros	Cons
Satellite 	<ul style="list-style-type: none">+ Extensive coverage+ Wide spectral capabilities	<ul style="list-style-type: none">- Expensive data- Relatively low-resolution (50 cm/pix)- Data acquisition bi-weekly/weekly
Aircraft 	<ul style="list-style-type: none">+ Large single-flight coverage+ High-resolution (7 cm/pix)+ Wide spectral capabilities	<ul style="list-style-type: none">- Very expensive (for large projects)- Image timing controlled by provider- Operations susceptible to weather
Drone 	<ul style="list-style-type: none">+ Image acquisition on demand+ Very high-resolution (1 cm/pix)+ Unaffected by cloud cover+ Cost effective and safe	<ul style="list-style-type: none">- Relatively small coverage- Drone regulations can restrict usage- Operations susceptible to weather
Surveying 	<ul style="list-style-type: none">+ Excellent positional accuracy+ Very high-resolution	<ul style="list-style-type: none">- Slow, tedious, and labour-intensive- Difficult to record tops of features- Some sites inaccessible on foot

Flying Time of Specific Drones



Cameras/Sensors Used in Drones

RGB Cameras

Image what we see for scouting and monitoring



Canon S110



**DJI Phantom
built-in Camera**

LiDAR Sensors

Provide high definition 3-dimensional information about the surrounding environment



Velodyne Puck LITE

Sensors Used in Drones

Thermal Sensors

Capable of measuring temperature from -40 to 160 Deg. C with a resolution of down to 0.1 C.



FLIR Duo

Multi Spectral Cameras

Analyse crop conditions



Parrot Sequoia



Micasense RedEdge

Cost of Fixed-Wing Drones

Model/Brand	Specifications	Price
<p>Trimble UX-5</p> 	<p>Flying time: 59 min. Coverage: 10-40 km²/flight Resolution: up to 1 cm/pix Accuracy: 3cm (H) / 5cm (V)</p>	30,000 USD
<p>SenseFly eBee Plus</p> 	Similar to above	25,000 USD
<p>Custom-built (AIT/NIED)</p> 	Similar to above	10,000 USD

Cost of Multi-rotor Drones

Model/Brand	Specifications	Price
<p>DJI-Phantom</p> 	<p>Flying time: 20-30 min.</p> <p>Coverage: 0.5 km²/Flight</p> <p>Resolution: up to 1 cm/pix</p> <p>Accuracy: 3cm (H) / 5cm (V)</p>	<p>1,200 USD</p>

Our Own Custom Built UAVs



Fixed-Wing



Testing

Drone Regulations

Country	Regulations
Philippine	- Drone owners and/or operators are now required to register their equipment with the CAAP, and secure a certification to operate from the agency-

Drones Applications

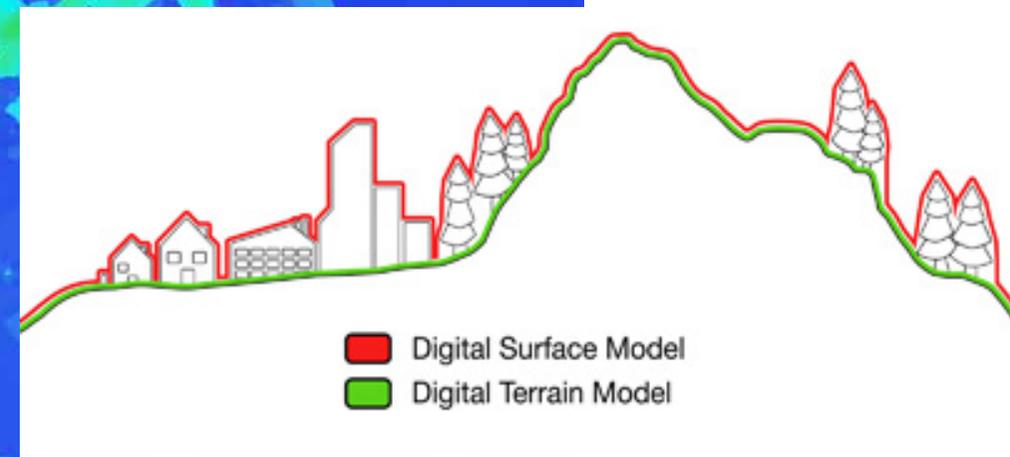
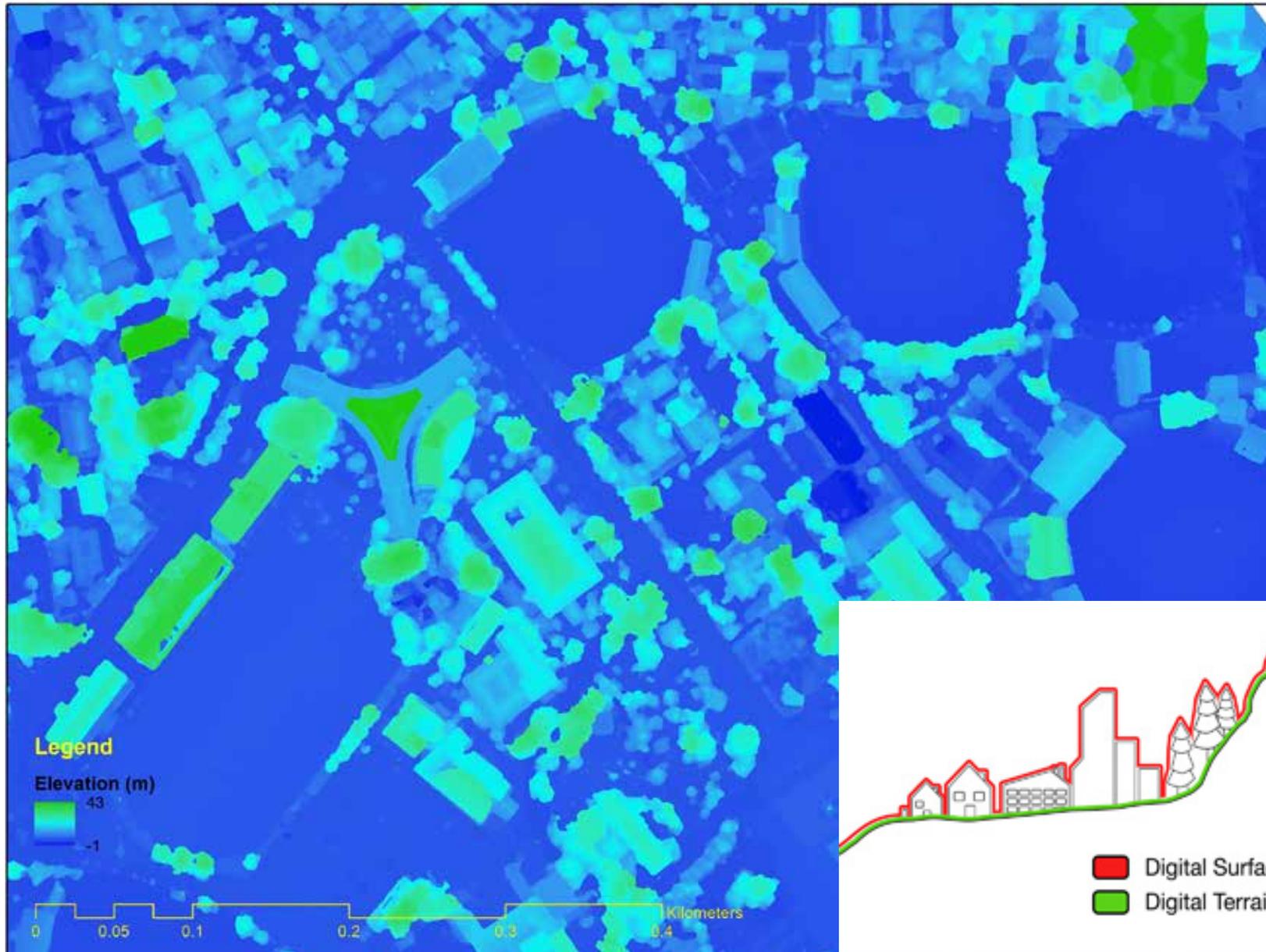
Urban Planning Related Applications Using Drones

Area	Applications
<p>Surveying and Mapping</p> 	<ul style="list-style-type: none">- Prepare accurate geo-referenced maps, including the base-maps- Extract point clouds and digital surface/elevation models- Provide ortho-mosaic- Prepare and provide contour Lines- Make 3D renderings of buildings and geographic feature- Estimation of cut/fill volume
<p>Infrastructure Planning</p> 	<ul style="list-style-type: none">- Site analysis, planning and design- Construction management and monitoring- Asset mapping and monitoring- 3D modelling and extraction of features (vegetation, buildings, roads etc.)
<p>Disaster Management</p> 	<p><u>Pre-disaster</u> Hazard and exposure mapping and risk assessment</p> <p><u>Post-disaster</u> Mapping and monitoring the extent of disasters Situational awareness for emergency response coordination Search and rescue operations Damage mapping for insurance industries for assessing the insurance claims</p>

Surveying & Mapping - Prepare Accurate Latest City Maps



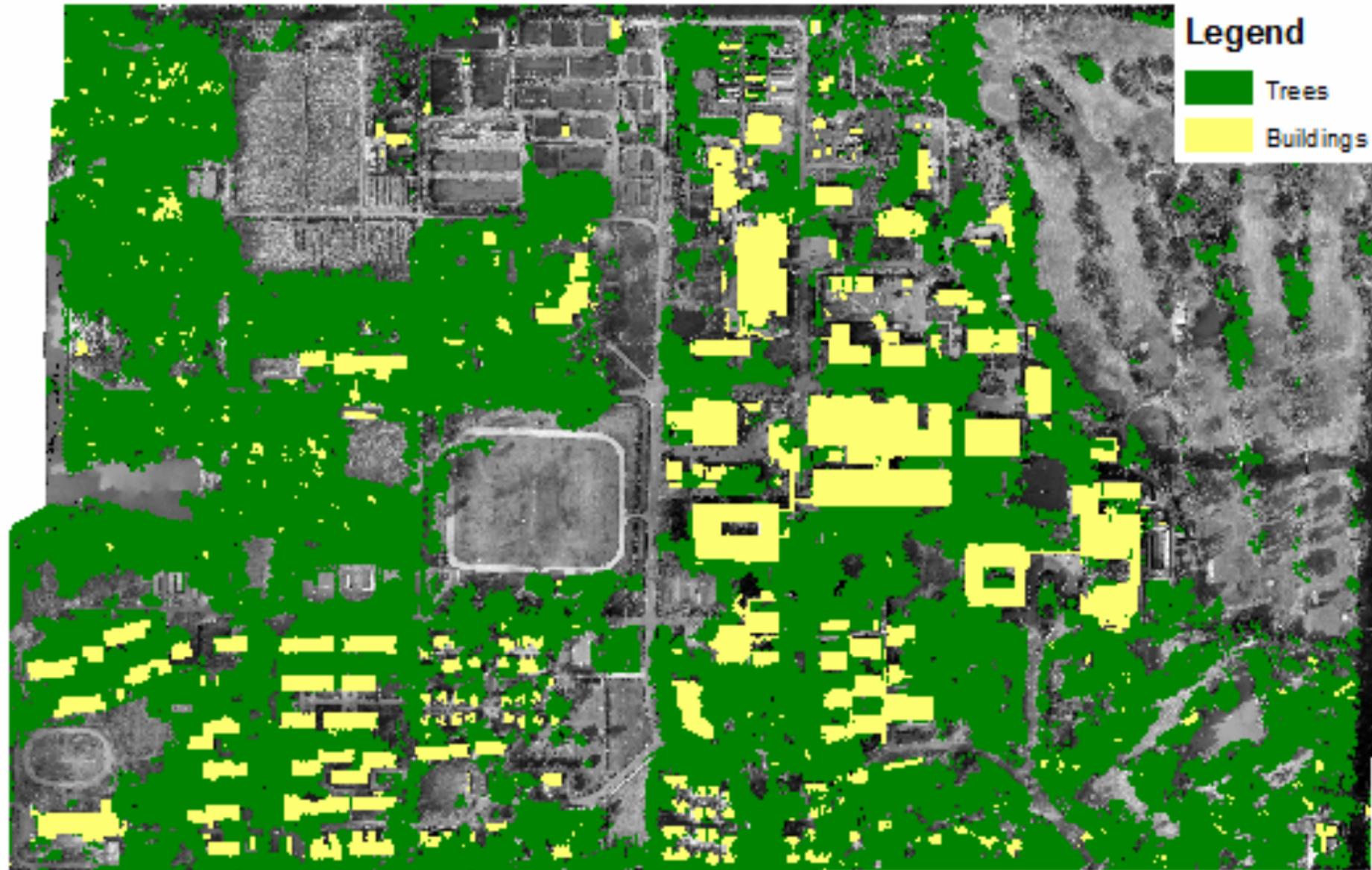
Surveying & Mapping - DEM (DSM and DTM)



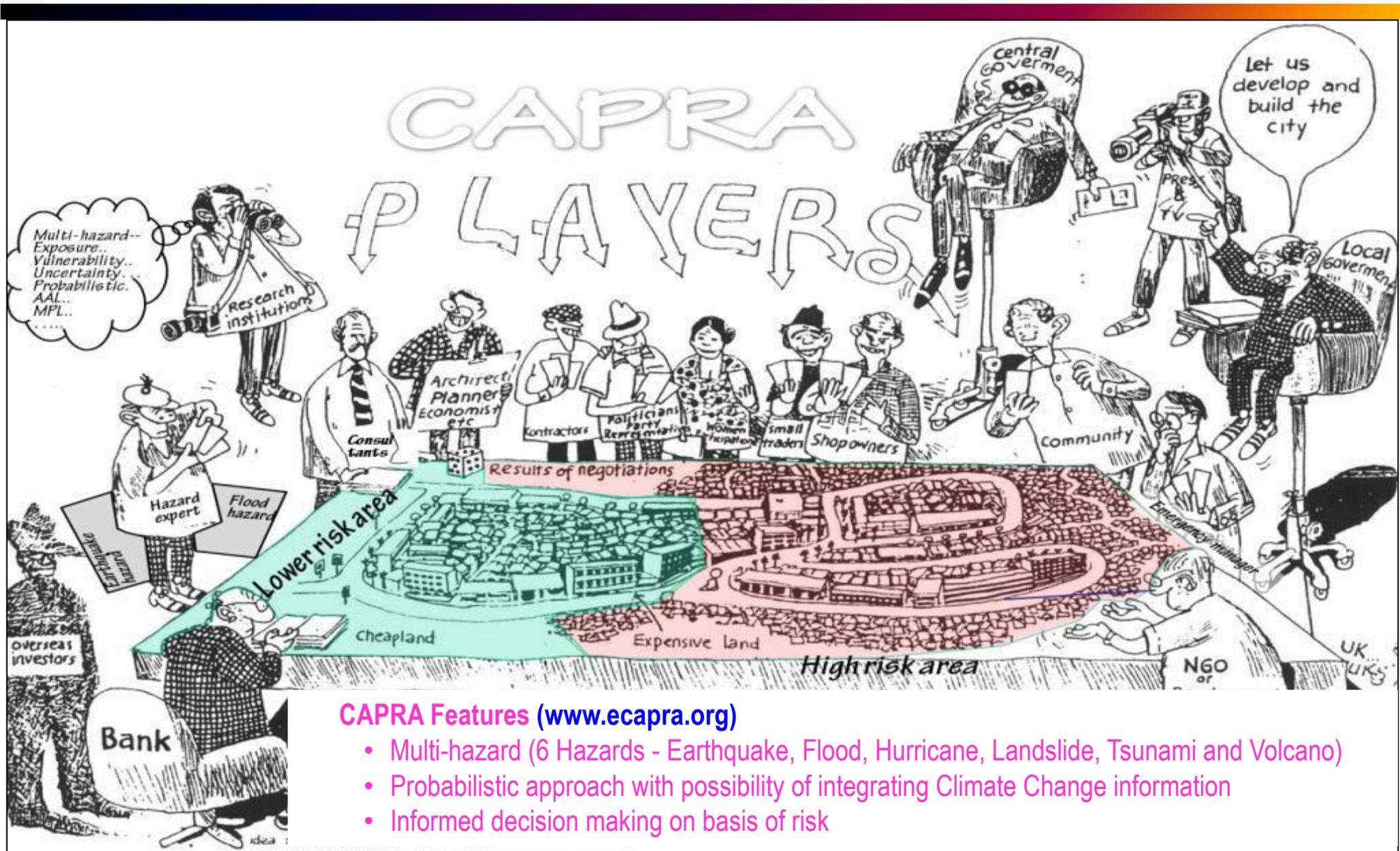
Surveying & Mapping -3D Model of Buildings



Surveying & Mapping - Mapping of Urban Green Areas



Pre-Disaster: Multi-hazard Risk Mapping



CAPRA Features (www.ecapra.org)

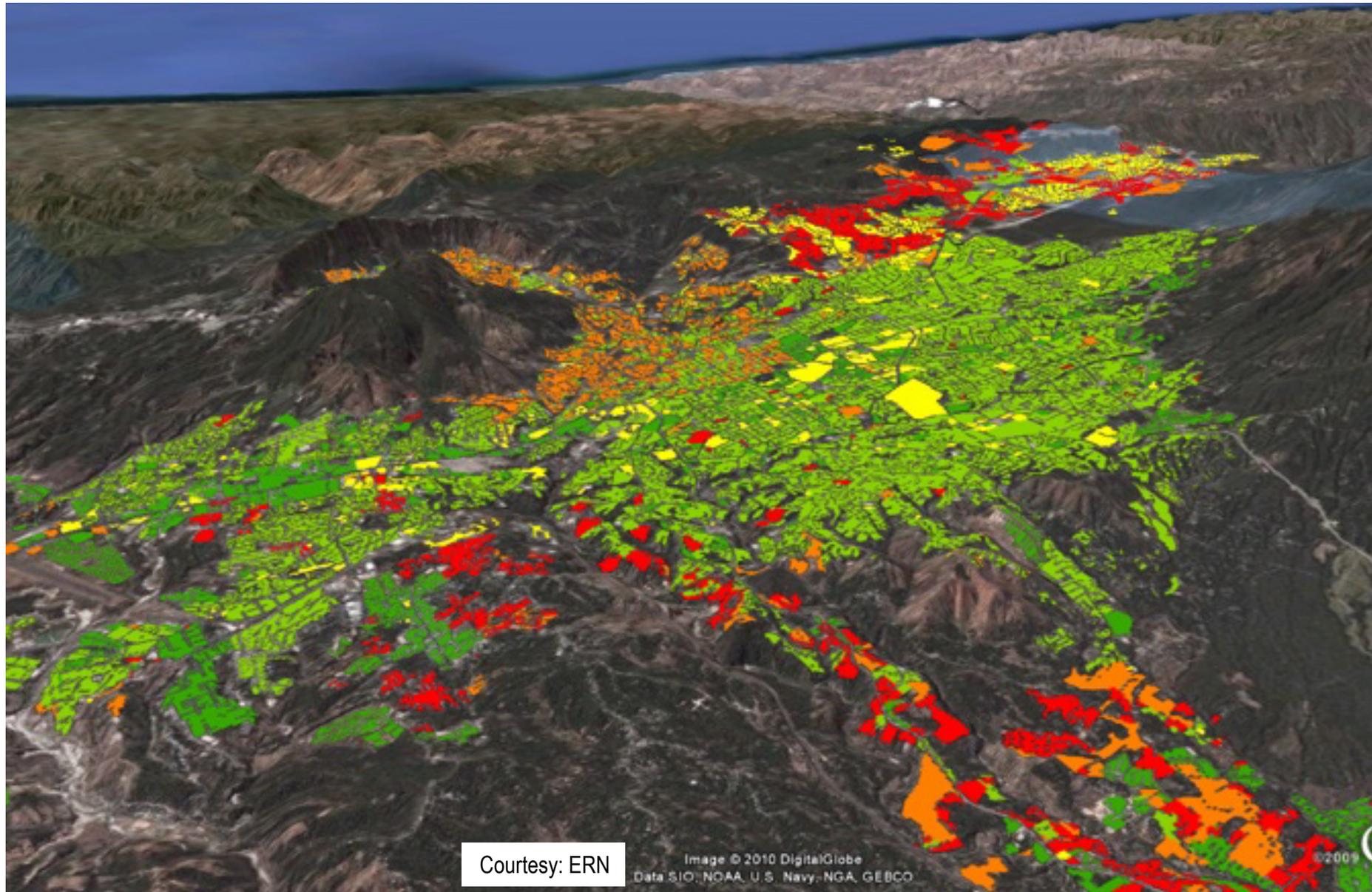
- Multi-hazard (6 Hazards - Earthquake, Flood, Hurricane, Landslide, Tsunami and Volcano)
- Probabilistic approach with possibility of integrating Climate Change information
- Informed decision making on basis of risk

Pre-Disaster: Disaster Risk Maps (Building Level)

Relative economic loss. - Probabilistic analysis for Wind and storm (Hurricane) surge combined



Pre-Disaster: Disaster Risk Maps (City Level)



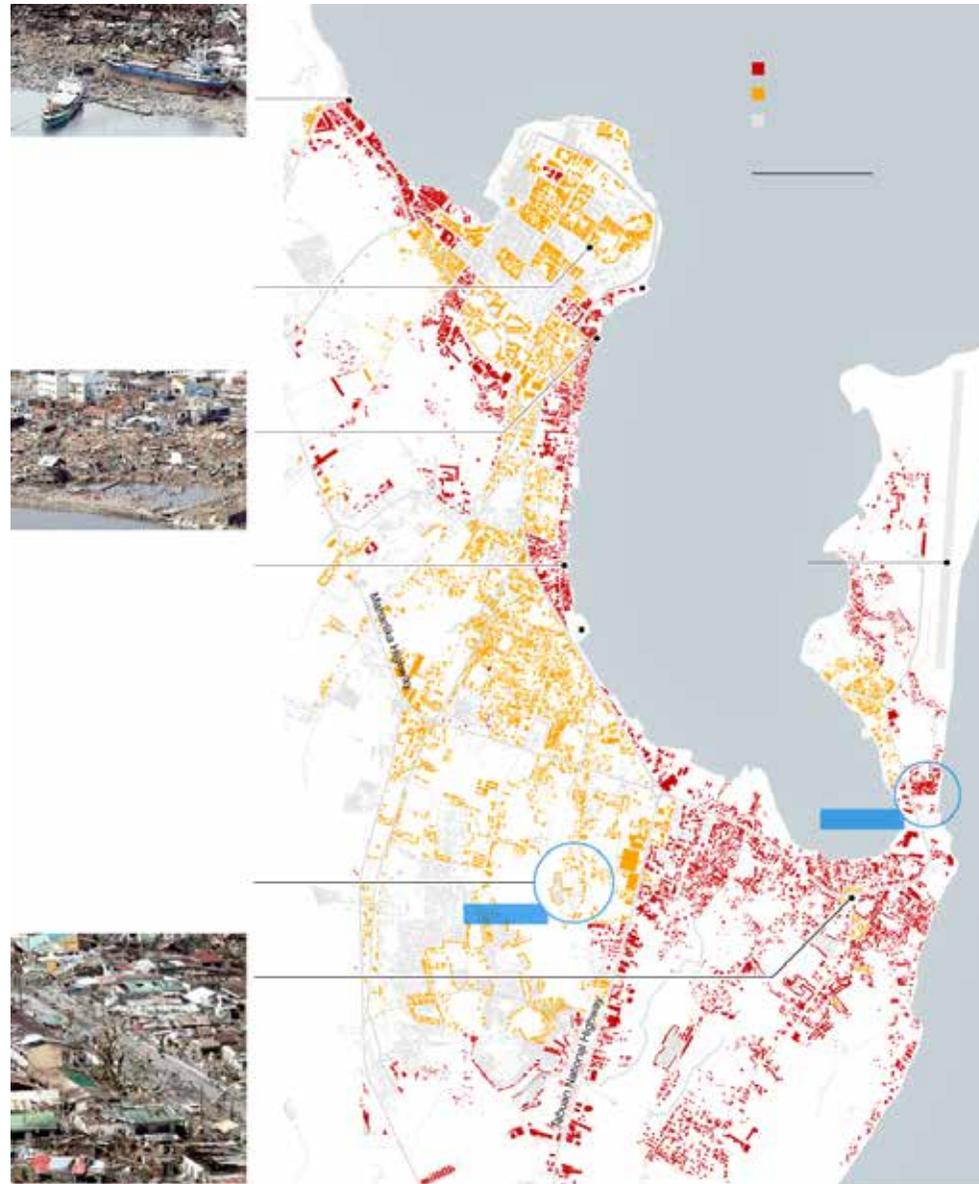
Post-Disaster: Mapping of Disaster Affected Areas



Post-Disaster: Assess the Extent of Damage by Insurance Companies



Hurricane Haiyan Damage (High-resolution Satellite Images)



Thank you for your kind attention

A thick, blue, brushstroke-style underline that tapers at both ends, positioned directly beneath the text.