Applying Geospatial Solutions to Tackle Climate Challenges

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Climate Change Impact in Singapore

Extreme weather

Source: Reddit

Source: TODAY file photo

Increased Temperature

Increased Rainfall

Source: Road SG/facebook

Source: Reuters

Change of transmission dynamics

Sea Level Rise and Coastal Inundation

High tide at East Coast Park Area B on 4 Feb,2016 (Source: Straits Times)

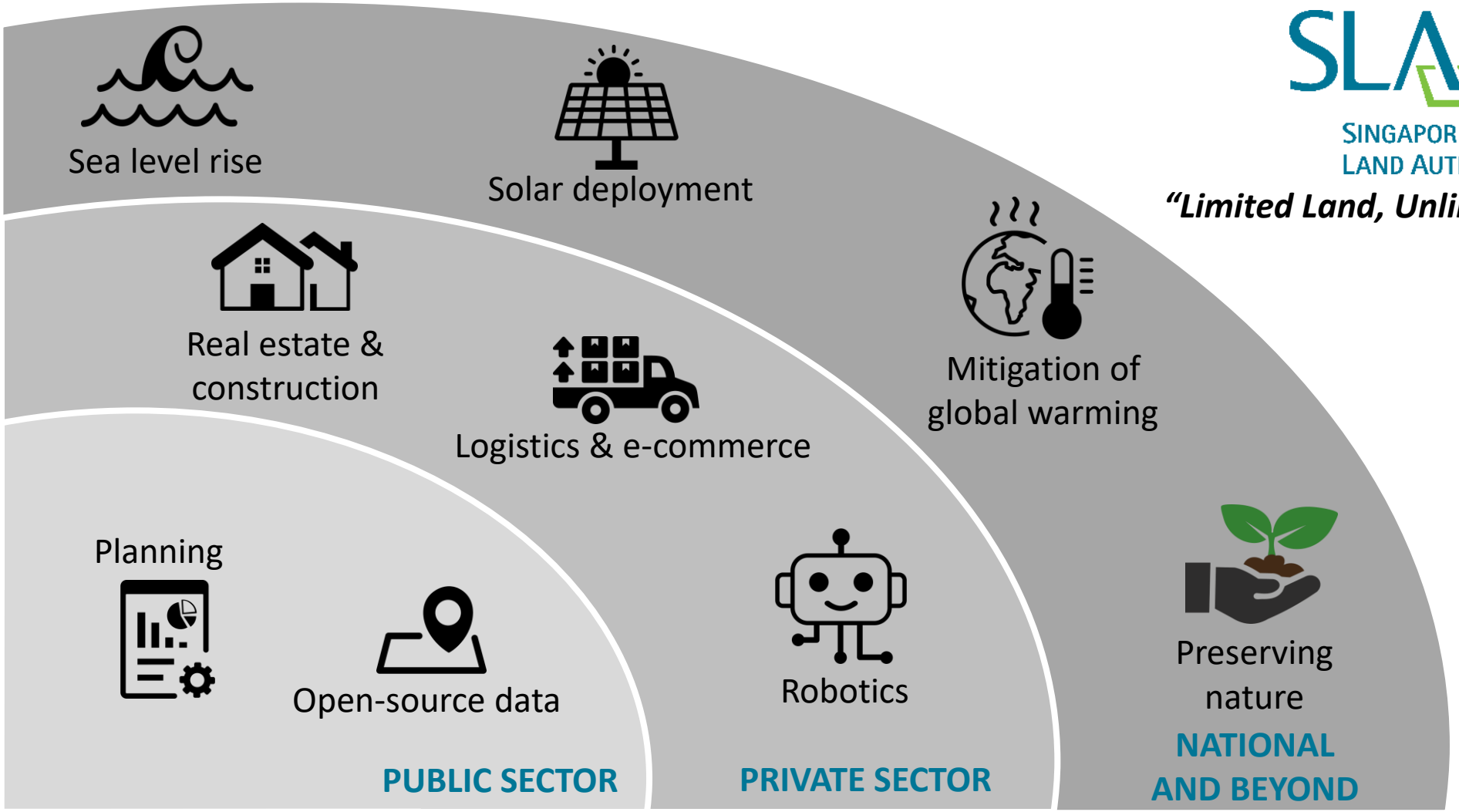
Submerged boardwalk at Sungei Buloh Nature Reserve during a spring tide in January 2015 (Source: Straits Times)

CLIMATE CHANGE IN SINGAPORE

SINGAPORE'S CLIMATE	DAILY TEMPERATURE	FREQUENCY OF WARM DAYS & NIGHTS	RAINFALL	WIND	SEA LEVEL RISE
OBSERVED CHANGES	From 1948 to 2016, annual mean temperatures rose at an average rate of 0.25°C per decade 	Since 1972, the number of warm days and nights has increased, and the number of cool nights has decreased 	From 1980 to 2016, annual total rainfall rose at an average rate of 101mm per decade 	General wind patterns influenced by northeast and southwest monsoons. There are no clear trends for wind speed as it is dependent on the environment 	Between 1975 to 2009, the sea level in the Straits of Singapore rose at the rate of 1.2mm to 1.7mm per year 
FUTURE CLIMATE PROJECTIONS	Daily mean temperatures are projected to increase by 1.4°C to 4.6°C 	More warm days and warm nights for February to September throughout the 21st century 	The contrast between the wet months (November to January) and dry months (February and June to September) is likely to be more pronounced. Intensity and frequency of heavy rainfall events is expected to increase as the world gets warmer 	Singapore will continue to be influenced by the northeast and southwest monsoons with potential increase in wind speeds during northeast monsoon season 	Sea levels are projected to rise by up to about 1 metre 

NEA Infographic

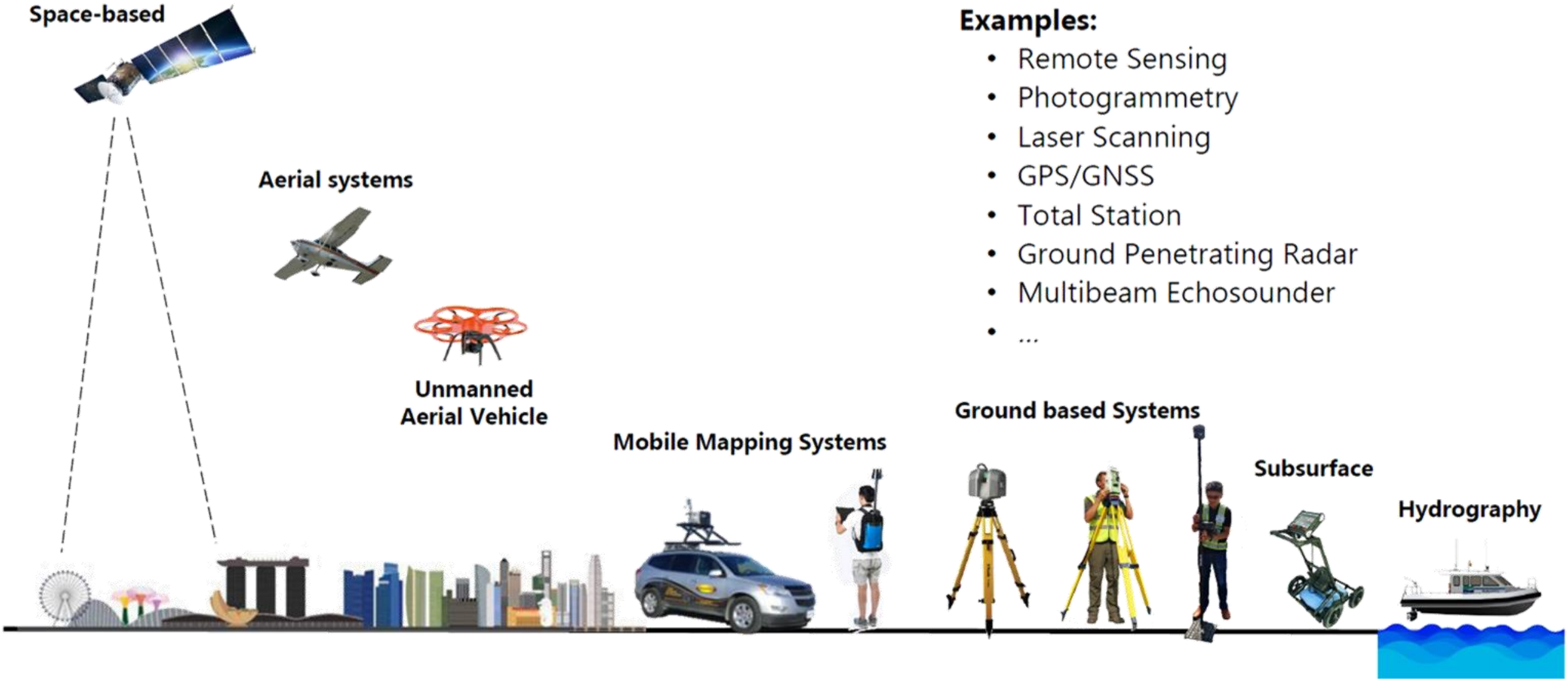
Maximising Land Through Better Spatial Knowledge



SINGAPORE LAND AUTHORITY

"Limited Land, Unlimited Space"

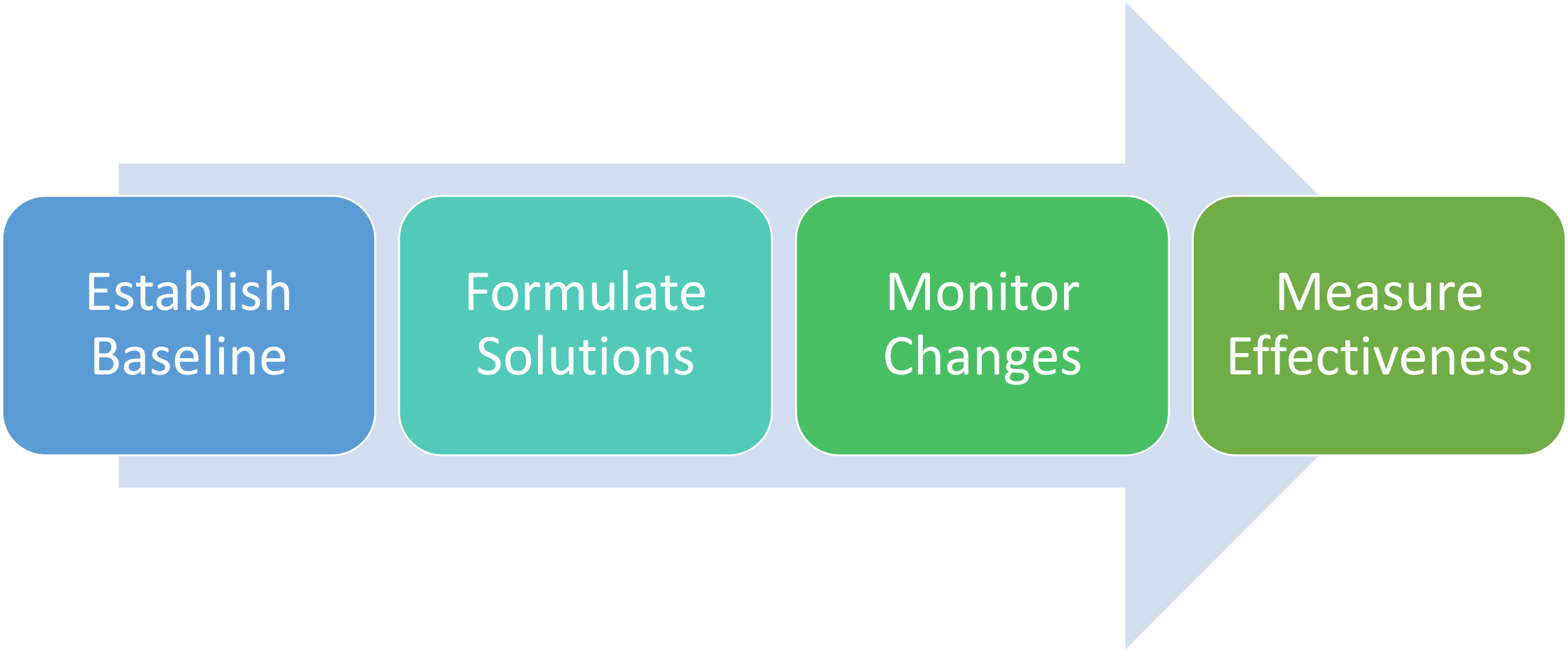
Adoption of Sensors Technologies



Examples:

- Remote Sensing
- Photogrammetry
- Laser Scanning
- GPS/GNSS
- Total Station
- Ground Penetrating Radar
- Multibeam Echosounder
- ...

Geospatial Solutions as Enablers in Climate Action

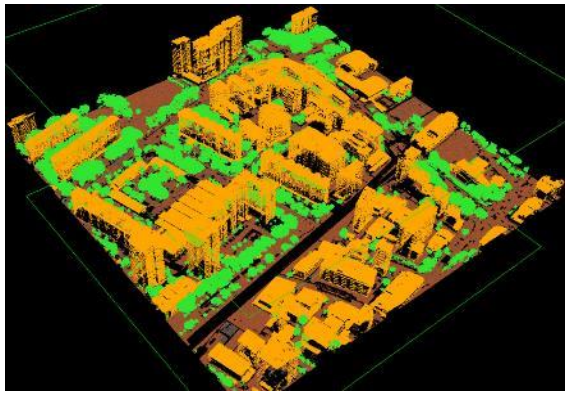


1. Establish baseline to take stock

2. of what is at risk and what to protect

Rapid Mapping Techniques

Aerial Mapping

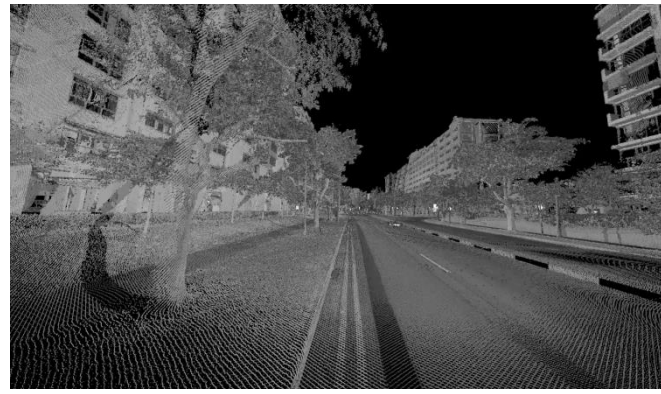


Aerial Point Cloud Data

Aerial Imagery (nadir & oblique)

Mobile Mapping

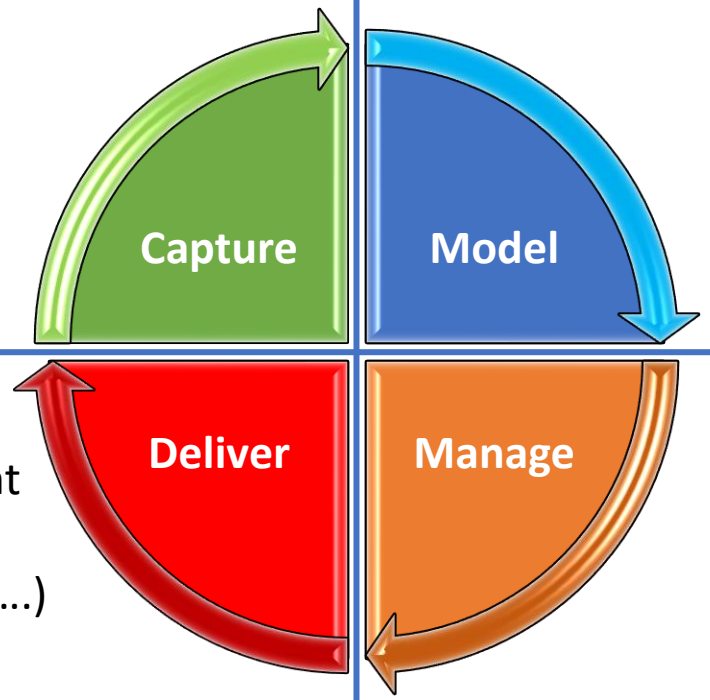
360 Panoramic Images



Mobile Point Cloud Data

Geospatial Development Framework

- Coordinate System
- Positioning Infrastructure
- Mapping Standard
- Platforms
- Sensors &Technologies

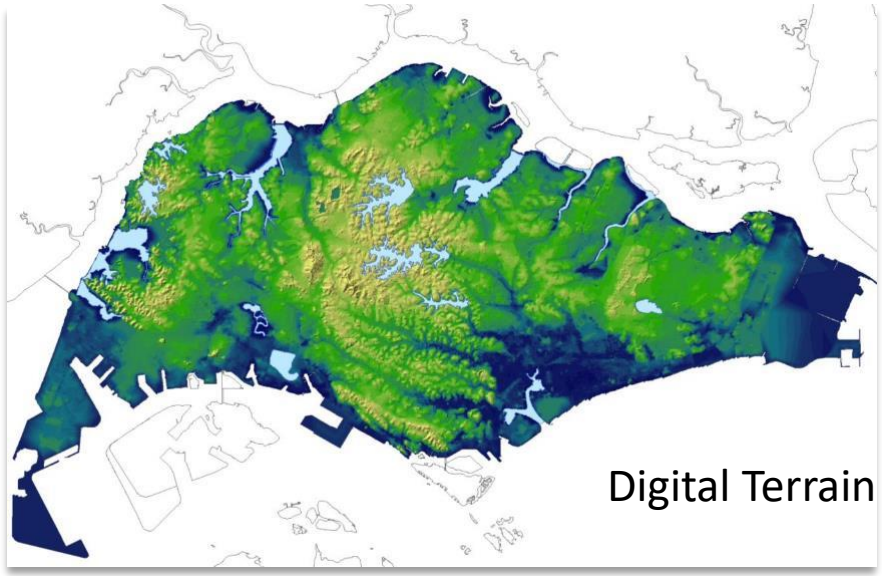


- Processing Techniques
- Modelling Techniques
- Data Standards
- Data Formats
- Resolution & Level of Detail (LoD)

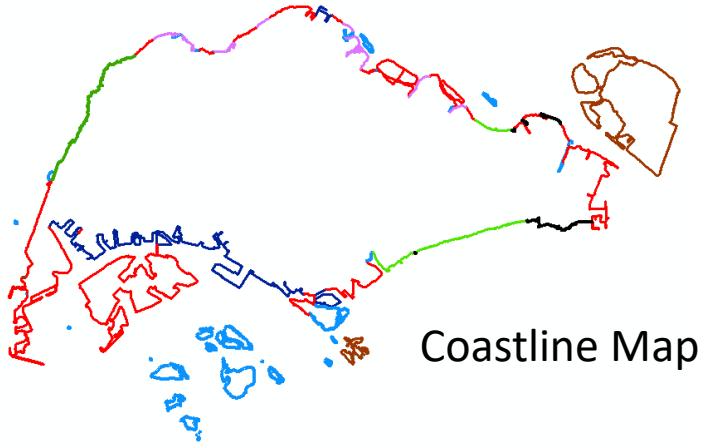
- Products and Maps Development
- Products and Maps Standards
- Advanced Visualisation (VR, AR ….)
- Map or Geo Data Services
- Solutioning ….

- Data Governance
- Database Management
- Change Detection and Updating Techniques and Workflow
- Data Exchange Standards

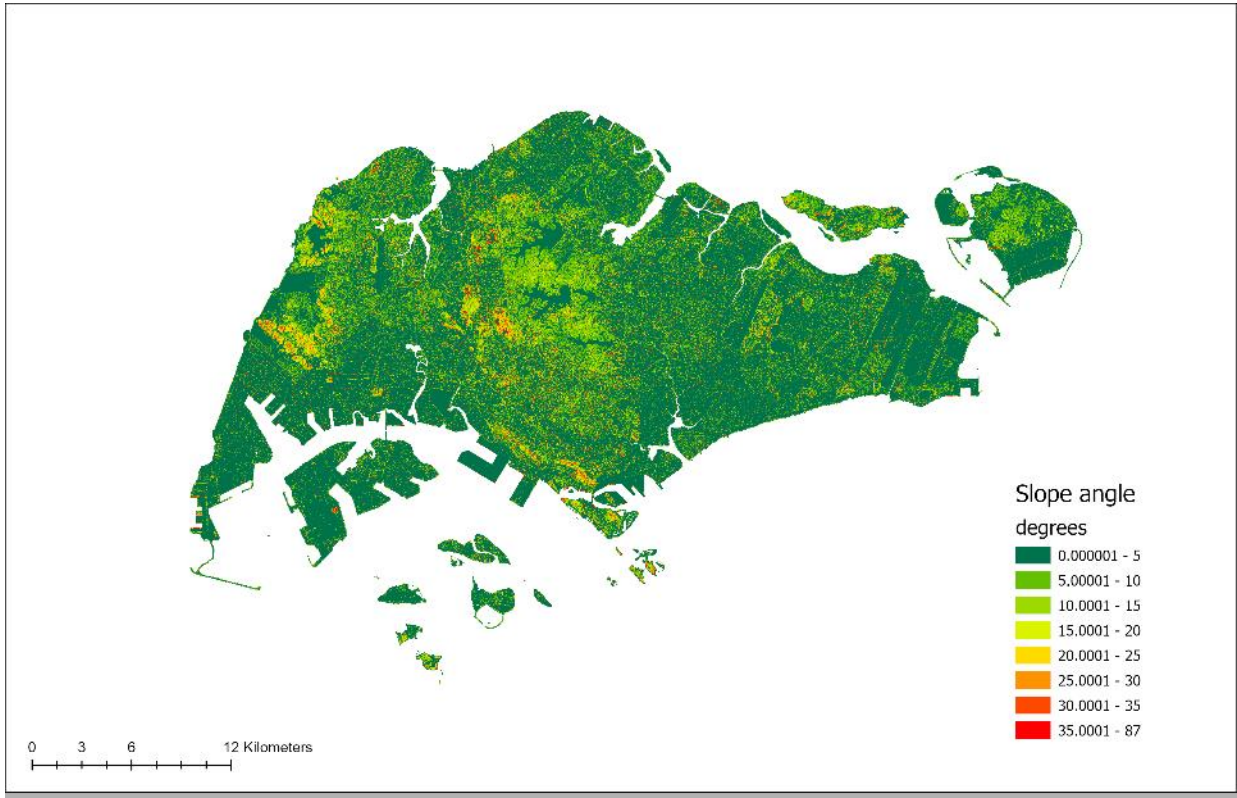
Authoritative Baseline Maps



Digital Terrain Model

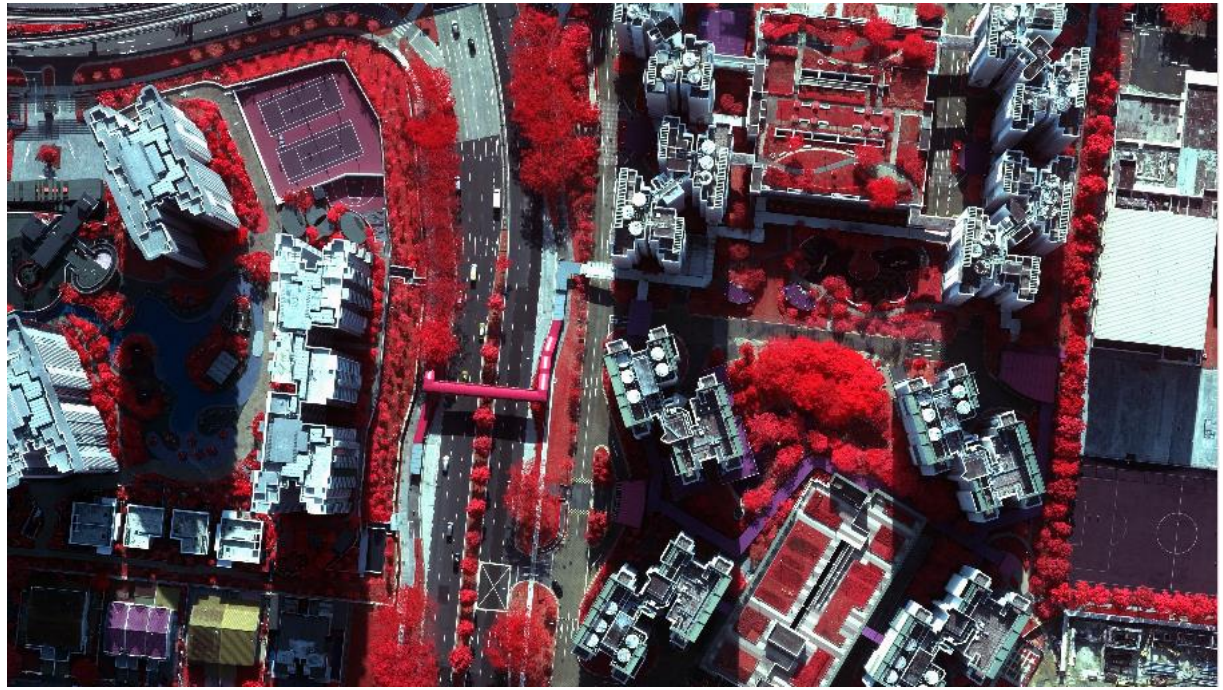


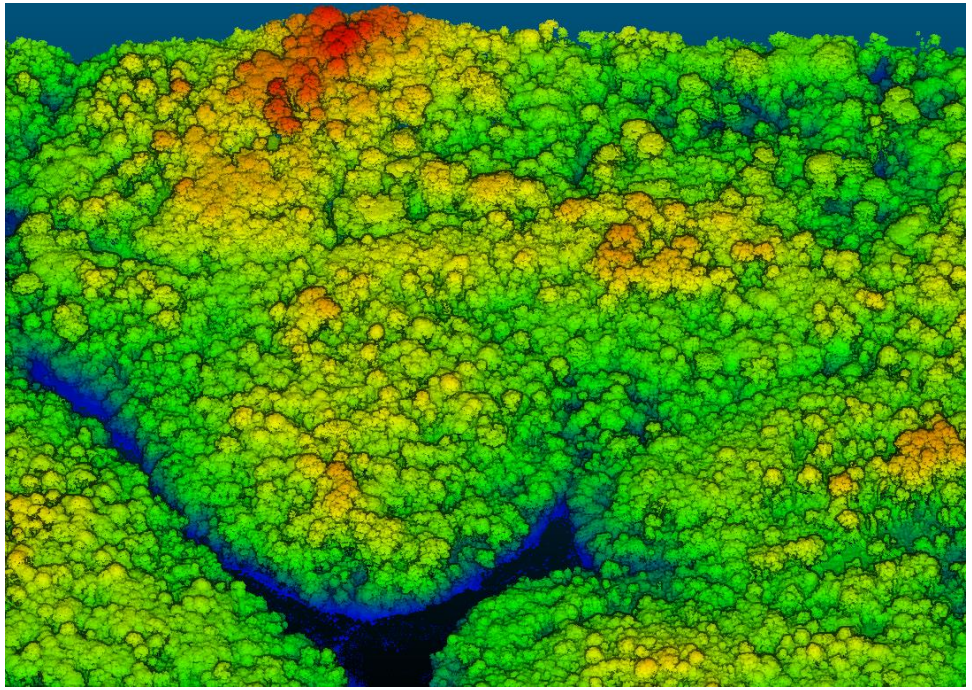
Coastline Map

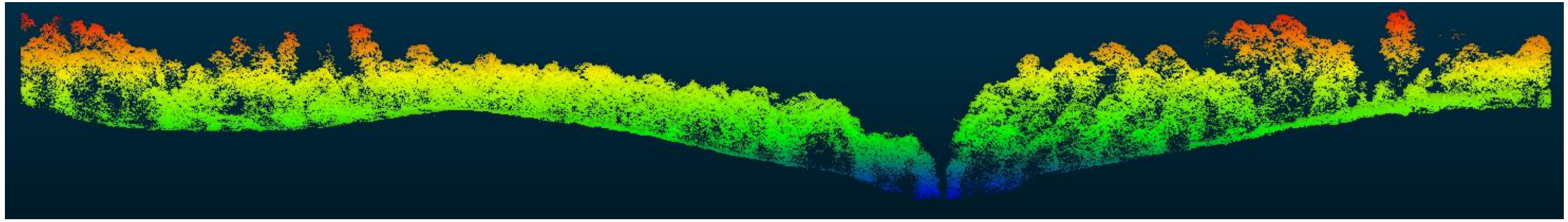


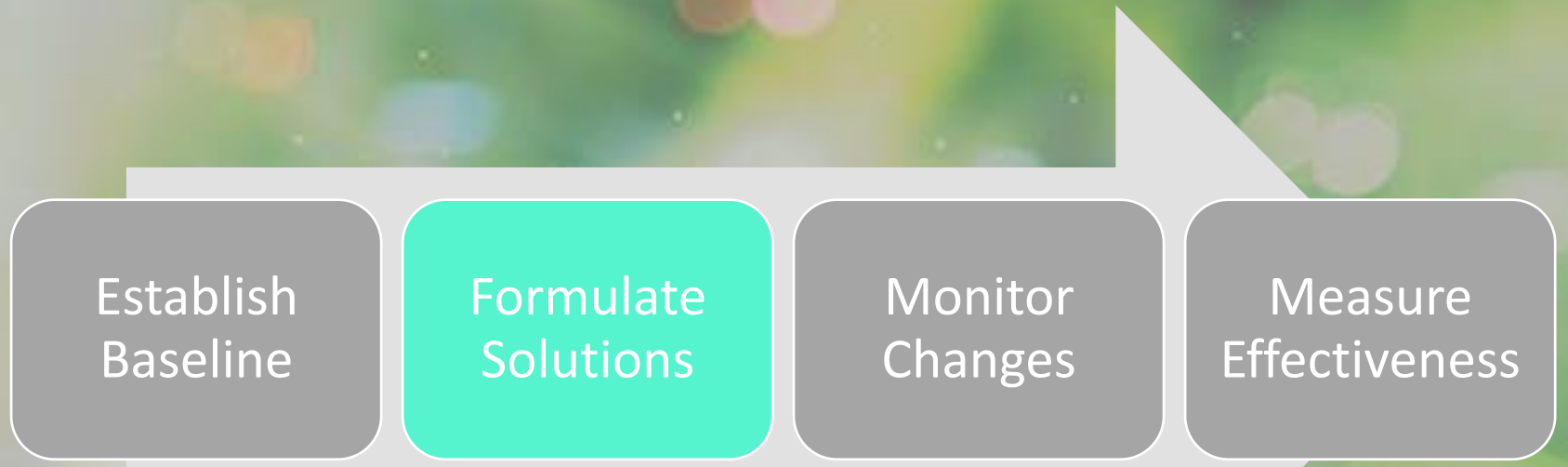
Distribution of slope angle in Singapore

Near Infrared Imagery and 3D Point Cloud







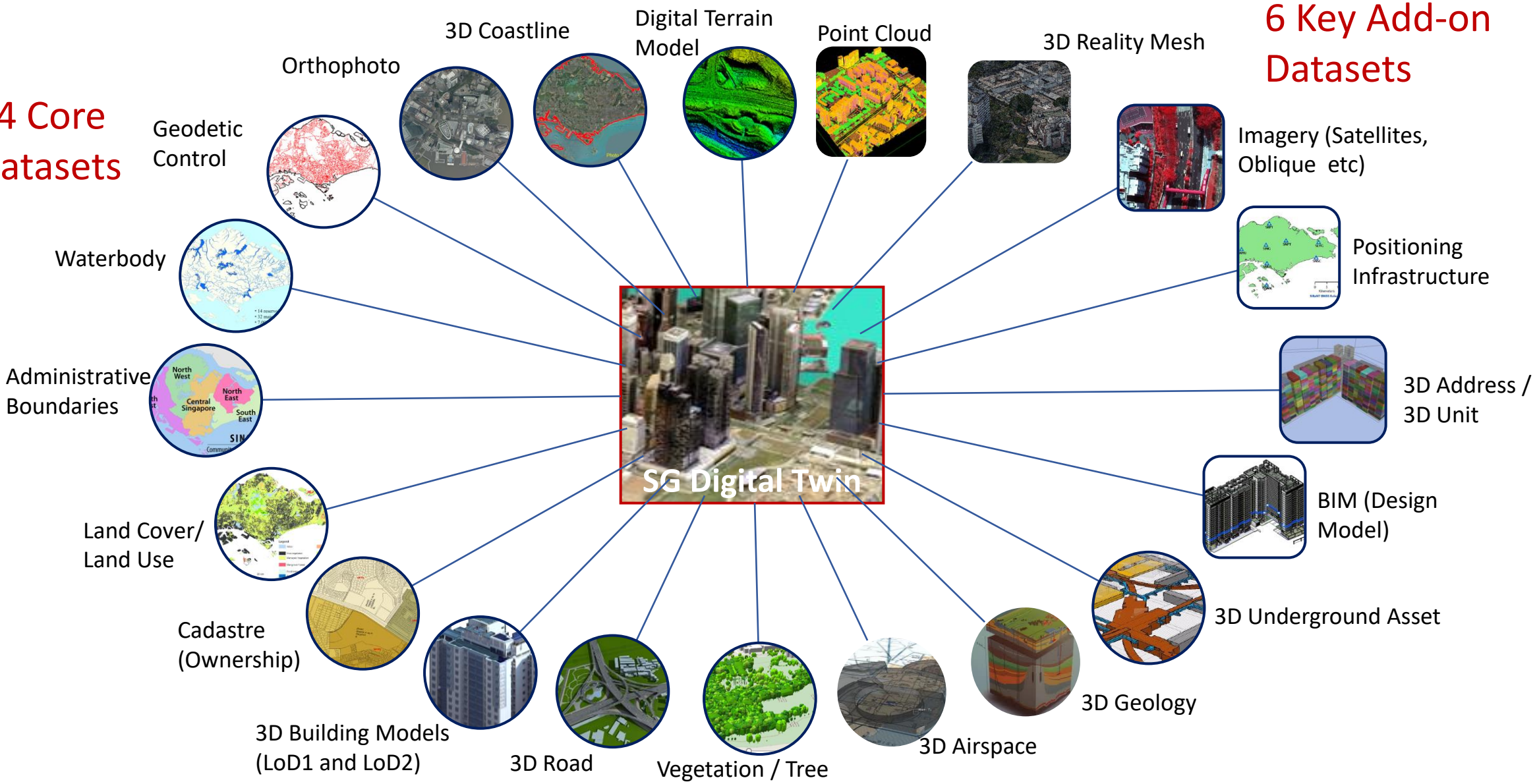


2. Formulate mitigation & adaptation policies and solutions

Digital Twin for Cities

14 Core Datasets

6 Key Add-on Datasets



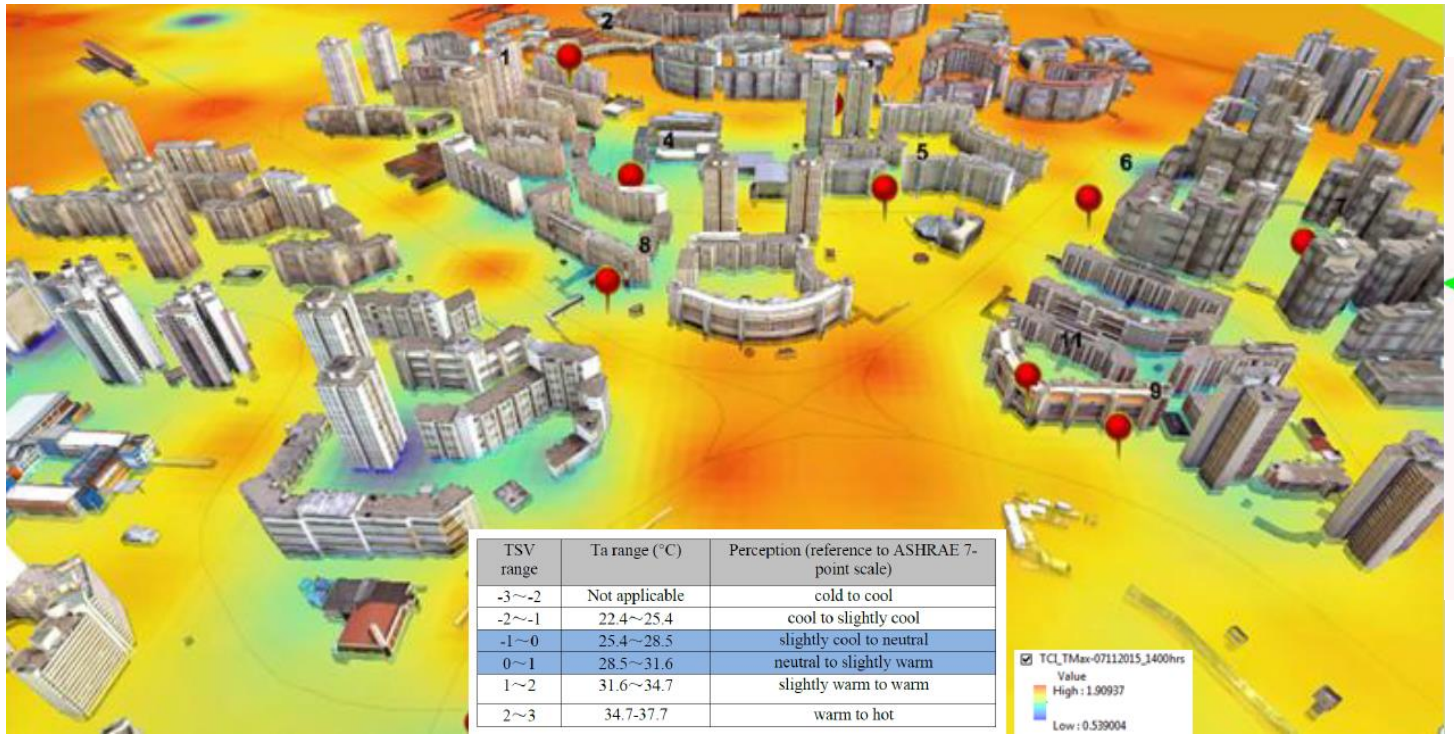
3D City Models

3D Vector Model

3D Mesh Model

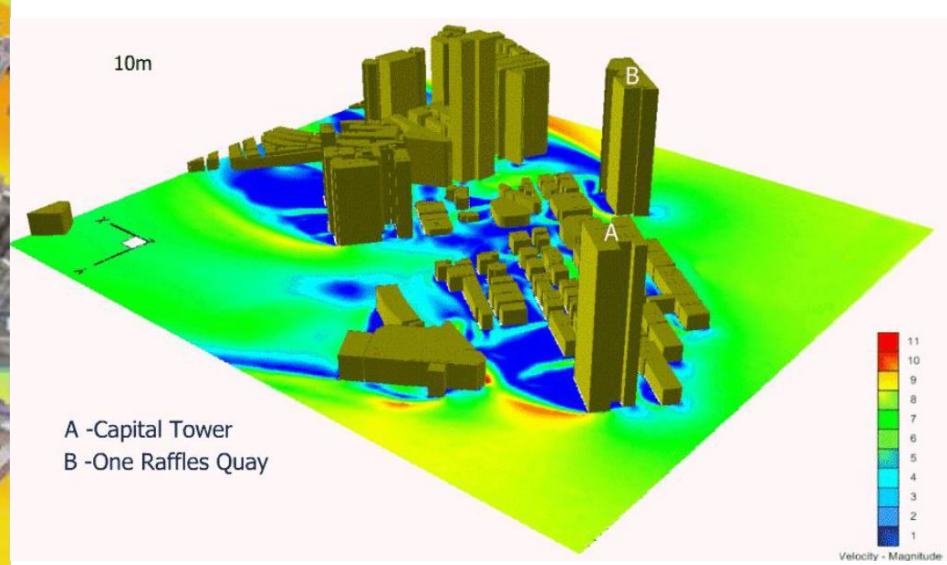
3D Visualisation

Multi-scale Urban System Modelling for Thermal Comfort



TSV range	Ta range (°C)	Perception (reference to ASHRAE 7-point scale)
-3~-2	Not applicable	cold to cool
-2~-1	22.4~25.4	cool to slightly cool
-1~0	25.4~28.5	slightly cool to neutral
0~1	28.5~31.6	neutral to slightly warm
1~2	31.6~34.7	slightly warm to warm
2~3	34.7-37.7	warm to hot

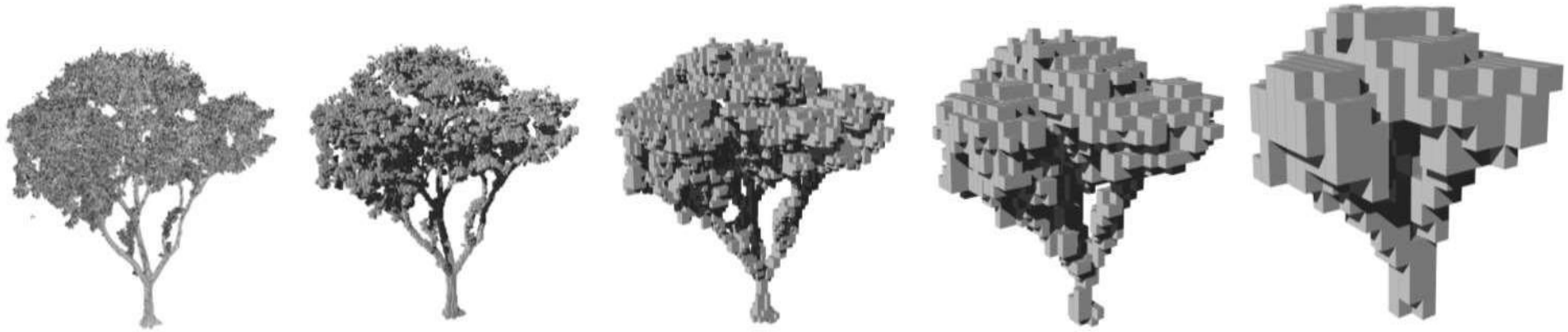
UHI-Thermal Comfort Map (100m resolution on 7 Nov 2015 1400hr)



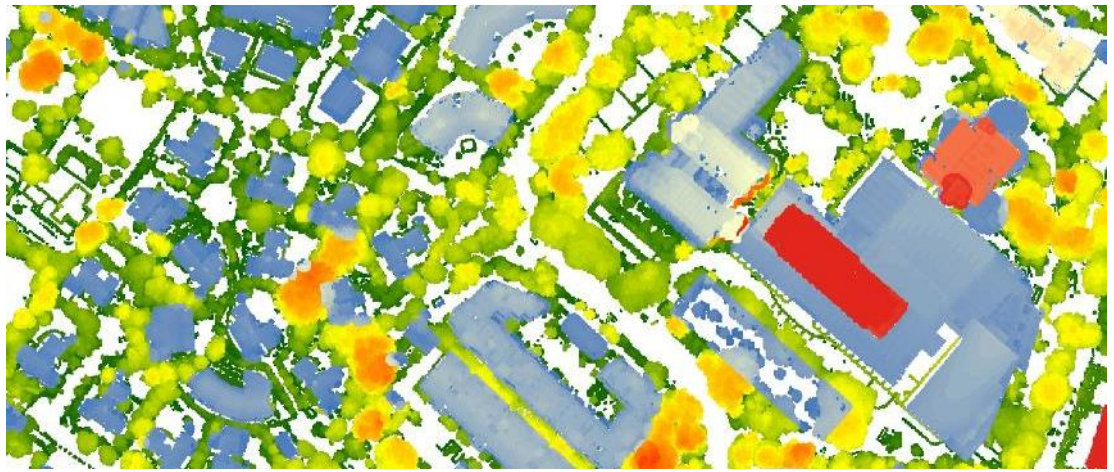
Wind Flow and Computational Fluid Dynamics (CFD)

Accurate Mapping of Trees and Vegetation

- Automated extraction of tree attribute
- Detail 3D modelling of road side trees



Voxels Modelling

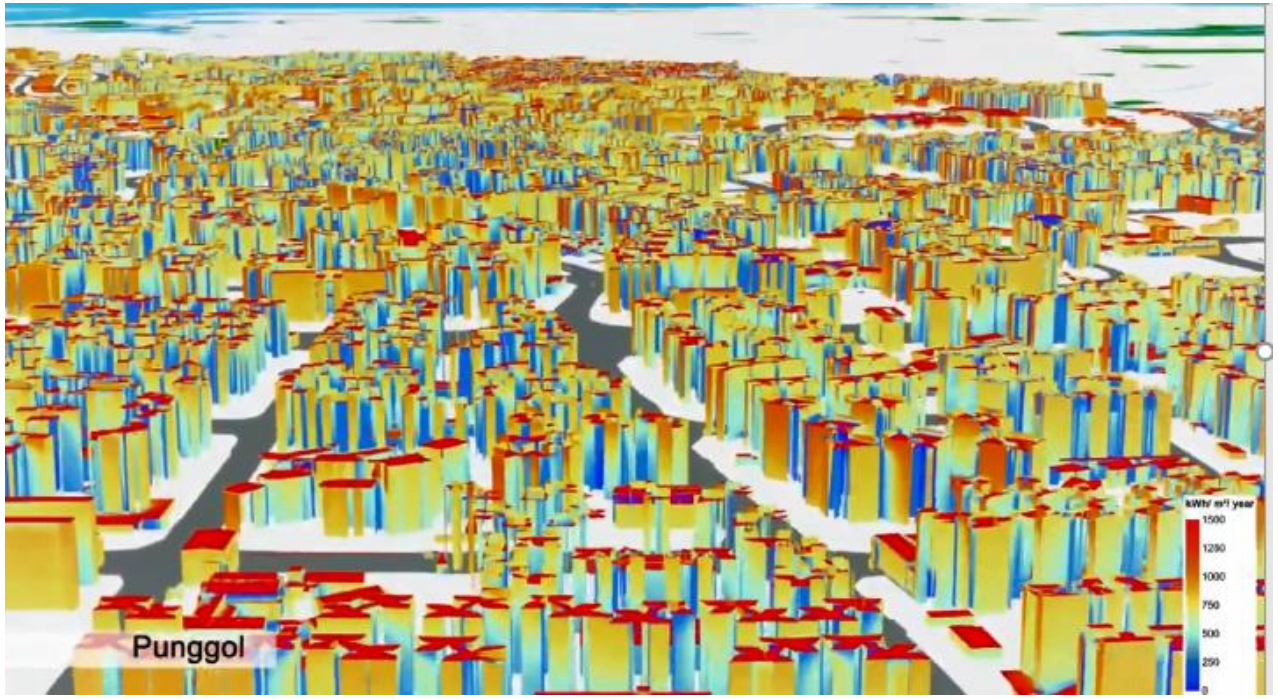


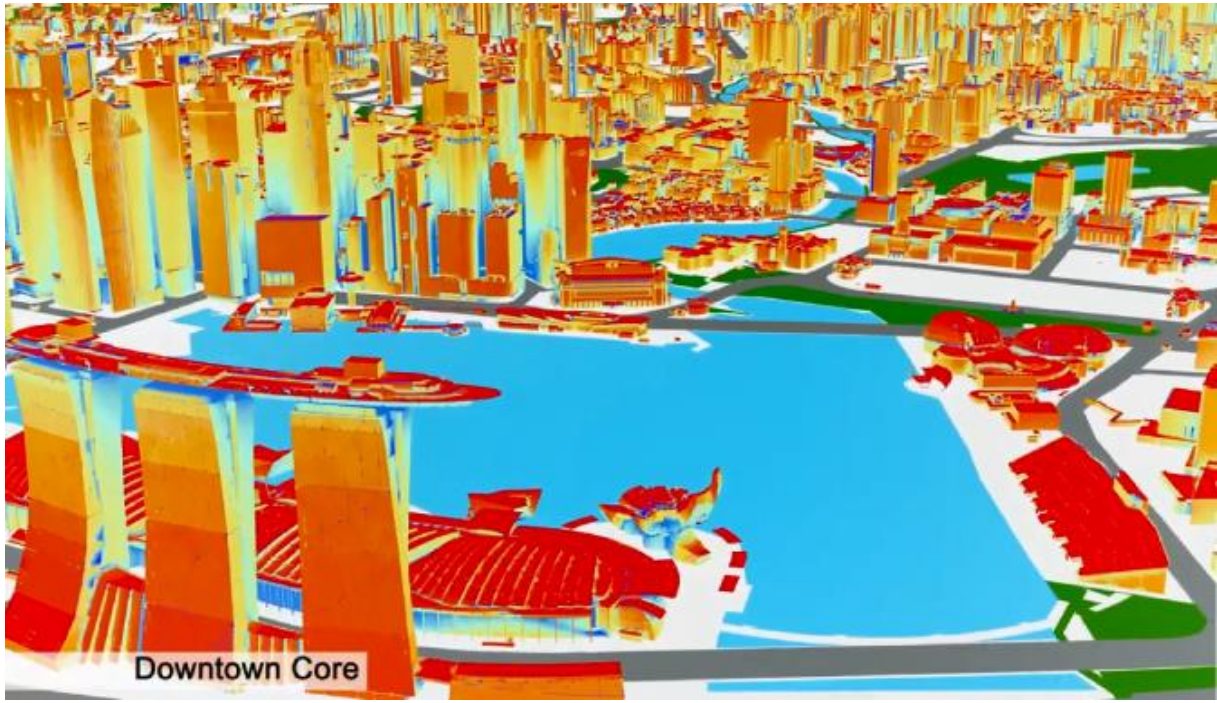
Images Courtesy of National Parks Board (NParks)

NATIONAL PARKS
SLA SINGAPORE LAND AUTHORITY
A*STAR Institute of High Performance Computing
CRISP National University of Singapore
GOVTECH SINGAPORE
RD ROADATA SMART CITY SOLUTIONS

3D Solar Potential Map

Collaboration between SERIS, NUS and SLA





Images Courtesy of Solar Energy Research Institute of Singapore (SERIS) and School of Design & Environment (SDE), National University of Singapore (NUS)

Carbon Estimation in Singapore

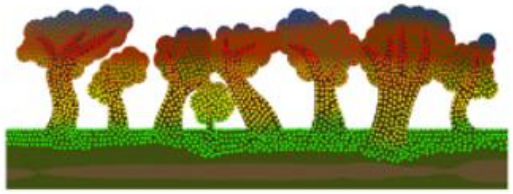
Collaboration between SLA and NUS Centre for Nature-based Climate Solution

1

LiDAR (Light Detection and Ranging)

This laser scanning technology emits hundreds of thousands of laser pulses per second to capture the physical world.

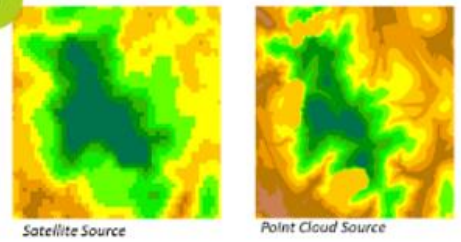
2



Point Cloud

Laser pulses could penetrate the canopy. The reflected signals are termed "point cloud".

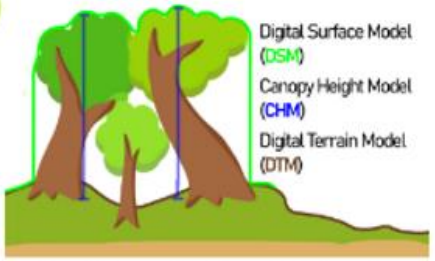
3



Reliable, High-Resolution 3D GeoInformation

Ground profile derived from the point cloud is 20 times more reliable than that from satellite imagery.

4



GeoInformation from 3D Mapping

Such information offers insights into the canopy height and other terrain-related data.

5

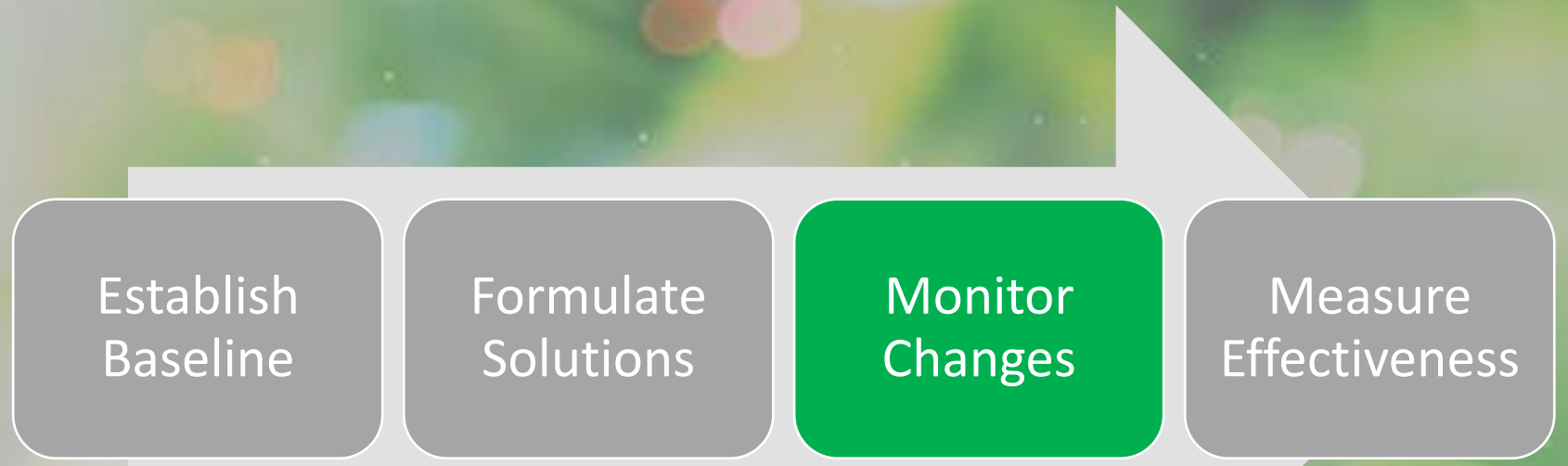
LiDAR-Carbon Model for Singapore

The collaboration between SLA and NUS enables efficient carbon estimation and derivation of carbon density across different ecosystems.

6

More Accurate Carbon Estimation

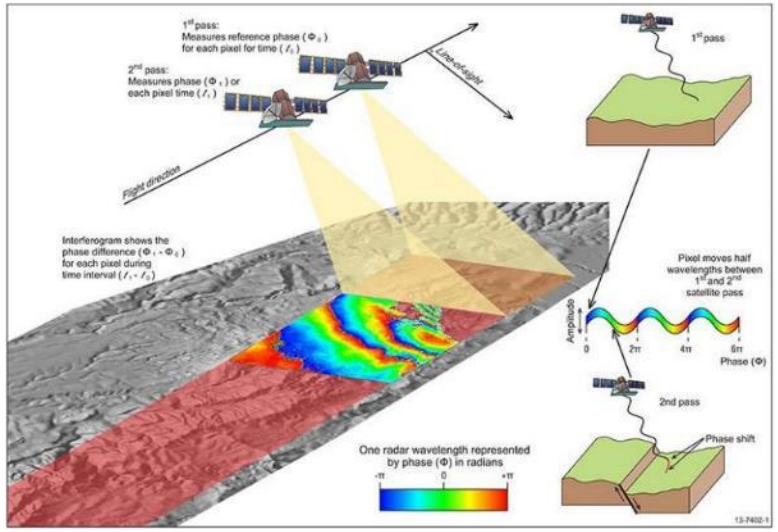
Accurate representation of carbon stock in forests will facilitate the planning of measures to address climate change challenges.



3. Monitor the rate at which the risks are unfolding

Monitoring of Vertical Land Motion

GNSS Reference Station Network (CORS)



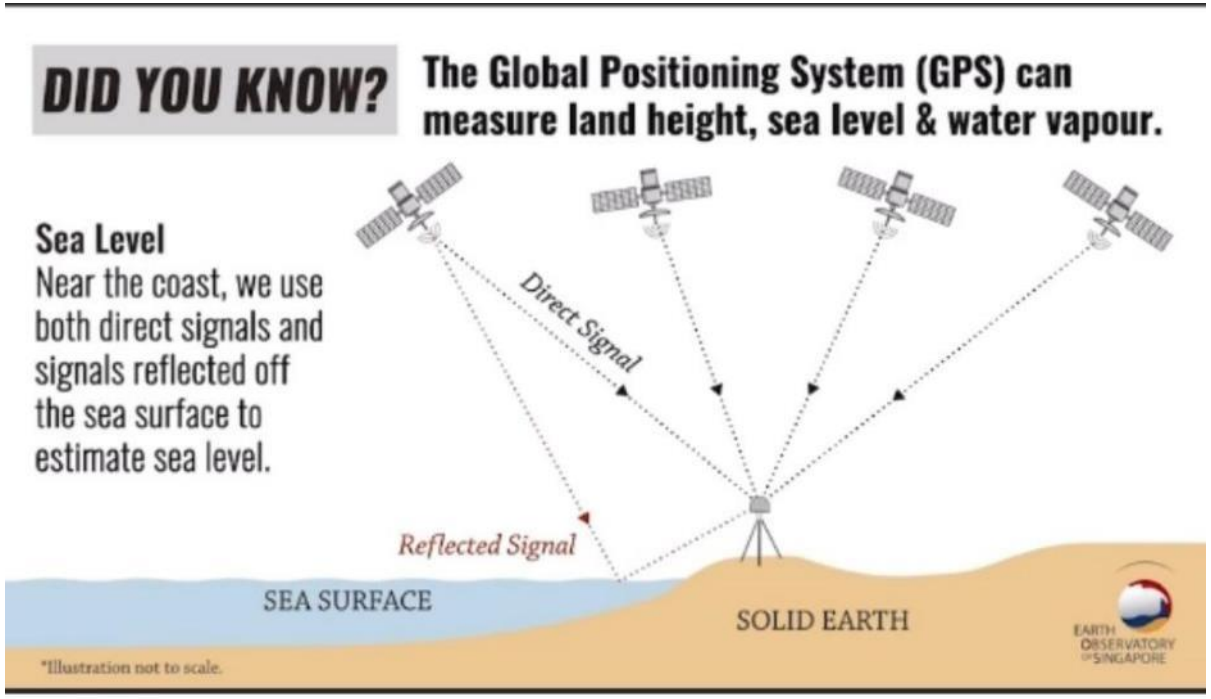
Interferometry SAR

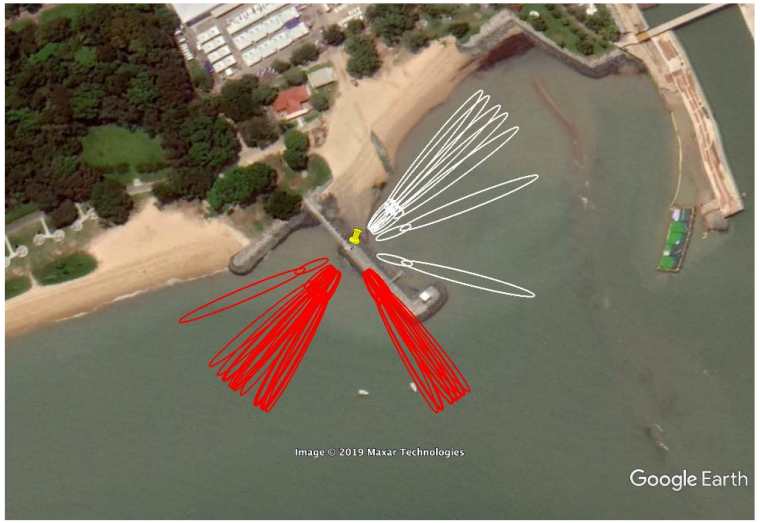
Global Navigation Satellite System (GNSS) Reference Infrastructure

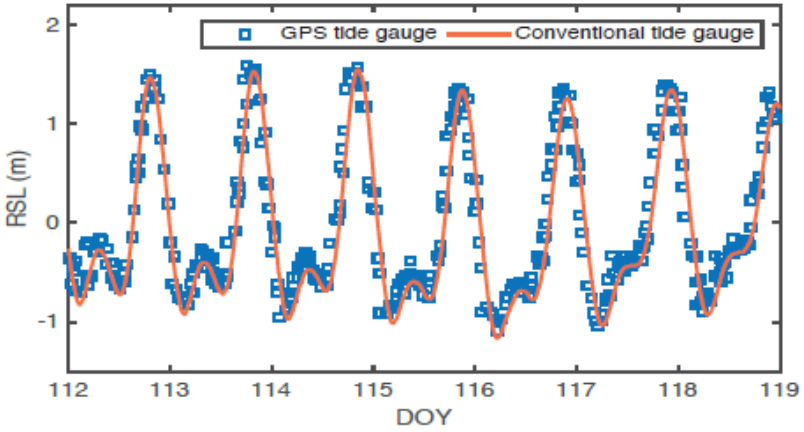
Source: http://www.ga.gov.au/__data/assets/image/0008/22859/13-7402-1-sml1.jpg

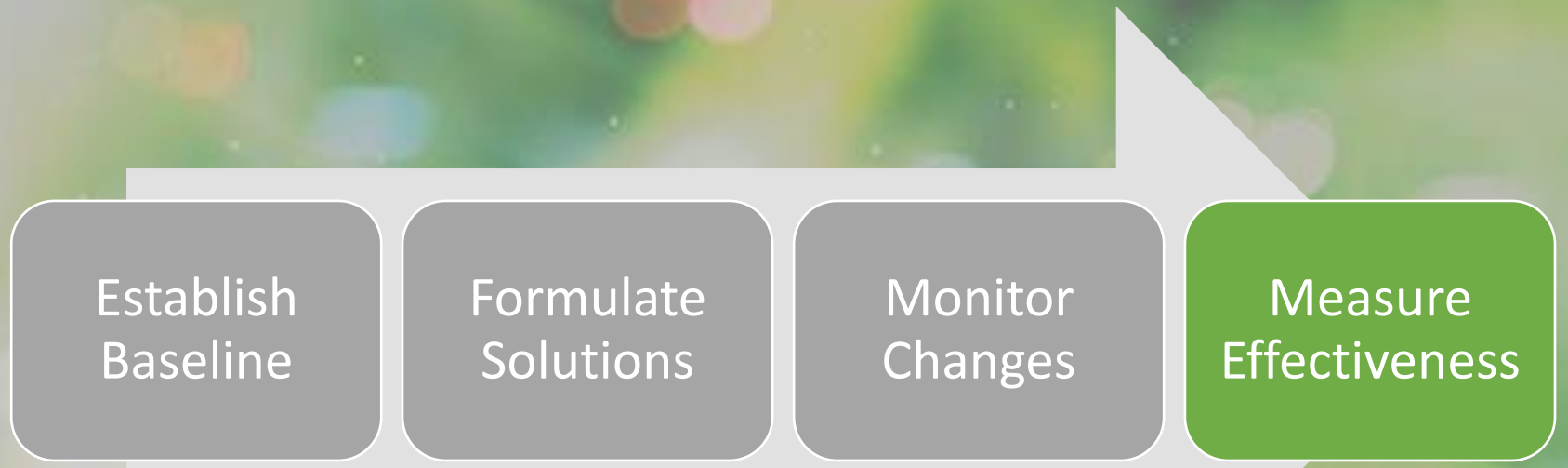
GNSS Reflectometry for Sea Level Monitoring

Collaboration between SLA and NTU Earth Observatory Singapore







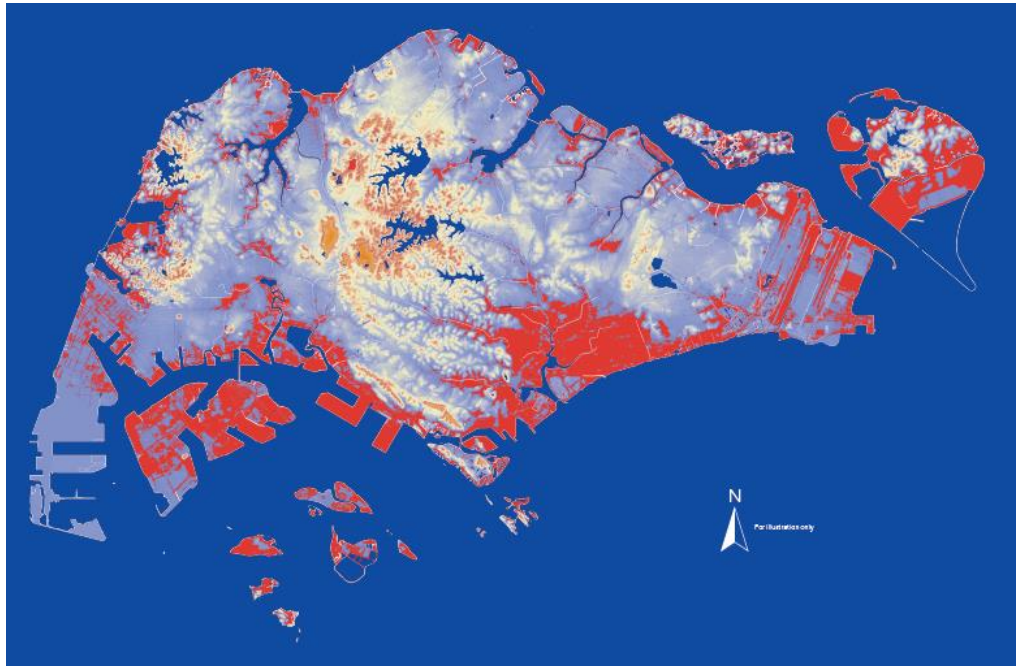


4. Measure effectiveness of the mitigation and adaptation solutions

Thank You

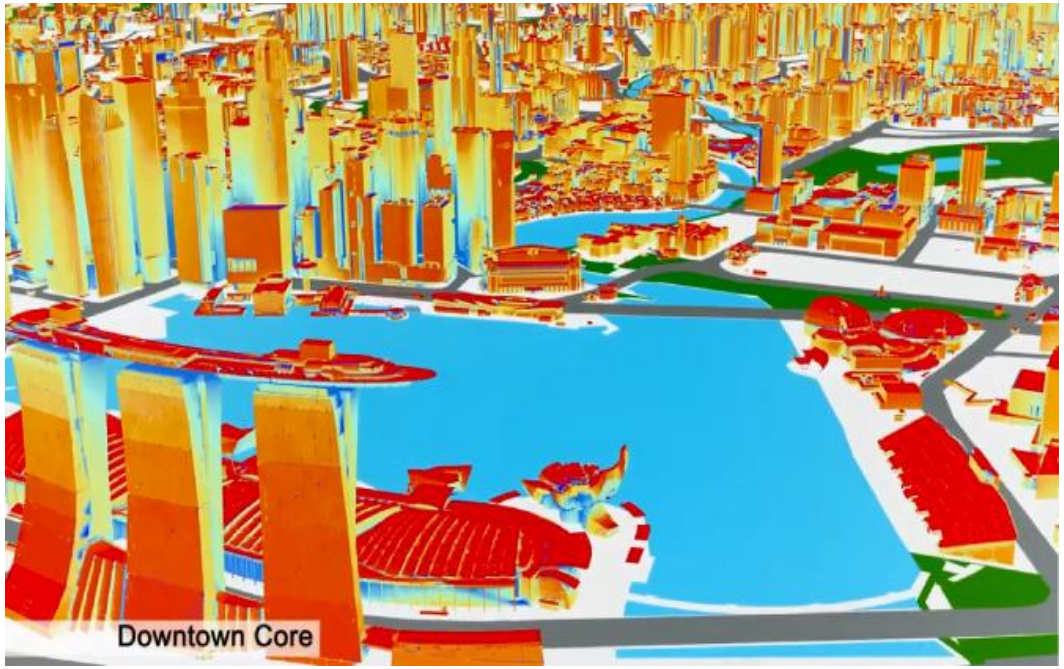
Protecting Life & Infrastructure

Identify low-lying areas and monitor environmental changes (e.g. surface motion, sea-level rise)



Deploying Solar Panels Efficiently

Generation of an island-wide solar potential map to ensure the best placement



Tackling Urban Heat

3D models facilitate study of the effects of Urban Heat Island effect, and simulation of urban climate