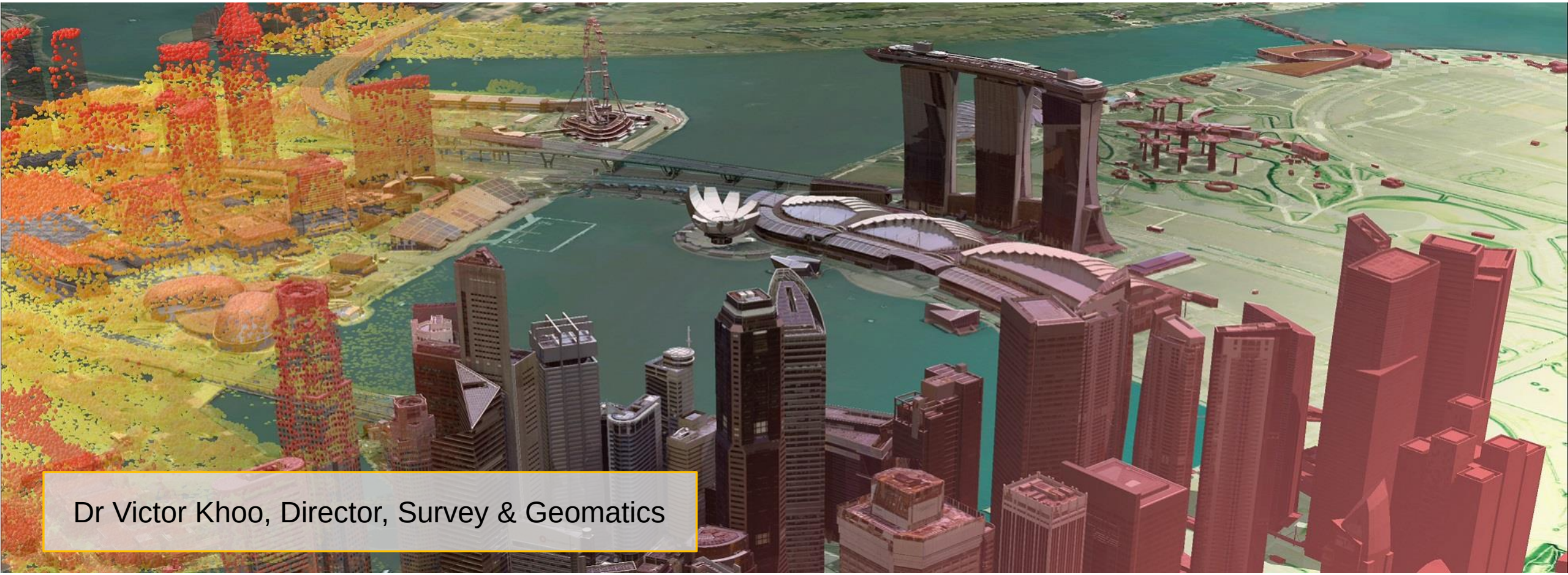
Applying Geospatial Solutions to Tackling Climate Challenges

SLA
SINGAPORE
LAND AUTHORITY



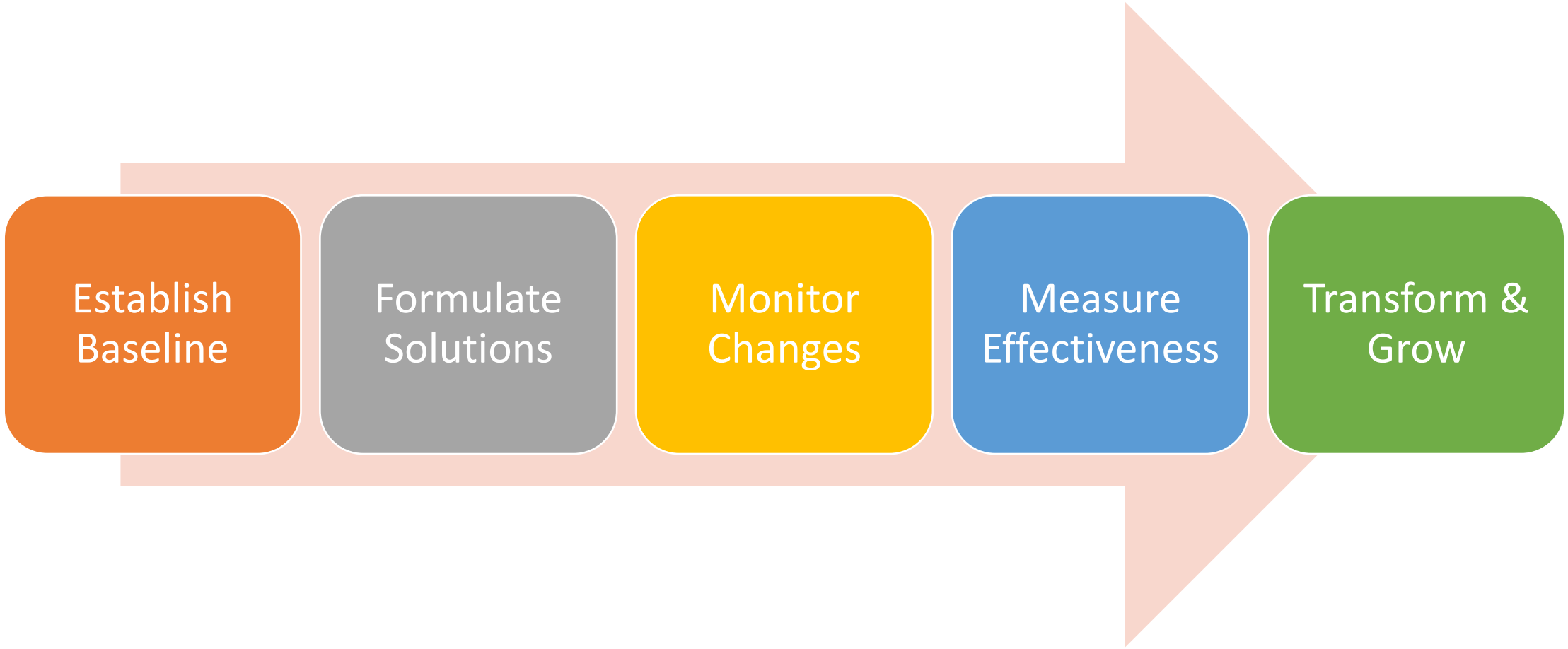
Dr Victor Khoo, Director, Survey & Geomatics

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

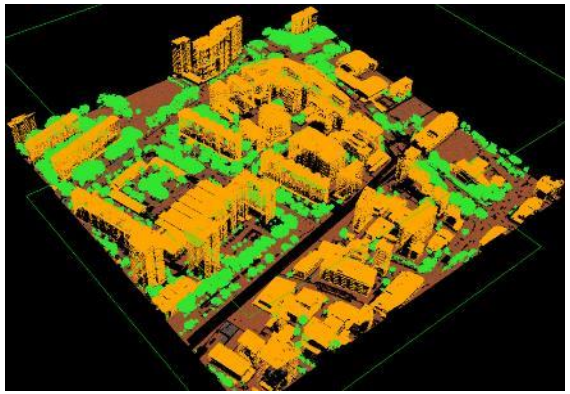
Geospatial Solutions as Enablers in Climate Action



1. Establish baseline to take stock of what is at risk and what to protect

Rapid Mapping Techniques

Aerial Mapping

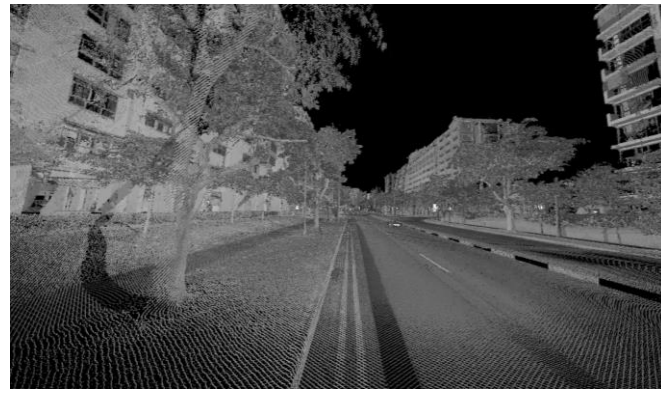


Aerial Point Cloud Data

Aerial Imagery (nadir & oblique)

Mobile Mapping

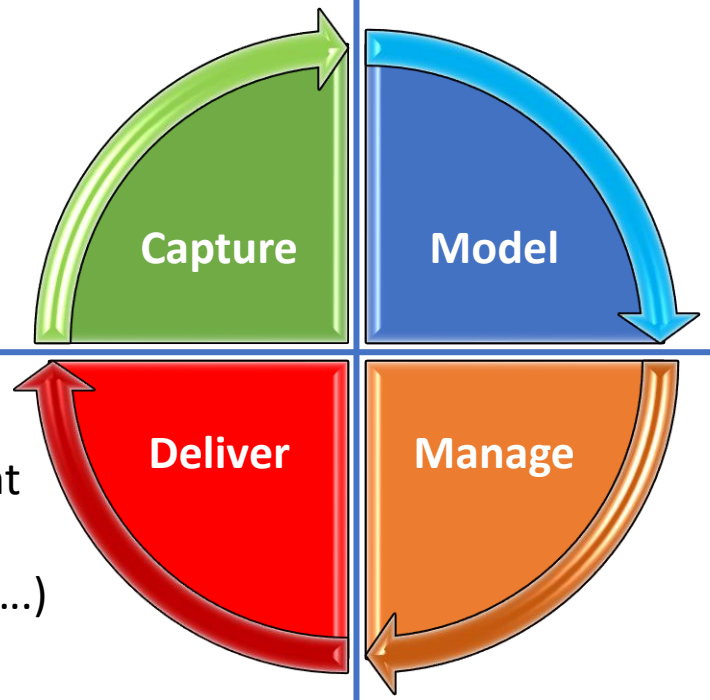
360 Panoramic Images



Mobile Point Cloud Data

Geospatial Development Framework

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

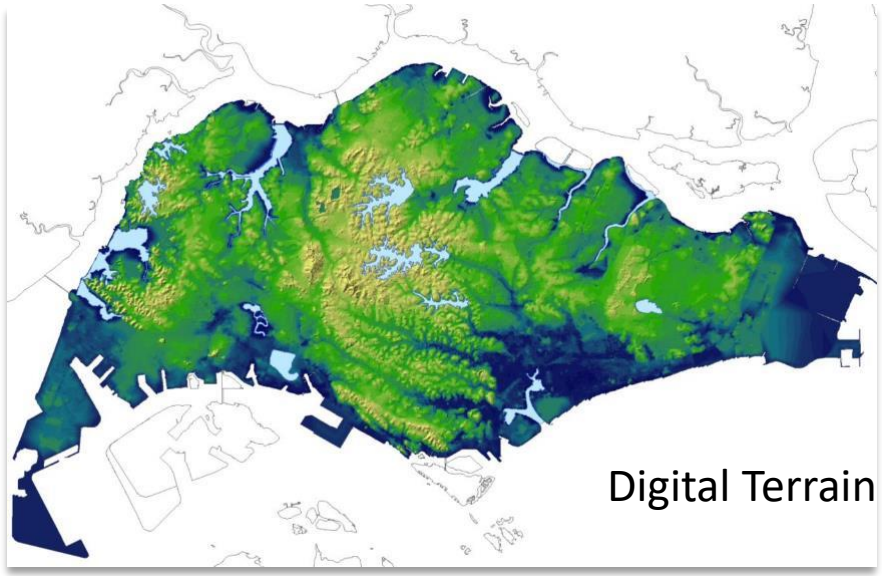


- Processing Techniques
- Modelling Techniques
- Data Standards
- Data Formats
- Resolution & Level of Detail (LoD)

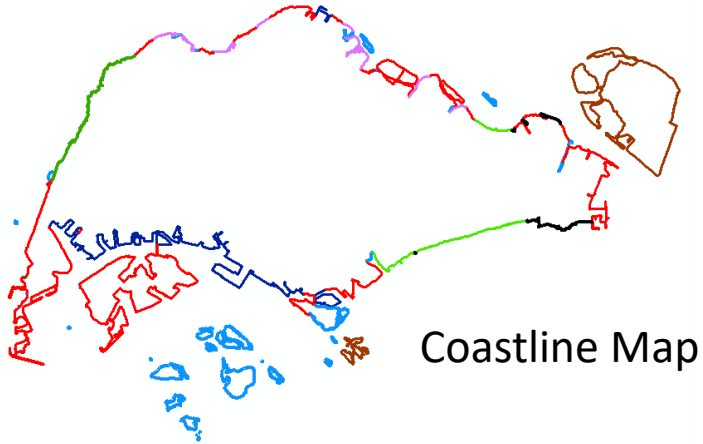
- Products and Maps Development
- Products and Maps Standards
- Advanced Visualisation (VR, AR ….)
- Map or Geo Data Services
- Solutioning ….

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

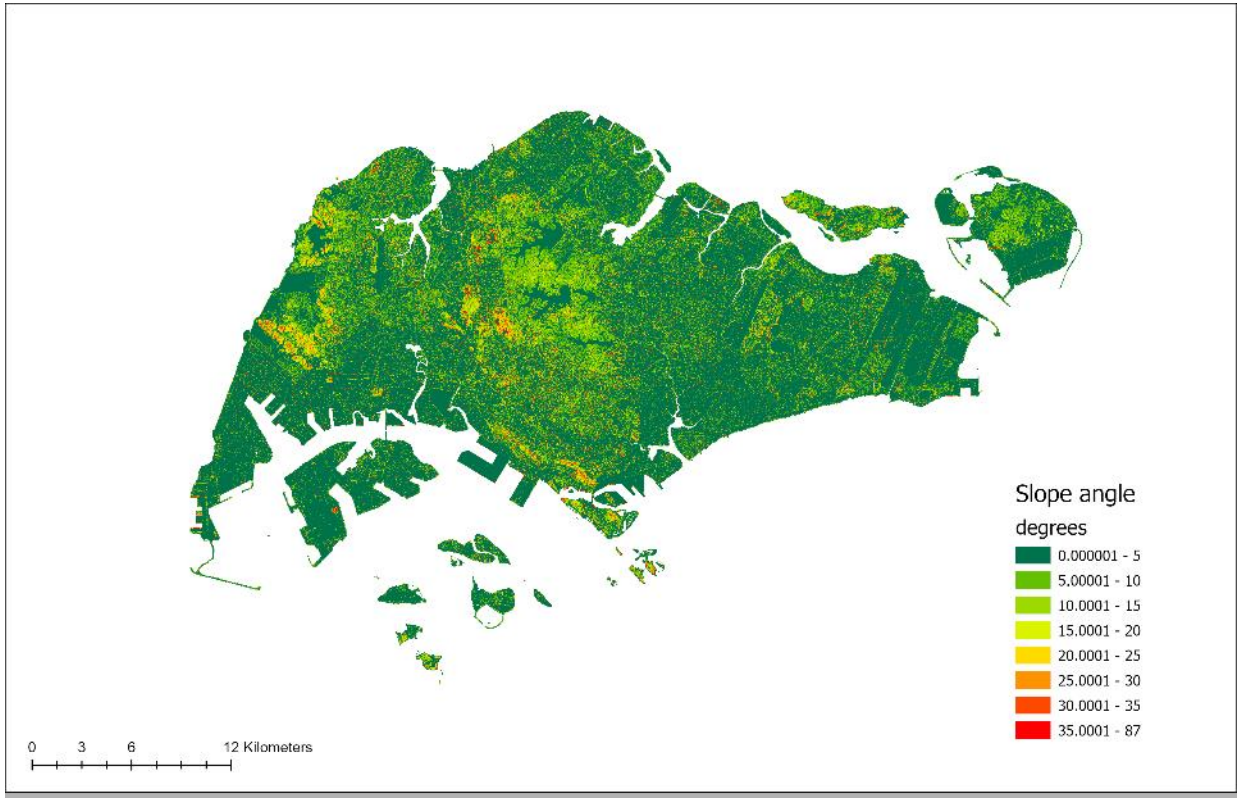
Authoritative Baseline Maps



Digital Terrain Model

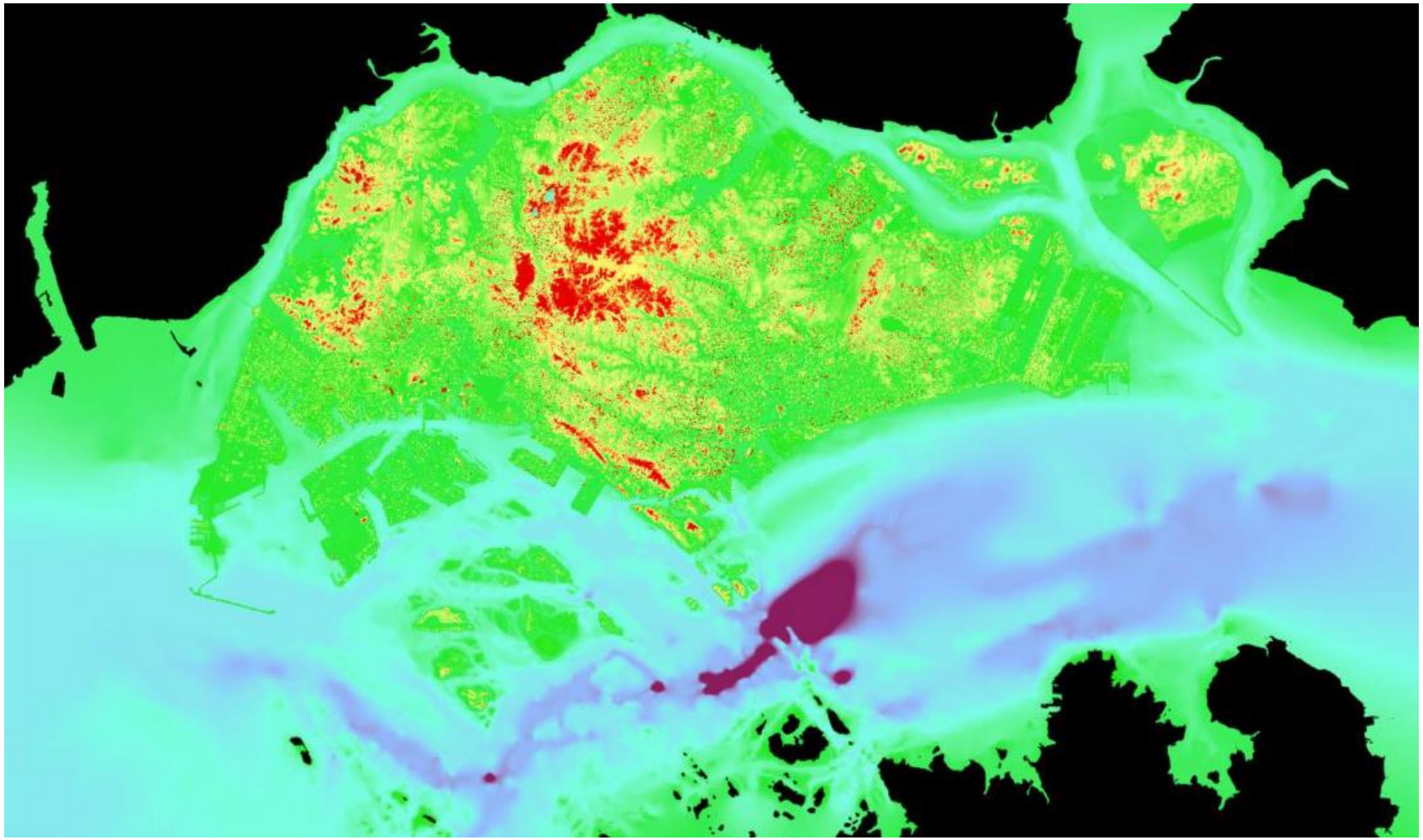


Coastline Map



Distribution of slope angle in Singapore

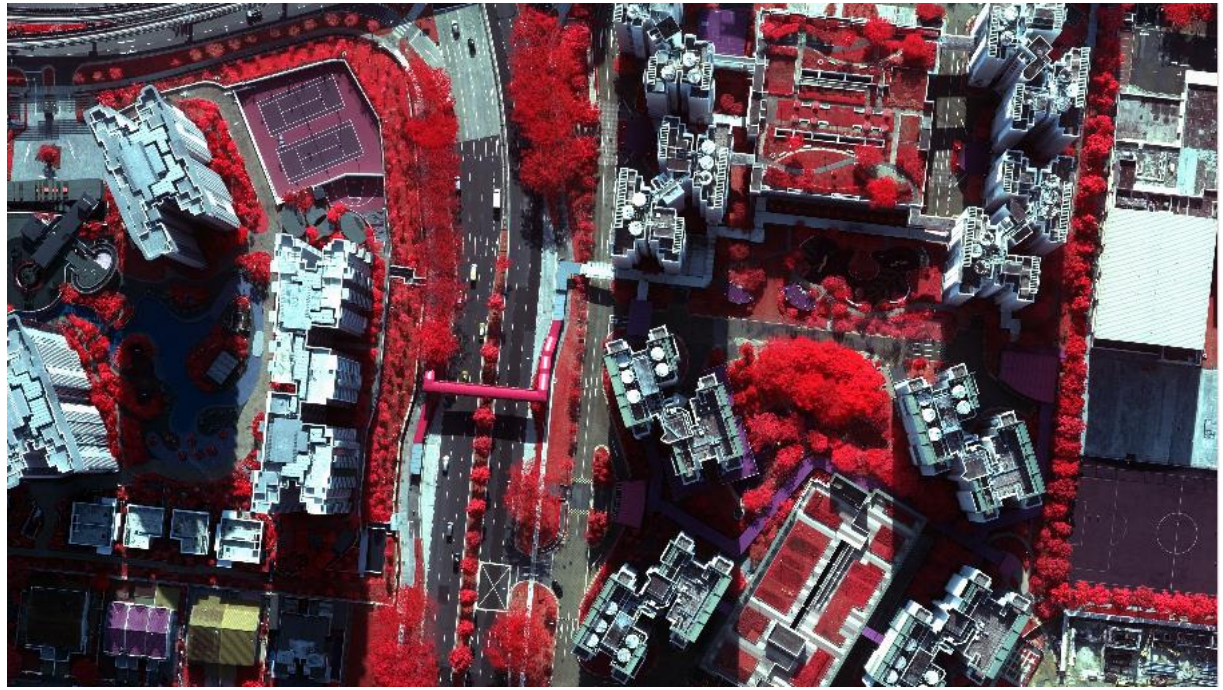
Integration of Topographic and Bathymetric Data

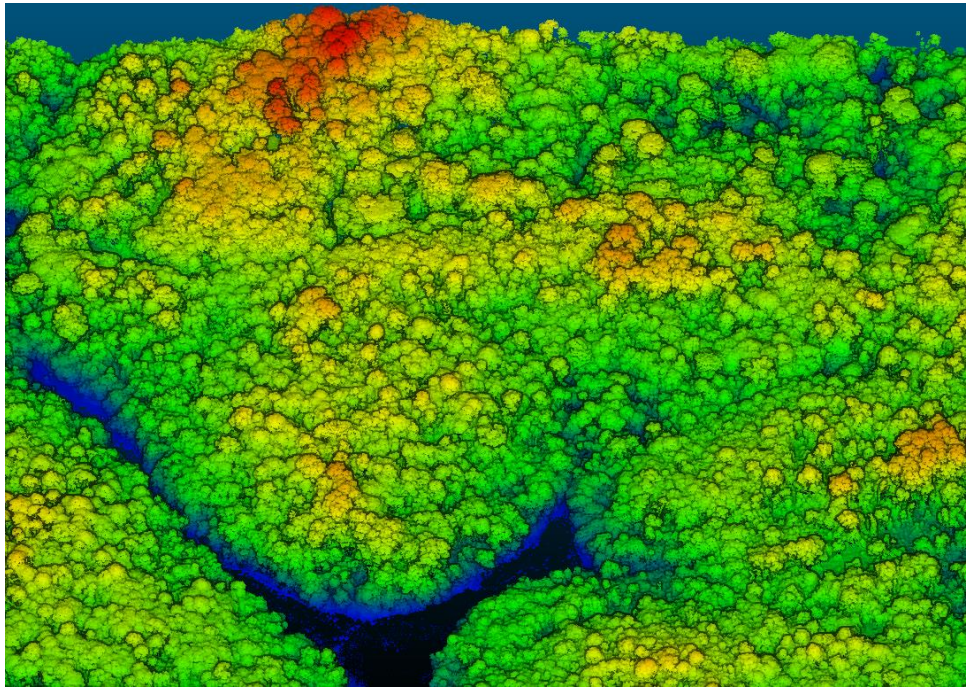


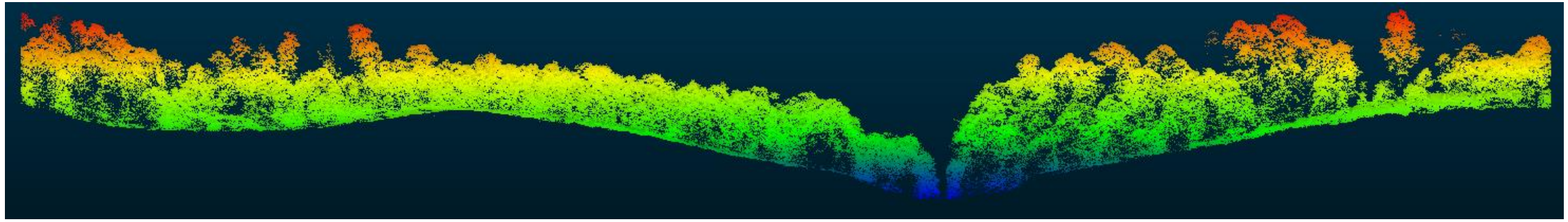
Singapore ETH-Centre
Natural Capital

TopoBathy Map of Singapore
Map of Singapore for modelling elevation continuum in Coastal Areas

Near Infrared Imagery and 3D Point Cloud

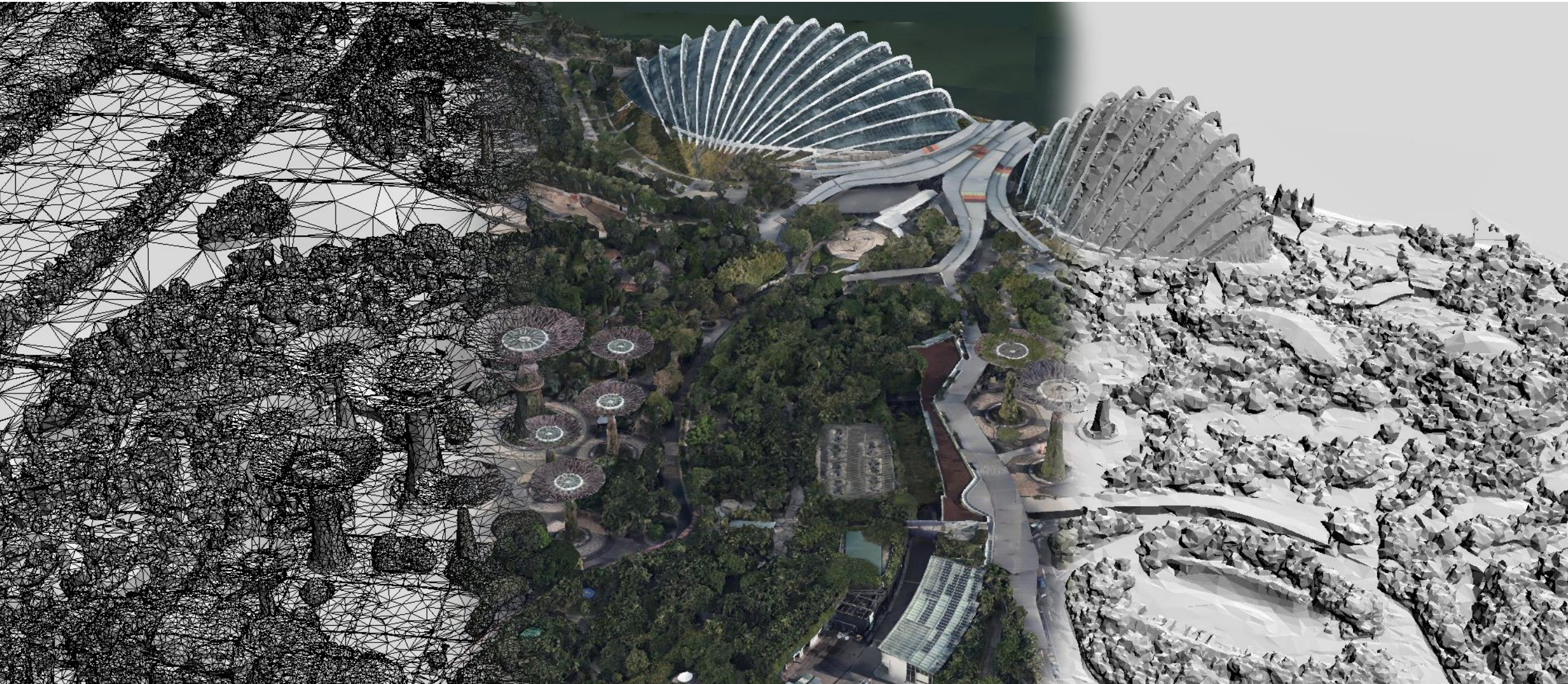






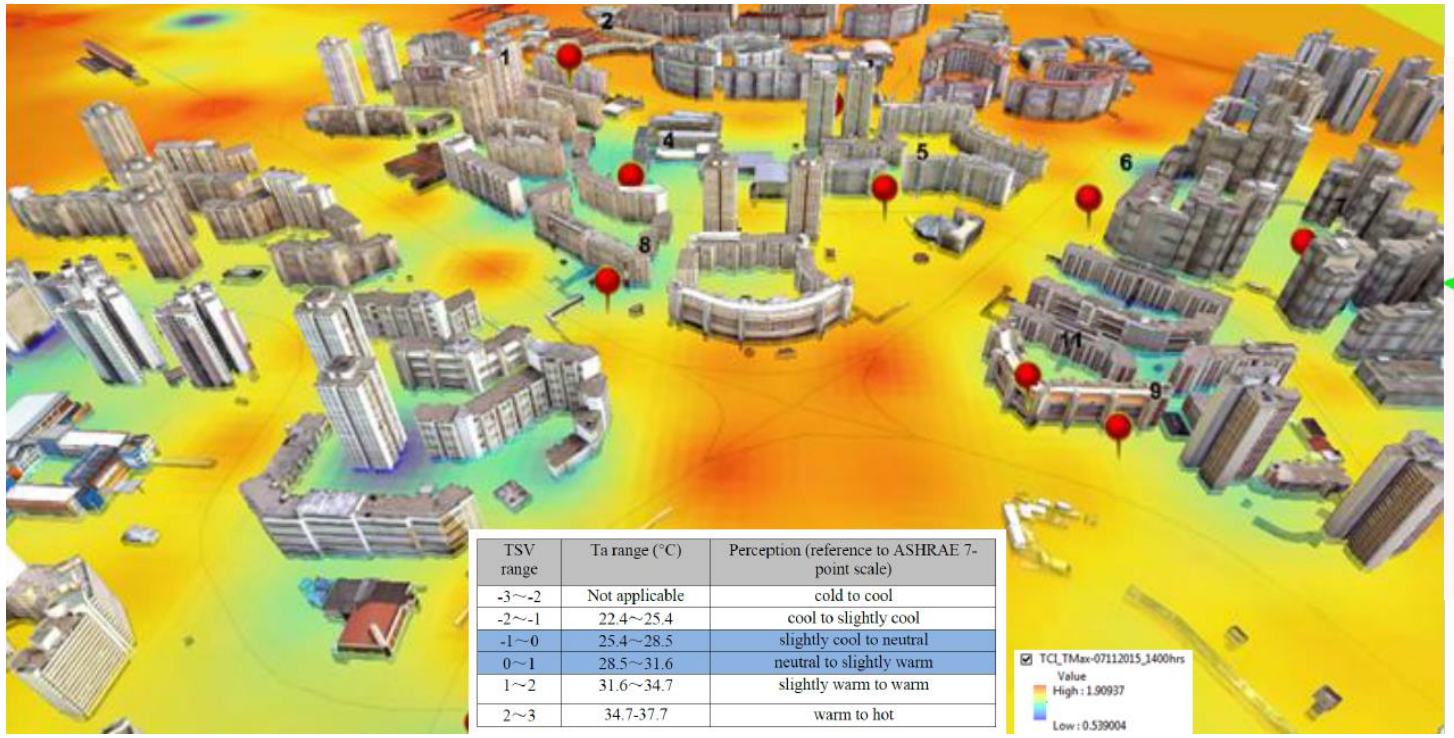
2. Formulate mitigation & adaptation policies and solutions

Development of Urban Digital Twin



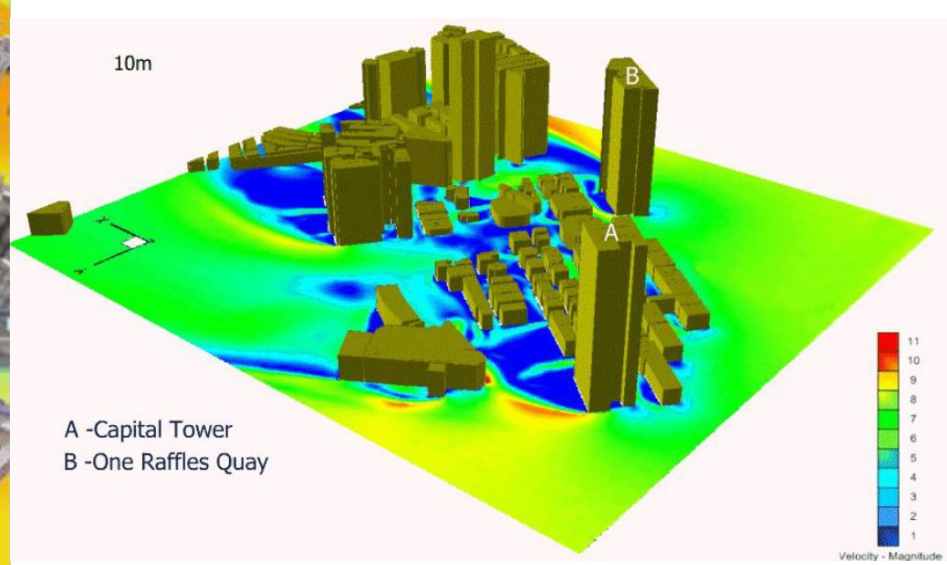
3D Visualisation and Simulation

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

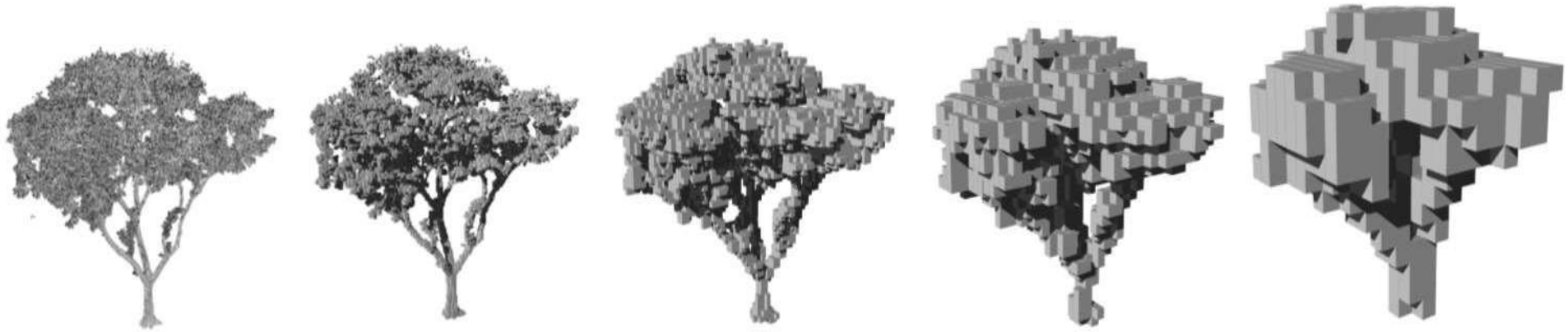
UHI-Thermal Comfort Map (100m resolution on 7 Nov 2015 1400hr)



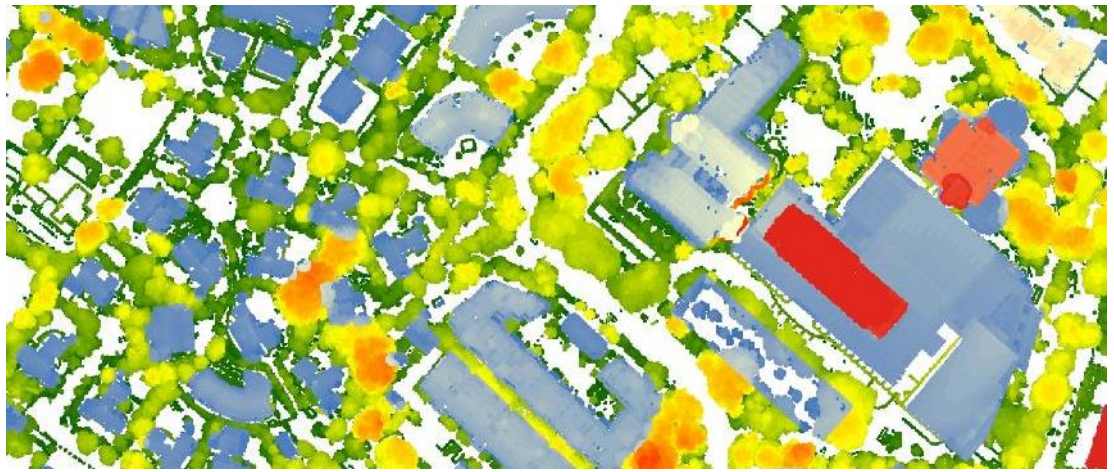
Wind Flow and Computational Fluid Dynamics (CFD)

Accurate Mapping of Trees and Vegetation

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



Voxels Modelling

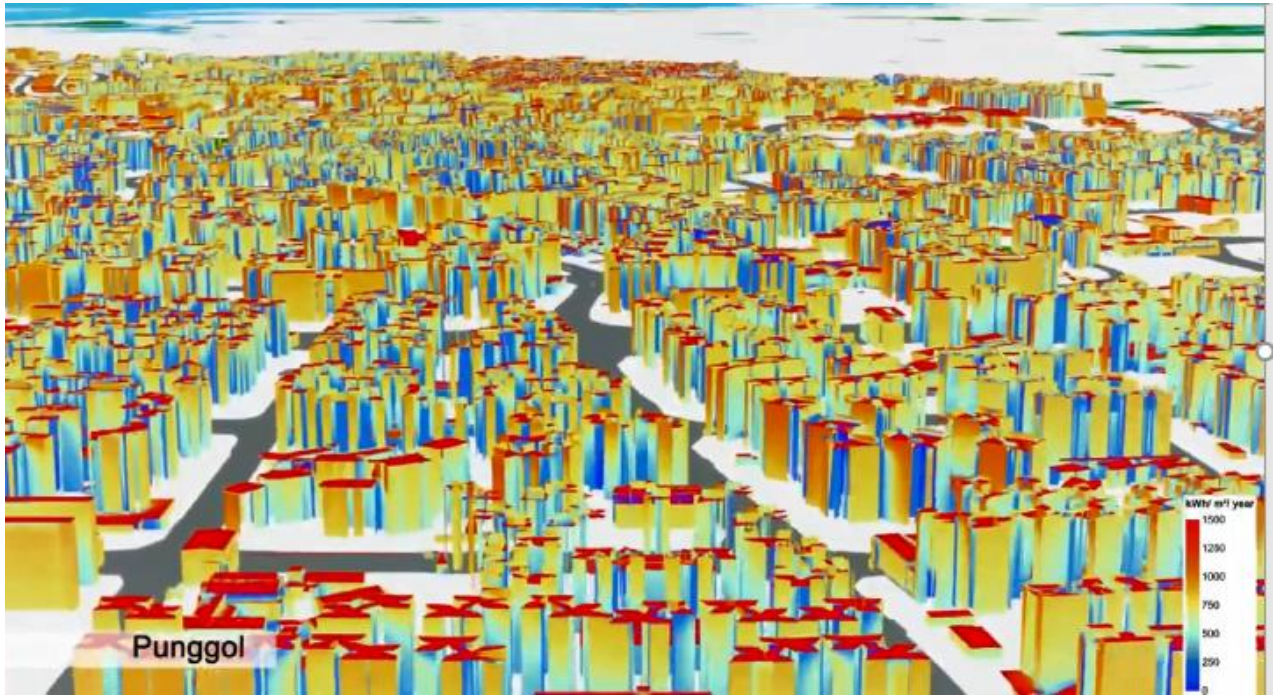


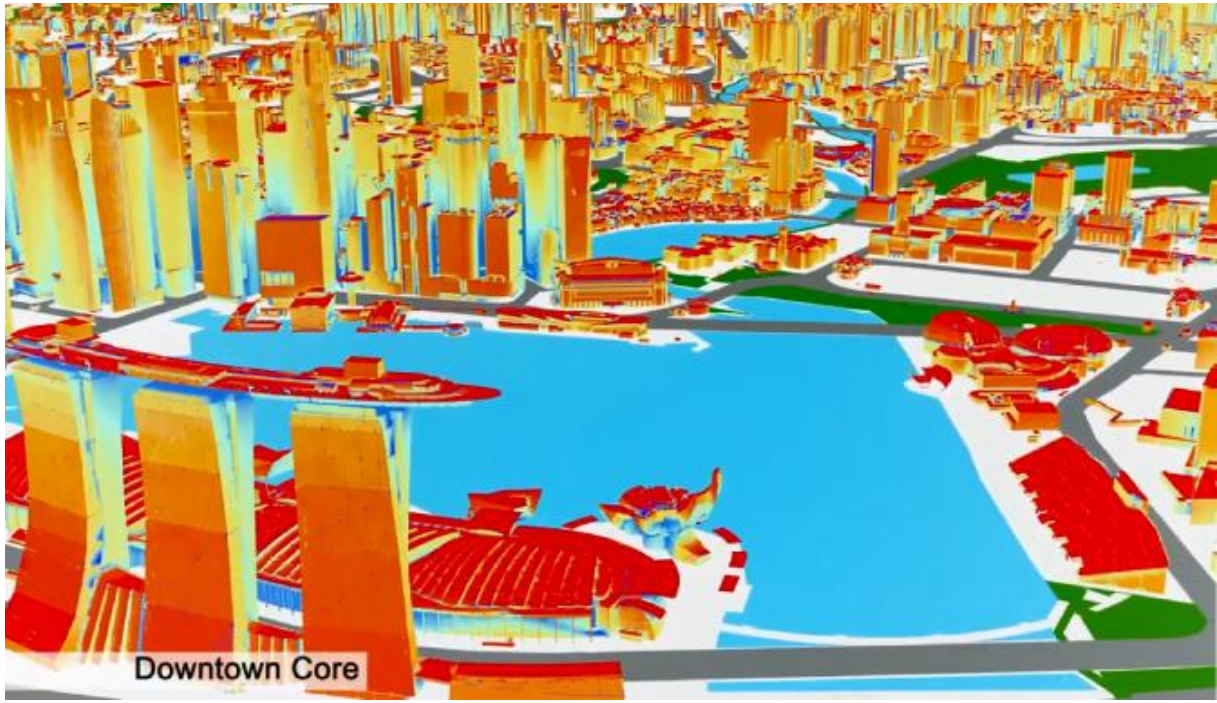
Images Courtesy of National Parks Board (NParks)

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

3D Solar Potential Map

Collaboration between SERIS, NUS and SLA

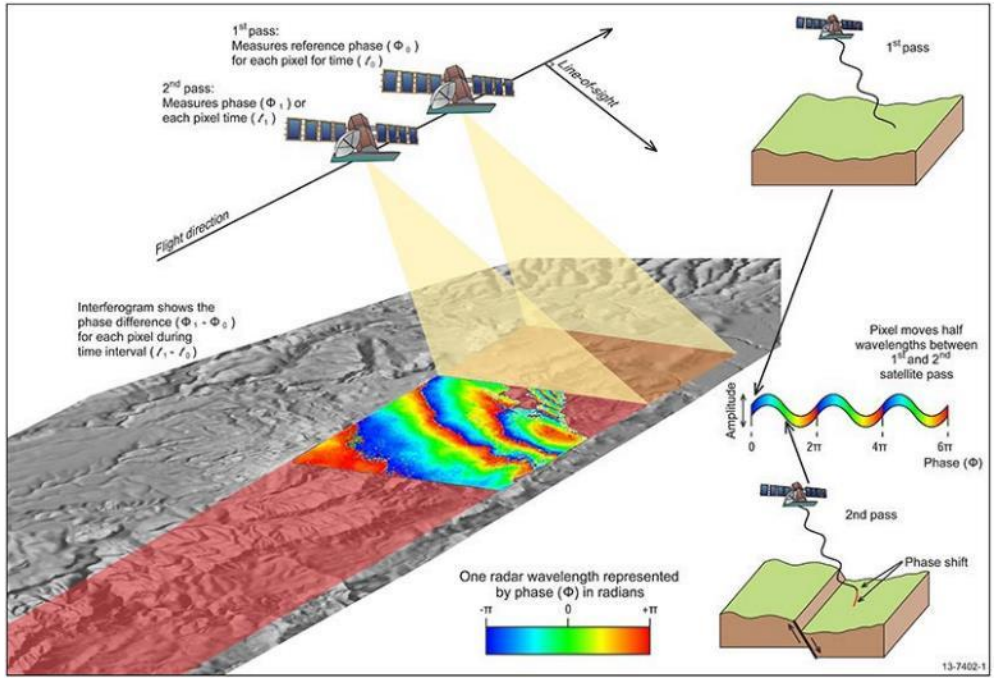




Images Courtesy of Solar Energy Research Institute of Singapore (SERIS) and School of Design & Environment (SDE), National University of Singapore (NUS)

3. Monitor the rate at which the risks are unfolding

Monitoring of Vertical Land Motion



Interferometry SAR

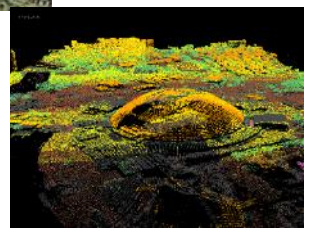
Global Navigation Satellite System (GNSS) Reference Infrastructure

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

4. Measure effectiveness of the mitigation and adaptation solutions

National 3D Mapping Programme (N3DMP)

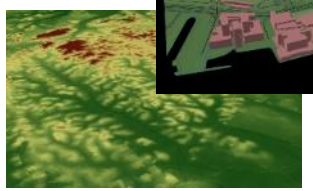
2014 | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021**



Commence 1st National Mapping Data Capturing

Data Processing

Apr **Jun**



Completion of 1st Aerial Mapping

Mar

Jun

Commence 1st Mobile Mapping

Aug

Completion of Mobile Mapping (Covering 5,500km public streets)

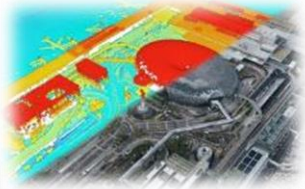
Aug

Year 1 Mobile Mapping Maintenance

Year 2 Mobile Mapping Maintenance

Commence 2nd National Mapping Data Capturing

Feb **Jun**

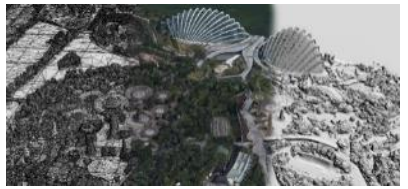


Data Processing

Aug

Completion of Mobile Mapping Maintenance

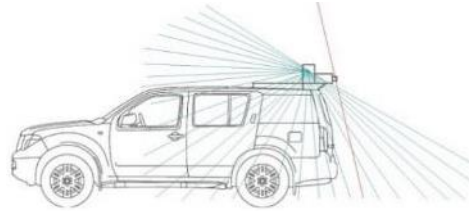
Covid-19 Circuit Breaker 7 Apr to 1 Jun

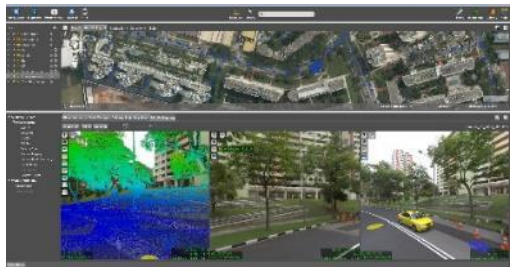


Completion of 2nd Aerial Mapping

Oct

Mobile Mapping Refresh Tender in 2022





5. Transform social, economic, environmental landscape

Integrated Spatial Planning

Thank You