2020 International Smart Cities e-Forum

Spatial Information for Sustainable Development and Environmental Management

Environmental Miracle in Taiwan

Why(Question)

WORLD 1st National power consumption

TWICE the global temperature raise over urban area

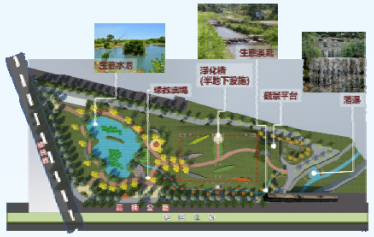
2.4 times more coastal waste per kilometer than in Japan, while 1.7 times more than Korea.

What(What can we do)

Solar Energy

Coastal Cleaning

Energy Saving



Urban Planning

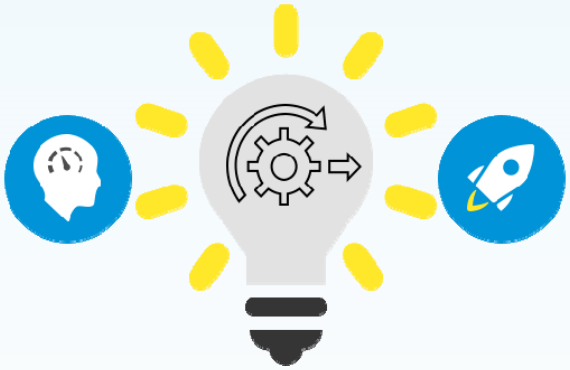
What else…?

World 1st carbon emission in thermal power plant

World 1st in natural disaster exposure by ratio

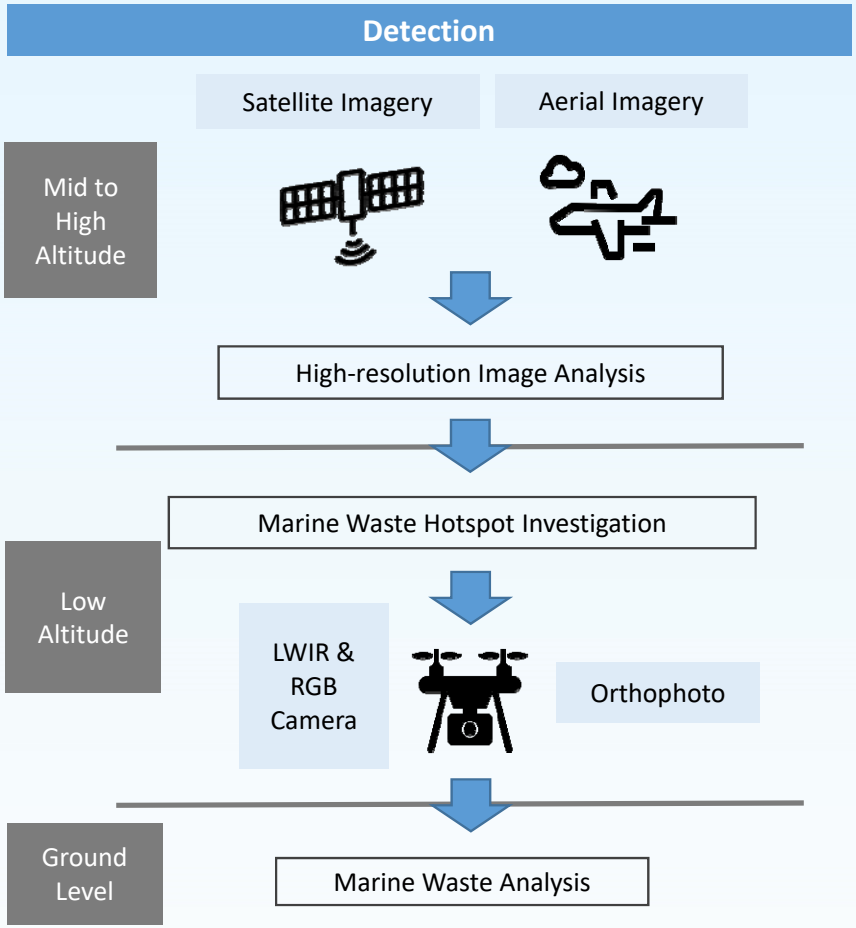
Okay, But…How?

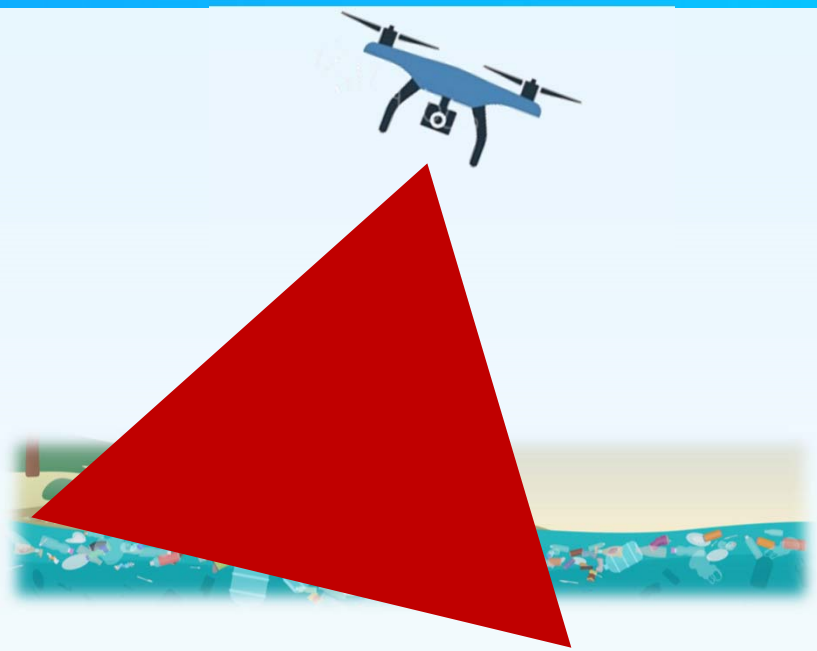
Come up with a smarter way!



As an island economy, ocean is our valuable asset and deserves our protection.

Image analysis of coastal waste





- Composition of coastal waste
- Potential source of waste
- Coastal hotspot and area
- Man power required

Image analysis of coastal waste

Coastal waste determination

Location	新北83.2k岩灘		台南國聖燈塔沙灘		彰化大城南段	
Waveband	Orginal image frequecy (R, G, B, NIR)		Orginal image frequecy (R, G, B, NIR)		Orginal image frequecy (R, G, B, NIR)	
Category	Garbage/Non-garbage	Detailed classification	Garbage/Non-garbage	Detailed classification	Garbage/Non-garbage	Detailed classification
Overall accuracy	61%	63%	72%	75%	87%	86%
KAPPA value	0.22	0.54	0.44	0.69	0.74	0.8
Import frequency	Image spectrum characteristic + original image frequency		Image spectrum characteristic + original image frequency		Image spectrum characteristic + original image frequency	
Category	Garbage/Non-garbage	Detailed classification	Garbage/Non-garbage	Detailed classification	Garbage/Non-garbage	Detailed classification
Overall accuracy	85.%	67%	89%	83%	97%	88%
KAPPA value	0.7	0.59	0.79	0.78	0.93	0.82

Increase AI learning in spectrum characteristic to enhance accuracy

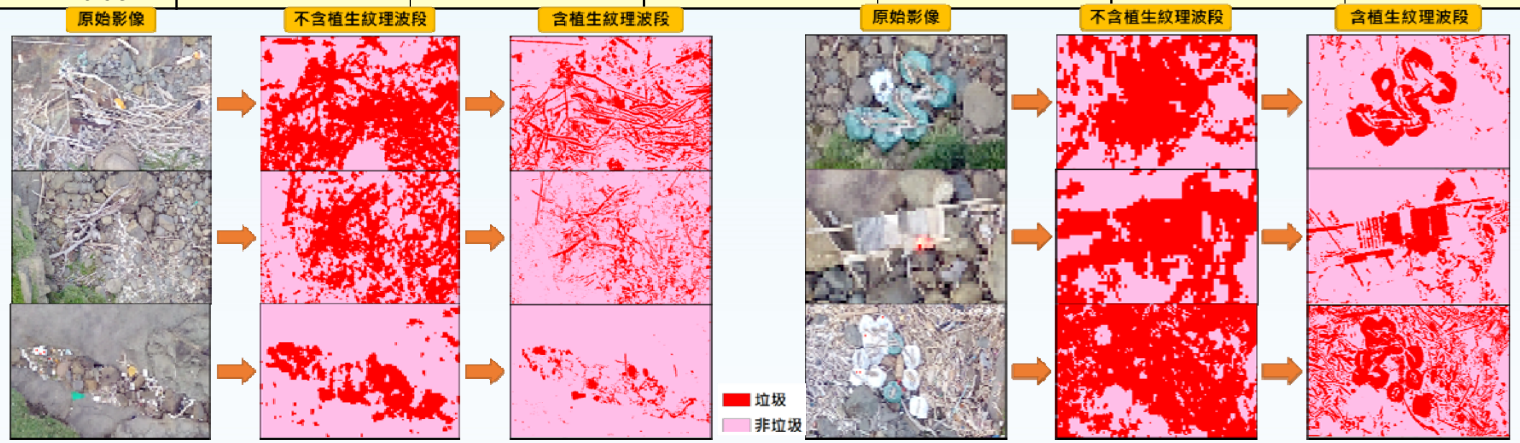


Image analysis of coastal waste

Before and After comparison of coastal cleaning

Location	Linkou (Before)		Linkou (After)	
Input frequency	Image spectrum characteristic + original image frequency		Image spectrum characteristic + original image frequency	
Category	Garbage/Non-garbage	Detailed classification	Garbage/Non-garbage	Detailed classification
Overall accuracy	85%	55%	80%	74%
KAPPA value	0.7	0.46	0.6	0.67

Image analysis before coastal cleaning

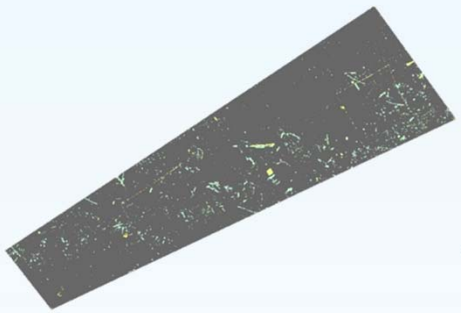
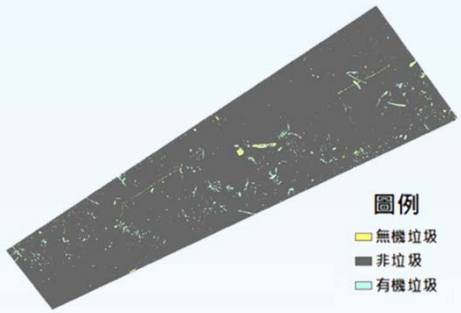
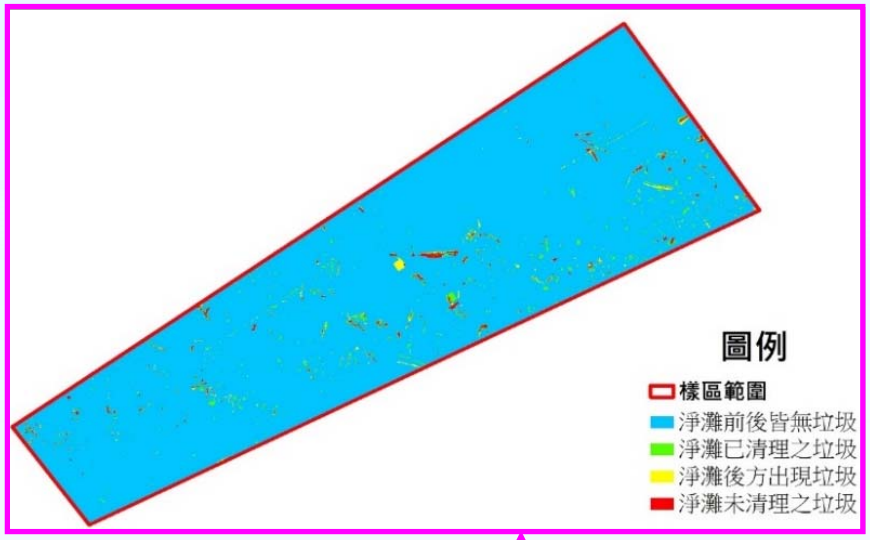


Image analysis after coastal cleaning





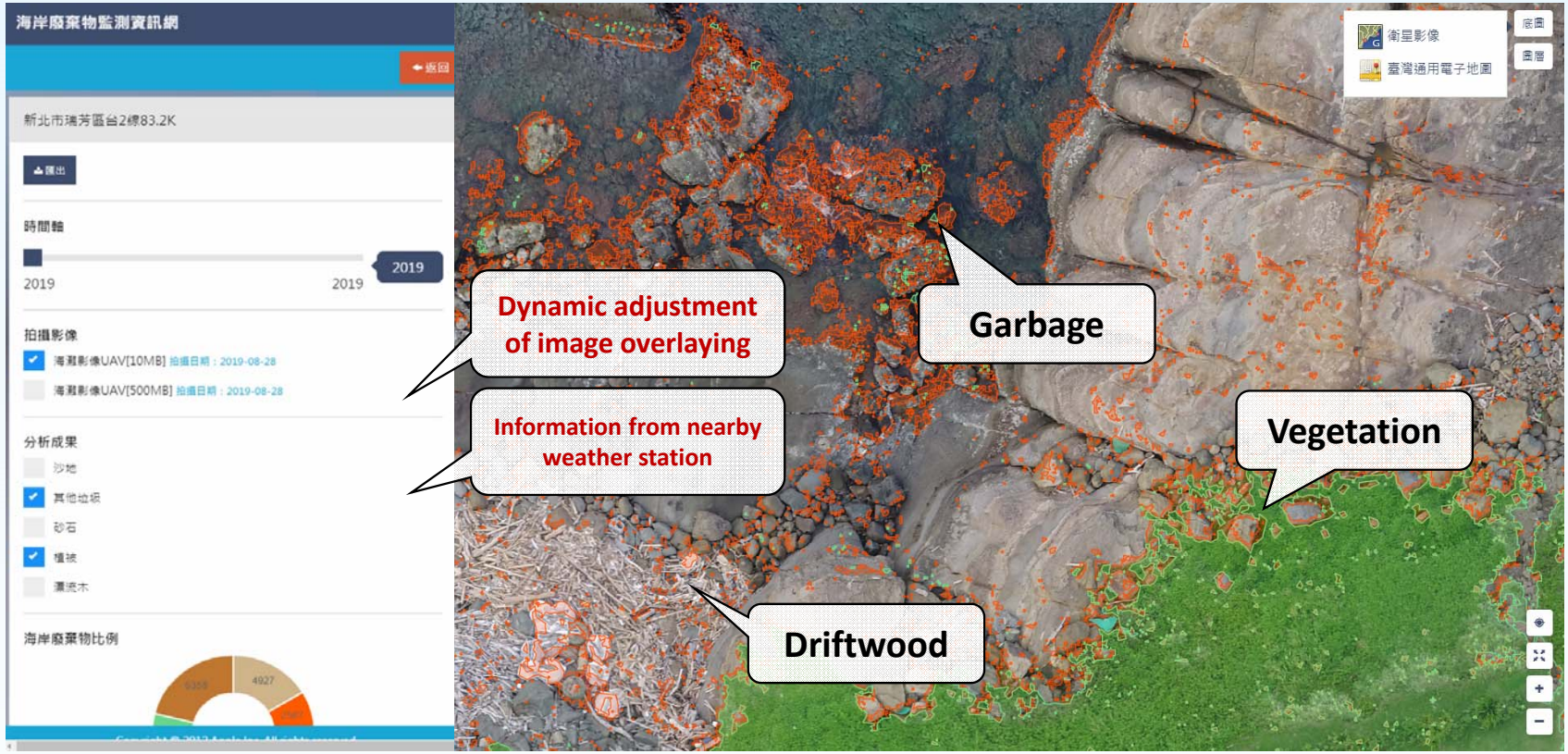
Garbage?		Area (Sq. Meter)
Before	After	
Yes	Yes	17.83
Yes	No	31.80
No	No	1409.59
No	Yes	16.72
合計		1475.94

42.4 kg of non-recyclable garbage and 19.1 kg recyclable garbage have been collected respectively.

Image analysis of coastal waste

Image overlaying

- Multiple images can be overlaid for analysis
- Displaying weather information in the past 3 days



System

Multi-dimensional image displaying platform for coastal waste

Purposes

1. Determination of coastal waste area and location
2. Source tracing

Earthwork and garbage calculation

Debris flow often occurs after heavy precipitation and earthquake. Through remote sensing technologies, disaster analysis and rescue planning can be executed in a flash of light.

Earthwork and garbage calculation

Before landslide

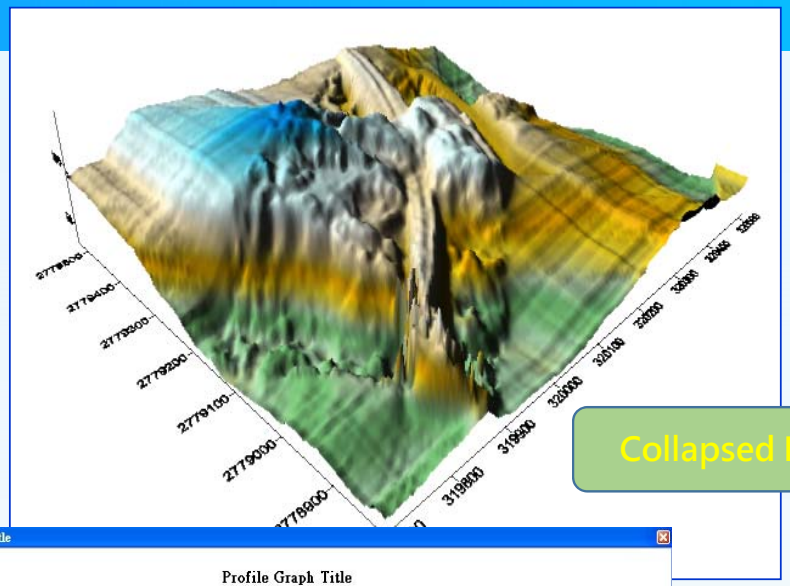
UAV Images after landslide

How to analysis disaster area?
How to calculate earthwork?
How to distribute manpower and resources?
How to complete in a short time?

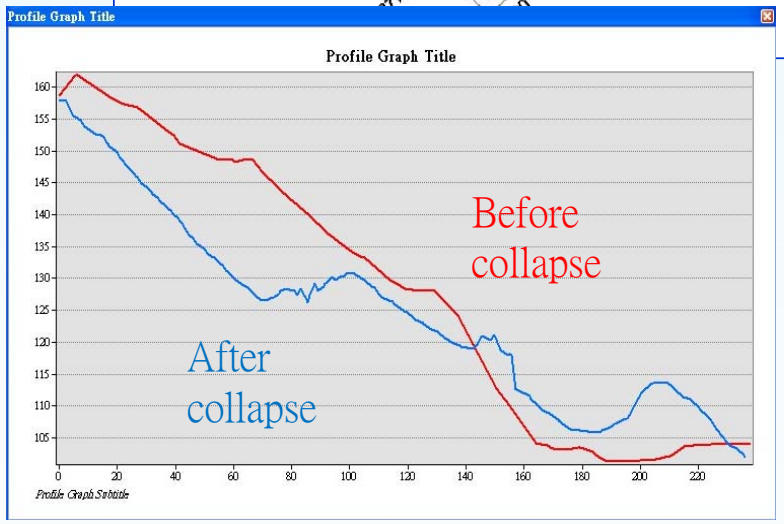
=

Earthwork and garbage calculation

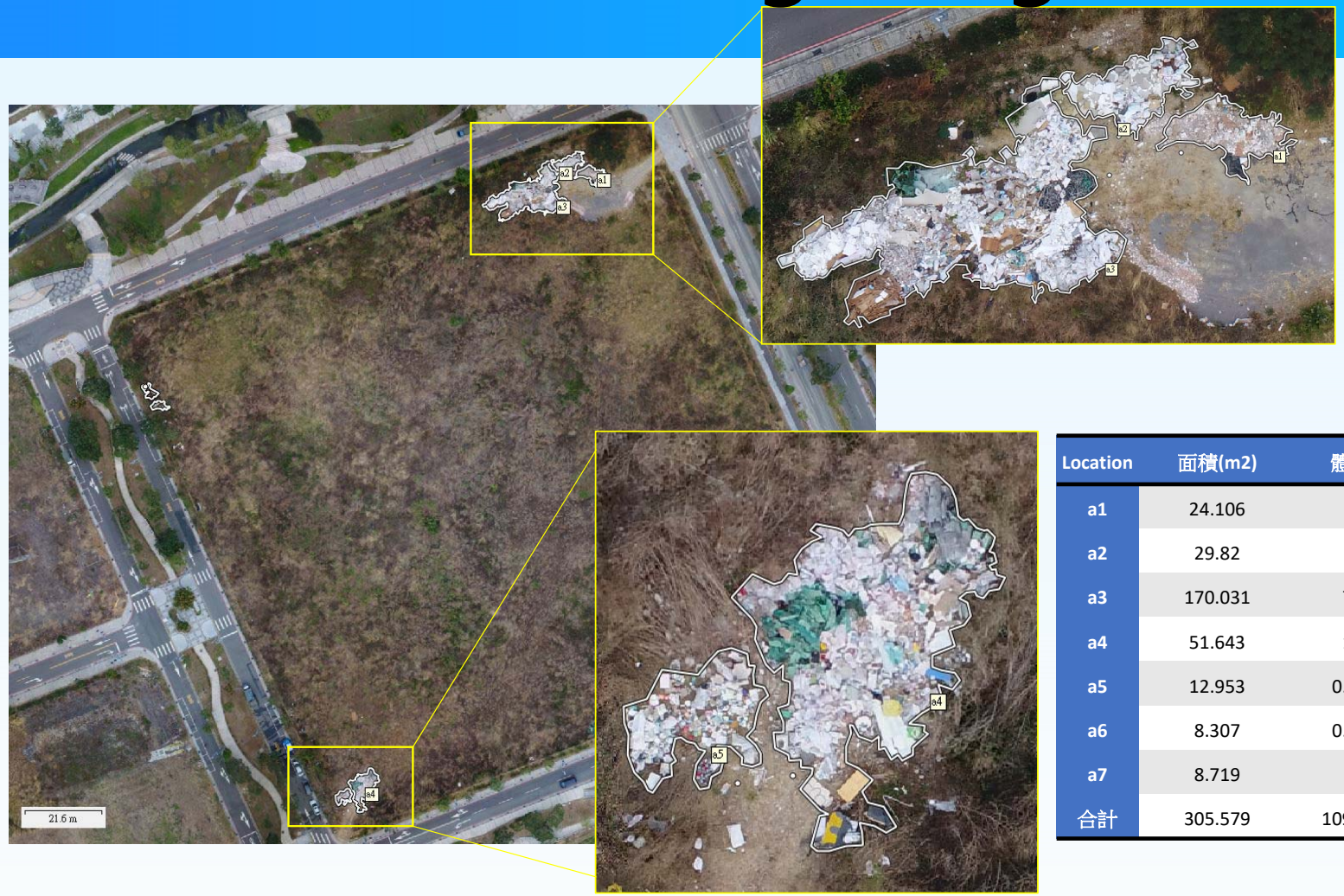
Analyzing DTM information by comparing 3D images of the landslide area. Earthwork estimation can also be carried out.

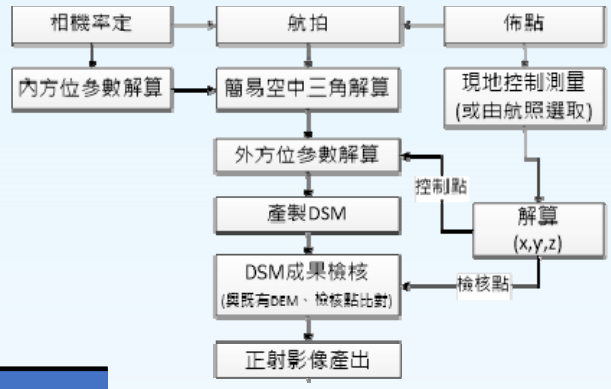


Collapsed Earthwork : 137,571 m³



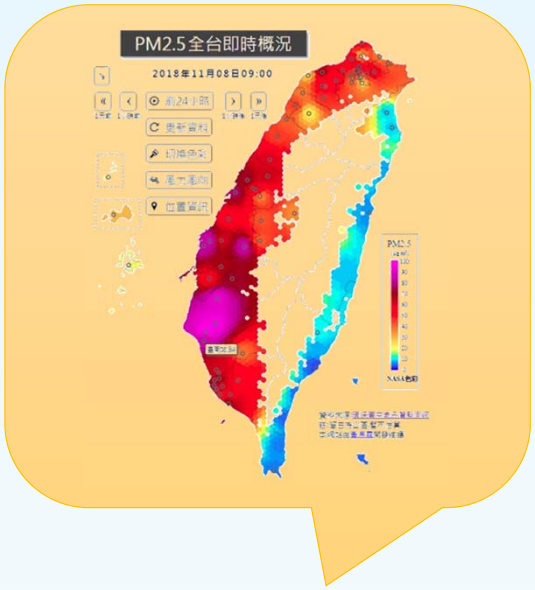
Earthwork and garbage calculation





Location	面積(m2)	體積(m3)
a1	24.106	3.308
a2	29.82	7.073
a3	170.031	78.447
a4	51.643	15.672
a5	12.953	0.744482
a6	8.307	0.422711
a7	8.719	4.228
合計	305.579	109.895193

Air pollution monitoring



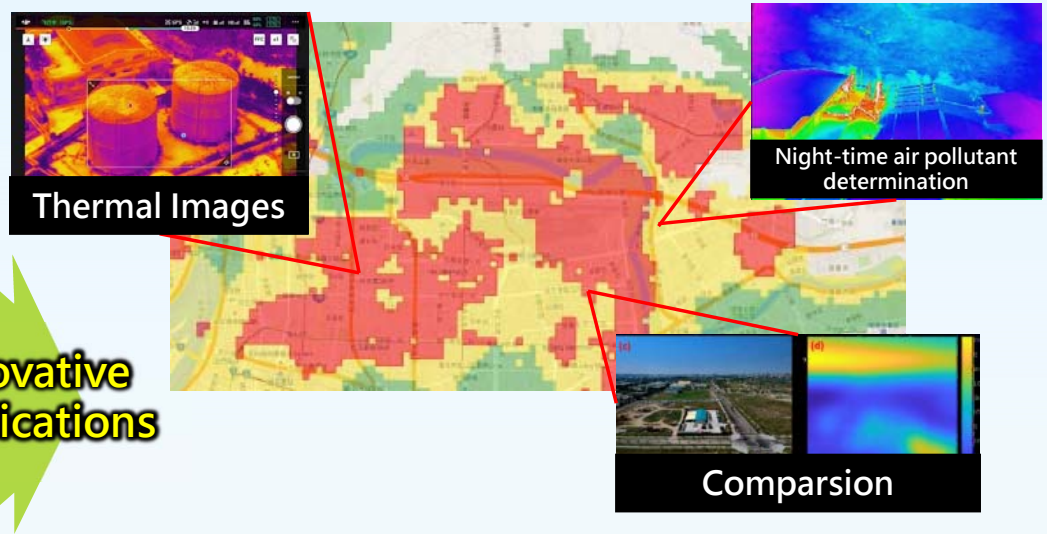
Air pollution monitoring

- Model ：DJI Inspire 2
- Endurance ：25 min
- Record area ：1 km²(100 ha) / flight
- Ground Resolution：RGB 20cm、IR 40cm

- Professional high level aerial work
- High-ended FILR thermal imaging system
- Dual camera：IR、RGB、mixed image
- Monitoring aspects：CO_2、Temperature
- Temperature detection：-40°C to +550°C

Innovative Applications

UAV thermal monitoring



Large area greenhouse gases/ air pollutants detection through multi-spectrum analysis.

Air pollution monitoring

Topics

Surface Monitoring

- Limited samples
- Lacking of high level pollution info

Irregular inspections

- High cost of labor

Information accuracy

- Hiding information
- Information transparency

Data Relevance

- Scrappy information
- Highly difficult in data analysis

Objective

High accuracy in regional continuous air pollution changes

Analysis in particular season, hour, region or unit to increase data relevance.

Air pollution monitoring

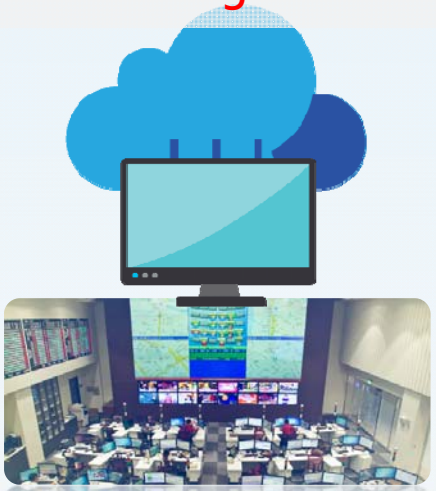
Traditional Method

Smart Environmental management

Accurate dispatching

Air pollutant source

Reporting by the public

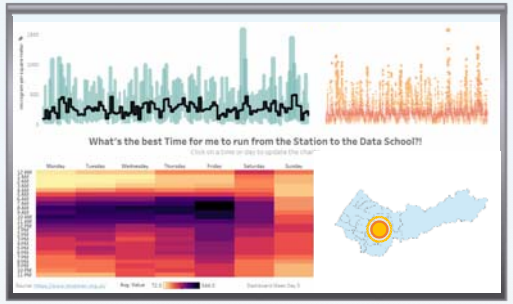


Smart monitoring in Gov. Department

Data monitoring in Gov.

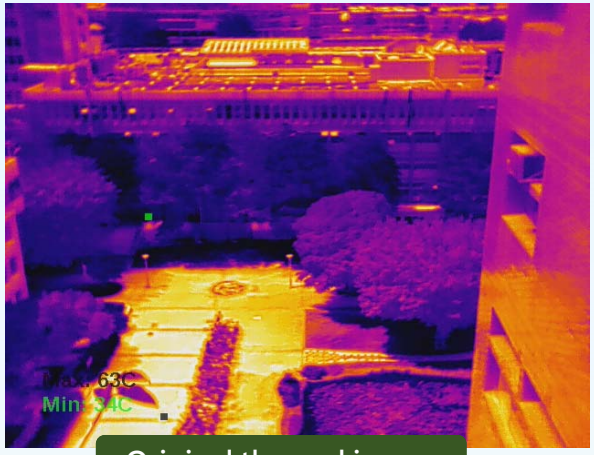
Open information

UAV monitoring

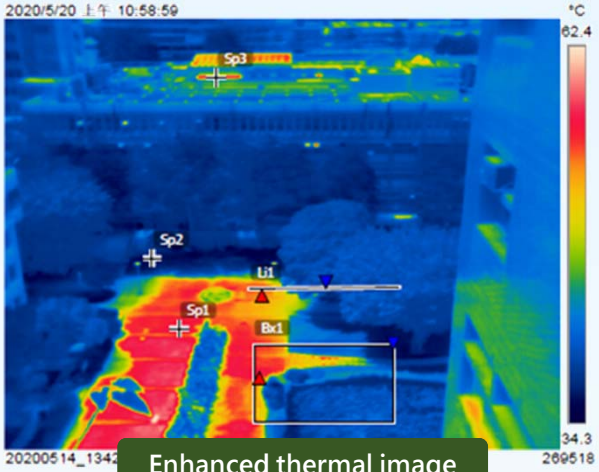


Data analysis

Air pollution monitoring



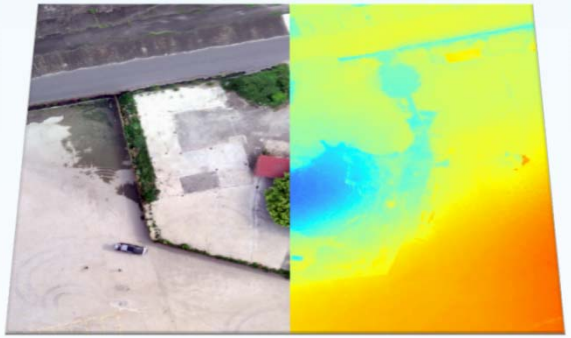
Original thermal image



Enhanced thermal image

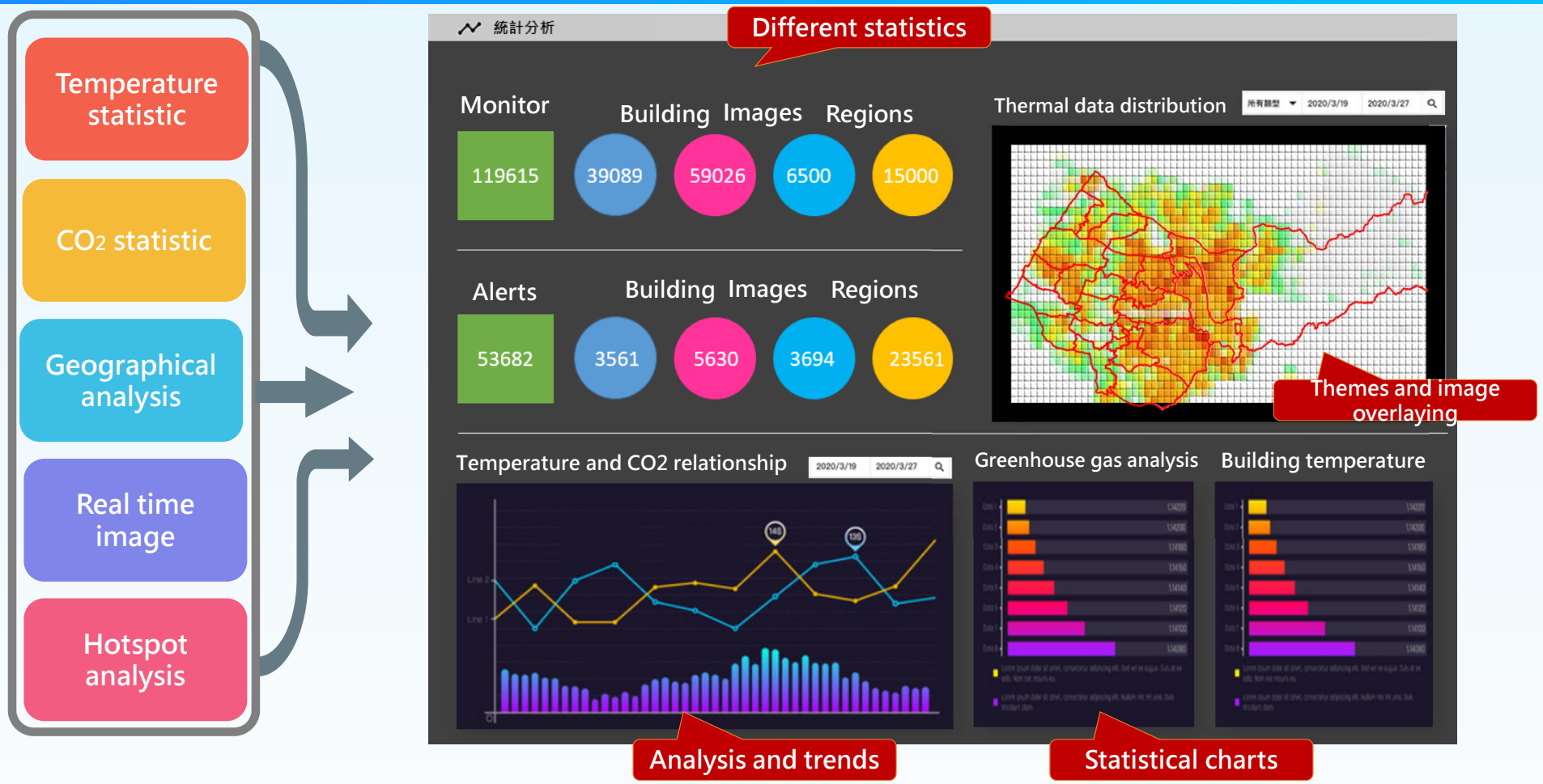
3D buildings
thermal distribution

RGB images

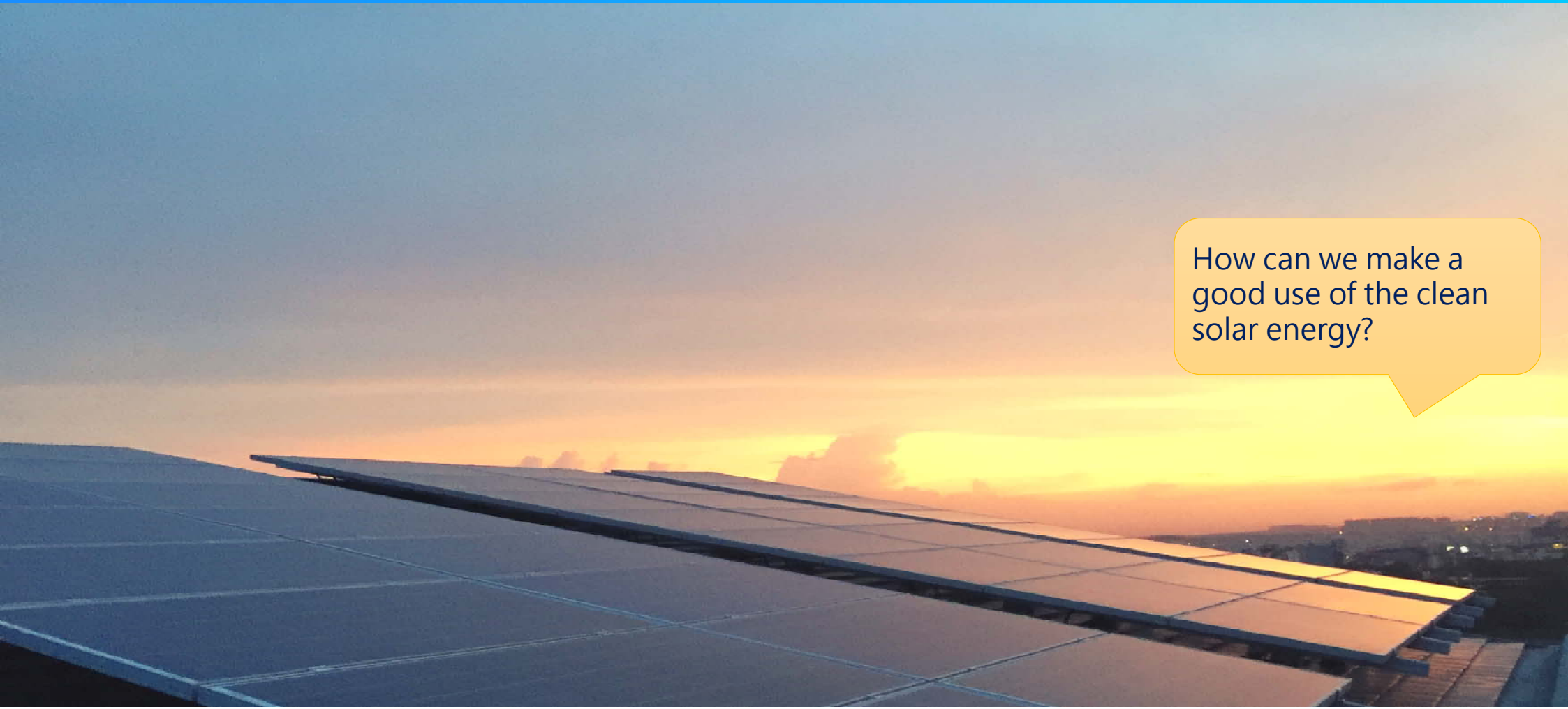


RJPG heat images

Air pollution monitoring

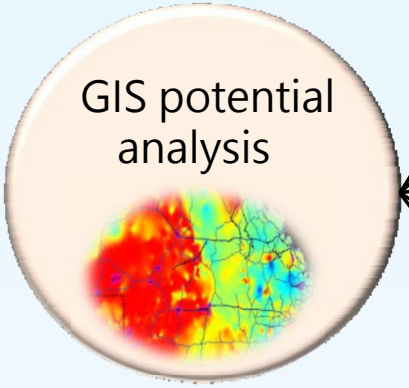


Power from the rooftop



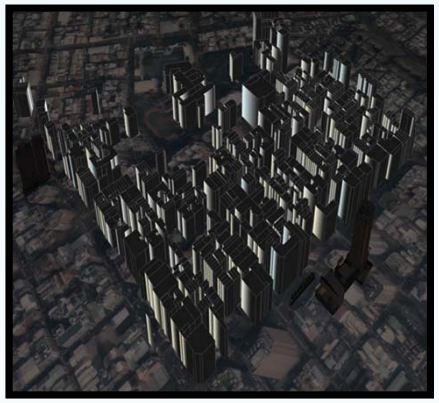
Power from the rooftop

Power from the rooftop

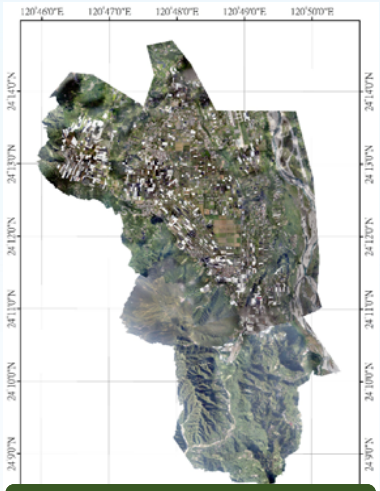


- UAV images
- Shielding
- Type of roof
- Solar capacity
- Daylight environment

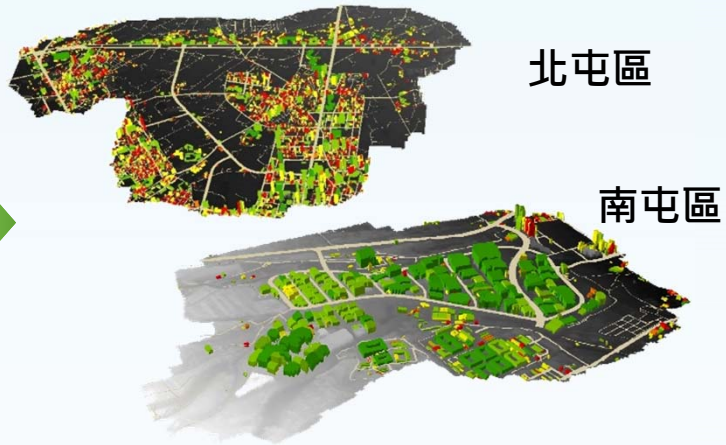
- Potential distribution of green roof
- Current situation of the building
- Reference for construction



Shielding simulation



DSM modelling



3D analysis of potential solar energy

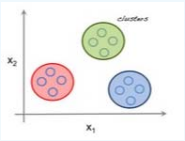
Power from the rooftop

Rooftop image analysis

Obtaining images

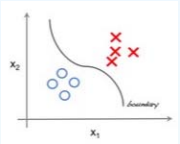
Image auto classification

Non-monitoring



Data gathering

Monitoring



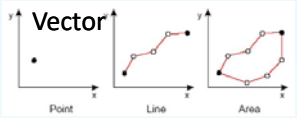
Collecting training samples

Building training samples

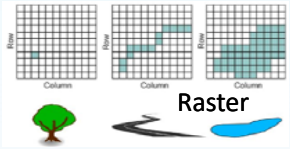
Graphic classification

Data analysis

Auxiliary image overlaying



Roadmap/ River stream

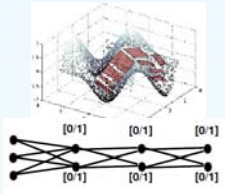


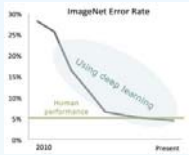
Overlaying analysis

Building Models

Image deep learning

Deep Learning





Reducing error

Characters extraction

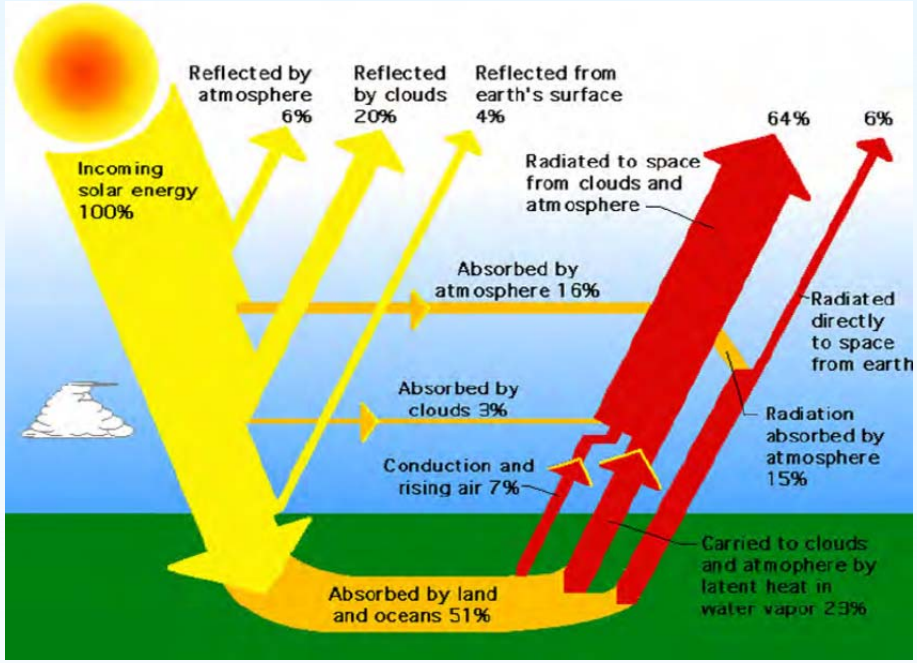
Model determination

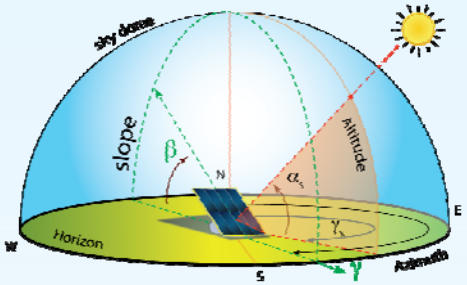
Result

Flat top and tilted top

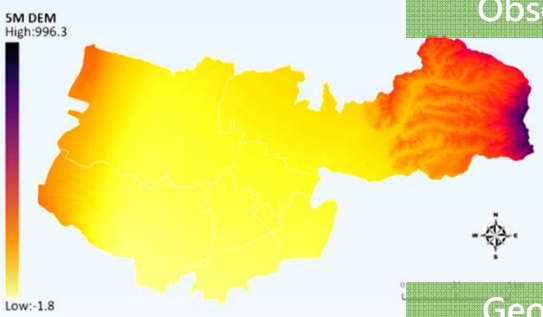
Power from the rooftop

Solar radiation calculation

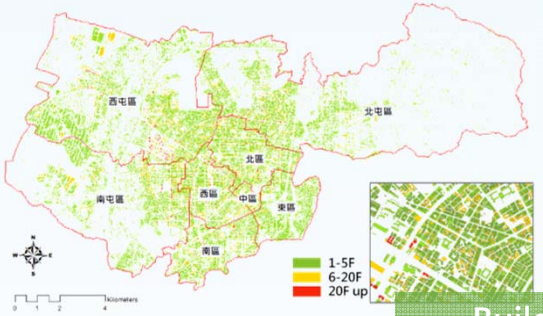




Observing angle



Geology factors



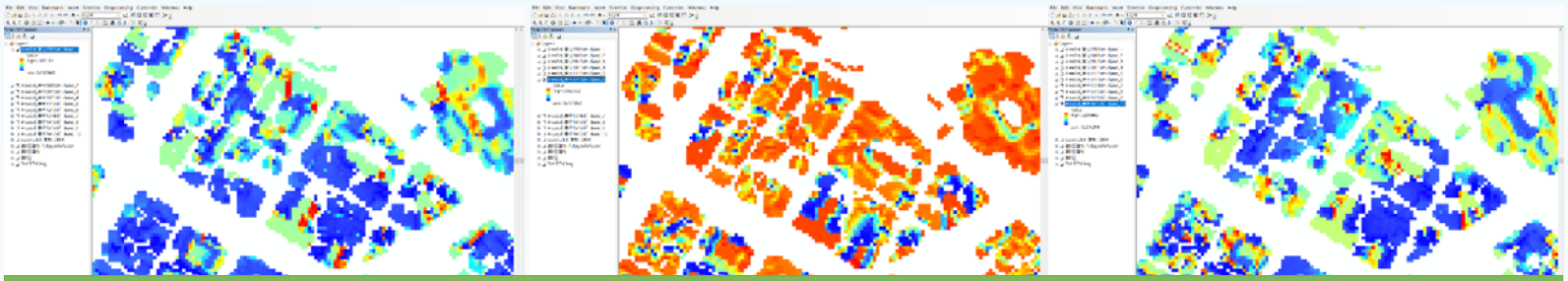
Building factors

Power from the rooftop

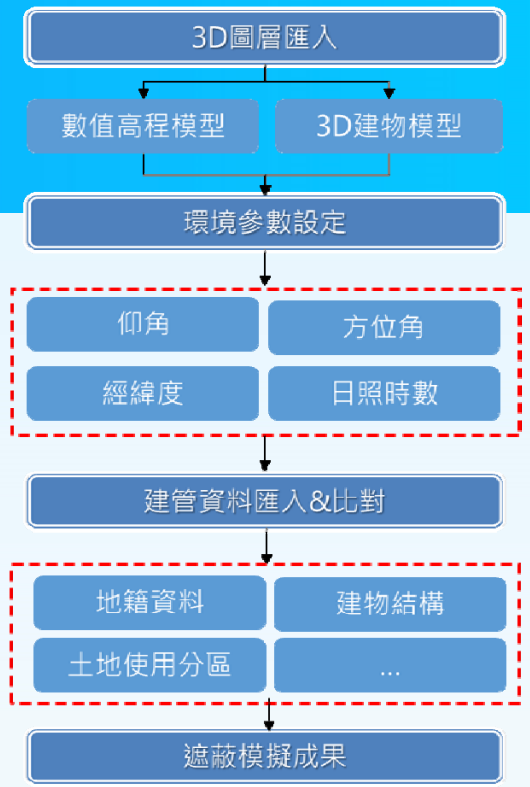
Change of solar strength

7:00~8:00 | 12:00~13:00 | 16:00~17:00

Change of shadow

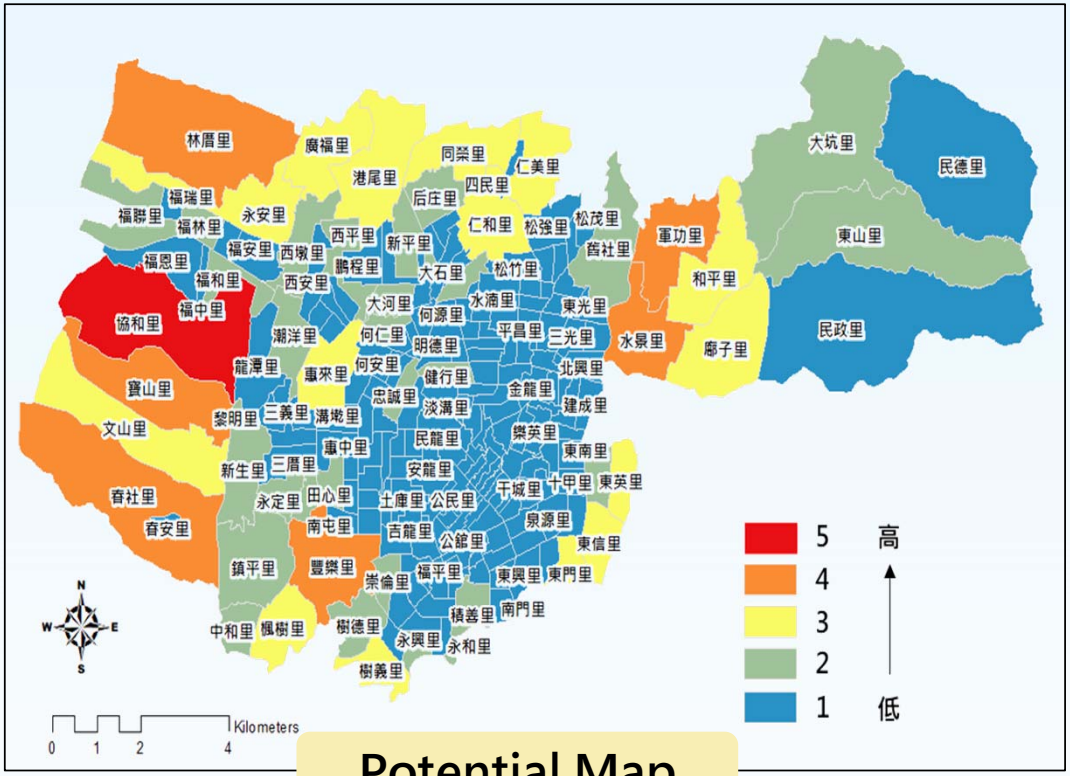


Change of solar radiation



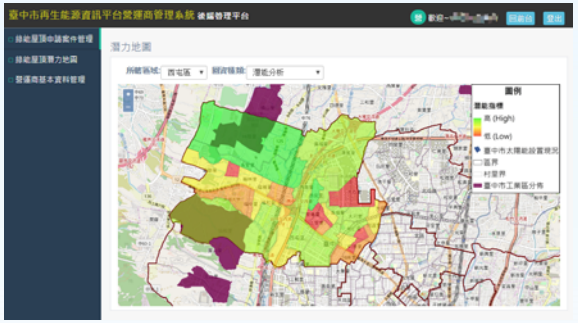
Power from the rooftop

Distribution of solar potential



Potential Map

Online calculation



Online enquiry

The better way is…

The purpose of Smart City is to solve the environmental problems while GIS can enhance the efficiency.

Thank You for Your Attention

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