Urban Micro-Climate Study with the Aid of GIS

From mono-curriculum to cross-curriculum

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About the Speaker

- Hong Kong's Teacher Representative "World Summit of Students for Climate" (Invited by the Environment Bureau)
- Introduced the AR sandbox into Hong Kong (invited by the Education Bureau) and upgrade into app version during the COVID-19 suspension
- Teacher advisor of the "Best GIS Application Winner" (competition held by the Education Bureau)
- "Best Lesson Plan" in STEM education

At the beginning… my experience of GIS

1. How to tell the police when you reporting the location of a traffic accident?

   Using the number on the lamp post

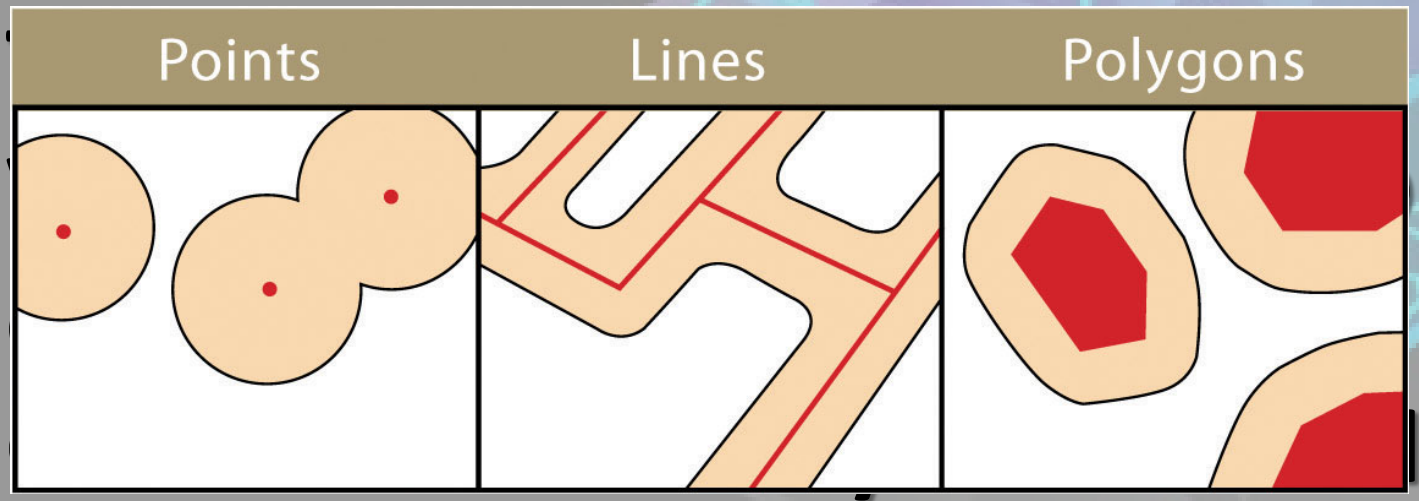
2. How to report a dolphin run-ground at a remote beach?

   Using the grid reference

My QUESTION: Do we teach students about these essential geographical skills?

What is GIS in K-12 education?

- GIS is a multiple layers of maps. Geographers studied through map layers before assisted by computers
- With IT support, spatial data are conv , lines and polygons for analysis
- with mod
- ly life. Geography teachers must face this change!!



Climate Change Education in Hong Kong

Stage	Climate Change Education	Practical in Daily Life
Pre-school	Since the nursery classes, green living is one of the themes in the study	High: parents are also receiving “reverse education”
Primary	“develop care and concern for the environment and practice green living.”	High to middle: using environment study throughout P1-P6 education

Climate Change Education in Hong Kong

Stage	Climate Change Education	Practical in Daily Life
Junior Secondary	Combination of Integrated Science (factors) and Geography (results)	Middle: covered in two subjects. Less practices in teaching
Senior Secondary	Divides in Liberal Studies and Geography. However, most of the issues are taught in Geography	Low: exam based issues

Non-Academic Climate Change Education

Result: promoting by events

- **Competition about climate changes + NGOs campaigns**
- **Pros: highly practical on daily life + cross-curriculum**
- **Cons: one-off event, non-sustainable**

Climate Change Education in Geography

- It is the compulsory topic in public exam
- Before 2017: focus on global warming
- After 2017: added the local climate issues
  1. closer to the principles in “Paris Agreement”
  2. encourage rooms for cross-disciplinary cooperation
  3. base on local issues → FIELDTRIP

My Trial Transformation

- Using AR Sandbox to simulate the climate change in Hong Kong

My Trial Transformation

- Using AR Sandbox to simulate the climate change in Hong Kong
- Crossover STEAM:
  1. energy saving
  2. building cooling
  3. renewable energy
- Multi-discipline: with ?Accounting?!

“The GREEN Tunnel” fieldtrip

To continue the STEM cooperation and discovery:

- Study the tree coverage next to the inner urban areas to compare the heat island effect
- Data to be collected:
  1. Vegetation: tree crown density, tree height
  2. Urban: location, building height, land uses
  3. Micro-climate: sunlight, temperature, wind speed, relative humidity

“The GREEN Tunnel”

What is a “GREEN TUNNEL”?

- It is a walkway which surrounded by vegetation
- There is a high tree crown density which may block all the sunlight shining on the ground by the trees’ shade
- When we walk through this walkway, we feel cooler

“The GREEN Tunnel” fieldtrip

Why do we need to study the “Green Tunnel”?

- To fulfil the needs of HKDSE public exam
- To study the methods on reducing heat-island effect
- To raise more awareness on urban greening: our students did not notice its existing

→ *HIGHLY practical in daily life*

Cross-disciplinary Studies

This fieldtrip needs sunlight as a data:

1. To reduce errors, the fieldwork must be completed in 1.5 hours
2. Using a solar clock from 3D printer (STEAM)
3. Notice the angle of sun → study the LUX from the sunlight

Integration STEAM in fieldtrip study

“The GREEN Tunnel” fieldtrip

1. Students can choose their own tools to study
2. Summary of the data collected by students:

	“Green Tunnel”	Inner City	Differences
Sunlight	Lower	Higher	600 W/m^2
Temperature	Lower	Higher	2°C
R. H.	Higher	Lower	10%
Wind Speed	Lower	Lower	-

“The GREEN Tunnel” fieldtrip

Their findings shows:

1. The shading of tree: reduce the energy absorb from sunlight
2. Higher R.H. in the “Green Tunnel” → latent heat released by transpiration
3. Wind might bring convection to inner city

The vegetation nearby the urban areas are effectively lower the heat-island effect

Reflection of Using GIS in teaching Climate Change

1. Cross-disciplinary STEAM teaching: more practical in daily life
2. Using “green tunnel” fieldtrip as an example, the trees are located within our community, but we seldom to look into the importance of them
3. In the aspect of environment education: too much efforts on teaching tree planting… we should put more efforts on concerning the urban greening

GIS in K-12 VS GIS in University

Secondary School

- Problem solving
- Teacher as a creator and student as an end-user
- Curriculum design
- Experience from simplified data
- Step-by step teaching

Tertiary Education

- Research
- Developer and researcher
- Research out-come and methods (e.g. Buffering)
- Errors controlled data collection methods
- GIS as a tool to study the research

GIS in the School of K-12 education

- Basic IT support: computers, tablet + “FREE” apps
- Advance inputs: AR Sandbox, VR (360° paramount photo), drone (aerial photos), 3D printing, digital sensors
- Application of GIS in different learning stages:

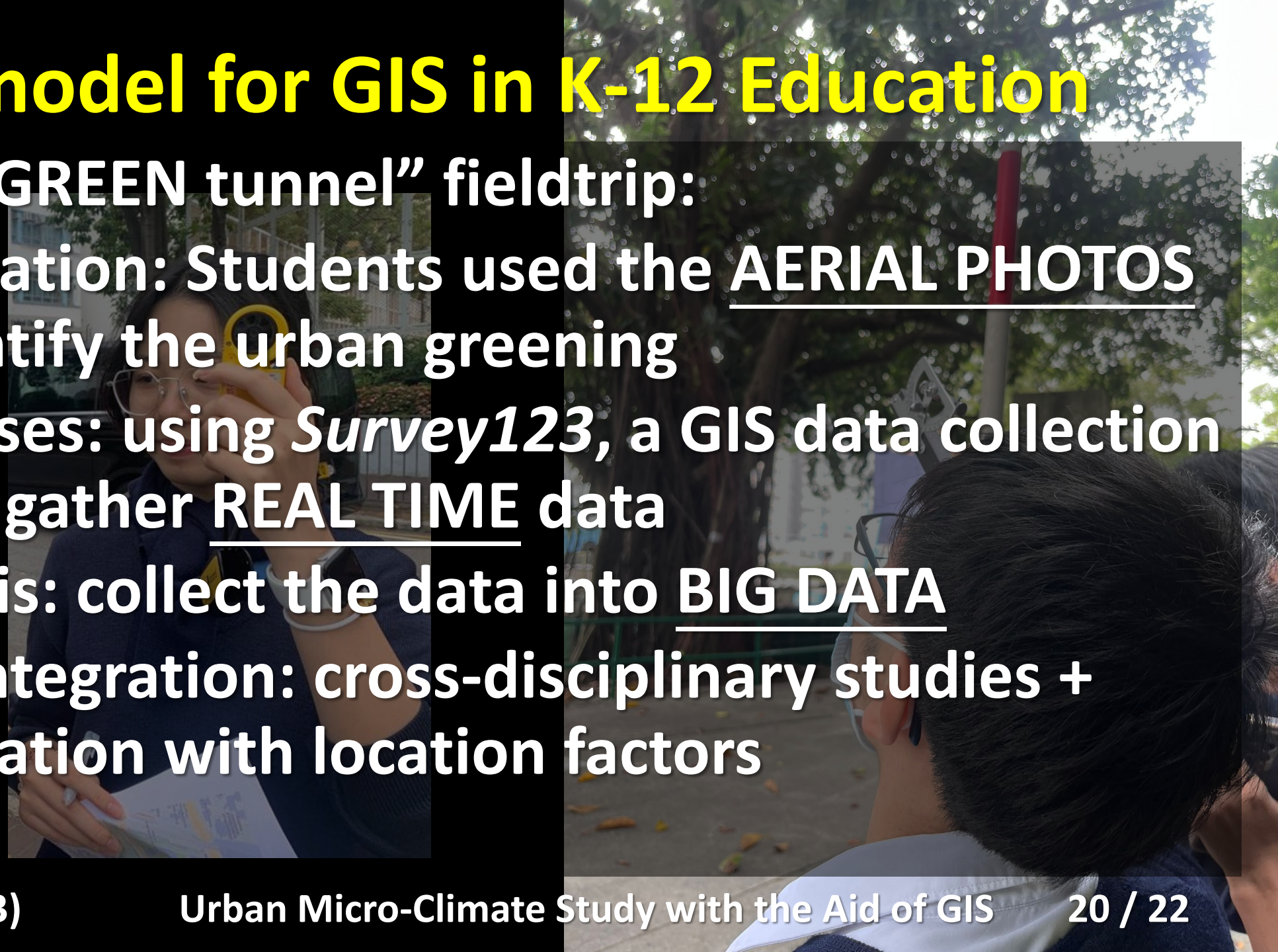
Pre-school	Primary	Junior Secondary	Senior Secondary	Tertiary
Knowing	Experience	Basic	Advance	Research

2. Senior forms: digital maps with GIS → “big” data analysis

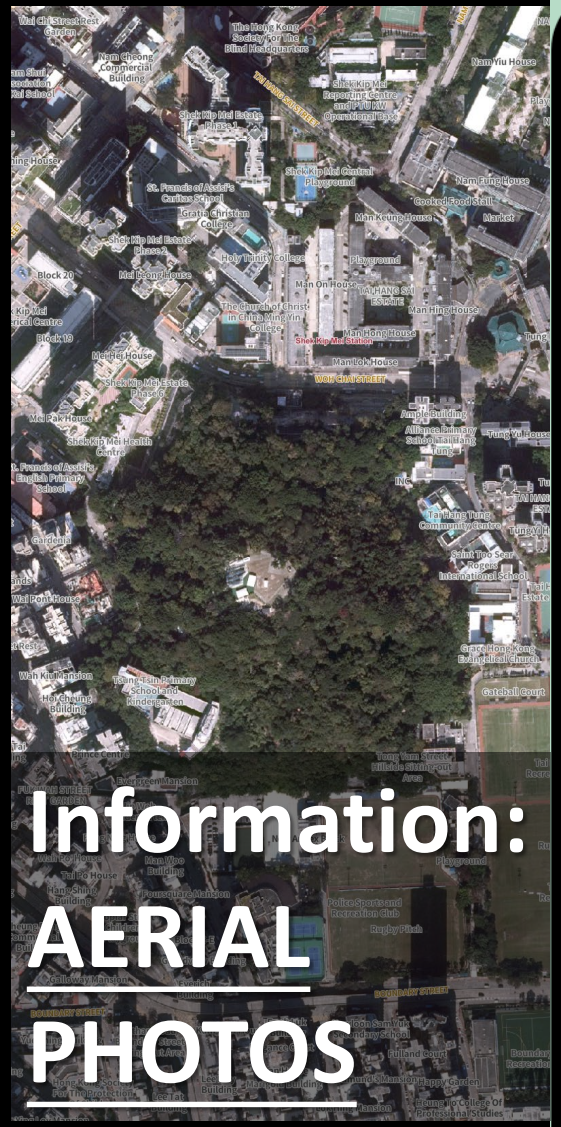
IPAD model for GIS in K-12 Education

During the “GREEN tunnel” fieldtrip:

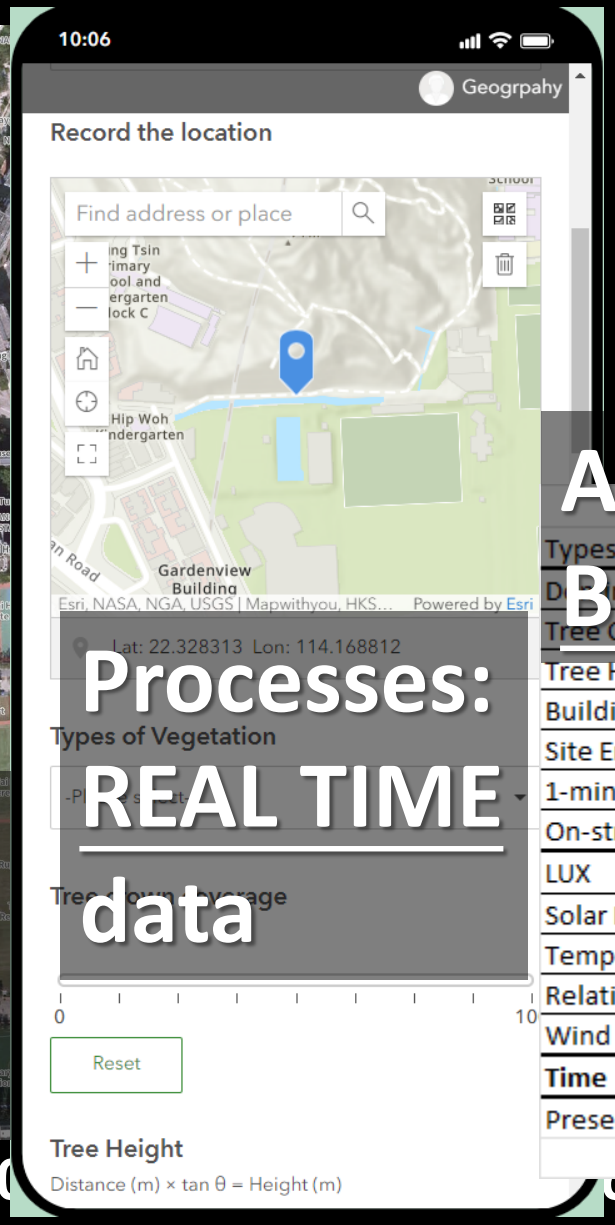
1. Information: Students used the AERIAL PHOTOS to identify the urban greening
2. Processes: using *Survey123*, a GIS data collection app to gather REAL TIME data
3. Analysis: collect the data into BIG DATA
4. Data Integration: cross-disciplinary studies + explanation with location factors



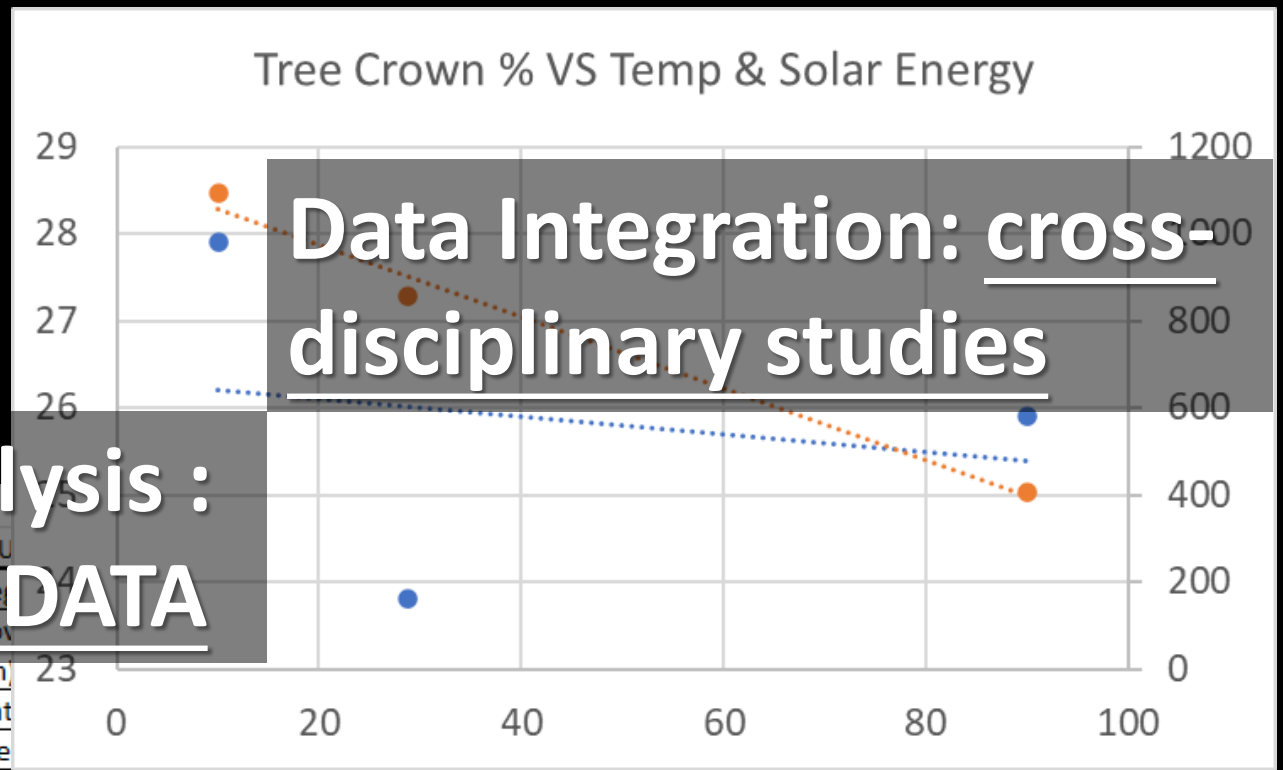
IPAD model for GIS in K-12 Education



Information: AERIAL PHOTOS



Processes: REAL TIME data



Analysis : BIG DATA

Data Integration: cross-disciplinary studies

					HKO King's Park Data	
Types of Land U						
Tree Crown Cov						
Tree Height (m)						
Building Height						
Site Enviornme						
1-minute Vehicle (no.)	10.5	*0*	***58***			
On-street Parking (no.)	2	*0*	***1***			
LUX	108200	*51600*	***138300***		525	635
Solar Energy (W/m sq.)	854.78	*407.64*	***1092.57***		23.7	22.3
Temperature (deg C)	23.8	*25.9*	***27.9***		65	64
Relative Humidity (%)	63.4	*67.7*	***17.7***		15	22
Wind Speed (km/h)	18.8	*1.7*	***4.7***		**11:20**	**12:30**
Time	**11:41**	***12:08***	***12:22***			
Present of Glassy Wall	1	*0*	***2***			
	Well-planned	*Forest*	***Urban***			

Next Steps…

1. Sharing in RTHK
   https://www.rthk.hk/radio/radio1/programme/climate_watcher2017/episode/919794
2. More “GREEN tunnel” field study for different schools
3. Promote to use GIS as an essential skill in daily life

   Learning something useful (not just examable)