



地球系統科學

EARTH SYSTEM

SCIENCE PROGRAMME



Earth System Science Programme

地球系統科學課程

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香港中文大學理學院<sub>1</sub>  
Faculty of Science, CUHK

# Global Environmental Change 全球環境變化



Climate Change



Air pollution



Food Security



Public Health



Water pollution



Natural Disasters



Biodiversity

● 學習和研究地球系統中各圈層的運作過程，以及它們之間的相互作用對地球環境所產生的影響。

● Study all “spheres” of the Earth system, and how their interactions shape the Earth’s environment



- 這些系統部份包括大氣圈、水圈、冰雪圈、岩石圈和生物圈等。透過學習這些部份的運作情況，可以瞭解及參與減輕自然和人為的環境威脅。

- The system consists of the atmosphere, hydrosphere, cryosphere, geosphere and biosphere. Via studying their processes, we understand and help mitigate natural and man-made environmental threats.



# 地球系統科學 Earth System Science

## Curriculum Design

- ✓ Building upon traditional science disciplines, including, e.g., **geology** (地質學), **meteorology** (氣象學), and **oceanography** (海洋學), we aim to establish an exciting **interdisciplinary** programme in Earth System Science (地球系統科學是一個橫跨傳統學科的嶄新課程).
- ✓ We aim to equip students with a solid foundation in **basic sciences** (physics, chemistry, biology), **quantitative skills** (statistics, computation), and **practical knowledge** of the Earth System, so that they are prepared to participate in tackling the various **environmental challenges** facing us today.

# 地球系統科學 Earth System Science

## Current Teaching Staff



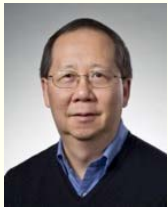
### Lin LIU (劉琳), Associate Professor & Division Head

Ph.D., U. of Colorado, Boulder; George Thomson Postdoctoral Fellow, Stanford  
Areas: Remote sensing applied to earth system science, Cryospheric Sciences, Space Geodesy, Deep Learning



### Yen Joe TAN (陳衍佐), Assistant Professor

Ph.D., Geophysics, Columbia University  
Areas: Volcanic eruption dynamics, Seismic imaging and monitoring with ambient noise, Machine learning and data science, Induced and triggered earthquakes



### Teng-fong WONG (黃庭芳), Research Professor & Founding Director

Ph.D., MIT; Former Chair, Dept. of Geosciences, Stony Brook University; AGU Fellow  
Areas: Earthquake mechanics, rock physics applied to natural resources, environmental hydrogeology.



### Hongfeng YANG (楊宏峰), Associate Professor

Ph.D., Seismology, Saint Louis University  
Areas: Subduction zone dynamics and megathrust earthquakes, High-resolution imaging of crustal fault zones and subsurface structure, Earthquake detection and location, Earthquake source mechanics

# 地球系統科學 Earth System Science

## Current Teaching Staff



**Man Nin CHAN (陳文年)**, Associate Professor & Director

Ph.D., Caltech; Postdoctoral Fellow, Lawrence Berkeley Nat. Lab.

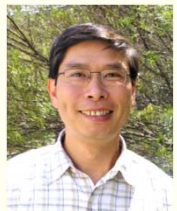
Areas: Aerosol chemistry, composition, formation and transformation of secondary organic aerosols, aerosol instrument techniques



**Gabriel N. C. LAU (劉雅章)**, Professor (by Courtesy)

Ph.D., U. of Washington; Professor, GFDL/Princeton

Areas: Dynamics of atmospheric circulation, atmosphere-ocean interactions, model simulations of atmospheric variability, impacts of climate change



**Joe Shing Yip LEE (李成業)**, Professor (by Courtesy)

Ph.D., Wetland Ecology, HKU; Professor, Griffith University, Australia

Areas: Ecology and biogeochemistry of estuarine wetlands, Application of stable isotopes in marine environmental research, Marine ecosystem dynamics, rehabilitation and restoration



**Amos P. K. TAI (戴沛權)**, Associate Professor

Ph.D., Harvard; Croucher Postdoctoral Fellow, MIT

Areas: Atmospheric chemistry & physics, climate-chemistry-biosphere interactions, impacts of global environmental change



**Francis C. Y. TAM (譚志勇)**, Associate Professor

Ph. D., Atmospheric and Oceanic Sciences, Princeton University

Areas: Climate dynamics, global warming and extreme events, dynamical downscaling

# 地球系統科學 Earth System Science

## Current Teaching Staff



**Tammy Pui Yuk TAM (譚佩玉), Lecturer**  
Ph.D., HKU; Postdoctoral Fellow, Assistant Lecturer, HKU  
Areas: Metamorphic Petrology and Geochronology, Structural Geology



**Andie Y.M. AU-YEUNG (歐陽綺雯), Lecturer**  
Ph.D., City University of Hong Kong  
Areas: tropical meteorology, seasonal climate prediction, tropical cyclone activities



# 地球系統科學 Earth System Science

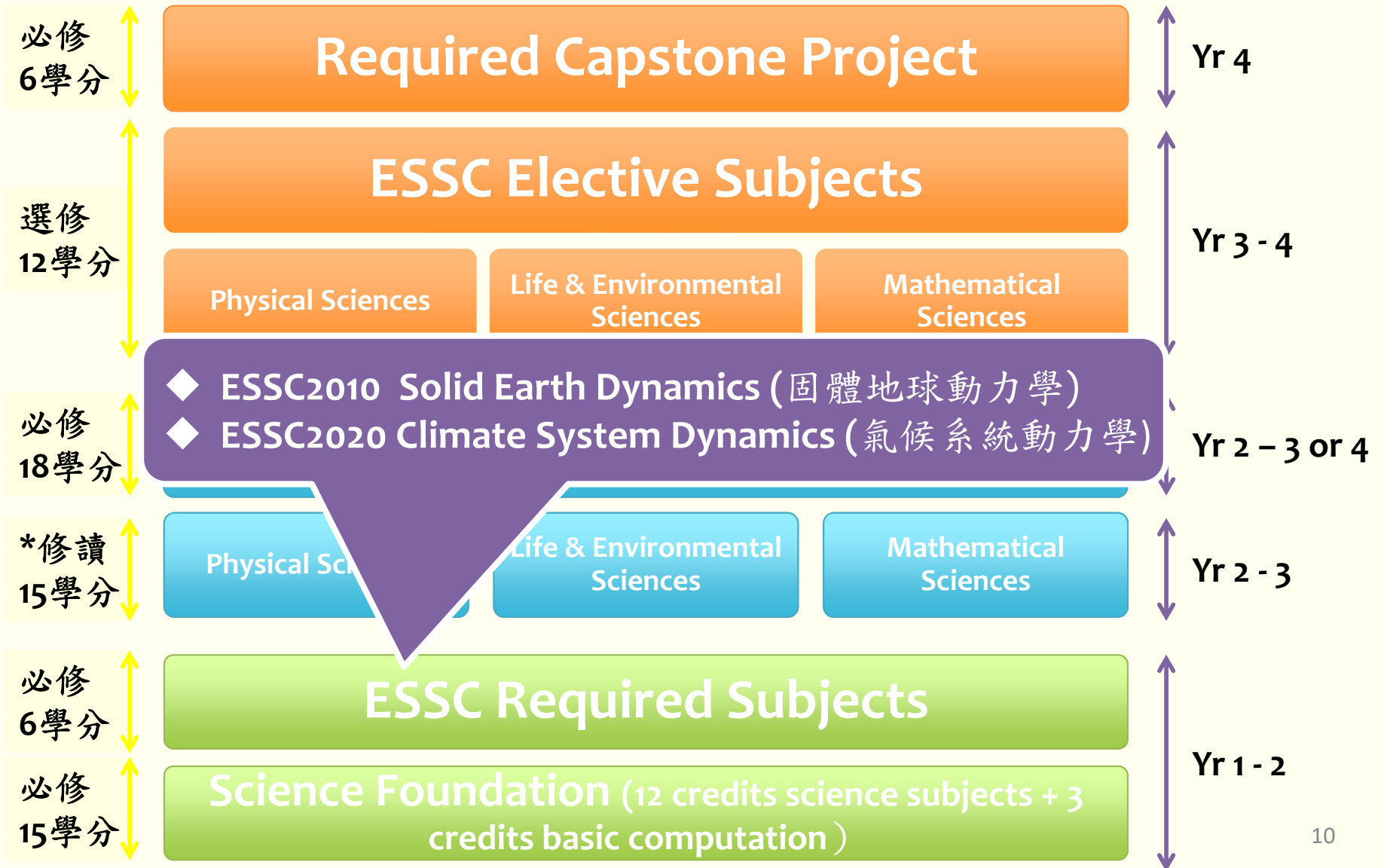
## Admission Scholarships

HKDSE Best 5 Score	Scholarships by the ESSC Programme
$\geq 33$	\$25,000 (one-off)
$\geq 31$ or 29 (including one 5** in BIO/CHM/PHY/M1 or M2)	\$10,000 (one-off)

The University and Colleges also offer admission scholarships for outstanding students.  
大學及書院亦會為成績優異的學生提供入學獎學金。

# 地球系統科學 Earth System Science

注：修畢以下72學分就可完成地球系統科學主修課程，修畢共123學分就可從本科畢業



# A Stimulating Way to Start Your Journey

## **ESSC2010 Solid Earth Dynamics (固體地球動力學)**

- ✓ **Under the scientific framework of plate tectonics theory, this course explores the physics and chemistry of the Earth, and a diversity of geologic phenomena over a broad spectrum of temporal and spatial scales.**
- ✓ **Exciting topics include: earthquakes and volcanoes, mysteries of minerals and rocks, use of earthquake waves to probe interior of the earth.**

## **ESSC2020 Climate System Dynamics (氣候系統動力學)**

- ✓ **An integrated introduction to the climate system, emphasizing the dynamics of the atmosphere and its physical and chemical interactions with other Earth system components.**
- ✓ **Applies basic scientific and mathematical principles to explain the history, current state and future of weather and climate, natural hazards, and climate change under natural variability and anthropogenic influences.**

# 地

注：修

必修  
6學分

選修  
12學分

- ◆ ESSC3100 Structural Geology (構造地質學)
- ◆ ESSC3120 Physics of the Earth (地球物理)
- ◆ ESSC3200 Atmospheric Dynamics (大氣動力學)
- ◆ ESSC3220 Atmospheric Chemistry (大氣化學)
- ◆ ESSC3300 Ocean and Climate (海洋與氣候)
- ◆ ESSC3320 Hydrogeology (水文地質學)
- ◆ ESSC3600 Ecosystems and Climate (生態系統與氣候)
- ◆ ESSC3800 Global Environmental Change (全球環境變化)

必修  
18學分

## ESSC Required Subjects

Yr 2 - 3 or 4

\*修讀  
15學分

Physical Sciences

Life & Environmental  
Sciences

Mathematical  
Sciences

Yr 2 - 3

必修  
6學分

## ESSC Required Subjects

Yr 1 - 2

必修  
15學分

Science Foundation (15 credits science subjects + 3  
credits basic computation)

# Course Recommendations

- You are strongly encouraged to take **ESSC1000** in **Term 1**.
- You are required to take **ESSC2010** in **Term 2**.
- You are **recommended** to take **ESSC2020** in **Year 1 Term 1** (Fast Track) if you have taken and **passed with grade 4** or above in one of the following combinations of DSE subjects:
  - Physics + M1/M2 + Chemistry
  - Combined Science with Phys & Chem + M1/M2
  - Physics + M1/M2 (but you are recommended to take CHEM1070 or CHEM1072 simultaneously in Term 1 to catch up the chemistry background)
- You are **welcomed** to take **ESSC2020** in **Year 1 Term 1** (Fast Track) if you have taken and **passed with grade 4** or above in the following combinations of DSE subjects:
  - Physics + Chemistry (but you are recommended to take MATH1010 or MATH1520 simultaneously in Term 1 to catch up the calculus background)
- Otherwise, you should take **ESSC2020** in **Year 2 Term 1** (Normal Track).

# Course Recommendations

- You should finish all these courses in **Year 1**:
  - MATH1010 (preferred), 1520
  - PHYS1111 (preferred), 1001, 1002, 1113
  - CHEM1070 (preferred), 1072
  - STAT1011 (preferred), 1012
- You should have taken the programming requirement (CSCI1120, 1510, 1520, 1530, 1540 or PHYS2061) by the end of Year 2. ENGG1110, with permission, may be used to satisfy this requirement too.

# Course Recommendations - Year 1

	Term 1	Term 2	Remarks
Faculty Packages x4	Physics, Mathematics, Chemistry, Statistics		
ESSC foundations	ESSC1000 Intro to ESSC		
	ESSC2020 Climate System Dynamics	ESSC2010 Solid Earth Dynamics	
Physics	PHYS1111	PHYS1122	
Mathematics		MATH2550 Quantitative Methods for Earth and Environmental Sciences	Pre-requisites: taken MATH1010 OR B or above in MATH 1510 or 1520 (For aiming ESSC3200 Atmospheric Dynamics in year 2 term 1)

## 高階科目 Upper Level Courses

- **Solid and Fluid Mechanics (固體與流體力學)**
- **Geoscience Field Course (野外地質實習)**
- **Applied Geophysics (應用地球物理學)**
- **Petrology (岩石學)**
- **Geomorphology (地貌學)**
- **Seismology (地震學)**
- **Marine Geology and Geophysics (海洋地質與地球物理學)**
- **Land-Atmosphere Interaction and Boundary Layer Dynamics (邊界層動力學及地氣相互作用)**
- **Tropical Meteorology (熱帶氣象學)**
- **Aerosol Physics and Chemistry (氣溶膠物理與化學)**
- **Air Pollution Science and Engineering (大氣污染科學與工程)**
- **Statistical Methods and Modeling (統計方法與模型)**
- **Remote Sensing (遙感)**
- **Numerical Methods and Modeling for Earth System Science (地球系統科學的數值方法與模型)**



# 兩個專修組別 Two Specialized Streams

**ESSC students can choose a specialized stream for more in-depth studies in one of two sub-disciplines.**

## ❖ **Atmospheric Science Stream (大氣科學組)**

- ✓ **Students in this stream undertake in-depth studies related to Atmospheric Sciences.**
- ✓ **They will take advanced undergraduate level courses such as atmospheric dynamics and chemistry, meteorology, oceanography, air pollution, numerical/statistical methods and other related courses.**

## ❖ **Geophysics Stream (地球物理組)**

- ✓ **Geophysics focuses on studying the Earth using gravity, magnetic, electrical and seismic methods.**
- ✓ **Students will acquire solid physical and mathematical foundations and quantitative understanding of the solid Earth: surface and internal structures, dynamics, geohazards and mitigation, exploration of mineral and natural resources.**

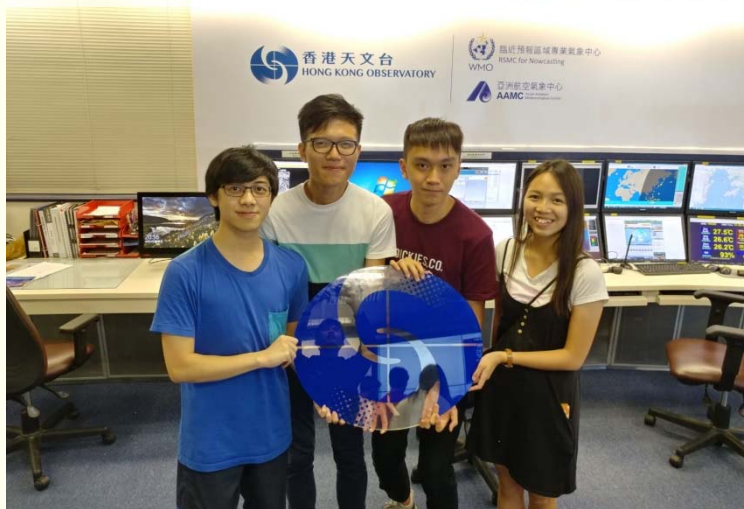
# Two Streams

- You are recommended to declare your stream early on (e.g., in Term 2), but you are allowed to change your stream at any point before graduation.
- Please note that careful selection of elective courses in both streams, with 1-2 additional courses in Physics, can fulfill the requirements of a Minor in Physics.

# 野外工作及校外實習 Field Work and Internship

To enhance the student's experience beyond a campus setting, internships and field trips are integral components of the curriculum.

HKO Placement Programme, 2018



ESSC3100 Field Trip to Bluff Head, 2019



Shennongjia Field Camp, 2018



Open Day, 20 Oct 2018



# 野外考察 Field Trips

ESSC2130 Integrated Geoscience Field Study 臺灣 (十天)

ESSC3110 Geoscience Field Course 山西，恒山-五臺山 (兩周)

ESSC4160 Marine Geology and Geophysics 海洋地質與地球物理學 浙江 舟山 (兩周)

長江三峽—神農架 地質地貌人文環境考察營 (兩周)



# 野外考察 Field Trips

## ESSC3110 Geoscience Field Course (地球科學野外課程)

- ✓ Study structural geology and petrology in the field. In 2014, 2015, 2016 and 2019 we collaborated with Peking University to conduct field course at Wutaishan, Shanxi.

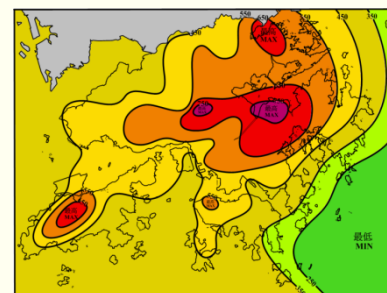
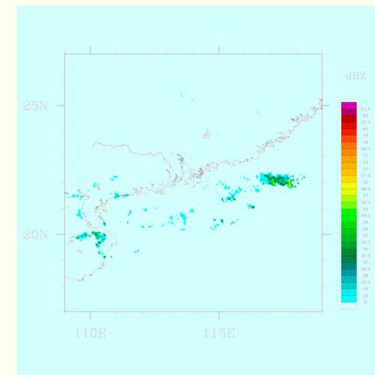


# 香港天文台實習計劃 HKO Placement Programme

Every year we send out a few qualified students to the **Hong Kong Observatory (HKO)** for a fascinating internship opportunity to not only embark on weather and climate research, but also allow the students to experience first-hand the nature and routines of meteorological services. Both **one-year** and **summer** placements are available.

- Improve interpolation method of monthly rainfall
- Analysis and short-range forecast of convective weather using satellite data
- Using the CCA (canonical correlation analysis) method to statistically downscale the GCM (general circulation model) output
- Using statistical methods to extract information about climate extremes in China from different data sources including model outputs, field observations and reanalysis of data

*And more....*



# 實習 Internship

Our students have the opportunities to gain hands-on experience that could be useful in an actual working environment.

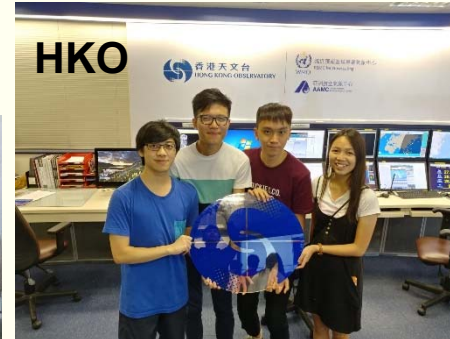
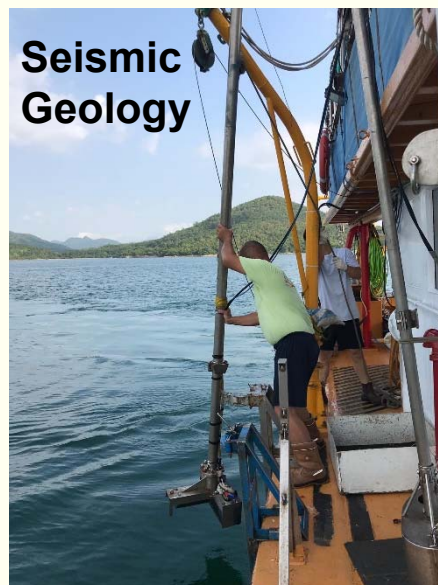
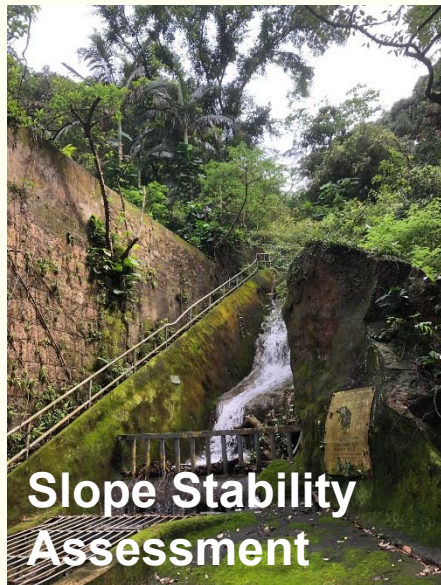
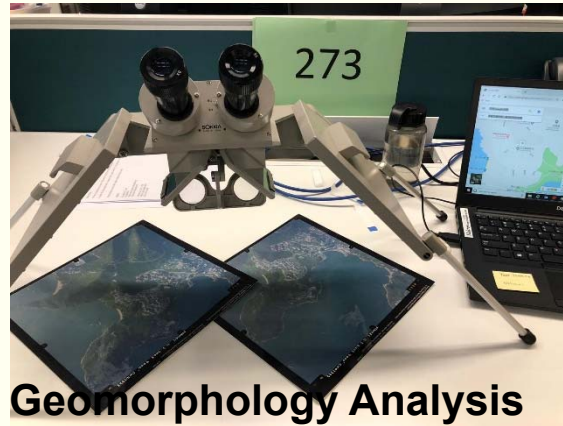
During the summer in 2018, our students have successfully planned and carried out a geo-tour (鶴咀地質文化一日遊) for the public. The tour was full half an hour after it is released on the website.

They gained experience in how to handle a tour in terms of the logistics and the geological knowledge.



# 實習 Internship

- Hong Kong Observatory
- EGS
- CM WONG
- Jacobs
- CEDD
- Education media production
- EPD





# Final Year Projects

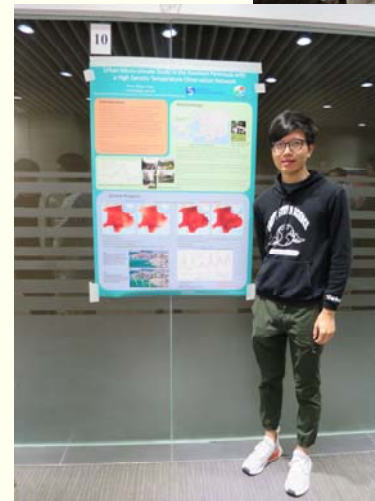
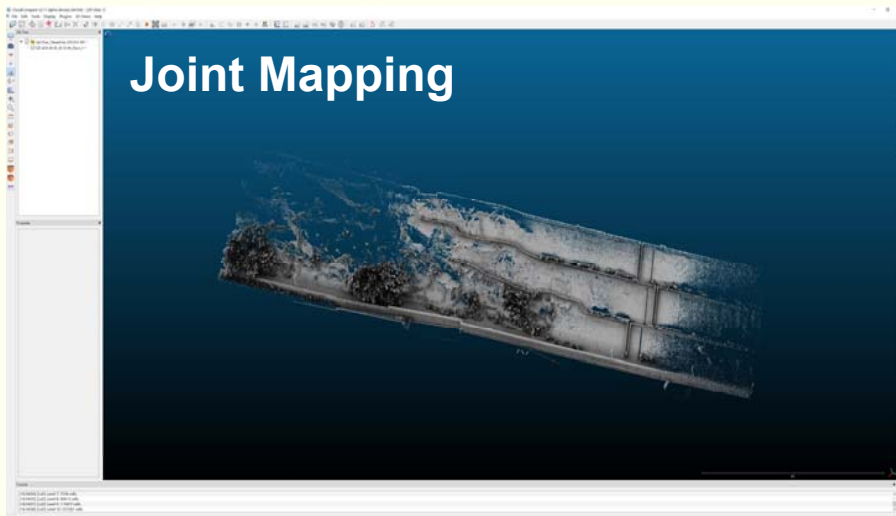
FYPs co-supervised by industrial professionals and ESSC teachers:

- HKO data analysis
- Seismic analysis
- Remote sensing study landslide
- Field mapping
- Regional metamorphic study
- Laboratory test
- EPD Street-Scale Model

**Field Mapping**



**Joint Mapping**





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