THE CHINESE UNIVERSITY OF HONG KONG

Micro-Module Courseware Development Grant

Scheme 1: Basic Scheme

Interim Report (2016-17)

Report due 31 October 2017.
Please return by email to mmcd@cuhk.edu.hk

PART I

Project title:	Micro-Modules on Geology, Climate Feedback, and Geophysical Fluid Dynamics
Principal supervisor:	Andie Au-Yeung Yee Man
Department / Unit:	Earth System Science Programme
Project duration:	From May 2017 to April 2018

Date report submitted: 2017 October 31st

1. Project objectives

Is the project on track to meet its objectives?
Have the objectives been changed as a result of the experience of working on your MMCDG project?

Micro-Module A: Rocks and Minerals Gallery

Objectives of this micro-module include: (1) to digitalise the physical resources in our petrology lab, which include a large amount of rock samples, mineral samples and petrographic thin sections; (2) to carefully organise the newly produced digital resource for educational purpose so as to provide an easily accessible resource pool to our students, which is not limited by time or venue; and (3) to recruit a group of student helpers who have shown good abilities and great interest in Earth System Science subject. By supervising these student helpers working for the project, we expect that an extra opportunity can be created for them to both further develop their abilities and have their knowledge consolidated. All activities conducted by now for developing the micro-module of Rocks and Minerals Gallery strictly meet the needs to achieve these objectives. Not have the objectives been changed with the process of the project, but our experience has proved that they are feasible and instructive.

Micro-Module B: Climate Feedback Model

The objectives of this micro-module are to (1) develop interactive simulation on how different factors affect climate feedback, (2) allow users to visualize different kinds of climate feedback (global warming/cooling), (3) give student helpers a chance to learn digital graphics and interactive animation at the same time and (4) raise the awareness of global warming/climate change issue after the interactive tool is put on the public website. The tool can be used in courses ESSC1000 and ESSC2020.

Micro-Module C: Geophysical Fluid Dynamics (GFD)

Several objectives of the GFD micro-module include (1) expressing advanced-level GFD equations in computer codes, (2) producing animations which visualize the fluid (air or water) motion described by the GFD equations and (3) corresponding MATLAB codes available for students to download and they can learn the coding skills there. The micro-module allows students to learn how to turn the knowledge obtained in class (traditional GFD equations) into practical computer codes which can carry out the air motion simulations.

Micro-Module D: Getting Started with Python Programming in Earth System Science

We have also developed a micro-module that was not mentioned in the application form. Since the Earth System Science Programme has not yet had its own computer programming course, students need some time to digest what they have learnt in the programming course offered by the computer science department to the scientific calculations needed in earth system science analysis. The micro-module acts as a crash course for programming beginners and hopefully will be useful in their future careers as python is the most popular language in the industry regarding to scientific programming. The objectives of the micro-module includes (1) to allow students to learn programming from scratch to cope with data analysis in Earth System Science and (2) to allow students to revise on the programming skills they have already obtained in the computer science course.

2. Progress on process, outcomes or deliverables

What have been accomplished so far?
Have any obstacles been encountered and what are the remaining tasks to be finished?
Is the project still on time for completion (which includes preparation of the final report) on or before the grant expiry date?
Provide a listing of project outputs to date.

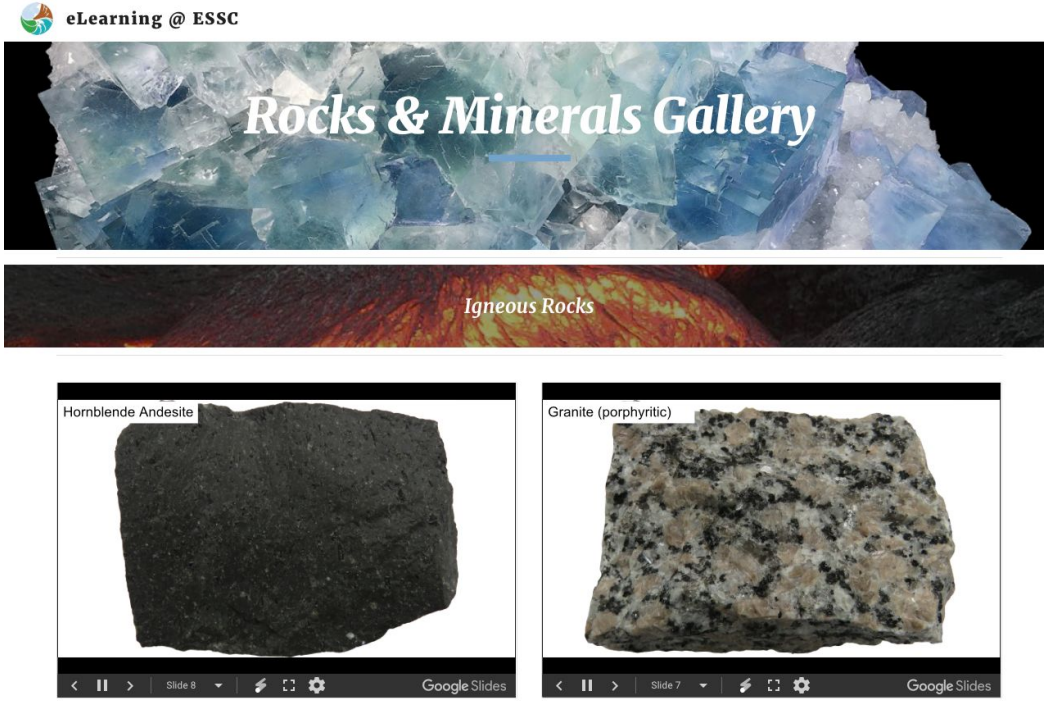
Four micro-modules are listed in here and three of them are completely finished (Micro-modules A, C and D).

Micro-Module A: Rocks and Minerals Gallery

To respond the aforementioned objectives of developing Rocks and Minerals Gallery, the following activities have been conducted.

(1) High resolution photos have been taken for each of our rocks and minerals samples, including three basic classifications of rocks (igneous, metamorphic, sedimentary) and two basic classifications of minerals (transparent, metallic). Photos can clearly show the mineral assemblage and texture for each sample. In addition to the digitalisation of our hand specimen, typical micrographs have also been taken using the petrographic microscope and the camera system for each of our petrographic thin sections. Micrographs can clearly show the physical characters of the common rock-forming minerals under PPL (plane polarised light) and XPL (cross-polarised light). Besides, these micrographs could also help students better understand rocks textures from the microscopic aspect, such as the differences among the phaneritic, aphanitic, and porphyritic textures of igneous rocks; the forming of foliated textures of the metamorphic rocks, etc. Both the sample photos and the thin section micrographs have played an important role in our digital resource pool.

(2) A website to integrate all digital resources from our unit has been built, where the Rocks and Minerals Gallery and the Minerals in Thin Sections are two important components. The google products, which are popular, easy-to-use, free and stable, are used to showcase our sample photos and thin section micrographs, which are carefully arranged in order to assist the syllabus of the petrology course. Students now can use the 24/7 self-service online to approach those limited resource in the lab no matter where they are. This is a snapshot of the website,



(3) The successful development of the digital resource cannot be achieved without our student helpers team. A team of five senior students who have taken the petrology course (ESSC4120) worked for this micro-module for three months. They had extra time, compared with other peers, to work with rocks, minerals and microscopes. Adept skills in identifying rocks and minerals are required, therefore, regular discussions between student helpers and teaching or teaching supportive staff were spontaneously encouraged.

Two obstacles have been encountered in the progress of the project, which include a technical problem in 3-D platform and the availability of student helpers.

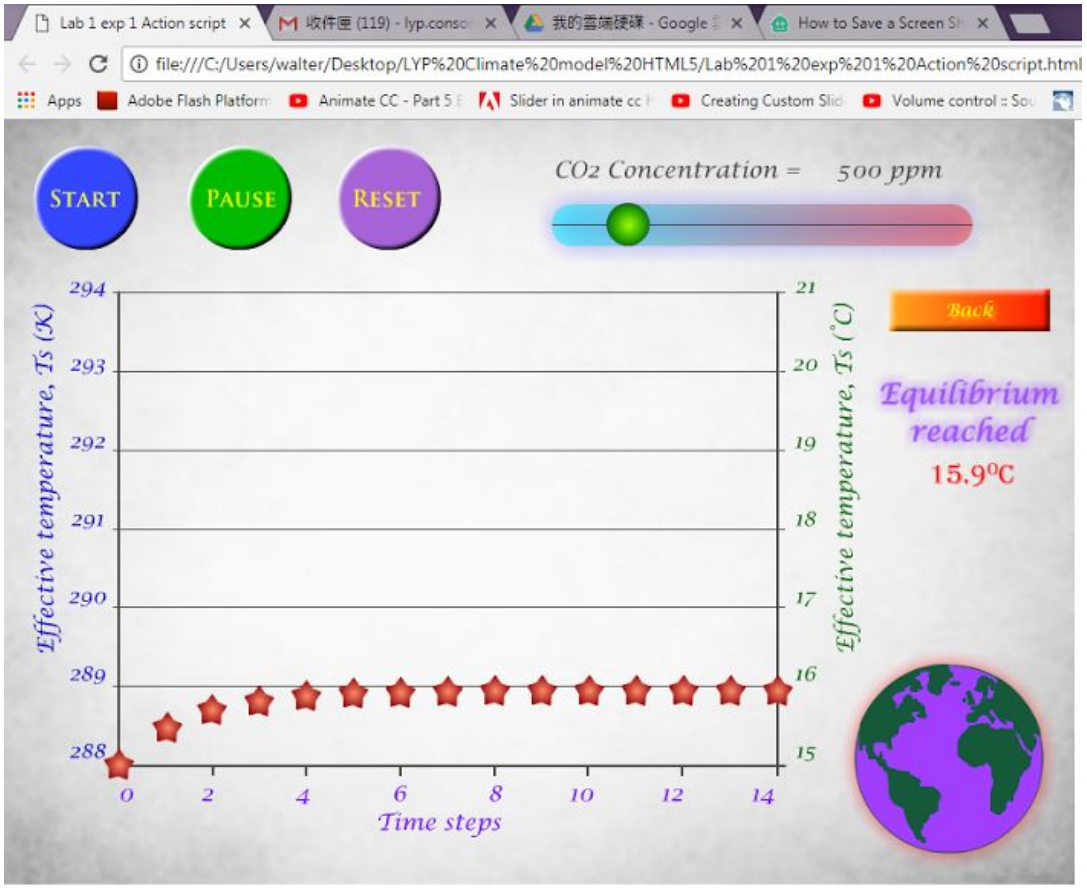
(1) Our firstly proposed plan is to produce a 360 degree view for each sample. But due to a lack of technical support on the fairly immature 3-D viewing platform, we finally persuaded ourselves to go back to the traditional way of 2-D presenting. However, it doesn't mean that we have to sacrifice the final products' quality or discount the objectives, as we believe the traditional way could fulfil an equivalent role in helping students sharp their skills. The reason is that we carefully selected the freshest surface of each sample to make sure that it can show the most typical characters when taking the photo. Students could, hence, directly focus on the best phenomenon instead of spending time to look for it. Of course, the 3-D presenting may provide a better way to conduct some more interactive learning, so we will still consider to develop it in the future if time is matured.
(2) Our first group of student helpers now stepped into their final year of study. Most of them cannot continue to work for the project thanks to such issues as graduation and job seeking. Therefore, we need to recruit new ones. However, the current year-3 students haven't completed their petrology course, and hence we have to stop for a while to wait them. The mid-term is now coming, and we believe our target students have learned the relevant knowledge and should be capable to handle the left work, such as to write descriptions for each photo. We are planning to recruit new student helpers from early November and have them for at least eight weeks till the end of the year. With sufficient communication and supervision, we believe the new helpers team will finish the job well. The completion of the project on time can be guaranteed.

Listing of project outcomes to date:

(1) 92 high resolution rock samples photos;
(2) 204 micrographs of petrographic thin sections;
(3) Webpage: Rocks and Minerals Gallery;
(4) Webpage: Minerals in Thin Sections

Micro-Module B: Climate Feedback Model

In the past few months, we have trained a student helper to code the preliminary simulations for our climate feedback model. Users can adjust the carbon dioxide concentration in the air to let the atmosphere to response to an equilibrium level with a certain temperature. More animations have yet to be added, including the changing state of the earth (shown in color) and a small factory on top of the earth releasing exhaust gas in coherent with the concentration set by the users in the slider. If the natural greenhouse effect is not strong enough, the earth will plunge into a global cooling state and a snowball earth will be shown accordingly (this part not finished yet). Here is the layout of the simulations of earth temperature in time.



There are several obstacles in producing this micro-module. First, it was difficult to find an ESSC student who is confident enough and also capable to carry out the task. We have overcome this by letting a student, who appeared to be enthusiastic during the interview, to learn the animation skills from scratch. The student managed to learn on his own and wrote the preliminary version of the animation. It is definitely a good training for the student helper and will be helpful in his future career. Second, the learning speed is slow for the student since he has to squeeze the working hours into his own busy study schedule.

Although the micro-module is not yet finished and the progress is slower than expected, this

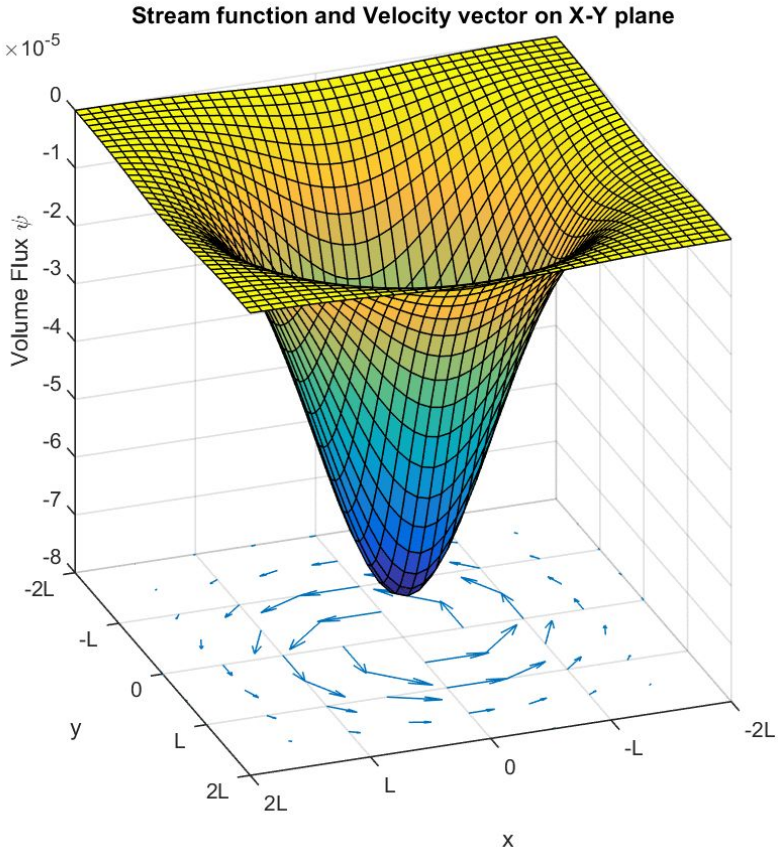
micro-module is expected to be fully functional in different devices (including mobile) before the grant expiry date. We will also ask this student helper to produce a simple tutorial so that he can pass on what he has learnt in this task to other student helpers for other elearning micro-modules.

Listing of project outcomes to date:

(1) Preliminary climate feedback model (not yet available online)

Micro-Module C: Geophysical Fluid Dynamics

We have finished all the planned tasks using MATLAB codes for 6 chapters in the book "Introduction to Geophysical and Fluid Dynamics". The codes consist of advanced-level GFD equations and they can produce animations for each corresponding GFD phenomenon. Animations can help student to visualize the physical properties or the motion of our atmosphere. Please see examples of our animations in here : streamfunc and KelvinWave. Here is a preview for one of the animations.



We have encountered an obstacle in the file format conversion while uploading the materials on the KEEP platform. The materials were prepared in powerpoint format with GFD equations. Since it is difficult for our elearning team to type those equations in the KEEP platform, some of the materials (text and equations) are uploaded in picture format. If we have time and manpower in the future, we can turn that into text formats (which will resize

according to the screen size). Nevertheless, the KEEP platform show our materials nicely at this moment. The materials are already being used by Professor Francis Tam in EASC5001 and Dr Andie Au-Yeung in ESSC3800 .They will be used in courses ESSC3300 and EASC5104 in the next semester.

Listing of project outcomes to date:

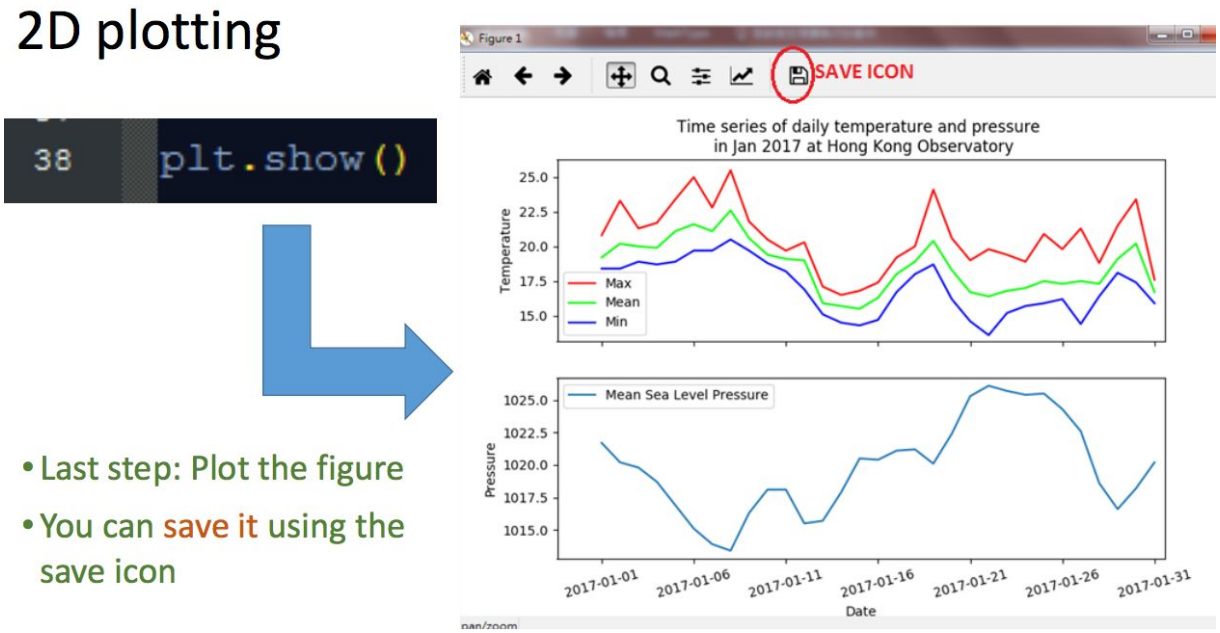
(1) MATLAB codes built-in with advanced-level GFD equations

(2) Animations which visualize the fluid (air or water) motion described by the GFD equations

(3) corresponding MATLAB codes are available for students to download from KEEP and they can learn the coding skills there

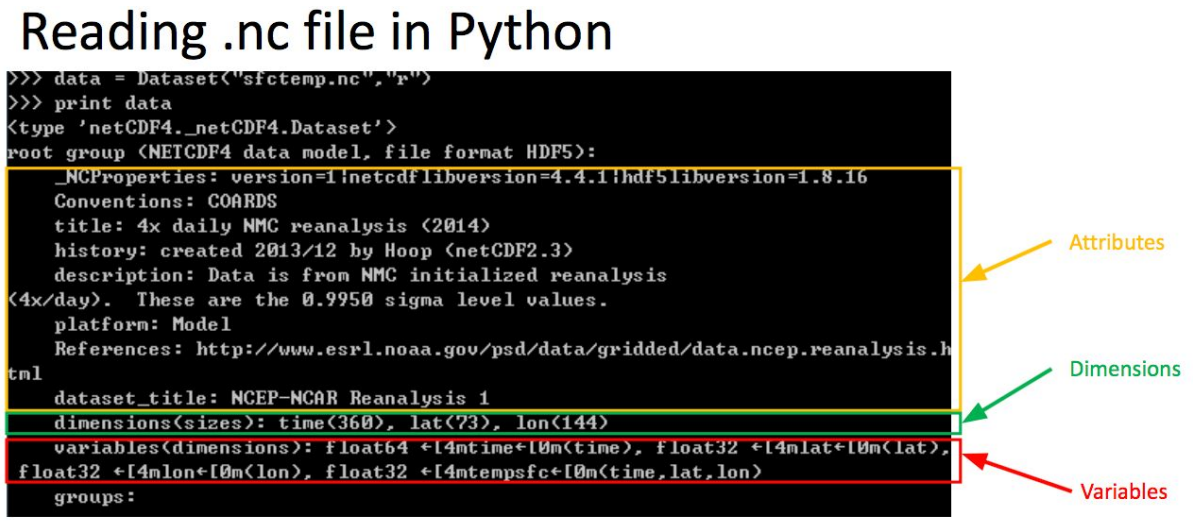
Micro-Module D: Getting Started with Python Programming in Earth System Science

There are a lot of self-learning materials in Python online, however they are not specifically for earth system science analysis We have developed 5 sections of self-learning materials for the Python programming in earth system science, including (1) installation and basic commands, (2) scripts, functions and arrays, (3) booleans and flow-control, (4) reading and writing data formats in earth system science analysis and (5) figures plotting skills. Here is some of the materials in section (5).



The materials can be used as the programming tutorial in courses ESSC3800 and ESSC4520 and they also serve as self-learning materials whenever the students need to refresh memory when they work on relevant assignments, little research projects with professors and their final year projects. The materials are fully coupled with the earth system science knowledge, meaning that the examples and the equations used here are all from our ESSC courses.

The obstacle that we have encountered is that we have to choose between windows/mac machines when we do a screen capture (which can make the explanation clear), like this



In the above we chose to capture the screen with a windows machine since we still have more students using windows at this moment. All the developed materials are uploaded in the KEEP platform.

Listing of project outcomes to date:

(1) 5 sections of self-learning materials and each section has
   (a) explanation
   (b) corresponding screen captures
   (c) corresponding graphs plotted
   (d) programming exercises for students

3. Evaluation Plan

Have you altered your evaluation plans?
Does your evaluation indicate that you have achieved your objectives?

Micro-Module A: Rocks and Minerals Gallery

The major means to evaluate the effectiveness of the newly produced digital resource include: (1) formal questionnaire and (2) informal interview. We will both encourage students to finish the online questionnaire and talk to students asking for feedback directly. The evaluation process will be kicked off from January, 2018.

Micro-Module B: Climate Feedback Model

When the micro-module is finished, it will be used in our CUHK open day (2018 October)

and visitors will be able to play with it. The student helpers in the open day event can give a brief feedback on the response of the visitors towards the micro-module. We can find out if people are interested in playing with it or not.
The micro-module will also be placed in our ESSC elearning website, where number of views will be counted and the users will be asked to leave behind a feedback once they are done with the model.

Micro-Module C: Geophysical Fluid Dynamics

The elearning materials including the animations and the MATLAB codes are mainly for the course ESSC3800, ESSC3300, EASC5001 and EASC5104. The evaluation will be done by self reflection of the teachers involved. Teachers will have to reflect on the usefulness of the animations in demonstrating the concepts.

Micro-Module D: Getting Started with Python Programming in Earth System Science

Students will be required to do the programming exercises after each section. Teachers can evaluation the elearning materials by their performance in working on the exercises.

4. Dissemination Activities (reports, websites, video links, products, *etc.*)

Provide a listing of dissemination activities to date.

Micro-Module A: Rocks and Minerals Gallery

We shared our project outcomes with other e-learning teams from The Hong Kong Baptist University and The Educational University of Hong Kong during a closed-door meeting on Oct.19. We are very happy to receive positive feedbacks.
Our website can be found through the following links:
https://sites.google.com/view/cuhk-essc-elearn
https://sites.google.com/view/cuhk-essc-elearn-gallery
https://sites.google.com/view/cuhk-essc-elearn-micrograph

Micro-Module C: Geophysical Fluid Dynamics

The materials can be found here,
https://edx.keep.edu.hk/courses/course-v1:CUHK+ESSC5002+2017_01/about

Micro-Module D: Getting Started with Python Programming in Earth System Science

The materials can be found here,
https://edx.keep.edu.hk/courses/course-v1:CUHK+ESSC4520+2017_01/about