GISC405-22S1(C) (21 February to 03 June 2022)
GIS Programming and Databases
"Advanced Earth and Environmental Analytics"

This handout contains important information about GISC405-22S1 and should be read carefully, and kept for reference. It outlines the course structure, teaching, learning outcomes and assessments in GISC405. It also contains guidelines with respect to the workload you can expect from this course and a summary timetable for lectures, labs and deliverables.

GISC405 is a 15-point course that intersects relevant disciplines such as Data Science, Geography, and Environmental Science, and Computer Science. The course is operated, and administered, by the School of Earth and Environment.

General course description: This course builds on student experience with geospatial skills and extends it with advanced geospatial analytics using opensource and self-developed code in climate and weather and its applications. In this course, students will be able to apply their skills to real-world problems such as energy, water, climate change, and hazards by interacting with meteorological and climate model outputs and transforming data into impact-based research applications. This course will provide students a flexible and multidisciplinary knowledge and skill base for tackling other contemporary environmental problems.

More specifically, this course will help students develop their Python skills, build upon existing open libraries for Earth and environmental data analytics, and develop new workflows using the Jupyter Notebook coding environment.

If you have any questions related to the material contained in this handout please contact:

Course Coordinator/Lecturer:

Marwan Katurji
Email: marwan.katurji@canterbury.ac.nz
Office hours: email to arrange

Welcome to GISC405! We look forward to working and developing with you.

Learning outcomes

The students will engage in both lecture and project-based material with the following ***learning outcomes***:

- To become familiar with **developing analytical code** to access national climate and meteorological databases
- To get hands-on experience with manipulating and **developing Python notebooks**
- To be able to **interrogate big data** for achieving research objectives
- To become familiar with opensource coding platforms and **geospatial programming libraries**
- To understand how complex spatiotemporal weather modelling datasets can be useful to **solve real-world environmental problems**
- To gain understanding on how data and analytics can be used to protect the New Zealand community from environmental hazards
- To build and develop practical coding and data science skills needed for competitive employability in the research and commercial domains
- To **communicate and collaborate effectively across environmental disciplines**

Theoretical content

The content of GISC405 is of a practical nature that utilizes existing and student developed Python code to analyse the spatial and temporal dynamics of meteorological and climate phenomena from numerical model outputs and observational stations. The theoretical content of the meteorological discipline, and when required, will be introduced in the form of short lectures.

Lectures and labs

We will be holding lectures and computer labs in the same location, The teaching/labs time slots are:

Lectures/Labs:
Mondays, 09 am – 12 pm
Ernest Rutherford 211a Computer Lab

The labs and lectures are organized according to the study timetable below. Tutorials and lab exercises will be carried out during the dedicated lab session and supervised by the teaching team. Some lab sessions will have a take home lab assignment which will be given to the students and then returned for assessment.

Self-learning

We expect you to be committed to learning throughout this course. We therefore expect that you will take responsibility for:

(a) Reading beyond your lecture notes throughout the course, in order to enhance the learning achieved in the formal lecture room and lab environments;
(b) Ensuring that you understand the course material, by working through your notes carefully, discussing matters with your fellow students, and asking questions for clarification if necessary, either pertaining to material encountered in the formal teaching environments, or material you encounter during self-learning;
(c) Spending approximately 8 hours each week in self-learning for this course (see *Workload* below)

Recommended online learning material

https://www.earthdatascience.org
https://www.earthdatascience.org/courses/use-data-open-source-python/
https://swcarpentry.github.io/python-novice-inflammation/

Lab specific material will also be provided – see lab Jupyter Notebooks

Marking and other guide-lines

Formal assessment for the GISC405-22S1 course is carried out throughout the teaching term and a final exam is not required. There will be 4 assignments carried out at various touch points during learning period.

Assessments
You will have four assignments throughout the course (see course material timeline below) and will be assessed based on a 25% mark for each. There is no final exam for this course.

Extensions
Extensions to assignments are not usually given except in exceptional circumstances, such as serious illness, accident or bereavement. To apply for an extension please contact the course coordinator/lecturer directly.

Late work penalties
Lab assignment and report handing in late without an approved extension will be subject to the following penalty. A **2% deduction will be applied for every late day (including weekends)**. A maximum of 1-week delay will be allowed after which a fail mark will be issued.

Workload

GISC405 is a half-year, 15-point course. You are therefore expected to spend about 10 hours per week on this course. The contact hours (lectures and labs) will average about 2 hours each week which leaves 8 hours each week for self-learning in relation to the course e.g. doing readings and taking notes, working on a lab assignments or presentation.

Key dates summary

Assessment due dates

Assignments

Assignment 01a: 7th of March, 2022 @ 10:00pm ⇒ 12.5%

Assignment 01b: 14th of March, 2022 @ 10:00pm ⇒ 12.5%

Assignment 02: 4th of April, 2022 @ 10:00pm ⇒ 25%

Assignment 03: 2nd of May, 2022 @ 10:00pm ⇒ 25%

Assignment 04: 3rd of June, 2022 @10:00pm ⇒ 25%

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Learning timetable

Time (Location in ER211)	Course Timeline & Deadlines
21 February	• Course introduction • SEE Jupyter hub access and control • Introduction to the learning environment using Jupyter Notebooks (JN)
28 February	• **JN1 (Introduction to Python):** Jupyter Notebook environment and Python basics Assignment 01a release
07 March	• **JN2 (Spatial Meteorological data):** Introduction to spatial data analysis from the Weather Research and Forecasting (WRF) model - Netcdf data structure Hand in Lab Assignment 01a by 10pm – 12.5% Assignment 01b release
14 March	• ***JN3 (Efficient N-dimensional data handling)***: Advanced exploration of WRF data structure and access Assignment 02 release Hand in Lab Assignment 01b by 10pm – 12.5%
21 March	• ***JN4 (Advanced analytics on N-dimensional data):*** Meteorological statistics and data visualization
28 March	Student lab work and assignment support
04 April	• ***JN5 (Fire Weather Index Calculator)***: Application of FWI to New Zealand meteorological observational station network – www.Envlib.org database and Tethys API Assignment 03 release Hand in Lab Assignment 02 by 10pm – 25%
11 April to 1 May	**Mid-Semester/Easter Break**
02 May	Hand in Assignment 03 10pm – 25%
09 May	Invited speaker, Darrin Woods – National Wildfire specialist - Fire Emergency New Zealand
16 May	Invited speaker (9:30am to 10:30am), Robin Hartley – Geospatial Scientist from Scion • ***JN6 (Exploration of high density point cloud data using opensource software):*** A land use and land cover database for wind gust modelling
23 May	Invited speaker, Eva Nielsen – PhD student at SEE – Antarctica climate spatial dynamics Machine Learning and AI in Eva's research Introduction to a machine learning based spatial detection anomaly algorithm (Isolation Forest, Clustering-SOM) Assignment 04 release
30 May	Student lab work and assignment support
03 June	**No lecture. End of semester week** Hand in Assignment 04 by 10pm– 25%

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Python Jupyter Notebook Roadmap