Academic Year	2017-2018	**Semester**	1
Course Coordinator	Judith Hubbard		
Course Code	ES2802		
Course Title	GIS and the Earth System		
Pre-requisites	ES1003 and ES2001		
No of AUs	3		
Contact Hours	3 (1 hour of lecture per week, 2 hours of tutorial)		
Proposal Date	28 September 2017		

Course Aims

In this course, you will become familiar with Geographic Information Systems (GIS). You will be able to navigate within the ArcGIS, import and export datasets, change the reference frame, create maps, use simple scripts, and search online to find and adjust GIS workflows within the context of Earth systems science. You will also learn how to generate 3D models using photogrammetry using the software Agisoft Photoscan, and how to export the data from those models into ArcGIS.

Intended Learning Outcomes (ILO)

By the end of the course, you will be able to:

1) Import datasets into ArcGIS
2) Explain the differences between the different projections, identify which projection is relevant, and change projections and reference frames
3) Georeference maps
4) Create meaningful, attractive maps that illustrate relevant data clearly, including scale bars, legends, appropriate color schemes, and different types of symbols
5) Measure values from maps in and use these in calculations
6) Calculate new spatial datasets from previous datasets (rasters, shapefiles, etc.)
7) Describe how GIS can be used in Earth systems science
8) Develop GIS workflows to solve specific problems using online help systems
9) Generate 3D models from photographs using Agisoft Photoscan
10) Collect your own photographs to develop 3D models
11) Export the results of their 3D models into ArcGIS for quantitative analysis
12) Work independently to solve GIS problems

Course Content

This course will cover the use of GIS to explore earth systems science. The course will start by introducing basic skills and workflows in ArcGIS. The students will then complete an independent project to assess the changing topography in Singapore, presenting the results in a professional consulting format. Following this, the course will introduce the topic of photogrammetry (using photographs to generate 3D models), and students will be guided through two labs that teach them to use the software Agisoft Photoscan, and how to export the results into ArcGIS. Students will then complete a second independent project, in which they will collect and process their own photographs to generate a 3D model of an object or location in Singapore.

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/Individual	Assessment Rubrics
1. CA1: Lab 1	1, 2, 5	1	8.75%	Individual	See Appendix 1
2. CA2: Lab 2	1, 4, 5, 6, 7	1, 6, 7	8.75%	Individual	See Appendix 1
3. CA3: Lab 3	1, 2, 4, 5, 6, 7	1, 3, 4, 6, 7	8.75%	Individual	See Appendix 1
4. CA4: Lab 4	1, 3, 4, 7	1, 6, 7	8.75%	Individual	See Appendix 1
5. CA5: Lab 5	1, 2, 4, 5, 6, 7, 8, 12	1, 2, 3, 6, 7	17.5%	Individual	See Appendix 1
6. CA6: Lab 6	9	1	8.75%	Individual	See Appendix 1
7. CA7: Lab 7	1, 2, 4, 5, 6, 7, 8, 9, 11, 12	1, 3, 4, 5, 6, 7	8.75%	Individual	See Appendix 1
8. CA8: Project 1	1, 4, 5, 6, 7, 8, 12	1, 2, 3, 4, 5, 6, 7	15%	Individual	See Appendix 1
9. CA9: Project 2	9, 10, 12	1, 3, 5, 6	15%	Individual	See Appendix 1
Total			100%		

Formative feedback

Each lab is returned to the students the week after they turn it in with a question-by-question breakdown for where they were correct or incorrect. Their maps are marked to indicate ways in which they could improve. The projects will have written feedback describing in general how their project was successful and how it could be improved, making reference to specific elements.

Learning and Teaching approach

Approach	**How does this approach support you in achieving the learning outcomes?**
"Taking off the training wheels"	The assignments start out very step-by-step, with specific instructions for every mouse click. With each progressive week, we remove instructions and leave more decision-making and problem-solving up to you. In this way, you will learn the skills early on and have them reinforced throughout as you are required to remember them. We also design the later labs and projects as if they are job assignments, so that you become comfortable with identifying and solving problems on your own.
Aesthetics	In early labs, you are provided with specific guidance on what map elements you must include for full credit. However, we still note aspects of the maps that could be improved (color choices, font size, placement of elements, etc.). In later labs, we begin to grade based on the aesthetics of the final product. Our goal is for you to begin to assess these elements of maps on your own so that you gain your own sense of what makes maps useful and clear.
Teaching assistance	During tutorial, the teaching staff will circulate through the room, providing guidance on both techniques and aesthetics, and explaining parts of the labs as necessary. The teaching staff will also provide assistance via office hours and email help. Typically, we try to guide you to discover the answer on your own by asking appropriate, targeted questions. Our goal is to ensure that you do not struggle with minor issues, but gain confidence in your own skills so that you learn how to problem solve on your own.

Reading and References

No textbook – students are provided with appropriate materials (handouts, etc.) in class.

Course Policies and Student Responsibilities

(1) Attendance and late policy

Students are expected to attend all classes punctually and complete all scheduled assignments by the due date. We allow students four free "late days," i.e. four labs may be turned in one day late each or 1 lab may be turned in four days late, or any combination that adds up to four. Projects must be turned in on time; no late projects will be accepted.

(2) Collaboration

For the labs, students are encouraged to work together to solve problems, but before asking a classmate for help, each student must make a significant effort to answer the question independently first. All materials turned in must be the student's own work. Projects should be completed independently.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Judith Hubbard	N2-01a-07	6592 7537	jhubbard@ntu.edu.sg
Kyle Bradley	N2-01a-14	6592 2494	kbradley@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction to ArcGIS	1, 2, 5	Lab 1
2	Earthquakes & calculations	1, 4, 5, 6, 7	Lab 2
3	Watersheds	1, 2, 4, 5, 6, 7	Lab 3

4	Georeferencing & digitizing	1, 3, 4, 7	Lab 4
5	Fires in Sumatra	1, 2, 4, 5, 6, 7, 8, 12	Lab 5
6	Fires in Sumatra	1, 2, 4, 5, 6, 7, 8, 12	Lab 5
7	GIS in Singapore	1, 4, 5, 6, 7, 8, 12	Project 1
8	GIS in Singapore	1, 4, 5, 6, 7, 8, 12	Project 1
9	Introduction to Agisoft Photoscan	9	Lab 6
10	Linking Agisoft with ArcGIS (air photos)	1, 2, 4, 5, 6, 7, 8, 9, 11, 12	Lab 7
11	Agisoft Project	9, 10, 12	Project 2
12	Agisoft Project	9, 10, 12	Project 2
13	Agisoft Project	9, 10, 12	Project 2

Appendix 1: Assessment Criteria

Labs

Labs include step-by-step instructions with periodic questions to assess whether you are completing the steps correctly and whether you understand what you are doing. They are graded based on the correctness of their answers. You must also turn in useful, informative, attractive maps. These maps are graded on whether they are presenting the correct information, and whether the map is a complete document with all metadata (legend, etc.) in a way that is easy for the reader to understand the material. The final grade is based on a weighting of these items. For labs, this is calibrated by how advanced the lab is; standards are higher for later labs.

Assessment Rubric for Labs

	Exemplary	Proficient	Satisfactory	Developing
Lab responses	Information that is presented is correct, demonstrating that the methodologies were appropriately applied. Units are included, numbers have appropriate precision, and explanations are clear and accurate.	Information that is presented is mostly correct, demonstrating that the methodologies were appropriately applied. Units are usually included, numbers usually have appropriate precision, and explanations are sufficient.	Information that is presented is mostly correct, demonstrating that the methodologies were usually appropriately applied. Units are included, and explanations are provided when requested.	Information that is presented is sometimes correct, demonstrating that the methodologies were sometimes appropriately applied. Explanations are sometimes unclear or lacking.
Maps	Maps are clear, useful, informative, and attractive. Choices in color, layout, and content work together. Metadata are complete and clear.	Maps are useful, informative, and attractive. Choices in color, layout, and content could sometimes be improved. Metadata are usually clear.	Maps are usually useful and informative. Choices in color, layout, and content could be improved. Metadata are sometimes clear.	Maps are sometimes useful and informative. Choices in color, layout, and content are often problematic. Metadata are often unclear.

Project 1 (15%)

Project 1 is a consulting-style report where students are provided with two topographic datasets from Singapore and asked to answer a series of questions explaining topographic change over time, in a format that would be appropriate for a general audience. Students are given a page limit for each question, and must decide for themselves how to use the datasets to answer the questions, source independent research material, and what visuals (maps, graphs, etc.) they should include to explain themselves. They are graded based on the effectiveness of their final written presentation, whether their research supports their answer, and whether the graphics are correct and useful.

Assessment Rubric for Project 1

	Exemplary	Proficient	Satisfactory	Developing
Project 1 - methodology	The methodology is correct. It is thorough and clear. It includes figures that explain the steps, and the text is well written and easy to follow.	The methodology is correct. It is usually thorough and clear. It occasionally includes figures that explain the steps, and the text is reasonably well written and easy to follow.	The methodology is usually correct. It is sometimes thorough and clear. The text is sometimes hard to follow.	The methodology is usually correct, but it can be confusing and hard to follow.
Project 1 - report	The answers provided are coherent and thorough, and reflect both significant work on the part of the student and (cited) independent research. Maps and figures are provided that strengthen the overall arguments. The text is interesting and concise.	The answers provided are coherent, and reflect both work on the part of the student and (cited) independent research. Maps and figures are provided that relate the overall arguments. The text is concise.	The answers provided are usually coherent, and reflect work on the part of the student. Maps relate the overall arguments.	The answers provided are sometimes incoherent. Maps do not support the overall arguments well.

Project 2 (15%)
Project 2 is a photogrammetry project. You will be graded based on whether your project is appropriately challenging (you will be given guidance on this), the completeness and resolution of your final result, and on the text (metadata) that you include in your final online project.

Assessment Rubric for Project 2

	Exemplary	Proficient	Satisfactory	Developing
Project 2	The subject of the 3D model fits within the criteria provided. The resulting model is well constrained, with high resolution, full coverage, and an accurate georeferencing and scale system. Clear, interesting, concise metadata are provided.	The subject of the 3D model fits within the criteria provided. The resulting model is well constrained, with medium resolution, nearly complete coverage, and a georeferencing and scale system. Metadata are provided.	The subject of the 3D model mostly fits within the criteria provided. The resulting model has moderate resolution, partial coverage, and a georeferencing and scale system. Metadata are provided	The subject of the 3D model mostly fits within the criteria provided. The resulting model has poor resolution and partial coverage. The georeferencing and scale system is lacking or inadequate. Metadata are missing or inadequate.