University of Victoria

Faculty of Social Sciences
Department of Geography

GEOG 476 (A01): Advanced Studies in Geomorphology: Geomorphic Applications of Ultra-high Resolution Remote Sensing Technology
January 2016

Instructor: **Michael Grilliot**

Office & hours: **DTB B316, TR 11:30-1:30 or by appointment**

Lectures: **M, 2:30pm – 5:20pm Cornett A225** (subject to change, specified weeks only as below)

Prerequisites: GEOG376; permission of the department.

Description: This course offers an advanced, assignment-oriented experience for senior students interested in exploring state-of-the-art mapping technologies used for geomorphic change detection. This course assumes that students have prior knowledge and experience in geomorphology and a basic understanding of remote sensing. Students are expected to synthesize information from various sources, most importantly peer-reviewed journals. Students who successfully complete GEOG 476 will be able to apply knowledge about detecting change in geomorphic systems using ground-based lidar or terrestrial laser scanning (TLS), Unmanned aerial system (UAS)-based photogrammetry, and structure from motion (SfM).

Learning Outcomes: This is a capstone course providing a final integrated learning environment in the UVic geomorphology series before your employment or continued education in graduate studies. Therefore, the intent of this course is to; 1) Review TLS, Photogrammetry, and SfM-based data acquisition and processing and their importance and utility to Geomorphology, 2) Compare & critique the use of these technologies in geomorphic literature, 3) Interpret geomorphic landscapes using data collected by these technologies via a group research project. Having actively participated in this course, you should be in a position to confidently demonstrate an understanding of the TLS and UAS technologies in a geomorphic context including: acquisition methods, data products, data-post processing, and geomorphic interpretation.

The course involves on-campus seminars and group research and technical assignments. Seminars are designed to engage students by exploring TLS and UAS technology while the group assignments key theories and literature about how geomorphologists use lidar and photogrammetry in geomorphic research. The research project involves student groups in data analysis on a specific geomorphic process and/or a site of interest.

CourseSpaces: The course is supported by a CourseSpaces website (log in at http://coursespaces.uvic.ca/), which will be serving as the authorized record of the course. I will normally make class announcements on the site and post there any modifications to the syllabus. As a student in the course you are responsible for checking the website regularly—at least once a week—to keep yourself informed and up to date.

Recommended Readings: Students will be provided with state-of-the-science review chapters from a major reference work (Sherman et al. 2013 from the *Treatise on Geomorphology*), which provides an extensive review of all aspects of lidar, photogrammetry, and structure from motion in geomorphology. Other leading texts will also be put on library reserve and should be consulted for more foundational information. Additional reading & review of peer-reviewed research literature (e.g., journal articles) is also required for projects.

Course Experience Survey (CES): I value your feedback on this course. Towards the end of term, as in all other courses at UVic, you will have the opportunity to complete an anonymous survey regarding your learning experience (CES). The survey is vital to providing feedback to me regarding the course and my teaching, as well as to help the department improve the overall program for students in the future. The survey is accessed via MyPage and can be done on your laptop, tablet, or mobile device. I will remind you and provide you with more detailed information nearer the time but please be thinking about this important activity during the course.

GEOG476 LECTURE SCHEDULE (SUBJECT TO CHANGE)

Date	Topic	*Notes*
M Jan. 4	Introduction	*General overview of course & deliverables. Form groups for Assignments*
M Jan. 11	Lecture #1	
M Jan. 18	Lecture #2	*Assignment #1 Due*
M Jan. 25	Lecture #3	
M Feb. 1	Lecture #4	
M Feb. 8	NO CLASS - Holiday	
M Feb. 15	UAS and TLS field acquisition	*Annotated Bibliography Due*
M Feb. 22	Mid-Term 1	
M Feb. 29	Guest Lecture/Work on Asgmnt #3	*Assignment #2 Due*
M Mar. 7	Guest Lecture/Work on Asgmnt #3	
M Mar. 14	Group Meetings	
M Mar. 21	Group Meetings	
M Mar. 28	NO CLASS - Holiday	
M Apr. 4	Assignment #3 Presentations	*Assignment #3 Due, Group Presentations*

Course evaluation scheme:

Mid-Term	15%
In-class participation	5%
Assignments	60%
1 – SfM + article review	20%
2 – TLS Vs UAS	20%
3 – KAP Project	40% (30% Paper + 10% presentation)

Details on requirements for each component are provided below.

**NOTE: students are required to complete all components of the course and obtain a passing grade on the assignments to obtain credit.*

ASSIGNMENTS (60%)

Introduction:

Combined, the three assignments (1: 20%; 2: 20%; 3: 40% (30% paper + 10% presentation) are worth 60% of your final grade. The assignments are designed with the following learning outcomes in mind:

	Assignment		
Learning Outcome	1	2	3
i) Evaluate the utility of commercially available photogrammetry, lidar, and visualization software to geomorphological research.	x	x	x
ii) Decide what data collection method is appropriate for your research goals.			x
iii) Formulate a group assessment rubric that we will use to evaluate group member work.	x	x	x
iv) Evaluate structure from motion technique positives and negatives for geomorphic research.	x		
v) Review and critically evaluate peer reviewed literature on TLS, UAV, SfM.	x	x	x
vi) Compare TLS and UAV data; collection, processing, interpretation.		x	
vii) Assemble an annotated bibliography.			x

Groups:

- *Work in groups of 2 to 4 (depends on class size).*
- *All members may not receive the same grade. Work together & be fair in sharing the load! As a class we will develop a rubric for evaluating each team members contributions. I will consult these evaluations when determining your project grade.*

Assignment Components & Evaluation: Additional information about each assignment will be provided during class.

Assignment #1: (20%) Structure-from-Motion (SfM) Paper review and Agisoft Photoscan© exercise. Work in groups of 2. Prepare a written review on a peer reviewed geomorphology journal article using structure from motion or photogrammetry. Using Agisoft Photoscan© you will collect, process, and analyze data in a report (1500 words Max, 12 point font, minus references & figures in appendixes) due on 18 January 2016.

Your task is two-fold:

1) to provide a constructive reviewer's report, similar to what is done for scientific journals, that addresses all of the items on the provided reviewer's checklist as well as the key suggestions for

effective peer---review by Waser et al. (1992). Cite specific instances (i.e., cited by line, page or figure/table number) for your constructive review. Highlight any particular strengths and shortcomings.

2) to collect SfM data on a geomorphic landform and process the images in Agisoft Photoscan©. In addition to the data deliverables, you will answer questions linking your knowledge of SfM and photogrammetry principles to the data collection and post-processing steps in Agisoft©.

Assignment #2: (20%) Terrestrial Laser Scanning (TLS) Vs Unmanned Aerial System (UAS) data comparison. Work in groups of 2. You will be provided with four QA/QC point clouds of the same beach covering two years (2013/2015) and two data collection types (TLS/UAS). You will process these surfaces in the Geomorphic Change Detection© (GCD) software and analyse the differences between the data products. Prepare a written report (1500 words max, 12 point font, minus references & figures in appendixes) due on 29 February 2016.

Assignment #3: (40%) Research project and presentation incorporating Kite Aerial Photography (KAP) based surface creation and interpretation. Work in groups of 4 (depending on class size). Each group will prepare a research paper (30%, 2500 words max, 12 point font, minus abstract, references, and figures in appendixes) and give a 10-15 min. conference-style presentation (10%), both due at the end of the semester on 4 April 2016.

Project ideas: Some suggested topics of interest include (but are not limited to):

- beach sediment volume & morphodynamic responses during a tidal cycle or following erosion
- tidal creek discharge, sediment load and geomorphic interactions
- large woody debris (LWD) influence on beach-dune systems
- investigation of coastal dunes or active bluff systems and shoreline changes (erosion and/or progradation) using aerial photography, site surveys &/or other 'dating' methods (e.g., dendrochronology)
- seasonal beach-dune morphodynamics and/or sediment budgets/volumes from long-term survey monitoring, historical aerial photography, and/or LiDAR
- implementation and effectiveness of coastal erosion control structures

Research paper (30%): will contain most of the following components, structured similar to a research journal article. From this, each group will prepare a PowerPoint talk that draws upon the components they see as necessary. Please prepare your paper with the format and referencing style of the journal Geomorphology (http://www.journals.elsevier.com/geomorphology/). Components:

i. Title: effectively describes the specific focus of your project

ii. List of Contributors: list all members of your group under the title

iii. Abstract: a concise (250 word) summary of your report stating purpose, objectives and main details/results of what is presented including conclusions & contributions made.

iv. Introduction: describes general focus, purpose & objectives of your report and presents a brief review of related research literature. As outlined in your proposal, provide some paragraphs that review the research context from the literature surrounding your topic. To do so, be sure to referring to at least 3-4 research articles. The articles you refer to should be critiqued, presenting your view of how effective the research is not only at meeting its own objectives (i.e., how effectively did the authors present their case), but also on the approach, design and contributions of the study. Be critical in your assessment of seminal and recent literature.

This frames your project in terms of what has been done. Be sure to properly cite ideas expressed in these works. See me for clarification or any journal article for examples of citation.

v. Methods and data: state rationale and approach(es) clearly &/or any sources of data used (e.g., airphotos, water levels, topographic surveys, climate data, etc.). Do not interpret anything (data, results) but consider that the reader/audience has no idea of what/how you did your work, so explain so the reader can follow exactly what you did and understand the rationale, limitations, decisions made, etc.

vi. Study site: using a proper map to show the broader study region, describe your specific study site. See any field research article for examples. Show pictures or diagrams of your methods, as appropriate.

vii. Results or summary of key findings from reviewed literature/case studies. At this point, you do not interpret them, just present and explain them. Interpretation occurs in the discussion section. Use maps, tables, statistics, graphs, photos, etc. to convey your results concisely and effectively.

viii. Discussion: In the body of your project, interpret what each of your results components 'means' in the context of other research findings/literature. Consider also how your results may converge on 3-5 points of discussion or 'integrated' ideas/issues/findings that emerge. Feel free to use sub-headings to structure these.

ix. Conclusion: a brief (2-3 paragraph) summary of main findings/points of your project. This can be done using bullet points & a leading paragraph. The leading paragraph should explain how you have addressed the purpose & objectives stated in the intro. Finish with a statement on the relevance & application of geomorphic research on features/processes like those you have studied.

x. Annotated bibliography: an annotated bibliography of all cited articles/sources including maps, government documents, etc. See *Geomorphology* for proper citation & bibliography formatting. An annotation summarizes the central themes and results of the work relevant to your research topic. This may include highlighting particular methods, discussion elements, or dissenting opinions. It may include the authors if particularly notable or questionable. The annotation will finally situate the importance of the work within the scope of your project, whether it be a seminal work or minor contribution to the discipline. The annotated bibliography including at least 5 articles will be due 15 Feb 2016.

Example Annotation:

Stembridge, J.E.J., 1979. Beach protection properties of accumulated driftwood, in: Proceedings of the Specialty Conference on Coastal Structures. US Army Corps of Engineers, Alexandria, Virginia, pp. 1052–1068.

Stembridge (1979) Stembridge provides one of the first accounts to describe the geomorphic role of large woody debris (LWD) in sandy coastal environments. He presents a brief literature review of LWD in Pacific Northwest geomorphology literature dating back to 1939. He postulates on the causes of increased LWD in the coastal environment and identifies a current decline of LWD on coasts in the region. Using a few examples from the coasts of California and Oregon he demonstrates the protection capabilities that LWD offers in sandy coastal environments. While this piece is technically grey literature as a conference proceeding it includes results of work published in *The Ore Bin* (now *Oregon Geology*) and *Remote Sensing of Environment*. He provides a useful historical perspective of the geomorphic role of LWD for my research.

Conference-style presentation (10%): Each group will give a 10-20 min. oral presentation using PowerPoint, etc. to present your research context, results & discussion. Similar to a conference, talks will be moderated for time & a few minutes will be allowed for questions.

Suggestions: i) try to use no more than 1 slide/minute of your talk, ii) you may not have time to cover everything in detail, so focus on key findings, iii) practice, practice, practice & time yourselves! I will also provide an example of a recent talk for your viewing pleasure!

Evaluation: The research paper and related presentation are worth 30% of your grade and will be evaluated based on the following criteria.

- *clarity & effectiveness of the title*
- *research context (i.e., how is the study situated in the broader knowledge/research literature)*
- *conciseness & focus of the purpose, objectives*
- *clarity, rationale & feasibility of methods*
- *linkage to & effective use of peer-reviewed literature (journal articles) via annotated bibliography*
- *quality & presence of required components including article title pages, annotated biblio, etc.*
- *indication of planning, preparation & equitable delegation of tasks*

CLASS PARTICIPATION (5%)

Attendance & Participation: Active Participation includes taking part in classroom discussions, activities, demonstrations, and preparing assignments for class discussions. Questions for readings assigned the week before class will count towards this assessment.

Course policies and important notes:

1. **Learning Environment:** The University of Victoria is committed to promoting, providing and protecting a positive and safe learning and working environment for all its members. To support this environment please be cordial in attending class and respect others opinions.

2. **Lateness policy:** A deduction of 25% of the total mark per day will be applied to late submissions. Concessions will be made only for extenuating circumstances with proper medical or counselling documentation provided.

3. **Academic Integrity:** Students should review the UVic Policy on Academic Integrity (http://web.uvic.ca/calendar2013/FACS/UnIn/UARe/PoAcI.html), which defines key violations such as plagiarism, multiple submissions, falsifying materials, etc. *Note that all written products will be submitted for originality assessments on Turnitin.com as a means to discourage plagiarism.*

4. **Grading scale:** according to the Dept. of Geography guidelines

Passing Grades	***Grade Point Value***	***Percentage****	***Description***
A+ A A-	9 8 7	90-100 85-89 80-84	**Exceptional, outstanding and excellent** performance earned by work which is technically superior, shows mastery of the subject matter, and in the case of an A+ offers original insight and/or goes beyond course expectations. Normally achieved by a minority of students.
B+ B B-	6 5 4	77-79 73-76 70-72	**Very good, good and solid** performance earned by work that indicates a good comprehension of the course material, a good command of the skills needed to work with the course material, and the student's full engagement with the course requirements and activities. A B+ represents a more complex understanding and/or application of the course material. Normally achieved by the largest number of students.
C+ C	3 2	65-69 60-64	**Satisfactory, or minimally satisfactory** performance earned by work that indicates an adequate comprehension of the course material and the skills needed to work with the course material and that indicates the student has met the basic requirements for completing assigned work and/or participating in class activities.
D	1	50-59	**Marginal** performance earned by work that indicates minimal command of the course materials and/or minimal participation in class activities that is worthy of course credit toward the degree.

**The grading scale for the evaluation of course achievement at the University of Victoria is a percentage scale that translates to a 9 point GPA/letter grade system. The 9 point GPA system is the sole basis for the calculation of grade point averages and academic standing. Standardized percentage ranges have been established as the basis for the assignment of letter grades. The percentage grades are displayed on the official and administrative transcripts in order to provide fine grained course assessment which will be useful to students particularly in their application to graduate studies and for external scholarships and funding. Comparative grading information (average grade [mean] for the class), along with the number of students in the class, is displayed for each course section for which percentage grades are assigned. (Excerpt from the current UVic Calendar).*