Dalhousie University
Faculty of Science/ Department of Oceanography
OCEA5320/Credit Hours: 3/Seafloor Mapping
Winter 2025

Class hours: 3, Classroom Location - Studley LSC-OCEANOGRAPHY O3652 (Tue and Thur 1005-1125)

Computer Lab hours: 2, Classroom Location - Studley LSC-BIOL&EARTH B3111 (Thur 1435-1625)

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Instructor: Craig J. Brown

Lectures: Tuesday/Thursday 1005-1125

Computer Labs: Thursday 1435-1625

Office: Room 4634, Life Sciences Centre, 1355 Oxford Street,

Office Phone: +1-902-494-7177

Office Hours: By appointment (to be set up by email)

Email: craig.brown@dal.ca

Course delivery: In-person

Course Description

A graduate-level course on ocean mapping technologies and techniques for study of the seabed environment. Acoustic remote sensing technologies, ground-validation techniques, and data processing and integration methods using geospatial software are covered. The focus of the course is on how these approaches are used to study and map the geology and biology of the ocean floor.

Course Prerequisites

Permission of instructor

Course Exclusion

None

Learning Objectives

With successful completion of the course, students will be able to:

Learning Outcome #1: Understand the basic theoretical concepts behind underwater acoustic remote sensing and seafloor mapping technologies;

Learning Outcome #2: Describe and explain the techniques for the acquisition, processing and interpretation of seafloor surveying and exploration data sets;

Learning Outcome #3. Analyse and interpret a diverse set of seafloor geospatial data for the solution of an academic/industrial problem.

Learning Outcome #4: Develop a range of key skills including numeracy, cartography, problem solving, presentation and communication appropriate to this area.

Course Materials

Reading material will be drawn from the peer-reviewed literature and assigned associated with the lecture material. All required course material will be made available through Brightspace. The following will also be used as reference material for the course.

- Lurton, X., Lamarche, G. (Eds) (2015) Backscatter measurements by seafloor-mapping sonars. Guidelines and Recommendations. 200p. http://geohab.org/wp-content/uploads/2014/05/BSWGREPORT-MAY2015.pdf
- Finkl, C.W. Makowski, C. (Eds) (2016) Seafloor Mapping along Continental Shelves: Research and Techniques for Visualizing Benthic Environments. Springer. 293p.

Students will also require an external hard drive for data storage (ideally USB-3 or USB-C and a minimum 100GB capacity).

Course Assessment

Grades will be based on six requirements, and a grading rubric for each assessment will be made available through Brightspace:

Assessment	Date of evaluation	Weight
Lab assignments (x3)	Due in week 3, 6 and 9	30% (10% each)
Essay	Due in week 9	10%
Mid term test	Week 5	15%
End of term test	Week 12	15%
Cartography assignment (Group)	Week 7	10%
Map Project	Week 12	20%

Grades will be assigned as below using the Dalhousie Common Grade Scale:

A+ (90-100) B+ (77-79) F (0-69)
A (85-89) B (73-76)
A- (80-84) B- (70-72)

Lab assignments

There will be three lab assignments, each worth 10%, which will test the students understanding of the analysis and interpretation of a range of seafloor geospatial data sets. These assignments will focus on: 1) Seafloor thematic map production 2) Seafloor bathymetric data; 3) Seafloor backscatter data. Software: ESRI ArcPro and QPS Qimera, Fledermaus and FMGT

Class tests

Tests will be held in week 5 and 12 to test understanding of the lecture material. Each test will be worth 15%.

Essay
Graduate students in the class will write an essay on a seafloor mapping technology of their choice, undertaking a deeper dive into the scientific and technical literature. Detailed instructions on what is required will be provided at the start of term. Students may choose to write their essay on any appropriate seafloor mapping technique, reviewing how the technology operates, seafloor mapping/scientific applications of the technique, and limitations. I will approve the topic of your paper once you have selected it (by end of week 3). You will then provide me with an outline of your paper by the end of week 5 (Title, subheadings providing structure to your paper, bullet points under each section outlining content, and listing key references for the paper). Your completed term paper will be due end of week 9 (8-10 pages, double spaced excluding refence list). This will 10% mark in total.

Cartography: Group assignments
In small groups, you will select a publicly available seafloor data set to present as a cartographic map. This will be produced as a poster-sized output and graded based on cartographic quality and content of the map, scientific interpretation, and quality of data processing. The class will present these maps in Week 7. This will carry a grade of 10%.

Map Project
The map project will build toward the production of a seafloor thematic map. Individually, you will present the results from the map project, providing a description of the underlying methods you used to map the seafloor, details on the analysis undertaken, and a summary of the seafloor characteristics which you were able to deduce and interpret from the mapping exercise. This will be documented as an ESRI Story Map, worth 20%.

Course Policies on Missed or Late Academic Requirements

Dalhousie students are asked to take responsibility for their own short-term absences (5 days or less) by contacting their instructor by phone or email **prior to** the academic requirement deadline or scheduled time and by submitting a completed Student Declaration of Absence (SDA) to their instructor in case of missed or late academic requirements. The SDA form can be found on our Brightspace page under "Assignments". Only **TWO** separate Student Declaration of Absence forms may be submitted per term for this course. Once the SDA has been submitted, alternate arrangements for the missed or late assignment will be at the discretion of the instructor.

Assignments submitted late without prior notification and the submission of an SDA, or without an approved extension will be deducted 10% per day. Extensions are granted with good reason and **must be requested at least one week prior** to the assignment's original due date. If you are ill for the class test you must contact the instructor by email and submit an SDA. A make up test will be scheduled for the week following the originally scheduled test.

Course Policies related to Academic Integrity

The use of Large Language Models (LLMs) such as ChatGPT are not permitted in producing the written assignments for this course. Assignments are designed to develop students' own knowledge and understanding on the topics covered during the course, and to share their own personal views on the topics covered, rather than falling back on the generic voice of artificial intelligence. If use of LLMs is suspected following grading of submitted work, a follow up oral discussion on the topic of the assignment will be scheduled with the course instructor. If the use

of LLMs is suspected following this oral discussion with the student, the matter will be referred to the Academic Integrity Officer.

Course Content

Week	Lesson	Topic	Activity
1 (6-10 Jan)	1	Course introduction	Lecture
	2	Seafloor measurements - history and basics	Lecture
	Lab 1	Intro – data import and software orientation	Comp. Lab
2 (13-17 Jan)	3	Thematic maps (plus cartography tips and tricks)	Lecture
	4	Navigation and positioning	Lecture
	Lab 2	Bathymetric data processing I	Comp. Lab
3 (20-24 Jan)	5	Underwater acoustic wave propagation	Lecture
	6	Reflection, scattering and target strength	Lecture
	Lab 3	Bathymetric data processing II	Comp. Lab
4 (27-31 Jan)	7	Transducers and receivers	Lecture
	8	Backscatter processing	Lecture
	Lab 4	Data visualization and export	Comp. Lab
5 (3-7 Feb)	9	Weather contingency/recap lecture	Lecture
	10	Class test 1	Test
	Lab 5	Backscatter data processing I	Comp. Lab
6 (10-14 Feb)	11	Singlebeam echosounders	Lecture
	12	Multibeam echosounders	Lecture
	Lab 6	Backscatter data processing II	Comp. Lab
17-21 February - Winter study week			
7 (24-28 Feb)	13	Sidescan sonars	Lecture
	14	Subbottom profilers	Lecture
	Lab 7	Cartography Assignment - presentations	Presentations
8 (3-7 Mar)	15	Mapping platforms	Lecture
	16	Ground-truthing approaches	Lecture
	Lab 8	Seafloor Mapping Project	Comp. Lab
9 (10-14 Mar)	17	Airborne remote sensors	Lecture
	18	Benthic Habitat Mapping	Lecture
	Lab 9	Seafloor Mapping Project	Comp. Lab
10 (17-21 Mar)	19	Benthic Habitat Mapping	Lecture
	20	Water column mapping	Lecture
	Lab 10	Seafloor Mapping Project	Comp. Lab
11 (24-28 Mar)	21	Geological/Biological/Archaeological applications	Lecture
	22	Weather contingency/recap lecture	Lecture
	Lab 11	Seafloor Mapping Project	Comp. Lab
12 (31 Mar -4 Apr)	23	Weather contingency/recap lecture	Lecture
	24	Class test 2	Test
	Lab 12	Seafloor Mapping Project	Comp. Lab

SECTION B: **University Policies and Statements**

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: https://www.dal.ca/about-dal/internationalization.html

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html)

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: http://www.dal.ca/cultureofrespect.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at:
https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at:
https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: https://www.dal.ca/about/leadership-governance/academic-integrity/faculty-resources/ouriginal-plagiarism-detection.html

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

DALHOUSIE UNIVERSITY

SECTION C: **Student Resources and Support**

University Policies and Programs

Important Dates in the Academic Year (including add/drop dates): http://www.dal.ca/academics/important_dates.html

Classroom Recording Protocol: https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-protocol.html

Dalhousie Grading Practices Policies: https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Grade Appeal Process: https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html

Sexualized Violence Policy: https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-violence-policy.html

Scent-Free Program: https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html

Learning and Support Resources

General Academic Support – Advising (Halifax): https://www.dal.ca/campus_life/academic-support/advising.html

General Academic Support – Advising (Truro): https://www.dal.ca/about-dal/agricultural-campus/ssc/academic-support/advising.html

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html

On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): https://www.dal.ca/campus_life/academic-support/On-track.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Indigenous Connection: https://www.dal.ca/about-dal/indigenous-connection.html

Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student Centre or contact the program at elders@dal.ca or 902-494-6803: https://cdn.dal.ca/content/dam/dalhousie/pdf/academics/UG/indigenous-studies/Elder-Protocol-July2018.pdf

Black Student Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre.html

LGBTQ2SIA+ Collaborative: https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-collaborative.html

Dalhousie Libraries: http://libraries.dal.ca/

Copyright Office: https://libraries.dal.ca/services/copyright-office.html

Dalhousie Student Advocacy Services: https://www.dsu.ca/dsas?rq=student%20advocacy

Dalhousie Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Human Rights and Equity Services: https://www.dal.ca/dept/hres.html

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Study Skills/Tutoring: http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Faculty of Science Advising Support: https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html

Safety

Biosafety: http://www.dal.ca/dept/safety/programs-services/biosafety.html

Chemical Safety: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

Radiation Safety: http://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Laser Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html