Numerical Modelling Syllabus

Department of Oceanography

OCEA4220 Winter 2026

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.

Course Instructor(s)

Name	Email	Office Hours
Jinyu Sheng	Jinyu.Sheng@dal.ca	09:00-17:00, LSC-5676
Dr. Hal Ritchie (Guest Lecturer)	Hal.Ritchie@ec.gc.ca	

Course Description

This course discusses numerical modelling techniques for simulating atmospheric and oceanic circulations. Material includes: review of governing equations; finite difference, finite element, and spectral methods; Eulerian, semi-implicit and semi-Lagrangian time integration techniques; accuracy and stability analyses; data assimilation and ensemble prediction methods; and boundary treatment for ocean models.

Course Prerequisites

1000-level calculus course and instructor's consent. An introductory class in fluid mechanics is also helpful.

Course Exclusions

None

Student Resources

List and describe the additional resources available to students (e.g., office hours, resource centers, etc.). Make sure to include when, where and how students can access these resources.

Course Structure

Course Delivery

in-person, no recording.

Lectures

8:35 am -9:25 am, Monday, Wednesday, Friday, LSC (Oceanography) O3652

Laboratories

(If applicable) List the days, times, location, and frequency of lab sessions.

Tutorials

(If applicable) List the days, times, location, and frequency of lab sessions.

Course Materials

1. *Haltiner, G. and Williams, R., Numerical Prediction and Dynamic Meteorology, John Wiley & Sons.*
2. *Haidvogel, D. B., and Aike Beckmann, A., Numerical Ocean Circulation Modeling. Imperial College Press, 1999.*
3. *Mesinger, F., and Arakawa, A., Numerical Methods Used in Atmospheric Models. Global Atmospheric Research Programme (GARP), WMO-ICSU Organizing Committee, GARP Publications Series No. 17, World Meteorological Organization. August 1976*

Course Content

Chapter 1: Introduction

- *1.1 Numerical Weather Prediction*
- *1.2 Ocean Modelling and Prediction*

7.1.2 Variational Method
7.2 Ensemble Prediction Method
Chapter 8: Lateral Boundary Treatment for Ocean Modeling
Chapter 9: Surface Boundary Treatment for Ocean Modeling

Assessment

Assignments

Component	Weight (% of final grade)	Date
Mid-term Exam	***20***	
Assignments	***40***	
Class Interaction	***10***	
Final Exam	***30***	

Tests/quizzes

A mid-term exam will be held based on the progress of lectures. The weight of the mid-term exam is 20% of the final grade

Final exam

Final exam will be held during the exam period. The weight of the final term exam is 30% of the final grade

Other course requirements

Students are encouraged to ask/answers questions during the class. The class interaction has 10% of the final grade.

Conversion of numerical grades to final letter grades follows the Dalhousie Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

Course Policies on Missed or Late Academic Requirements

Any missed academic requirements will get zero marks. A late assignment will get penalty of 10% reduction per day after the due day.

The course evaluation is based on periodic assignments, mid-term, term project and final exam.

There will be no supplementary exam.

Course Policies related to Academic Integrity

Explain your policy on collaboration (for individual and group assignments or projects) – state explicitly whether students are allowed to work together on assignments. Indicate if and how plagiarism software (e.g., Ouriginal) will be used in the course. **It is recommended that you include a statement about your expectations around generative AI and large language models (e.g., ChatGPT).**

Learning Objectives

Include a list of knowledge/skills that students are expected to have after completing the course.

Course Content

List the lecture topics along with an approximate schedule of their delivery.

(*Optional but encouraged*) Fill out the tentative course schedule to provide students with an expectation for all lessons and assessments throughout the term. Include the week and date the lesson or assessment takes place, the lesson topics or assessment type along with the reading associated with each date.

Week	Date	Lesson Topic(s)	Reading/Assessment
1	Date	Topics	Reading
2	Date	Topics	Reading/Assessment
…	…	…	…

University Policies and Statements

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.