

Earth & Ocean Sciences EOS 433 A01 (21335) Physics and Astronomy PHYS 480 A01 (23891) Earth & Ocean Sciences EOS 550 A01 (23870) UNIVERSITY OF VICTORIA 3-0-0 (1.5 UNITS) SPRING TERM 2025



We acknowledge and respect the Ləkwəŋən (Songhees and Esquimalt) Peoples on whose territory the university stands, and the Ləkwəŋən and WSÁNEĆ Peoples whose historical relationships with the land continue to this day.

COURSE OUTLINE (v1.0.1) The Physics of Climate TuWeFr 1030-1120 (Clearihue D131, face-to-face)

PREREQUISITES: You must have satisfied the prerequisites of EOS/PHYS 340. **PRE or COREQUISITES:** EOS/PHYS 340

CONTACT INFO:

Instructor(s):Prof Colin Goldblatt
(Coordinator)Dr Jake Eager-Nash
(Coordinator)Email:czg@uvic.cajeagernash@uvic.caOffice:BWC A323BWC A335Office Hours:Mondays 1300-1400Tuesdays 1130-1230

COURSE DESCRIPTION

Calendar Description:

Studies of the Earth's climate require an understanding of the intimate links between the hydrosphere, atmosphere, cryosphere and biosphere. Basic theories of the dynamics of ocean and atmosphere. The physics and biogeochemistry of coupled models are examined with emphasis on simple intuition-building mathematical models as well as discussion of large computer models.

However, the Calendar Description is out-of-date. We're resurrecting this class, which has not been offered consistently in a number of years. Here is a draft for a revised Calendar description:

Examines the physics that determines the climate of Earth, and controls how climate changes. May include study of Earth's atmosphere, ocean, and cryosphere, and comparison to other Earth-like planets. Examines a hierarchy of climate models, from back-of-the-envelope mathematical models to complex Global Climate Models, and analyses climate data.

In this offering, we will focus particularly on:

- Atmospheric processes, especially energy balance, the hydrological cycle and clouds.
- Climate states and planetary habitability.
- Climate models.

LEARNING OUTCOMES

This course is intended to teach you to:

- Understand the key controls on Earth's climate.
 - Understand Earth's energy balance
 - Understand how the greenhouse effect works
 - o Understand the role of the hydrological cycle in climate, especially in determining climate sensitivity
 - Understand how coupled radiative-dynamical-thermodynamical processes determine atmospheric structure and rates of the hydrological cycle
- Evaluate simple climate models to develop intuition for climate physics.
- Analyse climate data, from observations, models and/or reanalysis.
- Develop computer programming and data visualization skill in Python, for climate sciences.
- View Earth in a Comparative Planetology context
 - Compare Earth and Earth-like planetary climate
 - Understand the climate processes that control planetary habitability.
- Participate constructively in reading- and discussion-based learning.

COURSE MATERIALS

Required textbook

David Randall, *Atmosphere, Clouds, and Climate*, Princeton. ISBN: 9780691143750 Availability Options:

- UVic Library online copy, free to you: https://search.library.uvic.ca/permalink/01VIC_INST/12198k2/alma9957551802007291
- UVic Library print copy, free to you: <u>https://search.library.uvic.ca/permalink/01VIC_INST/12198k2/alma9928837243807291</u>
- Print copies are \$49 via well-known online booksellers.
- I did not order copies to the UVic bookstore, sorry.

Required additional reading

We will set additional reading from the primary literature, which is available free to you via the UVic Library,

Computing and Python

In-class activities and homeworks will involve extensive programming in Python. You should bring a device on which you have a functional Python installation to class.

BRIGHTSPACE

Brightspace is used – we will use a merged page for the three sections of this class: <u>https://bright.uvic.ca/d2l/home/401683</u>

EVALUATION

Participation in Class	5%
Participation via reading notes/questions	5%
Warm-up assignment	2.5%
Five regular Assignments @ 12.5%	62.5%
Take-home Final Assignment	25%

Due dates are listed in the Course Weekly Calendar.

EOS 550 students will have additional questions in some assignments.

Submitting 4 out of 5 regular assignments and the take-home final assignment is required to complete the course. If you do not submit these, you will receive an N grade.

Participation in class

Class activities include discussion of course materials and working on coding problems, in addition to lectures. You will receive a grade for participating in these activities and making a positive contribution to the learning environment in class. We will record attendance in support of assigning this grade (see course policy on *Attendance*).

Participation via reading notes/questions

Doing the assigned readings and discussing these in class are an essential part of the course. You should take notes on the readings to support you in this (you don't need to turn in your own notes). You do need to turn in one index card for each reading, due at the start of class. On one side of this, you will summarize the most important points of the reading and/or the most important points that you learned. On the other side, you will write questions that you'd like us to cover in the discussion.

Assignments

Our assignments will cover a mix of intuition-building climate models, and analysis of climate model output. We will code these in Python, generally in Jupyter Notebooks. Assignments typically cover two weeks of course activities, and are due the following Thursday. For assignments 0-5, you may discuss the assignments and get help from others in class, but you should not systematically work together on them. The final assignment is due during the exam period, and may cover material from any of the course. For the final assignment, you must work entirely by yourself. See course policies on *Academic Integrity* and *Use of AI*.

COURSE POLICIES

POLICY: CLASS CONDUCT

- Please be kind and respectful to everyone, and do your part to create a positive learning environment for everyone.
- Keep your devices away unless you are using them for the work that we are doing in class at that time.
- Recording (audio or video) and taking photographs are prohibited in all class settings (lectures, tutorials, meetings). The only exceptions to this are:
 - With an Academic Accommodation which permits this; if this applies, please discuss with the Instructor how to do this without causing disruption.
 - With written permission from the instructor, for other good cause.

POLICY: LATE/MISSED ASSIGNMENTS OR EXAMINATIONS

Please submit your work on time: this helps us return everyone's work in a timely manner.

If you are suffering illness, injury or family affliction that will impact your ability to submit appropriate quality work on time, you should speak to me in advance of the deadline. This is especially important if it will affect a number of assessment activities, or your overall ability to participate in the class. If in doubt, talk to us about it!

A five minute grace period will be allowed on all deadlines.

Late work will be penalized by 10 percentage points, plus 0.25 percentage points per hour. For example, if you submit

your work 11 hours late, it would be penalized by $10 + (11 \times 0.25) = 12.75$ percentage points. Then, if your work received a pre-deduction grade of 82% (A-), you would receive a final grade of 69.25% (C+).

In order to complete the course, you must submit the following:

- 4 out of 5 homeworks
- The final assignment

If you do not submit these, you will get an N grade.

Final grades may be submitted as soon as 48 hours after the deadline for the final assignment. If you have not submitted all required work by then, you will likely receive an N grade. If you anticipate needing to submit work late in the finals, talk to me before this time.

POLICY: ATTENDANCE

Come to class. Coming to class is highly correlated with getting a good grade.

Attendance is included as an aspect of the participation grade, and we will record who is in attendance to support us assigning grades. If you miss occasional classes, that is normal, and will not affect your grade. If you are absent for good cause, you should communicate this to the Instructor in a timely manner. Examples are: illness, accident, or family affliction; conflicting professional responsibility (e.g. field trips); a need to take a mental health day. If you anticipate, or come to, miss lots of classes you should talk to the lead instructor.

If you have a communicable disease, you must not come to campus. <u>Seriously</u>. Coming to class with a communicable disease would negatively affect your participation grade!

POLICY: ACADEMIC INTEGRITY

It is every student's responsibility to be aware of the university's policies on academic integrity, including policies on cheating, plagiarism, unauthorized use of an editor, multiple submission, and aiding others to cheat.

Policy on Academic Integrity: <u>web.uvic.ca/calendar/undergrad/info/regulations/academic-integrity.html</u>

If you have any questions or doubts, talk to me, your course instructor. For more information, see <u>uvic.ca/learningandteaching/cac</u>.

Additional guidance for this class:

- This is important. The work that you submit must be your own.
- It's okay to talk to the other students, the TA, and the Instructor about your work. These guidelines are to help you understand my expectations in this class, in addition to University Policies:
- You are expected to know and understand university policy around Academic Integrity:
 - See Information for Student on Academic Integrity
 - o Read the Policy on Academic Integrity
- The work you submit should be your own:
 - Do not copy anyone else's work or allow anyone else to copy your work.
 - Do not provide copies of your work to someone else, or ask for a copy of someone else's work.
 - Do not systematically work together on any activity.
 - Do not pay someone to do, or help you with, your work. Any use of an editor, or anyone else paid, in relation to your work is prohibited.
- It is okay to get help from other students, the TA, and the Instructor about your work, provided:
 - You should make a good-faith effort to figure out how to do something yourself, before seeking help.
 - You should not rely on help from someone else to substantively complete the work.
 - You must give a clear, <u>detailed</u>, and complete description of any help that you receive. This must be the truth, the whole truth, and nothing but the truth.

- You must likewise must give a clear, <u>detailed</u>, and complete description of any help that you have offered to another student. If you help another student after you have submitted your own work, you are still responsible for declaring this.
- In all cases, you must understand your work. Do not submit work that you substantively do not understand. We may ask you to explain what you have done verbally: if you are not able to do so, this would be evidence of poor scholarship.
- The spirit of this policy also applies to the use of AI, or other technology.

If you don't follow these guidelines, we may reduce your mark or give you a zero mark (for poor scholarship and failure to follow course policies), or refer you under UVic's Policy on Academic Integrity, which can have serious disciplinary consequences.

POLICY: USE OF AI

- We're in a brave new world with natural language AI software (e.g. ChatGPT). We are in the process of working out how this will support our work and learning, and what appropriate boundaries are.
- ChatGPT is great at coding. You may use ChatCPT or other AI tools for limited help in coding, subject to the following guidelines (which ChatGPT helped me with ☺):
 - You can use AI to help you, but not to substantively do your homework for you. AI is a tool to support learning and coding but should not replace genuine understanding or effort (make a good faith effort to figure things out yourself before using AI).
 - Examples of allowed use: to debug code, to seek explanations of Python syntax, physics concepts, or coding logic, or to generate code snippets, provided you understand and can explain the results.
 - Examples of prohibited use: submitting AI-generated code or answers without significant modification or understanding, misrepresenting AI-generated content as original work.
 - You must explicitly acknowledge when using AI, and this must be detailed and complete. For instance:
 "This code snippet was adapted from an AI-generated response using ChatGPT", or "I used ChatGPT to help debug the for-loop logic in this function."
 - You consent to provide the full chat history related to your assignment on request.
- See the *Supplementary Guidance on AI (ChatGPT)* for a broader explanation of this policy.
- If you do use AI software, please have an open conversation with us about it! This is new, and we would like to be able to understand how to support your learning.

In all cases, you must understand your work. We may ask you to explain what you have done verbally: if you are not able to do so, this would be evidence of poor scholarship or failure to follow course policies, and this could result in a zero mark.

COURSE FEEDBACK

This is a new manifestation of this course. Please talk to us during the course about how it is going, what is working, and what isn't working for you. That way we may be able to make it better in a timely way! You can talk to us verbally, or write us email – feedback that is respectful and reasonably thought out is a positive contribution to the class.

We 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 for 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 online and can be done on your laptop, tablet, or mobile device. We will remind you and provide you with more detailed information nearer the time but please be thinking about this important activity during the course.

COURSE WEEKLY CALENDAR

UVic Important Dates - uvic.ca/calendar/dates/

Last day to add courses: January 22nd

Last day to drop a course without penalty of failure: February 28th

Week	Tuesday	Wednesday	Friday	Reading due*	Homework due (9am)
1	Intros & expectations	Simple energy balance model	Review Randall Ch1	R Ch1, Friday	
2	Atmospheric Composition	Coupled carbon-climate model	Review Randall Ch2	R Ch2, Friday	HW0: Tues 14 Jan
3	Radiative transfer	Two-layer atmosphere	1D radiative transfer		
4	GCM analysis	GCM analysis	GCM analysis		HW1: Thurs 30 Jan
5	GCM analysis	Review Randall Ch3	Mystery	R Ch3, Wednesday	
6	Review Randall Ch4	Hydrological Cycle	Hydrological Cycle	R Ch4, Tuesday	HW2: Thurs 13 Feb
7	Review Randall Ch5	Cloud feedbacks	Cloud feedbacks	R Ch5, Tuesday	
8	Review Randall Ch6	Moist & Runaway Greenhouse	Moist & Runaway Greenhouse	R Ch6, Tuesday	HW3: Thurs 6 March
9	Moist & Runaway Greenhouse	Moist & Runaway Greenhouse	Moist & Runaway Greenhouse		
10	Review Randall Ch7	(Exo)planetary atmospheres	(Exo)planetary atmospheres	R Ch7, Tuesday	HW4: Thurs 20 March
11	Review Randall Ch8	(Exo)planetary atmospheres	(Exo)planetary atmospheres	R Ch8, Tuesday	
12	Review Randall Ch9	Mystery	Mystery	R Ch9, Tuesday	HW5: Thurs 3 April
Exams			Final HW: Tues 22 April		

This is a new implementation of this course. Updates to topics are likely. Updates to readings due are possible. Updates to HW deadlines unlikely.

* v0.9 note: Additional readings still to be assigned, especially in weeks without readings presently listed.

Key:			
Lead for this section			
Colin	Jake	Both / not sure yet	

CHANGES DUE TO UNFORESEEN CIRCUMSTANCES

The above schedule, policies, procedures, and assignments in this course are subject to change in the event of extenuating circumstances. In the event of significant changes, a revised outline will be posted/circulated.

APPENDIX

SCHOOL OF EARTH AND OCEAN SCIENCES INFO

- SEOS Website: <u>uvic.ca/seos</u>
- SEOS Office: <u>seos@uvic.ca</u>
- SEOS Director: Dr. Jay Cullen, <u>seosdirector@uvic.ca</u>
- SEOS Mental Health & Wellness Contact: Dr. Andy Fraass, andyfraass@uvic.ca
- SEOS Undergraduate Advisor: Dr. Jon Husson, seosadvisor@uvic.ca
- SEOS Graduate Advisor: Dr. Roberta Hamme, <u>seosgradadvisor@uvic.ca</u>
- Ocean Science Mentor: Dr. Jody Klymak, <u>seosoceansci@uvic.ca</u>
- Climate Science Advisor: Dr. Colin Goldblatt, climateadvising@uvic.ca

UNIVERSITY STATEMENTS & POLICIES

- Academic Calendar: Information for All Students
- Creating a respectful, inclusive, and productive learning environment
- Accommodation of Religious Observance
- <u>Accommodation and Access for Students with Disabilities</u>
- <u>Student Conduct</u>
- <u>Non-academic Student Misconduct</u>
- <u>Accessibility</u>
- Diversity / EDI
- Equity statement
- <u>Sexualized Violence Prevention and Response</u>
- Discrimination and Harassment Policy

UVIC GRADING SYSTEM - UNDERGRADUATE

As per the Academic Calendar:

Grade	Grade point value	Grade scale	Description
A+ A A-	9 8 7	90-100% 85-89% 80-84%	Exceptional , outstanding and excellent performance. Normally achieved by a minority of students. These grades indicate a student who is self-initiating, exceeds expectation and has an insightful grasp of the subject matter.
B+ B B-	6 5 4	77-79% 73-76% 70-72%	Very good , good and solid performance. Normally achieved by the largest number of students. These grades indicate a good grasp of the subject matter or excellent grasp in one area balanced with satisfactory grasp in the other area.
C+ C	3 2	65-69% 60-64%	Satisfactory , or minimally satisfactory . These grades indicate a satisfactory performance and knowledge of the subject matter.
D	1	50-59%	Marginal Performance. A student receiving this grade demonstrated a superficial grasp of the subject matter.
F	0	0-49%	Unsatisfactory performance. Wrote final examination and completed course requirements; no supplemental.
N	0	0-49%	Did not write examination or complete course requirements by the end of term or session; no supplemental.

GRADUATE GRADING SYSTEM

As per the Academic Calendar: **Passing Grades**

Grade	Grade Point Value	Percentage*	Description	Achievement of Assignment Objectives
A+	9	90 - 100	Exceptional Work	Technically flawless and original work demonstrating insight, understanding and independent application or extension of course expectations; often publishable.
А	8	85 - 89	Outstanding Work	Demonstrates a very high level of integration of material demonstrating insight, understanding and independent application or extension of course expectations.
A-	7	80 - 84	Excellent Work	Represents a high level of integration, comprehensiveness and complexity, as well as mastery of relevant techniques/concepts.
В+	6	77 - 79	Very good work	Represents a satisfactory level of integration, comprehensiveness, and complexity; demonstrates a sound level of analysis with no major weaknesses.
В	5	73 - 76	Acceptable work that fulfills the expectations of the course	Represents a satisfactory level of integration of key concepts/procedures. However, comprehensiveness or technical skills may be lacking.
B-	4	70 - 72	Unacceptable work	Represents an unacceptable level of integration,
C+	3	65 - 69	revealing some deficienciescomprehensiveness and complexity.in knowledge,techniques or concepts lacking. Every gunderstanding orcourse taken for credit in the Faculty of	comprehensiveness and complexity. Mastery of some relevant
С	2	60-64		course taken for credit in the Faculty of Graduate Studies must be
D	1	50-59	techniques	reviewed by the supervisory committee of the student and a recommendation made to the Dean of Graduate Studies. Such students will not be allowed to register in the next session until approved to do so by the Dean.

Failing Grades

Grade	Grade Point Value	Percentage*	Description
F	0	0 - 49	Failing grade. Unsatisfactory performance. Wrote final examination and completed course requirements.
N	0	0 - 49	Did not write examination or otherwise complete course requirements by the end of term or session. This grade is intended to be final.

* 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.

STUDENT RESOURCES

POSITIVITY AND SAFETY

The University of Victoria is committed to promoting, providing, and protecting a positive and safe learning and working environment for all its members.

Student Groups & Resources

ACADEMIC RESOURCES

<u>UVic Library</u> - UVic Library offers many services and resources for undergraduate and graduate students. <u>uvic.ca/students/academics/library-services</u>

<u>Learning Resources</u> - UVic Learn Anywhere is the primary learning resource for students that offers many learning workshops and resources to help students with academics and learning strategies. <u>onlineacademiccommunity.uvic.ca/uviclearn</u>

<u>Centre for Academic Communication</u> - Offers online and in-person one-on-one tutorials, workshops, and more. <u>uvic.ca/learningandteaching/cac</u>

<u>Math & Stats Assistance Centre</u> - Offers drop-in, face-to-face tutoring and a friendly, collaborative study space for 100and 200-level math and stats courses. <u>uvic.ca/science/math-statistics/current-students/undergraduate/msac</u>

MENTAL HEALTH & WELLNESS

A note to remind you to take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, getting enough sleep, and taking some time to relax. This will help you achieve your goals and cope with stress. All of us benefit from support during times of struggle. You are not alone.

<u>SEOS Mental Health & Wellness Contact</u> - Dr. Fraass is a faculty member who can act as a sympathetic ear and (more importantly) provide guidance about: how to access the multitude of University support services, and which are useful in different circumstances. Andy can be found by dropping by his office or lab (Bob Wright A431, B409). He is also available via email for questions or to arrange a time to have a chat. andyfraass@uvic.ca

<u>Student Wellness Centre</u> - Our team of practitioners offers a variety of services to support students' mental, physical, and spiritual health. <u>uvic.ca/student-wellness</u>

<u>Counselling Services</u> - Counselling Services can help you make the most of your university experience. They offer free professional, confidential, inclusive support to currently registered UVic students. <u>uvic.ca/services/counselling/</u>

<u>Health Services</u> - University Health Services (UHS) provides a full-service primary health clinic for students and coordinates healthy student and campus initiatives. <u>uvic.ca/services/health/</u>

ACCESSIBILITY

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a documented disability or health consideration that may require accommodations, please feel free to approach me and/or the Centre for Accessible Learning (CAL) as soon as possible.

<u>Centre for Accessible Learning</u> - The CAL staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course. <u>uvic.ca/services/cal/</u>

ADVISING

For academic advising-related questions, students in the School of Earth and Ocean Sciences are also encouraged to meet with the SEOS Undergraduate Advisor (seosadvisor@uvic.ca) as well as an academic advisor in the Academic Advising Centre early in their studies to help map out a plan to declare a major and complete university program requirements.

<u>Academic Advising Centre</u> - Academic advice and support is currently available by phone, email and virtual or in-person appointments. <u>uvic.ca/services/advising</u>

<u>Ombudsperson</u> - The ombuds office is an independent, impartial, and confidential resource for undergraduate and graduate students and other members of the University of Victoria community. The ombudsperson helps resolve student problems or disputes fairly. <u>uvicombudsperson.ca</u>

ACADEMIC CONCESSION

You can request an academic concession if your course requirements are affected by unexpected and unavoidable circumstances, or conflicting responsibilities. Concession requests can be for an in-course extension, deferral, withdrawal under extenuating circumstances, or an aegrotat. Please speak to an advisor at the Academic Advising Centre if you have questions on how requesting a concession will affect your academic program.

<u>Undergraduate Academic Concessions</u> - <u>uvic.ca/students/academics/academic-concessions-accommodations/request-</u> for-academic-concession/index.php

EQUITY AND HUMAN RIGHTS AT UVIC

EQHR is a resource for students, staff, and faculty who have experienced sexualized violence, discrimination, and/or harassment and are looking for informal and/or formal resolution options as well as advice, coaching, and/or education. We are available for confidential consultations so that you can ask questions and learn your options.

EQHR – By email at eqhr01@uvic.ca or in-person (Sedgewick C115). uvic.ca/equity

<u>Sexualized Violence Resource Office</u> – If you have been directly or indirectly impacted by sexualized violence, reach out to the SVRO for information, advice, resolution options (restorative and disciplinary) as well as support options and referrals. The SVRO is both survivor-centred and trauma-informed in their approach. You can reach us by phone at <u>250-721-8021</u> or by email at <u>eqhr01@uvic.ca</u> to book either an in-person (Sedgewick C119) or online appointment. <u>uvic.ca/svp</u>

RESOURCES FOR INTERNATIONAL STUDENTS

<u>International Centre for Students</u> - *The primary office supporting international students on campus at the universitywide level.* <u>uvic.ca/international-experiences</u>

<u>UVic Global Community Initiative</u> - *Provides various supportive programming, including a Mentorship Program and Conversation Partner Program.* <u>uvic.ca/international-experiences/get-involved/uvic-global-community</u>

RESOURCES FOR INDIGENOUS STUDENTS

<u>Indigenous Student Support</u> - UVic offers holistic services to Indigenous students throughout their academic journey. <u>uvic.ca/students/info-for/indigenous-students</u>

<u>Elders in Residence</u> - The Office of Indigenous Academic and Community Engagement (IACE) has the privilege of assembling a group of Elders from local communities to guide students, staff, faculty, and administration in Indigenous ways of knowing and being. <u>uvic.ca/services/indigenous/students/programming/elders</u>