

Guidelines for Graduate Students in the AOS Program

The Graduate Work Committee

Last update: 1/28/2022

This is an *informal* guide and manual for graduate students in the AOS Program at Princeton University. It is meant to help the student navigate through the Program from start to finish by providing advice and guidance on practical matters, and an interpretation of some of the rules. This guide should *absolutely not* be regarded as providing an authoritative source on rules and regulations. The Graduate School is the ultimate authority on all rules and procedures, and you should consult the Graduate School website (<http://gradschool.princeton.edu/>) for that, or speak to one of the AOS staff.

1 The Director of Graduate Studies, the Graduate Work Committee, and the Advisor

While the administrative responsibility for the AOS program as a whole (including postdoctoral fellows and research staff) rests with the Director of the AOS program, the oversight of the graduate program and the welfare of the graduate students is the responsibility of the *Director of Graduate Studies* (DGS). He or she is your point of contact for all academic matters in the program. From the point of view of students the DGS is also the primary faculty contact and guide should problems arise between students and advisors. The DGS also sits on the Faculty Committee on the Graduate School, which makes graduate policy for the university as a whole. Examples of issues that have come before the committee include admissions criteria, who may supervise dissertations, new graduate courses in different departments, and maternal leave policies. The DGS signs off on the readmission of each student each year and approves the final degree list.

The DGS chairs the *Graduate Work Committee* (GWC) consisting of two or three additional members of the AOS faculty; the GWC provides oversight for the program. Three important components of this are: (i) Recruitment — the GWC reads all the applications each year to help select students; (ii) Assessment — the DGS and GWC run the general exam each spring and in general monitor the progress of students; (iii) Development — the GWC works with students to help develop programs that meet the needs of the student body.

The *advisor* is the main academic guide that you will have over the course of your

research, and it is essential that you have good relations him or her. We talk more about the role of the advisor in the sections below.

2 Pre-Generals

The progress through the Ph.D. can be divided into two parts: the pre-general period and the post-general period. The 'Generals', a set of oral and written examinations, are taken toward the end of your second year and determine whether you can continue to pursue a Ph.D. Before your generals, you are doing both course work and research; after your generals, you are primarily doing research.

2.1 Committee and Advisor

The incoming student is normally initially assigned a principal advisor by the faculty upon admission on the basis of the research interests the student expressed in their admissions application, or in other communication with the faculty. However, this initial appointment may change as the student's scientific interests evolve, particularly as the student becomes more familiar with the atmospheric and oceanic sciences. The initial principal advisor may then not be the most suitable, and each student should seek out the best advisor for his or her proposed research, subject to scientific and financial considerations. If a student wishes to change advisor they must notify the DGS in writing or by email of the proposed change of advisor. The student should have settled on a pre-generals advisor by the end of the second semester of their first year.

A strong working relationship between the student and the advisor is very important to a successful Ph.D. The advisor will be the student's closest scientific contact, and must have an active interest in helping and advising. Both student and advisor should make an effort in ensuring regular communication between them. The student should consult the advisor regarding courses the student plans to take, and explore topics for pre-generals research with the advisor.

When the student has decided on an advisor, the advisor and student should agree upon and organize a pre-generals Advisory Committee, normally consisting of the advisor plus at least two other scientists. These are normally AOS or Geosciences faculty, but in some circumstances faculty from other departments, or GFDL scientists, may be appropriate. At least one other committee member must be an AOS faculty, and the committee must also be approved by the DGS. The committee provides, together with the advisor, the student's primary resource for information and advice. The composition of the committee may evolve with time as the research evolves, and the pre-general committee need not be the same as

the Ph.D. thesis committee. The DGS should be informed of, and approve, changes to the committee.

The pre-generals advisory committee should be formed no later than the fall semester of the second year. The main duty of the pre-generals advisory committee is to monitor the student's preparation for the General Exam, and his or her progress in course work and pre-generals research. The student is advised to meet with committee members regularly, and at least one formal committee meeting organized by the student is required per semester starting in the second year.

Compiled here are some general guidelines regarding committee meetings. Note, however, that different advisors have different preferences regarding committee meetings - as do students. Therefore, you should discuss with your advisor their specific expectations prior to convening your first committee meeting. Anything agreed upon by you and your advisor supersedes the guidelines listed here or suggestions from other students based on their own meetings. The only exception: you are required to notify Anna Valerio (apval@princeton.edu) of each official committee meeting, as they are documented in your file.

Committee meetings may take a variety of formats, depending on your needs and the stage of the research - from brainstorming research ideas to presenting recent results. In general, be prepared to communicate your progress and plans for the next few months and expect vigorous discussion with your committee members. You schedule the meeting and reserve a meeting room. In advance of the meeting you should discuss your proposed agenda with their advisor. Some students find it useful to also send the agenda and presentation slides to committee members beforehand - though this is not mandatory. You, the student, typically run the meeting: presenting the agenda, communicating your findings, and soliciting committee members for feedback on specific items discussed. Sayre Hall 312 is commonly used for in-person committee meetings (email Anna Valerio (apval@princeton.edu) to reserve Sayre Hall rooms). GFDL also has several meeting rooms (email Dale Walton (dale.walton@noaa.gov) to reserve rooms in GFDL). Committee meetings may also be conducted via video-conference, as conditions dictate, or as mutually agreed upon by the student and committee members.

2.2 Courses

A student will typically take three or four courses per semester in the first year, two or three in the first semester of the second year, and usually none or one course in the second semester of the second year. There are course requirements as part of the general exam; see Section 3 (The General Exam) for details. Not all students

will take the same courses, and some courses may be taken in other departments. There is a minimum number of AOS courses required for the general exam. A list of all courses currently offered in AOS is at https://aos.princeton.edu/phd_program/courses, and below we give examples of sequences in broad focus areas in the Program, which could comprise part of your course requirements. Note that some classes (like AOS 575 and AOS 547) are offered in alternate years, so that the semester in which they are taken may vary. *You should regard these sequences as examples only*— they are not formal tracks in any way.

Atmospheric or Oceanic Dynamics

Fall, Year 1	Spring, Year 1	Fall, Year 2	Spring, Year 2
AOS 571 GFD I	AOS 572 GFD II	AOS 576 Atmos.Dynamics	AOS 521 Southern Ocean
GEO 425 Intro. Phys. Ocean.	AOS 547 Atmos. Thermo & Convection	AOS 575 Numerical Methods in Atmos. & Ocean	
AOS 527 Atmos. Radiation	AOS 573 Physical Oceanogr.		
GEO 427 Fundamentals of Climate			

Atmospheric Physics and Chemistry

Fall, Year 1	Spring, Year 1	Fall, Year 2	Spring, Year 2
AOS 571 GFD I	AOS 572 GFD II	GEO 425 Intro. Phys. Ocean.	CEE 588/AOS 588 Boundary Layer Met.
GEO 561 Intro. Atmos. Sci	AOS 547 Atmos. Thermo & Convection	AOS 551 Deep Learning in GFD	
AOS 527 Atmos. Radiation	AOS 537 Atmospheric Chem.		
AOS/CEE 593 Aerosols			

Biogeochemistry

Fall, Year 1	Spring, Year 1	Fall, Year 2	Spring, Year 2
AOS 571 GFD I	AOS 578 Chem. Oceanography	GEO 428 Biological Oceanogr.	AOS 576 Physics of Glaciers
GEO 425 Intro. Phys. Ocean.	AOS 547 Atmos. Thermo. & Convection	AOS 527 Atmos. Radiation	
GEO 561 Intro. Atmos. Sci	AOS 573 Atmospheric Chem.		
GEO 427 Fundamentals of Climate			

For up-to-date information on the instructor and description of each course, and to see whether the course will be taught in the current year, please refer to https://aos.princeton.edu/phd_program/courses, or to the online university course offerings at <http://registrar.princeton.edu/course-offerings/>.

3 The General Exam

3.1 Overview

Graduate students in the AOS program take the general examination in the spring of the second year. The exam consists of a written project report and a research seminar presentation, and is evaluated as pass/fail by the AOS faculty. The purpose of the exam is to demonstrate (i) proficiency in geophysical fluid dynamics, physics and chemistry of the atmosphere and ocean, climate dynamics, and specialty areas; and to demonstrate the ability to work independently and conduct original research.

3.2 Outcome (pass/fail, retake, M.A., withdraw)

The student passes the General exam if the course requirements (detailed below) are met, and the oral presentation and written report have both been accepted by the faculty; evaluation criteria for the written report are detailed in a table later in this document.

In situations where students fail the General exam, the faculty may allow the student to re-take the failed part(s) of the exam (University-wide Graduate school rules require the reexamination to occur within one year after the date of the failed exam; and students may not be admitted to a fourth year without having passed the General exam). If a student is not granted a retake, they may be provided the opportunity to voluntarily withdraw, and if they have met the requirements for the M.A. (see below) leave with the M.A.

3.3 Qualifying for M.A.

The Master of Arts (M.A.) degree is normally an incidental degree on the way to full Ph.D. candidacy and is earned after a student successfully completes all course work and the written research report has been accepted by the AOS faculty for continued Ph.D.

candidacy. It may also be awarded to students who, for various reasons, leave the Ph.D. program, provided that the course requirements have been met, and the AOS faculty finds the written research report to be adequate for the granting of a Master's degree.

3.4 Timeline and criteria

Students submit their written report typically about 2 weeks before the oral exam, and the oral exam occurs towards the end of the Spring semester (i.e. late April) of the second year of graduate studies. Immediately following the oral exam, the faculty determines a preliminary grade for the oral exam that is *not* communicated to the student. The faculty convenes typically the week after Deans date (deadline for the submission of all written work), and evaluates the candidates based on the following criteria:

1. course load and grades satisfy the requirements;
2. the evaluation (letter grade) of the written project report provided by the adviser and committee (presented and discussed by the adviser);
3. the preliminary letter grade of the oral examination;
4. and at least one faculty member is willing to serve as adviser for at least 3 more years (i.e. students may switch topics and adviser following the General Exam, but must have a committed adviser).

3.5 The components of the General Exam

Course requirements: Students have passed at least 8 graduate level courses (i.e. courses with 400/500 numbers) with a minimum grade of B-. At least 6 out of these 8 shall be selected from the core courses list below (these are courses taught by AOS faculty with some specific additions); the remaining may be other relevant graduate level graded courses (other eligible courses are listed below). Other graduate level courses offered at Princeton University are possible but require approval by the adviser and faculty. The course selection shall reflect the program's objective for breadth within the climate sciences, and shall be communicated to the faculty at the end of the second semester.

Oral exam: The oral exam takes place towards the end of the spring semester, and is usually chaired either by the student's adviser or the Director of Graduate Studies. It consists of a 45 minute presentation generally attended by the faculty only (members of the GFDL technical staff who have specific knowledge of the project may also be asked to attend to provide the benefit of their expertise). During this presentation, questions from the audience should only be asked to clarify points raised by the student. The presentation is then followed by an extensive question period in which members of the faculty as a whole, and then the committee and adviser, ask questions about the research. These questions may extend to questions about the broader context of the work and may examine the student in detail about the theoretical or numerical underpinnings of the work in a way that would be more detailed than would be appropriate in a public seminar. The student then withdraws, the faculty discuss the presentation, the quality of the work and the level of answers to questions and assign a preliminary grade for the oral portion. This preliminary grade is not shared with the student until both the oral and written reports for

all of the candidates in a year's cohort are considered in a meeting of the AOS faculty as a whole.

Written research report: The written research report demonstrates the student's ability to conduct original research independently. The report must follow the structure outlined below, and each part is to be evaluated by the adviser and student committee, whose assessment is communicated to the faculty. All faculty are encouraged to read the written report, and the AOS faculty as a whole makes the decision about whether a student's written research report is acceptable to justify continued Ph.D. candidacy or the granting of a Master's degree.

1. *Motivation.* The student describes the research problem, and why it is relevant. [No more than 1 page].
2. *Previous work.* The student summarizes comprehensively all relevant previous work on this topic, and concludes with a brief summary of the current consensus understanding as well as contradicting arguments. The length may depend on topic, but generally about 10 pages (double line spacing), and about 30 (more or less depending on topic) references are expected.
3. *Theory.* The student demonstrates in-depth understanding of the theory underlying the research problem, and familiarity with canonical textbooks on the subject chosen. Specifically, the student presents all relevant equations, and discusses assumptions and simplifications in detail. Connections to courses taken should be explicitly discussed. This section is expected to be comprehensive - the length may depend somewhat on topic, but generally about 10 pages (double line spacing) are expected.
4. *Methods and data.* In this section, the student describes the methods and data chosen by the student to address the research problem. This section is expected to be similar in scope and depth to the corresponding section in a peer-reviewed research article (e.g. *JGR*, *JAS*, *J.Clim.* or *JPO*).
5. *Results.* In this section, the student describes the results of the project so far. This section is expected to be similar in scope and depth to the corresponding section in a peer-reviewed research article (as above). In cases where the student does not have enough substantial results, this section needs to convincingly demonstrate that the student will have enough results within the next 4 months.
6. *Discussion.* In this section, the student critically discusses the results in the context of previous work as outlined in the "Previous work" section. The student clearly articulates what is new, and to what extent the research results corroborate and/or challenge current understanding. This section is expected to be similar in scope and depth to the corresponding section in a peer-reviewed research article (as above).
7. *Post-General Exam research plan.* In this section, the student presents an outline on how to follow-up on the research project. The description provides enough detail and context to assess with confidence that the work is likely to succeed as PhD thesis. If the student anticipates that they will switch topics, this section provides an outline of the envisioned post-general research project.

Eligible courses:

Core courses:

GEO 422 "Data, Models and Uncertainty"
GEO 425 "Introduction to Physical Oceanography"
GEO 427 "Fundamentals of the Earth's Climate System"
GEO 576/AOS 579 "The Physics of Glaciers"
AOS 527 "Atmospheric Radiative Transfer"
AOS 537 "Atmospheric Chemistry"
AOS 547 "Atmospheric Thermodynamics and Convection"
AOS 551 "Deep Learning in Geophysical Fluid Dynamics"
AOS 571 "GFD I: Introduction to Geophysical Fluid Dynamics"
AOS 572 "GFD II: Atmospheric and Oceanic Wave Dynamics"
AOS 573 "Physical Oceanography"
AOS 575 "Numerical Prediction of the Atmosphere and Ocean"
AOS 576 "Current Topics in Dynamic Meteorology"
AOS 578 "Chemical Oceanography"
GEO 561 / AOS 561 "Earth's Atmosphere"
GEO 557 "Theoretical Geophysics"

Listed AOS graduate courses that are currently not offered:

AOS 523 "Water in the Atmosphere"

Other eligible courses, which are pre-approved to count toward the 8-course requirement, but not toward the requirement of 6 AOS core courses:

CEE 588/AOS 588 "Boundary Layer Meteorology"
CEE 593/AOS 593 "Aerosol Observations and Modeling"
GEO 521/AOS 521 "Southern Ocean Seminar"
SML 505 "Modern Statistics"

Other graduate level courses offered at Princeton University are possible for fulfilling the 8-course requirement, but require prior approval by the adviser and faculty on a case-by-case basis. Examples of such courses include:

CEE 591 "Radar Hydrometeorology"
MAE 552 "Viscous Flows and Boundary Layers"
ECE 535 "Machine Learning and Pattern Recognition"
APC 503 "Analytical Techniques in Differential Equations"

NOT eligible courses:

AOS503 "Responsible conduct of research" (Half-semester course offered only pass/fail). **Must be taken by the end of your second year.**

AOS 580 "Graduate seminar in atmospheric and oceanic sciences"

Evaluation criteria for the written report:

The **overarching evaluation criteria** is that the student demonstrates *technical competence*, *scientific originality*, and *creativity* to the extent required for PhD research.

Scores: Excellent (A), good (B), not sufficient (C).

Any section with “C” needs to be re-done; adviser and committee provide assessment to the faculty as a whole regarding whether they recommend offering the opportunity to submit an improved report.

Report section	Criteria to be evaluated	Score
Motivation & Definition of science question	The motivation introduces and explains the science questions to be addressed clearly and concisely. Precise definition of science problem.	
Previous work	A comprehensive summary of previous work logically following the motivation section. Previous work is set in context, and clearly states current understanding and open questions, and differences between arguments put forward.	
Theory	Demonstrates understanding of theory required to address the science question. It is complete, and embedded in the big picture of climate science; and proceeds smoothly to the particulars of the science problem, demonstrating the student’s in-depth understanding of the theoretical foundation required to address the science question. Demonstrates familiarity with textbooks, and ability to integrate material from classes.	
Methods and data	Accurate and complete description of methods and data that allows reproduction of research.	
Results	Are results lucid, original and novel? In cases where no clear results have emerged: Lucid description of precluding factors, and clear strategy how to proceed.	
Discussion	The results are put into context, and implications and limitations are well discussed.	
Post General Research Plan	Describes a convincing path forward to a PhD in the next 3 years. Student describes the research area and agenda for making significant progress; enough detail and context to assess with confidence that the work is likely to succeed as PhD thesis. This section provides an opportunity to make adjustments to pre-generals research (possibly including a change in adviser).	
Contributions from adviser & committee	Evaluates to what extent the report reflects the student’s work, and to what extent it reflects input from the student’s adviser and committee.	

Additional comments	(Anything not covered above, but that is important to note for the evaluation.)	
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4 Post Generals and Earning a Ph.D.

After passing the general exam, the student begins in earnest on the research for his or her Ph.D. The student should by now have settled on an advisor — which in many cases will be the pre-generals advisor -- and the student and advisor should form a committee, typically consisting of the advisor and two or three other scientists. These may be other AOS faculty members, or faculty members in other departments or even other universities, or GFDL scientists. At least one member of the committee, in addition to the advisor, should be an AOS faculty member. Other committee members are usually Princeton faculty members at the rank of assistant professor or higher, or with GWC approval may be GFDL scientists or scientists from other institutions with rank equivalent to assistant professor. The student should normally meet with the committee once per semester. Refer to Section 2.1 for some general guidelines on committee meetings.

Each year the student needs to be re-admitted to the Program, and this is normally made on the recommendation of the advisor, and approved by the DGS, based on the student making satisfactory progress toward his or her thesis. The re-enrollment process takes place late in the spring semester. To partially satisfy these requirements, the AOS Program requires that each student write a short annual progress report, and submit it to the GWC. Such a report is typically about two pages long, and summarizes the work completed in the past year. The report is due a few weeks before the end of spring semester. Sometimes, the fellowship or research grant that is supporting the student will also require an annual report, and in such cases, the two reports may be the same. Students will not be re-admitted without a satisfactory report. In accordance with graduate school requirements of satisfactory academic progress for re-enrollment, students must have two meetings with their committee per academic year (starting in the second year) to qualify for re-enrollment. The student is responsible for ensuring that these meetings are held.

4.1 The thesis and its requirements

To be awarded a Ph.D., a student must write a *thesis*, and *defend* this thesis in a public lecture, called the *Final Public Oral* (FPO, also known simply as the thesis defense) which is followed by questions from the audience and then the faculty. The formal requirements for the printed copy of the thesis maybe found at <https://library.princeton.edu/special-collections/policies/masters-theses-and-phd->

[dissertations-submission-guidelines](#). The thesis must be *read* by two readers (one of whom may be the advisor), and examined by three examiners (see the Graduate School web site <http://gradschool.princeton.edu/academics/policies> and the following section).

The timescales for these are as follows, working back from the FPO:

1. The FPO.
2. Two weeks prior to the FPO:
 - (a) The two readers' reports are due
 - (b) Advanced degree application
 - (c) Email the graduate secretary Anna Valerio (apval@princeton.edu), a PDF of your thesis
3. Four weeks prior to the reports being due, a copy of the thesis must be given to the readers, examiners, and advisor. (The readers may agree to a shorter reading period, or may request more time. In any case, the reports are due two weeks before the FPO.)

The following items are due in Seeley G. Mudd Manuscript Library **normally immediately after the successful completion of the FPO examination**, but in no case later than two weeks after the defense:

Full details of the Mudd Manuscript Library's requirements are available at <https://library.princeton.edu/special-collections/policies/masters-theses-and-phd-dissertations-submission-guidelines>.

- Before submitting final paperwork to the Graduate School, graduate students must take the following steps);
- FPO form signed by Chair of FPO or Committee or DGS (**Anna Valerio will upload signed form**)
- Submit dissertation PDF to Princeton's [ProQuest ETD site](#) applicable publishing and copyright fees (the Graduate School requires traditional or open access publication and does not allow publication restrictions);
- Complete the [Survey of Earned Doctorates](#) hard copy of the "Certificate of Completion" page of the SED);

- Complete the [Exit Survey](#) hard copy of the "Confirmation of Completion" page must be submitted);
- Complete the checkout process for students departing the University in [TigerHub](#).
- **Once all actions are complete, graduate students must log in to [TigerHub](#) to complete the submission of the final paperwork process. All final paperwork is normally submitted immediately following the successful completion of the FPO examination, but in no case later than two weeks after the defense or by the degree deadline, whichever comes first.**

Please note, students are required to submit a bound copy of your dissertation, prepared according to the specifications in the [Dissertation Formatting Guidelines](#) to the library *within six months of the FPO* (Attn: Sara Logue, Special Collections Suite, Firestone Library, One Washington Road, Princeton, NJ 08544-2098);

All documents must be received by the degree deadline.

Enrollment and Benefits following the FPO Enrollment and benefits typically end the first of the month following the successful defense. Students may wish to consult benefits and status after the FPO for information about benefits you may receive between FPO and degree conferral. Additional information can be found here: [Status Changes and End of Student Benefits](#),

4.1.1 Readers and Examiners

The readers and examiners are formal University positions. In most circumstances they correspond to your previously-formed thesis committee, but need not. The readers and examiners may partially overlap, and typically one person is both reader and examiner, but two of the examiners may not have been readers. The readers read your thesis and provide a written report; the examiners question you after your FPO. The readers and examiners are chosen by you and your advisor, and must be approved by the DGS and by the Graduate Dean. Qualified readers/examiners are those who are authorized to supervise doctoral dissertations in the University (such as, regular faculty at the rank of assistant professor or higher and certain others in senior research ranks.) External readers/examiners must be of comparable standing in another university or in the non-academic research community. In particular, any non-Princeton faculty will require justification, and their CV and an explanation of why the person should be on your committee will need to be submitted to the Graduate Dean. The AOS Program requires that at least one reader and one examiner are AOS faculty members, in addition to the advisor.

4.1.2 Time Frames and Publishing

The average time to PhD in the AOS program is about 5 years. Students may be enrolled for a maximum of up to 6 years; of this the first 4 years are in regular enrollment status, during which a student is permitted to take classes for credit. The final 2 years would be in “Dissertation Completion Enrollment” status, during which the student is writing up the thesis. However, financial support is only guaranteed for up to 5 years, and we normally expect the student to complete the PhD within 5 years. PhD completion in 4 years is possible, but only for well-organized, highly focused students who make an early start on their thesis research. Financial support is only provided if the student is resident in Princeton, unless the student is in absentia for research or academic purposes.

A Ph.D. thesis is expected to contain work that is publishable in the peer-reviewed literature, and students are expected to submit at least some of their work for publication before defending. Typically, a Ph.D. thesis would contain material for at least two substantial journal articles.

4.1.3 The Defense

The defense takes the form of a seminar by the student, normally lasting 45 minutes to an hour, followed by questioning from the public, followed by questioning from the examiners. After that, the public and the candidate are excused, and the examiners, readers and AOS faculty discuss the candidate's performance, and, if the defense is successful, sign the form approving the thesis. The candidate should ensure that the committee has the appropriate forms to sign.

4.2 The STEP Program

The Program in Science, Technology and Environmental Policy (STEP, see also the web site <https://cpree.princeton.edu/step-program>) is based in the Princeton School of Public and International Affairs and has strong ties to the High Meadows Environmental Institute. It offers an opportunity for students in the AOS Program, and elsewhere, to take some time to study the policy implications of their work. Thus, an AOS student may take a year in the STEP program doing research on some issue that connects science and policy, such as the economic impacts of global warming, or understanding how states might deal with pollution. Normally, a student will make contact with one of the faculty in the STEP program to discuss possible projects, and will then apply for a one year HMEI-STEP fellowship to work on a problem of mutual interest — see the HMEI-STEP web site (<https://cpree.princeton.edu/step-program>) for more details. Often, partaking in the

STEP program may add about a year to the time needed for completion of a Ph.D., but many students find it very worthwhile.

4.3 Teaching

Students are encouraged to teach — that is, to be a Teaching Assistant (TA), or, as they are called in Princeton, an Assistant in Instruction (AI) — for two semesters during their time here, and teaching for at least one semester is recommended. This normally comes after the general exam, in the third and fourth years in the Program. Most students find this to be a rewarding time, and it provides valuable experience for their future careers. Because the AOS Program does not have an undergraduate program, this teaching comes through the Geosciences Department or through HMEI. You should contact the AOS staff to arrange this. If financial support is required for a fifth year, the student is normally expected to have taught for two semesters, subject to availability. You will need to plan ahead for this, as teaching is generally not feasible in the fifth year itself.

5 Financial Support

Graduate students in the AOS program are normally provided with funding for tuition and a stipend (living expenses). Funding comes from a variety of sources, including outside (external) fellowships, research grants, GFDL funds, teaching positions (AIs), and the University. In return for support, graduate students are expected to make adequate progress on research and coursework (as determined by their Advisory Committees). *First Year:* All incoming graduate students in science and engineering are awarded a fellowship from the University at the prevailing rate. Other fellowships from the graduate school may be available on a competitive basis, and students are encouraged to apply for them. Additional information on these fellowships may be found on the graduate school website: <http://gradschool.princeton.edu/financial/fellowships/competitive/> *Second Year to End of Program:* After the first year, graduate students not on external fellowships may be supported as Assistants in Research (AR) or Assistants in Instruction (AI).

1. AR: Most students in the Program are supported by Assistantships in Research (AR). A full AR appointment requires the student to spend the majority of his or her working time on research relevant to the supporting grant and, as appropriate, to carry on a program of study (e.g, taking classes). These appointments are for the period September 1 to June 30. Support for Assistants in Research in the AOS program derives either from individual faculty member external grant funds or from funding from the Cooperative Institute for Modeling

the Earth System (CIMES), a collaborative research institute between the University and GFDL/NOAA (<https://cimes.princeton.edu/>). Students funded in total or in part by CIMES are expected to prepare yearly progress reports on their research and to participate in any CIMES science reviews when available. The prevailing rate for an AR stipend can be found on the graduate school website: <http://gradschool.princeton.edu/financial/assistantships/research/>

2. AI: AOS students may be funded in all or in part by teaching positions held within other departments (e.g. GEO or ENV). AI funding is not guaranteed for AOS students since AI allocations will first be used to meet the funding needs of other departments. However, AOS students are encouraged to seek out AI appointments during their tenure as a graduate student since the faculty feels that teaching experience is an important aspect of graduate education. The prevailing rate for an AI stipend can be found on the graduate school website: <http://gradschool.princeton.edu/financial/assistantships/teaching/>

External Fellowships: AOS graduate students are encouraged to apply for external funding. Such external funding enables the program to support more students and also is a mark of high achievement for the student receiving the award. A comprehensive list of external fellowships is available on the graduate school website: <http://gradschool.princeton.edu/financial/fellowships/external/>. In the recent past, AOS students have held external fellowships from the following organizations, and *we encourage students to apply for one or more of them.*

National Science Foundation

(<https://www.fastlane.nsf.gov/grfp/>) The National Science Foundation Graduate Research Fellowship provides three years of support for graduate study leading to research-based masters or doctoral degrees and is intended for students who are at the early stages of their graduate study. Applicants must be United States citizens or nationals, or permanent resident aliens of the United States. Fellowships are intended for individuals in the early stages of their graduate study. Applicants must have completed no more than twelve months of full-time graduate study at the time of their application. Applications due early November.

NASA Future Investigators in NASA Earth and Space Science and Technology (FINESST) Fellowship

(<https://go.nasa.gov/FINESST21>) Future Investigators in NASA Earth and Space Science and Technology solicits proposals from accredited U.S. universities and other eligible organizations for graduate student-designed

and performed research projects that contribute to SMD's science, technology, and exploration goals. The graduate student shall have the primary initiative to define the proposed FINESST research project and must be the primary author, with input or supervision from the proposal's Principal Investigator (PI), as appropriate. The proposal must present a well-defined research problem/activity and a justification of its scientific significance to NASA. FINESST awards are grants for up to three years and up to \$50K per year. Applications due early February.

DOE Computational Science graduate fellowship:

(<http://www.krellinst.org/csqf/>) This fellowship, for students pursuing doctoral degrees in fields of study that use high performance computing to solve complex science and engineering problems, provides \$36K annual stipend and tuition for up to 4 years, with a requirement that fellows spend 12 weeks at a DOE lab. Applications are due in January.

EPA Science to Achieve Results (STAR) Fellowship:

(EPA resources to support this fellowship are no longer available, but EPA may provide a replacement graduate fellowship opportunity in the future.)

Hertz fellowships:

(<https://www.hertzfoundation.org>) These are highly competitive and very prestigious fellowships, with an attractive financial package. You may apply only in the first year of grad school, or as an undergraduate. Awards are based on merit, not need. You must be a United States citizen or permanent resident, and have an excellent academic record and 'display evidence of exceptional creativity.'

National Defense Science and Engineering Graduate Fellowships:

(<http://ndseq.org/>) These fellowships, for US citizen only in several disciplines including oceanography and geosciences, last up to 3 years, pay all tuition and a stipend. Applicants must be in their first 2 years of graduate study.

Of course, not all fellowships are appropriate for all students, but often there will be a match to one or more fellowships.

3. Summer Support: Students in AOS are normally supported through the Program or by fellowships for summer (between June 1st and September 15th) at the prevailing rate. Summer appointments are full-time and therefore students

are expected to be working full-time during this period. Travel for non-research related purposes is not normally encouraged during this time, and any vacation must not exceed graduate school guidelines (see below). Stipends will be prorated to account for time away or excess vacation taken during this period.

6 Travel to Meetings

The intention of the travel provision for graduate students is to provide educational experiences that will be of direct benefit to their dissertation work. We encourage students to go to meetings to present results of their research, and to become acquainted with the 'business of research'. Of course all travel is subject to the availability of funding and is subject to the approval of the advisor. Please note:

- CIMES funds may be used to fund student travel to conferences/workshops, provided the student is presenting their own research. Due to budgetary constraints, CIMES will pay for no more than one full cost meeting per year per student (where full-cost means registration, hotel, airfare), unless there are exceptional circumstances. In such circumstances the student must request prior clearance from the Director or Associate Director of CIMES.
- Adviser and student should consider carefully the meetings the student may wish to attend over a coming year, and make a choice of the single most beneficial meeting for the use of CIMES travel funds. Smaller, more local meetings to which students might carpool, have informal accommodation arrangements, and have minimal registration fees, can be considered additionally, again at the discretion of the Associate Director or Director of CIMES.
- Before requesting CIMES funds, the student should explore all other funding sources, e.g. student travel funds provided by the academic society/conference (i.e. AMS/AGU), Princeton Graduate School (the Deans Fund for Scholarly Travel during the academic year and the APGA Summer Travel Grant for the summer: <http://gradschool.princeton.edu/financial/travel>), Geosciences travel allocations, or travel funds from their adviser's other grants. The graduate administrator will track each student's use of CIMES travel funds .
- The Geosciences department provides \$1,500 for travel per student to be used over the duration of their time in Princeton. You must e-mail the

Geosciences DGS a request prior to traveling.

- Graduate students are entitled to reimbursement of all reasonable expenses associated with their travel, including transportation, room, board, and registration fees. At the same time, graduate students should spend travel money as if it were their own, and seek to minimize transportation and hotel room costs, etc. The student must retain all receipts, including meals.
- You may use the department credit card for travel-related expenses such as registration, hotel, airline tickets, rather than purchasing them yourself and waiting to be reimbursed. Please contact the graduate administrator (Anna Valerio) for use of the credit card.
- Attendance at smaller meetings and workshops relevant to a student's research is seen an opportunity for enrichment and interaction with other researchers and is highly encouraged.

7 Vacation Policy

You should regard your graduate studentship as a full-time position that extends throughout the year, including the summer months. That is, regardless of the source of financial support, graduate students are expected to work essentially full time fulfilling their degree requirements. During a 12 month period from September 1 to August 31st, graduate students may take up to (but no more than) 4 weeks of vacation, including any days taken during university holidays and scheduled recesses (e.g. the fall and spring breaks, inter-term break). (Students should note that 4 weeks of annual vacation is the norm for university faculty too). As a consequence, if you have taken, for example, a week of vacation at winter break and a week at spring break, you would be able to take a maximum of 2 weeks in the summer. The specific periods taken as vacation must not conflict with the student's academic responsibilities, coursework, research, or teaching, and should be discussed in advance with the director of graduate studies, adviser, or dissertation committee. Vacation time may not be accumulated for later use. A student in their first two years (i.e. pre-generals) should only take vacation during normal recess periods. In particular, the summer between the 1st and 2nd academic year needs to be devoted to pre-generals research. Vacations outside normal recess periods, of more than a few days, must be approved by the advisor, and if longer than a week, also by the DGS.

If the student is receiving financial support over the summer, he or she is expected to work correspondingly over that time. In particular, a student receiving the full

summer support must be in residence for most of the summer (i.e. from June through August) except for a week or two of vacation in accordance with the 4 week annual limit. Summer support will be proportionally reduced if excess vacation is taken during that period, and students should inform the AOS office about their summer plans.