

## **Ph.D. Qualifying Exam Procedures Climate and Space Sciences and Engineering (CLaSP) (Updated November 2019)**

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chair:	chair of the exam, unique to each exam

The CLaSP Ph.D. qualifying exam consists of two steps.

Step 1 is an oral exam designed to test course knowledge and synthesize knowledge within three individual courses. The objectives are (1) to assess the student's breadth of knowledge and quantitative skill sets and (2) to identify any weakness(es) in the student's knowledge and quantitative skills and recommend a course of action to address these weakness(es).

Step 2 includes a research-based written report and an oral presentation, followed by an oral exam. The primary objective is to assess the examinee's research potential, likelihood to successfully finish the Ph.D. program, and ability to become an independent researcher. **Passing the Step-2 exam marks advancement to PhD candidacy.**

Step 1 must be passed without restrictions prior to completing Step 2.

Below are detailed procedures for both steps. In addition to procedures outlined below, appropriate accommodations can be made for an examinee with a documented learning disability.

### **Step 1 Exam Procedures**

#### **1. Timing**

Students are expected to take the Step 1 exam in May of their first academic year. At the time of the exam, (1) the examinee has completed the core courses required by the department (CLIMATE/SPACE 532 and 551) and (2) the examinee's cumulative GPA must be 3.3 (B+) or above. The two core courses plus one course related to the examinee's research major will be examined in the Step 1 exam.

If an examinee has not yet taken both core courses, they may take the exam upon approval of the Graduate Program Chair. Approval will be on a case-by-case basis. Under these circumstances, the examinee must take the remaining required course(s) before the Step 2 exam, and must obtain a grade of 3.0 (B) or above in the remaining required course(s). The examinee should expect the course knowledge to be

examined in their Step 2 exam. If grade requirements are not met, the knowledge required in the course will be assessed by the Qualifying Exam Committee during the Step 2 exam and the nomination to Ph.D. candidacy will be reviewed by the Graduate Program Chair.

If a student cannot meet the above requirements, they can defer the Step 1 exam to any time between May of their first academic year and the end of their second academic year.

## **2. Scope of Step 1 Exam**

**By February 15**, students must notify the Qualifying Exam Chair of their intent to take the exam in the spring, along with three courses to be examined. Two core courses plus one course related to the examinee's research major will be included in the Step 1 exam. The student should discuss with their advisor which course should be selected as the third course to be examined, guided by expectations of which course material will be most relevant for the student's research. If the timing of Step 1 is deferred, notification should be completed at least 3 months prior to the expected date of the exam.

The expected knowledge base and skill sets for each course should be clearly stated and defined in the skill set sheet for the course. By mid-February, the skill set sheets will be provided to examinees, together with the names of their exam committee members and general instructions about taking the exam. If the timing of this exam is deferred, then skill sets and committee composition should be provided at least 2 months prior to the expected exam date.

## **3. Selection of Step 1 Exam Committee members**

Once the scope of exam is decided, the oral exam committee of each examinee will be formed by the Qualifying Exam Committee. The committee will consist of four members plus the examinee's advisor. The chair of the qualifying exam will be a member of the Qualifying Exam Committee and is responsible for ensuring that exams are restricted to items on the skill sheets; avoiding bias in questions and outcomes; and ensuring consistency across exams. One committee member must be a cognate member from within the department, i.e. a climate faculty member serving on a space science exam or a space faculty member serving on a climate science exam. The other three faculty members should be familiar with the knowledge covered by the three courses selected for the examinee. Committee members may be teaching faculty, research faculty, or research scientists, but may not be post-docs.

The examinee's advisor is required to observe the Step 1 exam, as they will participate in the deliberation process after the exam. The advisor is not allowed to ask questions or give hints to the examinee during the exam, and should wait until the deliberation period to offer comments.

The examinee should contact their exam committee members and schedule a time for the oral exam. Except in the cases of deferred exams, the exam date should be no later than May 31.

#### **4. Procedure of the Step 1 oral exam**

(1) The oral exam will be presided over by the chair of the oral exam committee. The examinee is allowed to bring one letter-size front and back sheet of notes to the exam.

(2) Before the exam starts, the committee members will be provided with the examinee's transcript at UM, the skill set sheets for all three courses, and a one-page reminder of the oral exam procedures.

(3) At the beginning of the exam, the chair should ask the examinee to make a 2-minute self-introduction, covering topics such as their academic background and current research direction.

(4) The oral exam will be divided into a first half (~1-1.5hour) and a second half (~1-1.5hour), with a 10-minute break in between. **The exam should be scheduled for 2.5 hours and an early finish is allowed.** The 10-minute break is strategically important, as this is the time that committee members should go over the examinee's performance and decide how to refocus questions in the second half. Please keep in mind one of the objectives is to determine whether the examinee has certain weaknesses in their knowledge base and to assess the extent of such weaknesses.

It is expected that problems should be worked out on the board in front of the committee. However, examinees can take a minute or two to think through the problem before going to the board or even work first on scratch paper before presenting on the board.

(5) After the exam, the committee members will discuss and reach a consensus for the outcome of the exam. There are three potential outcomes for first-time examinees:

- (a) Pass
- (b) Conditional Pass with further work required, generally in the form of an additional course
- (c) Fail with retake

The chair of the committee will prepare a typed summary of the exam, incorporating feedback from all committee members, and **provide this summary to the Graduate Program Chair, Qualifying Exam Chair, and examinee's advisor within 1 week of the exam.** The Graduate Program Chair will then integrate this feedback into an official letter provided to the examinee within 2 weeks of the exam. The summary must provide sufficient detail to justify outcomes (b) or (c).

For a Conditional Pass (outcome b), the summary should also justify and describe a performance improvement plan designed to rectify critical deficiencies identified by

the committee. The availability of any recommended courses and the timing for the Step 2 exam should be considered when such recommendations are made. The examinee must take any recommended courses and obtain a grade of B (3.0) or above for the courses before their Step-2 exam. They will be reminded to expect questions related to the recommended courses in the Step 2 exam. Any conditions that are imposed as part of outcome (b) must be approved or revised by the Qualifying Exam Committee within 1 week of receiving the recommendations. The examination committee should also keep in mind that the intent of any imposed conditions should be to provide useful and relevant education to the student, rather than to be punitive or extend the examination process.

The examinee's advisor will participate in the deliberation process. In the case that a consensus cannot be reached after the deliberation, the chair will need to preside over a vote. Four committee members and the examinee's advisor will cast their votes and the outcome with majority vote will determine the outcome.

### **5. Retake of the Step 1 exam**

Any student who fails the Step 1 exam is automatically allowed to retake the exam once within the following academic year. The composition of the committee for the retake exam will be completely distinct from the original exam committee. If the student fails the exam again, under normal circumstances there will be no further retake opportunity and they will be dismissed from the program (see policies on academic probation and dismissal). Students can work with the Graduate Program Chair to ensure that they have sufficient credits for a Masters degree.

## **Step 2 Exam Procedures**

### **1. Timing**

After passing Step 1, the examinee should take Step 2 within the following academic year. The examinee should notify the Qualifying Exam Chair of their intent to take the exam at least 2 months prior to the exam, along with a list of suggested committee members. Once the committee has been approved, the examinee is then responsible for scheduling the date for the Step 2 exam with their committee members. Please note if the Step 2 exam is scheduled in the spring or summer semester, the examinee is required by Rackham to register for the semester, as passing of the Step 2 exam marks advancement to candidacy.

Once the exam date and time have been set, the examinee should work with the Graduate Coordinator to reserve a room for the exam, and then notify the Qualifying Exam Chair of the time and location of exam.

### **2. Scope of the Step 2 Exam**

The exam will primarily focus on the research that the examinee has conducted by the time they take the exam. After entering the Ph.D. program, the examinee is expected to carry out research under the supervision of their advisor(s). The **Step 2 exam will focus on the research progress made prior to taking the exam.** This

document could be a draft manuscript to be submitted to a peer-reviewed publication or a research proposal with preliminary results.

Students should expect knowledge-based questions closely related to their research project. In addition, students that conditionally pass the Step 1 exam should also expect questions on topics identified in the official notification letter provided after the Step 1 exam.

### **3. Selection of the Step 2 Exam committee members**

In order to take the Step 2 exam, the examinee needs to maintain a cumulative GPA of 3.3 (B+) or above. Once the student passes the Step 1 exam, the committee for their Step 2 exam will be formed. The guiding principles for this committee are:

- (1) For students with conditional pass of the Step 1 exam, 1-2 members of their Step 1 committee should be selected for the sake of re-examining the weakness(es) identified in the Step 1 exam.
- (2) One cognate member from within the department is required (i.e. a climate faculty member serving on a space science exam or a space faculty member serving on a climate science exam).
- (3) The examinee's advisor is required to sit in.
- (4) Preferably, the remaining members should be familiar with the research presented by the examinee.

The examinee should work with their advisor to identify potential committee members, and then suggest these members to the Qualifying Exam Chair. Committee members may be teaching faculty, research faculty, or research scientists, but may not be post-docs. One committee member will be designated by the Qualifying Exam Committee as the chair to preside over the exam.

The roles of the advisor are (1) to answer any questions that other committee members might have directly for the advisor, especially clarification questions; and (2) observe the exam and take part in the deliberation after the exam. Therefore, the advisor should not actively ask questions to the examinee during the exam. Should the advisor wish to comment on questions asked by the committee members, such comments will need to be deferred to the period of deliberation.

### **4. Written report**

The written report is due two weeks before the actual exam date. The examinees should submit the written report electronically to their committee members and also provide a hard copy to each committee member.

The written report should contain a title, abstract, context, references, and if applicable, figures, tables, and their captions. Excluding references and figures/tables, the body of the report should be 6-10 single-spaced pages. The written report should be based on the research progress made by the examinee. It could be a nearly finalized manuscript ready for submission or a research proposal with preliminary results. The examinee is expected to demonstrate their ability to

formulate scientific questions and strategies to address such scientific questions in the written report, as well as their scientific writing skills.

The examinee should adopt a style requirement used in a mainstream journal (e.g. AMS, AGU or IEEE journal author style guide) and prepare the written report in accordance with such style requirements. This will give the examinee a chance to gain familiarity with the discipline-specific formats of scientific writing. Further guidance on formatting, as specified by NASA for proposals, is: the main body of text and captions must use an easily read font of no more than 15 characters per horizontal inch (typical of 12-point Times New Roman) and no more than 5.5 lines per vertical inch (i.e. single spaced). There must be at least one-inch margins on all sides, and the proposal must be sized for US letter size (8.5x11) paper.

**The examinees must prepare and proofread the actual written report independently.** Please note that scientific writing is also a key factor in the assessment of a student's likelihood of becoming a successful independent researcher. Discussions with advisors and colleagues on the general outline of the report are acceptable. For native English speakers, the actual writing and proofreading must be done by the examinees themselves without any assistance from others. Non-native English speakers can seek help with English editing and proofreading from the staff in the English Language Teaching Unit (or similar English editing units) of the University. If a non-native English examinee chooses to seek such help, a signed statement from the helper(s) must be submitted together with the written report. The helper(s) must clearly state in the statement that their assistance has been limited only to English editing and that no effort has been made to improve other aspects of the report.

## **5. Procedures of the Step 2 oral exam**

The oral exam is expected to be 1-1.5 hours long, presided over by the chair of the exam committee.

(1) Before the exam starts, the exam committee members will have a brief discussion on their impression of the written report, and review the examinee's transcript and the evaluation of the Step 1 exam. Such practice will serve as a reminder if course-related questions still need to be examined in this exam. An evaluation sheet (see Appendix A) will be given to each committee member to complete.

(2) As in Step 1, the examinee will start with a ~2-minute self-introduction, describing their background and research project.

(3) **The examinee will give an uninterrupted presentation of 20-30 minutes about their research described in the written report.** The chair can stop the examinee if the presentation is over 30 minutes. Except for questions pertaining to clarification, no other questions should be asked during the presentation. This is intended to allow the examinee to present their entire talk coherently before extensive questioning may take away from the presenter's time.

(4) After the presentation, the committee members will ask questions about the presentation and written report. If course-related questions are needed to address Step 1 conditions, these will also be included.

### **6. Outcome of the exam**

The chair will ask the examinee to leave the examination room, and then the committee, including advisor, will deliberate to reach a consensus. Before the deliberation begins, each committee member should complete their own evaluation sheet independently. Then, the chair of the committee will complete a summary evaluation that reflects consensus of the group. Three possible outcomes of the exam are:

- (1) Pass
- (2) Fail with retake
- (3) Fail with no retake

The chair of the committee will prepare typed comments to append to the summary evaluation form, and will provide these to the Graduate Program Chair, Qualifying Exam Chair, and Graduate Coordinator within 1 week of the exam. The Graduate Chair will then integrate these comments into a formal notification letter that also includes the summary evaluation sheet. For cases (2) and (3), the committee should provide sufficient observations and justifications in the report. The exam chair can retain the individual and summary evaluation sheets to assist with composition of comments, but all sheets should be returned to the Graduate Coordinator once the comments have been prepared. The committee will notify the examinee about the outcome immediately at the conclusion of the exam.

## Appendix A: Step 2 Exam Evaluation Sheet

Examinee's Name

Committee member's Name

	<b>Strongly Agree</b>	<b>Agree</b>	<b>Neutral</b>	<b>Disagree</b>	<b>Strongly Disagree</b>	<b>No Basis to Judge</b>
Written report is well organized, well referenced, and well written in English						
The research progress is sufficiently described in the written report in a coherent and logical way						
The oral presentation is well organized, well delivered, and correctly referenced (if applicable)						
The examinee has good understanding of the motivation and background of the research project						
The examinee can justify the scientific methods employed in the research project						
The examinee can explain any results obtained so far in the context of overarching research question and the "big picture"						
The examinee has a well-thought-out plan for the follow-up work						
The examinee is aware of the frontier research topics related to their project						
The examinee can handle impromptu questions with logical thinking and scientific reasoning						
The examinee exhibits effective communication skills in both the presentation and Q&A session						

Remarks: (appended in typed form)