

## **Assessment plan for the Ph.D. in Atmospheric and Environmental Sciences (AES)**

### **1. Introduction**

The Atmospheric and Environmental Sciences is a multidisciplinary program shared by the core Atmospheric and Environmental Science faculty (those science faculty affiliated with the BS-IS/ATM and MS-AES program), Civil and Environmental faculty and Geology and Geological Engineering faculty, working with candidates who are pursuing science-oriented (as opposed to, for example, engineering) research on the Earth System.

### **OBJECTIVES & OUTCOMES**

OBJECTIVE 1: Students will have comprehensive knowledge of Atmospheric and Environmental Sciences.

Outcomes:

1. Atmospheric and Environmental Ph.D. graduates should have deep knowledge of principals the physics and dynamics of the earth system, ecology and climate system.

OBJECTIVE 2: Students will be able to perform effective research in Atmospheric and Environmental Sciences.

Outcomes:

1. All Atmospheric and Environmental Sciences Ph.D. graduates are expected to be able to independently formulate scientific hypothesis of atmospheric & environmental phenomena, and test those hypotheses through the integration of observation, theory and, where appropriate, simulation.
2. All Atmospheric and Environmental Sciences Ph.D. graduates are expected to be prepared for advanced and leadership-track career paths in research, operations or educational within the Atmospheric and Environmental Sciences, and adjacent disciplines.

OBJECTIVE 3: Students will communicate effectively.

Outcomes

1. All Atmospheric and Environmental Sciences Ph.D. graduates will communicate in writing about scientific and technical concepts concisely and completely.
2. All Atmospheric and Environmental Sciences Ph.D. graduates will organize and communicate ideas using words, mathematical equations, tables, graphs, pictures, animations, diagrams, and other visualization tools.

## **ASSESSMENT OF OBJECTIVES AND OUTCOMES**

**OBJECTIVE 1:** Students will have comprehensive knowledge of Atmospheric and Environmental Sciences.

Assessment:

1. Assessment in Objective 1 is primarily done through coursework, determined through program policy and expectations provided by the candidate's graduate committee. Continued enrollment without probationary status and eligibility for graduate assistantships requires the maintenance of at least a 3.00 grade point average. Course instructors are expected to evaluate student abilities in a given course using rubrics based on exams, homework assignments, and projects. In all courses, student opinion surveys (IDEA) and formative assessment measures such as open-ended questions and in-class discussions, analogy prompts, and feedback will be employed to assist faculty in continuous improvement of the curriculum.

Students have three formal examinations.

The first exam is a qualifying [candidacy] exam to assess the student's entry background in their proposed area. This qualifying exam is waived for SD Mines alums (e.g., graduates from the M.S. in AES, CEE, GEOL and GEOE programs). The content of the qualifying exam is determined by review of the student's transcript and by the student's committee. On passing this exam the student is admitted as a candidate of the Ph.D. program.

The second exam is a comprehensive exam which is evaluates the candidate's ability to explore a research question and defend it before the candidate's committee. This exam is administered in two parts. The first is a written, component, typically the proposal for the candidate's dissertation topic. Upon the successful acceptance of the written component, an oral component is administered which includes a presentation of the dissertation topic proposal with the floor open to the committee to assess the candidate's ability to pursue the research with respect to existing expertise, knowledge and resources.

The final exam is the formal dissertation defense. Here the candidate's independent is presented in a presentation for public review and the written dissertation artifact and candidate's skill as an independent researcher is assessed by the committee in private.

**OBJECTIVE 2:** Students will be able to perform effective research in Atmospheric and Environmental Sciences.

Assessment:

1. All Atmospheric and Environmental Sciences Ph.D. candidates must complete an independent research project of their own design, cumulating in a formal comprehensive dissertation. This is commonly, but not always, three manuscripts suitable for publication. Not all manuscripts must be accepted for publication before the final defense, but they should be ready for submission.

2. Exit interviews of graduating students, tracking of job placement, and alumni surveys will provide additional assessment. In all courses, student opinion surveys (IDEA) and formative assessment measures such as open-ended questions and in-class discussions, analogy prompts, and muddiest-point feedback will be employed to assist faculty in continuous improvement of the curriculum. Students are expected through help of their advisors to integrate into professional organizations (e.g., American Meteorological Society, Ecological Society of Society) and should attend at least one national-scale conference to begin the process of professional networking. Ph.D. students are strongly encouraged to begin developing their “personal college” network of professional contacts outside of SD Mines during their candidacy period. The program advisors are expected to facilitate this critical phase of their professional development as they continue their evolution from student into colleague.

OBJECTIVE 3: Students will communicate effectively.

Assessment:

1. Communication skills are evaluated primarily through a combination of the Seminar Course and individual work with the student’s major advisor as part of the student’s research dissertations and related presentations. In the seminar course, a set of rubrics will be used to assess these learning outcomes. Students are expected to present their research at least one nationally-recognized conference.
2. Communication quantitative data and abstract concepts are evaluated through relevant coursework, seminar and the candidate’s dissertation and related artifacts and presentations from the candidate’s tenure at SD Mines.