

Department of Atmospheric, Oceanic and Space Sciences
College of Engineering
University of Michigan

External Review Committee Report

Committee Membership:

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Process

The External Review Committee of the Atmospheric, Ocean and Space Science Department met in Ann Arbor on 31st October – 2nd November 2005. The basis for the work was an excellent and helpful internal review that the Committee received prior to the visit. Additional information was requested by the Committee and delivered promptly. The Committee had open, constructive and frank discussions with senior staff in the College of Engineering, and with faculty, staff and students in the AOSS Department. Preliminary findings of the Committee were discussed with the leadership of the Department and College on 2nd November, but the conclusions are those of the Committee itself.

General

The AOSS Department is implementing a new strategic plan under the very effective leadership of its chair and senior faculty. Both the undergraduate and graduate curricula have been revised to deal more comprehensively with current opportunities and challenges and to attract more undergraduate students into the program. These changes appear to be succeeding, particularly with respect to increasing the number of undergraduate majors. The department continues to have a strong, diverse and exciting research program that is evolving to address leading edge questions in atmospheric, planetary and space sciences. The department has a strong and viable vision for its future, which it is pursuing with vigor and determination.

The major thematic areas of department include; solar and heliospheric science, planetary science, magnetospheric and ionospheric physics, Earth climate studies, and Earth atmospheric chemistry. The department has many internationally prominent senior faculty doing excellent work and publishing well in each of the main thematic areas, representing broad and diverse excellence in scholarship and research. The department has a particularly strong program in numerical modeling of atmospheric, planetary and space sciences. It has a strong tradition of excellence in space instrumentation for the study of the Sun, Earth and other planets.

The presence of AOSS within the engineering college at UM gives it access to undergraduate students with strong math and science backgrounds. AOSS is exceptional among similar departments with its range of disciplines for the number and quality of the senior women faculty. In addition, for a physical sciences department, AOSS has good representation of women and minorities among the student population.

AOSS is unusual in that it is a science department within an engineering college. This gives the department many unique research opportunities. However, the department could exploit its engineering environment more to develop novel sensor and computing technologies, modeling methodologies, and participate more vigorously in broader programs in energy and the global environment.

The department has more research faculty (primary research scientists ~ 23) than tenure track faculty (~16). In addition, the department hosts a large research facility, the Space Physics Research Laboratory (SPRL) and its associated technical and administrative staff. The department and SPRL are in the process of coming under unified management, but appear to have separate administrative and financial organizations, and each can be the home for research proposals. The department and SPRL together have about \$14 million in external research funding, or about \$360K per research and T&TT faculty.

The AOSS Department is changing rapidly in response to changing science needs, and its name does not reflect its current program. This is an impediment to effective external representation, and marketing, and the Committee recommends that the Department consider changing its name to reflect its current strengths in Atmospheric, Space and Planetary Sciences.

Undergraduate Program:

The undergraduate program was restructured in 2004-5 and is now in its second year of implementation. Previously the undergraduate program was mainly focused on meteorology and atmospheric sciences. The new program will be called Earth Systems Science and Engineering (ESSE) and will feature three tracks in Meteorology, Climate Physics and Space Weather. It is hoped that this will broaden the appeal of the program and allow for more engagement in undergraduate teaching by the faculty working in space and planetary sciences.

The new curriculum has no flexibility for the first two years of a student's program outside that afforded by the humanities and social sciences electives, but it does have flexibility in the final two years (three courses each in technical and free electives). This is probably typical for engineering curricula, but affords less freedom than would be available in similar departments in science colleges at other universities. Current undergraduates complained that the curriculum does not allow them to learn about the 'real stuff' (e.g. weather forecasting) until their final year. They would find the program more rewarding if they could begin to gain some experience with advanced topics in the third year, rather than spending three years taking prerequisites and then only during the fourth and final year begin to delve into the ultimate purposes or central passions that drive interest in the major.

Marketing the new curriculum to undergraduates in COE has greatly increased the number of undergraduate majors, and from this perspective has been an immediate success. The curriculum is not fully developed however, and it will be critical to see how the experience of current undergraduates in an evolving program with inevitable startup problems affects recruitment in future years. Much work needs to be done in developing a full complement of linked courses. The success of the ESSE major also depends on a smooth working relationship with departments in the College of LS and A through which some of the ESSE courses are offered.

Graduate Program:

The graduate program has also been revised recently and now has a core curriculum and two programs: the atmospheric program and the space and planetary program. These two programs are further divided in two, yielding four concentrations: atmospheric chemistry and biosphere interactions, climate and remote sensing, space plasma, and planetary science. Significantly, no weather-modeling and forecasting concentration is offered. These tracks seem to be well designed and aimed toward coherent and important research areas.

Many of the courses required for the graduate degree are numbered below 500. One assumes that this allows undergraduates to enroll in the graduate courses as electives. At least one course is a requirement for both graduate and undergraduate concentrations. Unless the undergraduates are very good, this arrangement may not be optimal for them.

The graduate students seem happy and productive. They are concerned that the department work as effectively as possible in recruitment and retention of highly qualified graduate students. They have some perspectives to offer to which the department leadership should listen carefully

From discussions with graduate students it appears that PhD supervisory committees meet primarily at the general and final exams and are not actively engaged in mentoring students over the course of their years in the department. The mentoring process is in many cases almost exclusively between student and supervisor. Some students expressed a sense that they were actively discouraged from interacting with faculty other than their own advisors, and both they and the committee find this regrettable. The visiting committee feels that it would benefit the students and their research to appoint the PhD supervisory committee early in the Ph.D. program and to encourage students to seek advice more broadly, especially from all the members of their committee.

Challenges

Department Demographics and New Appointments

The age distribution of the T&TT faculty is skewed toward senior faculty, with a median age near 55 and about 75% of the T&TT faculty 50 or older. If one considers the research faculty and T&TT faculty together, then the age distribution is much better, since more research faculty are early career scientists. AOSS has a tradition of offering T&TT appointments to some of the highly qualified members of the research faculty. These appointments are usually made at mid-career level, which contributes to the unbalanced demographics of the department. Furthermore, because the research faculty often come to AOSS to work in the existing groups of the senior faculty, filling T&TT slots with research faculty tends to prevent the department from evolving into new areas and approaches. In order to develop new areas, AOSS has tended to bring in mid-career scientists. Many of the existing T&TT faculty have not had the experience of doing research and teaching at the TT Assistant Professor level, and we were told that several

previous TT assistant professors have not made it successfully through tenure review. It is not clear that the department has an effective process for developing and mentoring junior T&TT faculty. The visiting committee recommends that new T&TT hires be made at the early career stage, and that the department develop processes to mentor junior faculty as they move toward promotion and tenure. Areas of comparative opportunity where the department may benefit by strengthening its program are in biogeochemistry and in atmosphere-land interactions.

Teaching Credit and the Departmental Budget

The department has a relatively small undergraduate program, and a small ratio of graduate student population to research budget in comparison to other units in the college and university. The university and college funding allocation formulas strongly reward student credit hours, since tuition is a large fraction of the overall revenue stream for the university. This puts the department in an unfavorable position relative to units in the college with large undergraduate populations. Most other programs in the college have structured their majors with little flexibility for taking courses outside the major. It is thus very difficult for AOSS to increase its teaching load without increasing the numbers of its undergraduate major or graduate student populations.

In particular, the existing formulas for allocating credit for teaching discourage development of interdepartmental or cross-College programs. For courses that AOSS faculty may teach outside the college, the credit allocation formula favors the departments or colleges with which the students are affiliated (75%), rather than those with which the faculty are affiliated (25%). To realize its vision of becoming a world-leading Earth System Science Engineering department, AOSS needs to collaborate in interdisciplinary teaching and research with other departments at the University of Michigan, and particularly some departments in other colleges. Mechanisms for rewarding inter-college research and teaching do not seem to be in place.

Emphasis on Obtaining Extramural Funding

Perhaps because indirect cost return and offsets are so important to the operating budget of the department, AOSS leadership places strong emphasis on research budgets and seems to expect that substantial research grant revenue will be generated by its faculty members. It seems that this leads faculty members to place disproportionate emphasis on the funds that they and others obtain from external sources rather than on the science that is supported by the research funds. The external committee has the sense that the emphasis on grant and contract revenue may play too large a role in defining the vision and hiring strategy for the department.

Improved Communication

Although significant improvements in collegiality and shared vision for the department have been achieved in the past few years, to a considerable degree through the efforts of the department chair, continued attempts to improve communication are needed, both in

terms of clarity of expression and listening. One area where this is especially necessary is with regard to the department budget, where faculty perceptions appear to be very different from those of the chair and the administrator. Particularly widespread is the faculty resentment of the “offset requirement,” i.e. the expectation that they will raise 30% of their academic year salary from extramural funds. In addition, the department and the college hold different perceptions of how funds are allocated to the department.

Space Physics Research Laboratory (SPRL)

SPRL is closely linked to the department and has a long and illustrious history of providing critical space instrumentation for AOSS faculty. At present no major instrument development projects are in the pipeline. The probability of gaining leadership of a major space instrumentation project in the near future seems low, both because of the lack of experience in doing so among the current faculty, and because of the relative lack of opportunities anticipated for the near future. Other research challenges could be addressed with SPRL engineering, but at present it seems to be optimized for production of large space-qualified instrument projects rather than, for example, rapid prototyping of earthbound instruments.

It may be wise to maintain the engineering capacity of SPRL for a time to preserve the capacity to compete for space flight projects in the future, but to do so will be costly and may foreclose other opportunities. Temptations to maintain engineering expertise by building instrumentation as a service to outside organizations appear to us to be unwise. The external committee does not feel it is appropriate to maintain SPRL within the department, college or university unless it is serving the needs of cutting edge research. It is probably then advisable to reduce SPRL to a smaller group that is addressing cutting edge research issues related to interests of the present-day faculty.

Thanks

The external review committee would like to thank the internal review committee for a perceptive and informative report. Open discussions with college and department leadership, faculty, staff and students were extremely helpful in getting to know the department better. Thanks are also due to the staffs of the college and of the department for making excellent arrangements for our visit.