November 30, 2004

Paul Gough
South Dakota Board of Regents
306 East Capitol Avenue, Suite 200
Pierre, SD 57501

SUBJECT: REVIEW OF PROPOSED PHD PROGRAM IN ATMOSPHERIC AND ENVIRONMENTAL STUDIES AT THE SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY

Dear Paul:

Despite delayed flights in both directions, I enjoyed my visit to Rapid City and discussing the proposed program with your colleagues. I believe the South Dakota School of Mines & Technology has an opportunity to develop an innovative PhD program that links atmospheric processes, biogeochemical interactions, ecological causes and effects, and hydrologic transport. My concern, however, is that the program could neglect some of the school's strengths, and that it could produce students who have taken courses in a variety of disciplines but who have not learned to integrate knowledge across disciplines.

I offer my remarks in the spirit of trying to head off both threats. Having had a fruitful career in my own interdisciplinary work with John Melack that linked snow hydrology with nutrient cycling in mountain watersheds, and having launched our program at Bren, I believe I have some useful suggestions. I believe strongly in Planck’s 2nd Law, not the one that got him the Nobel Prize and his image on the German two-mark coin, but the other one: Max Planck observed that the exciting work is at the boundaries of the disciplines, because in any established field—e.g., atmospheric science, ecology, civil engineering, etc.—the problems that are both easy and important get picked off early, leaving us with problems that are either really hard or not particularly important. The breakthroughs come when someone looks from a new perspective.

Roughly in priority order, therefore, are my comments:

(1) The vision for the program amongst the key players is inconsistent. The proposal's boilerplate is fine—stressing the need to link the atmosphere, lithosphere, biosphere, and hydrosphere—but the more definitive statements in the body are focused too narrowly and are of different “orders” (a field site, an area of study, and an aircraft). Hydrology is neglected, both as a focus of study in its own right and as a link between physical climate and biogeochemistry. Perhaps part of the problem lies in the hurried way in which the proposal was written, but I suspect the issue is deeper: we all have a tendency to expand on our
own interests and to oversimplify what our colleagues do. When ideas for our UCSB interdisciplinary program were first floated in the late 1980s, everyone said, “What a great idea; we ought to center this new program on what I do.” Getting the key faculty to look beyond their own interests and design a program that meets society’s needs in the context of the campus’s strengths took leadership that derived not from designated authority but from the ability to persuasively articulate positions.

My recommendation, which would take advantage of the school’s strengths, is to develop a program that links physical climate, biogeochemistry, ecology, and hydrology, that combines theory and experiment, that primarily addresses regional and local issues (that may be globally significant), and that links between field/laboratory observations and larger scales. It should emphasize development of a predictive capability involving feedbacks between system components and land management practices.

(2) Making a program work is difficult when the faculty and students come from widely different backgrounds, strengths and weaknesses. Therefore, the program must use special mechanisms and provisions to make it cohesive. A core curriculum is sometimes implemented. For example, Stanford’s PhD in Environment & Resources includes core cores in interdisciplinary analysis, case studies in problem solving, and a seminar. The PhD at Bren/UCSB has no required courses, but we are thinking about one or two. Whatever the mechanism, students and faculty need help in looking at problems from someone else’s perspective, and a course or seminar where they work on or discuss a problem is a wonderful focal point to do this. Next quarter, for example, Charlie Kolstad and I are organizing a small seminar on Climate & Economics. We will use five speakers who will give a short talk and visit with the students; then on the following day after the speaker has departed we will meet with the students and discuss the issues that the talk brought forward.

With this integrating mechanism as a goal, the proposed set of core courses may miss the mark. The seminar and the “fundamental problems” course may be OK, although I am uneasy about plugging in an existing course that has developed around a different audience and purpose. I would usually not characterize courses in GIS or remote sensing as “core.” In the Bren School, the GIS course is the elective course with the highest enrollment, but none of us would argue to add it to the core.

Parenthetically, I urge the SDSM&T faculty not to model this PhD program on their own experiences as graduate students. The folks I interviewed all seemed to have come from fairly traditional PhD programs, although they have matured, expanded and integrated beyond their training. When they described their own PhD experiences, often in positive, glowing terms, I found myself thinking that their own graduate careers are poor templates for this one. The degree of this program’s success and recognition will depend on the faculty’s ability to not rely too much on their own experience.

(3) Quality control is essential to a PhD program but in practice hard to implement. How does the faculty as a group ensure that the standards are high throughout
the program, and that the students are not too narrow? Many graduate programs do this through a series of exams with names like comprehensive or qualifying in which the whole faculty poses questions and evaluates answers, and where many of the topics are far from the student's interests. I would urge you to think of a better mechanism. In Bren/UCSB, for example, we leave the quality control and breadth up to the student's committee, but the Bren faculty as a whole vote to approve the composition of each committee. The “vote” itself is unimportant, as we almost always reach consensus, but the discussion about the student often leads to a committee that is significantly different from the draft composition that started the discussion.

(4) An institute funded largely by soft money will run into difficulties in sustaining a PhD program. I found it surprising that the Institute of Atmospheric Sciences is a soft-money group in a university where such mechanisms are uncommon. This is a long-term issue, but I would urge the system to consider the program’s value (once it is demonstrated) and the likelihood of moving the people into positions with more stable funding.

(5) The program’s quality will depend partly on the quality of the students it recruits, and stable funding for students is often a powerful recruiting incentive. When we get so much of our funding through federal grants, we often go into the spring, when we’re recruiting students, with uncertainty about funding levels in the following fall. A mechanism to use state money to backstop federal funding will be essential to recruit the best graduate students.

I would be happy to respond to questions that my letter raises. Good luck in getting this program going.

Sincerely,

Jeff Dozier
Professor