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UNIVERSITY OF CALIFORNIA, MERCED
ENVIRONMENTAL SYSTEMS GRADUATE PROGRAM

To: Professor Wolfgang Rogge
School of Engineering Resources Committee

From: Professor Thomas Harmon, Chair
Environmental Systems Graduate Program

Cc: Environmental Systems Faculty, Dean Jeff Wright, Dean Maria Pallavicini, Dean Hans Bjornsson, SNRI Director Roger Bales, EVC Keith Alley

Date: November 18, 2008

Re: Environmental Systems input on FTE priorities for 2008-09 Strategic Plan

The Environmental Systems faculty held group meetings on October 17 and 31 to develop this plan. We began by revisiting the ongoing faculty searches and then discussed future priorities. Discussion and prioritization has since taken place via email through both the group and through the closely related Sierra Nevada Research Institute strategic planning process. The following positions emerged as priorities for strengthening the ES group's position in terms of graduate research quality and competitiveness, from the perspective of near-term and longer-term Central Valley, California, national, and global research issues and opportunities.

The Environmental Systems (ES) program strives to equip graduate research students with the knowledge and skills necessary to improve the scientific understanding of coupled Earth systems--atmosphere, hydrosphere, lithosphere and biosphere--and to use this understanding to (1) manage natural resources, (2) engineer the restoration of impaired environments, and (3) inform environment-public health decisions. This improvement in understanding is gained through the systematic study of biological, chemical and physical processes, and through rigorous individualized research programs in natural and engineered environments. Courses are designed to provide the scientific principles underlying the function and sustainability of natural and engineered environmental systems and the socioeconomic and political forces that shape decisions

about these systems. The ES program places the principles of natural science and engineering in the context of (1) ascertaining fundamental processes and properties of environmental systems, (2) integrating physical, chemical and biological cycles, (3) pollution prevention, treatment and ecosystem restoration and (4) resource management and decision making.

Our decadal vision for ES is to be an internationally recognized research and graduate program and our graduate students are known for their innovative and interdisciplinary approach to solving environmental issues. In addition, Environmental Systems is posed to contribute to the stated goals of the campus to increase our recognition as a research institute, promote the success of our junior faculty and to increase graduate student enrollment.

Accomplishments 2007-2008

The 2007-8 accomplishments of Environmental Systems graduate program, include the following: (1) we became the first and remain the only graduate group at UCM to achieve system approval for our graduate degrees, (2) we graduated our first PhD student and brought our total number of MS graduates to four, and (3) with the recruitment and addition of new faculty (Stephen Hart and J. Elliott Campbell, Asmeret Behre, Teamrat Ghezzehei, Wolfgang Rogge) the program now has a foundational elements in microbial ecology, sustainability, soil sciences and air pollution. This year (2007-2008), the total number of graduate students in the program grew to 28, total number of faculty to 23 and total number of research dollars to $5,790,629 (assigned on basis of PI affiliation with ES). We continue to offer a well-attended seminar series that covers the breadth of ES interests.

Goals 2008-2009

Issues of environmental sustainability: climate, ecosystems and energy have been highlighted in the proposed campus-wide Strategic Plan. Environmental Systems is poised to lead UCM in these areas. To that end, ES faculty have developed some short-term goals:

- Increase graduate enrollment 20% and expand our course offering to meet the breath and depth that address our graduate student needs [***Note:*** *to support more rapid graduate student enrollment growth, the ES faculty strongly endorses attainment of an graduate student fellowship endowment as a priority campus-wide development effort.*]
- Maintain sustained growth in research activity and to expand the ecology and ecosystems research to a level comparable to the climate, hydrology, and biogeochemistry research
- To increase the presence of our atmospheric dynamics/air pollution research efforts in California, nationally, and internationally (see requester? request for? reauthorization at the end of this document)

- Increase the base for graduate student support and improve administrative support for graduate program
- Continue to build links with other graduate programs and lay the foundation for the development of new graduate programs (e.g. management and public health) as well as enhance the profile of the Sierra Nevada Research Institute

To achieve these goals, we request the following positions (see Table 1 for resource implications):

Natural resource management. It is recommended that a tenured faculty member at the full or associate professor level be hired in this area. It is expected that this person would help lead the planning for a natural resources management track within the proposed management school. A research emphasis on water, forest, or range would complement existing faculty and help fill an important niche in the UC system. This person could also contribute to the Earth Systems Science degree in the School of Natural Sciences, to a Center for Spatial Analysis that is being investigated by faculty in SoE and SSHA, and to a possible Geography degree at UCM. At the graduate level, a number of discussions have taken place around starting a program in National Park Management, and this person could also contribute strongly to that program.

Rationale and Potential School Affiliation(s). UC Merced has proposed a school of management, and this FTE is needed if ES is to develop a major research thrust in this area. Relevant faculty would reside primarily in SoE or SoM (once it is developed). The graduate and upper division courses taught by this faculty member would contribute to the ES program, as well as to engineering economics and Earth systems science courses.

Ecological engineering or ecohydrology. We recommend an assistant or associate level search for a faculty member who uses engineering principles to design sustainable systems that integrate human activities with the natural environment**,** with particular emphasis on the linkage between hydrologic and ecological systems. Possible areas of research emphasis include interactions among hydrologic, biogeochemical, physiological, and soil processes; hydrologic ecosystem services, integrating water quality, water cycling; spatial analysis and scaling. Remote sensing, field-based measurements, laboratory experiments and modeling are all of interest. As a discipline, ecohydrology addresses the bi-directional regulation of hydrologic and ecological processes, e.g. the flow regime and pollutant levels of water in wetlands regulate the species and the populations that live in the ecosystem, while ecological processes in the wetland regulate the timing and magnitude of water and nutrient fluxes through the system. Ecological engineering involves the design, construction, restoration and management of aquatic and terrestrial ecosystems that have value to both humans and the environment, using principles from engineering, ecology, economics, and natural sciences. The extensive and large-scale ecosystem restoration efforts planned in the Central Valley provide excellent opportunities for both natural laboratories, and research support through applications partnerships with local landowners and conservation entities. Similar efforts are being carried out and across the Western U.S. This position would have collaborative opportunities and synergy with Bales, Conklin, Harmon, Guo, and Traina in SoE and Aguilar, Dayrat, Duffy, Ghezzehei , Kueppers, and O'Day in SoNS.

Rationale and Potential School Affiliation(s)**.** A large number of faculty in ES are actively engaged in national observatory initiatives which are already bringing long-term,

high-impact projects to UC Merced (e.g., NEON, Critical Zone Observatories, and WATERS Network Test Bed projects). The ES Group sees this hire as necessary to position the campus competitively in this new research domain. Major initiatives, including investments in research institutes and academic units, are currently being launched at several major research universities, another sign of the increasing prominence of this subject. Such an individual could reside in any of the Schools, or jointly between schools, depending on their specific expertise. The graduate and upper division teaching contribution by this faculty member would be within the ES program as well as in fundamental engineering, environmental engineering, and Earth systems science courses.

There are major opportunities for research on topics pertaining to ecohydrology concerned with habitat restoration and related issues in California, nationally, and internationally. In California alone, for example, continued allocations to the CALFED program (see website: http://www.calwater.ca.gov/index.aspx) and new allocations to the San Joaquin River Restoration, in support of the 2006 SJR Settlement Agreement (http://www.lao.ca.gov/analysis_2007/resources/res_05_anl07.aspx), will likely be exceed $250 million over the next few years. Given our strategic location and the current ES faculty makeup, an ecohydrologist would be well-positioned to play a major role in this work, bringing both state and national attention to the ES program and UC Merced as a whole.

Environmental health or epidemiology. This position contributes to an environmental health/air pollution focus. This person should be either a biostatistician/epidemiologist and/or molecular epidemiologist. Priorities would be for research focusing on asthma, lung cancer or cardiovascular disease as these are major problems associated with air pollution, which are the leading causes of health problems with major financial impact on the San Joaquin Valley. This position is an excellent complement to research of Forman, Traina, Leppert, and as well as the two other proposed environmental health positions. The teaching role for this person could be in statistics, molecular biology or physiology dependent upon their expertise. As this would be the first epidemiologist, a senior position is recommended.

Rationale and Potential School Affiliation(s). A significant air pollution-related research effort aimed at the understanding and mitigating the escalating air quality problems in the Central Valley, Sierra Nevada, and elsewhere is expected form UC Merced and has already been initiated in the ES group (Professors Rogge, Chen, and Leppert, and a pending air pollution hire) and in NS (Professor Forman). Professor Chen focuses on modeling spatiotemporal emissions distributions under various air pollution control policies. Professor Leppert examines physical-chemical properties of particulate pollution, while NS Professor Forman examines the physiological effects of air pollution on lung tissue. Epidemiology is clearly a gap in this cluster of activity. ES envisions that this position would reside in NS or NS-Management (when in place).

Table 1. Summary of teaching areas and resource requirements for requested faculty lines affiliated with Environmental Systems.

FTE	Primary undergrad teaching	Secondary undergrad teaching	Secondary graduate program	Startup needs	Space Needs
Natural resource management (assoc/full level)	Management (when instituted)	Environmental engineering or Earth systems science	Management (when instituted)	Postdoc support; computational resources	400 sq ft computational lab/student and staff office space
Ecological engineering or ecohydrology (asst/assoc level)	Environmental engineering or Earth systems science	Biology	Quantitative Systems Biology	Postdoc support; field equipment	Field equipment staging space (200 sq ft); wet lab (400 sq ft);
Environmental health or epidemiology (assoc/full level)	Management or Biology (depending on emphasis)	Biology or Management	Quantitative Systems Biology or Management	Postdoc support; computational resources	400 sq ft computational lab/student and staff office space

Addendum: Confirmation of Prior FTE Allocation: Air Pollution/Atmospheric Dynamics

The ES Group wishes to reconfirm its support for a previously allocated cross-school search in the area of atmospheric dynamics. This search has resulted in strong applicant pools in the past, owing to the extensive and unique opportunities for researchers here in the Central Valley. Offers to both a senior and junior candidate were declined, and the ES group voices a strong consensus that this position be searched again in order to build critical mass in this area as quickly as possible.

Atmospheric Dynamics. Atmospheric dynamics will continue to be long term research driver in the context of climate change and air quality management issue atmospheric dynamics involves observational and theoretical analysis of all motion systems of meteorological significance, including global- to regional-scale circulations. Research problems include many topics related to climate change, climate variability, stratospheric dynamics, and the general circulation. Problems in atmospheric chemistry evolve due to natural events, biological and anthropogenic activities, and are linked to the oceans, the solid earth and the biota. Anthropogenic perturbations such as land-use and industrial activities have profoundly modified the chemical composition of the troposphere and stratosphere, with potentially important consequences on future climate and living organisms. Examples of such changes including the formation of an ozone

hole over Antarctica since the late 1970s, the observed trends in long-lived greenhouse gases, the change in the concentrations of tropospheric ozone and acidic deposition due to growing emissions of hydrocarbons, nitrogen oxides and persistent chemicals in industrialized regions.

Rationale and Potential School Affiliation(s). UC Merced has the nucleus for a strong atmospheric dynamics group, but more FTEs are needed if ES is to develop a major research thrust in this area. Relevant faculty would reside primarily in SoE or NS, depending on their specific expertise. The graduate and upper division teaching contributions by this faculty member would contribute to the ES program as well as to fundamental engineering, environmental engineering, and Earth systems science courses.

Teaching Contributions: As discussed previously, this position would teach in the environmental engineering and Earth systems science undergraduate programs in addition to the Environmental Systems graduate program.

Resource Needs: Researchers in this area typically use computation models to understand and predict reactive atmospheric transport behavior. Hence, this faculty member would need support for postdoctoral staff to help initiate his/her research program, computational facilities and workspace (400 sq ft), and office space for his/her graduate students and staff.