

**LAWR STRATEGIC PLAN
2007-2014**

CLIMATE CHANGE

**ENVIRONMENTAL
QUALITY**

**SUSTAINABLE
AGRICULTURE**

**LANDSCAPE
INTERFACES &
PROCESSES**



ROAD MAP FOR THE NEXT DECADE

**Department of Land, Air and Water Resources (LAWR)
March 25, 2008**



Department of
LAND, AIR AND WATER RESOURCES
University of California, Davis

Climate Change • Sustainable Agriculture
Environmental Quality • Landscape Processes

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EXECUTIVE SUMMARY

The past several decades have seen unprecedented changes to the world's vital resources and environments. As economies have expanded and populations have risen, pressures on land, air and water resources have intensified and will intensify even more in the coming decades. Fact is that much of the fate of the world will depend on the decisions we make now, shaped largely by interactions between human and environmental resource systems. Among many questions, we must ask ourselves how we will deal with continued environmental resource changes and whether we can develop a predictive understanding of human-environment interactions for the future? These (and many other) questions present fundamental challenges to scientists and managers.

It is in this context that by way of three retreats and intensive follow-up discussions over the past 3 years, the Department of Land, Air and Water Resources has engaged in planning on the future of resources and environments— with particular focus on California. Here, we provide our vision for LAWR's future, which seeks to better integrate our exemplary disciplinary themes with multidisciplinary environmental teaching, research and outreach. We establish our plan of development along four of such integrated themes – climate change, environmental quality, agricultural sustainability, and landscape interfaces and processes that combined capture the core elements of LAWR while at the same time representing the strong disciplinary emphasis on hydrology, soils, and atmosphere. The aim of the strategic plan is to place LAWR in a unique position in which to attract top scientists in our research and teaching areas, meet student enrollment goals with high quality courses in a broad range of areas, and raise extramural support by increasing public awareness.

There were several factors that prompted this planning process. First, the typical IR fraction of LAWR faculty has recently increased substantially at the same time that future FTE allocations will be more determined than in the past by departmental teaching load, as expressed by Student Faculty Ratio (SFR). Second, the concomitant decrease in OR FTE mandated a re-evaluation of the scope and themes of departmental research and outreach. Third, it was felt that LAWR needs to clarify its identity for the College, University and stakeholders. Finally, in the next 5 years, LAWR expects about 12 retirements (3 in CE), causing significant gaps in its core areas. This plan was developed, parallel to the CAES planning process and includes components requested for UCD academic planning purposes.

The main outcomes of the LAWR's strategic planning efforts therefore are:

- The department has been instrumental in the creation of the new Environmental Sciences and Management (ESM) major, joining the ERS (LAWR) and EBM (ESP) majors. ESM will be an interdisciplinary major, which reflects interactions among (1) physical and chemical sciences, (2) biology and (3) social sciences. This integration is expected to create significant new opportunities, by including clearly defined and differentiated tracks in global climate change, Geographic Information Systems (GIS), watershed science, environmental management, and soil and biogeochemistry. That latter track allows a discontinued Soil Science major to retain its identity; the Atmospheric and Hydrologic Science majors will continue. Moreover, faculty agreed to maintain strong graduate programs in Atmospheric Science, Hydrology, and Soil & Biogeochemistry. A proposal for this new ESM major is close to being approved by UCOP

- LAWR faculty agreed to set minimum faculty teaching expectations and to define an expected teaching load. Faculty will develop a reward system to support both classes critical for the Department's teaching programs as well as for broader educational goals.
- LAWR is expanding its high-enrollment course offerings, specifically by developing lower division service courses, for example in Science and Society (SAS). This expansion will be accomplished by reducing the frequency of course offerings of low-enrollment disciplinary classes and adhering to overall greater teaching expectations.
- LAWR identified four integrated research themes that collectively represent the research, outreach, and to some extent teaching efforts of the Department. These are: Climate Change, Environmental Quality, Landscape Interfaces and Processes, and Sustainable Agriculture. We anticipate leading/contributing to new integrated research proposals, training grants and outreach programs in these departmental core areas.
- To ensure high quality research and to attract the best graduate students, LAWR faculty support increased integration of its 3 departmental-based graduate groups of Atmospheric Science, Hydrologic Sciences and Soil & Biogeochemistry, such as by planning joint graduate student recruitment days and an annual joint LAWR seminar series.
- LAWR is committed to broadening existing outreach activities and to generating new ones. Goals are to generate greater interest, funding, and stakeholder connections. The Department has completed the hiring of an outreach coordinator to work with faculty/students/staff to facilitate and increase departmental outreach activities.
- LAWR proposed and implemented a change of its administrative governance, to move from 3 Program Vice Chairs in Soils and Biogeochemistry, Atmospheric Science, and Hydrology, to a Chair-Vice Chair administrative structure. These faculty administrators will be supported by department-wide committees that are charged with cross-program responsibilities of teaching and curriculum, research, outreach and resource management.
- LAWR will increase efficiency of technical & administrative operations and management of space and facilities. Among other recommendations, the Department will seek ways to use extramural funds to help pay for maintaining existing and expanded resources and technical staff support.
- LAWR has identified 20 new high priority faculty positions (including CE), that collectively reinforce the interdisciplinary nature of its teaching, research and outreach programs along the four integrated research themes and that also maintain important core disciplinary areas. The comprehensive FTE list represents the department's integrated vision of the future, and presents departmental FTE needs in IR, AES and CE for the next decade. This list also considers expected retirements, program gaps, and strategic planning information of the 2007 CAES academic plan.

These 20 high-priority FTE positions, including 5 CE, are no-growth (steady state) FTE positions in the integrated research themes of LAWR (in no priority order):

- I. Climate Change (CC): (1) Cloud Physics; (2) Global Climate Modeling; (3) Regional Climate Modeling; and (4) Snow Hydrology.
 - II. Environmental Quality (EQ): (1) Air Quality, CE; (2) Nutrient Management, CE; (3) Ecosystem Biogeochemical Modeling; (4) Soil Microbial Genomics; (5) Environmental Geochemistry; (6) Regional and Agricultural Air Quality Soil; and (7) Biogeophysics.
 - III. Sustainable Agriculture (SA): (1) Irrigation Management and Water Use Efficiency, CE; (2) Soil Chemistry; (3) Water Management and Policy, CE; (4) Rhizosphere-soil interactions; and (5) Groundwater Resources Management.
 - IV. Landscape Interfaces and Processes (LIP): (1) Landscape-scale Ecophysiology; (2) Remote Sensing, Informatics, and Ecosystem Change; (3) Basin-scale Hydrologic Modeling; and (4) Watershed Management (CE).
- In addition, LAWR has prioritized 2 integrative growth positions in the areas of Climate Change Science (IR) and Water Resources (CE). At opportune times and when necessary, LAWR will prioritize additional growth positions in the other integrative cross-disciplinary themes.

I. STRATEGIC PLANNING PROCESS

The strategic planning was conducted in 4 phases, using departmental retreats to ensure full faculty participation and input. The first retreat was held in March, 2005 and focused on teaching in LAWR, defining ways for our faculty to respond to increasing teaching expectations. Faculty agreed to support the development of new, high-enrollment courses such as in SAS and to revise the ERS curriculum with the goal to ensure faculty commitment to the teaching of ERS and to increase student numbers in courses taught by LAWR faculty. Three working groups were appointed in September'05, each representing the 3 departmental programs and CE, and were charged to address the relevant emerging issues in areas of Research, Curriculum, Outreach, Human Resources (faculty resources and support staff), and Facilities (distributed office, lab, and storage space, and IT). During the second retreat in December, 2005, the working groups reported on (a) goals (b) existing efforts, (c) gaps, and (d) recommended actions. Considerations were given to programmatic research trusts, departmental governance and staffing structure, undergraduate curricula, facility needs, and need for integration with other CAES and campus units. The third phase of the departmental planning started in 2006, with the appointment of four new master working groups (WG's) in Research, Curriculum, Outreach, and Resources, to report at a third departmental retreat in March'06. Each WG was charged by identifying a vision, goals, gaps, and strategies for each of the four main areas, using the outcomes of the first two phases as guidance. The activities of these WG's were coordinated by a departmental strategic planning committee (SPC). In the fourth and last phase of the planning process, faculty committee's were charged in June'06 to identify clusters of faculty FTE, required to support the integrated core themes of the Department, as identified by the Strategic Planning process. The short position descriptions of this final list of FTE was completed in 2007, and presents departmental FTE needs in the next decade, satisfying expected teaching needs, and fill program gaps in current and future research areas that consider expected retirements, program gaps, and strategic planning information.

VISION: To develop the integrated academic environment, human resources and physical resources for support of fundamental scientific advances in understanding of the atmosphere, geosphere, hydrosphere and biosphere and their interactions, at local, regional, and global scales. This integrated academic environment with its exemplary teaching, research, and outreach programs will uniquely position LAWR in the CAES and UCD, so that we attract top scientists in our research and teaching programs, meet student enrollment goals by teaching high quality courses in a broad range of topical areas, and raise extramural support by increasing public awareness.

The context of this vision considers the changing academic working environment with a decline in OR FTE and budget resources, increasing teaching commitments and a campus shift towards interdisciplinary research and interdepartmental teaching. At the same time, LAWR is committed to maintain its high quality disciplinary curricula in Atmospheric Science, Hydrology, and Soil & Biogeochemistry.

Specific goals and action items were identified by working groups in the areas of curriculum, research, outreach and CE, and resources (see implementation section III). These are summarized by:

GOALS:

1. Support faculty in development of current and emerging environmental research programs that encourage inter-disciplinary efforts among faculty within LAWR and with graduate students, postdocs, and collaborators across CAES and UCD campus departments, centers and institutes;
2. Increase enrollment in departmental courses that teach students at UC Davis about the interactions of the atmosphere, geosphere, hydrosphere and biosphere at local, regional, and global scales;
3. To improve the integration of the current programs of Atmospheric Science, Hydrology and Soils & Biogeochemistry, thereby facilitating interdisciplinary research, teaching and outreach;
4. Provide expertise to government agencies, managers, NGOs, and farmers to help solve problems that require system perspective and expertise in basic components of integrated earth systems.

ACTIONS:

- Increasing inter- and multi-disciplinary research;
- Increasing student enrollment in lower division courses that contribute to general education (GE), Science and Society (SAS), and interdepartmental teaching. In the past 4 years, LAWR faculty developed about 10 new courses that have a enrollment goal of 100 or more;
- Re-evaluation of the administrative structure in LAWR, moving from leadership by program (program Vice-Chairs) towards departmental governance through department-wide committees with a Chair-Vice Chair administration;
- Anticipating needs of technical and administrative staff within the changing research and teaching environment;
- Developing alternative outreach and departmental funding, such as endowments, student fellowships, major donors, and recharging from grants. The Department has completed the hiring of an outreach coordinator to work with faculty/students/staff to facilitate and increase departmental outreach activities;
- Making more efficient use of current facilities, office, laboratory and storage space based on needs rather than legacy, using a transparent space and facilities policy, to enhance departmental productivity and interactions;
- Developing curriculum and FTE plans to meet program needs. The department has been instrumental in the creation of the new Environmental Sciences and Management (ESM) major, joining the ERS (LAWR) and EBM (ESP) majors;
- Developing proposals to bring additional faculty FTE into department to support both the disciplinary and interdisciplinary research and teaching areas of the department;
- Making better use of the LAWR web site to showcase research, teaching and outreach programs, and to generate public interest;
- Developing an equitable budget that meets operational needs of departmental programs and the Department as a whole.

II. PRIORITY FTE NEEDS LAWR: 2007-2014

The Department of Land, Air and Water Resources has a total of 39 faculty members, including 9 Cooperative Extension (CE) Specialists in the areas of Irrigation Water Management, Groundwater Quality, Atmospheric Science and Soil Science, and 5 adjunct faculty in addition. With no action, these numbers will be substantially reduced in the next 5 years. In addition to 3 retirements in 2006, LAWR expects about 12 additional retirements in the next 5 years, causing significant gaps in current core research areas, fundamental undergraduate and graduate teaching areas and influential Cooperative Extension programs. LAWR identified a list of 20 high priority faculty and CE positions that meet core disciplinary needs and collectively reinforce the interdisciplinary nature of its teaching, research, and extension programs along the four integrated core themes of the Department: Climate Change, Environmental Quality, Sustainable Agriculture, and Landscape Interfaces and Processes. The comprehensive FTE list represents the department's integrated vision of the future, and presents departmental FTE needs in IR, AES and CE for the next decade that satisfy expected teaching and extension needs, and fill program gaps in current and future research areas, considering expected retirements, program gaps, and strategic planning information. Position descriptions were developed that identify relevant courses that are needed to maintain both interdisciplinary and disciplinary undergraduate teaching programs in LAWR.

These positions offer the opportunity to join a group of outstanding atmospheric, soil biogeochemical and hydrologic scientists that encompass state-of-the-art research support facilities in a highly interactive and interdisciplinary research environment. Expectations for the I&R component involve research and teaching, while the expectations for the AES component involve mission-oriented research and outreach consistent with the California AES mission (<http://caes.ucdavis.edu/Research/AgExpStn.htm>). Teaching expectations may include the occasional sharing or permanent teaching of a high-enrollment lower division courses, such as in Science and Society, or within specific academic programs within the Department. An interest in practical research applications through collaboration with other physical, chemical, geological, biological or social scientists on campus is desirable for any of the listed positions. Consideration will be given for CE faculty to teach, with or without a I&R appointment. In summary, the comprehensive list was developed to portray the integrated vision of LAWR. The position descriptions are organized along clusters, each representing the four integrated research and outreach themes of LAWR: Climate Change, Environmental Quality, Sustainable Agriculture, and Landscape Interfaces and Processes. In addition, the FTE matrix in Table 1 (page 10) identifies the emerging areas of the 2007 CAES Academic plan for each of the 20 identified positions.

Of the 29 Academic Senate faculty, six are women, two are Asian/Asian Americans (one female, one male), and two are Chicano/Latino/Hispanics (both male). The July 12, 2006 Academic Utilization Analysis lists diversity goals of two women in LAWR. The following list of priority FTE positions in the Department of Land, Air and Water Resources (LAWR; <http://lawr.ucdavis.edu/>) was developed as part of the Department's 2008-14 Strategic Plan.

The comprehensive FTE list represents the department's vision of the future, and identifies high priority faculty positions to meet teaching needs for each of the 3 programmatic areas in Hydrology, Atmospheric Science and Soils & Biogeochemistry, as well as to continually support research and outreach programs within and across each of the 4 self-identified integrated core themes. The following considerations were used in the development of position descriptions for the 20 target positions:

1. Maintenance of strengths of the core teaching and research areas in Atmospheric Science, Hydrology and Soils & Biogeochemistry in the department;
2. Alignment of research, teaching and outreach priorities along the 4 integrated core themes of the Department, as developed by the strategic planning process;
3. Development of high-enrollment course offerings across a broad range of environmental sciences, thereby building a stronger department-wide curriculum as well contributing largely to college and campus teaching programs.
4. Fostering of interactions of teaching, research and outreach programs within the department, across the college and campus;
5. Integration of identified priority positions with the emerging areas of college-wide significance, as presented in the 2007 CAES Academic Plan;
6. Identification of critical mission-oriented research and outreach components, justifying AES appointments;

Although the 20 core positions (Table 1, page 10) were originally prioritized as steady state (no growth) positions, to replace faculty retirements and resignations, LAWR envisions growth positions in any of the 4 integrated research theme areas. Specifically, the department requested 2 of such growth positions to the Dean in February of 2008 in the broad areas of Climate Change Science (IR) and Water Resources (CE). The growth FTE were derived from the 20 core positions, combining relevant areas of positions CC3, CC4, LIP2 and LIP3 (Climate Change Scientist) and CE positions SA1, SA2, and LIP4 (Water Resources Specialist). The short position descriptions of the 20 high-priority FTE are listed in section V (page 27), whereas the corresponding expanded position descriptions are presented in Appendix A. The expanded position descriptions of the 2 growth positions are presented in Appendix B.

It is explicitly noted that about half of the 39 LAWR faculty were hired in the 1980's. Based on the current average faculty age of 55 (see Figure 1 on page 26), it is expected that close to half of the current LAWR faculty will retire in about 10 years from now, beyond the planning period of this strategic plan.

Iia. Table 1 with high priority FTE positions in LAWR in alphabetical order by Core Theme (no priority order).

LAWR Integrated Core Themes				
	CLIMATE CHANGE (CC)	ENVIRONMENTAL QUALITY (EQ)	SUSTAINABLE AGRICULTURE (SA)	LANDSCAPE INTERFACES & PROCESSES (LIP)
CAES Emerging Areas				
Agricultural Sustainability		1. Air Quality (CE) 2. Nutrient Management and Land Application of Wastes (CE)	1. Irrigation Management and Water Use (CE) 2. Soil Chemistry 3. Water Management and Policy (CE)	
Biodiversity & Ecosystem Services		3. Ecosystem Bio-geochemical Modeler		1. Landscape-scale Ecophysiology
Complex Microbial Systems		4. Soil Microbial Genomics	4. Rhizosphere-Soil Interactions	
Environmental and Human Health		5. Environmental Geochemist 6. Regional and Agricultural Air Quality		
Environmental Informatics				2. Remote Sensing, Informatics and Ecosystem Change
Global Change, Water & Watersheds	1. Cloud Physics 2. Global Climate Modeling 3. Regional Climate Modeling 4. Snow Hydrology	7. Soil Biogeophysicist	5. Groundwater Resources Management	3. Basin-scale Hydrologic Modeling 4. Watershed Management (CE)

Positions EQ3 and SS2: Hired in 2007 or recruitment in progress

Positions CC3, CC4, LIP2, and LIP3: Highest priority IR FTE – Climate Change Scientist

Positions SA1, SA2, and LIP4: Highest priority CE FTE – Water Resources Specialist

III. a. IMPLEMENTATION – CURRICULUM

Historically, LAWR teaches specialty programs with relatively small student numbers in Soil & Water, Hydrology and Atmospheric Science that typically serve junior and senior students only. These majors serve a very important national niche towards educating professionals with expert knowledge of soil, water and air resources. In addition, the department is the home for the Environmental Resource Science (ERS) major. Whereas the ERS enrolled large number of majors historically, the number of majors has dropped significantly in the last 5 years. LAWR has lost some of its international teaching allure, largely because of UC's ever-rising tuition costs and the impact of this on faculty's ability to recruit the top graduate students from around the world.

Both the lower number of undergraduate students in LAWR and the recent increase in the proportion of IR FTE have raised the awareness of faculty teaching responsibilities. New strategies are employed to increase departmental SFR ratio by (1) developing potential high-enrollment lower division courses that provide General Education (GE) credit for UCD students, such as SAS and Discovery Program courses, (2) increasing visibility of Departmental majors for high school students and the undergraduate student community (advertising, web page, student outreach, outreach coordinator), (3) actively participating and engaging in broader curriculum and teaching issues in the College, for example by exploring the further integration of environmental sciences majors, (4) considering teaching service courses (e.g. in applied mathematics, physics or chemistry), and (5) seeking and developing innovative approaches, such as serving international students through EAP and using distance-learning education (e.g. to coordinate a joint undergraduate soil science program with other UC campuses).

Vision

To develop and maintain a curriculum that satisfies both departmental and college teaching needs, thereby ensuring sufficient faculty expertise to support world class teaching and research programs in LAWR, the college and the campus.

Goals

- Develop large enrollment lower-division course offerings, in addition to maintaining vigorous departmental undergraduate majors of Atmospheric Science, Hydrology, Environmental Science and Management, and graduate programs;
- Through collaboration with ESP, the development of a new major that merges ERS and EBM, thereby creating more clarity for potential undergraduate students, minimize overlap between environmental majors, and create new opportunities for departmental teaching. This new ESM major (Environmental Science and Management) is close to being approved as of Winter'08;

- Develop teaching workload guidelines for individual faculty, striving to equity in teaching expectations among departmental faculty;

Gaps

- Faculty commitment to teach courses outside disciplinary majors;
- Lack of integrated undergraduate and graduate courses, especially field courses that bring students with different main interests together;
- Integration of ERS major with other environmental sciences majors in CAES;
- Lack of teaching expectations in the department;

Existing Efforts

- The development of the new ESM major that includes the creation of tracks in specialized areas, including Soil & Biogeochemistry, GIS & Remote Sensing, Watershed Science, Climate Change and Air Quality, and a capstone course;
- Continued development of new lower-division courses that are designed to service between 50-100 students per course offering, specifically using the Science and Society (SAS) curriculum;
- Elimination of Soil and Water undergraduate major, because of low number of undergraduates, however, curriculum is largely maintained through ESM Soil & Biogeochemistry track;
- Development of new high-enrollment courses, for example, to replace eliminated courses in geography major;
- Maintain instruction for courses required for disciplinary majors in Atmospheric Science and Hydrology, and Soil & Biogeochemistry track in ESM.

Actions

- Develop departmental policy with minimum teaching and advising expectations per unit IR FTE that includes the expectation for faculty with a below-expectation teaching record to co-teach a high-enrollment course;
- Consideration of the development of a reward system for above-expectation teaching record;
- Encourage faculty to teach new courses or co-teach existing high-enrollment courses, especially those that satisfy GE requirements;
- Work closely with ESP to develop a joint major – Environmental Science and Management (ESM) – that merges ERS and EBM;
- Maintain a yearly database of SFR teaching load for IR faculty, to evaluate the effects new teaching efforts such as the development of new courses;

- Appoint a departmental curriculum committee, with membership by major advisors, graduate group chairs and teaching staff, chaired by the LAWR Vice-Chair;
- Encourage faculty and students to use LAWR's new job posting web page: <http://lawr.ucdavis.edu/jobs.htm>;
- Develop webpage that will help attract new undergraduate students in the department. See the Student Scene @ http://lawr.ucdavis.edu/student_scene.htm ;
- Reinvigorate the LAWR Club, and find ways to more involve undergraduate students in departmental activities;
- Integrate graduate groups in LAWR and appoint a department-wide student recruiting committee. Seek funds to organize a LAWR seminar series;
- Include undergraduate recruitment as one of the charges of the outreach coordinator to be hired in the department;
- Develop innovative approaches, such as serving international students through EAP and using distance-learning education.

III.b. IMPLEMENTATION – RESEARCH

LAWR faculty members are internationally recognized for their research. Most faculty members have ongoing international research collaborations and consult/advise across a wide spectrum of agencies and institutions, nationally and worldwide. The reputation of our accomplishments as achieved in a CA setting of productive irrigated agriculture within a landscape of vulnerable natural ecosystems and subjected to increasing environmental constraints is widely recognized and serves many regions in the world with similar climates. This global context has developed historically and continues to grow.

Although recognized nationally and internationally for individual research accomplishments, faculty are realizing that current and future research funding is increasingly allocated to interdisciplinary research teams with multiple investigators. Whereas past success was measured by the productivity of the individual scientists, both institutional and national collaborations are now necessary to be competitive for major research funding (e.g. NEON, CUASHI, Critical Zone, Biocomplexity, MRI), student fellowships (IGERT, REU), and for allocation of faculty FTE (campus initiatives). It is suggested that the historical separation of LAWR programs by programs in Atmospheric Sciences, Hydrology, and Soil & Biogeochemistry has been a limiting factor in the development of cross-cutting departmental research programs and allocation of additional faculty FTE to the Department. Therefore, rather than presenting LAWR as a department with three separate programs, faculty are convinced that, in addition, benefits can be derived by integrating research in LAWR through the recognition of four interdisciplinary research themes that

collectively makeup the identity of the department in teaching, research and outreach, and contribute to mission-oriented AES activities. These integrated core areas are Sustainable Agriculture, Climate Change, Environmental Quality and Landscape Interfaces and Processes.

Vision

The vision of LAWR is to achieve status as the preeminent environmental research and education department at UC is to build and publicize four integrated research thrusts within the department. These research thrusts will foster interaction across the department, the college, and the campus, provide increased opportunities for extramural funding, attract outstanding graduate students, and provide a public service in helping to solve pressing environmental problems.

Goals

In order to achieve the status expressed in the vision statement, LAWR should pursue the following goals:

- Develop several integrated research themes in the department that address current and emerging critical state and national environmental issues;
- Through extensive faculty consultation, develop these themes into research plans capable of creating interdisciplinary interactions, attracting extramural research funding, promote interdisciplinary education, and justifying the allocation of new faculty positions to the department;
- Develop mechanisms, resources, and incentives to initiate and grow the programs within each research theme.

Gaps

- Lack of strategic planning and coherent development in the Environmental Sciences across the Division and on campus across existing departments, centers, and institutes;
- Lack of internal and external identity and recognition;
- Many faculty retirements over next 5 years and a pessimistic outlook for obtaining new faculty positions for at least 5 years;
- Inadequate resources from the college, endowments, donors, etc. to seed and foster new integrative research programs;

- Limited access to the most modern research equipment;
- Lack of long-term technical staff to support and maintain research equipment and to support development of new methods using this equipment.

Existing Efforts

- Through full participation by faculty, identify four integrated research themes: Climate Change, Environmental Quality, Landscape Interfaces & Processes, and Sustainable Agriculture;
- Development of a new web page for alumni and friends, to showcase our department and seek research and teaching support through gifts and endowments; see <http://lawr.ucdavis.edu/alumni&friends.htm> ;
- Develop needs for faculty endowment in the area of Air Quality;
- Hiring of outreach coordinator, helping define and publicize the department's integrated core research areas;
- Hiring of project management staff to coordinate state-funded projects;
- Identification of new and existing research areas for which new faculty FTE could be justified, e.g. Climate Change Science;
- Identify priority faculty positions that are needed as a result of current and near-future retirements in the Department.

Actions

- Revise the research themes through extensive LAWR faculty consultation and identify leaders for each of the research thrust areas with the charge to develop research plans similar to the “front end” of an extramural grant proposal and to develop strategies for aggressively implementing the research plan;
- Develop web-based research and information centers (RICs) for each of the research themes and develop a plan for keeping the sites current with information of interest to the environmental stakeholders;
- Identify needed faculty expertise to replace gaps in core research programs and to accelerate the development of the integrated research themes.
- Consider recruiting for soft money researchers to augment faculty expertise in the integrated research areas;

- Investigate mechanisms for engaging faculty from other departments and colleges in the integrated research projects;
- Aggressively seek donations, endowments, extramural grants to “grow” the research theme areas, e.g. through the web;
- The research theme chairs should meet with JMIE and other campus centers/institutes to coordinate LAWR programs with campus-wide initiatives;
- Define and articulate those research programs that clearly provide support and information to the research programs of other departments;
- Explore avenues for increasing resources to hire more technical staff;
- Consider the creation of a LAWR-based Sierra-to-the-Sea consortium by which faculty would build their individual research programs into a more unified group that integrates departmental research along a transect from Lake Tahoe through the Delta to the ocean.

III.c. IMPLEMENTATION – OUTREACH AND AES MISSION

Natural resource management for agriculture has been the most dominant theme of the AES mission for LAWR in the past, but is shifting as CA is readying for even larger urban populations, land-use transitions, and climate change. A greater recognition of LAWR’s role in integrated resource management is a high priority, as new approaches are needed to balance tradeoffs between environmental quality, agricultural productivity and human well-being (i.e. sustainability). LAWR’s goal is to better integrate and link research and outreach, and to increase cooperation between CE and other faculty in these areas. For that purpose, the hiring of an outreach coordinator to link outreach with LAWR’s 4 integrated research areas is a high priority, thereby providing a brand for the department and a means by which LAWR can better articulate how it differentiates from other departments across the campus.

To meet our vision and goals for the future, two themes for change were apparent. First, to change the process by which LAWR is involved in research and outreach, so that we increase our disciplinary linkages, increase cooperation between CE and other faculty, and increase the diversity of stakeholder involvement. In many cases, this will necessitate greater awareness of public decision-making and policies, and new approaches that use ‘integrative’ biophysical and social science. The other theme is to embark on new research and outreach topics that fill gaps in how we convey information about solving problems of land, air, and water resources to a broader range of stakeholders. LAWR identified 3 gaps in emerging outreach activities: (1) urban soil, water and air quality, (2) agricultural, wildland, and urban interfaces, and (3) recognition and effective use of LAWR’s contributions for natural resource management.

Vision

Develop new knowledge and distribute information about solving problems associated with land, air, and water resources, their linkages, and their relevance to biological systems. Create new outreach approaches that make the LAWR Department at UC Davis recognized as the “go to” Department for information on soil, water, and air, and their environmental services. Provide educational programs that are effectively used in decision-making and policies by a wide range of stakeholders and agencies in California, nationally and internationally.

Goals

- Find new ways to enhance AES Mission and outreach activities to demonstrate the role of soils and biogeochemistry, atmospheric science, and hydrology in solving natural resource and anthropogenic problems in agricultural, urban and wildland ecosystems. Clarify and amplify recognition both on- and off-campus of the importance of the LAWR disciplines for understanding and solving resource problems, including biological resource problems;
- Focus outreach on activities that demonstrate ongoing and potential integration among the LAWR disciplines, emphasizing the importance of that collaboration and integration for addressing resource problems. Make it known that LAWR is one of the few academic units in the world that houses the breadth of expertise needed to integrate natural resource research, outreach, and education;
- Broaden existing outreach activities to include a wider range of land users, other clientele and stakeholders with diverse needs, governmental and non-governmental agencies, and our own campus community. Demonstrate the usefulness of LAWR research to the public in California, including the urban population;
- Generate greater interest, funding, and connections with land users, agencies, and policy-makers in California by finding new directions for research, outreach, and extension, and publicizing LAWR contributions to these efforts;
- Nurture and develop education programs for our students and for various clientele groups that show effective and innovative ways to conduct outreach using the outputs of research by LAWR faculty.

Gaps

- Lack of visibility of departmental outreach activities;
- Need to educate the urban public on the issues related to soil, water and air quality within the State as a whole, partly because they dominate the vote on these issues that determine our long-term resource base. Outreach activities that demonstrate key issues about the natural resources in agricultural and wildland ecosystems should be made available in accessible and interesting ways, with an emphasis on K-12 education;

- Change focus from the natural resource base for agriculture to the interface between different types of ecosystems in agricultural landscapes leads in a new direction. It will better prepare California for dealing with the environmental issues related to human health. Bridging agricultural and wildland ecosystem management requires new scientific integrative approaches involving landscape modeling, interdisciplinary teams, and mediation to increase trust between stakeholders with different interests. LAWR should become increasingly involved in the development of campus centers and initiatives that cross cut disciplines to improve environmental quality in agricultural landscapes;
- Expand opportunities to increase the recognition of LAWR research toward solving problems related to natural resources and their environmental services. Specifically, to develop materials and education for a broader range of stakeholders, e.g., with new types of outreach methods, and to integrate information across landscapes such as for specific environmental issues.
- The lack of clear guidelines of mission-oriented research in the Department, considering the four integrated research themes;
- No clear LAWR designation of CE responsibilities and role in department. Need to define the relationship between CE specialists and farm advisors and the Department;

Existing Efforts

- Develop material for LAWR webpage regarding student recruiting and development purposes;
- Appointment of a department-wide CE and outreach committee;
- Development of the position description and hiring of departmental outreach coordinator;
- Ongoing search and recruitment for a new Hagan Endowed Specialist position in Water Resources Management;

Actions

- Develop guidelines for faculty to include technical and project development staff time in their grant budgets to partially support outreach coordinator salary. Consider to use research and teaching grants (e.g. NSF) to support outreach coordinator in the future;
- Develop priority list for outreach coordinator activities, and consider to include undergraduate student recruiting as one of the priorities;
- Develop RIC (Research Information Centers) and outreach webpage for the research themes in LAWR;
- Reconsider the benefits of a LAWR Advisory Committee and E-Newsletter;

- Develop workshops on land, air and water resource issues for specific urban stakeholders, e.g., geological engineers, city planners, urban farm advisors, landscape architects, master gardeners, local and regional professional societies;
- Work with UC Davis education program to develop K-12 ‘training modules’ for environmental sciences, possibly focusing initially on our nearby counties. Develop recruitment programs for high school seniors that demonstrate the potential for a wide range of jobs in environmental problem solving;
- Consider the pros and cons of recruiting farm advisors to join LAWR;
- Involve LAWR faculty in speaking out for science on controversial issues such as California’s climate change agenda. Distribute LAWR research on environmental problem solving to the general public, e.g., through a weekly newspaper column in the *Sacramento Bee*, to *California Farmer* or other popular press avenues;
- Increase our ability to cooperate with other disciplines to produce ‘integrative’ science for land, air and water resource-related issues in California;
- Recommend UCOP to change title code of Junior Specialist, as it devaluates the identity of a CE specialist;

III.d. IMPLEMENTATION – RESOURCES

Declining departmental resources have significantly impacted technical operations as technical staff numbers have continuously declined. The remaining staff is largely occupied with maintaining mandated safety and health regulations, operation of dedicated instrumentation and equipment, and teaching assistance for courses that need laboratory/field support. To better align resources and project timelines necessitates that LAWR increase the efficiency of its operations by implementing formal management procedures. LAWR agreed to develop guidelines for faculty to include technical and project management staff time in their grant budgets. Moreover, the Department plans to make increasing use of its webpage for equipment inventory, laboratory, and field safety information, and proposal and project management. An internal reward system will be developed to motivate administrative and technical staff for exceptional service.

Current space facilities for Atmospheric Science and Ustin’s remote sensing laboratory (CSTARS) are entirely inadequate. After 10 years of CSTARS moving about the campus, it is critical that LAWR’s facilities must incorporate CSTARS. Furthermore, Atmospheric Science faculty and students need work space that meet acceptable programmatic needs. The renovation of Hunt Hall is an extremely high priority for LAWR, as it provides office and laboratory space for both CSTARS and the Atmospheric Science program of LAWR. Additional resources that are integral to the success of LAWR’s research and teaching programs are the availability of shared field equipment and storage facilities, access to a well-equipped and staffed machine shop and a centralized computer-intensive cluster and server space.

Vision

To meet departmental needs to support anticipated faculty research, teaching and outreach programs, including administrative and technical staff, IT, field and laboratory support, laboratory and field equipment, efficient short-term and archival storage facilities.

Goals

- Provide and manage integrated LAWR office space and facilities to meet the needs of LAWR activities. Key functions include space distribution, facility scheduling, and maintenance of facilities;
- Provide and manage administrative staff to meet the needs of LAWR activities. Key functions include student advising, general personnel support, and addressing unfunded mandates by the college or university;
- Provide and manage financial services for accounts, payroll, and procurement to meet the needs of LAWR activities of all departmental faculty;
- Provide and manage technical operations to meet the needs of LAWR activities. These include information technology, laboratory operations, and field operations. Overseeing the health and safety of LAWR activities is an important component of LAWR technical operations;
- To include LAWR with CSTARs in a new Environmental Sciences Building, to be built as part of a Environmental Sciences Complex with other environmental departments and JMIE ;

Gaps

- Strong evidence of the lack of distributed and equitable distribution of laboratory and field operations. This creates serious problems in the allocation of shared facilities, the training of new users of facilities and equipment, and the proper maintenance of equipment. Moreover, because of the decentralized technical staff management, faculty resources are used inefficiently;
- The lack of project management software, to improve project efficiency of large, multi-investigator research projects;
- Staff and web-based resources support for project planning and management;
- Guidelines for charging project support such as IT and field/laboratory staff to research projects;
- Inventory of existing field and laboratory equipment;

- Absence of departmental staff and equipment tracking system to facilitate resource planning;
- Proposal tracking;
- Lack of well-managed field equipment and sample (plant and soil) storage facilities;
- Provision of centralized cluster/server computing needs, either in the department or centralized in the College or campus;

Existing Efforts

- Renovation of Drainage Laboratory towards a managed short-term field equipment storage facility that incorporates working space for field deployment of equipment and soil/plant sample processing. The new facility is now named the James Luthin Field Environmental Research Facility;
- Provision of long-term storage of soil and plant samples by way of a permanent storage container at the Campbell Tract field station;
- Making departmental inventory of all laboratory/field equipment, including their maintenance status and safety needs;
- Development of webpage for both laboratory and field safety, see <http://lawr.ucdavis.edu/health&safety.htm>;
- Hiring of project management administrative staff person who could also serve liaison responsibilities;
- Ensure that all LAWR employees satisfy cyber-safety guidelines;
- Cultivate administrative staff member skills to capitalize on E-initiatives by the campus, such as E-proposal submission, E-merits and promotions, E-travel, and E-effort reporting of cost-sharing;
- Appointment of a departmental space and facilities committee that provides guidelines for integration of shared storage facilities, office space for faculty, soft money positions, alumni and students, and laboratories in the department;
- Hiring of a soft-money IT staff person to develop, maintain and expand departmental web page;

Actions

- Development of a long-term storage facilities plan, that includes the J. Luthin environmental field research facility, the Airport Storage Bldg, Campbell Tract, and existing greenhouse space behind Hoagland Hall;

- Implementation of ‘matrix’ management for technical support staff, by which core functions are given top priority and short-term projects use skills of individual employees on an as-needed basis;
- Initiate pilot project with faculty volunteers to use MS software ‘Project’ for research project management;
- Evaluate the possibility of assigning using existing technical staff to support a lab&field equipment manager, to oversee all equipment management, safety, policy, QA/QC, maintenance, instruction and teaching use;
- Consider hiring a Junior Specialist to take on routine responsibilities to make up for equipment manager time;
- Expand proposal management webpage, to include information about required departmental resources and budgeted staff FTE;
- Develop a proposal submission and resource tracking system that includes project management tasks in research proposals;
- Develop guidelines for faculty to include technical and project development staff time in their grant budgets. Use these funds to support technical staff;
- Identify baseline support of administrative and technical support staff for the faculty;
- Consideration of the appointment of a departmental Resources Committee;
- Appointment of a PES facilities committee for optimum use of shared storage and research facilities between LAWR and Plant Sciences faculty in PES.

III. e. DEPARTMENTAL GOVERNANCE

Vision

To provide for an effective departmental administrative structure that allows for integrated development of department-wide teaching, research and outreach programs in the four identified core themes.

Goals

- Agree on a departmental administration that instead of vice-chair by Program, governs the department through Vice Chairs and/or department-wide committee's;
- Improve integration of departmental teaching, research and outreach programs;

Existing Efforts

- Consideration of program governance through the departmental Vice Chair, who has program responsibilities regarding program budget, curriculum, IER/IUC and program initiatives;
- Development of position descriptions of Vice Chair. See appendix K;
- Appointment of department-wide committees on IT, curriculum, outreach, space & facilities, safety and equipment, cooperative extension, and other committees that are considered relevant;
- Change merit and promotion process by assigning faculty sponsors to present action to faculty and to write departmental letter. Appointment LAWR committee to provide guidelines for department M&P process.

Department-wide committees will be appointed by the Chair in the following areas: Teaching and Curriculum, Research, Outreach and CE, Safety and Equipment, Space and Facilities, and IT. Committee charges will be developed by the EC, and assigned by the Chair. Committee Chairs will report to the faculty in regular faculty meetings.

As was done for Plant Sciences, a reorganization of the environmental sciences departments might lead to a clearer representation of the various distinct environmental teaching and research programs in the College.

IV. CAMPUS ACADEMIC PLANNING INFORMATION

The following information was provided to complement the CAES planning document as requested by the UCD campus in December'07. Though the timeline of the additional planning was very short, with the CAES deadline of March 23'08, most of the additional information was derived from LAWR's strategic planning efforts. We based our steady state and modest growth scenarios on expected LAWR retirements and campus growth numbers of about 1% growth per annum for the next 5 years. As of winter'08, LAWR is 1.7 FTE above the target FTE; however, this number will drop below target in the next 1-2 years because of retirements.

1. Highest priorities, programmatic strengths, and targets for development, including opportunities of collaboration with other units on campus;

LAWR identified a list of 20 high priority faculty and CE positions that meet core disciplinary needs and collectively reinforce the interdisciplinary nature of its teaching, research, and extension programs along the four integrated core themes of the Department: Climate Change, Environmental Quality, Sustainable Agriculture, and Landscape Interfaces and Processes. The comprehensive FTE list represents the department's integrated vision of the future, and presents departmental FTE needs in IR, AES and CE for the next decade. The 20 priority positions maintain the strong disciplinary teaching and research programs, with growth positions targeted to strengthen interdisciplinary programs within LAWR and between LAWR and other departments in CAES and on campus. The priority FTE are organized along clusters, each representing the four integrated research and outreach themes of LAWR.

a. Steady state (no growth). LAWR anticipates about 9 IR faculty retirements in the coming 5 years. In order to meet core research and teaching core requirements, the no growth scenario will require the hiring of about 2 positions/year.

b. Modest growth. The modest growth scenario includes departmental needs to meet strategic objectives to increase departmental integration of the 3 main academic programs in Atmospheric Science, Hydrology and Soil and Biogeochemistry. Growth positions will specifically be targeted to strengthen interdisciplinary programs within LAWR and with other units in CAES and on campus. For example, the requested **Climate Change Scientist** will greatly advance the strategic goals of LAWR, exemplifying its integrated vision for the future, while meeting urgent state-wide research needs on climate change. Other growth positions will seek on campus collaborations of LAWR in any of the identified integrative cross-disciplinary themes.

2. Optimum faculty size and diversity goals;

The Department of Land, Air and Water Resources has a total of 39 faculty members, including 9 Cooperative Extension (CE) Specialists, and consist of an additional 5 adjunct faculty. In addition to 3 retirements in 2006, LAWR expects about 12 additional retirements (including CE) in the next 5 years, causing significant gaps in current core research areas, fundamental undergraduate and graduate teaching areas and influential Cooperative Extension programs. It is also noted that about half of these faculty were hired in the 1980's. Based on the current average faculty age of 55, it is expected that close to half of the current LAWR faculty will retire in about 10 years from now, beyond the planning period of this strategic plan (See Figure 1 on page 26).

Of the 29 Academic Senate faculty, six are women, two are Asian/Asian Americans (one female, one male), and two are Chicano/Latino/Hispanics (both male). The July 12, 2006 Academic Utilization Analysis lists diversity goals of two women in LAWR. The LAWR Diversity policy numbers are listed in Appendix M.

3. Curriculum;

A proposal for a new major of Environmental Sciences and Management, ESM, is close to being approved by UCOP, being a joint major between ERS (LAWR) and EBM (ESP), to more clearly present choices between environmental majors in the Environmental Sciences Division of the College. The restructuring of the new interdisciplinary major reflects interactions among (1) physical and chemical sciences, (2) biology and (3) social sciences. The breadth of the ESM major is considerably greater than either the ERS or EBM major by itself, whereas the integration of all three subject areas into a single ESM major is expected to create significant new opportunities, by including tracks about the nature and effects of global climate change, Geographic Information Systems (GIS), watershed science, environmental management that spans physical and biological resources, and soil & biogeochemistry, thereby allowing soil science to retain its identity as a track;

LAWR has prioritized the teaching of high-enrollment course offerings, specifically by developing lower division service courses, for example in Science and Society (SAS) that provide for GE credit for undergraduate students. This can be accomplished by reducing the frequency of course offerings of low-enrollment disciplinary classes and agreement of new teaching assignments with new faculty. Already, in the past 4 years, LAWR faculty developed about 10 new courses that have a enrollment goal of 100 or more.

4. Graduate student goals, opportunities and constraints

To ensure high quality research and to attract the best graduate students, LAWR faculty supported to increase integration of its 3 departmental-based graduate groups of Atmospheric Science (AT GG), Hydrologic Sciences (HS GG) and Soil & Biogeochemistry (SBG GG), by planning joint graduate student recruitment days and the offering of an annual joint LAWR seminar series. The steady state number of graduate students in LAWR fluctuates between 80 and 120, with about equal number of students between each of the 3 graduate groups. The graduate student number is constrained by faculty research grants and office/laboratory space in the department. Opportunities mainly arise because of improved integration and collaboration with other campus units, for a projected growth to about 160 graduate students, with a 50-50 split between MS and PhD.

Faculty are increasingly realizing that future research funding is increasingly allocated to interdisciplinary research teams with multiple investigators, and recognize the need for institutional and national collaborations, e.g. through student fellowships (IGERT, REU) and research collaborations (e.g. NEON, CUASHI). Growth can occur mainly by involvement of more faculty outside LAWR in their graduate programs. It is anticipated that Climate Change and Environmental Quality, as well as the other integrated core themes of LAWR, will continue to be potential growth areas for the 3 graduate groups.

5. Assessment mechanisms

In their strategic planning, LAWR faculty considered the benefits of a departmental advisory committee versus a departmental review by an outside committee of experts. Whereas an advisory committee was considered beneficial to expand outreach to stakeholders, faculty were more supportive of an external review of their academic programs by a review panel.

6. Resources

Technical support staff is largely occupied with maintaining mandated safety and health regulations, operation of dedicated instrumentation and equipment, and teaching assistance for courses that need laboratory/field support. To better align resources and project timelines necessitates that LAWR increase the efficiency of its operations by implementing formal management procedures. Moreover, faculty agreed to develop guidelines for faculty to include technical and project management staff time in their grant budgets.

The renovation of Hunt Hall is an extremely high priority for LAWR, as it provides office and laboratory space for both CSTARS and the Atmospheric Science program of LAWR. Additional resources that are integral to the success of LAWR's research and teaching programs are the availability of shared field equipment and storage facilities, access to a well-equipped and staffed machine shop and a centralized computer-intensive cluster and server space.

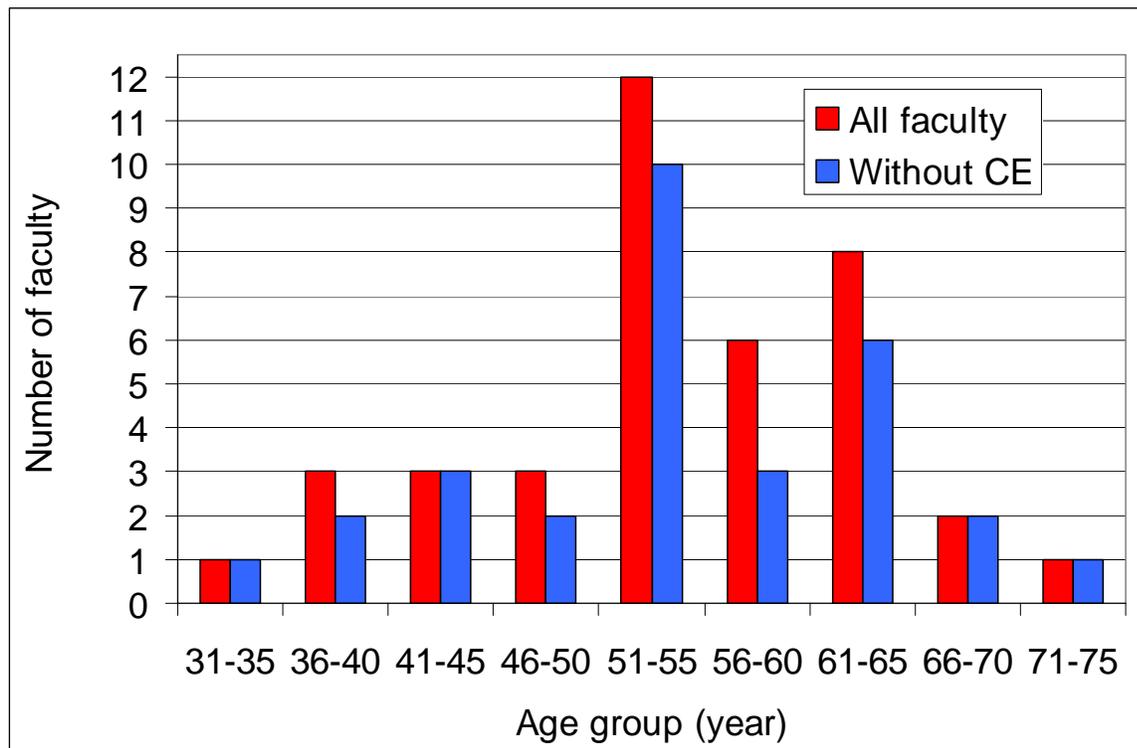


Figure 1. Age distribution of LAWR faculty distribution (2008).

V. Priority Positions: Short position descriptions: 2007-2014 (CC: Climate Change, EQ: Environmental Quality, SA: Sustainable Agriculture, LIP: Landscape Interfaces & Processes.

Position CC1: Cloud Physics

Advances in understanding the feedbacks among changing atmospheric composition (aerosols, water vapor, CO₂, etc), irrigation patterns, energy fluxes, and rising temperatures on clouds and precipitation are of paramount importance for climate-change predictions and projecting California's future water supply. Cloud-physics research may be focused on empirical, experimental, and modeling methods that assess interactions of cloud dynamics with earth surface processes at multiple scales. Teaching expectations include undergraduate and graduate courses on cloud physics and processes that control the formation and evolution of clouds. In addition, the candidate should be able to teach general courses in atmospheric sciences.

Position CC2: Global Climate Modeling

Integration of climatic processes across the land-sea boundary is crucial to predicting climate change impacts in California, the western United States, and globally. Advanced coupled models linking atmosphere/land/ice/ocean/biogeochemical interactions that are resolved at high spatial and temporal resolutions are needed to reduce prognostic uncertainties at the global scale. Expertise needed includes the development and use of high-resolution statistical and dynamical global climate models. Teaching needs include courses on global climate change, global climate modeling, and general atmospheric science at the undergraduate and graduate levels.

Position CC3: Regional Climate Modeling

Integration of climatic processes at the basin and regional scales is crucial to predicting climate change impacts in a California faced with dramatically increasing population through 2050 and declining water resources. Anticipated effects of climate change on increased temperatures and air pollution, coupled with reduced Sierra snow pack and early spring snowmelt, will critically impact agriculture, the municipal sector, water resources, and sustainability of ecosystem goods and services. The candidate's research should focus on modeling interactions at the regional scale between atmosphere/land/ocean/ biogeochemical cycles. Teaching responsibilities include the development of undergraduate courses on climate change influences on ecosystems and landscapes and a graduate course on modeling of regional climate dynamics.

Position CC4: Snow Hydrology

Snowfall, accumulation and melt are important hydrological processes in mountainous watersheds, such as the Sierras and Coastal Range. The current lack of an understanding of how snow processes are impacted by climate change and its variability prevents accurate prediction of regional flooding, water supply, hydropower energy production, and fish migration success. This position is expected to study snow processes and how those processes impact water resources and water availability for ecology, irrigation, urban and industrial uses. Candidate will be expected to teach an undergraduate course on snow hydrology, an interdisciplinary course on the role of snow in society, and a graduate course of their interest.

Position EQ1: Air Quality Specialist (CE)

Commodity representatives in California are very concerned about the economic viability of their agricultural operations in the face of new emissions regulations. Agricultural emissions degrade the air quality of downwind areas, while at the same time agricultural commodities suffer from air quality problems caused by urban areas, vehicles and utilities. The proposed position would focus

on the effects of agricultural emissions on air quality and exploring strategies to reduce agriculture's impacts. A Cooperative Extension Specialist is needed in the Department of Land, Air and Water Resources to develop an applied research and outreach program in air quality with emphasis on particulate forms of air pollution, and to develop a state-wide research and outreach program in the field of air pollution monitoring and emission control measures. The incumbent's extension and research program would benefit from, and complement, existing strengths in air quality research within the College and existing programs. This position will work closely with a diverse stakeholder group including policy makers, urban groups, farm advisors, and natural resource agencies to showcase research based information about pollution monitoring and control strategies.

Position EQ2: Nutrient Management and Land Application of Waste (CE)

This position will focus on problems associated with land application of nutrients and waste. Consumers are demanding foods grown with cleaner, safer, and more efficient agricultural practices. A Cooperative Extension Specialist in nutrient management and land application of waste is needed in the Department of Land, Air and Water Resources to fill gaps left by past and future retirements in this area. This position will deal with a variety of issues surrounding nutrient and waste management, many of which are central to the pending energy crisis, climate change, urbanization and food safety. A Cooperative Extension Specialist is sought to pursue research and outreach in the area of nutrient management and land application of waste, and who will work with a diverse stakeholder group including USDA-NRCS, growers, regulatory agencies (state water resource control board, regional water quality control board, Air Resource Board), fertilizer industry and municipalities.

Position EQ3: Ecosystem Biogeochemical Modeler

This position focuses on the forecasting of ecosystem change, biogeochemical process models of ecosystem dynamics must be expanded to regional and larger scales. Research will focus on the utilization of existing large-scale manipulations, large-scale spatial databases, and modeling to understand the impact of fluxes of biologically important elements on ecosystems. The scientist in this position will develop and validate models addressing effects of global and regional changes in sources, transport, transformation, and deposition of biologically important elements on terrestrial and aquatic ecosystems, with a non-exclusive focus on California ecosystems. Potential areas of teaching include: biogeochemical modeling, ecosystem biogeochemistry, global biogeochemical cycling, ecosystem dynamics, watershed dynamics and management, and an undergraduate course on environmental change.

Position EQ4: Soil Microbial Genomics

This position is focused on microbial molecular ecology and metagenomics in soil and subsurface environments with an emphasis on using genomics to investigate the phylogenetic and functional diversity of microorganisms and communities. Soil microorganisms, making up the most genetically and biochemically diverse communities on the planet; and contain millions of genes and thousands of genetic and regulatory processes. There is a growing need to better understand the activities and interactions of soil microorganisms at the molecular scale and link this information to microbial driven processes at the landscape and global scale. Expected research includes the development and application of molecular biological techniques, including metagenomic approaches, microarray technologies, and biological reporting systems. New courses in soil biotechnology or soil microbial genomics are expected, and this position could also co-teach soil microbiology.

Position EQ5: Environmental Geochemist

Recent retirements together with the increasing relevance of pollutant transport have left the campus and LAWR currently weak in the area of inorganic geochemistry and reactive transport of dissolved chemicals. Such expertise is essential for research and teaching on transport and fate of agricultural, urban and naturally occurring chemicals. This position is expected to create a strong, internationally recognized and independent research program with an emphasis on geochemistry in the context of reactive chemical transport and environmental tracers in surface and subsurface (soil, vadose zone, groundwater) waters. Teaching needs include undergraduate and graduate level courses in watershed chemistry, chemical transport processes, environmental tracers, or aqueous (geo)chemistry.

Position EQ6: Regional and Agricultural Air Quality

Air quality in the San Joaquin Valley is deteriorating and wide range of stakeholders as diverse as dairy feedlots and the San Francisco Bay Area's emissions have been blamed. In addition, air quality in the region is affected by climate change and affects climate change. Specifically, impacts of regionally-generated and transported materials and chemicals on gaseous and particulate air quality, with an emphasis on agricultural and/or regional issues. The air quality specialist will place emphasis on the processes and impacts of regionally-and/or agriculturally-generated and transported materials and chemicals on air quality (such as dust, PM10, PM2.5, aerosols, ammonia, organics and other trace constituents). Potential areas of teaching include undergraduate courses in air pollution and regional air quality.

Position EQ7: Soil Biogeophysicist

Only limited information is available on affects of land use and soil disturbance on the physical and biological processes affecting greenhouse gas (methane, nitrous oxide, carbon dioxide, etc.) emission from soil. As a result, predicting the extent of soil GHG emissions are distinct shortcomings in current predictive models of regional and global climate. Advances in understanding the feedbacks on soil processes affecting GHG emission from rising temperatures, agricultural intensification, and soil disturbance is needed to address the role of soils in influencing the composition of the atmosphere. This position emphasizes the study of relationships between soil physical and biological processes affecting the fate of GHG. This position is expected to teach an undergraduate on soil biogeophysics, and would teach general courses in soil and environmental sciences.

Position SA1: Irrigation Management and Water Use Efficiency (CE)

LAWR is highly regarded for its strengths in applied research and extension in the area of irrigation water management and water use efficiency. Future planned retirements will decimate this program unless positions are refilled to maintain excellence in this field. This position will work with agricultural stakeholders to improve the sustainability of irrigated agriculture in California directly addressing issues surrounding water supply, quality, and agricultural productivity at regional-scales. This position will conduct applied research and outreach in collaboration with stakeholders and farm advisors to develop and evaluate the efficacy of current irrigation practices in terms of water use efficiency and water quality, and develop new practices best suited for the conditions of California. This position is expected to provide leadership to highlight the irrigation program at University of California. Extension education programs will be directed towards all stakeholders in irrigated agriculture including water users, policy makers, regional planners and to the general public.

Position SA2: Soil Chemistry

The Boswell Chair in Soil Science is recruited at the Associate or Full Professor ranks, but must essentially be a mid-career applicant to conduct soil chemical research related to sustainable agriculture in California. The Boswell Chair will provide leadership in integrating application of soil chemical and physical principles to agriculture and natural resource challenges at farm and regional scales in California. The Boswell Chair is expected to develop major research initiatives on problems of agricultural sustainability such as potentially toxic trace elements (e.g., Se, As, B), saline and sodic soil management and reclamation, nutrient availability and transport dynamics, soil pH management, soil chemistry aspects of wetlands and evaporation ponds, soil quality-food quality relationships, and pesticide fate and transport. The candidate will contribute to development of and teach in the Agricultural Sustainability curriculum.

Position SA3: Water Management and Policy (Hagan Endowed Chair in CE)

A Cooperative Extension Specialist is needed in LAWR to develop a research and outreach program in the area of water management and policy. This position will work to maintain a sustainable water supply addressing the needs of the multiple and diverse stakeholders of California's water supply including agricultural users and irrigation districts, regulatory agencies, resource agencies, environmental groups, municipal demands, and recreational users. The proposed water management and policy CE position is designed to stimulate, integrate, and focus water science research on the Davis campus toward finding solutions to California's water policy problems. Extension Education programs will be directed towards parties involved in water policy and planning and to the general public.

Position SA4: Rhizosphere-soil interactions

This position on rhizosphere-soil interactions emphasizes the interactions among soil microorganisms, plant roots, and the soil environment and their control on plant productivity, cycling of resources and materials within ecosystems, and environmental quality at the landscape scale. Improved understanding of these processes should result in innovative management solutions that contribute to long-term agricultural productivity and maintenance of the resource base upon which agriculture depends, i.e., agricultural sustainability. This position would complement existing expertise in LAWR, and add new expertise to the microbial component of environmental and ecological studies in the department. Innovative areas of research could include investigation of mechanisms of how plant roots and microbial communities communicate and interact. This position would co-teach soil microbiology, and develop a new course in rhizosphere biochemistry or ecology.

Position SA5: Groundwater Resources Management

California has a large and complex water delivery system with most surface water sources developed and significant utilization of groundwater contributing to redistribution via interbasin storage and transfer projects regulated by many government and commercial entities. Irrigated agriculture utilizes much of the regional surface and subsurface water resources in California. The potential for more extreme weather years with climate change and the possibility of major changes in agricultural management and cropping patterns in response to reduced availability of water requires significant development of new optimization methods and models to anticipate conjunctive water use and predict consequences of water policy alternatives in the State. This position is expected to study diverse water resources management problems using new, advanced systems analysis methods. Teaching needs include an undergraduate course in water resources management and a graduate course in modeling water management from the perspective of climate change.

Position LIP1: Landscape-scale Ecophysiology: Plant and Soil Interactions

This position focuses on the study of plant-soil-water interactions with particular emphasis on ecological and hydrological land-surface processes at the plant to landscape scale. This area of study is especially relevant for California's natural ecosystems where forest understory management is key to fire protection, and for agricultural systems where water limits productivity and soils often accumulate salts, thereby impacting soil and water quality. Much of the needed expertise has vanished with recent retirements, yet it is becoming increasingly clear that environmental studies in natural environments lack the much-needed larger-scale expertise. This position would satisfy the teaching needs for an undergraduate course in environmental physics and/or ERS course in Trees/Forests, and a graduate course in evapotranspiration and plant-soil-water interactions.

Position LIP2: Remote Sensing, Informatics and Ecosystem Change

A wide range of information is needed to predict the consequences of climate change and to monitor the biogeochemical cycles, from properties that regulate fluxes of CO₂ and water, to estimates of standing biomass, land cover types, water resources, and land use history. Climate dynamics and land use together drive changes in ecosystem distributions and land cover, creating unpredictable patterns of environmental stresses and disturbance regimes in natural and managed ecosystems. There is a growing awareness among environmental scientists that remote sensing can and must play a major role in providing the data needed to assess and model environmental conditions and to monitor change at all spatial scales. Modern environmental informatics require data fusion using a wide range of data types, requiring expertise in database management and data workflows. Course needs include the application of digital remote sensing data and quantitative image processing methods and informatics, to assess environmental properties and conditions.

Position LIP3: Basin-Scale Hydrologic Modeling

A wide range of water users, including land owners, irrigation districts, flood control districts, and government agencies are in need of accurate predictions of precipitation, snowpack size, runoff, evapotranspiration, and groundwater levels to manage flood and drought risks. In addition, evaluation of the impacts of limited water resources on agriculture and progression towards a system of sustainable irrigated agriculture requires a holistic approach that considers water resources, delivery, application and cycling at the basin scale. Research should focus on scientific advances stemming from development and implementation of distributed hydrological models incorporating modules for climatic, agricultural, ecological, biogeochemical, and/or geomorphic processes, including their inter-relationships. Teaching expectations include an undergraduate course on the use of basin-scale hydrological models in solving environmental problems.

Position LIP4: Watershed Management (CE)

Pressing watershed issues facing California include a) maintenance of sustainable water supplies through protection of source waters, b) reduction of loadings of nutrients, suspended sediments, and toxic chemicals released by land use to waterways, c) landslide hazard assessment and reduction, and d) habitat assessment, protection, and restoration. The Department of Land, Air and Water Resources is a leader in producing science in support of watershed management, but the demand for outreach greatly exceeds the current capacity to provide it. A Cooperative Extension Specialist is sought to pursue research and outreach on watershed management. This position will work with a diverse stakeholder group that includes interaction with UCCE farm advisors, regulatory agencies, industry and municipalities to provide leadership in watershed management in wilderness, urban, rangeland and agricultural areas.