

**ARIZONA UNIVERSITY SYSTEM  
CHIEF ACADEMIC OFFICERS GUIDELINES FOR  
REQUESTS FOR IMPLEMENTATION AUTHORIZATION  
FOR NEW ACADEMIC DEGREE PROGRAM  
[DUPLICATIVE PROGRAM]**

**I. PROGRAM NAME, DESCRIPTION and CIP CODE**

**A. DEGREE(S), DEPARTMENT AND COLLEGE AND CIP CODE**

**Bachelor of Science; Department of Geography and Regional Development; College of Social and Behavioral Sciences; CIP CODE: 45.0701**

**B. PURPOSE AND NATURE OF PROGRAM**

Geographers study spatial distributions of physical and human phenomena over Earth's surface and the interrelationships of humans and the natural environment. Their work ranges from description and mapping, through scientific analysis and explanation, to forecasting and planning. Geography thus has a broad scope and integrates elements from the social and natural sciences. Two principal divisions of geography exist - human geography and physical geography - linked by a common background, mutual concern for humans and the environment, and a body of related theory and methodology. The Department of Geography and Regional Development (GRD) at the University of Arizona currently offers two degrees: a Bachelor of Arts in Geography, which includes concentrations in Environmental Geography, Social and Cultural Geography, and Development Studies, and a Bachelor of Science in Regional Development, which focuses on Demography, Economic Geography, Urban and Regional Development, and Planning. GRD also offer Minors in Geography, Regional Development, and Geographic Information Science.

We have designed the proposed Bachelor of Science in Geography to emphasize development of quantitative skills (math, computer science, statistics) and enhance background in the natural sciences. **The new degree would have three concentrations: Physical Geography, Geographic Information Science (GISci) and Water, Environment & Society:** The Physical Geography concentration would provide majors rigorous training in Earth and environmental science, emphasizing quantitative and scientific approaches to studying Earth's physical environment. Students would be expected to complement coursework in physical geography with relevant courses from allied disciplines (*see list below*). The GISci concentration would prepare students for employment opportunities and research in environmental analysis, assessment and management, map making, remote sensing, geovisualization, regional analysis, economic and urban spatial analysis, and teaching. The emphasis will not only be on training students in the use of GISci technologies (e.g., geographic information systems; remote sensing; research methods), but also on the theory and proper application of GISci tools. The Water, Environment & Society concentration would prepare students for resource planning careers in the public sector, non-governmental organizations, city and state governments and private industry.

We offer four compelling reasons for adding a Bachelor of Science in Geography:

1. A concentration in **Physical Geography** will focus on spatial pattern and process associated with climate, biota and landforms--all key topics in Earth System Science. The comparative rigor of the B.S. will attract science-oriented students, who recognize the competitive advantage of a B.S. in the marketplace (e.g., many federal resource management jobs require a Bachelor of Science). Our motivation stems also from a growing focus on physical geography within the UA Geography Department over the last decade, exemplified by the addition of physical scientists in both the core faculty (Andrew Comrie, John Kupfer, and Stephen Yool) and affiliate faculty (Julio Betancourt, Katherine Hirschboeck, Vance Holliday, Jon Pelletier, Tom Swetnam). This faculty has extensive training and professional reputations in natural sciences outside Geography (e.g., atmospheric science, botany, ecology, geology, and water resources) and publish regularly in related journals.
2. A dedicated **Geographic Information Science (GISci)** concentration within Geography will train students in applications of information technology. Geographic information science (including GIS, geovisualization and remote sensing) is an area of high growth and market demand for our majors, as well as a targeted area within Focused Excellence Information Technology efforts at the UA. Recent GRD recruitments in GISci (Keiron Bailey), addition of a Staff Cartographer and another GISci/water policy colleague in the near term, plus ongoing information technology projects by GRD faculty members Stuart Marsh, Stephen Yool, Chuck Hutchinson (Director, Office of Arid Lands Studies) Gary Christopherson (Director, Center for Applied Spatial Analysis), and Willem van Leeuwen demonstrate we are expanding GISci offerings. We have, accordingly, added three years ago an undergraduate Minor in GISci and, beginning AY 2005-2006, offered a graduate certificate in GISci.
3. A concentration in **Water, Environment & Society** will expose students to the broad scope of water supply and demand. This theme has emerged as a key planning issue in the Western United States, thus prompts the need for trained geographers. Three colleagues (Dr. Carl Bauer and Dr. Christopher Scott and Dr. Connie Woodhouse) comprise the core faculty for this concentration. They are joined by distinguished affiliate faculty (Dr. Bonnie Colby, Professor Kathy Jacobs, and Dr. Sharon Megdal) all of whom are leaders in the Arizona water policy arena.
4. GRD is one of the largest departments in the U.S., with over 350 students split between our two majors. GRD undergraduates have been extremely successful in recent years (e.g., recent winners of the Centennial Achievement Undergraduate Awards, College of Social and Behavioral Sciences/Arizona Foundation Outstanding Senior Award, and Secretary General for the 2004 United Nations Association of the USA Model United Nations Conference). We are a Top 20 program as ranked by the National Research Council. Following suggestions from a successful external review, we have been working on reorganizing our undergraduate curriculum. Among the primary suggestions of the reviewers was the addition of a B.S. in geography, an upgrade the department had long discussed. A current review of peer departments shows most offer both a B.A. and a B.S.,

and a handful offer only a B.S. Few offer only a B.A. Given the increased growth in departmental expertise in physical geography and information technology, we believe the B.S. in Geography is the next logical step in our growth.

### **C. PROGRAM**

#### **Proposed Bachelor of Science in Geography (36 Units)**

##### **Concentration: Physical Geography**

*Core: (15 units) (identical to Bachelor of Arts in Geography)*

Introduction to Human Geography course (GEOG 210, 251, 256) (3 units)

Introduction to Physical Geography course (GEOG 220, 230, 240) (3 units)

Methods courses (GEOG 303, 330, 357, 416A, 416C, 416D, 416E, 417, 419, 420, 422, 424, 457, 483, 484) (6 units)

Non-US Regional Geography course (GEOG 369, 409, 411, 412, 413, 460) (3 units)

*Advanced coursework: (15 units)*

Additional Introduction to Physical Geography course (GEOG 220, 230, 240) (3 units)

Additional Methods courses (GEOG 303, 330, 357, 416A, 416C, 416D, 416E, 417, 419, 420, 422, 424, 457, 464, 483, 484) (3 units)

Advanced physical geography coursework (GEOG 430, 431, 438, 450, 478, RNR 406L/R; RNR 438, RAM 382) (9 units)

*Electives: (6 units)*

Additional 200 or 300 level units to be selected from geography or other natural science courses as approved by Faculty Advisors.

##### **Concentration: Geographic Information Science (GISci)**

*Core: (18 units)*

Intro to Human Geography course (GEOG 210, 251 or 256) (3 units)

Intro to Physical Geography course (GEOG 220, 230, or 240) (3 units)

Geographic Information Science Core Classes (GEOG 330, 416A, 417 and 457) (12 units)

*Advanced coursework: (9 units)*

Additional GIS coursework (GEOG 303, 357, 416C, 416D, 416E, 419, 420, 422, 424, 483, 484) (9 units)

*Electives (9 units)*

Additional 200 or 300 level units to be selected from geography or other natural science courses as approved by Faculty Advisors.

##### **Concentration: Water, Environment & Society**

*Core: (18 units)*

Intro to Human Geography course (GEOG 210, 251 or 256) (3 units)

Intro to Physical Geography course (GEOG 220, 230, or 240) (3 units)

Geographic Information Science Core Classes (GEOG 330, 416A, 417 and 457) (12 units)

*Advanced coursework: (9 units)*

Additional coursework (GEOG 304, 440, 458) (9 units)

*Electives (9 units)*


Additional 200 or 300 level units to be selected from geography or other natural science courses as approved by Faculty Advisors.

**The curriculum proposed above for the B.S. differs significantly from the B.A. The B.S. trajectory offers students much greater disciplinary depth and methodological rigor in physical geography and geospatial information technology than required for the B.A. degree.**

#### **D. CURRENT COURSES AND EXISTING PROGRAMS**

All of the courses for the proposed B.S. are offered currently by Geography and Regional Development or as crosslists with other departments on the UA campus. We have developed via cross listings with other units a rich menu of courses to complement the GISci concentration. All our GISci courses are for example cross-listed with the School of Natural Resources (SNR). SNR collaborates also on our joint GIS Certificate, contributing the following courses: GEOG 417 (Intro GIS), GEOG 419 (Cartographic Modeling), GEOG 420 (Advanced GIS), and GEOG 422 (Resource Mapping).

#### **E. NEW COURSES NEEDED**

 New courses are needed and approved for the Water, Environment & Society concentration. We have made 3 hires (Bauer, Scott & Woodhouse) and incumbent no-cost affiliates (Jacobs and Megdal), who will all teach the following new courses:

AZ Water Policy (Megdal/Jacobs): Focuses on regional institutions and their roles in planning sustainable water supplies in arid lands. Offered in spring Bauer and Scott will assist by teaching one module/ session each next spring.

Intro to Water Resources Policy (Scott) focusing on international cases that bring together resources, management and policy should be offered a fall course.

Comparative and International Water Policy (Bauer): Focuses on legal frameworks, property rights, international comparative) would alternate with Intro to Water Resources Policy.

Applications of hydrologic and water resource models (Woodhouse): Surveys mechanisms of the hydrologic cycle and the fate of moisture in hydrologic systems.

The Woodhouse hire in Physical Geography gives GRD flexibility to maintain its current climate courses (GEOG230 and GEOG430/530) while expanding simultaneously the proposed concentration in Water, Environment & Society.

Current faculty service includes the courses proposed for the Geographic Information Science concentration, but we have no-cost flexibility to expand these offerings through collaborations in place with colleagues in the School of Natural Resources.

## **F. REQUIREMENTS FOR ACCREDITATION**

No accreditation is needed for Geography programs.

## **II. STUDENT LEARNING OUTCOMES AND ASSESSMENT**

### **A. What are the intended student outcomes?**

Student learning outcomes are identified in three areas:

1. Gain a full breadth of knowledge in the field of Geography.
2. Understand concepts required for success in a Geography or Geography-related profession.
3. Understanding geographic basis for regionalization and globalization
4. Be able to analyze and model demographic processes.
5. Understand theories and processes of growth and planning.
6. Understand theories of environmental justice, with application to social, cultural and economic geography.
7. Understand relationships between human activities and environmental/health sustainability.
8. Understand factors influencing climate patterns over Earth's surface.
9. Understand processes that determine spatial patterns of species and ecosystems.
10. Understand physical factors responsible for shaping Earth's landforms.
11. Understand causes and effects of regional and global environmental change.
12. Acquire the methodological skills required to act successfully on this knowledge base.

### **B. Provide a plan for assessing intended student outcomes.**

We will use an exit survey to assess student outcomes (Appendix B).  
We will archive results to track effects of future curriculum changes.

## **III. STATE'S NEED FOR THE PROGRAM**

### **A. How does this program fulfill the needs of the state of Arizona and the region?**

General college enrollment pressure is high in Arizona (Figures 1 & 2). More compelling still are the favoring in-state tuition rates, suggesting more graduating seniors will attend Arizona universities (Figure 3). The proposed B.S. in Geography is consistent with the UofA Focused Excellence initiative. Focused Excellence means excellence by familiar national academic standards. It requires distinction as a student-centered research university created by a culture of imagination and discovery. Focused excellence demands a stimulating learning environment both broadly inclusive of talent and characterized by intellectual distinction. Because resources will always be limited and true excellence is

expensive, it is necessary for the University of Arizona to focus available resources of time and money in specific domains across the spectrum of university activities, preserving a healthy balance among the arts, sciences, humanities, social sciences, professions that improve the human condition--resisting the temptation to offer every academic subject and meet every societal need. The B.S. in Geography, with its foci in physical geography and GISci, addresses the Earth Sciences and Environmental Programs theme identified in the UA Focused Excellence initiative. Statistics shown in Figures 1, 2 and 3 argue for increasing college enrollments.

Fig. 12. Projected High School Graduates, 2001-02 to 2011-12

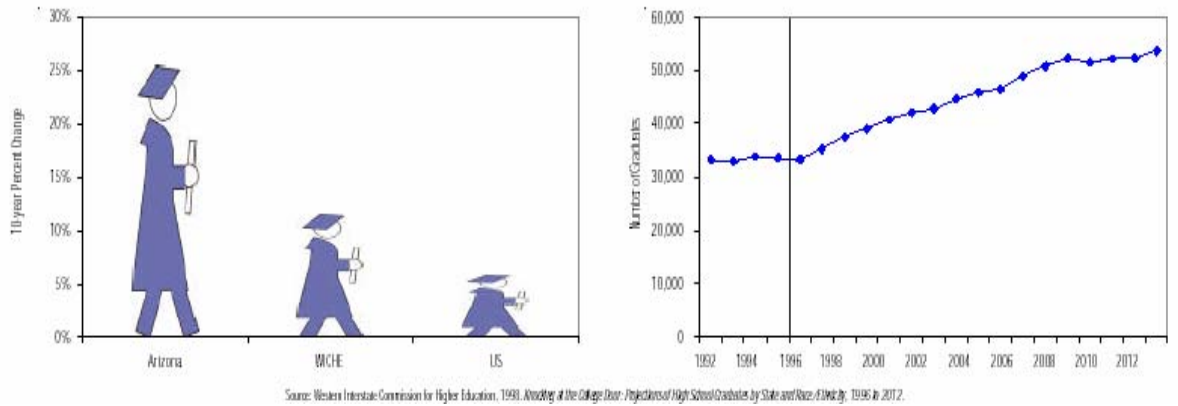


Figure 1. Arizona high school graduates exceed WICHE and US numbers (Source: WICHE)

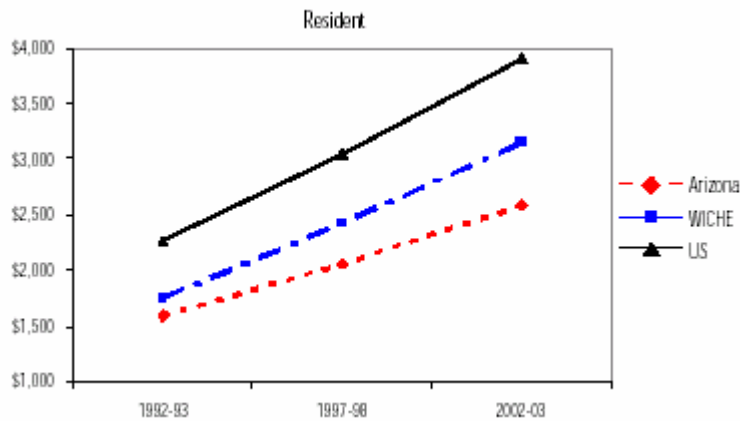


Figure 2. Arizona resident fees favor continued growth in in-state enrollments (Source: WICHE)

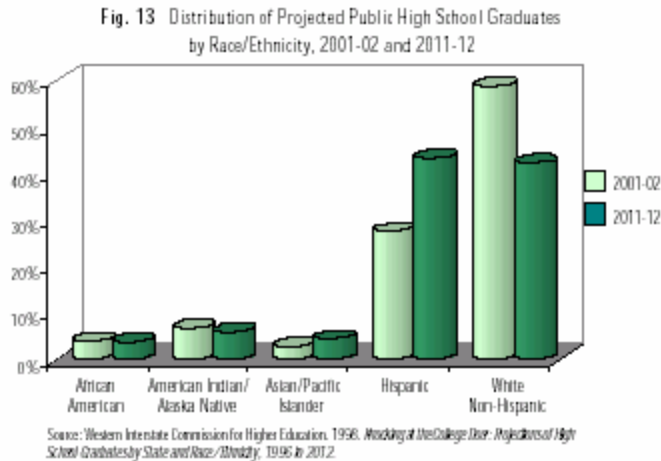


Figure 3. Significant college enrollment growth is expected in the next decade (Source: WICHE)

**B. Is there sufficient student demand for the program?**

1. What is the anticipated student enrollment for this program? (Please utilize the following tabular format).

<b>5-YEAR PROJECTED ANNUAL ENROLLMENT</b>					
	1 <sup>st</sup> yr.	2 <sup>nd</sup> yr.	3 <sup>rd</sup> yr.	4 <sup>th</sup> yr.	5 <sup>th</sup> yr.
No. Student Majors	60	66	76	91	114

**What is the local, regional and national need for this program? Provide evidence of the need for this program. Include an assessment of the employment opportunities for graduates of the program during the next three years.**

Numerous employment opportunities for Geographers will continue with federal/state/local government planning, mapping, resource management, economic development and transportation agencies (Figure 4). Examples include NOAA, NASA, National Imagery and Mapping Agency, USDA Forest Service, Environmental Systems Research, Inc, as well as in private-sector consulting firms, elementary and secondary schools.

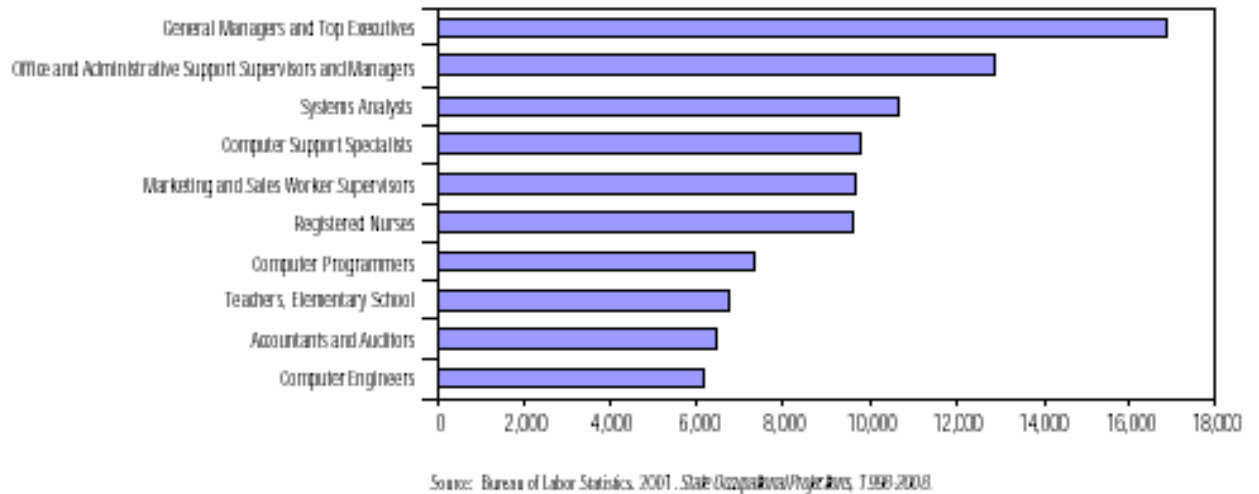


Figure 4. The GISci track of the proposed B.S. provides the skill set required in most of these job growth areas (Source: WICHE)

2. Beginning with the first year in which degrees will be awarded, what is the anticipated number of degrees that will be awarded each year for the first five years? (Please utilize the following tabular format).

<b>PROJECTED DEGREES AWARDED ANNUALLY</b>					
	<b>1<sup>st</sup> Year</b>	<b>2<sup>nd</sup> Year</b>	<b>3<sup>rd</sup> Year</b>	<b>4<sup>th</sup> Year</b>	<b>5<sup>th</sup> Year</b>
<b>No. Degrees</b>	30	36	43	52	62

#### IV. APPROPRIATENESS FOR THE UNIVERSITY

Much has been written about the University of Arizona Focused Excellence Strategy in response to the Changing Directions Initiative of the Arizona Board of Regents. When the President of the Arizona Board of Regents announced the ABOR Changing Directions Initiative in the annual Flagstaff retreat in August of 2002, the three university presidents were asked to propose visionary plans that could be implemented if ABOR did not constrain all three universities to a common destiny. ABOR realized financial burdens arising from the withdrawal of state funds threatened permanent damage to Arizona's public universities. They reasoned that by relaxing constraints they would empower effective use of scarce resources. UofA answered with a Focused Excellence strategy.

Focused Excellence means concentrating and reallocating resources at every level into top programs and priorities. The Provost has accordingly identified five thematic targets of



Focused Excellence: Life Sciences, Earth Sciences and Environmental Programs, Cognitive Sciences and the Neurosciences, and Cultural, Ethnic, Gender and Area Studies. The B.S. in Geography, with its foci in physical geography and GISci, falls under the Earth Sciences and Environmental Programs theme. *The B.S. Geography is conceived as an accessible student centered curriculum integrated with a world-class faculty focusing on earth sciences and environment. Our curriculum emphasizes hands-on applied research and field-based data collection and analysis. At its core therefore lies the preparation of students who will act intelligently in a diverse and technological world to improve the quality of life in Arizona or wherever their career paths lead them.*

**V. EXISTING PROGRAMS AT OTHER CAMPUSES**

**A. EXISTING PROGRAMS IN ARIZONA**

1. Arizona University System

<b>CIP CODE</b>	<b>PROGRAM</b>	<b>LOCATION ARIZONA UNIVERSITY SYSTEM</b>	<b>PROGRAM ACCREDITATION YES/NO</b>
45.0701	ASU	Tempe, Arizona	Yes
45.0701	NAU	Flagstaff, Arizona	Yes

2.  Other Institutions

There are no other programs at the same academic level currently offered by private institutions in the state of Arizona.

3. Programs offered in other *WICHE* States

<b>PROGRAM</b>	<b>WICHE INSTITUTION &amp; LOCATION</b>	<b>NAC ACCREDITATION? (Y or N)</b>	<b>PROGRAM ACCREDITATION? (Y or N)</b>
BS	Univ of AK, Anchorage	N	N
BS	AZ State Univ, Tempe	N	N
BS	Northern AZ Univ, Flagstaff	N	N
BS	Cal Poly Pomona	N	N
BS	Cal State Hayward	N	N

BS	San Diego State	N	N
BS	UC Santa Barbara	N	N
BS	Univ of Idaho, Moscow	N	N
BS	Montana State Univ	N	N
BS	Univ of Nevada	N	N
BS	New Mexico State Univ	N	N
BS	Univ of New Mexico	N	N
BS	Univ of N. Dakota	N	N
BS	Oregon State Univ	N	N
BS	Univ of Oregon	N	N
BS	Portland State Univ	N	N
BS	So Oregon Univ	N	N
BS	So Dakota State	N	N
BS	Brigham Young Univ	N	N
BS	Univ of Utah	N	N
BS	Utah State Univ	N	N
BS	Weber State Univ	N	N
BS	Univ of Wyoming	N	N

**B. JUSTIFICATION FOR DUPLICATIVE PROGRAM**

1. Basic Academic Subject

The inherent interdisciplinary nature of Geography qualifies it for a number of academic themes. We find as a consequence that Geography Departments may be associated with Colleges of Arts and Letters (e.g., UC, Santa Barbara), Social and Behavioral Sciences (e.g., University of Arizona). Most major academic institutions have Geography programs, and many have stand-alone Geography departments. These Geography Departments are distributed across the U.S., favoring the eastern U.S. There are comparatively few Geography programs in the West (Figure 6).

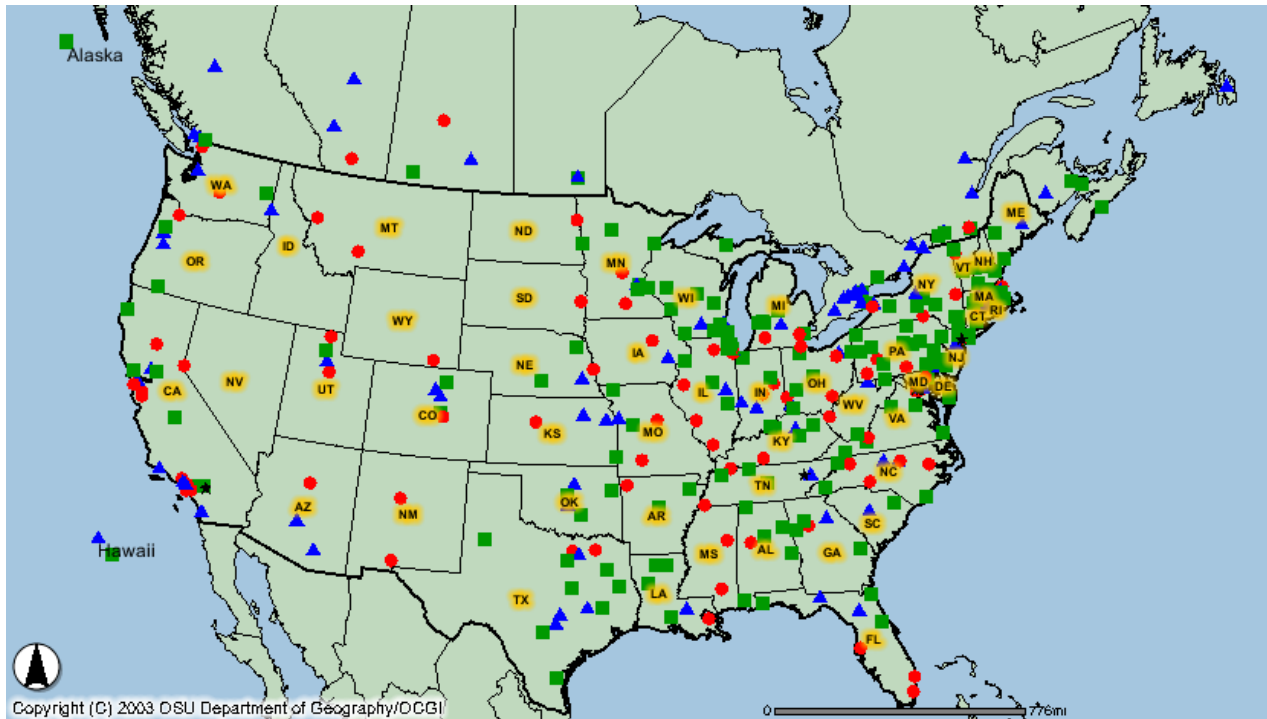


Figure 5. Geography Departments of North America (BS/BA = squares; MS/MA = circles; PhD = triangles)

2. Long-term Student Demand That Cannot be Met Satisfactorily by Existing Program(s)

<b>EXISTING PROGRAMS: ARIZONA UNIVERSITY SYSTEM*</b>						
<b>Historical Data: Degrees Awarded For The Past 5 Years</b>						
PROGRAM	No. Degrees	5 <sup>th</sup> yr. Past 98/99	4 <sup>th</sup> yr. Past 99/00	3 <sup>rd</sup> yr. Past 00/01	2 <sup>nd</sup> yr. Past 01/02	1 <sup>st</sup> yr. Past 03/04
ASU		39	42	45	57	27
NAU		38	40	48	40	87
<b>TOTAL</b>		77	82	93	97	114

<b>EXISTING PROGRAMS: ARIZONA UNIVERSITY SYSTEM</b>						
5 Year Projected Enrollment						
PROGRAM	No. Student Majors	1st Year	2nd Year	3rd Year	4th Year	5th Year
ASU		115	127	146	175	219
NAU		?	?	?	?	?
<b>TOTAL</b>						

<b>NEW PROGRAM</b>					
<b>5-YEAR PROJECTED ENROLLMENT</b>					
	1 <sup>st</sup> Yr.	2 <sup>nd</sup> Yr.	3 <sup>rd</sup> Yr.	4 <sup>th</sup> Yr.	5 <sup>th</sup> Yr.
<b>No. Student Majors</b>	60	66	76	91	114

### 3. Nontraditional, Older, or Part-Time Student Demand

We have developed a program that is sufficiently flexible to serve non-traditional students. Of our 53 Geography majors, 23 (43%) are female; 5 (22%) are 25 or older. Of the 30 (57%) male Geography majors, 10 (33%) are 25 or older. We believe we serve non-traditional students adequately, that these proportions have stabilized, and that no special resources are required to meet this demand.

### 4. Alternate Delivery Systems

a. Geography is by nature oriented towards field-based data collection and analysis. Proposed concentrations in Physical Geography and GIS are no exception. We therefore believe it to be sound pedagogically to include field methods in many of these courses. We do not believe computer-assisted instruction, proximate or distant, can substitute for field data collection, analysis and synthesis. Because ‘geography is learned through the soles of one’s boots’ we advocate for this B.S. a strong, engaging on-campus curriculum that supports off-campus field instruction.

b. Addressed in 4a above.

### 5. Collaborative Efforts

We propose for this B.S. courses for which we have reliable faculty teaching support. From a budgetary perspective, there is no apparent benefit from joint degrees, shared courses or team teaching.

## 6. Effect on Existing Program(s)

Establishing the B.S. in Geography will produce a balanced curriculum that gives our students flexibility that translates into increased career options. We will by this action join the other B.S. Geography programs at ASU and NAU, completing the cycle and strengthening overall the market position of the 3 Arizona state universities. Our proposed B.S. complements the existing B.A., which itself has no apparent adverse affects on existing B.A. programs. We believe the B.S. Geography will affect existing programs positively: We are confident the B.S. Geography would in intellectual rigor match our existing B.S. in Regional Development. Based on feedback from students and faculty advisors, we can by adding the B.S. anticipate movement among all programs: Some students in the B.A. Geography will upgrade to the B.S. Geography, while others in the B.S. Regional Development will transfer into either the B.S. or B.A. Geography. Our strategy overall is to offer the B.A and B.S. degrees in Geography and retain the B.S. in Regional Development—achieving in 5 years a balanced program with approximately 100 majors in each degree.

## 7. Resources Already Available

Courses proposed under the B.S. Geography are all offered by existing faculty—they are already available under the B.A., Geography, and the B.S., Regional Development. We are confident any changes, including new courses or more sections, can be achieved through internal reallocation of existing faculty resources. We have, moreover, established strong and enduring ties with the School of Natural Resources, enabling us to offer the full range of methods courses for the GIS concentration. A new hire (Woodhouse) will support existing and new courses in climate and climate change under the Physical Geography concentration. New hires in water resources (Bauer and Scott) enable us to offer a concentration in Water, Environment & Society. It is on the basis of both cross-campus affiliations and new faculty that we do not therefore anticipate significant additional costs for implementing this program.

# VI. EXPECTED FACULTY AND RESOURCE REQUIREMENTS

## A. FACULTY

### 1. Current Faculty

#### Core Faculty

Keiron Bailey	Assistant Professor	Ph.D.	GRD 100%
Carl Bauer	Associate Professor	Ph.D.	GRD 100%
Andrew Comrie	Professor	Ph.D.	GRD 25%
Stuart E. Marsh	Professor	Ph.D.	GRD 20%
Christopher Scott	Assistant Professor	Ph.D.	GRD 50%
Willem van Leeuwen	Assistant Professor	Ph.D.	GRD 50%
Marvin Waterstone	Associate Professor	Ph.D.	GRD 100%
Connie Woodhouse	Associate Professor	Ph.D.	GRD 100%
Stephen Yool	Associate Professor	Ph.D.	GRD 100%

Affiliated faculty

Julio Betancourt	Professor	Ph.D.
Katherine Hirschboeck	Associate Professor	Ph.D.
Vance Holliday	Professor	Ph.D.
Charles Hutchinson	Professor	Ph.D.
Thomas Swetnam	Professor	Ph.D.
Margaret Wilder	Assistant Professor	Ph.D.

2. Additional Faculty

None.

3. Current FTE Student and Faculty

Undergraduate students	277 students (225 Reg Dev, 52 Geography)
Graduate students	68 students (38 Ph.D., 30 M.A.)
Faculty FTE	12.9 FTE

4. Projected FTE Students and Faculty

Undergraduate students:	290 students
Graduate students:	72 students
Faculty FTE	14.4 FTE

Please see Appendix A for faculty Curriculum Vitae of Participating Faculty

**B. LIBRARY**

1. Current Relevant Holdings

The University of Arizona currently holds almost five million volumes in its collection to accommodate the needs of its diverse population. The Library supports the Department of Geography and Regional Development at both the undergraduate and graduate levels and faculty research needs.

Funding for Geography resources is allocated through the Geography and Physical Geography fund lines. According to the 2003-2004 fiscal year breakdowns, the University of Arizona spent \$17, 289 on monographic purchases, \$35,238 on serials purchases, and \$12,250 on maps. In addition, we purchased data sets for use by students and faculty. Any faculty or student can easily obtain any book, journal article, dissertation, or map that is not accessible in the Library at no cost through Inter-Library Loan. In addition, the Library subscribes to several key journal indexes of interest to the discipline, including GeoBase and Geo Ref.

The Library has recently developed a new web site: Arizona Electronic Atlas, <http://atlas.library.arizona.edu/>. It is an innovative interactive atlas that allows creation, manipulation, and downloading of accurate and current maps and data, and includes resources to assist instructors in creating assignments that use the Arizona Electronic Atlas. The Atlas combines Geographic Information Systems (GIS) and online mapping technology, makes spatial data readily accessible, and eliminates the need for users to store and manage large amounts of data. In addition, it is a valuable tool for developing geographic literacy and for strengthening users' critical thinking and problem solving skills.

## 2. Additional Acquisitions Needed

The B.S. Geography can be launched and sustained using library acquisitions available and continuing currently.

## **C. PHYSICAL FACILITIES AND EQUIPMENT**

### 1. Existing Physical Facilities

GRD supports a large network of computer teaching labs, research labs, graduate computing facilities, mobile teaching resources, and a large array of web, ftp, and file servers in addition to individual faculty, student, and staff computing resources. We consider these facilities adequate to support courses within the B.S. Geography.

The Spatial Analysis Laboratory is a technology teaching laboratory for GISci and (remote sensing instruction). The lab features 30 Intel-based workstations with Microsoft Windows and flat panel displays. To facilitate data (format) acquisition and storage, each workstation is outfitted with a DVD/CD-RW and a front USB drive. Network storage space is available for instructional data warehousing and personal project storage. The lab is configured with ESRI GIS products such as ArcGIS Desktop, Workstation, and ArcView. Remote sensing software includes Leica Imagine and Clark Labs IDRISI. The GIS and remote sensing software packages are complemented by SPSS for statistical analysis, Microsoft Office, and several climate simulation packages.

The Spatial Analysis Lab also features fifteen desktop digitizing tablets and one large, free-standing digitizing tablet for data input. Two high-capacity Hewlett-Packard laser printers are available in the lab; a monochrome letter/legal size laser printer, and a color letter/medium format size printer with duplex capability. A digital video projector with a wireless mouse, overhead projector, and large screen are available for presentations.

For instruction and presentation outside of the department, a laptop computer and video projector are available. Overhead projectors and slide projectors are available for use both in and out of the department. Stereoscope glasses and GPS devices are also available.

The department features several facilities available to research members with specialized software such as GIS and mathematical modeling software and hardware such as medium and large format printers, digital cameras, scanners, and GPS devices. The grant-funded

labs include the Pyrogeography Research Lab, Advanced Climate and Environmental Simulation Lab, and the Geovisualization Lab.

2. Additional Facilities Required or Anticipated

Having completed a technology refresh in 2004, we anticipate a new refresh in 2008.

**D. OTHER SUPPORT**

1. Other Support Now Available

None.

2. Other Support Needed, Next Three Years

None.

**VII. FINANCING**

**A. SUPPORTING FUNDS FROM OUTSIDE SOURCES --**

This is a \$0 request. GRD has the resources to implement the proposed B.S in Geography.

**B. NEW ACADEMIC DEGREE PROGRAM BUDGET PROJECTIONS FORM**

Not applicable.

**IV. OTHER RELEVANT INFORMATION**

None.



**Appendix A:**  
**Brief Curriculum Vitae of**  
**Principal Faculty**

## KEIRON BAILEY

### Education

- 2002: Ph.D., Geography, University of Kentucky (USA)  
1996: M.A., Geography, University of Hawaii (USA)  
1991: B.Sc. (Honors), Geography, University of Birmingham (England)  
1988: B.Sc. (Honors), Mechanical Engineering, University of Birmingham (England)

### Publications

- Bailey, K. and Grossardt, T. 2004. Structured Public Involvement in the Design of a Transit Oriented Development pp. 13-15 in Stephens, R. (ed) *InfoTEXT: IT Newsletter of the American Planning Association*.
- Bailey, K. and Grossardt T. 2004. EP-AMIS: Enhanced Participatory GIS/Multicriteria Methodology, *Proceedings of MapAsia2004*. Beijing, China: GIS Development.
- Bailey, K. and Grossardt, T. 2004. Community Design of a Transit-Oriented Development using Casewise Visual Evaluation (CAVE) pp. 123-129 in Schrenk, M. (ed) *CORP2004: Proceedings of the 9th International GeoMultimedia Symposium 9: 123-129*. Vienna, Austria.
- Bailey, K. and Grossardt, T. 2004. Towards Structured Public Involvement: Improving community involvement in transportation decision making. Ch. 89, pp. 547-552 In Warf, B., Janelle, D. and Hansen, K. (eds) *WorldMinds: Association of American Geographers Centennial Volume*. Netherlands: Kluwer.
- Bailey, K. and Grossardt, T. 2004. Better Visioning for Transit System Development: Framework for Improvement of Visualization and Its Successful Application in *Proceedings of the 84th Annual Meeting of the Transportation Research Board*. Washington, DC: National Academies.
- Bailey, K., Grossardt, T. and Brumm, J. 2003. Structured Public Involvement: Problems and Prospects for Improvement. *Transportation Research Record* **1858**: 95-102. Washington, DC: National Academies. Proceedings version available online.
- Bailey, K., Grossardt, T. and Arno, A. 2003. Developing the Next Generation of Technological Aids to Effective Public Involvement in Public Transportation. *Proceedings of the American Public Transit Association*.
- Grossardt, T. and Bailey, K. 2003. Community Design of a Light Rail Transit-Oriented Development. Pp.51-54 in *New IDEAS for Transit: Annual Progress Report of the Transit IDEA Program*. Washington, DC: National Academies.
- Bailey, K., Grossardt, T. and Brumm, J. 2002. Integrating Visualization into Structured Public Involvement: A Case Study of Highway Improvement in Central Kentucky. *Transportation Research Record* 1817: 50-57. Washington, DC: National Academies.
- Bailey, K., Brumm, J. and Grossardt, T. 2002. Enhancing Public Involvement through High Technology, *Transportation Research News* 220: 18-19. Washington, DC: National Academies.
- Brumm, J., Grossardt, T. and Bailey, K. 2002. AMIS: Least Cost Path Analysis for Transportation Planning. Paper 521, *Proceedings of the Environmental Systems Research Institute User Conference*. San Diego, CA: Environmental Systems Research Institute.
- Bailey, K., Brumm, J. and Grossardt, T. 2001. Towards Structured Public Involvement in Highway Design: A Comparative Study of Visualization Methods and Preference Modeling using CAVE (Casewise Visual Evaluation). *Journal of Geographic Information and Decision Analysis* 5: 1-15.
- Grossardt, T., Bailey, K. and Brumm, J. 2001. AMIS: Geographic Information System-based corridor planning methodology. *Transportation Research Record* 1768: 224-232. Washington, DC: National Academies.
- Policy and Systems Analysis Team. 2001. A Citizens Guide to Visualization. Lexington, KY: Kentucky Transportation Center.

### **Funding**

- \$52,765. National Science Foundation, Electrical and Communication Systems Division. 2004. "Collaborative Research: Investigation of Electric Transmission Line Placement using a Decision Landscape Based Methodology" (with Grossardt, T. and Jewell, W.)
- \$38,655. State of Arizona Prop.301 Information Technology/Information Systems. 2003. "Distributed Outreach/Geovisualization System." (with Jones, J.P. and Christopherson, G.)
- \$75,000. Transportation Research Board. 2001. Transit-IDEA T-33 "Community Design of a Light Rail Transit Oriented Development" (with Grossardt, T)

### **Awards**

- John Fraser Hart Award, South Eastern Division of the Association of American Geographers. Outstanding PhD Student Paper. 2002. "Community Design of a Light Rail Transit Oriented Development using Casewise Visual Evaluation (CAVE)"
- John Fraser Hart Award, South Eastern Division of the Association of American Geographers. Outstanding PhD Student Paper. 2001. "AMIS: Design of a GIS/Multicriteria Highway Corridor Evaluation Methodology."

### **Research Interests**

#### **(SPI)**

I am interested in how social theory helps to understand the properties of advanced geovisual and geospatial technologies. This research overlaps geography, planning, decision science and geoinformatics. [Structured Public Involvement](#), or SPI, seeks to improve public satisfaction with planning and design of transportation related infrastructure by fitting appropriate technologies to the social context. This research has been funded by the National Academies and a range of state and local agencies.

#### **Economic Geographies of Internationalization**

My second research area is economic geographies of internationalization with a special focus on the Pacific Basin and East Asia. This research seeks to understand how specific economic and cultural transformations are wrought by the interaction of complex global flows of money, power and cultural meaning with local practices, customs and economies.

**Carl J. Bauer, Ph.D.**

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<http://www.geog.arizona.edu/people/bauer.php>

**EDUCATION**

Ph.D. (1995), M.A. (1990) *Jurisprudence & Social Policy*, School of Law, UC-Berkeley.  
M.S. (1988) *Geography*, University of Wisconsin-Madison.  
B.A. (1983) *Geology*, Yale University, New Haven, CT.

**EMPLOYMENT**

2006-Present Associate Professor, Dept. of Geography & Regional Development, and Associate Director, Water Resources Research Center, Univ. of Arizona.  
1999-2006 Fellow, Resources for the Future, Washington, DC.  
2004 Visiting Professor, Diego Portales Univ. Law School, Santiago, Chile.  
2002 Visiting Professor, Catholic Univ. Law School, Santiago, Chile.  
1998 Lecturer, Dept. of Geography, Univ. California-Berkeley.  
1996-98 Independent consultant on water law, policy, and economics to various international organizations, Oakland, CA.  
1995-97 Ciriacy-Wantrup Post-Doctoral Research Fellow, Univ. California-Berkeley.  
1995 Lecturer, Dept. of Environmental Science, Policy, & Management, Univ. California-Berkeley  
1993, '95 Visiting Professor, Institute of Mining & Water Law, Univ. of Atacama, Santiago, Chile.

**EXPERTISE / RESEARCH AND TEACHING INTERESTS**

**Comparative and International Water Law and Policy – Political Economy of Water and Water Reform**

Water rights and water markets	Privatization, regulation, and courts
Hydropower and river basin governance	Environmental flows
Regional expertise in U.S. and Latin America	
Water issues, institutions, and policy debates in other parts of the world	

**Interdisciplinary Environmental Studies – Law, Geography, and Political Economy**

Human / environment relations	Environmental law, policy, and regulation
Property rights and institutions economics	Law and economics; institutional

**Qualitative and historical analysis**

**HONORS AND AWARDS**

2003 Fulbright Scholar Award for Lecturing / Research, U.S. Dept. of State and Council for International Exchange of Scholars, for a semester at National Univ. of Cuyo, Dept. of Political and Social Sciences, Mendoza, Argentina.  
2001-02 Visiting Scholar, Center for Applied Economics, Univ. of Chile, Santiago, Chile.  
1994 John M. Olin Foundation Fellowship, Univ. of California-Berkeley. Dissertation write-up.

- 1991-93 Fulbright-Hays Fellowship for Doctoral Dissertation Research Abroad; Social Science Research Council International Dissertation Fellowship; Inter-American Foundation Dissertation Fellowship. Fieldwork in Chile.
- 1989 U.S. Dept. of Education, Foreign Language & Area Studies Summer Language Fellowship, Mexico.
- 1985-86 Wisconsin Alumni Research Foundation Fellowship, Univ. of Wisconsin-Madison.

### **SELECTED PUBLICATIONS**

- 2005 “In the image of the market: The Chilean model of water resources management,” *International Journal of Water* Vol.3, No.2, pp.146-165.
- 2005 (Contributing author) “Freshwater ecosystem services,” *Ecosystems and Human Well-Being: Policy Responses*, Volume 3, pp.213-255, Millenium Ecosystem Assessment (Washington, DC: Island Press).
- 2004 *Siren Song: Chilean Water Law as a Model for International Reform* (Washington, DC: RFF Press). Also published in Spanish in 2004 as *Canto de Sirenas: El Derecho de Aguas Chileno como Modelo para Reformas Internacionales* (Bilbao, Spain: Bakeaz).
- 2004 “Results of Chilean water markets: Empirical research since 1990,” *Water Resources Research* Vol.40, W09S06, doi:10.1029/2003WR002838.
- 2000 “Derechos de agua, hidroenergía, y la gestión ecológica de aguas: El caso del oeste norteamericano,” *Revista de Derecho Administrativo Económico* Vol.2, No.1, pp.55-61 (Santiago, Chile). [“Water rights, hydropower, and ecological management of water resources: The case of the North American West,” *Journal of Administrative and Economic Law*]
- 1998 *Against the Current: Privatization, Water Markets, and the State in Chile* (Boston, MA: Kluwer Academic Publishers). Also published in Spanish in 2002 as *Contra la Corriente: Privatización, Mercados de Agua y el Estado en Chile* (Santiago, Chile: LOM Ediciones).
- 1998 “Derecho y economía en la Constitución de 1980,” *Perspectivas en Política, Economía y Gestión* Vol.2, No.1, pp.23-47 (Santiago, Chile). [“Law and economics in the 1980 Constitution,” *Perspectives in Politics, Economics, and Management*]
- 1996 “El mercado de aguas en California,” in Antonio Embid, ed., *Precios y Mercados del Agua*, pp.179-205 (Madrid, Spain: Editorial Civitas). [“The water market in California,” in *Prices and Markets for Water*]

### **PROFESSIONAL SERVICE AND OUTREACH**

#### **Non-Academic Presentations**

Numerous invited talks to government and public audiences in Latin America, Europe, and the U.S.

#### **International Consulting**

United Nations, World Bank, Inter-American Development Bank, Global Water Partnership, Danish and Swedish International Development Agencies

#### **Short Courses for Professionals in Latin America**

Water law and economics

#### **Membership in Professional Associations**

Association of American Geographers, International Water Resources Association, Law and Society Association, and others

## JULIO L. BETANCOURT

### EDUCATION

Ph.D. Geosciences, University of Arizona, 1989

M.S. Geosciences, University of Arizona, 1983

B.A. Anthropology/Geography College, University of Texas, 1975

### PROFESSIONAL AND ACADEMIC EXPERIENCE

Senior Scientist and Research Hydrologist, USGS 1989-present

Adjunct Professor, Depts. of Geosciences, Geography, University of Arizona, current

### 2006 PUBLICATIONS

For full CV, see [http://www.pazten.wr.usgs.gov/julio\\_cv.html](http://www.pazten.wr.usgs.gov/julio_cv.html)

Van de Water, P.K., Leavitt, S.L., Betancourt, J.L., Fischer, T. and Pedicino, L. 2006. Evaluation of  $\delta^{13}\text{C}$  of *Atriplex* leaf cellulose as a proxy for  $\delta^{13}\text{C}$  of atmospheric  $\text{CO}_2$  on time scales of decades to millennia. *Plant Cell & Environment* (In press).

Drees, K.P., Neilson, J.W., Betancourt, J.L., Quade, J., Henderson, D.A., Pryor, B., and Maier, R.M. Bacterial community structure of soils in a hyperarid region of the Atacama Desert. *Applied and Environmental Microbiology* (In press)

Smith, F.A. and Betancourt, J.L. 2006. Predicting woodrat (*Neotoma*) responses to anthropogenic warming from studies of the paleomidden record. *Journal of Biogeography* (In press).

Holmgren, C., Norris, J., Betancourt, J. L. 2006. Inferences about winter temperatures and summer rains from the late Quaternary record of C4 perennial grasses and C3 desert shrubs in the northern Chihuahuan Desert. *Journal of Quaternary Science* (In press).

Holmgren, C., Betancourt, J.L., and Rylander, K.A. 2006. A 36,000-yr history of the Peloncillo Mountains, southeastern Arizona, USA. *Palaeogeography, Palaeoclimatology, Palaeoecology* (In press).

McCabe, G., Betancourt, J.L., Hidalgo, H.G. 2006. Associations of decadal to multidecadal sea-surface temperature variability with Upper Colorado River flow. *Journal of the American Water Resources Association* (In press).

Gray, S.T., Betancourt, J.L., Jackson, S.T., Eddy, R. 2006. [Role of multidecadal climate variability in a range extension of pinyon pine.](#) *Ecology* 87, 1124-1130.

Latorre, C., Betancourt, J.L., and Arroyo, M.T.K. 2006. [Vegetation and climate history of a perennial river canyon in the Rio Salado Basin \(22 °S\) of northern Chile.](#) *Quaternary Research* 65, 450-466.

Keeley, J.E., Allen, C.D., Betancourt, J.L., Chong, G.W., Fotheringham, C.J. and Safford, H.D. 2006. [A 21st Century Perspective on Postfire Seeding.](#) *Journal of Forestry* March 2006, pp. 103-104.

Norris, J.T., Jackson, S.T., and Betancourt, J.L. 2006. [Classification tree and minimum-volume ellipsoid analyses of the distribution of ponderosa pine in the western USA.](#) *Journal of Biogeography* 33, 342-360.

### **SYNERGISTIC ACTIVITIES**

Innovations in teaching and contributions to the science of learning: As a USGS scientist, I do not teach formal courses. However, I annually support and mentor an average of 1 postdoc, 3 graduate and 3 undergraduate students. I regularly participate as a mentor and source of funding for undergraduates in the NASA Space Grant Internship Program and the Undergraduate Biology Research Program. In 1996-2000, I led an NSF-InterAmerican Institute program to develop late Quaternary vegetation histories of arid South America drawing on my own experience in arid North America. The main objective of the program was to provide field and laboratory training for professionals and students from Argentina, Bolivia, Chile and Peru. I've continued this tradition in my subsequent work in Chile. Two of my Chilean Ph.D. students currently occupy professorships in prominent Chilean universities.

Communication of research results to the general public: In my capacity as a federal scientist, I strive to assume leadership in response to emerging regional and national, environmental issues of environmental concern. For example, in 1997-1999, I coordinated a series of field visits by USGS interdisciplinary team to various National Park Service and USDA Forest Service Districts across the western U.S. to consider the effects on increasing wildfires on western watersheds. In 2003-2004, I gave over 30 presentations across the country on the climatic and historical context of the 1999-2004 drought, including keynote talks at several drought summits and workshops organized in western and Great Plains states. Beginning in 2004, I initiated a demonstration and outreach project to promote eradication of an invasive species (buffelgrass) in the Sonoran Desert. I also grant frequent interviews for national, regional and local print, radio, and television media.

Refinement of research results: I have coordinated key national and international workshops, such as the Pacific Climate (PACLIM) Workshops in 1989-1991 (<http://meteora.ucsd.edu/paclim/>); "Advances in Central Andes Paleoclimatology" in 2001 (<http://www.pazten.wr.usgs.gov/pcaw/>); "Improving the Application of Science in Western Drought Management & Planning" for the Western Governor's Association in March 2004; "Role of NEON in Addressing Ecological Implications of Climate Change" for AIBS in August 2004 (<http://www.neoninc.org/documents/neon-climate-report.pdf>), and the workshop to begin organizing the USA-National Phenology Network in August 2005. I serve on the Editorial Board of *Diversity and Distribution* and was a Founding Member of the International Biogeography Society. I currently serve on the NAS-NRC-Water Science Board Committee on Science needs for Colorado River Water Management, and also just completed a stint on the subcommittee that collated the U.S. Government review of the IPCC Fourth Assessment Report.

Broadening the participation of groups underrepresented in science: I came up through USGS as a graduate student under the DOI Minority Participation in the Earth Sciences Program, and have myself mentored several MPES students. I also make it a point to give lectures at local high schools with predominantly Hispanic student bodies.

**ANDREW C. COMRIE**

**Education**

- 1992 Ph.D., Geography, The Pennsylvania State University  
1988 M.Sc. Environmental and Geographical Science, University of Cape Town  
1985 B.Sc.(Honours), Atmospheric Science, University of Cape Town  
1984 B.Sc., Geography, University of Cape Town

**Employment**

- 1999 Associate Professor, Geography and Regional Development, University of Arizona.  
Joint appointments: Arid Lands Resource Sciences, Global Change, Remote Sensing and Spatial Analysis, Atmospheric Sciences.  
1992 Assistant Professor, Geography and Regional Development, University of Arizona.

**Selected Honors, Awards and Positions**

- Editor for the Americas, *International Journal of Climatology*, 2004-present.  
Editor of the international journal *Climate Research*, 2001-2003 (Editorial board 1999-2000).  
Editorial Advisory Board of the international journal *Atmospheric Environment*, 2000-present.  
Chair, Climate Specialty Group, Association of American Geographers, 2002-2004.  
Research Professorship, University of Arizona, Social and Behavioral Sciences Res. Inst., Spring 2000.  
Best Weather Graphic, American Meteorological Society, Southeast Arizona Chapter, 1999.  
Faculty Appreciation Award, Business and Public Admin. Student Council, Univ. of Arizona, 1997.  
Visiting Fellow, Udall Center for Studies in Public Policy (with fellowship support from the Institute for the Study of Planet Earth), University of Arizona, 1996/97.  
First Place, Faculty Best Article Competition (in College), University of Arizona, Social and Behavioral Sciences Research Institute, 1995.  
J. Warren Nystrom Award for Best Ph.D. Dissertation, Association of American Geographers, 1993.  
Award for Research Support in General Education, College of Arts and Sciences, University of Arizona, 1992.  
E. Willard Miller Award for Best Graduate Student Paper, Department of Geography, The Pennsylvania State University, 1991.  
Best Poster Presentation (Air Pollution), American Meteorological Society Annual Meeting with the Air and Waste Management Association, New Orleans, LA, 1991.  
Hans Neuberger Award for Outstanding Teaching, Dept. of Meteorology, The Pennsylvania State University, 1989.  
Masters Research Scholarship, Council for Scientific and Industrial Research, 1986-1987.  
Honours Research Scholarship, Council for Scientific and Industrial Research, 1985.  
W.M. Talbot Trophy for Outstanding Contributions to the Department of Geography, Univ. of Cape Town, 1984.

**Selected Publications**

- Comrie, A.C., 1990: The climatology of surface ozone in rural areas: a conceptual model. *Progress in Physical Geography* 14, 295-316.  
Comrie, A.C., 1991: The Climatology of Rural Ozone Pollution. Ch. 9 in Majumdar, S.K., Miller, E.W. and Cahir, J. (eds.), *Air Pollution: Environmental Issues and Health Effects*. Easton, PA: Pennsylvania Academy of Science, 121-135.  
Comrie, A.C., 1992: A procedure for removing the synoptic climate signal from environmental data. *International Journal of Climatology* 12, 177-183.  
Comrie, A.C., 1992: An enhanced synoptic climatology of ozone using a sequencing technique. *Physical Geography* 13, 53-65.



- Comrie, A.C. and Yarnal, B., 1992: Relationships between synoptic-scale atmospheric circulation and ozone concentrations in metropolitan Pittsburgh, Pennsylvania. *Atmospheric Environment* 26B, 301-312.
- Simini, M., Skelly, J.M., Davis, D.D., Savage, J.E. and Comrie, A.C., 1992: Sensitivity of four hardwood species to ambient ozone in northcentral Pennsylvania. *Canadian Journal of Forest Research* 22, 1789-1799.
- Comrie, A.C., 1993: A synoptic climatology of rural ozone pollution at three forest sites in Pennsylvania. *Atmospheric Environment* 28A, 1601-1614.
- Comrie, A.C., 1994: Tracking ozone: air-mass trajectories and pollutant source regions influencing ozone in Pennsylvania forests. *Annals of the Association of American Geographers* 84 (4), 635-651.
- Comrie, A.C., 1996: An All-Season Synoptic Climatology of Air Pollution in the U.S.-Mexico Border Region. *Professional Geographer* 48(3), 237-251.
- Comrie, A.C., 1997: Comparing Neural Networks and Regression Models for Ozone Forecasting. *Journal of the Air and Waste Management Association* 47, 653-663.
- Adams, D.K. and Comrie, A.C., 1997: The North American Monsoon. *Bulletin of the American Meteorological Society* 78(10), 2197-2213.
- Comrie, A.C., 1998: Mapping the climatology of ozone potential for the U.S.-Mexico border region. *Journal of the Arizona-Nevada Academy of Science* 31(1), 1-12.
- Comrie, A.C. and Glenn, E.C. 1998: Principal components-based regionalization of precipitation regimes across the Southwest United States and Northern Mexico, with an application to monsoon precipitation variability. *Climate Research* 10, 201-215.
- Comrie, A.C. and Diem, J.E. 1999: Climatology and forecast modeling of ambient carbon monoxide in Phoenix, AZ. *Atmospheric Environment* 33, 5023-5036.
- Comrie, A.C. 2000: Mapping a wind-modified urban heat island in Tucson, Arizona (with comments on integrating research and undergraduate learning). *Bulletin of the American Meteorological Society* 81, 2417-2431.
- Diem, J.E. and Comrie, A.C. 2000: Integrating remote sensing and local vegetation information for a high resolution biogenic emissions inventory: application to an urbanized, semi-arid region. *Journal of the Air and Waste Management Association* 50, 1968-1979.
- Kolivras, K.N., Johnson, P., Comrie, A.C. and Yool, S.R. 2001: Environmental Variability and Coccidioidomycosis (Valley Fever). *Aerobiologia* 17, 31-42.
- E. Wright, A. Long, A. Comrie, S. Leavitt, T. Cavazos and C. Eastoe, 2001: North American monsoonal moisture sources revealed using temperature, precipitation, and precipitation stable isotope timeseries. *Geophysical Research Letters* 28, 787-790.
- Diem, J.E. and Comrie, A.C. 2001: Air quality, climate, and policy: A case study of ozone pollution in Tucson, Arizona. *The Professional Geographer* 53, 469-491.
- Yarnal, B., Comrie, A.C., Frakes, B. and Brown, D.P. 2001: Developments and prospects in synoptic climatology. *International Journal of Climatology*, 21, 1887-1914.
- Diem, J.E. and Comrie, A.C. 2002: Allocating anthropogenic pollutant emissions over space: application to ozone pollution management. *Journal of Environmental Management* 63, 425-447.
- Diem, J.E. and Comrie, A.C. 2002: Predictive mapping of air pollution involving sparse spatial observations. *Environmental Pollution* 119, 99-117.
- Comrie, A.C. and Broyles, B., 2002: Variability and spatial modeling of fine-scale precipitation data for the Sonoran Desert of Southwest Arizona. *Journal of Arid Environments* 50, 573-592.
- Sheppard, P.R., Comrie, A.C., Packin, G.D., Angersbach, K., and Hughes, M.K. 2002: The climate of the US Southwest. *Climate Research* 21, 219-238.
- Cavazos, T., Comrie, A.C. and Liverman, D.M. Intraseasonal wave anomalies associated with wet monsoons in Southeast Arizona. *Journal of Climate* 15, 2477-2490.
- Brown, D.P. and Comrie, A.C. 2002: Spatial modeling of winter temperature and precipitation in Arizona and New Mexico, U.S.A. *Climate Research* 22, 115-128.

- Ni, F., Cavazos, T., Hughes, M.K., Comrie, A.C. and Funkhouser, G., 2002: Cool season precipitation in the Southwestern United States since AD 1000: Comparison of linear and nonlinear techniques for reconstruction. *International Journal of Climatology* 22, 1645-1662.
- Brown, D.P. and Comrie, A.C., 2002: Sub-regional seasonal precipitation linkages to SOI and PDO in the Southwest United States. *Atmospheric Science Letters*, in press.
- Komatsu, K., Vaz, V., McRill, C., Colman, T., Comrie, A., Sigel, K., Clark, T., Phelan, M., Hajjeh, R. and Park, B., 2003: Increase in coccidioidomycosis – Arizona, 1998-2001. *Morbidity and Mortality Weekly Report* 52, 109-112.
- Kolivras, K.N. and Comrie, A.C., 2003: Modeling valley fever incidence based on climate conditions in Pima County, Arizona. *International Journal of Biometeorology* 47, 87-101.
- Brown, D.B. and Comrie, A.C., 2004: A winter precipitation ‘dipole’ in the Western United States associated with multidecadal ENSO variability. *Geophysical Research Letters* 31, doi:10.1029/2003GL018726.
- Abraham, J.S. and Comrie, A.C., 2004: Real-time ozone mapping using a regression-interpolation hybrid approach, applied to Tucson, Arizona. *Journal of the Air and Waste Management Association* 54, 914–925.
- Kolivras, K.N. and Comrie, A.C., 2004: Climate and infectious disease in the southwestern United States. *Progress in Physical Geography* 28, 387-398.
- Crimmins, M. A. and Comrie, A.C., 2004: Interactions between antecedent climate and wildfire variability across southeast Arizona. *International Journal of Wildland Fire*, in press.

### **Selected Grants & Contracts**

- Converging NASA Mission Measurements and Products with the Rapid Syndrome Validation Project (RSVP) Decision Support System to validate and benchmark public health medical alerts and early warning forecasts. National Aeronautics and Space Administration (\$3.2 million total over 5 years, UA \$1,209,610 sub to U. New Mexico, S. Morain PI), UA co-PI with W. Sprigg, K. Thome, 2004-2008.
- Tailored Drought Planning for Arizona. TRIF (Prop. 301; \$95,000 over 2 years), co-PI with G. Garfin and B. Morehouse, 2003-2005.
- Integrated Epidemiological Study of Valley Fever. Arizona Disease Control Research Commission (\$690,339 over 3 years; consultant/collaborator), with M.K. O’Rourke, J. Tabor, M. Orbach, L. Shubitz et al., 2002-2005.
- Research Experience for Undergraduates (REU) – HERO project. National Science Foundation (\$80,000 per year for 4 years with Penn State et al.; UA ~\$15,000/yr, 35% PI), with D. Liverman, R. Merideth and R. Varady, 2002-2006.
- Human-Environment Research Observatory (HERO) Infrastructure Development. National Science Foundation (\$2,500,000 with Penn State et al.; UA \$290,000 over 5 years, 35% P.I.), with D. Liverman, R. Merideth and R. Varady, 2000-2005.
- Determination of Climatological Criteria for Natural Dust Events in Arizona. Arizona Department of Environmental Quality (\$25,000; 100% PI), 2000-2001.
- Updating the Department of Geography and Regional Development’s Spatial Analysis Laboratory. Learning Technologies Partnership, University of Arizona (\$15,000, 33% co-P.I.), with A. Esparza and S. Yool, 1999.
- Public Access to Environmental Monitoring Data in Tucson, Arizona. U.S. Environmental Protection Agency, EMPACT program, in collaboration with Pima County Department of Environmental Quality (\$485,000, University of Arizona portion \$175,000, 33% co-P.I.), with M.K. O’Rourke and J. Burgess, 1999-2001.
- Climate Data Analysis for Southern Africa. National Oceanic and Atmospheric Administration, with ASU Office of Climatology and the National Climatic Data Center (\$75,000, 5% co-P.I.), with R. Vose and T. Peterson, 1999.
- Climate Variability, Social Vulnerability, and Public Policy in the Southwestern United States: A Proposal for Regional Assessment Activities. National Oceanographic and Atmospheric Administration

- (\$4,600,000 over 6 years, 10% co-P.I.), with R. Bales, S. Sorooshian, D. Liverman, T. Finan, M. Hughes, et al., 1998-2001.
- System for Management, Observation, and GIS Modeling of Air Pollution (SMOGMAP). Pima Association of Governments (\$195,000 over 4 years, 100% P.I.), 1997-2001.
- National Aeronautics and Space Administration/UA Space Grant Program (\$17,500; \$3,500 per student/year). Undergraduate Research Intern (100% P.I.), 1997, 1998, 2000, 2001, 2003.
- Ozone Modeling Assessment Study. Pima Association of Governments (\$10,000, 100% P.I.). June 2 to September 1, 1997.
- Downscaling Regional Climate Data to Local Scales. Office of the Vice-President for Research, University of Arizona (\$4,000, 100% P.I.), 1996.
- Development of Carbon Monoxide Forecasting Models for Phoenix, Arizona. Arizona Department of Environmental Quality, Office of Air Quality (\$25,000, 100% P.I.). January 3 to December 1, 1996.
- A Virtual Communication and Spatial Analysis Laboratory. National Science Foundation, Instrumentation and Laboratory Improvement Grant (\$89,000; 50% Co-P.I.), 1994, with S. Yool and D. Plane.
- A Virtual Communication and Spatial Analysis Laboratory. University of Arizona, Instructional Computing Grant Program (\$19,000; 75% Co-P.I.), 1994, with S. Yool.
- A Synoptic Climate Database for Air Pollution Studies in the US-Mexico Border Region. University of Arizona, Social and Behavioral Sciences Research Institute, Small Grant (\$1,500; 100% P.I.), 1993.
- Assessing Air Pollution Transport to Wilderness Areas: The case of Tucson and the Saguaro National Monument. University of Arizona, Social and Behavioral Sciences Research Institute, Summer Stipend Grant for Proposal Development (\$5,000; 100% P.I.), 1993.
- Climatological evaluation of proposed Gansbaai/Agulhas nuclear reactor site. Contract with Environmental Evaluation Unit, University of Cape Town (R100; 75% Co-P.I.), with L. Loewenheim, 1987.
- Thermal Internal Boundary Layers in the South Western Cape. Council for Scientific and Industrial Research Grant NPWCAR-GBE1 (R22,000; 90% Co-P.I.), with C.S. Keen, 1987.
- Masters Research Grant. Department of Environmental and Geographical Science (R500; 100% P.I.), University of Cape Town, 1986.

**KATHERINE KRISTIN HIRSCHBOECK**

**CHRONOLOGY OF EDUCATION**

Rosary College, River Forest, Illinois (attended 1969-70)

University of Wisconsin - Madison, B.S. in Geography, minor in Geology (1973)

University of Wisconsin - Madison, M.S. in Geography (1975) M.S. Thesis: *The response of flooding in the Upper Mississippi Valley to Twentieth Century Climatic Variations*, James C. Knox, thesis director.

University of Arizona, Ph.D. in Geosciences, minor in Geography (1985). Ph.D. Dissertation: *Hydroclimatology of flow events in the Gila River Basin*, Victor R. Baker and C.W. Stockton, dissertation co-directors

**MAJOR RESEARCH & TEACHING FIELDS**

*Climatology* -- with emphasis on variations in synoptic atmospheric circulation systems, the climatology of extreme events, and mechanisms of climatic change.

*Hydroclimatology and surface water hydrology* -- with emphasis on flood analysis, flood hydroclimatology, and the response of geomorphic and hydrologic systems to spatial and temporal variations in climate.

*Dendroclimatology* -- with emphasis on synoptic dendroclimatology and the link between atmospheric circulation processes and regional tree-growth patterns.

**EMPLOYMENT**

Associate Professor of Climatology, Laboratory of Tree-Ring Research, University of Arizona, 1991 - present.

*Other University of Arizona Appointments:*

Chair, Global Change Graduate Interdisciplinary Program, University of Arizona, 2004 - present  
Joint Appointments in the following departments: Hydrology and Water Resources (1991 – present), Geography and Regional Development (1992 –present), Atmospheric Sciences (2004 – present)

Member of Arid Lands Resources Sciences Graduate Interdisciplinary Program (GIDP) Faculty  
Member of Global Change Committee / Global Change Minor GIDP Faculty Member

Associate Professor, Department of Geography and Anthropology, Louisiana State University, August 1990 - August 1991.

Assistant Professor, Department of Geography and Anthropology, Louisiana State University, August 1985 - August 1990.

Instructor, Department of Geography and Anthropology, Louisiana State University, August 1984 - August 1985.

Visiting Assistant Professor, Department of Geography, University of Oklahoma, January-May, 1984.

**HONORS AND AWARDS**

Provost's General Education Teaching Award, 2003.

American Meteorological Society Editor's Award for the *Journal of Hydrometeorology*, 2001.

Nominated by Provost Sypherd to be the University of Arizona faculty representative to: *Project*

*Kaleidoscope - Faculty for the 21st Century* (PKAL), a national network of science educators in higher education, 1996. (*PKAL faculty are recognized as those "emerging as leaders within their campus community and who have been identified by their deans as having the potential of making a significant contribution to undergraduate science, mathematics, engineering, and technology education into the next century."*)

- Warren Nystrom Award, 1987. Association of American Geographers, First Place. (*The Nystrom Award recognizes excellence in research. It is awarded for an outstanding written and oral presentation of a paper based on a recent dissertation*)
- National Science Foundation Travel Award, 1989. (For scholarly exchange with Bulgarian geographers).

## PUBLICATIONS

### Referred Chapters in Scholarly Books

- Hirschboeck, K.K.**, Ely, L. and Maddox, R.A., 2000, Hydroclimatology of meteorologic floods, in Wohl, Ellen, ed, *Inland Flood Hazards: Human, Riparian and Aquatic Communities*, Cambridge University Press, p. 39-72..
- House, P.K., and **Hirschboeck, K.K.**, 1997, Hydroclimatological and paleohydrological context of extreme winter flooding in Arizona, 1993: in Larson, R.A., and Slosson, J.E., eds., *Storm-Induced Geological Hazards: Case Histories from the 1992-1993 Winter Storm in Southern California and Arizona: Boulder, Colorado*, Geological Society of America Reviews in Engineering Geology, v. XI, p. 1-24.
- Hirschboeck, K.K.**, Ni, Fenbiao, Wood, M.L., Woodhouse, C.A., 1996, Synoptic dendroclimatology: Overview and prospectus, in Dean, J.S., Meko, D.M. and Swetnam, T.W., eds., *Tree Rings, Environment, and Humanity: Radiocarbon*, pp. 205-223.
- Hirschboeck, K.K.**, Floods, in *Encyclopedia of Climate and Weather*, Stephen H. Schneider, ed., 1996, Oxford University Press.
- Hirschboeck, K.K.**, Runoff, in *Encyclopedia of Climate and Weather*, Stephen H. Schneider, ed., 1996, Oxford University Press.
- Tobin, G.A.; Baumann, D.D.; Damron, J.E.; Emel, J.L.; **Hirschboeck, K.K.**; Matthews, O.P.; and Montz, B.E., 1989. Water resources research, in Willmott, C.J. and Gaille, G., eds., *Geography in America*, Merrill, 112-140.
- Hirschboeck, K.K.**, 1988. Flood hydroclimatology, in Baker, V.R., Kochel, R.C. and Patton, P.C., eds., *Flood Geomorphology*, John Wiley & Sons, 27-49.
- Hirschboeck, K.K.**, 1987. Catastrophic flooding and atmospheric circulation anomalies, in Mayer, L. and Nash, D.B., eds., *Catastrophic Flooding*, Allen & Unwin, 23-56.
- Hirschboeck, K.K.**, 1987. Hydroclimatically-defined mixed distributions in partial duration flood series, in Singh, V.P., ed., *Hydrologic Frequency Modeling*, D. Reidel Publishing Company, 199-212.

### Refereed Journal Articles

- Hirschboeck, K.K.** 2003. Respecting the drainage divide: a perspective on hydrological change and scale: *Water Resources Update*, no. 126.
- Michaud, J.D, **Hirschboeck, K.K.** and Winchell, M., 2001. Regional variations in small-basin floods in the United States: *Water Resources Research*, v. 37, no. 5, 1405-1416.
- Hirschboeck, K.K.**, 1999. A room with a view: some geographic perspectives on dilettantism, cross-training, and scale in hydrology: *Annals of the Association of American Geographers*, 89:696-706.
- Moss, P., DeBres, K., Cravey, A., Hyndman, J. **Hirschboeck, K.** Masuci, M., 1999. Toward a feminist mentoring praxis: strategies for ourselves and others: *Journal of Geography in Higher Education*, 23 (3):413-427.
- Faiers, G.E., Keim, B.D., and **Hirschboeck, K.K.**, 1994, A synoptic evaluation of frequencies and intensities of extreme three- and 24-hour rainfall in Louisiana: *The Professional Geographer*, v 42, no. 2, 156-163.
- Hirschboeck, K.K.**, 1991, Climate and floods, in National Water Summary 1988-1989 -- Hydrologic Events and Floods and Droughts: *U.S. Geological Survey Water-Supply Paper 2375*, 67-88.

- Lurry, D.L., Covay, K.J., **Hirschboeck, K.K.**, and Bolourchi, Z., 1990, Louisiana water supply and use in National Water Summary 1987 -- Hydrologic Events and Water Supply and Use: *U.S. Geological Survey Water-Supply Paper 2350*, 275-282.
- Breve, K.A., Bengtson, R.L., **Hirschboeck, K.K.** and Fouss J.L., 1990, Distribution and correlation of the rainfall erosion index in southern Louisiana. *Transactions of the American Society of Agricultural Engineers*, v.33, no. 2, 487-492.
- LaMarche, V.C., Jr. and **Hirschboeck, K.K.**, 1984. Frost rings in trees as records of major volcanic eruptions. *Nature*, v. 307, 121-126.
- Hirschboeck, K.K.**, 1980. A new worldwide chronology of volcanic eruptions, (with a summary of historical ash-producing activity and some implications for climatic trends of the last one hundred years). *Palaeogeography, Palaeoclimatology, Palaeoecology*, v.29, 223-241.

### Non-refereed Technical Reports & Proceedings Publications

- Hirschboeck, K.K.**, 2000. Climate Diagnostics of Flooding in Arizona and Implications for Climatological Forecasts of Hydrologic Extremes in, *Proceedings of the Twenty-Fourth Annual Climate Diagnostics and Prediction Workshop*, Tucson, Arizona Nov 5-9, 1999, U.S. Department of Commerce, NOAA, pp. 367-370.
- Hirschboeck, K.K.** and Cruise, J.F. , 1994. Hydroclimatic Regionalization of Flooding Variability: a Combined Stochastic-climatic Approach: Final Report, U.S. Geological Survey Water Resources Research Grant Program (Section 105) 26 pp of text plus appendices.
- Hirschboeck, K.K.** and Coxe, M.F., 1991. Identification of High-risk Atmospheric and Surface Conditions For Urban Flash Flooding in Louisiana.. Project Completion Report, Louisiana Water Resources Research Institute Louisiana State University. 62 pp of text plus appendices
- Hirschboeck, K.K.** and Klimas, D.K., 1988. Intermittent Stream Classification Development Project. Final Report for Office of Water Resources, Louisiana Department of Environmental Quality, LDEQ Interagency Agreement No. 64004-87-02, 55 pp. of text; 104 pp. of appendices.
- Southwest Environmental Service, 1980. Flood and Erosion Hazards in Tucson. Report prepared as part of a Floodplain Education Project supported by the National Science Foundation, Southwest Environmental Service, Tucson, Arizona, 116 pp. (**contributing author**)
- Knox, J.C., Bartlein, P.J., **Hirschboeck, K.K.**, and Muckenhirn, R.J., 1975. The response of floods and sediment yields to climatic variation and land use in the Upper Mississippi Valley. Institute for Environmental Studies Report No. 52, University of Wisconsin - Madison, 75 pp.

### GRANTS AND CONTRACTS

- A Tree-Ring Based Hydroclimatic Assessment of Synchronous Extreme Streamflow Episodes in the Upper Colorado and Salt-Verde River Basins 2003-2004 **P.I. K.K. Hirschboeck**, Co.I. D. M. Meko The Salt River Project. \$ 85,516
- A New Frost-Ring Initiative: Understanding the Mechanistic Basis for the Santorini Connection, 2003 **P.I. K.K. Hirschboeck**. The Institute for Aegean Prehistory. \$9,529
- Paleoflood Databank Development, Summer 2000, **PI: K.K. Hirschboeck**. Agency: *United States Bureau of Reclamation*. Three months duration. \$6,940.
- Paleoflood Databank Development Continuation, 2000-2001, **PI: K.K. Hirschboeck**. Agency: United States Bureau of Reclamation. One year duration. \$23,457.
- Structure & Dynamics of Rainstorms Inducing Floods in the Negev, 1999-2001, PI: Uri Dayan, Hebrew University, **Co- PIs: Adina Margalit, K.K. Hirschboeck, David Sharon**. Agency: *ILAC Research & Development Project* Proposal. Two years duration. \$68,045
- River Flooding and Global Climatic Change: A Multi-Sensor Approach, 1997-2001, PI: G.R. Brakenridge, **Co-PI: K. K. Hirschboeck, V.R. Baker, L.A.K. Mertes, K. Prestegaard, W.S. Warner**. Agency: NASA. Three-year duration. \$922,048 total (UA portion ~\$70,000 annually).

Synoptic Dendroclimatology in Western United States, 1996-2000 **PI: K.K. Hirschboeck**, Co-PI: D.M. Meko. *NOAA Global Change Program*. Two-year duration with extension. \$172,781.

Forecasting Major Flood Events in Arizona: A Pattern-Recognition Approach Combining Meteorology, Climatology, and Hydrology **PI: K. K. Hirschboeck**, Graduate Student: Mark Love, HWR Department. Agency: *NOAA - National Weather Service COMET/NWS Graduate Student Fellowship Program*, \$27,800.

General Education Course Development for Earth System Science and Global Change. *National Science Foundation*, Course and Curriculum Development Projects. (PI: Lisa Graumlich, **Co-PI's**: Roger Bales, **K.K. Hirschboeck**, S.W. Leavitt). Three years duration. Total funds requested: \$267,626.

A Global Paleoflood Database. *National Oceanic and Atmospheric Administration*, 1995 - 1997. (**PI: K.K. Hirschboeck** Co-PI: Victor R. Baker), \$98,498.

Paleoflood Hydrology. *National Science Foundation*, 1993-1996. (PI: Victor R. Baker, **Co-PI: K.K. Hirschboeck**), \$224,288.

The Influence of Rainfall Characteristics, Hydrologic Characteristics and Rainfall Measurement Strategy on the Accuracy of Flash Flood Forecasts. *National Science Foundation*, 1994-1996. (PI: Soroosh Sorooshian, **Co-PI: K.K. Hirschboeck**), \$229,010.

A Scale-Sensitive Strategy for the Detection and Analysis of Changing Hydrologic Extremes in Response to Changing Global Climate Regimes. *Department of Energy*, National Institute for Global Environmental Change, Western Regional Center, 1992-1993, **PI: K.K. Hirschboeck**, \$78,650.

Hydroclimatic Regionalization of Flooding Variability: A Combined Stochastic-Climatic Approach. *United States Geological Survey*, Water Resources Research Program, 1989-1994, **PI: K.K. Hirschboeck**, Co-PI: James P. Cruise, \$158,147.

## **SERVICE: CITIZENSHIP**

### **Extramural**

*Appointed to:* National Research Council/National Academy of Sciences *Committee on Geography*, Board on Earth Sciences and Resources, Commission on Geosciences, Environment, and Resources (1997 – 2000)

*Offices held:* Association of American Geographers, Water Resources Specialty Group, Secretary/Treasurer 1990-1992; Chair, 1992-1994; American Quaternary Association, Councillor for Paleoclimatology, 1992-1996.

*Member of:* American Meteorological Society (national and local chapters), Association of American Geographers, American Geophysical Union, American Institute of Hydrology; American Water Resources Association, Geological Society of America, The Tree-Ring Society, Phi Kappa Phi.

*Editorial service:* Reviewer of National Academy of Sciences reports; Reviewer of journal manuscripts for: *Journal of Hydrology*, *Water Resources Research*, *International Journal of Climatology*, *Climatic Change*, *Climate Research*, *Bulletin of the American Meteorological Society*, *Arctic and Alpine Research*, *The Professional Geographer*, *Annals of the Association of American Geographers*, *Journal of Geography in Higher Education*, *Southeastern Geographer*

*Grant reviewing service for:* NSF, NOAA Global Change Program, DOE WESTGEC

*Advisory Panel service:* National Science Foundation/Environmental Protection Agency Water and Watersheds peer review panel, July 14-17, 1996.

### **Intramural**

Chair, Global Change Interdisciplinary Program (GCIDP) executive committee (2004- present)

Global Change Interdisciplinary Program (GCIDP) executive committee (2003-2004)

University-wide Committee on Global Change (1992-present)

College of Science Awards Committee (2002-2004)

College of Science Millennium Project Committee (2003-2004)

Graduate College Graduate Student Orientation workshop on Mentoring (2000 - 2004)

General Education Assessment Committee (1999), Chair of Natural Sciences Team  
Computer Technology Committee, Dept of Geography & Regional Development (2003-2004)  
Physical Geography Committee, Dept. of Geography & Reg. Development (1992 – 2000)  
Desert Laboratory Committee, College of Science (1993 - 1996)  
Natural Science Core Curriculum Development Committee, College of Science (1995)  
Committee to Recruit and Retain Women in Science, College of Science (1993 - 1995)  
Search Committee for Desert Laboratory Faculty Position (1994)  
Search Committee for School of Renewable Natural Resources Faculty Position (1995)  
Office of International Programs Awards Committee

**Departmental**

Laboratory of Tree-Ring Research (LTRR) Curriculum Coordinator (2003-2004)  
LTRR Post-Tenure Review Committee (2001-2004)  
Chair, Search Committee for faculty position, Laboratory of Tree-Ring Research (2000, 2001)  
Search Committee member for faculty position, Laboratory of Tree-Ring Research (1999-2000)  
Organizer of “1998 Tree Ring Day” for the LTRR  
Promotion & Tenure Review Committee, Tree-Ring Laboratory (1993 – 1994)  
International Tree Ring Conference Committee, Tree-Ring Laboratory (1993 -1994)  
Climate data & Computer Support Committee, Tree-Ring Laboratory (1992 - 1994)



## VANCE T. HOLLIDAY

### APPOINTMENTS

**2002 - present: Professor**, Departments of Anthropology, Geography/Regional Development and Geosciences, University of Arizona, Tucson

**2002 - present:** Executive Director, Argonaut Archaeological Research Fund, Department of Anthropology, University of Arizona, Tucson.

**1995 - present: Full Professor**, Department of Geography, The University of Wisconsin-Madison.

**1990 - 1995: Associate Professor**, Department of Geography, The University of Wisconsin-Madison.

**1986 - 1990: Assistant Professor**, Department of Geography, The University of Wisconsin-Madison.

**1984 - 1986: Visiting Assistant Professor and Assistant Professor**, Departments of Geography and Anthropology, Texas A&M University.

**1983 - 1984: Visiting Assistant Professor**, Department of Geography, The University of Wisconsin-Madison.

### HONORS

Recipient of the 1998 Kirk Bryan Award of the Geological Society of America for *Stratigraphy and Paleoenvironments of Late Quaternary Valley Fills on the Southern High Plains*. (1995)

Recipient of the 1998 George R. "Rip" Rapp Archaeological Geology Career Award of the Geological Society of America.

Elected Fellow of the Geological Society of America (1992).

### AWARDS and GRANTS

National Science Foundation (Surficial Processes Program), 1988-1990, to study late Quaternary valley fills and paleoenvironments on the Southern High Plains, \$177,000.

National Science Foundation (Geologic Record of Global Change Program), 1993-1995, to study the genesis and paleoenvironmental significance of dunes on the Southern High Plains, \$140,000.

Recipient of the 1996 Gladys W. Cole Memorial Research Award (Geological Society of America) to study the origin and evolution of small playa basins on the Southern High Plains, \$12,000.

National Science Foundation (Earth Sciences Program/Earth System History), 1998-2000, to study the late Quaternary paleoenvironmental record of small playa basins on the Southern High Plains, \$140,000.

### SELECTED PUBLICATIONS -- BOOKS, ARTICLES and CHAPTERS

V.T. Holliday, 1985. Holocene Soil-Geomorphological Relationships in a Semi-arid Environment: The Southern High Plains of Texas. *In: John Boardman (ed.), Soils and Quaternary Landscape Evolution*, pp. 325-357. John Wiley and Sons, England.

V.T. Holliday, 1985. Archaeological Geology of the Lubbock Lake Site, Southern High Plains of Texas. *Geological Society of America Bulletin*, 96:1483-1492.

V.T. Holliday, 1987. Eolian Processes and Sediments on the Great Plains. *In: W. Graff (ed.), Geomorphic Systems of North America*. Geological Society of America, Centennial Special Volume 2, p. 195-202.

V.T. Holliday, 1987. A reexamination of late-Pleistocene boreal forest reconstructions for the Southern High Plains. *Quaternary Research*, 28:238-244.

V.T. Holliday, 1988. Mt. Blanco revisited: soil-geomorphic implications for the ages of the upper Cenozoic Blanco and Blackwater Draw formations. *Geology*, 16:505-508.

V.T. Holliday, 1989. Middle Holocene drought on the Southern High Plains. *Quaternary Research*, 31:74-82.

V.T. Holliday, 1989. The Blackwater Draw Formation (Quaternary): A 1.4+ m.y. record of eolian sedimentation and soil formation on the Southern High Plains. *Geological Society of America Bulletin*, 101:1598-1607.

V.T. Holliday, 1990. Pedology in Archaeology. In: N.P. Lasca and J. Donahue (eds.), *Archaeological Geology of North America*. Geological Society of America, Centennial Special Volume 4:525-540.

V.T. Holliday, 1990. Soils and landscape evolution of eolian plains: the Southern High Plains of Texas and New Mexico. In: P.L.K. Knuepfer and L.D. McFadden (eds.), "Soils and Landscape Evolution", *Geomorphology*, 3:489-515.

V.T. Holliday and T.C. Gustavson, 1991. Quaternary Stratigraphy and Soils of the Southern High Plains. In: Roger B. Morrison (ed.), *Quaternary Nonglacial Geology: Conterminous United States*, Geological Society of America, Centennial Special Volume.

V.T. Holliday, Ed., 1992. *Soils in Archaeology: Landscape Evolution and Human Occupation*. Smithsonian Institution Press, 254 p.

V.T. Holliday, C.V. Haynes, Jr., J.L. Hofman, and D. J. Meltzer, 1994. Geoarchaeology and geochronology of the Miami (Clovis) site, Southern High Plains of Texas. *Quaternary Research*, 41:234-244.

V.T. Holliday, 1995. "Stratigraphy and Paleoenvironments of Late Quaternary Valley Fills on the Southern High Plains." *Geological Society of America Memoir* 186, 136 p.

D. Muhs and V.T. Holliday, 1995. Active dune sand on the Great Plains in the 19th century: Evidence from accounts of early explorers. *Quaternary Research*, 43:198-208.

V.T. Holliday and D.J. Meltzer, 1996. Geoarchaeology of the Midland (Paleoindian) site, Texas. *American Antiquity*, v. 61, pp. 755-771.

V.T. Holliday, T.C. Gustavson, and S.D. Hovorka, 1996. Stratigraphy and Geochronology of Playa Fills on the Southern High Plains. *Geological Society of America Bulletin*, v. 108, pp. 953-965.

V.T. Holliday, 1997. *Paleoindian Geoarchaeology of the Southern High Plains*, University of Texas Press, 297 p.

V.T. Holliday, 1997. Origin and evolution of lunettes on the High Plains of Texas and New Mexico. *Quaternary Research* 47:54-69.

T. C. Gustavson and V. T. Holliday, 1999. Eolian sedimentation and soil development on a semiarid to subhumid grassland, Tertiary Ogallala and Quaternary Blackwater Draw Formations, Texas and New Mexico High Plains. *Journal of Sedimentary Research*, v. 69, p. 622-634.

P. Goldberg, V. T. Holliday, and C. R. Ferring (Editors.), 2000, *Earth Science in Archaeology*, Plenum Press, 513 p.

V.T. Holliday, 2000. Folsom drought and episodic drying on the Southern High Plains from 10,900-10,200 <sup>14</sup>C yr B.P. *Quaternary Research*, v. 53, p. 1-12.

V.T. Holliday, 2001. Stratigraphy and geochronology of late-Quaternary eolian sand on the Southern High Plains of Texas and New Mexico, U.S.A. *Geological Society of America Bulletin*, v. 113, p. 88-108.

V.T. Holliday, 2001. Quaternary geoscience in archaeology. IN P. Goldberg, V. T. Holliday, and C. R. Ferring (Eds.), *Earth Science in Archaeology*, Kluwer Academic/Plenum Publishers, p. 3-35.

D. J. Meltzer, L. C. Todd, and V.T. Holliday, 2002. The Folsom (Paleoindian) Type Site: Past Investigations, Current Studies, *American Antiquity*, v. 67, p. 5-36.

V.T. Holliday, J.C. Knox, G.L. Running, R.D. Mandel, and C.R. Ferring. 2002. The Central Lowlands and Great Plains. IN Anthony Orme, ed., *The Physical Geography of North America*. Oxford University Press, p. 335-362.

C. Britt Bousman, Michael B. Collins, Paul Goldberg, Thomas Stafford, Jan Guy, Barry W. Baker, D. Gentry Steele, Marvin Kay, Anne Kerr, Glen Fredlund, Phil Dering, Vance Holliday, Diane Wilson, Wulf Gose, Susan Dial, Paul Takac, Robin Balinsky, Marilyn Masson & Joseph F. Powell, 2002. The Palaeoindian- Archaic transition in North America: New evidence from Texas. *Antiquity*, v. 76, p. 980-990.

J. LaBelle, V.T. Holliday, and D. J. Meltzer, 2003. Early Holocene Paleoindian Deposits at Nall Playa, Oklahoma Panhandle. *Geoarchaeology*, v. 18, p. 5-34.

L. Litwinionek, E. Johnson, and V.T. Holliday, 2003. The playas of the Southern High Plains: An archipelago of human occupation for 12,000 years on th North American grasslands. IN M. Kornfeld and A. J. Osborn (Eds.) *Islands on the Plains: Ecological, Social, and Ritual Use of Landscapes*, University of Utah Press, p.21-43.

V.T. Holliday, 2004. *Soils in Archaeological Research*. Oxford University Press, 441 p.

## CHARLES F. HUTCHINSON

### EDUCATION

- 1973 - 1978 Ph.D. University of California, Riverside (Geography) Dissertation title: *The digital use of Landsat data for integrated resource survey: A study in the Mojave Desert, California.*
- 1972 - 1973 M.A. University of California, Riverside (Geography)
- 1970 - 1972 B.A. University of California, Riverside (Geography, *magna cum laude*)
- 1967 - 1970 Riverside City College (Computer Science)

### HONORS AND AWARDS

- 1996 First Prize, John J. Davidson President's Award for Practical Papers. American Society for Photogrammetry and Remote Sensing.
- 1988-89 Gilbert F. White Fellowship, Resources for the Future, Washington D.C.
- 1973-74 University of California Regents Fellowship
- 1970-72 Joseph Hunter Foundation Scholarship
- 1970-71 Mary E. Jaskey Award (Riverside City College)

### EMPLOYMENT

- University of Arizona** (3/04 – present). Director, Office of Arid Lands Studies, College of Agriculture and Life Sciences. Responsible for administering an interdisciplinary research group focused on the sustainable use of arid and semiarid lands (8 faculty, forty staff, 35 students).
- National Aeronautics and Space Administration** (5/01 – 4/02). Acting Director, Applications Division, Office of Earth Science, Headquarters. Seconded by University of Arizona to direct operations of the Applications Division of the Office of Earth Science.
- National Aeronautics and Space Administration** (1/98 - 12/98). Visiting Senior Scientist, Office of Earth Science (formerly Mission to Planet Earth), Headquarters. Seconded by University of Arizona to assist in planning a new Applications and Outreach Division of the Office of Earth Science.
- University of Arizona** (6/87 - present). Associate Professor and Professor (1995), Office of Arid Lands Studies, College of Agriculture; Adjunct Professor, Department of Geography and Regional Development and School of Renewable Natural Resources.
- Resources for the Future** (9/88 - 8/89). Gilbert F. White Fellow, Climate Resources Program. Awarded fellowship to examine methodological and institutional issues surrounding famine early warning systems used in sub-Saharan Africa.
- University of Arizona** (11/83 - present). Associate Director, Office of Arid Lands Studies. Responsible for assisting in the supervision and administration of a multidisciplinary research organization (approximately 50 staff).
- University of Arizona** (2/81 - 4/86). Assistant Research Scientist, Arid Lands, and Adjunct Assistant Professor, Geography and Regional Development, and Soils, Water and Engineering. Responsible for introductory and advanced courses in remote sensing and remote sensing applications (2 courses per year).
- University of Arizona** (1/80 - present). Director, Arizona Remote Sensing Center, Office of Arid Lands Studies. Responsible for operation and support of a remote sensing laboratory (3 faculty, 2 staff, 10 students) and develop research initiatives (see sponsored research).
- California Institute of Technology** (3/78 - 1/80). Member, Technical Staff, Jet Propulsion Laboratory, Systems Analysis Section. Responsibilities included: 1) performing environmental analysis of new

energy technologies; and 2) developing remote sensing and geographic information system research initiatives in environment and natural resource management.

**U.S. Geological Survey** (10/76 - 2/78). Geographer, Earth Resources Observation System (EROS) Program, Reston, Virginia. Planned and conducted research on the use of Landsat digital data for mapping integrated terrain units (dissertation support).

**University of California, Riverside** (1/73 - 12/76). Teaching and Research Assistant, Department of Earth Sciences. Assisted in the presentation of courses in physical and plant geography. Assisted in research projects in: remote sensing applications; soil survey; and historical land use impacts on vegetation.

**Aerial Information Systems**, Redlands, California (4/74 - 6/76). Co-Founder. Established a company that provides remote sensing services in resource inventory for planning.

**Environmental Systems Research Institute**, Redlands, California, (10/73 - 3/74). Resource Analyst. Gathered and analyzed field and archival information for development planning in Japan using remote sensing and geographic information systems.

### **SPONSORED RESEARCH, 1995 - present**

Assimilation of Nasa Science Results and Data into National Decision Support System. September 2002 – August 2005. \$600,000. National Aeronautics and Space Administration (with Stuart Marsh, Sam Drake, Willem Van Leeuwen, and Barron Orr).

Synergy IV: Extending and Operationalizing RangeView for Natural Resource Management. \$422,750. March 2003-March 2004. Raytheon Corporation (with S. Marsh, B. Orr, B. Hutchinson, G. Ruyle). Establishing a Basis for Carbon Management Policy at the State Level: Carbon Dynamics at Site, Landscape, and Regional Scales for Arizona State Lands. October 2001 – September 2004.

\$756,338. National Aeronautics and Space Administration (with Stuart Marsh, Martin Karpiscak, Stephen McLaughlin, Mitchell McClaran, Joseph E. DeSteiguer [University of Arizona], R. César Izaurralde, Eileen M. Perry, Norman J. Rosenberg [Battelle Pacific Northwest National Laboratory], and Eugene Trobia [State of Arizona]).

Interagency Personnel Agreement. May 2001 – May 2002. \$241,804. National Aeronautics and Space Administration.

Informing the Elk Debate: Applying NASA Earth Observing Data to Natural Resource Management in the Western States. March 2000-December 2000. \$378,492. Raytheon Corporation (Co-Investigators with M. Enns, L. Howrey, P. Krausman, and S. Marsh).

Planning, Coordination, Materials Preparation and Market Survey for Regional Informational Workshops. March 2000-May 2001. \$375,493. National Aeronautics and Space Administration (Co-Investigator with M. Wallendorf)

Modes and Models for Enabling the Use of NASA Earth Science and Data in Decision Making. March 1999-February 2003. \$650,000. National Aeronautics and Space Administration.

Interagency Personnel Agreement. January 1998 - December 1998. \$143,888. National Aeronautics and Space Administration.

Earth Observations Resources Infrastructure for Integrated Regional Assessments in the Sonoran Desert Region. October 1997 - September 1998. \$291,913. National Aeronautics and Space Administration. (Co-Investigator with R. Schowengerdt (PI), S. Sorooshian, and K. Thome).

Informing the Rangeland Conflict. January 1996 - June 1999. \$40,000. Udall Foundation. (with Thomas Sheridan).

Malawi Environmental Monitoring Program. March 1996 - March 1999. \$4,883,000. U.S. Agency for International Development (with J.R. Eastman, Clark University).

Developing a Digital Archive for the Santa Rita Experimental Range. May 1995-June 1997. Vice President for Research, University of Arizona (with Mitchel McClaran and Robert MacArthur).

**SELECTED PUBLICATIONS, 1995-present**

- Hutchinson, C.F. 2001. Famine and Famine Early Warning: Some Contributions by geographers. *Yearbook of the Association of Pacific Coast Geographers*. 63:137-144.
- Hutchinson, C.F., J.D. Unruh, and C.J. Bahre. 2000. Land use vs. climate as causes of vegetation change: a study in southeastern Arizona. *Global Environmental Change* 10:47-55.
- Reynolds, C.A., M. Yitayew, D.C. Slack, C.F. Hutchinson, A. Huete, M.S. Petersen. 2000. Estimating crop yields and production by integrating the FAO Crop Specific Water Balance model with real-time satellite data and ground-based ancillary data. *International Journal of Remote Sensing* 21(18): 3487-3508.
- Hutchinson, C.F. 1996. The Sahelian desertification debate: a view from the U.S. Southwest. *Journal of Arid Environments* 33(4):519-524
- Hutchinson, C.F. 1996. Africa and America: desert connections. *Forum for Applied Research and Public Policy* 11(3):34-36
- Mouat, D.A., C.F. Hutchinson, and B.C. McClure. 1995. Introduction. Special issue on desertification, *Environmental Monitoring and Assessment*: 37:1-4.
- Mack, Chris, S.E. Marsh, and C.F. Hutchinson. 1995. Application of aerial photography and GIS techniques in the development of an historical perspective of environmental hazards at the rural-urban fringe. *Photogrammetric Engineering and Remote Sensing* 61(8):1015-1020.

**STUART E. MARSH**

**Positions:**

Professor and Chair Arid Lands Resource Sciences  
Professor Geography and Regional Development  
Director Arizona Remote Sensing Center

**Education:**

Stanford University	Ph.D.	1979	Applied Earth Sciences
Stanford University	M.S.	1975	Applied Earth Sciences
George Washington University	B.S.	1973	Geology

**Professional – Academic Activity:**

2004 – Present	Director Arizona Remote Sensing Center
2002 – Present	Chair, Arid Lands Resource Sciences Ph.D. Program
2001 – Present	Professor University of Arizona
1988 – 2004	Associate Director Arizona Remote Sensing Center
1988 – 2001	Associate Professor University of Arizona
1986 – 1988	Manager, Geoscience Computer Services, Sun Exploration & Production
1983 – 1986	Manager, Remote Sensing Systems, Sun Exploration & Production
1981 – 1983	Senior Geologist, Sun Exploration & Production Company
1980 – 1981	Research Geologist, Gulf Oil Corporation
1979 – 1980	NRC Resident Research Associate, Jet Propulsion Laboratory
1974 – 1978	Geologist, U.S. Geological Survey, EROS Program

**Honors and Awards:**

American Society for Photogrammetry and Remote Sensing - Presidential Citation (1999)  
J. William Fulbright Senior Scholar Award for research/lecturing in Australia (1996/1997)  
John I. Davidson ASPRS President's Award for Practical Papers (1996)  
Elected Fellow, Arizona-Nevada Academy of Sciences (1996)  
President, Arizona-Nevada Academy of Sciences (1995)  
State of Arizona Geographic Information Council (1994-1996)  
NASA Certificate of Recognition (1983)  
National Research Council (NRC) Post-Doctoral Fellowship (1980)

**Active Grants and Projects:**

Remote Sensing of Land Status on the A-7 Ranch in Support of Water Protections. 2001-2005. \$76,365.  
City of Tucson and The Arizona Water Protection Fund (with C.F. Hutchinson).

Synergy V – Rangeview: A Decision Support Tool for Ecological Forecasting. 2004. \$249,999. NASA – Raytheon (with B. Orr, W. van Leeuwen, B. Hutchinson, C.F. Hutchinson, L. Howery, G. Ruyle).

Establishing a Basis for Carbon Management Policy at the State Level: Carbon Dynamics at Site, Landscape, and Regional Scales for Arizona State Lands. 2002-2004. \$756,338. NASA (with C.F. Hutchinson, M. Karpiscak, S. McLaughlin, M. McClaran, J. DeSteiguer, R.C. Izaurralde, E. Perry, and N. Rosenberg).

Advanced GIS, Data Analysis, and Visualization Tools for Semi-Arid Watersheds: Phase 3. 2002-2004. \$74,996. International Arid Lands Consortium (with B. Hutchinson, B. Orr, M. Baker).

Assimilation of NASA Science Results and Data Into National Decision Support Systems. 2002-2005. \$600,000. NASA (with C.F. Hutchinson, S. Drake, W. van Leeuwen, and B. Orr).

**Recent Publications:**

Shupe, S. and Marsh, S.E., 2004. Cover and Density Based Vegetation Classifications of the Sonoran Desert Using Landsat TM and ERS-1 SAR Imagery. *Remote Sensing of Environment*, 93(1-2):131-149.

Skirvin, S.M., Kepner, W.G., Marsh, S.E., Drake, S.E., Maingi, J.K., Edmonds, C.M., Watts, C.J., Williams, D.R., 2004. Assessing the Accuracy of Satellite-derived Land Cover Classification Using Historical Aerial Photography, Digital Orthophoto Quadrangles, and Airborne Video Data. In Lunetta, R.S. and Lyon, J.G. (Editors), Remote Sensing and GIS Accuracy Assessment, CRC Press: Boca Raton, FL.

Skirvin, S.M., Marsh, S.E., McClaran, M.P., Meko, D.M., 2003. Climate Spatial Variability and Data Resolution in a Semi-Arid Watershed, Southeastern Arizona. *Journal of Arid Environments*, 54(4):667-686.

Maingi, J.K. and Marsh, S.E., 2002. Quantifying Hydrologic Impacts Following Dam Construction along the Tana River, Kenya. *Journal of Arid Environments*, 50(1): 53-79.

Maingi, J.K. and Marsh, S.E., 2001. Assessment of Environmental Impacts of River Basin Development on the Riverine Forests of Eastern Kenya Using Multi-temporal Satellite Data. *International Journal of Remote Sensing*, 22(14): 2701-2729.

Weiss, E., Marsh, S.E., and Pfirman, E.S., 2001. Application of NOAA-AVHRR NDVI Time-Series Data to Assess Changes in Saudi Arabia's Rangelands. *International Journal of Remote Sensing*, 22(6):1005-1027.

Clay, G.R., and Marsh, S.E., 2001. Monitoring of Forest Transitions Using Scanned Ground Photographs as a Primary Data Source. *Photogrammetric Engineering and Remote Sensing*, 67(3):319-330.

Kepner, W.G., Watts, C.J., Edmonds, C.M., Maingi, J.K., Marsh, S.E., and Luna, G., 2000. A Landscape Approach for Detecting and Evaluating Change in a Semi-Arid Environment. *Journal of Environmental Monitoring and Assessment*, 64:179-195.

Clay, G.R. and Marsh, S.E., 1997. Spectral Analysis for Articulating Scenic Color Changes in a Coniferous Landscape. *Photogrammetric Engineering and Remote Sensing*, 63(12):1353-1362.

Hirosawa, Y., Marsh, S.E., Kliman, D.H., 1996. Application of Standardized Principal Components Analysis to Land Cover Characterization Using Multitemporal AVHRR Data. *Remote Sensing of Environment*, 58(3), 267-281.



**CHRISTOPHER A. SCOTT**

Assistant Professor  
Department of Geography and Regional Development  
University of Arizona  
410 Harvill Building, Tucson, Arizona 85721  
Phone: (520) 621-1652 Fax: (520) 621-2889  
Email: cascott@email.arizona.edu

**EDUCATION**

1994-97 Cornell University, Ph.D. Major Field: Hydrology  
Cornell University, M.S. Major Field: Hydrology  
1981-85 Swarthmore College, B.S. Major Field: Engineering; B.A. Major Field: Asian Studies

**TEACHING, SUPERVISING AND ADVISING**

Teaching Assistant, Irrigation & Drainage Design  
Supervised one postdoctoral researcher and 6 Masters and Ph.D. students

**ACADEMIC APPOINTMENTS AND EMPLOYMENT**

*Assistant Professor of Geography and Regional Development* (2006- ), University of Arizona  
*Assistant Research Professor of Water Resources Policy* (2006- ), Udall Center for Studies in Public Policy, Univ. of Arizona; affiliated with the Institute for the Study of Planet Earth.  
*Senior Project Specialist – Hydrometeorology* (2005-06), National Oceanic and Atmospheric Administration, National Weather Service, International Activities, Silver Spring, MD.  
*Principal Researcher - Hydrology; Director for Asia* (2001-05), International Water Management Institute (IWMI), Hyderabad, India.  
*Hydrologist* (2000-01), U.S. Agency for International Development, Global Environment Center, Washington, DC (seconded by IWMI, Colombo, Sri Lanka).  
*Senior Researcher, Mexico Program Leader* (1997-2000), IWMI, Guanajuato, Mexico.  
*Research Associate* (1994-97), New York City Watershed Project, Cornell Univ., Ithaca, NY.  
*Project Manager* (1992-94), Catholic Relief Services, Tegucigalpa, Honduras.  
*Research Assistant* (1991-92), Cornell Irrigation Studies Group, Ithaca, NY.  
*Intern - Watershed Management* (1990), The Ford Foundation, New Delhi, India.  
*Coordinator - Watershed Management and Small-scale Irrigation* (1987-89), Seva Mandir (an NGO), Udaipur, Rajasthan, India.  
*Consultant - Appropriate Shelter* (1987), Development Alternatives, New Delhi, India.  
*Assistant Engineer* (1985-87), Baker Engineers, Alexandria, VA.

**PUBLICATIONS – Selected Refereed Journal Articles**

Biggs, T.W., C.A. Scott, B. Rajagopalan, H.N. Turrall. Accepted, in revision. Trends in solar radiation due to changes in clouds and aerosols, southern India, 1952-1997. *International Journal of Climatology*.  
Biggs, T.W., C.A. Scott. Accepted, in revision. Radiation and potential evaporation estimated from satellites, FAO-56, and evaporation pans in Southern India. *Journal of Applied Meteorology and Climatology*.  
Ahmad, M., T.W. Biggs, H. Turrall, C.A. Scott. 2006. Application of SEBAL approach and MODIS time-series to map vegetation water use patterns in the data scarce Krishna river basin of India. *Water Science & Technology* 53(10): 83–90.  
Scott, C.A. and T. Shah. 2004. Groundwater overdraft reduction through agricultural energy policy: insights from India and Mexico. *Journal of International Water Resources Development* 20(2): 149-164.  
Scott, C.A., W.G.M. Bastiaanssen, M. Ahmad. 2003. Mapping root zone soil moisture using remotely sensed optical imagery. *ASCE Journal of Irrigation and Drainage Engineering* 129(5): 326-335.

Scott, C.A., H. El-Naser, R.E. Hagan, A. Hijazi. 2003. Facing water scarcity in Jordan: reuse, demand reduction, energy and transboundary approaches to assure future water supplies. *Water International* 28(2): 209-216.

Scott, C.A., P. Silva-Ochoa. 2001. Collective action for water harvesting irrigation in the Lerma-Chapala Basin, Mexico. *Water Policy* 3 (2001): 555-572.

Scott, C.A., M.F. Walter, G.N. Nagle, M.T. Walter, N.V. Sierra, E.S. Brooks. 2001. Residual phosphorus in runoff from successional forest on abandoned agricultural land: 1. biogeochemical and hydrological processes. *Biogeochemistry* 55(3): 293-309.

Scott, C.A., M.F. Walter. 2001. Residual phosphorus in runoff from successional forest on abandoned agricultural land: 2. hydrological and soluble reactive P budgets. *Biogeochemistry* 55(3): 311-325.

Scott, C.A., K.W. Weiler. 2001. Modeling soluble phosphorus desorption kinetics in tile drainage. *ASCE Journal of Irrigation and Drainage Engineering* 127(2): 70-76.

### **PUBLICATIONS – Selected Books/Edited Volumes**

Scott, C.A. 2005. Investing in the reuse of treated wastewater. Investment Note 5.3. Shaping the Future of Water for Agriculture: A Sourcebook for Investment in Agricultural Water Management. pp. 185-189.

World Bank, Washington, DC.

Sharma, B.R., J.S. Samra, C.A. Scott, S.P. Wani (eds.) 2005. Watershed Management Challenges: Improving Productivity, Resources, and Livelihoods. International Water Management Institute, New Delhi, India.

Scott, C.A., N.I. Faruqui, L. Rachid-Sally (eds.) 2004. Wastewater Use in Irrigated Agriculture. CABI Publishing, Wallingford, U.K.

*Contributed to the following chapters in this volume:*

Scott, C.A., T. Shah, S.J. Buechler, P. Silva-Ochoa. 2004. La fijación de precios y el suministro de energía para el manejo de la demanda de agua subterránea: enseñanzas de la agricultura mexicana. In C. Tortajada, R. Sandoval, E. Castelán (eds). Hacia una Gestión Integral del Agua en México: Retos y Alternativas. 521p. Mexico City, Porrúa Editores.

Wester, P., C.A. Scott, M. Burton. 2004. River basin closure and institutional change in Mexico's Lerma-Chapala Basin. Chapter 8 (pp. 125-144) in M. Svendsen (ed.) Irrigation and River Basin Management: Options for Governance and Institutions. CABI Publishing, Wallingford, U.K.

Scott, C.A. 2003. Recycling and reuse of 'derivative water' under conditions of scarcity and competition. pp. 102-119. In C. Figueres, C. Tortajada, J. Rockstrom, (eds.) Rethinking Water Management: Innovative Approaches to Contemporary Issues, Earthscan, London, 242 pp.

Scott, C.A., P. Silva-Ochoa, V. Florencio-Cruz, P. Wester. 2001. Competition for water in the Lerma-Chapala basin. In A. Hansen and M. van Afferden (eds.) The Lerma-Chapala Watershed: Evaluation and Management. Kluwer Academic/Plenum Publishers.

Scott, C.A., C. Garcés R. 2001. Conjunctive management of surface water and groundwater in the middle Río Lerma Basin, Mexico. In A.K. Biswas and C. Tortajada (eds.) Integrated River Basin Management. Oxford University Press.

### **PUBLICATIONS – Selected Research Reports**

Amarasinghe, U., B. Sharma, N. Aloysius, C.A. Scott, V. Smakhtin, C. de Fraiture. 2005. Spatial variation in water supply and demand across the river basins of India. IWMI Research Report. International Water Management Institute, Colombo, Sri Lanka.

Shah, T., C.A. Scott, A. Kishore, A. Sharma. 2003. Energy-irrigation nexus in South Asia: improving groundwater conservation and power sector viability. IWMI Research Report No. 70. International Water Management Institute, Colombo, Sri Lanka.

### **SCHOLARLY PRESENTATIONS**

"Urban wastewater impacts on the spatial distribution of solutes and microbial constituents in the Musi River, India." *American Geophysical Union Spring Meeting*, Baltimore, 23 May 2006.

“Soil and Water Quality under Wastewater Irrigation,” *International Soil Science Society Conference*, New Delhi, 28 January 2005.

“Wastewater Use in Irrigated Agriculture,” *World Water Week*, Stockholm, 15-20 August 2004.

“Groundwater in the Indus-Ganges Basin: Energy Supply and Pricing Impacts,” *World Water Week*, Stockholm, 15-20 August 2004.

“Groundwater Overdraft Reduction through Agricultural Energy Policy,” *III World Water Forum*, Kyoto, 21-24 March 2003.

“Energy Pricing and Supply for Groundwater Demand Management: Lessons from Mexican Agriculture,” *Forward-Thinking Policies for Groundwater Management: Energy, Water Resources, and Economic Approaches*, IWMI, Indian Council for Agricultural Research (ICAR) and Colombo Plan Secretariat, New Delhi, 2 - 6 September 2002.

“Visualizing the Invisible: Harnessing Local Initiative for Conjunctive Management of Surface and Groundwater,” *Indian Groundwater Policy Workshop*, ICAR and IWMI, Karnal, Haryana, 6-8 November 2001.

**GRANTS and CONTRACTS (P.M = PROJECT MANAGER; P.I. = PRINCIPAL INVESTIGATOR)**

Mexico River Forecasting. (P.M.) \$0.36 million collaborative grant from the Comisión Nacional del Agua (CNA) Gerencia de Aguas Superficiales e Ingeniería de Rios (2005-06).

India Climate Forecast Systems (Component of the Disaster Management Support Project). (P.M.) \$0.56 million collaborative grant from USAID/ New Delhi (2005-06)

Romania Destructive Waters Abatement and Management. (Co-P.M.) \$0.72 million collaborative grant from the Romanian Ministry of Environment & Water Management (2005-06)

Health & Food Safety from Expanding Wastewater Irrigation, South Asia. (P.I.) \$1.05 million competitive grant from German Cooperation Ministry (BMZ) (2004-05).

Urban & Peri-Urban Agriculture, South Asia. (P.I.) \$0.85 million merit-based grant from Netherlands Cooperation Department (DGIS) and Canadian International Development Research Centre (2004-05).

Agricultural Water Productivity in the Krishna Basin. (P.I.) \$0.96 million competitive grant from Australian Centre for International Agricultural Research (2004-05).

Linking Forest and Irrigation Management in the Himalayas. (Co-P.I.) \$0.3 million competitive grant from Consultative Group on International Agricultural Research, Challenge Program on Water and Food (2004-05).

Water-Energy Nexus in Agriculture. (P.I. for \$0.73 million IWMI subcontract under prime contractor P.A. Consulting) \$6 million, GSA schedule, 2-phase competitive grant from USAID (2002-05).

Livestock-Environment-Watershed Interactions. (P.I.) \$0.29 million merit-based grant from Swiss Development Cooperation and U.N. Food and Agriculture Organization (2002-04).

Pro-poor Irrigation Interventions. (Research Supervisor) \$0.11 million competitive grant from Asian Development Bank (2002-03).

Irrigation Management, Mexico. (Project Manager) \$1.5 million multi-phase merit-based grant from the Ford Foundation (1997-2000).

New York City Watershed Water Quality. (Research Associate). Conducted Ph.D. research on this project funded by NY City Dept. of Environmental Protection (1994-97); worked with P.I. Tammo Steenhuis to secure Role of Subsurface Drainage in Transport of Cryptosporidium Parvum Oocysts grant (USDA, \$0.184 million).

## THOMAS W. SWETNAM

### EDUCATION

- University of New Mexico, B. S., 1977, General Biology, Chemistry
- University of Arizona, M. S., 1983, Ph.D. 1987, Watershed Management, Dendrochronology

### EMPLOYMENT

- 2000 to Present: Director & Professor of Dendrochronology, Laboratory of Tree-Ring Research; joint appointments in School of Renewable Natural Resources, Ecology & Evolutionary Biology, and adjunct appointment in Geography and Regional Development
- 1994-1999: Associate Professor of Dendrochronology, Laboratory of Tree-Ring Research
- 1988-1994: Assistant Professor of Dendrochronology, Laboratory of Tree Ring Research
- 1987-1988: Research Associate, Laboratory of Tree-Ring Research, University of Arizona
- 1980-1987: Graduate Assistant in Research, subsequently Graduate Associate in Research, Laboratory of Tree-Ring Research, University of Arizona
- 1978-1980: Forestry Technician, Gila Wilderness, New Mexico, U. S. Forest Service
- 1976-1977: Park Technician, Grand Canyon National Park, Arizona, National Park Service

### AWARDS & HONORS

- A. E. Douglass Award University of Arizona (1983)
- Visiting fellow at Aldo Leopold Wilderness Research Institute, Missoula Montana (1994)
- Walter Orr Roberts Lecturer, Aspen Global Change Institute, Aspen Colorado (1999)
- Weaver Lecturer, School of Forestry and Wildlife Science, Auburn University (2000)
- W. S. Cooper Award, Ecological Society of America (2001)
- Henry Cowles Award, The Association of American Geographers, Biogeography Specialty Group (2002)

### 10 SELECTED PUBLICATIONS (approximately 80 total)

- Swetnam, T. W., and J. L. Betancourt. 1990. Fire-Southern Oscillation relations in the Southwestern United States. *Science* 249:1017-1020.
- Swetnam, T. W. 1993. Fire history and climate change in giant sequoia groves. *Science*. 262:885-889.
- Swetnam, T. W. and A. M. Lynch. 1993. Multi-century, regional-scale patterns of western spruce budworm history. *Ecological Monographs* 63(4):399-424)
- Swetnam, T. W., and J. L. Betancourt. 1998. Mesoscale disturbance and ecological response to decadal climatic variability in the American Southwest. *Journal of Climate* 11:3128-3147.
- Kaye, M. W. and T. W. Swetnam. 1999. An assessment of fire, climate, and Apache history in the Sacramento Mountains, New Mexico, USA. *Physical Geography* 20(4):305-330.
- Swetnam, T. W., C. D. Allen, and J. L. Betancourt. 1999. Applied historical ecology: Using the past to manage for the future. *Ecological Applications* 9(4):1189-1206.
- Allen, C. D., M. Savage, D. A. Falk, K. F. Suckling, T. W. Swetnam, T. Schulke, P. B. Stacey, P.

- Morgan, M. Hoffman, and J. Klingel. 2002. Ecological restoration of southwestern ponderosa pine ecosystems: a broad perspective. *Ecological Applications* 12(5):1418-1433.
- Kitzberger, T., T. W. Swetnam, and T. T. Veblen. 2001. Inter-hemispheric synchrony of forest fires and the El Nino-Southern Oscillation. *Global Ecology and Biogeography* 10 (3): 315-326.
- Swetnam, T. W. and C. H. Baisan. 2003. Tree-ring reconstructions of fire and climate history in the Sierra Nevada and Southwestern United States. pages 158-195, In: T. T. Veblen, W. Baker, G. Montenegro, and T. W. Swetnam, editors. *Fire and Climatic Change in Temperate Ecosystems of the Western Americas*. Ecological Studies Vol. 160. Springer, New York.
- Westerling, A. L., and T. W. Swetnam. 2003. Interannual to decadal drought and wildfire in the Western US. *EOS, Transactions of the American Geophysical Union* 84(49):545-560.

**SERVICE/OUTREACH (2000-present):**

Boards and Advisory:

- Ecological Society of America Annual Meeting Local Host (Tucson, 2002), Program Chair (2003-2004)
- Member, Board of Trustees, Valles Caldera National Preserve, 4-year term (2001-present), appointed by President William J. Clinton
- Member, Arizona Governor Janet Napolitano's Forest Health Advisory Council (2003-present).
- Member, Science Advisory Board, Malpais Borderlands Group, Animas New Mexico
- Member, Board of Advisors, Institute for Natural Resource Management, NSF-EPSCOR Program, New Mexico, 2003-present
- Member, Board of Advisors, International Multiproxy Paleofire Database, National Climate Data Center, NOAA, 2002-present.
- Testimony to Congress on fire ecology and fire management issues (testimony presented to two Congressional hearings in 2000, and a briefing to senate staffers in 2002).

Editorial:

- Associate Editor, *International Journal of Wildland Fire*, 1993-present
- Editor, *Tree-Ring Research* (formerly *Tree-Ring Bulletin*) 2000-2001
- Associate Editor, *Ecoscience*, 1994-1998
- Associate Editor, *Canadian Journal of Forest Research*, 1998
- Advisory Council, *Dendrochronologia*, 2002-present
- Editorial Board, *Ecological Applications*, 1998-1999
- Co-Editor with J. Dean and D. Meko on special issue of *Radiocarbon*, 1996

**Willem J.D. van Leeuwen**

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E-mail: leeuw@ag.arizona.edu

**Education:**

University of Arizona, Tucson, AZ, USA	Ph.D.	1995	Soil, Water & Environmental Science
Agricultural Univ. of Wageningen, NL	M.S.	1988	Soil Science and Remote Sensing
Agricultural Univ. of Wageningen, NL	B.S.	1986	Soil Science and Soil Fertility

**Professional Appointments – Academic Activity:**

2005 – present Assistant Professor, Office of Arid Lands Studies and Geography and Regional Development, University of Arizona, Tucson.

2002 – 2005 Research Scientist, University of Arizona, Office of Arid Lands Studies, Arizona Remote Sensing Center, Tucson.

1999 – 2002 Research Scientist, Météo France, Centre Nationale de la Recherche Scientifique and Centre National de Recherches Météorologiques Toulouse, France. SEVIRI Land Satellite Application Facility Team Member (France; adjunct)

1995 – 1999 Assistant Research Scientist, Department of Soil, Water and Environmental Science, University of Arizona, Tucson. (MODIS satellite Land Science Team Member; adjunct)

1990 – 1995 Research Associate, Department of Soil and Water and Environmental Science, University of Arizona, Tucson

**Professional Associations:**

Association of American Geographers (AAG)  
American Society of Photogrammetry and Remote Sensing (ASPRS)  
American Geophysical Union (AGU)  
IEEE Geoscience and Remote Sensing Society (IGARSS)  
International Association for Landscape Ecology (IALE)  
National Science Teachers Association (NSTA)  
Netherlands Society for Earth Observation and Geo-Information (BCRS)  
Committee for Remote Sensing and Spatial Analysis (CRSSA – UA)

**Publications:**

van Leeuwen, Willem J.D., Barron J. Orr, 2006. Spectral Vegetation Indices and Uncertainty: Insights from a User's Perspective. *IEEE Transactions on Geoscience and Remote Sensing*. Vol. 44, Issue: 7, Part 1, 1931- 1933.

van Leeuwen, W.J.D., B. Orr, S. Marsh, S. Herrmann, 2006. Multi-Sensor NDVI Data Continuity: Uncertainties and Implications for Vegetation Monitoring Applications. *Remote Sensing of Environment* Vol. 100 (1) 67-81.

Fang, Hongliang, Shunlin Liang, Mitchel P. McClaran, Willem J. D. van Leeuwen, Sam Drake, Stuart E. Marsh, Allison Thomson, R. Cesar Izaurralde, J. Norman, 2005. Biophysical characterization and management effects on semiarid rangeland observed from Landsat ETM+ data, *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 43, 1:125-134

Orr, B.J., G.M. Casady, D.G. Tuttle, W.J.D. van Leeuwen, L.E. Baker, C.L. McDonald, and S.E. Marsh. 2004. Phenology and trend indicators derived from spatially dynamic bi-weekly satellite imagery to support ecosystem monitoring. *Proceedings of the 5th Conference on Research and Resource*

*Management in Southwestern Deserts – Biodiversity and Management of the Madrean Archipelago II: Connecting Mountain Islands and Desert Sea.* May 11-15, 2004, Tucson (AZ).

- van Leeuwen, W.J.D. and J-L. Roujean, 2002. Land Surface Albedo from the Synergistic use of Polar (EPS) and Geo-Stationary (MSG) Observing Systems: an Assessment of Physical Uncertainties. *Remote Sensing of Environment*, 81(2-3):273-289.
- van Leeuwen, W.J.D., A. R. Huete and T. W. Laing, 1999. MODIS Vegetation Index Compositing Approach: A Prototype with AVHRR data. *Remote Sensing of Environment*, 69:264-280.
- Justice, C., Hall, D., Salomonson, V., Privette, J., Riggs, G., Strahler, A., Lucht, W., Myneni, R., Knjazihhin, Y., Running, S., Nemani, R., Vermote, E., Townshend, J., Defries, R., Roy, D., Wan, Z., Huete, A., van Leeuwen, W., Wolfe, R., Giglio, L., Muller, J-P., Lewis, P., and Barnsley, M., 1998. The Moderate Resolution Imaging Spectroradiometer (MODIS): Land remote sensing for global change research. *IEEE Transactions on Geoscience and Remote Sensing*. 36(4):1228-1249.
- van Leeuwen, W.J.D., A.R. Huete, C.L. Walthall, S.D. Prince, A. Begué and J.L. Roujean, 1997. Deconvolution of remotely sensed spectral mixtures for retrieval of LAI, fAPAR and soil brightness. *J. Hydrology*. 188-189:697-724.
- van Leeuwen, W.J.D. and A.R. Huete, 1996. Effects of standing litter on the biophysical interpretation of plant canopies with spectral indices. *Rem. Sens. Environ.* 55:123-138.
- van Leeuwen, W.J.D., A.R. Huete, J. Duncan, and J. Franklin, 1994. Radiative transfer in shrub savanna sites in Niger -- preliminary results from HAPEX-II-Sahel: 3. Optical dynamics and vegetation index sensitivity to biomass and plant cover. *Agricultural and Forest Meteorology*. 69:267-288.

#### **Research Synergistic Activities:**

- Dryland Vegetation Dynamics and Landscape Vulnerability to Wildfire. 2004-2006 (IALC grant)
- Vegetation phenology of desert ecoregions and sky islands
- Synergy V – Rangeview: A Decision Support Tool for Ecological Forecasting. 2000-2005. (NASA Grant).
- Assimilation of Science Results and Data into National Decision Support Systems. 2002-2007 (NASA Grant).

#### **Graduate Postdoctoral Advisors:**

A. Huete – Ph.D. – University of Arizona, Tucson AZ

A. Huete – Postdoctoral advisor – University of Arizona, Tucson AZ

#### **Thesis and Dissertation Advisor To:**

None

**Current Advisees (all graduate students including masters students and postdoctoral scientists):** Grant Casady (PhD, ALRS), David Fornander (PhD, GEOG), Jahan Kariyeva (PhD, GEOG), Youngwook Kim (PhD, SWES), Phillip O. Leckman (PhD, Anthro), Amy McCoy (PhD, ALRS), Elisabeth vanderLeeuw (MA, GEOG),

**Advisees (degree completed):** Casey Thornbrugh (MA, GEOG), Chris Uejio (MA, GEOG), Michael Kline (MS, GEOG)

**CONNIE A. WOODHOUSE**

NOAA Paleoclimatology Branch, National Climatic Data Center, 325 Broadway St., Boulder, CO 80305; phone: (303) 497-6297, fax: (303) 497-6513; e-mail: [connie.woodhouse@noaa.gov](mailto:connie.woodhouse@noaa.gov)

**EDUCATION**

Ph.D. (December 1996) Department of Geosciences, The University of Arizona, Tucson, Arizona  
MS (March 1989) Department of Geography, University of Utah, Salt Lake City, Utah  
BA (May 1979) Prescott College, Prescott, Arizona

**PROFESSIONAL POSITIONS**

Physical Scientist (Apr. 2000-present), Paleoclimatology Branch, NOAA National Climatic Data Center, Boulder, CO  
Research Scientist III, Fellow (Mar. 2004-present), Institute of Arctic and Alpine Research, University of Colorado, Boulder  
Adjunct Assistant Professor (Feb. 2001-present), Department of Geography, University of Colorado, Boulder, CO  
Faculty Affiliate (2004-2008), Department of Civil Engineering, Colorado State University, Fort Collins, CO  
Research Scientist II (Mar. 1999-Mar. 2004), Institute of Arctic and Alpine Research, University of Colorado, Boulder  
Visiting Scientist (May 1998-Apr. 2000), Paleoclimatology Program, NOAA National Geophysical Data Center, Boulder, CO  
Research Scientist I (Jul. 1997-Feb. 1999), Institute of Arctic and Alpine Research, University of Colorado, Boulder  
National Research Council Associate (Jan. 1997- Apr. 1998), Paleoclimatology Program, NOAA National Geophysical Data Center, Boulder

**PUBLICATIONS, last 3 years**

Woodhouse, C.A. and J.J. Lukas, accepted. Drought, tree rings, and water resource management. *Canadian Water Resources Journal*.

Meko, D.M. and C.A. **Woodhouse**, in review. Dendroclimatology, dendrohydrology, and water resources management, In: *Tree Rings and Climate: Sharpening the Focus*, (eds. H.F. Diaz and M.K. Hughes). Kluwer/Springer.

Woodhouse, C.A., S.T. Gray, and D.M. Meko, 2006. Updated streamflow reconstructions for the Upper Colorado River basin. *Water Resources Research*, 42, W05415. doi:10.1029/2005WR004455.

Woodhouse, C.A. and J.J. Lukas. 2006. Multi-century tree-ring reconstructions of Colorado streamflow for water resource planning. *Climatic Change* DOI: 10.1007/s10584-006-9055-0.

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## **PROFESSIONAL ACTIVITIES**

Tree-Ring Society, Vice President

International Tree-Ring Data Bank, chairperson of advisory board

International Multiproxy Paleofire Database, advisory board member

Rocky Mountain Hydrologic Research Center Board of Trustees,

Associate Editor, *Dendrochronologia*

National Academy of Sciences, Member of Committee on the Scientific Bases of Colorado River Basin Water Management

Peer reviewer for journal articles: *Arctic, Antarctic, and Alpine Research, Bulletin of the American Meteorological Society, Canadian Journal of Forest Research, Climatic Change, Climate Dynamics, Climate Research, Dendrochronologia, Earth Interactions, Earth Science Reviews, Journal of Climate, Ecology, Eos, Geology, Geophysical Research Letters, International Journal of Climatology, Journal of Geophysical Research – Atmospheres, Journal of the American Water Resources Association, Landscape Ecology, New Phytologist, Quaternary Research, Physical Geography, Science, The Holocene, Tree-Ring Research*

## **GRADUATE STUDENT COMMITTEES**

Karen Eisenhart, University of Colorado, Geography

Zeyad Tarawneh, Colorado State University, Civil Engineering

Shelly Rayback, University of Texas (Austin), Geography

## **POST DOC ADVISOR**

Nichole Barger, University of Colorado, INSTAAR

## **COLLABORATORS**

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## STEPHEN YOOL

### I. PROFESSIONAL PREPARATION

#### **Undergraduate Institution: California State University, Hayward**

Major: Management and Biological Science, 1969

Graduate Institution: California State University, Hayward

Major: Public Administration and Environmental Policy

Degree and Year: M.A., 1973

Graduate Institution: University of California, Santa Barbara

Major: Geography

Degree and Year: Ph.D., 1985

### II. APPOINTMENTS

2001-Present: Assoc. Prof., Geography, The University of Arizona

2001-Present: Adjunct Associate Professor, Planning, The University of Arizona

1996- 2001: Adjunct Assistant Professor, Planning, The University of Arizona

1995- 2001: Assistant Prof., Geography, The University of Arizona

1992 - 1995: Research Assistant Professor, Geography, The University of Arizona

1989 - 1992: Research Scientist, Lockheed, Sunnyvale and Palo Alto, California

1985 - 1989: Physical Scientist, Naval Ocean Systems Center, San Diego, California

1979 - 1985: Research Associate, Remote Sensing Unit, U.C., Santa Barbara

1978 - 1979: Remote Sensing Research Scientist, NASA/Ames Research Center

1978: Instructor, Environmental Studies, De Anza Community College

### III. SELECTED PUBLICATIONS

1. Henry, M. and Yool, S.R. (2002). Characterizing Fire-Related Spatial Patterns in the Arizona Sky Islands using Landsat TM Data. *Photog. Eng. & Rem. Sens.* 68(10): 1011-1019.
2. Miller, J.D. and Yool, S.R. (2002) Modeling Fire in Semi-desert Grassland/Oak Woodland: The Spatial Implications, *Ecological Modelling* 153: 229-243.
3. Miller, J.D. and Yool, S.R. (2002) Mapping forest post-fire canopy consumption in several overstory types using multi-temporal Landsat TM and ETM data. *Remote Sensing of Environment* 82: 481-496.
4. Rogan, J. and Yool, S.R. (2001). Mapping fire-induced vegetation depletion in the Peloncillo Mountains, Arizona and New Mexico. *Int. J. Rem. Sens.* 22(16): 3101-3121.
5. Patterson, M.W. and Yool, S.R. (1998). Mapping Fire-Induced Vegetation Mortality Using Landsat Thematic Mapper Data: A Comparison of Linear Transformation Techniques, *Rem. Sens. Env.*, 65: 132-142.
6. Yool, S.R. (1998); Multi-Scale Analysis of Pattern and Process in the Northern Chihuahuan Desert; *Journal of Arid Environments* 40: 467-483
7. Yool, S.R. (2000). Enhancing fire scar anomalies in AVHRR NDVI time series data. *GeoCarto International* 16(1):5-12
8. Miller, J.D. and Yool, S.R. (2003). Modeling potential erosion due to the Cerro Grande Fire with a GIS-based implementation of the Revised Universal Soil Loss Equation, *International Journal of Wildland Fire*, 12: 85-100
9. Medler, M.J. and Yool, S.R. (1998). Techniques for Terrain Stratification, *Physical Geography*, 19(5): 433-443.
10. Yool, S.R., Makaio, M.J., and Watts, J.M. (1997). Techniques for computer-assisted mapping of rangeland change, *Journal of Range Management*, 50(3): 307-314.

#### **IV. SYNERGISTIC ACTIVITIES**

1. Creation and Transfer of Knowledge: Wildfire Alternatives Biophysical Database, found at <http://walter.arizona.edu>
2. Teaching/Training: Interactive Learning Modules for self-paced learning of undergraduate/graduate Computer Cartography
3. Contributions to Science of Learning: Interactive Learning Modules for self-paced learning of Geographic Information Systems
4. Outside Service: Editorial Board and Fisher Scholarship Awards Committee, American Society of Photogrammetry and Remote Sensing
5. Outside Service: Research Paper Awards Selection Committee, Photogrammetric Engineering & Remote Sensing

#### **V. COLLABORATORS & OTHER AFFILIATIONS**

##### **a. Collaborators and Co-Editors**

Mary Henry, Geography, Miami University of Ohio, Oxford, OH  
Jay Miller, U.S.D.A., Tahoe National Forest, Sacramento, CA  
John Rogan, School of Geography, Clark University, Worcester, MA

##### **b. Graduate and Postdoctoral Advisors**

Daniel Botkin, U.C. Santa Barbara  
Frank Davis, U.C. Santa Barbara  
Alan Strahler, Boston University

##### **c. Thesis Advisor and Postgraduate-Scholar Sponsor**

John D. All, Ph.D., University of Western Kentucky  
Calvin Farris, Ph.D. Candidate, University of Arizona  
Mary Henry, Ph.D., Miami University of Ohio  
Peter Johnson, Ph.D. Candidate, University of Arizona  
Derrick Lampkin, Ph.D. Candidate, University of Arizona  
Michael Medler, Ph.D., Western Washington University  
Erick Sanchez, Ph.D. Candidate, University of Arizona  
Cynthia Wallace, Ph.D., U.S.G.S., Tucson, Arizona  
Number of graduate students advised (28)

**Appendix B:**

**Student Outcomes Assessment for the**

**Bachelors of Science, Geography**

**GEOGRAPHY AND REGIONAL DEVELOPMENT  
STUDENT OUTCOMES ASSESSMENT, BA and BS**

**Student Name:**

**Date:**

**I. Background Information**

1. When you complete your bachelors degree, how many years will you have attended college? \_\_\_\_\_

2. How many of these years were at the University of Arizona? \_\_\_\_\_

3. What was your classification when you became a geography major (freshman, sophomore, junior, senior)? \_\_\_\_\_

4. What courses, if any, convinced you to change your major to geography/regional development?

5. What other factors influenced your decision? Specific GRD faculty members? College advisors? Elementary or secondary school teachers?

6. What other majors have you had?

7. Do you plan to search for a job that is in your major field of study? If no, what do you intend to do when you graduate?

Yes

No

8. Where do you hope to live once you graduate? (be as specific as possible: city, state, region or country)?

9. As a geography/regional development major, what knowledge/skills do feel will be most valuable in obtaining and performing your first job?

10. Have you considered graduate school or some sort of post graduate professional program

Yes

No

If yes:

In what field?

When would you expect to start this program?

At what school (include a list if you are not yet decided)?

11. Were you in a specific concentration? If so, which one?

**II. Knowledge Areas in Geography:**

We expect our majors to develop some broad understandings of physical and human geography. Assess your knowledge of topics associated with the following topics using the scale:

**1. I understand this topic extremely well**

**2. I understand this topic well**

**3. I have some understanding of this topic**

**4. I know the basic concepts associated with this topic**

**5. I do not understand this topic**

Regionalization and globalization, including global economic and political processes	1	2	3	4	5
Economic geography, including location theory and spatial analysis of economic activity	1	2	3	4	5
Analysis and modeling of demographic processes	1	2	3	4	5
Urban growth and development, including theories and processes of growth and planning	1	2	3	4	5
Theories of social justice with application to social, cultural, and economic geography	1	2	3	4	5
Relationship between human activities and environmental health/sustainability	1	2	3	4	5
Factors determining climatic patterns over the earth's surface	1	2	3	4	5
Factors influencing spatial patterns of species and ecosystems	1	2	3	4	5
Physical factors acting to shape the Earth's landforms	1	2	3	4	5
Causes and effects of global and regional environmental change	1	2	3	4	5



2. Are there any courses that you would have liked to have taken in your major that are not currently offered?

3. Another goal of ours is to help you to develop proficiency in one or more specific geographic skill areas. Evaluate your proficiency in these four areas. Tell us if you feel you are highly proficient, somewhat proficient, not proficient but at least familiar with the field, or no knowledge of the skill.

Area	Proficiency			
	Highly Proficient	Somewhat Proficient	Familiar With	No Knowledge
Cartography				
Statistical Analysis				
Remote Sensing				
GIS				

#### IV. Contact Information

Now to wrap things up, we want to be able to get in touch with you after you have graduated. Please give us an address that will be good for at least a few months following graduation.

Your Name

Address (street)

City, State, Zip

Phone

Fax

E-mail

**We would like to know about your first job! Ask your advisor for his/her business card. This will give you a convenient way of getting in touch with us. As soon as you land a job, send us a copy of your business card so we will have a better idea of where you are and what you are doing.**

If you have any other comments, please include them below. We hope you have enjoyed your association with the department. Stay in touch and good luck!