THE UNIVERSITY OF ARIZONA

A Graduate Interdisciplinary Program - PhD Minor in

Remote Sensing & Spatial Analysis

Student Handbook

Updated August 21, 2024

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1.0 Contact Information

Program Website: http://rssa.arizona.edu/

Program Chair:

William Kolby Smith (Professor)

Committee on Remote Sensing and Spatial Analysis

The University of Arizona

ENR 2 Bldg., Rm. N417

Tucson, AZ 85721

Tel: (520) 621-1056
wksmith@arizona.edu

Program Coordinator

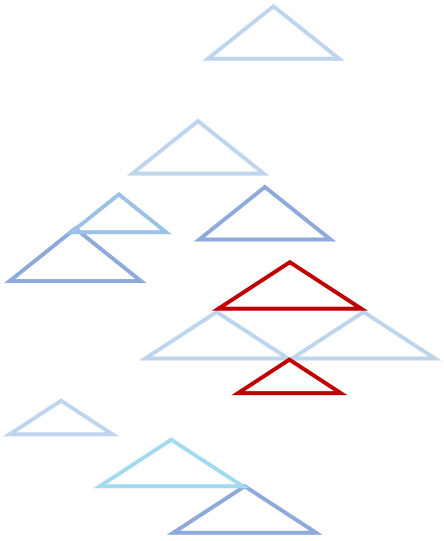
Jennifer Shim

Graduate Interdisciplinary Programs

ENR2 Bldg., Rm. N231

Tel: (520) 626-9111

jennifershim@arizona.edu



2.0 Introduction

The University of Arizona offers an unparalleled opportunity to pursue a multidisciplinary Ph.D. minor degree in remote sensing and related fields in spatial analysis.

2.1 Academic Opportunities

Our academic program covers all aspects of remote sensing & spatial analysis:

- · the fundamentals of physics and optics of remote sensing
- · the fundamentals of cartography, particularly digital representation and manipulation of maps.;
- · the tools of remote sensing & spatial analysis such as image processing, pattern recognition, geostatistics and geographic information systems; and
- · the application of remote sensing and spatial analysis in the fields of agriculture, anthropology, astronomy, engineering, geography, geology, hydrology, planetary sciences and renewable natural resources.

A graduate student wishing to minor in remote sensing & spatial analysis, may major in any field. Two options are available:

- · Remote Sensing Science—which is intended to meet the needs of students with the basic nature of remote sensing.
- · Spatial Analysis—is intended to serve students interested in remote sensing and spatial analysis as tools in their discipline.

2.2 Research Opportunities

The University of Arizona (UA) is widely known for its research program in remote sensing and spatial analysis. Within NASA's Earth Observing System (EOS) program, the UA boasts the largest number of principal investigators among all participating universities.

As a result of this high level of research activity, opportunities and financial support for dissertation research in remote sensing and spatial analysis exist in several departments at the University. Campus units particularly active in remote sensing and spatial analysis are the Advanced Resource Technology Group (ART, School Natural Resources and the Environment), Arizona Remote Sensing Center (ARSC, Office of Arid Lands Studies, Mining and Geological Engineering, the Planetary Image Research Lab (PIRL, Planetary Science), the Remote Sensing Group (RSG, Optical Sciences), School of the Environment, and the Spatial Analysis Laboratory (SAL) ,School of Geography ,Development and Environment), the Earth Observatory.

3.0 Admissions Information

3.1 Admissions Requirements

A graduate student wishing to minor in Remote Sensing and Spatial Analysis may major in any field. Two options are available to accommodate the diversity of backgrounds and interests among students interested in remote sensing and spatial analysis. The first option is Remote Sensing Science, which is intended to meet the needs of students concerned with the basic nature of remote sensing. The second option, Spatial Analysis, is intended to serve students interested in remote sensing and spatial analysis as tools in their discipline.

3.2. Eligibility Summary

- The Remote Sensing and Spatial Analysis Graduate Interdisciplinary Program is a Ph.D. minor program only and does not offer a bachelors, masters, or Ph.D. degree in Remote Sensing and Spatial Analysis.
- To be eligible to join the Remote Sensing and Spatial Analysis Program a graduate student must already be enrolled in one of the University of Arizona's Ph.D. (Doctoral major) programs.
- Prospective students interested in the Remote Sensing and Spatial Analysis Graduate Interdisciplinary Program who are not yet enrolled at the University of Arizona, will need to apply to an appropriate doctoral program and be accepted in order to be eligible for the Remote Sensing and Spatial Analysis Ph.D. minor program.

4.0 PhD Minor Degree Course Requirements

The goals of the RSSA PhD minor coursework are to develop knowledge and experience in the vast field of remote sensing and spatial analysis and expose graduate students to tools and research options in the context of the larger interdisciplinary area of remote sensing and GIS technology. Students should indicate their intent to declare for the RSSA PhD minor and seek input on their coursework well in advance of submitting their Plan of Study to take full advantage of this program.

Students will complete two required courses (six units) in their selected option and six additional graduate units from the courses listed in the RSSA PhD minor program of study with prior approval of at least one minor degree representative on the student's committee.

Prior approval of a proposed RSSA study plan for the minor will be made by a representative drawn from the Committee on Remote Sensing and Spatial Analysis (CRSSA), consisting of about 20 university faculty. The Chair of the CRSSA will also check if requirements are met

before approving the Study Plan and RSSA committee member who is part of the comprehensive written and oral exam.

4.1 Course Requirements (12 units)

4.1.1. Remote Sensing Science track

The Remote Sensing Sciences track takes one core course, one other remote sensing course and 6 additional units from the RSSA curriculum:

- One required core course: **REM 590 - Remote Sensing for the Study of Planet Earth** (3 units). This course is cross listed with several other departments;
- One other required Remote Sensing course (3-credit);
- Plus six (6) additional elective graduate units from the remote sensing OR spatial analysis courses approved by the CRSSA and listed on the RSSA website (including the ones mentioned above).

4.1.2 Spatial Analysis track

The Spatial analysis track takes two core course, one 3 unit remote sensing course one GIS courses and 6 additional units from the RSSA curriculum:

- Two required core courses:
  - REM 590 - Remote Sensing for the Study of Planet Earth, and
  - RNR 517 - Geographic Information Systems for Natural and Social Sciences
- Six **additional** elective graduate units from the remote sensing or spatial analysis courses approved by the CRSSA and listed on the RSSA website and includes courses such as:
  - ATMO 545 - Introduction to Data Assimilation (3 units)
  - RNR/GEOG 519 - Cartographic Modeling for Natural Resources (3 units)
  - RNR/GEOG 520 - Advanced Geographic Information Systems (3 units)

A current list of approved RSSA courses can be found at https://rssa.arizona.edu/complete-course-listing.

5.0 Remote Sensing and Spatial Analysis Courses

Remote Sensing Core Course

Course Number	Course Title	Units	Typically Offered	Instructor
REM 590**	Remote Sensing for the Study of Planet Earth**	3	Fall	William Smith

Spatial Analysis Core Courses

Course Number	Course Title	Units	Typically Offered	Instructor
RNR 517**	Geographic Information Systems for Natural and Social Sciences**	3	Fall	Craig A. Wissler
REM 590**	Remote Sensing for the Study of Planet Earth**	3	Fall	William Smith

Remote Sensing Technique Courses

Course Number	Course Title	Units	Typically Offered	Instructor
OPTI 506	Radiometry, Sources, and Detectors	3	Fall	Richard Koshel
OPTI 508	Probability and Statistics in Optics	3	Spring	Matthew Kupinski
ECE/OPTI 532	Digital Image Analysis	3	Fall	Jeffrey J. Rodriguez
ECE/OPTI 533	Digital Image Processing	3	Fall	Jeffrey J. Rodriguez
OPTI 539*	Estimation Methods in Optics	3	Fall	Currently Unavailable
ATMO555	Introduction to Atmospheric and Hydrology Remote Sensing	3	Fall	Ali Behrangi
GEN 560*	Electrical Exploration Methods	3	Fall	Currently Unavailable
GEOS 567	Inverse Problems in Geophysics	3	Fall and Spring	Richard Bennett
BE 585	Remote Sensing Data and Methods	3	Spring	Kamel Didan
OPTI 637	Principles of Image Science	3	Spring	Eric Clarkson

ATMO656A**	Atmospheric Radiation and Remote Sensing	3	Fall	Xiquan Dong
REM 696*	Remote Sensing Seminar (not listed)	1	Spring	Currently Unavailable

Remote Sensing Applications Courses

Course Number	**Course Title**	**Units**	**Typically Offered**	**Instructor**
PTYS 518*	Instrumentation and Statistic**	3	Fall	Chad Bender Ewan Douglas
ENVS 520*	Environmental Physics	3	Fall	Marcel Schaap
RNR/GEOG 522*	Resource Mapping Using Unmanned Aircraft Systems	3	Fall	Willem J.D. van Leeuwen
HWRS/ATMO 524*	Hydroclimatology	3	Spring	Guo-Yue Niu
GEOG 583	Geographic Applications of Remote Sensing**	3	Spring	W.J.D. van Leeuwen
ATMO 656A	Atmospheric Optics and Radiation**	3	Spring (even years)	Xiquan Dong

*ATMO 656B Currently Unavailable

Spatial Analysis Courses

Course Number	**Course Title**	**Units**	**Typically Offered**	**Instructor**
ATMO 545	Introduction to Data Assimilation	3	Fall	Avelino Arellano
GEOG 516C	Urban Geographic Information Systems**	3	Fall	Currently Unavailable
GEOG 516E	Geovisualization (GIS)**	3	Spring	Currently Unavailable
RNR 517	Geographic Information Systems for Natural and Social Sciences**	3	Fall	Craig A. Wissler

RNR/GEOG 519	Cartographic Modeling for Natural Resources	3	Spring	D. Phillip Guertin
RNR/GEOG 520	Advanced Geographic Information Systems	3	Spring	Craig A. Wissler
RNR/GEOG 522*	Resource Mapping Using Unmanned Aircaft Systems	3	Fall	Willem J.D. van Leeuwen
GEOG 524	Integrated Geographic Information Systems	3	Spring	Unavailable
GEOG 553	Advanced Location Theory**	3	Fall	Unavailable
GEOG 574G	Introduction to Geostatistics**	3	Spring	Unavailable
RNR/GEOG 573	Spatial Analysis & Modeling	3	Spring	D. Phillip Guertin
RNR/GEOG 584	Fire Mapping	3	Spring	Unavailable
GEOG 657*	Spatial Analysis	3	Spring	Currently Unavailable
GEOG 696C	Spatiotemporal Data Analysis	3	Fall (not every year)	Kevin Anchukaitis

Undergraduate Courses in Remote Sensing and Spatial Analysis

Course Number	**Course Title**	**Units**	**Typically Offered**	**Instructor**
GEOG 330	Introduction to Remote Sensing**	3	Fall	Tom Evans
BE 385	Precision Observations with Drones	3	Fall	Kamel Didan
RNR/GEOG 403	Applications of Geographic Information Systems	3	Fall and Spring	D. Phillip Guertin C.A. Wissler
GEN 407*	Photogeology	3	Spring	Currently Unavailable
RNR 417	Geographic Information Systems for Natural and Social Sciences**	3	Fall	Craig Wissler Gary Christopherson
RNR/GEOG 419	Cartographic Modeling for Natural Resources	3	Spring	D. Philiip Guertin

RNR/GEOG 420	Advanced Geographic Information Systems	3	Spring	Craig A. Wissler
RNR/GEOG 422	Resource Mapping using Unmanned Aircraft Systems	3	Fall	Willem J.D van Leeuwen
GEOS/GEN 448	Geophysical Exploration and Engineering	3	Fall	B.K. Sternberg
ECE 456*	Optoelectronics	3	Fall	Kelly Potter
GEOG 458	Geography of Transportation	3	Fall and Spring	Unavailable
GEOG 483	Geographic Applications of Remote Sensing	3	Spring	W.J.D. van Leeuwen
REM 490*	Remote Sensing for the Study of Planet Earth	3	Fall	upon request

*Courses are currently unavailable **Crosslisted with several other Departments

6.0 Committee on Remote Sensing and Spatial Analysis

Chair:

William K. Smith, Professor, School of Natural Resources and the Environment, PhD, 2013, University of Montana (Ecosystem and Conservation Sciences). Ecology, Applied Mathematics & Biology.

Executive Committee

Willem J.D. van Leeuwen, Professor, School of Natural Resources and the Environment, PhD, 1995, University of Arizona (Soil, Water & Remote Sensing). Arid Lands, Geospatial Science and Modeling, Global Change Management, Remote Sensing.

Avelino Arellano, Associate Professor, Department of Atmospheric Sciences, PhD, 2005, Duke University (Nicholas School of Environment and Earth Sciences). Human fingerprints in the atmosphere.

Julia Green, Assistant Professor, Department of Environmental Science, PhD, Columbia University (Environmental Engineering). Biospshere-atmopshere interactions, Ecohydrology, Climate extremes, Remote sensing, Machine learning.

Kyle Hartfield, Associate Professor of Practice, School of Natural Resources and the Environment, MA, 2005, University of Arizona (Geography). Geospatial Data and Remote Sensing.

Faculty

Steven Archer, Regents Professor, School of Natural Resources and the Environment, PhD, 1983, Colorado State University (Rangeland Ecosystem Science). Ecohydrology and Biogeochemistry, Global Change Management, Plant and Soil Ecology, Ecology, Management, and Restoration of Rangelands.

Victor R. Baker, Regents Professor, Department of Hydrology and Water Resources, PhD, 1971, The University of Colorado (Geology). Paleohydrology, Geomorphology, Flood processes, Mars hydrology.

Richard A. Bennett, Professor, Department of Geosciences, PhD, 1996, Massachusetts Institute of Technology (Geophysics). Space geodesy, active and neo-tectonics, and natural hazards

Heidi Brown, Associate Professor, Epidemiology and Biostatistics Department, PhD, 2007, Yale University, Division of Epidemiology of Microbial Diseases, Department of Epidemiology.

Gary Christopherson, Professor of Practice, PhD, 2000, University of Arizona (Near Eastern Archeology). GIS, Cartography, Spatial analysis, Human dimensions modeling, Fire modeling, Social science spatial data.

Andrew C. Comrie, Professor, PhD, 1992, The Pennsylvania State University (Geography). Climate and health, synoptic climatology, Urban and regional air pollution, Climate variability and change in the Southwest United States, Techniques for mapping climate and environmental information.

Kamel Didan, Associate Professor ABE http://www.environment.arizona.edu/kamel-didan

Julia K. Green, Assistant Professor, PhD, Department of Environmental Science. Biospshere-atmosphere interactions, Ecohydrology, Climate extremes, Remote sensing, and Machine learning

Hoshin Gupta, Professor, Department of Hydrology and Water Resources, PhD, 1984, Case Western Reserve University (Systems Engineering). Surface water hydrology, rainfall-runoff models, land-atmosphere transfer scheme models, flood forecasting, hydrology of semi-arid regions.

Charles Hutchinson, Professor Emeritus, School of Natural Resources and the Environment, PhD, 1978, University of California, Riverside (Geography). Remote sensing and geographic information systems for natural resource monitoring, primarily in arid lands.

Chris Lukinbeal, Associate Professor and Director of the Masters of Science in GIST, School of Geography and Development, PhD, 2000, San Diego State/University of California, Santa Barbara (Geography). Cinema and media emphasizing the relationship between political economy and cultural studies, on location filming, Geographic media literacy, Geographies of media form.

Matthew Marcus, Assistant Professor of Practice in GIST, PhD, Temple University (Geography). Nature-society interactions and sustainability science; primary interest in tropical forests and how their management impacts the well-being of people who live in that environment. Research draws heavily on remote sensing techniques and spatial modeling.

David Moore, Professor, School of Natural Resources and the Environment, PhD, 2005, University of Illinois (Ecology & Evolutionary Biology). Ecohydrology and Biogeochemistry, Geospatial Science and Modeling, Global Change Management, Plant and Soil Ecology, Remote Sensing.

Donald Myers, Professor Emeritus, Department of Mathematics, PhD, 1960, University of Illinois (Mathematics). Multivariate geostatistics, applications in hydrology, soil science, geosciences, environmental monitoring and assessment, ecology, image analysis.

Sudha Ram, Professor, Eller College of Management, PhD, 1985, University of Illinois at Urbana-Champaign (Management Information Systems). Business Intelligence and web analytics, Social media analytics, Enterprise data management, Data Provenance and semantic interoperability.

David Romano, Professor, The School of Anthropology, PhD, 1981, University of Pennsylvania (Classical Archaeology). Greek and Roman cities, sanctuaries and landscapes, Greek and Roman architecture, Computer applications in archaeology including digital cartography, GIS, remote sensing and spatial analysis, Greek and Roman athletics and the ancient Olympic Games.

Elizabeth Tellman, Assistant Professor, School of Geography, Development & Environment. Human-environmental geographer, seeking to address the causes and consequences of global environmental change for vulnerable populations, with a focus on flood risk and land use change.

Craig Wissler, Assistant Professor, School of Natural Resources and the Environment, M.L.A. 1993, University of Arizona (Landscape Architecture). Geospatial Science and Modeling.

Xubin Zeng, Professor, Department of Atmospheric Sciences, University of Arizona. UA Climate Dynamics and Hydrometeorology Center (CDHC)

Xiquan Dong, Professor, Hydrology and Atmospheric Sciences, Director of Graduate Studies-Atmospheric Sciences, PhD, 1996, Pennsylvania State University (Meterology). Development and application of ground- and satellite-based sensing techniques, cloud physics and radiation, and parameterizations for global climate models.

Ali Behrangi, Professor, Hydrology / Atmospheric Sciences, PhD, University of California Irvine, (Civil Engineering/Remote Sensing/Hydrometeorology). Remote sensing of precipitation and water cycle, Hydrology.

Tom Evans, Professor, Geography/Regional Development, PhD, University of North Carolina (Geography). Dynamics of human-environment relationships including land use, agricultural decision-making, food security and environmental governance.

Christopher Harig, Assistant Professor, Geophysics, PhD, 2010, University of Colorado (Geophysics). Mass balance of ice sheets and glaciers, geodynamics and rheology of the upper mantle, and linking local changes in Earth's gravity (and hence mass) to local causes.