CALIFORNIA STATE UNIVERSITY, FRESNO

October 11, 2011

MEMORANDUM

TO: Michael Caldwell, Chair
Academic Senate

FROM: Marilyn Wilson, Chair
University Graduate Committee

RE: **The Geographic Information Systems Graduate Certificate Program – University Graduate Committee**

The University Graduate Committee approved the Geographic Information Systems Graduate certificate program. The certificate program consists of four courses. This is an interdisciplinary program and open to students with a bachelor's degree in various fields. This program will be offered online through Continued and Global Education and therefore self-supporting. The program proposal is attached.

MW:vb

cc: William Covino, Provost
Ellen Junn, Associate Provost
Andrew Hoff, Dean, College of Science and Mathematics
Lynnette Zelezny, Dean, Continued and Global Education
Zhi Wang, Earth and Environmental Science

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ADVANCED CERTIFICATE IN GEOGRAPHIC INFORMATION SYSTEMS (GIS)

August 20, 2011 version

Program Coordinator: Dr. Zhi Wang

Core Faculty Members: Dr. Kathy Moffitt
Dr. Zhi Wang
Dr. Xiaoming Yang

Representatives in the affected service area and /or Schools/College:

Dr. Lynnette Zelezny, Associate Vice President for the Division of Continuing & Global Education
Dr. Sharon Brown-Welty, Dean, Division of Graduate Studies
Dr. Andrew Hoff, Dean, College of Science & Mathematics
Dr. Rick Zechman, Associate Dean, College of Science & Mathematics
Dr. Luz Gonzalez, Dean, College of Social Sciences

Required Online Coursework:

EES 211: Fundamentals of GIS (Z. Wang)	3 units
EES 212: Geospatial Technologies (X. Yang)	3 units
EES 214: Advanced Spatial Analysis (X. Yang)	3 units
EES 216: GIS Practicum (K. Moffitt)	3 units
Total Units	12 units

Appendix A: Syllabi
Appendix B: Faculty Resumes
Appendix C: Needs Assessment
Appendix D: Budget Proposal

ADVANCED CERTIFICATE IN GEOGRAPHIC INFORMATION SYSTEMS (GIS)

Program Need

The Advanced Certificate in Geographic Information Systems (GIS) with a focus in science and technology, has been developed to meet the growing need for GIS skills in today's job market. GIS uses digital technology to help people evaluate spatial information. GIS professionals acquire, manage, analyze, visualize, and represent geospatial data, or information related to geographical locations. This relatively new discipline incorporates spatial analysis, remote sensing, geovisualization, geocomputation, cognition, and computer science.

GIS is a tool for visualizing large databases that has become a multibillion-dollar industry that employs hundreds of thousands of professionals around the world. The ability of the technology to combine and synthesize nearly every form of geographic information has made it a major tool with global applications. Its use stretches from the individual to international companies.

GIS professionals often find work with federal agencies such as the U.S. Geological Survey, Bureau of Land Management, Army Corps of Engineers, Forest Service, National Oceanic and Atmospheric Administration, National Imagery and Mapping Agency, and Federal Emergency Management Agency. However, the vast majority of available jobs are with scientific (including medical fields), engineering, architectural, and technology firms.

In addition to the federal agencies named above, state and local agencies that need GIS skills include law enforcement, water and sewer agencies, tax assessors, planning and zoning departments, and emergency bureaus.

The private sector employs GIS professionals in specialty mapping firms, surveying and land companies, oil, electric, and gas utilities, real estate agencies, banks and insurance companies, construction companies, and national businesses that regularly seek new franchise locations. Nonprofit organizations such as environmental groups also need GIS professionals on a regular or consulting basis. Increasingly private foundations use GIS as their main tool; examples include Conservation International which uses GIS as their method for identifying threatened habitats, and the Keoge Foundation uses GIS extensively for climate modeling.

Students completing the certificate program will gain vital competency relevant to today's workforce in the areas of geospatial information technology. An already large $5 billion U.S. market in GIScience technologies is projected to increase to $30 billion within the span of the next few years, even with the economic downturn. The Department of Labor's Occupational Outlook Handbook (OOH 2006-07 Ed.) projects that employment in these fields is expected to grow between 9 and 14 percent through 2014.

In 2009, a survey of 154 local businesses, and state and federal agencies in the Fresno region was conducted to determine the need for employees with GIS skills; 91 responded with over 70% supporting the implementation of the Advance Certificate in GIS.

Overwhelmingly they indicated a strong need for professionals in their industry to use GIS to assess real-world problems and provide solutions.

This Certificate program is designed for students to learn a cutting edge technology and gain practical experience with GIS related software fully online. This program offers flexibility for those fully employed individuals interested in career advancement as well as for students who want to continue their education at the graduate level.

General Overview

The units responsible for offering this program are:
The Division of Continuing & Global Education in collaboration with the College of Science and Mathematics and the Division of Graduate Studies.

Program Coordinator:	Dr. Zhi Wang
Core Faculty Members:	Dr. Kathy Moffitt Dr. Zhi Wang Dr. Xiaoming Yang

The vitae of the core faculty are found in the section of this document labeled Faculty.

Mission

The mission of the Advanced Certificate in Geographic Information Systems is to provide a strong foundational education that delves into the principles and real-world applications of GIS. Students explore the principle tenets of GIS by completing coursework that builds their credentials and capitalize on a marketplace hungry for skilled employees.

The courses within the online certificate in GIS focus our students to the following:

- To become well-versed in GIS theory
- To become knowledgeable in designing and managing spatial databases
- To become versed in building and using spatial data models
- To become prescient in spatial decision-making

Program Structure

The Advanced Certificate in Geographical Information Systems consists of four courses for a total of 12 units of graduate level academic credit. The desired design is to complete the program as a cohort (I.e. lock-step program). Courses are based on the concepts learned in previous courses and students are advised to enroll in courses in the chronological order listed below. Successful completion of all four courses is required to earn the certificate.

Required Coursework:

EES 211: Fundamentals of GIS	3 units
EES 212: Geospatial Technologies	3 units
EES 214: Advanced Spatial Analysis	3 units
EES 216: GIS Practicum	3 units
Total Units	12 units

The online delivery mode is being utilized to accommodate participants' busy work schedules. The final course EES 216 provides a capstone experience where students will complete a project to show understanding of the basic tenets of GIS and apply geospatial analysis to demonstrate competency in spatial decision-making.

Audience

The target audience for the Advanced Certificate in GIS are varied and includes:

- non-traditional students, e.g. professionals from the private and public sectors, educators, local town government officials, etc., with an undergraduate degree in any area, who wish to acquire technical expertise.
- traditional students who wish to acquire specialized training to meet current or future job requirements in GIS.

Since the proposed certificate is online, students from outside the university service area may enroll in the program. The Certificate is designed for students with little or no experience in GIS.

Admission Criteria

Formal admission to Fresno State through CSU mentor is required for participation in this Advanced Certificate Program with the exception of graduate students who are currently admitted to the university. All candidates interested shall meet the university admission requirements including the following criteria. Applicants:

1. Already hold a bachelor's degree from an accredited institution of higher education.
2. Hold a 3.0 or higher grade point average.

Admission Process

Students shall submit a program application to the Certificate coordinator. The application can be found in the Program website http://www.csufresno.edu/cge/. Candidates admissible to the program will be notified via their email address.

Computer Requirements and Support

Participants must have access to a computer with a DVD drive and capable of running MS Windows-based software. The minimum system requirements are:

- Operating system: Windows 2000 Professional or higher
- CPU Speed: 1.6 GHz or higher
- Memory (RAM): 2 GB
- Free Disk Space: 5 GB **or**
- MAC with minimum of 2 G RAM running Windows 2000 Professional or higher under emulation software
    - VMware Fusion 2.0, or
    - Parallels Desktop 4.4 for Mac, or
    - Boot Camp.

All students will need to activate a Fresno State email account https://googleapps.fresnostate.edu/signup/ Visit the TILT (Technology Innovations for Learning and Teaching) website http://www.csufresno.edu/tilt/ to learn more about how to be successful with online learning. Students have access to online tutorials and frequently asked questions at the following website http://blackboard.csufresno.edu/students/index.shtml

Exit From Program

Students must first submit a "Proposal Program for the Certificate of Advanced Study" during the first two weeks of the semester they plan to complete all requirements in. The Advanced Certificate in GIS shall be issued upon completion of all coursework with a GPA of 3.0 or higher within a 4-year period.

Relationship to the Professional Science Masters (PSM) in Water Resource Management

The GIS program is a stand alone certificate. Students are not required to be enrolled in the PSM in Water Resource Management. However, two of the four GIS certificate courses count toward requirements in the PSM degree program should a student elect to switch into the PSM program. Such an action would disqualify the student from obtaining the Certificate but would recognize these graduate courses toward the PSM program.

Curriculum and Assessment of Learning Outcomes

Educational Objectives and Expected Student Learning Outcomes

The primary goal of the program is to ensure that students become sufficiently grounded in theoretical underpinnings of GIS to make informed use of existing GIS applications and gain skills needed to construct new applications in the physical or social realms. On completion of the Certificate program, students will:

- understand foundational theory and principles of cartography and geographic information systems.

- develop a critical eye when designing and interpreting maps.
- appropriately model landscape features and to analyze spatial relationships among them.
- conduct applied research projects using geospatial technology tools.

Specific learning outcomes are listed in the matrix below:

Course	***Objectives and Learning Outcomes: The students will:***
EES 211	1. Resolve issues involved in choosing a suitable GIS analysis procedure and toolset for the project; organize data and modify various map projections for the project purposes; This is evidenced by successfully completing labs in Chapters 1 and 2, student discussions on Blackboard and a term paper.
	2. Expertly apply ArcCatalog and Toolboxes in ArcGIS; properly choose, convert and align various coordinate systems in the GIS project, as evidenced by successfully completing labs in Chapters 1 and 2, and a term project.
	3. Compile, categorize and combine GIS tools, concepts, data and models to solve in-situ environmental problems. This includes identifying the scientific and application needs, data acquisition and analysis, and report writing at the professional level. Students in this course are required to complete two self-proposed GIS projects which will require synthesis and evaluation. This is demonstrated by completing labs in Chapters 1-4, 6-6 and 12-13, and a term project, as well as discussion board assignments.
	4. Create, devise, restructure and relate various GIS components such as maps, tables, digital documents, air photos, drawings, geological and geographic data etc. to produce mapping results of the combined GIS analyses. Critique the values of proposed ideas, materials and the GIS assessment results for decision making. This is learned through the term project proposal and its execution. This is applied in the midterm project on water uses by US counties. This is evidenced by completing labs in Chapters 5-12, and the midterm project on water resources utilization by US counties.
	5. Create and integrate GIS spatial data and demographic data from various sources to explore social, demographic, scientific, engineering, political and economic conditions of a given system. Delineate temporal and spatial distribution of human resources, economic status, natural resources and hazards etc. in a given geographic region.This is evidenced by completing labs in Chapters 10-12, and a term project.
	6. Create and conduct hypothesis or scenario testing; compare, evaluate and critique input data; interpret the results; summarize, conclude and produce recommendations on results. Disseminate results through reports, publications, presentations and/or other outlets.This is evidenced by completing labs in Chapters 12-13, advanced out-of-book labs 17-19 on terrain and 3-D analysis, and the term projects.
EES 212	1. Demonstrate understanding of common Remote sensing (RS) and global positioning system (GPS) terminologies.
	2. Critically evaluate and analyze data quality for their GIS project.
	3. Design a geo-database and defend the data type selection.
	4. Appraise the degree to which remote sensing data can be used efficiently and effectively.
	5. Critique the role of the Space Segment, the user Segment and the Control Segment to the operation of the GPS system. This will be demonstrated as evidenced by the annotated

	bibliographies and participating the discussions on a class discussion board.
	6. Interpret the significance of Dilution of Precision and its effect on position accuracies and evaluate correction techniques as evidenced by the annotated bibliographies and a report after taking the web seminar.
	7. Interpret the GPS signal and the factors that affect signal quality.
	8. Decide and defend the use of raster versus terrain when performing analysis with LIDAR data
	9. Combine LIDAR data with multiple data sources to create more complex three-dimensional surfaces
EES 214	1. Critically evaluate, defend and apply spatial analytical methods, as evidenced by the readings, discussion board among course participants and instructor, and successful completion of ESRI virtual campus classes, exercises, and training seminars.
	2. Design solutions for local, neighborhood, and regional analyses problems. This will be evidenced in the assigned readings, discussion board among course participants and instructor, and successful completion of ESRI virtual campus classes and exercises.
	3. Design terrain analysis with 3D data types and derive analytical surfaces as evidenced by the successful completion of ESRI virtual campus classes and exercises.
	4. Design, build and defend a regression model and establish a regression analysis workflow as evidenced by the assigned readings, discussion board among course participants and instructor, and successful completion of ESRI virtual campus classes and exercises.
	5. Generate linearly referenced features and incorporate them into GIS analysis as evidenced by the successful completion of ESRI virtual campus classes and exercises.
	6. Apply concepts of geo-statistical models to interpolate 3-dimensional data as evidenced by the assigned readings, discussion board among course participants and instructor, and the successful completion of the ESRI web course.
	7. Understand the process for building a regression model and explore a typical regression analysis workflow. As shown by the assigned readings, discussion board among course participants and instructor, and the report that will be submitted reflecting how to use geographically weighted regression.
	8. Solve network problems by through network analysis such as finding the best route and determining service areas as evidenced by the assigned readings, discussion board among course participants and instructor, and the successful completion of the ESRI virtual campus class and exercises.
	9. Evaluate and interpret spatial statistical results and spatial autocorrelation as shown by the assigned readings, discussion board among course participants and instructor, and the report written on an application of spatial statistics in the real world.
	10. Model geographic distributions and perform hot spot analysis as shown by the participation in a training seminar and discussion board.
	11. Identify and interpret spatial patterns and clusters as shown by the participation in a training seminar and discussion board.
EES 216	1. Students will be able to identify and then appraise, evaluate and defend the application of GIS technology to the solution of problems and realization of opportunities in an organization. As shown by the ability to identify a realistic problem at their place of work and propose an appropriate geospatial solution to the problem.
	2. Students will be able to select, evaluate, integrate, and creatively apply the methods and techniques, learned in earlier courses, to real-world problems and opportunities. As evidenced in the ability to apply what has been learned in earlier courses with minimal assistance from faculty.
	3. Students will be able to create accurate budgets for the project, including the time and effort

	involved in finding, obtaining, cleaning and protecting data; designing a defendable solution; and documenting the conduct and results of the project. As evidenced in the choice of problems and project proposal.
	4. Students will be able to develop and maintain managerial buy-in and support for implementing their GIS project and will provide a means of sharing project progress, outcomes and benefits with stakeholders. As evidenced by utilizing various means of documentation discussed on the class discussion board.
	5. Students will evaluate the need for managerial buy-in and support for implementing a GIS project in an organization as evidenced by organizational by-in of the proposed project.
	6. Students will evaluate need for appropriate documentation of project outcomes to interested and supporting parties evidenced by the ability of others to understand the work accomplished, as well as the data utilized, modified and created for the project.

Assessment Strategies

The matrix below lists the various assessment strategies that will be utilized to evaluate student-learning outcomes to be used in the curriculum.

Course	*Assessment Strategies to be utilized*
EES 211	Course portfolio
	Results of lab exercises
	Individual inputs on the discussion board
	Data quality for term project
	Analysis tools used
	Map quality
	Term project proposals and reports
EES 212	Report on web seminar
	Completion of virtual class
	Virtual class exercises
	Graded class discussions
EES 214	Report on web seminars
	Successful completion of virtual classes
	Virtual class exercises
	Graded class discussions
EES 216	Critical analysis of proposal
	Critical analysis of paper
	Critical analysis of map project
	Critical analysis of documentation
	Quality of on-line discussions

Grading Methodology

Grading for the courses will be based on reading/writing and lab assignments, discussion board postings, map presentation and one major term project.

Grading for Reading/Written and Lab Assignments

Grading will be 4 (high) to 0 (low) for each topic
4=The student shows a superior understanding of the topic and is able to analyze and synthesize concepts in depth relating theory to findings. Uses appropriate tools in GIS.
3=The student demonstrates an accurate grasp of the topic and is able to relate theory to findings in adequate depth, but shows less detailed knowledge and synthesis. May have 1 or 2 errors.
2=The student demonstrates an acceptable but commonplace understanding of the topic. Is able to present important factors but explains them with the most obvious specifics and implications. May have 3 to 4 errors.
1=Assignment is late and/or quality of writing and data interpretation is poor.
0=Incomplete or missing assignment.

Discussion Board Grading

Each required topic thread and each required response or reply will be graded from 4 (high) to 0 (low).
4=The student shows a superior understanding of the topic and is able to analyze and synthesize concepts in depth relating theory to findings. Responses are on time and use appropriate GIS vocabulary.
3=The student demonstrates an accurate grasp of the topic and is able to relate theory to findings in adequate depth. Shows less detailed knowledge and synthesis. Responses are on time. May have 1-2 grammatical and/or spelling errors.
2=The student demonstrates an acceptable but commonplace understanding of the topic. Is able to present important facts, but explains them with the most obvious specifics and implications. Responses are on time. May have 3-4 errors.
1=Content could be any of the above, but the responses are late and/or grammatical and spelling errors are so numerous that the quality of writing does not reflect that of a professional educator.
0=Incomplete or missing assignment.

Grading rubrics for term project and papers will be included.

ALL ASSIGNMENTS ARE REQUIRED TO RECEIVE A PASSING GRADE. THIS INCLUDES TIMELY INTERACTION ON THE DISCUSSION BOARD.

Courses in Summary

EES 211 Fundamentals of GIS (3 units)

This course will provide basic and advanced GIS concepts and techniques with special skills on spatial information management, analysis, interpretation, map generation and display using advanced GIS software packages.

EES 212 Geospatial Technologies (3 units)

This course focuses on remote sensing and global positioning systems. The data from these two technologies provides key inputs to Geographic Information Systems. Remote sensing is obtaining information about an object without physical contact while GPS is used to collect the locations of objects or navigate to and/or from locations.

EES 214 Advance Spatial Analysis (3 units)

Spatial Analysis is an advanced course that provides the knowledge and skills necessary to investigate the spatial patterns that result from social or physical processes. Concepts include measures of geographical distribution and spatial autocorrelation, regression analysis, network connectivity, interpolation and geostatistics, and surface and three-dimensional analysis.

EES 216 GIS Practicum (3 units)

This course is the culminating experience for the Advanced Certificate in GIS. It consists of a project that utilizes fundamental concepts in geospatial analysis and conveys clear and meaningful connections between project identification, evidence, analysis and conclusions.

Program Budget with Narrative

1. Projected changes in enrollment (FTES)

• *Recent enrollment history of the program and what effects will the proposed changes have on enrollment.*
Not applicable
• *If FTES is expected to increase, what proportion represents new FTES and what proportion represents shifts from existing programs?*
The program is offered through Continuing and Global Education, and therefore, will not impact FTES.

• *How did you estimate your expected changes in enrollment?*
Expected enrollment will be 20-30 students annually. Normally students finish the program within a two-year period.

2. Projected changes in existing curriculum

• *Will there be changes in the cost of delivering the curriculum? What will those costs be and what is their basis*?
As a self support program the fee structure is set within the approved range that will maintain the program. The program will be offered as a 'self-support' program via the Division of Global and Continuing Education (DCGE). Faculty will be paid separately through the DCGE contracts, which will reflect the salary level of each individual faculty based on rank and enrollment.

• *For new courses, what is the estimated class size, frequency and level/classification of course*

delivery?
There are four new courses. The projected class size is between 20-30 students. Courses will be offered in a sequence annually. The coursework includes EES 211, EES 212, and EES 214 with a practicum experience (EES 216).

• *For courses currently being offered, will there be changes in class size, frequency, level or classification of course delivery?*
Not applicable

• *Will courses be dropped from the existing curriculum?*
This certificate is designed for post-masters students. The curriculum is new and therefore no courses will be dropped from the existing curriculum.

3. Projected changes in faculty

• *Will there be a shift in faculty assignments? If so, what will be the difference between current and proposed assignments?*
There are no anticipated shifts in faculty assignments. As a special session self-support program faculty are all adjunct and teaching outside their assignments at Fresno State. Over time there may be other faculty that will be offered the opportunity to teach in this program.

• *Will there be shifts in faculty numbers or distribution? If so, what will they be?*
It is not projected that there would be any shift in faculty numbers or distribution and no new faculty positions would be added that would be supported through state FTE funding.

•*Will new positions be added/required and what resources will be used to acquire them?*
Teaching positions would be paid for through Salary Code 2322 utilized by the Division of Continuing and Global Education.

4. Projected changes in budget

• *What is your current operating budget?*
The Division of Continuing and Global Education operating budget has experienced a fluctuation over the last five years due to a number of factors such as transitioning to Year Round Operation and elimination of summer session as well as reinstituting summer session and intersession. The range in the Division operating budget continues to be in flux however the range has been between $1.7 to $2.5 million annually.

• *What are your current positions?*
The Division currently has 10 full-time staff position and two part-timers.

•*Do you anticipate outside revenue to support your program?*
Self-support student fee structure.

• *Will budget requirements change and what will those changes be?*

An anticipated increase in fees within the next year (2011-12) will be considered as added features to the online service may be added (e.g. student support services).

• *Will there be any increase in administrative roles/responsibilities that require buy-back or release time?*
None required.

•*How will the expected changes in budget requirements be met?*
Through self-support fee structure.

• *Has the budgetary impact of the proposal been reviewed by the Dean of the Division of Graduate Studies, Budget Committee and the Division of Continuing and Global Education AVP?*
By Division of Graduate Studies and Division of Continuing and Global Education Associate Vice President.

5. Effect on Support Services and programs in other Colleges/Schools

• *Are support services required for program implementation and function?*
This will be an online facilitated program offered through the DCGE.

• *Are programs in other Colleges/Schools directly affected by the proposal and in what way?*
While an undergraduate GIS certificate program is offered through the Department of Geography at Fresno State, this Certificate is specific to post-baccalaureate level students, is fully on-line and has a focus in science and technology. As such this program has no anticipated impact on other departments or colleges.

• *Who are the representatives in the affected service area and /or Schools/Colleges that have been contacted?*

Dr. Lynnette Zelezny, Associate Vice President for the Division of Continuing & Global Education
Dr. Sharon Brown-Welty, Dean for the Division of Graduate Studies
Dr. Andrew Hoff, Dean, College of Science & Mathematics
Dr. Rick Zechman, Associate Dean, College of Science & Mathematics
Dr. Luz Gonzalez, Dean, College of Social Sciences

Appendix A: Syllabi
Appendix B: Faculty Resumes
Appendix C: Needs Assessment
Appendix D: Budget Proposal

Appendix A: Syllabi

Submitted separately

Syllabus
EES 211 -Fundamentals of GIS (3 units)

Advanced Certificate in GIS
Department of Earth and Environmental Sciences
College of Science and Mathematics, California State University, Fresno
(online course offered through Division of Continuing and Global Education)

Fall 2011 (August 22 – Dec 16, 2011)

Instructor: Dr. Zhi (Luke) Wang
Phone: (559)278-4427 M - F 9:00 am – 6:00 pm Leave a message if there is no response. The call will be returned within 24 hours unless the instructor is out of town.

Office Location: Science II, room 121
Department of Earth and Environmental Sciences, California State University, Fresno
Fax: (559)278-5980
E-mail: zwang@csufresno.edu

Basic Course Information
This is a 3-unit online course (equivalent to 5 hours per week) to be learned at any time during the offering period.The course materials are available through Blackboard (login using your CSUF e-mail passwords)

Information for the entire class will be posted on announcements weekly, or more often if necessary. For personal questions, email or telephone the instructor. When writing an E-mail to the instructor, be sure to write "***EES211-LastName-Initial-lab# or question***" (no space anywhere) in the subject line, otherwise the email will be deleted as junk mail.

Response Times: The instructor will check and respond to email and the discussion board at least 4 days a week. Assignments will be graded, posted in the grade book and returned within the week of the due date.

Catalog Description
EES 211. Fundamentals of GIS (3)
Prerequisites: None. Fundamental concepts and techniques of GIS; hands-on labs on data exploration and analysis; advanced skills in spatial and 3-D analysis on terrain and watershed delineation; midterm and final term projects. Asynchronous online.

Additional Course Information
While there are no specific prerequisites, this course is intended for:

- Bachelor's degree holders and equivalent professionals who did not have chance to learn GIS but need to use it now as is needed or required in many professions.
- Master's or Ph. D. candidates or degree holders who want to use GIS for enhancing research, employability and continued education in science and computer applications.

- Any other matriculated persons who have desirable backgrounds in basic science and computer applications(including but not limited to environmental studies and sciences, geosciences, biosciences, physical sciences, engineering, social and economic sciences, etc.), familiar with database and spreadsheet software packages (such as dBase, Access and Excel etc.).

Course Goal

The goal of this course is to teach the advanced skills of GIS and abilities to build various GIS analysis models using diverse input data and information to resolve issues in natural resources management.

Student Learning Outcomes

Upon completion of this course the students will be able to:

1. Compile, categorize and combine GIS tools, concepts, data and models to solve in-situ environmental problems. This includes identifying the scientific and application needs, data acquisition and analysis, and report writing at the professional level. Students in this course are required to complete two self-proposed GIS projects which will require synthesis and evaluation.
2. Create, devise, restructure and relate various GIS components such as maps, tables, digital documents, air photos, drawings, geological and geographic data etc. to produce mapping results of the combined GIS analyses. This is applied in the midterm project on water uses by US counties.
3. Critique the values of proposed ideas, materials and the GIS assessment results for decision making. This is learned through the term project proposal and its execution.
4. Resolve issues involved in choosing a suitable GIS analysis procedure and toolset for the project; organize data and modify various map projections for the project purposes; expertly apply ArcCatalog and Toolboxes in ArcGIS; properly choose, convert and align various coordinate systems in the GIS project.
5. Integrate data, vector and raster models, and convert from one to another.
6. Create and integrate GIS spatial data and demographic data from various sources to explore social, demographic, scientific, engineering, political and economic conditions of a given system.
7. Delineate temporal and spatial distribution of human resources, economic status, natural resources and hazards etc. in a given geographic region.
8. Create and conduct hypothesis or scenario testing; compare, evaluate and critique input data; interpret the results; summarize, conclude and produce recommendations on results.
9. Disseminate results through reports, publications, presentations and/or other outlets.

Required Textbook

K-T Chang, *Introduction to Geographic Information Systems*, 5th edition.McGraw Hill Higher Education, 2010 (ISBN 978-0-07-352283-8).

Bases for Course Grade

Assignment	Weight
Online Attendance	10%
Lab exercises	60%
Midterm project	10%
Term project	20%
Total	**100%**

Letter grade	Percentage
A	90% or higher
B	80% or higher
C	70% or higher
D	60% or higher
F	Lower than 60%

Online Discussion Attendance:
The instructor will post questions on the "Discussion Board" of Blackboard. Student input on the "discussion board" is required (beneficial to oneself and others) and will be tracked by the Course Statistics function and utilized in determining the points for on-line attendance.

Online Lab Exercises:
There are up to 20 hands-on lab exercises designed to help you learn the methods/techniques of GIS in a step-by-step fashion. You must complete at least 15 labs in order to pass the course. These lab exercises will generally be due by 5 pm Friday of the assignment week. Each lab counts for 5.0 points. Labs submitted after the deadline will lose 0.5 point (10%) per day of delay.

Midterm Project:
The instructor assigns a midterm project on **water resources usage by all counties in the United States.** There are various water resources such as fresh, salty, surface and subsurface water etc. that can be used for various beneficial purposes such as irrigation, aquaculture, domestic use, industrial, recreation and power generation, etc. The dataset is provided by USGS in text and Excel formats. Students will choose certain uses of the water resources and conduct GIS mapping analysis. The results, including a written report and all map and document files, will be submitted through Blackboard. The submitted zipped ArcMap document and data **must** be able to display properly on another computer, otherwise, 1/10th of the midterm grade will be deducted. Specific directions will be given for packaging the document and data files.

Term Project:
A student proposed, but instructor approved, term project on **natural resources management** in general will be conducted. The instructor will help you define a geographic region and the problem of interest during the last four weeks. You will then obtain and create various datasets for the ***project area.*** You will apply and integrate almost all the GIS techniques learned in the course for your research in the project. You are required to submit a comprehensive project report. A detailed **"Lab and Term Project Guideline"** is attached to the end of this syllabus.

Required Materials - Hardware and Software Requirements, Cost
Each student must have access to a computer with a DVD drive and capable of running MS Windows-based software. The student bears the cost of hardware and Internet access. The minimum system requirements are:

- Operating system: Windows 2000 professional or higher
- CPU Speed: 1.6 GHz or higher
- Memory (RAM): 1 GB
- Free Disk Space: 5 GB
- Broadband Internet access
- ArcGIS Desktop software, including the Spatial Analyst, 3D Analyst, Network Analyst, and Geostatistical Analyst extensions, will be provided at no cost to students.

Resources
- Students must have Fresno State email account Campus Email(http://email.csufresno.edu/). Your username and password will be used to login for courses and various services on campus. To access this course, you need to login toBlackboard (http://blackboard.csufresno.edu/)
- Student resources can be found at Blackboard 9.1 Student Guide! (http://blackboard.csufresno.edu/students/index.shtml)
- If you find you are unable to access the Blackboard, first contact the Technology Innovation for Learning and Teaching (TILT) (http://www.csufresno.edu/tlt/) or call the TILT Blackboard

resource center at 559-278-7373 Monday through Friday from 8:00am to 5:00pm. After hours, email TILT at dcfeedback@csufresno.edu or call 559-278-7000 seven days a week between 7:00am to 10:00pm. If there is still a problem contact the instructor.

- When in Blackboard view the initial announcement. A link to Blackboard 9.1 Student Guide can be found at Blackboard 9.1 Student Guide!(http://blackboard.csufresno.edu/students/index.shtml). Read it through before you access the course materials below.

How to Learn in This Web-Based Course

1. With your work or home computer connected to the internet, login to Blackboard (http://blackboard.csufresno.edu/) using the login name and password of your CSUF e-mail account. Click on the name of this course.
2. Click on **First Day: Orientation and Software Installation** to go through the brief orientation, read the syllabus, and install required computer programs (provided).
3. Click on the "Required Basic Computer Skills" to go through the Excel and Access tutorials for your lab 0.
4. To begin the formal course work, first go to the "Weekly Modules" which include lecture notes and labs. Review the lecture notes, read the book chapters and then complete the required labs. Afterward, you must answer the questions posted on the "Discussion Board" to earn the attendance score.
5. Please provide your CREATIVE inputs on the "Discussion Board" (do not copy from others), so that other students may have the benefit of your queries. I will check the "Discussion Board" regularly. Personal questions (such as grade concerns) should be sent to the instructor by e-mail.
6. Please provide CREATIVE answers and do not copy from others. You are encouraged to view and correct the answers from others.
7. For e-mail communications and all submissions, you must follow the e-mail rules in this course, otherwise, your e-mail may get lost. **E-mail Rules:** In the SUBJECT line of your e-mail, type**"EES211-YourLastName-FirstName-HomeWork#" (e.g., EES211-Smith-John-Lab1, EES211-Smith-John-question).** ***If you do it EXACTLY, your e-mail will go directly to the designated mail box for EES211 and will not get lost.*** **Thanks for your corporation!! Send your e-mail to zwang@csufresno.edu.**
8. Finally, I am reminding you that this is a highly technical and very time-consuming course (depending on your computer programming and GIS literacy). Thus, if you have a heavy schedule or time conflict, please adjust it to leave more time for this course.

E-mail Rules

- Login to your e-mail account. The e-mail should be sent to zwang@csufresno.edu.
- In the "SUBJECT" line of your e-mail, type **"EES211-YourLastName-Initial-HomeWork#" (e.g., EES211-Smith-John-Lab1, EES211-Smith-John-ProjectReport).**
- In the "Attachment" line, attach your PDF file (one lab per e-mail). Click on "send" button and wait until the e-mail is sent out.

EES 211: Fundamentals of GIS, Tentative schedule

Week	Date	Monday-Tuesday	Wednesday-Friday Labs are due by 5 pm Friday
1	8/22-26	Lab0: Excel and database skill	*Lecture 1: Introduction*
2	8/29-9/3	**Lab1**: Chpt 1, Tasks 1 and 2	*Lecture 2: Map projection* **Lab2**: Chpt 2, Tasks 1-4
3	9/5-9	September 5 - Labor Day - no classes on campus.	*Lecture 3: Representing Real World* **Lab3**: Chpt 3, Tasks 1-6
4	9/12-16	**Lab4**: Chpt 4, Tasks 1-3	*Lecture 4: Data Input and Preparation*
5	9/19/23	**Lab5**: Chpt 5, Tasks 1-3	**Lab6**: Chpt 6, Tasks 1-3
6	9/26-30	**Lab7**: Chpt 7, Tasks 1-5	**Lab8**: Chpt 8, Tasks 1-6
7	10/3-7	**Lab9**: Chpt 9, Tasks 1-3	**Lab10**: Chpt 10, Tasks 1-3
8	10/10-14	**Lab11**: Chpt 11, Tasks 1-3	*Lecture 5: Vector Analysis* **Start Mid-term project**
9	10/17-21	**Work on Mid-Term project**	**Submit Mid-Term project report by 5 pm Monday**
10	10/24-28	*Lecture 5: Raster Analysis* **Lab12**: Chpt 12, Tasks 1-5	**Lab13**: Chpt 13, Tasks 1-3 *Lecture 6: Digital Elevation Modeling*
11	10/31-11/4	**Lab14**: Chpt 14-Tasks 1-4	**Lab15**: Chpt 15-Tasks 1-5
12	11/7-11	**Lab16**: Chpt 17-Tasks 1-6	November 11 - VETERANS' DAY; no classes on campus.
13	11/14-18	**Lab17**: Taming TIGER data (Bb)	**Lab 18**: download, merge, Clip and Analyze DEM files, creating 3-D maps and TIN (Bb)
14	11/21-25	**Lab19**: Spatial and 3-D Analyst: ArcScene (Bb)	No classes on campus (Thanksgiving Recess) **Submit GIS Project Proposal by email**
15	11/28-12/2	**GIS project**	**GIS project**
16	12/5-9	**GIS project**	**GIS project**
17	12/12-16	**Examination week on campus**	**Submit project reportby 5 pm Dec 16**

TextBook Chapters

Chapter 1: Introduction

Chapter 2: Coordinate Systems

Chapter 3: Vector Data Model

Chapter 4: Raster Data Model

Chapter 5: GIS Data Acquisition

Chapter 6: Geometric Transformation

Chapter 7: Spatial Data Editing

Chapter 8: Attribute Data Input and Management

Chapter 9: Data Display and Cartography

Chapter 10: Data Exploration

Chapter 11: Vector Data Analysis

Chapter 12: Raster Data Analysis

Chapter 13: Terrain Mapping and Analysis

Chapter 14: Viewsheds and Watersheds

Chapter 15: Spatial Interpolation

Chapter 16: Geocoding and Dynamic Segmentation

Chapter 17: Path Analysis and Network Applications

Chapter 18: GIS Model and Modeling

Evaluation Rubrics for GIS Online Discussion and Labs

Contents\Grade	Poor 2pts	Fair 3 pts	Good 4pts	Excellent 5 pts
Discussion Have the analysis answers been written in detail with accuracy and insight?	Answers to the online questions show limited detail, accuracy and insight.	Answers to the online questions show some detail, accuracy and insight.	Answers to the online questions show considerable detail, accuracy and insight.	Answers to the online questions show a high degree of detail, accuracy and insight.
Map Organization Has the map been designed in an organized manner?	The organization of the map is displayed with limited effectiveness.	The organization of the map shows some effectiveness.	Map is displayed and organized in an effective manner.	There is a high degree of effectiveness in the organization.
Map Technology Has the student exhibited an ability to use the software to achieve the desired results?	Exhibits no command of the software and is able to use it with limited effectiveness.	Exhibits satisfactory command of the software and is able to use it with some effectiveness.	Exhibits good command of the software and is able to use it effectively.	Exhibits a high degree of ability in the use of the software.
Map Application Does the layout contain all the necessary cartographic elements?	The layout is missing several elements. These may include a legend, compass, title etc.	The layout is missing one or two of the following: a legend, compass, title etc.	The layout is designed with effectiveness and includes necessary cartographic elements.	The layout contains all necessary elements and is designed with a high degree of effectiveness.

Evaluation Rubrics for GIS Term Project Reports

Qualities & Criteria	Poor (0-59.9)	Moderate (60-79.9)	Good (80-100)
Format/Layout *(Weight 15%)*	Follows poorly the requirements related to format and layout.	Follows, for the most part, all the requirements related to format and layout. Some requirements are not followed.	Closely follows all the requirements related to format and layout.
Content/Information/Map *(Weight 50%)*	The essay is not objective and addresses poorly the issues referred in the proposed topic. The provided information is not necessary or not sufficient to discuss these issues. **Maps were poorly organized and displayed.**	The essay is objective and for the most part addresses with an in depth analysis most of the issues referred in the proposed topic. The provided information is, for the most part, necessary and sufficient to discuss these issues. **Maps were well organized and displayed.**	The essay is objective and addresses with an in depth analysis all the issues referred in the proposed topic. The provided information is necessary and sufficient to discuss these issues. **Maps were very well organized and displayed.**
Quality of Writing *(Weight 20%)*	The essay is not well written, and contains many spelling errors, and/or grammar errors and/or use of English errors. The essay is badly organized, lacks clarity and/or does not present ideas in a coherent way.	The essay is well written for the most part, without spelling, grammar or use of English errors. The essay is for the most part well organized, clear and presents ideas in a coherent way.	The essay is well written from start to finish, without spelling, grammar or use of English errors. The essay is well organized, clear and presents ideas in a coherent way.
References and use of references *(Weight 15%)*	Most of the references used are not important, and/or are not of good/scholarly quality. There is not a minimum of 5 scholarly resources, and/or they are not used effectively in the essay. References are not effectively used, and/or correctly cited and/or correctly listed in the reference list according to APA style.	Most of the references used are important, and are of good/scholarly quality. There is a minimum of 5 scholarly resources that are for the most part used effectively in the essay. Most of the references are effectively used, correctly cited and correctly listed in the reference list according to APA style.	All the references used are important, and are of good/scholarly quality. There is a minimum of 5 scholarly resources that are used effectively in the essay. All the references are effectively used, correctly cited and correctly listed in the reference list according to APA style.

Overriding criterion: Originality and authenticity. If the essay is identified as not being original, and/or not done by the student, the instructor has the right to grade the paper as an F.

Reference Materials

- Gorr, W.L, and K. S. Kurland, *GIS Tutorial Workbook for ArcView 9*, ESRI Press, 2005. (ISBN 1-58948-127-5)
- Bernhardsen, T., 1999. *Geographic Information Systems: An Introduction*, 2nd Edition, John Wiley & Sons, New York.
- Clarke, K.C., 2003. Getting Started with Geographic Information Systems, 4th edition, Prentice Hall, New Jersey.
- DeMers, M.N., 2000. *Fundamentals of Geographic Information Systems*, 2nd Edition, John Wiley & Sons, New York.
- ESRI, 1990. *Understanding GIS: The ARC/INFO Way*, Environmental Systems Research Institute, Redlands.
- ESRI, 1996. *Using ArcView GIS*, Environmental Systems Research Institute, Redlands.
- ESRI, 1999. *Getting to know ArcView GIS*, Environmental Systems Research Institute, Redlands.
- Heywood, I., Cornelius, S. and Carver, S., 1998. *An Introduction to Geographical Information Systems*, Addison Wesley Longman, New York.
- Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (eds.), 1999. *Geographical Information Systems*, 2nd Edition, John Wiley & Sons, New York.
- Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (eds.), 2001. *Geographical Information Systems and Science*, 2nd Edition, John Wiley & Sons, Chichester.
- Star, J. and Estes, J., 1990. *Geographic Information Systems: An Introduction*, Prentice Hall, Englewood Cliffs.
- Tomlin, C.D., 1990. *Geographic Information Systems and Cartographic Modelling*, Prentice Hall, Englewood Cliffs.
- Zeiler, M., 1999. *Modeling Our World: The ESRI Guide to Geodatabase Design*. Environmental Systems Research Institute, Redlands.

Course Policies

You must satisfactorily complete at least 15 out of the 20 lab sessions. You will receive an "Incomplete" or "F" grade automatically if you miss more than 10 lab exercises, regardless of the work you have completed. These lab exercises will generally be due at 5 pm Friday of the assignment week. Late penalty for exercises and assignments is 10% per day (i.e. Don't be late unless you have a legitimate reason, such as illness or real emergencies.) The project report must be presented with acceptable professional standards, i.e. clear logical layouts, neat and legible, no scribbling, no untidy work.

University Policies

Students with Disabilities:

Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in the Henry Madden Library, Room 1202 (278-2811).

Honor Code:

"Members of the CSU Fresno academic community adhere to principles of academic integrity and mutual respect while engaged in university work and related activities." You should:

a) understand or seek clarification about expectations for academic integrity in this course (including no cheating, plagiarism and inappropriate collaboration)
b) neither give nor receive unauthorized aid on examinations or other course work that is used by the instructor as the basis of grading.

c) take responsibility to monitor academic dishonesty in any form and to report it to the instructor or other appropriate official for action.

Instructors may require students to sign a statement at the end of all exams and assignments that "I have done my own work and have neither given nor received unauthorized assistance on this work." If you are going to use this statement, include it here.

Cheating and Plagiarism:
"Cheating is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that it include any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. Plagiarism is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work." Penalties for cheating and plagiarism range from a 0 or F on a particular assignment, through an F for the course, to expulsion from the university. For more information on the University's policy regarding cheating and plagiarism, refer to the Class Schedule (Legal Notices on Cheating and Plagiarism) or the University Catalog (Policies and Regulations).

Computers:
"At California State University, Fresno, computers and communications links to remote resources are recognized as being integral to the education and research experience. Every student is required to have his/her own computer or have other personal access to a workstation (including a modem and a printer) with all the recommended software. The minimum and recommended standards for the workstations and software, which may vary by academic major, are updated periodically and are available from Information Technology Services (http://www.csufresno.edu/ITS/) or the University Bookstore. In the curriculum and class assignments, students are presumed to have 24-hour access to a computer workstation and the necessary communication links to the University's information resources."

Disruptive Classroom Behavior:
"The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. ... Differences of viewpoint or concerns should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop and understanding of the community in which they live. Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class."

Copyright policy:
Copyright laws and fair use policies protect the rights of those who have produced the material. The copy in this course has been provided for private study, scholarship, or research. Other uses may require permission from the copyright holder. The user of this work is responsible for adhering to copyright law of the U.S. (Title 17, U.S. Code). To help you familiarize yourself with copyright and fair use policies, the University encourages you to visit its Copyright Web Page (http://csufresno.edu/library/information/copyright/).

Technology Innovations for Learning & Teaching (TILT) course web sites contain material protected by copyrights held by the instructor, other individuals or institutions. Such material is used for educational purposes in accord with copyright law and/or with permission given by the owners of the original

material. You may download one copy of the materials on any single computer for non-commercial, personal, or educational purposes only, provided that you (1) do not modify it, (2) use it only for the duration of this course, and (3) include both this notice and any copyright notice originally included with the material. Beyond this use, no material from the course web site may be copied, reproduced, re-published, uploaded, posted, transmitted, or distributed in any way without the permission of the original copyright holder. The instructor assumes no responsibility for individuals who improperly use copyrighted material placed on the web site.

Subject-to-Change Notice

This syllabus and schedule are subject to change depending on the course progress. The above schedule and procedures are subject to changes in the event of extenuating circumstances. If you are absent from class, it is your responsibility to check on announcements made while you were absent. Any substantive changes to this syllabus will be accompanied by the distribution of a revised syllabus.

Lab and Term Project Guideline

1. How to produce PDF files for your labs and combine them into one PDF for submission:

- In ArcView 9.x (ArcGIS): Access "layout view" by clicking the button at the lower left corner of normal view. Go to "file/export map", then "save as" PDF file. Name the file as "EES211-YourLastName-Firstname-Lab#"
- Combine your PDF files into one file for the same lab, by opening the first PDF file, then insert new pages using "Documents/Pages/Insert" functions, or follow the specific procedures in your version of Adobe PDF software.
- Please E-mail your PDF file as an attachment file (one PDF per lab) and **use the correct SUBJECT name of the e-mail**. Otherwise, your homework could be lost in the system.

2. How to prepare a project proposal?

In this term project proposal you will:

- Specify your project's objectives
- Briefly describe the information sources you expect to use
- List the expected results in terms of knowledge gained or analysis accomplished

It is understandable that in preparing a project proposal many things are not completely understood in the beginning and it is possible that major changes in the project may occur as you execute it. The main purpose of this outline is to give me an understanding of what you intend to do so that I can help you define a project that is feasible within the time frame and the information resources that are available. It is better to focus your ideas rather narrowly first and then broaden them out later. Many students start out attempting to do more than the time available during the semester will permit.

3. How to prepare the term project report?

A written report detailing each step should be submitted on or before the stated deadline. Ideas for term projects may come from past students, your professional work, GIS web sites, GIS magazines or research journals, etc. The written report should be double-spaced typed and limited to 10 pages or less, including necessary figures and tables. This report should have all components as outlined below. In the body of the report you are to present a thorough discussion of the data, the analysis, problems encountered and the solutions and new findings. As the reports will be graded somewhat subjectively and loosely based on their levels of usefulness, students are advised to seek for in priori approval from the instructor and must include the following sections:

- Title page (project title, abstract, student name, and email address)
- Introduction and Problem statements (up to 1 page)
- Data collection and assembly (up to 1 page)
- Analytical methodology and procedures (up to 2 pages)
- Results and discussion (up to 5 pages)
- Concluding remarks (up to 1 page)
- Cited references (list and cite at least 5peer-reviewed references)

Reports will be graded based on

- Whether or not the problems can be solved without using GIS.
- Use of appropriate data sources
- Proper use of data analysis techniques (including 3-D analysis)
- Analytical methodology
- Grammar, spelling
- Report structure (abstract, table of content, bibliography, etc.)

CALIFORNIA STATE UNIVERSITY, FRESNO
Geospatial Technologies
Academic Department Office Location:
Science II, Room 121
Department of Earth and Environmental Sciences
Fax: (559) 278-5980

Course Information	Instructor Information
Course No: EES212	Instructor: Xiaoming Yang, PhD
Units: 3	Email: xmyang@csufresno.edu
Prerequisite: None	Online Office Hours Mon. & Wed. 9-11:3mam

Basic Course Information:

This is a 3-unit online course to be learned at any time during the offering period. The course materials are available through Blackboard (login using your CSUF e-mail passwords)

Information for the entire class will be posted on announcements weekly, or more often if necessary. For personal questions, students may email the instructor directly. When writing an E-mail to the instructor, be sure to write "EES212-LastName-Initial and question, otherwise the email will be deleted as junk mail.

Response Times: The instructor will check and respond to email and the discussion board at least 2 days a week. Assignments will be graded, posted in the grade book and returned within the week of the due date.

Online office hours may be accessed from course menu in Blackboard.

Catalog Description:

EES 212: Geospatial Technologies
Prerequisites: None. The course introduces global positioning systems, remote sensing, and light detection and ranging technology and their integration with Geographic Information Systems. Asynchronous online.

Course Goals:

The goals of this course are to:

- Provide knowledge about the fundamentals of remote sensing, sensor systems and image characteristics
- Provide knowledge about the GPS system and its components, the GPS signal structure, the types of GPS measurements and their errors and biases

- Provide an introduction to LIDAR data and discusses how to integrate and manage LIDAR data in GIS
- Enhance student understanding of characteristics of spatial data that come from different sources
- Enhance student understanding of data quality issues when integrating different data sources in GIS.

Student Learning Outcomes:

Upon successful completion of the class, students should be able to:

- Critically evaluate and analyze data quality for their GIS project
- Design a geo-database and defend the data type selection
- Appraise the degree to which remote sensing data can be used efficiently and effectively
- Interpret the GPS signal and the factors that affect signal quality
- Interpret the significance of Dilution of Precision and its effect on position accuracies and evaluate correction techniques
- Decide and defend the use of raster versus terrain when performing analysis with LIDAR data
- Combine LIDAR data with multiple data sources to create more complex three-dimensional surfaces

Textbooks:

Ahmed El-Rabbany; Introduction to GPS: The Global Positioning System, Second Edition; published by Artech House; ISBN 978-1-59693-017-9

David L Verbyla; Satellite Remote Sensing of Natural Resources; Published by CRC Press; ISBN 1-55670-107-4

Assignments:

There are three (3) ESRI web courses to be completed and two (2) ESRI training seminars to be attended. The web courses must be completed by the due date. A report on what have you learned from the seminar must be submitted after finishing the training seminar and submitted by the due date. Late completion of assignments will result in reduction of the grade by 10% per day for the first five days and will result no credit after the fifth day.

The report on the GPS seminar should focus on

- Why GPS is critical to GIS
- Differential correction and GPS data accuracy
- Considerations in selecting GPS device for GIS applications

The report on the imagery seminar should focus on

- Elements of image interpretation

Required Materials - Hardware and Software Requirements, Cost

Each student must have access to a computer with a DVD drive and capable of running MS Windows-based software. The student bears the cost of hardware and Internet access. The minimum system requirements are:

- Operating system: Windows 2000 professional or higher
- CPU Speed: 1.6 GHz or higher
- Memory (RAM): 1 GB
- Free Disk Space: 5 GB
- Broadband Internet access
- ArcGIS Desktop software, including the Spatial Analyst, 3D Analyst, Network Analyst, and Geostatistical Analyst extensions, will be provided at no cost to students. The software was supplied to students at the beginning of EES 211.

Evaluation Procedures:

- Grading:
  - Four quizzes: 60%
  - GPS training seminar report 10%
  - Visualizing and Analyzing Imagery seminar report 10%
  - Working with Raster exercise 10%
  - Using LIDAR Data exercise 10%
- Grading scales:
  - 90-100% = A
  - 80-89% = B
  - 70-79% = C
  - 60-69% = D
  - Under 60% = F

Grading Rubric for Training Seminar Reports:

- Each report is graded based on the following criteria:

Criteria	3	2	1
Introduction	Presents a concise lead-in to the report	Gives very little information or too much information--more like a summary	Does not give any information about what to expect in the report
Research	Focus on the topics and includes many other interesting facts	Focus on some topics and includes a few other interesting facts	Does not focus on the topics
Conclusion	Presents a logical explanation for findings and addresses most of the topics	Presents a logical explanation for findings and addresses some of the topics.	Presents an illogical explanation for findings and does not address any of the topics

Criteria	3	2	1
Grammar & Spelling	All grammar and spelling are correct	Only one or two errors	Very frequent grammar and/or spelling errors
Timelines	Report handed in on time	10% reduction per day	10% reduction per day

- Total points are summary of each criterion.

Grading Rubric for web courses:

- Each web course is graded out of 5 points.
- 5-Completed web course and greater than 95% correct on the course evaluation
- 4- Completed web course and 90% to 94% correct on the course evaluation
- 3- Completed web course and 85% to 89% correct on the course evaluation
- 2- Completed web course and 80% to 84% correct on the course evaluation
- 1-Completed web course and <80% correct on the course evaluation
- 0-Incomplete web course

Expectations:

Communications: The course is an online class; therefore, most of our interactions will be asynchronous. Three ESRI training courses and two seminars will be assigned in the class. ESRI classes are graded by the above criteria; a report (2 to 4 pages; double spaced; 12 pt font; 1" margins) is required for the two of the ESRI Training Seminars. The report must be submitted to the instructor via the Blackboard Assignment link.

Workload: Students should expect to spend 10-12 hours per week completing the work in this course.

Resources:

This course will be presented through Blackboard where all course materials and online discussions will be hosted. The primary resource for the course is the textbook. The following link is provided for extra readings:

Aerial Photography and Remote Sensing webpage (http://www.colorado.edu/geography/gcraft/notes/remote/remote_f.html) - RS

Remote Sensing Tutorial webpage (http://www.fas.org/irp/imint/docs/rst/Front/tofc.html) - RS

U.S. Government Global Positioning System webpage (http://www.gps.gov/) - GPS

GPS Errors & Estimating Your Receiver's Accuracy webpage (http://edu-observatory.org/gps/gps_accuracy.html) - GPS

UNIVERSITY POLICIES:

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Services (http://www.csufresno.edu/ITS/) or the University Bookstore. In the curriculum and class assignments, students are presumed to have 24-hour access to a computer workstation and the necessary communication links to the University's information resources."

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Copyright policy:

Copyright laws and fair use policies protect the rights of those who have produced the material. The copy in this course has been provided for private study, scholarship, or research. Other uses may require permission from the copyright holder. The user of this work is responsible for adhering to copyright law of the U.S. (Title 17, U.S. Code). To help you familiarize yourself with copyright and fair use policies, the University encourages you to visit its copyright web page:
http://www.csufresno.edu/library/libraryinformation/campus/copyright/copyrtpolicyfull.pdf

For copyright Questions & Answers:
http://www.csufresno.edu/library/libraryinformation/campus/copyright/faqcopyright.pdf

Tentative Course Schedule:

Week	Topic	Reading Assignment	Assignment/Quiz/Test
1	Introduction	Chapter 1	
2	GPS Details	Chapter 2	
3	GPS Satellite Orbit/ GPS Errors and Biases	Chapter 3 & 4	Quiz 1
4	GPS Positioning Modes	Chapter 5	
5	GPS Data and Correction Services/ GPS Stand Format	Chapter 7 & 8	
6	GPS Integration with GIS	Chapter 9.1	GPS training seminar – report due on Wednesday of week seven
7	Satellite Image and Image Processing Systems	Chapter 1 & Chapter 2	Quiz 2

Week	Topic	Reading Assignment	Assignment/Quiz/Test
8	Spectral Regions	Chapter 3	Visualizing and Analyzing Imagery seminar – report due on Friday of week nine
9	Radiometric Corrections & Geometric Corrections	Chapter 4 & 5	Quiz 3
10	Unsupervised Classification & Supervised Classification	Chapter 6 & 7	Working with Raster exercise
11	Classification Accuracy Assessment	Chapter 8	Quiz 4
12	Using LIDAR Data	Getting Started with LIDAR	Using LIDAR Data exercise

This syllabus and schedule are subject to change. Adequate notice will be given to students. It is your responsibility to check Blackboard announcements to obtain this information.

CALIFORNIA STATE UNIVERSITY, FRESNO
Advanced Spatial Analysis
Academic Department Office Location:
Science II, Room 121
Department of Earth and Environmental Sciences
Fax: (559)278-5980

Course Information	Instructor Information
Course No: EES214	Instructor: Xiaoming Yang, PhD
Units: 3	Email: xmyang@csufresno.edu
Prerequisite: Introduction to GIS	Online Office Hours via ***Elluminate Live!*** Mon. & Wed. 9-11:30am

Basic Course Information:

This is a 3-unit online course to be learned at any time during the offering period. The course materials are available through Blackboard (login using your CSUF e-mail passwords) Information for the entire class will be posted on announcements weekly, or more often if necessary. For personal questions, students may email the instructor directly. When writing an E-mail to the instructor, be sure to write "EES214-LastName-Initial and question, otherwise the email will be deleted as junk mail.

Response Times: The instructor will check and respond to email and the discussion board at least 2 days a week. Assignments will be graded, posted in the grade book and returned within the week of the due date.

Online office hours in ***Elluminate Live!*** may be accessed from course menu in Blackboard. A microphone is recommended for audio communication.

Catalog Description:

EES 214: Advanced Spatial Analysis

Prerequisites: EES 211 and 212. Spatial Analysis is an advanced course in GIS that exposes students to an array of spatial analysis theories, techniques and practices. Reading, demonstrations, applied assignments. Primarily asynchronous online.

Course Goals:

The goals of this course are to:

- Provide students with a comprehensive understanding of the theories, assumptions, and context of spatial analysis methods.
- Enable students to identify and apply the correct analytical tools for a problem solving, and
- Enhance students' ability to correctly and appropriately interpret and present the analysis results.

Syllabus: EES 214 – Advanced Spatial Analysis

Student Learning Outcomes:

Upon successful completion of the class, students should be able to:

- Critically evaluate, defend and apply spatial analytical methods.
- Design solutions for local, neighborhood, and regional analyses problems
- Design terrain analysis with 3D data types and derive analytical surfaces
- Generate linearly referenced features and incorporate them into GIS analysis
- Apply concepts of geo-statistical models to interpolate 3-dimensional data
- Design, build and defend a regression model and establish a regression analysis workflow
- Solve network problems by through network analysis
- Model geographic distributions
- Identify and interpret spatial patterns and clusters
- Analyze spatial relationships
- Evaluate and interpret spatial statistical results

Textbook:

M. de Smith, M. Goodchild, P. Longley; Geospatial Analysis - a comprehensive guide. 3rd edition © 2006-2009; Published by Matador (an imprint of Troubador Publishing Ltd) on behalf of The Winchelsea Press; ISBN 13: 9781848761582; Free web version site: Spatial Analysis site (http://www.spatialanalysisonline.com/output/)

Assignments:

There are a total of seven (7) ESRI web classes and four (4) ESRI training seminars to be completed. The web courses must be completed by the due date. A report on what have you learned from the seminar must be submitted after finishing the training seminar and submitted by the due date. Late completion of assignments will result in reduction of the grade by 10% per day for the first five days and will result no credit after the fifth day.

The first report covers two seminars: *Understanding Spatial Statistics* and *Introduction to Spatial Pattern Analysis*. The report should focus on

- Why use spatial statistics

The second report is based on the seminar *Geographically weighted Regression Analysis* and it should focus on

- Why regression analysis on is used with spatial data

Required Materials - Hardware and Software Requirements, Cost:

Each student must have access to a computer with a DVD drive and capable of running MS Windows-based software. The student bears the cost of hardware and Internet access. The minimum system requirements are:

- Operating system: Windows 2000 professional or higher
- CPU Speed: 1.6 GHz or higher
- Memory (RAM): 1 GB
- Free Disk Space: 5 GB
- Broadband Internet access

- ArcGIS Desktop software, including the Spatial Analyst, 3D Analyst, Network Analyst, and Geostatistical Analyst extensions, will be provided at no cost to students. The software was supplied to students at the beginning of EES 211.

Evaluation Procedures:

- Grading:
  - Successful completion of all the exercises: 65%
  - Seminar reports: 10%
  - Participation in the class discussion 25%
- Grading scales:
  - 90-100% = A
  - 80-89% = B
  - 70-79% = C
  - 60-69% = D
  - Under 60% = F

Grading Rubric for ESRI web courses:

- Each web course is graded out of 5 points.
- 5-Completed web course and greater than 95% correct on the course evaluation
- 4- Completed web course and 90% to 94% correct on the course evaluation
- 3- Completed web course and 85% to 89% correct on the course evaluation
- 2- Completed web course and 80% to 84% correct on the course evaluation
- 1-Completed web course and <80% correct on the course evaluation
- 0-Incomplete web course

Grading Rubric for ESRI Training Seminar Reports:

- Each report is graded based on the following criteria.

Criteria	3	2	1
Introduction	Presents a concise lead-in to the question	Gives very little information or too much information--more like a summary	Does not give any information about what to expect in the report
Research	Focus on the question and includes many other interesting facts	Focus on question and includes a few other interesting facts	Does not focus on the question
Conclusion	Presents a logical explanation for findings and addresses most of the question	Presents a logical explanation for findings and addresses part of the question	Presents an illogical explanation for findings and does not address any of the question

Grammar & Spelling	All grammar and spelling are correct	Only one or two errors	Very frequent grammar and/or spelling errors
Timelines	Report handed in on time	10% reduction per day	10% reduction per day

- Total points are summary of each criterion.

Grading Rubric for participation in the class discussion:

Criteria	3	2	1
Discussion	Answers to the online questions show a high degree of detail, accuracy and insight.	Answers to the online questions show some detail, accuracy and insight.	Answers to the online questions show limited detail, accuracy and insight.

- Total points are summary of each criterion.

Expectations:

Communications: The course is an online class; therefore, most of our interactions will be asynchronous. Three ESRI training courses and two seminars will be assigned in the class. ESRI classes are graded by the above criteria; a report (2 to 4 pages; double spaced; 12 pt font; 1" margins) is required for the two of the ESRI Training Seminars. The report must be submitted to the instructor via the Blackboard Assignment link.

Workload: Students should expect to spend 10-12 hours per week completing the work in this course.

Class discussion: Students are expected to participate in weekly discussion. A student is expected to post a minimum FIVE questions during the duration of the course. Each week a student is expected to respond to at least **ONE** question posted by the instructor or other students. All the questions and responses should be written in detail with accuracy and insight.

Resources:

This course will be presented through Blackboard where all course materials and online discussions will be hosted. If you find you are unable to access the Blackboard, first contact the Technology Innovation for Learning and Teaching (TILT) webpage at (http://www.csufresno.edu/tilt/index.shtml) or call the TILT blackboard resource center at 559-278-7373 Monday through Friday from 8:00am to 5:00pm. After hours, email TILT at dcfeedback@csufresno.edu or call 559-278-7000 seven days a week between 7:00am to 10:00pm. If there is still a problem contact the instructor.
The primary resource for the course is the textbook. For extra readings visit the GIS and Science webpage (http://gisandscience.com/)

UNIVERSITY POLICIES:

Students with Disabilities:

Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in the University Center Room 5 (278-2811).

Honor Code:

"Members of the CSU Fresno academic community adhere to principles of academic integrity and mutual respect while engaged in university work and related activities." You should:

a. understand or seek clarification about expectations for academic integrity in this course (including no cheating, plagiarism and inappropriate collaboration)
b. neither give nor receive unauthorized aid on examinations or other course work that is used by the instructor as the basis of grading.
c. take responsibility to monitor academic dishonesty in any form and to report it to the instructor or other appropriate official for action.

Instructors may require students to sign a statement at the end of all exams and assignments that "I have done my own work and have neither given nor received unauthorized assistance on this work." If you are going to use this statement, include it here.

Cheating and Plagiarism:

"Cheating is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that it include any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. Plagiarism is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work." Penalties for cheating and plagiarism range from a 0 or F on a particular assignment, through an F for the course, to expulsion from the university. For more information on the University's policy regarding cheating and plagiarism, refer to the Class Schedule (Legal Notices on Cheating and Plagiarism) or the University Catalog (Policies and Regulations).

Computers:

"At California State University, Fresno, computers and communications links to remote resources are recognized as being integral to the education and research experience. Every student is required to have his/her own computer or have other personal access to a workstation (including a modem and a printer) with all the recommended software. The minimum and recommended standards for the workstations and software, which may vary by academic major, are updated periodically and are available from Information Technology Services (http://www.csufresno.edu/ITS/) or the University Bookstore. In the curriculum and class assignments, students are presumed to have 24-hour access to a computer workstation and the necessary communication links to the University's information resources."

Disruptive Classroom Behavior:

"The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. ... Differences of viewpoint or concerns

should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop and understanding of the community in which they live . . . Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class."

Copyright policy:

Copyright laws and fair use policies protect the rights of those who have produced the material. The copy in this course has been provided for private study, scholarship, or research. Other uses may require permission from the copyright holder. The user of this work is responsible for adhering to copyright law of the U.S. (Title 17, U.S. Code). To help you familiarize yourself with copyright and fair use policies, the University encourages you to visit its copyright web page:
http://www.csufresno.edu/library/libraryinformation/campus/copyright/copyrtpolicyfull.pdf
For copyright Questions & Answers:
http://www.csufresno.edu/library/libraryinformation/campus/copyright/faqcopyright.pdf

Tentative Course Schedule:

Week	Topic	Reading Assignment	Assignment
1	Introduction to course and review GIS fundamentals	Terminology/ Notation /Statistical measures and related formulas	Understanding Map Projects and Coordinate Systems exercise
2	Conceptual Frameworks for Spatial Analysis	Basic Primitives/ Spatial Relationships/ Spatial Statistics/ Spatial Data Infrastructure	
3	Spatial analysis Methodology	Spatial Analysis as a Process/ Analytical Methodologies/ Geospatial Analysis and Model Building	
4	Learning ArcGIS Desktop		Learning ArcGIS Desktop
5	Learning ArcGIS Desktop		Learning ArcGIS Desktop
6	Building Block of Spatial Analysis -- I	Spatial Data Models and Methods/Geometric and Related Operations/ Queries, Computations and	Geoprocessing exercise

Syllabus: EES 214 – Advanced Spatial Analysis

Week	Topic	Reading Assignment	Assignment
		Density	
7	Building Block of Spatial Analysis -- II	Distance Operations/ Directional Operations / Grid Operations and Map Algebra	
8	Data Exploration and Spatial Statistics -- I	Statistical Methods and Spatial Data/ Exploratory spatial Data Analysis/ Grid-based Statistics	Understand Spatial Statistics seminar Spatial Pattern Analysis seminar -- report due on Monday of the ninth week
9	Data Exploration and Spatial Statistics -- II	Point sets and Distance Statistics/ Spatial Autocorrelation / Spatial regression	Geographically Weighted Regression Analysis seminar -- report due on Friday of the tenth week
10	Surface and Field Analysis -- I	Modeling Surface/ Surface Geometry	Raster analysis exercise
11	Raster analysis exercise		Raster analysis exercise
12	Surface and Field Analysis -- II	Visibility / Watersheds and Drainage/ Gridding, Interpolation and contouring	Terrain analysis exercise
13	Terrain analysis exercise		Terrain analysis exercise
14	Surface and Field Analysis -- III	Deterministic Interpolation Methods/ Geostatistical Interpolation Methods	Geostatistical exercise
15	Network and Location analysis -- I	Introduction to Network and Location Analysis/ Key Problem in Network and Location Analysis	Linear Referencing exercise
16	Network and Location	Network Construction, Optimal Routes and	Using Network functions

Week	Topic	Reading Assignment	Assignment
	analysis -- II	Optimal Tours / Location and Service Area Problems	seminar

This syllabus and schedule are subject to change. Adequate notice will be given to students. It is your responsibility to check Blackboard announcements to obtain this information.

Syllabus

EES 216 – GIS Practicum

Advanced Certificate in GIS
Earth and Environmental Sciences
College of Science and Mathematics
Spring 2012 – 3 Units

Instructor: Kathleen Moffitt

Office: Peters Bldg, Dean's Office PB 282

Office Hours: TBA – office hours will be held through discussion board, chat and Elluminate *Live!* Face-to-face office hours by appointment.

E-Mail: kathym@csufresno.edu

See "Response Times and Location of Information" for information on response times

Phone: 559-278-2482

Blackboard: To access the course on login to Blackboard at (http://blackboard.csufresno.edu) using your Fresno State username and password.

Course delivery: is primarily asynchronous. There will be one face-2-face meeting near the end of the semester to present projects. Those who cannot attend in person will be required to attend through Elluminate *Live*!

For help with Blackboard, contact Technology Innovations for Learning and Teaching (TILT) at 278-7373 or send an email to dcfeedback@csufresno.edu

Location of single face-2-face meeting location TBA

Subject to Change: This syllabus and schedule are subject to change. Adequate notice will be given to students. It is your responsibility to check Blackboard announcements to obtain this information.

Catalog Description:

EES 216. GIS Practicum (3)
Prerequisites: EES 211, EES 212; EES 214 co-requisite. Culminating experience for Advanced Certificate in GIS designed to demonstrate advanced working knowledge of GIS. Proposal; data privacy and management; GIS project; documentation; write-up; and presentation. Primarily asynchronous online.

Required Textbooks and Materials:

No new textbooks, software, supplies or equipment, beyond those required of the initial three-course sequence in the Advanced Certificate in GIS curriculum, are required. It is required that you have all earlier course textbooks and materials in your possession for use as reference material during this course.

- Operating system: Windows 2000 professional or higher
- CPU Speed: 1.6 GHz or higher
- Memory (RAM): 1 GB
- Free Disk Space: 5 GB
- Broadband Internet access
- ArcGIS Desktop software, including the Spatial Analyst, 3D Analyst, Network Analyst, and Geostatistical Analyst extensions, will be provided at no cost to students.

Course Expectations:

- Students are expected to develop a thoughtful, creative question that engages them in a challenging project. A proposal documenting the proposed project is to be written.
- Students are expected to obtain information gathered from a variety of quality sources. Data is to be obtained and used in a legal and ethical manner. The manner of use shall protect the privacy of individuals whose personal and/or other confidential data is obtained for or used in the project.
- Students are expected to apply, and appropriately document, the methods and techniques learned in their prior courses and utilized in the project.
- Students are expected to write a well written, concise and appropriately referenced paper describing the project's subject, analytical methods and outcome. This paper shall be essentially error free in terms of mechanics. The paper shall convey conclusions and demonstrate clear and appropriate connections among project identification, evidence, analyses and conclusions.

Student Learning Outcomes:

- Students will be able to identify and then appraise, evaluate and defend the application of GIS technology to the solution of problems and realization of opportunities in an organization.
- Students will be able to select, evaluate, integrate, and creatively apply the methods and techniques, learned in earlier courses, to real-world problems and opportunities
- Students will be able to create accurate budgets for the project, including the time and effort involved in finding, obtaining, cleaning and protecting data; designing a defendable solution; and documenting the conduct and results of the project
- Students will be able to develop and maintain managerial buy-in and support for implementing their GIS project and will provide a means of sharing project progress, outcomes and benefits with stakeholders.

Major Assignments:

There are no examinations. Assessment will be based upon the project proposal, your evaluation of the work(s) of your teammate(s), quality (emphasis) and quantity of

discussions, and the final project and its presentation. There is no make-up work. All work is expected to be completed on time and to a high level of quality.

Submission of assignments: all assignments will be submitted through Blackboard using the upload feature associated with the Assignment Description. Assignments are to be named according to the instructions given with the assignment at Blackboard.

Discussion Board: the primary Discussion Board assignment will be on the topic of privacy and how this relates to GIS in general and your project in particular. Students will be expected to share the privacy policies of their place of work (or for those who do not work, a search of appropriate privacy policies found with a Web search) and the discussion will flow from this. The outcome of this discussion will be a Project Privacy Policy that will be applied to all projects developed for this course. The final Privacy Policy will be developed within the Wiki feature of Blackboard.

Proposal: Identify a problem that can be solved or an opportunity that can be realized through the application of GIS technology at your place of business. **The topic must be original and not currently in use or development at your place of business or elsewhere.** If you are not employed, please see instructor for project ideas. Develop a proposal (maximum 7 pages 1.5 or double spaced, 12 point font, 1" margins) that will be, in its instructor approved form, given to appropriate management at your place of business. **Note:** it needs to be written as a proposal. The proposal should:

1) Include a cover sheet with the following statement: "The ideas contained in this report are my own, are original and are not taken from an existing or planned implementation of GIS" followed by your signature and typed name (submission will be accepted as your signature). Please take this very seriously.
2) Describe the problem/opportunity,
3) Discuss why GIS is a viable and preferred means of addressing the problem/opportunity,
4) Discuss the types of data that will be needed, including what is available inside your organization and what will need to be obtained from outside sources,
5) Address how private and/or confidential data will be handled in order to maintain privacy and meet legal, regulatory and policy requirements.
6) Discuss the broad analytical approach that will be taken.
7) Finally, discuss the value of the geographic analysis to the organization including any competitive advantage that might accrue.

Note: The proposal will be approved by the instructor and then will be presented to the appropriate manager at your place of business for their approval. An approval sheet will be provided.

GIS Project: This will be the project that is implemented to address the approved proposal. The project shall be done using ESRI software. Students are expected to obtain information gathered from a variety of quality sources. Data is to be obtained

and used in a legal and ethical manner. The manner of use shall protect the privacy of individuals whose personal and/or other confidential data is obtained for or used in the project. All project work shall be saved using the relative path map property method and in a well-controlled and consistent manner where the folder structure is established for easy zipping and transfer of the entire project (map document, surfaces, data, etc.) for evaluation on a different computer. Data used in or created for the project shall have metadata present or entered for it. Project outcome shall be presented as a map(s) created using the Layout feature of ArcGIS.

Documentation: Data acquired for and/or created for the project shall be documented as per source, metadata and techniques used to create the data. File naming standards and storage location structure shall be documented. The methods employed to protect private and/or confidential data in order to maintain privacy and meet legal, regulatory and policy requirements shall be documented.

Project Write-Up: Students are expected to write a well written, concise and appropriately referenced paper describing the project's subject, analytical methods and outcome. This paper shall be essentially error free in terms of mechanics. The paper shall convey conclusions and demonstrate clear and appropriate connections among project identification, evidence, analyses and conclusions. Maximum 7 pages, 1.5 or double spaced, 12 point font, 1 inch margins. The title page is to include your project title, your name, company sponsor information and the following *statement "I have done my own work and have neither given nor received unauthorized assistance on this work."* This statement on the submitted paper is construed to act as your signature.

Participation Standards:

Students will be placed into small groups that will have specific duties assigned during the semester. Students will self-select into these groups. Group size will be determined by the instructor on the basis of the overall class size. Students within a group are expected to review and comment on the work of each other and otherwise help each other during the progress of the class. A specific rotation of review duties/assignments will be made once the group size and membership is established.

Discussion Board/Wiki participation will be assessed on the basis of quality (major emphasis) and quantity of contributions.

Technical Support and consultation: The "Buddy System" will be used in this class. Students, especially those in your group, are expected to help each other with technical and conceptual problems. The instructor is also available but students are expected to make a serious effort in both giving and obtaining help to/from each other. There will be a discussion board set up for just this but use of Elluminate *Live!* may be needed in order to solve some problems. In addition, Dr. Xiaoming Yang and Dr. Luke Wang will be available technical assistance during the project in cases where a resolution **cannot** be arrived at within the regular course structure. Please contact Dr. Moffitt prior to requesting help from Drs. Wang or Yang.

Grading: Basis of Grade

Assignment	Points
Proposal	125
Project - GIS	275
Project - Write-up and Documentation	200
Discussion Board/Wiki – primarily Privacy Policy	100
Group review	100
Presentation	100
Total	**900**

Letter Grade	Points
A	>= 810
B	>= 720 and < 810
C	>= 630 and < 720
D	>= 540 and < 630
F	< 540

Practicum in GIS Project Rubrics

	PROJECT IDENTIFICATION:	INFORMATION EVALUATION:	PROJECT TRANSLATION:	INFORMATION INCORPORATION:	PROJECT ANALYSIS:	PROJECT INTERPRETATION:
	Appropriately determines the nature and scope of the project to be addressed	**Critically evaluates information and sources**	**Selects appropriate technology and effectively translates the project into a suitable model**	**Effectively incorporates selected information**	**Executes the application of technology effectively and correctly to analyze the problem**	**Critically and competently evaluates and interprets the results obtained**
4	Students develop focused requirements of the project, identifying all major concepts and related terms critical to describing the information needed.	Students assess the range of information both needed and available, and access the most relevant and appropriate information from a variety of quality sources	Students develop an appropriate model that captures the essence of the project to be addressed in a manner that can be analyzed with technology purposively selected for use.	Students integrate accurate, relevant, and comprehensive information from a variety of sources	Students efficiently and correctly conduct the application.	- Students effectively convey their conclusions and demonstrate clear and appropriate connections between their project identification, their evidence, their analyses and conclusions. - Students' perspectives are evident in their conclusions, recommendations and implications.
3	Students pose focused requirements of the project, identifying key concepts and related terms that describe the information needed.	Students analyze information from a variety of sources to determine its applicability to the project identified.	Students design the application of technology to achieve the project goals, identify most key components of the project, and appropriately analyze relationships between them.	Students organize information from a variety of sources to determine applicability to the project identified.	Students execute the application to recognize planned solutions, but may make minor errors in the application of technology.	- Students effectively communicate their results but the work lacks fully articulated connections between the stated problem, their evidence, their analyses and conclusions. - Recommendations and implications are impartially developed and/or incompletely connected to the conclusions of the project.
2	Students construct requirements of a project that lend themselves to readily available answers.	Students recognize information that is applicable to the project identified.	Students identify limited or inappropriate use of the technology, enumerate some key components of the project but misrepresent relationships between the components identified.	Students accrue information that meets a particular information and project need.	Students employ technology to achieve some of the key project goals but make some errors in the application of technology.	- Students need to work on communicating their results more effectively. - The work lacks appropriate transitions between the body of the project and the conclusions.
1	Students develop requirements of the project that require little creative thought or rely primarily on instructor-generated questions and details.	Students use information that is insufficient, inaccurate, or misleading to mount a solution to the project identified.	Students plan inappropriate uses of technology and fail to identify essential key components of the project.	Students present insufficient information in a variety of different formats that do not facilitate use of technology.	Students fail to execute the application of technology or are dependent on instructor assistance to apply technology.	- The project does not present appropriate or adequate bases for conclusions of the work.

Course Policies:

Confidentiality:
In this class, we will discuss matters relating to students' business situations and employers. Every student has an obligation to keep such information confidential, within the confines of this course, and not disclose it outside this course. Thus, by remaining in the class, each student has agreed to keep such information confidential, unless the person who posted/provided the information consents in writing to disclosure of the information. The Privacy Policy developed for the course will be applied to all project work.

Email Policy and Blackboard Posting Policy:

- The instructor will answer only email that is of a personal nature and that should not or cannot be shared with the remainder of the class. Examples might be, setting up an appointment, emailing that you cannot get into Blackboard, etc.
- Before sending me an email, please ask yourself if anyone else in the class could use the requested information. If the answer is "yes", please post it to Blackboard. This will provide an opportunity for students to answer each other's questions and for the instructor's answers to be of benefit to other students.
- The instructor will be subscribed to the Blackboard discussion forums. It is suggested that you also subscribe.
- Students are encouraged to respond to each other's postings.
- Formatting emails:
    - All emails must include your first and last name.
    - All email is to start with "EES 216" in the subject line or it will not be read. This is a requirement to help manage information overload.
    - You must set your email account preferences to list your actual name in the sender field (rather than a cute nickname).
- **DO NOT** email homework to the instructor – the only acceptable means of electronic submission is through the Blackboard assignment feature.

Response Times and Location of Information:
Instructor will respond to email and Discussion Board postings at least four days a week. Information for the entire class will be posted in Blackboard announcements. Students are expected to check announcements and the discussion board at least four days per week.

University Policies:

Students with Disabilities:
Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in the Henry Madden Library, Room 1202 (278-2811).

Honor Code:
"Members of the CSU Fresno academic community adhere to principles of academic integrity and mutual respect while engaged in university work and related activities." You should:

a) understand or seek clarification about expectations for academic integrity in this course (including no cheating, plagiarism and inappropriate collaboration)
b) neither give nor receive unauthorized aid on examinations or other course work that is used by the instructor as the basis of grading.
c) take responsibility to monitor academic dishonesty in any form and to report it to the instructor or other appropriate official for action.

Instructors may require students to sign a statement at the end of all exams and assignments that "I have done my own work and have neither given nor received unauthorized assistance on this work." If you are going to use this statement, include it here.

Cheating and Plagiarism:
"Cheating is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that it include any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. Plagiarism is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work." Penalties for cheating and plagiarism range from a 0 or F on a particular assignment, through an F for the course, to expulsion from the university. For more information on the University's policy regarding cheating and plagiarism, refer to the Class Schedule (Legal Notices on Cheating and Plagiarism) or the University Catalog (Policies and Regulations).

Computers:
"At California State University, Fresno, computers and communications links to remote resources are recognized as being integral to the education and research experience. Every student is required to have his/her own computer or have other personal access to a workstation (including a modem and a printer) with all the recommended software. The minimum and recommended standards for the workstations and software, which may vary by academic major, are updated periodically and are available from Information Technology Services (http://www.csufresno.edu/ITS/) or the University Bookstore. In the curriculum and class assignments, students are presumed to have 24-hour access to a computer workstation and the necessary communication links to the University's information resources."

Disruptive Classroom Behavior:
"The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. ... Differences of viewpoint or concerns

should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop and understanding of the community in which they live. Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class."

Copyright policy:

Tentative Course Schedule

Week	Date	Topic	Due
Week 1	Date ??	First Day of Instruction; Discuss project proposal	
Week 2	Date ??	Privacy Policy Discussion; Discuss proposal and project	
Week 3	Date ??	Privacy Policy Discussion (cont); discuss proposal and project	Proposal to group for evaluation
Week 4	Date ??	Develop Privacy Policy for Course	Proposal back to author for rework
Week 5	Date ??		Proposal to instructor for approval
Week 6	Date ??	Begin project -- discussion and help	Employer approved proposal
Week 7	Date ??	Discuss what constitutes good documentation	
Week 8	Date ??	Asynchronous discussion of project issues; discussion of project write up	
Week 9	Date ??	Asynchronous discussion of project issues	
Week 10	Date ??	Asynchronous discussion of project issues and preparation for project presentation; practice run on Elluminate *Live!*	
Week 11	Date ??	Project Presentations in face-2-face setting or through Elluminate *Live!*	
Week 12	Date ??	Help finalizing all project deliverables	Final Project Package due

Appendix B: Faculty Resumes

CURRICULUM VITAE

Zhi WANG

Associate Professor
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Education

1997 Ph.D., Hydrology and Soil Physics, Katholieke Universiteit Leuven, Belgium
1985 M. Sc., Irrigation and Drainage Engineering, Northwestern Agricultural University, China
1982 B. Eng., Civil and Hydraulic Engineering, Xi'an University of Technology, China

Dissertation, thesis and project design

Ph.D. Dissertation: "Dynamic Simulation of Liquid-Air Displacement and Preferential Flow in Porous Media", KU Leuven Dissertation #347, 1997. Fully published in four articles in **Water Resources Research**, 1997-98.

M. Sc. Thesis: "Experimental Study of the Long Border Segment Irrigation Systems". Fully published in **Irrigation and Drainage** (Chinese), 5(4): 15-26 1986.

B. Eng. Project and Thesis: Design of the Multi-Stage Pumping Stations in Jingtai County, Gansu Province; Thesis on Computer analysis of the safe concrete block sizes to stabilize pipelines. 1982.

Professional Experience

2008-present: Associate Professor, Department of Earth and Environmental Sciences, California State University, Fresno.
2003-2007: Assistant Professor, Dept of Earth and Env Sciences, CSU Fresno.
1998-2002: Post doctoral researcher, Dept of Environmental Sciences, University of California, Riverside (advisor: Prof. William A. Jury, member of the US Academy of Sciences).
1993-1997: Graduate Researcher, Institute for Land and Water Management, Catholic University Leuven, Belgium (advisor: Prof. Jan Feyen, former director of the Institute).
1985-1992: Assistant Professor (1988-92), Director of the Irrigation Engineering Division, College of Civil and Hydraulic Engineering, Northwestern A&F University, China.

Honors and Awards

Provost's Research Activity Award ($25,000), California State University, Fresno (March 2008)
Selected Scientist on E-print Network (www.osti.gov/eprints), US Department of Energy, Office of Scientific and Technical Information (2006-)
Selected California Concerned Scientist, signed letters to California State Governor and Legislators, leading to new laws to limit the green house gas emissions in California (April 2005) and the destruction of forest land for bio-fuel crops (April 2009)
Elected president of Chinese American Faculty Association at CSUF (2005-06)
Doctoral Full Scholarship and Research Fund, K.U. Leuven (Belgium 1993-97)
Elected President of Chinese Student Association of Leuven (1995-96)
Outstanding Teacher, Northwestern Agricultural University, China, 1987-90

International Services

Guest Professor (2009-2014), Research Center for Echo-Environ. Sci., Chinese Academy of Sciences
Adjunct Professor (2010- 2012), Institute for Water and Environment, ChangAn University, Xian, China
HouJi Guest Professor (2010-2014), Northwest A&F University, Yangling, China

Memberships in Professional Organizations

American Geophysical Union (AGU, 1998-)
American Society of Agronomy (ASA, 1998-)
Soil Science Society of America (SSSA, 1998-)
European Geophysical Society (EGS, 1995-98),
American Association for the Advancement of Science (AAAS, 1998-2000)

PROFESSIONAL AND SOCIETY SERVICES

External Scientific Society Services and Assignments

Professional Service Committees

- Member, Graduate Student Award Committee, Soil and Water Conservation (Section-6), Soil Science Society of America (2006-)
- Member, Western Regional Soil Physics Research Project W-1188 (2002-)
- Member, Central Sierra Watershed Committee (2003-)
- Member, Madera County Water Advisory Commission – Subcommittee (2008-)

Session Chair, International Conference

- Session #341: Surface, Subsurface Hydrological Processes and the Impact of Land Use Changes. Centennial ASA-CSSA-SSSA International Annual Meetings in **New Orleans**, LA, Nov. 4-8, 2007.

Invited Guest Speaker at Professional Conferences

- GIS-based modeling of water quality and water supply in Fresno River Watershed. The 12th Annual California GIS Conference (**Santa Barbara**, CA, April 5-7, 2006);
- GIS Day 2006, **Fresno**, CA, November 15, 2006)
- Soil Science Society of America 91st Annual Meeting (**Salt Lake City**, UT, 1999);
- International Conference on Water-Repellent Soils (**Wagningen,** The Netherlands, 1998).

Invited Reviewer (External Grant Proposals)

- US National Science Foundation (NSF), Geoscience – Hydrology proposals (2000-02, 07-09)
- U.S. State Department, Civilian Research and Development Foundation proposals (2003)
- Israel Science Foundation (2009)

Invited Reviewer (International Journal Manuscripts)

- ASCE Journal of Irrigation and Drainage Engineering,
- Catena
- Ecological Modeling
- Environmental Fluid Mechanics
- Environmental Management
- European Journal of Soil Science
- Geoderma
- Journal of Colloid and Interface Science
- Journal of Contaminant Hydrology
- Journal of Earth System Science
- Journal of Environmental Quality
- Journal of Hazardous Materials
- Journal of Hydrology
- Science of the Total Environment
- Soil Science
- Soil Science Society of America Journal
- Vadose Zone Journal
- Water Resources Research

Invited Special Seminars

Wang, Z., Effects of Unstable Flow on Water System Contamination and Remediation. Department Earth and Environmental Sciences, California State University - Fresno, **Fresno**, CA, April 5, 2002.

Wang, Z., Effects of Unstable Flow on Water System Contamination and Remediation. Department Environmental Sciences, Rutgers University, The State University of New Jersey, **New Brunswick**, NJ, March 13, 2002.

Wang, Z., Measurement and Prediction of Unstable Flow in the Vadose Zone and Groundwater Aquifers, Department of Civil and Environmental Engineering, University of Tennessee, **Knoxville**, TN, February 13, 2002.

Wang, Z., Measurement and Prediction of Preferential Flow and Solute Transport in Soils, Soil and Water Science Department, University of Florida, **Gainesville**, FL, May 3, 2001.

Wang, Z, Dynamic Simulation of Liquid-Air Displacement and Preferential Flow in Porous Media, Department of Environmental Sciences, University of California, **Riverside**, CA, April 9, 1998.

California State University, Fresno Campus Committees and Duties

- University Graduate Committee (2007-2010)
- University Task Force on Grants and Contracts, CSUF (2002-03);
- University Air Quality Resources Group, CSUF (2003-)
- University Coordinator, Unitrack AP Environmental Science program for high schools (Clovis West, Clovis and CART) since 2003
- CSU Fresno RISE Program faculty mentor (2004-)
- College Curriculum Committee (2004-2008)
- College International Education Committees (2005-2008)
- Inter-College Equal Employment Officer (EEO) on Faculty Search committees – Department of Industrial Technology and Department of Viticulture (2007 and 2008)
- Department Faculty RTP (retention, tenure and promotion) Committee Chair (2008)
- Department Graduate Faculty Committee (2002-)
- Undergraduate Program Coordinator, the Joint BS Environmental Science Program with CSU Fresno and UC Riverside (2005-)
- Department GIS computer lab supervisor (2002-)
- Web master: Department website (www.csufresno.edu/ees, 2002-)
- Web master, Asian Faculty and Staff Association of CSUF website (www.csufresno.edu/afsa) (2009-)

TEACHING

Teaching and Supervising Activities

New Courses Developed and Cataloged at CSU Fresno

1. EES 004: Environmental Science - for GE (taught since Fall 2006)
2. EES 108: Soil and Water Science (approved in Fall 2004)
3. EES 109: Atmospheric Science (approved in Fall 2004)
4. EES 178: Geostatistics (taught since Fall 2006)
5. EES 230: Contaminant Transport (graduate course approved in Fall 2008)
6. EES 115: Environmental Earth and Life Science (Web-based, taught since Spring 2007)

Courses Taught at CSU Fresno

1. EES 004: Environmental Science (2006-)
2. EES108: Soil and Water Science (2010-)
3. EES 112: Earth System History (2009-)
4. EES 117: Hydrogeology (2002)
5. EES 177: Quantitative Methods for Earth Science (2003-2004)
6. EES 178: Geostatistics (2006-)
7. EES 180: Computer Applications in Geology (2003-2006)
8. **EES 186: Environmental GIS (2002- present)**
9. EES 217T: Contaminant Hydrology (2003-04)
10. EES 217T: Unsaturated Zone Hydrology (2003-04)
11. NSCI 115: Environmental Earth and Life Science – for distance learning mode (2004-)
12. NSCI 115: Environmental Earth and Life Science – for web-based instruction (2007-)
13. NSCI 115: Environmental Earth and Life Science (2002-2005)

Courses Taught Elsewhere

- Surface Irrigation Engineering - Design and Field Evaluations, graduate course taught at **Universidad de Cuenca, Ecuador** (Feb-March 1997)
- *Irrigation and Drainage Engineering (undergraduate), **Northwestern Agricultural University, China** (1985-1992)*
- Economic Evaluation of Irrigation Projects (undergraduate), **Northwestern Agricultural University, China** (1985-1992)

Funded Teaching Project at CSU Fresno

- CSU Fresno Assessment funding Award ($5,000), Office of the Provost and Office of Institutional Assessment, Assessment and Planning (2005-06).

Visiting Scientist and Scholar Advising

Zili He Northwest A&F University, China Nov 2007- July 2009

Graduate Student Advising at CSU Fresno (as Major Advisor)

Student name	*Degree*	*These Topic*	*Completion Date*
James R. Meier	MS Geology	Groundwater bank	**Aug 2005**
Ori Sartono	MS Geology	Fractured rock Aquifer	**Aug 2007**
Sana Alsaoudi	MS Geology	SJR Water source isotope	**Dec 2007**
Jorge Baca Jr	MS Geology	Fresno R watershed erosion	**Oct 2009**
Doug DeFlitch	MS Geology	SJ River sediment transport	**April 2010**
Joe Knight	MS Geology	SJV Selenium transport	Aug 2006- present
Ronald Holcomb	MS Geology	Watershed assessment	Aug 2004- present
Ashley Ross	MS Geology	Kings R Watershed Erosion	Aug 2009-present

Graduate Student Advisory Committees at CSU Fresno

Student name	*Degree*	*Department*	*Major Advisor*	*Completion Date*
Nelson F. Bernal	MS Geology	EES	John Suen	Dec 2007
Rose Marrero-Cuebas	MS Geology	EES	John Suen	Dec 2007
Susan Bratcher	MS Geology	EES	John Suen	Dec 2007
Sean P. Boyd	MS Geology	EES	Fraka Harmsen	in progress
Zachary Hoover	MS Biology	Biology	Steve Blunmenshire	in progress
Brett Moore	MS Biology	Biology	Steve Blunmenshire	in progress

Undergraduate Thesis Advising at CSU Fresno (as Major Advisor)

Student name	*Degree*	*These Topic*	*Graduation Date*
Louis Tesseo	B. Sc. Geology	GIS Snow-pack calculation	**May 2007**
Brent Vanderburgh	B. Sc. Geology	GIS Snow water calculation	**May 2008**

Undergraduate Program Advising (as major advisor)

- Geology majors (4): Graduated in 2005-08.
- Environmental Science majors (27): As Coordinator of the Joint BS in Environmental Science program between CSUF and UCR:

RESEARCH

Research Interests

- Measurement and prediction of surface and subsurface water flow and contaminant transport
- Fluid Mechanics in porous media including soils and underground aquifers for water and oil
- Evaluation, measurement and prediction of soil and groundwater quality
- Climate change effects on hydrological processes and eco-system sustainability at various scales
- Measurement and prediction of unstable (finger) flow in soils and geological formations
- GIS applications in natural resources, watershed and groundwater management and modeling
- Development and calibration of hydraulic devices and structures for discharge measurement
- Irrigation engineering and pumping system design, simulation and installation

Publications

In Peer-reviewed Journals:

1. Liu, X., B. He, Z. Li, J. Zhang, L. Wang, Z. Wang. Influences of land terracing on agricultural and ecological environment in Loess Plateau regions, China. **Environmental Earth Sciences**, DOI: 10.1007/s12665-010-0567-6, 2010.
2. Liang, X., D. Su, S. Yin, and Z. Wang. Leaf water absorption and desorption functions for three turfgrasses. **Journal of Hydrology**, 376: 243–248, 2009.
3. He, Z., Z. Wang, C.J. Suen, and X. Ma. Climate Change Impacts on Water Availability in the Upper San Joaquin River Watershed, California. (submitted) 2009.
4. Yu, Xinxiao, Derong Su, Yuan Tian, and Z. Wang. Performance of the ridge-furrow rain harvesting system in semiarid regions of China. (resubmitted), 2009.
5. Li, He-li, Huai-en Li, Zhi Wang, Wen-juan Shi. Research of Finger Flow in Porous Media: Review and Perspective, **Soils**, 41: 27-33, 2008.
6. Kim, S.B., H.S. On, D.J. Kim, W. A. Jury, and Z. Wang. Determination of bromacil transport as a function of water and carbon content in soils. **Journal of Environmental Science and Health Part B**, 42, 529–537, 2007.
7. Wang, Z. Watershed Monitoring and Hydrologic Simulation using GIS, **CSU Geospatial Review**, Vol. 4, Spring 2006.
8. Mathieu, J., Z. Wang, J. Feyen, D. Elrick and M. Vanclooster. Correction to "Prediction of fingering in porous media". **Water Resources Research.**, Vol. 41, No. 4, W04005, doi:10.1029/2004WR003831, 2005.

9. Wang, Z. Invited Book Review: Seepage in soils – principles and applications by Lakshmi N. Reddi. John Wiley & Sons, Inc. **Vadose Zone Journal**, 3:728-729, 2004.
10. Wang, Z., W.A. Jury, A. Tuli, and D.J. Kim. Unstable flow during redistribution: Controlling factors and practical implications. **Vadose Zone Journal**, 3: 549-559, 2004.
11. Wang, Z, A. Tuli, and W.A. Jury. Unstable flow during redistribution in homogeneous soil, **Vadose Zone Journal**, 2: 52-60. 2003.
12. Jury, W.A., Z. Wang, and A. Tuli. A conceptual model of unstable flow in unsaturated soil during redistribution, **Vadose Zone Journal**, 2: 61-67, 2003.
13. Wang, Z., L. Wu, T. Harter, J. Lu and W.A. Jury. A field study of unstable preferential flow during soil water redistribution. **Water Resources Research** 39 (4): 1075, doi:10.1029/2001WR000903. 2003.
14. Wang, Z., A. Chang, L. Wu, and D. Crowley. Assessing the soil quality after long-term wastewater irrigation - principal component and factor analysis. **Geoderma** 114: 261-278, doi:10.1016/S0016-7061(03)00044-2. 2003.
15. Wang, Z, J. Lu, L. Wu, T. Harter, and W.A. Jury. Visualizing preferential flow in field soils using ammonium carbonate and a pH indicator, **Soil Science Society of America Journal**, 66, 347-351, 2002.
16. Wang, J., B. Fu, Y. Qiu, L. Chen, and Z. Wang. Geostatistical analysis of soil moisture variability on Da Nangou catchment of the loess plateau, China. **Environmental Geology**, 41: 113-120, 2001.
17. Jury, W. A., and Z. Wang. Unresolved Problems in vadose zone hydrology and contaminant transport. In **Dynamics of Fluids in Fractured Rock**, AGU Geophysical Monograph 122, edited by B. Faybishenko, P. A. Witherspoon and S. M. Benson. pp. 67-72, 2000.
18. Wang, Z., L. Wu, and Q. J. Wu. Water-entry value as an alternative indicator of soil water repellency and wettability, **Journal of Hydrology**, 231-232: 76-83, 2000.
19. Wang, Z., Q.J. Wu, L. Wu, C.J. Ritsema, L.W. Dekker and J. Feyen, Effects of soil water repellency on infiltration rate and flow instability. **Journal of Hydrology**, 231-232:265-276, 2000.
20. Zerihun, D., J. Feyen, J. M. Reddy and Z. Wang. Minimum cost design of furrow irrigation systems. **Transactions of the ASAE**, 42(4): 945-955, 2000.
21. Wang, Z., Jan Feyen, and D.E. Elrick. Prediction of Fingering in porous media. **Water Resources Research**, 34: 2183-2190, 1998.
22. Wang, Z., Jan Feyen and C. J. Ritsema. Susceptibility and predictability of conditions for preferential flow. **Water Resources Research**, 34: 2169-2182, 1998.
23. Wang, Z., J. Feyen, M. Th. van Genuchten and D. R. Nielsen. Air entrapment effects on infiltration rate and flow instability. **Water Resources Research**, 34(2): 213-222, 1998.
24. Wang, Z., J. Feyen, D. R. Nielsen and M. Th. van Genuchten. Two-phase flow infiltration equations accounting for air entrapment effects. **Water Resources Research**, 33(12): 2759-2768, 1997.
25. Zerihun, D, Z. Wang, J. Feyen and J. M. Reddy. Empirical functions for dependent furrow irrigation parameters. 2: Applications, **Irrigation Science**, 17:121-126, 1997.
26. Zerihun, D., Z. Wang, S. Rimal, J. Feyen and J. M. Reddy. Analysis of surface irrigation performance terms and indices. **Agricultural Water Management**, 34:25-46, 1997.
27. Wang Z., D. Zerihun, and J. Feyen. General irrigation efficiency for field water management. **Agricultural Water Management**, 30(2): 123-132, 1996.
28. Wang, Z., J. M. Reddy and J. Feyen. Improved 0-1 programming model for optimal flow scheduling in irrigation canals, **Irrigation and Drainage Systems**, 9: 105-116, 1995.
29. Wang, Z. and J. Feyen. Unsaturated infiltration properties affected by soil air pressure. **Unsaturated Soils** (edited by E. E. Alpnso and P. Delage, A.A. Balkema Publisher, Rotterdam), Vol. 1: 417-422, 1995.
30. Wang, Z.Y., Z. M. Zhen and Z. Wang. The use and conveyance of hyper-concentrated turbid flow. **ICID Bulletin CIID**, 43(2) 117-126, 1994.

31. Lin, X. C., Z. Wang, W. Meng, L. Zhao, W.Z. Fan and Q.L. Shen. A quantitative evaluation of on-farm irrigation methods and techniques, **Journal of Northwestern Agricultural University** (Acta Univ. Agric. Boreali-occidentalis), 23(5): 17-22, 1995.
32. Wang, Z., F. S. Zhu and X. M. Liu. Experimental study of parabolic throat-less flumes. **Journal of Water Resources**, 23(7):12-23, 1994.
33. Wang, Z., Ai-Min Zhang and De-Hua Liao. Field study of on-farm irrigation efficiencies in XiYingHe irrigation district. **Water Resources & Water Engineering**, 4(1):17-25, 1993.
34. Wang, Z. and F. Zhu. Optimal flow regulation in canal systems using 0-1 programming method, **Irrigation & Drainage**, 11(3): 8-13. 1992.
35. Wang, Z., Parabolic cut-throat flumes for U-shaped canals, **Shaanxi Water Conservancy**, (4): 16-19, 1990.
36. Xiong, Y.Z., S. Kang, Z. Wang, X.C. Ling, and Z.N. Wang. Water saving irrigation in semi-arid regions of northwestern China, in **Water-Saving Agriculture and Development of Irrigation & Drainage Technologies**, Oct., 1989, 16-21, 1989.
37. Wang, Z. Recession/advance model for design of Long Border Segment Irrigation systems, **People's Yellow River**, 1989(3): 33-37, 1989.
38. Wang, Z. Evaluating application parameters of soil infiltration characteristics, **Irrigation & Drainage and Small Hydro-Power**, 1989(1): 30-33, 1989.
39. Wang, Z., An analytical model for predicting surface flow advance and the rational length of borders, **Irrigation & Drainage and Small Hydro-Power**, (1): 30-33, 1987.
40. Wang, Z. A mathematical model for border irrigation flow advancement, **Journal of Northwestern Agricultural University** (Acta Univ. Agric. Boreali-occidentalis, China), 15(4): 47-54, 1987.
41. Wang Z. and F. Zhu. Venturi-pipe devices for open canal water measurement, **Water Measurement Techniques and Devices**, 4: 58-64, 1986.
42. Wang, Z. Simulation and design of Long Border Segment Irrigation Systems, **Irrigation & Drainage**, 5(4): 15-26, 1986.

Abstracts in Conference Proceedings:

1. Ori Sartono, Z. Wang, C. J. Suen, and K. D Schmidt. Parameterization of a fractured hardrock aquifer in western foothills of the Sierra Nevada, California, *GSA Abstracts with Programs*. Vol. 39, No. 6, 2007.
2. Wang, Z., William A. Jury, and Atac Tuli. Observation and Modeling of Unstable Flow during Soil Water Redistribution. *Proceedings of the 2nd International Symposium on the Dynamics of Fluids in Fractured Rock*, Lawrence Berkeley National Laboratory, Berkeley, CA, Feb. 10-12, 2004.
3. Wang, Z. Does Water Flow Become Unstable in All Soils? *Proceedings of the Twenty-Fourth Annual Central California Research Symposium*. California State University, Fresno. CA, April 17, 2003.
4. Wang, Z. Effects of soil water repellency on infiltration rate and flow instability. International Workshop on "*Soil Water Repellency - origins, assessment, occurrence, consequences, modeling and amelioration*", Wageningen, The Netherlands, September 2-4, 1998.
5. Wang Z. and J. Feyen. Effects of air entrapment on water flow. *Proceedings of the International Conference Kearney Foundation of Soil Science*, Vadose Zone Hydrology: Cutting across Disciplines. University of California, Davis, sep. 6-8:163-164, 995.
6. Wang, Z. and J. Feyen. Inter-displacement behaviors between air and water during unsaturated infiltration. In: *Annales Geophysicae of the XXth general Assembly of the EGS*, Hamburg, Germany, Apr. 3-4, 7pp. 1995.
7. Wang, Z.. and J. Feyen. Effect of air entrapment on water flow and solute transport. *Proceedings of International workshop on Water and Matter Transport at Various Scales*. Leuven, Belgium April 18-19, 1995.

8. Zerihun D, Z. Wang, J. Feyen and J. M. Reddy. Performance Curves for Border irrigation. *Proceedings of the first International Conference on Water Resources Engineering*, ASCE (August 14-18, 1995, San Antonio, Texas, USA), edited by W.H. Espey, Jr. and P.G. Combs, Vol. 2: 1595-1599, 1995.
9. Feyen J., W. Mulonga, F. Liu, D. Zerihun and Z. Wang, 1994. Computer applications in irrigation and drainage education, research and practice. *Proceedings of the 5th MANCID* (Malaysian National Commission on Irrigation and Drainage) *Annual National Conference on "Hydroinformatics - Information technology for Irrigation, Drainage and Water Resources.* Pangkor Island, Malaysia. Nov. 25-27, 1996.
10. Wang, Z. and J. Feyen. A criterion for design, evaluation and optimization of on-farm irrigation systems. *Proceedings of the 45th ICID International Executive Council Meeting and 17th European Regional Conference* on "Effective and ecological sound use of irrigation waters", Varna, Bulgaria, May, 1994.
11. Wang, Z. and F. Zhu. Parabolic throat-less flumes for open channel discharge measurement, *Proceedings of the International Conference on Agricultural Engineering* (Beijing): V86-V92, 1992.
12. Wang, Z. and F. Zhu. Water-saving agriculture in Shaanxi Province, Proceedings of the *Symposium on Water Resources Utilization in NW China*, October, 1990, Xi'an. pp:20, 1990.

Conference Presentations (underlined are Students and Advisees)

1. Wang, Z. (oral presentation). The effects of first floods and soil erosion on water quality in the Fresno River watershed. Central Sierra Watershed Committee meeting. **Oakhurst**, California, April 28, 2010.
2. DeFlitch, Douglas., Zhi Wang (oral presentation). Measurement and monitoring of bedload sediment transport along the upper San Joaquin River. The 31st Annual Central California Research Symposium, **Fresno**, California, April, 23, 2010.
3. Wang, Z. (oral presentation). Assessment of eco-system health, services and restoration - Case studies in California and the Loess Plateau of China. Chinese Academy of Sciences. **Beijing**, China, April 2, 2010.
4. Wang, Z. (oral presentation). Eco-hydrology, infiltration, irrigation engineering and hydrogeology with applications in California and the Loess Plateau of China. Institute for Water and Environment, ChangAn University, **Xi'An**, China, January 2-18, 2010.
5. Wang, Z. (oral presentation). Eco-hydrological measurement and simulation of watershed sustainability with respect to global climate change. Chinese Academy of Sciences. **Beijing**, China, Dec 28, 2009.
6. Suen, C. John, Bernad. F. Nelson, Ori Sartono, Z. Wang (poster presentation). Using isotope hydrology, fracture mapping, and pump tests to characterize groundwater flow through the fractured rock terrane of the Sierra Nevada foothills, GSA Annual Meeting, **Portland**, Oregon, October 18-21, 2009.
7. Wang, Z, Zili He, John Suen, Xiaoyi Ma (Oral presentation). Climate Change Impacts on the Headwaters of San Joaquin River, California. The 30th Annual Central California Research Symposium, **Fresno**, California, April, 30, 2009.
8. Baca, Jorge Jr., Zili He, Zhi Wang, Steve Blumenshine (Poster). Estimating Soil Erosion Potential within the Fresno River Watershed using the RUSLE model and GIS. The 30th Annual Central California Research Symposium, **Fresno**, California, April, 30, 2009.
9. Moore, Brett, Steve Blumenshine, Zhi Wang, Zili He (Poster). Influence of sedimentation on the distribution of macroinvertebrates in the upper Fresno River. The 30th Annual Central California Research Symposium, **Fresno**, California, April, 30, 2009.

10. Wang, Z. (oral presentation). Estimating Soil Erosion Potential in the Fresno River Watershed using the RUSLE Model and GIS. Central Sierra Watershed Committee meeting. **Oakhurst**, California, May 27, 2009.
11. Wang, Z. (oral presentation). Impacts of the first flood events and sedimentation on water quality in the Fresno River wathershed. Central Sierra Watershed Committee meeting. **Oakhurst**, California, February 25, 2009.
12. Wang, Z., and S. Blumenshine (oral presentation). Monitory plan for the upper Fresno River watershed. Oakhust area public information meeting sponsored by Central Sierra Watershed Committee. **Oakhurst**, California, October 16, 2008.
13. Wang, Z., Louis A. Tesseo (Poster). Upper San Joaquin River: A Geostatistical Analysis of the Snowpack water yield in the upper San Joaquin River watershed. GIS Day at Fresno State, **Fresno**, CA, Nov. 14, 2007.
14. Ori Sartono, Nelson F. Bernal, C. John Suen, Zhi Wang (Poster). Groundwater Flow through a Fractured Rock Aquifer in the Sierra Nevada Foothills of California. AGU 2007 Fall Meeting, **San Francisco**, California, December 10-14, 2007.
15. Wang, Z., Louis A. Tesseo (Oral presentation). Spatial Analysis of Snowpack Water Resources in Sierra Nevada for San Joaquin River. International Annual Meetings of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America in **New Orleans**, Louisiana. Nov. 4-8, 2007.
16. Xinxiao Yu, Derong Su, Yuan Tian, Zhi Wang (Oral presentation)., Performance of ridge and furrow water-harvesting system in Loess Plateau of China. International Annual Meetings of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America in **New Orleans**, Louisiana. Nov. 4-8, 2007.
17. Ori Sartono, Zhi Wang, C. John Suen, and K. D Schmidt (Poster). Parameterization of a fractured hard rock aquifer in western foothills of the Sierra Nevada, California, GSA Annual Meeting and Exposition. **Denver,** Colorado, Oct 28-31, 2007.
18. Wang, Z. (Invited Oral Presentation). Geospatial Analysis in Earth and Environmental Sciences, GIS Day 2006 for San Joaquin Valley, **Fresno**, CA, November 15, 2006.
19. Wang, Z. (Invited Oral presentation). GIS-based modeling of water quality and water supply in Fresno River Watershed. The 12th Annual Cal GIS Conference, Fess Parker's Doubletree Resort, **Santa Barbara**, CA, April 5-7, 2006.
20. Wang, Z. (Oral presentation). Characterizing Mass and Energy Transport at Different Scales. Western Regional Soil Physics Research Project W-1188 Annuposital Meeting, Desert Research Institute, 755 E. Flamingo Road, **Las Vegas**, NV, Jan. 2-4, 2006.
21. Wang, Z., Ronald E. Holcomb, Ori Sartono, Jim Meier (Oral presentation). Moving Toward GIS-Based Modeling of Watersheds and Groundwater Banks in San Joaquin Valley. Western Regional Soil Physics Research Project W-1188 Annual Meeting, **Las Vegas**, NV, Jan. 2-4, 2005.
22. Wang, Z., William A. Jury, and Atac Tuli. (Poster presentation). Observation and Modeling of Unstable Flow during Soil Water Redistribution. The 2nd International Symposium on the Dynamics of Fluids in Fractured Rock, Lawrence Berkeley National Laboratory, **Berkeley**, CA, Feb. 10-12, 2004.
23. Wang, Z., S. Blumenshine, and M McClanahan. (Oral presentation). Fresno River Monitoring. Central Sierra Watershed committee meeting, **Oakhurst**, CA, April 28, 2004.
24. Wang, Z., William A. Jury, and Atac Tuli. (Oral presentation). Critical depth of infiltration for unstable flow during redistribution. US West Region Soil Physics Workshop (W-188), **Las Vegas**, January. 4-7, 2004.
25. Wang, Z., O. Satono, S. Blumenshine, and M McClanahan. (Oral presentation). GIS-Aided Watershed Modeling. GIS Day 2003, California State University, **Fresno**, CA, November 19, 2003.

26. Wang, Z., William A. Jury, and Atac Tuli. (Oral presentation). Does Water Flow Become Unstable in All Soils? Twenty-Fourth Annual Central California Research Symposium. California State University, **Fresno.** CA, April 17, 2003.
27. Wang, Z., S. Blumenshine, and M McClanahan. (Oral presentation). Fresno River Monitoring Plan and initial results. Central Sierra Watershed committee meeting, **Oakhurst**, CA, September 4, 2003.
28. Wang, Z. (Oral presentation). Contaminant flow in water. Western Athletic Conference (WAC) Universities Academic Alliance Symposium on Energy & Water Issues in Homeland Security and Health Disparities. **San Jose, California**. June 5-7. 2003.
29. Jury, W.A., and Z. Wang. (Oral presentation). Experimental and theoretical studies of unstable flow during soil water redistribution. US West Region Soil Physics Workshop (W-188), **Las Vegas**, January. 6-8, 2003.
30. Wang, Z. A. Tuli and W. A. Jury. (Poster presentation) Evidence of unstable preferential flow during soil water redistribution. AGU 2002 Fall Meeting, **San Francisco**, USA, December 4-10, 2002.
31. Wang, Z., W.A. Jury and L. Wu. (Oral presentation). Preferential flow in non-structured field soils. US West Region Soil Physics Workshop (W-188), **Las Vegas**, January. 2-5, 2001.
32. Wang, Z., W.A. Jury and L. Wu. (Oral presentation). Measurement and prediction of unstable flow, American Society of Agronomy, Crop Science Society of America, Soil Science Society of America 91ST Annual Meeting, **Salt Lake City**, Oct. 31 – Nov. 4, 1999.
33. Jury, W.A., and Z. Wang. (Oral presentation by Dr. Jury). Recent Developments and Unresolved Problems in Vadose Zone Hydrology and Contaminant Transport. International Symposium (in Honor of Paul A. Witherspoon) on "Dynamics of Fluids in Fractured Rocks: Concepts and Recent Advances", Ernest Orlando Lawrence Berkeley National Laboratory, **Berkeley**, California, February 10-12, 1999.
34. Wang, Z. and L. Wu. (Oral presentation). Effects of soil water repellency on infiltration rate and flow instability. International Workshop on "Soil Water Repellency - origins, assessment, occurrence, consequences, modeling and amelioration", **Wageningen**, The Netherlands, September 2-4, 1998.
35. Wang, Z. (Oral presentation). Prediction and observation of preferential flow in porous soils. US West Region Soil Physics Workshop (W-188), **Las Vegas**, January. 5-8, 1998.
36. Wang, Z., Jan Feyen, D.E. Elrick. (Poster presentation). Prediction of fingering in porous media. AGU 1997 Fall Meeting, **San Francisco**, USA, December 8-12, 1997.
37. Wang, Z., Jan Feyen and C. J. Ritsema. (Poster presentation). Susceptibility of conditions for preferential flow. 22nd General Assembly of EGS, **Vienna**, Austria, 21-25 April 1997.
38. Wang, Z., and J. Feyen. (Presentations, demonstrations, field experiments, exercises and exams). Surface Irrigation System Measurement and Design, International Post-graduate Program by University of Leuven and Universidad de Cuenca, **Cuenca**, Ecuador, Feb 23-Mar. 8, 1997.
39. Wang, Z., J. Feyen. (Poster presentation). Two-phase flow infiltration equations accounting for air entrapment effects, EGS XXI General Assembly, **The Hague**, The Netherlands, May 6-10, 1996.
40. Wang, Z. and J. Feyen. (Poster presentation). Fingered Flow Visualization in Two Dimensional Columns. Gordon Research Conference on "Modeling of Flow in Permeable Media", Proctor Academy, **Andover**, New Hampshire, USA, August 4-9, 1996.
41. Wang, Z., J. Feyen. (Poster presentation). Air entrapment effects on infiltration rate and flow instability. International workshop on "Vadose Zone Hydrology: Cutting across disciplines", University of California, **Davis**, Sept. 6-8, 1995.
42. Wang, Z. and J. Feyen. (Oral presentation by Dr. DJ Kim). Unsaturated infiltration properties affected by soil air pressure. First International Conference on Unsaturated Soils, **Paris**, France, Sept. 6-8, 1995.
43. Wang, Z. and J. Feyen. (Oral presentation). Inter-displacement behaviors between air and water during unsaturated infiltration. European Geophysical Society (EGS) X General Assembly, **Hamburg**, Germany, April 3-7, 1995.
44. Wang, Z.. and J. Feyen. (Oral presentation). Effect of air entrapment on water flow. Workshop on Water and Matter Transport at Various Scales. **Leuven**, Belgium, April 18-19, 1995.