Syllabus:
EVS 42x/52x and Certificate in the Application of Geospatial Science to the Field Sciences

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Introduction

This syllabus covers the 420 and 520 series of courses taught by the Department of Biological, Geological, and Environmental Sciences, as well as the Certificate in the Application of Geospatial Science to the Field Sciences, whose core comprises the 420/520 series. The reasons for handling these courses in a single syllabus are [1] the similarity in their delivery system makes this an appropriate device, and [2] the interrelationships of the various courses with each other and with the certificate makes it useful to include the courses that are interrelated and to indicate how they each contribute to the certificate.

The series includes three 2-course sequences, as shown in the following table:

	Substantive	Practicum
Applications of GIS to the Field Sciences	422/522	423/523
Introduction to Remote Sensing	424/524	425/525
Advanced Topics in Remote Sensing and GIS	426/526	427/527

In all three cases, the even-numbered, or "Substantive" course provides the general overview of the substantive material in the course, including basic theory or information, details of the concepts underlying laboratory exercises, and an overview of the laboratory exercises. The odd-numbered, or "Practicum" course provides intensive hands-on work in the Remote Sensing Laboratory designed to provide the student with first-hand experience with a broad range of software applied to a broad range of issues.

The Certificate in the Application of Geospatial Science to the Field Sciences comprises the entire 420 or 520 series plus at least 2 credit-hours of research, independent study, or internship using the geospatial tools presented in the 420/520 series. This practicum may consist of a free-standing 2-credit-hour course (e.g. EVS 496 or 497), but it will more likely be 50% of the 4-credit-hour capstone requirement for the EVS Bachelors degree or the equivalent of 2 credit-hours within the student's graduate thesis or exit project work at the Master's level.

The nature of undergraduate advising and the logistics of a Master's career at CSU necessitate a restricted template for completing the Certificate. Students tend not to enter their majors until their junior year. Hopefully, students interested in the Certificate will be advised to take EVS 322/323 [Geospatial Concepts and Tools], which is prerequisite to the 420 series. Graduate students do not have the option to take this course, and will have to bring themselves up to date on the course material if they do not have it in their backgrounds. Once entered in the 420/520 series, students will be able to learn a broad range of skills, techniques, and applications that will provide them with a basis for using geospatial science in their careers or research.

The certificate can be completed as follows:

	Fall Semester	Spring Semester
First Year	[Geospatial Concepts & Tools]	GIS Applications to Field Sciences
Second Year	Introduction to Remote Sensing	Advanced Topics in Remote Sensing & GIS + Capstone Practicum

The substantive courses in the 420/520 series are all section 501. Lectures and Laboratory overviews are presented in on-line video format. Specific class times are not scheduled, and students are encouraged to attend lectures at home or whenever they can most reasonably do it. The practicum courses in the 420/520 series are all section 1, with laboratory time scheduled on two afternoons per week.

Why Do It?

The 420/520 series of courses is designed to introduce students to Remote Sensing and Geographic Information Systems (GIS), which have become crucial tools for dealing with spatially distributed data in a broad range of fields. Graduates from our program noticed that potential employers wanted a background in geospatial science as entries into careers, and so they requested that we offer both courses that cover a reasonable range of substantive material in geospatial science as well as a certificate representing a credential that potential employers can see. Experience has demonstrated that many potential jobs either require or recommend GIS in a student's background, and serious involvement with geospatial science in field-oriented applications requires the use of remotely-sensed imagery. It takes all three courses in the 420/520 series to provide sufficient background in these areas. The certificate in the Application of Geospatial Science to the Field Sciences was developed – at students' request – to meet the demands of both research applications and the job market. We concentrate on the applications of Geospatial Science in research in the field sciences – e.g. geography, geology, environmental science, biology, archeology, and natural resources. Because the overwhelming majority of these applications use data derived from remotely sensed imagery, the majority of our data sources are from remote sensing. However, we must also include a heavy emphasis on GIS as well.

Application of GIS to the Field Sciences (422/522/523/523)

The purpose of these courses is to provide students with a working knowledge of ArcGIS and the application of GIS in general to the field sciences. GIS in its strictest sense refers to the mapping of objects – points, lines, and polygons. These objects may be single point locations such as sample sites; they may be linear objects such as migration corridors; they may be area objects such as ponds, fields, or nesting areas. We will also deal with raster images, such as aerial photographs and satellite images, since these are significant sources of data for the field sciences.

Introduction to Remote Sensing (424/524/425/525)

The purpose of this course sequence is to provide students with a working knowledge of the available approaches to extracting information from remotely sensed imagery, including aerial photographs and satellite imagery. These are perhaps the most important methods we have to map land cover over a reasonably large area. Land cover is crucial to mapping habitat, stream flow, land use, and related issues. To provide students with the most useful grounding, we use the two most widely used image-processing software products: ERDAS Imagine and ENVI.

Advanced Topics in Remote Sensing & GIS (426/526/427/527)

The purpose of these courses is to deal with issues across the spectrum of geospatial science that cannot be dealt with adequately in the first two course sequences. These issues include a more detailed discussion of the sources and significance of error, multitemporal analyses, modeling land-cover change, LiDAR, and object-based imagery analysis. As as possible, we will try to use students' theses or capstone projects as an organizing vehicle for the course, so that the actual range of issue covered may vary substantially from year to year.

All three courses together

Geospatial science is a very broad field that has different configurations in different applications. For the field sciences, the most important applications are related to land-cover analysis, as land cover is the basis of habitat for organisms, land use either by humans or by non-human organisms, the geological nature of the ground, and the nature of both the natural and built environment. At the same time, we must fit the patterns of land cover into the human melieu, including land-ownership patterns, land-use planning zones, census records, etc. The three courses taken together are designed to enable students to generate data that they can use in their research as well as to use data sets from public or private sources. Those students who complete the Certificate in the Application of Geospatial Science to the Field Sciences will have accumulated a portfolio that will demonstrate to potential employers that they have learned a broad range of skills.

Do you need to complete the certificate in order to profit from taking more than one of these courses? Clearly not. Experience and competence in either GIS or Remote Sensing will provide students with the ability to carry out research and analyses in the field. However, our graduates have reported to the Department that the job market into which they are going puts a very high value on skills dealing with geospatial objects and imagery. This is true regardless of whether they view themselves as being biologists, geologists, archeologists, environmental scientists, etc. These courses fit together and support each other. If used as the core of the certificate, you will graduate from CSU with a solid credential – and portfolio – that will make a difference in your career.

Course Materials

All course materials are available in the Environmental Remote Sensing Laboratory, SR G-71. Students involved in research projects may also use the research satellite laboratory in SR G-76. Materials for the substantive courses are on line and can be accessed from home. Student versions of some software products are also available for download.

The table below summarizes the materials in each course. Textbooks are available in the University Bookstore. Sharing is encouraged! Most course imagery is available on the disk indicated; these volumes are available only in the remote sensing laboratory. A broader selection of imagery is available on the R: drive. All 3 courses in this sequence, as well as students' research projects, will use this imagery archive. Where appropriate, students will also get material from the Worldwide Web.

	URL for On-Line Materials	Textbook	Course Material Drive
Application of GIS to the Field Sciences	www.bges.csuohio.edu/evs423	*Geographic Information Systems & Science (3rd edition)*, by Paul Longley, Michael Goodchild, David Maguire, and David Rhind	P:
Introduction to Remote Sensing	www.bges.csuohio.edu/evs425	*Introduction to Remote Sensing (5th edition)*, by James B. Campbell.	Q:
Advanced Topics in Remote Sensing & GIS	www.bges.csuohio.edu/evs427	Same textbooks as in the first two courses in the sequence	S:

Conduct of the Courses

As indicated above, materials for the substantive courses consist of a formal lecture and an overview of each unit's laboratory exercise. These materials are on line and are available in any on-campus

laboratory or from a student's home. In general, you will receive a new unit each week. *Students should attend the lecture and the laboratory overview BEFORE coming to a scheduled laboratory class!* Audio controls for the on-line courses are the same as used in EVS 323 and should be familiar to all.

The laboratory in each of these courses will operate as a cross between a standard laboratory, in which students work by themselves, and a seminar, in which they share a great deal of information. It is to be anticipated that these exercises will raise questions. Indeed it is to be *hoped* that they will raise questions in your minds that will lead you to experiment. In either case, you should communicate your questions, observations, plans, etc. to the class as a whole. Students are strongly urged to raise questions in class and to point out things of interest. Different students will often be working on different images, and a great deal of the learning process will be to compare notes and see how different types of land cover lead to different kinds of problems. Students' contribution to class discussions will be included in their grades.

Laboratories in this course will all work in the same general fashion. You'll receive a handout in the fist recitation of the week. This handout will include detailed instructions for the following week's work in the laboratory, as well as a specification for materials to be included in your portfolio. You can do the laboratory work any time you choose, and you should budget enough out-of-class time to insure that your portfolio is up to date. The format of all of the units in this course is the same. The first part of the unit will contain the detailed instructions for the exercises within the unit. The second part will be a series of questions, which you are to answer on the discussion group on Blackboard prior to the recitation. The questions and observations which you raise and share with your colleagues in the class will serve as the springboard for our discussions in the recitation. Your contributions to the laboratory seminar will constitute a significant portion of your grade. The third part of each unit will be a specific assignment for your portfolio. At the beginning of the semester, as you are still learning how to use various software products, these portfolio assignments will be fairly cut and dried. Toward the end of the semester, they will be considerably less so. You should bring the portfolio outputs to the recitation. Again, your having completed them by the time of the recitation will show up in your grade. Your completed portfolio will constitute a significant portion of your grade.

You should also note that there are often several different ways in which a task can be completed. For example, icons on a workspace may represent actions that can also be accomplished using the mouse or keystrokes on the keyboard. I will try to indicate as many of these as possible in our scheduled meetings, but you should learn to keep it in mind that there are often several ways to "skin the cat".

All of the images that you create in this course will be stored on your X: drive. To ensure that nobody's activities screw up other students in the class, you will not be able to store images on any of the other drives used in the course.

The course will have two meetings each week, In general, you should attend the on-line lecture prior to coming to a scheduled lab-seminar. You will be given new handouts at the first meeting of the week. At that recitation, I will provide an orientation to the week's laboratory materials, and you will have an opportunity to work on laboratory materials with my active involvement. The second meeting of the week will be more informal, generally providing an opportunity to work on lab exercises and to discuss problems that have arisen during the week. Both recitations will typically be interrupted with explanations of issues raised by students as you work on laboratory exercises. You should take these discussions as significant amplifications of the on-line lectures, and they represent a significant aspect of the courses' delivery system.

Graduate Students

Students registered in the EVS 520 sequence will be required, in addition to the portfolio and the final examination, to prepare a project design for an application of Geospatial Science that would be applicable to a research project in their field. Where possible, this should be an application relevant to their thesis or dissertation. It is important that this project design discuss both the substantive basis of the proposed project (i.e. the portion relevant to the even-numbered course) as well as its practical implementation (i.e. the portion relevant to the odd-numbered course). A grade will be assigned to the project design for both

courses. This project must be completed satisfactorily – i.e. with a grade of at least a B for *both* its practical and substantive aspects, before a grade other than an 'I' will be given for either course. Project documents that are not satisfactory when first presented may be revised.

Grading

Each laboratory unit will include at least one map to be included in your portfolio. There will also be a midterm and a final examination. Grades will be computed as follows:

	Examinations	Participation in Lab/Seminars	Portfolio	Project Design
Substantive Courses				
Undergraduate Students	100% (midterm & final)			
Graduate Students	85% (midterm and final)			15%
Practical Courses				
Undergraduate Students	20% (final)	20%	60%	
Graduate Students	18%	17%	50%	15%

For both undergraduate and graduate students, grades from both courses will be averaged together, and you will receive either separate grades for each course or the average grade for both courses – whichever is more beneficial to your GPA.

All materials submitted for grading must be submitted through the Evaluation Administration program. You have used this program in EVS 323, so it should know how it works. The semester will be divided into two halves, with the midterm in the middle. The midterm examination for the substantive course will be based on the substantive material of the first half of the course. You will get your questions from the Evaluation Administration program at the second recitation of the week before "midterm week," and your answers will be due on Thursday of "midterm week." The portfolio for the first half of the semester will also be due on the Friday of "midterm week." Simultaneously, your portfolio from all exercises assigned prior to "midterm week" will be due on Friday of "midterm week." No maps from the first half of the semester will be accepted after that Friday unless prior arrangements have been made.

You will receive your final examination at the second recitation of the last week of class. This examination will differ from the midterm in that it will count toward your grade in *both* class segments. It will include questions related to the substantive materials of the course as well as a practical component, and it will attempt to merge the substantive and practical aspects of the course. Your answers are due on Friday of Exam Week. Again, you will have one week to complete the final and turn it in through the Evaluation Administration program. Likewise, the remainder of your portfolio needs to be turned in through the Evaluation Administration program by Friday of Exam Week.

All submissions, both answers to test questions and portfolio images, will be graded using the following scoring schedule:

A+	1	B+	4	C+	7	D+	10	F	15
A	2	B	5	C	8	D	11		
A-	3	B-	6	C-	9	D-	12		

To calculate grades, the scores of all submissions will be averaged and weighted as indicated above. Course grades for undergraduates will be assigned using the table below.

A	0.0-2.5	B+	3.5-4.5	C	6.5-8.5	D	8.5-12.5	F	>12.5
		B	4.5-5.5						
A-	2.5-3.5	B-	5.5-6.5						

Graduate students should note that they are not eligible for the grade of D. Averaged scores greater than 8.0 will receive the grade of 'F'.[1]

Course Schedule

Attached to this syllabus is the schedule for the current offering of each course. The schedule in each case is subject to change.

[1]For those uncomfortable with an unusual grading schema, these scores can be converted to a 0-100 scale by the following formula: $Grade_{100} = (305 - 10*Score) /3$. I prefer the scoring system used because it is simpler and does not contain some of the misleading implications of the 0-100 system.

EVS 422/423/522/523: GIS Applications to Field Sciences

Course Schedule – Subject to Change!

Week	Monday	Substantive Course Unit	Laboratory Unit
1	16 January	GIS and mapping	Basic operations I
2	23 January	Overview of applications	Basic operations II
3	30 January	Relational Databases	Relational databases
4	6 February	Sampling Issues	Joins and Relates
5	13 February	Georeferencing	Projections
6	20 February	Data modeling	Linking GPS and GIS
7	27 February	Data collection and Databases	Geodatabases
8	5 March	Visualization	Topology
Break	12 March		
9	19 March	Midterm Examination Week	
10	26 March	Data analysis I	3-D modeling
11	2 April	Data analysis II	Buffering
12	9 April	Data analysis III	Networks
13	16 April	Data analysis IV	Distance
14	23 April	Data Analysis V	Coordinate Geometry
15	30 April	Modeling in ArcGIS	Model Builder
Exam	7 May	Final Examination Week	

All submissions are due on the Wednesday of Midterm Examination and Final Examination Week. All submissions will be made through the Evaluation Administration Program. Examinations are administered through EVS 422/522. Portfolio submissions are to be made through EVS 423/523.

EVS 424/425/524/525: Introduction to Remote Sensing

Course Schedule – Subject to Change!

Schedule for Laboratory Exercises

Week	Monday	Substantive Course Unit	Laboratory Unit
1	30 August	The electromagnetic spectrum and how it relates to imagery	Basic operations in ERDAS and ENVI
2	6 September	File types and interaction with image-processing software	Making map compositions in ERDAS and ENVI (and Corel Draw)
3	13 September	The raster data model and raster images	Operations on Raster Images
4	20 September	The vector data model and vector images in the field sciences	Operations on Vector Images
5	27 September	Standard datasets and reference systems	DEMs, DLGs, and Map Reference Systems
6	4 October	Linking vector and raster data models	More on Vector images
7	11 October	Automating image-processing operations	Using the Spatial Modeler
8	18 October	Midterm Week	
9	25 October	Image registration	Satellite Image Rectification
10	1 November	Standard Classification I	Supervised Classification
11	8 November	Standard Classification II	Unsupervised Classification
12	15 November	Quantitative Classification	Quantitative Classification
13	22 November	Finding out how good you are	Error Assessment
14	29 November	Band Ratios	Band Ratios
15	6 December	Image sources	Finding Remote Sensing Imagery
Exam	13 December	Examination Week	
The final exam will be available at the time of the last class. Your examination and portfolio (and project design for graduate students) must be completed and turned in by *5:00 on Tuesday* of Examination Week.			

EVS 426/427/526/527: Advanced Topics in Remote Sensing & GIS

Course Schedule – Subject to Change!

Week	Monday	Substantive Course Unit	Laboratory Unit
1	16 January	Error – What? Me Worry?	Error in GPS & rectified imagery
2	23 January	Spectral Libraries & Band Ratios	Spectral Libraries & Band Ratios
3	30 January	What image to use; effects of seasons, haze etc	Comparison of information extraction from different seasons
4	6 February	Multi-temporal Image formation	Multi-temporal Image formation
5	13 February	Thermal Imagery	Using the Landsat Thermal Band(s)
6	20 February	Data Fusion	Data Fusion
7	27 February	Other data formats: hyperspectral, aerial photographs, radar, MODIS, ASTER, etc.	Hyperspectral imagery
8	5 March	Visualization	Environmental Modeling
Break	12 March		
9	19 March	Midterm Examination Week	
10	26 March	LiDAR I	LiDAR I
11	2 April	LiDAR II	LiDAR II
12	9 April	Object-Based Imagery Analysis I	eCognition & Object Formation
13	16 April	Object-Based Imagery Analysis II	eCognition & Object Analysis I
14	23 April	Object-Based Imagery Analysis III	eCognition & Object Analysis II
15	30 April	Object-Based Imagery Analysis IV	eCognition & Object Analysis III
Exam	7 May	Final Examination Week	

All submissions are due on the Wednesday of Midterm Examination and Final Examination Week. All submissions will be made through the Evaluation Administration Program. Examinations are administered through EVS 426/526. Portfolio submissions are to be made through EVS 427/527.