EVR 6268 Remote Sensing in Hydrology
Department of Earth and Environment

Spring 2017

Location: GL 274
Time: T 5:00 - 7:40 PM
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Course Description

The course will cover a wide range of areas of applications of remote sensing in understanding the hydrology and water fluxes at different scales. It is designed to expose students to the principles of remotes sensing data acquisitions, processing, correction, calibration, classification, interpretation and model input parameterization. Various air and space-borne sensors, their characteristics and application in the water resources studies will be covered. The processing and model parameter generation of data acquired from active and passive sensors of different radiometric, spectral and spatial resolutions for understanding the major components of the hydrologic cycle will be presented using lectures, exercises, home works and project. The use of remotely-sensed data of various sensors in different electromagnetic spectra for directly or indirectly quantification of evapotranspiration, precipitation, runoff, soil moisture, water quality, water productivity and mapping and delineation of wetlands, floodplains, drainage areas and land cover will be presented.

Objectives

The course is designed to help students to

1. acquaint themselves with remote sensing principles as applied to water resources management
2. apply remote sensing and image processing tools to correct, preprocess and calibrate images
3. acquire hydrologic input parameters from remotely-sensed data
4. understand the integration of GIS and remote sensing for efficient use of large volumes of spatial data
5. quantify the different hydrologic variables using models

Learning outcomes

At the end of the course students will be able to

- understand the basics of remote sensing, data acquisition and processing
- perform various corrections to images, classify and interpret
- generate various input parameters for hydrological modeling
- integrate remote sensing and GIS to hydrological modeling
- validate remotely sensed precipitation with measured values

Prerequisite: GLY 5754 or equivalent or permission of instructor and EVR 5215 or EVR 4211 or equivalent or permission of instructor

Required Text:

No text for this course but reading materials and additional web-based reading assignments will be assigned.

Software:

ENVI, ArcGIS 10.X

References on Remote Sensing

1. John R. Jensen, 1996. Introductory Digital Image Processing, A Remote Sensing Perspective, 2nd Ed. Prentice Hall, Englewood Cliffs, New Jersey.
2. James B. Campbell, 1987. Introduction to Remote Sensing, The Guilford Press, New York.
3. C. H. Chen, Information Processing for Remote Sensing
4. Peter M. Atkinson, Advances in Remote Sensing and GIS Analysis
5. John R. Schott, Remote Sensing: The Image Chain Approach (Oxford Series in Optical and Imaging Sciences)
6. C. H. Chen, Frontiers of Remote Sensing Information Processing
7. Steven M. de Jong, Remote Sensing Image Analysis: Including the Spatial Domain (Remote Sensing and Digital Image Processing)
8. John A. Richards, 1993. Remote Sensing Digital Image Analysis, An Introduction. 2nd Edition. Springer-Verlag, New York.
9. Asrar, ed.,1989. Theory and Application of Optical Remote Sensing, Wiley, Toronto.
10. Etachi, C., 1987. Introduction to the Physics and Techniques of Remote Sensing, Wiley, Toronto.
11. Pratt, 1991. Digital Image Processing, Wiley, Toronto.

The following links are recommended for information on various topics

NASA's Remote Sensing Data and Information

USGS's Satellite Images of Environmental Change

TerraServer Online Satellite Images and Photos

NASA's Remote Sensing Tutorial

Satellites, sensors and applications

Global Land Cover Facility-Landsat and other images (University of Maryland)

Ocean Color and water productivity (SeaWIFS, MODIS, CZCS)

USGS GLOVIS (Landsat data link)

HydroSHEDS (Hydrological data and maps based on **SH**uttle **E**levation **D**erivatives at multiple **S**cales)

Weather Radar

Tropical Weather

TRMM (Tropical Rainfall Measuring Mission)

Remote sensing Tutorial

GIS/RS Software Providers

- ESRI (ArcGIS)
- ENVI/IDL

- Intergraph (GeoMedia, MGE)
- Ecognition
- MapInfo (MapInfo)
- AutoDesk (AutoCAT)
- GE Smallworld
- PCI Geomatics
- ER Mapper
- INTEGRAPH

Major Remote sensing Journals

- Remote Sensing of Environment
- IEEE Transactions on Geoscience and Remote Sensing
- Journal of Geophysical Research
- Geoscience and Remote Sensing Transactions
- Sensors
- Remote Sensing
- Canadian Journal of Remote Sensing
- International Journal of Remote Sensing
- Photogrammetric Engineering and Remote Sensing
- Cartographica
- Cartography and Geographic Information Systems
- Geographic Information Sciences
- International Journal of Geographical Information Systems

GRADING:

Exercises	15%
Home works	25%
Paper review and presentation	10%
Final Project (PPP*)	50%

A	90-100
B+	88-89
B	80-87
C+	78-79
C	70-77
D	60-69
F	<60

***PPP: proposal (10%), presentation (15%) and paper (25%)**

- Students are required to attend classes regularly
- Late home works will be subjected to point deductions

- Students will review peer-reviewed articles and present in class. The paper should demonstrate a clear use of remote sensing tools and data to solve hydrologic problems. A 5 minute PowerPoint or poster presentation is required.
- Each student will work on final project where remotely-sensed data and image analysis tools will be used to answer hydrologic questions. As part of the final project, a 1-2 page proposal idea, two power point presentations (proposal and final result) and a final report (5-8 pages) will be required.

Academic Misconduct

Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas, and community service. All students should respect the right of others to have an equitable opportunity to learn and honestly demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.

COURSE OUTLINE

Date	Week	Lec. #	Topic	Assignments/Reading
01/10	Wk 1	1	Course Overview **Review of Hydrology, Hydrological cycles and processes**	• Work on spectral signature exercise (Ex 1a)
		2	**Review of Remote sensing concepts and principles I**: Energy source, EM radiation	• Work on Ex 1b
01/17	Wk 2	3	**Review of Remote sensing concepts and principles II**: Radiation and atmospheric interaction	
		4	**Review of Remote sensing concepts and principles III**: Radiometry, resolutions	
01/24	Wk 3	5	**Exercise 1: Satellites and sensors overview**	• **Ex 1**
		6	**Sensors**: Active and passive **Platforms**: Air-borne and space-borne **Satellites** : Earth Resources mapping and weather satellites	
01/31	Wk 4	7	**Homework 1** **Exercise 2: Landsat, MoDIS, RFE and TRMM data download and preprocessing**	**HW1 and Ex 2**
		8	**Image classification and accuracy assessment** Classification algorithms : Minimum distance classifier, Maximum likelihood classifier Accuracy Assessment : Confusion matrix and Kappa analysis	**Homework 1 due**
02/07	Wk 5	9	**Terrain mapping:** DEM, NASA Shuttle Radar Topography Mission (SRTM) and HydroSHEDS, Global 30-m DEM	

		10	**Exercise 3: Image processing and land cover classification**	**Ex 3**
02/14	Wk 6	11	**MODIS/Landsat global vegetation cover, vegetation indices**	
		12	**Landsat, MODIS-based fractional vegetation cover (FVC) and fractional imperviousness concept**	
02/21	Wk 7	13	**Exercise 4: FVC and FIS computation**	**Ex 4**
		14	**Runoff**: RS in Runoff Estimation Space-based Flood Monitoring and Inundation Mapping **Homework 2**	**HW 2**
02/28	Wk 8	15	**Paper review presentation I**	
		16	**Project proposal concept presentation**	
03/07	Wk 09	17	**Precipitation**: Sensors, platforms and rainfall products, validation and comparison	**Homework 2 Due**
		18	**Groundwater/surface water level**: Altimeter, Groundwater-GRACE (Theory, Data and Applications)	
	Wk10		**SPRING BREAK (March 13-18, 2017)**	
03/21	Wk 11	19	**Paper review presentation II**	
		20	**Soil Moisture**: AMSR-E, TMI, RadarSAT, Microwave (Principle, products, application and limitation)	
03/28	Wk 12	21	**Evapotranspiration**: Landsat, MODIS, ASTER sensors, surface energy balance, application and limitation **Homework 3**	**HW3**
		22	**Exercise 5: ET from remote sensing perspective**	**Ex 5**
04/04	Wk13	23	**Ocean/coastal water productivity**: Ocean color (SeaWIFS, MODIS, CZCS), theory, application	**Homework 3 Due**
		24	**Water quality mapping and modeling using remote sensing**	
04/11	Wk 14	25	**Final project presentation**	
		26	**Final project presentation**	
04/18	Wk 15	27	**Work on final paper**	
04/25	Wk 16	28	**Final paper submission**	**Paper Due on April 24, 2017**