

Bob Ford Home	SPOLE 665 Info-Tech. Decision Science	BIOL 549 Biodiver. Conservat.	SPOLE 624 Nature/Society Thought/Policy	SPOLE 554 Env. Equity, Economics & Dev. Policy	ESSC 401-2 Earth System Science	ESSC 575 Field Practicum	ESSC 541-2 Modeling & Remote Sensing
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## Syllabus

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### SPECIAL TOPICS

- **Agriculture (see also Food Insecurity and Biosphere / LULCC):**
- **Data Portals - How to Get Earth Observation Data (see also GIS/RS Sources):**
- **GPS Resources (see also Geography - GPS/Field Methods):**
- **Health resources: (see also World Regions / Public Health / Medicine)**
- **Landcover/Landuse Change - Selected Case Studies (see also Biosphere / LULCC):**
- **Ocean/Marine/Coastal Resources (see also HYDROSPHERE):**

## Description

### Catalog Description - ESSC 541-542:

Provide students fundamental knowledge and skills of modern remote sensing for environmental data acquisition and analysis as well as applications in related social, earth, health, social, and biosciences. Topics include GIS-based image interpretation and spatial data generation, satellite remote sensing applications, and case studies in sustainable development, social policy, health, and biosciences. Spatial analysis software tools used will include Clark labs **IDRISI Kilimanjaro** and **Leica-Geosystems ERDAS Imagine** as well as **ArcPAD**, **ArcGIS**, **GPS/Garmin-Recon**.

In addition, the course introduces students to the concepts and methods of **systems science** as a methodology within the social, health, earth, and biosciences. Specifically focus on use of dynamic **modeling tools** such as **STELLA** or **iThink** (from **Isee Systems**) as well as spatial and non-spatial tools and datasets such as **Spatial Analyst-ArcGIS**, **GeoNetweaver**, **EMDS**, **Criterion PLUS**, and other tools as needed. Learn to apply systems thinking and analysis

frameworks to specific interdisciplinary policy issues within sustainable development, forensic science, earth systems science, social and health policy, and other applied sciences.

### **Catalog Description - ESSC 575:**

Students and teachers work together in the field to apply geospatial tools, Earth System Science methods and concepts, social policy analytical frameworks, and other conservation science methods to integrated place-based **sustainability** problems within a given ecosystem, community or region. The focus is on applying in practice the concepts and tools of **sustainability science** (see: <http://sustsci.harvard.edu/index.html> ). Practice using in the field modern **field analytical tools** such as GPS, ArcPAD (mobile GIS), varied ecological monitoring and assessment instruments (focused on ecosystems analysis, e.g. water, land, air, ecosystems), **PRA** (Participatory Rural Appraisal) as well as traditional ethnographic and socioeconomic **qualitative research** methods. Places studied will include both domestic and international, e.g. limnogeology in the Rocky Mountain province, biology of rattlesnakes in the US Southwest, as well as coastal zone management (CZM) and biodiversity conservation on the Mosquito Coast of Honduras and Fiji , East Africa, Jamaica, and the Bahamas, as well as environmental health geographic problems such as air pollution or cancer risk in Southern California.

## **Prerequisites:**

This is a senior undergraduate and graduate-level project-oriented course designed for pre-certification Education majors, Environmental Studies, Biology, Geology, Public Health, Computer Science, Nursing, Medicine, and Physical Sciences majors. Students must have completed the core sequence of **ESSC (Earth System Science)** courses or their equivalent **AND** a basic **sequence of courses in GIS** (equivalent to the core courses of the **Health Geoinformatics Certificate**):

### **Earth Systems/Sustainability Core or equivalent:**

- **ESSC 401/402 - Earth Systems and Global Change** or an equivalent **Physical Geography, Physical Geology OR one of the following:**
- **SPOL 554 - Environment, Resources, and Development Policy**
- **SPOL 624 - Nature/Society Thought and Social Policy**

**AND/OR equivalent:**

**SPOL 665 - Information Technology and Decision Science**

### **GIS Prerequisites:**

Students who enter **ESSC 541-542** must demonstrate they have taken the equivalent of the following courses in the **Health Geoinformatics Certificate** or have equivalent experience. **Waivers and permission by the instructor** should be signed by both **Dr. Robert Ford (SST)** and/or **Seth Wiafe or Samuel Soret of the Health Geoinformatics Lab**.

**Equivalent courses at LLU:**

**ENVH 521 Principles of GIS and Science (3)**

**ENVH 522 Cartography and Map Design (2)**

**ENVH 524 GIS Software Applications and Methods (3)** - students may also show equivalence by taking the online **ESRI Virtual Campus** course = **Learning ArcGIS 9**

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## ESS (Earth System Science) Core Courses:

The courses (**ESSC 541-542, 575**) are part of a sequence of active learning interdisciplinary senior undergraduate and graduate-level courses (**ESSC 401-402, SPOL 665, SPOL 524, BIOL 549, SPOL 624, and ESSC 541-542**) that provide the opportunity for students to experience "**how earth system and sustainability science is done**" by active participation in analysis of *real-world* global change/sustainability science and social policy problems inherent in **real places**, ecosystems, regions, sociocultural or public policy institutional/community settings (urban or rural). The course expands experiences first encountered in foundation courses which are all part of the **LLU ESSE21 Project** (Earth Systems Science Education for the 21st Century).

The **methods, tools, and concepts** emphasize use of computer visualization, modeling, and other **Geospatial Decision-Support-System (GDSS)** tools besides traditional field methods from the social, behavioral, health, and biophysical sciences applicable to a diversity of **integrated systems science and thinking situations** encountered in both formal as well as applied science such as planning, marketing, and public policy. The focus will be on use of **Geographic Information Science (GIS), Global Positioning Systems (GPS), Remote Sensing (RS)**, and other **modeling tools** ( STELLA , NetWeaver ) as well as qualitative methods such as **PRA (Participatory Rural Appraisal)** or collaborative decision-making.

**Themes and issues** chosen for analysis are by design **inter-disciplinary and place-based**-- that is they focus on real places, regions, ecosystems, social policy problems and issues that lend themselves to **ESS (Earth Systems Science)** critical thinking, analysis, and problem-solving.

**A key goal** is to promote **team-research skills** by providing a mechanism for linking students and faculty with local experts and the community at large in policy analysis and implementation, i.e. these will be real problems not just make-do classroom exercises and experiences.

**Academic resources** for the courses bring to bear expertise, networks, software/hardware, datasets, and field research linkages within the Loma Linda University (LLU) , School of Science and Technology and other partners (e.g. School of Public Health, Geoinformatics Unit ) and well as with outside partners in the Inland Empire and globally including:

- **CEEMaST**, Center for Education and Equity in Mathematics, Science, and Technology, California State University, Pomona. Contact: Dr. Jodye I. Selco Email: <mailto:jiselco@csupomona.edu>
- **CGISR**, Center for Geographic Information Science Research: Contact : Miriam Cope, Director  
Email: <mailto:macope@csupomona.edu>
- **Redlands Institute**: CES / MS\_GIS in cooperation with ESRI's - Sustainable Development solutions group.
- **Leica/Geo** - ERDAS Imagine
- **Clark Labs** - IDRISI Kilimanjaro
- **Isee, Inc.**(STELLA)
- **ICRSE** - International Center for Remote Sensing Education
- **CGIAR**-Consortium for Spatial Information
- **SCIENCE@ NASA** home

**Problems and places studied** include both domestic and international, e.g. limnogeology in the Rocky Mountain province, biology of rattlesnakes in the US Southwest, as well as coastal zone management (CZM) and biodiversity conservation on the Mosquito Coast of Honduras and Fiji, East Africa, Jamaica, and the Bahamas, as well as environmental health geographic problems such as air pollution or cancer risk in Southern California.

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## **Introduction**

This is a graduate-level course designed to introduce the student in an integrative manner to the exciting field of **Remote Sensing and Systems Modeling** within the broad arena of **Sustainable Development Policy and Science**--see **Course Objectives**. The course will build on knowledge acquired about **sustainability science** as a concept and methodology in **SPOL 554 Environment, Equity, Economics and Development Policy**. In addition, it will explore how modeling and remote sensing can help operationalize research and application in the field.

We will see how the concept of **sustainability** has influenced real-world practice in various development sectors: health, knowledge management, agriculture, natural resource management, poverty reduction, and so on. And, through hands-on activities and laboratories (much of it in a small-team setting). Students and faculty will work together on real problems that lend themselves to analysis with remote sensing tools and data, e.g. biodiversity and conservation, health risk assessment, land management, community-based natural resource management, disaster management.

Following is a brief introduction to some of the key sectoral, technical, and conceptual issues and themes within the overall field (more will be presented in the course).

## **History of Remote Sensing and GIS**

- **Concept of Remote Sensing:**
  - **Overview and Foreward -**
  - **Concept of Remote Sensing - Overview and Foreward - The Remote Sensing Tutorial (RST) - GSFC/FAS**
- **Earth Science Enterprise System Components - NASA ("coins chart")**
- **Eyes in the Sky (NASA)**
- **History of Aerial Photographic Interpretation - Vol 1 - RS-Core Curriculum**
- **History of Remote Sensing (NASA)**
- **History of Remote Sensing: In the Beginning; Launch Vehicles - NASA/RST - Remote Sensing Tutorial**
- **Landsat Program Chronology - LANDSAT homepage**
- **Operational Remote Sensing Satellites - US Centennial Flight Commission**
- **Remote Sensing in History - NASA Observatorium**
- **Remote Sensing: Introduction and History - Earth Observatory/NASA**
- **The Pecora Legacy - Land Observation Satellites in the Next Century**
- **VIDEO - Blue Planet, Smithsonian/IMAX**

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### Key Textbooks:

- **Anderson, Virginia and Lauren Johnson. 1997.** *Systems Thinking Basics: From Concepts to Causal Loops*. Pegasus Communications; Bk&CD-Rom edition.
- **Breman, Joe. Ed. 2002.** *Marine Geography: GIS for the Oceans and Seas*. ESRI Press.
- **Campbell, James B. 2002.** *Introduction to Remote Sensing*. (3rd Edition). The Guilford Press.
- **Craig, William J. and Trevor M. Harris, Daniel Weiner. 2002.** *Community Participation and Geographical Information Systems*. CRC Press.
- **Cuomo, Andrew. 2000.** *Mapping Your Community: Using Geographic Information to Strengthen Community Initiatives*. Diane Pub Co; Reprint edition.
- **Few, Arthur. 1996.** *System Behavior and System Modeling (Using Stella)*. University Science Books.
- **Ford, Andrew. 1999.** *Modeling the Environment* Island Press. See: **Chapter 1**. Overview - Exercises - Models and Cases (Amazon listing).
- **Foresman, Timothy W. et al.1998.** *History of Geographic Information Systems: Perspectives from the Pioneers.* , Editor. Prentice Hall, 1998.
- **Goodchild, Michael F. and Donald G. Janelle. 2004.** *Spatially Integrated Social Science (Spatial Information Systems)*. Oxford University Press.
- **Isee Systems. 2004.** *Introduction to Systems Thinking with STELLA Guide (Win)*.
- **Jankowski, Piotr, and Timothy L. Nyerges. 2001.** *GIS for Group Decision Making*. CRC Press.
- **Jensen, John R., 2000.** *Remote Sensing of the Environment: An Earth Resource Perspective*, Prentice Hall: Upper Saddle River, NJ, 544 pages. (Amazon.com listing).
- **Jensen, John R., 2004.** *Introductory Digital Image Processing*, 3rd Ed., Upper Saddle River, NJ: Prentice Hall, 526 pages.
- **Knapp, Connie L. 2003.** *Making Community Connections: The Orton Family Foundation Community Mapping Program*. ESRI Press.
- **McCoy, Roger M. 2005.** *Field Methods in Remote Sensing*. The Guilford Press.
- **National Academy of Sciences. 1998.** *People and Pixels: Linking Remote Sensing and Social Science*. Washington DC.
- **National Academy of Sciences, 2002.** *Down to Earth: Geographic Information for Sustainable Development in Africa*, Committee on the Geographic Foundation for Agenda 21, Committee on Geography, Mapping Science Committee, National Research Council.
- **Richmond, Barry. 1999.** *Systems thinking: critical thinking skills for the 1990s and beyond*. (downloadable PDF file).
- **Spencer, John, Brian G. Frizzelle, Phillip H. Page, John B. Vogler 2003.** *Global Positioning System: A Field Guide for the Social Sciences*. Blackwell Publishers.
- **Tang, Winnie and Jan Selwood. 2003.** *Connecting Our World: GIS Web Services*. ESRI Press.
- **Turyatunga, Frank R. 2004 .** *DISCUSSION PAPER: Tools for Local-Level Rural Development Planning: Combining use of Participatory Rural Appraisal and Geographic Information Systems in Uganda. WRI (World Resources Institute)*.

### KEY ONLINE RESOURCES - General Resources (see also GIS/RS):

#### OVERVIEW Modules:

- **Concept of Remote Sensing - GSFC/NASA - Remote Sensing Tutorial**
- **Remote Sensing Process (Jensen, Jackson, Faust, etc - Module #1 - RSCC**
- **Intro to Digital Image Processing - Jensen and Schill (Module #2 - RSCC**
- **Key Terms: Remote Sensing and Cosmology**
- **Key Terms: Map Use and Interpretation**
- **NASA - How to get Earth Observation data. and Earth Science Enterprise System**

**Components ("coins chart").**

- **PRINCIPLES OF REMOTE SENSING** - CRISP/Singapore
- **Utah State University-LEMA / BLM: Using GIS for Better Decision Making**
- **Introduction to Geographic Information Systems (GIS)** - from **UMN Design Center** =

**View on Screen | Download Slides (1.75 MB) | Download Narrative (183 KB)**

- **GPS Basics** - Paul Burgess - Redlands Institute - (Powerpoint)
  - See also **Topic #5: Map Use and Interpretation - ESSC500**
  - **GPS - Global Positioning System Overview** - Peter Dana
  - **Maps-gps-info.com** site - excellent resources!

**SPECIAL TOPICS:**

- **Agriculture** (see also **Food Insecurity and Biosphere / LULCC**):
- **Data Portals - How to Get Earth Observation Data** (see also **GIS/RS Sources**):
- **GPS Resources** (see also **Geography - GPS/Field Methods**):
- **Health resources:** (see also **World Regions / Public Health / Medicine**)
- **Landcover/Landuse Change - Selected Case Studies** (see also **Biosphere / LULCC**):
- **Ocean/Marine/Coastal Resources** (see also **HYDROSPHERE**):

The resources listed under **TOOLS** and **LINKS BY THEME** - publications, research groups, online courses, for you to consult and use during the course.

**Agriculture (see also Food Insecurity and Biosphere / LULCC):**

- **CGIAR-Consortium for Spatial Information**
- **CSI-KM - CGIAR Program on Knowledge Management**
- **Ecoagriculture Partners**
- **EVALUATION OF AN INEXPENSIVE IMAGING SYSTEM FOR AGRICULTURAL REMOTE SENSING** - ARS (Agriculture research service)
- **FAOs Geonetwork**
- **Hyperspectral Remote Sensing Systems and Analysis** (in agriculture) - ARS (Agriculture research service)
- **ICRAF (World Agroforestry Center) - a member of CSI-CGIAR**
- **Introduction to Remote Sensing for Agriculture - ARS/USDA - US Water Conservation Lab - Remote Sensing Research Program**
- **Remote Sensing and Soils - University of Calgary/Canada**
- **Remote Sensing in Precision Agriculture: An Educational Primer** - Ames NASA Research Center
- **Remotely Sensing and Precision Irrigation Management - USWCL**

See also online resources produced by the **VGD (Virtual Geography Department)** and its various resource groups including cultural geography, world regional and area studies and others such as the **EES (Earth's Environment and Society)**

**Data Portals - How to Get Earth Observation Data:****Key Documents:**

**Key Imagery Data and Web Services Partner -- GeoBrain/NEHEA Project (NASA EOS Higher-Education Alliance) (LAITS) George Mason University:**



## Other Resources

- **American Museum of Natural History - Center for Biodiversity and Conservation -**
  - **Remote Sensing Resources - Locating and Downloading Data** - Before we can get very far we need to find images that cover our area of interest. These guides provide information on how to locate, order, and download imagery (in some cases for free).
- **CCRS - Canada Center for Remote Sensing**
  - **Learning Resources -**
  - **Outreach materials (Canada)**
  - **Glossary**
- **CIESIN's Thematic Guide to Social Science Applications of Remote Sensing**
- **Earth Science Enterprise System Components - NASA "Coins Chart";**
- **EarthNet Online - ESA (European Space Agency) -See = How to get Earth Observation data.**
- **GCLF (Global Land Cover Facility) - Data Guide and FAQ:**
  - Earth Science Data Interface (ESDI)
  - ESDI Help files
- **Remote Sensing: An Overview - South Carolina's Coast: A Remote Sensing Perspective** is a two-volume CD-ROM set that demonstrates the utility of information acquired by satellite and airborne remote sensing systems for coastal South Carolina.
- **Remote Sensing and GIS Glossaries** - University of Nebraska
- **Remote Sensing Core Curriculum** - home
- **Spatial Information Clearinghouse - De-mining Center James Madison University:**

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## OTHER SOURCES AND PORTALS:

- **AAG-GeoTASK project Resources**
- **Airborne Lidar , Use of LIDAR in Creating Accurate Terrain Elevation Models for Floodplain Mapping**
- **ARS/USDA - US Water Conservation Lab - Remote Sensing Research Program**
- **Berkeley Digital Library SunSITE**
- **California Spatial Information Library**

- **CCRS - Canada Center for Remote Sensing**
  - **Glossary of RS Terms**
  - **Radar data/sources**
  - **RADARSAT-2 - CCRS**
  - **Tour Canada from Space**
- **CGIAR-Consortium for Spatial Information (CSI)**
- **CIESIN's SEDAC and PERN (Population-Environment Research Network)**
- **Coastal Services Center - NOAA - home**
- **CORE Software Technology - e.g. TerraSoar™ Suite**
- **CORONA Summary - Space Policy Project**
- **Declassified Satellite Imagery (CORONA) - USGS - see also EastView**
- **Digital Globe (formerly EarthWatch) - QUICKBIRD, SPOT, LANDSAT, DGQs, Ortho Imagery,**
- **Directions Magazine GIS File Library**
- **Dynamap/1000 Shapefile Download Center - Dynamap/1000** is a vector based, digital, geographic database in which streets and features are represented as line segments. Each side of a street or feature has associated data such as Census codes and Federal Information Processing Standards (FIPS) codes. The internal street network database contains nearly every street in the nation. The data is available for all 50 states and Puerto Rico
- **EarthNet Online - ESA (European Space Agency) -See = How to get Earth Observation data**
- **Earth Observing System - NASA - data services**
- **Earth Portal and ICRSE (see also ManyOne.net - Earth Portal)**
- **Earth Trends - World Resources Institute (Environmental Information Portal)**
- **ENVISAT DATA - ESA (European Space Agency)**
- **ESA (European Space Agency) - How to get Earth Observation data - ENVISAT DATA**
- **ESDIS Project - NASA/GSFC - Earth Observing System Data Gateway**
- **ESRI Inc. - Global Map/GSDI grant**
- **ExploreSat - Providing low-cost satellite image products on DVD. Offering Landsat-7 Pan-Sharpended Mosaics covering various geographic regions worldwide.**
- **FAO - Geonetwork - home**
- **Federation of Earth Science Information Partners (ESIP)**
- **GeoCommunity's GIS Data Depot**
- **GeoDATA-2.gov - Geospatial One-Stop**
- **Geographic Technology - from About.com's Geography page**
- **GES - DISC - GSFC - Goddard Space Flight Center /DAAC - home**
- **GLCF - University of Maryland Global Land Cover Facility (GLCF)**
- **GlobeXplorer - World's Largest Online Library of Aerial / Satellite Imagery and Maps**
- **GNIS - Geographic Names Information System - USGS**
- **GOF/GOLD Fire Monitoring and Mapping Implementation Team - home**
- **GOS - Geospatial-One-Stop - data portal**
- **GSDI Association - Global Spatial Data Infrastructure Gateway (use Mozilla or Firefox)**
- **ImageSat-International - EROS Hi-Res Imaging Satellites**
- **Imagery Sources - Spatial Information Clearinghouse, Mine Action Information Center - James Madison University**
- **IMaRS - Institute for Marine Remote Sensing - University of South Florida**
- **ISCGM - International Steering Committee for Global Mapping**
- **ISRO - Indian Space Research Organization - IRS-1 is India's dedicated Earth resources satellite system operated by ISRO and the National Remote Sensing Agency (NRSA).**
- **IWMI - RS/GIS Unit - Great RS/GIS sites**
- **JAXA - Japan Aerospace Exploration Agency - Earth Observation Satellites - Main data distributors of remote sensing data - Japan Association of Remote Sensing - Remote Sensing Tutorials**
- **JSC (Johnson Space Center) - NASA - Digital Image Collection - home**
- **JSC - Johnson Space Center, Houston, TX - Earth From Space Images - selected via clickable map and by topics and geographical region**
- **KSC (Kennedy Space Center) - NASA - historical archive of manned missions**
- **Land Processes Distributed Active Archive Center (LP DAAC) - NASA/USGS**
- **LANDSAT-7 - NASA**
- **ManyOne.net - Earth Portal**
- **MDA Federal Inc. (formerly Earthsat)**

- **MODIS Land Discipline Web Site**
- **MODIS Rapid Response System - NASA/GSFC - MODIS Data Products**
- **NASA - Earth Observatory - home**
  - **NASA - EOS - Earth Observing System - data service**
  - **NASA's Land Cover Land Use Change Program (LCLUC)**
  - **NASA's Observatorium is a public access site for Earth and space data**
  - **SCIENCE@ NASA home**
- **NGDC/NOAA - WDCA MGG - Exploring the Ocean Basins with Satellite Altimeter Data**
- **NGIA - National Geospatial Intelligence Agency - Products and Services**
- **NOAA - NESDIS - satellite and environmental information homepage**
  - **NOAA Photo Library - home**
  - **NOAA - Satellite Active Archive - Comprehensive Large Array-data Stewardship System (CLASS) archives and distributes NOAA's environmental data and derived data products**
- **NSDI (National Spatial Data Infrastructure) - FGDC (Federal Geographic Data Committee) home**
- **Oak Ridge National Lab - DAAC - source for biogeochemical and ecological data**
- **Orbimage - Global Imaging - OrbView-3 Imagery**
- **Remote Sensing of Coral Reefs Project NASA/JSC**
- **SAR (Spaceborne Synthetic Aperture Radar ) - Imaging radar - JPL**
- **Satellite Imaging Corporation - QUICKBIRD, DEMs, 3D Terrain Visualization, ASTER, SPOT, EROS, IKONOS, etc.**
- **Satellite Images of Tsunami Affected Areas - CRISP/Singapore - Principles of Remote Sensing**
- **SIC (Spatial Information Center) - Online Presentation - SIC/JMU (James Madison University)**
- **SIR-C/X-SAR Data and Images - JPL - Imaging Radar Home - - Clickable Map of the World -**
- **Software for Ocean-Colour Data - IOCCG - International Ocean-Colour Coordinating Group**
- **Space Imaging - IKONOS, RADAR, DEMs, etc.**
- **Spaceborne Remote Sensing Platforms and Sensors - CRISP/Singapore**
- **SPOT Image - France**
- **SRTM - Shuttle Radar Topographic Mission**
- **TeleAtlas, Inc.**
- **TERRA satellite data- (ASTER, MODIS, MISR, CERES, MOPITT) - Images and data - the EOS Flagship homepage**
- **TERRAserver.com - home**
- **UNEP/GRID data sets - UNEP-NET - global portal to authoritative environmental information based on themes and regions**
- **University of Arkansas Libraries' Guide to U.S. Geospatial and Attribute Data**
- **U.S. National Imagery and Mapping Agency (NIMA)**
- **USFS - Remote Sensing Applications Center (RSAC) - Fire response center - home**
- **USGS - National Center for Earth Resources Observation & Science (EROS)**
- **USGS - National Mapping Center - USGS Node of the National Geospatial Data Clearinghouse (NSDI)**
- **World-Wide-Web Virtual Library: Remote Sensing**

### **General Resources (see also GIS/RS)**

- **AAG-GeoTASK project Resources**
- **American Museum of Natural History - Center for Biodiversity and Conservation - Remote Sensing Resources**
- **Applications in Remote Sensing - Vol. 4 - RS- Core Curriculum**
- **Archeologists use remote sensing to decode the past - International Society for Optical Engineering**
- **CCRS - Canada Center for Remote Sensing**
  - **Learning Resources -**
  - **Outreach materials (Canada)**
  - **Glossary**
- **CIESIN's Thematic Guide to Social Science Applications of Remote Sensing**
- **Colleagues Using Remote Sensing in Education - CEO/UK**
- **Concept of Remote Sensing - NASA/RST - Remote Sensing Tutorial**
- **DICTIONARY OF ABBREVIATIONS (GIS, Remote Sensing, etc.)**
- **Earth Science Enterprise System Components - NASA ("coins chart")**

- **Educator's Resources - NASA Observatorium**
- **Empowerment, Marginalization And Public Participation GIS - Project Varenius of the NCGIA**
- **Eyes in the Sky (NASA)**
- **FGDC - Federal Geographic Data Committee**
- **Free Remote Sensing Software - ARS**
- **GEOGRAPHY-Mapping Resources - GIS/Remote Sensing - GEO-IT site (USAID)**
- **GSDI - Cookbook Index - SDI Newsletters - GSDI Association**
- **ICRSSED - International Center for Remote Sensing Education**
- **IAPAD - Integrated Approaches to Participatory Development**
- **Japan Aerospace Exploration Agency - home**
- **Key Terms - Remote Sensing**
- **Key Terms - Map Use**
- **Mine Action Center - TOPICS - James Madison University**
- **NASA - Approach to Earth System Science + Read the Document (2.3 MB, PDF)**
  - **NASA - Earth Observatory - home**
  - **NASA - January 6, 2005 draft of the Earth Science Research Plan**
  - **NASA/RST - Remote Sensing Tutorial**
  - **NASA - Scientific Visualization Studio - GSFC**
  - **Satellite Overpass Predictor - NASA**
  - **SCIENCE@ NASA home**
- **Public Participation GIS (PPGIS) WebRing - Rutgers/CRSSA**
- **PPGIS - Public Participation GIS Conference (PPGIS) by URISA**
- **PPgis.net** - electronic forum on **participatory use of geo-spatial information systems** and technologies.
- **PRINCIPLES OF REMOTE SENSING** Dr. S. C. Liew, *Centre for Remote Imaging, Sensing and Processing, National University of Singapore*
- **Remote Sensing - About GIS/RS** (Spatial Information Clearinghouse, Mine Action Information Center - James Madison University ).
- **Remote Sensing: An Overview - South Carolina's Coast: A Remote Sensing Perspective** is a two-volume CD-ROM set that demonstrates the utility of information acquired by satellite and airborne remote sensing systems for coastal South Carolina.
- **Remote Sensing and GIS Glossaries** - University of Nebraska
- **Remote Sensing GLOSSARY - LDEO/Columbia University**
- **Remote Sensing Core Curriculum** - home
- **Remote Sensing Process (Vol 3 - RS-Core Curriculum) - John R. Jensen and Mark W. Jackson**, Department of Geography, University of South Carolina
- **Research and Reference Tools: GIS/RS, Knowledge Management, Decision Support, Information Science**
- **SDI Africa: An Implementation Guide (GSDI) (UNECA - Geoinformation Team)**
- **SIC (Spatial Information Center) - Online Presentation - SIC/JMU**
- **University of Minnesota (UMN) Design Center -**
  - **Picturing the Landscape: A Guide to Aerial Photography (PDF) (2.3 MB)**  
This design brief presents the lessons of years of aerial photography by Design Center staff. It covers arranging helicopter service, preparing for a flight, basic equipment needs, types of images, and tips for organizing an image collection.
  - **University of Minnesota (UMN) Design Center - Environment and Physical Activity GIS Protocols Manual** - see also: **Taking Notice: Green Spaces in Urbanized Settings (PDF)**
  - **Introduction to Geographic Information Systems (GIS)** - from **UMN Design Center** - Introduction to Geographic Information Systems (GIS) gives you a quick overview of digital mapping — what it is and how it can be used. The presentation includes links to on-line resources and examples of some common applications from within the planning field
- **Utah State University-LEMA / BLM: Using GIS for Better Decision Making**
- **Web Publishing & Image Editing (Ford)**
- **Why Satellite Images have different colors Virtual Hawaii**

### GPS Background Materials:

- **GPS Basics** - Paul Burgess - Redlands Institute - (Powerpoint)

- See also **Topic #5: Map Use and Interpretation - ESSC500)**
- **GPS - Global Positioning System Overview - Peter Dana**
- **GPS Explained**
  - <http://www.gpspassion.com/Hardware/explained.htm>
  - <http://www.avweb.com/news/avionics/183232-1.html>
  - [http://www.colorado.edu/geography/gcraft/notes/gps/gps\\_f.html](http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html)
- **GPS World Trade Magazine**
  - <http://www.gpsworld.com/gpsworld/>
- **Trimble GPS Tutorial**
  - <http://www.trimble.com/gps/>
- **Coordinate Systems**
  - <http://www.colorado.edu/geography/gcraft/notes/coordsys/coordsys.html>
- **Datums**
  - [http://www.colorado.edu/geography/gcraft/notes/datum/datum\\_f.html](http://www.colorado.edu/geography/gcraft/notes/datum/datum_f.html)
- **Convert Lat Long to UTM and vice versa**
  - <http://www.uwgb.edu/dutchs/UsefulData/UTMFormulas.HTM>
- **Maps-gps-info.com site - excellent resources!**
- **OPUS – Online Positioning Service - The National Geodetic Survey operates the On-line Positioning User Service (OPUS) as a means to provide GPS users easier access to the National Spatial Reference System (NSRS).**
  - <http://www.ngs.noaa.gov/OPUS/>

### **Health resources (see also World Regions / Public Health / Medicine):**

- **Canadian West Nile Virus - home**
- **Center for Health Applications of Aerospace Related Technologies - (ECOSAT) Branch of the Earth Science Division at the NASA Ames Research Center - Data Sources**
- **CGIAR-SIMA (Systemwide Initiative on Malaria and Agriculture)**
- **CDC - West Nile Virus**
- **CIESIN's Thematic Guide to Social Science Applications of Remote Sensing - Section 5.2 Human Health and Epidemiology**
- **GNOSIS GIS Network (Schistosomiasis)**
- **GIS and Public Health (CDC-NCHS)**
- **ISTM - International Society of Travel Medicine**
- **Lee De Cola's Prototype Health Atlas**
- **Mapping West Nile Virus - Pennsylvania**
- **Mosquito Distribution Maps - NASA Space Flight Center**
- **NBII Wildlife Disease - West Nile Virus**
- **Pennsylvania West Nile Virus Surveillance System - homepage**
- **Remote Sensing/GIS and Human Health: A Partial Bibliography**
- **University of Nebraska Resources for Health and GIS/RS**
- **West Nile Virus info site - National Agricultural Library**
- **West Nile Virus (WNV) - USGS**
- **West Nile Virus Maps - USGS**

### **Landcover/Landuse Change (see also Biosphere / LULCC):**

- **About Land Cover and Change Analysis Data - NOAA/Coastal South Carolina Project**
- **Africover - LCCS Tool - Global Land Cover Network**
- **Applications in Remote Sensing - Vol. 4 - RS- Core Curriculum**
- **CORONA Satellite Photography for Studies of Yanomamo Settlement Patterns - Nathan Craig,**
- **DEMIS Web Map Server - software**
- **Digital Analysis of Northern Italy (Population) - Professor Ray Lougeay, Department of Geography, State University of New York - Geneseo, Geneseo, NY 14454**
- **ENVIRONMENTAL WARFARE: 1991 Persian Gulf War - Professor Paul R. Baumann, Department of Geography, State University of New York, College at Oneonta**
- **Flood Analysis - 1993 Mississippi Flood - Paul R. Baumann**

- **Forest Fire Imaging Experimental System (FIRES)** - Digital Imaging and Remote Sensing Laboratory
- **LAND USE, LAND COVER, and LOCAL CLIMATE** - Professor Ray Lougeay, Department of Geography, State University of New York - Geneseo, Geneseo, NY 14454
- **LEAF OPTICAL PROPERTIES BIBLIOGRAPHY** - UCLA
- **NASA/Ames Research Center, Learning Resources Project - World Mind** geobrowser software
- **RANGELAND MANAGEMENT** - Professor Paul T. Tueller, Department of Environmental and Resource Sciences, University of Nevada, Reno
- **Range View** - website provides applications for viewing, animating, and analyzing satellite imagery in order to monitor vegetation dynamics through time and across landscapes.
- **Remote Sensing Applied to Vegetation Classification** - University of Calgary
- **Remote Sensing of Vegetation and Soil** - Chris Banman (Dec. 2001)
- **Remote Sensing of Vegetation** - University of Arizona
- **Terrestrial Biophysics and Remote Sensing (TBRS)** Lab is part of the Soil, Water, and Environmental Science Department at the University of Arizona.
- **Urban Heat Islands** - Kevin P. Gallo and Mr. Tim Owen
- **Wetlands Restoration** - Paul Mause

### **Ocean/Marine/Coastal and Water Resources (see also HYDROSPHERE):**

- **2004 Indian Ocean earthquake** - From Wikipedia, the free encyclopedia
- **Airborne Oceanographic Lidar Laboratory - Ocean Science Home** - A collection of NASA Airborne Oceanographic Lidar (AOLFL) fluorosensing data products from missions over the last few years.
- **ARS/USDA - US Water Conservation Lab - Remote Sensing Research Program**
- **Asian Tsunami - before/after satellite images - Denmark (google/Tsunami Relief site) - Receding waters, Kalutara Beach, Sri Lanka** - Digital Globe
- **Asian Tsunami** - NOAA Animations
- **Asian Tsunami-2004 CGIAR-CSI resources** - IWMI page
- **CCOM - Center for Coastal and Ocean Mapping** - University of New Hampshire
- **CICEET - Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET)** - University of New Hampshire
- **Coastal and Estuarine Science News (CESN)** - newsletter
- **Coastal and Marine Resource Assessment (CAMRA) - ESRI/Abstract - GIS/IMS - Florida Map Viewer**
- **Coastal Science & Research News** from Across the USGS
- **Coastal GIS and Remote Sensing/NOAA** - *South Carolina's Coast: A Remote Sensing Perspective* is a two-volume CD-ROM set that demonstrates the utility of information acquired by satellite and airborne remote sensing systems for coastal South Carolina.
- **DVRL - Data Visualization Lab** - University of New Hampshire
- **ECOMAR - JRC (EU-Joint research Center) - Inland and Marine Waters Unit** - home
- **ESRI Conservation Resources - Marine and Coastal**
- **ESRI - Asian Tsunami Diasaster 2004 - resources** - see also Geodata.gov
- **ERF - Estuarine Research Federation**
- **ESTUARIES** is the bimonthly journal of the Estuarine Research Federation
- **Florida Marine Research Institute (NSDI Project)** - Florida Department of Environmental Protections - Marine Research Institute - Florida (FMRI) - marine GIS resources
- **GIS Methodology Applied for a Statewide Assessment of Propeller Scar Damage in Seagrasses:** Florida.
- **IMaRS - Institute for Marine Remote Sensing** - University of South Florida
- **Indian Ocean Disaster (Tsunami) - ESRI**
- **IOCCG - International Ocean-Colour Coordinating Group - homepage - NEWSLETTER**
- **IWMI - RS/GIS Unit - Great RS/GIS sites**
- **MAPPING ENVIRONMENTAL STRESS IN ELKHORN SLOUGH, CENTRAL CALIFORNIA USING HYPERSPECTRAL DATA: A MANAGEMENT TOOL FOR AN AT-RISK COASTAL ECOSYSTEM** - Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), administered by NOAA and the University of New Hampshire. (POSTER)
- **Marine Research Institute - Florida (FMRI) - marine GIS resources - Telemetry - Manatees**
- **MBARI - Monterey Bay**

- **Mote Marine Laboratory** -
- **NOAA/Coastal South Carolina Project** - home
- **Ocean-Colour Sensor Data - IOCCG - International Ocean-Colour Coordinating Group** - homepage
- **Oceanic Atlas of the Gulf of Mexico**
- **Optical Remote Sensing - Institute for Marine Remote Sensing (IMaRS)**
- **PMEL - Tsunami Research Program - NOAA**
- Protecting Florida's Oceans
- **Remote Sensing for Marine and Coastal Environments - 8th International Conference** (May 17-19 2005 Halifax, Nova Scotia)
- **Remote Sensing of Coral Reefs Project NASA/JSC**
- **SeaWiFS Project - Studying Ocean Color From Space**  
Teacher's Guide with Activities
- **Satellite Images of Tsunami Affected Areas - CRISP/Singapore - Principles of Remote Sensing**
- **Software for Ocean-Colour Data - IOCCG - International Ocean-Colour Coordinating Group**
- **SOEST - School of Ocean and Earth Science and Technology - University of Hawaii**
- **Seafloor Mapping Lab (SFML) - Division of Science and Environmental Policy - California State University Monterey Bay**
- **Supporting In-Situ Data - IOCCG - International Ocean-Colour Coordinating Group**
- **University of New Hampshire - Marine Programs**
- **Whitney Lab for Marine Biology - University of Florida - Center for Marine Studies**

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## Course Objectives:

**ESSC 575** (this is the capstone course for the full sequence):

1. Introduce students to the **systems approach** to learning and doing research in STEM (Science, Technology, Engineering, and Mathematics) and encourage capable students to pursue careers in this arena, particularly in applied areas of CBNRM (Community-based Natural Resource Management).
2. Develop basic competence in the use of integrative computer modeling and mapping/GIS analysis tools such as **IDRISI , ERDAS , ArcGIS, SAS , NetWeaver, EMDS, Criterion PLUS**, and other tools as well as **STELLA** and field tools such as **ArcPAD , GPS** and qualitative tools such as **PRA (Participatory Rural Appraisal)** for collaborative decision-making.
3. **Learn-by-doing in a team setting** how science is done in the real world--particularly in the field in developing-country situations, e.g. hypothesis testing and defining, data analysis and collection, critical thinking and written communication, and proposing policy solutions as well as participating in implementation of plans, etc.

**ESSC 541 Objectives (Pre-Requisite to ESSC 575):**

1. Learn the characteristics of various remote sensing **instruments and sensors** and their utility for various applications (multispectral and hyperspectral systems, thermal infrared, passive and active radar, microwave/LIDAR).
2. Understand the basics of **projections, datums, and coordinate systems** which are essential for doing any type of remote sensing, GIS or use of GPS.
3. Learn the basics of **aerial photographic interpretation** (using the visible portion of the spectrum).
4. Learn the advantages and disadvantages of various **platforms (airborne, satellite, telemetry, etc.)**
5. Understand **electromagnetic radiation and spectral reflectance** properties of the earth's surface.

6. Learn **where to find** and **how to download** and **adapt geodatasets** from various global, regional and local data portals, e.g. **Digital Earth, NASA, USGS, FAO, UNEP....**
7. Learn how to use field data collection tools such as **GPS, PDAs and field-mapping** tablets.
8. Learn how to use at a basic level **Clark lab's IDRISI Kilimanjaro** and **Leica-Geosystems' ERDAS Imagine** as well as **ArcPAD, ArcGIS, GPS** software for digital image processing and analysis.

#### **ESSC 542 Objectives (Pre-Requisite to ESSC 575):**

1. Learn where to find data--spatial and non-spatial and how to acquire it and prepare it for use in modeling.
2. Learn how to integrate all types of **data for decision-making** in real-world situations
3. Learn how to apply both **qualitative research** methods and tools with **quantitative spatial analysis tools**, e.g. use of **PRA (Participatory Rural Appraisal)** with tools such as **GeoNetweaver, Criterion Plus, EMDS, STELLA**.
4. Learn the fundamentals of **modeling** and **systems thinking** via use of such tools like **STELLA, Spatial Analyst from ArcGIS**, and **IDRISI/Kilimanjaro's decision-support** function and tools.
5. Understand what are **Decision-Support-Systems (DSS)** as how they are used in the basic and applied sciences, i.e. in management and research practice for public/private decision-support. in government, industry, sustainable development, environmental science.

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## **Grading Criteria and Assignments:**

Grades will be based upon performance in **FOUR** areas:

**(40% of grade) Lectures, Readings and TESTS (Mid-term and Final).**

**(30% of grade) Laboratory and Take-Home Activities**

**(10%) Participation in team-setting and online in the discussion forum (BLACKBOARD).**

**(20%) Individual or team project focused on a Policy Problem with a Sustainability Focus**

Each student will participate in studying a specific problem or issue within the arena of sustainable development and social policy to explore in depth . The topics could be many such as listed below (this is only illustrative). Your instructors will help you choose, and you must get permission before finally choosing a topic as it will be a **TEAM EFFORT**. Changes may me made in choice of final project, but no later than half way through the course.

**Note the second phase of the course (ESSC 542 will be primarily focused on a project).**

## **Illustrative List of Topics:**

- geo-information science, regional science and development
- land and property rights, entitlement issues

- knowledge management and information technology
- measuring and defining development: indicators
- perceptions and attitudes about development
- political economy, macro-economic policy and development
- communications, social marketing, extension and development
- rural development theory and history (social thought)
- population-land-environment interaction
- sustainable agricultural production and agro-ecosystems
- agricultural intensification and population issues
- disaster mitigation, refugees, and sustainable development
- poverty reduction and trade competitiveness
- women, gender and development
- risk assessment, industrial ecology and pollution
- Carrying capacity, land degradation and population pressure
- political (cultural) ecology theory and history
- global health and disease
- sustainability science: theory and practice
- biotechnology and genetic resources
- global environmental governance and security
- Industrial ecology and energy
- ethno-ecology and ITK (indigenous knowledge systems)
- regional and sectoral natural resource management issues such as:
  - o agroforestry
  - o drylands goods and services
  - o mountain development
  - o river basin water resource management
  - o sustainable tourism
  - o coastal and insular zone management
  - o Antarctica and polar zone issues

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## Grading Rubric:

**\*\*\*See also: Criteria for Written Projects, Papers and Presentations:**

**For an A grade:**

**Above 94% on all tests, reports and take-home or lab exercises as well as exceptional work on the project (see above). To get an A you must demonstrate high creativity, initiative, resourcefulness in all areas of the course and have an excellent participation and attendance record as well.**

**For a B grade:**

**For a B+ you must get above 87% on all tests, reports and take-home or lab exercises as well as work on the project (see above). For a B you must achieve between 84 - 86% and a B- will be given to those scoring between 80 - 83%.**

**For a C grade:**

**Below 80% on all tests, reports and take-home or lab exercises as well as work on the project (see above). and below average participation and attendance: C+ = 75 -79%, C = 70 -74%, C- =**

**65 - 69%.**

**For a D or F grade:**

**To get a D+ = 60 - 64% and D = 55 - 59%; D- = 50 - 54%. Below 50% is a failing grade = F**

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## **Procedures and Regulations:**

**No make-up will be allowed except by prior arrangement for good cause (official University business and death in the immediate family). In all cases you must notify the instructor before you make-it-up. Make-up work must be normally taken within one week of the missed project is due.**

**Doing your best consists in:**

- **regular attendance and participation in all class discussions and activities**
- **reading required assignments before you come to class**
- **handing-in or doing assignments on time--this also applies to class presentations where the quality of your presentation in terms of visual/graphical appeal are evaluated AND**
- **clarity, organization and quality of material given in the oral presentation.**

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## **Notes on Communications:**

- **Throughout the entire course a strong emphasis will be put on use of various forms of written, oral, and graphic communication--emphasis on use of HTML Web-based material as well as use of maps and charts. See list of [Web Publishing Resources](#) for more information.**
- **See also the various WWW Resources relating to cartography, map and aerial photo interpretation, GIS/RS (remote sensing) included in the ESSC course ( ESSC 500 ) -- [Resources for Earth System Science](#).**
- **Students will also be expected to use electronic communications effectively such as email. Much of the course will be carried out online via the [BLACKBOARD](#) site.**
- **Interaction with people and resources beyond the course in THE REAL WORLD is strongly encouraged.**
- **One of the goals is to not only teach good email writing skills and *netiquette*, but more important HOW TO USE THE INTERNET to do research and communicate across the globe.**

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## Time and Location - Activity Due Dates:

**LECTURE PRESENTATIONS - Geoinformatics Lab - Del Webb Library, Conference Room - 4:00-6:00 PM (Monday evenings)**

**LABORATORY ACTIVITIES - GEOINFORMATICS Lab, Del Webb Library, Conference Room 6:00-9:00 PM (Tuesday evenings) and**

**INDIVIDUAL WORK TIME: Thursday evenings (5:00 - 7:00 PM) former Jergensen Learning Center.**

**ONLINE DISCUSSIONS AND ASSIGNMENTS via BLACKBOARD**

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<b>Bob Ford Home</b>	<b>SPOL 665 Info-Tech. Decision Science</b>	<b>BIOL 549 Biodiver. Conservat.</b>	<b>SPOL 624 Nature/Society Thought/Policy</b>	<b>SPOL 554 Env. Equity, Economics &amp; Dev. Policy</b>	<b>ESSC 401-2 Earth System Science</b>	<b>ESSC 575 Field Practicum</b>	<b>ESSC 541-2 Modeling &amp; Remote Sensing</b>
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**Last Revised: January 16, 2006 - Robert E. Ford Instructor - Email: [rford@llu.edu](mailto:rford@llu.edu)**