Course Syllabus, Spring 2008, Indiana University, Bloomington

Human Ecology from Space: Introduction to Remote Sensing in the Social Sciences

E600: Mon: 9-11:10 a.m. (S.B. 230)

Prof. Eduardo S. Brondizio, Dept. of Anthropology; Office: Student Building 131
Scott Hetrick, ACT, Special RS/GIS consultant,

This course combines a historical review on the use of remote sensing in the social sciences (particularly anthropology), the study of its applications to social science inquires and applied work (e.g., settlement pattern, land use and resource management, population studies, archeological analysis, etc.), and a formal introduction to remote sensing principles, data, and processing techniques based on lectures and hands on laboratory sessions. The course will consist of a lecture/discussion and a laboratory session each week. Students will take active role in both sessions and each student will be responsible for developing an individual project in their areas of research interest (dissertation and thesis related projects are especially encouraged).

Activities and Grading policy:

-Students will be required to read articles/book chapters and participate in class discussion throughout the semester; an extensive list of required and suggested readings is provided to motivate student's involvement in the field;

-Lab assignments also constitute an important part of the learning process. Since our lab time is limited most assignments will require you to finish your lab exercise during the week. Most office hours will be dedicated to assist you on lab assignments. Office hours will be held my office (S.B. 131) or at a specified lab (either S.B. 231) depending on availability.

-Individual project: a major goal of the course is to motivate students to develop a research project in the student's area of interest or dissertation research. The project will be divided in two parts:

-Individual project phase 1 (mid-term). Students will need to prepare a "mid-term paper" discussing the first phase of the project (with emphasis on the research question and/or application, methodological strategy, and data selection). It should include: Introduction, literature review, question and/or hypothesis, background, methodological strategy, and preliminary results (if applicable).

-Individual project phase 2 (final). Built upon phase 1 (mid-term paper) a "final paper" is required. It should be a improved version of the mid-term paper and include sections of results, discussion, and conclusion.

Your final grade will consist of:
Student participation: 10% (readings and discussion)
Lab assignments: 30% (including a mid-term individual check on image processing software skills)
Literature/journal review project: 10%
Erdas Imagine test:10%
Final Project: 40% (complete paper)

Most important, at the end of this course I expect you to:
-be familiar with remote sensing data and tools and their potential applications in the social sciences

-be capable of discussing, selecting, acquire, and carry on the basic steps of remote sensing data analysis (including image classification and product outputs)
-be familiar with the literature in your field of interest and main areas of investigation
-be proficient in the basic technical language of remote sensing and have basic software skills for image analysis;
-be prepared for an advanced course in remote sensing

This is an introduction course. Remote sensing is a constantly expanding field not only in terms of satellites/sensors and software, but also in theory and application. This should be your first step in this field and I highly encourage you to take other courses in remote sensing and Geographic Information Systems available at IU.

Classes and Readings: Each reading is assigned a number according to the list of books and articles provided below. This list represents a historical sequence of applications of remote sensing to social sciences issues. Some technical readings are listed apart. Note: *This list aims at providing you with access to a variety of historical material on the topic; Only a limited number of selected readings of this list will be assigned for each class/topic*.

Class 1 (Jan 7)
Scope of the course: remote sensing and its use in the social sciences
2.1, 2.2, 3.1, 8, 66, 79.1, 79.6
Additional resources: #11, 13, 16, 20, 22, 23, 34, 35, 59, 60, 61, 63, 68, 76

-Basic elements and physical principles of remote sensing: Light, atmosphere, surface, and sensor interactions
2.2, 2.3a, 4.1, 76

Class 2 (Jan 14)
-Class discussion: trends in remote sensing and social sciences
#34, 93, 99

-Basic structure of remote sensing data and implications for social science questions: Temporal, spatial, spectral, radiometric resolution [Multispec software lab]
#1.1, 2.3b, 4.1, 76

Class 3 (Jan 28)
-Platforms and sensors and their applications in the social sciences: basic history, temporal, spatial, and spectral characteristics compared (Landsat, Spot, AVHRR, ETM, Vegetatio, Ikonos, Aster, Modis, Radar(s), etc.)
3.2, 4.1, 3.8, 3.11, 51, 64

-Selecting, searching, quality evaluation and ordering remote sensing data
3.11, 2.3b, 4.4, 77 6.1 (+ hand out)
[Includes introduction of ArcCatalog by Scott Hetrick]

Class 4 (Feb 4)
-Spectral behavior and exploratory image analysis: reading single bands and color composites to qualify land cover and land use patterns (Class 7)
1.1, 4.1, 76

-Introduction ArcGis by Scott Hetrick

Class 5 (Feb 11)
- Pre-processing techniques for digital data
- Georefencing: principles and types and Georeferencing exercise
1.2, 4.1, 4.2 (+ hand out)

Class 6 (Feb 18)
- Atmospheric/Radiometric correction
1.2, 4.1, 4.2, 6, 6.1, 87

Class 7 (Feb 25)
-Special transformation techniques: Indices and Principal Components Analysis
3.9, 4.1, 4.2, 81

Class 8 (Mar 3)
Guest workshop: Staffan Peterson (Anthropology Dept/GBL): "GIS for Historical Data Integration and Analysis": In this hands-on workshop you will explore, visualize and analyze data with time, location, and attribute information using ArcMap. Images and maps can be integrated with statistical or textual data, and quantitative analysis can be performed allowing users to explore new relationships hidden within the data.

Class 9 (Mar 17)
Level of analysis and sampling: sociodemographic, institutional, ecological
79.1, 79.5, 88, 92, 100
Additional resources# 3.4, 3.6, 4.2, 4.3, 19, 20, 43, 47, 49, 54, 55, 56, 67, 68, 69, 71, 73, 75, 83

Class 10 (Mar 24)
- Classification systems: categorizing the biophysical and socioeconomic landscapes
1.3, 4.1, 7, 67, 72, 78 (hand out)
-Classifiers: types and functioning
62, 4.1, 79.2, 79.4, 80, 97 (hand out)

Class 11 (Mar 31)
12.3 Classification 1: land use and land cover pattern recognition
see class 10 + (hand out)
12.4 Classification 2: unsupervised techniques
see class 10 + (hand out)

Class 12 (Apr 7)
- Ethnographic fieldwork and remote sensing: Ethic issues and using images in the field
- Field data collection: Spot checking, aerial survey, ethnoecology, and vegetation and soil inventories
2.4, 41, 44, 62, 70; Additional resources: # 20, 29, 13, 33, 38, 46, 62

Class 13 (Apr 14)
-Supervised and hybrid classification using field data
1.3, 4.1, 36, 37
- Accuracy assessment and post-classification products
1.3, 4.1, 9

Class 14 (Apr 21)
- Historical depth and change detection
1.4, 4.1, 36, 36b, 38, 53, 63, 67, 71, 75, 101

Class 15 (Apr 28)

-Remote sensing and social sciences: Challenges of an evolving field
please, review readings of Classes 1 and 3

- Students' project presentations

Suggested and required readings:
Availability: On-course and selected material on reserve at the Geography Library, located at the Student Building 015.

Selected Remote Sensing Journals:
Photogrammetric Engineering and Remote Sensing
International Journal of Remote Sensing
Remote Sensing of Environment
Geocarto International
Cannadian Journal of Remote Sensing
Remote Sensing Review

Books and web pages:

1. Jensen, J. (1996). Introductory digital imagem processing: A remote sensing perspective. Upper Saddle River: Prentice Hall. (see online abbreviated version at http://www.r-s-c-c.org/)

1.1 (pages 77-86): initial statistics extraction
1.2 (pages 107-135): image pre-processing: radiometric and geometric corrections
1.3 (pages197-256): image classification
1.4 (pages 257-280): digital change detection

2. Wilkie, D. (1996). Remote sensing imagery for natural resources monitoring: A Guide for first-time users. New York: Columbia University Press.

2.1 (pages 1-7): purpose and scope: the scale of human land transformation
2.2 (pages 10-26): what is remote sensing?
2.3 A (pages 29-37): remote sensing for monitoring and managing natural resources
2.3 b(pages 37-60): How much detail is achievable and necessary?
2.3 c (pages 61-87): Commonly used types of remote sensing data.
2.3d (pages 88-98): Acquiring data
2.4 (pages 186-193): executing a field survey

3. Liverman, D. E. Moran, R. Rindfuss, and P. Stern (eds.) (1998). People and Pixels: Linking Remote Sensing and Social Science**.** Washington DC: National Academy Press. (see page 8 for chapters)

3.1 Linking remote sensing and social sciences: the need and the challenges (Rindfuss and Stern)
3.2 A brief history of remote sensing applications, with emphasis on Landsat (Morain)
3.3 "Socializing the pixel" and "pixelizing the social" in land-use and land-cover change (Geoghegan et al).
3.4 Linking satellite, census, and survey data to study deforestation in the Brazilian Amazon (Wood and Skole).
3.5 Land-use change after deforestation in Amazonia (Moran and Brondizio)
3.6 Land-use/land-cover and population dynamics, Nang Rong, Thailand (Enwistle et al).
3.7 Validating prehistoric and current social phenomena upon the landscape of the Peten, Guatemala (Server)
3.8 Extraction and modeling of urban attributes using remote sensing technology (Cowen and Jensen).
3.9 Social science and remote sensing in famine early warning (Hutchinson).
3.10 Health applications of remote sensing and climate modeling (Epstein).

3.11 An annotated guide to earth remote sensing data and information resources for social sciences applications (Chen).
3.12 Glossary (Patterson).

4. Homepages: (SEE FURTHER LIST OF WEBSITES AT THE END)
4.1 NASA Remote Sensing Tutorial, Nicholas Short: http://rst.gsfc.nasa.gov/
4.2 ERDAS Imagine tutorial guide (online version through Imagine, SB 230)
4.3 Landsat.org. Basic Science and Remote Sensing Initiative, Michigan State University, http://www.bsrsi.msu.edu; http://rst.gsfc.nasa.gov/
4.4 USGS Earth Explorer http://edcsns17.cr.usgs.gov/EarthExplorer/

General readings:

5. Woodcock, C. F. and A. H. Strahler (1987). The factor of scale in remote sensing. Remote Sensing of Environment 21:311-332.

6. Lu, Dengsheng, Paul Mausel, Eduardo Brondizio, and Emilio Moran. 2002. Assessment of Atmospheric Correction Methods for Landsat TM Data Applicable to Amazon Basin LBA Research. International Journal of Remote Sensing 23(13):2651-2671.

6. 1 Green, G, C. Schweik, and M. Hanson (manuscript). Radiometric calibration of Landsat Multispectral Scanner and Thematic Mapper images: Guidelines for the global change community.

7. Anderson, J. Et al. (1976). A land use and land cover classification system for use with remote sensor data. Washington: Geological Survey Professional Paper 964.

8. National Academy of Sciences (2002). Earth observations from space: History, Promise, and Reality. Washington: National Academy Press.

9. Janssen, L. L. F. and F. J. M. van der Wel (1994). Accuracy assessment of satellite derived land-cover data: A review. Photogrammetric Engineering and Remote Sensing 60(4): 419-426.

Social Sciences readings (organized by year):

1970's:
10 Aschmann, H. H. et al. (eds) (1975) People: past and present. In R. G. Reeves et al. (eds). Manual of Remote Sensing. Falls Church (Va): ASPRS (chapter 26: 1999-2060). (the manual was reprinted in 1983).

10.1 Lyons, T. R. and T. E. Avery (1977). Remote Sensing: A Handbook for Archeologists and Cultural Resource Managers. Washington: Cultural Resources Management Division, National Park Service.

11. Connant, F. P. (1978). The use of Landsat data in studies of human ecology. Current Anthropology 19: 382-384.

12. Reining, P 1979. Challenging Desertification in West Africa: Insights from Landsat into Carrying Capacity, Cultivation, and Settlement Sites in Upper Volta and Niger. Athens: Center for International Studies, Ohio University.

1980-1984:
13. Conklin, H.C., 1980. Ethnographic Atlas of Ifugao: A Study of Environment, Culture and Society in Northern Luzon. New Haven: Yale University Press. (on reserve)

14. Draeger, W. C. And L. R. Pettinger (1981). Remote sensing: A tool for park planning and management. Parks Magazine 6(3): 1-6.

15. Lyons, T. R. and F. J. Mathien (1980). Cultural Resources Remote Sensing. Washington: Cultural Resources Management Division, National Park Service.

16. Connant, F. P. (1984). Remote sensing, discovery and generalizations in human ecology. In E.F. Moran (ed.) The Ecosystem Concept in Anthropology. Boulder: Westview Press.

17. Server, T. And J. Wiseman (1984). Remote Sensing and Archeology: Potential for the Future. Report on a Conference, March 1-2, 1984. Mississipi: Earth Resources Laboratory, NASA. (on reserve)

18. Myers, V. I. Et al. (1975, reprinted 1983). Remote sensing applications in agriculture. In R. N. Colwell (ed.) Manual of Remote Sensing (Volume II: Interpretation and Applications). American Society of Photogrammetry. (pages 2111-2228).

1987 – 1989:
19. Wilkie, D. (1987). Cultural and ecological survival in the Ituri Forest: The role of accurately monitoring natural resources and agricultural land use. Cultural Survival Quarterly 11(2): 72-74.

20. Foster Brown, I. and T. Stone (1988). Using satellite photography for grassroots development in Amazonia. Cultural Survival Quarterly: Fall 1988.

21. Helfert, M. R. and K. P. Lulla (1989). Monitoring tropical environments with space shuttle photography. Geocarto International (1): 55-67.

1990-1992:
22. Moran, E. F. (1990). Levels of Analysis and analytical level Shifting: Examples from Amazonian ecosystem research. In E.F. Moran (ed.) The Ecosystem Concept in Anthropology. Ann Arbor: Michigan University Press.

23. Connant, F. P. (1990). 1990 and beyond: Satellite remote sensing and ecological anthropology. In E.F. Moran (ed.) The Ecosystem Concept in Anthropology. Ann Arbor: Michigan University Press.

24. Morren G.E.B. (1990). New technology and regional studies in human ecology: A Papua New Guinea example. In C. Jonh (ed.) Proceedings of the symposium "Applications of Space-Age Technology in Anthropology", John C.Stennis Space Center.

25. Jonh, C. (ed.) (1990). Proceedings of the symposium "Applications of Space-Age Technology in Anthropology", John C.Stennis Space Center: NASA. (see readings 24, 27, 28, 29, 30)

26. Gibbons, A. (1991). A “new look” for Archeology. Science 252: 918-252.

27. Wilkie, D. 1990. Protecting Rain Forests and Forager's Rights Using Landsat Imagery. In C.John (ed.). Conference Proceedings "Appl ications of Space-Age Technology in Anthropology". John Stennis Space Center.

28. Behrens, C.A., (1990). Applications of satellite image processing to the analysis of Amazonian cultural ecology. In C. Jonh (ed.) Conference proceedings " Applications of Space Age Technology in Antropology",Jonh C.Stennis Space Center: NASA.

29. Chagnon, N. A. (1990). GIS, GPS, political history and geo-demography of the Aramamisi Yanomamo expansion. In C.John (ed.). Conference Proceedings "Applications of Space-Age Technology in Anthropology". John Stennis Space Center.

30. Winterhalder B. and T. Evans (1990). GIS Analysis of the Agricultural Landscape of Cuyo Cuyo, Department of Puno, Peru. In C. John (ed.) Conference proceedings " Applications of Space Age Technology in Antropology",Jonh C.Stennis Space Center.

31. Behrens, C. (1992). A formal justification for the application of GIS to the culture ecological analysis of land use intensification and deforestation in the Amazon. In M. Aldenderfer and H. Maschner (orgs.) Conference "The Anthropology of Human Behavior Through Geographic Information Analysis." University of California at Santa Barbara, February 1-2, 1992.

32. Jones, J. (1992). Determining correlates of Honduran deforestation with GIS, MSS imagery and socio-cultural data. In M. Aldenderfer and H. Maschner (orgs.) Conference "The Anthropology of Human Behavior Through Geographic Information Analysis." University of California at Santa Barbara, February 1-2, 1992.

32b. Stone, G. (1993). Settlement Ecology. Tucson: University of Arizona Press.

1993-1995:
33. Guyer, J. I. and E. F. Lambin (1993). Land use in an urban hinterland: Ethnography and remote sensing in the study of African intensification. American Anthropologist 95(4): 839-859.

34. Behrens C.A. (ed.) (1994). Recent advances in the regional analysis of indigenous land use and tropical deforestation, special issue of Human Ecology 22(3):243-247.

35. Connant, F. P. (1994). Human ecology and space age technology: Some predictions. Human Ecology 22(3): 405-413.

36. Brondízio, E.S.; Moran, E.F.; Mausel, P. and Y. Wu, (1994). Land Use Change in the Amazon Estuary: Patterns of Cabloco Settlement and Landscape Management. Human Ecology 22(3):249-278.

36b. Mausel P., Wu Y., Moran E., and Brondízio E.S.(**1993**). Spectral identification of successional stages following deforestation in the Amazon. Geocarto International, 8(4): 61-71 (special issue: *Global Environmental Change*)

37. Behrens, C.A.; Baksh, M.G. and M. Mothes, (1994). A Regional Analysis of Barí Land Use Intensification and its Impact on Landscape Heterogeneity. Human Ecology 22(3): 279-316.

38. Sussman, R. W., G. L. Green, and L. K. Sussman (1994). Satellite imagery, human ecology, anthropology, and deforestation in Madagascar. Human Ecology 22(3): 333-354.

39. Sader, S. A., T. Server, J. C. Smoot, and M. Richards (1994). Forest change estimates for the Northern Peten region of Guatemala – 1986-1990. Human Ecology 22(3): 317-332.

40. Stoffle, R. W. et al. (1994). Reefs from space: Satellite imagery, marine ecology, and ethnography in the Dominican Republic. Human Ecology 22(3): 355-378.

41. Wilkie, D. (1994). Remote sensing imagery for resource inventories in Central Africa: The importance of detail field data. Human Ecology 22(3): 379-404.

42. Moran, E.F.; Brondizio, E.S.; Mausel, P. and W. You (1994). Deforestation in Amazonia: Land use change from ground and space level perspective. Bioscience 44(5): 329-339.

43. Cultural Survivor 1995. *Geomatics*. Cultural Survival Quartely, Winter 1995.

1996

44. Brondizio E.S., Moran E.F., Mausel P. and Y. Wu,(1996). Changes in land cover in the Amazon estuary: Integration of thematic mapper with botanical and historical data. Photogrammetric Engineering and Remote Sensing 62(8):921-929.

45. Hall, F. G. et al. (1996). The role of remote sensing in the large-scale biosphere-atmosphere experiment in Amazonia (LBA). Workshop Report, December 8-10, 1995, Cachoeira Paulista, Brazil.

1998-present (sample)

46. Liverman, D. E. Moran, R. Rindfuss, and P. Stern (eds.) (1998). People and Pixels: Linking Remote Sensing and Social Science**.** Washington DC: National Academy Press. (see #3)

47. McCracken, S., E. Brondizio, D. Nelson, E. Moran, A. Siqueira, and C. Rodriguez-Peraza. (1999). Remote Sensing and GIS at Farm Property Level: Demography and Deforestation in the Brazilian Amazon. Photogrammetric Engineering and Remote Sensing**.** 65(11):1311–1320.

48. Sohn, Y., E. F. Moran, and F. Gurri (1999). Deforestation in North-Central Yucatan (1985-1995): Mapping secondary succession of forest and agricultural land use in Sotuta using the cosine of the angle concept. Photogrammetric Engineering and Remote Sensing 65(8): 947-958.

49. Walsh, S. J. et al. (1999). Scale-dependent relationships between population and environment in Northeastern Thailand. Photogrammetric Engineering and Remote Sensing 65(1): 97-105.

50. Paylor, E. D. et al. (1999). Earth science enterprise science and technology for society. EOM 8(3): 08-12. (http://www.eomonline.com)

51. Willians, D. et al. (1999). Overview of the Landsat 7 mission. EOM 8(3): 14-16. (http://www.eomonline.com)

52. Corbley, K. P. and T. Mace (1999). Environmental applications of ESE data and information. EOM 8(3): 50-52. (http://www.eomonline.com)

53. Brondizio, E.S., S.D. McCracken, E.F. Moran, A.D. Siqueira, D.R. Nelson, and C. Rodriguez-Pedraza. 2002. The Colonist Footprint: Toward a Conceptual Framework of Deforestation Trajectories Among Small Farmers in Frontier Amazônia. In: Deforestation and Land Use in the Amazon. C. Wood and R. Porro (eds.) University Press of Florida, Gainesville, Florida. Pgs. 133-161.

54. McCracken, S., A.D. Siqueira, E.F. Moran, and E.S. Brondizio. 2002. Land Use Patterns on an Agricultural Frontier in Brazil; Insights and Examples from a Demographic Perspective. In: Deforestation and Land Use in the Amazon. C. Wood and R. Porro (eds.) University Press of Florida, Gainesville. Pgs. 162-192.

55. Mahar, D. and E. Ducrot (1998). The Political Economy of Land-Use Zoning in Rondonia, Brazil. The World Bank Series (complete publication number).

56. Smith, Pariona, and Tuesta (1999). Long-range Land Use Planning for Indigenous Territories in the Peruvian Amazon: Building a System of Georeferenced Data as a First Step. In C. Wood (ed.) Patterns and Processes of Land Use and Forest Change in the Amazon. University of Florida Press.

57. Foresman, T.W. (1999). Government and planing applications for remote sensing. EOM 8(3): 30-33. (http://www.eomonline.com)

58. Alechandre, A. et al. (1998). "Mapa como ferramenta para gerenciar recursos naturais: Um guia passo-a-passo para populacoes tradicionais fazerem mapas usando imagens de satelite". Rio Branco: Brilhograf, 36p, il.

59. Moran, E. (1998). Human role in global change. AAA Anthropology Newsletter. October 1998.

60. Moran, E. (1998). Remote sensing as a tool. AAA Anthropology Newsletter. November 1998.

61. Schweik, C. M. (1998). The spatial and temporal analysis of forest resources and institutions. Doctoral dissertation, Indiana University, published by CIPEC's dissertation Series, No. 2. (see chapters: 5 and 6)

62. DeCastro, F, M. C. Silva-Fosberg, W. Wilson, E. Brondizio, E. Moran (2002). The use of remotely sensed data in rapid rural assessment. Field Methods (formely Cultural Anthropology Methods) 14(3): 243-269 (August 2002).

63. Nyerges, Endre A. and Green, Glen Martin (2000). The Ethnography of Landscape: GIS and Remote Sensing in the Study of Forest Change in West African Guinea Savana. American Anthropologist. v. 102, n. 2, pp. 1-19. (for color figures see: http://www.cipec.org/publications/nyerges_and_green2000.html)

64. Hurtt, G., Xiao, X., Keller, M., Palace, M., Asner, G.P., Braswell, R., Brondizio, E.S., Cardoso, M., Carvalho, C.J.R., Fearon, M.G., Guild, L, Hagen, S., Hetrick, S., Moore III, B., Nobre, C., Read, J.M., Sa, T., Schloss, A., Vourlitis, G., Wickel, A.J. 2003. Ikonos imagery for the large scale biosphere-atmosphere experiment in Amazonia (LBA). Remote sensing of environment, 88: 111-127.

65. McConnell, W. J., and E. F. Moran, eds. (2001). *Meeting in the* Middle: The Challenge of Meso-Level Integration. An International Workshop on the Harmonization of Land Use and Land Cover Classification*, Ispra, Italy*, October 17-20, 2000. LUCC Report Series No. 5. Bloomington: LUCC Focus 1 Office, Indiana University. Available on line at http://www.indiana.edu/~act/focus1/

66. Moran, E., and E. Brondízio (2001). Human Ecology from Space: Ecological Anthropology Engages the Study of Global Environmental Change. In Ecology and the Sacred: Engaging the Anthropology of Roy Rappaport, ed. M. Lambek and E. Messer, 64-87. Ann Arbor: University of Michigan Press.

67. Pinedo-Vasquez, M., Pasqualle, J. B., Dennis Del Castillo Torres, K. Coffey (2002). A tradition of change: The dynamic relationship between biodiversity and society in sector Muyuy, Peru. Environmental Science and Policy 221(2002) 1-11.

68. Porro, R. (2000). Reflections on the promises and perils of integrating remote sensing in anthropological research. Paper awarded the R. Rappaport Prize in Ecological Anthropology by the "Anthropology and Environment" session of the American Anthropological Association.

69. Moran, E. F., A. D. Siqueira, and E. S. Brondizio (2003). Household demographic structure and it's relationship to deforestation in the Amazon basin. In J. Fox, V. Mishra, R. Rindfuss, and S. Walsh (eds.) People and the Environment: Approaches to Linking Household and Community Surveys to Remote Sensing and GIS. Kluwer Academic Press.

70. J. Pickles (ed.) (1994). Ground Truth. Guilford Press. (selected parts)

71. Turner, B.L. et al (2001). Deforestation in the southern Yucatan peninsular region: An integrative approach. Forest Ecology and Management 154 (3): 351-352 (special issue: *New directions in tropical forest research*)

72. Zarin, D., et al (2001). Landscape changes in tidal floodplains near the mouth of the Amazon river. Forest Ecology and Management 154 (3): 351-352 (special issue: *New directions in tropical forest research*)

73. Brondizio, E. S. (2004). Agriculture intensification, economic identity, and shared invisibility in Amazonian peasantry: Caboclos and Colonists in comparative perspective. Culture and Agriculture 26(1 and 2): 1-24.

74. Futemma C. and E.S. Brondizio. 2003. Land reform and land use changes in the Lower Amazon: Implications to agricultural intensification. Human Ecology 31(3): 369-402.

75. Lu, D., P. Mausel, E. Brondizio, and E.F. Moran. 2004. Change Detection Techniques. *International Journal of Remote Sensing* 25(12): 2365-2407.

76. Cd-ROM: Mausel, P., et. Al (2001). Exploring wetlands with satellite remote sensing. Indiana State University. http://www.indstate.edu/gerstt.

77. ERDAS Imagine (1998). Map Projections (Appendix D). Erdas Imagine Field Guide. (pgs. 307-320).

78. Di Gregorio, A. and L. J. M. Jansen. (2000). Land cover classification system [LCCS]: Classification concepts and user manual. Rome: Food and Agriculture Organization of the United Nations. (on reserve)

79. J. Fox, V. Mishra, R. Rindfuss, and S. Walsh (eds.) 2003. People and the Environment: Approaches to Linking Household and Community Surveys to Remote Sensing and GIS. Kluwer Academic Press.

Chapters:
79.1 Rindfuss, R et al Linking household and remotely sensed data: Methodological and practical problems (Pp. 1-31)
79.2 Walsh, S. et al. Integration of Longitudinal surveys, remote sensing time series and spatial analyses: Approaches for linking people and place. (Pp. 91-130)
79.3 Rindfuss, R. t al. Household-Parcel linkages in Nang Rong, Thailand: Challenges of large samples. (Pp. 131-172)
79.4 BurnSilver, S et al. Linking pastoralists to a heterogeneous landscape: The case of four Maasai group ranches in Kajiado District, Kenya. (Pp. 173-200)
79.5 Lambim, E. Linking socioeconomic and remote sensing data at the community or at the household level : two case studies from Africa. (Pp. 223-240)
79.6 Axim, W. and J. Barber. Linking people and land use: A sociological perspective. (Pp. 285-293)

80. K. Homewood, E. F. Lambin, E. Coast, A. Kariuki, I. Kikula, J. Kivelia, M. Said, S. Serneels, and M. Thompson From the Cover: Long-term changes in Serengeti-Mara wildebeest and land cover: Pastoralism, population, or policies? *PNAS* 2001; 98: 12544-12549.

81. Lu, D., P. Mausel, E. Brondizio, and E.F. Moran. 2004. Relationships Between Forest Stand Parameters and Landsat TM Spectral Responses in the Brazilian Amazon Basin. Forest Ecology and Management 198:149-167.

82. Turner and Taylor 2003. Critical Reflections on the Use of Remote Sensing and GIS Technologies in Human Ecological Research Human Ecology, Vol. 31, No. 2, June 2003 (C° 2003)

83. Michael W. Binford, Tae Jeong Lee, and Robert M. Townsend Sampling design for an integrated socioeconomic and ecological survey by using satellite remote sensing and ordination PNAS 2004 101: 11517-11522;

84. Ronald R. Rindfuss, Stephen J. Walsh, B. L. Turner, II, Jefferson Fox, and Vinod Mishra Developing a science of land change: Challenges and methodological issues
PNAS 2004 101: 13976-13981; published online before print as 10.1073/pnas.0401545101

85. Moran, Emilio F., and Elinor Ostrom, eds. 2005. Seeing the Forest and the Trees: Human-Environment Interactions in Forest Ecosystems. Cambridge, Mass.: MIT Press.

86. Tucker, Catherine M., Darla K. Munroe, Harini Nagendra and Jane Southworth. 2005. Comparative Spatial Analyses of Forest Conservation and Change in Honduras and Guatemala.

Conservation and Society 3(1):174–200. URL: http://www.conservationandsociety.org/cs-3-1_10_jtuckeretal.pdf.

87. Green, Glen M., Charles M. Schweik, and J. C. Randolph 2005. Retrieving Land-Cover Change Information from Landsat Satellite Images by Minimizing Other Sources of Reflectance Variability. In Seeing the Forest and the Trees: Human-Environment Interactions in Forest Ecosystems, ed. Emilio F. Moran and Elinor Ostrom, 131–160. Cambridge, Mass.: MIT Press.

88. Brondizio, E. S. 2006. Landscapes of the past, footprints of the future: historical ecology and the analysis of land use change in the Amazon. In W. Balée and C. Erikson (eds.) Time and Complexity in Historical Ecology: Studies in the Neotropical Lowlands. NY: Columbia U. Press. Pp. 365-405.

89. Carlos M. Souza, Jr.2006 Mapping land use of tropical regions from space. PNAS 2006 103: 14261-14262;

90. Lisa M. Curran and Simon N. Trigg 2006 Sustainability science from space: Quantifying forest disturbance and land-use dynamics in the Amazon PNAS 2006 103: 12663-12664

91. Damian Evans, Christophe Pottier, Roland Fletcher, Scott Hensley, Ian Tapley, Anthony Milne, and Michael Barbetti A comprehensive archaeological map of the world's largest preindustrial settlement complex at Angkor, Cambodia PNAS 2007 104: 14277-14282

92. Elinor Ostrom and Harini Nagendra 2006 Inaugural Article: Insights on linking forests, trees, and people from the air, on the ground, and in the laboratory PNAS 2006 103: 19224-19231;

93. Jane I. Guyer et al 2007. Temporal Heterogeneity in the Study of African Land Use Interdisciplinary Collaboration between Anthropology, Human Geography and Remote Sensing. Hum Ecol (2007) 35:3–17

94. Kojo S. Amanor & Opoku Pabi 2007 Space, Time, Rhetoric and Agricultural Change in the Transition Zone of Ghana, Hum Ecol (2007) 35:51–67

95. Peter A. Walker & Pauline E. Peters 2007. Making Sense in Time: Remote Sensing and the Challenges of Temporal Heterogeneity in Social Analysis of Environmental Change—cases from Malawi. Hum Ecol (2007) 35:69–80

96. Douglas C. Morton, Ruth S. DeFries, Yosio E. Shimabukuro, Liana O. Anderson, Egidio Arai, Fernando del Bon Espirito-Santo, Ramon Freitas, and Jeff Morisette 2006 Cropland expansion changes deforestation dynamics in the southern Brazilian Amazon PNAS 2006 103: 14637-14641;

97. Marcia Caldas de Castro, Roberto L. Monte-Mór, Diana O. Sawyer, and Burton H. Singer Malaria risk on the Amazon frontier PNAS 2006 103: 2452-2457; published online before print as 10.1073/pnas.0510576103

98. VanWey, L., A. O. D.Antona, and E.S. Brondizio. 2007. Household Demographic Change and Land Use/Land Cover Change in the Brazilian Amazon. Population and Environment 28:163-185.

99. B. L. Turner, II, Eric F. Lambin, and Anette Reenberg 2007. Land Change Science Special Feature: The emergence of land change science for global environmental change and sustainability PNAS 2007 104: 20666-20671.

100. Steven M. Manson and Tom Evans 2007 Land Change Science Special Feature: Agent-based modeling of deforestation in southern Yucatán, Mexico, and reforestation in the Midwest United States PNAS 2007 104: 20678-20683

101. Brondizio, E. S. and E. F. Moran (submitted). Untangling Trajectories and Scale-Dependent Processes in Amazonian Deforestation since 1970. PNAS.

Some useful websites: (Students are welcome to contribute to this list of Web sites)
National Spatial Data Infrastructure
http://www.cas.sc.edu/geog/rslab/Rscc/mod3/3-3/3-3.html
FAO
http://WWW.fao.org/
UNEP/GRID
http://www.grida.no/
Global Observation Information Network (GOIN) Project
http://www.nnic.noaa.gov/GOIN/GOIN.html
Earth Science data on the Global land information system
http://edcwww.cr.usgs.gov/webglis
Earth Explorer
http://edcsns17.cr.usgs.gov/EarthExplorer/
INPE (Instituto Nacional de Pesquisas Espaciais, Brasil)
http://www.inpe.br
Multispec (Purdue/LARS)
http://dynamo.ecn.purdue.edu/~biehl/MultiSpec/
ERDAS IMAGINE
http://www.erdas.com/
Spot Image, French SPOT Satellite Images
http://www.spot.com/
ACT - Anthropological Center for Training and Research on Global Environmental Change
http://www.indiana.edu/~act
CIPEC - Indiana University
http://www.cipec.org

I hope you enjoy this course! ESB