

Additional Reading list for GEOG6039 PART 1

Recommended reading in support of lectures is provided in the following lists. The vast majority of the articles listed are held in the University library and/or available electronically through the library internet site.

Lecture 1 Introduction to Remote Sensing

The course will be introduced and a general overview of remote sensing will be provided. This will include a brief history of the development of remote sensing and some examples of the applications of remote sensing. The remote sensing model and electromagnetic radiation will also be introduced

Campbell, J. B. (2002) *Introduction to Remote Sensing*, Third edition, Taylor and Francis, London (Chapter 1).

Elachi, C. (1987) *Introduction to the Physics and Techniques of Remote Sensing*, Wiley, New York, (Chapter 1).

Gibson, P. J (2000) *Introduction to Remote Sensing*. Routledge, London (Chapters 1 & 2)

Harris, R. (1987) *Satellite Remote Sensing: An Introduction*, Routledge and Kegan Paul, London (Chapter 1).

Lillesand, T.M., Kiefer, R.W. and Chipman, J. W. (2004) *Remote Sensing and Image Interpretation*. Fifth edition, Wiley, New York (Chapter 1).

Mather P. M. (1999) *Computer processing of remotely-sensed images*, Second edition, Wiley, Chichester (Chapter 1)

Lecture 2 Electromagnetic Radiation and the Electromagnetic Spectrum

Electromagnetic radiation provides the link between the components of the remote sensing model outlined in the first lecture. A basic understanding of the properties of electromagnetic radiation is, therefore, essential in remote sensing. This lecture provides a brief overview of the salient features of electromagnetic radiation required for environmental remote sensing

Barrett, E.C. and Curtis, L.F. (1992) *Introduction to Environmental Remote Sensing*, Third edition, Chapman and Hall, London (Chapter 2).

Campbell, J.B. (2002) *Introduction to Remote Sensing*, Third edition, Taylor and Francis, London (Chapter 2).

Elachi, C. (1987) *Introduction to the Physics and Techniques of Remote Sensing*, Wiley, New York (Chapter 2).

Gibson, P. J (2000) *Introduction to Remote Sensing*. Routledge, London (Chapters 1 & 2)

Harris, R. (1987) *Satellite Remote Sensing: An Introduction*, Routledge, London (Chapter 2).

Lillesand, T.M., Kiefer, R.W. and Chipman, J. W. (2004) *Remote Sensing and Image Interpretation*. Fifth edition, Wiley, New York (Chapter 1).

Mather P. M. (1999) *Computer processing of remotely-sensed images*, Second edition, Wiley, Chichester (Chapter 1)

Rees W. G. (2006) *Physical Principles of Remote Sensing*, 2nd Edition, Cambridge University Press, Cambridge, (chapter 3)

Lecture 3 and 4 EMR Interactions with the Atmosphere and Earth Surface Features

The spectral response of a target measured by a remote sensor is determined by the way electromagnetic radiation interacts with the target. These lectures will outline the main interactions of EMR with the atmosphere, the environment, and with soils, water and vegetation in particular. Knowledge of the factors controlling radiation interaction can help substantially in the analysis of remotely sensed data and so it is important that the basic principles are understood.

(i) General:

Campbell, J.B. (2002) *Introduction to Remote Sensing*, Third edition, Taylor and Francis, London (Chapter 2 and 16).

Gibson, P. J. with Power, C. H. (2000) *Introductory Remote Sensing: Principles and Concepts*, Routledge, London (first half of chapter 2).

Jensen J. R. (2000) *Remote Sensing of the Environment: An Earth Resource Perspective*, New Jersey; Prentice Hall (or the newer 2007 version if you can get it!)

Lillesand, T.M., Kiefer, R.W. and Chipman, J. W. (2004) *Remote Sensing and Image Interpretation*. Fifth edition, Wiley, New York (Chapter 1).

Mather P. M. (1999) *Computer processing of remotely-sensed images*, Second edition, Wiley, Chichester (Chapter 1)

Rees, W.G. (1990) *Physical principles of Remote Sensing*, CUP, Cambridge (Chapter 4)

Szekiolda, K.H. (1988) *Satellite Monitoring of the Earth*, Wiley, New York (Chapter 4).

Rees W. G. (2006) *Physical Principles of Remote Sensing*, 2nd Edition, University Press, Cambridge, (chapter 4)

(ii) Specific:

Gitelson, A. A., Vina, A., Ciganda, V., Rundquist, D. C. and Arkebauer, T. J. (2005). "Remote estimation of canopy chlorophyll content in crops." *Geophysical Research Letters* 32: doi:10.1029/2005GL022688.

Harris, A., Bryant, R. G. and Baird, A. J. (2006). "Mapping the effects of water stress on *Sphagnum*: Preliminary observations using airborne remote sensing." *Remote Sensing of Environment* 100: 363.

Harris, A., Bryant, R. G. and Baird, A. J. (2005). "Detecting water stress in *Sphagnum* spp." *Remote Sensing of Environment* 97: 371-381.

Jackson, T. J., Chen, D., Cosh, M. H., Li, F., Anderson, M. C., Walthall, C., P, P. D. and Hunt, E. R. (2004). "Vegetation water content mapping using Landsat TM derived NDWI for corn and soybean." *Remote Sensing of Environment* 92: 475-482.

- Schmidt, K. S. and Skidmore, A. K. (2003). "Spectral discrimination of vegetation types in a coastal wetland." *Remote Sensing of Environment* 85: 92-108.
- Soudani K, Francois C, le Maire G, Le Dantec V, Dufrene E (2006) Comparative analysis of IKONOS, SPOT, and ETM+ data for leaf area index estimation in temperate coniferous and deciduous forest stands." *Remote Sensing of Environment* 102: 161-175.
- Jackson, T. J. (2002). "Remote sensing of soil moisture: implications for groundwater recharge." *Hydrogeology Journal* 10: 40-51.
- Serrano, L., Ustin, S. L., Roberts, D. A., Gamon, J. A. and Penuelas, J. (2000). "Deriving Water Content of Chaparral Vegetation from AVIRIS Data." *Remote Sensing of Environment* 74: 570-581.
- Datt, B. (1999). "Visible/near infrared reflectance and chlorophyll content in Eucalyptus leaves." *International Journal of Remote sensing* 20: 2741-2759.
- Sims, D. A. and Gamon, J. A. (2002). "Relationships between leaf pigment content and spectral reflectance across a wide range of species, leaf structures and developmental stages." *Remote Sensing of Environment* 81: 337-354.
- Curran, P. J. (1989), Remote Sensing of foliar chemistry. *Remote Sensing of Environment*, 30, 271-278.
- Curran, P. J., Kupiec, J. A. and Smith, G. M. (1997) Remote Sensing the biochemical composition of a slash pine canopy. *IEEE Transactions on Geoscience and Remote Sensing*, 35, 415-420.
- Sims, D. A. and Gamon, J. A. (2003). "Estimation of vegetation water content and photosynthetic tissue area from spectral reflectance: a comparison of indices based on liquid water and chlorophyll absorption features." *Remote Sensing of Environment* 84: 526-537.
- Bhargava, D.S. and Mariam, S. (1990) Spectral reflectance relationships to turbidity generated by different clay materials, *Photogrammetric Engineering and Remote Sensing*, 56, 225-229.
- Blackburn, G.A. and Steele, C.M. (1999) Towards the remote sensing of matorral vegetation physiology: Relationships between spectral reflectance, pigment, and biophysical characteristics of semiarid bushland canopies, *Remote Sensing of Environment*, 70, 278-292.
- Coleman, T.L. and Montgomery, O.L. (1987) Soil moisture, organic matter and iron content effect on the spectral characteristics of selected Vertisols and Alfisols in Alabama, *Photogrammetric Engineering and Remote Sensing*, 53, 1659-1663.
- Fiella, I. and Peñuelas, J. (1994) The red-edge position and shape as indications of plant chlorophyll content, biomass and hydric status, *International Journal of Remote Sensing*, 15, 1459-1470.
- Forster, B., Baide, X. and Xingwai, S. (1994) Modelling suspended particle distribution in near coastal waters using satellite remotely-sensed data, *International Journal of Remote Sensing*, 15, 1207-1219.
- Gausman, H.W. (1974) Leaf reflectance of near-infrared, *Photogrammetric Engineering and Remote Sensing*, 40, 183-191.
- Gobron, N., Pinty, B., Verstrate, M. M. and Widlowski, J.-L. (2000) Advanced vegetation

indices optimized for up-coming sensors: design, performance and applications, *IEEE Transactions on Geoscience and Remote Sensing*, 38, 2489-2505.

Huck, A.R. (1989) Soil influences in remotely sensed vegetation-canopy spectrum. In: Asrar, G. (ed) *Theory and Application of Optical Remote Sensing*, Wiley, New York, 107-141.

Hunt, E.R. and Rock, B.N. (1989) Detection of changes in leaf water content using near-an middle-infrared reflectances, *Remote Sensing of Environment*, 30, 43-54.

Liu, W.D, Baret, F., Gu, X.F., Tong, Q.X., Zheng, L.F. and Zhang, B. (2002) Relating soil surface moisture to reflectance, *Remote Sensing of Environment*, 81, 238-246.

Nagler, P. L., Daughtry, C. S. T. and Goward, S. N. (2000) Plant litter and soil reflectance, *Remote Sensing of Environment*, 207-215.

Palacios-Oreuta, A. and Ustin, S. L. (1998) Remote sensing of soil properties in the Santa Monica mountains I. Spectral analysis, *Remote Sensing of Environment*, 65, 170-183.

Pinter Jr, P. J., Hatfield, J. L., Schepers, J. S., Barnes, E. M., Moran, M. S., Daughtry, C. S. T. and Upchurch, D. R. (2003) Remote sensing for crop management, *Photogrammetric Engineering and Remote Sensing*, 69, 647-664.

Ritchie, J. C., Zimba, P. V. and Everitt, J. H. (2003) Remote sensing techniques to assess water quality, *Photogrammetric Engineering and Remote Sensing*, 69, 695-704.

Lecture 5 sensor technology and lecture 6 Major remote sensing systems

The first of these lectures will introduce some of the fundamental principles of image acquisition. Attention will then focus mainly on the properties of some widely used remote sensing systems, with particular regard to their spatial resolution, spectral resolution, image size and repeat coverage. The lectures will focus on long-established and widely used systems (e.g. Landsat TM) but, as this rapidly developing subject, some of the references below point to more recent developments of which you should have some awareness.

Campbell, J. B. (2002) *Introduction to Remote Sensing*, Third edition, Taylor and Francis, London. (Chapters 4, 6 and 7).

Lillesand, T. M., Kiefer, R.W. and Chipman, J. W. (2004) *Remote Sensing and Image Interpretation*, Fifth edition, Wiley, Chichester. (Chapters 6, 7 and 8)

Mather P.M. (2004) *Computer Processing of Remotely Sensed Images*, Third edition, Wiley and Sons, Chichester. (Especially chapters 2, 5 and 6).

Richards, J.A. (1993). *Remote Sensing Digital Image Analysis. An Introduction*. Springer-verlag, Berlin. (Chapter 1).

Sabins, F. F. (1997). *Remote Sensing: Principles and Interpretation*, Freeman and Company, New York. (Chapters 7 and 8).

Considerable information on new and proposed sensor is available on the internet. For example,

ESA, 2005. *The ERS Instruments*. <http://earth.esa.int/ers/instruments/index.html>

ESA, 2005. *Envisat Instruments*. <http://envisat.esa.int/instruments/>

Hobish, M.K., 2006. *Earth Systems Science - Earth Science Enterprise and the EOS Program*. Section 16 in NASA's Remote Sensing Tutorial. <http://rst.gsfc.nasa.gov/Front/tofc.html>

NASA, 2006. *Sensor Technology*. In NASA's Remote Sensing Tutorial. <http://rst.gsfc.nasa.gov/Front/tofc.html>

NASA, 2006. *History of Remote Sensing*. In NASA's Remote Sensing Tutorial. <http://rst.gsfc.nasa.gov/Front/tofc.html>

NASA, 2006. *Other Remote Sensing Systems*. In NASA's Remote Sensing Tutorial. <http://rst.gsfc.nasa.gov/Front/tofc.html>

NASA, 2006. *Radar and Microwave Remote Sensing*. Section 8 in NASA's Remote Sensing Tutorial. <http://rst.gsfc.nasa.gov/Front/tofc.html>

NASA, 2006. *MODIS Web*. <http://modis.gsfc.nasa.gov/>

NASA, 2006. *TERRA: The EOS flagship*. <http://terra.nasa.gov/>

USGS, 2006. *Welcome to the Landsat Program*. <http://landsat7.usgs.gov/>

NOAA, 2005. *Advanced Very High Resolution Radiometer* <http://noaasis.noaa.gov/NOAASIS/ml/avhrr.html>

CRISP 2006 SPOT <http://www.crisp.nus.edu.sg/~research/tutorial/spot.htm>

DIGITALGLOBE, 2007, Quick bird http://www.digitalglobe.com/product/product_docs.shtml

Lecture 7 and 8 Introduction to image processing

This first lecture will focus on the steps necessary to prepare the remotely sensed data for use in data analysis.

Usually the raw data recorded by a remote sensor are not in a format conducive to immediate analysis but will typically contain, amongst other things, atmospheric, topographic, radiometric and geometric distortions. A series of pre-processing operations may be used to correct for these and other errors in the data. Once pre-processed appropriately, the data set is ready for classification.

The second lecture will focus on image enhancement techniques which could alter the appearance of an image in such a way that the information contained in the image is easily interpreted visually. This will also focus on various filtering techniques used to suppress or enhance some property of an image that is of interest to user.

There is a large literature on the pre-processing of remotely sensed data. As a starting-point, the following may be helpful:

Chavez, P.S. (1988) An improved dark-object subtraction technique for atmospheric scattering correction of multispectral data, *Remote Sensing of Environment*, 24, 459-479.

Chavez, P.S. (1989) Radiometric calibration of Landsat thematic mapper multispectral images, *Photogrammetric Engineering and Remote Sensing*, 55, 1285-1294.

Chavez, P. S. (1996) Image-based atmospheric corrections - revised and revisited, *Photogrammetric Engineering and Remote Sensing*, 62, 1025-1036.

Che, N., and Price, J.C. (1992) Survey of radiometric calibration results and methods for visible and near infrared channels of NOAA-7, -9 and -11 AVHRR's, *Remote Sensing of Environment*, 41, 19-27.

Ekstrand, S. (1996) Landsat TM-based forest damage assessment: correction for topographic effects, *Photogrammetric Engineering and Remote Sensing*, 62, 151-161.

Ford, G.E., and Zanelli, C.I. (1985) Analysis and quantification of errors in the geometric correction of satellite images, *Photogrammetric Engineering and Remote Sensing*, 51, 1725-1734.

Hall, F.G., Strebel, D.E., Nickeson, J.E., and Goetz, S.J. (1991) Radiometric rectification: toward a common radiometric response among multirate, multisensor images, *Remote Sensing of Environment*, 35, 11-27.

Lavreau, J. (1991) Dehazing Landsat Thematic Mapper images, *Photogrammetric Engineering and Remote Sensing*, 57, 1297-1302.

Lillesand, T.M., Kiefer, R.W. and Chipman, J. W. (2004) *Remote Sensing and Image Interpretation*. Fifth Edition. Wiley, New York (Chapter 7).

Mather, P.M. (2004) *Computer Processing of Remotely-Sensed Images - An Introduction*, Third edition, Wiley, Chichester (Chapters 5,7).

Richards, J.A. (1993) *Remote Sensing Digital Image Analysis - An Introduction*, Second edition, Springer-Verlag, London (Chapter 2).

Song, C., Woodcock, C. E., Seto, K. C., Lenney, M. P. and Macomber, S. A. (2001) Classification and change detection using Landsat TM data: when and how to correct atmospheric effects, *Remote Sensing of Environment*, 75, 230-244.

Ichoku A, Meisels A, Chorowicz J (1996) Detection of drainage channel networks on digital satellite images. *International Journal of Remote Sensing*, 17, 1659–1678.

Budkewitsch, P., Newton, G., and Hynes, A. J.(1994) Characterization and extraction of linear features from digital images. *Canadian Journal of Remote Sensing*, 20, 268- 279.

Marr D. and Hildreth, E. (1980), Theory of Edge Detection, *Proceedings of the Royal Society of London*. Series B, Biological Sciences, Vol. 207, No. 1167. 187-217.

Lecture 9 Estimating Earth's Surface Properties using Remote Sensing

This lecture provides an introduction to how remotely sensed images can be processed and analysed to derive properties and information about the status of the surface types present on Earth. References will be given in the lectures but it is also advisable to supplement your reading with applications from the literature e.g. through reading journals such as *Remote Sensing of Environment* and *International Journal of Remote Sensing* etc.

Rouse, J.W., R.H.Haas, J.A.Schell, and D.W.Deering, 1973: Monitoring vegetation systems in the great plains with ERTS, *Third ERTS Symposium*, NASA SP-351 I: 309-317.

Dash, J, and Curran, P. J., (2004). The MERIS terrestrial chlorophyll index, *International Journal of Remote Sensing*, 25, 5403-5413.

Huete, A., Justice, C., and Liu, H. (1994). Development of vegetation and soil indices for MODIS-EOS. *Remote Sensing of Environment*, 49, 224– 234.

Jensen J. R. (2000) *Remote Sensing of the Environment: An Earth Resource Perspective*, New Jersey; Prentice Hall (chapter 11).

Martin, S., (2006), *An introduction to ocean remote sensing*, Cambridge University Press, Cambridge, (chapter 5)

Lectures 10 and 11 Image Classification

Digital image classification is the process of assigning pixels to classes. By comparing pixels to one another and to those of known identity, it is possible to assemble groups of similar pixels into classes that match the informational categories of interest to users of remotely sensed data. These classes form a region on a map or image. Lectures 9 and 10 will cover the concepts of unsupervised and supervised classification.

Campbell, J. B. (2002) *Introduction to Remote Sensing*, Third edition, Taylor and Francis, London.

Czaplewski, R.L. (1992) Misclassification bias in areal estimates, *Photogrammetric Engineering and Remote Sensing*, 58, 189-192.

Fuller, R.M. (1987). The changing extent and conservation interest of lowland grasslands in England and Wales: a review of grassland surveys 1930-1984. *Biological conservation* 40, 281-300

Fuller, R.M., Parsell R.J., Oliver, M. & Wyatt, G. (1989a). Visual and computer classifications of remotely-sensed images. A case study of grasslands in Cambridgeshire. *International Journal of Remote Sensing*, 10, 193-210.

Fuller, R.M. & Parsell, R.J. (1990). Classification of TM imagery in the study of land use in lowland Britain: practical considerations for operational use. *International Journal of Remote Sensing*, 11, 1901-1917.

Fuller, R.M., Groom, G.B. & Jones, A.R. (1994). The Land Cover Map of Great Britain: an automated classification of Landsat Thematic Mapper data. *Photogrammetric Engineering & Remote Sensing*, 60, 553-562

Wang, F. (1990), Fuzzy classification of remote sensing images, *IEEE Transactions on Geoscience and Remote Sensing*, 28, 194-201.

Civco, D.L. (1993), Artificial Neural Networks for Land-Cover Classification and Mapping, *International Journal of Geographical Information Systems*, 7, 173-186.

Mather, P.M. (2004) *Computer Processing of Remotely-Sensed Images - An Introduction*, Third edition, Wiley, Chichester (Chapter 8).

Lillesand, T. M., Kiefer, R.W. and Chipman, J. W. (2004) *Remote Sensing and Image Interpretation*, Fifth edition, Wiley, Chichester. (Chapter 7)