DEPARTMENT OF GEOGRAPHY
UNIVERSITY OF PORTSMOUTH

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Masters in Geographical Information Systems

2019/20

# Image processing and spatial data analysis

(U26162- 30 credits)

# Unit Handbook

# Unit outline

This unit focuses on the use of image processing and spatial analysis techniques to manage, manipulate and analyse spatial data. The unit will introduce students to the broad range of remote sensing data sources routinely used for a variety of Earth Observation applications, with a particular focus on the acquisition and analysis of these. The unit employs a variety of image processing and statistical software package to investigate and solve a number of 'real world' problems. The unit employs a 'hands on' approach to investigating such problems and develops key data analytical skills commonly used in the workplace, albeit in those types of organisations routinely dealing with spatially referenced data for managing and targeting resources.

# Aims

1. To enable students to integrate and apply geographical skills in problem solving situations requiring the spatial analysis of geographical information using a variety of software for problem solving tasks.
2. To appreciate the importance of data preparation and recoding within exploratory data analyses.
3. To progress to the analysis and modelling of geographical data with the aid of software using alternative data models and approaches.
4. To introduce the use of multivariate statistical causal modelling in geographical research and to consider alternative ways in which results can be displayed professionally and effectively within reports and other publications.
5. To understand the nature of statistical significance and confidence within the reporting of model outcomes.
6. To introduce the physical background and key applications of remote sensing datasets, including aerial photographs, satellite imagery, radar and LiDAR.
7. To apply a variety of image processing methods, including unsupervised and supervised classifications, Normalised Difference Vegetation Index (NDVI) analysis, and pan-sharpening techniques.

# Learning Outcomes

At the end of the Unit you should be able to:

1. Demonstrate a comprehensive understanding of image processing and spatial data analysis techniques and methodologies applicable to a variety of circumstances.
2. Use technical expertise or developing new skills or procedures for new situations using image processing techniques.
3. Demonstrate self-direction and originality in problem solving and act autonomously in planning and implementing image processing tasks at a professional or equivalent level.
4. Demonstrate a level of conceptual understanding that will allow him / her to critically evaluate research, advanced scholarship and methodologies and argue alternative approaches to spatial data analysis.
5. Undertake, with critical awareness, analysis of complex spatial problems communicating the outcome effectively.

# General Unit Reading

You need to read widely for this Unit. These are useful general texts:


- Fotheringham, A.S. , & Rogerson, P., 1994, Spatial Analysis and GIS, London: Taylor and Francis (0748401032)
- Longley, P.A. , Brooks, S.M., McDonnell, R. & MacMillian, B., 1998, Geocomputation: A Primer, Chichester: John Wiley & Sons (0471985759)
- Konecny, G., 2003, Geoinformation: Remote Sensing, Photogrammetry and Geographic Information System, London: Taylor Francis (0415237955)
- Lillesand T M, Kiefer R W and Chipman J W , 2015, Remote Sensing and Image Interpretation (7th Edition), London: Wiley ()
- Rogerson, P, 2014, Statistical Methods for Geography: a student's guide (4th Edition), London: Sage (978-1-4462-9573-1)
- Field A, 2013, Discovering Statistics using IBM SPSS Statistics (4th Edition), London, Sage (9781446249185)


You will find additional reading lists and resources under the major topic headings on Moodle.

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# Times and location

Sessions will take place on Wednesday mornings and early afternoon in Buckingham 2.10. Please make a note of the timetable shown below (which will also be on your portal) but tutors will confirm timetable arrangements each week.

# Timetable

| Week | Date | Time/Room | Topic | Lecturer |
|---|---|---|---|---|
| 1 (26) | 22/01/20 | 10am–1pm Bk2.10 | **Programming and Python 1**<br>Why program?<br>Python 1 – Practical exercises | AT/MS |
| 2 (27) | 29/01/20 | 10am–1pm Bk2.10 | **Programming and Python 2**<br>Programming concepts and methods<br>Python 2 – Practical exercises | AT/MS |
| 3 (28) | 05/02/20 | 10am–1pm Bk2.10 | **Programming and Python 3**<br>Programming for geo/data science<br>Python 3 – Practical exercises | AT/MS |
| 4 (29) | 12/02/20 | 10am–1pm Bk2.10 | **Spatial modelling 1**<br>Recap - The multivariate model<br>*Formative practical: revision* | LH/MS |
| 5 (30) | 19/02/20 | 10am–1pm Bk2.10 | **Spatial modelling 2**<br>Data centering; stereotypical observations, dummy variables.<br>*Formative practical on above* | LH/MS |
| 6 (31) | 26/02/20 | 10am–1pm Bk2.10 | **Spatial Modelling 3**<br>Introduction to Multilevel modelling (MLM)<br>*Formative Practical: Introduction to MLM* | LH/HL |
| **Consolidation week** | | | | |
| 7 (33) | 11/03/20 | 10am–1pm Bk2.10 | **Spatial Modelling 4**<br>MLM continued and other approaches<br>*Formative Practical continued.* | HL |
| 8 (34) | 18/03/20 | 10am–1pm Bk2.10 | **Remote Sensing/Image Processing 1**<br>Lecture: Introduction to unit, remote sensing, and assessment and study area<br>*Practical: Introduction to ERDAS and downloading and stacking satellite data* | HL |
| **Easter break** | | | | |
| 9 (39) | 22/04/20 | 10am–1pm Bk2.10 | **Remote Sensing/Image Processing 2**<br>Lecture: Image classification 1<br>*Practical: NDVI, change detection and unsupervised classification* | HL |
| 10 (40) | 29/04/20 | 10am–1pm Bk2.10 | **Remote Sensing/Image Processing 3**<br>Lecture: Image classification 2<br>*Practical: Supervised classification* | HL |
| 11 (41) | 06/04/20 | 10am–1pm Bk2.10 | **Remote Sensing/Image Processing 4**<br>Lecture: Introduction to spatial modeller<br>*Practical: Using spatial modeller for speckle removal and 'burning' vector data into a classification* | HL |

# Unit team

*Harold Lovell – Unit Leader* (HL, Buckingham, Room 2.26 – harold.lovell@port.c.uk)
*Adrian Tear – Unit Leader* (AT, Burnaby 3.04 - adrian.tear@port.ac.uk)
*Martin Schaefer – Python Support* (MS, Buckingham – martin.schaefer@port.ac.uk)
*Linley Hastewell – Data Analysis* (LH, Buckingham – linley.hastewell@port.ac.uk)

# Assessment schedule

1. Coursework (50%) – 2,000 words spatial analysis report to be submitted via Turnitin no later than 4pm, **09/03/20 (FIRST DEADLINE FROM SEGG TIMETABLE TBC)**.
2. Coursework (50%) – 2,000 Remote Sensing Report to be submitted via Turnitin no later than 4pm, **18/05/20 (SECOND DEADLINE FROM SEGG TIMETABLE TBC)**.

# A note on your electronic submission

- All text must be in black, font size 12 (Times New Roman or Arial), double spaced with the default margins (3.17cm left and right).
- The Student ID must be in the footer on all pages.
- A submission coversheet must be included at the start of the submission which will be supplied by the unit leader via the Moodle site. This cover sheet will have a space to include the word count.
- All coursework to be submitted via the Turinitin drop box
- Students must use their student ID number as the file name when uploading the files to Turnitin.