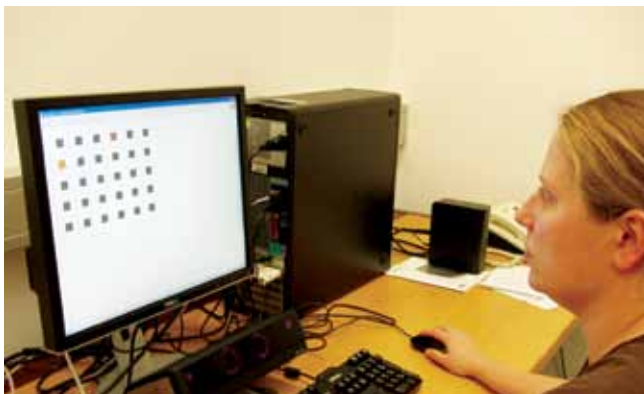


Geographic Information Science

Geographic Information Science is the study of the fundamental principles of geographic information and what makes geographic information different from other types of information. It is an interdisciplinary field, composed of researchers from geography, information science, cognitive psychology, mathematics, engineering, surveying, computer science, statistics and philosophy. Its focus is on theoretical advances in the handling, representation and communication of geographic information rather than on individual applications of geographic technologies (e.g., GPS, GIS and Remote Sensing). Within PEMS, our focus is on the representation and communication of geographic information, although several individuals in School of Engineering and Information Technology (SEIT) work on problems of data handling. Research in our group includes topics ranging from radar remote sensing of large mining projects in the Asia Pacific Region to evaluating the effects of data quality and error propagation on spatial analysis to understanding perceptual and cognitive factors that influence whether or not map readers see moving clusters in animated maps.



This image shows the infrared light from the eye-tracker that is being bounced off my eyes to detect where I am looking.



This image shows an introduction screen from the test instrument that we use to investigate visual cluster detection.

Members

Academic Staff:

Dr Amy Griffin (a.griffin@adfa.edu.au) BA (Hons) *Macalester College*, MSc, PhD Pens, GrCrt *UNSW*

Prof. Brian Lees (b.lees@adfa.edu.au) BA PhD *Syd.*

Dr David Paull (d.paull@adfa.edu.au) MA *Adel.*, PhD *UNSW*

Visiting Fellows:

Assoc. Prof. Zhongming Wen (z.wen@adfa.edu.au) PhD *CAS*

Dr Robert J. Williams (bob.williams@dsto.defence.gov.au)

Research Students:

Bahaa Eldin Aly Abdel Alim Abdel Hamid – Research Topic – Multi-agent spatial modeling of Equine Influenza.

Jin (Tracy) Cui - Research Topic - Classifying urban green space distribution: Analyzing spatial relationship of human-natural process by integrating remote sensing and socioeconomic data.

Thomas Grice - Research Topic - A case study on the impact of geospatial uncertainty on dynamic decision making during the Aceh Tsunami response in 2005/06.

Shibani Mishra - Research Topic - Developing a spatial database and GIS application for natural resource assessment and management for sustainable development in coastal Orissa, India.

Recent Graduate Student:

Bambang Hendro Trisasongko - Research Topic - Monitoring a mine-influenced environment in Indonesia through radar polarimetry, Masters Thesis, 2008.

Research Collaborators:

Cartographic Representation and Geographic Information Science

Prof. Hussein Abbass (SEIT, UNSW@ADFA)

Dr A. Banos (Centre National de la Recherche Scientifique, Laboratoire Image et Ville, Universite Louis-Pasteur)

T. Bhowmick (GeoVISTA Center, Penn State University)

Dr P. Durr (CSIRO)

Prof. S. Fabrikant (University of Zurich)

Ms B. Kluhmann (Penn State University)

Prof. E. Lengerich (Penn State University)

Prof. A. MacEachren (GeoVISTA Center, Penn State University)

Dr A. Robinson (GeoVISTA Center, Penn State University)

Remote Sensing and Environmental Monitoring

Assoc. Prof. Glenn Banks (Massey University, New Zealand)

Dr C. Ballard (ANU)

Prof. D. Gillieson (JCU)

Geographic Information Science and Artificial Intelligence

Dr B. McKay (UNSW@ADFA)

Dr S. Yin (UNSW@ADFA)



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Current Research

Clusters on the move (with Sara Fabrikant):

Dr Amy L. Griffin

One of my current research projects is investigating the process of visual cluster detection in animated and static maps. In this research, we are examining the effectiveness and efficiency of different visual representations for seeing clusters that move through space and over time. We do this through experimental work with map readers, using methods such as behavioral analysis and eye-tracking. We have also explored the use of signal detection theory for describing map readers' success rates in correctly identifying moving clusters. In late 2007, I collected eye-movement data while working with Sara Fabrikant at the University of Zurich in Switzerland. We have also recently acquired an eye-tracker in the School of PEMS at UNSW-ADFA.

'Are Google and Web 2.0 making us stupid?': Spatial information synthesis in a data-rich age

Dr Amy L. Griffin (with Anthony Robinson)

The Internet has changed the way many people work. Instead of having too little information, our problem is now sorting through, evaluating the reliability of and integrating a surplus of information into a coherent understanding of 'the big picture'. Many professions, including intelligence analysis, emergency response and policy development require workers to integrate spatial information to solve important problems. Our research examines the impact of interactive digital technologies on how well we integrate geographic information and will produce guidelines for developing computer tools and strategies that information workers can use to more accurately and efficiently bring together information from multiple sources and formats.

This research aims to understand whether and how using interactive digital spatial technologies alters our thinking habits and capacities. Specifically, we investigate spatial information synthesis – the integration of spatial information from multiple, messy sources to develop a coherent story about a problem. This information integration task (synthesis) - the ability to see 'the big picture' - is important in professions as diverse as emergency response, intelligence analysis and policy development and its results are often the basis for important decisions. Knowledge of the effects of technology on our thinking habits will enable the development of more effective computer tools and training materials to better support this capability.

Geographical analysis and environmental modelling; Geocomputation; Coastal geomorphology; the application of geographical analysis and environmental modelling, GISc and remote sensing to managing global change

Professor Brian Lees

Professor Lees and his students maintain an active research program focused on aspects of Global Change.

The **first phase** was the construction of a database of geomorphic evidence for past climate change across northern Australia. Most of this information has been published. A comprehensive review and re-assessment of this work is in preparation together with a reassessment of the implications of chenier dates in Northern Australia.

The **second phase** arose from the initial International Global-Biosphere Program (IGBP) meetings where it was clear that a great number of scientists from other disciplines were placing an unwarranted reliance on remote sensing to detect global change.

Prof. Lees set up a research program to improve the reliability of change detection techniques. This led to work in adapting inductive and data driven modelling techniques to the predictive mapping of land cover and land degradation. Prof. Lees and his students, have built up comprehensive GIS databases based on a range of field sites. These have been used to test, and refine, the use of inductive learning, and other artificial intelligence techniques such as neural networks and genetic algorithms, for environmental management. We have been very successful. Some of this work has been published, but some is currently in preparation, including new work on the impacts of DEM error, and on the rescaling of SRTM data.

Prof. Lees set up a major database to test, refine, and develop these techniques at Kioloa field station (www.geography.anu.edu.au/associated/pathfinder/index.html). This was subsequently adopted as one of the 60 or so NASA LANDSAT PATHFINDER GLCTS PROJECT sites. This was NASA's main high resolution, long-term, land cover change detection project. NASA was seeking very high quality, high-resolution, data-rich sites for this project and it was a triumph to be one of the final selections. There were only four of these sites identified in Australia and the Kioloa site is the only one to have been completed. Through NIES and NASDA Prof. Lees has received a considerable amount of support, and Japanese and NASA data for this site. The research activity of Prof. Lees continues to be the development of tools to carry out integrated analysis of these data.

The **third phase** of research has been recently developed through the active encouragement of Professors Barry Garner and Ron Horvath. They encouraged thinking about, and application of some of the analytical skills and techniques I had developed to social geographic problems. This has led to encouragement of several PhD candidates, a human geographer, an ecologist and a geomorphologist, to consider tackling such problems.

In concert with established social researchers, such as Chris Devery and Jerry Ratcliffe, and the NSW Police, we have started applying geographical analysis to crime and disorder. Several papers have been submitted on the topic. This integration of quite diverse strands of geographic thought is proving very productive and several more projects are under consideration.

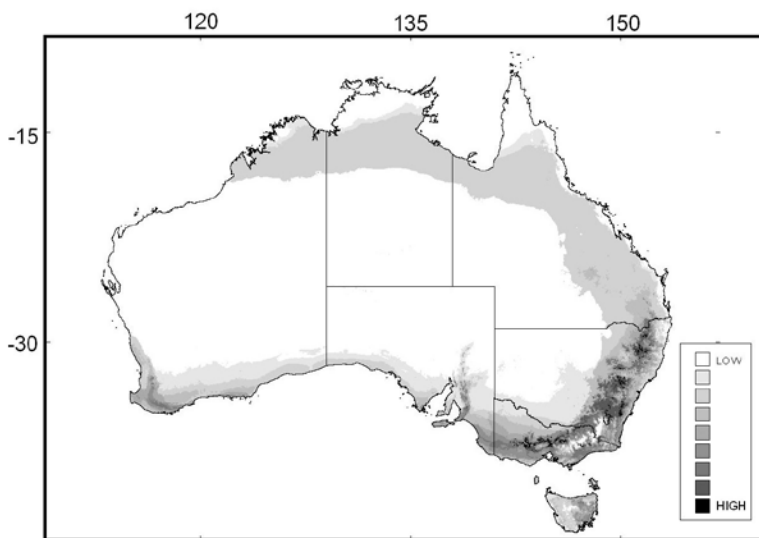
Predicting truffle growing areas in Australia

Dr David Paul

The Australian Black Truffle industry is a young and burgeoning enterprise. First established in Tasmania in the 1990s, productive truffle orchards or truffières are currently found in WA, SA, Vic and NSW, with immature plantings also in SA and Qld. In these truffières, the fungus *Tuber melanosporum* is inoculated onto the roots of host trees, including oaks and hazelnuts. Maturation of Australian truffles occurs in winter, which is the Northern Hemisphere off-season, thus creating an export niche to high demand markets in Europe and Asia. This study aims to map existing Australian truffières, characterise their physical geography and predict the distribution of land that may be suitable for future production. To date no rigorous attempt has been made to identify the places best suited for truffles and their host trees but it is generally recognised they grow well in free draining soils where summers are hot and winters are cold. Other factors that determine success of truffières include access to water for irrigation

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and proximity to air freight for export. Based on an understanding of the ecological requirements of truffle and host, this study integrates spatial datasets of climate, soil and infrastructure to predict where the industry may expand.



Suitability of climate for growing Black Truffles in Australia.

Recent Achievements

Brian Lees has been invited to take part in the prestigious European Commission's Erasmus Mundus Scheme. This scholarship is funded by the European Union and provides for a one month visit to the GEM Consortium (GEM - Geo-Information Science and Earth Observation for Environmental Modelling and Management) members between September 2009 and March 2011. The Erasmus Mundus Scheme (2009-2013) is a program encouraging cooperation and communication in higher education and aims to enhance the quality of European higher education and to promote dialogue and understanding between people and cultures through cooperation with Third Countries.

Student Research

A case study on the impact of geospatial uncertainty on dynamic decision making during the Aceh Tsunami response in 2005/06

Thomas Grice (thomas.grice@student.adfa.edu.au) MPhil (started 03/2009)

Field of Study: Geographic Information Science

Classifying urban green space distribution: Analyzing spatial relationship of human-natural process by integrating remote sensing and socioeconomic data

Jin Cui (j.cui@student.adfa.edu.au) MSc

Field of Study: Geographic Information Science

Research over the past two decades has highlighted the many benefits of urban green space brought to human beings. The spatial

distribution of urban green space is influenced by human activities and social economic development through time. Cities can be seen as sustainable ecosystems, but the connection between urban green space, socioeconomic and biophysical factors in varying combinations, and quality of life is not comprehensively understood. The focus of the project is to use GIS and remote sensing to investigate how these factors interact in space and time.

Developing a spatial database and GIS application for natural resource assessment and management for sustainable development in coastal Orissa, India

Shibani Mishra (s.mishra@student.adfa.edu.au) PhD

Field of Study: Geographic Information Systems

This research focuses on developing a public participation GIS for the sustainable management of fisheries resources in Orissa, India. Currently, the fisheries resources at Chilika Lake are threatened by over-exploitation and environmental pollution. Barriers to the sustainable development of this area include a lack of updated environmental information and the lack of a method whereby residents of the region can participate in making decisions that affect the lake's resource base. This research involves developing a public participation GIS that will both be a repository of current environmental information and provide a forum through which village members can cooperatively work to develop a management strategy that will satisfy the needs of village members without destroying the resource base.

Multi-agent spatial modeling of Equine Influenza

Bahaa Eldin Aly Abdel Alim Abdel Hamid (b.abelhamid@student.adfa.edu.au) PhD

Field of Study: Geographic Information Science

This research aims at designing and developing an integrated modeling framework for studying the dynamics of spread of infectious diseases. The framework incorporates several modeling approaches ranging from the classical system of differential equations to the more sophisticated and spatially explicit Cellular Automata and Agent Based approaches. It should be able to handle different data availability situations as they arise in the different stages of a disease outbreak. It can be used to study the behavior of various hypothetical disease spread scenarios and test the outcomes of various prevention, containment and eradication strategies that can be directed to a potential outbreak before making any real investment in a certain strategy.

PhD Opportunities and Scholarships

If you are interested in a PhD or Masters by research in Geographic Information Science:

Contact:

Prof. Brian Lees (b.lees@adfa.edu.au)

Dr Amy Griffin (a.griffin@adfa.edu.au)

Dr David Paull (d.paull@adfa.edu.au)



Geographic Information Science

Major Facilities

- ENVI, Definiens and ERDAS Imagine remote sensing packages, ArcGIS software.
- Eye tracking laboratory with Tobii eye-tracker

Publications

In Press

Journal – Letter or note

Griffin, A.L., Book Review: Map Use, Reading and Analysis, Sixth Edition, Kimerling, A.J., Buckley, A.R., Muehrcke, P.C. & Muehrcke, J.O., ESRI Press, Redlands, *Journal of Spatial Science*.

Conference - Full paper (Non-refereed)

Abdel Hamid, B.E. & **Griffin, A.L.**, Durr, P., Disease outbreak dynamics: modeling and simulation for complex realities, *European Conference on Complex Systems*, 2009 (ECCS'09).

Griffin, A.L., 2009, Analyzing sequential data from geovisualization user interfaces, *Proceedings of the International Cartographic Conference*, Santiago, Chile, 15-20 November 2009, (no page numbers).

2009 publications

Journal - Refereed

Griffin, A.L. & Bell, S., 2009, Applications of signal detection theory to geographic information science, *Cartographica*, 44(3), 145-158.

Simmonds, F., Wang, X.H. & **Lees, B.G.**, 2009, Comment on 'Marine GIS: Identification of mesoscale oceanic thermal fronts', *International Journal of Geographic Information Science*, 23(3), 369-373, doi: 10.1080/13658810701851404.

Journal – Letter or note

Lees, B.G., 2009, Recent trends in IJGISc (editorial), *International Journal of Geographical Information Science*, 23(1), 1-6, doi: 10.1080/13658810802628594.

Fisher P. & **Lees, B.**, 2009, Peter Alan Burrough in memoriam, *International Journal of Geographic Information Science*, 23(4), 551, 10.1080/13658810902885292.

Other refereed contribution – editor of journal issues

Lees, B.G. (ed.), 2009, *International Journal of Geographical Information Science*, 23(1-2).

Book - Chapter

Griffin A.L., 2009, Color mapping, in *International Encyclopedia of Human Geography*, volume 2, R. Kitchin & N. Thrift (Eds), Oxford, Elsevier, pp. 195-201.

Griffin A.L., 2009, Information graphics, in *International Encyclopedia of Human Geography*, volume 5, R. Kitchin & N. Thrift (Eds), Oxford, Elsevier, pp. 459-468.

Roddick, J. R & **Lees, B.G.**, 2009, Spatio-temporal data mining paradigms and methodologies, in *Geographic Data Mining and Knowledge Discovery*, Second Edition, H.J. Miller & J. Han (eds), Chapman & Hall/CRC, Boca Raton, pp. 27-44.

2008 publications

Book - Edited

Zhou, Q., **Lees, B.G.** & Tang, G., 2008, *Advances in Digital Terrain Analysis*, Springer-Verlag, Germany.

Book - Chapter

Griffin, A.L., 2008, Visual Variables, in *Encyclopedia of Geographic Information Science*, K. Kemp (Ed), Thousand Oaks, CA, SAGE Publications. pp. 506-509.

Jupp, D.L., **Lees, B.G.**, Rui, L. & Suiping, F., 2008, The application of 3S technology to Plank Road research and development of spatial information systems in the Qinling and Daba Mountains: I. Geographical, geological and historical background, in *The Collected Papers of the International Symposium on Historical Research of Plank Roads and Applications of 3S Technology*, Shan Xi People's Education Publisher, China, pp. 6-55.

Jupp, D.L., **Lees, B.G.**, Rui, L. & Suiping, F., 2008, The application of 3S technology to Plank Road research and development of spatial information systems in the Qinling and Daba Mountains: II. 3S Technology and the Australia-China project, in *The Collected Papers of the International Symposium on Historical Research of Plank Roads and Application of 3S Technology*, Shan Xi People's Education Publisher, China, pp. 55-77.

Lees, B.G., 2008, Progress in digital terrain analysis, in *Advances in Digital Terrain Analysis*, Q. Zhou, B.G. Lees, & G. Tang, (eds), Springer-Verlag, Germany, pp. 461-462.

Lees, B.G., 2008, Remote sensing, in *The Handbook of Geographic Information Science*, J.P. Wilson, A.S. Fotheringham (eds), Blackwell Publishing, US, pp. 49-60.

Lees, B.G., 2008, The Language and grammar of maps, in *The Collected Papers of the International Symposium on Historical Research of Plank Roads and Applications of 3S Technology*, Shan Xi People's Education Publisher, China, pp. 175-203.

Lees, B.G., Huang, Z.F., Van Niel, K. & Laffan, S.W., 2008, The impact of DEM Error on predictive vegetation mapping, in *Advances in Digital Terrain Analysis*, Q. Zhou, B.G. Lees, & G. Tang, (eds), Springer-Verlag, Germany, pp. 349-362.

Zhou, Q., **Lees, B.G.** & Tang, G., 2008, Advances in digital terrain analysis: the TADTM Initiative', in *Advances in Digital Terrain Analysis*, eds, Springer-Verlag, Germany, pp. 3-10.

Journal - Refereed

Bhowmick, T., **Griffin, A.L.**, MacEachren, A.M., Kluhsman, B.C. & Lengerich, E.J., 2008, Informing geospatial toolset design: Understanding the process of cancer data exploration and analysis, *Health & Place*, 14(3), 576-607, doi: 10.1016/j.healthplace.2007.10.009.

Journal - Letter or note

Lees, B.G., 2008, Just another node..., *International Journal of Geographical Information Science*, 22(1), 1-3.

Conference – Full Paper (Non-refereed)

Griffin, A.L., 2008, Applying sequence alignment for analyzing user interactions with geovisualizations, *Autocarto 2008*, 8-10 September 2008, Shepherdstown, WV.

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Thesis

Trisasongko, Bambang, 2008, Monitoring a mine-influenced environment in Indonesia through radar polarimetry, School of Physical, Environmental & Mathematical Sciences, Australian Defence Force Academy, UNSW, Masters Thesis, Available at: <http://handle.unsw.edu.au/1959.4/39747>.

Grants

External Grants

A. Griffin, Scholarship top-up for Bahaa Abdel Hamid, CSIRO, 2009: \$7,000.

UNSW Grants

A. Griffin (with H. Abbass, M. Barlow, S. Alam & M. Copeland, co-CIs), Eye tracking laboratory, UNSW Major Equipment and Infrastructure Investment Scheme(MREII), 2009: \$76,000.

A. Griffin, Multi-agent spatial modeling of equine influenza, DSARC Scholarship 2007-2010: \$60,000.

Conference Participation

Griffin, A.L., Signal detection theory and its potential application to geographic visualization, *Association of American Geographers 2008 Annual Meeting*, 15-19 April 2008, Boston, MA, USA.

Griffin, A.L., Applying sequence alignment for analyzing user interactions with geovisualizations, *Autocarto 2008*, 8-10 September 2008, Shepherdstown, WV.

Griffin, A.L., Signal detection theory as a method for understanding map-driven decision-making under conditions of uncertainty, *NACIS XXVII*, 8-11 October 2008, Missoula, MT.

Griffin, A.L. & Fabrikant, S., Clusters on the move: Why animations are better for cluster detection, *GIScience 2008*, 23-26 September 2008, Park City, UT.

Griffin, A.L., Analyzing sequential data from geovisualization user interactions, *Association of American Geographers 2009 Annual Meeting*, 22-27 March 2009, Las Vegas, NV, USA.

Griffin, A.L., Analyzing sequential data from geovisualization user interfaces, *International Cartographic Conference*, 15-20 November 2009, Santiago, Chile.

Hamid, B.E.A.A.A., *European Conference on Complex Systems, 2009 (ECCS'09)*, 21-25 September 2009, University of Warwick, UK.

Lees, B., Laffan, S., Jupp, D. & Yang, Q., The effects of re-scaling terrain variables, *Association of American Geographers 2008 Annual Meeting*, 15-19 April 2008, Boston, MA, USA.

Mishra, S., Encroachment: A threat to resource sustainability in Chilika Lake, India, *2009 Conference of the Institute of Australian Geographers*, 28 September-1 October 2009, Cairns, Australia.

Memberships

Dr Amy Griffin

- Member, North American Cartographic Information Society
- Member, Australian and New Zealand Map Society Inc.
- Member, Canadian Cartography Association
- Member, British Cartographic Society
- Corresponding member, International Cartography Association Commission on Geovisualization

Service

Dr Amy Griffin

- Editorial Board Member, *Cartographic Perspectives*
- Editorial Board Member, *Cartographica*
- Board of Directors, North American Cartographic Information Society
- Business Manager, Australian and New Zealand Map Society Inc.
- Secretary, GIScience Study Group, Institute of Australian Geographers

Prof. Brian Lees

- Appointed as a Special Invited Professor, Institute of Soil and Water Conservation (ISWC), Chinese Academy of Sciences, Yanling.
- Appointed as an Adjunct Professor in the State Key Laboratory of Resources and Environmental Information Systems (LREIS), Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Science, Beijing.
- Member of the Academic Consultative Committee, Key Laboratory of Virtual Geographic Environment, Nanjing Normal University, Ministry of Education, China.
- Chairman of the International Geographical Union Commission on Geographical Information Science.
- Member of the Australian Academy of Science National Committee for Geography.
- Editor in Chief, *International Journal of Geographic Information Science*.
- Editorial board of *GEOINFORMATICA*.

Visitors

Dr A. Robinson, GeoVISTA Center, Penn State University was hosted by **Amy Griffin**.

Assoc. Prof. Zhongming Wen is being hosted by **Brian Lees** for most of 2009. Dr Wen's special research interest is in spatial ecology.