



COMBINING HEALTH INFORMATION, COMPUTATION AND STATISTICS

ANNUAL REPORT 2011

CHICAS is a statistics research group led by Professor Peter Diggle, and based in the School of Health and Medicine at Lancaster University. Research in CHICAS is concerned with the development and application of novel statistical and epidemiological methods, motivated by substantive problems in the biomedical and health sciences.

The type of work we do

- Methodological research in the fields of spatial and longitudinal statistics, with an emphasis on health outcomes, and in the field of environmental epidemiology
- Collaborative work with universities, and national and international health agencies on investigating the risk factors for and distributions of a wide range of health outcomes
- Postgraduate and continuing professional development training in statistics and epidemiology

Research

Members of CHICAS have particular expertise in the following methodological areas:

- Longitudinal data analysis
- Spatio-temporal statistics
- Latent variable methods
- Environmental epidemiology
- Exposure modelling

Examples of recent methodological work:

- Preferential sampling in model-based geostatistics
- Handling positional errors in geostatistical data
- Partial likelihood methods for spatio-temporal point process data
- Joint modelling of repeated measurements and time-to-event outcomes
- Bivariate spatial modelling



Current applications of our work and ongoing studies:

We aim to apply our methods to substantive problems in the broad field of epidemiology, although we also work on projects in fields such as criminology and psychology. Examples of some current projects and collaborators are:

- Developing an early warning system for incipient renal failure in primary care patients, with Royal Salford Hospital and the University of Minho (PD)
- Short term forecasting of meningitis epidemics in sub-Saharan Africa, with the Meningitis Environmental Risk Information Technologies (MERIT) consortium (PD, LA, MS)
- Developing methods and software for modelling the early outbreak of H1N1v (Swine Flu) in the UK from 2009, with the Health Protection Agency West Midlands (PD, BR)
- Assessing the risk of adverse health outcomes in the proximity of large incinerators in England, with the Health Protection Agency North West (NR, PD, TF, TK)
- Causal models of executive function in pre-school children (IS-T)
- Evaluation of a training programme for oncologists, with the University of Sussex (IS-T)
- Modelling the spatio-temporal distribution of Leptospirosis incidence in Salvador, Brazil, with Fiocruz Research Foundation and Yale University (PD, MC, NC, MS)
- Prevalence mapping of Loa loa in equatorial Africa, with the African Programme for Onchocerciasis Control (APOC) (PD, BR)
- Risk of cancer with exposure to industrial pollutants, with the Spanish Centre for Epidemiology (RR, PD)
- Paternal occupation and risk of childhood cancer (TK)
- Nerve agent exposure in UK servicemen 1939-1989 (TK)
- Relative deprivation and coronary heart disease in England (TK)
- Spatial modelling of lymphangiogenesis in the uterine cervix, with University Hospitals of Morecambe Bay NHS Foundation Trust (TF)
- Modelling patient safety data with University Hospitals of Morecambe Bay and Lancashire Teaching Hospitals NHS Foundation Trusts (LD, PD)

Teaching and CPD

Staff in CHICAS are involved in a variety of teaching activities at undergraduate and postgraduate level. These include the delivery of an environmental epidemiology MSc module, several Special Study Modules on the undergraduate medical curriculum and short courses in model-based geostatistics and longitudinal data analysis.



Consulting and other collaborative work

We are actively engaged in collaborative health-related research through ongoing consultancy contracts with:

- The National Institute for Health Research, Research Design Service (RDS) in the North West region
- Lancashire Teaching Hospitals NHS Foundation Trust
- Liverpool Women's NHS Foundation Trust

Staff

Professor Peter Diggle is head of CHICAS. His research interests are in spatial and/or temporal models and methods; applications in UK and developing country settings include swine flu, norovirus (winter vomiting) and incipient renal failure in the UK, Loa loa (eyeworm) in equatorial Africa, meningitis in sub-Saharan Africa, Leptospirosis (Weil's disease) in northern Brazil.

Collaborating institutions include the Health Protection Agency and the NHS in the UK, Johns Hopkins, Columbia and Yale Universities in the USA, Fiocruz Research Foundation in Brazil, World Health Organisation in Switzerland, Niger, Burkina Faso.

Dr Tom Fanshawe, lecturer in medical statistics. His main research area is in developing spatial statistical methods with applications in environmental epidemiology. He is also a core adviser for the National Institute for Health Research, Research Design Service (RDS) in the North West region.

Dr Thomas Keegan, lecturer in epidemiology. His research interests are in the areas of environmental and occupational epidemiology. Recent work includes assessing exposures to chemicals at Porton Down and measuring the impact of area-level deprivation inequality on rates of coronary heart disease mortality in England.

Barry Rowlingson, senior research associate. He is developing methods and software for modelling the early outbreak of H1N1v (swine flu) in the UK from 2009, and more generally works at the interface between statistical modelling and open-source software environments for space-time statistical data analysis and mapping.

Dr Ivonne Solis-Trapala, MRC research fellow in biostatistics. Her current research is in statistical modelling of longitudinal discrete data motivated by collaborations in projects of psycho-oncology, developmental psychology and bipolar disorder.



Dr Olivia Grigg, research associate. She is working to develop novel statistical methods suitable for applications such as the prediction of emergent meningitis in sub-Saharan Africa and the rapid detection of possible disease outbreaks in the UK.

Dr Ben Taylor, research associate. He is working collaboratively on spatio-temporal statistical methods and associated computational algorithms, and the integration of these into web-based information systems.

Dr Rebecca Ramis, visiting research fellow (Spanish Centre for Epidemiology, Madrid). She works on spatial statistical methodology for environmental cancer risk factors, and on a study of associations of cancer with industrial pollution, using Bayesian hierarchical models.

Dr Marcelo Cunha, visiting research fellow (Fiocruz Research Foundation, Rio de Janeiro). He works on spatial statistical methodology and its application to the epidemiology of leptospirosis in urban slum settings.

Currently there are nine full-time, part-time or visiting postgraduate students: Lydiane Agier, Philip Alderson, Nicolas Capian, Lisha Deng, Monica Teran Hernandez, Alex Oldroyd, Nicola Reeve, Michelle Stanton and Dan Wootton.

Cathy Thomson, administrative staff

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For further details of current and past projects, seminars, posters and publications by group members, and where to find us, please visit the group's website:

<http://www.lancs.ac.uk/shm/med/chicas/>



Appendix : Publications 2009-10

Carpenter, L.M., Linsell, L., Brooks, C., Keegan, T.J., *et al.* (2009). Cancer morbidity in British military veterans included in chemical warfare agent experiments at Porton Down: cohort study. *BMJ*, **338**: 655.

Fenton, S., Clough, H., Diggle, P.J., Evans, S., Davison, S., Vink, D. and French, N. (2009). Spatial and spatio-temporal analysis of Salmonella infection in dairy herds in England and Wales. *Epidemiology and Infection*, **137**: 847–857.

Gabriel, E. and Diggle, P.J. (2009). Second-order analysis of inhomogeneous spatio-temporal point process data. *Statistica Neerlandica* **63**: 43–51

Keegan, T.J., Walker, S.A.S., Brooks, C., Langdon, T., *et al.* (2009). Exposures Recorded for Participants in the UK Chemical Warfare Agent Human Research Programme, 1941-1989. *Annals of Occupational Hygiene*, **53**(1): 83-97.

Paez, M. and Diggle, P.J. (2009). Cox processes for estimating temporal variation in disease risk. *Environmetrics* **20**, 981-1003.

Venables, K.M., Brooks, C., Linsell, L., Keegan, T.J., *et al.* (2009). Mortality in British military participants in human experimental research into chemical warfare agents at Porton Down: cohort study. *BMJ*, **338**: 358.

Wilson, D.J., Gabriel, E., Leatherbarrow, A.J.H., Cheesbrough, J., Gee, S., Bolton, E., Fox, A., Hart, C.A., Diggle, P.J. and Fearnhead, P. (2009). Rapid evolution and the importance of recombination to the gastro-enteric pathogen *Campylobacter jejuni*. *Molecular Biology and Evolution* **26**(2): 385-397.

Bartolucci, F. and Solis-Trapala, I. (2010) Multidimensional latent Markov models in a developmental study of inhibitory control and attentional flexibility in early childhood. *Psychometrika*, **75**(4): 725-743.

Dadvand, P., Rushton, S., Goffec, L., Rankin, J., Diggle, P. and Pless-Mulloli, T. (2010). Using spatio-temporal modeling to predict long-term exposure to particulate matter at fine spatial and temporal scale. *Atmospheric Environment*, **45**: 659-664.

Diggle, P.J. (2010). Spatial point pattern. In *International Encyclopaedia of Statistical Science*, ed. M. Lovric. New York: Springer.

Diggle, P.J., Kaimi, I. and Abellana, R. (2010). Partial likelihood analysis of spatio-temporal point process data. *Biometrics* **66**(2): 347-354.



Diggle, P.J., Menezes, R. and Su, T-L. (2010). Geostatistical analysis under preferential sampling (with discussion). *Applied Statistics* **59**, 191-232.

Gabriel, E., Wilson, D.J., Leatherbarrow, A.J.H., Cheesbrough, J., Gee, S., Bolton, E., Fox, A., Fearnhead, P., Hart, C.A. and Diggle, P.J. (2010). Spatio-temporal epidemiology of *Campylobacter jejuni* enteritis, in an area of Northwest England, 2000-2002. *Epidemiology and Infection* **138**(10): 1384-1390.

Gelfand, A., Diggle, P.J., Fuentes, M. and Guttorp, P. (2010). *Handbook of Spatial Statistics*. Boca Raton: CRC Press.

Green, G.H. and Diggle, P.J. (2010). Contribution to the discussion of "Discovering the False Discovery Rate" by Y. Benjamini, *Journal of the Royal Statistical Society, Series B*, **72**(4): 405-416.

Grove-White, D.H., Leatherbarrow, A.J.H., Cripps, P.J. and Diggle, P.J. (2010). Temporal and farm management associated variation in the faecal pat prevalence of *Campylobacter jejuni* in ruminants in three zones in Lancashire. *Epidemiology and Infection* **38**: 549-558.

Hottor, B., Bosio, P., Waugh, J., Diggle, P.J., Byrne, S., Ahenkorah, J. and Ockleford, C.D. (2010). Variation in composition of the intervillous space in term placentas of mothers with pre-eclampsia. *Placenta* **31**, 409-417.

Rodrigues, A. and Diggle, P.J. (2010). A class of convolution-based models for spatio-temporal processes with non-separable covariance structure. *Scandinavian Journal of Statistics* **37**(4): 553-567.

Rodrigues, A., Diggle, P. and Assuncao, R. (2010). Semi-parametric approach to point source modelling in epidemiology and criminology. *Applied Statistics*, **59**(3): 533-542.

Solomon, L.R., Cheesbrough, J.C., Leonard, E., Heap, M., Al-Sayed, T., Millband, N., Waterhouse, D., Mitra, S., Rema, S., Bhat, R., Schulz, M. and Diggle, P.J. (2010). A randomized, double-blind, controlled trial of taurolidine-citrate catheter locks for the prevention of bacteremia in patients treated with hemodialysis. *American Journal of Kidney Diseases* **55**(6): 1060-1068.