OVERVIEW OF UK RESEARCH IN QUANTITATIVE GEOGRAPHY, GIS & CARTOGRAPHY

1. Background and approach
This briefing document has been developed through consultation with the Chairs and Members of the RGS-IBG’s Quantitative Methods Research Group (QMRG) and Geographic Information Science Research Group (GISRG), a number of senior UK academics and international experts attending the 2012 AAG meetings in New York. We have also consulted specialist journals in GIS, spatial analysis and cartography as well as some relevant parts of the wider scientific literature. Research Council funding, the findings of the 2008 RAE and broader impact activity have also received attention.

Our focus here is upon human, rather than physical, geography, and environmental geography receives attention only in passing1. Some of our correspondents commented that quantitative geography, GIS and cartography have become somewhat disparate areas: GIS related activity has become largely subsumed within ‘GIScience’, a term coined by US geographer Mike Goodchild in 1991 and this focus is reinforced by a biannual international conference series of this name since 2000 (www.giscience.org/). ‘Geocomputation’ is an area of activity formalised by Leeds geographer Stan Openshaw in the 1990s and has become the focus of similar international activities since 1996 (www.geocomputation.org/). The term ‘spatial analysis’ and more recently ‘geospatial analysis’ has found favour but in general there is no strong consensus about a single name for the area as it merges into many other disciplines on its edges, particularly computer science. The Quantitative Revolution in UK geography dates from the work of Chorley and Haggett in the 1960s who were key in translating the movement from Seattle, Chicago and Michigan where it had taken root in the late 1950s and early 1960s. It has not been subsumed within GIS, and retains a distinctive profile at a small number of UK universities under an even smaller number of senior academics and their junior colleagues, working in urban and economic geography, health and spatial epidemiology, and in spatial statistics2. Cartography has never had the kind of distinctive profile in the UK that it has developed in North America and parts of Europe such as Switzerland, although scientific visualisation has led to a renaissance in cartographic design principles in a small number of centres (notably in Information Science at City University, London, the Geography division at Manchester University, and at Sheffield University).

1 There are important links between this area and the development and use of methods and data in physical geography and environmental science, although our view is that there is only limited fundamental research in GIS and quantitative geography emanating from these cognate areas. Linkage is stronger to computer science, geomatic engineering and remote sensing.

2 There are however some elements of the growing tradition of ‘new economic geography’ and urban economics that are strongly quantitative in focus, and we forecast that this activity will grow in the next decade.
The vast majority of the submissions to the 2008 Research Assessment Exercise (RAE) Panel did not feature research clusters in which quantitative or GIS methods were pre-eminent. Of the 49 geography units submitted to the RAE in 2008, we estimate that no more than 15 units had 2 or more staff submitted in these areas, and of the 1,120 full time equivalents (FTE) staff entered for evaluation, we guess that no more than 75 are in the domain we are benchmarking. This we believe is a generous estimate and it includes academics who may be teaching but not actively researching this domain. This low number – some 7 percent of those researching in geography – is consistent with the general dearth of skills in quantitative methods in the UK in general and in UK social science in particular. It is quite contrary to the prominence of GIS and cartography in the US, and even in other western European countries such as the Netherlands. When we examine geography elsewhere, particularly in Asia Pacific, we find a very different picture from the UK with a strong concentration on GIS per se.

Very few of the 49 RAE units of assessment featured active research in cartography. It is apparent that all the areas in this domain account for a relatively smaller share of academic posts than was the case 20 or even 10 years ago, although this trend is less pronounced in research intensive universities. Some of our correspondents commented that these areas are much more prominent in most US departments where the discipline has been under greater pressure to demonstrate relevance, impact and co-funding with other disciplines. The paucity of quantitative training of geographers means that the subject is missing a big opportunity to become a numerate social science – there is some evidence that it is losing out to economics in fulfilling commitments to quantitative training in ESRC Doctoral Training Centres, for example. Like physical geography, quantitative geography, GIS and cartography are not well represented at most annual Royal Geographical Society conferences, but the annual GISRUK conference series (www.geo.ed.ac.uk/gisruk/gisruk.html) has been a vibrant series since 1993, and attracts c.150 delegates from disciplines with core interests in spatial analysis and GIS. UK delegates are regular participants in international specialist meetings in these areas.

Against this somewhat disparaging backcloth, a number of centres of excellence undoubtedly remain at the cutting edge of research and applications internationally. The UK has provided many of the founders of this general domain, often working in North America, and it continues to produce world class research in the field. Many of the key journals are edited from the UK, and UK academics are very active in organizing the field. There is evidence that geographers participate very successfully in interdisciplinary research teams funded within and without ESRC activities. The current focus on data, particularly spatial data, is being strongly led by UK geographers and this illustrates the important interdisciplinary focus of the effort, with UK academics being central not only to methods and data at ESRC but also to various initiatives being pioneered by other research councils, particularly EPSRC and NERC. Many individuals who received their research training in Geography today are making leading contributions in disciplines such as computer science (Glamorgan), geomatic engineering (Nottingham and University College London, UCL), information science (City University), and planning (Cardiff, Liverpool, UCL). The results of our consultation exercise also suggest that important publishing activity in these areas takes place in other disciplines, as well as in the specialist journals that have developed in GIS and spatial analysis. Our correspondents also suggest that research and outreach activities of
academics working in these areas achieve wide impact, wholly disproportionate to the small and concentrated academic base working in these areas.

2. A ten year research perspective

There is no comparator to the US University Consortium on GIScience (UCGIS) ([www.ucgis.org/priorities/research/2006ResearchNextSteps.htm](http://www.ucgis.org/priorities/research/2006ResearchNextSteps.htm)) to provide a consolidated view of research priorities in GIScience. Nor do we have a clear view of what lectures and workshops in quantitative geography, GIS and cartography are offered in the 49 programs that were evaluated in 2008 RAE. This would require a full survey that as far as we are aware has not been carried out, although there is some anecdotal evidence from GISRUK and the QMRG that the majority of departments do not offer full courses in any of these areas at the undergraduate level, notwithstanding some minimal introduction to these areas as part of basic methods training. Quantitative methods research training has been a requirement of ESRC doctoral training programmes, although this is often shared across disciplines. However there is clear evidence of leading research that contributes to the international research agenda. Important core methodological contributions have been made to agent-based modelling (UCL), Bayesian analysis (Cambridge, Liverpool), geographically weighted regression (Liverpool, St. Andrews), modifiable areal unit effects (St. Andrews) and multi-level modelling (Bristol, Imperial). Important applied contributions have been made to cartometric transformation (Sheffield), dasymetric mapping and remodelling of spatial distributions (Birkbeck, St. Andrews, Southampton, UCL), the design of areal units for population censuses and surveys (Southampton, St. Andrews), mining of ‘big’ spatio-temporal datasets (Nottingham, Leicester, UCL), demography (Leeds, Liverpool, St. Andrews) and the creation of geodemographic classifications (Bristol, Leeds, Liverpool, Sheffield, UCL).

In addition to core methodological and applications research, quantitative geography, GIS and cartography also remain in the vanguard of broader secular and interdisciplinary changes to the practice of social science. The term ‘neogeography’ has been used to describe developments in Web 2.0 mapping technology and spatial data infrastructures that allow non-specialists to assemble, share, and interact with geographic information online. A related development is the increased crowd sourcing by online communities of ‘volunteered geographic information’ (VGI). Both of these areas have strong representation across disciplines at UCL: the OpenStreetMap project originated in Physics and the Bartlett School at UCL; the Centre for Advanced Spatial Analysis (CASA) in Architecture and Planning (The Bartlett) has been at the forefront of developments in participatory web mapping; and research in citizen science and VGI has developed in Geomatic Engineering. In fact, the rise of mapping and ‘big’ data’ in the context of spatial thinking and representation in the most popular of web-based contexts is providing massive opportunities for new varieties of geographical research. Many of those involved in this domain are responding to there challenges but as the field is small numerically, there are many more opportunities that can be realised by geographers.

A second secular development has been the proliferation of spatially referenced datasets, many of them now being released for the first time under central and regional government ‘open data’ initiatives, and other re-use of administrative data. In addition to established concerns with the UK Census of Population ([inter alia](http://www.ucgis.org/priorities/research/2006ResearchNextSteps.htm)), geographers
have been at the forefront of utilising open data in a range of applications areas, including electoral geography (Bristol), understanding participation rates in higher education (Liverpool), health geography (UCL) and crime and policing (UCL). Moreover, quantitative geography and GIS are central to applied research and development in data linkage (especially work on Scotland carried out at St. Andrews) that is likely to develop apace if the Census of Population is no longer carried out post 2011. There are likely to be increasing demands upon the skill base in these areas in the future, in view of ongoing government concerns with improving transparency, accountability and economic performance against a background of austerity in public spending. In addition to ever closer work with government data, there are also signs of improved dialogue between quantitative and GIS expert geographers and the private sector, such as broad-based links arising out of ESRC’s ‘Retail Research & Data’ initiative (www.esrc.ac.uk/funding-and-guidance/collaboration/working-with-business/dissertation-opportunities.aspx).

3. Key academic outputs
Perhaps the most transformative publication of the last 10 years in terms of outreach and readership is *The Atlas of the Real World: Mapping the Way we Live* (2008: Thames and Hudson, London) by Daniel Dorling, Mark Newman and Anna Barford (available in 9 languages and nearly 100,000 sales). Dorling and his group at Sheffield have produced eight other influential atlases and books based upon statistical data over the last ten years. An enduring and authoritative statement of the principles, techniques and management practices of GIScience is the book, now in its third edition, of *Geographic Information Systems and Science* (2001, 2005, 2011: Wiley, Hoboken, NJ), authored by Paul Longley, Mike Goodchild, David Maguire and David Rhind (with all these authors other than Goodchild based in the UK). This book has wide exposure internationally in four languages.


The view of our correspondents was that specialist journals in these areas have developed well, with many being edited from the UK. Some correspondents felt that these sub-disciplines had been less well served by the Royal Geographical Society’s flagship *Transactions of the Institute of British Geographers* than is the case in the United States, where a separate section in the *Annals of the Association of American Geographers* on ‘Methods, Models and GIS’ has maintained a steady flow of manuscripts in these areas, in addition to other specialist areas. Some of our correspondents suggested that their best work was published in general scientific journals (such as *Science* and *Nature*) or journals in other more inherently quantitative disciplines such as political science and demography. Together this presents a mixed picture of the representation of these areas in the human geography literature.

4. Impact

As noted above, our sense is that the impacts of quantitative geography, GIS and cartography upon social science in general are disproportionate to the numbers of current practitioners in UK Geography. Some of the key academic outputs identified above are noteworthy for the numbers of copies sold internationally, as well as their academic content. 25 years ago ESRC promoted spatial data and GIS through their Regional Research Laboratories and the residues of this initiative are still evident in the organization of this research in the UK. Several of the groups and departments we have noted reflect this. At the same time, the US National Science Foundation’s (NSF) National Centre for Geographic Information and Analysis (NCGIA) provided a world focus for this research in the 1990s and there has been substantial interchange of ideas between the UK and US through this initiative. The European Science Foundation (ESF) GISData Initiative run from Sheffield established a major presence of these ideas in Europe in the 1990s. The ESRC Census initiative and now the development of open data applications have been heavily influenced by UK geographers in this field, and the recent initiatives by the Joint Information Systems Committee (JISC) in the geospatial domain include projects by geography researchers. Membership of key non-departmental public bodies (NDPB) such as the Advisory Panel on Public Sector Information (Batty, Longley, Rhind) and the UK Statistics Authority (Rhind) reflect this geographical expertise. Indeed the next population census project **Beyond 2011** is being driven by UK experts in GIS and cartography who are extremely active in new applications of online and participatory mapping and data mining. It is worth noting that many academics in these fields have also acquired high honours as members of various
national academies, more than proportionate to their current numerical presence in UK geography departments.

In the last ten years, the landscape established in the 1990s has changed a little in that centres and clusters of research at UCL (CASA, Geography, Geomatic Engineering), Nottingham (Geography and Engineering), Liverpool (Geography and Civic Design), St. Andrews (Geography), City University (Informatics), Glamorgan and Cardiff (Computer Science, City Planning) have emerged. Some of the centres which were part of the Regional Research Laboratory initiative 20 years ago have changed focus such as Newcastle where this domain has moved from Geography to Engineering. It is worth noting that the Irish initiative at NUI Maynooth – the National Centre for Geocomputation (NCG) – was largely established by UK researchers in the early 2000s.

A number of specific projects with wide contributions to the public understanding of science are worth noting and these include the following. Work at UCL has developed visualization and planning support systems, online mapping archives, and crowdsourcing; and work on the geo-genealogy of family names, has attracted over 1 million unique users every year (see worldnames.publicprofiler.org/webstats/index.html), has been used by over a dozen health care organizations to improve ethnic and linguistic classification of patient records, and has been the focus of three interactive museum exhibits. Work at City University on new forms of visualization and at Sheffield on poverty and inequality indicators of various forms is making use of highly innovative methods of visualization, while work at Leeds on simulating crime and welfare policies is being used by local authorities and regional agencies. There has been a strong focus in this community on data and retailing at UCL, Southampton and Cardiff and this has had a direct impact on national policy as well as on the retail industry’s use of spatial methods for location. A variety of spinoff companies have emerged over the last 10 years from these various groups such as GeoFutures and Intelligent Space at UCL and Placr at City University, while small consulting projects have also emerged from this domain. In fact within geography, there is still considerable potential for spinoffs into the commercial and quasi public sector. But in order to realize these possibilities, there need to be many more academics appointed into this area so that geography can enrich itself with the many possibilities that beckon. For example, massive new spatial data sources are coming onstream from diverse sources such as electronic ticketing, GPS feeds from mobile phones, point of sales data and so on. All these need to be unlocked by people with key skills in GIScience and then interpreted by people with expertise in geographical thinking.

To realise these possibilities, many more than the current 7 percent of full time equivalent academics will be needed. The field is at its lowest level for 40 years but the opportunities

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3 There are 6 Fellows of the British Academy (FBA: Section S3 Anthropology and Geography) who fall squarely within the general area of quantitative geography, GIS and cartography: namely Batty, Cliff, Haggett, Rees, Rhind, Wilson (Batty, Rhind and Wilson are also Fellows of the Royal Society), and there are 4 more Fellows who use explicit quantitative methods and GIS to pursue their research, namely Bennett, Johnston, Martin and Taylor. There are 34 Fellows who are classed as geographers excluding corresponding fellows. We estimate that some 24 members of the Academy of Social Sciences are in this domain where there are a total of 833 members.
for geographical research and the training of a new generation of geographers in these skills have never been greater. This poses an enormous challenge for the field.

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