

GeoHealth Laboratory
Te tai whenua o te hau ora

GeoHealth Laboratory: Annual Report 2013-14

July 2014

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Executive Summary

This report details the activities undertaken by the GeoHealth Laboratory between July 2013 and June 2014. The report describes the infrastructure, work plan, milestones, achievements and key events in the eighth year of operation of the Laboratory; as well as outlining the aims and work plan for the coming year (July 2014 to June 2015).

• 2013-2014 Key Achievements

A key aim of the GeoHealth Laboratory is to undertake innovative and policy-relevant research in the areas of health geography, spatial and social epidemiology, and Geographic Information Systems (GIS); and to increase research capacity and research outputs in the health and GIS academic sectors. Some of the projects have been funded directly with core GeoHealth Laboratory funding and others from other external sources through opportunities which have arisen due to the profile of the Laboratory.

Research projects have continued to utilise existing Ministry of Health data sources such as the New Zealand Health Surveys, mortality, cancer registration, hospital admissions/discharge data collections and other administrative data sets, and thereby add supporting evidence and value to policy development.

Key projects this year have included:

- Continued projects looking at spatio-temporal analysis of anxiety-related health effects of the Canterbury earthquakes with preliminary results presented at international conferences.
- Concluded a series of projects and papers on the health effects of living near green (parks) and blue (water) spaces.
- The development of online health data
- Research examining comparative mortality rates between Australia and New Zealand using the Lexis mapping software program.

During 2013/2014 the Laboratory had eighteen health-related research articles published. A number of these publications were outputs of planned projects approved by the Ministry of Health. These directly fed into policy development and have been presented to policy analysts at the Ministry of Health. In 2013/14, one student successfully completed their Master's degree, two students commenced study for a Master's degree, three PhD candidates made good progress with their research and one member of staff was awarded a Doctoral Degree. With the exception of the latter, all were/are funded by GeoHealth Laboratory Scholarships.

• Plans for 2014-2015

Next year the GeoHealth Laboratory intends to increase its collaboration with the Ministry of Health by undertaking projects that reflect issues that have been highlighted by the Ministry of Health or that are of high interest to specific policy groups, take advantage of data collected in the New Zealand Health Survey, and complement the Health & Disability Intelligence (HDI) work plan. We will also start the process of establishing a Data Lab at the Geohealth Laboratory.

1. Introduction

The GeoHealth Laboratory was established in 2005 as a partnership between Health & Disability Intelligence (HDI) (formerly Public Health Intelligence (PHI)), in the Ministry of Health, and the Department of Geography, University of Canterbury. It was launched by the then Minister of Health, the Hon. Annette King MP, in November 2004 at the *GeoHealth 2004* Conference in Wellington, and formally opened on the 18th February 2005.

The Laboratory seeks to advance Ministry of Health policy and the University of Canterbury's health sciences research agenda for the mutual benefit of the New Zealand health sector. Its aims are to:

- Build a strategic partnership around health geography, spatial epidemiology, and Geographical Information Systems (GIS)
- Increase research capacity and research outputs in health and GIS.

1.1 *Eighth Annual Report of the GeoHealth Laboratory*

This is the eighth annual report of the GeoHealth Laboratory and describes the activities undertaken between July 2013 and June 2014. The report outlines the infrastructure, work plan, milestones, achievements, and key events in the eighth year of operation of the Laboratory; as well as setting out the aims and work plan in detail for the coming year (July 2014 to June 2015). It includes all the work of the Laboratory, and not just the work funded directly by the core Ministry of Health contract.

Section 2 outlines how the Laboratory is structured, including information about funding, personnel, facilities, equipment, and management. Sections 3 and 4 describe publications, completed projects, policy impacts, ad hoc work, and scholarships. Section 5 covers the important publicity and promotional activities undertaken to increase awareness and publicise the Laboratory; whilst Section 6 outlines the immediate goals for the coming year and the strategic direction beyond.

2. GeoHealth Research Laboratory Infrastructure

The structure of the Laboratory is explained under the following five sub-headings:

- Funding
- Personnel
- Facilities
- Equipment
- Management

2.1 Funding

The Laboratory has two principal funding streams, one directly provided by the Ministry of Health and the other indirectly provided by the Department of Geography at the University of Canterbury.

Ministry of Health (direct funding)

Prior funding from the Ministry of Health was set out in the contract between the Ministry of Health and the University of Canterbury dated 17th July 2009. A new contract was signed on 27th June 2012 for an additional three years of funding.

University of Canterbury (indirect funding)

The University of Canterbury provides indirect funding to the Laboratory through the Department of Geography in the form of staff time and associated resources. In addition, the Laboratory also benefits from the time given for research by its many visitors (see end of 2.2).

Additional Funding

The Laboratory attracts additional funding beyond that provided as part of the GeoHealth Laboratory contract and from the University. In the past year this has included support from Canterbury Medical Research Fund for a project looking at *Breath Exposure and Response – does increased ambient acetonitrile in the workplace environment affect the exhaled amount.*

2.2 Personnel

The Laboratory currently has two full-time researchers; Dr John McCarthy and Dr Paul Beere are based in the Laboratory at the University of Canterbury (Christchurch). As part of the partnership, the time and associated costs of the management team is provided and funded by the UC Department of Geography external to the contract costs. The Laboratory also funds Masters and PhD Scholarships (detailed in section 4 below). These students are located in, and contribute to the work of, the GeoHealth Laboratory. The Laboratory draws upon the wider expertise of Department of Geography staff. In this respect, the Laboratory

also hosts a number of Department of Geography postgraduate students and Research Assistants. Similarly, the Laboratory accesses the expertise of the wider Ministry of Health group. An outline of Laboratory personnel is provided in Table 1. Until June 2014, the Laboratory had a member of staff seconded to the Ministry of Health in Wellington. The process of recruiting a replacement is underway.

Part of the budget (amounting to approximately 3% of salary of the Laboratory Researcher posts) is allocated for training and conference attendance to enable staff development and lift the profile of the work of the Laboratory.

The flexible hosting arrangement of the Laboratory affords access to a larger pool and greater diversity in expertise than the funding permits, and is one of the main direct advantages to the Ministry of Health. This means that, in practice, for the funding of three posts, the Laboratory is able to draw upon the expertise of an excess of 40 people. This number can be added to by including the visitors to the University of Canterbury who are attracted by the presence of the Geohealth Laboratory. These have included:

- Prof. Gerry Kearns (National University of Ireland Maynooth, Ireland, 2014)
- Prof. Philippe Apparicio (Institut National de la Recherche Scientifique (INRS), Canada, 2012)
- Prof. Mike Emch (University of North Carolina, USA, 2011)
- Prof. Ian McKendry (University of British Columbia, Canada, 2011)
- Prof. Graham Bentham (University of East Anglia, UK, 2010)
- Prof. Bob Haining (University of Cambridge, UK 2009)
- Prof. Danny Dorling (University of Sheffield, UK, 2005 and 2009)
- Assoc. Prof. Howard Bridgman (University of Newcastle, Australia, 2009)
- Prof. Rich Mitchell (University of Glasgow, UK, 2007)
- Prof. Peter Brimblecombe (University of East Anglia, UK, 2007)
- Prof. Graham Moon (University of Southampton, UK, 2006)
- Prof. Robin Flowerdew (University of St Andrews, UK, 2006)
- Dr. Iain Lake (University of East Anglia, UK, 2006)
- Prof. Robin Haynes (University of East Anglia, UK, 2006)

2.3 Facilities

The Laboratory is located in a dedicated room situated within the Department of Geography. The Laboratory room is fitted with eight workstations and a hot desk. In addition, there is a large meeting table, projector and screen, a small library, a secure safe for data storage, and a white board. The laboratory is locked and has swipe-card protected entry available to Laboratory employees only. The Laboratory layout was carefully considered to provide a conducive working and research environment with an extra capacity beyond initial requirements to allow for growth and to accommodate visits from collaborators.

Table 1. GeoHealth Research Laboratory Personnel 2013-2014

Post	Location	Name
Directors	Dept of Geog	Prof Simon Kingham
	Dept of Geog	Dr Malcolm Campbell
International Advisor	Uni of Edinburgh	Prof Jamie Pearce
Postdoctoral Research Fellow	Laboratory	Dr Paul Beere
	Laboratory	Dr John McCarthy
Researchers	Ministry of Health	Ed Griffin (to June 2014)
PhD students	Laboratory	Niamh Donnellan (started February 2012)
		Daniel Hogg (started Feb 2013)
		Alison Watkins (started March 2013)
Masters students	Laboratory	Daniel Nutsford (finished February 2014)
		Nick Brunsdon (started February 2014)
		Andreas Wilson (started February 2014)
Other UC academic staff	Dept of Geog	Prof Ross Barnett (retired January 2014)
		Dr Gregory Breetzke (to June 2014)
	Dept of Maths & Stats	Dr David Conradson
		Prof Jennifer Brown Dr Elena Molchanova
Dept of Geog technical staff	Dept of Geog	John Thyne
		Paul Bealing
		Marney Brosnan

2.4 Equipment

The GeoHealth Laboratory has been refurbished to provide desk space and computer terminals for up to eight people. At present there are eight networked PCs, most with 24 inch screens. There is also a dedicated GeoHealth network drive for the storage of the geodatabase and other health-related data files which are regularly archived.

Each PC has ArcGIS software, a number of statistical applications (SPSS, R) as well as standard PC word processing and numerical software tools. These applications are updated and maintained through University of Canterbury site licenses. Technical support is provided by GIS specialists and management within the Department of Geography, and University of Canterbury central IT services.

2.5 Management

The directorship and management of the Laboratory is undertaken primarily by Prof Simon Kingham and Dr Malcolm Campbell of the Department of Geography; who are responsible for the work activities of the Laboratory. Additional research guidance and support is provided by Prof Jamie Pearce. Oversight and governance are provided by Denise Hutana and Jackie Fawcett at the Ministry of Health who, along with the Directors, are responsible for generating and agreeing the Laboratory work programme.

3. Work Plan Core Activity: Research

The Laboratory work plan is centred on three core activities: research, scholarships, and training. As these three programmes form the bulk of the Laboratory work, they are outlined in detail in the separate sections that follow.

3.1. Introduction

An integral component of the GeoHealth Laboratory's strategic aims is to undertake ground breaking and policy-relevant research in the area of health, spatial analysis techniques, and health services. Key drivers of our research have been the New Zealand Health Strategy and the HDI work plan. Attention to these drivers has assisted us in developing policy-relevant research projects which are of key strategic importance to the Ministry of Health. Our approach has been to develop projects which are not only of particular policy relevance, but also lend themselves to high quality research in line with the Department of Geography's research strategy, and are relevant to contemporary scholarship in health geography. A number of academic and research staff have been heavily involved in developing and undertaking these projects.

Following on from the progress made in the first seven years, we have continued to undertake joint and individual projects. Some of the projects are ongoing from previous years, whilst others are new, just commencing, or in the pipeline. The projects have been funded from a range of sources, published in high quality journals and employed a number of different researchers. Some of the projects have been funded directly with core GeoHealth Laboratory funding and others from other external sources through opportunities which have arisen due to the rising profile of the Laboratory. In this section, we list publications from Laboratory staff, students, and affiliated academic staff. We also provide a brief synopsis of the GeoHealth staff's key projects undertaken during the past year and plans for 2014/2015.

Research projects have continued to utilise existing Ministry of Health data sources such as the New Zealand Health Surveys, mortality, cancer registration, hospital admissions/discharge data collections, and other administrative data sets. For example, regression modelling techniques have allowed us to explore the relationships between individual health status and behaviours from routine surveys (such as BMI, diet, physical activity), and neighbourhood level contextual measures affecting obesity.

3.2. Publications 2013-14

2013

Bowie C, Beere P, Griffin E, Campbell M, Kingham S, 2013. Variation in health and social equity in the spaces where we live: A review of previous literature from the GeoHealth Laboratory. *New Zealand Sociology Journal* 28,3, 164-191.

Campbell, M.H. and Ballas, D. 2013. A spatial microsimulation approach to economic policy analysis in Scotland. *Regional Science Policy & Practice* 5, 3, 263-288. <http://dx.doi.org/10.1111/rsp3.12009>

Campbell M, Ballas D, Dorling D, Mitchell R, 2013. Mortality inequalities: Scotland versus England and Wales. *Health and Place* 23, 179-186. <http://dx.doi.org/10.1016/j.healthplace.2013.06.004>

Nutsford D, Pearson A, Kingham S, 2013. An ecological study investigating the association between access to urban green space and mental health. *Public Health* 127, 11, 1005-1011. <http://dx.doi.org/10.1016/j.puhe.2013.08.016>

Kingham S, Longley I, Salmond J, Pattinson W, Shrestha K, 2013. Variations in exposure to traffic pollution while travelling by different modes in a low density, less congested city. *Environmental Pollution* 181, 211-218. <http://dx.doi.org/10.1016/j.envpol.2013.06.030>

Kingham S, Pattinson W, Pearson AL, Longley I, Campbell M, Apparicio P, 2013. The use of a land use regression model to predict NO₂ air pollution in two small areas of Auckland. *Air Quality and Climate Change* 47, 3, 40-44.

Longley I, Kingham S, Dirks K, Somervell E, Pattinson W, Elangasinghe A, 2013. *Detailed observations and validated modelling of the impact of traffic on the air quality of roadside communities*. New Zealand Transport Agency, pp203.

Pearson AL, Pearce J, Kingham S, 2013. Deprived yet healthy: Neighbourhood-level resilience in New Zealand. *Social Science and Medicine*, 91, 238-245. <http://dx.doi.org/10.1016/j.socscimed.2012.09.046>

Pearson AL, Griffin E, Davies A, Kingham S, 2013. An ecological study of the relationship between socioeconomic isolation and mental health in the most deprived areas in Auckland, New Zealand. *Health and Place*, 19, 159-166. <http://dx.doi.org/10.1016/j.healthplace.2012.10.012>

Pearson A, Kingham S, Mitchell P, Apparicio P, 2013. Exploring hotspots of pneumococcal pneumonia and potential impacts of ejecta dust exposure following the Christchurch earthquakes. *Spatial and Spatio-temporal Epidemiology*, 7, 1-9. dx.doi.org/10.1016/j.sste.2013.08.001

Richardson EA, Pearce J, Mitchell R, Kingham S, 2013. Role of physical activity in the relationship between urban green space and health. *Public Health*, 127, 4, 318-324. dx.doi.org/10.1016/j.puhe.2013.01.004

Salmond JA, Williams DE, Laing G, Kingham S, Dirks K, Longley I, Henshaw GS, 2013. The influence of vegetation on the horizontal and vertical distribution of pollutants in a street canyon. *Science of the Total Environment* 443, 287-298. <http://dx.doi.org/10.1016/j.scitotenv.2012.10.101>

2014

Bowie C, Pearson AL, Campbell M, Barnett R, 2014. Household crowding associated with childhood otitis media hospitalisations in New Zealand. *Australia and New Zealand Journal of Public Health* 38, 3, 211-215. <http://dx.doi.org/10.1111/1753-6405.12162>

Campbell M, Apparicio P, Day, P, 2014. Geographic analysis of infant mortality New Zealand, 1995-2008: an ethnicity perspective. *Australia and New Zealand Journal of Public Health*. 38. 3, 221-226. <http://dx.doi.org/10.1111/1753-6405.12222>

Pearson AL, Barnard L, Pearce J, Kingham S, Howden-Chapman P, 2014. Housing quality and resilience in New Zealand. *Building Research & Information*. 42, 2, 182-190. <http://dx.doi.org/10.1080/09613218.2014.850603>

Pearson AL, Bentham G, Day P and Kingham S, 2014, Associations between neighbourhood environmental characteristics and obesity and related behaviours among adult New Zealanders. *BMC Public Health* 14, 553.

Pearson AL, Winter PR, McBreen B, Stewart G, Roets R, Bowie C, Nutsford D, Donnellan N, Wilson N, 2014. Obtaining fruit and vegetables for the lowest prices: Pricing survey of different outlets and geographical analysis of competition effects. *PLOS ONE*, 9, 3. <http://dx.doi.org/10.1371/journal.pone.0089775>

Tisch C, Pearson AL, Kingham S, Borman B, Briggs D, 2014. Environmental Health Indicators: A review of initiatives worldwide. *Management of Environmental Quality: An International Journal*, 25, 4. 4486-466.

Walls KL, Benke GR, Kingham S, 2014. Potential increased radon exposure due to greater building energy-efficiency for climate change mitigation. *Air Quality & Climate Change*, 48, 1, 16-22.

3.3. *Projects 2013-2014*

COMPLETED

1. Exploring historical trends in Trans-Tasman mortality differentials

This study focused on the determinants of health and mortality inequalities in New Zealand and Australia have been subjected to research, with the influence of a range of socio-economic and demographic influences (deprivation, social class, ethnicity) receiving notable attention. Both countries are considered privileged, positioned amongst the world leaders in rankings of mortality and life expectancy. This paper reported on observed rates of mortality and views how the countries have fared over time with respect to one another. The age-standardised rates were visualised using the Lexis mapping software program, showing the relative differences between the countries over time whilst simultaneously highlighting age, period and cohort effects. Relative to Australia, New Zealand had advantageous rates of mortality across almost all age groups between the years 1948 and 1980 (approximately). For both sexes, a reversal of fortunes in New Zealand has followed relative to Australia. For example, for younger males in New Zealand, the reversal is apparent. Over the period observed, males aged 10-20 in New Zealand have moved from an advantageous position of having a mortality rate 20% lower than Australia to a relative position of 50% higher. The social and economic forces in both New Zealand and Australia, which may have driven the divergence, require further scrutiny. It could be argued that one key element changing relative mortality fortunes are processes of selective migration, and the large-scale population movements between the two countries. These findings have important implications for policy formation and service planning, if the inequality in mortality is to be addressed.

2. Suicide and unemployment

This study explored whether male and female suicide rates are associated with variation in unemployment rates at a national level in NZ for the period 1970-2009. Suicide rates by age-group and sex in the working population (15-64 years) were calculated for the period 1970-2009. Using historical records of national unemployment for the same period, regression analyses were used to examine the effect of both quarterly unemployment rates, percentage unemployed, and the percentage change in unemployment between quarters, on national suicide rates. This relationship was adjusted for age and gender. Unemployment had a positive relationship with suicide rates such that a 1% rise in national unemployment increased suicide rates in the working age population by approximately 15.2%. Younger age groups and males were identified as being most at risk of increased suicides during periods of higher unemployment. No effect of percentage change in unemployment between quarters was evident. Periods of high national unemployment may be drivers of increased suicides in New Zealand, this relationship varied across gender and age groups. The implications are that resources should target vulnerable groups, in particular young unemployed adults and those who have been made unemployed for the first time due to adverse economic conditions.

3. Natural urban environments and their influence on mental health: the role of visibility of green and blue space

Natural environments, namely green and blue spaces, have been found to have positive influences on mental health outcomes globally. As the contribution of poor mental health to disease burden increases, the mechanisms through which natural environments may improve health are of growing importance. This study creates a novel visibility index methodology and investigates whether i) views of natural environments and ii) access to natural environments, are associated with psychological stress and physical activity in Wellington, New Zealand. It also builds upon the work conducted in New Zealand as the first

study to investigate links between blue space and mental health and provides an insight into the mechanisms through which increased natural environments may improve health. Data New Zealand Health Survey data was obtained and GIS was used to investigate whether area-level exposure to natural environments influenced their psychological stress and levels of physical activity. Results from regression analysis indicate that increased distance to visible green space (beyond 3km), visible blue space, and a combination of green and blue spaces from neighbourhood centroids reduce psychological stress. Some access measures to natural environments were found to have positive associations with psychological stress, however, increased proximal access to green space was associated with decreased physical activity. The findings conclude that the visibility of natural environments appears to have stronger associations with stress reduction than access to them. The findings of this paper should influence urban development and inform decision and policy making, particularly the development and/or relocation of health related facilities.

4. Natural urban environments and their influence on health: the role of private greenspace

The contribution of contextual factors such as greenspace exposure and accessibility towards individual health has been subject to an increasing amount of research in the recent years. However, significant results elsewhere have not been widely replicated in New Zealand. This study looked at the time spent undertaking physical activity and mental health symptoms in Auckland, New Zealand, relating it to a range of measures of neighbourhood greenspace. Greenspace exposure and accessibility was calculated for each meshblock in Auckland City using GIS. Indicators such as accessibility to usable greenspace through network distance, the area of all public greenspaces within a Euclidean buffer, the area of all greenspaces (including private gardens within a Euclidean buffer, and a new method to determine impervious surface data were incorporated into the analyses. Regression analysis related these area level variables to health variables from the New Zealand Health Survey, controlling for a range of demographic factors. Vigorous physical activity was found to be lowest in neighbourhoods with the highest access to usable greenspace, and a significant relationship was found between private greenspace and nervous disorder symptoms, although with a contradictory direction of association. No significant relationship was found between any measures of greenspace and depressive symptoms. A number of opportunities to investigate the contribution of greenspace and bluespace on health are recommended. Understanding how urban environments influence health is important to inform urban planning.

5. Breath Exposure and Response – does increased ambient acetonitrile in the workplace environment effect the exhaled amount.

Studies of pollution and health are hampered by an inability to assess pollution “dose”, i.e. pollution from various sources (woodsmoke vs vehicles) actually entering the body. This project, funded by the Canterbury Medical Research Foundation, used the SIFT-MS V200 to survey the exhaled acetonitrile concentration in participants from several departments around the University, matched with ambient air samples from their offices or laboratories. Additionally it investigated how long raised acetonitrile concentrations persist in breath after a period of non-exposure (i.e. the weekend or holidays). It was found that short exposures to high ambient concentrations increased all participants’ breath concentrations. The exhaled concentrations dropped within 30 minutes following exposure, but did not return to baseline. The length of time required for breath concentrations to return to baseline was not investigated, but based on the results of the lab workers who had significantly longer

exposure and whose breath concentrations remained elevated despite periods of non-exposure, chronic exposure to acetonitrile may result in storage by the body.

ONGOING

6. The use of Healthline and the impact on emergency department (ED) attendance: does distance from health services matter?

Telephone triage is becoming increasingly prevalent as a health tool to connect with geographically distant populations. Additionally, such services are developed as a way to address increasing issues of Emergency Department (ED) overuse and overcrowding. Telephone triage systems have been established across a range of different healthcare systems internationally with generally positive outcomes. New Zealand's equivalent, Healthline, has been present since 2001 but is yet to be the focus of intensive analysis or scrutiny. This research sought to develop an understanding of the role that distance to ED had upon Healthline users' compliance with advice given by the service. Additionally, it sought to determine whether deprivation and socio-economic status also played a role within Healthline's influence upon caller behaviour. This project is ongoing.

7. Is there a spatial relationship between the extent of physical damage from natural disasters and psycho-social stress-related health outcomes?

The 22nd February 2011 Christchurch earthquake killed 185 people, injured over 8,000, and damaged over 100,000 buildings. On-going aftershocks maintained high anxiety levels. This stage of this project examined the dose-exposure effect of earthquake damage assessments, earthquake intensity measures, liquefaction and lateral spreading, on mood and anxiety disorders in Christchurch after this event. It was hypothesised that such disorders are more likely to develop in people who have experienced greater exposure to these earthquake impacts within their neighbourhood than others who have been less exposed, but also live in the city. For this project, almost all clinically diagnosed cases in the Christchurch urban area, consisting of annual incident and relapsed cases of help-seekers, were analysed. Spatio-temporal cluster analysis shows that people living in the widely affected central and eastern parts of the city after the 2010/11 earthquakes have a 23% higher risk of developing a mood or anxiety disorder than people living in other parts of the city. Generally, mood and anxiety-related disorders increase with closer proximity to damage from liquefaction and moderate to major lateral spreading. Furthermore, it is shown that living in closer proximity to areas that are more likely to suffer from damage in future earthquakes increase the odds of having a mood or anxiety disorder.

8. Using the New Zealand Health survey for microsimulation of small areas health statistics

The early stages of this project involved a literature review of what is known about the geography of obesity in New Zealand. This is currently undergoing revision in preparation for resubmission. Additionally, the programming framework for the model was constructed and tested using small data sets. The project has moved from the initial application of a spatial microsimulation model of obesity for NZ using the New Zealand Health survey, the New Zealand Census and spatial microsimulation algorithms, to modelling patterns of obesity by small area unit. The first model has been constructed and validated against the National Diabetes Register. The next stage will involve further testing, construction, and validation of the spatial microsimulation model. The PhD scholarship began in March 2013 and forms the basis of Alison Watkins' PhD scholarship.

9. A Geospatial approach to understanding the impact of the built environment on active transport behaviours and health

A recent trend in the literature has been on investigating the effects of the built environment on active travel behaviour and related health outcomes. Research to date has focused mainly on walkability, and to a lesser extent, bikeability, of the built environment. However, other modes of transport commonly used in daily life such as public transport and car use have received less attention. One of the main aims of this research is to build on previous research and create GIS based indices of walkability, bikeability, public transport-ability and drive-ability for neighbourhoods in two cities in New Zealand: Auckland and Wellington. A second aim is to assess how these indices relate to active transport behaviours and health outcomes. These indices may be used by city planners and policy makers alike in deciding where to situate neighbourhood and community resources, as well as identify areas that can be developed to promote more active forms of transport. It is also important for health research to help inform why residents of some neighbourhoods actively engage in physical activity in their local environment while others do not. Having completed a comprehensive review of the literature on the indicators of the built environment that influence active transport and health, I am currently developing the first indicators in GIS. The next step will be to assess the relationship between these indicators, and specific health outcomes, such as physical activity and mental health.

10. Online Mapping of health data

An important development in GIS over the last two to three years has been the ability to visualise and use geographic data interactively online. Previously, if an organisation wanted to publish geographic data on the internet, they were often constrained by poor technology, high costs, use of time, and acquiring the expertise needed to implement a solution. With the advent of Google maps, open layers, open map, ArcGIS Online, and ArcGIS Server, it has become easier and relatively inexpensive for organisations to develop and implement a simple mapping solution to display their socio-spatial data. Transparency in government organisations has become an integral part of building confidence among the public and disseminating data and statistics is an important way to demonstrate openness. We are working with the Ministry to identify ways to improve access to geographic data as spatial information is currently only available on request. This project has continued to serve health data onto ArcGIS Online. The Ministry are serving six NZHS data maps at DHB level, including self-rated health (adults), parent-rated health (children), and adult and childhood obesity. There is ample scope to expand on this.

11. School scores in national standards tests and availability of greenspace in the home and school environment

Research exploring the relationship between natural environments and health outcomes has demonstrated a positive link between 'greenspace' exposure and physical and mental wellbeing. A number of case studies have demonstrated that green spaces can have a significant positive effect on improved concentration duration, behaviour in the classroom, and educational and social development for school-aged children. This paper seeks to add to the case study literature by applying Geographical Information Systems (GIS) techniques to examine the relationship between greenspace exposure surrounding primary schools in New Zealand, and academic achievement. Greenspace within a mean school zone buffer was calculated for each non-integrated primary school. National Standards data were obtained from the Ministry of Education. Using linear regression modelling, the association between greenspace exposure and the percentage of children achieving 'Above and 'Well below' National Standards was examined, controlling for, gender, ethnicity and decile. Results show that greenspace exposure has a mild, non-significant effect on school

achievement, even when controlling for gender and ethnicity. Decile has the greatest influence on school achievement, where 'Above' National standard achievement for maths, reading, and writing increases as deprivation decreases ($p < 0.001$). For reading and writing, increased greenspace corresponded to a minimal decrease in academic achievement, but this can be explained by the fact that areas of high deprivation also have more greenspace. Further analysis at smaller scales that can control for the 'quality', composition, and 'viewsheds' of greenspace to be accounted for is required to expand on these findings in order to draw comparisons to previous case study research.

3.4. Ad-hoc Tasks Completed for the Health Sector in 2013/14

The role of GIS is becoming more prominent in the health sector; however GIS capability varies greatly among DHBs as developing expertise is both expensive and time consuming. In addition to the research outlined above, GIS technicians and GeoHealth Laboratory staff in the Department of Geography and the Ministry of Health, continue to play an important role in providing GIS ad-hoc services for the Ministry of Health. These range from email and telephone advice, geocoding and mapping tasks to more advanced analytical support. The more significant ones include:

Title/Area	Outcome
NZ Health Families Scheme	Identifying communities to participate in the NZ Health Families scheme
Rheumatic Fever: Mapping	To produce a map detailing the locations of Rapid Response and Pacific Engagement Services in the Auckland and Porirua regions.
Rheumatic Fever (Phase 1): Healthcare access for 'high risk' populations	To quantify the proportion of the New Zealand population considered 'high risk' (with respect to contracting Rheumatic Fever) within specified distance of free healthcare sites
Rheumatic Fever (Phase 2): Healthcare access for 'high risk' populations	To quantify the proportion of the New Zealand population considered 'high risk' (with respect to contracting Rheumatic Fever), using improved demographic information
Analysis of COPD admission data for the Canterbury District Health Board	To quantify and visualize cases of COPD in Christchurch for the Canterbury District Health Board (CDHB).
Mapping the effect of maternity service closure for the Waikato DHB	To quantify the effect of closing maternity services on increased distance for women who gave birth at two maternity hospitals if those services were closed.

4. Work plan Core Activity: Scholarships

4.1. Introduction

A core driver of the Laboratory is to ensure that the New Zealand health sector has access to a pool of young and talented individuals that are amongst the 'best and the brightest' and have practical GIS skills in the emerging areas of geohealth research. To meet this aim the Laboratory provides two Masters Degree scholarships per year, and one PhD scholarship. The scholarships have two aims: firstly, for undertaking multidisciplinary research of practical benefit to the New Zealand health sector; and secondly, providing a gateway to the health sector that is of direct benefit to the student and health sector employers.

The Laboratory welcomes innovative scholarship research proposals from recipients from wide background across a broad spectrum of geo-health, environmental, and public health areas including:

- Neighbourhood built environments and health
 - Determinants of obesity
 - Alcohol related behaviours and harms
- Social environments and health
 - Social inequality and smoking
 - Crime and health
 - Social dimensions of cancer incidence and survival
- Physical environments and health
 - Air pollution and health
 - Environmental health indicators
- Health inequalities
- Hospital admissions and access to primary care
- Healthy, resilient populations and places
- Health service planning and use

Each Masters scholarship covers domestic tuition fees and provides a \$15,000 living allowance. For PhD scholarships this covers tuition fees and provides a \$25,000 living allowance. The GeoHealth Laboratory has also endeavoured to cover research costs associated with the student's research and, for example, is contributing towards the cost of attending conferences or other associated training. We also secured funding from the CRCSI for a PhD scholarship related to the non-injury health impacts of the Canterbury earthquakes (see Section 2.1.3).

4.2. Masters Students

1. Dan Nutsford (completed February 2014) (GeoHealth scholarship)

Subject: Natural urban environments and their influence on mental health: A New Zealand Case Study

2. Jayden MacRae (part-time, completed March 2014)

Subject: Using a natural experiment to assess the effect of spatial barriers on health service utilization.

3. Nick Brunson (commenced February 2014) (GeoHealth scholarship)

Subject: Regional patterns in excess winter mortality and morbidity amongst the elderly in New Zealand

4. Andreas Wilson (commenced February 2014) (GeoHealth scholarship)

Subject: Identify the exposure level of primary school children to obesity based on the characteristics of the food and physical environments within the surrounding neighbourhood

4.3. *PhD Students*

5. **Niamh Donnellan (commenced February 2012)** (GeoHealth scholarship)

Subject: A geospatial approach to understanding the influences of the built environment on active transport behaviours and health outcomes

6. **Daniel Hogg (commenced February 2013)** (CRCSI scholarship)

Subject: Spatial and spatio-temporal variation of stress-related health outcomes as a result of the Canterbury earthquakes

7. **Alison Watkins (Commenced March 2013)** (GeoHealth scholarship)

Subject: The social and spatial distribution of obesity in New Zealand: A spatial microsimulation approach

5. GeoHealth Laboratory Promotion

During the past year we have adopted a number of strategies to raise the profile of the Geo Health Laboratory, both domestically and internationally. These are listed below.

5.1. *Conferences and other presentations*

The work of GeoHealth Laboratory staff has been presented at a range of international conferences in the period July 2013 – June 2014.

The New Zealand Ministry of Health, Wellington, NZ (various dates)

- Brunsdon N, 2014, The Influence of private and public greenspace on short-term health indicators
- McCarthy J, 2014, Rheumatic Fever – Access to Free Healthcare
- Watkins A, 2014, A Spatial Microsimulation Approach to the Geography of Obesity in New Zealand.
- Paul Beere delivered a presentation entitled ‘Network Analysis’ to Ministry of Health employees, providing guidance in the use of the Network Analysis extension in the ArcGIS mapping software

International Medical Geography Symposium, Michigan State University, USA, 8-12th July 2013

- Bowie C, Pearson A, Campbell M and Barnett R, Otitis media associated with household crowding in a developed country.
- Griffin E, Population change and its effects on health service demand: a global issue, a spatial problem.
- Bowie C, Griffin E and Kingham S, Will disparities in access to vaccination lead to inequalities in Rotavirus among New Zealand children?
- Donnellan N, Kingham S and Campbell M, Measuring the built environment for active transport: A review.
- Griffin E, Kingham S and Costilla R, Methods to explain geographic variation of calls to a free-dial, telephone triage line.
- Nutsford D, Pearson A and Kingham S, Urban green space: does it influence our mental health?
- Hogg D, Kingham S, Campbell M, Wilson T and Ardagh M, Geographical variation in the health impacts of earthquakes in Christchurch, New Zealand.

Conference of ISEE, ISES and ISIAQ, Basel, Switzerland, 19th - 23rd August 2013

- Kingham S, Reed K, Campbell M, Hogg D, Wilson T and Ardagh M, Estimating the impact of earthquake exposure on stress related health; preliminary results from Christchurch, New Zealand.
- Kingham S, Nutsford D and Pearson A, The influence of urban green space on mental health in Auckland, New Zealand.

University of Canterbury Showcase, Christchurch, NZ, 13th November 2013

- Watkins A, The Problem with Describing the Geography of Obesity in New Zealand

CRCSI Annual Conference, University of Canterbury, Christchurch, NZ, 19-21 November 2013

Campbell M, Health and Well-Being in the Sensing City.

- Kingham, S., Hogg D, Reed K., Campbell M, Wilson T. and Ardagh M, Spatial effects of natural disasters on mental health.
- Hogg D, Kingham S, Wilson T and Ardagh M, Mood/anxiety in Christchurch after the 2010/2011 earthquakes. Poster presentation.

Rhise Group Symposium, Christchurch, NZ. 22 November 2013 (in New Zealand Medical Journal 1386. <http://journal.nzma.org.nz/journal/126-1386/5930/>)

- Kingham S, Hogg D, Reed K, Campbell M Wilson T and Ardagh M, Spatial variations in stress related health compared to earthquake exposure: preliminary results and future directions.
- Hogg D, Kingham S, Wilson T and Ardagh M, Mood/anxiety in Christchurch after the 2010/2011 earthquakes. Poster presentation.

5.2. Web pages

A comprehensive set of web pages outlining the GeoHealth Laboratory activities are available and are regularly updated by GeoHealth staff and Paul Bealing (Department of Geography, Web Administrator). For a link to the Laboratory's web page, see www.geohealth.canterbury.ac.nz/.

The site:

- outlines the aims and objectives for the Laboratory
- gives an overview of Laboratory activities
- provides details of the various GeoHealth research projects
- provides details of the available scholarships
- provides a list of recent staff publications
- provides an overview of all staff members and postgraduate students
- has regular news items

5.3. Social media

The GeoHealth Laboratory uses social media to disseminate news and features. To view the Laboratory's Twitter feed, see www.twitter.com/GeoHealthLab.

6. Plans for 2014/15

The Laboratory will continue with the three stream core work programme that underpins the Laboratory. The Directors will also aim to further increase their network of contacts and raise awareness of the Laboratory particularly across the health sector.

6.1. Research

The following research projects will be continued during the 2014/15 year:

1. **The use of Healthline and the impact on emergency department (ED) attendance: does distance from health services matter?**
2. **Is there a spatial relationship between the extent of physical damage from natural disasters and psycho-social stress-related health outcomes?**
3. **Using the New Zealand Health survey for microsimulation of small areas health statistics**
4. **A Geospatial approach to understanding the impact of the built environment on active transport behaviours and health**
5. **Online Mapping of health data**
6. **School scores in national standards tests and availability of greenspace in the home and school environment**

Additional research projects for 2014/15 are yet to be finalised but will be selected from the following list - an indication is given for their inclusion in this years' work programme:

- Obesity in the urban environment
- Obesity and the environment in and around children's routes to and from school
- Obesity: fast food, diabetes and obesity
- Microsimulation of obesity
- Alcohol and drug related harm
- Variations in coronary heart disease (ethnic, geographic)
- Rheumatic fever and overcrowding
- Rheumatic fever and free health checks
- Are rates of problem gambling (using the NZ Health Survey) associated with living near to gambling venues?
- Access to free health care for high risk populations
- Proximity to maternity health services and health baby outcomes
- Long term health conditions (using the NZ Health Survey) live nearer or further from GPs and/or hospitals?
- Is health related to sunshine exposure adding in climatic factors that could restrict likelihood of people going outside (e.g. temp, sun) and thus affect any relationship?
- Does private greenspace affect population health?
- Vulnerable children vs. before school check (BSC)

6.2. Scholarships

Scholarships will continue to be awarded to the most promising candidates with innovative research proposals.

6.3. Training

There are four undergraduate and four graduate GIS courses offered by the Department of Geography at University of Canterbury, and one undergraduate and one graduate course in Health Geography. In 2011, the new Masters in GIS (MGIS) programme, primarily developed at the University of Canterbury, commenced. This included a newly developed *Geographic Information Systems (GIS) in Health* course which includes almost exclusive contributions by GeoHealth Laboratory staff. This course provides a unique forum for those working or interested in working in the health sector to learn GIS and how this is utilised in health research. This course includes students joining by videoconference from Wellington (Victoria University) and Auckland (AUT).

6.4. Data Lab

In 2014/15 the GeoHealth Laboratory will establish a 'data lab' workstation to host sensitive datasets such as the NZHS, DHB supplied data that contains address information, and any other data supplied for 'ad hoc projects'. The GeoHealth Laboratory is also in negotiation with Statistics New Zealand about the possibility of host some of their data. This proposed workstation will have added levels of security in addition to the existing protocols governing data management in the GeoHealth Laboratory. This includes, but is not restricted to, log on access being restricted to the Directors and to the Postdoctoral Fellows employed. Additional training will be undertaken by these staff, where applicable, in order to ensure confidentiality, data quality, and analysis are conducted in appropriate ways.

6.5. Promotion and Publication

Planned Conference Attendance for 2014/15

These are conferences we currently anticipate attending to present GeoHealth related research (**not** all funded by the GeoHealth contract):

- Seminars in the Ministry of Health, Medical Schools and Geography Departments in New Zealand and around the world.
- NZGS/IAG, University of Melbourne, Australia, June 30th-July 2nd 2014.
- ISEE, University of Washington, Seattle, USA, August 24th- 28th 2014.
- CRCSI annual conference, Perth, Australia, 4th-7th November
- New Zealand Population Health Congress, Aotea Centre, Auckland, 6th -8th October 2014

Appendix A: Previous GeoHealth Laboratory Students

Masters students

Catherine Tisch (completed September 2006) (GeoHealth scholarship)

Title: [Has mortality become geographically polarised in New Zealand? A case study: 1981-2000.](#)

On completion of her Masters Catherine worked at the Institute of Environmental Science and Research (ESR) as a Health Information Analyst in the Population and Environmental Health team, then as a Research Associate with GeoHealth. Catherine has recently joined a research group in GeoSciences at the University of Edinburgh.

Katrina McPherson (completed December 2006) (GeoHealth scholarship)

Title: [Food insecurity and the food bank industry: A geographical analysis of food bank use in Christchurch.](#)

On completion of her Masters Katrina joined the Christchurch City Council as a Research Assistant.

Erin Holmes (completed March 2007) (GeoHealth scholarship)

Title: [Mandatory disease notification and under-ascertainment: A geographical perspective.](#)

On completion of her Masters Erin joined the Ministry of Health as a full time Research Analyst and is now a Senior Advisor for the National Health Committee.

Esther Rhind (completed June 2007) (GeoHealth scholarship)

Title: [Investigating the spatial distribution of campylobacteriosis in New Zealand.](#)

Esther completed a PhD at the University of Norwich, UK and now works in the research group in GeoSciences at the University of Edinburgh.

Paul Moth (completed July 2008) (GeoHealth scholarship)

Title: [Examining the environmental justice of sea-level rise and storm tides.](#)

Paul completed a four month internship with the Ministry of Health and is now teaching at a High School in the US.

Michael Brown (completed February 2009) (funded by FRST)

Title: [The health effects of PM10 air pollution in Reefton, South Island, New Zealand.](#)

Michael is working with Watercare Services in Auckland as an Environmental Analyst.

Anjeela Kumar (completed June 2010) (GeoHealth scholarship)

Title: [The effect of the neighbourhood built environment on obesity in Christchurch.](#)

Anjeela is now working at the Christchurch School of Medicine.

Sam Valentine (completed May 2011) (GeoHealth scholarship)

Title: [Public health service rationing for elective surgery in New Zealand, 2004-2007.](#)

Sam is now working as an Assistant Project Manager at Appian Group in Sydney.

Chris Bowie (completed May 2011) (GeoHealth scholarship)

Title: [Socioeconomic inequalities in adolescent smoking behaviour and neighbourhood access to tobacco products.](#)

Chris is based in Wellington, working for OPUS International Consultants.

Matt Willoughby (completed May 2012) (GeoHealth scholarship)

Title: [Neighbourhood level impact of crime on community health outcomes.](#)

Matt is now working for the Canterbury District Health Board.

Kim Reed (completed February 2013) (GeoHealth Scholarship)

Title: [The spatial and temporal patterns of anxiety and chest pain resulting from the Canterbury earthquakes](#)

Kim is currently working in Christchurch as a GIS professional.

Daniel Nutsford (completed February 2014) (GeoHealth scholarship)

Title: [Natural urban environments and their influence on mental health: A New Zealand Case Study](#)

Daniel is currently working in London as a GIS professional.

Jayden MacRae (completed March 2014)

Title: [Using a natural experiment to assess the effect of spatial barriers on health service utilization.](#)

Jayden is CEO of Patients First in Wellington.

PhD students

Jeff Wilson (completed in April 2006) (funded by University of Canterbury doctoral scholarship)

Title: [Spatial variability of intra-urban particulate air pollution: epidemiological implications and applications.](#)

Jeff is now in on the academic staff at the University of Texas, Brownsville, USA.

Laura Miller (completed in April 2008) (GeoHealth scholarship)

Title: [Population mixing and the geographical epidemiology of childhood leukaemia and type 1 diabetes in New Zealand.](#)

Laura is now working as a Spatial Analysis Research Officer with Child and Adolescent Community Health, Western Australian Department of Health.

Francis Ayuka (completed in March 2011) (GeoHealth scholarship)

Title: [Examining place influence on alcohol-related behaviour and health outcomes New Zealand.](#)

Francis is now working as a researcher in Nairobi, Kenya.