

Cartographic Activities in New Zealand 2015-2019

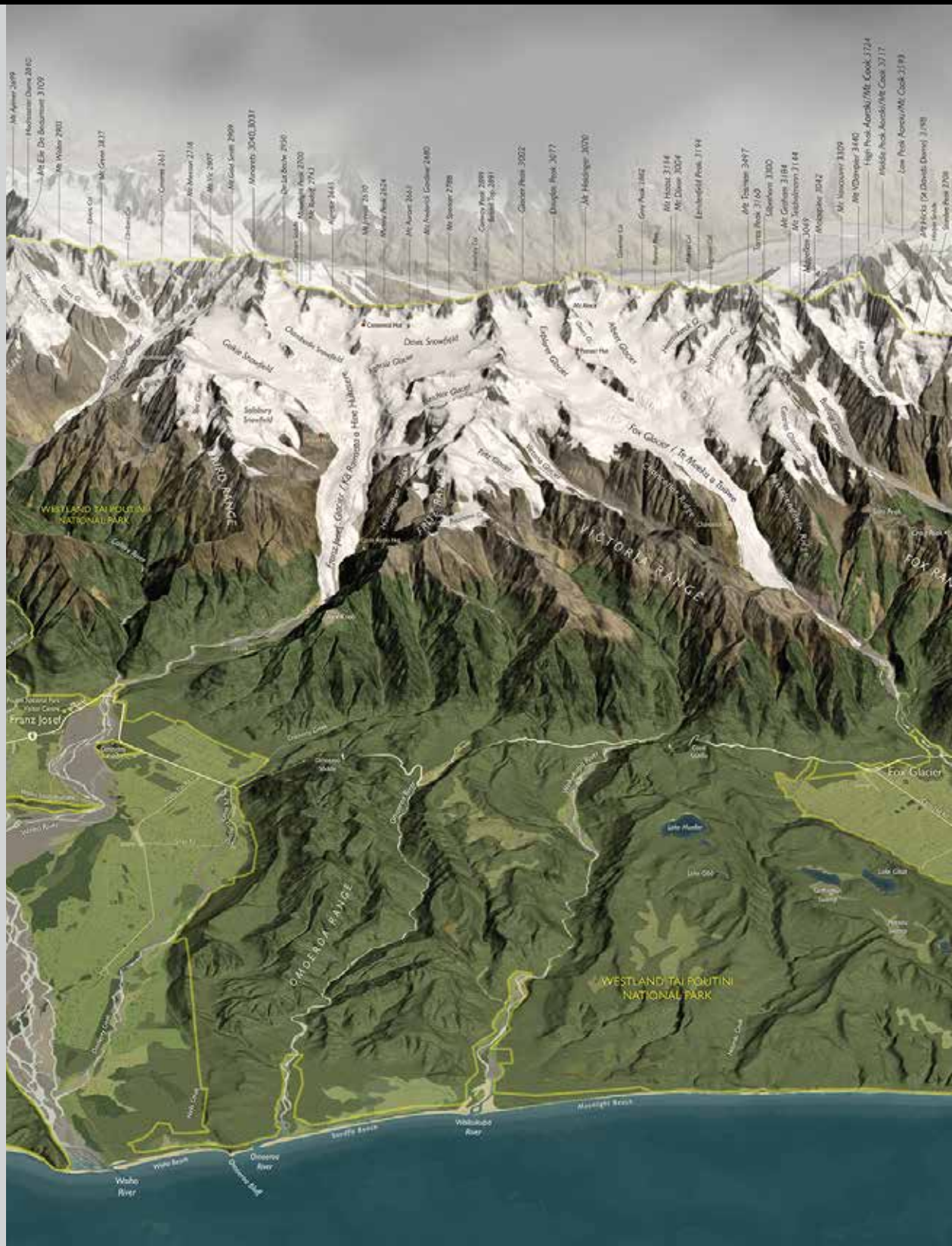
National Report to the 18th General Assembly
of the International Cartographic Association

15th and 20th July 2019, Tokyo, Japan



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Cartographic Activities in New Zealand 2015-2019

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of the International Cartographic Association**

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*Edited by
Igor Drecki and Antoni Moore*



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New Zealand Cartographic Society
2019

NZCS Publications Committee

Geoff Aitken : Igor Drecki : Antoni Moore

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An obliquely projected map of *Westland Tai Poutini National Park* by Roger Smith, Geographx Ltd.

Foreword

When reading through all the material contributed by organisations and individuals to this report, I was struck, not for the first time, by the richness and diversity of cartographic activity we undertake in New Zealand. Sure, we have an interesting country to map, both in terms of physical geography and the multi-cultural nature of our society. However I see the range and variety of contributions more as evidence of just how ubiquitous mapping has become, how important it is to helping us understand our world and finding solutions to the ever-changing everyday challenges we face. When, twenty years ago, I mentioned to friends that I was embarking on a new career to make maps, I was frequently met with the response – hasn't everything already been mapped? Well, clearly no it hasn't. The hunger for maps and the value to be gained from them has never been greater.

This document does not claim to be a complete record of cartographic activities undertaken in New Zealand. Unfortunately not all the organisations we invited to contribute could spare the time or resources to do so within the available time frame.

Despite that, the report provides an invaluable overview of the spatial industry in New Zealand and cartographic initiatives undertaken over the past four years. Whilst compiled primarily for tabling with the International Cartographic Association, I commend it also to students and others looking at a possible career in cartography or geographic information sciences. It certainly provides a very useful introduction.

Finally, a big thank-you to our editors, Igor Drecki and Antoni Moore, who have solicited contributions from the industry, collated the results and produced this report and publication.

Roger Smith
President
New Zealand Cartographic Society

Setting the Scene

Each national member of the International Cartographic Association (ICA) is required to submit a report on cartographic activities for the period between General Assemblies. This report has been prepared by the New Zealand Cartographic Society to meet the above requirement for the 2015-2019 term.

A number of organisations and individuals have been invited to present a general perspective on cartographic activities in New Zealand. These contributions are either formal or simply offering personal views of individual contributors. It is believed that this approach gives another dimension to understanding the cartographic endeavours undertaken recently in New Zealand. Due to the limited resources of time and resources, unfortunately not all parties have been contacted. Also, some of those contacted have not responded to the invitation.

The report provides a 'snapshot' of some of the activities being carried out within the cartographic establishments and professional communities. It aims to bring together and highlight the accomplishments of professionals and researchers who advance cartography in the government, military, research and private sectors, as well as in education. The support provided by specialised cartographic libraries and map trade is acknowledged.

The report is arranged thematically. The themes include:

- Cartographic and Mapping Societies
- Central Government Organisations
- Local Government Organisations
- Military Organisations
- Crown Research Institutes
- Universities
- Commercial Cartographic Firms
- Non Profit Initiatives
- Libraries and Museums

There are two active map-oriented professional societies in New Zealand; the New Zealand Cartographic Society (NZCS) and the Australian and New Zealand Map Society (ANZMaps). These are non profit organisations that gather a wide range of individuals – professionals, educators, curators and map enthusiasts. Over the last several years, NZCS and ANZMaps shared events and developed interactions of mutual interest, culminating in signing Memorandum of Understanding in March 2019. Another common initiative involved organisation of a joint conference in September 2018 in Wellington.

In New Zealand, there are several government departments that engage in cartographic activities, mainly in map publishing, assembly and maintenance of various spatial databases and dissemination of maps on the Internet. These include Land Information New Zealand (LINZ), Department of Conservation and Statistics New Zealand. LINZ is the national mapping organisation that publishes all topographic maps and nautical charts for New Zealand. Department of Conservation maintains a wide range of databases on conservation lands, including tourist infrastructure. Statistics New Zealand provides a wide range of statistical and administrative mapping products. Other government organisations produce maps on irregular basis and maintain a vast array of spatial databases relevant to their area of operation.

Most local government organisations in New Zealand are similar in their approach to cartographic activities. Cartography is carried out by either GIS, Planning or Draughting departments. They produce and publish maps of their areas of responsibility on a variety of themes. District and City Councils are primarily concerned with the production of zoning, planning and infrastructure maps, while Regional Councils focus on environmental control and resource mapping.

The GEOINT New Zealand (GNZ) of the New Zealand Defence Force services the geospatial requirements of New Zealand Army, Air Force and Navy.

Crown Research Institutes (CRIs) are government-owned businesses with a scientific purpose. Each institute is based around a productive sector of the economy or a grouping of natural resources. Three CRIs in particular are actively engaged in cartographic activities. These are: GNS Science, Manaaki Whenua Landcare Research and National Institute of Water and Atmospheric Research (NIWA). GNS Science publishes a range of New Zealand geological and magnetic maps, as well as other related scientific maps. Manaaki Whenua publishes a range of research-driven cartographic products. NIWA publishes a variety of oceanic and bathymetric charts.

Amongst the eight universities in New Zealand, only the University of Otago, Victoria University of Wellington, the University of Auckland and the University of Canterbury offer courses with a strong cartographic content. Cartography has not been taught at any New Zealand polytechnic since 1994. Due to the absence of academic cartographers and funding opportunities, cartographic research in New Zealand is somehow limited but growing. GeoCart, National Cartographic Conference and recently established New Zealand Geospatial Research Conference are the only national cartographic fora specifically dedicated to share research ideas and facilitate networking amongst cartographic and geospatial community. Contributions from New Zealand authors are increasingly appearing in the international cartographic literature.

The commercial cartographic industry in New Zealand continues to expand overall, with more small companies taking advantage of decreasing costs of computer hardware and software, and liberal access to a wide range of spatial databases. The ever increasing sophistication of cartographic and analytical tools provides right environment for experimentation and innovation. As a result we see emergence of new products and solution being offered. The background to the selection of actors in the mapping arena, big and small, is presented in this volume.

For the first time, we report on non profit initiatives. MapsPast, a cartographically inspired equivalent of hugely popular Papers Past that provides access to millions of pages of digitised New Zealand newspapers, is proving its worth by facilitating access to historical fabric of New Zealand geography through georeferenced and mosaiced cadastral and topographic maps. This resource gains rapid popularity by a wide range of users.

There are a number of map collections and repositories in New Zealand, which have sufficient depth to provide materials for serious research. However, map digitisation efforts, acquisitions of born digital maps and charts, and management of geospatial collections are posing a number challenges to libraries and museums in New Zealand. Many libraries are making good progress with embracing digital cartographic collections, although there is still plenty to be done.

The map trade in New Zealand is operated mainly through bookstore and outdoor equipment chains. The selection is very limited, primarily topographic and travel maps, and generally focused on each store's local area. Souvenir shops in tourist areas frequently offer a selection of maps for local recreation. There are only a handful of specialised map shops, most notably The Map Shop in Wellington, MapWorld in Christchurch, and Map and Chart Shop in Hamilton.

The New Zealand Cartographic Society is the national member of the ICA for New Zealand since 1976, while Land Information New Zealand became an affiliate member of the ICA in 2009. The Australian and New Zealand Map Society applied for affiliate membership of the ICA at this General Assembly strengthening the involvement of our region in world cartography.

Igor Drecki and Antoni Moore
Editors

Introduction

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New Zealand Cartographic Society

► cartography.org.nz

The Society

The New Zealand Cartographic Society Incorporated (NZCS) (PO Box 10220, The Terrace, Wellington 6011, info@cartography.org.nz) was founded on 23 February 1971 and its mission is to promote the development of cartography. The Society is an open association for those individuals and organisations with an interest, passion and excitement in the study, production and use of maps. The membership, available as an individual or corporate, is open to all interested persons and organisations. Currently the Society has about 80 individual members, and three corporate members, i.e. Land Information New Zealand (LINZ), Boffa Miskell, and National Institute of Water and Atmospheric Research (NIWA). Aeropath Ltd, responsible for aeronautical charting in New Zealand, was a corporate member in 2017 and 2018.

Services

Volunteer members manage all Society activities. Services provided include:

- organising GeoCart, the biennial National Cartographic Conferences
- organising biennial National Cartographic Exhibitions
- coordinating the National Children's Map Competitions (part of the ICA Barbara Petchenik Children's World Map Competitions)
- organising cartographic workshops, seminars and courses
- publishing the Society newsletter Cartogram, as well as monographs and occasional publications
- maintaining the Society's website and Facebook page
- providing general cartographic information and advice

In 2018, the Society inaugurated the Young Geospatial Competition for students and young professionals (under 30) presenting the best paper at GeoCart. Also,

since 2018, NZCS sponsors the New Zealand Cartographic Society Awards at the annual New Zealand Spatial Excellence Awards (NZSEA).

Committee

The Society's current Committee comprises Roger Smith (President), Antoni Moore (Vice President), Shannon McColley (Secretary), Lesley Murphy (Treasurer) and four members: Brent Brady, Andrew Douglas-Clifford, Igor Drecki and Benjamin Jones. During the 2016-2018 term, the following individuals also served on the Committee: Mark Bagnall, Marney Brosnan, Mairéad de Róiste, Michelle Knight, Geoff O'Malley and Andrew Steffert. Andrew Douglas-Clifford served as a non-Committee student representative; the Society wishes to acknowledge and thank them for their contributions over the years.

General and Committee Meetings

The Society holds its General Meetings biennially in conjunction with the National Cartographic Conferences GeoCart. The last two meetings were held on 1 September 2016 and 6 September 2018, both in Wellington.

The Society's Committee meets virtually several times a year and once every two years for a full day face-to-face (F2F) meeting devoted to discussing strategy and initiatives. Within the 2015-2019 term, the Committee met twelve times:

- 2015: 15 October

2016-2018 NZCS Committee (*front row, left to right*): Mark Bagnall, Michelle Knight, Lesley Murphy, Shannon McColley; (*back row*): Igor Drecki, Mairéad de Róiste, Antoni Moore, Marney Brosnan, Roger Smith, Geoff O'Malley



- 2016: 21 April, 4 August, 1 September (GeoCart), 16 December
- 2017: 16 February, 6 May (F2F in Wellington), 18 December
- 2018: 6 September (GeoCart), 5 December
- 2019: 26 February, 29 June (F2F in Wellington)

Regional Meetings

On the initiative of Lesley Murphy, Auckland-based Society members have met on several occasions since May 2016. The idea is to maintain contact with fellow members, discuss matters relating to cartography and the Society, and visit places and events of interest. Here is the full schedule of meetings held so far, including the venues and themes:

- 29 May 2016: Torpedo Bay Navy Museum; inaugural meet up.
- 7 August 2016: Torpedo Bay Navy Museum; GeoCart'2016 presentations run-through
- 20 November 2016: University of Auckland Library Map Room; map collections and Christmas function
- 2 April 2017: GTO Print, Birkenhead; an old fashioned letterpress print shop
- 26 August 2017: Warwick Henderson Gallery, Newmarket; A sense of place exhibition, Auckland member Mark Wooller's cartographic artworks
- 26 November 2017: Torpedo Bay Navy Museum; D-Day landing maps documentary and Christmas function
- 29 April 2018: Auckland City Library; Don't leave home till you've seen the country exhibition of maps, posters and photographs
- 22 July 2018: Torpedo Bay Navy Museum; Lesley's map collection
- 2 December 2018: Ravenhill Café; Society wall maps and Christmas function
- 5 May 2019: University of Auckland Library Map Room; international map collection

Awards

The Society's Honorary Membership recognises the outstanding contribution by an individual to cartography and mapping in New Zealand. In September 2016, at the GeoCart Gala Dinner, Dr Kenneth Field (United Kingdom) was awarded an Honorary Membership of the New Zealand Cartographic Society. The award was presented to Ken in recognition of his unparalleled dedication to the Society, New Zealand cartography and particularly map design, which he so keenly and generously popularises through a string of highly regarded and appreciated Map Design Workshops – thank you Ken!

Recognition

Inaugurated in 2014, the New Zealand Spatial Excellence Awards (NZSEA, www.nzsea.org) celebrate outstanding examples of innovation and excellence in the geospatial community each year. The awards are divided into two main categories: for individuals and for organisations; both categories are made up of a number of separate awards. NZSEA also presents additional awards that are separate to the categories open for entry. They are judged based on entries to the individual and organisational awards categories, or may be selected by the NZSEA judging panel independent of an entry.

Between 2015 and 2019, the Society members, both individual and corporate (as well as the Society itself), were recognised at each edition of NZSEA. Here are the individual winners:

- 2015: Mairéad de Róiste in the Education and Professional Development category
- 2016: Antoni Moore in the Education and Professional Development category
- 2017: Roger Smith – Award for Outstanding Contribution to Spatial Award
- 2018: Geoff O'Malley – Award for Outstanding Contribution to Spatial Award

A visit to GTO Print, an old fashioned letterpress print shop by Auckland-based Society members (*left*); Andrew Douglas-Clifford receives inaugural New Zealand Cartographic Society Award from Roger Smith



- 2018: Andrew Douglas-Clifford – New Zealand Cartographic Society Award
- The winners amongst the organisations were:
- 2016: Land Information New Zealand in the Technical Excellence category
 - 2017: Land Information New Zealand in the Environmental Sustainability category
 - 2017: New Zealand Cartographic Society in the People and Community category

Conferences and Events

National Cartographic Conference GeoCart'2016

The 8th National Cartographic Conference GeoCart'2016 convened on 31 August – 2 September 2016. It was held at the National Library of New Zealand and Victoria University of Wellington in the Coolest little Capital in the World – Wellington. The conference was jointly organised by the New Zealand Cartographic Society (NZCS) and Mapping Sciences Institute, Australia (MSIA), and received endorsement from the International Cartographic Association as the 4th ICA Regional Symposium on Cartography for Australasia and Oceania. Furthermore, the event incorporated an InterCarto/InterGIS stream on Sustainable Mapping. The conference theme Unfolding the Map was influenced by the superbly organised cartographic exhibition of the same name, which was concurrently run by the Library (see below for details).

Submissions were invited on any topic in cartography, map curatorship, history of cartography or exploration, geovisualisation and GIScience, or related disciplines, covering work of a professional and academic nature. All submitted papers and abstracts were refereed by at least one national or international expert. Presentations were given by representatives from academia, government and commercial organisations from New Zealand and overseas.

The conference programme included six plenary sessions, ten parallel paper sessions (including InterCarto special session) and a poster session. The keynote speakers were: Serena Coetzee (University of Pretoria, South Africa), Amy L. Griffin (University of New South Wales, Australia), Aaron Jordan (Land Information New Zealand, New Zealand), Chris Kinzett (Land Information New Zealand, New Zealand), Trevor Menzies (Mapping Sciences Institute, Australia) and Menno-Jan Kraak (President of the ICA, The Netherlands). In total, 50 paper and 3 poster presentations were delivered, contributing to a solid conference programme highly appreciated by 107 participants.

The conference also played host to the National Cartographic Exhibition and GeoExpo'2016, and featured the traditional Panel Discussion with keynote speakers and an extensive social programme, including Ice Breaker and Gala Dinner (see ICA News, No 67, December 2016 for the report from GeoCart'2016 – icaci.org/ica-news/).

Winning maps at the cartographic exhibition were:

- Best of Show: *Waikato Plan* – a set of seven thematic maps by Clint Prior, Waikato Regional Council
- People's Choice: *State Highways Metro Map: New Zealand North and South Island* by Andrew Douglas-Clifford, The Map Kiwi

4th Map Design Workshop

Immediately prior to GeoCart'2016, the Society, together with Esri, organised a 2-day Map Design with ArcGIS Workshop Compelling Cartography, 29-30 August 2016. The Workshop, facilitated by Ken Field and held at the Victoria University of Wellington, explored high quality, compelling cartography and focused on the availability of new approaches, techniques and capabilities of the Esri ArcGIS Platform. The programme covered a range of cartographic requirements and provided an opportunity to focus

There is just over 80 people on this image, about two-thirds of all GeoCart'2018 participants



on particular examples or techniques that attendees were most interested in. It attracted 27 attendees from local government, commercial sector, academia and defence. This was the fourth edition of this highly popular workshop series organised as part of the Society's EduCart initiative launched in 2007.

National Cartographic Conference GeoCart'2018

The 9th National Cartographic Conference GeoCart'2018 and the 46th AMZMapS conference convened on 5–7 September 2018. As in 2016, Wellington played host to the conference, and again, the National Library of New Zealand opened their doors to welcome us and offer their superb facilities to meet and celebrate cartography. GeoCart'2018 was jointly organised by the New Zealand Cartographic Society and the Australian and New Zealand Map Society (ANZMapS). The conference theme was Cartographies of Change: Then, Now and Tomorrow in recognition of the dynamic nature of cartography and increasingly important linkage of the past, current and future developments of our discipline.

Submissions were invited on any topic in cartography, map curatorship, history of cartography or exploration, geovisualisation and GIScience, or related disciplines, covering work of a professional and academic nature. All submitted papers and abstracts were refereed by at least one national or international expert. 71 conference paper, poster – and for the first time – Young Geospatial Competition (YGC) presentations were received, and allocated into sessions. Presentations were delivered by representatives from academia, government and commercial organisations from New Zealand and overseas.

The Conference programme included six plenary sessions, twelve parallel paper sessions, a poster session and an inaugural NZCS Young Geospatial Competition (YGC). The keynote speakers were: Linda Beale (Esri Inc., USA), Aileen Buckley (Esri Inc., USA), Roger Carman (Land Information New Zealand, New Zealand), Chris Fleet (National Library of Scotland, United Kingdom), Kent Lee (East View Geospatial Inc., USA) and Chris McDowall (freelance data analysis and visualisation specialist, New Zealand).

The GeoCart'2018 programme also included a Special Session presented by Women in Spatial featuring Linda Beale. One of the highlights of the conference was presentation of the inaugural Young Geospatial Competition award to Tessa Pocock from the School of Physical Education, Sport and Exercise Sciences at the University of Otago for her paper School Neighbourhood Environment and Adolescents' Transport to School – congratulations Tessa!

Other events included the National Cartographic Exhibition, sponsors' stands, traditional Panel Discussion with keynote speakers and an extensive social

programme, including Ice Breaker and Gala Dinner (see ICA News, No 71, December 2018 for the report from GeoCart'2018).

Winning maps at the cartographic exhibition were:

- Best of Show and People's Choice: *North America: Portrait of a Continent* by Anton Thomas, Anton Thomas Art
- Best Paper Map: *Westland Tai Poutini National Park* by Roger Smith, Geographx NZ Ltd
- Best Digital Map: *Colonial Frontier Massacres in Central and Eastern Australia* by Lyndall Ryan and others, University of Newcastle, NSW, Australia
- Highly Commended: *Kahurangi*, Geoff Aitken, NewTopo NZ Ltd; *Jacaranda Atlas*, Spatial Vision, John Wiley & Sons, Australia; *Queen Charlotte Sound and Kaikoura*, Kevin Mackay and others, NIWA; *Southern Grampians Outdoor Recreation Guide*, James Gordon, Spatial Vision, Australia

Due to the changes implemented by the ICA Executive Committee surrounding the organisation of ICA regional cartographic events, including substantial additional requirements expected of National Organising Committees (icaci.org/regional-cartographic-conferences/), the Society reluctantly decided against submitting a bid to have GeoCart'2018 endorsed by ICA as a regional event. This marked the end of an era, as the ICA Regional Symposium on Cartography for Australasia and Oceania had been the longest running ICA-endorsed regional cartographic event worldwide.

5th Map Design Workshop

Prior to GeoCart'2018, the Society, together with Esri, organised a 2-day Map Design Workshop: Discovering ArcGIS, 3–4 September 2018. The Workshop, facilitated by Aileen Buckley and held at the Victoria University of Wellington, was designed for anyone wishing to know how to make and share maps using the ArcGIS platform. It focused on mapping in the context of a modern web GIS, covering the wide range of mapping capabilities available with ArcGIS Pro and ArcGIS Online. The course covered relevant conceptual ideas, descriptions of methods, and diverse and useful examples of ArcGIS in action. Participants were given the background necessary to understand how ArcGIS could be used to map their own data, answer their own questions, and solve their own problems. This was the fifth edition of this highly popular Workshop, which attracted 15 attendees from local government, commercial sector, academia and defence.

Northland High Schools Geography Conference

The Society supported the Northland High Schools Geography Conference held on 13 June 2019 in Whangarei. The event was organised for senior secondary school students and their teachers to demonstrate

practical applications of GIS and mapping in professional practice and research. The Conference featured over 20 speakers representing local government, academia, professional organisations and local businesses. The Society contributed to the programme with a presentation by Committee member Benjamin Jones on the use of high resolution LiDAR data for mapping archaeological sites in New Zealand.

State of New Zealand Cartography Seminar

On 28 June 2019, the Society organised the *State of New Zealand Cartography* seminar at the National Library of New Zealand in Wellington. The event consisted of 16 presentations on recent and current mapping activities from contributors representing cartographic and map societies, government departments, universities, libraries, military organisations, Crown research institutes, commercial mapping companies and freelance cartographers.

The seminar was the result of the Society's initiative concerning organisation of events alternating with the National Cartographic Conferences and thus providing additional networking opportunities for members and wider community to share, engage and exchange ideas. Inspired by similar events organised by the Society during the 1970s, 1980s and 1990s, the requirement of producing the National Report to the ICA provided an ideal platform (and theme) for organising this seminar. This seminar was attended by 70 participants and the presentations form part of this report.

National Children's Map Competitions

The Society's last two National Children's Map Competitions, part of the Barbara Petchenik Children's World Map Awards, were coordinated by Geoff O'Malley and the Society wishes to acknowledge his work and

dedication to this unique world-wide initiative – thank you Geoff. Thanks to many sponsors and contributors, the Society was able to award New Zealand children with several prizes.

The winners of the 2017 competition by age category were:

- **6-8 Years:** 1st Place – I See Maps in Everything I Love, Abby Hurt (7 years), Matakana School; 2nd Place – We Love Maps Because They Can Help Save Our Lives!, Poppy Heazlewood (8 years), Churchill Park School, Auckland; 3rd Place – The Interwebbed Connection of the World Showing Unity, Sophie Clay (8 years), Matakana School.
- **9-12 Years:** 1st Place – If a Picture is Worth a Thousand Words Then a Map Must be Worth Much More!, Abby Heazlewood (10 years), Churchill Park School, Auckland; 2nd Place – A Melting World!, Charlie Blampied (9 years), Matakana School; 3rd Place – Power of Maps, Molly Player (12 years), Evans Bay Intermediate School, Wellington.
- **13-15 Years:** 1st Place – Through a Child's Eyes, Rebecca Kneale and Akira McTavish-Huriwai (both 15 years), Tauranga Girls College; 2nd Place – Trumps World, Phoebe McClean (15 years), Bishop Viard College, Porirua; 3rd Place – We Grow With The World, Natasha Walmsley, Jessica Butler and Mia Da Silva (15, 14 and 14 years), Tauranga Girls' College.

There were no entries in the under 6 years category.

The NZSEA People and Community Award mentioned above recognises "...products or projects that make a difference to national, regional or local issues and affect communities via 'grass roots' initiatives, and/or educational programs, services or tools that permit the widespread adoption, use, understanding and access to spatially enabled products or services." The 2017 award was presented to the Society for organising the 2017 National Children's Map Competition, which attracted a record 250 map entries

State of New Zealand Cartography seminar (left) featured a number of presentations from contributors to the National Report; work of New Zealand children displayed at the international event at ICC 2017 in Washington



from school students all across the country. Geoff was instrumental in entering the NZSEA on Society's behalf and fittingly accepted the award at the Awards Ceremony on 15 November 2017 in Wellington.

The winners of the 2019 competition by age category were:

- **9-12 Years:** 1st Place – A Turtle's Tear: Our Plastic Oceans, Barnaby Blampied (9 years), Matakana School; 2nd Place – Eye Love Maps, Atina and Ada Hu (both 11 years), Saint Kentigern Girls School, Auckland; 3rd Place – Disappearing Earth, Kitty Yan (11 years), Saint Kentigern Girls School, Auckland.
- **13-15 Years:** 1st Place – The Earth is our Best Friend, Jasmine Tran and Jessica Ou (both 13 years), Saint Kentigern Girls School, Auckland; 2nd Place – My world My Culture - I love it, Gabrielle Van Lierde and Georgia Corneal (both 14 years), Te Kauwhata College; 3rd Place - Is this Progress?, Sarah Lee and Sukhleen Kaur (both 14 years), Tauranga Girls College.

There were no entries in the under 6 and 6-8 years categories.

Congratulations to all winners!

Society Projects

NZCS History

The Society is working on a project that involves collating information, documents and archives concerned with its history. The National Library of New Zealand, as well as many individuals, are assisting in this task. The information will be particularly useful in organising and celebrating the 50th anniversary of the New Zealand Cartographic Society in 2021.

Cartographic Heritage

The Society continues to support the development and enhancement of the government maps repository hosted by the University of Auckland Library. Society members supply maps and charts to fill the gaps in the collection, as well as share their expertise and provide feedback. The repository contains over 25,000 maps and charts, however only 20,000 are accessible and 2,600 searchable via the developing GeoDataHub service (geodatahub.library.auckland.ac.nz). GeoDataHub also provides access to the New Zealand digital topographic data.

Publications

CartoPRESS is the Society's publication initiative, which aims to promote the discipline of cartography and New Zealand's cartographic and mapping heritage.

Geoff Aitken, Antoni Moore and Igor Drecki serve on the NZCS Publications Committee, which involves soliciting submissions for publications and editorial tasks. Since the launch in 2011, CartoPRESS published two monographs and five occasional publications. Listed below are titles that appeared in the 2015-2019 term.

Monograph

Map Projections and Datums in New Zealand, Development and Applications was published in February 2017. This 88-page monograph was written by Professor Emeritus John Hannah from the University of Otago. It provides a comprehensive account of New Zealand map projections and datums. It covers the development of national mapping systems and includes a thorough detailing of the local meridional circuits underpinning the surveying coordinate systems used in New Zealand. An accessible mathematical basis for the main projection types is provided together with an overview of offshore island, Pacific island and Antarctic projections.

The book has been selected as a prescribed course reading text by the National School of Surveying at the University of Otago. Copies were acquired by their University Bookshop and made available to students and staff.

Occasional Publications

In August 2016, the Society published the second volume (No 2) of their CartoPRESS Occasional Publication series (ISSN 2382-0381): *Cartographic Journeys Through Space and Time*, Proceedings of the GeoCart'2014 Conference (ISBN 978-0-473-35883-9). This 156-page publication was edited by Antoni Moore, Brendan Whyte and Igor Drecki. It is the record of the conference, consisting of 51 papers and abstracts. There are sections on Historical mapping, 20th Century Cartography, Map Repositories and Archiving, National Mapping and Data Infrastructure, General Mapping and Design, Crowdsourcing and Usability, Natural and Social Environment, Remote Sensing, Photogrammetry and Georeferencing.

In June 2017, the Society published internationally reviewed GeoCart'2016 Proceedings *Unfolding the Map* as the third volume (No 3) of the CartoPRESS Occasional Publications series (ISBN 978-0-473-38351-0). This 166-page publication was edited by Antoni Moore and Igor Drecki. The material reflects the diversity of cartography, map curatorship and research, geovisualisation, surveying, geospatial sciences and related disciplines. The Proceedings contain 53 papers and abstracts including a brief record of keynotes and posters presented at the conference. The main sections consist of Historical, Archiving and Exhibition, Social and Natural Environment, Sustainable Mapping, Map Design and Neocartography, Surveying

and Photogrammetry, Education, Professional and Usability, 3D, Web and Multimedia, Mapping in Organisations, and Community and Data themes.

The fourth volume (No 4) of the Society's Occasional Publication series *Cartographies of Change: Then, Now and Tomorrow*, Proceedings of the GeoCart'2018 Conference were published as a pre-conference publication in August 2018. This 167-page volume was edited by Antoni Moore and Igor Drecki. The Proceedings provide the record of the conference, consisting of 71 papers and abstracts. There are sections on History of Cartography, Map Curatorship and Gazetteers, History and Exploration Cartography, Art and Critical Cartography, Mapping in Space and Time, Web Cartography, Marine Cartography, Topographic and Terrain, Mountains and Ice, Coasts and Water, Urban and Human, and Health, complemented by poster and Young Geospatial Professional Competition abstracts.

This volume is the Society's fifth volume (No 5) in the CartoPRESS Occasional publication series: *Cartographic Activities in New Zealand 2015-2019*, National Report to the 18th General Assembly of the International Cartographic Association (ISBN 978-0-473-48764-5). Published in July 2019, it contains contributions from cartographic and map societies, central and local government organisations, military organisations, Crown research institutes, universities, commercial cartographic firms, non-profit initiatives, libraries and museums. This 84-page publication was edited by Igor Drecki and Antoni Moore, and serves as extended Proceedings of the *State of New Zealand Cartography* seminar held in Wellington on 28 June 2019.

Cartogram

The last issue of the Society's non-regular, PDF-based newsletter was published in December 2014 (No 77). Cartogram was edited by Geoff Aitken for several years and the Society acknowledges his work and dedication

to this worthwhile publication. In July 2015, the Society has changed the delivery format of Cartogram to an on-line newsletter. However, due to having no dedicated editor to solicit relevant news, the newsletter was discontinued in early 2018. The Society is currently considering reviving the Cartogram.

Society on the Internet

NZCS Website

The Society website (cartography.org.nz) is maintained by Shannon McColley, Society Secretary and webmaster. Several new features have been introduced in 2016-2017, including an expansion of our Publications section and a new Product for Sale section. Another development involved creating sister websites devoted to the GeoCart'2014 and GeoCart'2016 conferences with links to various conference materials.

Early in 2018, the Society website was redeveloped and markedly enhanced introducing several new and important features, including news section, Cartogram archives, CartoPRESS publications, children's map competition, and membership information. The website has an e-commerce backend that allows membership payments and purchase of products and services. It also features members' only zone accessible via a login. At the same time, a dedicated GeoCart'2018 website was launched featuring comprehensive information about our flagship event, including online registration, conference programme and information about pre-conference workshops.

Some of the most recent developments include publication of the 2019 National Children's Map Competition results, and updates to the Publications and Events sections. The Society wishes to acknowledge Shannon's entirely voluntary work – thank you.

In the 2015-2019 term, CartoPRESS published a monograph (*left*) on official map projections and datums used in New Zealand and three Occasional Publications from GeoCart conferences in 2014, 2016 and 2018



NZCS Facebook Page

7 June 2016 marked the launch of the NZCS Facebook page (www.facebook.com/New-Zealand-Cartographic-Society-1101021419960764/). This development provides an alternative way of engaging with our Society and the other social media users, and learning more about our initiatives and developments. It also facilitates exchange of ideas and provides a platform to leave comments. Although the Society still experiences rather small traffic, there are over 210 'likes' and 220 followers, and growing!

International Cartographic Association

The New Zealand Cartographic Society (NZCS) is the official New Zealand representative to the ICA (since the 5th General Assembly in Moscow in 1976). Over the last four years, the Society maintained a strong relationship with ICA by attending General Assemblies and actively participating in the International Cartographic Conferences, International Cartographic Exhibitions and ICA Commissions' meetings. Igor Drecki is the Society liaison to the ICA.

New Zealand Representation to ICA Commissions

Antoni Moore is a member of the ICA Commission on Art and Cartography, the ICA Commission on Cognitive Issues in Geographic Information Visualization, the ICA Commission on Geospatial Analysis and Modeling, and the ICA Commission on Visual Analytics. Roger Smith is a member of the ICA Commission on Map Design and the ICA Commission on Mountain Cartography. Igor Drecki is a member of the ICA Commission on Cartographic Heritage into the Digital, and the ICA Commission on Map Design. Geoff O'Malley is a member of the ICA Commission on SDI and Standards. Geoff Aitken and Peter Howorth are both members of the ICA Commission on Mountain Cartography.

New Zealand and the ICA

The Society members attended and/or organised the following ICA events:

- 27th International Cartographic Conference (including pre-conference workshops) and 16th General Assembly of ICA in Rio de Janeiro, Brazil, August 2015
- Unfolding the Map Exhibition (part of the International Map Year 2015-2016 celebrations) in Wellington, opened in October 2015
- Cartographic Summit in Redlands, CA, USA, February 2016
- 10th ICA Mountain Cartography Workshop in Berchtesgaden, Germany, April 2016
- 4th ICA Symposium on Cartography for Australasia and Oceania in Auckland, New Zealand, August-September 2016
- 28th International Cartographic Conference (including pre-conference workshops) and 17th Extraordinary General Assembly of ICA in Washington D.C., USA, July 2017
- 11th ICA Mountain Cartography Workshop in Hvar, Croatia, May 2018

ICC 2015, Rio de Janeiro, Brazil

Three Society members, Antoni Moore, Geoff O'Malley and Igor Drecki, along with LINZ, the ICA affiliate member (represented by Aaron Jordan), participated in the International Cartographic Conference (ICC) in Rio de Janeiro, Brazil, 23-28 August 2015. New Zealand contributed four papers and a poster to the ICC 2015 programme. Antoni (principal delegate) and Geoff (deputy) represented New Zealand at the 16th General Assembly of the ICA. A detailed report from ICC 2015 is provided in ICA News, No 65, December 2015.

Prior to ICC 2015, Geoff attended a workshop organised jointly by the ICA Commission on Geoinformation Infrastructures and Standards, the ICA Commission on Open Source Geospatial Technologies and the Open

New Zealand representatives Geoff O'Malley (left) and Antoni Moore at the 16th General Assembly of the ICA in Rio de Janeiro; a banner outside National Library of New Zealand advertising *Unfolding the map* exhibition, part of IMY 2015-2016 celebration



Geospatial Consortium (OGC) in Rio de Janeiro, 20-21 August 2015.

In another pre-ICC 2015 event, Antoni contributed to the future cartographic research agenda workshops organised jointly by the ICA Commissions on Cognitive Visualization, GeoVisualization, Map Design, and Use and User Issues in Curitiba, Brazil, 21 August 2015. This effort resulted in producing a paper in Research Special Issue of the International Journal of Cartography: Anthony C. Robinson, Urška Demšar, Antoni B. Moore, Aileen Buckley, Bin Jiang, Kenneth Field, Menno-Jan Kraak, Silvana P. Camboim & Claudia R. Sluter (2017) Geospatial big data and cartography: research challenges and opportunities for making maps that matter, *International Journal of Cartography*, 3:sup1, 32-60, DOI: 10.1080/23729333.2016.1278151.

IMY 2015-2016 Unfolding the Map Exhibition

Unfolding the Map – The Cartography of New Zealand exhibition inaugurated the International Map Year (IMY) 2015-2016 celebrations in New Zealand. Officially opened on 15 October 2015 by the Minister for Internal Affairs, the Honourable Peter Dunne and the National Librarian Bill Macnaught, the exhibition explored the changing nature of New Zealand cartography from pre-European times to the present day. It featured historic and contemporary maps and charts, and examined the impact of new technology, the rise of social mapping and other factors that are transforming and challenging cartography. The exhibition, which closed in March 2018, was curated by Roger Smith and held at the National Library of New Zealand in Wellington (see ICA News, No 65, December 2015, for a brief report).

Cartographic Summit, Redlands, CA, USA

Two Society members, Antoni Moore and Roger Smith, were invited to take part in the Cartographic Summit: The Future of Mapping organised by the ICA and Esri, 8-10 February 2016. The meeting examined new directions in mapping with leading thinkers from academia, government, media and design discussing how cartography can and should meet changing needs and expectations. Both Antoni and Roger contributed to a number of break-out discussions held at the meeting. A detailed report from the Summit is published in ICA News, No 66, June 2016 (as part of the President's Report).

10th ICA Mountain Cartography Workshop, Berchtesgaden, Germany

Three Society members, Geoff Aitken, Peter Howorth and Roger Smith, participated in the 10th ICA Mountain Cartography Workshop organised by the ICA Commission on Mountain Cartography, 26-30 April 2016. Presentations covered various mountain

cartography topics, from cutting-edge research to overview reports, and included both theoretical and practical aspects of the discipline such as relief, mountain and hiking, ecology, glaciers, snow and skiing, and history. Geoff and Peter contributed to the workshop programme by presenting a paper each. The theme of the workshop was Unbounded Mapping of Mountains, which provided enough scope for reporting on any aspect of cartography dealing with mountains – a detailed report is available from ICA News, No 66, June 2016.

4th ICA Regional Symposium on Cartography

The Society organised the 4th ICA Symposium on Cartography for Australasia and Oceania in Wellington, 31 August – 2 September 2016 (together with GeoCart'2016). Attended by 107 delegates from seven countries, the programme delivered 53 paper and poster presentations, including six keynote addresses and a special presentation by Professor Menno-Jan Kraak, President of the ICA. Amongst the conference speakers were William Cartwright (former President of the ICA) and chairs of several ICA Commissions: Serena Coetzee (SDI and Standards), Kenneth Field (Map Design), Amy L. Griffin (Cognitive Issues in Geographic Information Visualization), and Vladimir S. Tikunov (Geographic Information for Sustainability and former Vice President of the ICA) who also chaired a special session of InterCarto/InterGIS on Sustainable Mapping.

ICC 2017, Washington D.C., USA

Four Society members, Antoni Moore, Igor Drecki, Roger Carman and Ian Reese participated in the International Cartographic Conference in Washington D.C., USA, 2-7 July 2017. Roger and Ian were also representing LINZ, ICA affiliate member. New Zealand contributed five papers and one poster to the ICC 2017 programme. Igor (principal delegate) and Ian (deputy) represented New Zealand at the 17th Extraordinary General Assembly of the ICA. At the ICA Awards session held at the conference, Igor was awarded the Diploma for Outstanding Services to ICA. A detailed report from the ICC 2017 is provided in ICA News, No 69, December 2017.

In addition, Igor attended a pre-ICC 2017 workshop organised jointly by the ICA Commission on the History of Cartography, the ICA Commission on Atlases and the ICA/IGU Commission on Toponymy at the Library of Congress, Washington D.C., 28-30 June 2017. The workshop titled *Charting the Cosmos of Cartography: History – Names – Atlases* delivered 24 presentations and featured a technical tour Map Vault of the Library of Congress' Geography & Map Division. Igor contributed to the workshop's programme by delivering a paper.



New Zealand contribution to the International Cartographic Exhibition at ICC 2017 in Washington, including a winning map *The Olivine Wilderness* (No 290) by Roger Smith, Geographx Ltd

Antoni participated and presented in another pre-conference event, the *Maps and Emotions* workshop organised jointly by the ICA Commission on Art and Cartography, the ICA Commission on Cognitive Issues in Geographic Information Visualization, and the ICA Commission on Topographic Mapping, 1-2 July 2017. The George Washington University hosted the event.

ICC 2017 International Cartographic Exhibition

The 2017 national call for maps and cartographic material resulted in 11 entries being selected by the Society to represent New Zealand at the International Cartographic Exhibition, Washington D.C., USA. The entries were:

- *Marlborough Sounds* by Geoff Aitken, NewTopo NZ Ltd
- *The Old Ghost Road* by Geoff Aitken, NewTopo NZ Ltd
- *Chatham Island (Rēkohu)* by Simon A Bardsley and Tim J Nolan, NZ Spatial Ltd
- *New Zealand State Highway Metro Map* by Andrew Douglas-Clifford, The Map Kiwi
- *The University of Auckland Campus Map* by Igor Drecki, University of Auckland
- *Tour de Coffee Culture* by Clynton Drumm, Coffee Culture
- *The Waikato Plan* by Clint Prior, Waikato Regional Council
- *The Olivine Wilderness* by Roger Smith, Geographx Ltd
- *New Zealand Wall Mural* by LINZ Data Service, Land Information New Zealand

- *Auckland LiDAR: Mangere* by LINZ Data Service and New Zealand Geodetic Office, Land Information New Zealand

- *Kaikoura/Waipapa Bay: Post-earthquake Bathymetry* by LINZ Data Service and New Zealand Geodetic Office, Land Information New Zealand

Subsequently, *Kaikoura/Waipapa Bay: Post-earthquake Bathymetry* map was withdrawn and the remaining ten entries submitted to the exhibition.

The International Judging Panel awarded second place in the prestigious Maps on Panels category to *The Olivine Wilderness* by Roger Smith, Geographx NZ Ltd. It is the second time Roger's map was singled out at the ICA's International Cartographic Exhibition (*Tongariro National Park* map was awarded in 2013).

ICC 2017 Barbara Petchenik Children's World Map Award

The Society coordinated New Zealand's contribution to the 2017 Barbara Petchenik Children's World Map Awards. Six entries were sent to the international competition held at the International Cartographic Conference 2017 in Washington, D.C., USA. Two maps produced by New Zealand children won an award at the international level. Rebecca Kneale and Akira McTavish-Huriwai from Tauranga Girls College were placed second in the 13-15 years old category for their work entitled *Through a Child's Eyes*. Phoebe McClean from Bishop Viard College in Porirua won the inaugural ICA's Creativity Award for her work *Trumps World*. NZCS Committee members Lesley Murphy and Igor Drecki visited Tauranga Girls College to present the ICA's certificates to Rebecca and Akira, and Geoff



Panel discussion with keynote speakers, a regular feature of the National Cartographic Conferences; at GeoCart'2018 panel included (from left) Chris Fleet, Linda Beale, Chris McDowall and Aileen Buckley

O'Malley presented the ICA's Creativity Award to Phoebe in Porirua.

11th ICA Mountain Cartography Workshop, Hvar, Croatia

Three Society members, Geoff Aitken, Peter Howorth and Roger Smith, participated in the 11th ICA Mountain Cartography Workshop organised by the ICA Commission on Mountain Cartography, 21-25 May 2018. The meeting helped to further define the topics of mountain cartography, to promote the methods and knowledge of mountain cartography and to discuss and demonstrate the state of the art in practical and theoretical approaches to mountain cartography. The overall theme of the workshop was Mapping for Outdoor Activities in Mountains with the idea to address local issues in the field of mountain cartography. Geoff and Roger contributed to the workshop programme by presenting a paper each. A detailed report is available from ICA News, No 70, June 2018. It is worth noting that our Society maintains a strong connection with the ICA Commission on Mountain Cartography, having attended most of their Business Meetings and Workshops since 2008, and contributing to their publication effort and research.

GVIZ Workshop, Melbourne, VIC, Australia

Antoni Moore co-organised and presented at the GVIZ workshop co-located with the GIScience 2018 conference in Melbourne, VIC, Australia on 28 August 2018. The workshop titled New Directions in Geovisual Analytics: Visualization, Computation, and Evaluation focused on eliciting and sharing nascent

challenges in visual design, evaluation, and computation related to geovisual analytics. The core concept of this workshop was to focus on exploring ideas for new approaches – not simply to recap what has already been accomplished. The meeting gathered members of the ICA Commission on Visual Analytics, including commission chair Anthony Robinson (viz.icaci.org/GVIZ2018/2018/02/05/workshop/).

ICA News

Igor Drecki continued as Editor of ICA News, the newsletter of the ICA in the 2015-2019 term. In this period, eight issues were produced – from No 65 (December 2015) to 72 (June 2019). From issue No 66, a new design has been implemented incorporating more colour, lighter visual elements and a brand new typeface, supporting even the most demanding typographic requirements. After 12 years, Igor steps down from his role at the end of this term.

ICC 2019, Tokyo, Japan

New Zealand representatives to the 18th General Assembly of the ICA are two Society members, Igor Drecki and Antoni Moore. The Society coordinated an entry to the Barbara Petchenik Children's World Map Awards featuring six maps, and prepared the National Report. The ICC 2019 programme includes contributions by New Zealand authors.

ICC 2019 International Cartographic Exhibition

The 2019 national call for maps and cartographic material resulted in 6 entries being selected by the Society to represent New Zealand at the International

Cartographic Exhibition, Tokyo, Japan. The entries are:

- *North America: Portrait of a Continent* by Anton Thomas, Anton Thomas Art
- *Westland Tai Poutini National Park* by Roger Smith, Geographx Ltd
- *What Lies Beneath – New Zealand's Coastal Seafloor Revealed* (four map posters) by Kevin Mackay, Helen Neil, Erica Mackay and S. Wilcox, all National Institute of Water and Atmospheric Research (NIWA), and Roger Smith, Geographx Ltd
- *Kahurangi* by Geoff Aitken, NewTopo NZ Ltd
- *Te Reo Māori Map of Aotearoa/New Zealand* by Andrew Douglas-Clifford, The Map Kiwi
- *Waikaremoana* by Geraldine Moore and others, Department of Conservation

Society in the Region

Regional Organisations

The Society continues to maintain a good relationship with other organisations in the region with similar

agendas, in particular with Australian and New Zealand Map Society (ANZMapS) and Mapping Sciences Institute of Australia (MSIA). Unfortunately, in early 2017 the International Map Industry Association, Asia Pacific (IMIA AP) ceased operation in our region.

Memorandum of Understanding

One of the newest developments in the Society's international relations was the signing of the Memorandum of Understanding (MoU) between NZCS and ANZMapS in March 2019. The MoU provides a framework for a continuing liaison between both organisations. This will be achieved by maintaining and increasing the opportunities for scientific, technical, professional, academic and educational exchange between their members, through a continuous programme of cooperation leading to mutual sharing of knowledge and expertise to the advantage of both organisations.

Contribution by Igor Drecki and Roger Smith

Australian and New Zealand Map Society

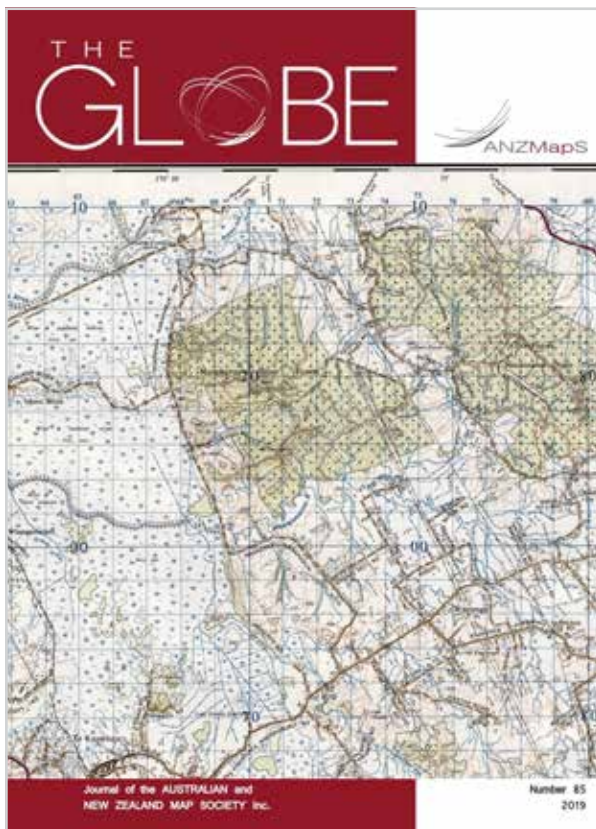
► www.anzmaps.org

The Society

The Australian and New Zealand Map Society (ANZMapS) promotes all aspects of cartography, map uses and applications. Formed from the amalgamation of the Australian Map Circle (established in 1973) and the New Zealand Map Society (established in 1977), membership includes cartographers and GIS specialists, academics, map producers, librarians and curators of libraries and state mapping agencies in Australia and New Zealand.

ANZMapS promotes communication through regular conferences and workshops, to improve the knowledge, skills and status of persons working with maps and geospatial data, and acts as a forum for study and effective use of map collections.

The Globe, May 2019 cover, 'Swamps on the Waikato plains,' site of New Zealand's only canal navigation.



ANZMapS publishes a refereed journal, *The Globe*, with contributions on a wide range of topics from cartographers and researchers.

Conferences

The Society held the following conferences:

Canberra 2015

The Power of Maps was held at the National Library of Australia, in Canberra, 29 April to 1 May 2015. Attended by 90 delegates, the event was held in partnership with the Mapping Sciences Institute, Australia. Keynotes included Dr Christopher Cummins (Decision Games), and Mr KHIN Maung Maung, (Geocomp International, Melbourne).

Wollongong 2016

The 44th annual conference of the society, *Encircled by sea*, was held in Wollongong, New South Wales, 7-9 September, 2016. The conference explored European mapping of Australia and New Zealand and the role explorers, surveyors and cartographers have played in shaping and documenting the changing coastal landscape and our views, over more than 200 years. Presenters included key geospatial agencies, including QTopo (Queensland's Department of Natural Resources and Mines), the Australian Defence Department, NSW Department of Finance, Services & Innovation, and the Australian Hydrographic Service.

Melbourne 2017

Mastering maps, from creation to care; attended by 75 delegates, the conference was preceded by workshops at the University of Melbourne and State Library of Victoria, showcasing techniques and software for using historical maps with geospatial systems, and practical advice for map collectors caring for maps, books and atlases.

Wellington 2018

GeoCart'2018 – ANZMapS partnered the New Zealand Cartographic Society to deliver *Cartographies of Change: Then, Now and Tomorrow*, 5-7 September at the National Library of New Zealand. At GeoCart'2018, ANZMapS was pleased to sponsor the visits of Chris



Chris Fleet, Map Curator National Library of Scotland.

Fleet, Maps Curator at the National Library of Scotland, and Kent Lee from East View Geospatial. Chris' keynote presentation discussed their approach to presenting maps through the web, the types of metadata required to make searching easy and defining maps to allow others to utilize the collection through their API. Prior to the conference Chris Fleet also presented a workshop on getting historical maps online. Kent Lee's gripping talk about how he developed access to Soviet military mapping at the end of the Cold War, gave interesting background to how his company has built on that repository of content providing access to maps and data from all corners of the globe.

Canberra 2019

Mapping in Action, will be held at the National Library of Australia, September 24-25, 2019. The focus is on student cartography with contributions from tertiary students in geospatial, heritage, conservation and other fields of study, demonstrating how maps and spatial science help us interact, interpret and understand society, the environment, history and science.

Awards

Between 2015-2019, ANZMapS has awarded the Dorothy Prescott Prize, in honour of Dorothy Prescott OAM, a key figure in map librarianship and cartographic description. The following researchers and cartographers were awarded for their papers, published in *The Globe*:

- 2015: Stuart Braga, 'Anzac Panorama' – a survivor's tribute to the Anzacs, August 1915
- 2016: Elizabeth Moylan, *Understanding Aboriginal Cultural Landscapes in the Illawarra: the role of historical maps*

- 2017: Caitlin Buckle, *Mapping migration biographies: Using Google Earth to explore migration at varying spatial scales* joint winner with Albertine Hamilton and Marika Kocsis, *Meek's Atlas: Insights into the Care of Oversized Map Materials*
- 2018: Anton Thomas, *Drawing North America*

The Society also provides an annual monetary award for excellence in cartography in honour of the late Patricia Alonso, awarded specifically to third-year students in the GIS course at RMIT University in Melbourne. The Society is keen to extend support to tertiary cartography courses both Australia and New Zealand.

Vale Professor Emeritus Victor Prescott

It is with sadness that I report the passing of Professor Emeritus Victor Prescott, a respected colleague who has long been a part of the ANZMapS community. Victor was a British and Australian academic, author, and professor emeritus at the University of Melbourne. During a distinguished career he earned a Personal Chair in Geography in 1986, published many internationally influential works in political geography, served a year as Academic-in-Residence for then Foreign Minister Bill Hayden working on the United Nations Convention on the Law of the Sea, and made a major contribution as Vice-President and President of the University of Melbourne's Academic Board and a Pro Vice-Chancellor. Victor was a key member of the Australian Map Circle and later ANZMapS, as President and in other roles over many years.



Contribution by Martin Woods

Land Information New Zealand

► www.linz.govt.nz

Topographic Strategy

In 2015 Land Information New Zealand (LINZ) released a Strategy that would guide our Topographic work over the next five years. This Strategy contains five specific goals:

1. Actively engage with customers, stakeholders and the international topographic community.
2. Ensure topographic data reflects real-world change at levels of spatial, temporal and attribution accuracy that maximise its value
3. Coordinate other sources of topographic data into open national datasets to maximise opportunities for its reuse
4. Coordinate the acquisition and release of imagery and elevation data into open national datasets to maximise opportunities for its reuse
5. Expand the production of topographic products and services to include those specifically for digital use

These goals have acted as our guiding principles over the past five years. We have delivered large packages of new data as well as transitioning our core processes from a product centric approach to a data centric focus.

Mapping

LINZ has a mandate to undertake topographic mapping and to maintain publicly available core geographic information, that supports the constitutional framework, national security and emergency services responses. It also requires LINZ to undertake topographical mapping with national coverage and consistent standards, to a degree of quality and quantity defined by the defence force, police, fire service, ambulance, search and rescue, and agricultural, horticultural and forestry central government Ministries.

LINZ's core deliverables have not changed, however, the Topographic Strategy has focused our work on up-to-date digital topographical data. All our data and maps are available online (at no charge), while we continue to produce a range of paper topographic maps, which are provided to emergency services, and sold to the public through map retailers.

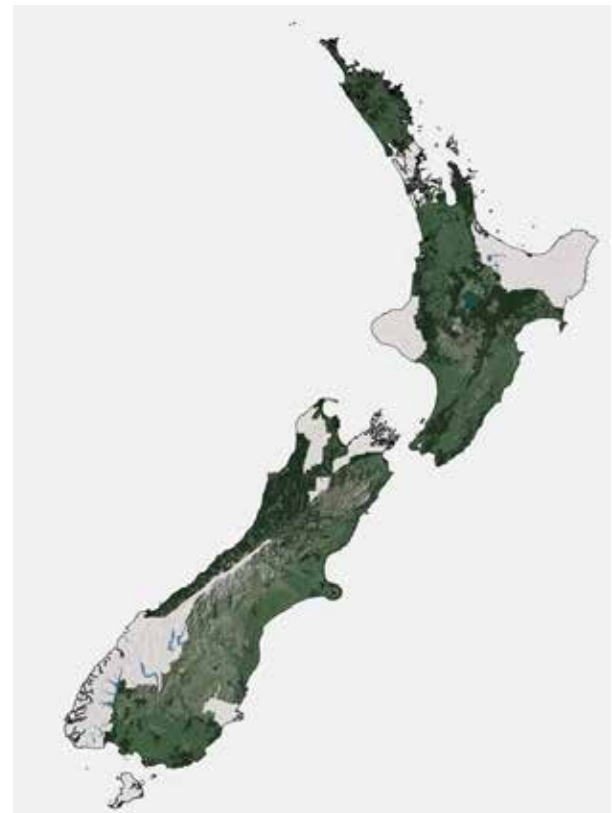
Our prioritisation process ensures that the entire NZTopo50 series is reviewed every seven years and that investigation continues and, if appropriate, integrates externally sourced and independent datasets to aid in this process.

Independent Datasets

Building Outlines

In 2016, LINZ conducted a pilot project to capture building outlines over three regions of New Zealand (Canterbury, Hawke's Bay and Waikato). The dataset provides building outlines within mainland New Zealand. The building outlines consist of 2D representation of the edge of a building as visible from aerial imagery, most commonly the roofline edge.

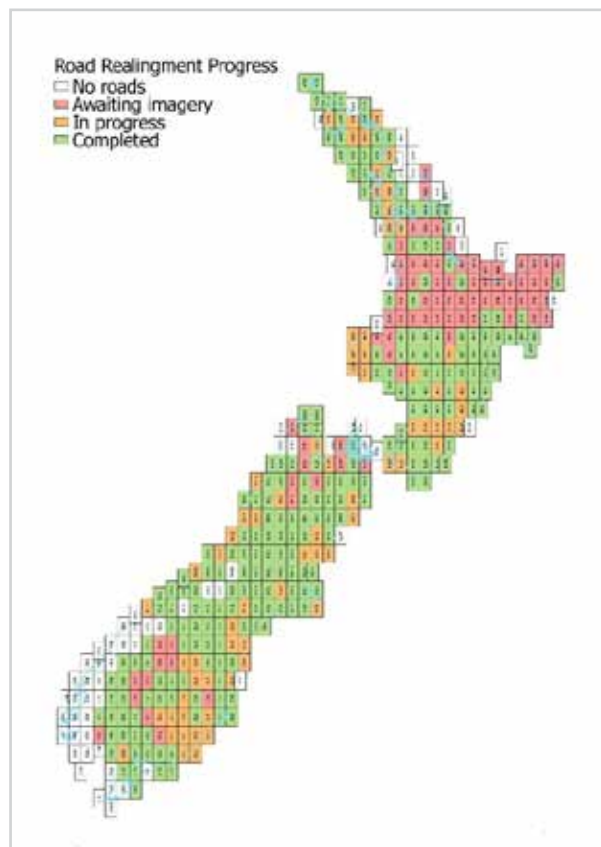
Coverage of the current building outline dataset, as on 15 April 2019.



Off the back of the successful pilot, LINZ decided that it would continue to procure building outlines aligning with aerial imagery capture. The current dataset has over 2.8 million building outlines, with significant regions still to be captured.

Roads

LINZ is currently realigning its road centrelines ($\pm 2\text{m}$) for the NZTopo50 product, with the plan to releasing all the realigned road data as a new independent dataset by the end of 2019.



Progress of road realignment project for NZTopo50 topographic map, as on 15 April 2019.

Rivers

LINZ has been working on a River Naming project since the beginning of 2018 by attributing river names to river centrelines and polygons. These changes will make this data useful for a wide range of purposes:

- the ability to identify river featured by name, to enable searching, showing extents and analysing specific rivers
- time saving and data consistency
- the ability to display cartographic text for river names on digital maps

This work is due for completion mid-2019. We are already investigating what the next phases of enhancements to this dataset could look like.

National Imagery

During the last four years, the coordinated approach to the acquisition of aerial imagery in New Zealand continued. The main drive for Aerial imagery comes from the Regional Councils, with LINZ acting in a coordinating role to ensure that aerial imagery also meets the wider national needs. This includes additional financial contribution to regional imagery capture from LINZ, the Ministry for Primary Industries and the Department of Conservation.

In general, regional imagery is renewed on a 3-5 year cycle at $\sim 30\text{cm}$ resolution with some low change areas having a lower level of re-fly. All Aerial Imagery is procured in line with the 'Specifications relating to the acquisition of orthophotography'. This ensures a consistent projection, tile layout, open licensing, etc.

All the aerial imagery is released via the LINZ Data Service on a Creative Commons CC-BY 4.0 (INT) licence that allows full utilisation of the imagery for anyone wishing to use it. Like other large data sets the cost of storage and dissemination is high. In future, storage options will need to be looked at for older imagery as the volumes continue to increase at an ever increasing rate.

Below an example of a historical image from 1941 and a current aerial image from 2017 is shown. On the right-hand side, the outline of the runway of the Wellington Airport is visible underpinning the importance of aerial and historical images capturing infrastructure development.

Crown Historic Aerial Imagery Archive

The Crown Historic Aerial Imagery Archive contains almost 500,000 images on film from 4,200 aerial surveys, captured between 1936 and 2005. This imagery was acquired for a range of purposes including mapping and land management. In 2014, LINZ purchased two scanners with the goal of scanning the entire archive.

The successful coordination and partnership model used for aerial imagery has been utilised for the scanning of the imagery archive. LINZ has entered into partnerships with regions for co-funding to get the Crown Archive scanned to ensure preservation, easier access, and better use of this valuable national resource. As of April 2019, LINZ has scanned 88% of the images and expects completion of the partner regions in late 2019. The full storage size of the scanned images is expected to be over 100TB, which will require long term storage.

Dissemination of the Crown Archive has been undertaken by the regional partners via retrolens.nz, an imagery service that allows a geographic search of the



The images above show the current location of the Airport in Wellington; on the left-hand side a historic image from 1941 is shown while the right-hand side shows the current infrastructure changes.

scanned images. All the images are released on a Creative Commons CC-BY 4.0 (INT) licence that allows full utilisation by anyone wishing to use them. With the release of these images, additional uses were identified in addition to the original reasons for capture. These include analysis of erosion/accretion in coastal areas, contaminated land investigations, analysis of river channel movements, geothermal vegetation analysis, Emissions Trading Scheme evidence, archaeological investigations, historic catchment areas, identification of land reclamation, and potential flooding issues.

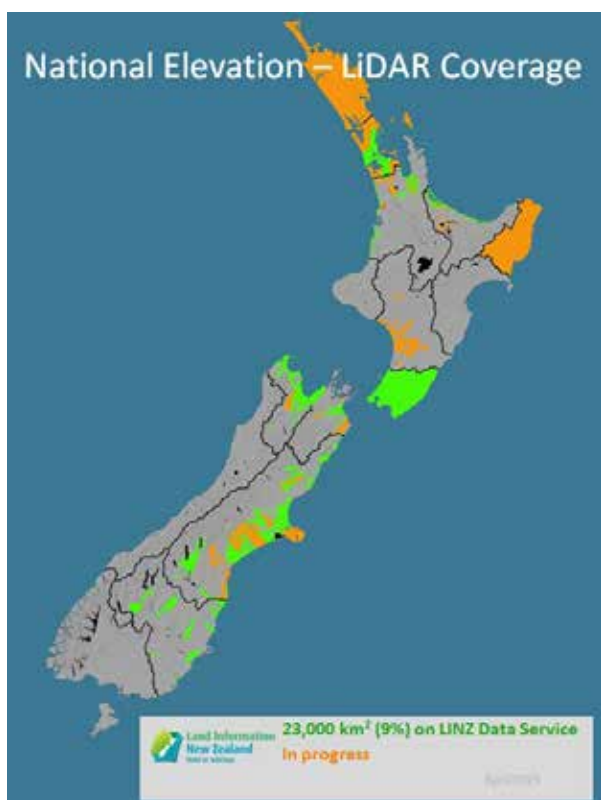
Elevation Data (LiDAR)

LINZ has taken an active role in the coordination of national LiDAR (Light Detection and Ranging), similar to the partnership approach used for National Imagery Coordination. The first step was to produce a New Zealand aerial LiDAR base specification. This specification provides a foundation for New Zealand public sector LiDAR procurements. It sets minimum standards to ensure that high quality LiDAR point cloud data and digital elevation models are suitable for inclusion in

the LINZ led National Elevation Programme to facilitate easier discovery and access through central data management. Data captured under this specification will contribute to the overall National Elevation Model.

The National Elevation Programme has moved from minimal LiDAR being publicly available to 23,000 km² of National Specification Elevation Models available on the LINZ Data Service as of April 2019, which is equivalent to 9% of the whole country with an additional 33,000 km² (another 12%) currently being captured.

In October 2018, the Ministers for Regional Economic Development and Land Information jointly announced that up to \$19 million co-funding from the Provincial Growth Fund (PGF) is available over five years for the capture of National Specification LiDAR. The co-funding is to help regions obtain a baseline elevation dataset, which will deliver enormous practical value and multiple uses over the coming decades to councils and regional industries. It is anticipated that the PGF co-funding will contribute approximately 50% of the cost for procuring region-wide LiDAR data coverage. As with other LINZ led programmes there is the expectation that the data will be released on a Creative Commons CC-BY 4.0 (INT).



Overview of New Zealand's concurrent (April 2019) National Elevation – LiDAR coverage.

Base Maps

As part of goal 5 of the Topographic strategy, developing new digital products has been a focus area. The enhancement of existing datasets has opened the possibility of developing a digital base map. A proof

of concept and then a prototype were developed. In 2019 the development of a full product will begin. This product will provide support for several LINZ existing services and provide a consistent base map that contains only information from recognised sources.

Mapping New Zealand 2025

New Zealand is in a unique position internationally. The national Geodetic, Hydrographic and Topographic offices are all part of a single agency. This unique situation has prompted LINZ to look at what opportunities are present, and how this advantage could be used for the benefit of all New Zealanders.

Mapping New Zealand 2025 (MNZ2025) vision of seamless land and sea mapping, from the top of Aoraki/Mt Cook to the edge of the continental shelf. This programme of work is separated in to five main components. The key area that will drive a step change is the Joining Land and Sea (JLAS) project.

Height and depth datasets in New Zealand are captured, reduced and disseminated in relation to a range of reference surfaces or datums. JLAS defines the relationship between the disparate vertical datums and creates the transformations required.

With JLAS in place coastal mapping becomes possible and existing and new datasets across land and sea can then be integrated. A number of the projects under MNZ2025 relate to capturing high accuracy data. Being able to integrate these datasets means we are maximising their value. Areas of particular interest for New Zealand are sea level rise, coastal erosion and tsunami inundation.

Graphic overview of the Mapping New Zealand 2025 Programme.



Hydrography

The New Zealand Hydrographic Authority (NZHA) collects, manages and shares marine geospatial information for the benefit of New Zealand. The NZHA has a responsibility under the International convention for Safety of Life at Sea (SOLAS) to provide navigational products and services in New Zealand waters, parts of the South West Pacific and the Ross Dependency in Antarctica. It produces Electronic Navigational Charts (ENCs) for use with Electronic Chart Display & Information Systems (ECDIS), traditional paper charts and the New Zealand Nautical Almanac. All official charts and publications are updated by fortnightly Notices to Mariners. Unofficial 'not for navigation' chart images are freely available to the public through the LINZ website and LINZ Data Service.

The navigation products created rely on high-quality bathymetric data captured by the best modern survey technology. The NZHA currently prioritises hydrographic survey areas based on factors which contribute to navigational safety. In recognising the value of marine geospatial information for New Zealand, additional deliverables such as seabed and water column backscatter data are now included as standard survey deliverables. This data is available to

the public under open Creative Commons licensing as are other key data sets including coastlines, maritime boundaries, and aids to navigation information.

The NZHA is embracing the future of e-navigation and the new international data models and standards on the digital horizon. Complete ENC coverage of NZ waters has been available for NZHA's jurisdiction since 2018. The NZHA actively contributes to, and leverages from, the international hydrographic community and international hydrographic and marine geospatial initiatives including GEBCO Seabed 2030, GEBCO Sub-Committee on Undersea Feature Names (SCUFN), United Nations Global Geospatial Information management (UNGGIM) Marine Geospatial Information Working Group, The Open Geospatial Consortium (OGC) Marine Domain Working Group, and many International Hydrographic Organisation (IHO) working groups.

Cartography remains a major element of the NZHA. As the NZHA actively pursues its 'digital first, data centric' ethos, nautical cartography as a definition will adapt, evolve and embrace this active shift.

Contribution by Roger Carman, Andrew Ferrell, Melissa West, Ben P. Jones and Rachel Gabara

Statistics New Zealand

► www.stats.govt.nz

Since 2015, Statistics New Zealand (Stats NZ) has been increasing the range of cartographic products available to subject matter areas to include in official releases. These areas include products for goods and services trade, labour markets, agricultural production, building consents and population projections. In 2016, Stats NZ and the Ministry for the Environment won a NZ Spatial Excellence Award for the maps produced for Environment Aotearoa 2015, the national State of the Environment report.

Cartograms, web applications and grids have started appearing in publications as have an increasing number of interactive maps. A global trade map styled as a classroom chalkboard was shared widely on social media. This brought a fun aspect into releases in order to engaging with new and different audiences.

The 2018 Census field force were equipped with mobile mapping tools to capture and validate dwelling addresses in preparation for the first census to mail out forms. At the time of publication, the results from the 2018 Census are being finalised which will result in another suite of maps produced over 2019 and 2020.

Cartography and spatial analysis using Stats NZ data are being enhanced by improvements to the statistical geographic areas and the use of geocoded address data. This will improve the accuracy of geographically aggregated data and provide flexibility to develop new geographic aggregations. One such example is the use of gridded data to map populations. This will provide users with a fixed geography, normalised by land area, that is more suited to time series and geographic linking to other data sources.

There is also a growing number of map builders using non-traditional, open source GIS tools such as R/Shiny. These are programming tools that are more accessible, familiar and cheaper than GIS licenses, but can have a significant productivity overhead. Many of these programmers do not have cartographic or design backgrounds so require education and training in cartographic fundamentals.

Contribution by Karl Majorhazi

Auckland Council

► www.aucklandcouncil.govt.nz

The Council

Auckland Council has 32 geospatial professionals within the Geospatial Team and over 200 federated GIS users within its wider geospatial community. A change in structure within the Geospatial Team has brought new team members with new skills, training and experience that have extended the team's capabilities in many areas, including business analysis, remote sensing and project coordination. Agility is the focus of the new operational model.

The Geospatial Team works towards enabling its customers to achieve exceptional outcomes by supporting evidence-based decision making throughout Auckland Council and by facilitating the exploration, application, development and custodianship of trusted geospatial data. The team aspire to be a key enabler, a trusted partner and a high-performance team. The services we provide include:

- information product provision (e.g. cartographic, diagrammatic and data provision)
- GIS applications as a service (e.g. web applications, GIS licences)
- training and consulting as a service (e.g. customer support and analysis),
- content management as service (e.g. data maintenance and management)
- solution delivery as a service (provide services to define, architect, design, deliver and deploy GIS solutions)

Since 2015, geospatial as a whole has continued to grow at Auckland Council. Measured by software installs, there has been a 38% growth in new installs of our core GIS software, ESRI ArcGIS, over this period. Additionally, the focus for geospatial delivery has continued the shift from traditional hard copy and pdf maps to delivery via the web using out of the box and customised web mapping tools. The team are focused on an upgrade of our enterprise ArcGIS installation which will extend our geospatial and, especially, web mapping capability. The team is also promoting the uptake of ArcGIS Pro, as well as exploring how open source software might be incorporated into the corporate GIS ecosystem.

Since the previous National Report, a cartographic working group was formed, and progress has been

made on creating a framework for cartographic principles at Auckland Council. Additionally, core geospatial governance documents, such as the Council's Service Delivery Framework (SDF), are currently being reviewed and updated, especially in light of technology changes as a result of the upgrade

Web Mapping

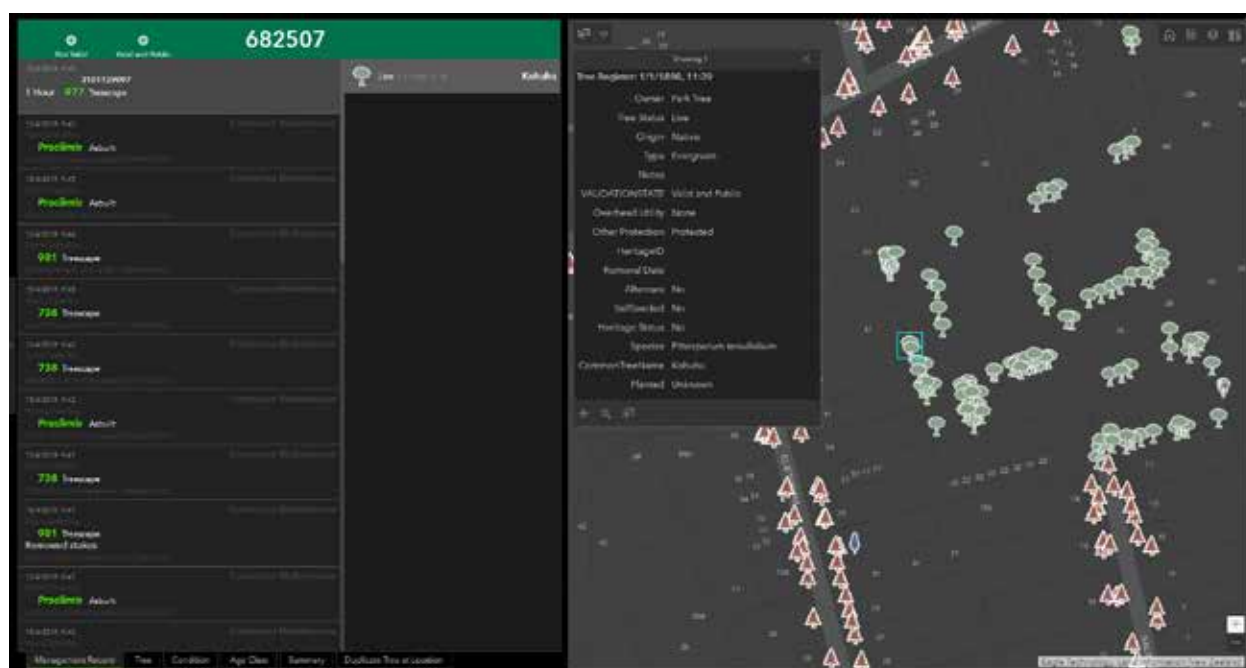
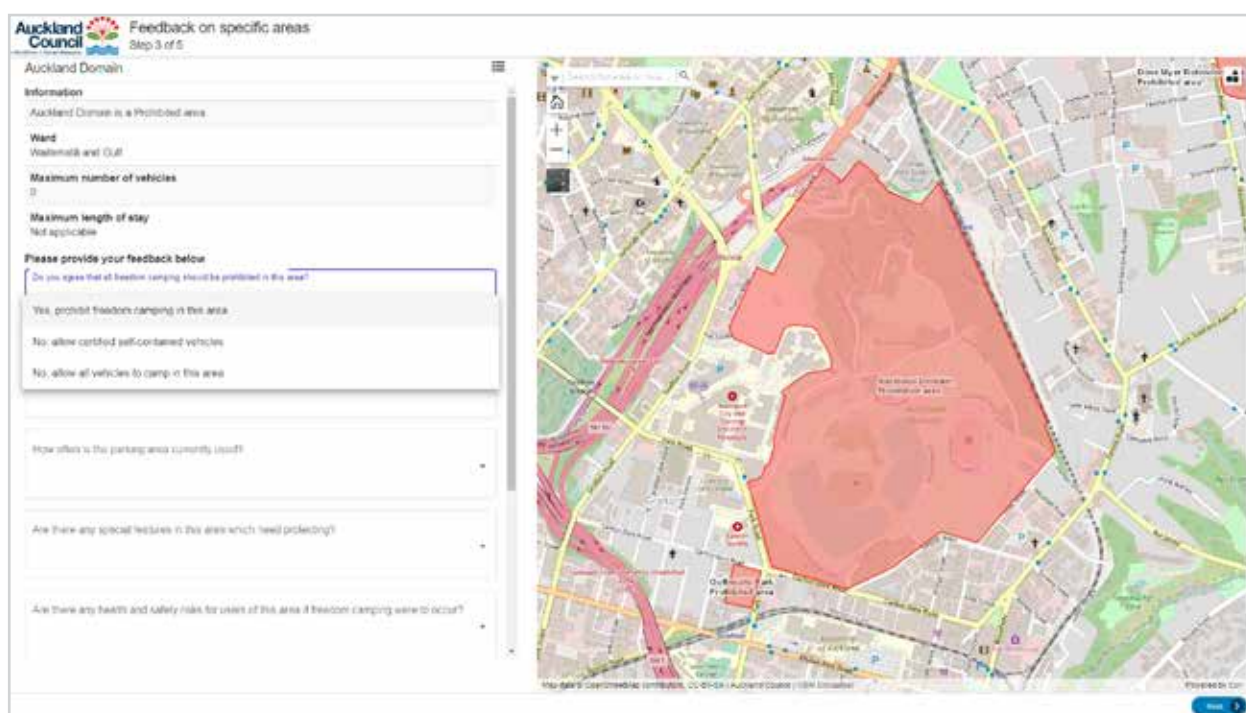
Using Esri's ArcGIS Online and Portal, the geospatial team at Council have been making web maps and apps that are readily available for internal and external users. Our main GIS viewer, GeoMaps, saw over 289,242 external users from July 2017-2018 and had over 28,646 internal users over the same period. Additionally, several targeted and customised applications have been released, both for internal use and public consultation. Demand for these products has grown steadily since 2015 and is expected to continue to grow over the next four years

While web maps are more accessible and interactive, they present unique challenges for the creator and the user. Cartographic elements like colour and symbology are hard to control in web maps as the user can choose to view any layer or combination of layers and, in some cases, even change the symbology within the web map. Subsequently, the effectiveness of the cartography used in the web map may be dependent on the choices the user makes. In a sense, the user has become the cartographer. Excellent design and, further, accessibility in this new web environment is something that the Council's geospatial community continues to explore.

Dashboards

While they do not necessarily need to contain maps, dashboards have been growing in demand at Council. Dashboards leverage both spatial and non-spatial views (summary statistics, charts and more) of data sources. Over 20 dashboards have been created over the last few years.

Notable work is the TreeAdmin dashboard (see overleaf) and a dashboard for Local Boards, called



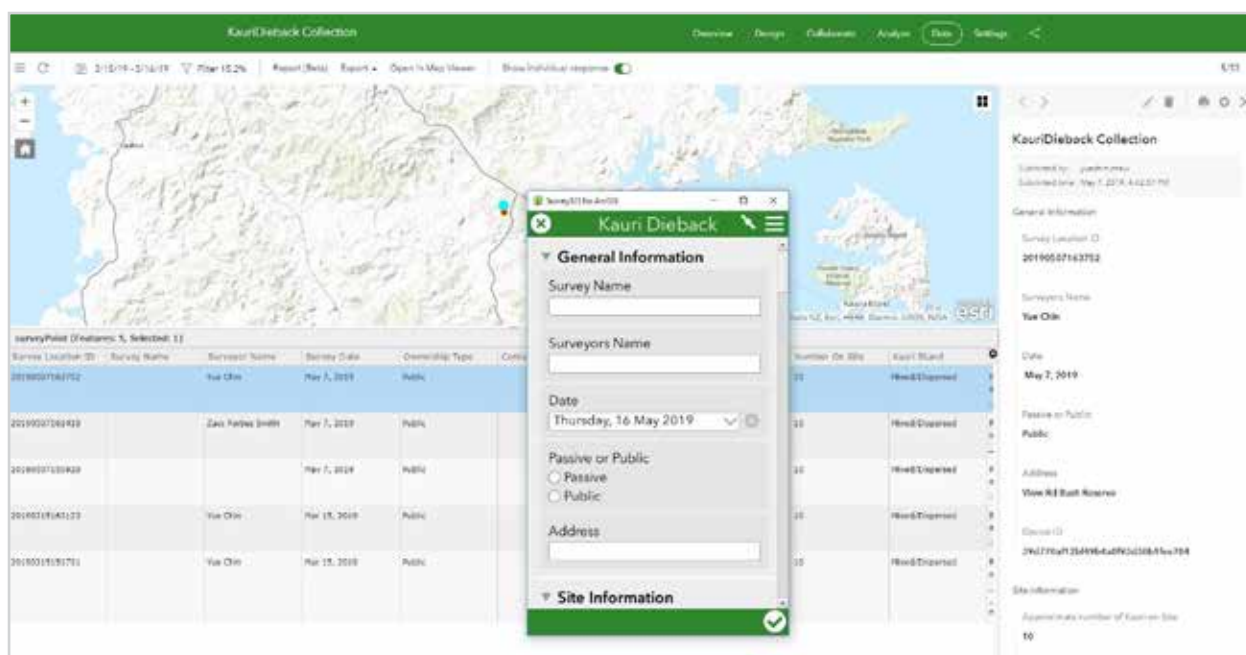
Example of freedom camping web application - a customised web application developed to collect feedback from the public (top); TreeAdmin Dashboard shows trees and associated information.

LocalDash, which is currently under development. LocalDash can allow local board members to view maps and critical statistics for their board and, also, to compare their area to other local boards in the region.

Mobile Mapping Applications

As the business becomes more mobile, so does the demand for real-time mobile GIS applications.

Business units are utilising more mobile applications, including but not limited to, applications built using ESRI's Survey123 and Collector applications. The Geospatial team have produced mobile services for many projects, including projects aimed at monitoring Auckland's trees, management of cemeteries, hull surveillance and stopping the spread of Kauri die-back. The growth in the use of these applications has highlighted the need to guide the implementation, standards and procurement of new GPS hardware,



Kauri Dieback survey123 form with associated ArcGIS Online web service.

which is something the team will explore over the next few years.

Satellite Imagery

Recently, the Geospatial team created a new imagery base-map using DigitalGlobe Worldview 2 imagery. This type of mosaic was a first for the team and

The new Worldview 2 mosaic, usable as a reference layer and a base map.



presented processing and production challenges. The satellite imagery provides an updated view of the region, especially in rural areas. The multispectral component of the raw imagery is expected to be highly utilised in analysis and feature extraction projects in the coming years.

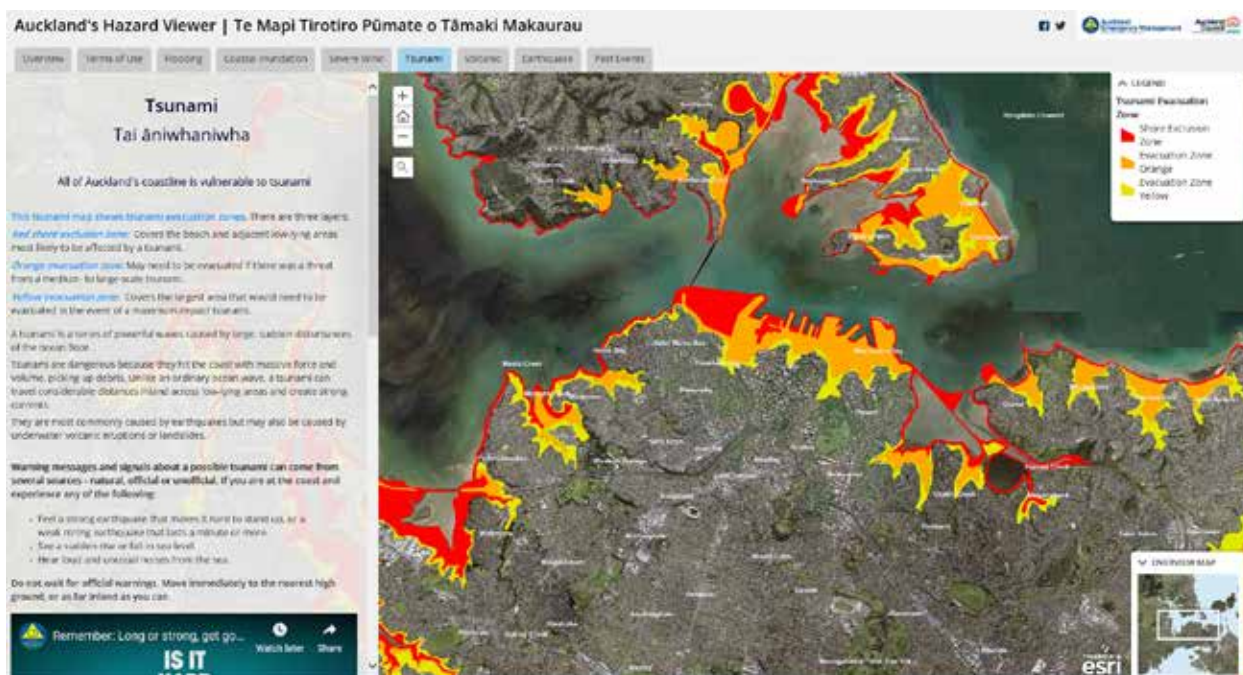
Story Maps

Story maps are a way to guide a user through a subject, to tell a story, using both spatial and non-spatial information. A notable and successful application of this product type is the Auckland Hazard viewer (see overleaf), which was created for Auckland Emergency Management (AEM). This viewer allows the public to explore maps of natural hazards across Auckland, while also providing useful text-based information aimed at improving public safety through increased awareness, education and preparedness.

Newsletters and Lightning Talks

The Geospatial Team at Auckland Council is proactive in communicating with our business customers. The team sends out monthly Geospatial Newsletter and runs regular “lightning” talks with presenters from across Council and external organisations.

The talks cover a range of subjects, including cartography, surveying, geodesy, virtual reality, mobile tools and more. These talks are popular and see regular return visitors.



Tsunami tab of the AEM Hazards viewer, showing evacuation zones.

Support for Geospatial Groups

The Geospatial team have also been proactive in supporting several spatial groups by providing venues and resources for these groups to hold spatial gatherings. The Emerging Spatial Professionals (ESP) have held presentation evenings with us, and we are proud to support these newer entrants into the geospatial

arena. Woman in Spatial has also seen our support and sponsorship within the last few years.

Contribution by Simon Bardsley

Attendees at an Emerging Spatial Professionals (ESP) presentation evening.



GEOINT New Zealand

► www.nzdf.mil.nz/about-us/geoint/

GEOINT New Zealand (GNZ), part of the New Zealand Defence Force (NZDF), services the geospatial intelligence (GEOINT) needs of the New Zealand Army, Air Force, Navy, and wider NZDF community, and beyond to other New Zealand government agencies. GNZ's responsiveness to mapping and data provision requirements results in the delivery of a wide range of products and services.

In-house production of topographic maps remains part of the core portfolio. Production continues at standard scales and formats governed by accepted military specifications or alternatively, as tailored thematic maps to fulfil specific requests. Recent focus has

been in the Southwest Pacific; however areas of interest are national or global as required.

Since the last report, GNZ's engagement in the Southwest (SW) Pacific has extended to the provision of geospatial training and support to Pacific nations' geospatial organisations. In 2017, GNZ facilitated GEOINT focused Humanitarian Aid and Disaster Relief (HADR) training at Devonport Naval Base in Auckland. Our Pacific Island counterparts were well represented and as a result, are better equipped to support their home nations in HADR events. A second course is programmed for June 2019. GNZ continues to contribute SW Pacific data to the Multinational Geospatial

2017 HADR course exercise at the Devonport Naval Base, Auckland.



Co-production Program (MGCP), with efforts currently focused on revising previously captured data of Samoa. In addition, GNZ has entered into the multi-national TREx co-production programme, processing TanDEM-X and TerraSAR-X data in an effort to develop a global digital elevation model at 12 metre post spacing. Focus is on TREx production over the South Island of New Zealand.

Aeronautical data and chart support to the Royal New Zealand Air Force (RNZAF) includes the production of two bespoke aeronautical navigation chart series, the R470 and the more recent R571 series. The R470 is a 1:500,000 Tactical Pilotage Chart (TPC) series of four sheets. It has an annual revision cycle to maintain currency and safety of navigation, and is currently in its 6th edition. The R571 Low Flying Chart (LFC) series is at 1:250,000 and two of the eleven sheets in the schema have been produced. GNZ is also concurrently revising its Aeronautical Plotting Chart (APC) SW Pacific series at 1:3,000,000. Sheet lines have been optimised and two new charts added. The series now comprises nine sheets and coverage extends from Papua New Guinea to Pitcairn Island, and south to Antarctica.

Maritime support to the NZDF continues to focus on the provision of hydrographic charts for safety of

navigation and customised production of maritime charts for military exercises involving the Royal New Zealand Navy (RNZN). GNZ has recently initiated the development of a Satellite Derived Bathymetry capability and is working with international partners on portrayal standards for remotely sensed hydrographic data for use with military geospatial products.

Analytical products generally present geographical information and include line-of-sight 'view sheds' or safety radii in a readily digestible portrayal. Analytical products modelling terrain, vegetation and infrastructure data are also part of the product range. These are designed to identify characteristics, for example helicopter landing zones, drop zone suitability, travel times, vehicle mobility and flood potential, thereby enabling the planning of activities supporting HADR events.

Maps and charts are delivered on a variety of media, depending on user requirements, ranging from paper products through to online web-mapping and handheld GPS devices.

Contribution by Lesley Murphy and Aaron Napier

GNS Science

► www.gns.cri.nz

GNS Science is a government-owned agency specialising in earth and isotope science research. Public Good Science funding has supported continued publication of geological maps and datasets that was previously undertaken by GNS's predecessor, the New Zealand Geological Survey.

Geological Map of New Zealand 1:250,000 (GM1) – Second Edition

GNS has maintained a digital geospatial database of the onshore geology of New Zealand at 1:250,000 scale, providing essential geological information to local and central government, planners and business interests. These data are also available through a Web Map Service (WMS), a Web Feature Service (WFS), ArcGIS Server and are viewable through a web map application. The second edition of the Geological Map of New Zealand is a digital product which provided an update of selected geological data and has made extended use of the Open Geospatial Consortium (OGC) GeoSciML Standard, which defines a model and encoding for geological features commonly described and portrayed in geological maps and databases.

Geology and Geomorphology of Urban Christchurch and Eastern Canterbury (GM3)

2016 saw the release of the anticipated first offering of a new series of publications devoted to the geology of New Zealand's urban areas. The area covered in this publication includes most of the urban area of Christchurch City, and numerous outlying towns and rural residential areas. The purpose of this geological dataset, maps and models, is to provide improved knowledge of the materials that lie beneath the Canterbury Plains in the Christchurch area, as an aid to derivative work such as geological research, geotechnical characterisation and hazard mitigation. It also provides a resource for city planning, emergency management, groundwater management and gives a general indication of likely foundation conditions across the city. This geological dataset is published in

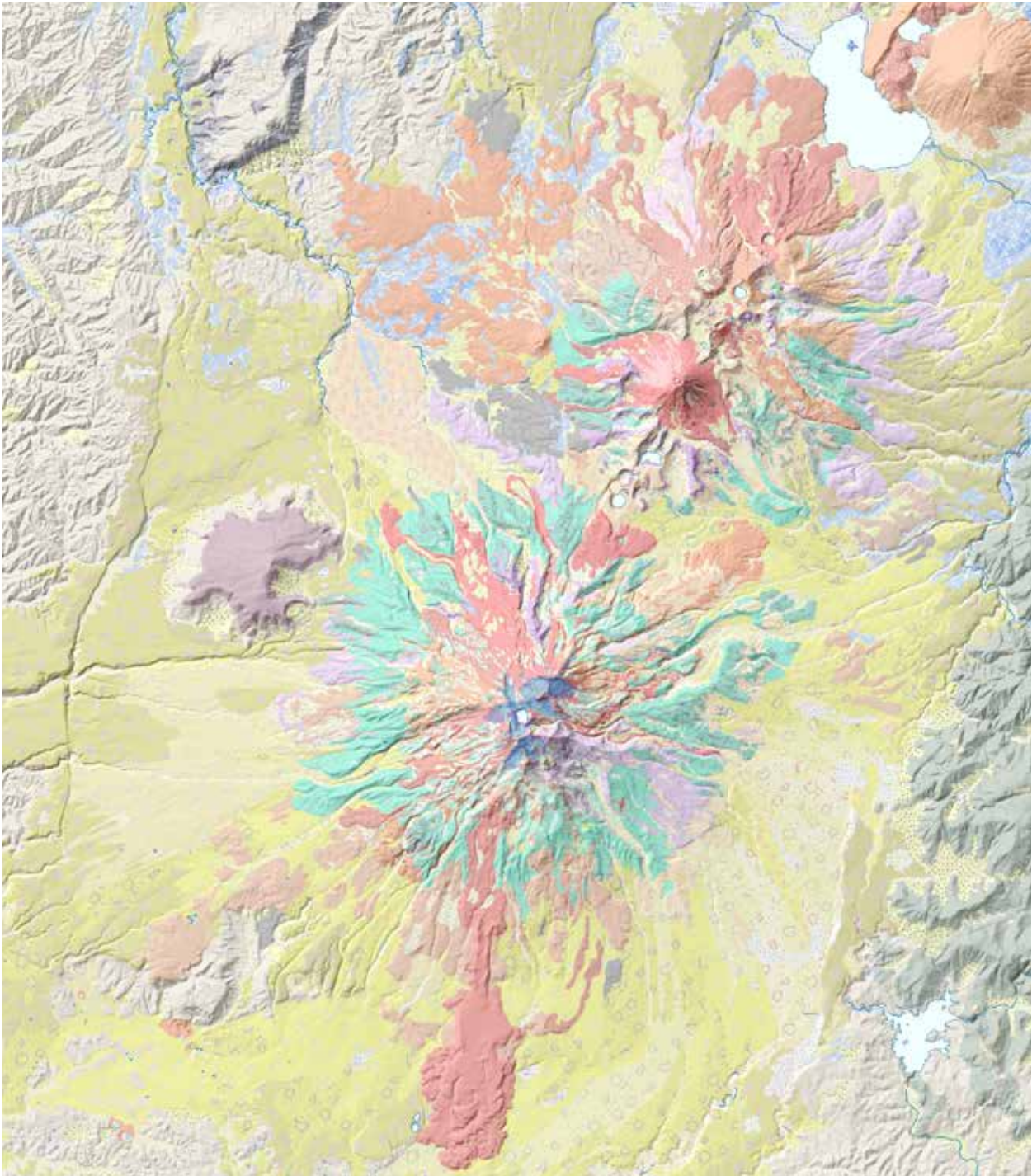
digital form only, and comprises a PDF-printable geomorphological map, presented at a scale of 1:50,000; three 3-dimensional geological/geotechnical models in Leapfrog GEO viewer file format, developed to represent materials beneath the study area; and an explanatory text.

Geology of the Tongariro National Park Area (GM4)

Despite their prominence in the landscape and history of the central North Island, no single map had described the geological history and structure of the volcanoes within the Tongariro National Park (TNP) in detail greater than 1:250,000. To fill that gap, a geological map of Tongariro National Park map at 1:60,000 and accompanying text were produced through collaboration between GNS Science, the Department of Conservation and Victoria University of Wellington (see overleaf). The map, published in 2018, has been paper-printed because of anticipated demand for the map and is also available in digital GIS-based files and through web services. The map and the stratigraphic descriptions are relatively detailed and interpret the volcanic geology and eruption history of TNP within the regional setting of New Zealand geology. The map is aimed at members of the public interested in volcanoes and geology, and intended as a baseline resource for technical users. The map shows the distribution and stratigraphy of landscape-forming geological deposits across the TNP area. It is expected that this map will provide an interesting and rich source of knowledge for New Zealanders and visitors alike.

Geology of the Middlesmarch Area (GM5)

A 1:50,000 digital-only map and text covering 864 km² (24 km by 36 km) of East Otago around Middlesmarch township was published in 2016. The availability of regional airborne geophysics data (magnetics and electromagnetics) was a key factor in deciding to update the existing geology for this sheet and is a point of difference between this and earlier geological maps. New geological interpretations presented

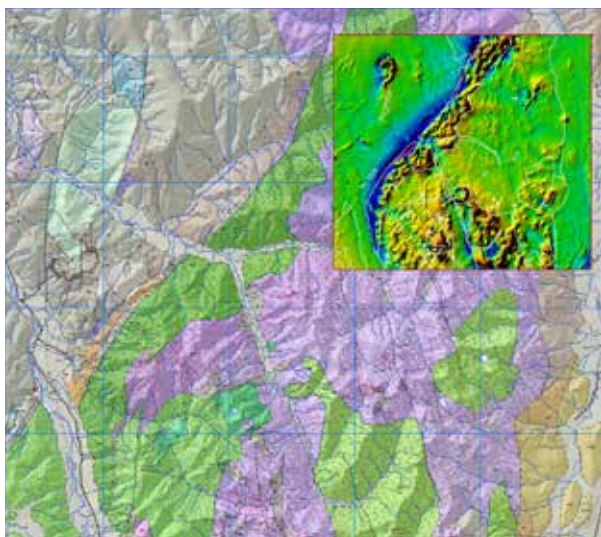


The Geology of the Tongariro National Park area map depicts the eruptive events that have shaped the Tongariro and Ruapehu composite volcanoes.

here are particularly relevant to understanding the distribution of groundwater, metals and other natural resources, and this resource focus is evident in the updated localities of resource occurrences on the map and in detailed overviews of Barewood and Nenthorn goldfields. The map product includes a cartographic PDF-printable map and a GIS dataset available on physical media and is also available through web services.

Geology of the Victoria Range Area (GM6)

A 1:50,000 digital-only map published in 2019 focusses on the depiction of the plutonic geology in the Victoria Range area of the Karamea Batholith on the west coast of the South Island of New Zealand. Plutons have been mapped, and subdivided into suites, based on mineralogy and geochemistry and dated using U-Pb zircon and monazite geochronology. Dense forest over two



Show geological units draped over shaded relief map of a portion of the rugged Victoria Range. The inset shows total aeromagnetic anomalies which reflect magnetic differences in the plutonic rocks.

thirds of the area has hindered accurate mapping of pluton boundaries although interpretation of recent aeromagnetic surveys has been used to augment the map in several areas. The map product includes a cartographic PDF-printable map and a GIS dataset available on physical media and will also be available through web services.

Looking Ahead

Regional Geological Map Archive and Data File (RGMAD)

GNS Science is custodian of a representative set of more than 9000 geological maps and field sheets that date back to the late 19th century. These historical

documents record valuable information and evolving interpretation and understanding of the geology of New Zealand. Accessibility to this archive is being improved through scanning and documenting the maps. All maps are now scanned, some are already available online through GNS Science's Geonet-work-based Dataset Catalog at data.gns.cri.nz/catalog and the remainder are soon to be added. RGMAD will be searchable and maps downloadable through the Dataset Catalog.

GeoMAP

The first version of GeoMAP will be released soon, providing a modern geological GIS dataset describing exposed bedrock and surficial geology of Antarctica. GeoMAP compilation has occurred from 2015-2019 through an international effort involving ~18 key collaborators, 11 student volunteers, and much manual labour. The aim was to capture existing geological map data, update its spatial reliability, and improve representation of glacial sequences and geomorphology. The new GIS dataset comprises over 83,000 polygons that describe 'known geology' of rock exposures, rather than 'interpreted' sub-ice features, using a mixed chronostratigraphic- and lithostratigraphic-based classification. A rich attribute table enables these data to be displayed or queried in a wide-variety of ways. Other spatial data captured for GeoMAP includes a source bibliography of 502 polygons outlining maps and previous work, 1476 fault lines and 3850 structural data points. GeoMAP has potential to provide fresh perspectives, for example, through combined geological legends and interrogation of continent-wide time-space plots. It is also ideal for continent-wide perspectives and cross-discipline science.

Contribution by Belinda Smith Lyttle

Manaaki Whenua Landcare Research

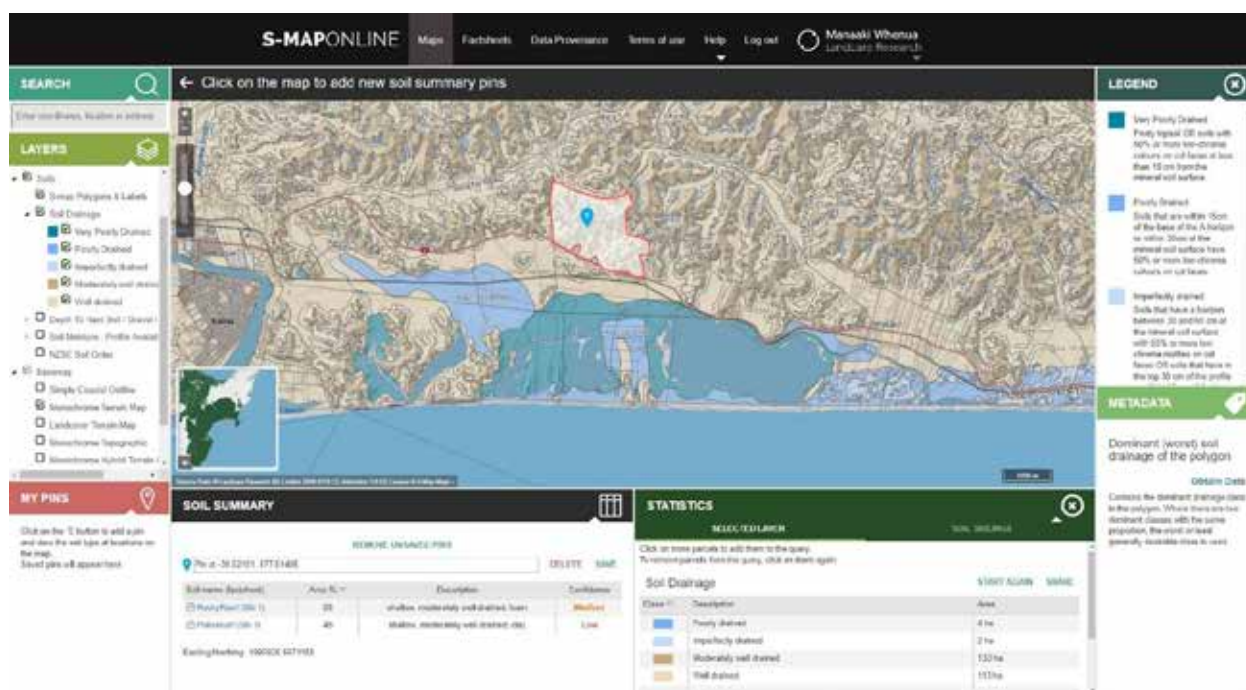
► www.landcareresearch.co.nz

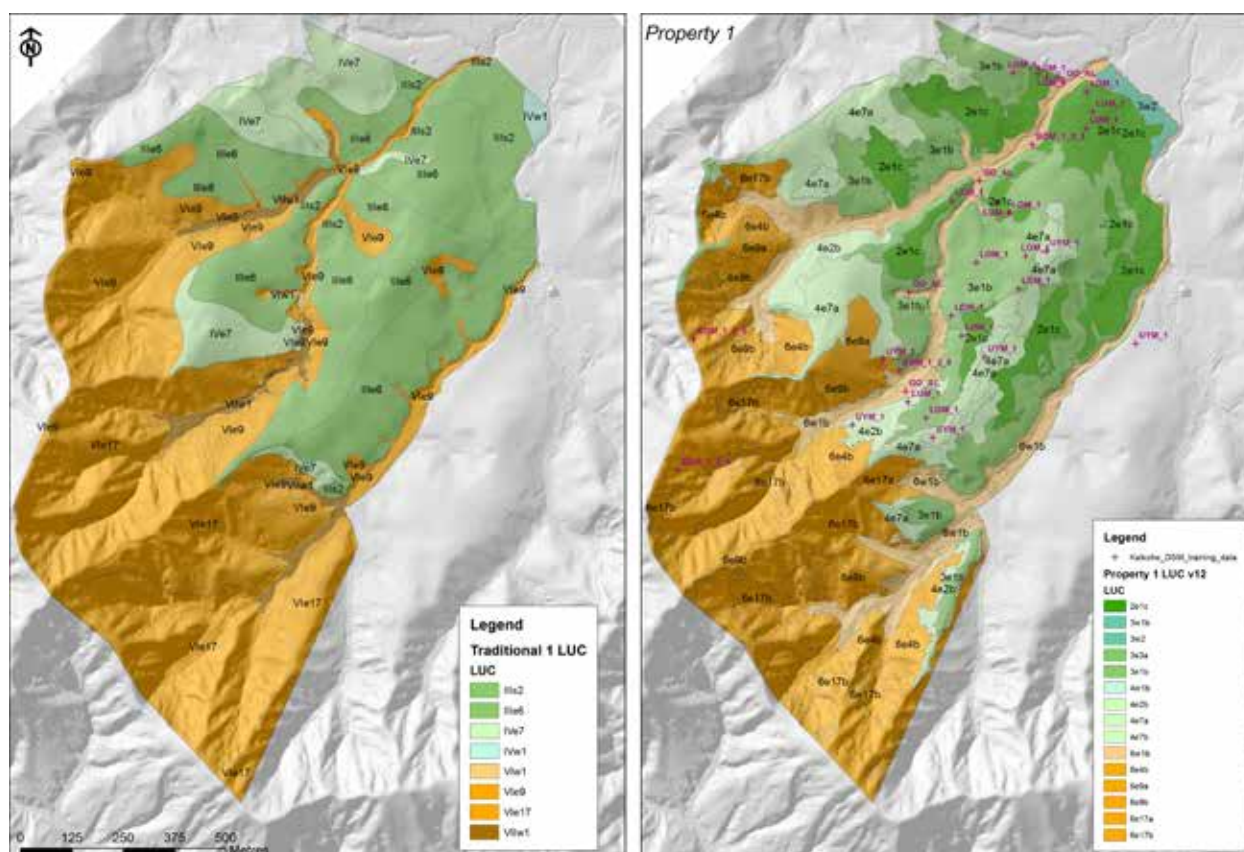
Manaaki Whenua Landcare Research (MWLR) continues in its core purpose of driving innovation in the management of terrestrial biodiversity and land resources. In the period of 2015–2019, MWLR's presentation of online data and knowledge has continued to evolve. Development of online cartographic services were marked by the launch of upgrades to the LRIS Portal (lris.scinfo.org.nz – built on the Koordinates platform), including the capability for setting cartographic styling for web map services (as yet not used extensively). In 2019, S-map Online (smap.landcareresearch.co.nz), Our Environment (ourenvironment.scinfo.org.nz), the Antarctic Environment Portal (www.environments.aq/map/), and MWLR's web map services (maps.scinfo.org.nz) have all received refreshes including improving performance of the underlying web map services. These portals all use Open Source Geospatial (OSGeo) tools, and, along with a commitment to delivering web services adhering to OGC standards, continue a major investment in effort to deliver high-quality, interactive online

map and data query services, as well as high-quality PDF maps up to A3. Considerable effort has also been expended on associated reporting and visualisation of underlying soils and environmental data in support of maps (see figure). MWLR is a leading participant in and advocate for New Zealand's slowly emerging Spatial Data Infrastructure and works internationally on the development of geospatial standards.

Modern digital mapping and modelling techniques are valuable for understanding soils. However, they depend on dispersed, inconsistent, and difficult to access digital data. Modern, harmonized, and interoperable information systems are required to integrate these data into a consistent set of soil data. Initiatives have started work on this by defining soil data information models. MWLR, in partnership with the Commonwealth Scientific and Industrial Research Organisation (CSIRO, Australia) and ISRIC World Soil Information Institute (Netherlands), were lead agencies in a 6-month interoperability experiment. Other international participating agencies include

A screenshot of the 2019 release of S-map Online illustrating the on-screen cartography, querying of Smap soil polygons and delivering area reporting of soils against LINZ land parcels via WFS from LINZ data service.





Traditional farm-scale LUC units (*left*) mapped at approximately 1:10,000 scale compared with (*right*) digitally generated LUC based on LiDAR slope mapping, parent material, digital soil mapping and aerial imagery acquired with the LiDAR.

Agriculture and Agri-Food Canada, the US Department of Agriculture National Resources Conservation Services, the US Geological Survey, and the Research Centre for Agrobiological and Pedology (Italy). MWLR is now working with ISRIC and other agencies on the development of a global soil information system.

The Open Geospatial Consortium's (OGC) 105th Technical & Planning Committee (TC/PC) Meeting was hosted by MWLR in Palmerston North from 4th to 8th December 2017. This was the first time an OGC meeting has been held in New Zealand and provided a great opportunity to bring international and local expertise to the table to participate in the variety of OGC Domain and Standards Working Groups. Two open summits (Environmental Data and Data Interoperability and Agritech) created the platform for engagement between local and international experts on topics of importance to New Zealand.

During this reporting period, MWLR also worked on a Sustainable Land Management and Climate Change (SLMACC) project funded by the Ministry of Primary Industry *Use of Modern Technology including LiDAR to Update the New Zealand Land Resource Inventory* (www.mpi.govt.nz/dmsdocument/30615/send). While focussed on the creation of high-resolution environmental data, this project involved a significant

component of automated cartography generating land use capability map units based on field data collection (e.g. soil auger observations), remotely acquired terrain and environmental covariate data, and geospatial modelling. Where previously any mapped LUC unit boundaries would have been drawn manually, the vector LUC units for this project were generated through an automated process including segmentation and simplification of multiple raster input layers. The project mapped 100 km² of complex Northland terrain and included making comparisons with traditional manual mapped LUC units (see figure).

A similar approach has been applied to digital soil mapping of new soils data for S-map, particularly in complex hill country areas. In the case of S-map, the cartographic processing workflow has also been ported from a desktop environment using proprietary software (ArcGIS™) to the New Zealand eScience Infrastructure (NeSI) High Performance Computing (HPC) facilities at the University of Auckland to permit parallel processing of tiled input data. This process also involved porting processing to an open source GIS (GRASS).

Contribution by James Barringer

National Institute of Water and Atmospheric Research

► www.niwa.co.nz

The National Institute of Water and Atmospheric Research (NIWA) three core areas of expertise, where they have the responsibility as New Zealand's predominant science provider, are climate and atmosphere, freshwater, and oceans – natural environments that are interconnected in innumerable ways. But these also present economic and social opportunities which require comprehensive scientific understanding for New Zealand to take advantage of them responsibly.

Through its Coasts and Oceans portfolio NIWA is tasked with the mapping of New Zealand's near-shore and open ocean environments using the latest technology including multibeam echosounders. As a means of getting this research into the public domain NIWA produces a range of high-quality informative posters for schools, industry groups, and the general public.

Kapiti

This high definition map, published in 2016, of the seafloor surrounding Kapiti Island covers an area of significant cultural and environmental value. The island is a nature reserve, which is partially surrounded by the Kapiti Marine Reserve that was established in 1992.

This map provides detailed information about the seafloor topography and the locations of different habitat types, which is useful for the management of the region. The seafloor was mapped using a multi-beam echosounder that provides information on the morphology and geology of the seafloor. The data highlight fine details such as sand waves and dunes; shallow rocky reefs, such as the Tarapunga Shoal; current scours in the 70 m-deep Rauoterangi Channel; sediment flats and rocky beaches.

New Zealand Fisheries Management Areas

Published on 2017, this map shows areas the extent of areas that are used for the management of fisheries in New Zealand waters. These areas include:

- Fisheries Management Areas
- General Statistical Areas
- Benthic Protection Areas
- Seamount Closures

This map is an update to a map first published in 2005.

Queen Charlotte Sound/Totaranui and Tory Channel/Kura Te Au

This frameable high resolution seafloor map, published in 2018, shows Queen Charlotte Sound/Totaranui and Tory Channel/Kura Te Au which form the main waterways within the eastern part of the Marlborough Sounds at the top of New Zealand's South Island. Here, the calm waters of the sounds interact with one of the world's most energetic stretches of water in Cook Strait (Rau Kawakawa). This shallow, sheltered sound, dotted with islands and bordered by its distinctive bays, is home to several towns and settlements. It is also a transport hub, contains a commercial port, numerous tourist attractions, and includes recreational, customary and commercial fishing grounds. The variability and complexity of the seafloor is revealed in this map. It shows the sweeping signature of sediment erosion, transport and deposition. Channels and scours filled with shell and gravel in the outer sounds and Tory Channel/Kura Te Au merge with the typically flat, pockmarked seabed of fine-grained mud and sand in the inner sounds.

Queen Charlotte Sound/Totaranui, Grove Arm – Dieffenbach Point

This frameable high resolution seafloor map, published in 2018 and is part of the series of maps in the Queen Charlotte Sound/Totaranui and Tory Channel/Kura Te Au area, shows the inner part of Queen Charlotte Sound/Totaranui. This is a mostly benign tranquil region, dotted with picturesque bays and holiday homes serviced by the nearby town of Picton. The seafloor is largely featureless and that, and gently deepens towards the east. The slopes around the bays on the northern coast are generally steep, while the southern bays are more gently shoaling. Mooring blocks and scours are numerous in Okiwa Bay, Picton Harbour and Waikawa Bay.

Queen Charlotte Sound/Totaranui, Bay of Many Coves – Cape Koamaru

This frameable high resolution seafloor map, published in 2018 and is part of the series of maps in the Queen Charlotte Sound/Totaranui and Tory Channel/Kura Te Au area, shows the middle part of Queen

Charlotte Sound/Totaranui. The coastal fringes of the middle Queen Charlotte Sound/Totaranui have relatively steep slopes but the seafloor is typically flat. Meretoto/Ship Cove is a key focal point of the middle Queen Charlotte Sound/Totaranui, which was Captain James Cook's favourite New Zealand base during his three voyages of exploration. Passing from Cook Strait into Queen Charlotte Sound, a broad flat bank or sill spans across the entrance, with the islands dividing it into three channels. The greater volume of water entering the sounds from Tory Channel/Kura Te Au significantly affects conditions creating localised turbulence and upwelling, and persistent northwards flow along the western coast. Many holes, likely formed by freshwater seeps, have been eroded by tidal flows into complex pockmark structures, especially around the coastal areas. Tidal flow has also formed deep scour holes out headlands, with Blumine and Long Islands also extending as rocky reef structures into the sounds.

Queen Charlotte Sound/Totaranui, Resolution Bay – Cook Strait

This frameable high resolution seafloor map, published in 2018 and is part of the series of maps in the Queen Charlotte Sound/Totaranui and Tory Channel/Kura Te Au area, shows the outer part of Queen Charlotte Sound/Totaranui. The outer Queen Charlotte Sound/Totaranui is best known for its natural exposure to wind from all directions. Its rough waters have often proved hazardous as shown by the shipwrecks in the region. At its entrance is the aptly-named Long Island which is surrounded by the Long Island – Kōkōmohua Marine Reserve boasting phenomenal diving and snorkelling experiences. The entrance to the outer sound is a complex mix of undersea ridges, sediment waves and depressions that extend into the strait. These include isolated steep-sided ridges and shoals along the western coast from Cape Jackson to Walkers Rock, and deep scouring in Jacksons Hole. A rock ridge extends from Cape Koamaru to the emergent Cook Rock, with several depressions on the western side. The Brothers form part of a ridge and shoal system in Cook Strait, with distinctive sediment waves to the west.

Tory Channel/Kura Te Au

This frameable high resolution seafloor map, published in 2018 and is part of the series of maps in the Queen Charlotte Sound/Totaranui and Tory Channel/Kura Te Au area, shows Tory Channel/Kura Te Au. Tory Channel/Kura Te Au is a complex, fast-flowing stretch of water between Cook Strait (Rau Kawakawa) and Queen Charlotte Sound/Totaranui. At its entrance is East Head, one of the easternmost points in the South Island. Tory Channel/Kura Te Au is also the

principal channel for interisland ferries. Tidal flows in this narrow and shallow constricted channel can reach speeds of over 2 metres per second. These flows are accelerated around its headlands, resulting in erosion of the seafloor forming nearshore rock reefs, depressions or holes. Gravel covering the seafloor is common where these strong currents scour the underlying seabed, transporting finer sediment away. This complex environment provides a range of habitats hosting a trove of biodiversity. Coastal kelp, sea grass beds and rocky reefs support fish, algae and invertebrates. Further offshore, the waters of this region sustain fish, seabirds, whales and dolphins.

Picton Harbour and Waikawa Bay

This frameable high resolution seafloor map, published in 2018 and is part of the series of maps in the Queen Charlotte Sound/Totaranui and Tory Channel/Kura Te Au area, shows Picton Harbour and Waikawa Bay. At the head of Queen Charlotte Sound/Totaranui is the picturesque seaside town of Picton, the northern terminus of the South Island's rail and road networks and the gateway to the South Island. To the east lies Picton's Waikawa Bay which is home to New Zealand's third-largest marina. New data has revealed numerous anchor drag marks off Mabel Island and Wedge Point, disturbed seafloor in Picton Harbour and evidence of dredging next to Waimahara Wharf in Shakespeare Bay. Mooring blocks and scours are apparent in the heads of the bays, while features resulting from submarine cables are seen traversing the sounds. Circular pockmarks, often formed by freshwater seeps, speckle the seafloor outside of the bays.

Queen Charlotte Sound/Totaranui: a view of the entrance

This frameable high resolution seafloor map, published in 2018 and is part of the series of maps in the Queen Charlotte Sound/Totaranui and Tory Channel/Kura Te Au area, shows an oblique perspective view of the entrance to Queen Charlotte Sound/Totaranui. The calm waters of Queen Charlotte Sound/Totaranui interact with Cook Strait (Rau Kawakawa), one of the world's most energetic stretches of water. Strong tidal flows, with speeds of up to 10 kilometres per hour, have produced the complex seafloor revealed in this map.

Tory Channel/Kura Te Au: a view of the entrance

This frameable high resolution seafloor map, published in 2018 and is part of the series of maps in the Queen Charlotte Sound/Totaranui and Tory Channel/Kura Te Au area, shows an oblique perspective view of the entrance to Tory Channel/Kura Te Au. Tory Channel/Kura Te Au forms one of the main waterways in the Marlborough Sounds. This channel, particularly

near the heads, is a demanding stretch of water where conditions change quickly. Details of the complex sea floor revealed here have been used to produce world-class nautical charts, making it safer for the increasing number of vessels using these waterways.

Kaikoura

This frameable high resolution seafloor map, published in 2018, shows the variability and complexity of the Kaikoura seafloor is revealed in this map. Sediment erosion, transport and deposition within the offshore canyons is evident. However, here we also see in unprecedented detail the nearshore rocky reefs and platforms. Seven key areas were mapped specifically to identify the distribution and extent of rocky reef habitats. As a result of the Kaikoura 2016 earthquake the seabed rose up to 6 metres along the Kaikoura and Marlborough coasts, posing a hazard to safe navigation and impacting the marine environment. Mapping the seafloor from Kaikoura to Cape Campbell comprised over 140 days on the water. Multibeam echosounders were used to produce a fan-shaped array of acoustic beams that reflect off the seafloor, enabling the surveyors to precisely calculate the depth of the seafloor,

and map the seascape in detail. This survey has gathered more than 18 billion depth-data points over 400 km².

New Zealand Digital Bathymetry

NIWA also provides gridded bathymetric datasets and imagery, including a 250m resolution gridded bathymetric data set encompassing New Zealand's Exclusive Economic Zone which is available in multiple high-resolution file formats to suit a range of imagery and mapping needs. A project providing coverage maps where NIWA has high resolution multibeam and seismic data around New Zealand is also available via the Coastal and Marine data portal. The data is captured from New Zealand and international vessels undertaking research in the region for a variety of projects. Associated metadata provides information about voyage number, vessel used and systems used, it also directs the user to the data custodian from whom the actual data and further information can be sourced.

Contribution by Kevin Mackay and Arne Pallentin

University of Auckland

► www.fmhs.auckland.ac.nz/hgd.html

School of Population Health

Located in the Section of Epidemiology and Biostatistics at the School of Population Health, the Health Geography and Deprivation (HGD) team, led by Associate Professor Daniel Exeter undertakes research into the impacts of deprivation and health inequities on health and social conditions.

Our aim is to improve our understanding of service quality and the degree of disparities across population groups, to inform agencies and policy makers, and to prompt system change, and promote greater responsiveness and equity of health service provision.

At present, the two major strands of research the HGD team has been involved in include leading the development of the Index of Multiple Deprivation and as co-investigators on the Vascular Informatics using Epidemiology and the Web (VIEW) programme of research, both of which were funded by the Health Research Council of New Zealand. The team comprises:

- Associate Professor Daniel Exeter
- Senior Research Fellow, Dr Jinfeng Zhao
- Senior Research Fellow, Dr Arier Lee
- Research Assistant, Michael Browne

Creation of Data Zones

Using the 2013 Census Meshblocks as our building bricks, we divided the New Zealand land mass into 5,958 small areas called Data Zones (DZ, www.fmhs.auckland.ac.nz/imd/data-zones), as the geographic base upon which we developed the Index of Multiple Deprivation (IMD). Most data zones (in red, see right) have populations ranging from 500 to 1000 (mean 712). They were developed using criteria such as contiguity, compactness and internal homogeneity. Data zones have the power to produce better small area information without losing their contents to suppression and confidentiality rules. For example, data for the population aged ≥ 65 years is suppressed in only 0.3% of data zones across New Zealand, (compared with 7.22% of CAUs and 18.6% of meshblocks).

Data Zones were designed to ensure that we could maximise the use of routine administrative data from

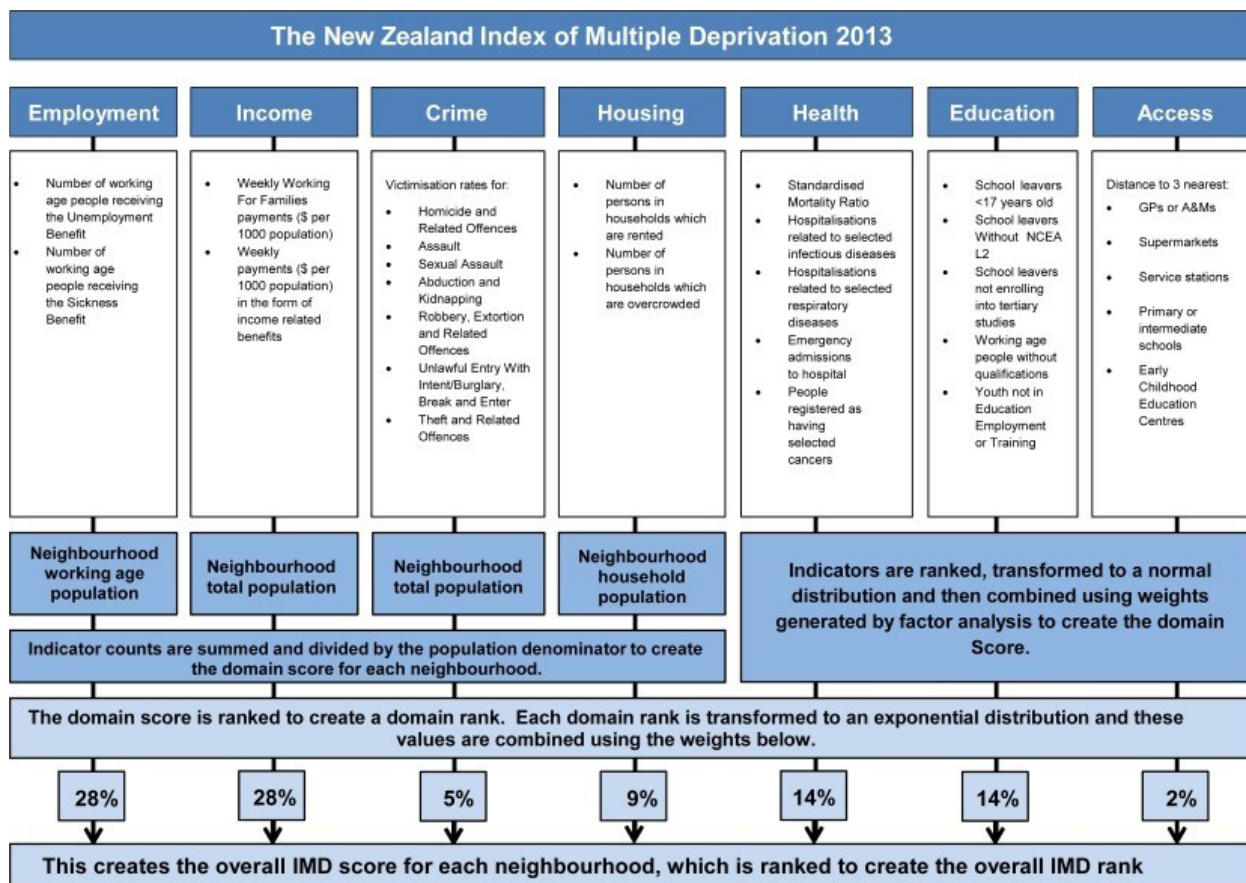


Small area geographies in New Zealand: Meshblocks and Census Areas (top), and Meshblocks and Data Zones

Statistics New Zealand's Integrated Data Infrastructure (IDI). The figure below demonstrates how Meshblocks nest completely the inside Data Zones, which in turn nest inside most (92%) of Census Area Units (CAU, New Zealand's suburban-level geographies).

Introduction of the New Zealand Index of Multiple Deprivation (IMD)

The New Zealand Index of Multiple deprivation (IMD) is a set of tools for identifying concentrations of deprivation in New Zealand. Developed by Associate Professor Daniel Exeter, Dr Jinfeng Zhao, Associate Professor Sue Crengle, Dr Arier Chi Lun Lee and Michael Browne, with help and support from numerous individuals and organisations, the IMD measures deprivation at



Developing the New Zealand Indices of Multiple Deprivation: an overview of indicators, domains and weights; adapted from the Scottish Index of Multiple Deprivation (2012)

the neighbourhood level in custom-designed data zones. The IMD uses routinely collected data from government departments, census data and methods comparable to current international deprivation indices to measure different forms of disadvantage. The 28 indicators grouped into seven domains of deprivation: Employment, Income, Crime, Housing, Health, Education and Access to services. The IMD is the combination of these seven domains, which may be used individually or in combination to explore the geography of deprivation and its association with a given health or social outcome. Diagram above shows the IMD's 28 indicators and seven domains.

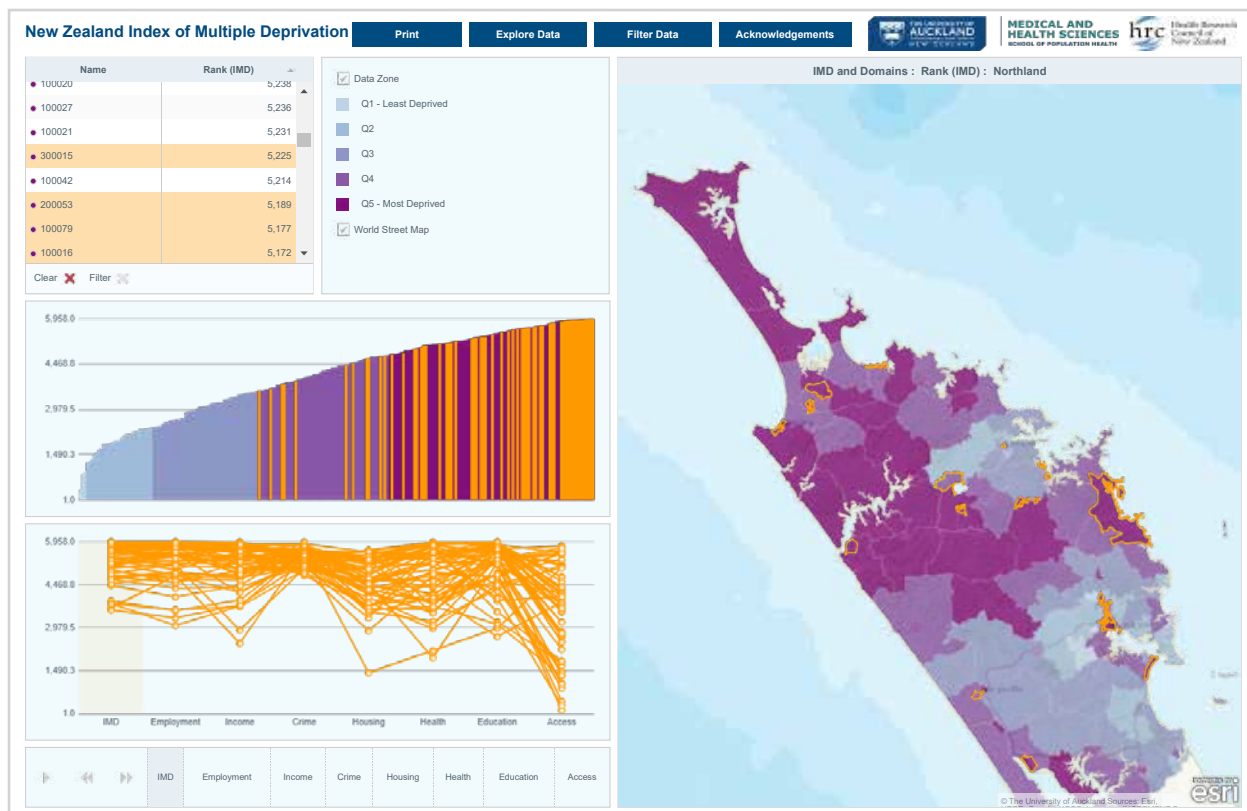
We designed a short YouTube clip outlining the deprivation map of New Zealand, which can be found at youtu.be/de5a_FMAPtw. In this short clip (3:40) we describe the geography of deprivation, how the domains work, highlight some of our key outreach since the IMD's release in August 2017.

Cartographic Outputs

The primary cartographic output for the IMD is an interactive atlas developed using InstantAtlas software

and available at www.imd.ac.nz/NZIMD_Single_animation_w_logos/atlas.html. By default, the online atlas displays the geographic distribution of overall deprivation according to the IMD. However, a particular strength of the IMD is its ability to compare places with similar levels of deprivation and determine which of the seven domains underlie the deprivation in those selected places.

The screen shot from our InstantAtlas on the right (www.imd.ac.nz/NZIMD_Single_animation_w_logos/atlas.html) shows the spatial relationship between deprivation and crime victimisations. The 'scene of the crime' data are mostly comprised of assaults (17.5%), burglaries (24.4%) and thefts (54.9%) and we have selected (in orange) only those areas with New Zealand's 20% highest rates of crime victimisation. Many (certainly not all) of the selected areas are also coloured dark purple (New Zealand's 20% most deprived). However, most of the dark purple areas don't have high rates of crime victimisation. The bar chart shows that New Zealand's 20% highest rates of crime victimisation occur across the spectrum of deprivation, but it is clear that there are fewer instances of high crime rates in less deprived areas. While the InstantAtlas maps enable users to zoom into their



The IMD Crime Domain in Northland, as seen in Instant Atlas

Territorial Authority, District Health Board (DHB) , or General Electoral District, we recognised that there some users required other functions. In collaboration with the Centre for eResearch at The University of Auckland, we developed an open-source interactive web mapping application (imdmap.auckland.ac.nz/) that provides a geocoding facility for individual or a batch of addresses, using the Google API. In addition, this atlas allows users to select their geographical territory of interest (Regions, DHBs, General Electoral Districts, Territorial Authorities) and produce a PDF file profiling deprivation according to the IMD, for the selected locality.

The screenshot overleaf shows the average deprivation profile for the IMD and its seven domains for the Taranaki Territorial Authority in the left hand window (where users can do the geocoding). Clicking the “Report” button at the top produces a PDF using RMarkdown to provide a more detailed deprivation profile.

A third cartographic output we developed used ArcGISOnline to provide users the ability to save high-resolution maps, share links, add extra layers of information and so forth. The strength of this tool is the ‘Situation Awareness’ feature, in which users select a point of interest and a search distance, and the map provides summary statistics of the IMD and its domains for the selected data zones.

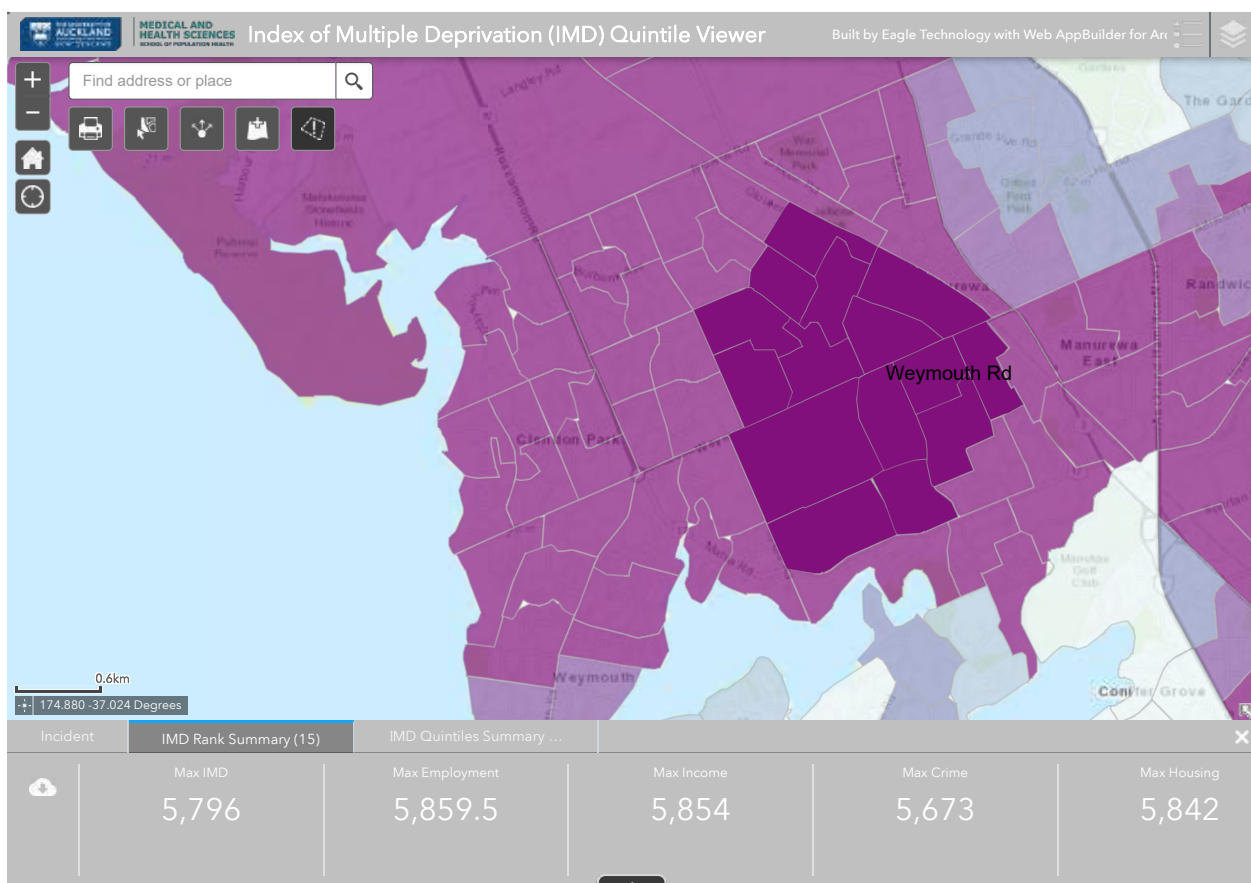
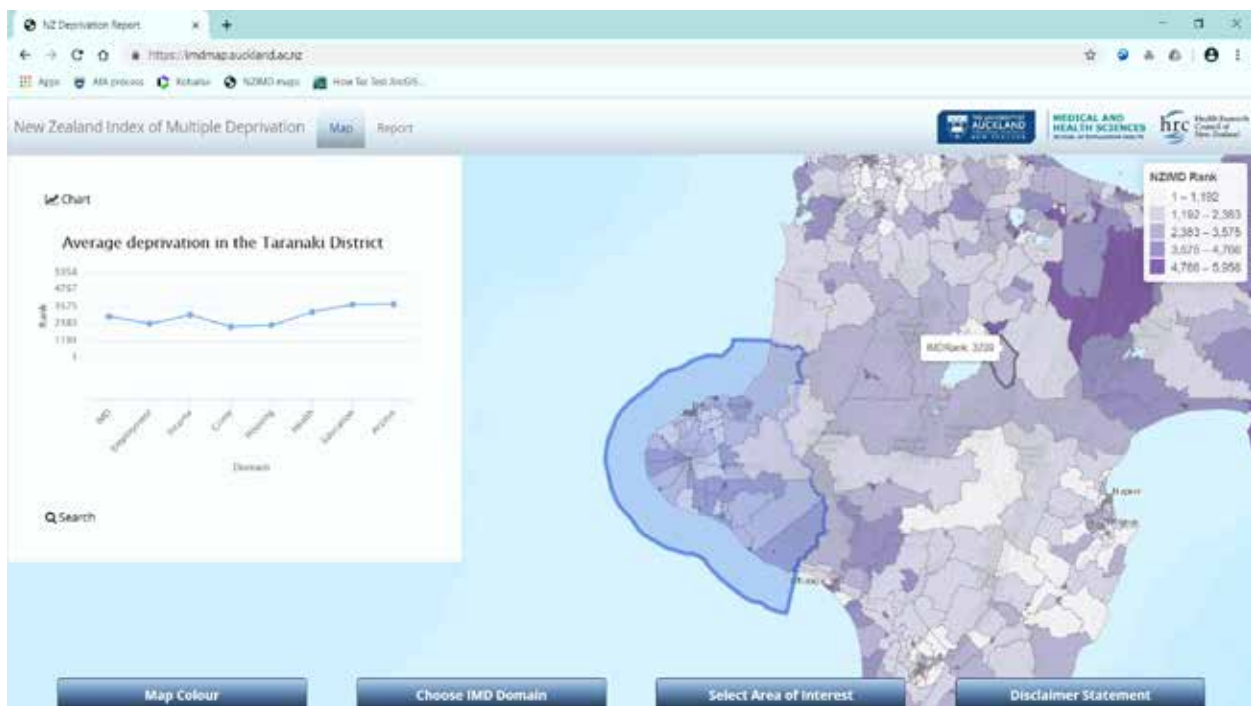
The screen shot below shows that there are 15 data zones in this area of interest, and the numbers at the bottom of the view summarise the ranks of deprivation. Given that there are 5,958 zones across NZ, this selected area suffers extremely high levels of deprivation overall (Max IMD rank=5796), with Employment, Income and Health deprivation also very high.

ESRI Shapefiles and Excel worksheets are available for users to download (at no cost) from the IMD web-site (www.fmhs.auckland.ac.nz/imd).

Outreach

Between 2015 and 2019 we have delivered more than 70 presentations and reports to audiences ranging from policy makers and health researchers to local, regional and national government administrators, iwi health trusts and development agencies, DHBs, and NGOs such as Child Poverty Action Group and Alcohol Healthwatch. Topics for our presentations and collaborations have included childhood oral health, obesity, perioperative mortality, cervical cancer screening, CVD and other health issues.

We have also co-operated on social issues such as household rating reviews, housing, liquor licence applications, vulnerability to climate change and coastal hazards, regional development, identifying



The Taranaki Territorial Authority selected, to generate an automated IMD deprivation profile (top); results from the Situation Awareness Tool in ArcGISOnline

a catchment area for an Early Childhood Centre, and more.

In addition, following the publication of a paper about diagnosed diabetes in the Auckland Region, a secondary school teacher used another InstantAtlas map as the basis of an NCEA Level 3 Standard for geography students. This Standard asks students to use spatial thinking and determine the best place to add a park/greenspace in the community in order to combat the level of diabetes in the community.

Subsequently we have been working with Year 9 students at a Secondary College in South Auckland to use ArcGISOnline in which they use different layers of information to determine which (if any) of the 4 proposed sites should be granted a liquor license to sell alcohol in a bottle store.

Ringmaps

Dr Jinfeng Zhao used integrated visualization techniques to investigate associations between cardiovascular health outcomes and residential mobility in Auckland, New Zealand. She shared her techniques with Thora Majlund Kjærulff from Copenhagen to visualise Danish data on acute myocardial infarction (AMI).

The ringmap overleaf shows age-standardized CVD rates by Upper Zones (UZ, population range 12,000 to 18,000) in the Auckland Region, for internal migrants ('movers') in five prioritized ethnic groups (with all movers shown in the innermost ring). At the centre of the ringmap is a population-scaled cartogram, which makes geographic data more visible where densely populated urban areas have relatively small land areas.

The blue dots on the inner ring represent CVD rates for all movers, and the pale blue circles on the five outer rings represent CVD rates for movers of each ethnicity. If an upper zone has no CVD patients among movers or stayers, there will be no symbol on the corresponding sector.

In general, higher CVD rates for all movers (bright blue circles on the inner ring) are associated with higher levels of deprivation. However, the pattern varies immensely, with a number of instances of high CVD rates for all movers in the least-deprived quartiles. The contribution by each ethnicity to a UZ's overall CVD rate for movers varies enormously. Māori, Pacific, and Indian movers each have the highest CVD rate in

about a quarter of the UZs in the most-deprived quantile. Other Asian movers have the highest rate once (in UZ 78) and NZEO movers never have the highest CVD rate. Surprisingly, it is in one of the least-deprived areas (UZ4) that the highest overall CVD rate for movers is recorded (for the Pacific ethnicity).

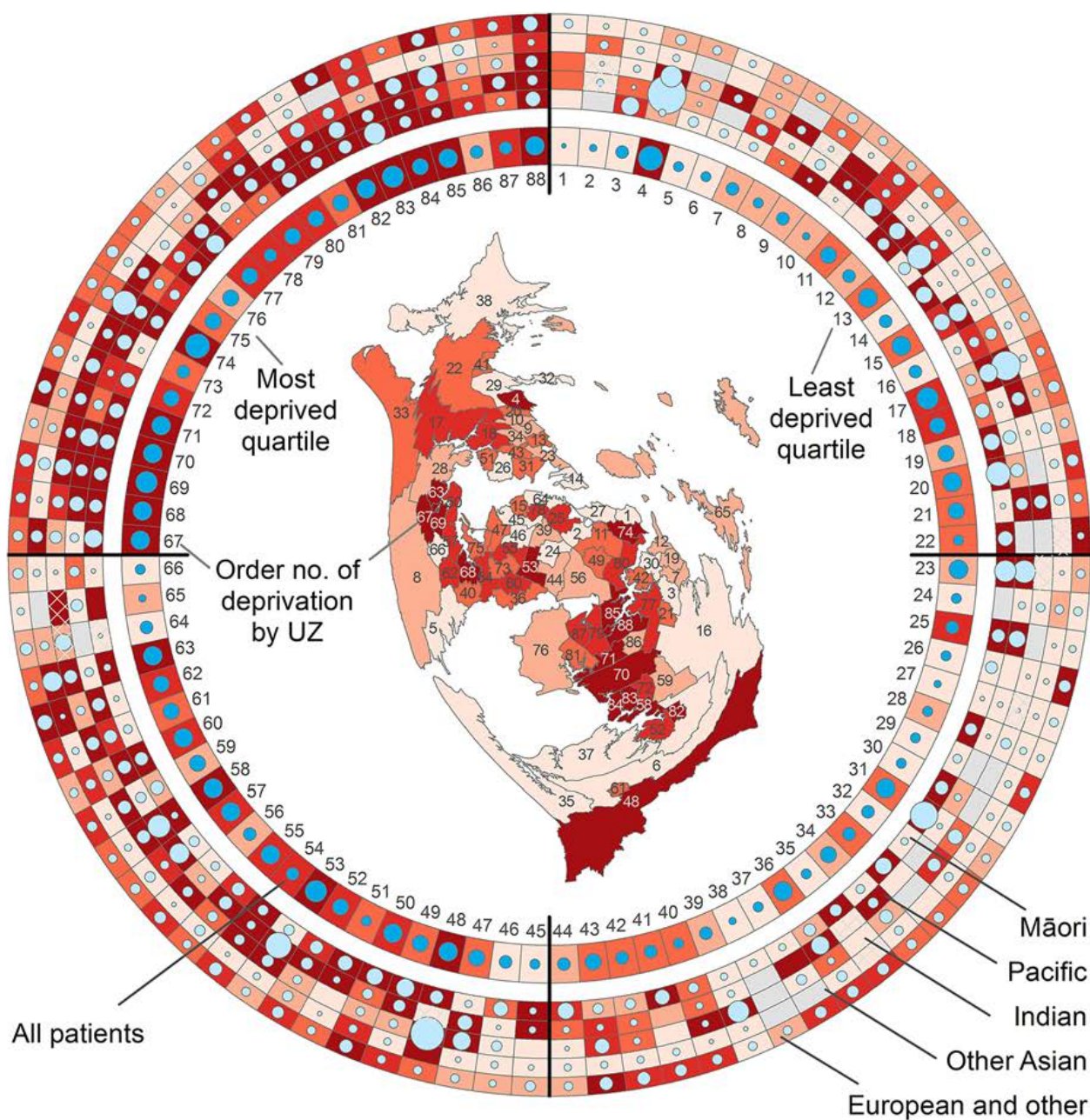
Awards and Recognition

The School of Population Health attracts postgraduate students enrolled in programmes such as the Bachelor of Health Sciences (Hons), Masters in Health Sciences and Masters in Public Health. One of the BHSc(Hons) students supervised by Associate Professor Daniel Exeter used GIS to explore life expectancy of residents living within 2km of the major train stops in Auckland, as well as the Northern busway which services Auckland's North Shore. The Student, Daniel Surkalim, assigned calculated the average deprivation score within the transport station buffers and calculated life expectancies for males, females and all persons. His work identified a social gradient in life expectancy with a gap of more than 10 years between the best-and worst-life expectancies.

In 2018, Daniel Surkalim was awarded the NZ ESRI Young GIS Scholar award. This prestigious award (one of 28 around the world) saw Daniel attend the Young Professional's Network week of events at the ESRI User Conference in San Diego, July 2018.

The pinnacle of our success regarding the development of the Data Zones and IMD to-date was being awarded the 2018 NZ Spatial Excellence Award in the People and Community division. This recognised the collaborative work we had done in the community with the Waikato Region and Alcohol HealthWatch. We co-authored a report on the area deprivation conditions in the Waikato Region, highlighting that no two Territorial Authorities within the Region experienced the same levels, or types of deprivation. Working with AlcoholHealthWatch, we used the Situation Awareness Tool to provide valuable contextual information about the severe levels of deprivation in communities where liquor licenses had been requested. At the time of the award nomination, we had successfully lobbied to have 5 licenses either withdrawn or declined by the District Licensing Committees.

Contribution by Daniel Exeter



Ringmap showing associations between residential mobility and CVD outcomes, by age and ethnicity

University of Canterbury

► www.canterbury.ac.nz

Cartography is taught at the University of Canterbury through a number of geospatial courses in the second, third and fourth year in the Department of Geography (which soon will be integrated with the new School of Earth and Environment - Te Kura Aronukurangi). Basic principles of Cartographic Design are introduced to students in the second year as part of an introductory course to GIS. More advanced topics related to cartography and geovisualization are taught in two third-year geospatial courses. These include geospatial analysis, geographic information visualization, interactive cartography, theory and principles of map animations, HCI, usability and cognitive issues in geovisualization, spatial databases, web mapping and geo-crowdsourcing. The second and third year geospatial courses are continuously enriched by distinguished international academics invited yearly to teach through the Erskine Fellowship Programme; in 2019, the role was taken by the world-renowned cartography and geovisualization Professor Dr Sara Irina Fabrikant from the University of Zurich.

In the fourth year, advanced spatial analysis and GIS programming and databases are taught as part of the Professional Masters in Geospatial Science and Technology offered since 2019 by the Department of Geography, and is currently the main GIS Masters programme of the University of Canterbury.

During recent years, GIS Masters graduate Andrew Douglas-Clifford and PhD candidate David Garcia from the University of Canterbury have become recognizable cartographers and map makers in New Zealand and internationally, with Andrew's *New Zealand State Highway Metro Maps* and David's *Hundred Largest Islands of the World* (see overleaf) having attracted large media attention.

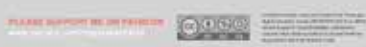
Current academic staff research related to cartography and geovisualization includes the development of interactive cartographic interfaces for geoinformation retrieval by Dr Ben Adams, investigation of navigation and wayfinding behaviour of travellers in unfamiliar urban areas using immersive virtual environments by Dr Ioannis Delikostidis and spatial analysis and geovisualization of health-related research by the GeoHealth lab staff members. Forthcoming relevant PhD theses include *Crowdsourcing Spatial Data Infrastructure in the Global South: Developing a Zambian Prototype* by

Levi Mutambo and *Exploring the potential of crowd-sourced spatial information to complement expert decision making processes* by Hamish McNair.

A stream of PhD researchers working under Geospatial Research Institute (GRI) of the University of Canterbury use a range of GIS, geospatial analysis, cartographic visualization, interactive mapping and (geo)crowdsourcing methods and tools in their projects. Their research ranges, amongst others, from species distribution modelling to urban planning, investigation of inequalities between population groups, infrastructure vulnerability analysis, epidemiology and crowdsourcing-based humanitarian action. GRI continues to offer a monthly Geospatial Research and Innovation Seminar Series (GRISS) for spatial professionals and students, involving speakers from academic, professional and governmental organizations. GRI also hosted New Zealand Geospatial Research Conference 2017 which focused on many aspects of geospatial research and practice, including theory, technology, application, and innovation. The conference included a range of academic sessions, plenary lectures and social events and brought together a wide range of scientists, academics, researchers, postgraduate students, government and industry professionals interested and involved in the geospatial field.

Contribution by Ioannis Delikostidis

www.elsevier.com/locate/jmb



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University of Otago

► www.otago.ac.nz

Cartography and geovisualisation activity at the University of Otago for the reporting period has been concentrated in three groups on campus: at the National School of Surveying, the Department of Geography and the School of Social Sciences (Archaeology). The following account covers research, postgraduate, teaching and professional areas.

Research

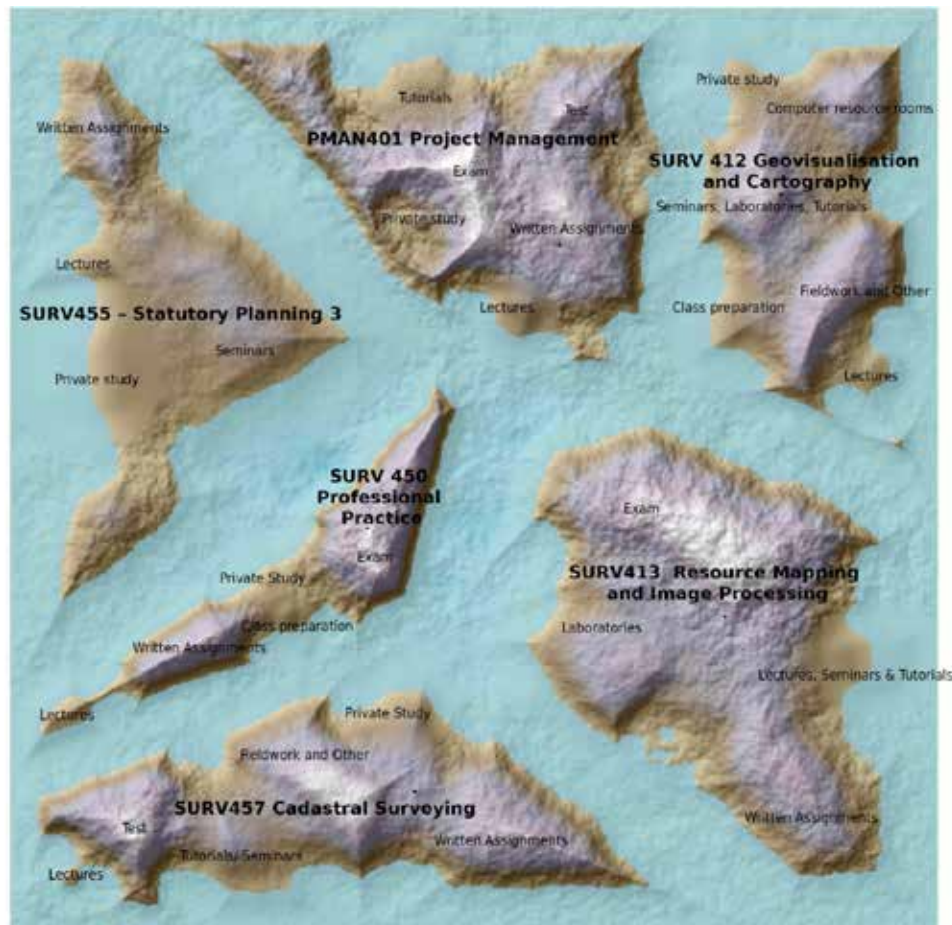
In the last 4 years, there have been seven journal papers, one book chapter and 25 conference / workshop contributions from or contributed to by Otago

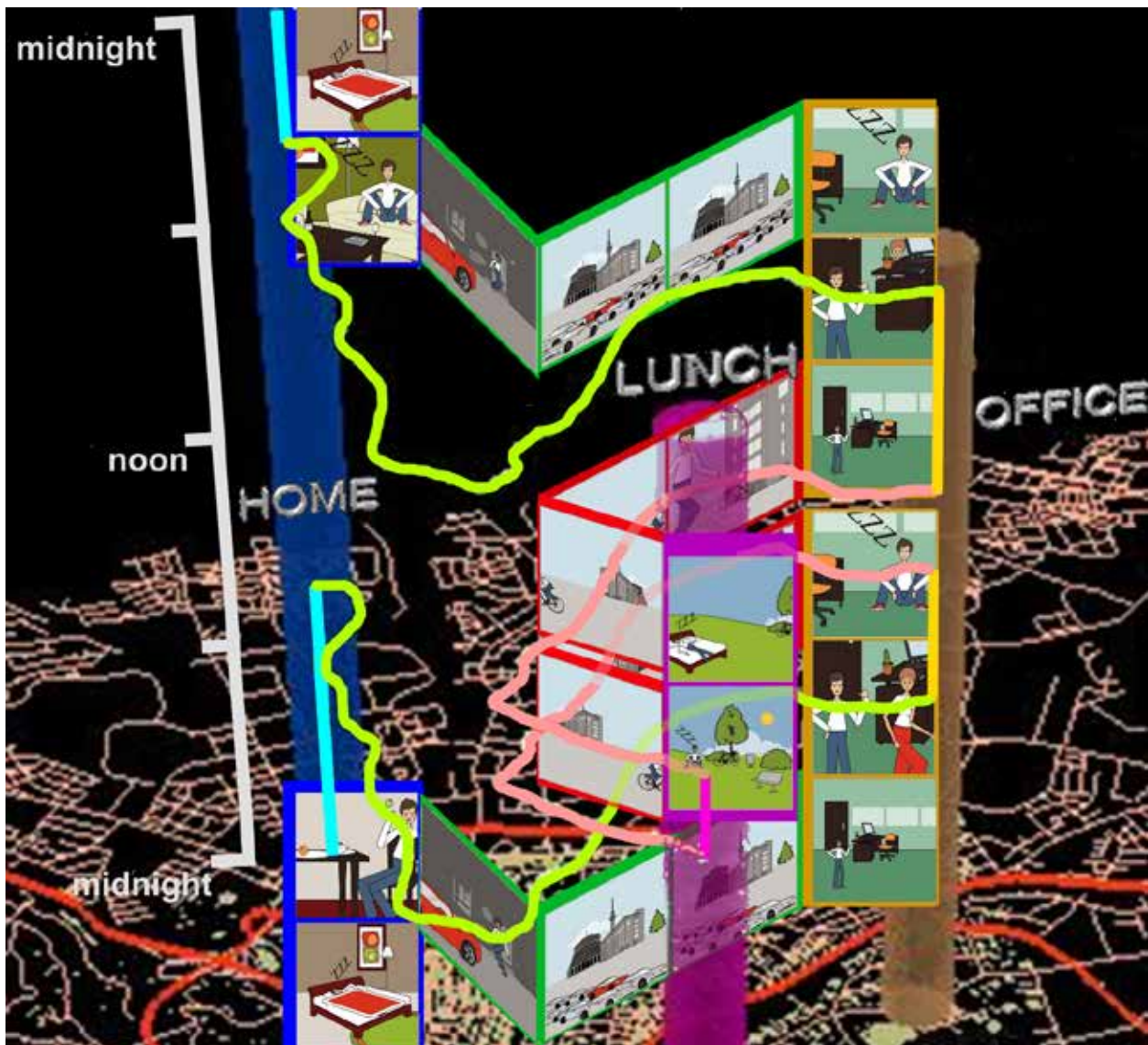
researchers in Surveying conducting cartographic / geovisualisation research.

The journal papers featured a spatialisation technique published in Environmental Earth Sciences, with examples of non-spatial university curricula being turned into maps (Marc Russwurm from Technical University Munich collaborated on this while visiting Otago, building on work with Mike Bricker, Porirua City Council and Otago BAppSc graduate) (see below).

A collaboration with Professor William Cartwright (RMIT), on coding and extracting geographic artefacts (maps, graphics, text) from propaganda, satirical and personal cartoons of Gallipoli 1915 was published in the Journal of Spatial Science (Moore and Cartwright,

A spatialisation of the 4th Year Bachelor of Surveying curriculum at Otago; each academic paper is an island, with attributes such as difficulty translated into topographical facets (e.g. height) (Russwurm and Moore, 2015)





Located comic strip of an everyday routine (home-commute-work-lunch-work-commute-home) embedded in an xyt time geographic space. This was the cover figure of ISPRS International Journal of GeoInformation, 7, 7 (Moore et al, 2018)

2015). Work is ongoing on this, with Professor Christina Hulbe, Dean of Surveying.

Other comic-related (rather graphic novel) work with Christina features the development of an expressive syntax to systematically describe the spatial and temporal narratives in such sequential art (this is COMics Markup Language – COML, reported at the 2016 New Zealand Geographical Conference). They have also worked with Mariusz Nowostawski and Christopher Frantz (Norwegian University of Science and Technology) to publish a technique that embeds the comic strip in the map (see above, Moore et al, 2018).

Many of the conference contributions were to GeoCart'2016 and GeoCart'2018, the proceedings of which were co-edited with Igor Drecki (University of Auckland) (see New Zealand Cartographic Society chapter) with a large Otago attendance at the latter conference in particular.

There has been geovisualisation research agenda building work, on cartography in the age of Big Data. This collaboration between several ICA commissions started at a workshop in Curitiba, Brazil, attached to the Rio ICC 2015, carried on in a second workshop attached to the 2016 San Francisco AAG conference, culminating in a special issue of the International Journal of Cartography. Otago also participated in the inaugural ICA Cartographic Summit at Esri HQ, Redlands, California. This exercise has been a spark to further art and cartography research, a collaboration with Prof. Bin Jiang (University of Gavle) on the data-driven generation of art through fractals and deep neural networks. This research was reported at the 2018 ICA Visual Analytics workshop attached to GIScience in Melbourne, a workshop that was also co-organised by Otago. Fuller details on ICA agenda building, workshops and summits can be found in



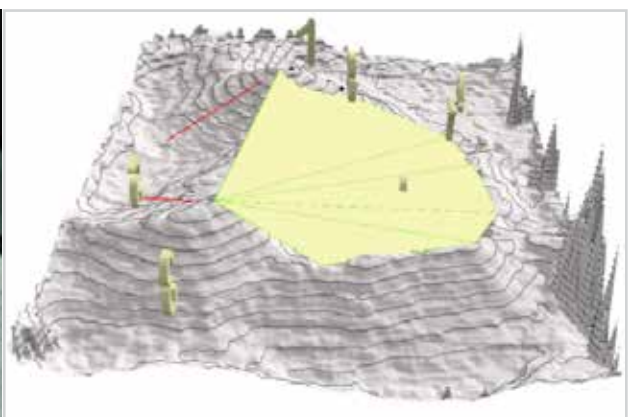
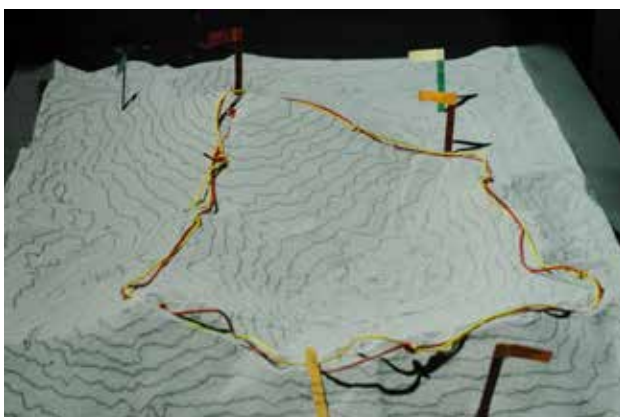
University of Otago staff, postgraduates and alumni at GeoCart'2018 Conference held at the National Library of New Zealand, Wellington (Photo: Shannon McColley)

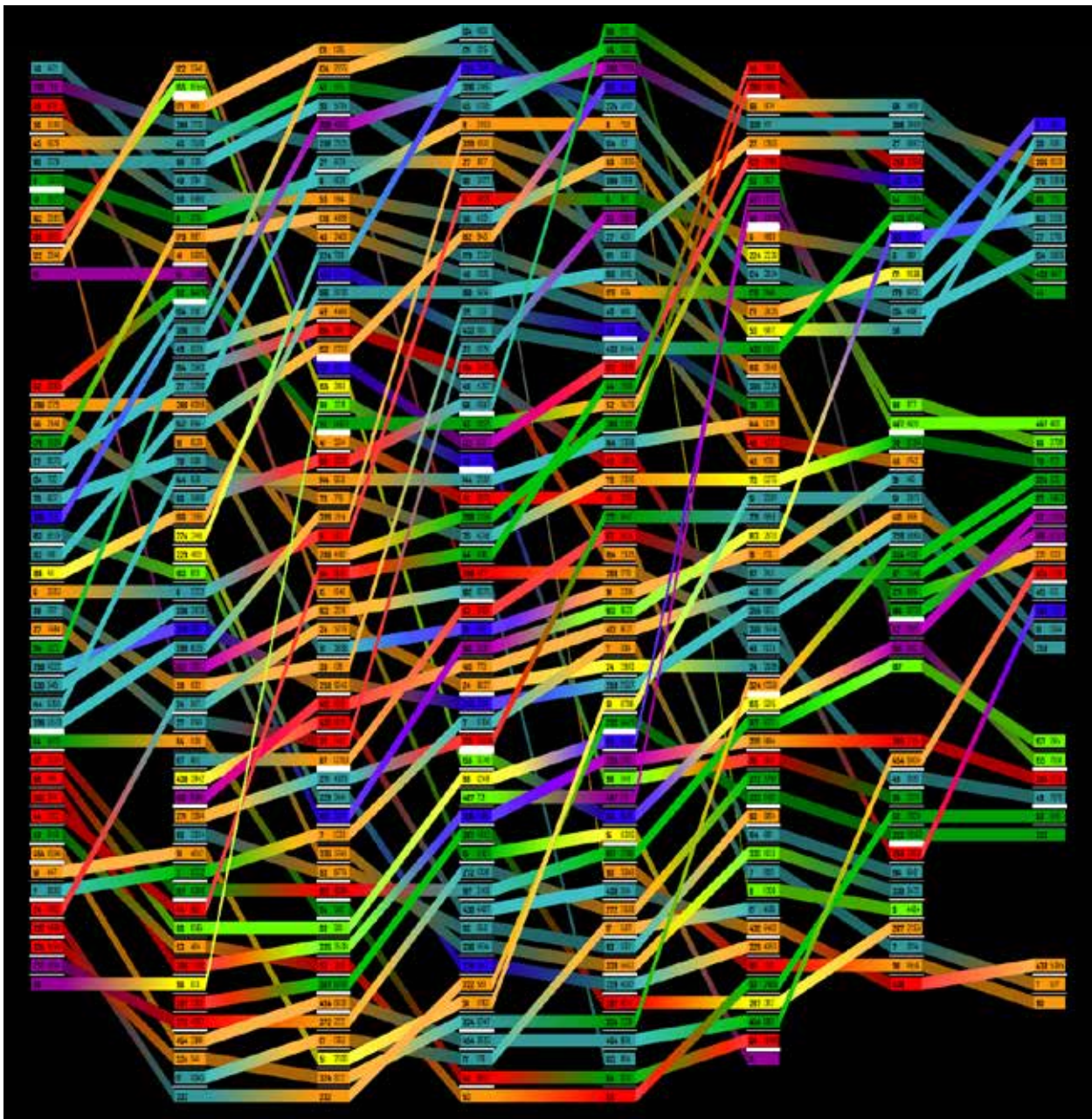
the New Zealand Cartographic Society chapter in this report.

The period under review also marked the construction, testing and deployment of the Otago Augmented Reality Sandtable in a project led by Surveying (Tony Moore and Greg Leonard). In 2016, the sandtable was built and assessed for its value in teaching terrain, hydrological and civil engineering contexts. The sandtable allows a malleable surface to be captured in 3D, with a real-time contour map (or other fields) projected onto the surface for immediate feedback to users. This project is a collaboration including Computer Science, Information Science, and the Higher Education Development Centre (HEDC). A grant from the Otago Committee for the Advancement of Learning

and Teaching (CALT) allowed us to study the efficacy of the sandtable environment with students in the Introduction to GIS paper (GIS for terrain and hydrological tasks) and Land Development Engineering paper (utilities engineering for water volume estimation tasks). Even though the technology is mature and used in teaching programmes worldwide, this was the first time a rigorous usability test was applied in an educational context. Briefly, students performed tasks more quickly and with more satisfaction using the sandtable (below left), relative to conventional technologies (3D GIS in the case of surface analysis, below right; drawn contour plan in the case of water volume modelling). However, students were generally more accurate when using the GIS and contour plans. We

The Otago Sandtable with terrain usability experiment markers (*left*); the equivalent marked surface in a 3D GIS (Moore et al 2019)





Adaptive Relative Motion (ARM) diagram of Hector's dolphins in Te Wae Wae Bay, Southland; each line is a dolphin, which can be traced relative to other dolphins by proximity in the diagram across eight seasons (columns) (Judy Rodda, PhD 2016)

concluded from our studies that the best use employs the sandtable to introduce concepts in an accessible manner, leading to more accurate, and complex, tasks performed using conventional teaching technologies. Our findings have been written up in a manuscript that has been submitted to an international journal. The sandtable has been a great asset for the School and for the University, being exhibited at international science fairs, schools and other events regularly since 2016, and strengthening collaboration with the Otago Museum.

Other ongoing research involves the repurposing of the famous Douglas-Peucker-Ramer generalisation

algorithm to efficiently dissect track data collected by GPS, a project led by Aubrey Miller, who has joined Surveying as a GIS professional practice fellow. Instead of generalising a line by removing some vertices based on their x and y coordinates, they used the accumulated interpoint distance between successive points on the x axis and elevation on the y axis to segment points into their uphill and downhill portions of the track. It was an exciting and novel application of this classic map generalisation algorithm.

Postgraduate

At postgraduate level, one PhD student and two Masters students with theses containing cartography / geovisualisation research have graduated. Topics included the application of a new space-time representation technique, Adaptive Relative Motion (ARM) (see left), to simplify the complex trajectories of dolphins (Dr Judy Rodda, with Zoology). This research was reported in a Cartographic Journal paper.

In addition, a comparative study of online virtual environments (with GIS and CAD) was conducted by Sisi Zhang (LINZ) to gain a Master of Applied Science (research that was previously published as a 3D Geo-Info conference book chapter). Finally, Zeno Correia (Directorate for Land, Property and Cadastral Services, Dili, Timor-Leste) graduated with a Master of Science in Surveying with her usability study of a land information access prototype system.

Postgraduate research currently underway include PhD studies on the visualisation of adolescent active transport and associated data (Long Chen, with Physical Education), intelligent representation and modelling of movement phenomena (Saeed Rahimi, with Information Science) and community mapping of the inner city environments of young adults (Rosee Hodgson, with Preventive and Social Medicine). An ongoing Master of Applied Science project features the Augmented Reality visualisation of active transport safety data (Andrew Bell, with Physical Education).

Teaching

In the School of Surveying, cartography and geovisualisation is taught at 1st Year (as part of Geospatial

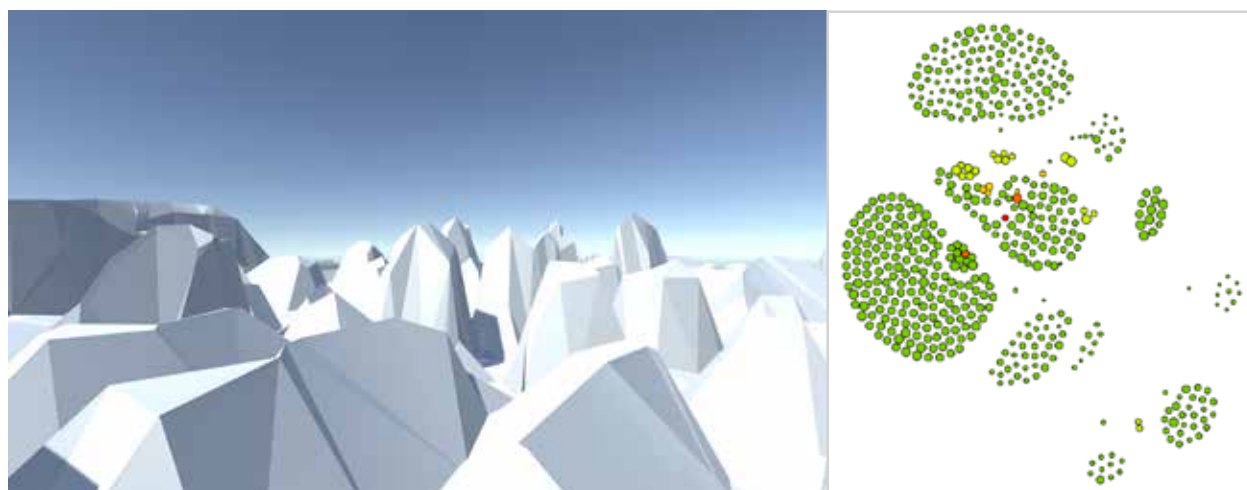
Science – see mobile GPS map in the Professional section for an example activity of this paper), introductory GIS 2nd Year (to all surveyors and GIS minor students) and advanced levels at the University of Otago, with plans to introduce content at intermediate level. In addition, Geography teach a 6-week GIS module as part of their field studies course and Archaeology (School of Social Sciences) includes a 10-week GIS module in its 3rd year Landscape Archaeology course, to be applied to a cultural heritage management report. The dedicated advanced course on Geovisualisation (SURV 412 / 512) has been taught since 2010, supporting undergraduate and postgraduate GIS and Surveying degrees. The major project component of this paper is now well-established, with notable topics including the spatialisation of academic networks (see below), online VR projects, mobile geovisualisation as well as computer cartography tasks (e.g. implementing fractal surfaces and generalisation algorithms in Python). This programming side of cartography is planned to become a component of the intermediate GIS paper (Spatial Algorithms and Programming) in future years, in alternate years to the advanced geovisualisation paper, which will run every second year from 2019.

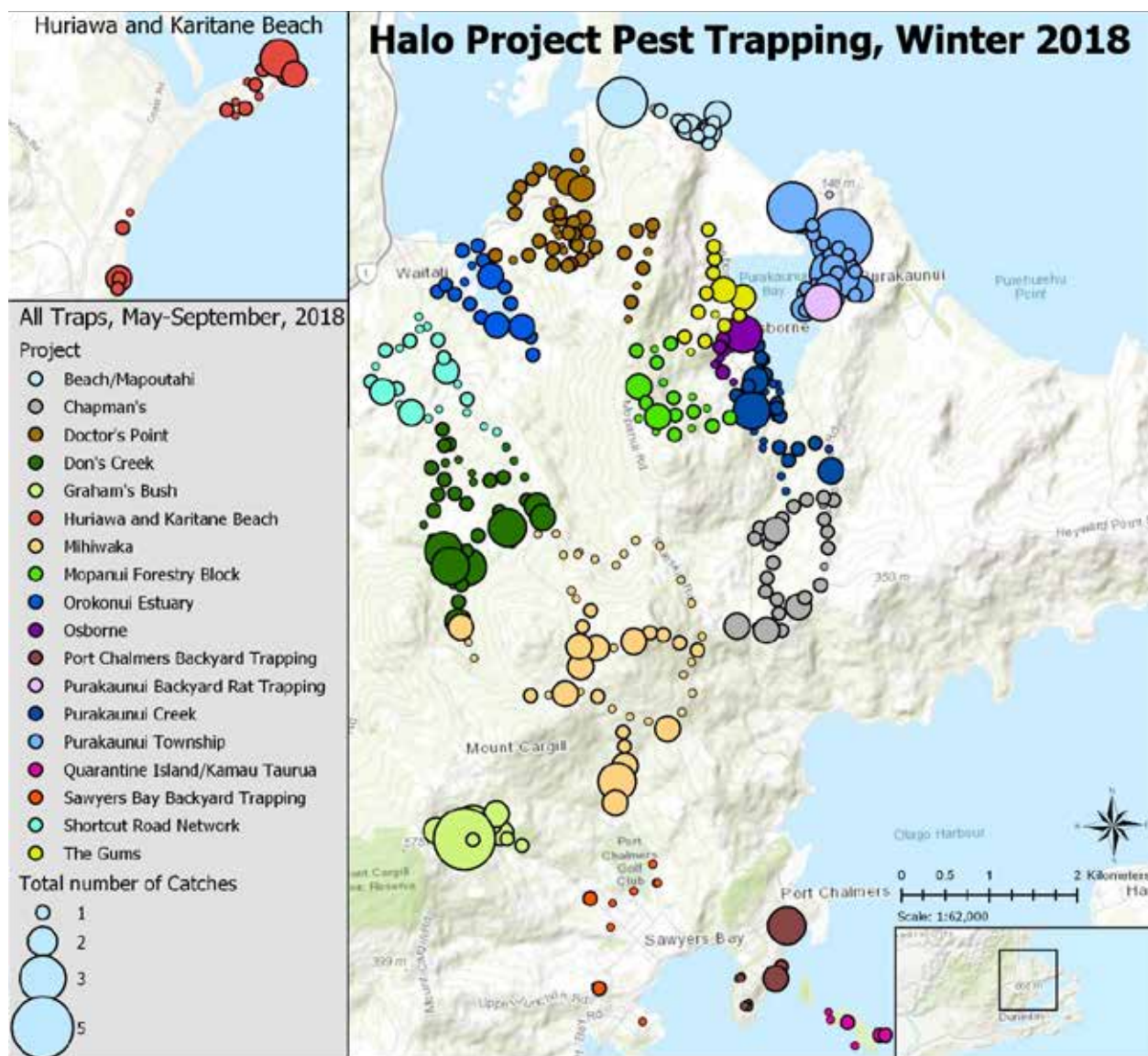
Professional

Surveying Outreach

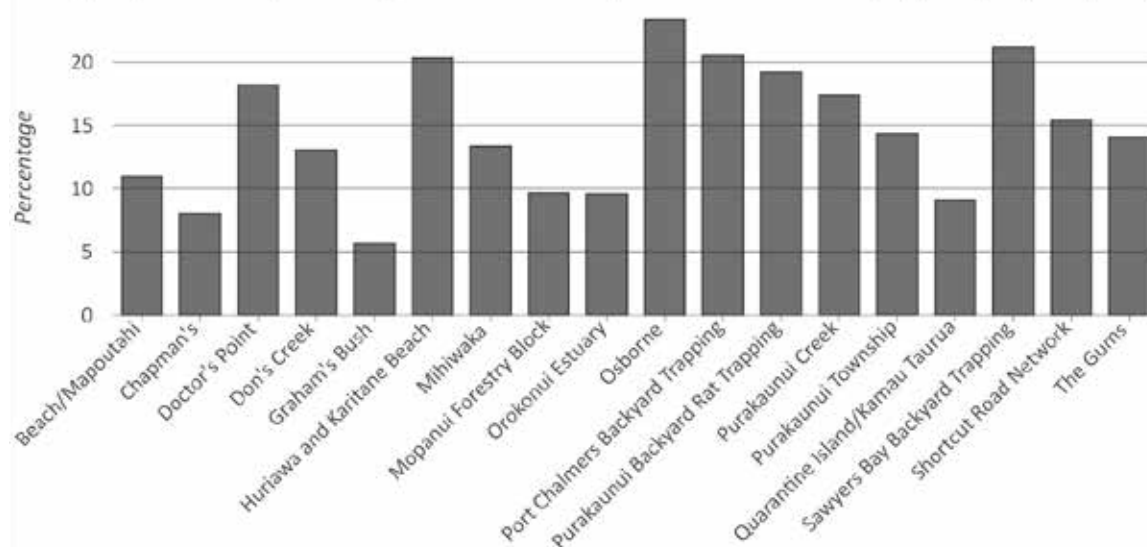
Aubrey Miller has led several outreach mapping projects from the School of Surveying. One is the University of Otago Campus Map, where staff and students have helped the university's Property Services and IT Departments to translate existing CAD data into spatially-aware data for campus mapping. The Campus

Spatialisation of landslide reference citations (VR compatible in Unity) with spatial arrangement based on a network of co-authorship (with each circular node representing an author), modelled by inter-node forces in d3.js (SURV 512 project by Clare Lewis, MSc GIS candidate)





Trapping Efficiency: Average Percent of Trap Visits With Catch, by Project, May-Sept.2018



Example map from the Halo Trapping project (Aubrey Miller)

Map, including a new map delivered in a mobile app, is always up-to-date and relevant. The map is also easier to use and will in the future support 3D building data.

Through the Halo Project Trapping project twice-yearly updated maps are produced, showing progress in pest trapping in the region north of Dunedin. The maps are sent out in a newsletter to volunteers who check the traps to show which trap lines (and volunteer groups) are catching the most pests. Figure on the left shows an example map. Surveying are also collaborating with the Halo Project through the Source to Sea Project. Rural school students are given an opportunity to use spatial data to better understand their backyard streams. Several WebGIS were built for students to interact with imagery and historical maps and other data. You can visit and interact with one by going to arcg.is/0bP9fm. The students are also visiting the School of Surveying and will make their own maps to bring home.

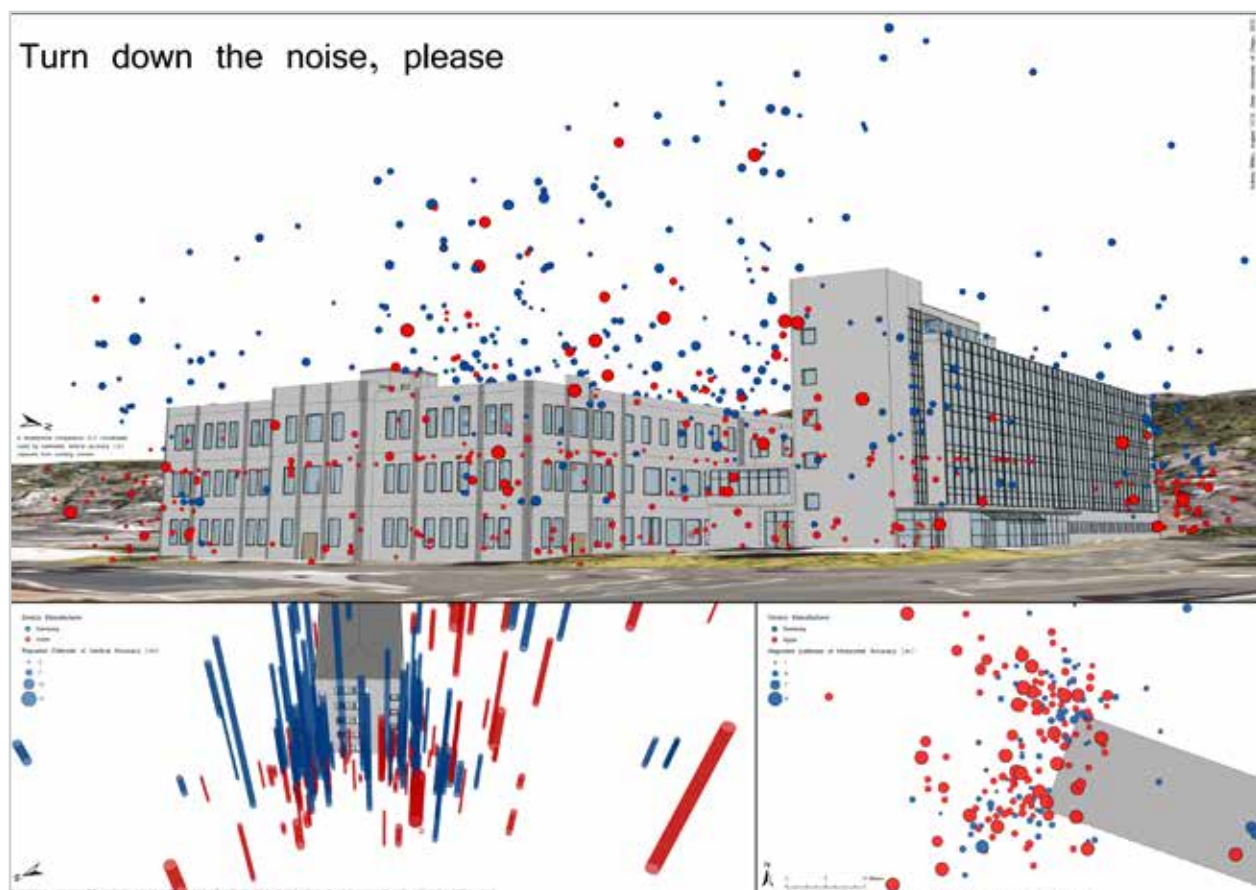
Finally, a map output from Aubrey's coordination of the 1st Year Geospatial Science paper students. In the Measure Up assignment, students have started using a new teaching tool for data collection (smart phones) to measure the corners and heights of the Surveying School building and neighbouring college. Back in the

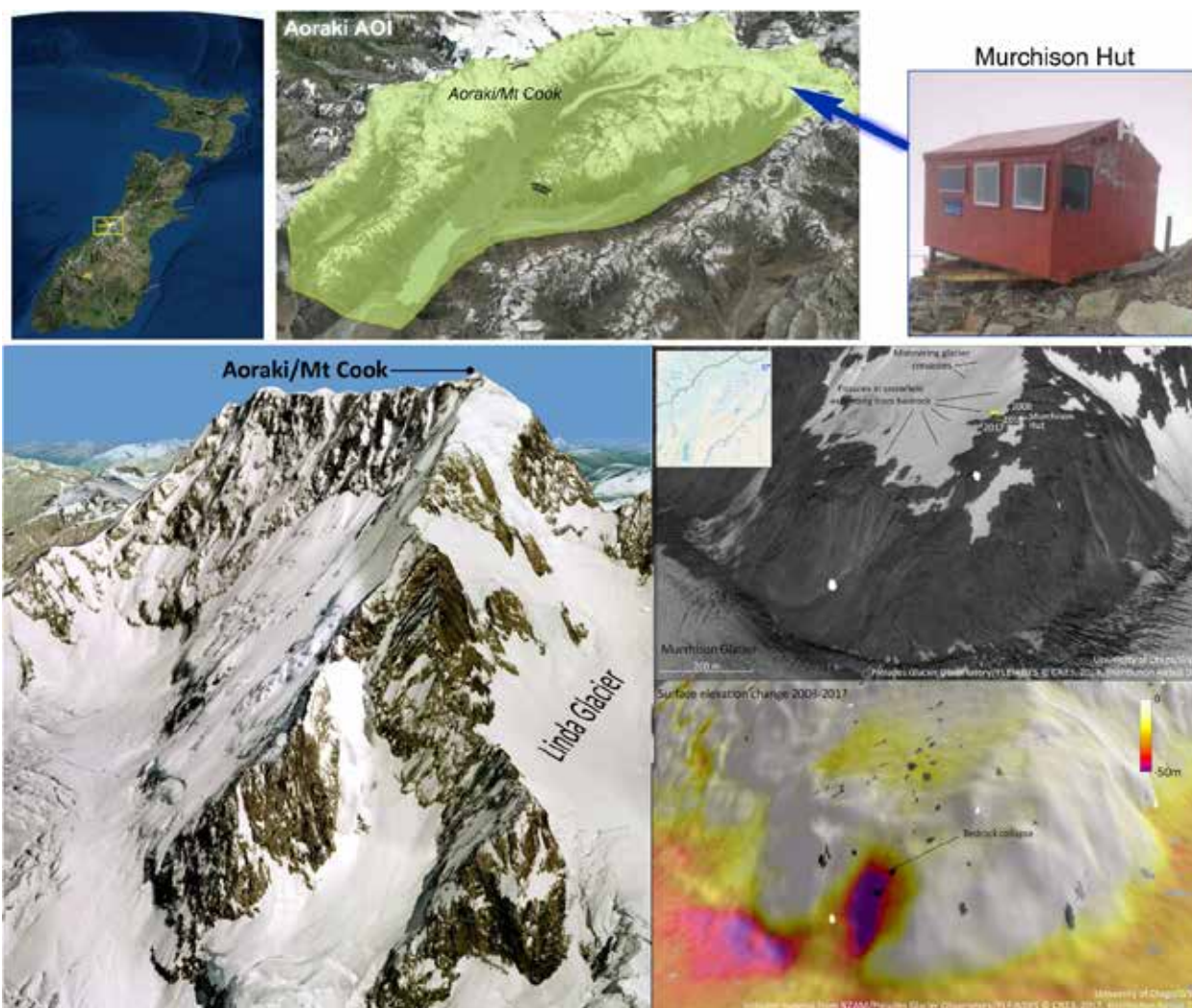
lab the students constructed 3D buildings from their measurements. The data collected have a lot of noise and make for a perfect demonstration of using the right tool for the job. Aubrey created a 3D map from the data the students collected and presented it at GeoCart'2018 (see below).

Mountain Cartography in Surveying

Supporting mountain cartography, the School of Surveying, led by Pascal Sirguey, has invested significantly in new photogrammetric processing capability (supported by national and international funding: Pléiades Glacier Observatory program led by French remote sensing research laboratory LEGOS and French Space Centre CNES), specifically targeted at the challenges offered by mountainous terrain. This takes advantage of recent developments in space borne stereo-imagers and photogrammetry that provide an important on-demand revisit capability that allows changes in this tectonically and glacially dynamic environment to be detected, relative to the valuable, detailed yet currently long-term return nationwide LiDAR programme recently instigated by LINZ. Some 2500 km² of the Southern Alps was remapped at 2m resolution and sub-metre accuracy between 2017 and 2018 from

3D map showing various attempts to fix the corner positions of Hayward Hall residential college with smartphone GPS (Miller, 2018)





Detection of life-threatening geohazards with 3D-CD at Murchison hut, Aoraki / Mt Cook National Park (Sirguey and Cox, 2017; image credit: University of Otago/PGO/© CNES (2017), Distribution Airbus DS), also featuring the 2008 photogrammetric survey of Mt Cook itself (credit: Pascal Sirguey)

stereo-imagery from a satellite constellation operated by Airbus Defense and Space. This enabled surface movements with life-threatening consequences to be detected and mitigated (see the Murchison hut example above). These are ways in which accurate and timely knowledge of land elevation underpins the economic development, environmental sustainability, and resilience of our society.

This initiative started back in 2013 with a joint Otago Surveying / Geography team completing a survey of Aoraki / Mt Cook and, combined with a new photogrammetric survey, confirmed a new orthometric height of 3724m. This was a significant readjustment from the 3754m height held to be true since a photogrammetric survey that was conducted after a collapse of the mountain peak in 1991. The initial project was reported at the ICA 2014 Mountain Cartography Workshop (Sirguey et al, 2014) and featured on the cover of the GeoCart'2014 proceedings (see above). The new capability is gaining momentum, as this method (with

funding from GNS Science) has successfully mapped the West Coast Glacier region (Fox and Franz-Josef Glaciers), featuring some of the most challenging terrain in New Zealand in unprecedented detail (from Pléiades tri-stereo imagery acquired in 2012). With the availability of 2014 repeat archive imagery, and high feasibility of regular monitoring in future, New Zealand is pioneering “dynamic surface cartography”.

Todd Redpath (PhD candidate, Surveying) created a map that displays the snow cover climatology of the Otago region, produced from a 16-year time series of snow cover data, derived from MODIS satellite imagery. Average annual snow cover duration (in days) is sampled from a raster dataset (250 m resolution) to produce the "Joy Plot" symbology. The larger the peaks on the lines, the longer the snow cover duration at the corresponding location. The purpose of the map is to convey the spatial variability across the Otago Region, which closely, but imperfectly mimics the topography of the mountains. Snow cover



Snow cover map of the Otago Region using “Joy Plot” symbology (Redpath, 2018)

data was processed using the MODImLab software (Sirguey et al., 2009). Todd’s map was presented at GeoCart’2018 (see above).

Geography

Cartographic activity in the School of Geography (Chris Garden) has been in the form of outputs for journal articles and books. As well as the aforementioned

GIS module, GIS tutorials featuring cartography are run for students; additionally, staff and students are increasingly using web-based and mobile-based GIS for data collection and visualisation. Also notable are two postgraduate projects with a decent amount of cartography. One is an MA thesis by Jovan Mokoraka-Harris (Rū Te Whakaturu Whenua: Understanding Hapū Relationships Through Cultural Mapping) that

included participatory mapping techniques to capture ancestral knowledge in the Hokianga. Another community mapping project is Audrey Heyzer's PhD (co-supervised with Zoology) – as part of the People, Cities and Nature research programme, members of the public have been mapping greenspaces that are important to them.

Archaeology

The Archaeology program of the School of Social Sciences (Anne Ford) incorporates mapping components in most archaeological field projects to record the location of archaeological sites in New Zealand and the Pacific. They also have postgraduate students who produce maps using GPS or total stations, as well as using GIS as both a data visualization and a spatial analysis tool. James Robinson (2016) mapped archaeological features on the Poor Knights islands for his PhD "Tawhiti Rahi: "Nga Poito o te Kupenga o Toi Te Huatahi" A multi-disciplinary study of Maori settlement of Tawhiti Rahi, an offshore island in northern New Zealand". Greg Hil completed an Honours (2016) thesis and a Masters (2018) thesis that mapped the location of archaeological sites in the coastal areas of

Otago to assess the current level of damage that these sites had suffered, using aerial photography in particular to determine erosion rates, and then used GIS to model potential risks to these sites with predicted sea level rise.

Laura Bowers (2015) completed an Honours thesis where she produced maps using GIS on Rakiura Stewart Island to identify patterns of landscape use and resource exploitation over time, using site density analysis and some nearest neighbour measures. Jessie Hurford (2017) also completed a Masters using survey data from Tetepare, Solomon Islands and GIS to identify spatial patterning in the distribution of ancestral shrines. Baylee Smith (2018) used GIS mapping and statistical analysis to complete a Masters exploring the density and distribution of pā sites across New Zealand to identify the rules behind their spatial patterning. Tristan Wadsworth (2015) and Teina Tutaki (2017) also explored the spatial distribution of pā, through modelling the proximity and intervisibility of pā to other Maori archaeological sites using GIS, with Wadsworth focusing upon the Queen Charlotte Sounds region and Tutaki on South Taranaki and Whanganui.

Archaeological site locations and shoreline change (from Hil 2018 MA thesis)

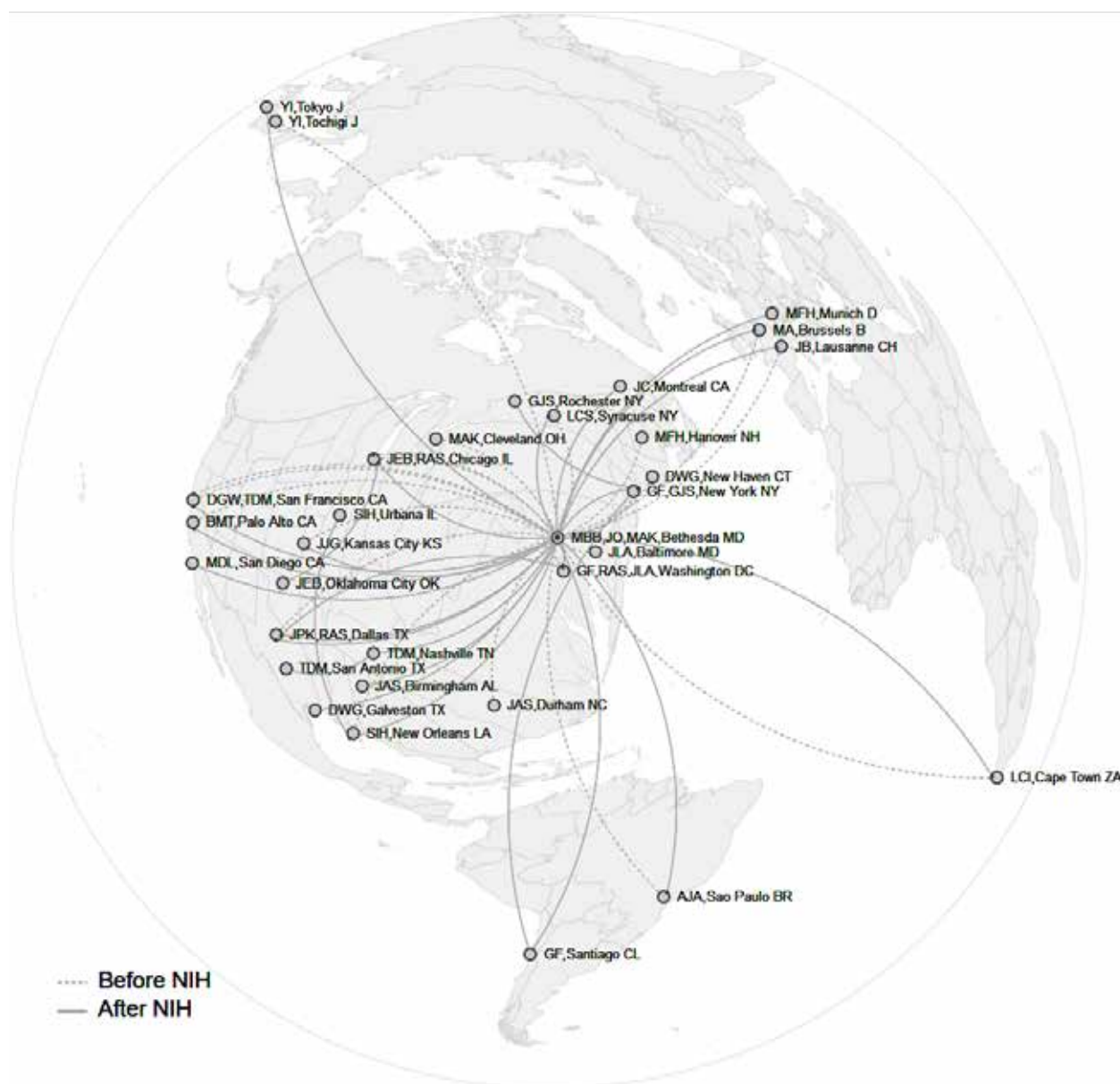


Other Surveying Maps

Other map making activities coming out of Surveying include a knowledge flow map (also collaboration and co-authorship network graphs) supporting a paper (written with Kirk Hamilton, Department of Physiology) commemorating 50 years of an integral renal physiology technique and its initiator. The map shows international researchers migrating to the lab where the technique was devised and taught before disseminating this knowledge across the world (see below). The expansion of space applied to allow the mapping of national migrations (across the USA) as well as international ones is a technique that has been turned to other contexts, such as research collaboration

networks (to support a School review) and active transport mapping. Finally, a collaboration of artist (Charlotte Parallel) and cartographer involved the creation of a 2m x 2m PVC street map that people could walk on as a feature of the exhibit (called XY Domain). Focussing on a single block around the location of the exhibit (Art and Space exhibition, Otago Museum Skinner Annex, 17th September – 2nd October 2016), located buttons underlying the map emitted a sound that had been transformed from the light source found at that part of the map (see overleaf). The mixture of sounds and their characteristics elicited when many people walk on the map is meant to represent the chaotic state of data regularly experienced today.

Flow map of researchers migrating to Bethesda MD to learn the perfused tubule technique, before returning home or moving onto other locations (Hamilton and Moore, 2016)





The XY Domain artwork (Moore and Parallel, 2017)

Acknowledgements

Thanks to all who contributed to these projects: Marc Russwurm, Mike Bricker, Bill Cartwright, Christina Hulbe, Mariusz Nowostawski, Christopher Frantz, Bin Jiang, Greg Leonard and the sandtable team, Judy Rodda, Sisi Zhang, Zeno Correia, Long Chen, Saeed Rahimi, Rosee Hodgson, Andrew Bell, Clare Lewis,

GNS Science, Jovan Mokoraka-Harris, Audrey Heyzer, James Robinson, Greg Hil, Laura Bowers, Jessie Hurford, Baylee Smith, Tristan Wadsworth, Teina Tutaki, Kirk Hamilton and Charlotte Parallel.

Contribution by Tony Moore, Aubrey Miller, Chris Garden, Pascal Sirguy, Todd Redpath and Anne Ford

Blackant Mapping Solutions

► www.blackant.co.nz

Blackant Mapping Solutions (BAMS) is a small freelance cartographic company based in Christchurch, NZ. For the past 20 years we have provided cartography and GIS services to a broad range of clientele including planning firms, publishing houses, research institutions, and the local government and health sectors.

In recent years (2015-2019) BAMS has focussed on cartographic production for books, producing one-off maps or a series of maps & graphics for print publications.

Some recent contributions to book projects include:

- *Place Names of Banks Peninsula and the Port Hills* by Gordon Ogilvie (2017) (www.canterbury.ac.nz/engage/cup/recent/place-names-of-banks-peninsula-and-the-port-hills.html)

- *We Could Be Heroes: Gods & heroes of the ancient Greeks and Romans*, edited by Gary Morrison, Penelope Minchin-Garvin and Terri Elder (2017) (www.canterbury.ac.nz/engage/cup/catalogue/books/we-could-be-heroes-the-gods-and-heroes-of-the-ancient-greeks-and-romans.html)
- *Beyond Manapouri: 50 years of environmental politics in New Zealand* by Catherine Knight (2018) (www.canterbury.ac.nz/engage/cup/new/beyond-manapouri-50-years-of-environmental-politics-in-new-zealand.html)
- *The New Biological Economy: How New Zealanders are Creating Value from the Land* by Eric Pawson et al (2018) (store.press.auckland.ac.nz/the-new-biological-economy-how-new-zealanders-are-creating-value-from-the-land/)

Banks Peninsula and the Port Hills map produced for a book by Gordon Ogilvie





A map created for the book *We Could Be Heroes: Gods & heroes of the ancient Greeks and Romans*, edited by Gary Morrison, Penelope Minchin-Garvin and Terri Elder; the base map was produced using Natural Earth datasets

- *He Kupu Tuku Iho: Ko te Reo Maori te Tatau ki te Ao* by Timoti Kāretu & Wharehuia Milroy (2018) (store.press.auckland.ac.nz/he-kupu-tuku-iho-ko-te-reo-maori-te-tatau-ki-te-ao/)
- *The Gumfields: Northern Wairoa to the Far North* by Kaye Dragicevich (2018) (www.dragicevich.com)

We are thankful to Nathaniel Vaughn Kelso and Tom Patterson who led the team at Natural Earth (www.naturalearthdata.com) and have made beautiful small scale map data available to cartographers everywhere! We are certainly one of the beneficiaries of their development.

In addition to cartography, BAMS also carries out GIS analysis and modelling for clients, often with the final output not necessarily being a map. The advent of more frequent collection and availability of LiDAR elevation data for New Zealand, including the LINZ's Mapping New Zealand 2025 work program (see Land Information New Zealand chapter), has meant that more detailed analysis and modelling of landscape characteristics is becoming more feasible.

For instance, more accurate modelling of individual catchment characteristics (e.g. slope, water

flow paths, landcover, landuse, soil characteristics, infrastructure, etc.) means that better models/representations of reality can be used to facilitate better planning choices, and also generate data inputs for other experts to incorporate into their workflow. One example that BAMS has been involved with recently is using GIS to predict locations in the landscape that are suitable for installing pollution retention ponds for farms.

Contribution by Tim Nolan

Critchlow Ltd

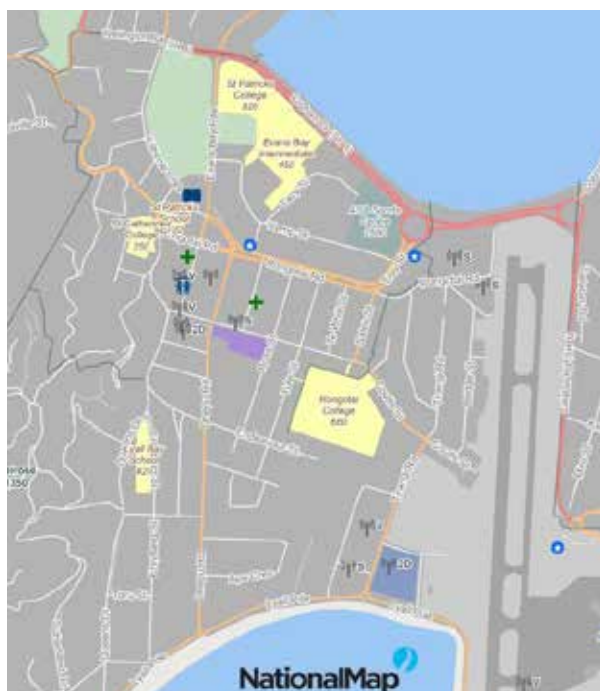
► www.critchlow.co.nz

Critchlow Ltd has 28 years' experience in New Zealand's Location Intelligence industry, it is a 100% New Zealand owned and operated company delivering spatial solutions to central and local government and the private sector.

At the very core of all geographic analysis, and resulting cartographic products, are high quality data. NationalMap is Critchlow's flagship product consisting of the NationalMap Roads and Transport product and the NationalMap Location product. These can be used separately or together.

NationalMap Roads & Transport is a multi-use connected network of roads, walkways and ferry routes that can be used in a wide variety of applications including routing applications and geocoding/addressing products. This network has a rich set of very usable attributes that includes: name (and alternative names), road hierarchy, legality, surface, legal speed limit, practical routing speed, direction of travel for one-way streets; height, weight, & width restrictions, toll road and tunnel flags, and turn restrictions.

NationalMap Basemap boasting authoritative, nationwide standardised content



It can be used out-of-the-box with all current network and routing software.

NationalMap Location Data are a hybrid of precise New Zealand-centric contextual and points of interest (POIs) data, and site and administration boundaries. These include over 25 layers of vertically integrated datasets that include parks, built up areas, retail areas, shopping centres, airports, land use, commercial and non-commercial points of interest.

In addition to NationalMap we also maintain our CNAR (Critchlow National Address Register). This is a database of 2.3 million postal and delivery addresses, primarily used for geocoding purposes. Every address in this database is linked to a road segment in the NationalMap road network for accurate pickup/delivery and routing purposes.

A key focus over the past five years has been data quality, and we have conducted a number of data improvement projects – these include: the alignment of all road centrelines to +/- 2 metres of real world location, the review of over 30,000 POIs and the commitment to regularly review these. The review of property access roads, so that no address will be further than 250 metres from a navigable road link.

As well as specific quality improvement projects, Critchlow employs a robust quality assurance process that sees over 120 specific validation checks conducted prior to each release of the data.

Critchlow is very aware of the need to solve real world problems and has worked with both private enterprise and government in responding to real needs that exist in New Zealand. One recent example is the Emergency Management Basemap that has been made available to the emergency management community via data.govt.nz.

Contribution by Andrew Smith

Femke Reitsma

► femkereitsma.com

I recently transitioned to GIS consultancy from being an academic at The University of Canterbury. I now work partly on a GIS contract and partly on my own projects, that include building a method and tool for exploring sets of harmonious colours. This transition has been revitalising and has involved constructing a website to give an idea of what I can do as a first step in setting up. Developing this website has started me down the path of finding new tools and building my own extensions for visualising spatial data on the web. It has led me to a niche I am enjoying and growing, to creating beautiful web based visualisations of spatial data.

Enabling large amounts of spatial data on the web for quick and light browsing is challenging, and technologies I am exploring include fast and lightweight javascript libraries for visualising spatial data as SVG and for graphing attributes, and larger out of the box tools such as Mapbox. Web visualisation tools are developing rapidly, and often need to be modified for

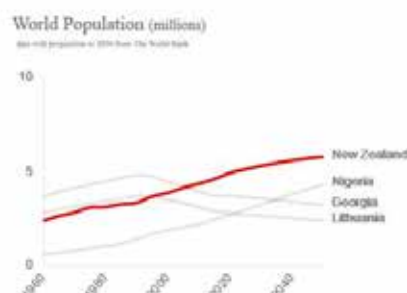
GIS projects. These new tools often leave developers falling off the edge of the map of support, a virtual cliff of knowledge, where building out code is often based on a passing comment in a forum or a minor detail noted at the bottom of documentation.

Working in this space involves creating methods that translate GIS output to be consumed by these new libraries, wrestling with formats at the lowest level of detail, such as whether there is supposed to be a comma between x or y or a space. And exploring the benefits or disbenefits of where to weight client-server architecture.

Would you believe, I am actually enjoying it. After ten years of being an academic, it is refreshing to step into building solutions for clients and feel the joy of a functioning “thing”.

Contribution by Femke Reitsma

One of the interactive visualisations featuring on my website; it links a country on the world map with population statistics



LUCID
DESIGN

Geographx Ltd

► geographx.co.nz

Geographx is a small privately-owned cartographic design company. It employed multiple staff and worked on a number of significant international mapping projects up until 2013. Since then it has been run as a one-man operation by owner and founder Roger Smith. Not surprisingly the focus is now on smaller projects, mostly within New Zealand. Cartographic design and production remain the primary activities, however there has been a widening range of peripheral activities.

The map design work has centred on the company's recognised strengths – custom, large format, topographically-themed relief maps featuring natural colour basemaps, both plan view and obliquely projected. These maps are mostly destined for wall display in visitor information centres, transport terminals, exhibition halls and other public spaces. Boutique luxury lodges provide another market, and the past four years has seen an unexpected increase in commissions for custom-designed, large format maps as feature wall art installations in private homes.

Geographx has a diverse range of clients. The majority are active in or have interests in wilderness, conservation, recreation/adventure sports and tourism.

In the 2015-2019 period, Department of Conservation (DOC) projects included new maps for Kaimai-Mamaku Forest Park, signboards for Arthur's Pass National Park, wall maps for DOC and/or iSITE visitor centres in Franz Josef, Haast, Te Anau, Hokitika, Queenstown, Christchurch, Huntly, Auckland and Rotorua. A number of signboard maps have been produced for the Te Araroa Trail, and a series of maps featuring New Zealand's gazetted Wilderness Areas was produced for Federated Mountain Clubs. Maps have been produced too for the New Zealand Fish & Game Council, the New Zealand Alpine Club and the Nature Heritage Fund.

Other projects have resulted in maps for adventure races, cycling and walking trails, for ecotourism and adventure tourism companies, and route/operational maps for a number of helicopter and fixed-wing flight operators. Geographx worked with operator user groups to identify and visualise flight corridors, reporting points, landing areas and directional protocols in the often-congested airspace over the West

Coast glaciers and Aoraki/Mt Cook. In late 2016 Roger Smith travelled to Patagonia to oversee development of a new trekking map for Torres del Paine National Park. Also in 2016 Geographx contributed its 100th map to NZ Wilderness magazine. Other magazines to feature Geographx mapping since 2015 include National Geographic, Australian Geographic and New Zealand Geographic.

The New Zealand Wine Industry has provided Geographx with significant work in recent years. Clients include the NZ Wine Growers Association, the NZ School of Food and Wine, wine companies both domestic and international, and numerous vineyards scattered throughout the country's wine growing regions.

A series of Geographx field maps covering New Zealand's Great Walks was first published in 2014. The maps have been maintained and a new map is under development for the new Paparoa Pike29 Great Walk which will open later this year. The company also has a catalogue of its own wall maps, prints of which can be purchased online. The number and range of available maps is slowly increasing.

Geographx has contributed maps to several books from which it receives royalties; two in particular are best sellers. A new, extensively revised edition of *Tramping in New Zealand* was published in 2015. Work on a new edition of *Day Walks in New Zealand* is now close to completion. Mapping undertaken for book publishers includes battlefield and campaign maps to illustrate written military histories. Several projects have focused on the 19th century New Zealand (land) wars, but in recent years most have related to World War 1, as sponsored WW100 projects administered by the Ministry of Culture & Heritage.

Other mapping work includes dynamic 3D maps to be rendered as zoom-in and fly-through video. In 2018 Geographx worked with NIWA to produce a series of high resolution seafloor map posters for Kaikoura, the Queen Charlotte Sound and the Bay of Plenty. Current projects at date of writing include a series of heliski terrain maps for a New Zealand operator, maps to support a written history of the 19th century triangulation of India, maps to monitor potential contaminants in the New Zealand honey industry, and a giant globe showcasing plate tectonics for Te Papa Tongarewa,



A private home installation of a Geographx map of the South Island

the National Museum of New Zealand. A Geographx map of the *Olivine Wilderness* was awarded second place in the Maps on Panels category at the 2017 International Cartographic Exhibition in Washington DC. In 2018 a new obliquely projected map of *Westland Tai Poutini National Park* (see the cover), won Best Print Map at the 2018 New Zealand Map Awards.

On the data side, the 30 billion pixel Geographx New Zealand natural colour basemap dataset was extensively revised and updated in 2016 to incorporate new releases of NZTopo50 from LINZ, and the Land Cover Database (LCDB) from Landcare Research. The basemaps feature in many, if not all Geographx maps. Geographx has made them freely available to DOC

to support its internal operational mapping, and to not-for-profit environmental organisations engaged in weed and pest control and ecosystem rehabilitation. And plans are in train to integrate the basemaps into onboard navigational systems for New Zealand's newly restructured Air Rescue helicopter operations.

Geographx continues as New Zealand distributor for Skyline Software Systems, a suite of dynamic 3D applications used by the New Zealand Defence & Intelligence community.

In 2015, Roger Smith, representing Geographx, was contracted by the National Library of New Zealand to curate *Unfolding the Map*, an exhibition showcasing the cartography of New Zealand. The exhibition opened in October 2015 and ran for 30 months, closing in March 2018. During the exhibition the National Library also acquired for New Zealand a copy of the *Earth Platinum World Atlas*. Geographx had a major role in its production. *Earth Platinum* was published in 2013 and is recognised as the largest atlas ever produced.

In 2016 Roger participated in a 3 day summit on the Future of Mapping, hosted by ESRI at Redlands, California, USA. He presented at the 2016 ICA Commission on Mountain Cartography workshop in Berchtesgaden, and again at the 2018 Mountain Cartography workshop held on Hvar in Croatia. On the domestic front he represented Geographx at GeoCart, the biennial New Zealand cartographic conference, in 2016 and again in 2018.

In 2017 Roger, again representing Geographx, was engaged by Victoria University of Wellington to teach 6 weeks of the MGIS 403 paper on Cartography & Geovisualisation. Later the same year he was honoured with the 2017 New Zealand Spatial Excellence Award for Outstanding Contribution to the Industry. Roger is the current President of the New Zealand Cartographic Society.

Contribution by Roger Smith

The Map Kiwi

► www.andrewdc.co.nz

The Map Kiwi represents the cartographic work of Andrew Douglas-Clifford, a 25-year-old cartographer and geospatial analyst based in Christchurch.

Originally beginning as a blog in early 2016, The Map Kiwi was initially dedicated to sharing various maps created by Andrew while studying towards his Masters in Geographic Information Science (MGIS) thesis. One such map of New Zealand's State Highways, in the style of the London Underground, gained widespread attention across social media; this extended to the work being reported on in the *New Zealand Herald*, *Stuff*, *Lonely Planet* and on an interview with John Campbell on Radio New Zealand's (RNZ) *Checkpoint* programme. The map also earned the New Zealand Cartographic Society People's Choice Map Award for 2016 and was presented on during the 2016 GeoCart Conference in Wellington.

Since then, The Map Kiwi has opened an online store selling a variety of beautiful, aesthetically pleasing cartographic prints. With a focus on New Zealand, The Map Kiwi designs tailored print maps across a variety of subjects and locations. Cartography styles have also been diverse, including Underground style network maps (like the original), topographic maps inspired by historical cartography styles, typographic maps, and a range of art inspired and experimental cartography. In addition to numerous online sales over the past few years, many designs have also found themselves in retail shops as art prints, including Map World, HAPA, Industria and retail partner Shopology, located in Christchurch's Arts Centre. To date, print designs from The Map Kiwi find themselves on hundreds of walls across New Zealand and abroad in the unlikeliest of places.

New Zealand's State Highways map (detail)



Andrew's maps have continued to gather interest on social media and reporting outlets. In 2017, a map titled *Nobody Lives Here: Uninhabited Areas of New Zealand* showing the sparseness of New Zealand's landscape went viral; this was followed by a profile piece in *The Press* newspaper on the cartography of The Map Kiwi. In 2018, a second map titled *Far From Any Road* showing New Zealand areas inaccessible by roads also went viral. A map poster and accompanying interactive web map of New Zealand showing Te Reo Māori place names drew the attention of New Zealand during Māori Language Week in 2018, with a radio interview about it with Wallace Chapman on RNZ's Sunday Morning Programme.

The Map Kiwi was nominated as a finalist in the Undergraduate of the Year category of the New Zealand Spatial Excellence Awards in 2016 and 2018 and was also a winner of the New Zealand Cartographic Society Award for Best Map Design in the latter. In late 2018, Andrew presented on the topic of teaching Cartography and GIS to the Auckland Geography Teacher's Association conference.

In 2019, capacity for tailored cartography services by the Map Kiwi has been reduced due to Andrew's full-time industry position as a Geospatial Analyst at environmental consultancy Tonkin + Taylor. However, the efforts of The Map Kiwi continue strong with further commission work and several new map designs on different types of mediums.

Efforts to support the industry and wider community have also grown. Following the terrible events of the March 15th Mosque shooting in Christchurch, The Map Kiwi offered a set of heart shaped map wall decals for sale, with the proceeds being donated to the shooting victims. Andrew is also helping to support the OpenStreetMap and mapping community in Christchurch by fostering the newly created MapTime chapter in Christchurch. As a New Zealand Cartographic Society member since 2016, Andrew currently sits on the Society's committee.

Contribution by Andrew Douglas-Clifford

NewTopo NZ Ltd

► www.newtopo.co.nz

NewTopo's maps are designed to encourage tramp-ing on the many public tracks within the New Zealand National Parks and elsewhere, and are available through visitor centres, tour operators, shops, and through direct sales via the internet. On scales appropriate to the area of interest, the maps show a realistic landform which provides a useful geographic context for the essential topographic information. There are currently 36 maps at scales varying from 1:30,000 to 1:150,000.

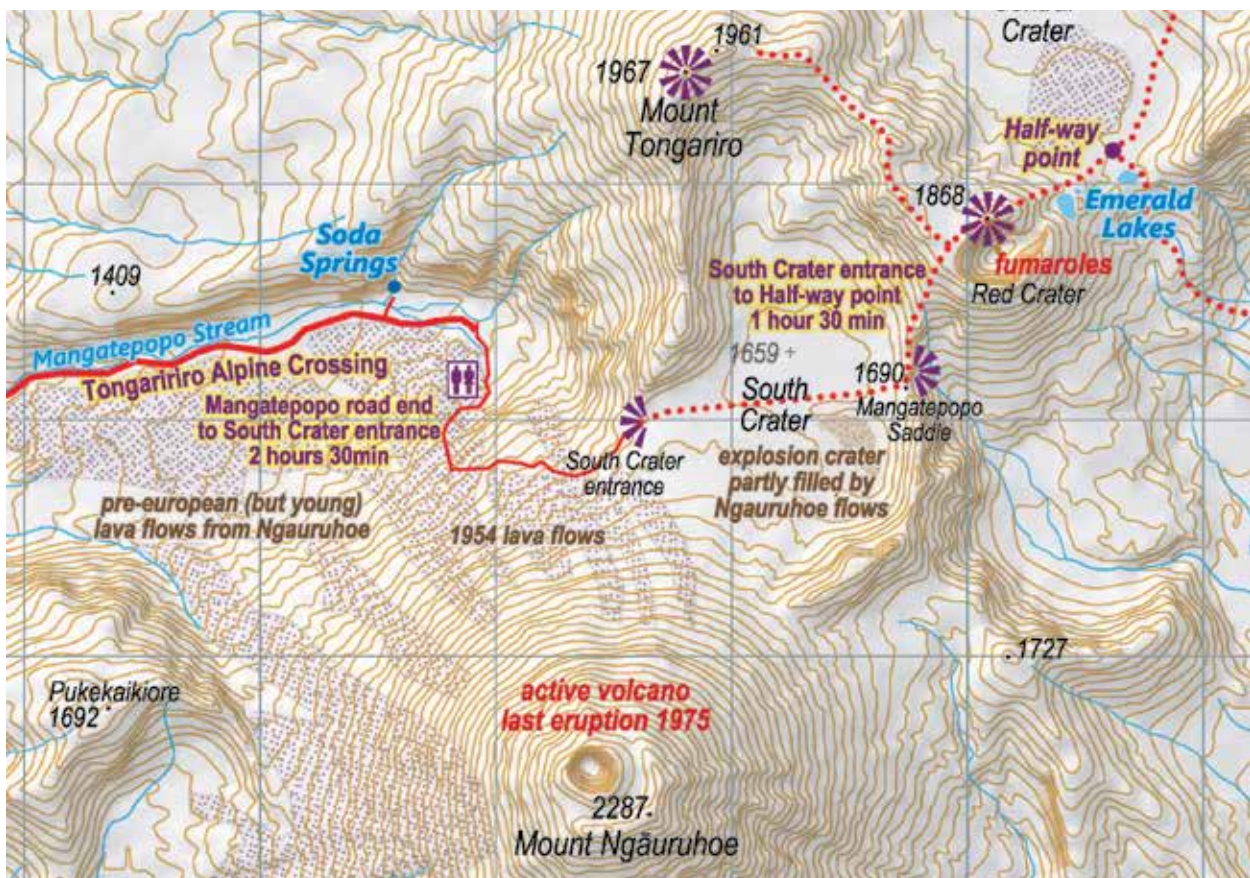
The maps explore the utility of Land Information New Zealand's LIFF 1:50,000 topographic data and the graphic versatility of Lorient's Lorik suite of cartographic software to produce a useful map product for walkers. Printed on synthetic paper,

high-wet-strength, or quality coated papers, the maps are presented folded in a clear vinyl wallet. They reflect a high level of cartographic technology and production, resulting in very high-quality long-lasting products. NewTopo's maps were the first topographic maps to be produced on the New Zealand Transverse Mercator Projection.

Papers describing these features and the development of NewTopo's unique graphic presentation were presented to the Society's GeoCart conferences in 2006, 2010 and 2014.

Contribution by Geoff Aitken

Tongariro Northern Circuit map, Edition 5, 2017 (detail)



MapsPast

► mapspast.org.nz

MapsPast is a volunteer-run, not-for-profit project. It was established in 2015 with the aim of making the major current and historical national map series of New Zealand available to all users through a single, simple-to-use web-based mapping interface. Specifically we wished to allow users to scroll and zoom seamlessly throughout New Zealand, display the area of interest, and switch between the available maps from different years to observe change over time.

For simplicity of hosting and use, we decided to produce one end-of-decade snapshot per decade, rather than trying to capture every individual change in each map. End-of-decade snapshots show the latest maps available as of the last day of the decade. Snapshots have been produced for each decade since production of standardised national map series began in the late 1800s. The map series chosen for each decade was based on a trade-off between available coverage and the level of detail shown, with topographic map series (NZMS 1, NZMS 260 and NZTopo50) chosen preferentially once they became widely available.

Our maps can be viewed through a simple browser-based interface. Each end-of-decade mapset is also accessible by GIS software using the appropriate TMS plugin (see the GIS dropdown at mapspast.org.nz for details). Specific map regions can also be downloaded through the web interface as simple images or with georeferencing data included. All maps and data are displayed in the current NZTM2000 projection.

The Project

Over 700 hours have been spent on the project to date, the vast majority on georeferencing and cropping the large number of historic map sheets that make up each layer. Production of each layer involved four stages:

Sourcing maps

The University of Auckland Library's GeoDataHub (GDH) (geodatahub.library.auckland.ac.nz) has scanned high-resolution copies of all major past

End-of-decade snapshots currently hosted by MapsPast

Decade -ending	Map series	Original Scale	Type	Number of sheets**
1899	NZMS 13	1:63,360	Cadastral	95
1909	NZMS 13	1:63,360	Cadastral	151
1919	NZMS 13	1:63,360	Cadastral	216
1929	NZMS 13	1:63,360	Cadastral	490
1939	NZMS 13	1:63,360	Cadastral	629
1949	NZMS 15	1:63,360	Cadastral	199
1959	NZMS 1	1:63,360	Topographic	200
1969	NZMS 1	1:63,360	Topographic	257
1979	NZMS 1	1:63,360	Topographic	315
1989	NZMS 260*	1:50,000*	Topographic	532*
1999	NZMS 260	1:50,000	Topographic	328
2009	NZTopo50	1:50,000	Topographic	445

* During the 1980s the NZMS 1 inch to 1 mile series was being completed in some areas at the same time as the new NZMS 260 1:50,000 series was being started in others. MapsPast overlays both map series, showing the most recent map from the two series for any given location.

** Inset maps are counted separately to the main sheet



New Zealand map series. The map images from the GDH form the backbone of MapsPast. In a few cases ‘missing’ series sheets and earlier pre-series sheets were sourced from the National Library of New Zealand (natlib.govt.nz). Land Information New Zealand (LINZ) is the copyright holder for all the national map series images used. LINZ have made the maps used available under the Creative Commons (attribution) NZ license.

Georeferencing

Georeferencing of the older cadastral maps was carried out by locating trig points on the scanned map, and matching them to entries in the National Geodetic Database (GDB). Where possible a minimum of 6 trig points was used, to allow erroneously mapped trigs to be identified and removed. This proved a challenging task in many areas where the positions of original trigonometric points have been lost or discarded from the database due to inaccuracy – for example many of the pre-1930 trig points in the Hawke’s Bay. Where trig stations were not available, surviving property boundary intersections were used.

Cropping and mosaicing

Cropping the scanned map images to the geographic extent was simple from NZMS 1 series onwards as these later map series use rectangular extents on known grid systems. However, older NZMS 13 and NZMS 15 maps show data bounded by survey district boundaries (NZMS 13) and county boundaries (NZMS 15). These district/county boundaries follow a mixture of arbitrary lines, geographical features and property boundaries – and change significantly over time. No accurate digital data for these boundaries were available, so a polygon representing the extent of each map sheet (survey district/county) had to be manually digitised off the scanned raster map for each map edition used. The scanned sheets were georeferenced, cropped, reprojected to NZTM2000 and then mosaiced into a single national virtual raster which was then tiled to create a TMS layer suitable for viewing over the internet.

Publishing

Each end-of-decade national map layer has been published as TMS (Tile Map Service) dataset on Amazon Web Services.

Stratford in 1924, 1964 and 1987 showing the three main styles of mapping used over the last 100 years – NZMS 13 cadastral series 1:63,360 (top), NZMS 1 topographic series 1:63,360 (middle), and NZMS 260 topographic series 1:50,000

The Future

MapsPast has attracted a wide range of users: it is referenced by groups as varied as hikers and hunters, genealogists and gold-diggers. Data and images sourced from it appear equally widely: newspaper articles, academic papers, resource consent applications, local government district plans.

Our aim from now focuses on longevity, maintenance and stability: MapsPast should remain the

up-to-date, reliable source by which all people can access historical mapping of New Zealand long into the future. When somebody references MapsPast as a source, they should be able to do so confident that any future reader will be able to visit the site and view that same information.

Contribution by Matt Briggs

Alexander Turnbull Library

► natlib.govt.nz/collections/a-z/cartographic-collection

The Alexander Turnbull Library was established in 1920 following Turnbull's bequest to the nation of his magnificent library. It is now a division of the National Library of New Zealand, and its collections and services are housed within the National Library building in Wellington. The Alexander Turnbull Library holds New Zealand's national documentary heritage collections. We collect a wide range of materials relating to New Zealand and the Pacific, and cartography is proactive collecting area. You can see our cartographic collecting plan here natlib.govt.nz/about-us/strategy-and-policy/collections-policy/cartographic.

In the period 2015-2019 major activities have included:

Exhibitions

- *Unfolding the Map — the cartography of New Zealand*; a major exhibition curated by Roger Smith, which opened on 16 October, 2015 in the National Library Gallery.
- *Measured Works; surveyors' views of early European settlement in Wellington*; an exhibition curated by

Mark Bagnall, the Curator of the Cartographic Collection, which ran 7 December 2015 – 26 February 2016 in the Turnbull Gallery.

Events

- On Wednesday 28 February 2018 Mark Bagnall, the Curator of the Cartographic Collection, delivered an illustrated lecture on the history, context and use of Thomas Ward's 102 sheet, detailed map of Wellington in 1891.
- GeoCart'2018: the 9th National Cartographic Conference / 46th Annual Australian and New Zealand Map Society Conference, was held in the National Library of New Zealand, September 5-7, 2018

Acquisitions

Significant acquisitions during this period include:

- Consolidated Gold Fields of New Zealand Ltd. Gore Porter Plans Collection. 362 plans and longitudinal sections from surface of mines, generated by Consolidated Gold Fields of New Zealand Ltd.
- Wellington Manawatu Railway Co. Limited from 26

Wealth of Nations - Golden Fleece Lease Plan (detail): natlib.govt.nz/records/36997313





Image 26 from Wellington Manawatu Railway Co. Limited from 26 Miles to 36 Miles: ndhadeliver.natlib.govt.nz/delivery/DeliveryManagerServlet?dps_pid=IE31418646&dps_custom_att_1=emu

Miles to 36 Miles. 1 volume of unpublished survey maps and levels for the Wellington to Manawatu railway

- Chirag Jindal : Auckland lava caves digital spatial data. A collection of LiDar digital spatial data and accompanying information created during a survey of ten lava caves located under three volcanoes; Te Tātua-a-Riukiuta (Three Kings), Maungawhau (Mount Eden), Māngere and Maungakiekie (One Tree Hill) in Auckland City

Contribution by John Sullivan

Auckland Central City Library

► www.aucklandlibraries.govt.nz

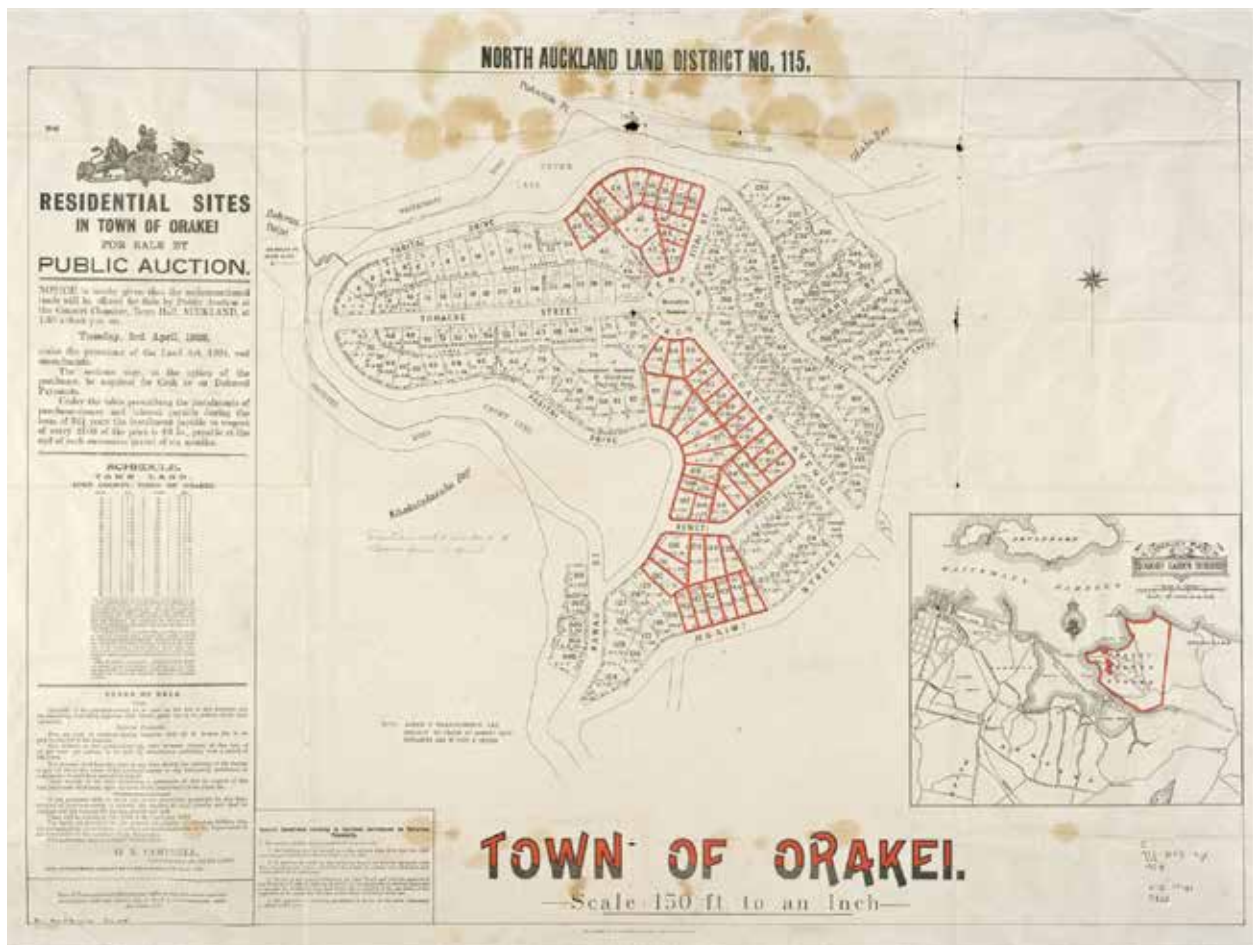
The map collection in Sir George Grey Special Collections, at Auckland Central City Library, consists of approximately 9000 items. This collection contains significant maps from throughout New Zealand, from the 1830s onwards. These are hydrographic charts, street maps, topographic maps (including maps in series), scientific maps, aerial maps, architectural plans, cadastral maps, tourist maps and early real estate maps. Some of the maps are unique manuscripts, or have manuscript annotations. Maps found in books in the printed book collections, the British Parliamentary Papers, and in the general manuscript

collections are catalogued as part of this collection. The Church map collection consists of land auction maps from the 1860s to the early years of the 20th century. Most are for land sales in the Auckland region. The library bought the collection from the bookseller George Church in 1916. For the period from the 1950s to the present day collecting has focussed primarily on comprehensive coverage of Auckland and the old Auckland Province area.

Additions are made through purchase, often at auction, donation, and transfer from the general collections of outdated editions.

Auckland, N.Z. This view is compiled and drawn as from a point one thousand feet above and one hundred feet to the rear of the hospital during the year 1885 and part of 1886, by George Treacy Stevens (Auckland Libraries Heritage Collections Map number 4641)





Town of Orakei, a map of allotments for sale in Orakei on 3 April 1928, the second group to be offered, described as North Auckland Land District no. 115 (Auckland Libraries Heritage Collections Map number 5323)

The map collection also includes some world, Pacific region and Australian maps, including atlases, nineteenth century and World War I battlefield maps. There are also maps bound within books in the pre-1800 printed collection. Most of the nineteenth century world and Australian maps come from the donation of Sir George Grey. Additions to this part of the collection are mostly through donation.

About 2170 maps from the collection have been digitised and are accessible on the library's new Kura Heritage Collections Online database, but this is a work in progress. Map records without digital images are currently accessible via the older Heritage Images database, with the aim of uploading all records to Kura

in the near future. Ultimately Kura will be the home for images, audio, manuscripts, collection records and indexes, from across the entire system, providing unified access to Auckland Libraries heritage collections. Current map digitisation work will focus on recent acquisitions and on filling in any 'gaps' as they are identified.

Sir George Grey Special Collections is on the second floor of the Auckland Central City Library and is open to the public every day.

Contribution by Katrina Laan

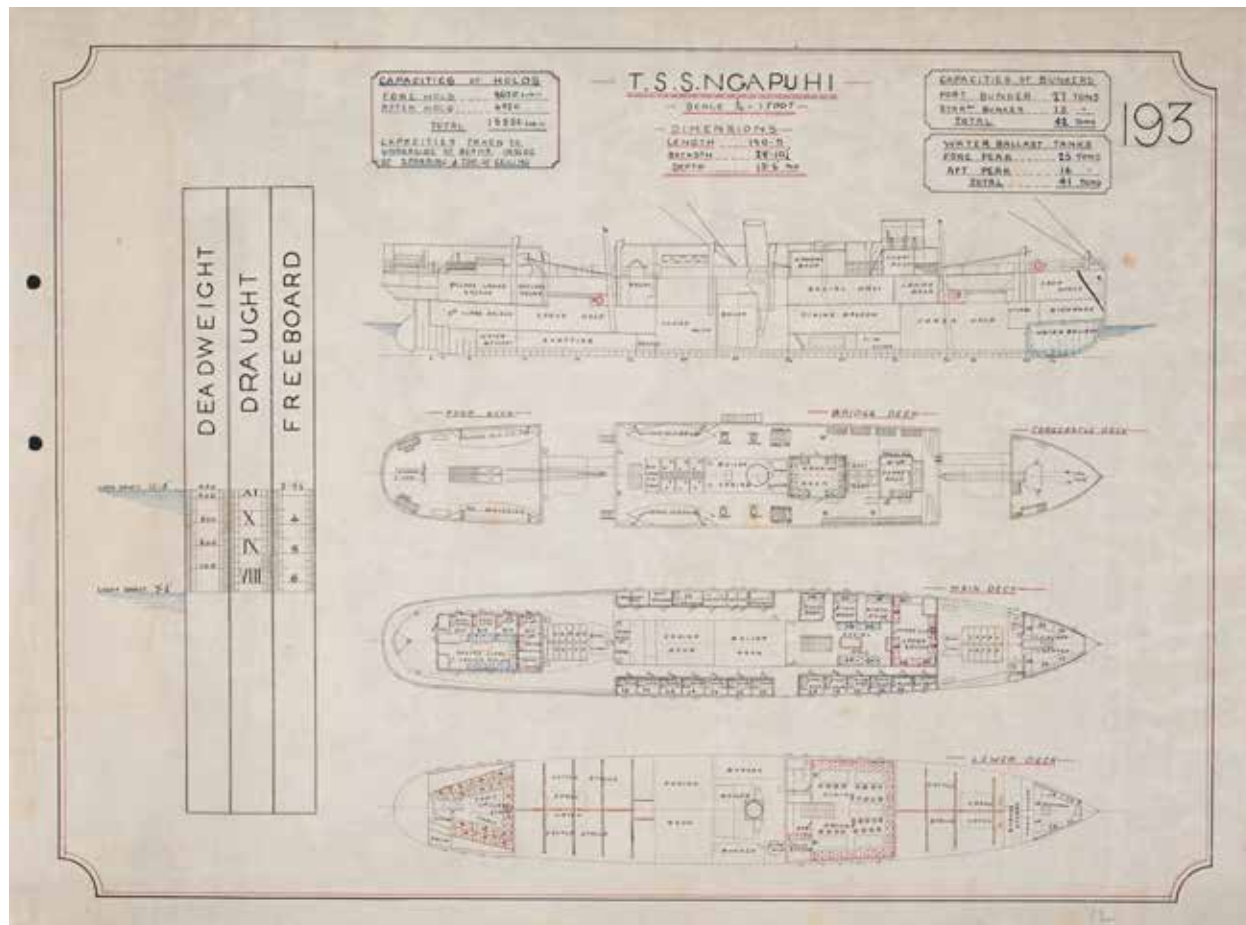
Auckland War Memorial Museum – Tāmaki Paenga Hira

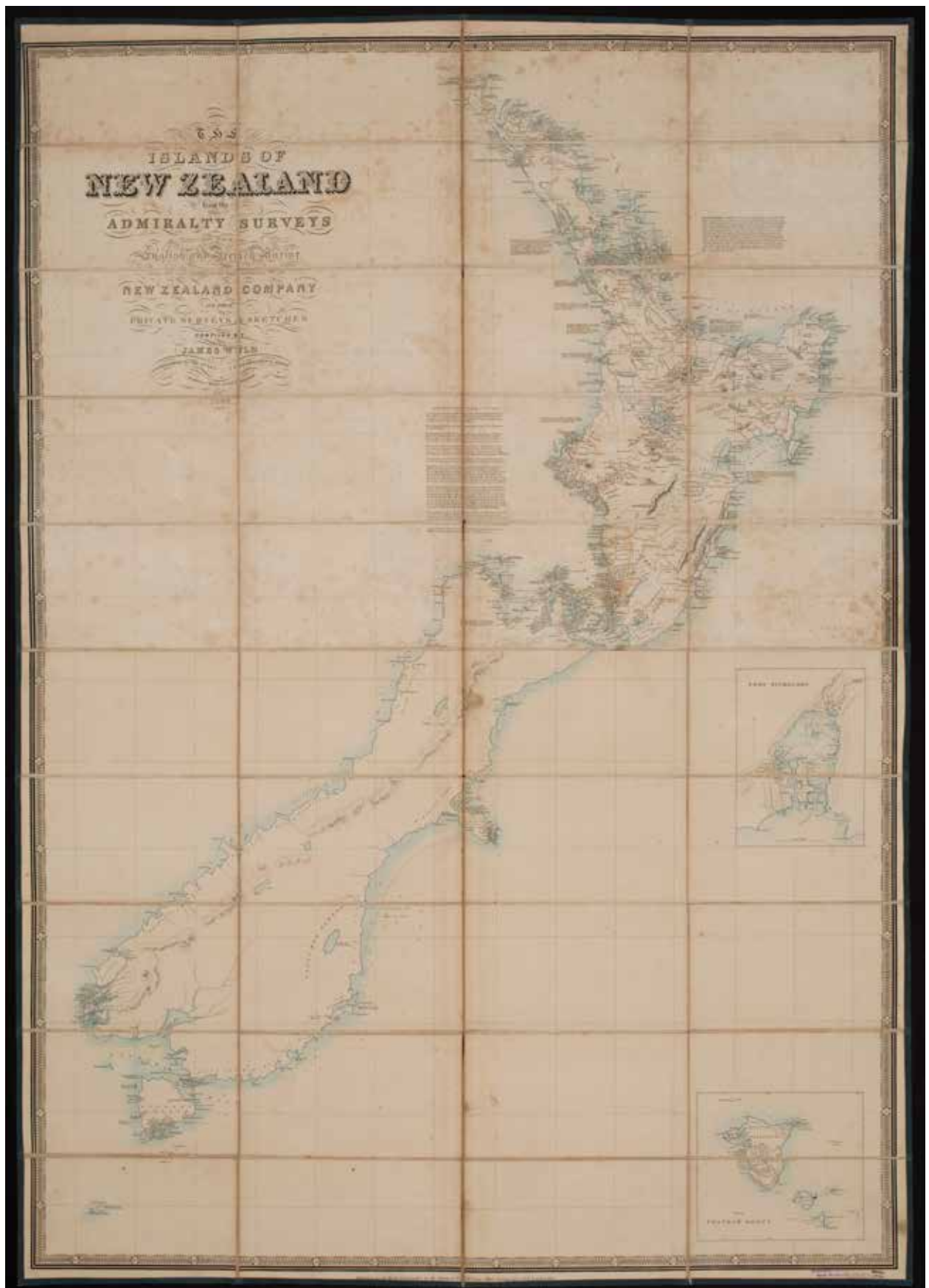
► www.aucklandmuseum.com

The Museum Research Library Te Pātaka Mātāpuna's map collection is chiefly of historic rather than contemporary value. It is based on a substantial deposit of 20th-century sheet maps in series (e.g. New Zealand topographic map NZMS 1 series 1:63,360). The collection is added to on an ad-hoc basis through auction and donation where single items are deemed necessary to fill historic gaps or are required for exhibition purposes. The main themes of the collection reflect the Museum's Collection Development Plan which broadly encompass Aotearoa New Zealand's military engagement, Māori and Pacific themes, and the settlement, growth & subdivision of Tāmaki Makaurau.

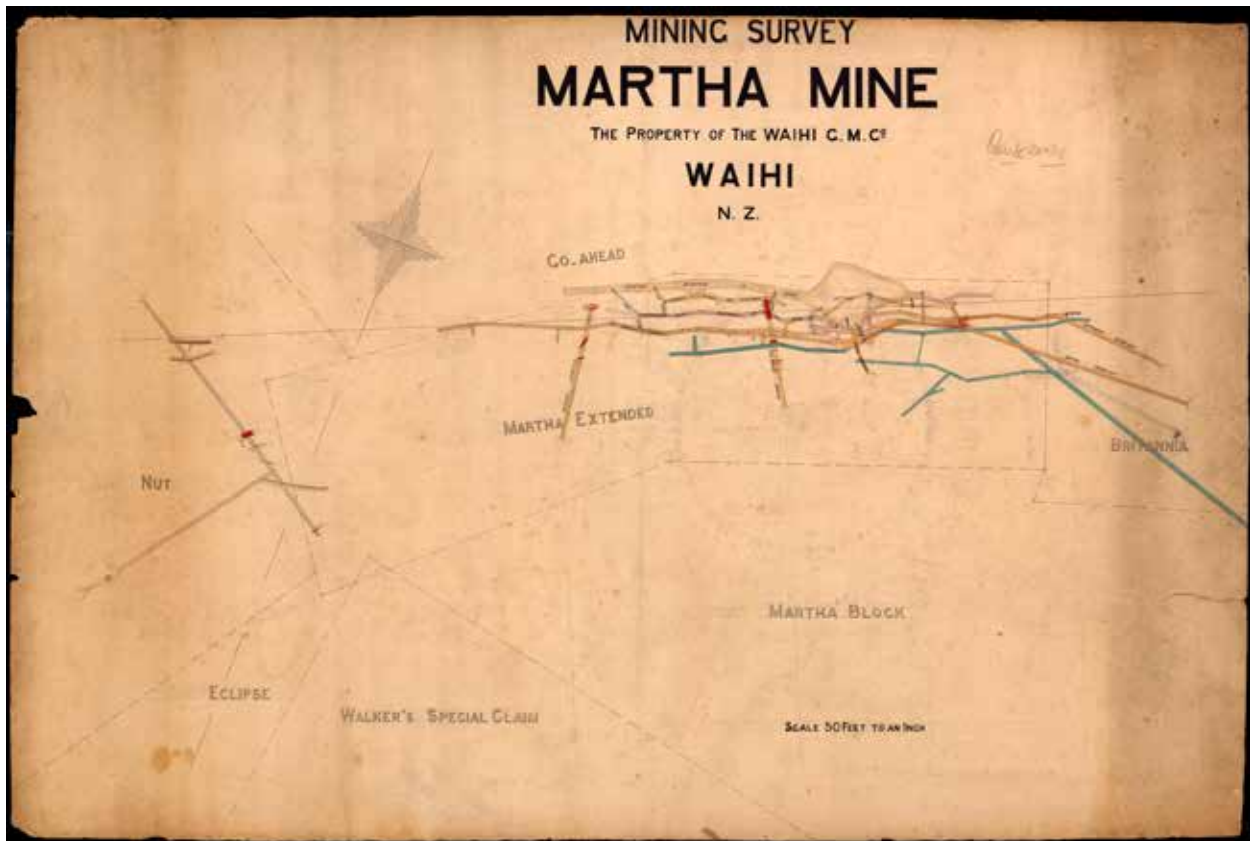
It is estimated the collection holds approximately ten thousand individual sheet maps, 100+ atlases, and an underused resource of material bound into volumes such as the AJHRs, official and scientific reports with hydrographic volumes, and individual volumes of voyages & travels (although many official resources such as Parliamentary Papers, AJHRs, etc. are now online through Papers Past or other resources). Whilst most of the bound volume material is catalogued and some of the rarer topographic views and pictorial content is described and digitised, less than half of the sheet map material is catalogued. Two large-format collections were digitised as part of the Museum's

Auckland Museum Tāmaki Paenga Hira; TSS *Ngapuhi* [1903]. PL108-001





Auckland Museum Tāmaki Paenga Hira; *The islands of New Zealand from the Admiralty surveys...* / James Wyld, 1846. G9080



Auckland Museum Tāmaki Paenga Hira; *Mining survey, Martha Mine / Martha Gold Mining Co. 1897. MS-1998-63_plan 67*

5-year backlog project: circa 120 technical drawings of ships (recto and verso), and 75 folded maps (recto, verso, cases, labels, etc.).

However, to avoid duplication of resources and effort, should digitised cartographic material be available elsewhere (e.g. the University of Auckland's GeoDataHub) requests for images are always referred on, unless the Museum's copy is desirable for its unique features (e.g. annotation).

In a major external digitising project in partnership with OceanaGold Mine Corp., the Museum shared its collection of historic mine plans from the Martha Mine in Waihi. This came about as a result of the Pike River Mine disaster in 2010; the New Zealand government commissioned a sub-surface investigations consultant to locate all known mine plans held in NZ heritage institutions to build a database of the country's mines. The Museum's contribution of Waihi and Thames gold-field plans is unique with 150 large-format mine plans catalogued and digitised.

In 2017 Auckland Museum published its five-year strategic plan and has invested considerable resources in diverse activities such as—research projects; opening its Pacific collections to the community; offsite storage; refreshment of public galleries. The library team has similarly undergone significant organisational change; the kaitiaki of the Documentary Heritage collections (including cartographic material) has shifted away from the traditional concept of 'library' firmly into the rarified air of curatorial interpretation.

The Research Library is open to the public Monday to Friday, 10am to 3pm and Saturday 10am to 5pm; closed Sunday and public holidays. All collection enquiries are welcome through the Museum's contact page www.aucklandmuseum.com/your-museum/contact-us.

Contribution by Julie Senior

University of Otago, Hocken Collections – Uare Taoka o Hākena

► www.otago.ac.nz/library/hocken/

The Hocken Collections owes its existence to the extensive collecting and subsequent generosity of Dunedin doctor, Thomas Morland Hocken (1836-1910). Dr Hocken collected items relating to New Zealand, the Pacific and early Australia. In 1897, Dr Hocken offered his collection to Dunedin and the people of New Zealand under Deed of Trust. The University of Otago in trust for the nation manages the Collections.

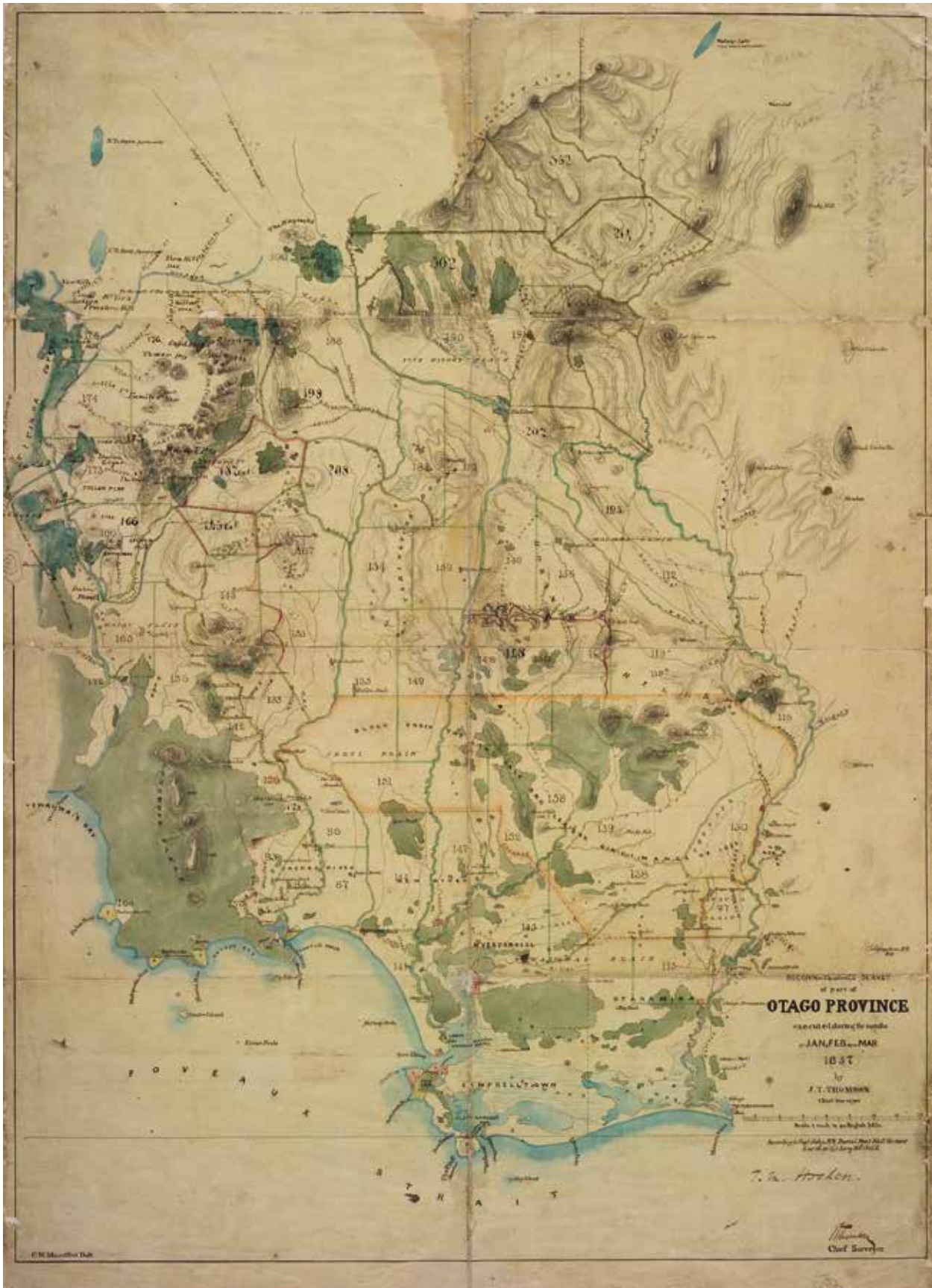
Dr Hocken's original collection of 80 maps has now increased to over 14,000 items. The bulk of the map collection consists of cadastral and topographic sheet maps, thematic maps such as geological surveys, hydrographic charts, atlases and reference material related to cartography, including books and periodicals. There are published and manuscript maps in the

collection and maps are also found within Publications, Photographs and Archives collections.

Material in the collection ranges from 16th Century to present day. The earliest pre Tasman maps are of the world as explored at that time and give a wider worldview. From the late 18th Century the focus shifts to the south Pacific with New Zealand as a whole and by region, Australia, Antarctica and Pacific Islands. Maps with a relationship to New Zealanders, such as theatres of war, are also included. The collection has particularly strong coverage of Otago, Southland and Dunedin sales plans. Thanks mainly to generous donations it also houses an extensive collection of maps from the 18th and 19th Centuries, including an extremely rare East India Pilot, Norie 5th ed. with

Township of Waverley, sunny side of harbour immediately opposite Rattray St. Jetty, Dunedin. Connell & Moodie Surveyors, Ferguson & Mitchell Litho. 1881. Hocken Collections. Hoc: Map: H++ 885.991 1881 bje





Reconnaissance Survey of part of Otago Province executed during the months of Jan., Feb. and Mar. 1857. J. T. Thomson, Chief Surveyor and C. W. Mountfort delt

additions to 1829, and the Geological map of the Province of Otago, New Zealand by James Hector, Provincial Geologist, 1864.

The collection continues to grow with historic and currently published maps acquired through purchase and donation, and holds up to date official topographical series maps and charts for the whole of the country and for Pacific areas under New Zealand's jurisdiction.

Although the Collections are part of the University of Otago Library system they are also freely available to the public. Researchers come from the local, national and international communities. University of Otago staff and students, and researchers from other educational facilities, use the collection for a wide range of topics. These include looking at changes in coastline over time, reclamation, land use, gold mining, location of businesses, tracking down localities and changes through time of dwellings and land holdings using cadastral survey maps, farm subdivision plans and sales plans. Geography, surveying and history

researchers from within the University make good use the collection, as well as genealogists, historians and archaeologists.

The Library has a significant New Zealand Art Collection and gallery display area. Maps are often included in displays in the Gallery.

Last year the last vertical map storage cabinet was replaced with horizontal storage for sheet maps. Efforts to protect and preserve the many rare and significant items in the collection are ongoing. A digital assets management strategy for the collections is in its early stages.

The cataloguing backlog is steadily decreasing so that around ninety percent of maps are findable on the online catalogue searchable through the University of Otago on line catalogue, Library search/Ketu (www.otago.ac.nz/library/index.html).

Contribution by Karen Craw

University of Auckland Library – Te Tumu Herenga

► www.library.auckland.ac.nz

Collections

The value and importance of cartographic and geospatial collections has long been recognised at the University of Auckland. They have been collected, invested in, and are used extensively across Schools and Faculties by Architecture, Engineering, Population Health, Biological Sciences, Planning, Geography and Earth Sciences students, and academic and professional staff. Between 2015 and 2018, Curator, Cartographic and Geospatial Resources received over 810 enquires relating to these collections and provided over 270 research consultations.

Cartographic and geospatial resources collected by the Library focus primarily on New Zealand, the South Pacific and Ross Dependency in Antarctica, although they extend to the entire world. Preference is given to materials sourced from authoritative publishers and data producers, such as governments, research institutes or universities.

Print material includes maps and charts, atlases, aerial photography prints and miscellaneous material (e.g. gazetteers, indexes, catalogues, etc.).

The map and chart collection consists of approximately 50,000 sheets. New Zealand material comprises the majority of the collection and includes general, topographic, cadastral, photo-mosaic, planning and scientific (geology, soil, land utilisation, bathymetry)

maps, as well as street maps, tourist maps, hydrographic charts and a selection of aeronautical charts. Most of the maps date from 1945 onwards. The strength of the collection follows geographic proximity; strongest for Auckland and Northland, weakest for Otago and Southland. The Pacific Islands and Ross Dependency collections are substantial and contain general, topographic, thematic and scientific maps. In addition, a wide selection of street, cadastral and aerial mosaic maps, and hydrographic charts is available for South Pacific nations. Maps covering other parts of the world are often dated and include general, scientific and a selection of topographic maps.

New maps and charts are actively acquired for New Zealand, South Pacific and Ross Dependency, or for specific research or teaching needs, usually at the request of an academic staff and/or researcher.

The Library maintains a collection of atlases, including world, national, thematic and scientific. The historic aerial photography print collection is complete for Auckland and Northland, good for the remainder of the North Island and very fragmented for the South Island. In 2018 a substantial acquisition of prints was made for areas covering southern North Island and northern South Island, but they have not been incorporated into the main collection yet.

Digital resources contain digital maps and charts, aerial and satellite imagery, and geospatial datasets,

Examples of cartographic and geospatial resources held by the University of Auckland Library: NZMS 2 New Zealand Topographic Map, Baring Head lighthouse area; KiwiImage satellite view of Emerald Lakes along the Tongariro Alpine Crossing track; rendering of LiDAR data of pre-2011 earthquake city of Christchurch, with Avon River meandering through



boasting over 31TB of data. The vast majority of digital maps and charts comes from collaborative scanning projects that aim at enhancing the University's geospatial resources. The collection consists of over 25,000 digitised government map images and includes New Zealand Mapping Service (NZMS) series maps and charts, Lands and Survey (L&S) series maps, miscellaneous government maps, New Zealand Geographic Board manuscripts and other maps and charts. In addition, there are approximately 2,500 born-digital maps that include the current official topographic (Topo) series and a range of scientific climate and geological maps. These resources are available in multiple raster-based file formats, i.e. TIF, JPG and as georeferenced GeoTIF.

The Library also maintains a collection of high resolution aerial photography sourced from scanned Crown Historic Aerial Imagery Archive and available in TIF file format. This acquisition was prompted by specific research needs and currently focuses on photography covering the East Cape area. Born-digital aerial imagery is collected for Auckland, Northland and Waikato, with some sets also covering Bay of Plenty and Hawke's Bay. These resources are provided as orthorectified TIF and/or JPG images. In addition, the Library holds KiwiImage and Sentinel satellite imagery of New Zealand, which is available in TIF or compressed ECW format.

Geospatial datasets comprise the official Topo datasets, a national DEM, a comprehensive set of Auckland Council data (infrastructure, property, environment, terrain, LiDAR, planning), as well as geological, climate and environmental datasets. A selection of datasets is held for Northland, Waikato, Hawke's Bay and Canterbury. These datasets are available in file formats that are compatible with University run software.

The physical collections are located in the Map Room, General Library building, at the heart of the

University's City campus. The digital collections are available from the Library's GeoDataHub (geodata-hub.library.auckland.ac.nz).

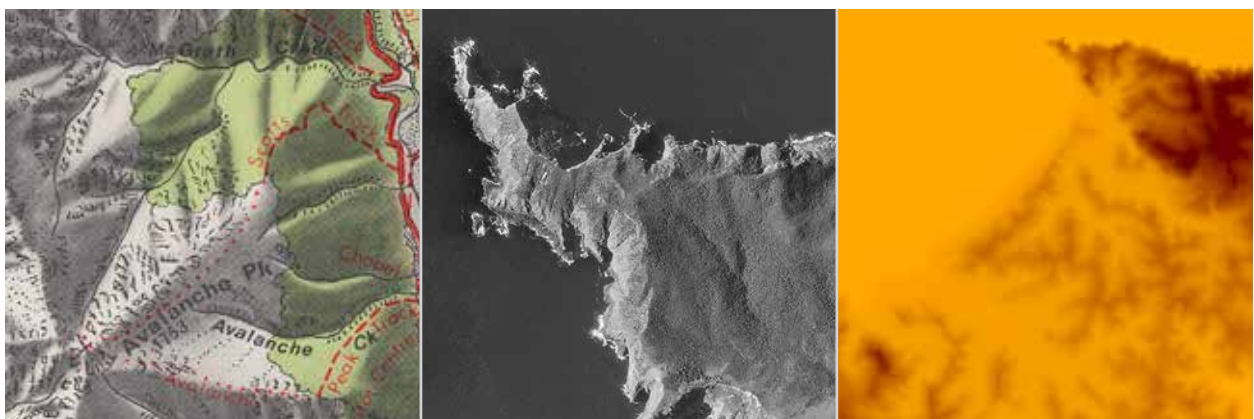
Activities

An update of the Collection Management Plan was one of the early tasks of the Curator, Cartographic and Geospatial Resources (appointed in January 2015). It involved appraising physical space occupied by maps and charts (103 cabinets), and digital storage devoted to geospatial datasets (60TB), as well as assessing the relevance of cartographic resources held by the Library to the current and future needs of the University's research and academic programmes. This strategic work was completed in July 2016 setting the path for refocusing, enhancing and optimising the collections, and providing clear direction for selection, acquisition and provision of the cartographic materials.

Improving discoverability of and access to cartographic and geospatial resources was the key undertaking in 2016. Retrospective cataloguing of the New Zealand maps and charts resulted in creating over 10,000 new records, vastly improving access to these most utilised materials. At the same time, the Library concluded a seven-year collaborative programme of digitising New Zealand government maps. This development allowed the publishing of over 20,000 digital maps and charts in the web-based rudimentary Cartographic and Geospatial Resources Repository that was launched in August.

In 2017, a significant effort was devoted to adopting and eventually implementing standardised geospatial metadata records for digital resources. A number of in-house solutions were developed to create these records in XML format, making them readily available for ingest into the GeoNetwork, a catalogue application

Cont: L&S 167 Arthur's Pass National Park map enlargement of Bealey Valley; an aerial view of Great Island, the largest of the Three Kings Islands; rendering of the national DEM data around Spirits Bay (Piwhane Bay) area, Northland, with Hooper Point (Ngataea) to the north





Landing page of GeoDataHub, highlighting the three modules: discovery (GeoNetwork), access (Geospatial Data Repository), and learning (Knowledge Base)

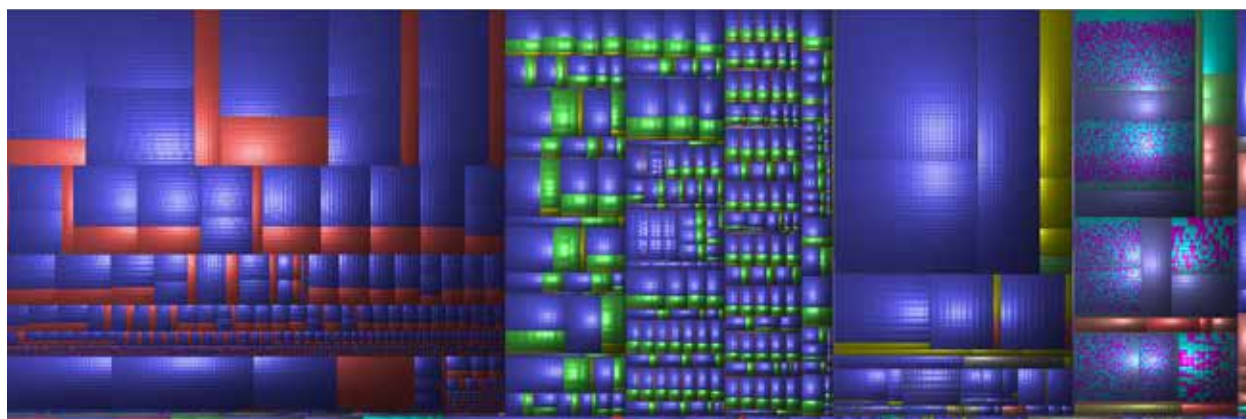
selected by the Library to manage spatially referenced resources. Another piece of work involved enhancing bibliographic records of maps by creating and then linking map thumbnails, and embedding links to pre-view the maps. Due to a major update of the Library's bibliographic cataloguing application Primo, these enhancements are not currently available.

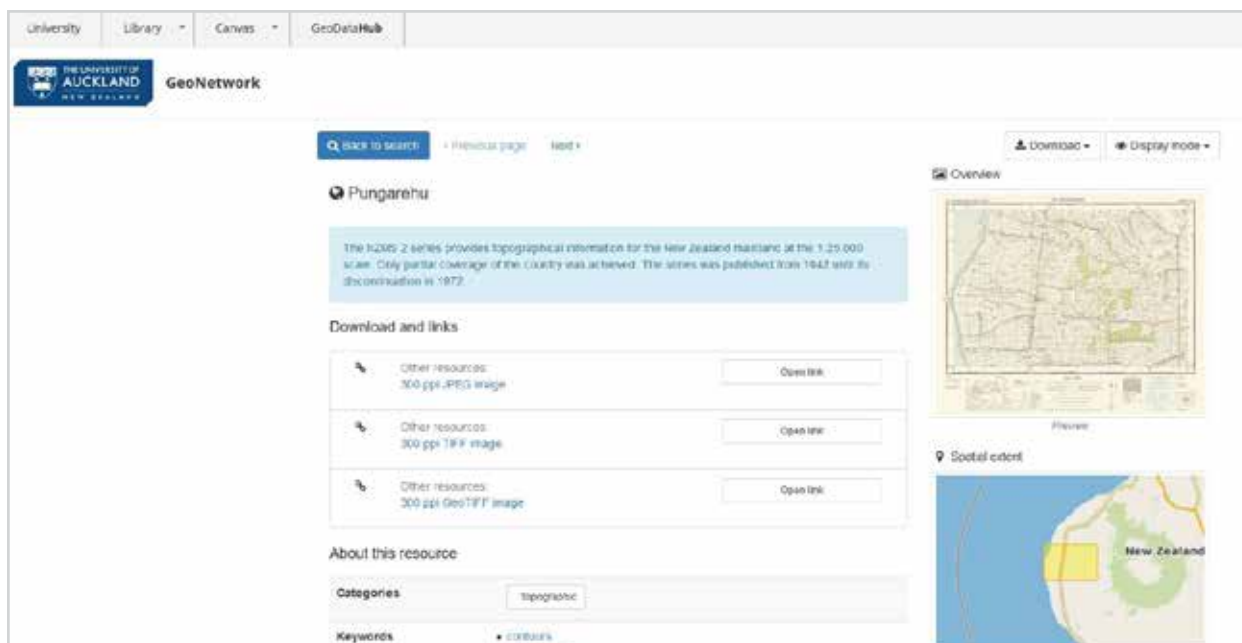
A major reorganisation of geospatial resources was undertaken in 2018. Over 30TB of data was assessed, optimised and logically organised according to geographical coverage, theme and access rights. This process also addressed data duplication, inconsistent data structures, corrupted datasets, standardisation of file formats and file naming conventions. Geospatial data was organised into national, regional and Auckland datasets and then thematically. A clear

distinction between publicly accessible data and data restricted to University users only was implemented via server permission protocols.

The most prominent development of the last four years was the soft launch of the GeoDataHub in August 2018. GeoDataHub is the centralised repository of authoritative cartographic and geospatial resources curated by the University of Auckland Library. Its objectives are to enhance discoverability of cartographic materials; support innovative research, teaching and learning; provide integrated data access for various research and professional communities, as well as the public of New Zealand; and build a unique knowledge base concerning New Zealand's cartographic heritage and mapping. This undertaking built on, significantly expanded and ultimately replaced the Cartographic

WinDirStat (windirstat.net) treemap of the GeoDataHub showing clusters of various file formats and their relative sizes, the most common being TIF format which is shown in dark blue, JPG – red, JPG2000 – green, SHP – turquoise, ECW – yellow





A result for NZMS 2 topographic map of Pungarehu at the scale of 1:25,000; an abstract and download options, together with a map thumbnail and spatial extent preview, are part of the standardised geospatial metadata record

and Geospatial Resources Repository mentioned above.

GeoDataHub consists of three modules encompassing discovery, access and learning. The discovery module is augmented by GeoNetwork cataloguing application, which is based on the principles of free and open source software, and international and open standards for services and protocols (ISO/TC211). The software provides a multi-modal search engine (textual, spatial and temporal) for geospatial data, resource download facility, and powerful management and metadata editing tools. Currently there are over 2,500 records in the catalogue consisting of New Zealand topographic and cadastral maps.

Geospatial Data Repository is the heart of GeoDataHub. It allows browsing, accessing and downloading digital maps, data and imagery either directly or by mapping a drive. Connecting to the geodata server is particularly useful to experienced users, while direct interacting with the content of the repository is preferred by other users. A large proportion of resources is open to the public (NZMS, L&S, Topo maps and Topo data), while all other datasets are restricted to the University users.

The learning module is delivered through the Knowledge Base, which aspires to provide information about authoritative maps published in New Zealand. This developing resource currently covers government maps and charts produced by Provincial governments since the 1860s, and since 1876, by the Department of Lands and Survey. It also provides an introduction to the current topographic datasets, including New Zealand and its offshore islands, Cook Islands, Niue,

Tokelau and Ross Dependency in Antarctica produced by Land Information New Zealand.

In October 2018, the University of Auckland Library went through a restructure that had a direct impact on the delivery and management of cartographic and geospatial resources. The position of Curator, Cartographic and Geospatial Resources was disestablished with no equivalent role created in the new structure. The print collections were transferred to Cultural Collections, while the management of digital geospatial collections became the responsibility of Research Services. While the geospatial portfolio has been identified as part of the Research Services Adviser role, there is currently no dedicated role in Cultural Collections to manage the physical collections of maps and charts.

While the above situation is being addressed, Research Services provide temporary management of print collections involving acquisition of new materials, cataloguing, specialist consultancies and responding to general enquiries. In February 2019, Research Services embarked on a six-month project focusing on optimising the physical collection of maps to support research, learning and teaching requirements at the University of Auckland.

Outlook

The Library is committed to further enhancing and expanding the GeoDataHub. Work is underway to create geospatial metadata records for a number of map series, particularly New Zealand topographic

and cadastral. Similarly, KiwiImage satellite imagery is being targeted to complete capture of temporal information and optimise data delivery protocol. Acquisition of new geospatial datasets is ongoing with the release of Antarctic's Southern Victoria Land geological data being the most recent example. Another development involves acquisition of digital hydrographic charts and datasets from the New Zealand Hydrographic Authority. These resources will vastly increase the portfolio of digital collections and complement many terrestrial datasets already available from GeoDataHub.

Long term, the Library is looking at adding value to its digital resources by georeferencing scanned maps and charts. Currently, around 6,500 maps are georeferenced but no new maps were added since 2016 due to other priorities. Another planned initiative involves acquisition of geospatial data for the South Pacific. Negotiations with the Government of Samoa for the supply of vector topographic data and digital imagery are already underway. The Library is also investigating the acquisition of historic aerial imagery for the northern North Island, a coverage coinciding with the old Auckland Province and incorporating the current regions of Northland, Auckland, Waikato, Bay of Plenty and Gisborne.

Enhancing the Library's discovery zone by importing map thumbnails and embedding preview links in bibliographic records will be revisited. This is perceived as an important piece of work that will improve the Library Catalogue search experience and promote cartographic and geospatial resources in particular. This development will also see an implementation of a direct link to the GeoDataHub from the Library's landing page.

The project concerning refocusing and optimisation of physical collection of maps will continue until September 2019. Completing cataloguing of New Zealand maps and charts, and undertaking cataloguing of South Pacific and Antarctic material becomes a priority. This work will be complemented by the assessment and consolidation of the historic aerial photography print collection held by the Library, including recently acquired material. Another area requiring attention is the Library's atlas collection, which in many cases is dated and needs updating.

Contribution by Igor Drecki

State of Cartography in New Zealand

*This summary was written from the concluding remarks of the **State of New Zealand Cartography** seminar organised by the New Zealand Cartographic Society on 28 June 2019 in Wellington (see page 5). This publication serves as the extended Proceedings of the seminar, hence the inclusion of the following statement.*

There has been a continuation of high effort and high profile cartographic and geovisualisation activity in a comprehensive range of sectors in New Zealand. These include national societies, all levels of government, map libraries, universities, research institutes, defence institutes and commercial perspectives. This summary attempts to draw some notable trends and commonalities from all these sectors.

There is a diversity of cartographic activity in New Zealand beyond the nature of projects in the various sectors listed above. Nowhere is this more apparent than in the scale of activity, from local, through national to international. Societal coverage is another diversity trend of note, with projects spanning all ages, ethnicities and socioeconomic statuses.

These activities have a strong foundation of numerous relationships and collaborations across all sectors. There is a strengthening inter-society link between New Zealand Cartographic Society (NZCS) (Igor Drecki, Roger Smith) and Australian and New Zealand Map Society (ANZMapS) (Martin Woods), cemented by the recent Memorandum of Understanding. This is remembering that ANZMapS itself forged many links between isolated map experts across Australia. Nationally, the Land Information New Zealand (LINZ) Partnership Programme represents a data-based network to numerous local government institutions, as well as lots of others (Roger Carman). The Wellington company Critchlow (Andrew Smith), cited their LINZ partnership underpinning their National Map online interface. This is not to ignore the multi-faceted and long-standing coordination with the ICA, Manaaki Whenua Landcare Research and GNS Science involvement with the Open Geospatial Consortium, and industry-research collaboration examples (such as the usability testing of Manaaki Whenua's Land Cover Data Base with Amy Griffin of RMIT University, Melbourne). It follows that the cartographic community in New Zealand is always open to contribution and suggestion, as well as collaboration.

Powering these connections are important conferences, workshops and seminars such as this one. They are central and are focal points for both of the aforementioned societies, forging new relationships and strengthening existing ones. An essential complement to these events are publications that record these cartographic activities and also document critical historical, technological, scientific and artistic topics of interest to the New Zealand geospatial community.

A commonly recurring theme is the **central role for spatial data and how it is the fuel for cartography**. Similar analogies communicating the vitality of data abound, how it is the oxygen on which GIS lives or to borrow Statistics New Zealand's vision (Karl Majorhazi), part of the "locational spine" underpinning management of environmental, societal and economic resources. The national mapping agency LINZ is central to this, with their enlightened policy on national spatial data provision freeing up widespread map creation in New Zealand. Example datasets include national imagery, ongoing LiDAR coverage and value added data for features such as roads, buildings, rivers and tracks. This database is augmented by valuable contributions from other sources, such as Statistics New Zealand census data and deprivation data from Daniel Exeter in the University of Auckland.

Collectively, **there is a huge effort to digitise data from the past**, so the efforts are not purely on current data. This is mainly the initiative of national libraries (John Sullivan @ Alexander Turnbull; Martin Woods @ National Library of Australia), other map libraries (e.g. Igor Drecki @ University of Auckland) and research institutes (James Barringer @ Manaaki Whenua; Belinda Smyth Lyttle @ GNS Science). The digitisation is happening to different degrees, from metadata and thumbnails level documentation, to full georeferenced scans available to be browsed through

web portals. Martin gave a cautionary note, which is to maintain the map expert personnel in map libraries, archives and repositories, as their job positions are under threat.

Data is now often collected and made available in very complex and voluminous forms and is regularly the single biggest task in the mapmaking process. Complexity challenges addressed includes some that have been faced by cartographers and GIScientists for decades. Karl and Daniel made an account of their innovative efforts to overcome the limitations and assumptions of the choropleth map when reporting human-based phenomena (census, health). Manaaki Whenua (James) and National Institute for Water and Atmospheric Research (NIWA) (Arne Pallentin) are wrangling with large datasets in the background of their map products, with NIWA in particular facing the formidable SeaBed 2030 target.

If data is a large part of the ‘locational spine’ infrastructure then cartography is a prominent component of this too (a ‘cartographic spine’). There are many examples of this, from Karl’s and Daniel’s mission to capture and map highly ‘volatile’ domains, to stepping outside of the traditional cartographic toolbox (e.g. Andrew Douglas-Clifford’s light experiments with Blender). Exploratory tools to capture dynamic data were featured, including visual analytics (Daniel again), non-spatial ‘dashboards’ and interactive online maps (Karl again). Static map efforts also included a diversity of ‘visual candy’: abstracted space-time trajectory diagrams, ‘JoyPlot’ style maps (Todd Redpath), space-time cubes, cartograms, ringmaps, small multiples, bivariate maps and hex binning (Karl and Daniel yet again!).

There is an increasing realisation, with evidence, of the map’s ability to carry stories and narratives. Esri’s Story Map interface featured a few times throughout the day (Manaaki Whenua, NIWA) as an explicit example of this. Visual narratives can also be placed into the map in comic strip or photo strip form (Antoni Moore). Use of art in this manner is an important storytelling mechanism but the nature of ‘artistic’ expression is shifting to creative programming efforts behind the scenes, proposed Aaron Napier (GEOINT New Zealand). But through Daniel Exeter’s deprivation tale in the style of a weather forecast, maps are just superb props for the grand storytelling tradition.

Ultimately, New Zealand has produced a lot of fine, fine map products in the last four years. Some have been highlighted already (Arne, Belinda, James, Andrew Douglas-Clifford, Todd, Daniel, Karl) but we also have the rich, world-class topographic and mountain maps of Roger Smith (one of which adorns this publication) and Geoff Aitken. Another trend of note is the critical and timely maps produced for the military (Aaron). But I would like to single out Andrew Douglas-Clifford for his imaginative experimentation with what a map can do. He and Roger are also at the forefront of cartography making for the mainstream, through national media (Andrew) and high profile international projects (Roger).

In summary, the State of Cartography in New Zealand is very healthy. In the style of Daniel’s weather forecast, “the outlook is fine!”

Thanks for all the goodies!

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This is the 2015-2019 National Report to the International Cartographic Association (ICA) on cartographic and geovisualisation activity in a comprehensive range of sectors in New Zealand. These sectors include national societies, all levels of government, defence, research institutes, universities, commercial, non-profit, libraries and museums perspectives.

The report's contents reflect the diversity, connectedness and impact of the New Zealand cartographic community and its mapping efforts. These endeavours reveal an enlightened spatial data policy, a strong effort to capture cartographic heritage, successful control of the complex data we encounter, an eclectic, experimental and story-driven approach to cartography, and of course, high quality maps.

CartoPRESS is the New Zealand Cartographic Society's publication initiative, which aims to promote the discipline of cartography and New Zealand's cartographic and mapping heritage.

