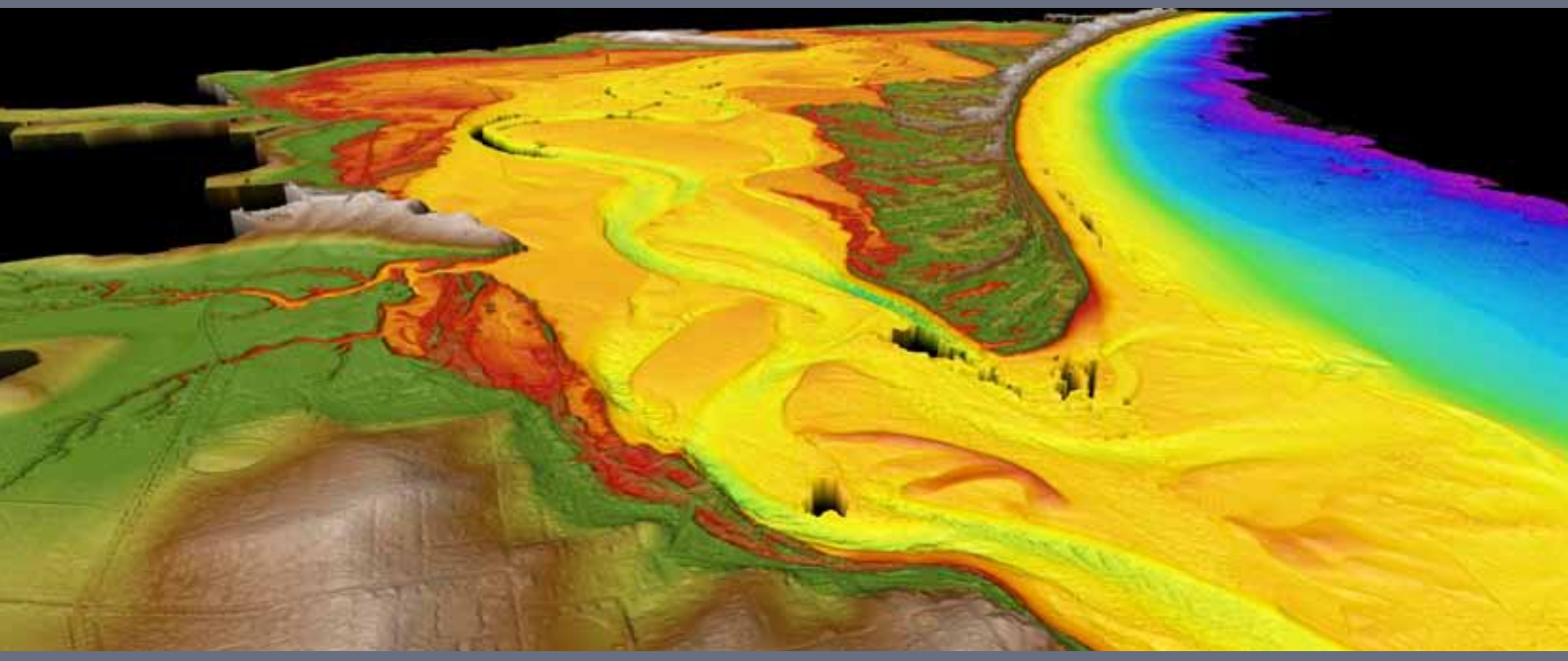
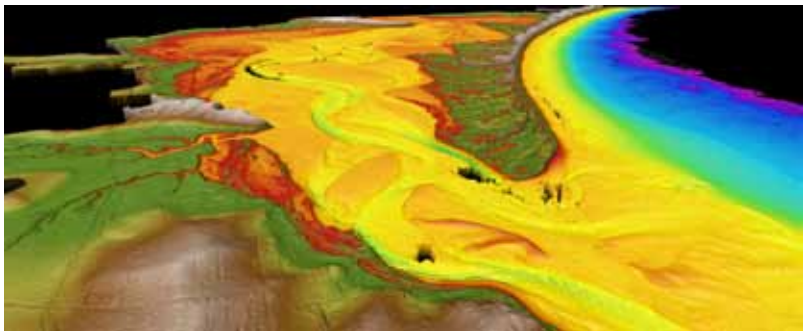
ANNUAL REPORT 2010-11

COOPERATIVE RESEARCH CENTRE FOR SPATIAL INFORMATION





CRCSI acknowledges The Department of Sustainability and Environment, Victoria, through the Future Coasts program, for providing the topographic and bathymetric digital elevation data used to develop the front cover image.

CONTENTS

Overview

At a glance 2

Project Snapshots 3

Executive Summary 4

Strategic Plan 5

Governance and Management 6

Projects

National Data Grid Project 10

Geovisualisation of Health Data 12

International Forest Carbon Initiative (IFCI) 14

Urban Digital Elevation Modelling (UDEM) 16

Biomass Business 18

Flight Assist System (FAS) Demonstrator 20

Financials 22

CRCSI People and Projects

CRCSI Projects 24

CRCSI Management 27

CRCSI Program Boards 29

CRCSI Participants

Essential Participants 31

Support Participants 32

43PL Companies 33

AT A GLANCE...

IN BRIEF

ORGANISATION

Total Staff	56
Locations	16
Total Budget 2010-11	$7.9m

RESEARCH AND OUTPUTS

Ongoing Research Projects	20
Annual Publications in 2010-11	53

PARTNERSHIPS AND INTERNATIONAL

Domestic Partnerships	70
International Partnerships	8
Total Partners	78

EDUCATION & OUTREACH

Supervised Postgraduate students	32
Annual Conference Participants	295

- CRCSI stands for Cooperative Research Centre for Spatial Information.
- The CRC for Spatial Information is a joint venture of government, academic and private sector organisations.
- The CRCSI undertakes user led research involving spatial technologies to solve complex problems of national significance for Australia and New Zealand.
- The overall goal is to accelerate the spatial enablement of the two nations.
- We were established in 2003 under the Australian Governments CRC Program
- The spatial information industry is one of the fastest growing in the world.
- The spatial information sciences include positioning (GPS and other Global Navigation Satellite Systems), remote sensing from satellites and aircraft, and geographic information systems analyses.

- Our 78 partners include federal and state government agencies, universities, companies and overseas research organisations.
- There are two categories of partners: Essential Participants and Supporting Participants. Essential participants make substantial cash and inkind contributions. All participants are organisations, not individuals, and all have equity in the CRCSI.
- The CRCSI has established a unit trust called 43pl through which our partnering companies are able to join the CRCSI as an Essential partner.
- CRCSI has committed projected resources (cash and in-kind) of $160m (and growing) over the period 2010-2018.
- 80 per cent of our total expenditure was directed to the Research program in 2010/11. This is expected to increase to 89 per cent in 2011-12. The remainder goes on business development, the education program and administration.
- Our research will lead to major innovation and productivity advances in key industry sectors:
  - agriculture, natural resources and climate change
  - defence and security
  - energy and utilities
  - health
  - sustainable planning for urban development
- Our values state that we will be collaborative in our relationships, create excellence in our research, and be transformational in our impact.

PROJECT SNAPSHOTS

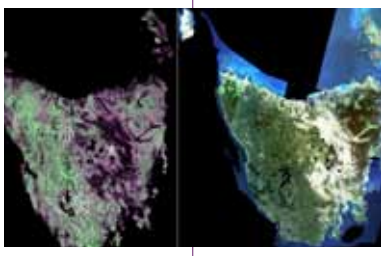
The CRCSI has 14 projects under various stages of development with many more to come. The project snapshots describe the research achievements of the most significant of these projects with comprehensive summaries beginning on page 10. A full list of projects is given on page 24.

The National Data Grid

The NDG has demonstrated an innovative infrastructure for the management of the grid cell data as a component of the Australian Spatial Data Infrastructure. The benefits of this National Data Grid infrastructure have resulted in significant cost savings and efficiency gains in state-wide and national grid cell data infrastructures. 10

Geovisualisation of Health Data

The project focuses on new spatial web technologies capable of integrating map products, modelling output and providing an 'intelligent' interpretation of results. It aims to build new privacy protection processes that allow the use of raw spatially related health data to be used by an increasing number of end-users. 12

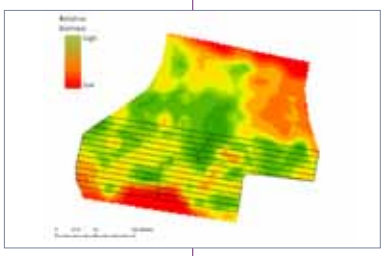


International Forest Carbon Initiative (IFCI)

Australia is a leader in national carbon accounting systems and an influential participant in international forums that address carbon accounting, emissions trading, and other aspects of climate change. This project established Tasmania as an international climate change demonstrator area. 14

Urban Digital Elevation Modelling (UDEM)

The National Elevation Data Framework Portal has been implemented to provide easy web access to a wide range of digital elevation data and derived products in response to the growing demand for better information on the risks to infrastructure, communities and natural systems from climate change. 16



Biomass Business

This research is examining the inextricable link between increasing agricultural productivity and the need to secure landscape diversity and health. The project seeks to develop, evaluate and integrate new knowledge, measurement and interpretation protocols and access systems. 18

Flight Assist System (FAS) Demonstrator

Ergon Energy launched a strategic initiative to create precise, 3D geospatial representations of powerline assets and to capture and evaluate information about their entire 150,000 km power network. To acquire this information a precision navigation system and an efficient route planning capability have been developed. 20

EXECUTIVE SUMMARY

The CRCSI is an unincorporated joint venture operating under the Cooperative Research Centre Program of the Australian Commonwealth Government. The purpose of the Program is to build critical mass in research ventures between end-users and researchers tackling clearly articulated, major challenges for the end-users. The 78 partners from government, private and research sectors have agreed to provide $185m (cash and in-kind).

The CRCSI started its second term of eight and half years on 1 January 2010 following a successful extension bid in Round 11 of the CRC Program. The period January to June 2010 saw the transition from the first term of the CRCSI ("CRCSI-1 from 2003 - 2009") to "CRCSI-2". This period involved the sign up of 78 partnering organisations, the establishment of the new Board, formation of a new management structure, completion of strategic and operational plans and establishment of the new research program. We were very fortunate to receive strong support from our partners during the demanding set up phase, and more partners are anticipated.

Our partners have been formed into three 'Colleges': Government (agencies); Research and Education (mainly universities); and industry (companies).The Colleges operate independently of each other and help represent the views of their respective members especially in the formation of policy, the development of strategy, nominations of candidate directors to the Board and the admittance of new partners.

For each of the three Research Programs and five Applications Programs, Boards have been established, Chaired in each case by a senior end-user to ensure that the research projects and their outputs are strongly end-user driven.

A significant number of new partners have been brought into the CRCSI over the past 18 months. The inclusion of New Zealand as a major partner sees the creation of a strong bilateral international partnership through the New Zealand lead government agency Land Information New Zealand. The University of Canterbury became New Zealand's first full Essential Participant. Four New Zealand companies also became members of 43pl.

With this solid foundation, the next year will continue the commitment to high quality collaborative research in the spatial industry through a suite of research activities addressing the CRCSI's strategic objectives with a new crop of PhD candidates and researchers.

Finally, every partner will complete a Partner Engagement Plan that sets out their expectations. These are used to monitor the performance of the CRCSI and to refine the Strategic Plan and the Annual Business Plan.

Peter Woodgate, Chief Executive Officer, CRCSI

STRATEGIC PLAN

By 2018 the CRCSI will be recognised world-wide for the high impact of our research, especially in the enabling role we played in creating a single, multi-GNSS network in Australia, and adding value to the development of the Australia-New Zealand Spatial Marketplace. A thriving spatial industry will acknowledge the central role of the CRCSI. We will be considered an essential partner for complex spatial information research collaborations both locally and internationally. Spatial education will be improved as a result of the CRCSI's activities, significantly enhanced by 50 or more new CRCSI PhD's. The transition of the CRCSI from the CRC Program to a permanent entity will be complete.

Our strategic objectives

Objective 1 - Positioning

To conduct research that solves the signal processing and economic impediments to the creation of a sparse, continental-scale, precise positioning multi-GNSS network operating at 2 cm (x and y) accuracies anywhere outdoors.

This objective supports the objective of the Australian federal, state and territory governments to achieve a new National Positioning Infrastructure (NPI) involving many hundreds of base station receivers across Australia and New Zealand. The CRCSI will develop a new theory for the estimation and validation of the integer ambiguities across multiple frequencies and multiple satellite systems. The research requires the cooperation of all six nations that operate GPS and GPS-like systems (the US, China, Japan, Russia, the European Union and India), all government jurisdictions in Australia and the harnessing of the collective research capability of most of Australia and New Zealand's geodetic research community and a number of leading overseas research institutions.

Objective 2 – Feature Extraction

To develop our research capability to enable ourselves and our partners to become Australia's leading centres for automated processing of information from terrestrial, airborne and satellite platforms and from existing data sources.

This objective recognises the current explosive growth in remote sensing from space, aerial and terrestrial platforms for a host of public and private sector earth observation activities, from environmental monitoring through to infrastructure asset management and mapping. A principal impediment to the wider application of image- and range-based remote sensing technologies is data-to-information product

Our Values

We will be collaborative by nature in our relationships, strive for excellence in our research, and always aim to be transformational in our impact.

conversion, which remains a manually intensive or at best semi-automated operation. The research aims to enhance sensor-to-user data processing and to advance the state of the art in automated spatial information generation through new developments in feature extraction. New mathematical models and algorithms for the 3D image concept for both the fusion of imagery and laser ranging data, and the extraction of geometric and semantic features from the resulting 3D Image are early critical aims. Partners include federal and state spatial information agencies, 43pl companies, four member universities and international research collaborators in China, Germany and Japan. Research outcomes will contribute to improving the capabilities and competitiveness of the Australian remote sensing, mapping and GIS industries.

Objective 3 Spatial Infrastructure

The CRCSI seeks to identify and solve the research issues that will enable the operators of the Australia and New Zealand Spatial Marketplace to construct the infrastructure, operate the Marketplace and enable the creation of value-added applications with new technologies for the many thousands of spatial data sets that exist across the two nations. This aims to be the largest and most extensive marketplace of its kind in the world. The Marketplace requires the cooperation of the federal, state and territory governments of Australia and the national government of New Zealand.

Objective 4 - Applications

Applications include the realisation of high impact use of the CRCSI's research in the following areas:

- Agriculture and Natural Resources affected by Climate Change (4.1) through the creation of a biomass and carbon monitoring system for application on farms at sub-paddock scale on a weekly basis, and through improved environmental monitoring;
- Defence (4.2) by adapting the emerging capabilities of CRCSI's research portfolio;
- Energy Utilities (4.3) to enable remote monitoring of the condition of built assets in near real time;
- Health (4.4) by helping agencies to spatially enable their clinical databases; and
- Urban development (4.5) to build new tools, paradigms and theories including agglomeration economy and greyfield regeneration to support sustainable urban development.

Objective 5 - Education

By 2012 the CRCSI will have a plan to improve the skilled capability of the Australian and New Zealand workforce by working with the education providers. As a priority by 2018 the CRCSI will have invested in at least 50 PhD's with our university partners.

Objective 6 - Industry development

To establish a program of assistance for our partners, in particular 43pl, that

helps them find ways to develop and exploit their IP; and to establish an innovation program for 43pl members in particular and the industry generally that enables them to systematically improve the management of their internal innovation and R&D programs. These programs seek to encourage investment in R&D by spatial businesses.

Objective 7 - Commissioned research

Is expected to generate an additional $10m of activity in the CRCSI (from January 2010) tackling complex research needs involving multiple partners from both the public and the private sectors. Initially most of this research will be taken on around the existing core expertise. In time this will grow into new areas of expertise.

Collaboration

Strategic collaboration will be sought where it enhances the effectiveness of the CRCSI. In addition to our Australian and New Zealand partners, the CRCSI will be an active partner in the Global Spatial Network for Networks, the alliance of CRC-like entities from around the world. The CRCSI will continue to grow its relationship with CE-ODE and Wuhan University (China), GEOIDE and TECTERRA (Canada) and with other selected organisations.

Risks

The strategic risks are:

- that other research developments domestically and internationally render the CRCSI's research programs obsolete;
- we fail to retain and nurture a cadre of eminent researchers;
- we fail to attract an adequate cohort of postgraduate candidates;
- we lose our reputation as the leading spatial research institution in Australia and New Zealand;
- we fail to generate sufficient independent funding and support to transition to a self-sustaining entity;
- we fail to continue to meet the expectations of our partners.

Performance Indicators

1. A solution for the impediments of multi-GNSS signal processing and economic arguments for a continent-wide, ubiquitous, sparse, precise positioning network.
2. Wide recognition by our partners of the CRCSI's role in helping establish and value-add to the Australia and New Zealand Spatial Marketplace .
3. An Educational Program that is judged to be transformational by our partners.
4. Demonstrable progress towards becoming a self-sustaining entity by 2018 and development of a transition.

CRCSI Vision

Spatial enabling Australia and New Zealand

The CRCSI will be widely recognised for its high impact, collaborative research that leads to accelerated industry growth, improved social well-being and a more sustainable environment.

GOVERNANCE AND MANAGEMENT

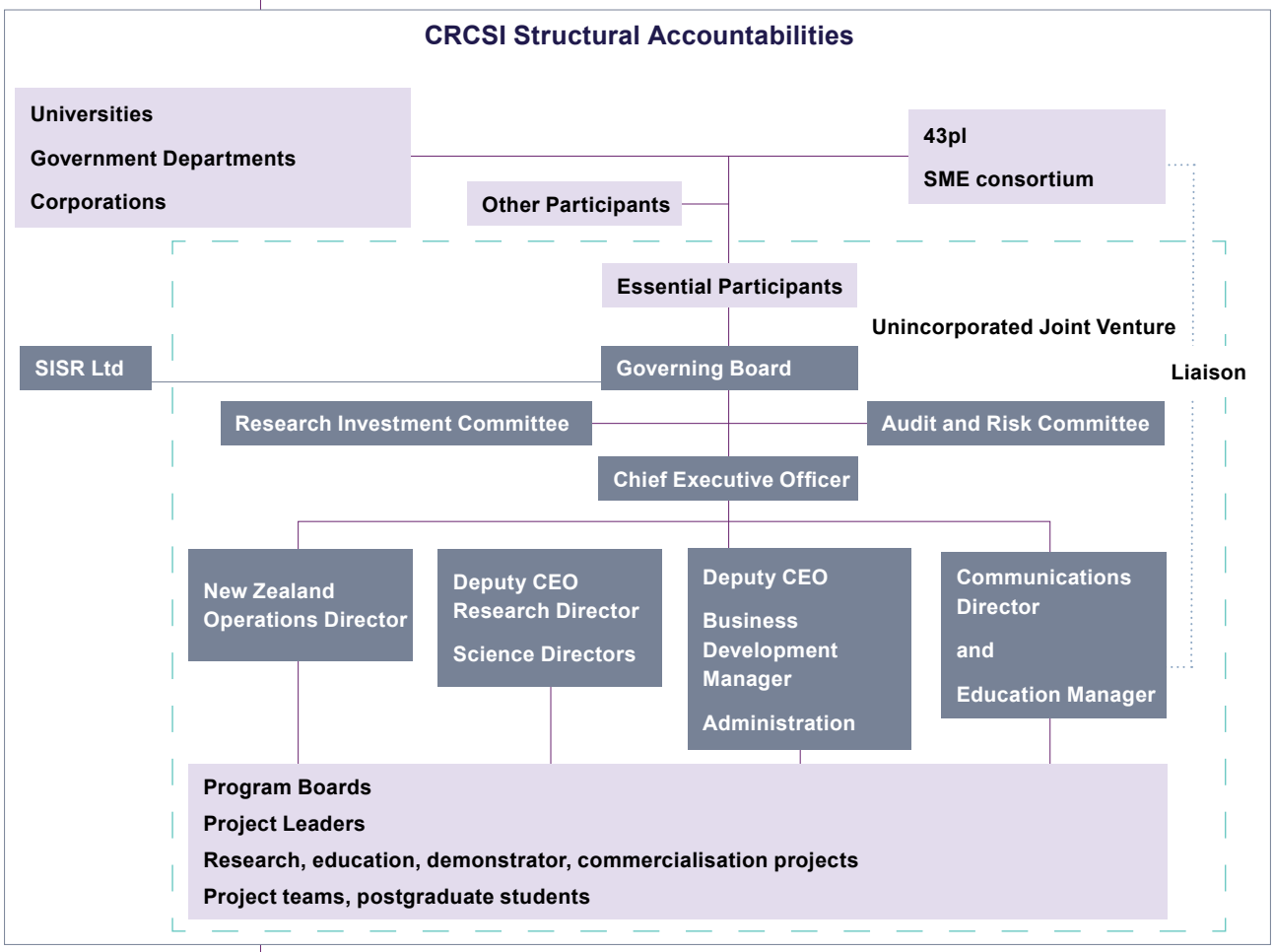
The CRCSI is an unincorporated joint venture (UJV) under the terms and conditions set out in the Commonwealth Agreement and the Essential Participants Agreement. The Centre will be funded from January 2010 to June 2018.

The CRCSI is governed, managed and operated by a single company, Spatial Information Systems Research Limited (SISR) which itself is owned by the UJV. SISR is a company limited by guarantee, which acts as trustee of the CRCSI intellectual property, employs the management staff, undertakes contract research work and otherwise manages the Centre's operations. The Board of the company is also the Board of the CRCSI UJV. Each Essential Participant may be a member of SISR.

At present there are seven Essential Participants who are members of SISR: They are:

- 43pl (43 Pty Ltd, version 2)
- Curtin University of Technology
- Department of Sustainability and Environment, (VIC)

CRCSI Structural Accountabilities



- Land and Property Information, (NSW)) (formerly known as the Land and Property Management Authority)
- Landgate, (WA)
- Queensland University of Technology
- University of New England

There are 78 formal participants in the CRCSI from the government, private and research (university) sectors with a further 10 organisations committed through letters of agreement. They have been formed into three Colleges, one representing each of these three sectors; 43pl (with 56 companies), the Research and Education College (primarily universities), and the Government Agencies College managed by ANZLIC. The Colleges operate independently of each other and help represent the views of their respective members especially in the formation of policy, the development of strategy, nominations of candidate directors to the Board and the admittance of new participants. They also provide a vital mechanism for two-way feedback and communication.

The seven member skills-based Board, appointed after an extensive College-led nomination and selection process, was formed in early 2010 with the non-executive directors appointed for an initial term of one year with provision for renewal.

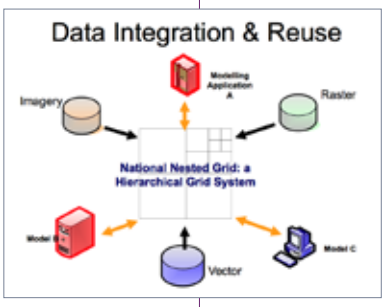
The Board is responsible for the governance and operations of the CRCSI (through SISR Ltd). The Board has adopted formal protocols, detailing its functions and responsibilities. These are reviewed annually. While the Board has overall control of the CRCSI, it has delegated a range of its powers, duties and responsibilities to its committees and executive management team.

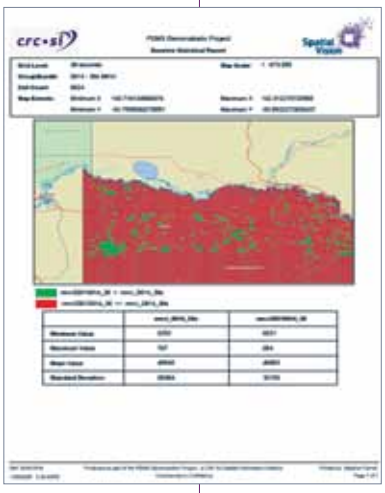
The Board is advised by the Research Investment Committee, the Audit & Risk Committee and the Nominations and Remuneration Committee. A comprehensive suite of governance protocols, policies and guidelines have been implemented.

Management comprises a CEO, Deputy CEO, Research Director, Communications Director, New Zealand Director of Operations and support staff, as well as Science Directors, Program Managers, and Project Leaders. Program Boards, a newly implemented level of management, are program-wide panels tasked with the responsibility of reviewing the strategic direction of the research programs and making recommendations to the CRCSI Board with regard to the continuation, expansion, change in direction or termination of projects in their program. These Boards are chaired by a lead end-user and meet several times a year. Project Management Groups meet quarterly to review each project's progress and future are chaired by a lead end-user.

Top to bottom: CRCSI Directors: Mary O'Kane (Chair), Chief Scientist & Engineer, NSW; Peter Woodgate, Chief Executive Officer, CRCSI; Andrew (Drew) Clarke, Secretary, Dept of Resources, Energy & Tourism; Malcolm McCoy, Managing Director, Vekta (43pl member); Tina McMeckan, Director, Riverview Consulting; Warwick Watkins,CEO, Land & Property Management Authority; Graeme Wright, Acting Deputy Vice Chancellor, Curtin University.

NATIONAL DATA GRID (NDG)





The world has entered the 'Big Data' era. Electronic data is growing at about 40 per cent compound per annum and spatial data is especially volume intensive and expensive to move around. The National Data Grid (NDG) was created in response to these needs and in particular to help modellers who were spending significant resources in terms of finance, time and effort in managing existing spatial data in grid cell (or raster) format.

The NDG has demonstrated an innovative infrastructure for the management of the grid cell data such as the huge national satellite imagery holdings, as a component of the Australian Spatial Data Infrastructure. The benefits of this National Data Grid infrastructure have resulted in significant cost savings and efficiency gains in state-wide and national grid cell data infrastructures in which grid cell data could be generated using common agreed processes and managed in agreed grid standards.

The NDG has delivered:

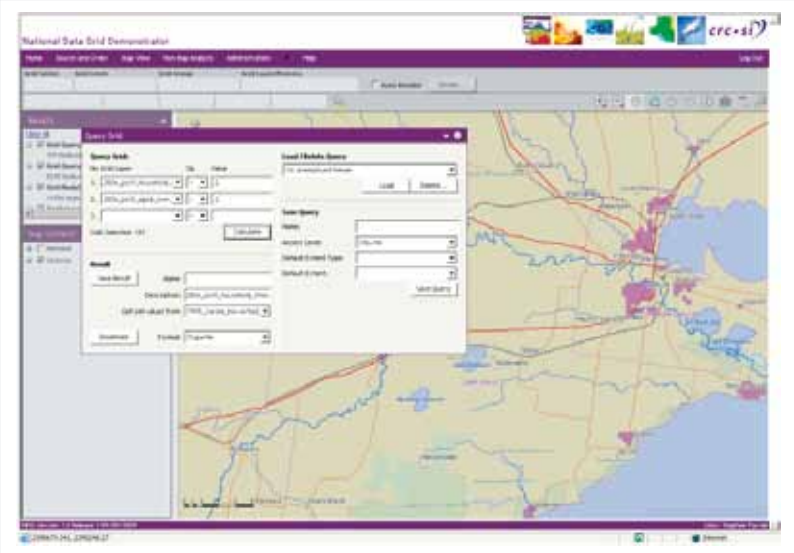
1. An improved system that builds on the technical functions and architecture of the previous demonstrator model and supports operational users in nominated business processes.
2. An extended national and jurisdictional grid data store that provides greater opportunity to demonstrate a more diverse range of scenarios and potential applications.
3. A road map, for managing scalability issues faced, is supported by the development of priority solutions in the form of an exemplar application.

Highlights and Achievements

The NDG Project now seeks to evolve from its success as a demonstrator application to a production system in national and state agencies across Australia.

Following on from the initial success of the NDG Project, Geoscience Australia and Lockheed Martin Australia are leading a consortium of partners, including the CRCSI, to utilise the National Data Grid as part of an innovative satellite workflow processing system to publish data derived from archived and future LANDSAT data. This project is called "Unlocking the Landsat Archive (ULA)" and is funded by the Australian Space Research Program. This partnership will see one of the first implementations of the National Data Grid production system.

To help realise the national benefits of the National Data Grid Project, the partnership gained support for an ANZLIC project to develop an ANZLIC Specification Guide for a national nested grid (NNG). This builds on



the National Nested Grid concept put forward by the NDG Project.

In addition to the ULA Project, the NDG has also been selected to take part in a National Land Account Pilot jointly sponsored by ABS and the Victorian Government. This pilot will trial a process to populate the current National Land Account with real data using Victoria as a test case. The data will be generated by an innovative application called “Environmental Systems Modelling Platform (EnSym)” developed by the Ecomarket Program in the Victorian Department of Sustainability & Environment. An implementation of the NDG will support EnSym in data management and publishing. If successful, the National Land Account Pilot would pave the way for adoption of the NDG as a production system.

The Next Steps

As part of the ongoing promotion of the NDG production system, the Project is committed to its continued engagement with key national stakeholders such as Geoscience Australia, Bureau of Meteorology, Australian Bureau of Statistics, and other national institutions such as CSIRO, the Terrestrial Ecosystem Research Network (TERN), the Australian Urban Research Information Network (AURIN), and other jurisdictional stakeholders.

This engagement involves collaboration as part of the ANZLIC NNG Specification Guide process to establish an agreed National Nested Grid standard and to successfully complete the ULA Project and National Land Account Pilot.

Opposite page top to bottom

Grid cell data integration and reuse facilitated by the adoption of a National Nested Grid

Reporting and visualisation of NDVI data for North-west Victoria

The design of a spatial grid cell data infrastructure for Australia

This page

Efficient query to identify sites that have multiple attributes in the area west of Geelong, Victoria

Images courtesy of DSE (Vic).

GEOVISUALISATION OF HEALTH DATA: HEALTHTRACKS

The Geovisualisation of Health Information project builds upon a previous CRCSI Demonstrator Project which successfully shifted the focus of spatial information in health from 'provision of data' to 'creation of knowledge'. This was achieved by developing web applications that formed the basis of a "Spatial Health Intelligence Platform". This project expands the capability of the platform to a suite of connected, interactive, web-based mapping, spatio-temporal analysis and visualisation tools for health professionals.

The project focuses on new and novel spatial web technologies capable of integrating map products, modelling output and providing an 'intelligent' interpretation of results. It aims to build new privacy protection processes that allow the use of raw spatially related health data to be used by an increasing number of end-users, in both public and private health sectors, who stand to benefit from this CRCSI research and development. The final product will disseminate and translate spatio-temporal health information and analysis results to end-users, allowing them to discover gaps in health service delivery and identify populations of greatest health risk. It will also improve communication of these identified gaps and risks to program leaders, decision makers and health researchers for making informed and evidence-based decisions.

Highlights and Achievements

Traditionally Geographical Information Systems have been used to display

the outputs of health research and analysis using desktop software. With small numbers of skilled staff and minimal resources, wide spread adoption of spatial information in health has been limited. With the advent of publicly available web-mapping capabilities including 3D representations the public, researcher and health professionals now have an expectation of timely map-based information delivered via the web.

The Demonstrator Project built two separate applications: a spatial module called HealthTracks: Mapping for mapping health and demographic information, and an epidemiology reporting tool HealthTracks: Reporting for creating population health profiles and summary health statistics in a report format. HealthTracks has decreased the time that it takes to extract summary tables, charts and maps of population-level health statistics from two months to 20 minutes. These applications have been successfully released within the Department of Health WA and are now accessed regularly by over 150 users, including epidemiologists, data analysts and research officers. They have also been used by DoHWA to quickly respond to urgent needs of external users.

The project has been running since January 2010 and work so far has been devoted to the investigation of visualisation and privacy techniques to build server-sided tools for wide ranging analysis of health and ancillary data. Both proprietary and open source tools have been investigated and an architecture is being developed to give flexibility in the choice of server-sided tools.

The new project extends two previous tools; HealthTracks: Mapping and HealthTracks: Reporting. To date, a better interface, improved code and robustness, improved privacy rules, improved access to data, and the ability to log fine grained information from users have been incorporated. This went live in June 2011 and analysis of reporting logs is being examined to determine the popularity of different datasets and whether restrictions have been applied to the results to protect patient confidentiality. This information will be used to inform the development of HealthTracks: Reporting v2.

The Next Steps

Involve:

- **Finalising the new architecture for HealthTracks: Reporting v2 and develop new system functionality.**
- **Investigating visualisation tools for implementation.**
- **Exploring privacy methods to allow visualisation using raw data while safeguarding patient confidentiality.**

Opposite page top to bottom.

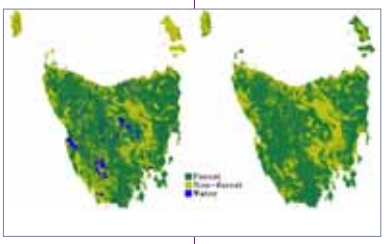
Health Tracks in use

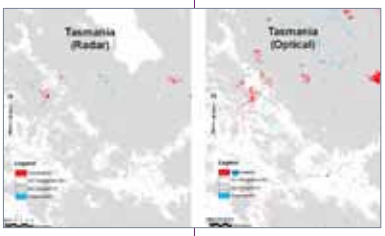
Example of reporting screen for Health Tracks Reporting tool.

Health Tracks Mapping visualisation tool.

Images courtesy of Curtin University.

INTERNATIONAL FOREST CARBON INITIATIVE (IFCI)





Belief in human-induced climate change has increased to the point where it is generally accepted as fact. Critical to virtually all aspects of climate change is an ability for each nation to obtain internationally accepted estimates of the amount of carbon held (or "sequestered") in its forests and trees.

Australia is a leader in national carbon accounting systems and an influential participant in international forums that address carbon accounting, emissions trading, and other aspects of climate change. As part of these efforts, Australia is investing in research that will allow the principles of its National Carbon Accounting System (NCAS) to be extended to other countries with an emphasis on developing countries.

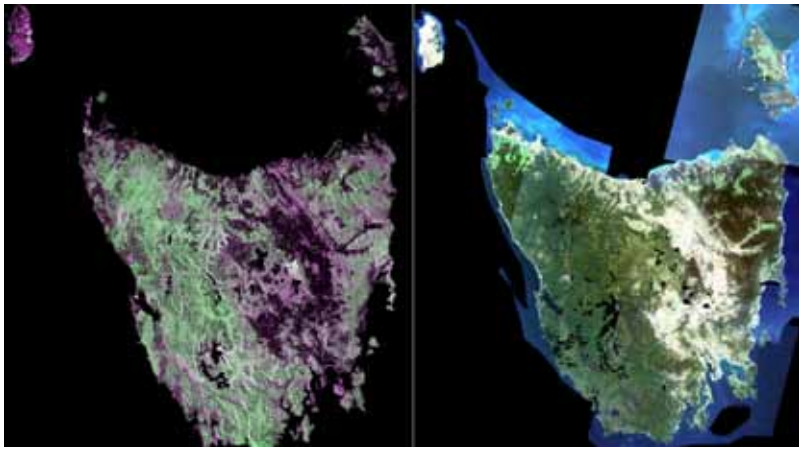
This project established Tasmania as an international climate change demonstrator area within the context of the Group on Earth Observations Forest Carbon Tracking (GEO-FCT) task. Funded by the Australian Federal Department of Climate Change and Energy Efficiency (DCCEE), the project links experts from the CRCSI and CSIRO in a task-oriented research alliance.

The project:

1. Evaluated the interchangeability of various types of satellite imagery (ALOS, PALSAR, RADARSAT, Landsat TM) for use in national carbon accounting systems.
2. Established statistically robust techniques to quantitatively describe the strengths and weaknesses of national estimates of forest area.
3. Supported the transfer of NCAS remote sensing principles internationally by providing training in image analysis and classification evaluation

Highlights and Achievements

Image processing research focussed on analysing optical and radar imagery



to produce forest/non-forest maps over time. Thematic Mapper (TM) imagery was the focus of the optical work and radar research concentrated on L-band imagery obtained from the Japanese satellite PALSAR.

Tasmania-wide forest/non-forest classifications for 2007-2009 were produced from L-band radar imagery and compared to 2007- 2009 classifications produced from the optical imagery. Forest/non-forest classifications were also compared against a constantly updated photo-interpretation-based map known as "TasVeg" that is produced by the State Government of Tasmania. These comparisons showed that maps derived from optical imagery indicate the highest amount of forest area and TasVeg indicated the least.

The optical- and radar-derived forest/non-forest classifications show major differences at local and statewide scales; this is true for both single date and multi-temporal maps of deforestation and forest regeneration. This suggests that carbon accounting systems based on optical imagery will have difficulty using radar imagery and vice versa.

Research on quantitative metrics to describe differences in images has focussed on two types of image products — single date and multi-temporal landcover change maps. The goal of these metrics is to summarize differences between an image-derived forest/non-forest map and "verification data" that are assumed to be of higher quality. A suite of area-based measures has been developed that assesses differences at a local and statewide level using an optimal sample size.

The project conducted two training courses to improve capacity to calibrate and/or classify images for forest/non-forest maps for carbon accounting systems.

In addition to scientific research, personnel have maintained important linkages internationally. It is planned that eventually there will be at least 10 international demonstrators across countries as diverse as Mexico, Guyana, Borneo, Sumatra, and Australia. Tasmania is the most advanced of the planned demonstrators to date. The project produced the GEO-FCT core document on principles of evaluation for image derived single date forest/non-forest maps and multi-temporal landcover change maps.

The Next Steps

Though originally due to finish in June 2011, the research project has been extended for one year to June 2012. During this time, further work will be undertaken on image/radar processing and evaluation metrics for image classifications.

The goal of the image/radar processing work is to find ways to increase the agreement of forest/non-forest maps derived from optical and radar imagery. In addition, the radar work will be expanded beyond its original L-band focus due to the failure of the PALSAR satellite in early 2011.

The research on evaluation metrics will include an assessment of the utility of different types of data to produce meaningful regional and statewide statements of the quality of image-derived single date forest/non-forest maps and multi-temporal landcover change maps.

Opposite page top to bottom:

2009 images of Tasmania – L-band radar (left) and Thematic Mapper (right).

2009 forest/non-forest maps derived from L-band radar (left) and Thematic Mapper (right) images.

Comparisons of landcover change maps derived from radar (left) and optical Thematic Mapper (right) data.

Research Alliance personnel collecting field information in Tasmania.

Vegetative types and field trips.

URBAN DIGITAL ELEVATION MODELLING (UDEM)

About 85 per cent of Australia's population live within 50 kilometres of the coast. Due to this concentration of our population, and also of our natural and built assets in the coastal zone, Australia is highly vulnerable to the predicted impacts of climate change on the coast.

Governments at all levels are increasingly concerned about the risks and costs associated with potential damage to housing, infrastructure and natural ecosystems in vulnerable coastal areas. There is a growing demand from decision-makers, particularly in local government but also in the planning, engineering and construction professions for better information to assess the risks to infrastructure, communities and natural systems from coastal inundation and other impacts as a result of projected climate change.

A key impediment to such an assessment has been the absence of high-resolution elevation data that enables government to effectively assess climate change risks and adequately inform adaptation efforts and investment decisions. The Australian Federal Department of Climate Change and Energy Efficiency commissioned the Urban Digital Elevation Modelling in High Priority Regions (UDEM) project to acquire very high resolution (15 cm vertical resolution) ground surface topography data to provide a spatial assessment of the possible impact of inundation due to climate change.

Highlights and Achievements

Priority urban coastal regions were mapped for Perth, Melbourne, Sydney, NSW Central Coast, Adelaide, Brisbane, Gold Coast and Darwin. Over 20,000 km^2 of elevation data were acquired and data licensing was negotiated to ensure ongoing access across all levels of government for non-commercial public good use.

High resolution digital elevation models (DEMs) were developed and hydrologically conditioned to accu-

rately represent water flow across the land surface. Inundation layers were developed for each region and these inundation layers provided key inputs into two further products:

1 A web-based sea level rise visualisation tool, which allows government users to display the inundation layers over an aerial map of the region.

2 A series of static sea level rise maps that identify low-lying areas that are vulnerable to the impacts of climate change (available at www.ozcoasts.org.au/climate/sd_visual.jsp).

The National Elevation Data Framework (NEDF) Portal has been implemented to provide easy web access to a wide range of digital elevation data and derived products for government and public good use. The NEDF Portal (nedf.ga.gov.au) is being hosted by Geoscience Australia as an important part of the ongoing development of the NEDF.

The Minister for Climate Change and Energy Efficiency, The Hon Greg Combet AM MP released several of the products publicly in December 2010 and said; “The Government recognises that coastal areas of Australia are a priority for adaptation action, with many communities vulnerable to impacts such as erosion and sea inundation. Developed in partnership with the CRCSI, these maps are an important product for the community to understand potential risks to infrastructure and properties and to prepare for the climate change impacts of sea level rises”. “The maps provide useful initial information to decision-makers to prepare for potential risks from rising sea levels in coastal areas.”

Research projects have commenced to answer the following questions:

Research projects have commenced to answer the following questions:-

1. How well do different technology derived DEMs perform in a range of coastal environments? What is the distribution of their respective vertical errors?
2. What are the user needs for differing resolution DEMs and what is the optimal process for developing DEMs of differing resolutions?
3. What is the best method to integrate land-based (topographic) DEMs with near shore bathymetric DEMs?
4. How useful is the near shore DEM derived from bathymetric LiDAR to modellers and what are the alternatives for collection of near shore bathymetry to meet the defined needs?

The Next Steps

The next steps for the UDEM project are: further data acquisition over priority areas, including hydrological conditioning of acquired data in selected areas, expansion of the NEDF Portal capabilities, and enhancement of the visualisation tool.

Opposite page top to bottom
Minister for Climate Change and Energy Efficiency the Hon Greg Combet AM MP at the launch of the Digital Elevation Mapping work in Newcastle.

Minister for Climate Chamge and Energy Efficiency the Hon Greg Combet AM MP second from left with Professor Bruce Thom AM, Dr Peter Woodgate CEO CRCSI and Dr Andrew Ash CSIRO in Newcastle at the launch of the products of the first phase of the DEM work.

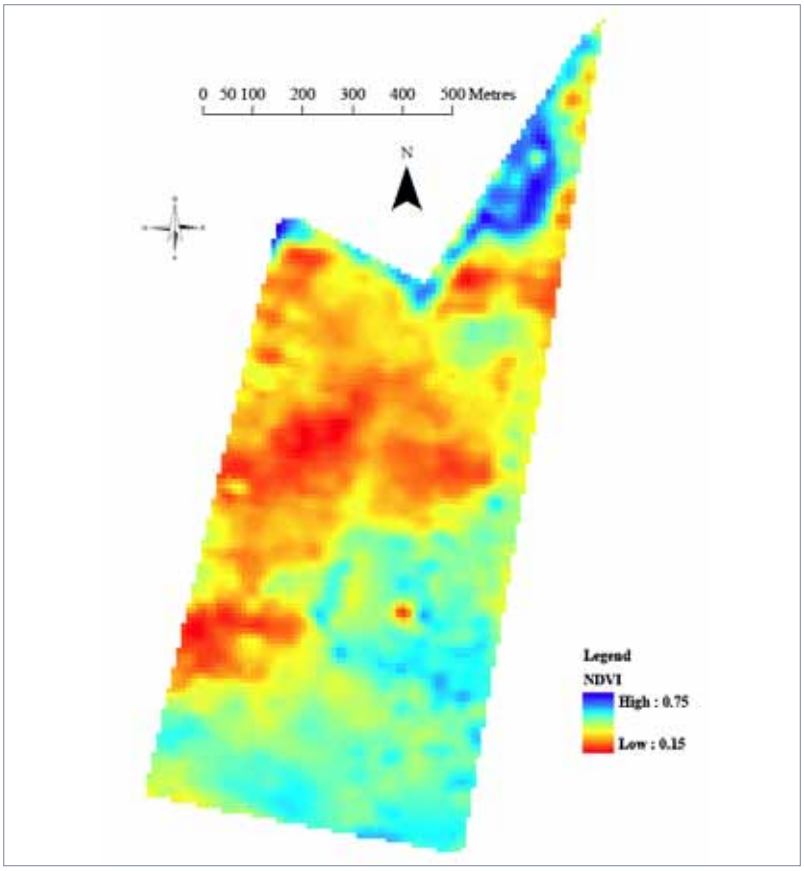
Images courtesy of the AuStralian Federal Department of Climate Change and Energy Efficiency.

BIOMASS BUSINESS

The project commenced in July 2010 and seeks to develop, evaluate and integrate new knowledge, measurement and interpretation protocols and access systems based on field-scale, quantitative measurement and mapping of biomass in its many forms (including animals). The research is covering the inextricable link between increasing agricultural productivity and the need to secure landscape diversity and health.

Under three distinct, yet interwoven themes the project sets out to:

1. Formulate enterprise-relevant, spatially enabled measures of water and fertilizer use efficiency in crop and animal production, including plant canopy-based indicators of fertility status and biomass, and develop/refine sensors and protocols necessary to acquire these measurements.
2. Create large and small scale, spatially enabled, measurement and interpretation protocols, and a knowledge/data access system, for managing stocking rate on monoculture and composite grazing lands (including rangelands)



based on measures of pasture growth and availability, as well as time-based growth and grazing demand models.

3. Explore and establish techniques for data acquisition and fusion to describe vegetative carbon and biomass across entire production enterprises ('farmscapes'), including the development of high-definition inventory measurement and interpretation protocols for carbon and biomass on farms at sub-paddock scale.

Highlights and Achievements

> Sundown Pastoral Company, Twynam Agriculture, Superair and University of New England completed the 'Raptor' airborne sensor trial at 'Collymongle'. The Raptor is attached underneath a low-flying aircraft and enables rapid scanning of crop biomass over entire paddocks. This "active system" works by directing rapid pulses of red and near-infrared light onto the crop plants and measuring the light reflected back to the aircraft. The Raptor system was developed to address key limitations in the traditional methods of using satellite or aerial imagery to map crop vigour. The sensor can be easily retrofitted to any standard crop duster or agricultural spray plane, so that crop scans can be carried out when spraying or fertiliser applications are being done.

> University of New England and Sundown Pastoral Company are working to link spatial livestock tracking technologies to grazing behaviour and pasture availability. The Biomass Business project evaluated a system to model grazing behaviour with the aim of developing an alert system used to enable producers to know when to rotate those animals onto another site. These systems hold great potential to increase the productivity, efficiency and sustainability of grazing systems, and the project has observed some interesting trends in livestock movements, overlaid with maps for soil moisture, biomass and grazing preference.

> Curtin University, Landgate and Milne AgriGroup have embarked on an ambitious project to MODIS satellite imagery to ascertain available grazing biomass level at the end of the wet season over enormous tracts of rangeland country in northern WA. The proposed 'Rangelands Watch' tool, currently being calibrated over the 260,000 Ha Liveringa Station (approximately equal in size to the ACT) in the Kimberly region of WA is aimed at assisting pastoralists set stocking rates during their once-a-year muster.

Opposite page top to bottom
Plane (carrying the Raptor sensor mounted underneath its belly), flying one of its many transects over the cane at 50 m above the canopy.
A Raptor-generated map of relative biomass (wheat crop).

Images courtesy of the University of New England.

The Next Steps

Include:

> **Detailed field sampling and data analysis of Biomass/ Carbon assessment sites.**

> **Continued development of Forage Assessment Tool Calculating Head On Pasture algorithm and wet-season field sampling and calibration as well as major water use efficiency trials.**

> **Continued data analysis of livestock tracking and grazing trial and field-testing of new optical reflectance and ranging sensor.**

FLIGHT ASSIST SYSTEM (FAS) DEMONSTRATOR

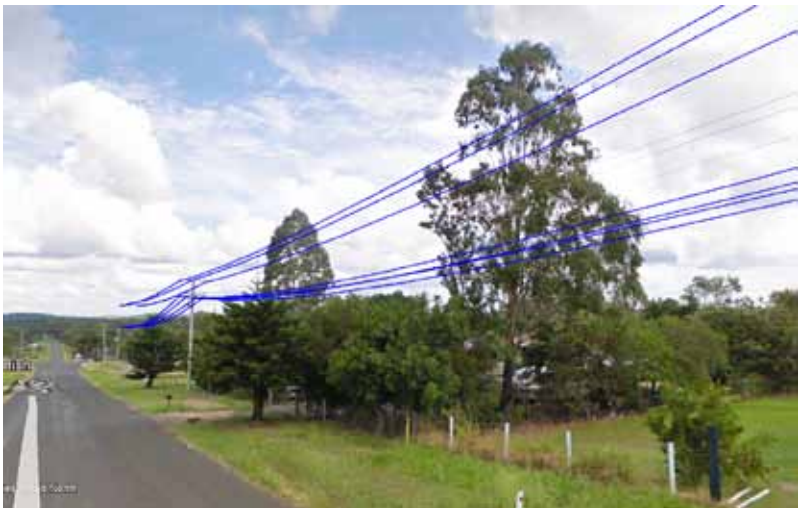
Ergon Energy, a major partner of the CRCSI, launched a strategic initiative called the ROAMES program (Remote Observation Automated Modelling Economic Simulation). ROAMES is deploying aerial surveillance and remote sensing technology, to create precise 3D geospatial models of electricity infrastructure and the environment for Ergon's entire 150,000km of electricity network, using the information to make better business decisions. To acquire this information a precision navigation system and an efficient route planning capability have been developed.

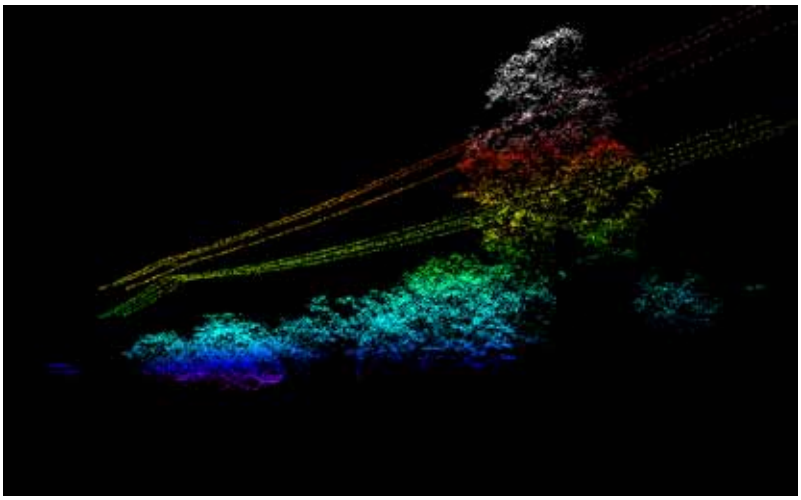
Highlights and Achievements

As a vegetation and asset management tool, ROAMES is a fundamental part of Ergon Energy's core business. It will lead to reduced costs, as well as increased safety and reliability of electricity supply. The sheer size of Ergon Energy's distribution area, which covers 97 per cent of Queensland (over 1.5m square kms) and 150,000 kilometres of network, was an important motivation for finding smarter ways of managing the assets and the surrounding environment. Two ROAMES aircraft have been unveiled to date. During a visit to Seabird Aviation the Queensland Minister for Energy Stephen Roberson said: "It's both challenging and expensive to build, maintain and operate a large geographically dispersed network. The ROAMES program along with Google Earth Builder will enable Ergon staff to improve decision making and realise operational efficiencies, by delivering to them rich, timely, spatial and precise information about its network in the context of the real world in which it exists. By using data from ROAMES to generate 3D computer models, Ergon Energy expects to save $44m over five years".

Furthermore Ergon Energy's Chief Executive Mr Ian McLeod on the same visit said: "When ROAMES becomes fully operational in November, the aircraft and the sensor technology will commence scanning Ergon Energy's electricity network. It will then be checked annually via ROAMES, compared with every three years by the current manual inspection system".

In 2011, the development phase of the Flight Assists System was completed by the CRCSI. The avionics hardware, Flight Planning and Flight Assist Software were completed and delivered to Ergon. Flight testing proved that the system was able to successfully guide the aircraft along the planned path.





The Next Steps

The next step for the project is a full field evaluation of the system. During this phase, spatial information will be collected using the LiDAR system and evaluated by the ROAMES team.

Opposite page top to bottom

Ergon Energy Chief Exectutive Mr Ian McLeod, announceing Ergon Energy's aerial inspection technology.

Specially modified aircraft fitted with sensors that include photographic and LiDAR distance measurement equipment.

Streetview- extracted vegetation encroaching on powerline

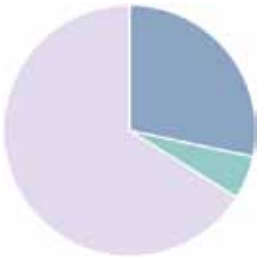
This page top to bottom

Streetview - unclassified LIDAR point cloud

Streetview - powerline vectors automatically extracted from LIDAR point cloud

Images courtesy of Ergon Energy

FINANCIAL SUMMARY



2010-11 Expenditure by Department

Governance & Administration	28%
Business Development	6%
Research Program	66%
Communications & Education	0%

2011-12 Forecast Expenditure

Governance & Administration	16%
Business Development	3%
Research Program	78%
Communications & Education	3%

2010-11 Funding by Source

Essential Participants	30%
Other Participants	2%
CRC Program Funding	27%
Commissioned Research/Other	41%

2011-12 Funding Forecast

Essential Participants	37%
Other Participants	10%
CRC Program Funding	49%
Commissioned Research /Other	4%

The CRCSI operated well within its available resources for 2010-11 and ended the year in surplus by $172k against a forecast budget deficit of $3.2m. The CRCSI remained in a healthy cash position at the end of the 2010-2011 year and has sufficient funding to meet its debts. FTE Staff In-Kind totalled 31.6 with non-staff inkind of $4.0m for the year.

Favourable expenditure to budget in 2010-11 was largely driven by delayed expenditure in the Research Program area as well as cost savings in other areas. The expenditure pattern is consistent with operations in the first Centre (for the period 2003 to 2009). As current projects progress and further projects commence, deferred expenditure in the current year is expected to be spent in line with budget in future years.

Around 80 per cent of total expenditure (cash and in-kind) was directed to the Research program in 2010/11. This is expected to increase to 89 per cent in 2011-12. The remainder goes on business development, the education program and administration.

In excess of $5m of commissioned research funding was received in 2010-11 equating to 40 per cent of the total funding received. This mostly related to advanced receipt of Urban Digital Elevation Modelling Phase 2 project funds of $3.7m with the related expenditure to be allocated through to 2012-13.

After a lengthy negotiation process, the ATO has endorsed the tax-exempt status for SISRL effective from company registration date and no provision for income taxation is therefore required. A related decision with regard to payroll tax is pending from the State Revenue Office.

PKF Chartered Accountants and Business Advisors were appointed as external auditors for the period and the related Financial Reports and Statements have been prepared in accordance with the Australian Accounting Standards, International Financial Reporting Standards and Interpretations and Commonwealth of Australia guidelines where required.

CRCSI FUNDING 2010-11	2010-11 Actual ($ '000s)		2011-12 Forecast ($ '000s)	
Funds (Cash)	4,039	Essential Participants	2,954	Essential Participants
	238	Other Participants	782	Other Participants
	3,674	CRC Program	4,002	CRC Program
	5,423	Commissioned Research/Other	300	Commissioned Research/Other
Total Income	**13,427**		**8,038**	

CRCSI EXPENDITURE 2010-11	2010-11 Actual ($ '000s)		2011-12 Forecast ($ '000s)	
Expenditure (Accrual)	1,662	Governance & Administration	2,076	Governance & Administration
	333	Business Development	438	Business Development
	3,861	Research Program	10,182	Research Program
	NIL	Communications & Education	423	Communications & Education
Total Expenditure	**5,856**		**13,119**	

Cumulative Contributions	2010-11 Actual ($ '000s)	2011-12 Forecast ($ '000s)
Cash	13,427	8,038
FTE In-Kind	7,526	11,284
Non-Staff In-Kind	3,981	5,506
Total	**24,934**	**24,828**

CRCSI PROJECTS

Number	Title	Lead Researcher	Project Partners
Positioning			
1.01	New carrier phase processing strategies for achieving precise and reliable multi-satellite, multi-frequency GNSS/RNSS positioning in Australia	Professor Peter Teunissen Curtin University	Delft University of Technology, University of NSW, RMIT University, Queensland University of Technology, Geoscience Australia, Curtin University, Septentrio, AAM Group, Landgate, GP Sat Systems, Omnistar, Leica Geosystems
Automated Spatial Information Generation			
2.01	Multimodal data acquisition and feature extraction from multi-sensor terrestrial mobile mapping systems	Professor Geoff West Curtin University	Whelans, Curtin University, AAM Group, Landgate, Lester Franks,Vekta, Fugro, DSE (Vic), Land and Property Information (NSW), Fusion GIS, Geomatic Technologies, Dept of Transport (Vic)
2.02	Feature extraction from multi-source airborne and space-borne imaging and ranging data	Dr Chunsun Zhang University of Melbourne	University of Melbourne Landgate, Queensland Department of Environment and Resource Management, Land and Property Information (NSW), Geoscience Australia, Ergon Energy, AAM Group, Geomatic Technologies, Fugro, Sinclair Knight Merz, Vekta, Geoimage, Terranean Mapping Systems
2.07	Australian woody vegetation landscape feature generation from multi-source airborne and space-borne imaging and ranging data	Dr Andrew Haywood DSE Vic Professor Simon Jones RMIT University	DSE (Vic), RMIT University, Queensland Department of Environment and Resource Management, Department of Trade & Investment, Regional Infrastructure and Services (NSW)

Research Projects Effective 30/6/2011

Number	Title	Lead Researcher	Project Partners
Spatial Infrastructures			
3.05	Unlocking the LANSAT archive for future challenges	Glenn Frankish Lockheed Martin	Lockheed Martin, Geoscience Australia, VPAC, Australian National University
3.06	Alignment analysis of spatial data supply chains for SDIs	Maurits van der Vlugt Mercury Project Solutions	Mercury Project Solutions, Landgate
Agriculture, Natural Resource Management & Climate Change			
4.12	Biomass Business *Page 18*	Professor David Lamb University of New England	Milne Agrigroup, Department of Environment Climate Change & Water (NSW), University of New England, Sundown Pastoral, Curtin University, AgLab, Twynam Investments, Eco Logical Australia, Landgate, Superair, Queensland University of Technology
4.15	Towards operational monitoring of key climate parameters from synthetic aperture radar	Professor Kim Lowell CRCSI	University of Melbourne
Energy and Utilities			
4.31	Enhanced flight assist system for automated aerial survey of powerline networks *Page 20*	Dr Jason Ford Queensland University of Technology	Ergon Energy, Queensland University of Technology
Health			
4.41	Geovisualisation of health information *Page 12*	Professor Geoff West Curtin Unversity, ESRI	Spatial Vision,Telethon Institute Department of Health (WA), Landgate, Curtin University, ESRI Australia, Sinclair Knight Merz
4.42	Spatial-temporal modelling of cancer incidence, survival and mortality	Professor Kerrie Mengersen Queensland University of Technology	Cancer Council QLD, Curtin University, Queensland University of Technology, Department of Health (WA), Telethon Institute for Child Health Research (WA), University of Sydney

Number	Title	Lead Researcher	Project Partners
Sustainable Urban Planning			
4.51	Greening the Greyfields – A Spatial Information Platform for 21st Century Sustainable Urban Planning	Professor Peter Newman Curtin University of Technology	Curtin University, Department Planning (WA), Landgate, Swinburne University, City of Canning (WA), Department of Planning & Community Development (VIC), Manningham City Council
Contract Research			
9.06	Urban Digital Elevation Modelling (UDEM) - Phase 2 *Page 16*	Dr Graeme Kernich Manager, CRCSI	Department of Climate Change and Energy Efficiency (Commonwealth)
9.07	Flight Assist System (FAS) Demonstrator *Page 20*	A/Professor Duncan Campbell Queensland University of Technology	Queensland University of Technology, Ergon Energy
9.09	Kokoda Remote Sensing Pilot Project	Professor Tony Milne CRCSI	Department of Environment & Conservation, Papua New Guinea
9.11	International Forest Carbon Initiative *Page 14*	Professor Kim Lowell CRCSI	Department of Climate Change and Energy Efficiency (Commonwealth)

CRCSI MANAGEMENT

CEO

Dr Peter Woodgate

Business Manager/Deputy CEO

Dr Graeme Kernich

Research Director/Deputy CEO

Dr Phil Collier

Communications Director

Mr Michael Ridout

Director, CRCSI New Zealand

Ms Mary Sue Severn

Business Development Manager

Mr George Curran

CRCSI SCIENCE DIRECTORS

Program 1 - Positioning

Professor Peter Teunisson - CUT

Program 2 - Data Interpretation

Professor Clive Fraser - CRCSI

Program 3 - Spatial Infrastructures

Professor Geoff West - CUT

Program 4

4.1 - Agriculture, Natural Resources, Climate Change

Professor Kim Lowell - CRCSI

4.4 - Health

Professor James Semmens - CUT

4.5 - Sustainable Urban Development

Professor Peter Newman - CUT

Note: Programs 3, 4.2 and 4.3 are vacant.

CRCSI PROGRAM BOARDS

Name	Position	Organisation	Professional Title
Program 1 - Positioning			
Chris Pigram	Chair	Geoscience Australia	Chief Executive Officer
John Dawson	Program Manager	Geoscience Australia	Acting Section Manager NGRS
Peter Teunissen	Science Director	Curtin University	Professor/ARC Federation Fellow, Dept of Spatial Sciences
Graeme Blick		Land Information, NZ	Chief Geodesist
Chris Earls		AAM Group	Technical Manager
James Millner		DSE (Vic)	Positioning Service Delivery Manager
Mary Manov		Landgate	Manager Innovation & Research, Business Development
Paul Digney		Sinclair Knight Merz	Project Manager
Peter Grognard		Septentrio	Managing Director
Program 2 - Data Interpretation			
Mark Judd	Chair	Geomatic Technologies	Director
Clive Fraser	Science Director	CRCSI	Professorial Fellow, University of Melbourne
James Bangay		Roames (Ergon)	General Manager
Geoff West		Curtin University	Professor of Spatial Information
Paul Duncan		Langate	Manager, Location Products & Services
David Abernethy		Land and Property Information (NSW)	Team Leader, Products & Imagery Services
David Sinclair		Vekta	Director
John White		DSE (Vic)	Product Manager
Chris Earls		AAM Group	Technical Manager
Simon Clode		Fugro Spatial Solutions	General Manager
Andrew Haywood		DSE (Vic)	Director Forests and Parks, Management and Operations
Joanne Poon		Sinclair Knight Merz	Image Anaylst
Program 3 - Spatial Infrastructures			
Mike Bradford	Chair	Landgate	Chief Executive
Kylie Armstrong	Program Manager	Landgate	Spatial Infrastructure Program Director
Geoff West	Science Director	Curtin University	Professor of Spatial Information
Dan Paull		PSMA	Chief Executive Officer
Sue Gordon		Land Information, NZ	General Manager, Strategic Development & Support
Stephen Meekin		Defence Imagery and Geospatial Organisation	Director
Liz Marchant		ANZLIC	Executive Director
Cathy Crooks		DSE (Vic)	Senior Business Engagement Advisor
Alan Smart		SIBA	Chairman

CRCSI PROGRAM BOARDS

Name	Position	Organisation	Professional Title
Program 4.1 - Agriculture & Natural Resources			
Matthew Adams	Chair	Landgate	Manager, Satellite Remote Sensing Services
Kim Lowell	Science Director	CRCSI	Professorial Fellow in Spatial Systems Modelling
Simon Jones		RMIT University	Professor of Remote Sensing, Geospatial Sciences
Richard Hicks		Dept of Environment Climate Change & Water (NSW)	Manager, Remote Sensing
Neil Bennett		Dept of Environment Climate Change & Water (NSW)	Director of Information Services
Alan Forghani		Murray Darling Basin Authority	Director, National Resource Information Unit
Peter Morrison		Twynam Investments	Business Manager
Christian Witte		Queensland Department of Environment and Resource Management	Manager, Remote Sensing Centre
Program 4.4 - Health			
Tarun Weeramanthri	Chair	Dept of Health (WA)	Executive Director, Public Health Division
Narelle Mullan	Program Manager	Curtin University	Health Program Manager
James Semmens	Science Director	Curtin University	Professor, Department of Public Health
Kerrie Mengersen		Queensland University of Technology	Research Professor of Statistics
Peter Baade		Cancer Council QLD	Senior Research Fellow, Biostatistics
Peter Somerford		Department of Health (WA)	Principal Epidemiologist
Tony Wheeler		Akuna Consulting	Director
Program 4.5 - Sustainable Urban Planning			
Martin Mileham	Chair	Department of Planning (WA)	Executive Director, Infrastructure Planning & Coordination
Peter Newman	Science Director	Curtin University	Professor of Sustainability
Charlie Hargroves		Curtin University	Research Principal TNEP
John Chortis		Department of Planning (WA)	Director, Infrastructure Planning and Coordination
Mike Moritz		City of Canning	Executive, City Futures
Howard Drabsch		Department of Planning (WA)	Operational Manager, Mapping and GeoSpatial Directorate
Marnie Leybourne		Wallis	Director
Stuart McKnight		Department of Planning (WA)	Planning Manager, Land Coordination & Delivery

ESSENTIAL PARTICIPANTS

SUPPORT PARTICIPANTS

GEOIDE

Telethon Institute for Child Health Research

Government of Western Australia
Department of Health

Government of Western Australia
Department of Agriculture and Food

RMIT UNIVERSITY

SWINBURNE UNIVERSITY OF TECHNOLOGY

NSW GOVERNMENT
Department of Environment, Climate Change & Water

Toitu te whenua
Land Information
New Zealand

Australian Government
Department of Defence

43PL COMPANIES

As at June 30, 2011

AAM Group

AgLab

Akuna Consulting

Alexander and Symonds

Brazier Motti

Brown and Pluthero

Clyde Agriculture

CNG Systems

Costa Group

Critchlow

CR Kennedy and Co

CTF Projects

CTG Consulting

Eco Logical Australia

ERDAS Inc

e-Spatial

ESRI Australia

Fitzroy Basin Association

Fugro Spatial Solutions

Fusion GIS

Geoimage

Geomatic Technologies

Geometry

GeoSmart Maps

GPSat Systems

Hames Sharley

iintegrate Systems

Insight GIS

Land Equity International

Lester Franks Survey & Geographic

Lisasoft

McMullen Nolan & Partners Surveyors

Mercury Project Solutions

Milne Agrigroup

NGIS Australia

Omnilink

Omnistar

Photomapping Services

PSMA

Scanalyse

Septentrio

Sinclair Knight Merz

SkyView Solutions

Spatial Information Technology Enterprises

Spatial Vision Innovations

Sundown Pastoral

Superair

Terranean Mapping Systems

ThinkSpatial

Trimble Navigation Australia

True 3D

Twynam Investments

Vekta

VPAC

We-Do-IT

Whelans

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An Australian Government Initiative