Australian Government

Earth Observations from Space (EOS) National Infrastructure

Priorities for Australia's Space Policy

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INTRODUCTION

The Government has requested the Space Policy Unit within the Department of Innovation, Industry, Science and Research to bring forward a comprehensive National Space Policy for its consideration. Earth Observations from Space (EOS) are an essential component of Australia's space policy.

This paper provides a consensus view, shared by key Commonwealth agencies and representative State agencies and academic institutions, of the priorities that need to be addressed to deliver and sustain Australia's infrastructure requirements in relation to acquisition and custodianship of Earth Observations from Space (EOS) and their utilisation for national benefit across all levels of government, industry and the research sector.

Importantly, 'Infrastructure' is taken to include the full extent of enabling systems required to deliver value from EOS, from the physical acquisition of space-based observations through to quality control, data analysis, archiving and delivery of information in the forms needed to address national priorities. There are some similarities with the broad concept of *landmark research infrastructure*[1] , with an important difference being the need for support of *ongoing*, *operational* infrastructure to underpin EOS across the full spectrum of uses.

BACKGROUND

In 2009 the Australian Academy of Science (AAS) and the Australian Academy of the Technical Sciences and Engineering (AATSE) put forward a report *An Australian Strategic Plan for Earth Observations from Space* which emphasised the importance of EOS to Australia and the potential socio-economic benefits of government investment in this area.

Australia is a major user of EOS, but has very little control over supply. Currently there are government programmes totalling more than $1.3 billion in annual expenditure[2] that have an explicit dependency on EOS. Most of the EOS data streams utilised are sourced from public-good missions flown by major space-capable nations, such as USA, Japan, China and Europe.

The role, capabilities, and importance of commercially operated satellites are growing. Although commercial capabilities will not replace public-good missions, it is important that commercial data be used as effectively as possible, and wherever appropriate, for example for high resolution emergency response imaging.

Reliable and sustainable access to EOS data is critical for addressing key national challenges in climate change, water, natural disasters, weather

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[1] National Research Infrastructure Council, (2010). *A process to identify and prioritise Australia's Landmark Research Infrastructure needs*. Discussion Paper.
[2] Geoscience Australia (2010), *A National Space Policy: Views from the Earth Observation Community*, 7th National Remote Sensing Technical Reference Group

forecasting and warnings, renewable energy, agriculture, forestry and natural ecosystems, coasts and oceans, and national security[3].

Furthermore, there are serious capacity issues across the major agencies to extract the potential benefits from the current and planned suite of EOS platforms.

Only a national approach can draw together the needs and capabilities of the Australian Government *and* State and Territory government players. Coordination will underline and strengthen the roles and responsibilities of key Commonwealth agencies, such as the Bureau of Meteorology and Geoscience Australia, that depend on EOS in delivery of core national services, the CSIRO, which relies on EOS for tackling some of Australia's major national challenges, and State and Territory governments which have responsibility for land and environmental management and for emergency response, all of which are major and growing drivers for EOS. State and Territory governments, with their increasing dependencies, are seeking a larger role in planning of national EOS capabilities.

A national approach is required for the coordination, analysis and dissemination of information from satellites in emergency response situations. Emergency responses, for major floods, tropical cyclones and other severe weather, fires, oil spills and even search and rescue are increasingly using satellite observations.

Australia's ground station and associated infrastructure, used to receive and process data from satellites and to move information around the country and internationally, faces several challenges. Despite investments from the key agencies, the current infrastructure will be inadequate to capture higher volumes of data from an increasing number of satellites, sending more information at higher frequencies. In some instances, existing antennas may need to be relocated away from major population centres to allow optimal use of radiofrequency spectrum; however, this incurs higher communications costs.

Current communications bandwidth to ground stations is inadequate in some instances, leading to delays in data access which do not satisfy users' expectations for timely information. Finally, increases in the amount of data being received from satellites with increasingly sophisticated sensors calls for high performance computing environments to analyse and store the data and extract and disseminate information in a timely manner.

STAKEHOLDERS

At the Commonwealth level, the major EOS stakeholders are:

- Geoscience Australia (GA)
- Bureau of Meteorology
- Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Defence Imagery and Geospatial Organisation (DIGO)

Other Commonwealth stakeholders include:

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[3] Australian Academy of Science and the Australian Academy of the Technological Sciences and Engineering (2009), *An Australian Strategic Plan for Earth Observations from Space*,.

- Department of Climate Change and Energy Efficiency (DCCEE)
- Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), including the Australian Antarctic Division
- Department of Agriculture, Fisheries and Forestry (DAFF)
- Australian Institute of Marine Science (AIMS)

Most national reception infrastructure is owned and operated by the Bureau of Meteorology and Geoscience Australia. There are also two major consortium-owned facilities:

- the Western Australian Satellite Tracking and Applications Consortium (WASTAC), which includes the Bureau, GA, CSIRO, Landgate, Curtin University and Murdoch University
- the Tasmanian Earth Resources Satellite Station (TERSS) which includes GA, the Bureau, CSIRO, the Australian Antarctic Division and the University of Tasmania.

Other stakeholders include state and local government agencies, industry and the research sector. Particular mention should be made of the most active jurisdictional stakeholders: Landgate, a WA State Government statutory enterprise with a lead role in WASTAC; the NSW departments of the Environment, Climate and Water (DECW) and the Land and Property Management Authority (LPMA); and the Queensland Department of the Environment and Resources (QDERM).

NATIONAL NEEDS

A clear need exists for a coordinated national approach to the acquisition and handling of EOS data. The approach should address the following concerns:

- geographic location of reception sites to provide optimum coverage and operational resilience;
- data communications from reception sites back to a central hub sufficient to provide near-real-time access, especially in emergency situations;
- interoperability of systems across the network;
- value adding (including R&D) to convert raw data to readily usable, timely information
- provision of raw and value-added data to stakeholders;
- consolidated archives of EOS data, readily accessible to key stakeholders as on-network traffic and available to external parties;
- traceability and quality control of EOS data, and the provision of calibration and validation facilities.

PRIORITIES FOR ACTION

The drivers and issues identified above suggest that Australian Government investment in EOS should address the following issues (not in priority order):

- **Coordination and Cooperation** through:
    - **Governance** structures to coordinate the efforts of all agencies and jurisdictions; and
    - **Imagery coordination and crisis mapping**, in the form of a national facility or virtual facility for satellite coordination, to

assist planning and preparedness for disaster risk reduction and to provide rapid access to information from satellites in emergency response situations, which span marine safety and oil spill response; monitoring of off-shore oil and gas operations; and response to floods, fires, landslides and storms for Australia and the region.

- **Securing Future Earth observations** as efficiently as possible through:
    - **Ensuring access to international public-good** observation sources, including weather, climate, water, land and ocean observations;
    - **Ensuring** appropriate and efficient **use of commercial capabilities**; and
    - **Ensuring** Australian engagement and/or **international partnerships** in ongoing and new **EOS** missions, if necessary through co-investment;
- Investment in **Ground infrastructure** and **communications** through:
    - A **strategically** planned and geographically distributed **national antenna network to** ensure that Australia is able to receive (directly from space and via international telecommunications networks) and distribute the data we need;
    - **High speed communications** linking the ground stations with the operating agencies to facilitate the timely analysis and release of information; and
    - Assured access to **radiofrequency spectrum** for (a) satellite downlink of public-good data and for (b) protection of sensitive passive atmospheric sounding bands ("fingerprints of nature").
- **Extracting value** through
    - **Data processing, scientific analysis and delivery systems**, to provide the high-volume storage and intensive computational capacities required to ensure that data are rapidly and effectively processed into the information required by users – in weather, agriculture and resource management, environmental accounting, emergency response and other applications;
    - **Calibration, data quality and certification** capabilities to ensure the maximum value possible can be extracted from EOS data, to ensure reliability of information for decision making, including monitoring and enforcement activities, and to support key Australian contributions to international civil EOS activities; and
    - Opening the door to **innovative new research outcomes** across all sectors that utilise and benefit from EOS.
- Sustained **capability to deliver** through
    - Ensuring **Australian scientists** are available and have the knowledge and opportunity to shape future operational and specialist science missions, to meet specific Australian requirements;
    - Continuous development of scientific **capability to process, calibrate, interpret and ensure uptake** of new EOS data streams; and

- Continuous development of capabilities required to support and **sustain the technical and physical infrastructure** for EOS data generation, acquisition, and handling.

BENEFITS

EOS have already become a key dependency in the delivery of core government services including disaster risk reduction activities. The benefits from improved coordination and more efficient and effective utilisation of EOS across Australian society are substantial and include:

- Lives saved and property losses reduced
  - Improved disaster preparedness, planning, prediction and mitigation and improved responsiveness to emergency response situations, through rapid coordinated access to information from satellites;
  - Ensuring Defence and the national security community have efficient and timely access to available EOS resources when needed;
- Economic returns and productivity
  - The return on investment from EOS in Australia today exceeds 30 to 1[4]. Actioning the priorities will therefore both address an urgent need and deliver increased GDP.
  - Enabling Australia to draw benefit from over $100 billion of investment in the EOS sector by other countries, particularly the United States and the European Commission[5].
  - Leveraging the Government's investment in the National Broadband Network and research infrastructure such as IMOS, TERN, Auscope.
  - Cost-effective provision and utilisation of EOS data by government, industry, research and the community.
- More efficiently and effectively meeting the business needs of Government
  - Improved service delivery, such as through improved weather forecast lead time and location-specific detail, and through improved ability to target relief funding following major events such as the 2011 flooding in Eastern Australia;
  - Demonstrating and promoting, through tangible service delivery examples, a whole-of-government policy with close linkages to both Gov 2.0 and APS reform, particularly around Open Government, public accessibility, strong state linkages and private sector partnerships;
  - Avoiding future duplication of activity through improved governance and a whole-of-government approach to EOS capabilities;

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[4] Recent reports identify that EOS activities contribute at least $3.3 billion to GDP (2010, *The Economic Value of Earth Observation from Space*, ACIL Tasman) from outlays of $105 million on the EOS system (2010, *Analysis of Australian Government Space Activities*, DIISR Space Policy Unit)

[5] Committee on Earth Observation Satellites – CEOS, listing of current and planned EOS missions: http://www.eohandbook.com/index.html

    - Sustainability of EOS activities across whole-of-government through the sharing of expertise and organisational knowledge;
    - An energised EOS research sector through readily available and accessible data;
- Enhanced climate outcomes for government
    - Maintaining continuity of data records, important for long-term studies of climate;
    - Contributing to Australia's climate science, as 28 of the 48 Essential Climate Variables[6] are dependent on Earth Observations from Space;
    - Significantly contributing to Australia's international weight as seen in the recent international climate change negotiations, the successes of which were due in large part to Australia's leadership in the use of EOS for measurement, reporting and verifiability of the quantities of carbon contained within living forests;
    - Significantly contributing to Australia's regional narrative though the International Forest Carbon Initiative and the Indonesia Australia Forest Carbon Partnership, and through engagement with emerging regional capabilities, such as Sentinel Asia, for the use of space in disaster response;
- Regional and rural development
    - The construction and ongoing operation of regional EOS facilities;
    - Increased productivity, particularly in the resources and agricultural sectors;
- Building the national innovation system
    - Providing new data from space to develop innovative solutions for matters of emergency management, urban growth, water shortages, environmental accounts and climate change;
- Delivering assured environmental intelligence
    - Helping to establish the EOS components of a National Plan for Environmental Information (NPEI), which will be a major user of EOS.

Improved national infrastructure for EOS will deliver real benefits across all industry sectors, including to farmers, miners, emergency services workers, insurance assessors, environmental managers, researchers, plant operators, transport operators, the energy sector, infrastructure developers and operators, and ordinary citizens.

The priorities and benefits are summarised in Table 1, below.

[6] Committee on Earth Observation Satellites (2010), *The Earth observation handbook*.

Priority Areas	Actions	Benefits
Coordination and Cooperation	**Governance** structures to unite the efforts of all agencies and jurisdictions; and	• united efforts of all agencies and jurisdictions • avoiding future duplication within and between levels of government as spend on space capabilities and services increases. • sustainability of capability through the sharing of expertise
	Imagery coordination and crisis mapping, in the form of a national facility or virtual facility for satellite coordination, to provide rapid access to information from satellites in emergency response situations, which span marine safety and oil spill response; monitoring of off-shore oil and gas operations; and response to floods, fires, landslides and storms for Australia and the region.	• improved responsiveness to emergency response situations through rapid access to information from satellites • reduced duplication across all levels of government
Securing Future Earth observations	Ensuring **access to international public-good** observation sources;	• maintained continuity of data records • cost-effective provision of EOS data to government, industry, research and the community • continuity of core national services and sustained emergency responsiveness
	Ensuring appropriate and efficient **use of commercial capabilities**; and	• cost-effective provision of EOS data to government, industry, research and the community • availability of capabilities above and beyond public good data
	Ensuring that Australian **scientists are fully engaged** with future specialist science missions and engagement in global efforts that define future missions;	• access to, and the knowledge to apply, new sources of scientific data for understanding of Earth and environmental resources and processes. • Participation in design and operation of future EOS missions, ensuring maximum benefit to Australian users. • capability building within the Australian research and industry sectors
Investment in **Ground infrastructure** and **communications**	A strategically planned and geographically distributed **national antenna network to** ensure that Australia is able to receive (directly from space and via international telecommunications networks) and distribute the data we need; and	• improved national ground capability, adequate for the immediate future • efficiency improvements through the exploitations of synergies and removal of duplication • sustainability of capability

		through the sharing of expertise • improved participation in international EOS missions leading to improved access to data
	High speed communications linking the ground stations with the operating agencies to facilitate the timely analysis and release of information.	• improved services from operational agencies • more timely information and improved responsiveness to natural disasters and other events • improved resilience through improved communications reliability and redundancy • increased interoperability and sharing of data between agencies, and avoidance of duplication
Extracting value	**Data processing, scientific analysis and delivery systems**, to ensure that the data received are rapidly and effectively processed into the information required by users – in weather, agriculture and resource management, environmental accounting, emergency response and other applications; and	• improved services from operational agencies • increased return on investment from EOS through effective and timely integration of the information required by users into their data processing and decision support systems – in weather, agriculture and resource management, environmental accounting, emergency response and other applications.
	Calibration, data quality and certification capabilities to ensure the maximum value possible can be extracted from EOS data, to ensure reliability of information for decision making, including monitoring and enforcement activities and a key Australian contribution to international civil EOS activities.	• improved services from operational agencies • increased return on investment from EOS through increased quality, and quality assurance, of data – in weather, agriculture and resource management, environmental accounting, emergency response and other applications .
Sustained capability to deliver	Ensuring that Australian **scientists are fully engaged** to shape future operational and specialist science missions, to meet specific Australian requirements;	• access to, and the knowledge to apply, new sources of scientific data for understanding of Earth and environmental resources and processes. • capability building within the Australian research and industry sectors
	Continuous development of scientific capability to process, calibrate, interpret and ensure uptake of new EOS data streams	• sustained ability to convert EOS data into timely information to inform national priorities
	Continuous development of the capabilities needed to support and sustain the technical and physical infrastructure for EOS data	• sustained ability to receive and handle data from EOS sources

	acquisition and handling.	

Table 1 - Priority Actions and Benefits

STANDING

This paper has the following endorsements:

Geoscience Australia(endorsed)
Bureau of Meteorology (endorsed)
Commonwealth Scientific and Industrial Research Organisation (endorsed)
Defence Imagery and Geospatial Organisation (endorsed)
Department of Climate Change and Energy Efficiency (endorsed)