TRUST IN EARTH OBSERVATION DATA: DEPENDENCIES, RISKS AND OPPORTUNITIES FOR AUSTRALIA

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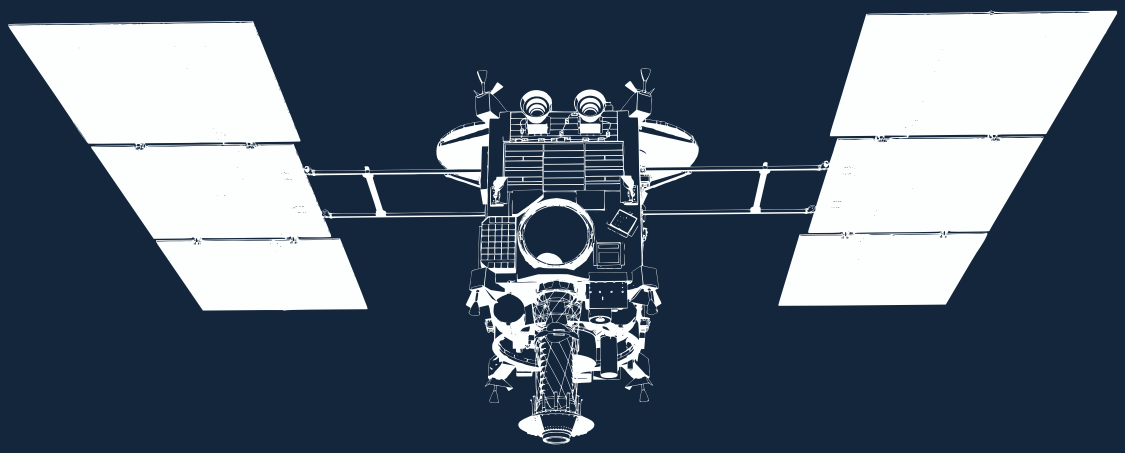

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Summary

- Australia's economy and national security depend heavily on Earth Observation (EO) satellite data. This data contributes $3.2bn to our GDP. The federal government spends $100 million annually for this data.
- The EO data Australia relies on are from (a) paid "timeshare" arrangements on foreign satellites, (b) purchased from foreign commercial entities, or (c) provided by foreign partner nations for whom we provide ground-based infrastructure and data quality improvement in Australia.
- It is difficult to verify the quality or accuracy of commercially provided data, and there are limited ways to verify the precision of the satellite instruments. Data can also be deliberately interfered with, sometimes without easy detection.
- Australia is a world leader in the "ground" and "data" aspects of EO infrastructure, including calibration of foreign EO satellites and validation (quality assurance) and management of EO data.

Policy recommendations

- EO data should be included as critical infrastructure by federal laws, policies and strategies under the Department of Defence, Department of Foreign Affairs and Trade, Department of Home Affairs and the Department of Industry, Science and Resources. This should be in a coordinated approach across the whole of government.
- The Department of Prime Minister and Cabinet should task the Space Coordination Committee to (a) consult expert risk assessments of current operation and future potential loss of service of EO data, and (b) map and provide clear recommendations for a whole of government approach to consolidating government activity and mitigating these risks.
- The Australian Government should leverage Australia's sovereign strengths in EO data management, validation and calibration as a national strategy. In return for being heavy users of foreign EO data, we can be a key contributor to global EO infrastructure.

EO data is critical to multiple aspects of our individual, community and national lives, and should therefore be recognised as part of our national critical infrastructure. The information collected from EO satellites informs people about their business needs and environmental realities and provides data for public policy and national security decision-making. EO has wide-ranging applications that serve and enable a broad range of Australian industries and government needs, including:

- climate monitoring;
- monitoring the health of flora, fauna freshwater and coastal environments;
- augmenting Indigenous land and water management data;
- precision data for agricultural planning and operations;
- prospecting for critical minerals and mining;
- real-time and predictive data for disaster response, including bushfires and floods;
- evidence for police investigations and in the courtroom; and
- security and intelligence (GEOINT).

Earth Observation capabilities as critical infrastructure

EO data from satellites brings over $3.2 billion into Australia's GDP, while the Australian government spends approximately $100 million per year on purchasing this data.[1] There are economic and operational dependencies on EO for a wide range of sectors.

For example, EO data aids the agricultural sector by enabling better weather prediction and monitoring, determining irrigation and fertilisation needs, and predicting yields.[2] Regular functioning of agricultural practices hinges on this data, increasingly so given predicted food supply chain shortages due to climate change. EO assists the mining sector in finding new critical mineral deposits, monitoring site landscapes, and ensuring compliance with cultural protection and environmental requirements.

EO capability is also imperative for meteorology and climate change response. Half of the world's climate data comes from EO satellites, and some of that data can only be sourced form space. The data from these satellites can aid in drought resilience, bushfire prediction, mitigation and response, as well as disaster management and sustainable environmental management. For example, monitoring and protecting the health of the Great Barrier Reef depends on EO data. Indigenous communities also frequently rely on EO data to augment the management of waters and lands, including tracking fauna and accessing up-to-date information about flora and water health.

EO infrastructure

EO infrastructure consists of four segments:

1. The space segment (Earth observation satellites with remote sensors);
2. The data link segment (sending data packages from the satellite to a receiving ground station)
3. The ground segment (ground stations, data processing, and ground sensors used to ensure the satellite sensors are accurately calibrated)
4. The human segment (satellite owners and operators, data scientists, data providers, government agencies, clients such as businesses and public sector institutions, and individual end users).

EO data is used in legal proceedings during investigations and as evidence in the courtroom. The Queensland government is one of the world leaders in using EO data to prosecute illegal logging and water theft.[3] Globally, EO data from satellites has also been indispensable to prosecuting war crimes and crimes against humanity in international tribunals and is integral to military operations. Notably, several commercial EO data providers have donated their data to the Ukrainian government to help it understand and respond to attacks on its territory.[4]

The federal government departments that rely heavily on EO data include the Australian Bureau of Meteorology, the Australian Bureau of Statistics, Australian Federal Police, CSIRO, the Department of Agriculture, Forestry and Fisheries, the Department of Climate Change, Energy, the Environment and Water, Defence, and Geoscience Australia. State government departments also employ EO data for state or territory police needs, departments of resources, and departments dealing with development, infrastructure and planning.

Given these national dependencies, the infrastructure supporting data from EO satellites should be defined as critical infrastructure for Australia in relevant legislation and policies. This includes ground infrastructure, such as ground sensors, necessary to ensure the accuracy and precision of EO satellite sensors (calibration), the processing and accessibility of the data, and the data itself.

In particular, the *Security of Critical Infrastructure Act* (SOCI Act) includes "the space technology sector" as critical infrastructure. However, this language is so broad as to become meaningless and creates implications for researchers, scientists and small start-ups, which may be unnecessarily burdensome. Home Affairs is currently working on creating clearer, more specific, and more detailed definitions of space technologies and activities that fall under this Act, including sovereign EO data infrastructure and EO data that is not sovereign-owned. The implications of this are far-reaching and require careful consideration and expert input.

Australia's dependencies on foreign EO infrastructure

Currently, there are approximately one thousand EO satellites, some of which belong to government space agencies, but the vast majority of which belong to commercial entities.[5] Despite our national dependencies, Australia has no sovereign EO satellite capability. Instead, Australian companies and government agencies depend upon (a) "timeshare" arrangements under which the Australian government pays to access satellites owned by partner nations, (b) data purchased from foreign commercial entities, or (c) data provided by foreign partner nations via reciprocal arrangements where Australia provides data quality improvement.

However, these data quality arrangements rely on significant Australian sovereign capability which we provide to partner nations in Europe, the US, and the Indo-Pacific in exchange for access to the EO data for our national needs. Trust in EO data is entirely dependent on the ability to verify the precision of the instrumentation (calibration) and the accuracy of the data (validation), two areas in which Australia excels.

There is an opportunity for Australia to leverage these technology areas in which we have recognised world-leading capabilities, to strengthen our technology and innovation partnerships globally. This requires a more coordinated national approach. Policies and strategies under Defence, DFAT, and Home Affairs should consider how we can use our sovereign ground-based and data capabilities to contribute to the resilience of critical global EO infrastructure and decrease

the data risks for ourselves and our partners and allies.

The recent Australian Government decision not to proceed with the implementation phase of the National Space Mission for Earth Observation (NSMEO) has brought a sharper focus on risks linked to sustainable access to high-quality EO data for Australian users. The NSMEO was to be a government-procured and owned constellation of four EO satellites, to be used for government mapping, climate response, disaster management, and potentially Defence intelligence. As a unique contribution to existing EO infrastructure, the NSMEO satellites were meant to provide space-based calibration of other satellites, to achieve consistent EO data quality across systems from a range of countries and commercial suppliers. With its cancellation, Australia declined the opportunity to contribute cutting-edge infrastructure to the global EO data supply and continues to rely entirely on foreign government and commercial agreements for access to critical EO data.

It is necessary to understand the risks and challenges Australians face in ensuring sustainable access to high-quality EO data.

Risks to Australian industries and national priorities

First, dependence on timeshare or free access to EO data from partner nations means there are geopolitical risks that may lead to loss of access to that data. Much of the crucial information that Australia relies on for its weather, agriculture, mining, policing, intelligence, and flooding and bushfire management comes from an agreement to access data from the European Commission's Copernicus Sentinel satellites.[6] CSIRO employs a timeshare arrangement—along with countries like the United Kingdom, India, and the Philippines—on the commercially developed NOVASAR-1 satellite to collect data and monitor the Australian environment and disasters for ten per cent of its time in orbit.[7] Australia depends on Japanese, US, and European satellites for *all* its weather information.

Continued access to EO data from other countries remains dependent on diplomatic channels remaining open and in good standing. It requires a dependable national and geopolitical climate where partner nations do not need to reassess their needs and priorities in managing their space assets; specifically, in sharing their EO satellite-enabled data. Thus, an uninterrupted supply of EO data from partner nations in Australia is not guaranteed. If those nations have emergency priorities or find themselves in a shifting geopolitical environment, or if they change their data policy or decide to commercialise EO infrastructure that was once government-owned, loss of access to EO data would cause major disruption to Australian industries and to the government's ability to respond to national priorities such as bushfires, floods, climate change and national security needs.

Second, as Australia necessarily depends on commercial EO data providers, there are risks of poor or unreliable data quality. Whereas EO satellites used to be overwhelmingly government-owned two decades ago, today 95% of all EO satellites are owned by commercial entities, a trend that will soon reach 97%. There is no national or global oversight of the companies offering EO data or the quality or trustworthiness of the data being provided. This leads to low-quality, unreliable, corrupted, or inaccurate data risks.

EO satellite data must be "consistent, of high quality, reliable, and repeatable over time."[8] The quality of EO data relies on the precision calibration of the instrumentation that collects it and the validation of the accuracy of the data. There are many points of vulnerability along the chain of custody of

data that is collected, processed, and sold by satellite companies. These vulnerabilities include faulty or poorly calibrated satellite sensors, a deficient quality assurance process, deliberate nefarious interference, and deliberate alteration of the final data packages and images for commercial reasons, such as cutting costs. There is a known instance of a commercial satellite image being manipulated to remove clouds before being supplied to an Australian government agency, thereby compromising the integrity of the data.

Third, there is no control over who else has access to the data gathered by commercial EO satellite operators about Australia's food security, primary industries, urban planning, and maritime activities.

Fourth, the coordination between all the actors involved in providing and using EO data is an additional challenge. Given the many different sources of data and the varied number of Australian industries and departments that need it, there are often inefficient uses of resources in procurement and application. Such inefficiencies have been particularly evident during national crises, such as the 2002 Bali bombings or bushfires or floods, with federal government departments required to purchase the same EO image multiple times from commercial vendors due to licensing constraints.

Opportunities under a whole-of-government approach

The risks associated with our national dependency on foreign-supplied EO data need to be properly understood in economic, operational, environmental, geopolitical and national security terms. This is an urgent whole-of-government concern and requires immediate action across multiple portfolios.

In the 2023 budget, the federal government shifted the mandate of the Australian Space Agency to focus on "strategy and policy". The Department of Prime Minister and Cabinet should task the Space Coordination Committee—a whole of government committee chaired by the Space Agency—to consider all existing expert information on Australian dependencies on EO data and associated risks and to provide recommendations for coordinated, whole of government responses. There are resources which should be brought to the full attention of the Australian Government, including a recent report identifying approximately 60 risks to EO data continuity for Australia,[9] the Deloitte "Economic study into the Australian Earth observation sector";[10] reports on the agricultural and urban planning sectors' use of EO data,[11] and others.

There is an opportunity to build on Australia's role as a key contributor and world leader in EO data management. This should become a national strategy to strengthen Australia's technological and innovation partnerships through our sovereign strengths in ground segment calibration and data validation.

For example, CSIRO, Geoscience Australia and the New South Wales, Queensland and Western Australian governments support the Copernicus Australasia Regional Data Hub, which provides free, open, trusted and reliable access to European EO data for Australasia, South-East Asia, the South Pacific, the Indian Ocean and the Australian Antarctic Territory.[12]

CSIRO has procured a ground station from the Indigenous-owned Centre for Appropriate Technology to download data from a commercial EO satellite to which Australia has a ten per cent timeshare access.[13] A recent initiative is the Maya Nula program developed by SmartSAT CRC, an industry and university collaboration funded by DISR. Maya Nula uses EO data in combination with on-ground sensors to assist farmers to integrate climate resilience and "adapt to changing weather conditions, minimise crop failures, ensure a stable food supply, higher efficiency and maintenance of profits".[14]

Minister Madeleine King (Resources and Northern Australia) recently signed a commitment for $207.4 million, plus ongoing funding, to expand Australia's contribution to Landsat Next.[15] Australia has benefited from Landsat data for over 40 years, and this commitment represents what was always intended to be part of the NSMEO, namely next-generation sovereign ground segment and data management capabilities, as a contribution to the global EO infrastructure. This should be considered as a step towards further development of sovereign EO capabilities.

In addition to the current $100 million per year spent on purchasing EO data, there are over 170 ongoing federal and state government programmes involving EO infrastructure. A recent risk report estimated that 135 of those programmes are worth up to $10 million each.[16] Therefore, existing government investments in EO infrastructure should be publicly communicated as part of a national, values-based approach to whole-of-nation needs and should include a narrative about our world-leading strengths in the ground and data aspects of EO space systems.

A coordinated, whole-of-government approach can both mitigate the risks associated with our foreign dependencies on EO data, and also maximise our role as key technology contributors, through our world-leading, sovereign ground and data capabilities for the global EO infrastructure. This is critical for our climate, our economy, and our national and regional security commitments.

Notes

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[2] Estefania Puricelli, Mary Mitkish and Inbal Becker-Reshef, "From Space To Farm: How Earth Observation Technologies Are Revolutionizing Global Agri-Food Systems", NASA Harvest, https://nasaharvest.org/news/space-farm-how-earth-observation-technologies-are-revolutionizing-global-agri-food-systems

[3] Ray Purdy and Denise Leung (eds.), *Evidence from Earth Observation Satellites: Emerging Legal Issues,* Studies in Space Law, 7 (Brill, 2012): https://brill.com/edcollbook/title/19567. A report is also forthcoming from the Australian Centre for Space Governance which will cover the last 10 years on how EO data is used in Australian courts.

[4] Mariel Borowitz, "War in Ukraine highlights the growing strategic importance of private satellite companies – especially in times of conflict", The Conversation, 15 August 2022, https://theconversation.com/war-in-ukraine-highlights-the-growing-strategic-importance-of-private-satellite-companies-especially-in-times-of-conflict-188425

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[10] Pradeep Philip, "Economics of Earth observation: An economic study into the Australian Earth observation sector", Deloitte, 25 May 2021,https://www.deloitte.com/au/en/services/economics/perspectives/economics-earth-observation.html

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[12] The Copernicus Australasia Regional Data Hub, https://www.copernicus.gov.au/

[13] Mikayla Keen, "Indigenous-owned ground station supports our NovaSAR-1 satellite research facility", CSIRO, 8 July 2021, https://www.csiro.au/en/news/all/articles/2021/july/novasar-1-research-facility

[14] "SmartSat launches Maya Nula Research Program to develop Australian agricultural intelligence from space", Smart Sat Cooperative Research Centre, 23 May 2023, https://smartsatcrc.com/smartsat-launches-maya-nula-research-program-to-develop-australian-agricultural-intelligence-from-space/

[15] Cassandra Steer, "Australia just committed $207 million to a major satellite program. What is it, and why do we need it?", The Conversation, 27 March 2024, https://theconversation.com/australia-just-committed-207-million-to-a-major-satellite-program-what-is-it-and-why-do-we-need-it-226621

[16] Symbios, The University of Queensland, and Earth Observation Australia Inc., *Continuity of Earth Observation Data for Australia: Risks*, 9 April 2024, https://www.eoa.org.au/news/2024/4/9/continuity-of-earth-observation-data-for-australia-risks-report-released

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The Australian Centre for Space Governance advocates for Australia's interests in space in the 21st century and advances the agenda for responsible space governance.

We bring together the nation's leading experts in fields such as space law, governance, policy, science and technology studies, security, property, history, ethics, political, and social sciences from across six different universities in Australia (Australian National University, Flinders University, RMIT University, University of Adelaide, UNSW Canberra, and Western Sydney University).

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