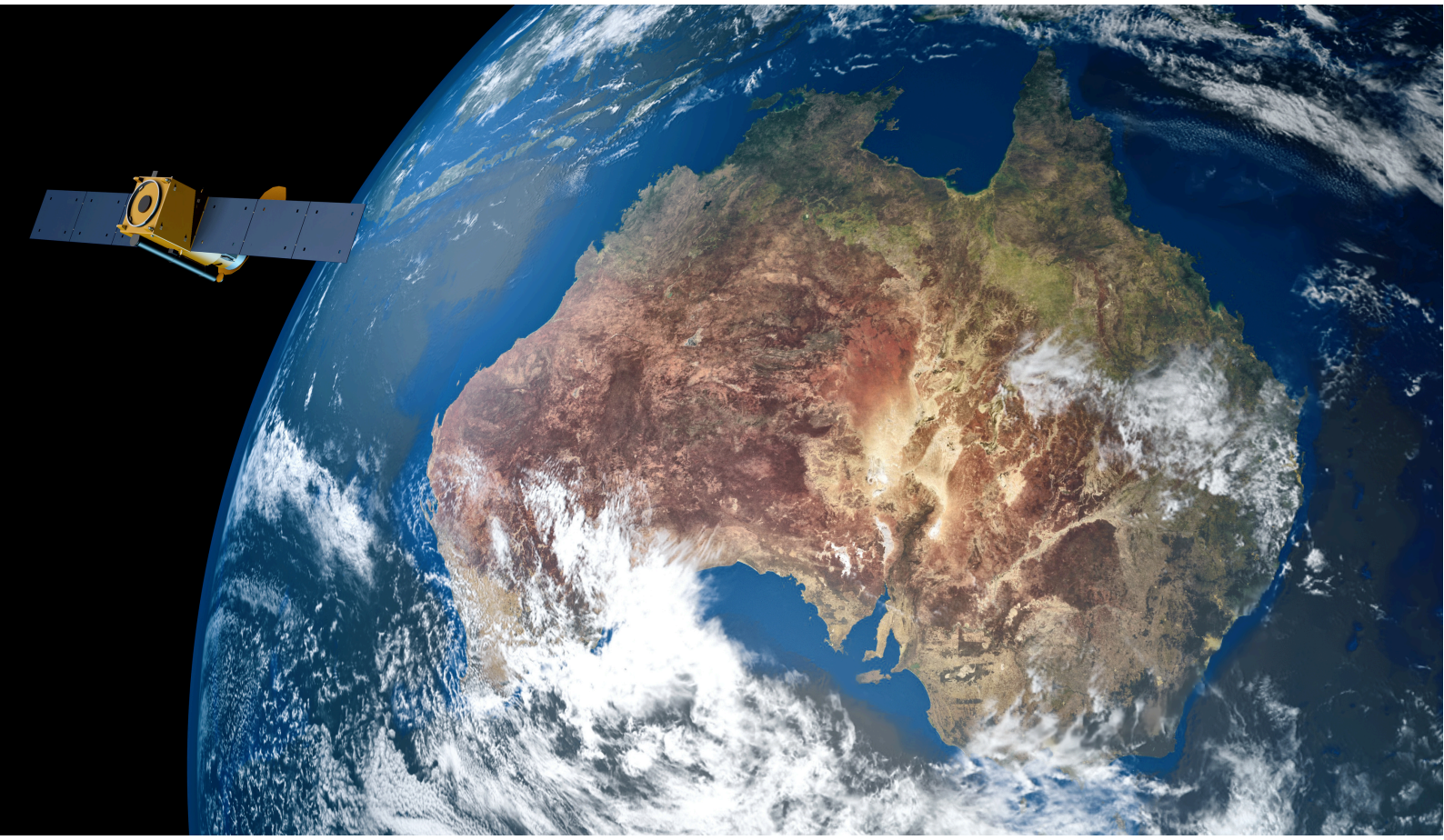
SECURING AUSTRALIA THROUGH SPACE: CLIMATE INFORMATION AND WHY EARTH OBSERVATION DATA MATTERS

GEORGE DYKE AND STEPHEN WARD



ACSG Policy Paper Series
December 2024
www.spacegovcentre.org

ACSG
AUSTRALIAN CENTRE FOR SPACE GOVERNANCE

About the Authors

George Dyke, Symbios.
Stephen Ward, Symbios.

About the Securing Australia Through Space Policy Papers Series

The Australian Centre for Space Governance hosted a workshop in March 2024 titled “Securing Australia Through Space”, where the question was posed: what does Australia need to secure, and how do space technologies help us to do so?

The workshop was attended by over 90 people, with the vast majority of attendees coming from a range of federal government departments and agencies. Experts from academia, government and industry were invited to give presentations and take part in roundtable discussions. This policy paper series is a result of the workshop.

The papers are authored by those who presented, and edited by Sarah O’Connor, Tristan Moss and Cassandra Steer on behalf of the Australian Centre for Space Governance. The opinions expressed in each paper are those of the authors in their individual capacity, and do not represent the views of any of their employers.

About the Australian Centre for Space Governance

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).

The ACSG has received funding from the Department of Defence, Geoscience Australia and the Department of Home Affairs.

Citation

George Dyke and Stephen Ward, ‘Securing Australia Through Space: Climate Information and Why Earth Observation Data Matters’, Australian Centre for Space Governance, 2024.

SECURING AUSTRALIA THROUGH SPACE: CLIMATE INFORMATION AND WHY EARTH OBSERVATION DATA MATTERS

George Dyke and Stephen Ward

Summary

- Australia is a continent scale country that relies on foreign satellites for over 170 critical government programs and yet invests almost nothing in the satellites themselves.
- This lack of investment in key satellite capabilities puts Australia in a vulnerable position relying on foreign satellite data sources for our climate understanding and for the delivery of related government programs and services.
- Reducing methane emissions is one of the most cost-effective ways to support climate mitigation. There are emerging satellite capabilities that provide methane emission observations, which inform climate action and regulation.

Policy recommendations

- The Australian Space Agency should work with the Department of the Prime Minister and Cabinet to identify the key policies that are supported by, or dependent on, foreign space infrastructure and satellite data sources and assess the risk of loss of that data supply.
- The Department of the Prime Minister and Cabinet should implement a whole-of-government strategy on services from space, starting with Earth observation, position, navigation, and timing, and communications to optimise for continuity and ensure access to the necessary technology and data.
- The Australian Space Agency, in coordination with key user agencies Geoscience Australia, the Bureau of Meteorology and CSIRO, should pursue a strategic and coordinated effort to sustain engagement and investment in key international partnerships and relationships around data supply for programs.
- The Department of Climate Change, Energy, the Environment and Water should support the Global Methane Pledge by investing in emerging space-based capabilities that can monitor methane emissions and encourage or mandate Australian industry to join the Oil & Gas Methane Partnership 2.0.

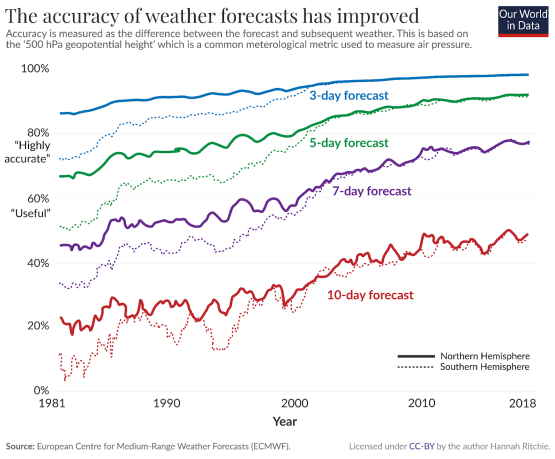
Australians have arguably benefited more than any other people on the planet from data and observations from space. Australia has enjoyed tremendous access to Earth observations (EO) for a nation with almost no EO satellites of its own. We are amongst the countries most at risk, notably from fires and floods, where EO information is invaluable in helping to predict, mitigate and manage those risks to reduce loss and damage and to save lives and livelihoods. There is, therefore, a need for a coordinated effort to sustain engagement and investment in key international partner relationships around data supply for programs.

The centrality of EO in weather prediction

Until the space age, information about the southern hemisphere's environment and geography was sparser than that of the northern hemisphere. The southern hemisphere is notably dominated by the ocean, and therefore has fewer opportunities for observations by people or instruments of any kind. The southern hemisphere also has a significantly smaller population than the northern hemisphere. Northern nations tend to be wealthier on average than in the southern hemisphere, which means they tend to have larger economies, better infrastructure and more information generally.

EO satellites have dramatically enhanced our ability to monitor the natural environment globally, with particular benefits for the southern hemisphere. EO satellites cover the globe multiple times daily and have improved both our understanding of the natural environment in many ways. For example, the single biggest contributor to improvements in weather forecasting in the past century has been the increased volume of observations fed into the Numerical Weather Prediction (NWP) forecasting models that major weather centres operate to generate their forecasts.[1] For the most part, these observations have come from EO satellites.

The chart below summarises improvements in weather forecast accuracy since 1980 for 3-, 5-, 7- and 10-day forecast windows. In 1980, southern hemisphere forecasts were 20% less accurate than northern hemisphere forecasts, meaning that a European 5-day forecast was as good as the 3-day forecast in Australia. This two-day forecast advantage makes substantial differences in areas where forward planning is dependent on weather, for example in industry, shipping, logistics, as well as disaster response.



Improvement in weather forecasts over time (Figure: Our World in Data)[2]

EO satellites have levelled the information playing field, meaning that forecast accuracy for all periods is comparable between the northern and southern hemispheres.

The Australian Bureau of Meteorology (BOM)'s global NWP model uses more than 30 satellite data streams as input. Other international forecast centres, for example in Europe and the United States of America (US), use up to 100 data

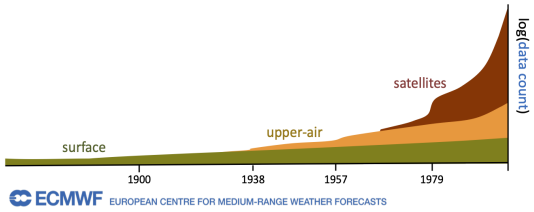
streams. The BOM model forms the Australian government basis for its climate predictions and climate-related policies for the country. This is exemplified in the recent joint CSIRO-BOM *State of the Climate 2024*[3] report that relies heavily on satellite data and provides key information to government and industry to help inform adaptation decisions and actions.

Climate change is impacting our prosperity and national security, the reliability of our food supply, and will result in increasing costs from loss and damage. Our ability to forecast such impacts is of major importance and will be a defining feature of a modern and resilient economy. Australia will be at a disadvantage if we do not have such capability, a capability that at its heart requires EO-data driven information supply.

EO's role in climate data and policy

Detailed climate data is vital in informing climate policy. The European Centre for Medium-range Weather Forecasting (ECMWF) produces a state-of-the-art climate dataset known as Reanalysis 5th Generation (AR5)[4]. This model, and others like it, form the foundation of our scientific understanding of the climate. These models are one of the key inputs to national and international planning and coordination efforts, including the work of the United Nations (UN) Framework Convention on Climate Change, and the UN Intergovernmental Panel on Climate Change.

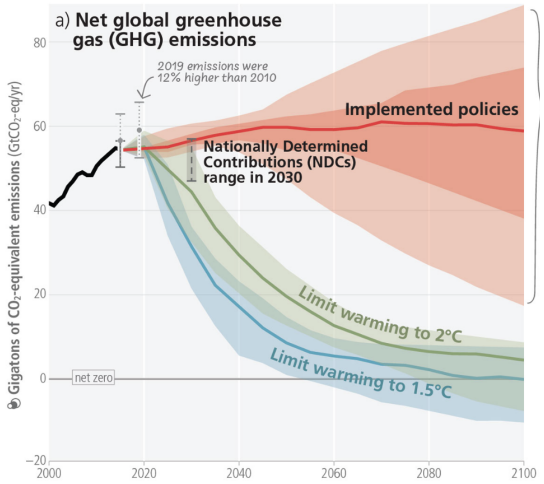
The scale and density of these datasets is remarkable, with AR5 based on global hourly data on atmospheric, land-surface and oceanic variables from 1950 through to near-real-time today. Collecting data at this scale and frequency is a massive accomplishment and satellite data is a cornerstone of this effort, providing extensive coverage of the Earth's atmosphere, oceans and land surfaces.



Observation sources making up climate datasets over time (Figure: ECMWF[5])

This data comes from a wide variety of instrument types, measuring parameters from space across a wide range of domains and types. These observations are collected and shared with Australia freely and openly by governments and companies in Europe, the US and Asia. None of these space-based observations are collected by Australia itself.

This data has informed the establishment of the legally binding Paris Agreement, which commits the governments of the world to achieving net-zero emissions. The Agreement includes a mechanism called the Global Stocktake which is conducted every five years (the first being in 2023). The Stocktake is based on Nationally Determined Contributions which are revisited periodically, seeking to assess progress towards net-zero and ratcheting up policy in line with ambitions to limit warming.



Nationally Determined Contributions and impact on expected warming (Figure: IPCC 6th Assessment Report, AR6[6])

The sustained, repeated and systematic observations on all scales provided from space are essential to informing the Global Stocktake process and the drive to limit warming.

The Global Climate Observing System (GCOS) has developed a set of Essential Climate Variables (ECVs) which critically contribute to climate characterisation and tracking. The ECVs seek to establish a broad assessment of the health of the climate. 55 ECVs have been identified across the atmosphere, oceans and land. Of these 55 variables, satellites have been deemed to make a significant contribution to 38, and many of these are exclusively derived from satellite observations.

The ECVs identify the observations needed to gather the empirical evidence required to understand, predict, and mitigate and adapt to climate change. The dependency of the ECVs on satellite observations underscores the importance of these observations in planning climate actions.[7]

Tracking methane emissions with EO

In addition to capturing important information on the past and the current state of the climate, EO satellites also have a key role to play in supporting the mitigation and prevention of future emissions.

Australia's energy and agriculture sectors contribute significantly to methane emissions, making EO data critical for meeting global climate targets. Methane is the second largest driver of global atmospheric warming, and reducing emissions of this powerful greenhouse gas is one of the most cost-effective ways to limit warming.[8]

The United Nations Environment Program (UNEP) has established the International Methane Emissions Observatory to provide open, reliable and actionable data to individuals and organisations who can act to reduce methane emissions. To a large extent, reducing methane emissions is a cost-neutral climate mitigation measure, with benefits for both industry and the climate. The International Energy Agency estimates that around 40% of the world's methane emissions could be avoided at no net cost,[9] representing a win-win for industry and the environment.

Data from EO satellites has led directly to states taking action. For example, a BBC report on a major 2023 methane leak in Kazakhstan relied on significant evidence from satellite images and observations and led to significant fines by the national regulator.[10]

Similarly, the Oil & Gas Methane Partnership 2.0 (OGMP 2.0)[11] is the flagship oil and gas reporting and mitigation programme of the UNEP. Australian companies are amongst those who have

joined the partnership, committing to a comprehensive measurement-based reporting framework, which improves the accuracy and transparency of methane emissions data from the oil and gas sector. Given the national interest in these sectors, the Department of Climate Change, Energy, the Environment and Water should encourage – or potentially mandate - Australian companies to engage. This will help increase competitiveness of these companies, including with trade partners who may become increasingly climate sensitive. Many new and emerging missions for this purpose have been documented by the Committee on Earth Observation Satellites.[12]

Advancing Australia as a contributor to global EO infrastructure

EO data is critical to understanding climate change. Climate information is increasingly important to many nations' prosperity, resilience and domestic and international security. This includes for mitigation and the legally binding net zero goal of the Paris Agreement, as well as to inform actions to support adaptation to an already changing climate.

In the case of adaptation to climate change within Australia, EO data assists in planning for sustainability of the Australian way of life and ensuring continued prosperity, stability and resilience. It also helps to assure adaptation in regions vulnerable to the increasing frequency and intensity of floods, fires and storms.

However, Australia's EO data supply is dependent on foreign sources. To date, Australia's access to data and state-of-the-art technology has been enabled by using commercial and foreign space-based systems. Given the vulnerability that comes with dependency, it would be prudent to consider how to secure Australia's EO data supply.

Technical agencies such as Geoscience Australia and CSIRO have long recognised the risks to Australia's EO data supply and developed the Continuity of Earth Observation Data for Australia (CEODA) series of reports to highlight these. The 2024 edition identifies more than 170 government programs that are dependent on EO data, most of which are valued at over AU$10 million each and have a high dependency on EO data.[13] The Department of Home Affairs should analyse the risks identified in the 2024 CEODA risks report and identify mitigations.

Despite not having any sovereign satellite programmes, Australia has continually invested in ground infrastructure and data management, as a support to its international partners, in return for the data they provide.[14] Geoscience Australia and CSIRO have led these efforts to date, including the satellite dishes leased from an Indigenous business, the Centre for Appropriate Technology in South Australia, and the recent commitment to support the US EO program, Landsat Next.[15] These agencies, together with BOM and the Australian Space Agency, should pursue a strategic and coordinated effort to sustain engagement and investment in key international partner relationships around EO data supply.

It is vital that Australia develop a whole-of-government strategy to mitigate the supply risks identified, including measures to ensure continuity and ongoing access to the necessary data streams and investment in key international supply partner relationships. Given that Australia's dependencies on this foreign-provided data covers a range of national priorities,

including urban planning, primary industry, national security and climate resilience, there is a role for the Department of the Prime Minister and Cabinet to lead a whole-of-government strategy on services from space, which would include not only EO, but also communications and position, navigation, and timing, to optimise for continuity and ensure access to the necessary technology and data.

Australia has benefited as much as, or more than, any other nation from the use of EO satellite data to address serious climate changes risks. To continue to do so without adequate and coordinated foresight and planning presents significant risks to both the supply of satellite EO data, as well as to the delivery of government programs and services Australian taxpayers expect.

To secure our climate future, Australia must act now to secure access to crucial EO capabilities, strengthen international partnerships and leverage emerging technologies. Failure to do so will leave us dangerously unprepared for the challenges of a rapidly changing world.

Notes

[1] A. J. Simmons and A. Hollingsworth, 'Some aspects of the improvement in skill of numerical weather prediction', *Quarterly Journal of the Royal Meteorological Society,* 128:580, January 2022, accessed 11 December 2024, https://doi.org/10.1256/003590002321042135
[2] Hannah Ritchie, 'Weather forecasts have become much more accurate; we now need to make them available to everyone', *Our World in Data*, 12 March 2024, accessed 11 December 2024, https://ourworldindata.org/weather-forecasts
[3] CSIRO and Bureau of Meteorology, *State of the Climate 2024*, Commonwealth of Australia, accessed 11 December 2024, https://www.csiro.au/en/research/environmental-impacts/climate-change/state-of-the-climate
[4] European Centre for Medium-Range Weather Forecasts, *ECMWF Reanalysis v5 (ERA5)*, https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-v5
[5] Dick Dee, *Use of satellite data in reanalysis,* , European Centre for Medium-Range Weather Forecasts, 2014, accessed 11 December 2024, https://www.ecmwf.int/sites/default/files/elibrary/2014/14665-use-satellite-data-reanalysis.pdf
[6] Intergovernmental Panel on Climate Change, *Sixth Assessment Report*, 20 March 2023, accessed 11 December 2024, https://www.ipcc.ch/assessment-report/ar6/
[7]Committee on Earth Observation Satellites, *Space Data for the Global Stocktake: Earth Observation Handbook 2023*, 20 November 2023, accessed 11 December 2024, https://eohandbook.com/gst
[8] Framework Convention on Climate Change, *Technical dialogue of the first global stocktake: Synthesis report by the co-facilitators on the technical dialogu*e, 8 September 2023, accessed 11 December 2024, https://unfccc.int/documents/631600
[9] International Energy Agency, *Global Methane Tracker 2024: Key findings*, accessed 11 December 2024, www.iea.org/reports/global-methane-tracker-2024/key-findings
[10] Marco Silva and Rayhan Demytrie, 'Company fined over massive Kazakhstan methane leak', *BBC*, 21 February 2024, accessed 11 December 2024, https://www.bbc.com/news/world-asia-68347437
[11] *Oil and Gas Methane Partnership 2.0*, accessed 11 December 2024, https://ogmpartnership.com/
[12] Committee on Earth Observation Satellites, *CEOS Database*, accessed 11 December 2024, https://database.eohandbook.com/ghg/
[13] Symbios, The University of Queensland and Earth Observation Australia Inc, *Continuity of Earth Observation Data for Australia: Risks*, April 2024, accessed 11 December 2024, https://www.eoa.org.au/news/2024/4/9/continuity-of-earth-observation-data-for-australia-risks-report-released
[14] Cassandra Steer, 'Australia's Maturing Space Capabilities in a National and Regional Context', *Asia Policy*, 19:4, October 2024, accessed 11 December 2024, https://www.nbr.org/publication/asias-space-ambitions-driving-the-next-chapter-in-global-space-competition/
[15] Department of Industry, Science and Resources, 'Australia to join US satellite program in Landsat 2030 International Partnerships Initiative', Media Release, 22 March 2024, accessed 11 December 2024, https://www.minister.industry.gov.au/ministers/king/media-releases/australia-join-us-satellite-program-landsat-2030-international-partnerships-initiative

Australian Centre for Space Governance

E contact@spacegovcentre.org
W www.spacegovcentre.org
linkedin.com/company/spacegovcentre

ACSG
AUSTRALIAN CENTRE FOR SPACE GOVERNANCE