

Transitioning Australian Research to Operational Earth Observation Products Prioritisation Workshop

Canberra 6 - 7 August 2019

Post-Workshop Report

for

The Earth Observation for Government Network



Earth Observation
Australia



Australian Government

Geoscience Australia

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1. Executive Summary

Earth Observation Australia has partnered with Geoscience Australia to establish and run the Earth Observation for Government Network (EOGN). The EOGN will maximise the benefits to government agencies in Australia at Commonwealth and State levels for using earth observation by:

- facilitating and sustaining a shared understanding of earth observation needs and uses in all levels of government;
- increasing the use of earth observation (EO) products and services by reducing barriers to access; and
- transitioning earth observation research to continental-wide operational products that are available for use by all levels of government.

As a part of this agenda the EOGN ran the Transitioning Australian Research to Operational Earth Observation Products Prioritisation Workshop. The workshop was held in Canberra on the 6th and 7th of August 2019.

The workshop:

- enabled direct Commonwealth and state government feedback on the Australian EO Capability Database (Appendix);
- established a framework to link earth observation research to operational delivery products and services from universities/research institutions to research infrastructure to the different operational capabilities of state and Commonwealth governments;
- completed a draft exercise linking policy needs through to EO products and service delivery; and
- informed the prioritisation of the next national EO operational workshops for EOGN which will take research-proven continental scale products to operational.

Workshop outcomes:

- A revised Australian Earth Observation Capability Database (see Appendix 1) for use by:
 - research agencies to prioritise EO research activities and partnerships;
 - research infrastructure programs to prioritise EO products to be transitioned from research proven to pre-operational continental scale products/services;
 - responsible Commonwealth and State Agencies to deliver operational continental scale products/services; and

- EO users interested to know what EO products are in the pipeline and will soon become available for use.
- Establishment of an engaged and active group of EO researchers, producers and users and refinement of a process that can be used to review and prioritise national and state EO products and services with a view for this to be run on an annual basis.
- Revised definitions of “operational” EO products and services for Commonwealth and state government activities.
- A mechanism to link State and Commonwealth EO activities and requirements in the short (1 year) and long (5 year) terms, to enable coordinated national planning and to inform the Australian Space Agency (ASA) of the current activities and future needs of EO in Australia.

Product priorities:

Research-proven EO activities that were identified as requiring prioritisation for their transition to nationally available EO products were:

- Land cover/land use
- Vegetation/biomass
- Water
- Topography

The EOGN will run a series of workshops to progress the transition of these activities in 2020, with land cover/land use and vegetation/biomass being first. In addition, support will be sought to run national webinars to progress the following activities:

- Fire
- Soils
- Biosecurity
- Coastal
- Oceanic

This priority list will continue to evolve and may change in response to the identification of urgent national needs.

EOGN beyond 2020:

Participants highlighted that this workshop must be considered the start of a sustained and regular conversation and an ongoing process that can be used to inform the advancement of EO use in Australian governments and in development and implementation of policies into the future. The Earth Observation for Government Network (EOGN) is currently funded until February 2020 through Geoscience Australia. A sustainability plan for the EOGN, 2020-2026 is presented with a view to EOGN delivering an enduring and coordinated collaborative network of Commonwealth and State

agencies, and research institutions and infrastructure that will continue to develop and deliver essential EO products and services. Ideally, this will be done in association with the Australian Space Agency's activities to coordinate EO across government, industry and research in Australia.

2. Objectives and Aims of the workshop

Primary objective:

To establish what EO products are research tested and ready to transition to operational delivery at continental scale through Geoscience Australia's Digital Earth Australia program, or other programs in government and industry where relevant.

Secondary objectives:

To establish priorities for future EO research and identify paths for transitioning these activities to operational capabilities.

A database of activities will be established and this process can be re-run each year to maintain an accurate picture of the research to operational continuum and drive EO research and uptake in Australia.

Workshop aims:

1. To review the Australian Earth Observation Capability Database (Appendix 1);
2. To understand Commonwealth priorities versus state priorities;
3. To develop a national research plan and priority areas of action; and
4. To use the research plan to guide further research workshops run by EOGN.

3. Australian Earth Observation Capability Database

The Australian Earth Observation Capability Database (Appendix 1) was established to provide a record of all Australian EO activities within the pre-research to operational continuum. By documenting these activities and making the information available throughout the EO community people are able to see what products are currently available for use and how they can be accessed as well as the areas of research and development for new applications of EO data.

Workshop participants were asked to provide input into the database as a part of the process of updating it prior to its use in the workshop breakout sessions. Moving forward the EOGN will be looking

at ways to ensure that the database captures all Australian EO activity, is publically accessible (likely through the EOA inc. website) and can be easily updated and maintained.

4. Workshop Agenda

Tuesday 6 August			
12:30	Welcome	<p>Beth Brunoro - First Assistant Secretary, Knowledge and Technology Division, Department of the Environment and Energy</p> <p>Dr Trevor Dhu - A/g Branch Head, National Earth and Marine Observations Environmental Geoscience Division, Geoscience Australia</p>	
12:50	<p>Introduction</p> <ul style="list-style-type: none"> • Aims and outcomes • Explanation of format • Code of conduct 	<p>Prof. Stuart Phinn - University of Queensland</p> <p>Alla Metlenko - Director, Data Enabling Services, Operations Section, National Earth and Marine Observations Branch, Environmental Geoscience Division, Geoscience Australia</p>	
13:10	EO Research to Operations Capability Database: Clarifications and discussion of all key terms and purpose	Alla Metlenko and Prof. Stuart Phinn	
13:30	Breakout discussion: Identifying requirements for the use of EO in 12 months and 5 years, covering policy drivers and technology at a high level	Everyone	<p>Break out groups and group lead:</p> <p>Commonwealth Ian Warren, Dept. of Environment and Energy</p> <p>State Matt Miles, Dept.for Environment and Water, SA</p> <p>Industry and NGOs Dr. Peter Scarth, Dept. of Environment, QLD</p> <p>Research Dr. Marta Yebra, Australian National University</p>
14:10	Report back and discussion to highlight priority policy and technical change drivers.	Prof. Stuart Phinn	
14:25	Break: afternoon tea		
14:40	<p>Review session 1: Operational level products</p> <ul style="list-style-type: none"> • Review of relevant products • Review of alignment between state/ territory agencies and commonwealth • Specification of improvements • Requirement for field data coordination and alignment • Identification of gaps 	Everyone	<p>Break out groups and group lead:</p> <p>Commonwealth - Ian Warren</p> <p>State - Matt Miles</p> <p>Industry and NGOs - Dr. Peter Scarth</p> <p>Regional Dr. John Leys, Dept. of Planning, Industry and Environment, NSW</p> <p>Research Prof. Albert van Dijk, Australian National University</p>
15:20	Report back and agreement on modifications	Prof. Stuart Phinn	
15:35	Break: tea and coffee		

15:50	<p>Review session 2: Pre-operational level products</p> <ul style="list-style-type: none"> ● Review of relevant products ● Specification of improvements ● Specification of the potential roles of collaborative infrastructure to support this ● Identification of gaps 	Everyone	<p>Break out groups and group lead:</p> <p>Commonwealth - Ian Warren State - Matt Miles Industry and NGOs - Dr. Peter Scarth Regional - Dr. John Leys Research - Prof. Albert van Dijk</p>
16:30	Report back and agreement on modifications	Prof. Stuart Phinn	
16:45	Wrap up and close of Day 1	Prof. Stuart Phinn	
Wednesday 7 August			
09:00	Recap of Day 1 and Introduction to Day 2	Prof. Stuart Phinn	
09:15	<p>Review session 3: Research-proven, research and pre-research products</p> <ul style="list-style-type: none"> ● Review of relevant products ● Specification of improvements ● Identification of gaps 	Everyone	<p>Break out groups and group lead:</p> <p>Commonwealth - Ian Warren State - Matt Miles Industry and NGOs - Dr. Peter Scarth Regional - Dr. John Leys Research - Prof. Albert van Dijk</p>
09:55	Report back and agreement on modifications	Prof. Stuart Phinn	
10:10	Break: morning tea		
10:25	<p>Final review: Groups to review each level of product specification, highlighting priorities for what products need to transition from research to operational.</p> <p>Focus on “cross field/ department validation of products” for use in ABS and National Accounts</p>	Everyone	<p>Break out groups and group lead:</p> <p>Commonwealth - Ian Warren State - Matt Miles Industry and NGOs - Dr. Peter Scarth Regional - Dr. John Leys Research - Prof. Albert van Dijk</p>
11:05	Report back and agreement on modifications	Prof. Stuart Phinn	
11	<p>Discussion Panel: Setting Priorities for the Future. A question lead discussion with panel providing initial commentary leading to questions from participants.</p> <ul style="list-style-type: none"> ● How the capability database can be used for guiding EOGN workshops and DEA. ● The process for updating the capability database so it continues to be used to transition products from research to operational and drive EO research and uptake in Australia. ● Achieving the best outcomes for all levels of government - Coordination of Australian Earth Observation Activities – Australian Space Agency Civil Space Priorities, and how this links to Space Coordination Committee 	Moderator: Prof. Stuart Phinn	
12:00	Break: lunch		

12:40	<p>Closing actions:</p> <ul style="list-style-type: none"> ● Finalise Australian EO research to operations assessment 2019 database ● Finalise research to operations process, across research institutions- research infrastructure – government – industry ● Actions for GA-DEA and other partners to progress research proven to operational, includes EOGN workshops and webinars ● Recommendation for Australian Space Agency EO Round Table and GA- EOA to set schedule and funds to repeat this assessment annually and publish results. 	Prof. Stuart Phinn	Draft set of action points to be tabled in EOGN report to GA and Australian Space Agency for government-research collaboration
13:10	Wrap up, thanks and close	Prof. Stuart Phinn, UQ	

5. Workshop Participants

Workshop participants were drawn from Commonwealth and State agencies as well as the research sector and industry and represented a diverse array of EO producers, supporters and users. A full list of workshop participants can be found at Appendix 2.

6. Workshop Output

During the breakout discussion and review session participants worked in three groups (Commonwealth, state, and research/ngo/industry) with a series of Google Documents used to capture points of interest, discussion and agreement. These full and unedited Google Documents have been included in the appendices.

Appendix 3: Breakout discussion

Appendix 4: What is 'Operational'?

Appendix 5: Review Session 1

Appendix 6: Review Session 2

Appendix 7: Review Session 3

7. Key Workshop Findings

1. Common requirements across Commonwealth and state levels of government include:

- Land (cover, use, value)
- Vegetation (clearing, regrowth, structural parameters e.g. biomass, condition, specific communities eg. riparian)
- Topography (elevation, erosion, subsidence)

- Water (extent, quality)
- Fire (fuel loads, burnt area, burn intensity, timing, frequency)
- Soil (mineral and clay content)
- Biosecurity
- Bathymetry
- Coastal - terrain, benthos and quality of water
- Oceanic – physical and biological oceanographic measurements

2. Commonwealth and state agencies in general, are tied to monitoring and reporting for specific Acts, State of Environment, ecosystems, and national and international agreement monitoring.

3. Commonwealth and state agencies' focus five years from now is on climate change impacts (water, energy, food security), and urban expansion and monitoring.

4. Commonwealth and state agencies' technological focus in five years includes:

- Increased variety of all scales and forms of data
- Increased ability to integrate all scales and forms of data
- Faster and larger processing, transfer and storage
- National training and validation databases
- Increased acquisition frequency
- Improved cybersecurity
- Consistent metadata
- Whole of process dashboard/access and control
- Visualisation
- Linked optical-SAR

5. The 12 month and 5 year focus for state agencies includes:

- Mapping programs for monitoring air, land and water resources and associated fauna, and livestock
- Measuring impact of management controls over time on air, offset and mitigation assessment, land and water resources and associated fauna.

6. A future focus for state agencies is on linking these to ground or water based autonomous sensors to improve spatial-temporal coverage and accuracy.

7. In terms of research:

- There is a general alignment of projects to support Commonwealth and state/territory information requirements. However, it is not a comprehensive alignment and some states/territories have well developed research to operational capability while others have very limited capacity.
- There is a very significant need to improve the use of National Collaborative Research Infrastructure Strategy (NCRIS) facilities for development, calibration and validation of EO data, products and services as there is a disconnect between NCRIS and operational state and Commonwealth EO activities. Ideally NCRIS enables research to be proven at continental scale, then the process and data can be transferred into an operational government program (e.g. Digital Earth Australia) to deliver operational products. EOGN can provide this essential linkage and the push to get it through.

8. Participants placed a high value on the networking opportunities that the workshop provided.

Knowledge sharing and discussing experiences in the application of EO products has lead to a more connected EO community with collaborations, particularly between Commonwealth and state agencies.

These key findings highlight the need for regular national meetings and webinars to keep lines of communication open and enable the sharing of experience and knowledge particularly between commonwealth agencies and state agencies and research and research infrastructure.

8. Workshop Outcomes

Key outcomes of the workshop are:

- A revised Australian Earth Observation Capability Database (see appendix 1) to be used by:
 - Research agencies to prioritise EO research activities and partnerships.
 - Research infrastructure programs to prioritise EO products to transition from research proven to pre-operational continental scale products and services.
 - Responsible Commonwealth and state agencies to deliver operational continental scale products and services.
- Establishment of a broad network of people working in state and Commonwealth agencies and a process to be used to review and prioritise national and state EO products and services to be repeated on an annual basis.

- Revised definitions of “operational” EO products and services for Commonwealth and state government activities.
- A mechanism to link state and Commonwealth EO activities and requirements for short (1 year) and long (5 year) to enable coordinated national planning and to inform the ASA of the current activities and future needs of EO in Australia. See diagram below.

Australian Space Industry EO Advancement



Source: Professor Stuart Phinn, Director, EOA

Acronyms: EO - Earth Observation, CRC = Cooperative Research Centre, DEA = Digital Earth Australia, NCRIS = National Collaborative Research Infrastructure, TERN = Terrestrial Ecosystem Research Infrastructure, IMOS = Integrated Marine Observing System, NCI = National Computational Infrastructure, CSIRO = Commonwealth Scientific and Industrial Research Organisation, AIMS = Australian Institute of Marine Science, GA = Geoscience Australia, EOGN = Earth Observation for Government Network (part of EOA), JRSRP = Joint Remote Sensing Research Program (part of UQ Remote Sensing Research Centre),

- Priority listing of the following EO products and services to proceed to national workshops:
 - Land cover
 - Vegetation and Biomass
 - Water
 - Topography
- Priority listing of the following EO products and services to proceed to national webinars:
 - Fire
 - Soils
 - Biosecurity
 - Coastal
 - Oceanic

Priorities for both workshops and webinars may change as data and product needs emerge in response to environmental events or policy developments. Updated lists of EOGN workshops and webinars will be available on the EOA website.

- A sustainability plan for the Earth Observation for Government Network, 2020-2026, to deliver an enduring and coordinated channel for communication and collaboration between Commonwealth and State agencies, and research institutions and infrastructure that will continue to develop and deliver essential EO products and services.

9. Proposed Activities

Based on the identified priorities the proposed activities and schedule for EOGN through to February 2021 are as follows, and will be linked with Earth Observation Australia national, whole of community webinars when required:

Topic	Activity
Land cover/land use	A pre-workshop webinar - Late January 2020 Workshop (Canberra) - Late March 2020
Vegetation/Biomass	A pre-workshop webinar - Late January 2020 Workshop (Canberra) - Late April 2020
Water	A pre-workshop webinar - June 2020 Workshop (Canberra) - July 2020
Topography	A pre-workshop webinar - June 2020 Workshop (Canberra) - July 2020
Fire Note - due to the extensive 2019/20 fire season in Australia and the level of interest in the EOA Whole of Community webinar 'Understanding Fire in the Australian Landscape', this area is likely to become a higher priority activity, and may have three webinars in Q1-Q2 2020.	webinar - April 2020
Soils	webinar - August 2020
Biosecurity	webinar - October 2020
Coastal	February 2021
DEA skills regional outreach	Online workshop to build skills and encourage the use of DEA. Similar to Copernicus Hub workshop. Government/industry collaboration (suggest partnering with CRC SmartSAT and FrontierSi) - April 2020
Capability development	Webinars to be established on technical and soft skills for EO users – data acquisition, storage,

	processing and distribution technologies. To be presented as panel based guided webinars to keep up to date and introduce industry where relevant. - May 2020 - February 2021.
Government/Industry links	Discussions through EOGN on strengthening Government and industry support and collaboration - ongoing

10. Moving forward - Sustainability Plan for the Earth Observation for Government Network, 2020-2026

Given EOGN's network of collaborators and ability to work with Commonwealth, and State governments as well as researchers, research infrastructure providers and industry in a collaborative, dynamic and timely way, it is clear that EOGN has the potential to play an important role in being a conduit between these sectors within the EO community.

By ensuring EOGN has a structure and funding arrangements to make it sustainable, EOGN will be able to deliver a process that ensures Australian government agencies (Commonwealth and state) are able to continue to access and to improve EO based products and services to support their activities, including data, algorithms, skilled staff and collaborations. This process will directly inform applied research priorities and use of national research infrastructure for EO. By doing so the process will also provide a link for Australian Space Agency (ASA) to be informed of the status of government EO use and future needs.

Partnerships

In addition to continuing to partner with Geoscience Australia to bring continental scale EO products to delivery through Digital Earth Australia, and other appropriate platforms, and reducing barriers to access for users, EOGN has the potential to inform and support the work of the Australian Space Agency (ASA) in addressing its "increasing earth observation capacity" civil space priority as part of its current civil space strategy.

It is therefore suggested that:

- o EOGN meetings continue to include an ASA representative
- o EOGN provides direct reports to the ASA Australian EO Technical Advisory Group (Round Table) highlighting any whole of government (Commonwealth and state/territory) needs to ASA, and communicating ASA requirements to relevant EO communities.

Tasks

Moving forward EOGN will be responsible for the following activities in association with the ASA to ensure Australia’s EO communities remain connected and coordinated in supporting Commonwealth and state/territory government EO activities as well as those of the ASA. The activities to be completed regularly and provided as services are:

- Updating the Australian Earth Observation Capability Database to be used to:
 - guide EOGN workshops and DEA
 - transition products from research to operational and drive EO research and uptake in Australia.
- coordinate Australian earth observation activities leading to the best outcomes for all levels of government

It is proposed that EOGN will operate as a service provided through Earth Observation Australia to Geoscience Australia, Australian Government Earth Observation from Space Working Group and the Australian Space Agency Earth Observation Round Table.

General schedule of activities

Schedule of Activities (post May 2020)

- EOGN Steering Committee meetings every 2 months (online meeting)
- All participants (advisory group) meet every 3 months to review and update the EO capability database (webinar)
- Annual national research to operations workshop face to face (2-3 days) - to align with AEO Forum
- Up to 3 other national webinars on EO product development and 2 webinars on capability development (note this is 1 FTE to run)
- Bi-weekly coordination meetings with GA and ASA
- GA to fund 2020/2021 and GA and ASA to fund beyond 2021

Required Resources

- Website
- Secretariat (1 x 0.5 FTE dedicated position and operating)
- Education/Research
- Steering Committee
- EO Roundtable
- EOA
- Annual national research to operations workshop
- Regular webinars

Item	In-Kind	Direct Cost
Coordination and communication activities - Secretariat for 0.5 FTE, Research Officer HEW 6-7, + oncosts		56,000

- Office space and resources	15,000	
Webinar set up and operations		6,000
Website hosting and maintenance	5,000	
2x Workshop organisation and delivery (travel, accommodation, operating)		30,000
Total per 12 months	20,000	102,000

In-kind Contributions: EOA and ASA, GA, CSIRO, BoM and Defence

Appendix 1: Australian Earth Observation Capability Database

<https://drive.google.com/file/d/11zgY0MZpyghC6KgrN1zmX9GxLkPhPwOo/view?usp=sharing>

Appendix 2: Workshop participants

Alla Metlenko	Geoscience Australia
Leo Lymburner	Geoscience Australia
Terry Hills	Department of Environment and Energy
Ian Warren	Department of Environment and Energy
Katrina Phillips	Department of Environment and Energy
Fiona Dickson	Department of Environment and Energy
Alison Cowood	Department of Environment and Energy
Jeremy Groves	Department of Environment and Energy
Lauren Carter	Department of Environment and Energy
Juan Guerschman	CSIRO
Kristen Williams	CSIRO Land and Water
Jane Stewart	ABARES
Tom Walter	Australian Bureau of Statistics
Stuart Phinn	UQ
Albert Van Dijk	ANU
Marta Yebra	ANU
Peter Scarth	Department of Environment and Science (QLD)
Katherine Zdunic	Department of Biodiversity, Conservation and Attractions (WA)
Chris Jackson	Department of Environment, Land, Water & Planning (VIC)
Matt Miles	Dept. for Environment and Water, SA
Lindsay Mitchell	Dept. of Primary Industries, Water and Environment (TAS)
David Weldrake	Murray Darling Basin Authority
Matthew Bethune	Murray Darling Basin Authority
John Leys	Department of Planning, Industry and Environment (NSW)
Marie-Chantal Pelletier	Department of Planning, Industry and Environment (NSW)
Sue Rea	Department of Planning, Industry and Environment (NSW)
Grant Staben	NT Government

Appendix 3: Breakout Discussion

Identifying requirements for the use of EO in 12 months and 5 years, covering policy drivers and technology at a high level

	Research/NGO/Industry	State	Commonwealth
<p>Identify your group's main policy drivers for collecting and using EO data, products and services, over the next 12 months. [Note - this can be at a high/summary level]</p>	<p>Whole of landscape biodiversity biomass and leveraging new EO space borne lidar and radar. Land cover, water - that can be extracted from existing and new EO data sources. Human health, emerging research on birth weights, mental health and education performance (NAPLAN) - e.g. correlation of birth weight vs bare soil, and atmospheric/climatic changes. Fire impact modelling, mitigation, vegetation recover and habitat condition, help determining species distribution. Environmental offset to encourage preservation of biodiversity.</p>	<p>Main drivers:</p> <ul style="list-style-type: none"> ● Biodiversity legislation in most states (Regional Forest Agreements) forestry, fisheries <ul style="list-style-type: none"> ○ habitat mapping as input to modelling ○ Veg clearance and regrowth (NSW has budgets) ○ Veg structure ○ Woody veg legislation ○ Natural/non-natural condition eg native grasslands ○ Fire tracking - burnt area, frequency, timing, intensity ○ steep lands erosion risk - elevation -regulate clearing ● Coastal Acts <ul style="list-style-type: none"> ○ Coastal management (erosion) and protection acts ○ Inundation and vulnerability ○ Marine Parks ○ Near shore marine - seagrass ● Water Acts <ul style="list-style-type: none"> ○ Riparian zones ○ Water quality , aquatic ecosystems, wetlands - MDB Plan ○ Groundwater Dependant Ecosystems ● Planning Acts <ul style="list-style-type: none"> ○ Land use /management ○ Urban issues - livability ● Aboriginal Acts <ul style="list-style-type: none"> ○ Aboriginal heritage - mapping cultural heritage, use of EO to model site risk (tas), NSW use DEMs and veg type and geomorph (sandhills) to model ● Emissions acts <ul style="list-style-type: none"> ○ Carbon credits (NT)- Fire tracking - burnt area, frequency, timing, intensity 	<p>Land Cover - NRM Land Cover - EEA Land Cover / Fractional - ABS Data GA</p> <p>Change Detection, Land Cover - International</p> <p>Main Policy Drivers</p> <p>EPBC Act - Regulation - Impact warning Systems and Compliance EEA - Land Value, Land Use - National Strategy Plan signed on by the states State of the Environment - State of The Forest Reporting Environmental Investment (NRM) - Monitoring, Prioritisation Natural Resource management and monitoring (Landcare) Greenhouse Reporting - International Reporting - IPCC, Obligations - Kyoto and Paris Agreement Emission Reduction Fund - Montreal Biosecurity</p> <p>Cloud based - IT Security / Cybersecurity leg</p>

		<ul style="list-style-type: none"> ○ Air quality ○ Soil erosion ● Mining Acts ○ Minerals ○ Veg change ○ Subsidence 	
Identify your group's likely main policy drivers for collecting and using EO data, products and services, 5 years from now. [Note - this can be at a high/summary level]	Human health and impact of climate change. Finding dry land. Finding and using water more effectively. Integrative science to better cope and adapt to natural disasters and improve usage of resources including ground water. Scale effects. Semantic Segmentation.	<ul style="list-style-type: none"> ● Climate change ● Water security ● Energy security ● Urban expansion ● Impervious surfaces (started in Vic) ● Heat mapping ● Canopy cover ● Food security - change on land use and crop types ● Coastal monitoring (NT) - sea level rise ● Animals <ul style="list-style-type: none"> ○ Thermal sensors to find pigs in forests (in development in WA) ○ Monitoring data for abundant species - roos, pigs, camels, birds ● Weed monitoring and mapping 	As above plus: Water and Carbon Blue Carbon Climate Change impact Urban Extent monitoring - Energy EPBC - Agricultural Clearing From Boolean change ---> Why the change has occurred
What does your group consider the main technological changes will be over the next 5 years that will significantly impact or change how you collect and use EO data, products and services?	Integration of data sources will become essential, combining spatial, optical and radar and other sources operationally. New data sources from low orbit satellites, geospatial satellites. Machine learning, curation of national training data to build intelligence for prediction and forecasting. FaaS.	<p>In 5 years time, can we see all of the current needs at better scales, resolution? And repeated measures to see change Increased product confidence from year 1 ie sufficient ground observations across whole country), Collation of ground observations</p> <p>Hi-res (10cm) hyperspectral Monthly burned area mapping (WA) Radar change mapping Storage for drone data Access to large data stores - decision support interfaces - free</p> <p>LiDAR</p>	<p>Faster update IT Infrastructure - Cloud DGGS - Thematic Standards Linked Data Standards</p> <p>Algorithm metadata - Approved and peer reviewed - Cover type limitation Controlled vocab - ie "definition of forest" Ground truthing coverage</p> <p>Future platforms - building future compatibility</p> <p>Better resolution Bigger datasets Bigger compute More sensors</p> <p>3D and small sat - 1m daily - where do we store and access Increasing API access, Distributed compute</p> <p>Government agencies falling behind in regards to tech - Cybersecurity, FTP, restrictions Approved software to access infrastructure -</p>

			<p>Visualisation dashboards</p> <p>Web based access to compute ie NCI - IT departments get nervous at software that needs to be installed</p>
Any other comments relevant to this session?	<p>Convergence of government and industry digital and data infrastructure - increase disruptions expected. e.g., increase in the speed of change. Standardisation of functionality and interoperability. Deluge of data and being able to make sense of it. Smart Satellites. Increase in data latency that will allow for users to get information in near-real time.</p>	<p>drone data challenges . consistent, agreed grids for agregating and modelling accessibility to large growing amount of products - instantly access to latest products education of higher level officials to enable sustainability of access tools created within a project education to enable business process within state agencies to make use of new products as they may modify the way - perhaps demonstrations of what has worked in the past as government and programs and available technology have changed</p>	<ul style="list-style-type: none"> - Imagery subscriptions and whole government access and negotiation - Government agencies are getting more restrictive in regards to technology - installing software and using programming languages is being locked down - there is a need to have easy way of accessing/analysing data in cyber-security friendly way - Big data / ML / serverless tech

Appendix 4: What is ‘Operational’?

Participants were also asked during the Breakout Session to jot their thoughts on post-it-notes to the question ‘what is operational?’ This produced several key findings that highlight significant differences between what each agency considers is suitable for “operational” applications, including whether a product is:

- accessible 24/7, 365 days a year
- Reproducible/replicable with publicly available documentation
- Verified and validated with evidence and meta-data that can be checked
- Fit for a specific use

Responses to the question ‘what is operational?’ were:

Operational means never having to say you're sorry.	In use and available.
Reliable (someone ready to fix if it breaks. Continuous application dependant.	Something appropriate, validated, supported and accessible within the time constraints of the system and task at hand.
Available all the time, reliable and repeatable.	It's the right product in the right form.
Works/accessible when needed. Reliable - confidence in what it represents.	It just works when you need it. Like calling an Uber (in the city).
Information used to make decisions on a daily, weekly, monthly or yearly time frame.	I can rely on it being there when I need to make a decision. Daily, weekly, quarterly, yearly, 5 year
Accessible: - Technically - legislation Agreed: - supported by all levels of government and industry Ongoing: - updated data	Operational for a (State government) monitoring program must have regularity that matches the program. 5yr: SOE 1yr: funding Seasonal: landscape
Working on demand. Reliable delivery frequency. Good metadata.	It's there when I need it!
Fit for purpose. Clearly/thoroughly documented. Attributes defined. Accuracy/reliability known/articulated. Maintained. Validated.	Reliability of service (downtime). Latency. Future-proof (inputs, maintenance) QA/QC, documentation
Reliable - any spatial product which can provide information in a consistent and uniform way and which meets its clearly stated objective.	Accessible in a timely fashion (i.e. refresh rate less than 10 seconds) across a variety of locations Australia wide 24/7 with known prior outages at low usage times with the ability for offline access.
Embedded within a business system of standards and process implemented by an entity (government/industry) that tables primary responsibility to maintain and deliver products for a defined need and end users in an ongoing way.	EO products produced automatically with a given time frequency, system is reliable and accessible 24/7 but information does not necessarily need to be updated daily.

Appendix 5: Review Session 1

Review session 1: Operational level products

- Review of relevant products
- Review of alignment between state/ territory agencies and commonwealth
- Specification of improvements
- Requirement for field data coordination and alignment
- Identification of gaps

	Research/NGO/Industry	State	Commonwealth
Which products are suited to your applications?	<p>VHR=<10m, HR=10-50m, MR=50-500m, LR>500m</p> <p>Operational:</p> <ul style="list-style-type: none"> - LR evapotranspiration (BoM AWRA) - Sentinel Hotspots - WOfS (DEA, but NCI bound) - HR Frac Cover * - MR Frac Cover (NCI) - BoM AWRA <p>Pre-operational:</p> <ul style="list-style-type: none"> - HR evapotranspiration (e.g., CMRSET) - MR fuel moisture content (AFMS) - HR burn scar (GA-ANU DEA) - DEA derived services and products (GA, CSIRO, ANU) - Australia's Environment vegetation, water, carbon, fire etc (annual synthesis products) <p>Input to (pre-)operational:</p> <ul style="list-style-type: none"> - HR and MR BRDF reflectances 	<p>Rainfall</p> <p>Vegetation Change</p> <p>Fractional Cover</p> <p>Ground Cover</p> <p>Persistent Green Surface reflectance</p> <p>Water Observations from Space - continental water recurrence percentage since 1986.</p> <p>GA Surface Reflectance from Landsat and Sentinel 2</p>	<p>WOfS, 500 m fractional cover, DoEE veg change, Intertidal extents</p> <p>Annual vegetation cover and change - DoEE</p> <p>Urban extent and change - ABS, DoEE</p> <p>FAO classified landcover - ABS, foundation to landuse mapping - ABARES</p> <p>Integrated condition product - NDVI, ecosystem type & condition & change, fractional cover</p> <p>WoFS - DoEE</p> <p>ITEM & mangroves - DoEE</p>
Specification of improvements to existing earth observation products so that they are suited to your applications	<ul style="list-style-type: none"> - Derived services and products: summary & interpretative, e.g., customised to meet particular policy or management. - Improve latency, e.g. immediate (fire risk, flood) but also regular (e.g., NCAS, dynamic land cover) - Data access (e.g., DEA on NCI) - MR hi-freq data ingestion into DEA (Sentinel-3, MODIS) 	<p>Rainfall and Met data - Fast API Access</p> <p>Vegetation Change - Not as lat-long! Equal areas. Faster turnaround :)</p> <p>Fractional Cover - Customised compositing and NRT generation</p> <p>Ground Cover - Needs to be operationalised</p> <p>Persistent Green - Needs to be operationalised</p> <p>Water Observations from Space - NRT and adapting for other sensors</p> <p>GA Surface Reflectance from Landsat and Sentinel 2 - Critical to have as tiles/chips for easy ML ingest</p>	

Requirement for field data coordination and alignment so that they are suited to your applications		Nothing specific. All operational and validated.	Field/training data coordination to support traditional and machine learning/AI approaches and an enduring system of field data collection that's acquired with EO product validation in mind. Vegetation training data
Review of alignment between state/territory agencies and commonwealth – earth observation and field data requirements and activities		Possibly water colour samples to improve water models. Single point help desk for operational product issues	Vegetation change - clearing and regrowth with State SLATS data
Identification of gaps in operational earth observation products list		Burnt area (for masking)	Where is the coastline, native forest harvesting data, urban extent, FAO land cover, agriculture, crop presence/absence, broad type, commodity specific, ecosystem types (from land cover) - Oz . Vegetation structure (height/above ground woody biomass). Wetlands/farm dams from a fullcam perspective. Reef and island vegetation

Appendix 6: Review Session 2

Review session 2: Pre-operational level products

- Review of relevant products
- Specification of improvements
- Specification of the potential roles of collaborative infrastructure to support this
- Identification of gaps

	Research/NGO/Industry	State	Commonwealth
Review of products - which products are suited to your group's applications?	<p>- HR annual crop mapping (CSIRO, Crop Frequency & Type report, Long Paddock)</p> <p>- HR evapotranspiration (e.g., CMRSET)</p> <p>- MR fuel moisture content (AFMS)</p> <p>- HR burn scar (GA-ANU DEA)</p> <p>- DEA derived services and products (GA, CSIRO, ANU)</p> <p>- Australia's Environment vegetation, water, carbon, fire etc (annual synthesis products)</p> <p>Vegetation condition and phenology</p> <p>Fractional cover dynamics</p> <p>Rangeland/pasture aboveground standing biomass</p> <p>Rangeland/pasture net-primary productivity dynamics</p> <p>Fractional cover</p> <p>Persistent fractional cover</p> <p>Ecosystem Disturbance</p> <p>Vegetation condition and phenology</p> <p>Fractional cover dynamics</p> <p>Rangeland/pasture aboveground standing biomass</p> <p>Rangeland/pasture net-primary productivity dynamics</p> <p>Fractional cover</p> <p>Persistent fractional cover</p> <p>Ecosystem Disturbance</p>	<p>solar exposure - unknown for this group</p> <p>NDVI - yes but use from various sources</p> <p>Surface reflectance - yes but use from various sources - what is fit for each purpose - many use JRSRP, AGO</p> <p>Fractional Cover - problematic in WA (Land monitor starting to do it with DoEE), NSW uses CSIRO and JRSRP versions inc seasonal products, Tas uses but only from time to time knowing its problematic in areas, NT use it from JRSRP sentinel and landsat plus own seasonal products; Vic uses from JRS; SA uses with local modifications would prefer to consume off the shelf. Take home = states essentially use one of just a few sources</p> <p>Persistent green - every state uses one way or another</p>	<p>Soil attributes and landscape grids</p> <p>Biomass</p> <p>Fractional</p> <p>Growing season and NDVI</p>
Specification of improvements - to existing EO products so they are suited to your group's applications?	<p>- We definitely need crop mapping</p> <p>Vegetation condition and phenology</p> <p>Fractional cover dynamics - customised stats</p> <p>Rangeland/pasture aboveground standing</p>		<p>- Lack of documentation of these products</p> <p>- Done for a set period of time and not continued</p> <p>- No metadata or publication backed data</p>

	<p>biomass - national land type maps required!</p> <p>Ecosystem Disturbance - in a database corresponding to disturbance types</p>		<p>Hard to determine your best bang for your buck - economic saving</p> <p>Hard to determine fit for purpose - resolution / fit for purpose</p> <p>Public - negative and positive risks</p>
<p>Requirement for field data coordination and alignment - to existing EO products so they are suited to your group's applications?</p>	<p>- CSIRO has a survey based crop data base (National Paddock) would be great to publish</p> <p>- standardise JAXA (TERN) biomass database</p> <p>- burn extent (AFAC)</p> <p>- fuel structure and moisture (GlobeFMC)</p> <p>Forest/rangeland/pasture aboveground standing biomass</p> <p>Ecosystem Disturbance</p>		
<p>Review of alignment between State/Territory agencies and Commonwealth - EO and field data requirements and activities</p>	<p>See TERN field forms for biomass, fire, FC etc.</p>	<p>woody Veg change - WA uses NCAS (they have invested in NCAS over time with ground observations) , NSW uses SLATS and Tas uses SLATS method but home bakes it, SA has SA Land Cover but this is only 5 year epochs and looking to be more regular, NT under development, Qld using 'new' version of SLATS (inc regrowth). Take home = ad-hoc coordination at best resulting in different resulting numbers.</p>	
<p>Identification of gaps in pre-operational EO products list</p>	<p>- biomass time series EO</p> <p>- pasture growth (NPP)</p> <p>- land type / community mapping (veg X soil)</p> <p>A perfect Sentinel 2 cloud mask!!!</p>	<p>Improvement suggested:</p> <ol style="list-style-type: none"> 1. 'WMS' or Geoglam/veg machine style access to any of the 'number 2' listed to enable. including mosaics. Geoglam does not consume #2's yet 2. Ensure quality of data output products - calibration/validation for any given region - 3. Can we build ability to support local ground data to test and implement a standard algorithm? Should that then feed back into national models or kept separate? 	<p>Vegetation type and condition time series</p>

		<p>4. Perhaps an organization could configure their own 'workbench' with access to smaller local scale hi resolution data and reporting tools</p> <p>5. Needs good and useful metadata to enable fit for purpose</p> <p>6. Training for people to know these exist</p> <p>7. Ability to download and overlay use with your own data in your own system</p>	
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Appendix 7: Review Session 3

Review session 3: Research-proven, research and pre-research products

- Review of relevant products
- Specification of improvements
- Identification of gaps

	Research	State	Matt Miles (DE&W,SA)
Review of products - which products are suited to your group's applications?		<p>Surface brightness - NSW uses for dust plume id, evapotranspiration</p> <p>Urban extent</p> <p>LCCS ? need better spatial resolution than current land cover</p> <p>Impervious surfaces - Vic starting in on this</p> <p>Land Management practices is needed, understand that this is currently in research stage</p> <p>Spraying, grazing, ploughing, cropping</p> <p>Evapotranspiration- monthly MODIS product published (Guerschmann, 2009) MDB</p> <p>Sustainable Yields</p> <p>Albert working on similar landsat product</p> <p>Veg extent (tree cover) from ML</p> <p>Cumulative rainfall grid</p>	most of the list is useful to some part of our business.
Specification of improvements - to existing EO products so they are suited to your group's applications?		<p>Gaps - native veg that's not trees: chenopods, grasslands</p> <p>LCCS looking good but a native element needed, perhaps density</p>	<p>our priorities would be to test and improve validation/confidence of multiple products to SA environments. eg fractional cover for rangeland condition, woody veg extent (including native/non-native split, land cover LCCS including urban extent. and even crop type.</p> <p>tassel cap for wetland and groundwater connection is very valuable for wetland delineation and persistence as well as drought refugia.</p> <p>burn scar mapping</p> <p>operationalization of access (i.e training our staff to know how to access and use trusted products) s a key 'improvement' challenge</p>
Requirement for field data		see veg condition in comments	

<p>coordination and alignment - to existing EO products so they are suited to your group's applications?</p>			
<p>Review of alignment between State/Territory agencies and Commonwealth - EO and field data requirements and activities</p>			
<p>Identification of gaps in research-proven, research and pre-research EO products lists</p>		<p>Blended products that could 'improve' spatial and temporal resolution. Perhaps guidance needed for when to blend and what to blend - testing needed. Sometimes products can be made worse, but done well, improvements are possible. States wanting to know what is fit for use in Aus from the range of products from eg sentinel.</p>	
<p>Any other comments for this section?</p>		<p>Veg condition - review needed of the variety of approaches. All states want it and do their own methods mainly for woody. What are the barriers to attaining a condition product - political, technological? We are replicating the work and defending research patches. Conceptually similar, implementation different. States have different field measurement. How do we scale that up to national approach . Conversation needed about things we always need to measure in the field. Perhaps a group like NCLUMI that enables cross over and learning. NVIS group is one part of the equation but combining with EO community is key to pushing through. HCAS method created by locking ecologists and Remote sensors in a room to work out the solution. This hits biodiversity issues (yes?) but not rangelands. So an approach is needed that</p>	

		<p>enables moving away from 'one condition measure can be fit for all purposes'. Lots of smart people around thinking about this area (from field work, to modelling to EO) - but we need some efficiency in this.</p> <p>Two opposing objectives - production, conservation need to be recognized when talking of 'condition'. Then there is reporting to assess the spending of money on program initiatives, ie funding masters need reports on activity that do not necessarily inform the state of an asset.</p> <p>From EO research point of view: Understanding fundamental biophysical parameter and spatial and temporal scales that are appropriate. EO research can provide the set of 'key EO attributes' and present ways for users to pick and choose which to combine. Perhaps a dedicated workshop needed on base level products and agreed algorithms to derive a blended product. Then there is attribution or interpretation to understand what is happening at a pixel, rather than simply a correlative model that produces a class.</p> <p>For time being, EO research is constrained to currently operational data streams. Yes benefits lie in future combination with field, lidar, hyperspectral data streams.</p> <p>Data quality issue: USGS sets water boundary that had implications for MODIS coastlines - western facing coasts are problematic. A collective approach to 'fixing' this could enhance national ways of dealing with this data. Is there a need to be aware of this kind of issue for future platforms such as sentinel?</p>	
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Appendix 8: Final Review

Groups to review each level of product specification, highlighting priorities for what products need to transition from research to operational.

Focus on “cross field/ department validation of products” for use in ABS and National Accounts

Which products are essential to transition from the pre-operational stages as soon as possible to be used for your group's applications (and why)?	Are there other EO products not listed in our reviews that are essential to transition from the pre-operational stages as soon as possible to be used for your group's applications (and why)?	Are there any “cross field/ department validation of products” that can be undertaken to assist these activities?	Any other comments for this section ?	Name - Affiliation
<p>Land Cover - LCCS classification based. Covers requirements for many areas of interest as well as National reporting for Environmental Accounts. State/research based products will feed into specific classes (important to get agreement on how this is applied across all jurisdictions to give endorsement).</p> <p>ABS interest in change/detection of urban extent (another sub-set of LCCS).</p>	<p>ABS interest in getting to specific crop types. Acknowledge the challenges here and see broad crop/non-crop as a precursor. Another subset of Land Cover.</p>	<p>Yes, collaboration through the EOGN group, Environmental Accounting group and NCLUMI would be appropriate forums to identify best value opportunities for this.</p>		<p>Tom Walter - ABS</p>
<p>New land cover product from GA; blended products to unlock temporal and spatial resolution; veg condition products (but noting HCAS & MDBA stand condition work - to be built on and further calibrated /validated); improved WOFS & snow line cover products.</p>	<p>Yes, it's essential to build a national framework of conceptual models - without this impossible to guide and ensure strategic allocation of resources to build training data sets and interpretation of RS (including of blended products) will remain limited; sorting out standards for data streams provided by NASA, USGS etc so they are not pre-processed sub-optimally by data providers.</p>	<p>Continue to build the Australian Ecosystem Models Framework (and other in state / territory dynamic ecosystem models); cross-evaluate MDBA stand condition & HCAS condition products.</p>	<p>useful conversations - should happen regularly</p>	<p>Fiona Dickson - DoEE</p>
<p>N/a</p>	<p>Annual coastline position to provide insight into coastal erosion hotspots. Above ground woody</p>	<p>Co funded field campaigns of TLS for AGWB. Collation of existing wetland survey</p>		<p>Geoscience Australia</p>

	<p>biomass to compliment optical based estimates of canopy cover. Fractional cover of water measures to compliment terrestrial fractional cover products.</p>	<p>results and consistent experimental design for future surveys designed to validate water FC. Collation of existing beach surveys and coastal LIDAR Surveys</p>		
<p>In order of priority: 1) Successfully NRT cloud-masked Sentinel-2 : essential for many services going forward 2) low latency (January subs. Year) annual summary statistics (min,max,average,median) of existing DEA products: wofs, fract cover, lccs level 1 and 2. Would avoid large & potentially duplicating processing. 3) low latency annual forest cover (by any definition, eg NCAS). For env reporting -currently nothing available. 4) NRT landsat/ Sentinel evapotranspiration product. Would support rollout of current local area to nation-wide water license compliance monitoring. 5) annual forest burn extent (aka BurnCube) product. Important for use in land cover change attribution.</p>	<p>Apols, haven't checked #1 against that list</p>	<p>Likely, but trials (eg pilot accounts) are the most effective way of evaluating products imho, and will lead to better specified field data collection requirements.</p>	<p>Recommend a workshop on evaluating the use of EO products in env accounting trials so far, connecting govt initiatives with research projects. Would be happy to help organise.</p>	<p>ANU Centre for Water and Landscape Dynamics</p>
<p>Water extent, ecological condition and vegetation extent. Linking hydrograph to satellite imagery Evapotranspiration, irrigated extent and farm information (AKA Northern Basin Work)</p>	<p>Background Technology - improved interfaces between difference data sources and consistent formats to make analysis more efficient and consistent and prevent duplication of data. 3d surface mapping for detecting land infrastructure changes (eg levees or farm dams).</p>	<p>Happy to support validation for MDBA relevant products. Give us a call. Have high spatial resolution irrigated horticulture extent (including crop type) for validation Happy to support validation of the Tasselled Cap Wetness methods for determining full inundation extent.</p>	<p>A central source for processing and access to data from different sources (eg GA/Google Earth Engine etc). A national approach for high resolution imagery access and use (ie Planet).</p>	<p>Dave and Matt - MDBA</p>
<p>Vegetation height and structure, Biomass, Land cover types- Important for example for fire risk modelling All fire-related products (fire extent, fire severity, etc..)</p>	<p>The Australian Flammability Monitoring System (AFMS)-We are already talking to GA to transition the system to them for an operational long term maintenance. It is important for this to happen ASAP as the project funds finish July next year and the ANU will not be able</p>	<p>Different fire departments regularly collect data on burned extent that is not standardized nor compiled in a single repository. Having an standardized database would greatly help to validate burned extent algorithms</p>	<p>Most of the times different groups develop different algorithms to generate the a specific remote sensing product. Cross-comparison activities using standardized validation databases are always beneficial to build up</p>	<p>Marta Yebra-ANU</p>

	<p>to maintain the system beyond that date.</p> <p>Burned extent and fire severity- ANU developed the burncube, an algorithm that uses Landsat imagery in the DEA. There is a need for a consistent continental scale algorithm so agencies can report for example on carbon emissions.</p> <p>Vegetation recovery after disturbance. This information is essential for example to estimate fuel accumulation after fire or plan restoration activities for biodiversity conservation. There are some research products that could potentially be transitioned to a pre-operational stage (e.g Massetti et al. 2019, RSE)</p>	<p>Fire managers also collect lot of information on the fuel condition (or vegetation condition) prior prescribe burns. Similarly it will be great to have access to an standardized database containing that information.</p>	<p>confidence and also get an idea on uncertainties. Consequently, I would like to encourage these activities.</p>	
<p>Doee environmental economic accounting</p> <p>Land accounts - land cover - land cover types and change over time between types (fa0 lccs) land use - land use types and when change occurs (abares national product)</p> <p>Ecosystem accounts - vegetation/ecosystem types and change over time (lccs and aus eco models) vegetation/ecosystem type condition (HCAS)</p> <p>These datasets are the basis for the land and ecosystem accounts that we are aiming to produce.</p> <p>Would require national coverage, time series, at resolution tat is applicable to property, local, regional, state and national usage</p>	<p>NDVI, veg externt and change/NCAS, persistent greenness, fractional cover, wofs, intertidal and coastal extent, veg condition and phenology, land cover, biomass, primary productivity, mangroves, ecosystem disturbance, veg height and structure, flooded veg extent and dependance, flood map, urban extent and change, burnt/fire areas, bare soil, tasslecap,</p> <p>all these products can inform the datasets we require at Q1, but also improve datasets required to look at ecosystem services and links between land and veg to production, regulation and social/cultural, economic etc.</p>	<p>our stakeholders are commonwealth, state/territory, local government, but also the wider research and non-government entities. we need to have agreement between stakeholders that the data, classes, thresholds etc meet all of their use needs and data standards</p>		<p>DOEE environmental economic accounting section</p>
<p>- urban extent/geoscape type product - energy use and future urban extent modelling</p>	<p>- automated change detection - land</p>	<p>automated change detection is currently a</p>		<p>Ian Warren - DoEE</p>

<p>- habitat condition - a number of business cases in DoEE - environmental investment, state of the environment, EEA, offsetting in the regulatory space</p> <p>- land/cover and land use - used to create a mask for threatened species and community prediction models</p>	<p>use/land clearing - 24hr latency</p>	<p>common requirement across most if not all environment departments in both commonwealth and state government.</p> <p>geoscape - whole of gov agreement procurement planet - whole of gov procurement</p>		
<p>Sentinel 2 Ground Cover (relies on Sentinel 2 Persistent Green)</p> <p>Pixel Based vegetation density is useful for many applications across government and industry. NOTE: My preference would be to develop the functions for these to apply as needed rather than producing a "canned" model to support the broadest range of end users.</p>	<p>Grace2 Groundwater deficit and changes</p> <p>Broad scale plant fluorescence for drought monitoring</p> <p>SAR Interferometry for subsidence</p> <p>Space-borne Lidar Grids customised for Australian conditions.</p> <p>- for vegetation structure, regrowth monitoring and extent validation.</p> <p>Forest Type - Primary/Secondary "regrowth" potentially derived from DoEE data but requires validation</p>	<p>All the data for cover is available. Be great to have some segmentation guidelines for condition work... Scale etc.</p>		<p>Peter Scarth</p>
<p>Woody Burn & severity- NSW currently working on Fire severity and other related products.</p> <p>Tasselled Cap Wetness statistics - wetland characterisation - to assist with identity of wetlands to help with vulnerable and sensitive lands , biodiversity legislation</p>	<p>SCDI -seasonal cover disturbance index based on landsat time series</p> <p>NSW in development stages ?? (Tim Danaher)</p>			<p>Sue Rea OEH NSW</p>
<p>The highest priorities are centred around woody vegetation, e.g. Sentinel based woody extent (with FPC values) and Sentinel based woody change (SLATS style process currently undertaken but needs streamlining - mostly due to cloud contamination).</p> <p>Automated burn scar mapping is also a priority as current methods require a lot of manual editing. In recent times burn severity had also been repeatedly asked for.</p> <p>Other vegetation parameters desirable such as vegetation height and structure (higher resolution than current) and</p>	<p>Hard to justify 'essential' products that are missing, but more work would need to be done in combining the products listed into higher level products e.g. disturbance and recovery metrics.</p> <p>There seems to be a growing requirement for means to quantify environmental offsets and ecosystem services.</p>	<p>We currently undertake SLATS style star transects but we are willing and happy to assist in the field work for any activities discussed in the workshop.</p>		<p>Lindsay Mitchell - DPIPW (TAS)</p>

<p>biomass is always desirable.</p> <p>Soil moisture is currently being investigated and a validated product in this space would be highly desirable.</p>				
<p>Fractional ground cover - sentinel monthly product Rangeland/pasture above ground standing biomass - monthly product any sensor Woody cover - density and extent Fractional cover percentiles / anomaly - seasonal and annual percentiles of the CSIRO and JRSRP fractional cover algorithm Vegetation extent - as a time series Vegetation Height and Structure - as a time series landcover - LCCS and sub layers Landuse - time series</p>	<p>seasonal disturbance - tim Danaher is working on this and maybe links to your listed Ecosystem Disturbance product</p>	<p>Hopefully JohnLeys' LandMAPT data (land use, land management, disturbance type (tillage or grazing or) erosion level, cover level, cover type etc</p>	<p>1) need to have excellent comms. Issue of same product reporting something at different scales 2) still difficult to find these new layers, need a comms out of TERN(?). I find more at these meetings than other ways 3) there are levels of availability; downloadable, WMS served 4) need promotion and training in use of web interfaces like VegMachine and GEOGLAMM for decision makers (ie on the EO GIS people)</p>	<p>John Leys DPIE</p>
<p>burnt area mapping/severity (Sentinel-2 and Sentinel-3) - used by industry, government and public. The existing burnt area products are used for biodiversity assessment modelling, prescribed burning management/planning and integrated into the production of other EO products.</p>	<p>biomass woody vegetation - assessment of land clearing applications, carbon credits</p>	<p>field data collected across the NT which is available via the QLD remote sensing centre - would need to consult with managers before release of these data.</p>		<p>Grant Staben - NTG</p>
<p>Land Cover Change: to use in current SEEA case study for Western Sydney, needing time series information on urban green spaces characteristics (grass vs trees, native vs exotic veg) that can be linked to ecosystem services.</p>	<p>Information on vegetation growth/regrowth that can be used in carbon sequestration accounting, including time series that can capture change overtime.</p>			<p>Marie-Chantale Pelletier, NSW DPIE (formerly OEH)</p>
<p>Vegetation condition and phenology Land-cover (NDVI) and Fractional cover dynamics Rangeland/pasture aboveground standing biomass Rangeland/pasture net-primary productivity dynamics Fractional cover Persistent fractional cover Mangroves Enhanced Vegetation Index Phenology FPAR - Fraction of Photosynthetically Active Radiation</p>	<p>Imperviousness index data (high res reflectance - derived)</p>	<p>DELWP WCG Imperviousness data (WATER TEAM)</p>	<p>Follow up discussions regarding standard outcomes, foundational data and standardised derived products are definitely required.</p>	<p>Chris Jackson - DELWP</p>

<p>Ecosystem Disturbance Landcover Dynamics Vegetation Height and Structure Biomass Gross Primary Productivity InSAR mapping of ground deformation and subsidence 25m landcover and Native Vegetation extent mapping for SA and Victoria Growing season (winter/summer) maximum NDVI composite Fractional cover percentiles - seasonal and annual percentiles of the JRSRP fractional cover algorithm National Intertidal Digital Elevation Model (NIDEM) - A Mean Sea Level based elevation model for the intertidal zone based on ITEM v2.0 Condition of flood dependent forests/woodlands across the Murray-Darling Basin Evapotranspiration SAR mapping of floods Urban extent and change Land Cover Classification System - test of the FAO LCCS in Australia Woody burn map of Australia - map of burn location and severity for woody vegetation areas of Australia Bare soil composite - continental coverage of barest pixel derived from Landsat data Tasselled Cap Wetness statistics - wetland characterisation Use of SAR amplitude and InSAR coherence to map bushfire InSAR coherence mapping to deduce spatial variations of land cover Blended products - landsat/MODIS; Landsat/sentinel land management practices vegetation / rangeland condition cumulative rainfall prediction of fractional cover</p>				
<p>Actual Evapotranspiration (AET) - MODIS 2000-current monthly - ready AET blended MODIS Landsat (30m, monthly 2000-current) - applied regionally, could be applied nationally (or develop 'on the fly' application of algorithms) Review broadly what MODIS Landsat (30m, monthly 2000-current) blended</p>	<p>Land management practices - e.g. stubble management, fallow rotations, use of fire, etc Benchmark or reference condition natural areas (not actively managed)</p>	<p>Field observation data of habitat condition for training/cal/val harmonised or agreed protocols across state jurisdictions Land management practices data collected by different agencies</p>	<p>Need national focal working groups tasked with collaboration to resolve how to harmonise across different data collection protocols, such as habitat condition, management practices, best</p>	<p>CSIRO Land and Water - Juan Guerschman and Kristen Williams</p>

<p>products will provide an advantage for example with seasonal dynamics for applications such as habitat condition assessment CSIRO DigiScape crop type mapping using Sentinel</p>		<p>could be brought together</p>	<p>practice blending and priority products that would benefit from blending, unlocking the long-term RS archives for trend data, etc</p>	
<p>* Ensuring Fractional vegetation cover products (MODIS, Landsat, Sentinel) remain comparable (i.e. underpinned by the same algorithm/rules). Potential to use blending to fill data gaps. Field validation sites are collated, checked and maintained within a national database. Would encourage all attributes of field methodology be collected (i.e. land use, land management). Community of practice for field collection and then application/s of dataset. * Fractional ground cover products (MODIS, Landsat, Sentinel) validated nationally - to address ground cover under tree canopy cover 20-50% (which is commonly grazed) Monitoring fractional cover as an indicator of sustainable management and to minimise wind and water erosion risk for the National Landcare Program * Soil and Landscape Grids of Australia - development of derived/simplified products at appropriate depth groupings (determined by application i.e. agricultural crops vs forestry). Additional and ongoing field data required for attributes modelled. (would include land capability here to - particular interest in arable land) * Land cover - confidence in the construction of the classes, as input layer to assist land use and to flag potential areas of change for further investigation. Engage widely in a transparent manner to inform the rules around each class. * Persistent green - further validation and ongoing production * Vegetation height and structure * Gross primary productivity - agricultural production modelling * Woody change - for land clearing - nationally consistent time-series dataset</p>	<p>Would like to consult more widely within my organisation on the products under questions 1 and 2, as hadn't seen the spreadsheet until at the workshop (don't have access to google drives).</p>	<p>See comments under 1. Need standards for field/validation for products. Consider some common elements in all field collection across EO products - collect once, use many, noting products will have particular/unique aspects that need to be collected. Build capacity through training to ensure consistency in data collection. Include users in the validation of products.</p>	<p>A centrally organised data acquisition and delivery of EO products will be highly beneficial for many of our on-going and future projects. Some points for consideration: 1. Timely and continuous availability of satellite data products at mainly 3 broad spatial scales, processed on a nationally consistent manner (quality filtering , geo-referencing etc.) a) Regional scale (eg. MODIS) b) Farm scale (eg. Landsat and Sentinel) c) Finer scale – on demand products for detailed analysis (Eg. RapidEye, SPOT and Planetscope) 2. Landscape characterisation products (eg. DEM – SRTM) 3. Weather data (eg. TRMM and Himawari) 4. Central data processing system to allow HPC based processing at the server level and download only required final processed products. 5. Computing framework for generating and sharing data processing tools. Many of these data and facilities are already available through NCI and other</p>	<p>Jane Stewart - ABARES/Department of Agriculture</p>

<p>* Biomass * Phenology - crop types</p>			<p>Data Cube infrastructure. However, accessing these systems from the departmental network is not easy considering our IT policy and security environment. We need to develop software systems that can access these facilities without compromising our IT security, which will require coordinated efforts including our IT staff as well.</p>	
<p>Vegetation cover, density and structure products will meet policy requirements to monitor the extent and condition of native vegetation. This includes woody, perennial grasses, annuals, shrubs. Potential products that can be built on includes vegetation extent from NCAS; fractional cover; for WA specific fractional cover analysis and spinifex cover information. Vegetation structure variation from Sentinel-1 for monitoring purposes and perhaps to inform improved vegetation type derivations that are essential for assessment of condition and the severity of impacts e.g. fire, flood. A common denominator found from cross government workshops in WA was variation in bare ground in both dry and wet seasons.</p>	<p>The change in bare areas both in wet season and dry season is a useful indicator of impacts on native vegetation when consistent definitions of vegetation cover and condition are not available.</p>	<p>The use of UAV imagery to create 1 hectare plots with point cloud structural information and vegetation description.</p>		<p>K Zdunic - DBCA</p>
<p>Forest extent and change data & post-1990 plantations data - migration to Sentinel-2 - to meet IPCC 2006 guidelines for reporting greenhouse gas emissions & removals</p>	<p>Harvesting in native forests - essential input to forest management modelling in NCAS. Currently tabular data produced by ABARES. Require history archive from 1987 Crop type and crop yields - essential input to soil carbon modelling in NCAS. Currently combined ABARES clum, ABS Ag census tabular data, CSIRO crop growth model & daily climate data. Require 5 yearly crop maps</p>	<p>ABARES, CSIRO, GA</p>		<p>DoEE</p>

	<p>from 1990</p> <p>Spatial fire (prescribed, wildfire, intensity, crop residue burning) - to estimate greenhouse emissions from bushfires</p> <p>Spatial distribution of farm dams/wetlands - support wetlands accounts. Require history archive from 1990</p>			
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Appendix 9: Discussion Panel

A question lead discussion with the panel providing initial commentary leading to questions from participants.

<p>How the capability database can be used for guiding EOGN workshops and DEA ?</p>	<ul style="list-style-type: none"> - Ability to determine common requirements between parties/organisation - Ability to determine Common policy drivers - Determining what work is being done in a particular thematic area - Add more details/url/metadata for each of the datasets on the database would make it more useful. - Look at multiple but similar datasets and comparison between each dataset - What is the audience of the d/b? Researchers, public - What is the purpose of the d/b? - Ownership? - Resourced FTE to manage d/b? <p>Linking the actual users/use cases of the dataset to the dataset - how are they using it.</p> <p>Gives an impact rating for each of the datasets. Why are the users using the dataset? Policy drivers?</p>	<p>Collating all these products in a single place is a great start. Adding more detail on each would be useful. Coming together as a group (like this workshop) is a great way to promote discussion on prioritisation of these products.</p> <p>The database needs to be underpinned/endorsed by a community of experts and users to give it weight.</p> <p>There are clearly some competing priorities, so having a steering committee with State/Federal/Research/Industry representation is important.</p>	<p>Make policy drivers clear in the database - and determining which data streams can assist in decision needs. Having enough detail in the database about the temporal / spatial resolution & applicability of the datastreams would assist more productive workshops. Need enough clarity to be able to distinguish between products; versioning of data products needs to be clear to enable comparison and clarity about applicability to decisions by policy makers. *Need to think about audience and purpose for database - is it policy makers or more expert users? Ownership also -who will maintain it. * Inventories of data sets are notoriously prone to failure - need really clear governance and ownership to ensure maintenance. Linkage between products & what they're being used for currently would also be useful - impact rating? Also knowing the limitations of data sets as they're encountered by end users. Teasing out variable confidence levels is important. Derived products may be more useful for policy makers than the raw data products.</p>
<p>The process for updating the capability database so it continues to be used to transition products from research to operational and drive EO research and</p>	<p>EOGN as potentially the gatekeeper</p> <p>ACLUMP secretariat - about 100K</p> <ul style="list-style-type: none"> - organise meetings - organise workshops - land management practises, land use - clear users <p>EOGN currently funded by GA - How do we build it up?</p>	<p>Collaborating as a larger EO community to discuss and share emerging sources and products to feed into the database, and to update each other on progress towards Operational products AND seek endorsement for those products to ensure they see an uptake in use and reporting against them is trusted.</p>	<p>Endorsement of products by EO would be useful - structure and Secretariat support for this work important. (e.g. ACLUMI = 300k per year. Secretariat about \$100k per year, 1 annual face to face; teleconferencing x 5. Generally thematically driven meetings to address particular challenges - but NLWRA provided mandate).</p>

<p>uptake in Australia.?</p>	<p>Input from users - Are they happy with the product? Agreement from the community about fit for purpose</p> <p>Clear reporting requirements</p> <p>EOGN champions?</p> <p>Evaluation of the users - who is using it? who is not using it?</p> <p>Quality control d/b for currency and map dependencies and older versions of the same product - How the dataset was derived? Input datasets</p> <p>GA (DEA) Would like guidance for research priorities?</p>		<p>EOGN needs inputs from users and developers; standards around validation of products as they develop; ensuring fit for purpose. Need to think about evaluation of products - Albert thinks a bit of hobby horses in the database at the moment - need to make sure its contemporary etc. Rationalise it. Better structure data; need hierarchy of information. How is the product derived. Link to publications. Meeting Open Data requirements? What constitutes free? Leo: Research priorities? Consensus views on research priorities its possible to determine where to allocate GA effort. Space Agency - key national interests - will be welcomed with open arms. How does DEA work with the research community? Needs a lot work to garner the of activity between DEA, government & research community. How OGN can drive collaboration.</p>
<p>3. Achieving the best outcomes for all levels of government - Coordination of Australian Earth Observation Activities – Australian Space Agency Civil Space Priorities, and how this links to Space Coordination Committee ?</p>	<p>- ASA potential funder for coordination - - do we focus on one theme as EOGN to give us a clear pathway forward and use case of the group. Use it as a pilot for further thematic datasets. Use if as a flagship program Water and Atmosphere, Ocean and Coasts - not really covered by EOGN - do we need to incorporate them more</p> <p>How do we spin up something sustainable? (like ACLUMP) and persisted. A need to be coordinated and a recognised group of experts in the field.</p> <p>Who would the group report to? Are we looking for an official mandate?</p> <p>Important to have good coverage of groups,</p>	<p>Having a single agency leading coordination for an EOGN group would be valuable (like ABARES do for NCLUMI)...</p>	<p>Space Agency - key national interests - will be welcomed with open arms. How does DEA work with the research community? Needs a lot work to garner the of activity between DEA, government & research community. How OGN can drive collaboration. Space Agency receiving order of magnitude more funding than the EO community receiving presently - and part of this is presentation of an organized face to community. Potential funder of EO. How do we build sensors & satellites to develop capability nationally. ASA could coordinate or fund EOGN? Clear picture of what we need is sensible. We need to focus on key priorities to take this to the ASA. Products that can hit multiple objectives important. e.g. improved, high res land cover product. Oceans well done on IMOS. Strong bias to</p>

	<p>with/state/research</p> <p>Technical officer groups? but need the buy in from higher .</p> <p>Steering Committee</p> <p>Is the scope clear of the group? broad vs terrestrial only</p> <p>Multiple streams under the broader steering group?</p> <p>What are the government policy drivers? linking the outputs to the DEA and federal and state policy - what are the vital data streams (enduring supply and access)</p>		<p>land in current EOGN. Water (including terrestrial) less represented. Coordination of community of practice - evolving group - connection to industry, local government etc still needs to happen. How do we spin off something that is sustainable. Group and capacity needs to remain sustainable and flexible to changing mandates & different capacities / capabilities. Possible Reference Group. Is it clear we are looking at terrestrial EO? Stuart - broad better to start with? Current representation isn't broad. Oceans experts more integrated with terrestrial peeps than atmospheres (at the moment). Best to have global group looking at all, and then specific terrestrial, oceans & atmospheres underneath. End user focused communities. What are the ToR for the DEA? Communication requirement to make DEA ToR clear.</p>
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Appendix 9: Case Study - Fractional Cover by Peter Scarth

https://drive.google.com/file/d/1gk7boGk1z_IEMZYSRxMttHSrpE6hqCKt/view?usp=sharing

Appendix 10: Case Study - Mangroves by Leo Lymburner

<https://drive.google.com/file/d/1te5-4b1jc6AyQyM1tDCs2rCXRY8DEJ4D/view?usp=sharin>