COPERNICUS AUSTRALASIA REGIONAL DATA HUB

EOA Webinar

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REGIONAL DATA HUB

FRONTIER SI

WEBINAR OUTLINE

- Copernicus Australasia Regional Data Hub *(10min)*
- Sentinels, Data, Applications and Case Studies *(20min)*
- Working with Copernicus Australasia Regional Data Hub
  - Sentinel Australasia Regional Access (SARA) map-based GUI *(10min)*
  - SARA python API for advanced users *(10min)*
  - NCI's THREDDS server *(10min)*
  - Directly through the NCI's file system for registered NCI users
- Questions *(15min)*

COPERNICUS AUSTRALASIA REGIONAL DATA HUB

WHY, HOW AND WHAT?

- **WHY**: Australia relies on Earth observation (EO) data but does not have its own EO satellites, European Union's Copernicus Programme from 2014 - free and open data
- **HOW**: Copernicus Programme offering a deluge of data - **2,500 TB** (2.5 Petabytes) in the last 3.5 years, how to get this **big data** here given the distance and huge volume?
- **WHAT**: Copernicus Australasia Regional Data Hub (the Hub) is *the* regional data repository providing **fast**, **free**, **open**, **trusted** and **reliable** access to Sentinel satellite data for users in Australasia, South-East Asia, the South Pacific and Australia's Antarctic Territory.

PARTNERS & USERS

Consortium partners

- Geoscience Australia (GA)
- the Queensland Department of Environment and Science (DES)
- the New South Wales Office of Environment and Heritage (OEH)
- the Western Australian Land Information Authority (Landgate)
- the Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- New Zealand's XERRA Earth Observation Institute

Delivery partners

- The National Computational Infrastructure (NCI) operate the master data repository
- Australia's Academic and Research Network (AARNet) / GÉANT

Supporting partners

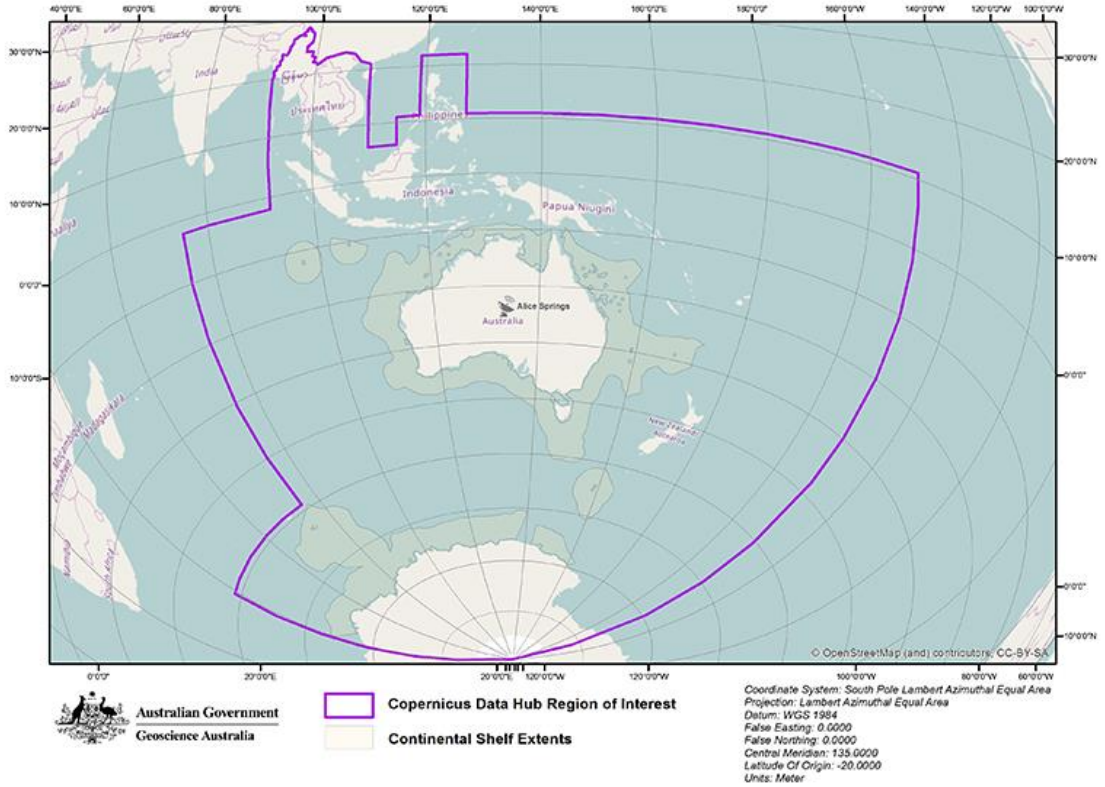
- The European Commission
- the European Space Agency (ESA)
- the European Environment Agency
- the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)

The primary users of the Hub are the partner agencies, large government organisations and the scientific research community.

The Hub is looking to expand its user base to include industry, academia and non-government sectors across the region.

REGION COVERED BY COPERNICUS AUSTRALASIA

The Hub syncs and provides access to data over the region shown for Sentinel-1 and -2 and globally for Sentinel-3. Sentinel-5P data will also be synced globally.



DATA SYNCED BY THE HUB

Sentinel-1, 2014 to present - *all-weather, day and night RADAR imagery for land and marine services*

Sentinel-2, 2015 to present - *high-resolution multispectral imagery for land and marine services*

Sentinel-3, 2016 to present - *high-accuracy optical, RADAR and altimetry data for land and marine services*

Sentinel-5P, soon to be added - *precursor to provide dedicated atmospheric composition monitoring*

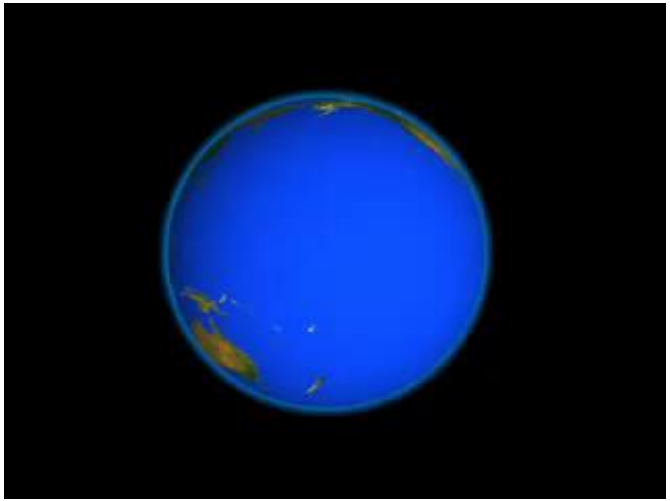
Data Processing Level	Sentinel-1	Sentinel-2	Sentinel-3				Sentinel-5P (coming)
			OLCI	SLSTR	SYNERGY	Altimetry	
Level 2	Ocean data	L2A BOA Reflectance data	• Ocean & Atmosphere data • Land & Atmosphere data	• Sea Surface Temperature • Land Surface Temperature	• Synergy product • VGT-P like product • VGT-S like product	• Marine data • Land data	Atmospheric data
Level 1	Single Look Complex & Ground Range Detected data	L1C TOA Reflectance data	TOA Radiance data	• Brightness temperatures • TOA Radiances	-	-	-
Level 0	Raw data	-	-	-	-	-	-

SENTINELS, DATA & APPLICATIONS

MISSIONS OVERVIEW

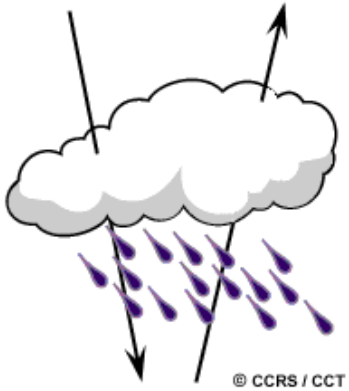
- The **Copernicus Programme** was formally known as Global Monitoring for Environment and Security (GMES)

Sentinels 1, 2 and 3



Polar orbiting satellite example

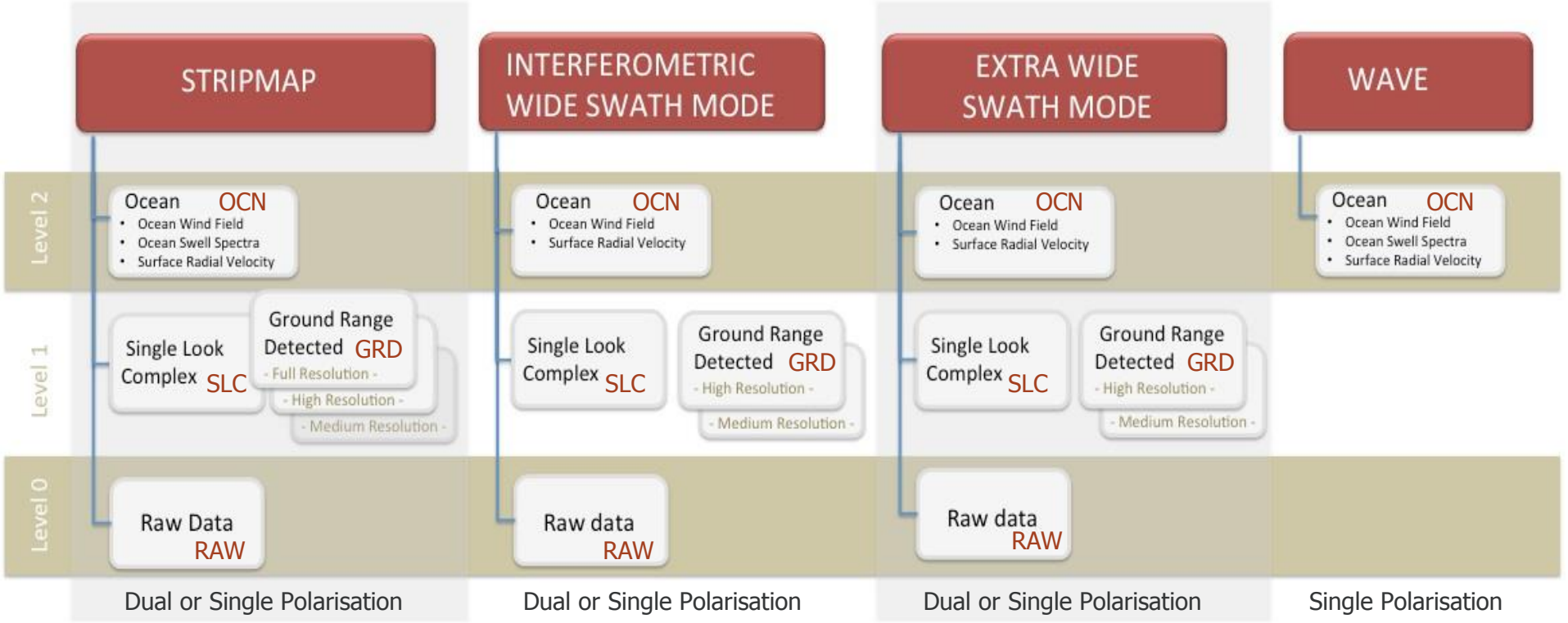
SENTINEL-1 OVERVIEW



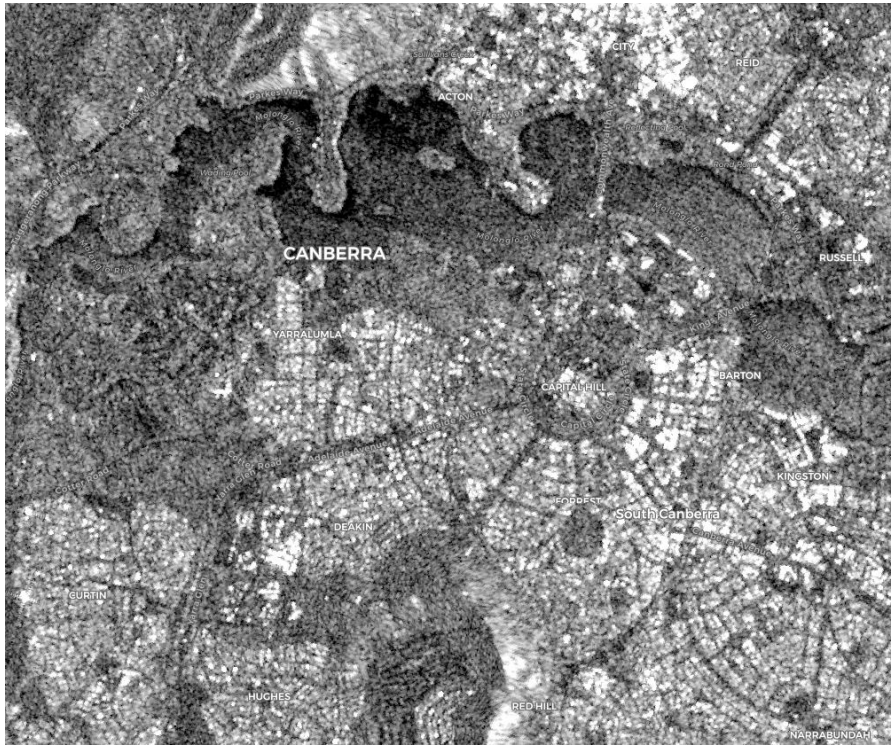
- Sentinel-1 is an imaging **Synthetic Aperture RADAR** (SAR) mission.
- SAR operates at wavelengths in the microwave range (central frequency of 5.404 GHz) that can penetrate cloud cover and are not impeded by a lack of solar illumination, so can acquire **continuous all-weather, day-and-night imagery**.
- Sentinel-1 comprises **single instrument** platforms carrying C-band (3.75 – 7.5 cm wavelength) SAR (C-SAR).
- The Sentinel-1A and 1B constellation provides **high reliability**, **short revisit** time (6 days), geographical coverage, dual polarisation capability and rapid data dissemination to support operational applications in the priority areas of marine monitoring, land monitoring and emergency services.
- Sentinel-1 captures **all global landmasses**, **coastal zones** and **shipping routes** at high resolution and covers the **global oceans** at regular intervals.

SENTINEL-1 DATA PRODUCTS

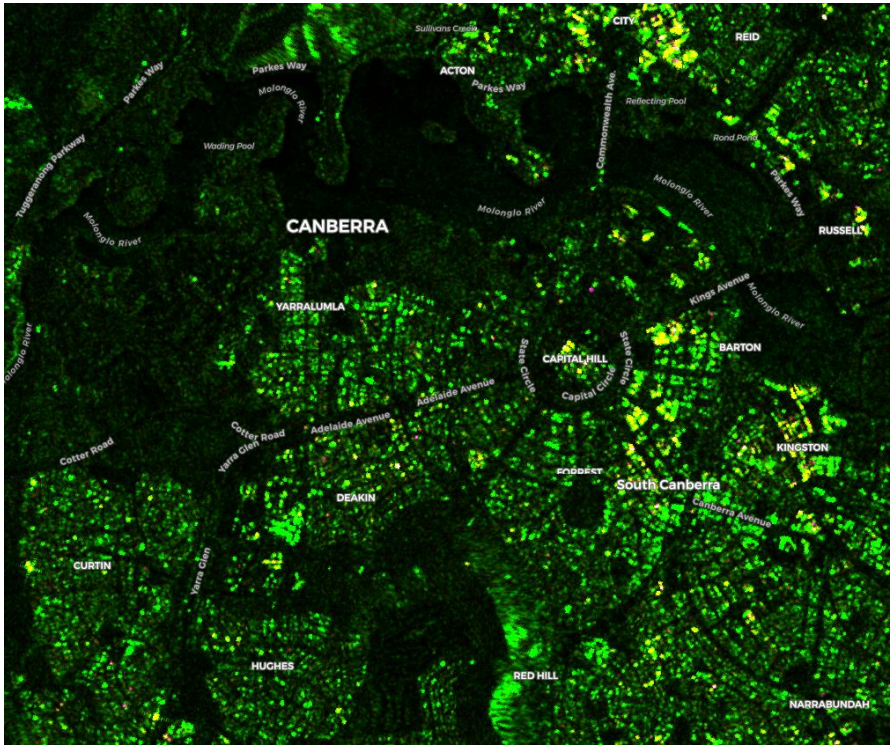
**Data Product Names in SARA*



SENTINEL-1 DATA PRODUCT EXAMPLE



Sentinel 1 – orthorectified VV



Sentinel-1 - RGB composite of (VH, VV, VH-VV)

SENTINEL-1 APPLICATIONS

Applications of **backscatter products** (using the amplitude/intensity images for either or both polarisations):

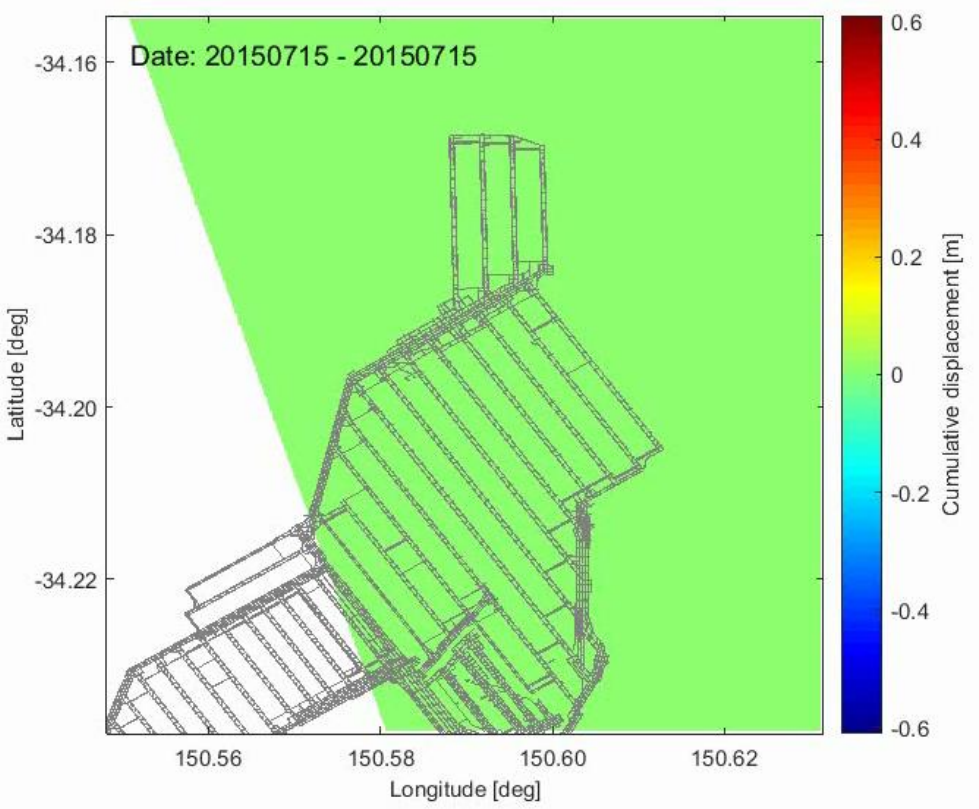
- Agriculture
- Forestry
- Hydrology
- Oceanography
- Security

Applications of **InSAR products** (using interferometric products e.g. interferograms & interferometric coherence):

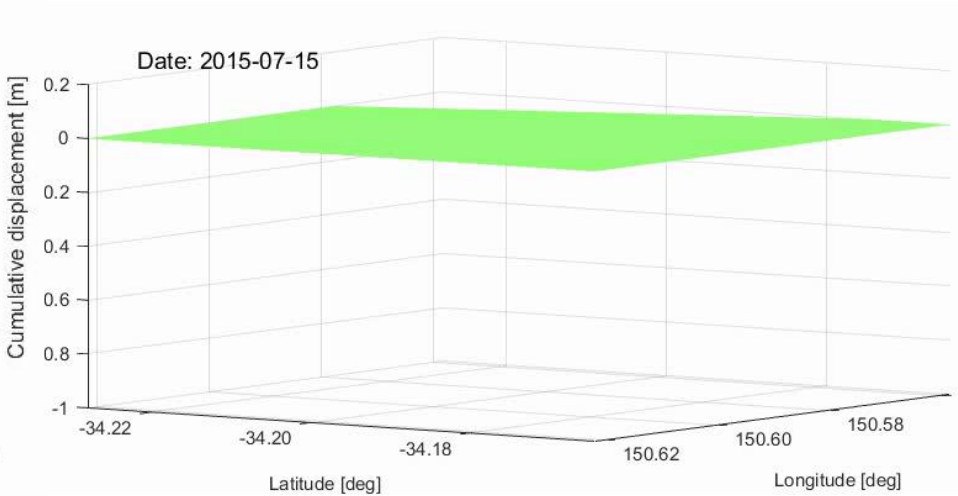
- Time-series analysis of surface deformation
- Glacier motion analysis
- Digital elevation mapping
- Geophysical monitoring of natural hazards

Oil Spill Monitoring

SENTINEL-1 APPLICATIONS



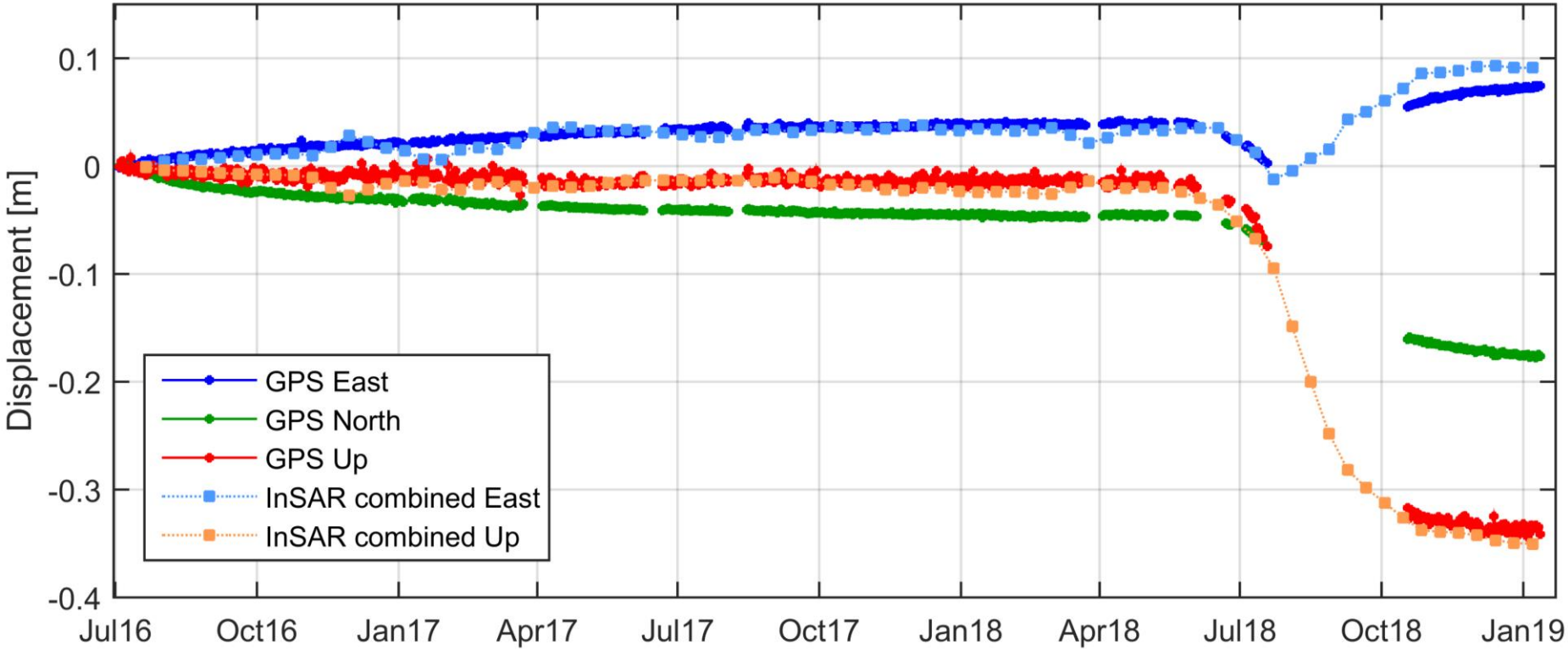
Mine Deformation Monitoring



Acknowledgement: Thomas Fuhrmann & Matt Garthwaite (GA)

SENTINEL-1 APPLICATIONS

Mine Deformation Monitoring



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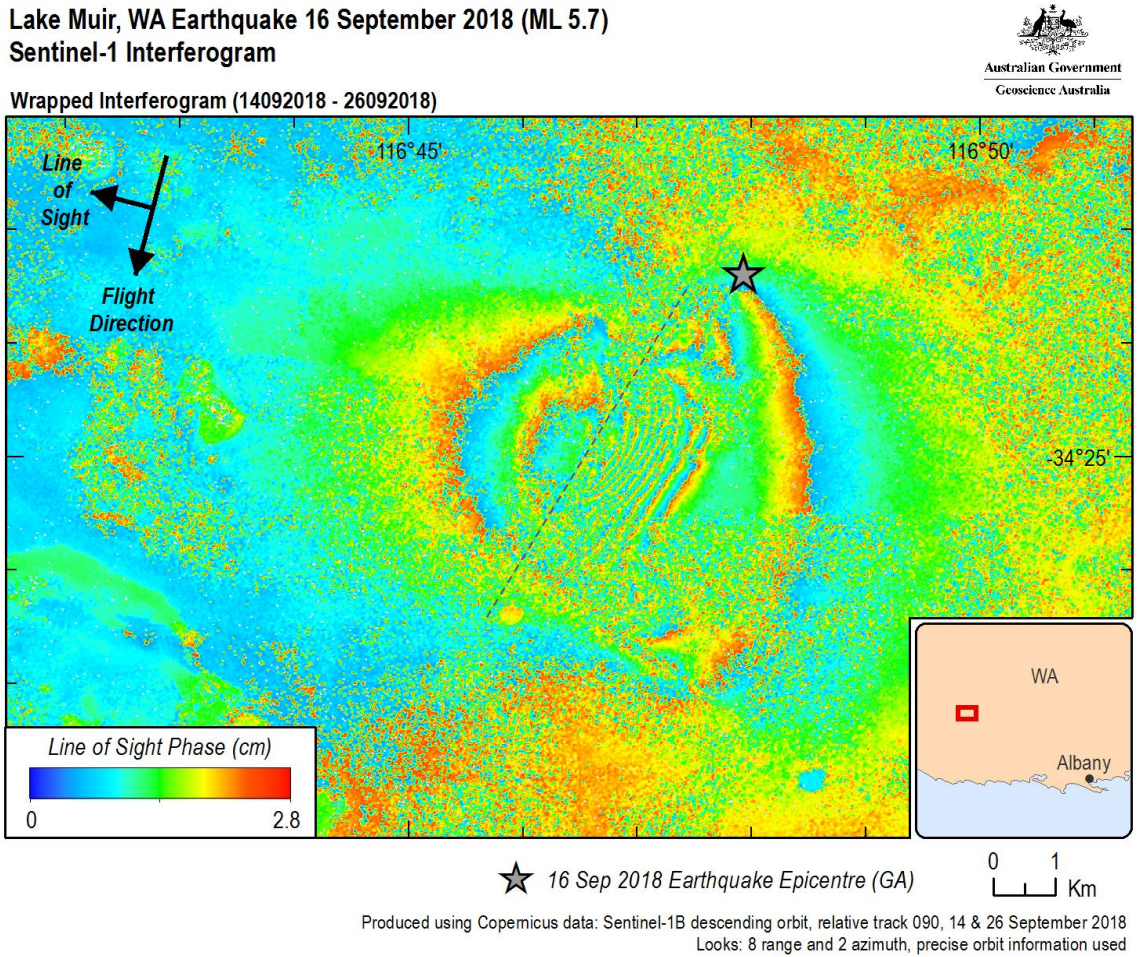
SENTINEL-1 CASE STUDY

Mapping Surface Deformation with Sentinel-1 InSAR

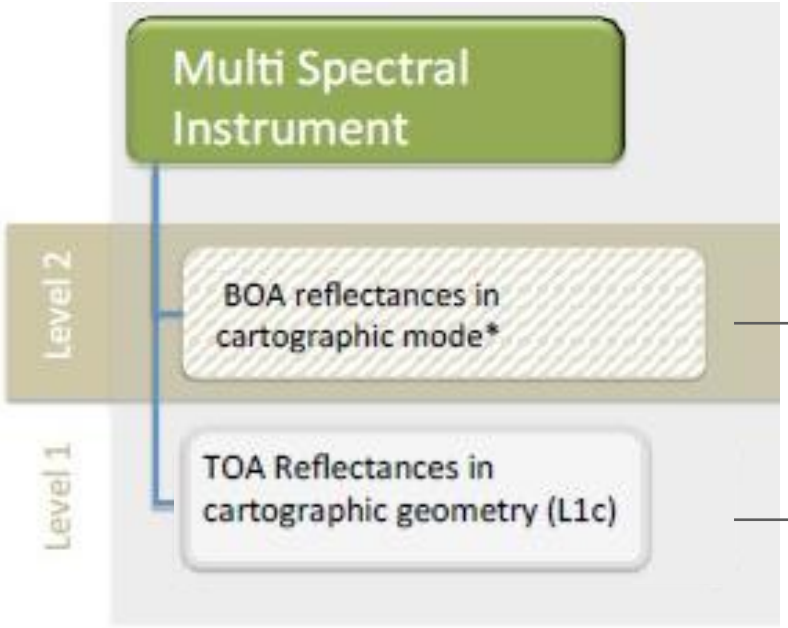
Sentinel-1 interferogram of the Lake Muir earthquake, that occurred on 16 September 2018



SENTINEL-2 OVERVIEW

- Single instrument platforms carrying **Multi-Spectral Instruments** (MSI).
- Wide-swath (290km), high-resolution, **multispectral optical imaging**.
- The MSI samples **13 spectral bands**: four bands at 10 m, six bands at 20 m and three bands at 60 m spatial resolution.
- The mission coverage and **high revisit frequency** of five days at the Equator provides for the generation of geoinformation at local, regional, national and international scales.
- The data is designed to be modified and adapted by users interested in applications such as land management, agriculture and forestry, disaster control, humanitarian relief operations, risk mapping and security concerns.

SENTINEL-2 DATA PRODUCTS



Product Name in SARA	Description
S2MSIL2A	S2 MSI Level-2A Bottom-Of-Atmosphere reflectance
S2MSIL1C	S2 MSI Level-1C Top-Of-Atmosphere reflectance

SENTINEL-2 DATA PRODUCT EXAMPLE

TOA Level-1C image data (left) and associated Level-2A BOA image data (right) generated using Sen2Cor processor

SENTINEL-2 APPLICATIONS

Land monitoring e.g.

- water monitoring
- forest and vegetation monitoring
- land carbon, natural resource monitoring
- global crop monitoring

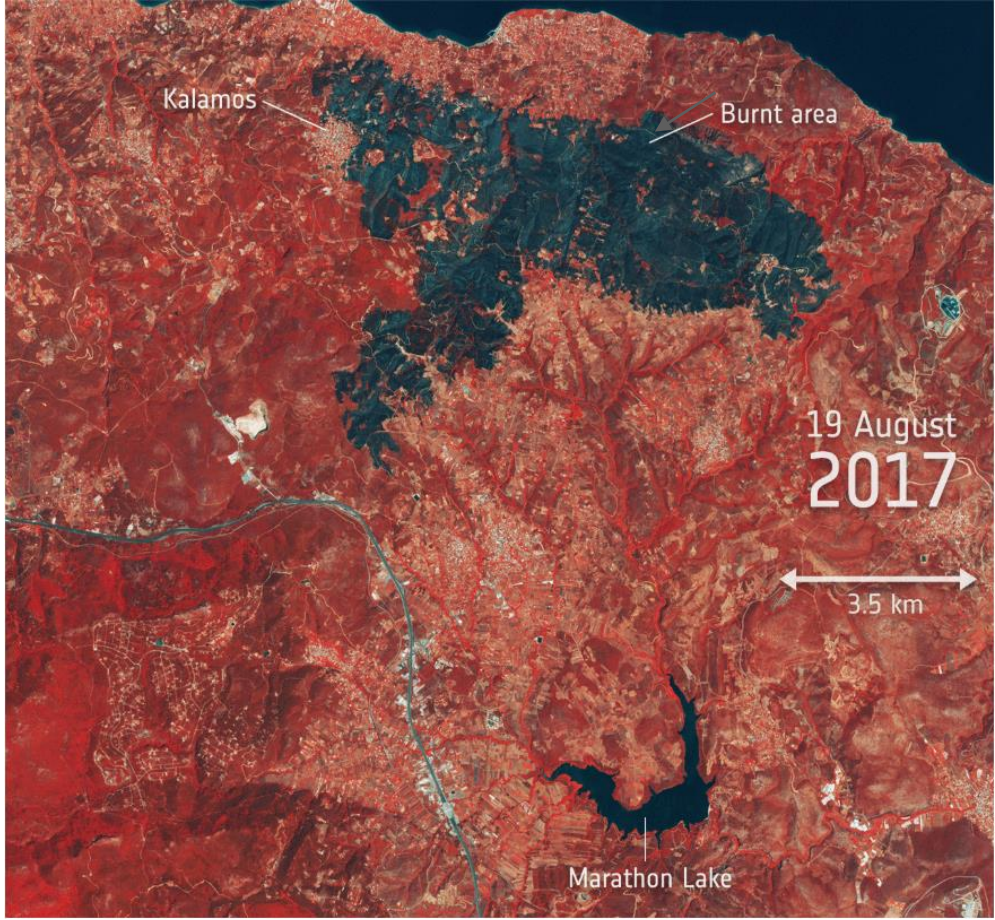
Emergency management e.g.

- natural disasters
- humanitarian crises

Security domains e.g.

- maritime surveillance
- infrastructure surveillance
- peace-keeping

Fire Monitoring

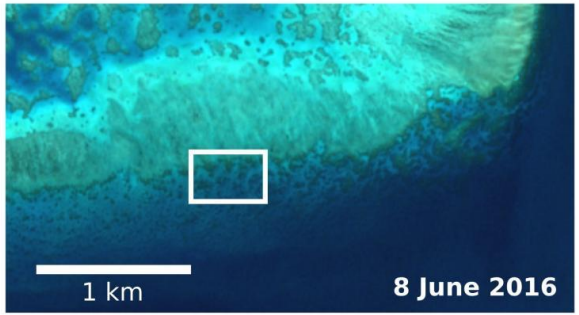


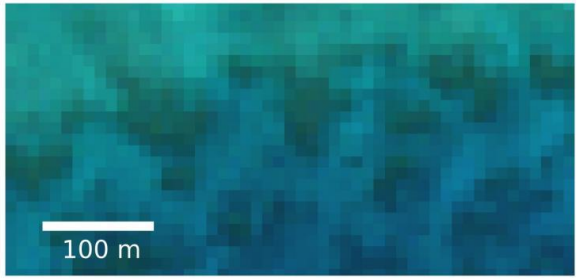
Vegetation appears red in this S2 false-colour image and burn scars appear black

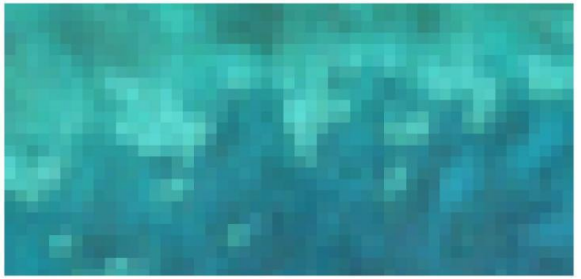
SENTINEL-2 APPLICATIONS

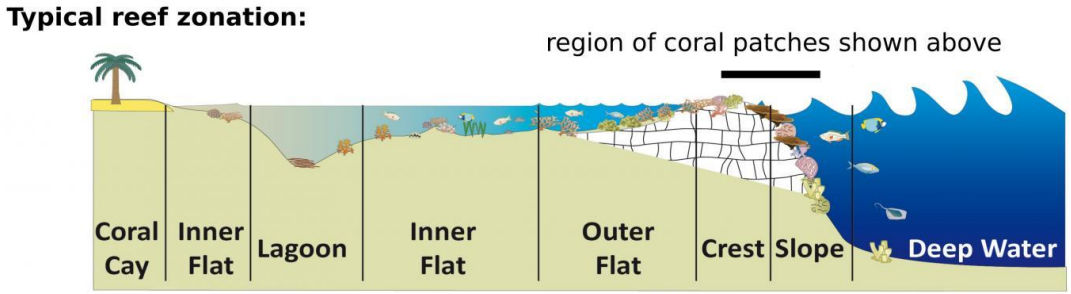
Great Barrier Reef Coral Bleaching

Images from the Copernicus Sentinel-2A satellite captured on 8 June 2016 and 23 February 2017 show coral turning bright white for Adelaide Reef, Central Great Barrier Reef.

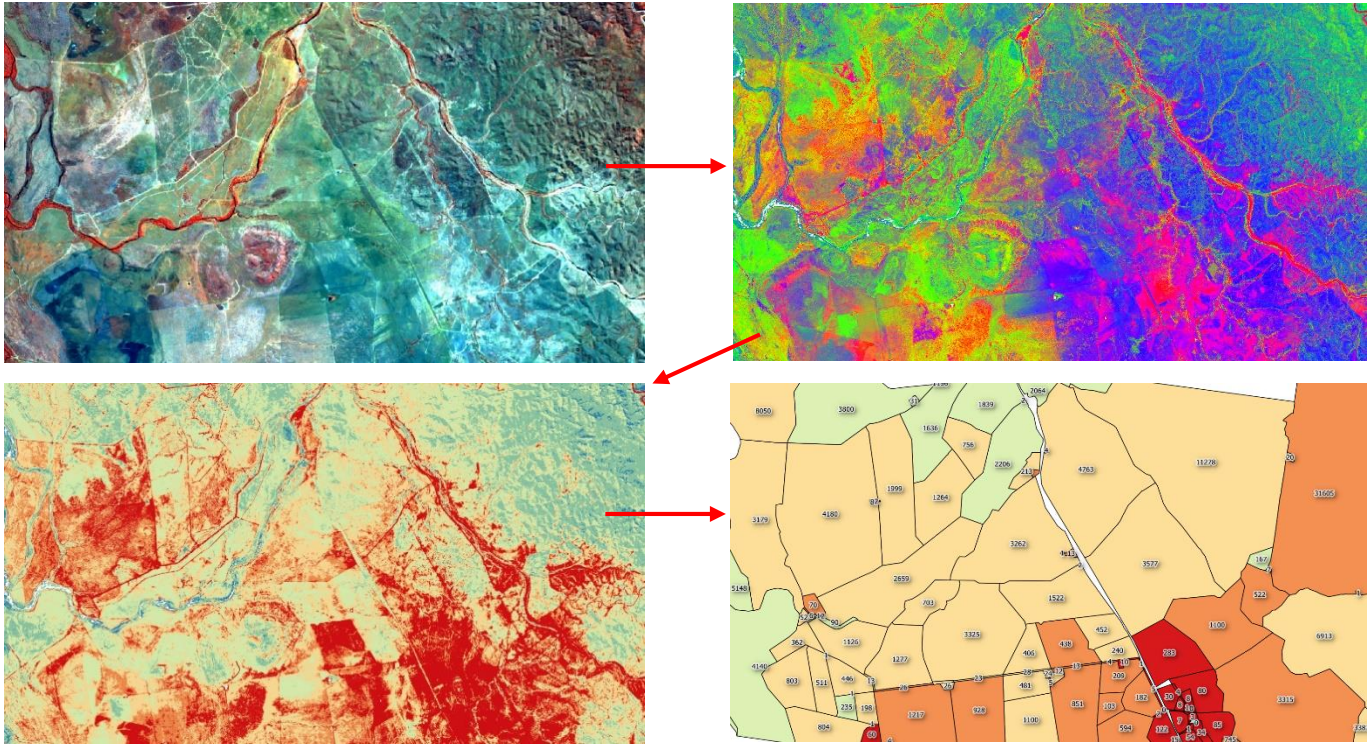








SENTINEL-2 CASE STUDY

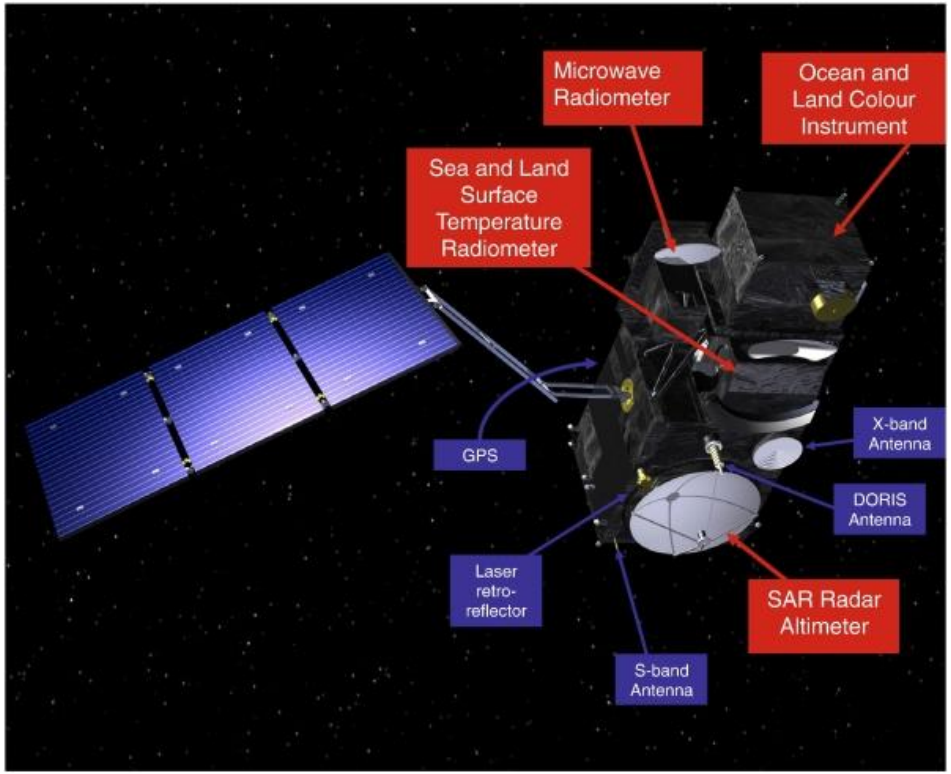


A New Approach to Estimating Pasture Biomass

Cibo Labs pasture biomass: 5 daily fully calibrated 10m imagery (top left) to Fractional Cover (top right) to Total Standing Dry Matter (TSDM) in kg/ha (bottom left) to TSDM per paddock (bottom right) (Images supplied by Cibo Labs)

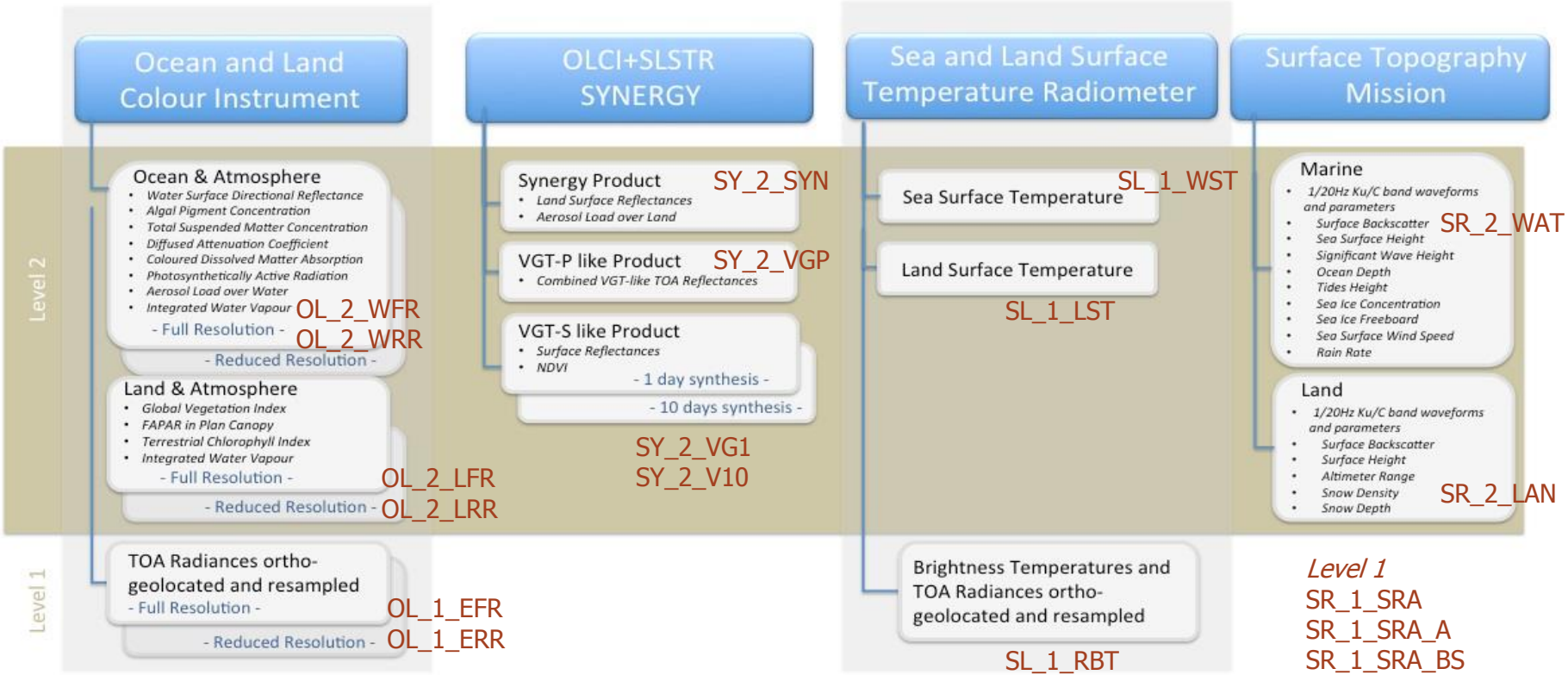
SENTINEL-3 OVERVIEW

- The Sentinel-3 mission objective is to measure **sea surface topography**, **sea and land surface temperature**, and **ocean and land surface colour** with high accuracy and reliability to support ocean forecasting systems, environmental monitoring and climate monitoring.
- Sentinel-3 satellites carry **4 main instruments**:
  - Ocean and Land Colour Instrument (OLCI)
  - Sea and Land Surface Temperature Radiometer (SLSTR)
  - Synthetic Aperture RADAR Altimeter (SRAL)
  - Microwave Radiometer (MWR)
- The 2 satellites enable a short revisit time of less than two days for OLCI and less than one day for SLSTR at the equator.

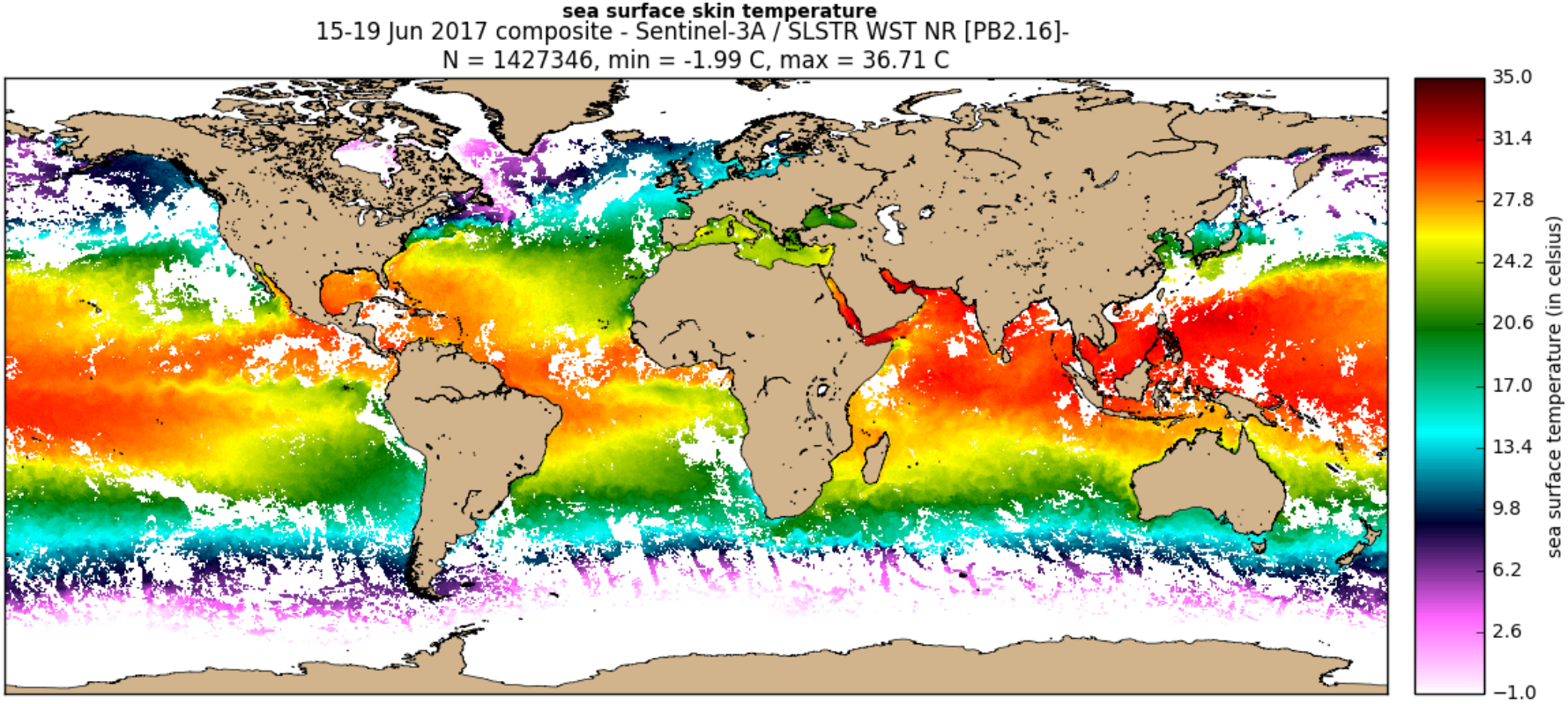


SENTINEL-3 DATA PRODUCTS

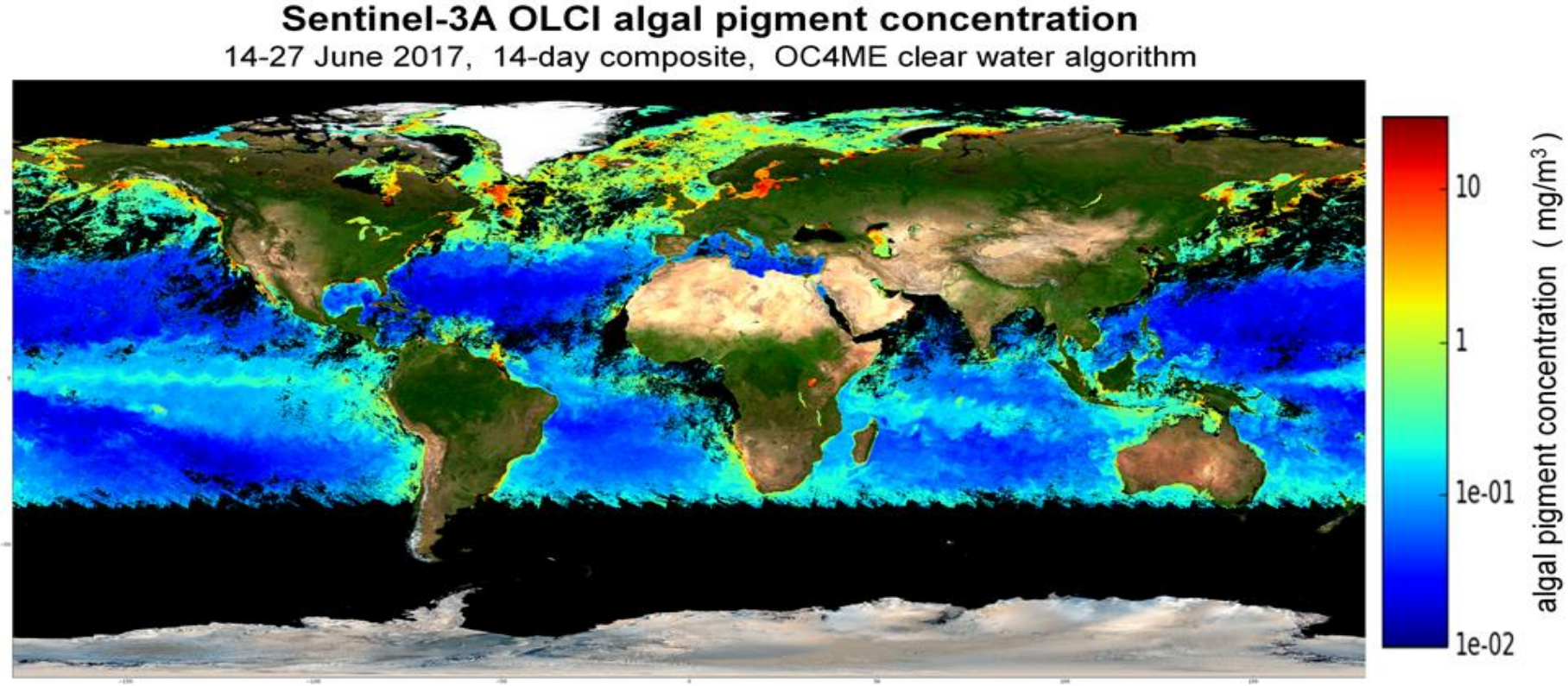
**Data Product Names in SARA*



SENTINEL-3 DATA PRODUCT EXAMPLES

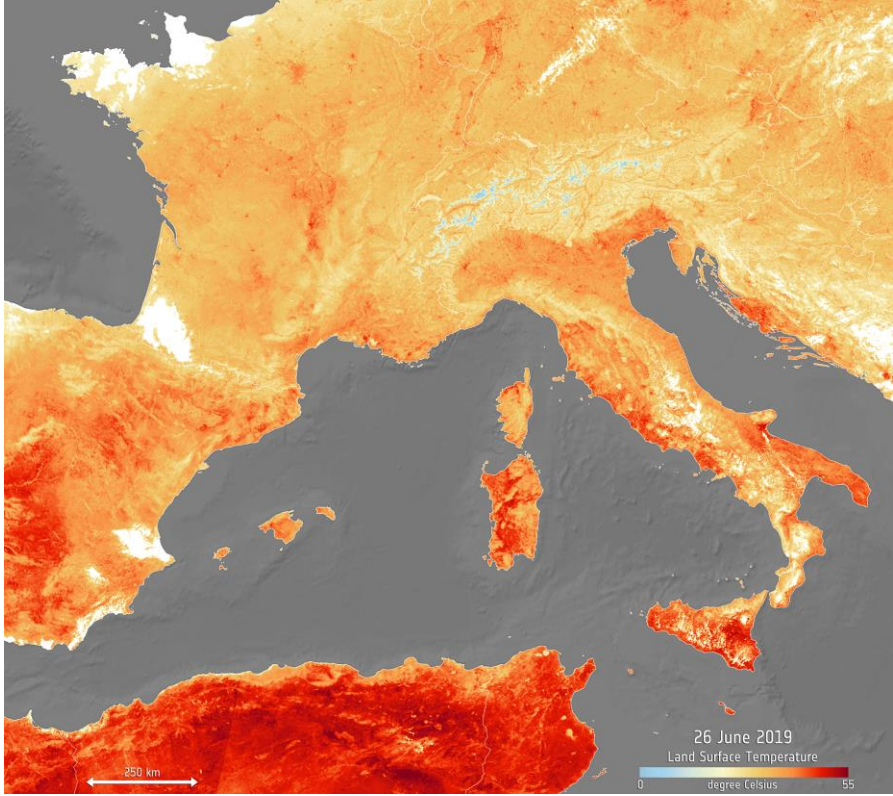


SENTINEL-3 DATA PRODUCT EXAMPLES



SENTINEL-3 APPLICATIONS

- **OLCI** - screens the ocean and land surface to harvest information related to biology plus provides information on the atmosphere and contributes to climate study.
- **SLSTR** - provides global and regional Sea and Land Surface Temperature to a very high level of accuracy for both climatological and meteorological applications.
- **SRAL** - provides ocean topography including mean sea level, wave height, wind speed over the surface, sea-ice, ocean currents, Kelvin and Rossby waves, eddies and tides.
- **SYNERGY** - provides continuity with SPOT VEGETATION, the primary objective being land use monitoring, as well as worldwide food security and the study of climate.

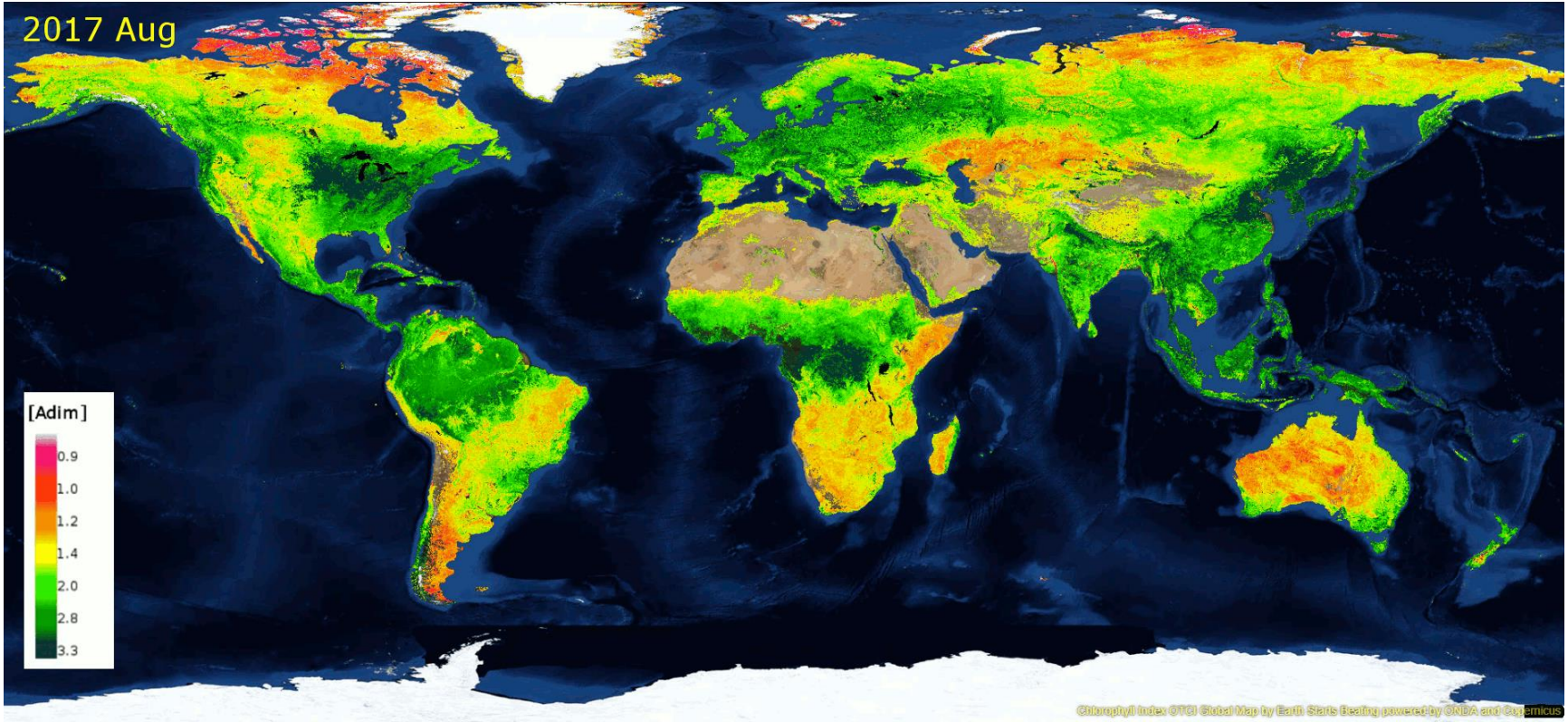


Land Surface Temperature

Images from Sentinel-3 SLSTR captured 25 July 2019 cand the previous heatwave on 26 June 2019.

SENTINEL-3 APPLICATIONS

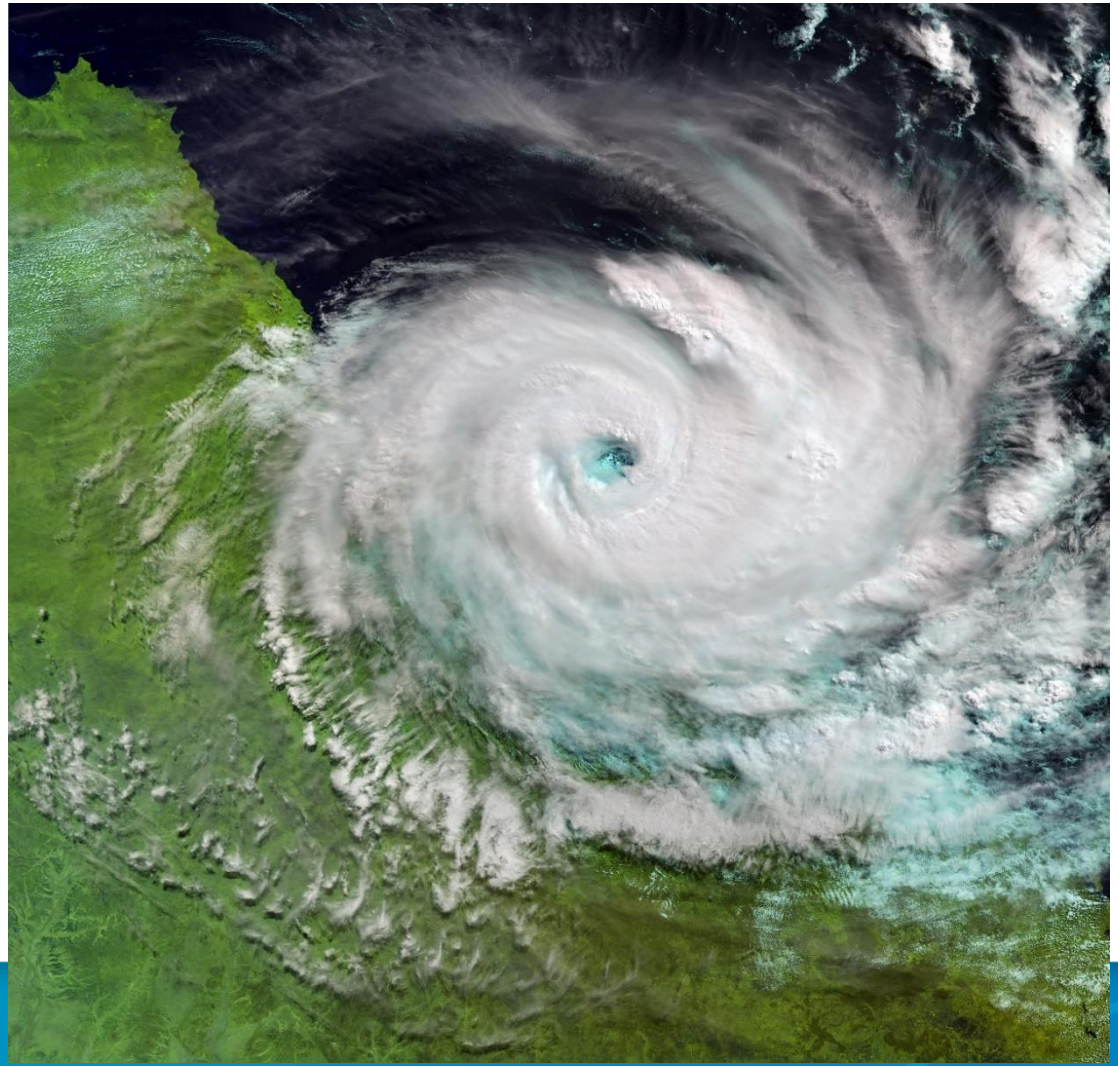
OLCI terrestrial chlorophyll index (OTCI) 1 year evolution



SENTINEL-3 APPLICATIONS

Cyclone Debbie

The Copernicus Sentinel-3A satellite's Ocean and Land Colour Instrument captured Cyclone Debbie as it struck eastern Australia on 27 March 2017.

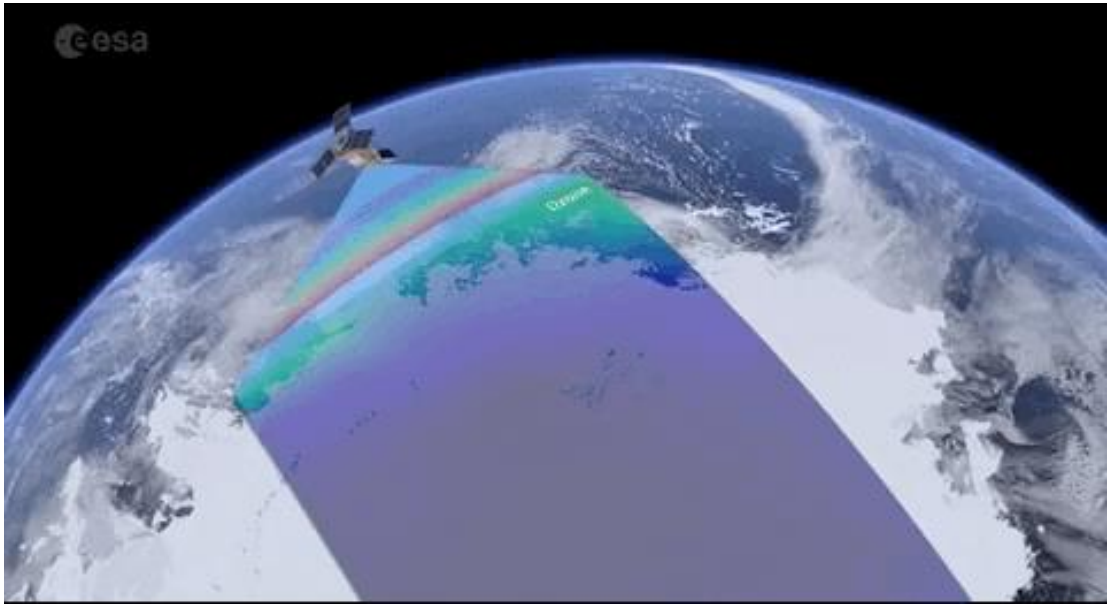


SENTINEL-5P OVERVIEW

- The objective of the Sentinel-5P mission is to perform **atmospheric measurements** with high spatio-temporal resolution, to be used for air quality, ozone and ultraviolet radiation, and climate monitoring and forecasting.

- The mission has one satellite carrying the **TROPOspheric Monitoring Instrument** (TROPOMI) instrument.

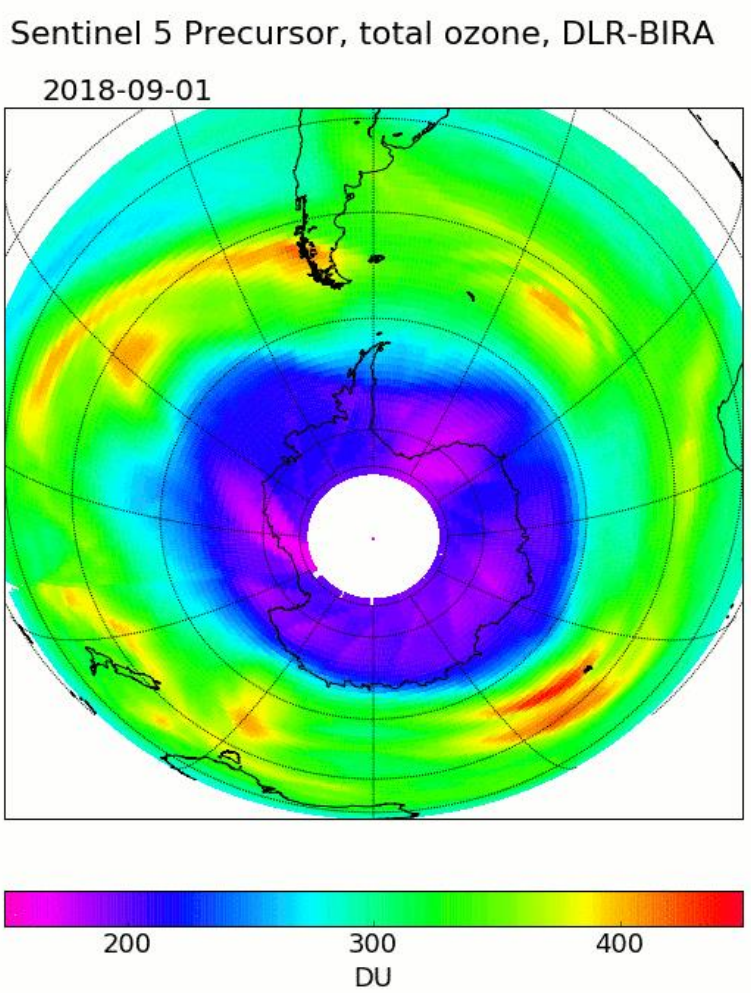
- The Sentinel-5P data will be available soon on the Copernicus Australasia Regional Data Hub.



SENTINEL-5 APPLICATIONS

The applications and services of Sentinel-5P include:

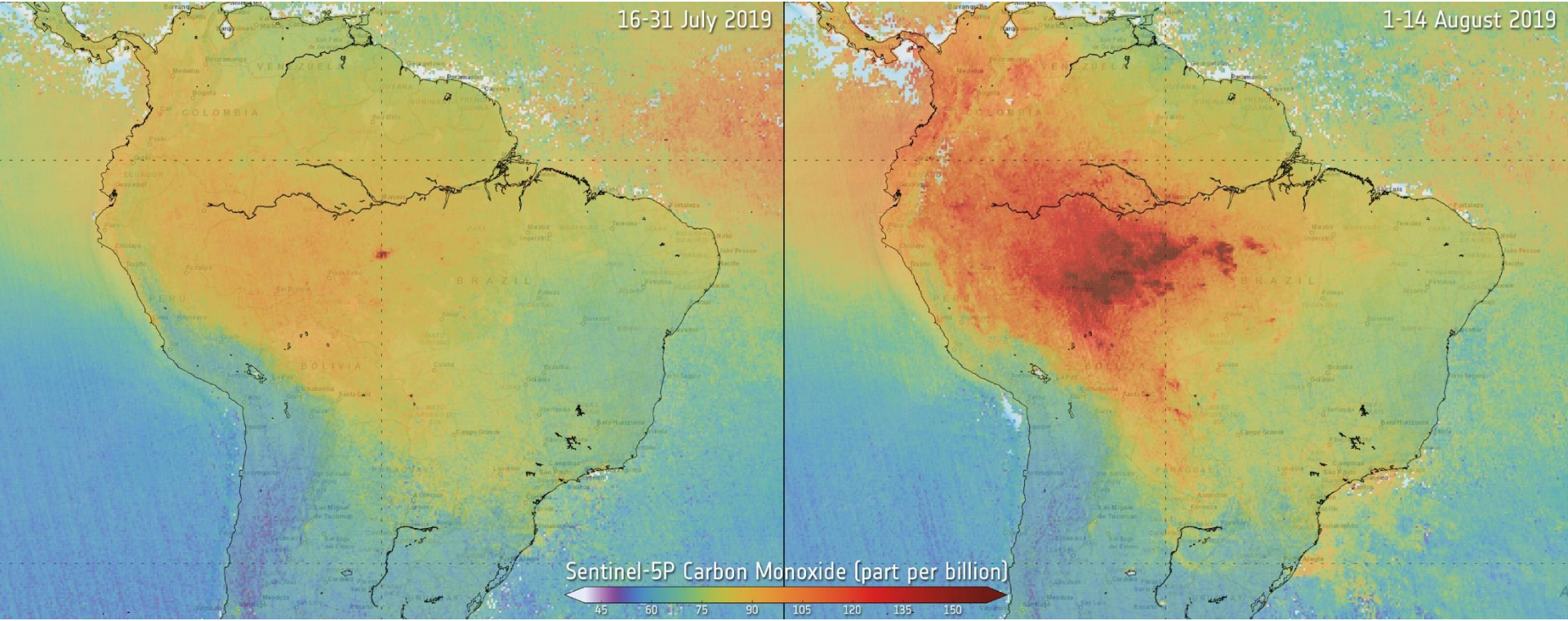
- Provide services to weather forecast centres
- Monitoring volcanic eruption activities
- Determine sources and sinks of atmospheric pollutants
- Issue poor air quality alerts



Ozone hole over Antarctica

SENTINEL-5P APPLICATIONS

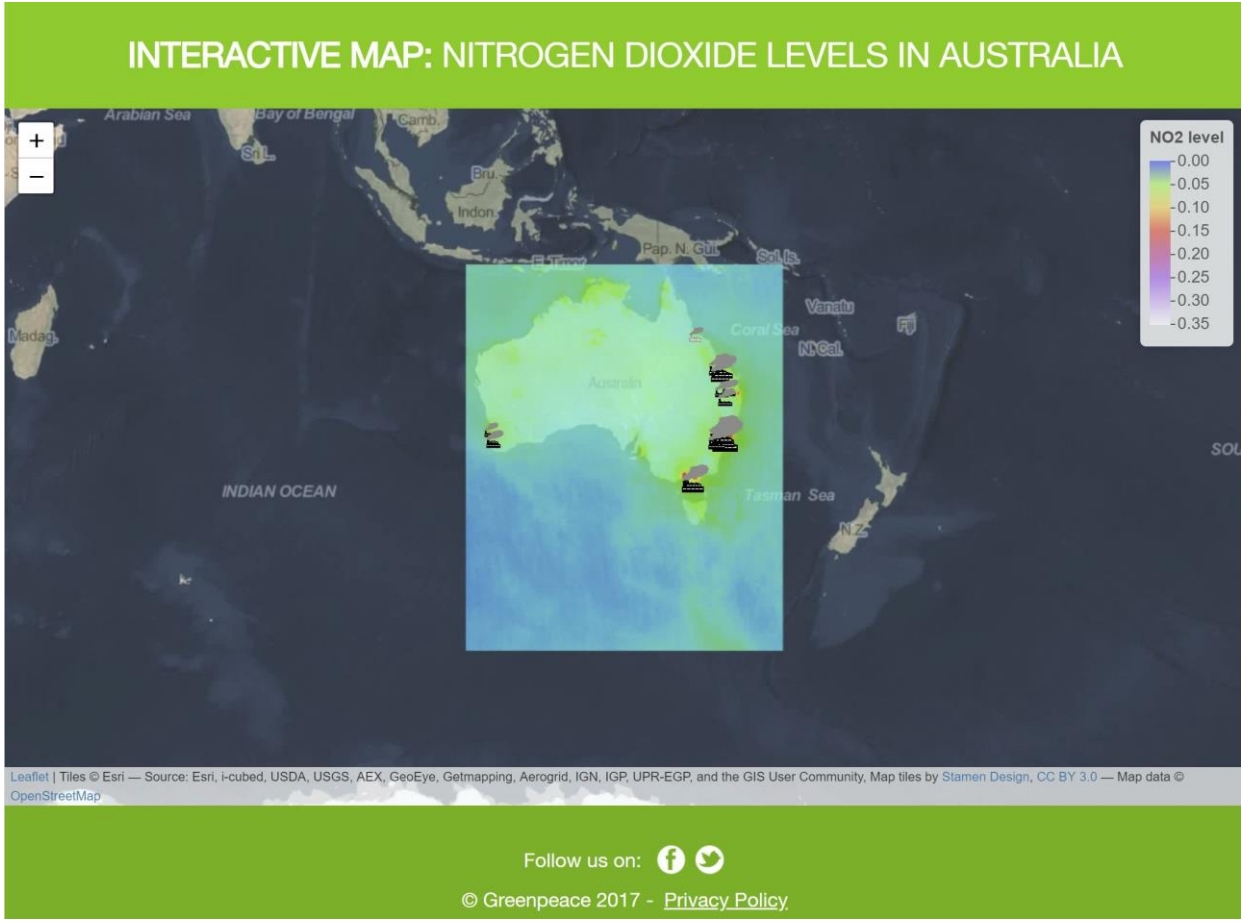
Carbon Monoxide



Copernicus Sentinel-5P satellite imaged carbon monoxide from the Amazon fires between July and August 2019

SENTINEL-5P APPLICATIONS

Nitrogen Dioxide



WORKING WITH COPERNICUS AUSTRALASIA REGIONAL DATA HUB

DOWNLOADING DATA

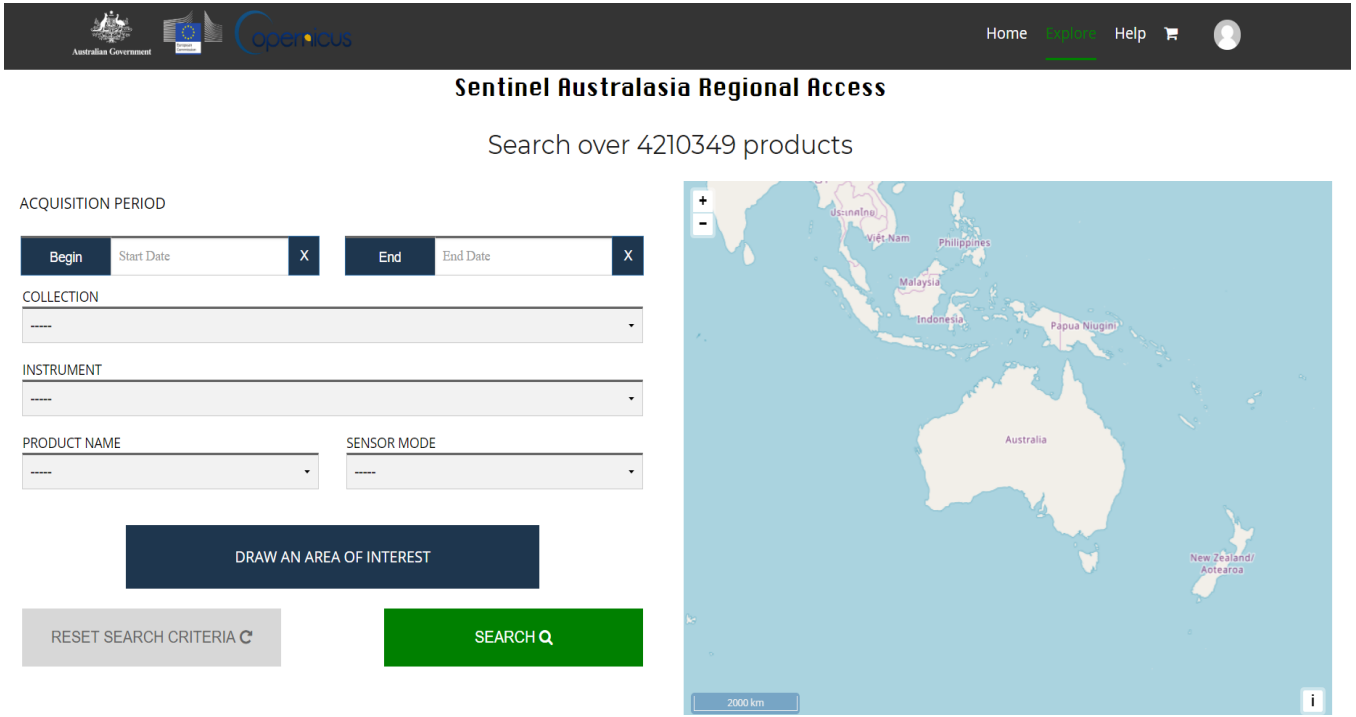
There are multiple ways to access data from the Hub:

1. Sentinel Australasia Regional Access (SARA) map-based GUI
2. SARA python API for advanced users
3. NCI's THREDDS server
4. Directly through the NCI's file system for registered NCI users

The **SARA map interface and API** are the recommended access paths and we will now run through data download using both methods as well as THREDDS. The SARA methods require users to register before they can download data.

SARA GUI

1. Register
2. Login
3. Explore Data
4. Single Download



Welcome to Copernicus Australasia

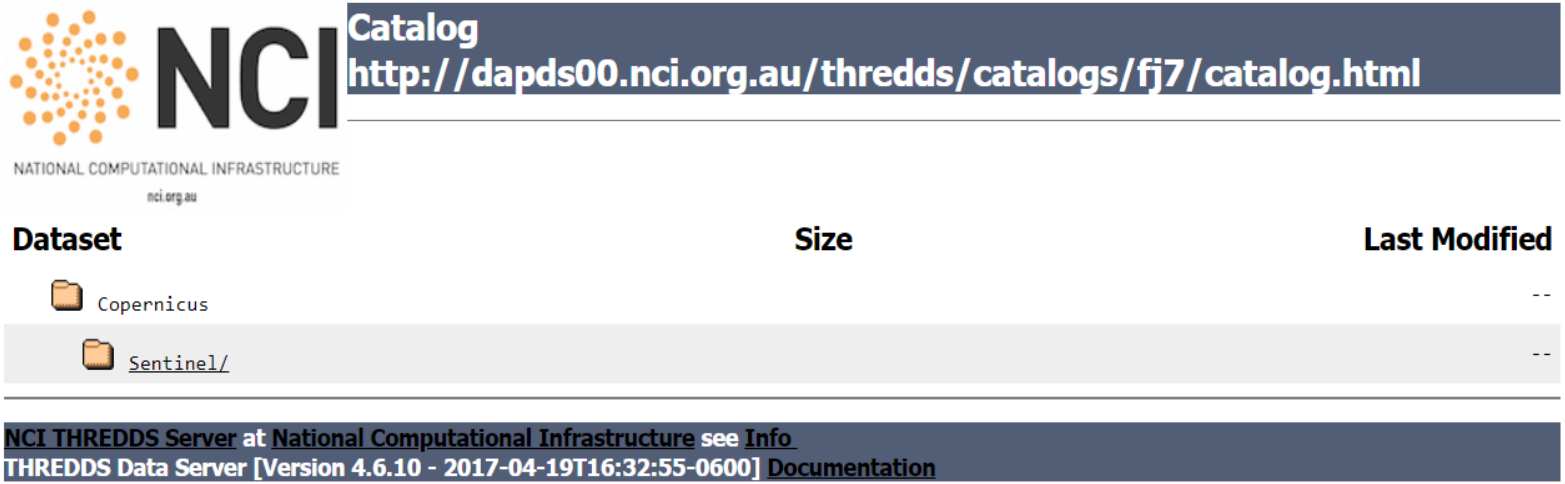
Copernicus Australasia is a regional hub supporting Copernicus, Europe's most ambitious and multifaceted Earth observation programme to date. We provide free and open access to data from Europe's Sentinel satellite missions for the South-East Asia and South Pacific region.

More information about Copernicus Australasia can be found here. For general inquiries, please contact earth.observation@ga.gov.au

DOWNLOADING DATA WITH THE SARA API

THREDDS

1. Access
2. Navigate
3. Download



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NCI FILE SYSTEM

1. Access – **Only for users with approved NCI access**
2. Navigate – Data is stored and named the same way as on THREDDS
3. Download

THANK YOU

FrontierSI has prepared this training material on behalf of the Copernicus Australasia Regional Data Hub Steering Committee.

FrontierSI has prepared this document in good faith based on the information provided to it, and has endeavoured to ensure that the information in this document is correct. FrontierSI does not warrant or represent that the document is free from error or omissions and does not accept liability for any errors or omissions.

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