



Australia's National Science Agency

Exploring the World's Open Data Portals

Discovery, Visualisation and Analysis of Open Data with TerriaJS

Nick Forbes-Smith | FOSS4G 2022 Firenze



Australia's national science agency



One of the world's largest multidisciplinary science and technology organisations



5,200+ dedicated people working across 58 sites globally



State-of-the-art national research infrastructure



We delivered \$7.6 billion of benefit to the nation in FY21



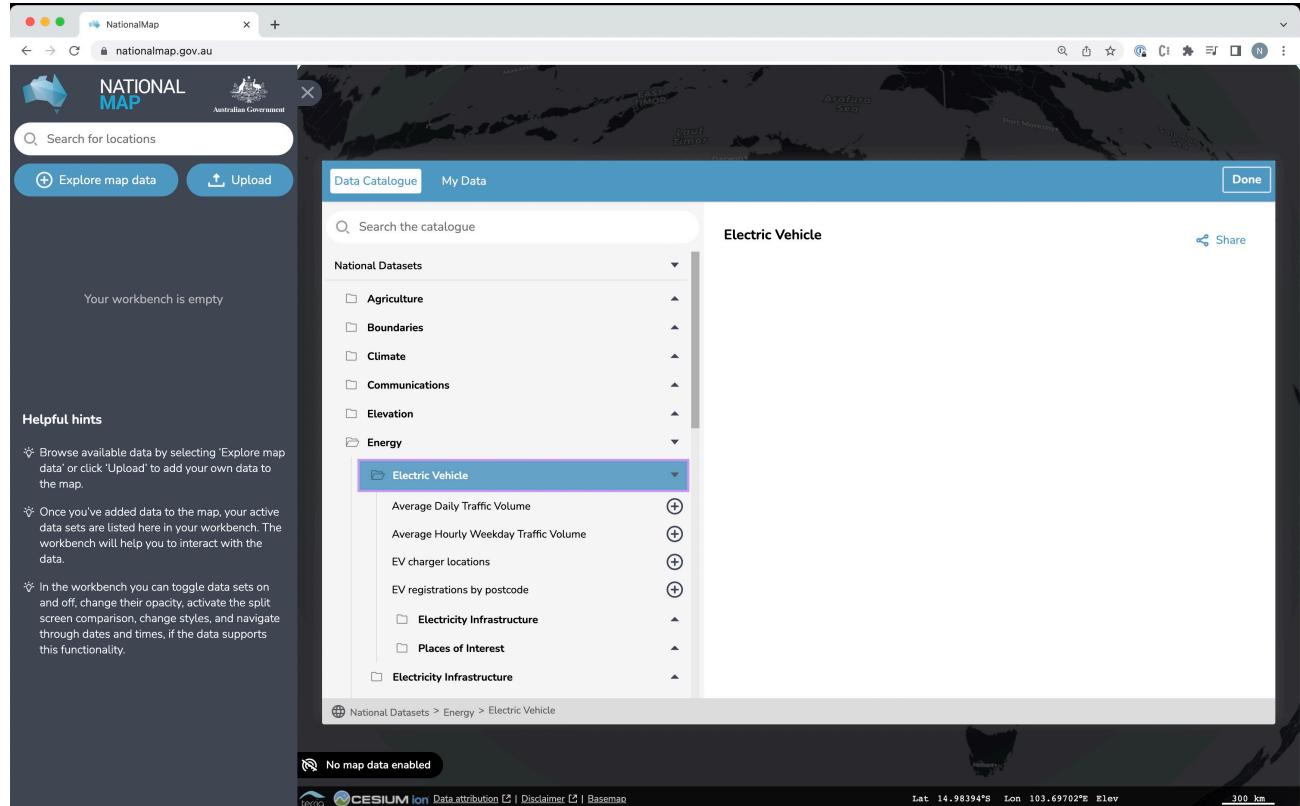
TerriaJS

- An open-source framework for web-based geospatial catalogue explorers
- **Cesium/Leaflet** based in-browser tool for looking at 2D and 3D data
- Find us at terria.io



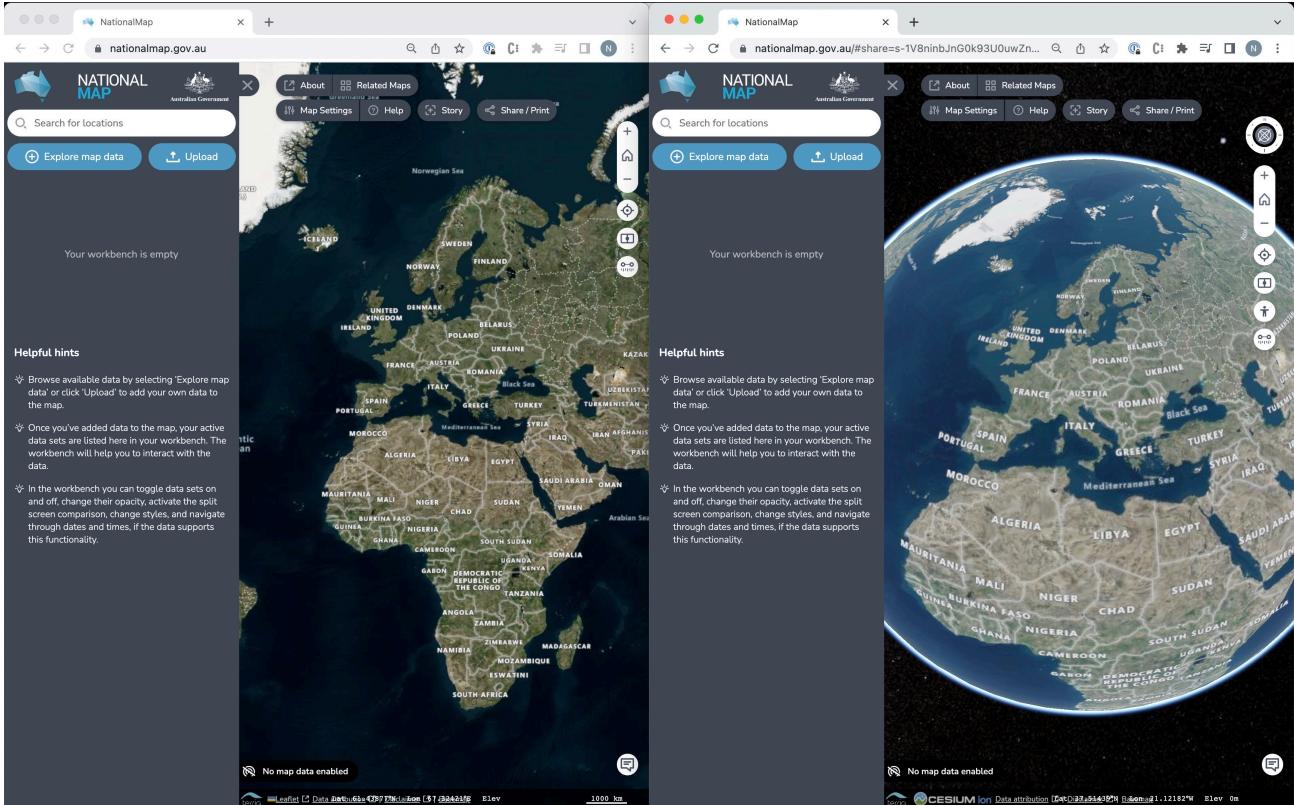
TerriaJS

- Catalog
 - Tree structure
 - Search
- Map
 - 3D with 2D fallback
- Data controls
 - Workbench
 - Panels/tools



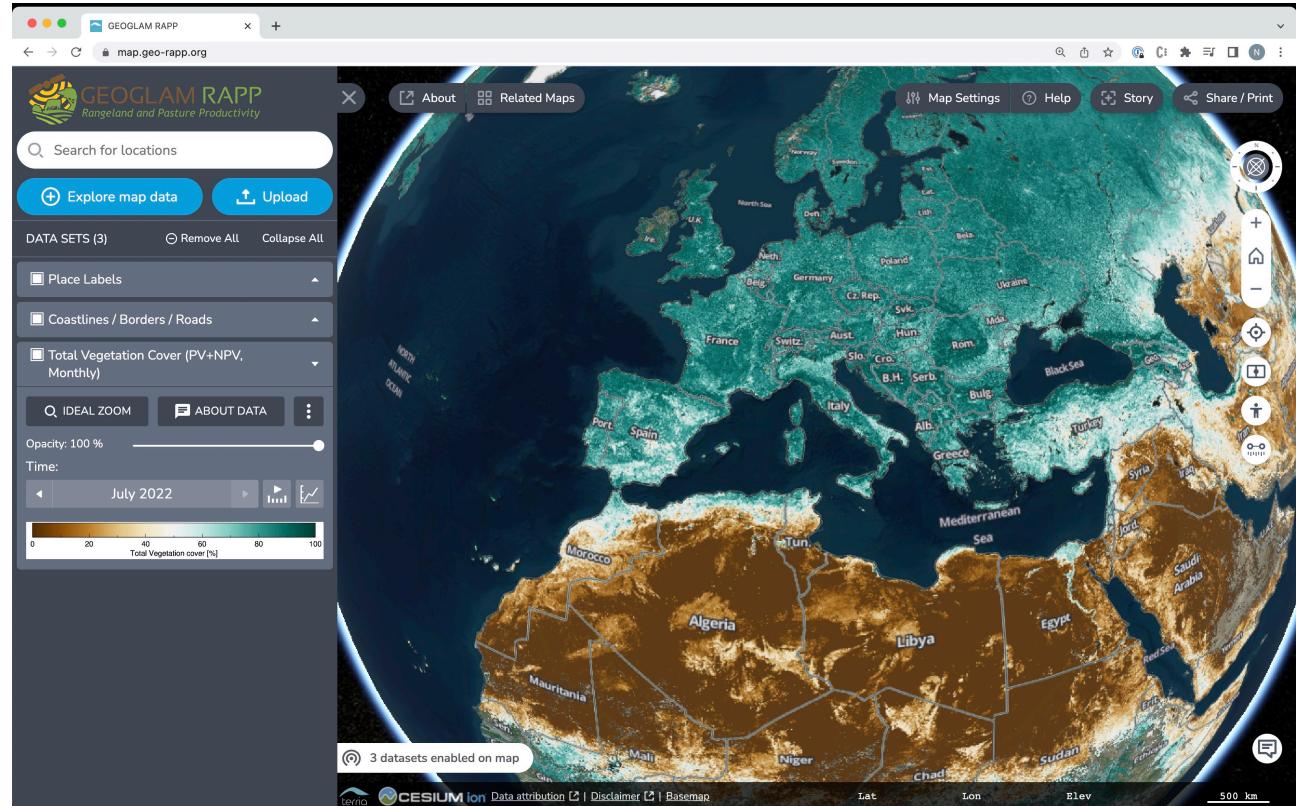
TerriaJS

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TerriaJS

- Catalog
 - Tree structure
 - Search
- Map
 - 3D with 2D fallback
- Data controls
 - Workbench
 - Panels/tools





How? FOSS!

- Leaflet (2D) / Cesium (3D)
- React / mobX
- Protoproj.js (vector tiles)
- d3, turf.js
- TypeScript
- node_modules.....



Our Maps

Fully Open - Open data portal focus

- Client-side heavy
- All using same open-source code-base - just configuration!

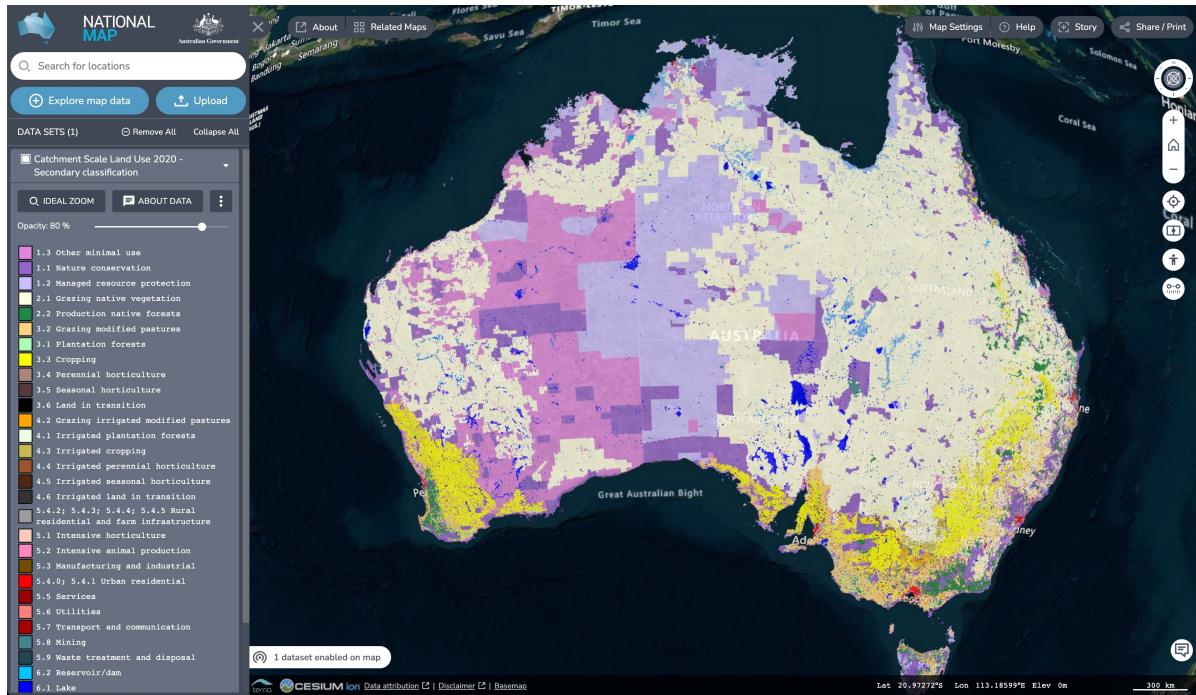
Partially Closed - Digital twin focus

- Server-side heavy
- 3D data
- Closed/proprietary formats + format conversions
- Enterprise auth/access control

(Australian) NationalMap – Open

nationalmap.gov.au

- Birth of TerriaJS
- Geospatial data discovery, visualisation and sharing
- Launched 2014
- 14,000+ datasets, 30,000+ sessions/month





(Australian) NationalMap – Open

nationalmap.gov.au

- 46 open data portals
- (1105 curated datasets)
- = 14,000+ datasets

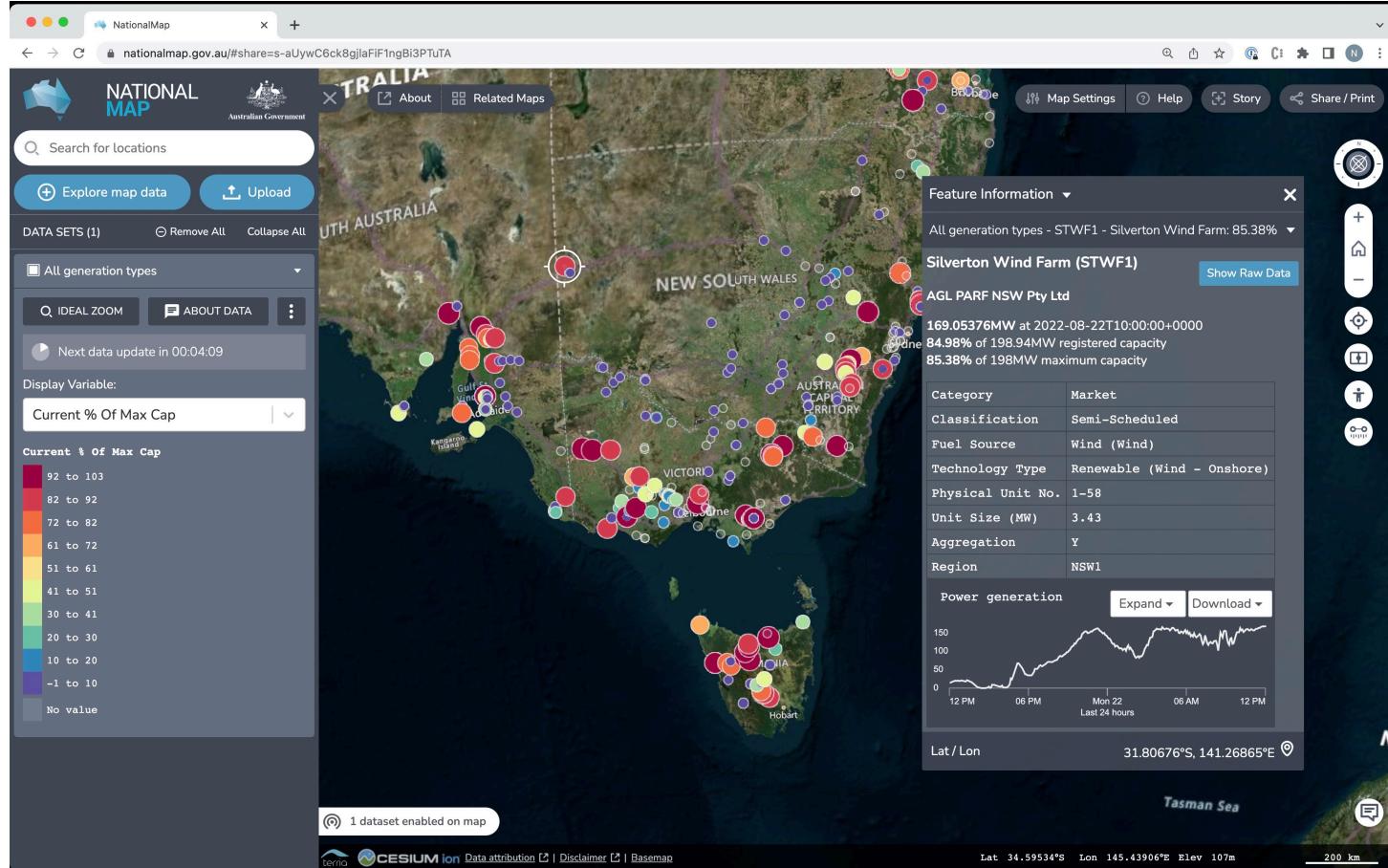
The screenshot shows the NationalMap website's Data Catalogue interface. At the top, there's a search bar labeled "Search for locations" and buttons for "Explore map data" and "Upload". Below this, a message says "Your workbench is empty". On the left, a sidebar titled "Helpful hints" provides tips for using the map and workbench. The main area is titled "Data Catalogue" and "My Data". It features a search bar and a sidebar menu under "National Datasets" which includes Agriculture, Boundaries, Climate, Communications, Elevation, and Energy. The "Energy" section is expanded, showing "Electric Vehicle" as the selected category. Under "Electric Vehicle", there are several data layers listed with "+" icons to add them to the map: "Average Daily Traffic Volume", "Average Hourly Weekday Traffic Volume", "EV charger locations", and "EV registrations by postcode". There are also collapsed sections for "Electricity Infrastructure" and "Places of Interest". A "Share" button is located in the top right corner of the catalog area. At the bottom, it says "No map data enabled". The footer includes links for "Data attribution", "Disclaimer", and "Basemaps", along with coordinates "Lat 14.98394°S Lon 103.69702°E Elev" and a scale "300 km".



National Map example

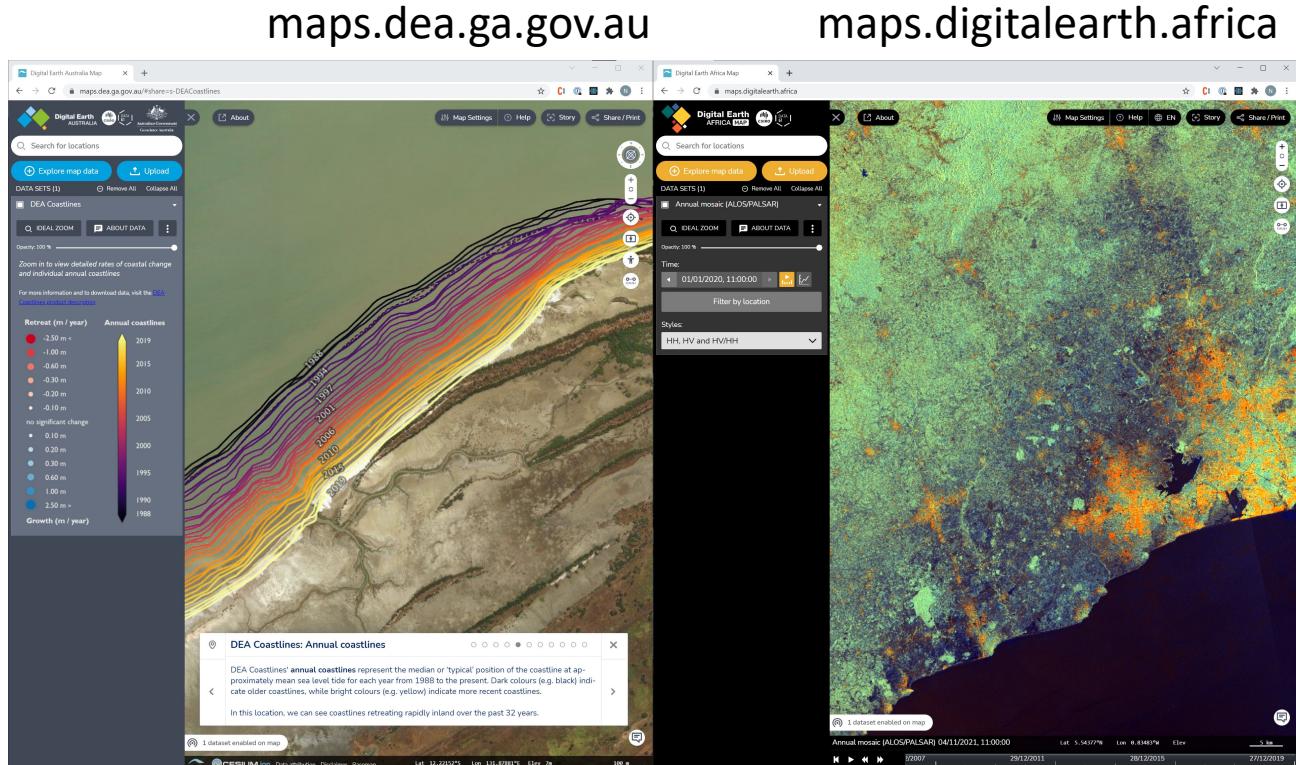
nationalmap.gov.au

- Australian power generation
- CSV



Digital Earth Australia/Africa – Open

- With Geoscience Australia
- Landsat/Sentinel satellite imagery
- Satellite imagery derived products and "analysis ready data"
- Integrated with OpenDataCube OWS

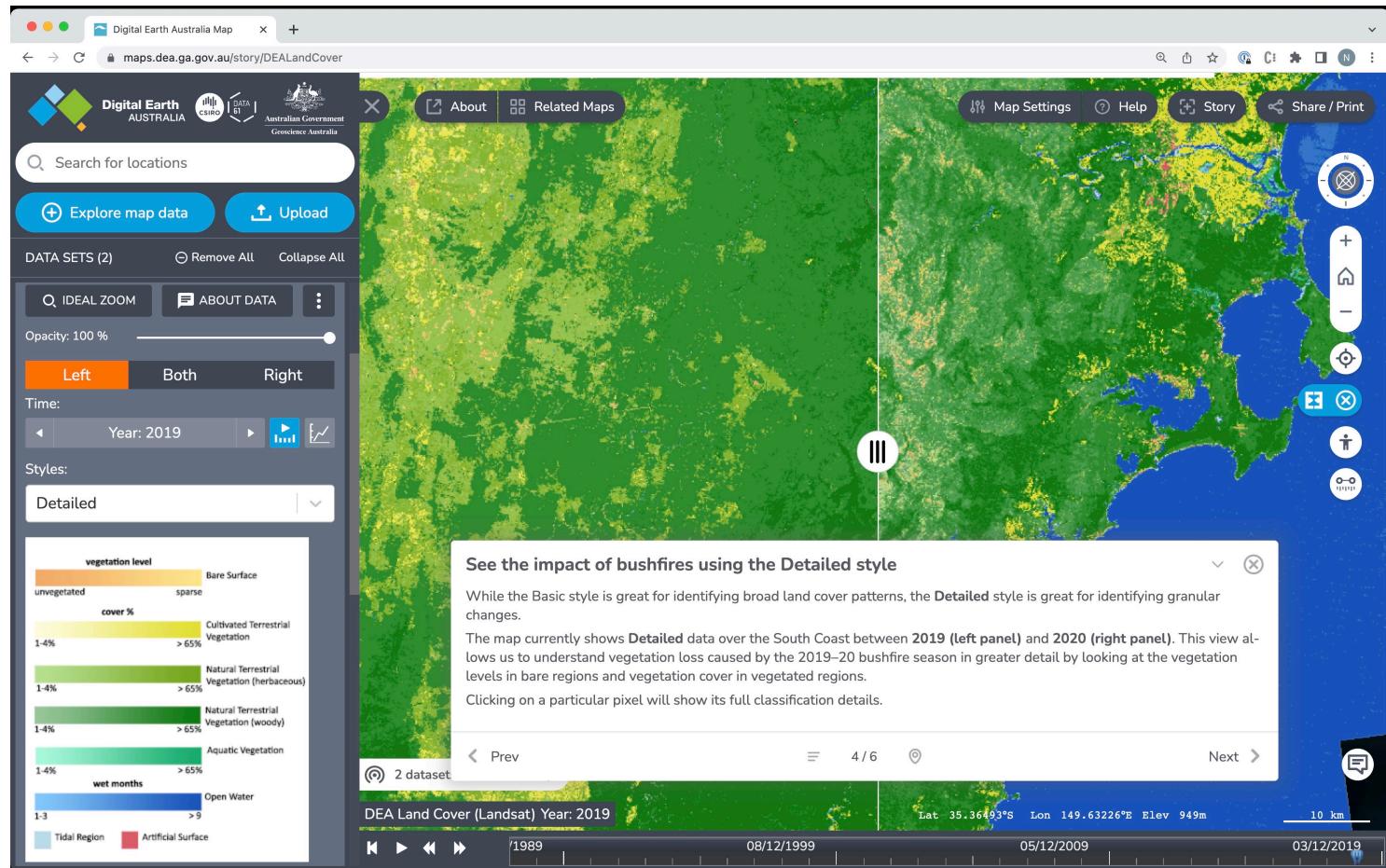




Digital Earth Australia

maps.dea.ga.gov.au/story/DEALandCover

- OpenDataCube WMS
 - Time series
 - Multiple styles
- Story
- Imagery compare

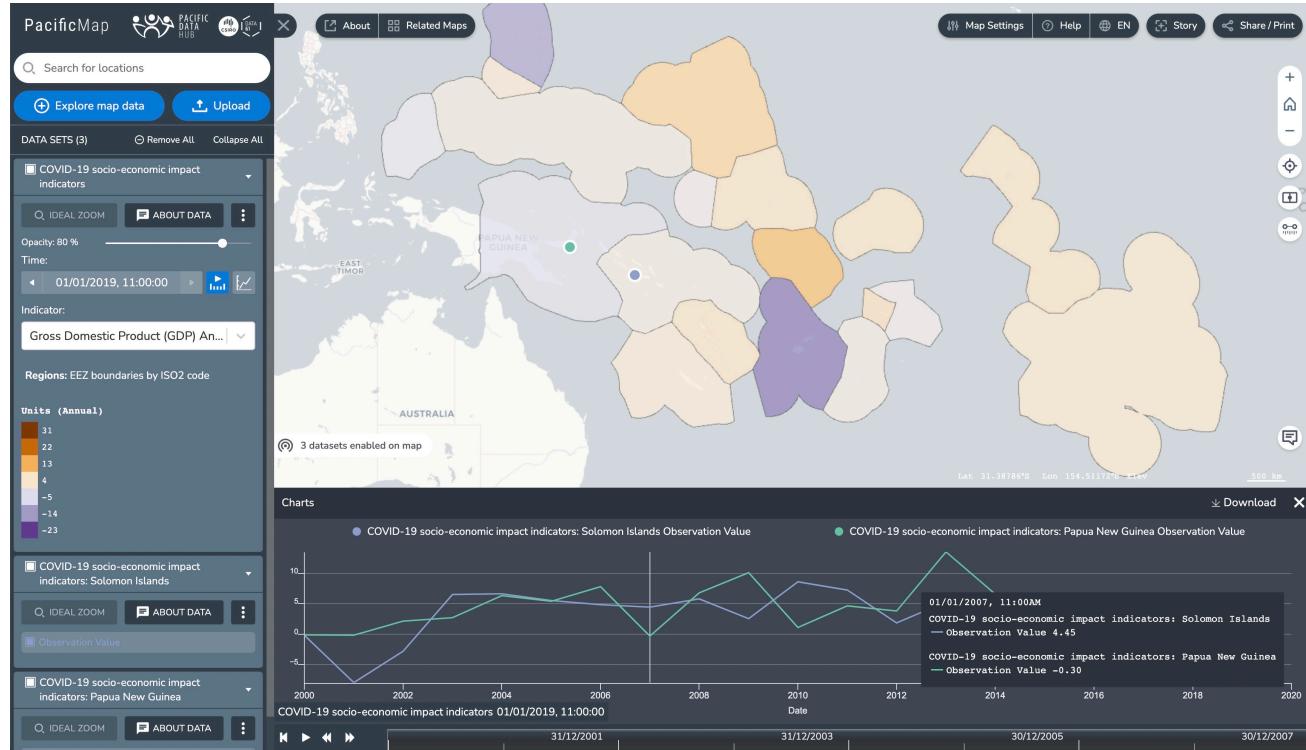




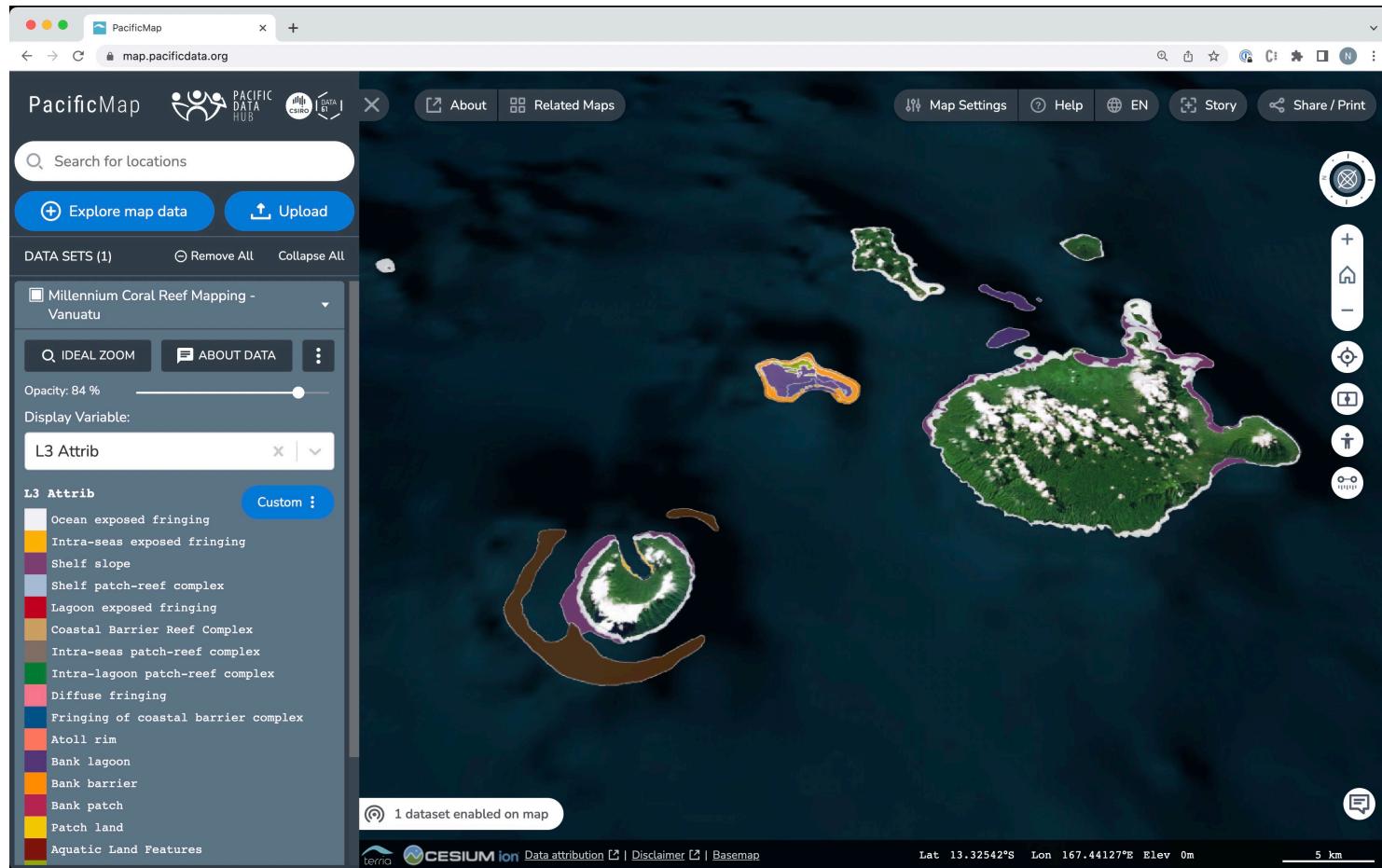
Pacific Map – Open

map.pacificdata.org

- With **Secretariat of the Pacific Community (SPC)**
- Integrated with **Pacific Data Hub (PDH)** - CKAN and SDMX



- GeoJSON
 - geojson-vt
 - Protopmaps.js
- Automatic data-driven styling

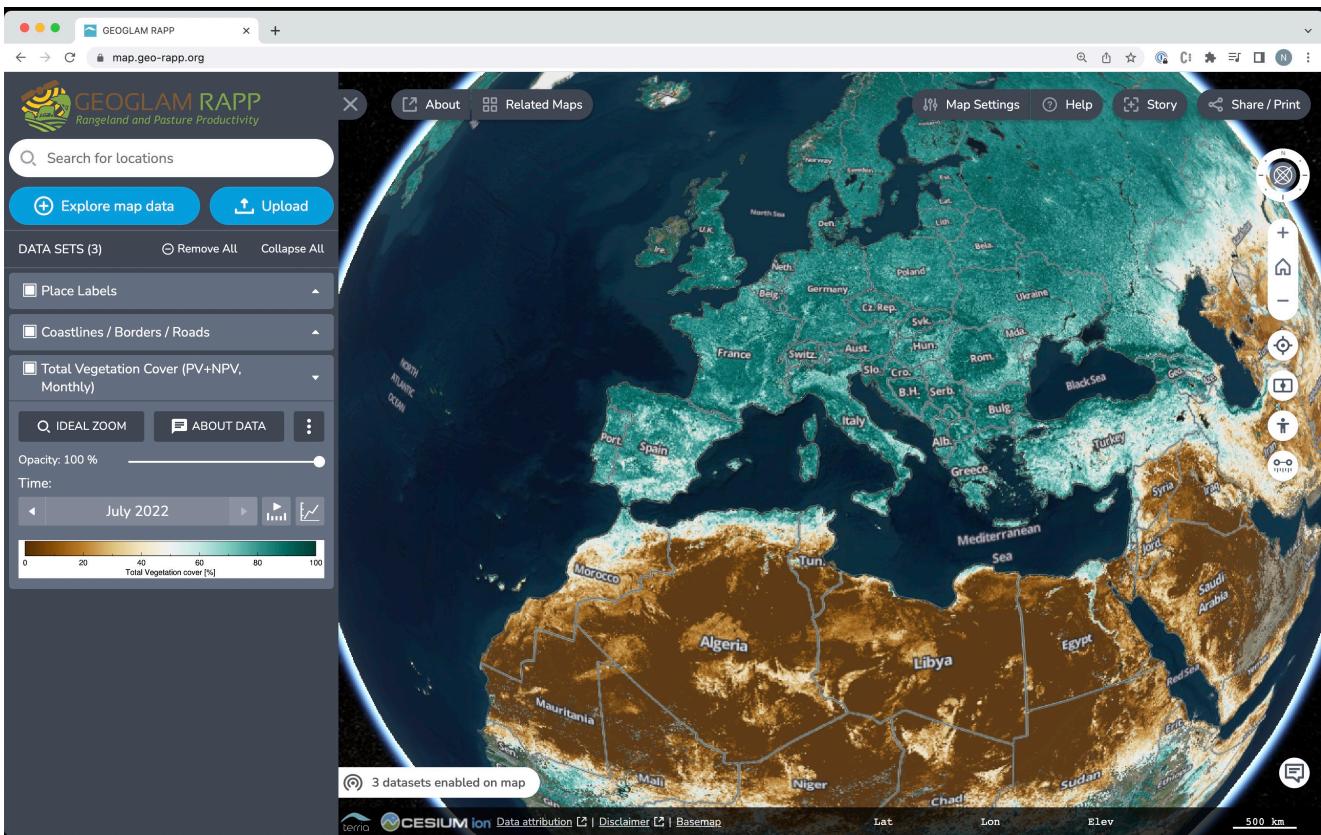




GEOGLAM RaPP Map – Open

map.geo-rapp.org

- Rangeland and Pasture Productivity (RaPP)
- Group on Earth Observations Global Agricultural Monitoring (GEOGLAM)



- WMS
- WPS
 - GeoJSON input
 - Calculate vegetation cover over time
 - Returns Terra JSON with CSV time-series





Terria Digital Twins

Bringing together 2D, 3D + time-series geospatial with BIM, IoT/sensor data

- Three largest states in Australia
- More "closed"
- Server-side heavy
- Format conversions
- Proprietary formats
- Enterprise auth / access control
- Not really discussed in this talk



Victoria Digital Twin

vic.digitaltwin.terria.io

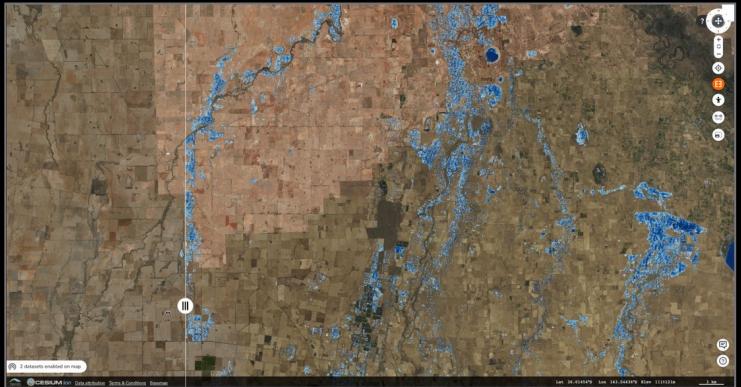
Just
launched!



Linking to national open datasets



Draws on massive aerial imagery archive



Historical data supports preparation for future



Visualise plans in place before construction begins



Victoria Digital Twin

vic.digitaltwin.terria.io

The screenshot displays the Victoria Digital Twin platform. On the left, a sidebar titled "Digital Twin Victoria" contains a search bar, "Explore map data" and "Upload" buttons, and a list of "DATA SETS (10)". The list includes "Great Ocean Road 3D Photomesh" (selected), "Melbourne Central 2021 3D Photomesh", "Electricity Transmission Lines", "Tree Density", "Watercourse Levels", "Secondary Freight Route - road", "Distribution powerlines", "All generation types", "Orbost 2012 2D Aerial Imagery", and "Snowy River 2012 2D Aerial Imagery". The main area shows a detailed 3D aerial view of a city, likely Melbourne, with roads, buildings, and water bodies. A floating callout box for "Great Ocean Road" is visible at the bottom. The top right features a navigation bar with "Map Settings", "Help", "Story", and "Share / Print" buttons, along with a zoom control. The bottom right shows coordinates: Lat 37.81989°S Lon 144.98423°E Elev 8m.

VICTORIA Australia

Digital Twin Victoria

DATA 61

Search for locations

+ Explore map data Upload

DATA SETS (10) Remove All Collapse All

- Great Ocean Road 3D Photomesh
- Melbourne Central 2021 3D Photomesh
- Electricity Transmission Lines
- Tree Density
- Watercourse Levels
- Secondary Freight Route - road
- Distribution powerlines
- All generation types
- Orbost 2012 2D Aerial Imagery
- Snowy River 2012 2D Aerial Imagery

IDEAL ZOOM ABOUT DATA :

Opacity: 100 %

Shadows:

- None

Clip model

Great Ocean Road

5 datasets enabled on map

CESIUM Ion

Map Settings Help Story Share / Print

?

Map Settings Help Story Share / Print

Lat 37.81989°S Lon 144.98423°E Elev 8m

50 m



Terria Connectors

All in a web browser

- Imagery (tiled services)
 - No client-side raster yet...
- Vector
- 3D
- Tabular/Sensor
- Portals



Imagery (tiled)

- **WMS/WMTS/XYZ sources**
 - Tight integration with OpenDataCube OWS
- MapboxStyle / Carto (v2) / BingMaps
- ArcGis Imagery / Map Service

Bold = open



Vector

- **Web Feature Service/ArcGis Feature Service**
- **GeoJson/Shapefile/KML/CZML/GPX/GeoRSS**
- **Mapbox Vector Tiles**



3D

- **Cesium 3d-tiles**
- **Cesium Terrain**
- **CZML** (Cesium JSON graphical scene format)
- **GLTF**
- Converter for 40+ 3D file formats
 - assimpjs: WebAssembly **Open Asset Import Library**



Tabular/sensor data

Point (lat/long) or Region mapping

- **CSV**
- **SDMX**
- **SensorObservationService**
- **Socrata**
- **OpenDataSoft**



Open data portals!

These create data sources previously outlined (depending on implementation)

- CKAN
- Catalog Service for the Web (CSW)
- Socrata
- OpenDataSoft
- Magda
- THREDDS
- WMS/WFS/WPS
- ArcGis Portal
- ArcGis Map/Feature Service
- SDMX



All in a web browser!

All client-side in a web browser

Usual limitations...

- File size
- Geom complexity
- Web/cloud-optimised
- CRS



What do I do?

Sydney, Australia

Software Engineer for TerriaJS

2D data visualisation

- vector
- raster
- tabular/sensor/point based

API/portal connections

- OGC - WMS, WFS, WPS, CSW, SOS
- THREDDS
- Socrata
- OpenDataSoft
- SDMX



Explore the Open Data with Terria!

- Discovery
- **Visualisation**
- Analysis
- Create/share maps with the world!

Warning – lots of videos...



Discovery

- Catalog
- "Query" open data services
- Search / indexing



Discovery - Catalog

- Tree-structure
- Groups for curated datasets
- Open data portals

The screenshot shows the NationalMap Data Catalog interface. At the top, there's a search bar labeled "Search for locations" and buttons for "Explore map data" and "Upload". Below this, a message says "Your workbench is empty". On the left, a sidebar titled "Helpful hints" provides instructions on how to use the platform, such as exploring map data or uploading your own data. The main area features a map of Southeast Asia with various regions labeled: Java, Ujung, Flores Sea, Flores Sea, Savu Sea, Timor Sea, Arafura Sea, Gulf of Papua, Port Moresby, and Tasmania. To the right of the map, there's a "Data Catalogue" tab and a "My Data" tab. A sidebar on the right lists "National Datasets" under categories like Agriculture, Boundaries, Climate, Communications, Elevation, Energy, Environment, Habitation, Health, Infrastructure, Land Cover and Land Use, Marine and Oceans, and Processes. Below the map, a message says "Select a dataset to see a preview" followed by "- OR -" and a button labeled "Go to the map". At the bottom, there's a footer with links for "No map data enabled", "TERMO", "CESIUM ion", "Data attribution", "Disclaimer", "Basemap", and coordinate information (Lat 25.60920°S, Lon 107.40014°E, Elev 0m).



Discovery - "Query" open data services

- Follows catalog tree-structure

Provides way to search through datasets

- Depends on API or implementation

e.g. might group datasets by subject, etc

The screenshot shows the NationalMap Data Catalogue interface. At the top, there's a map of Southeast Asia with labels for Java, Flores Sea, Timor Leste, and Port Moresby. Below the map is a sidebar with the following sections:

- Data Catalogue** tab (selected)
- My Data** tab
- Search for locations** input field
- Explore map data** button
- Upload** button
- Your workbench is empty** message
- Helpful hints** section with three bullet points:
 - Browse available data by selecting 'Explore map data' or click 'Upload' to add your own data to the map.
 - Once you've added data to the map, your active data sets are listed here in your workbench. The workbench will help you to interact with the data.
 - In the workbench you can toggle data sets on and off, change their opacity, activate the split screen comparison, change styles, and navigate through dates and times, if the data supports this functionality.
- Local government data** section with a **Share** button
- Search the catalogue** input field
- Social and Economic**, **Transport**, **Vegetation**, **Water** categories
- Data.gov.au** section
- New South Wales Government** section
 - Live data (beta)** category
 - Local government data** category (selected, highlighted in blue)
 - Mosman**, **Lake Macquarie**, **Sydney** sub-categories
 - State data** category
- Northern Territory Government** section
- No map data enabled** message
- Attribution**: terria, Cesium ion, Data attribution, Disclaimer, Basemap
- Coordinates**: Lat 25.60920°S Lon 107.40014°E Elev 0m
- Scale**: 500 km

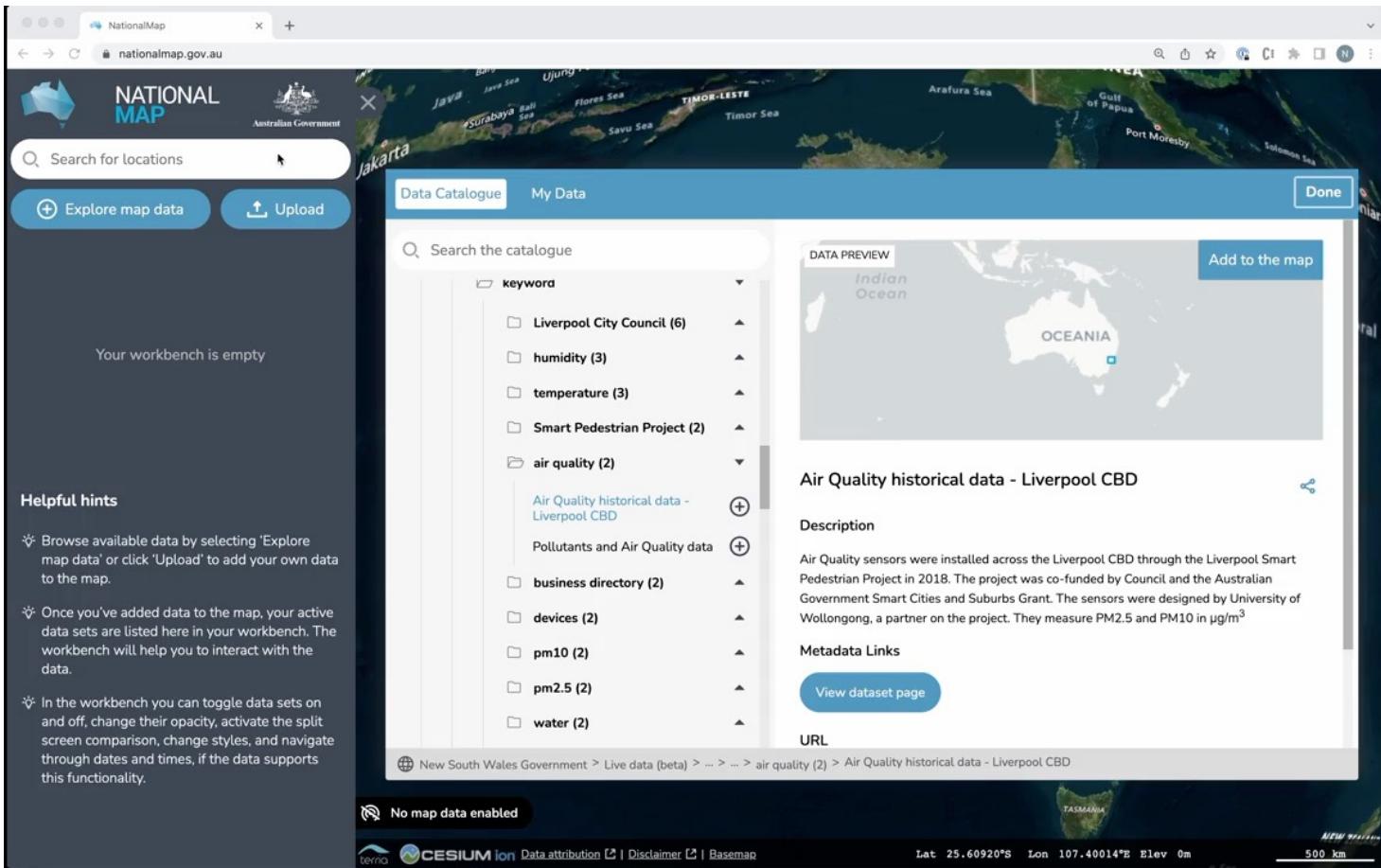
Discovery - Search / indexing

2 Methods

Depends on size and nature of Catalog

- Dynamic in-browser search
- Static catalog index file

46 data portals to search?!



The screenshot shows the NationalMap Data Catalogue interface. At the top, there's a search bar labeled "Search for locations" and buttons for "Explore map data" and "Upload". Below this, a message says "Your workbench is empty". On the left, a sidebar titled "Helpful hints" provides tips for using the platform. The main area is titled "Data Catalogue" and shows a search result for "air quality". The results list includes categories like "Liverpool City Council (6)", "humidity (3)", "temperature (3)", "Smart Pedestrian Project (2)", and "air quality (2)". Under "air quality (2)", it shows "Air Quality historical data - Liverpool CBD" and "Pollutants and Air Quality data". To the right, there's a "DATA PREVIEW" section showing a map of Oceania with a highlighted area over Australia, and a button "Add to the map". Below this, there's a detailed description of the "Air Quality historical data - Liverpool CBD" dataset, which mentions the Liverpool Smart Pedestrian Project and its sensors installed across the Liverpool CBD. It also links to a "View dataset page" and provides a "URL". At the bottom, it says "No map data enabled".

Visualisation!

Imagery

- Time-series + Animation over time
- Compare

Vector data

- Automatic styling
- Edit styling

Tabular data

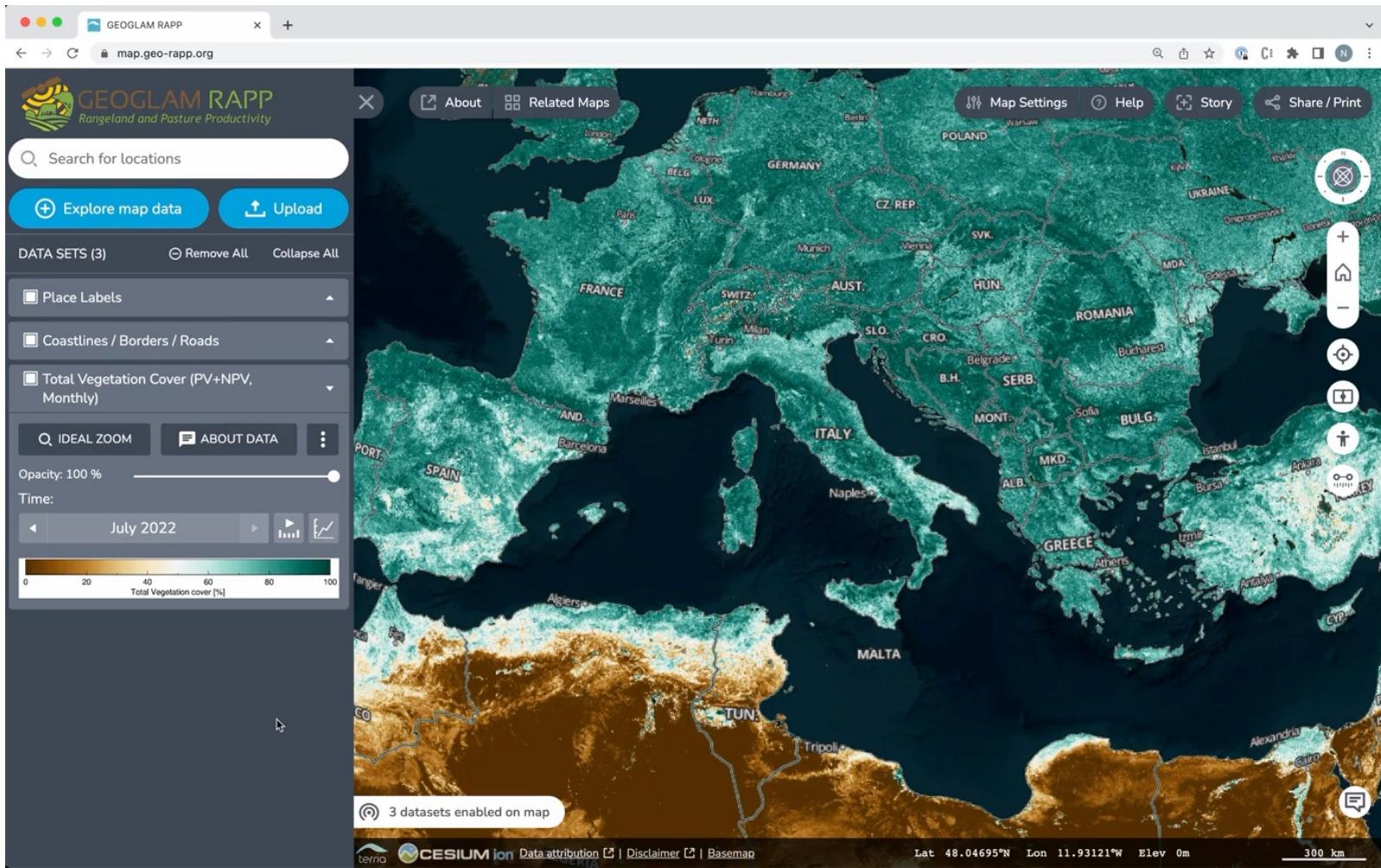
- Time-series
- Charting
- Region mapping
- Automatic styling / Edit styling

3D (not in this talk)

Imagery

Example:

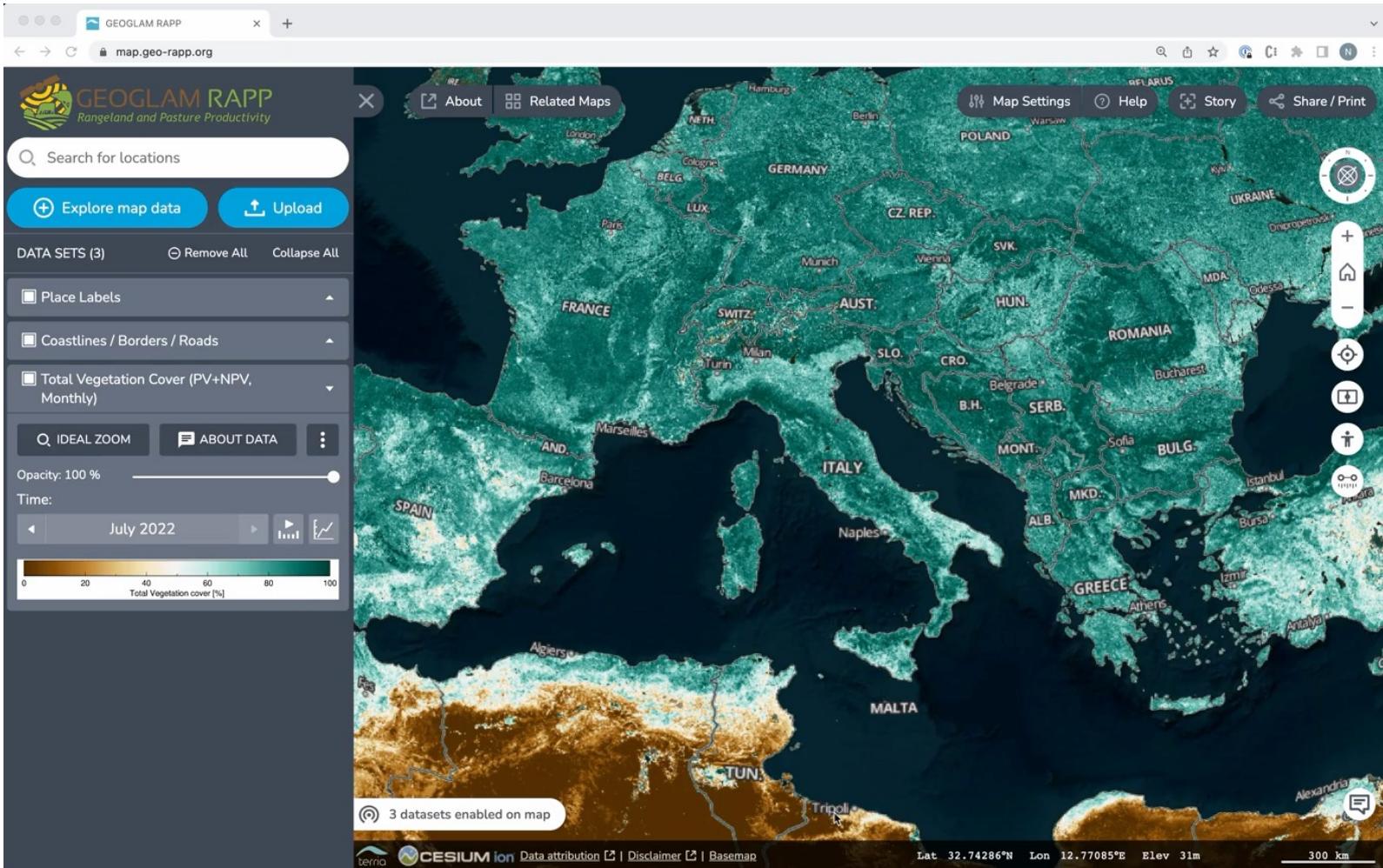
- Veg cover calculated from MODIS
- WMS



Imagery time series

Example:

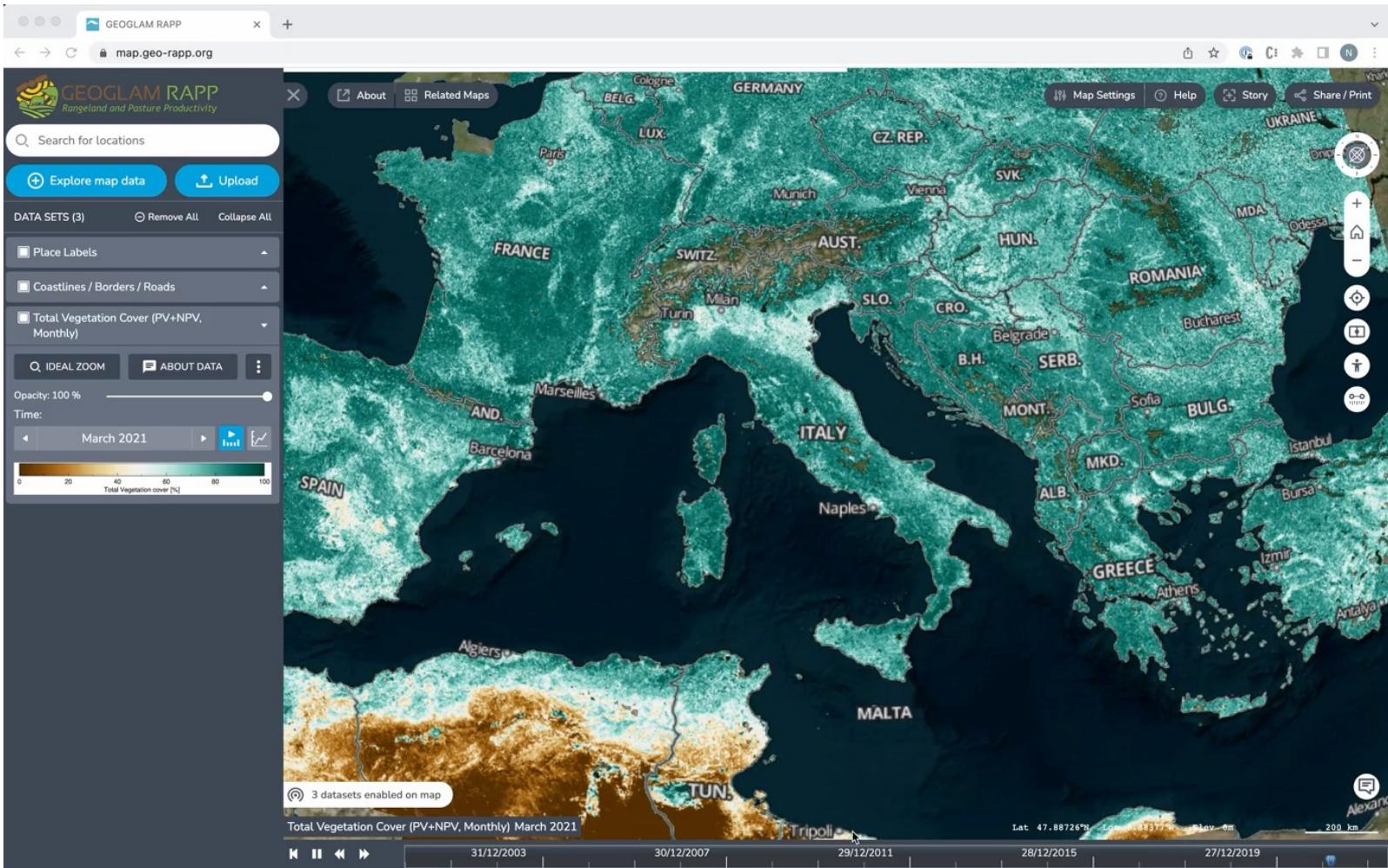
- Veg cover calculated from MODIS
- WMS



Imagery time series animate

Example:

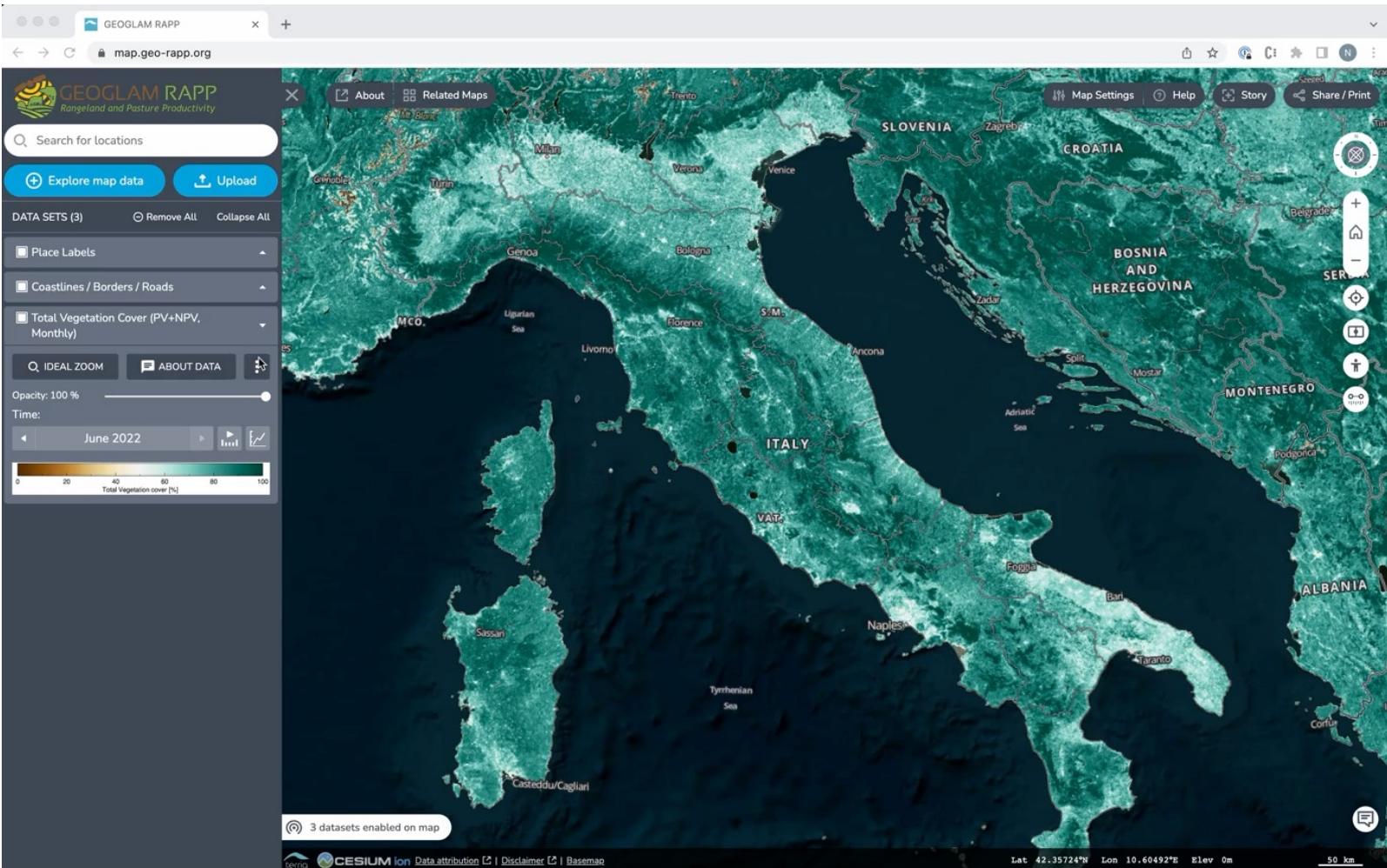
- Veg cover calculated from MODIS
- WMS



Imagery compare

Example:

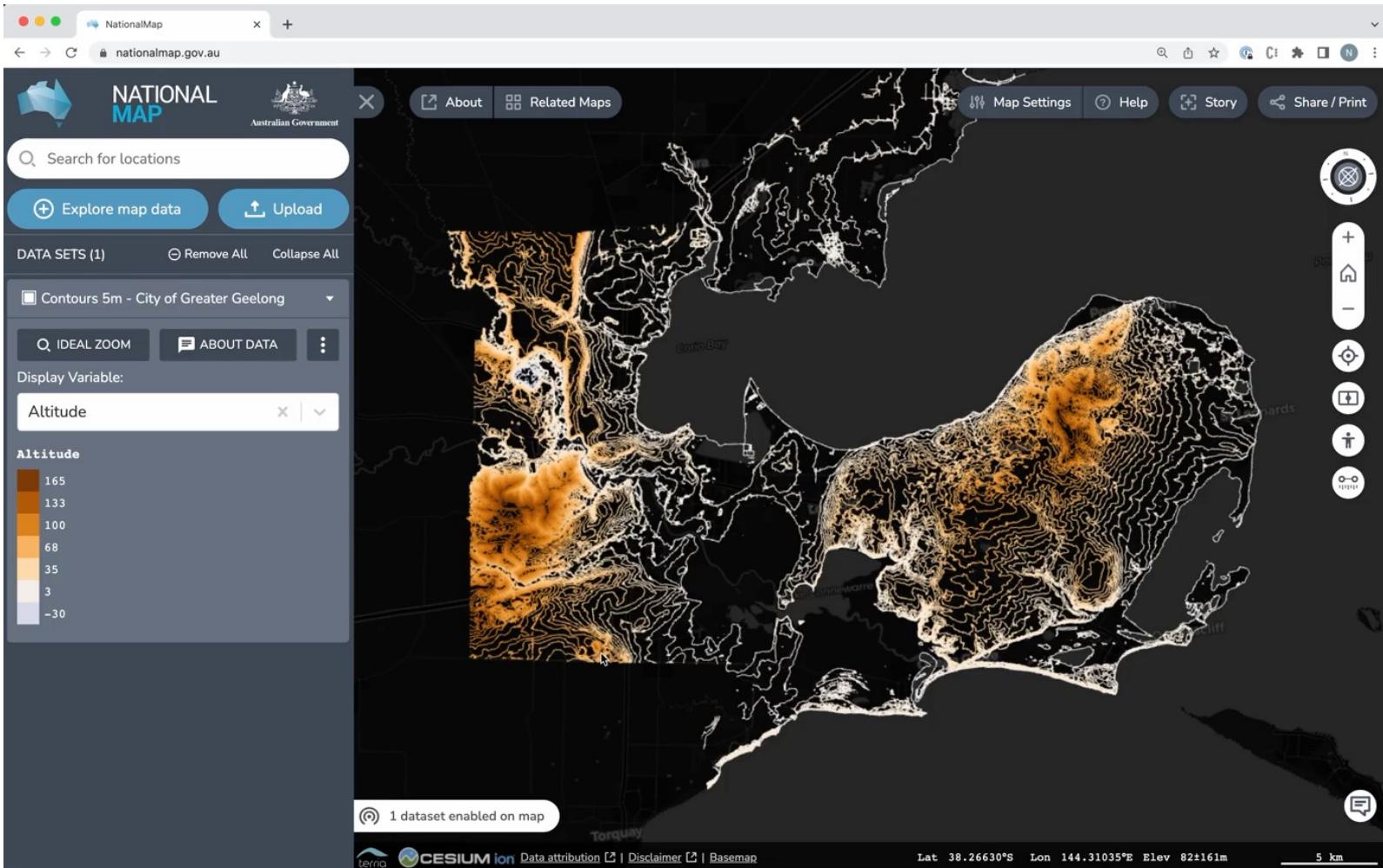
- Veg cover calculated from MODIS
- WMS



Vector automatic styling

Example:

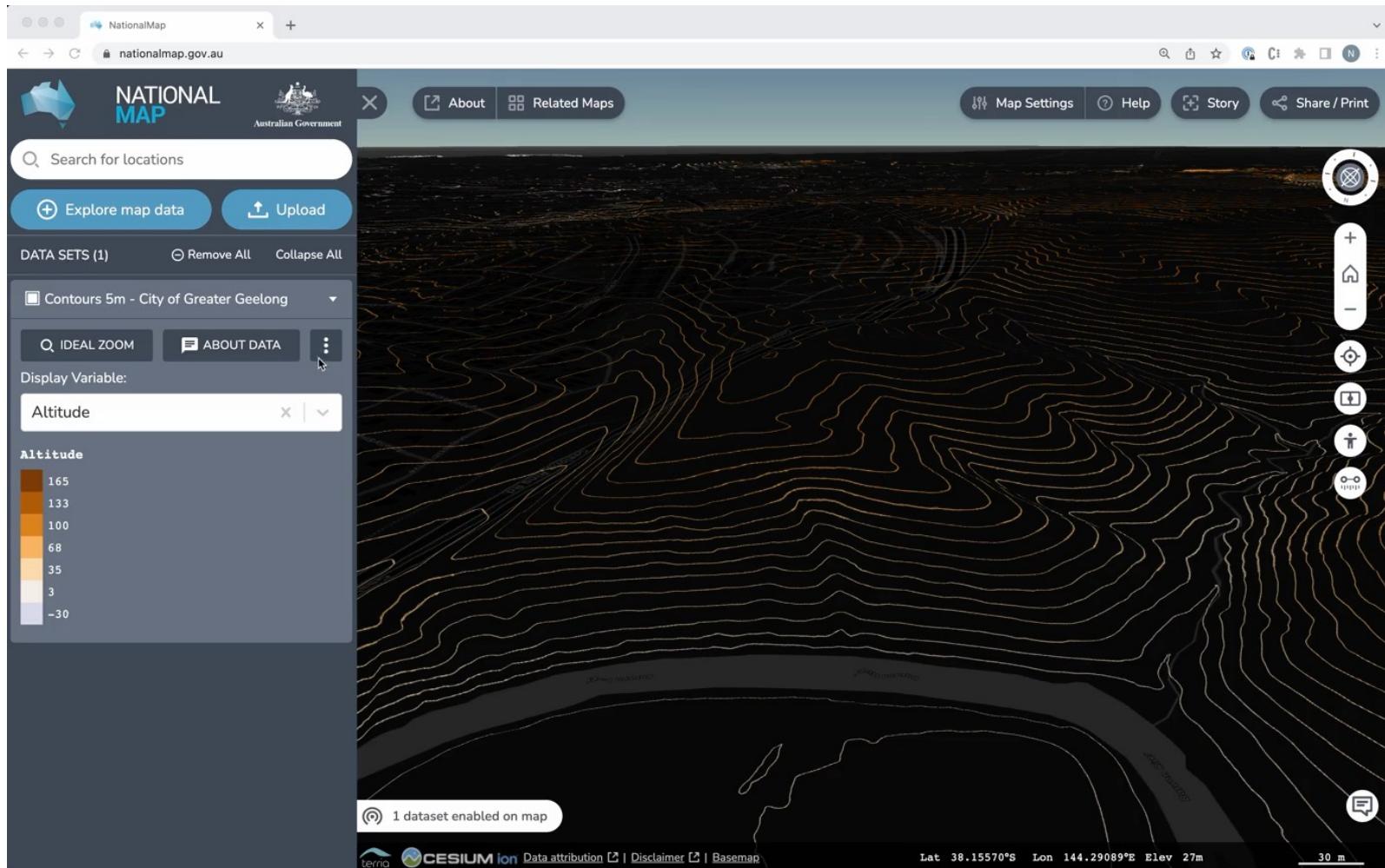
- 5m contours
- WFS
- ~200MB GeoJSON



Vector edit styling

Example:

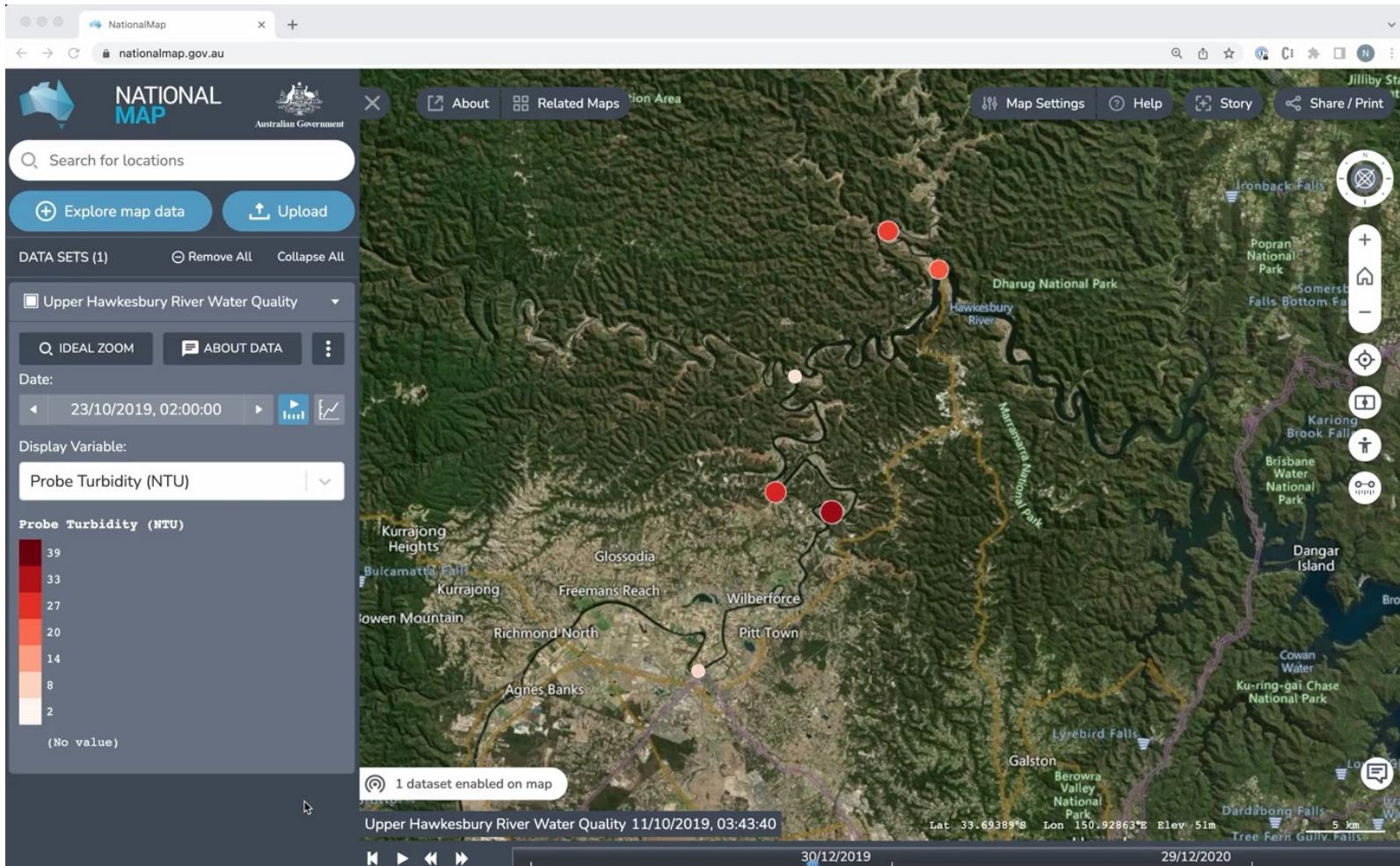
- 5m contours
- WFS
- ~200MB GeoJSON



Tabular time-series

Example:

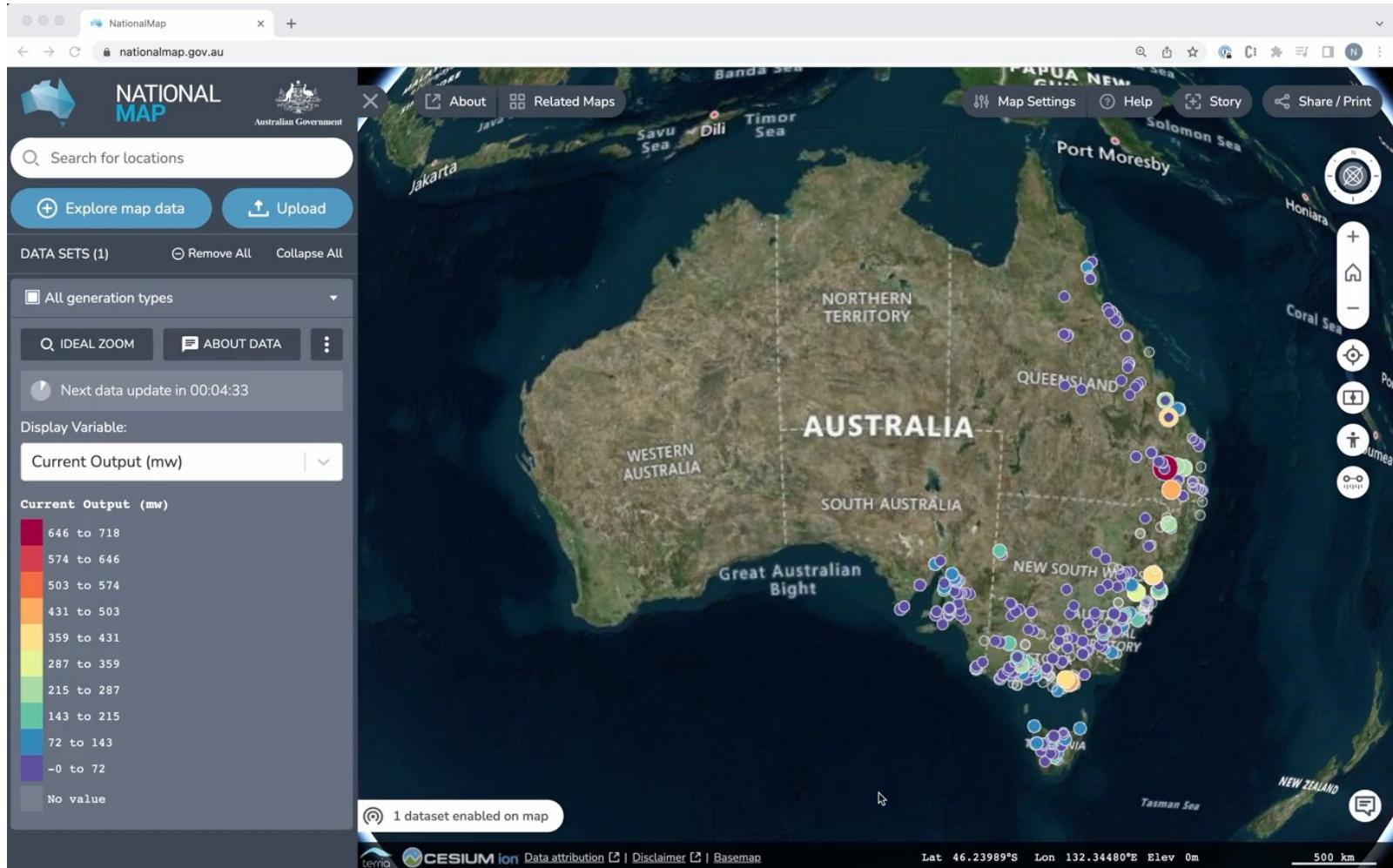
- Hawkesbury, NSW, AUS
River water quality sensor data
- OpenDataSoft



Tabular time series charts

Example:

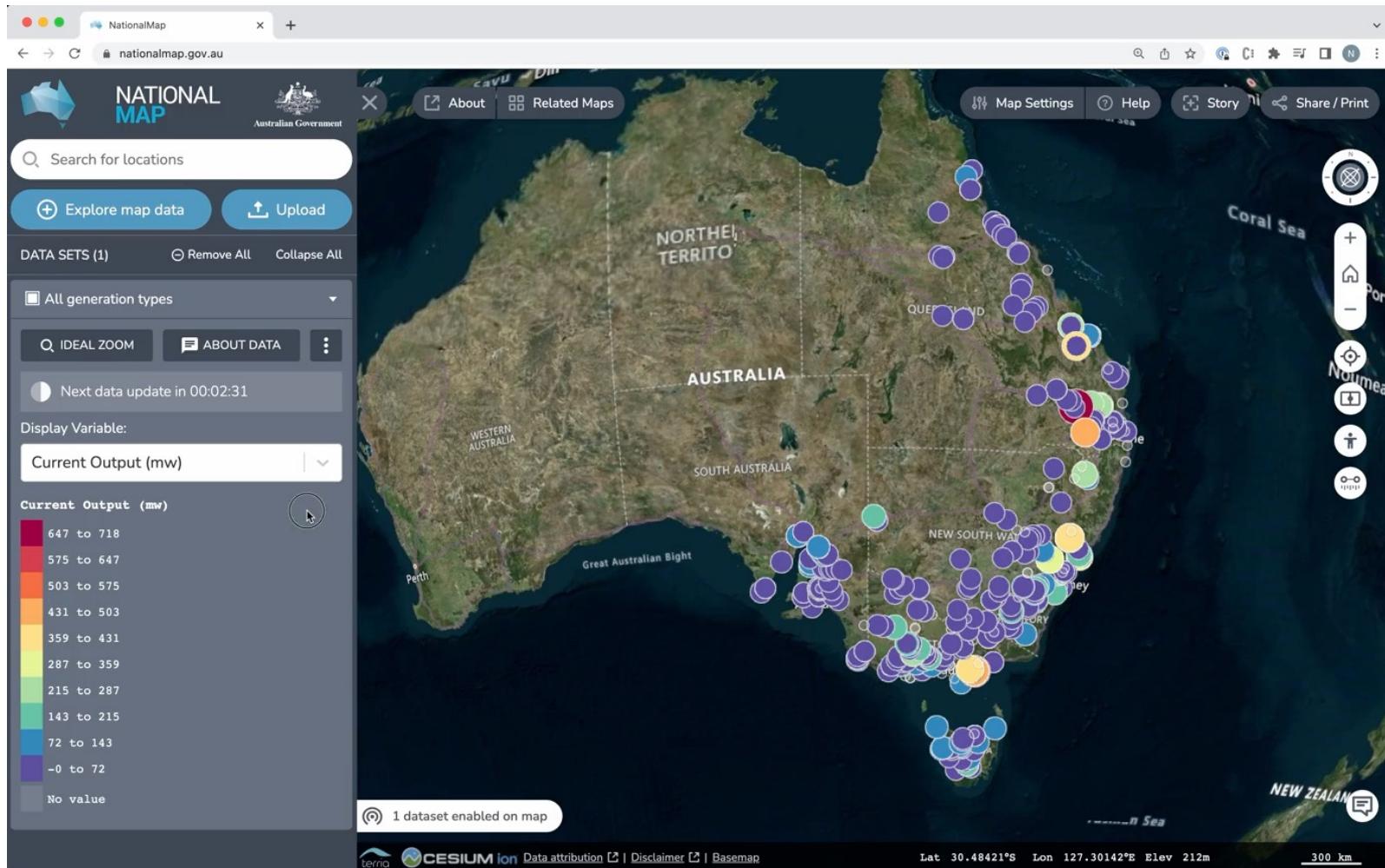
- AUS power generation
- CSV (API)



Tabular automatic /edit styling

Example:

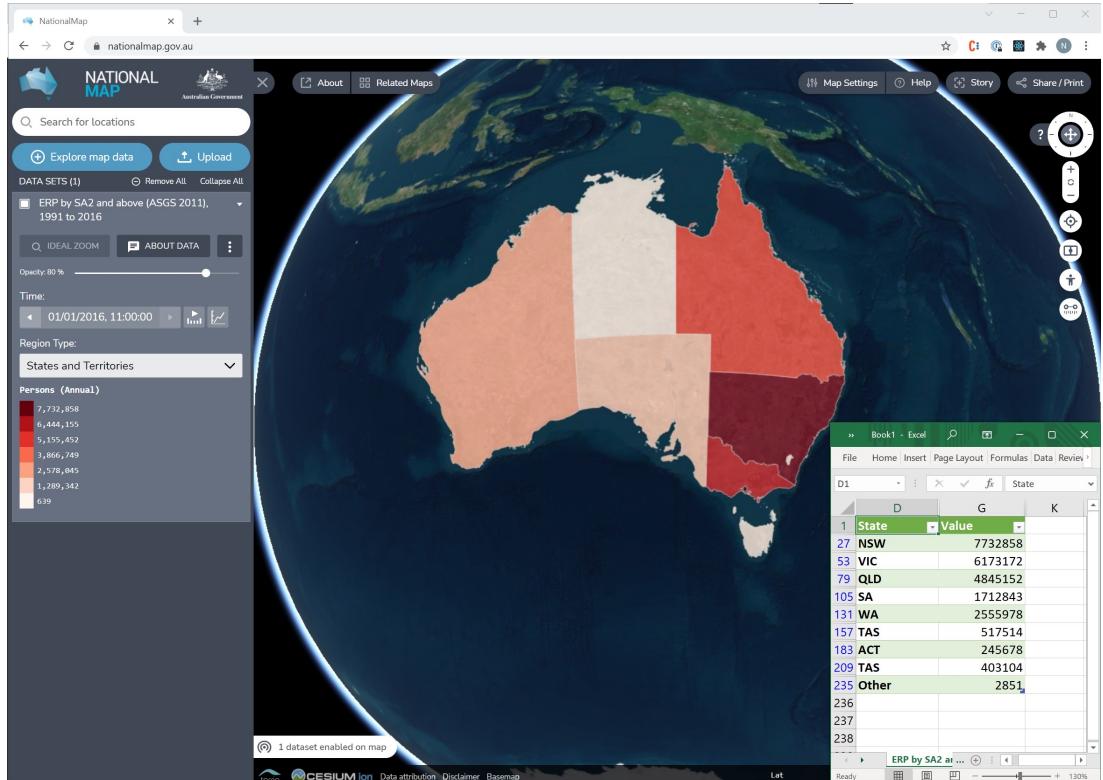
- AUS power generation
- CSV (API)





Tabular – Region Mapping

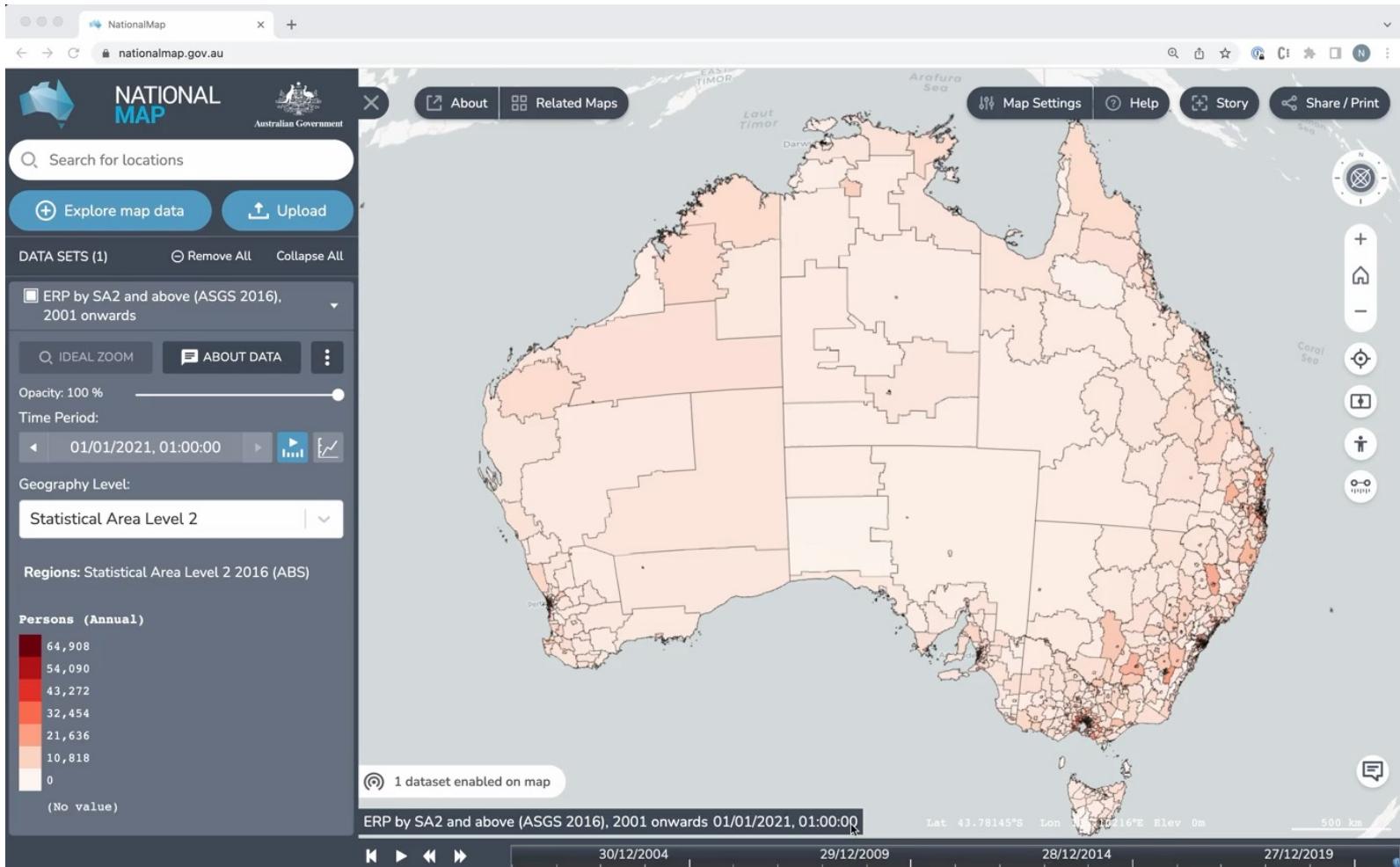
- Vector tile based
- Matches region geometry to rows in a table
- Terria supports over 100 region sets (mostly Australian)
- We provide a tool to generate your own from SHP/GeoJSON
 - github.com/TerriaJS/boundary-tiles
 - Using tippecanoe



Tabular region mapping

Example:

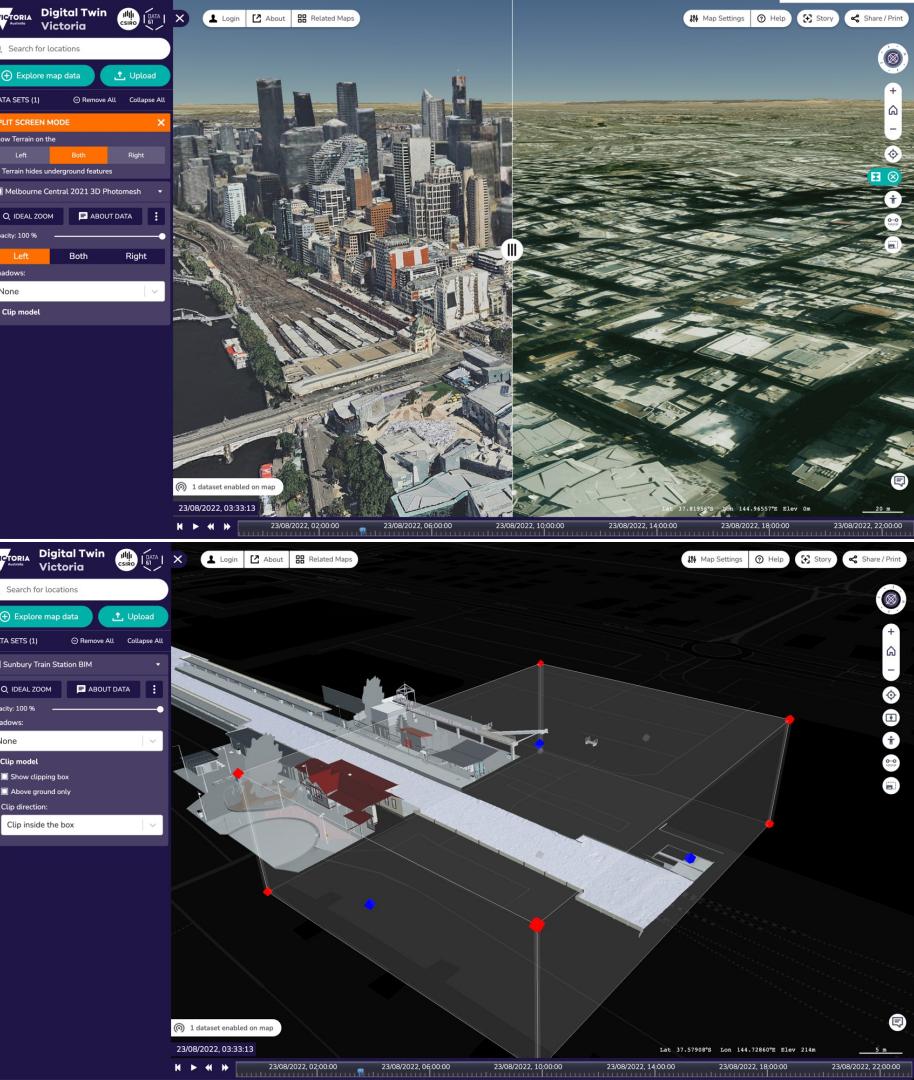
- Australia Estimated Residential Population
- ABS
- SDMX





3D open data

- Not much open data available
- No support through data portals



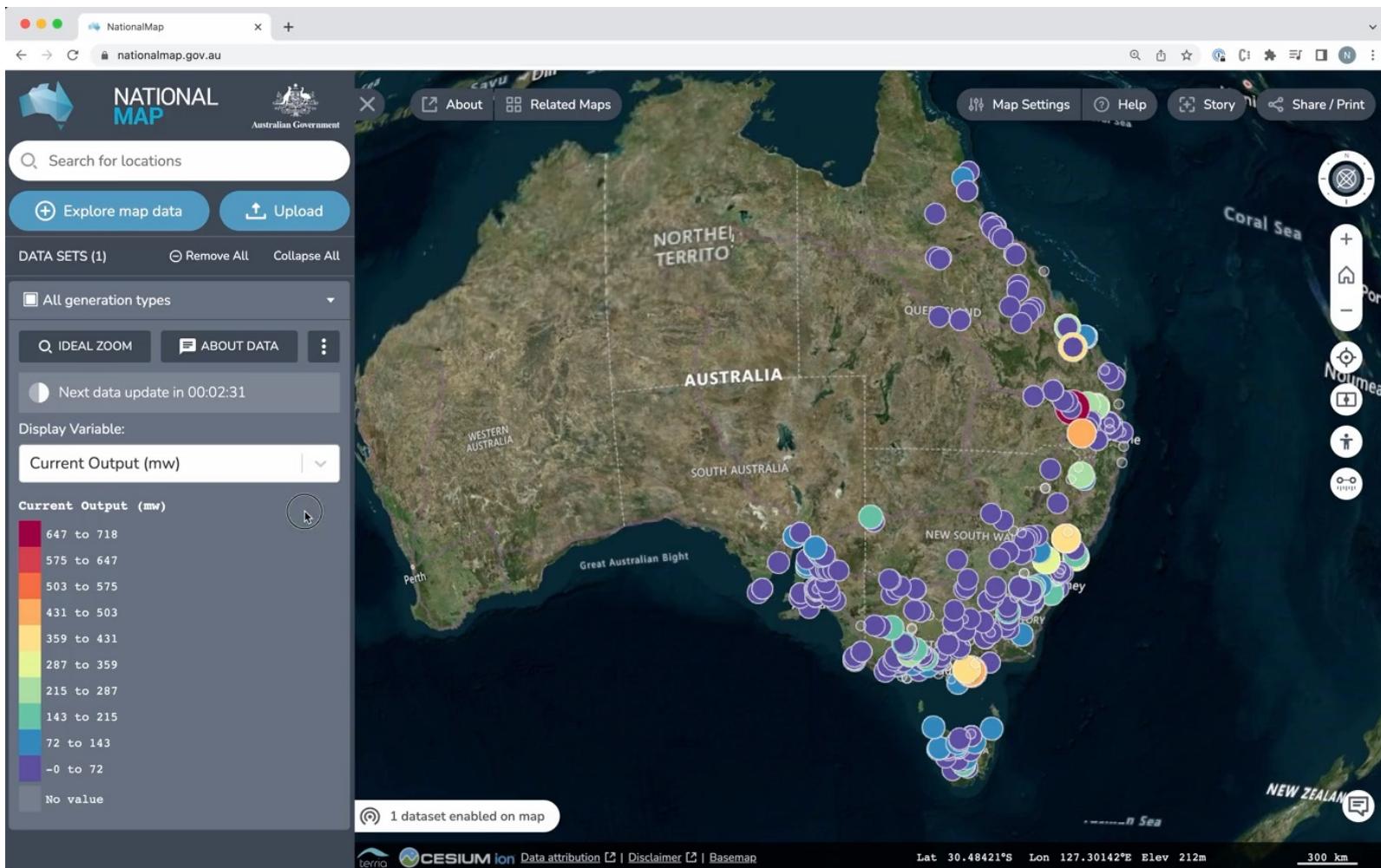
“Analysis”

- Export
 - WCS Export
 - Vector/Tabular export
- Compare*
- Terria tools
 - Measure
 - More to come...
- Web Processing Service
- Open data cube
 - Filter by location
 - Difference tool

Web Processing Service

Example:

- AUS power generation
- CSV (API)



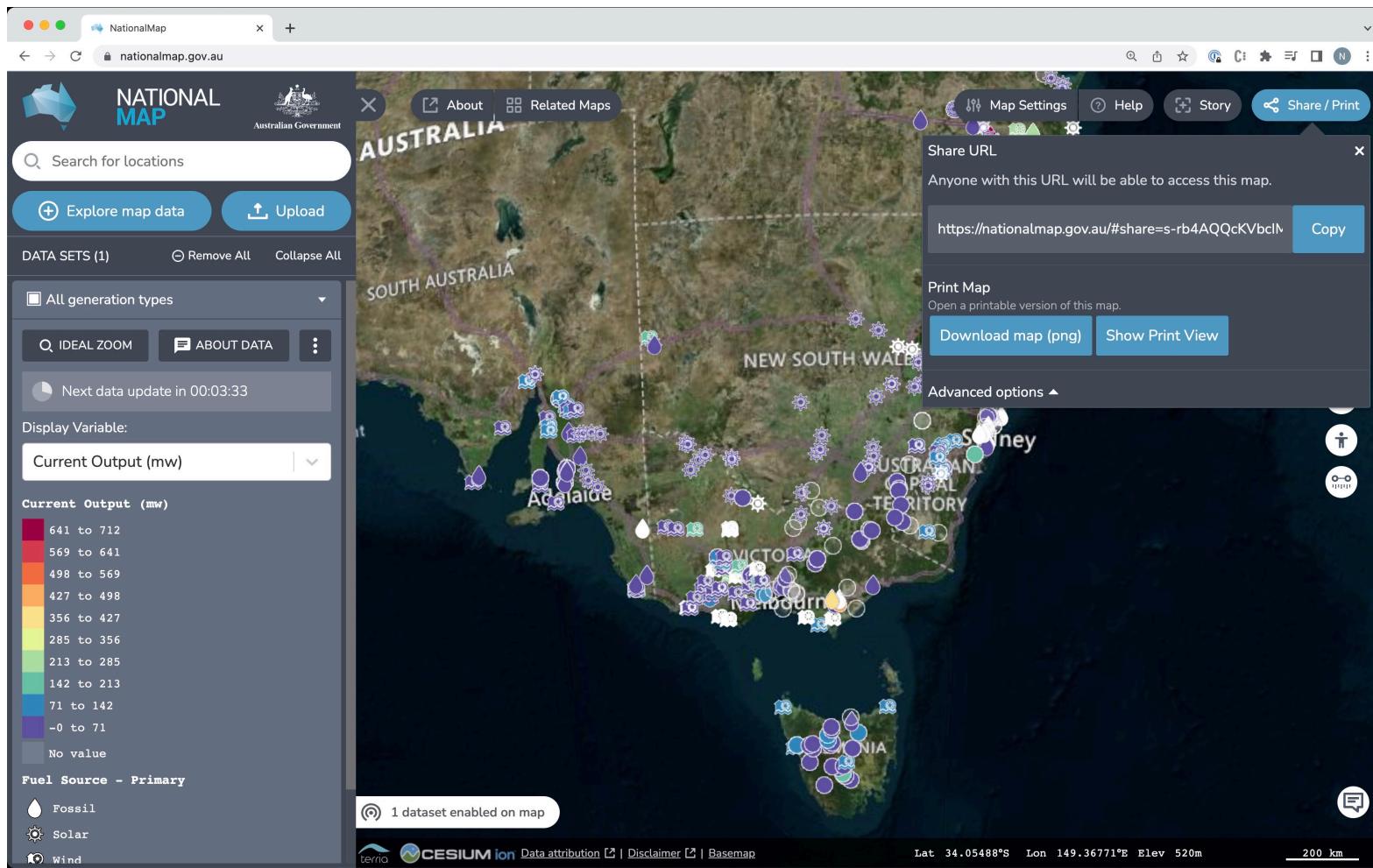


Create/share maps with the world!

- Share links
- Stories
- Embed

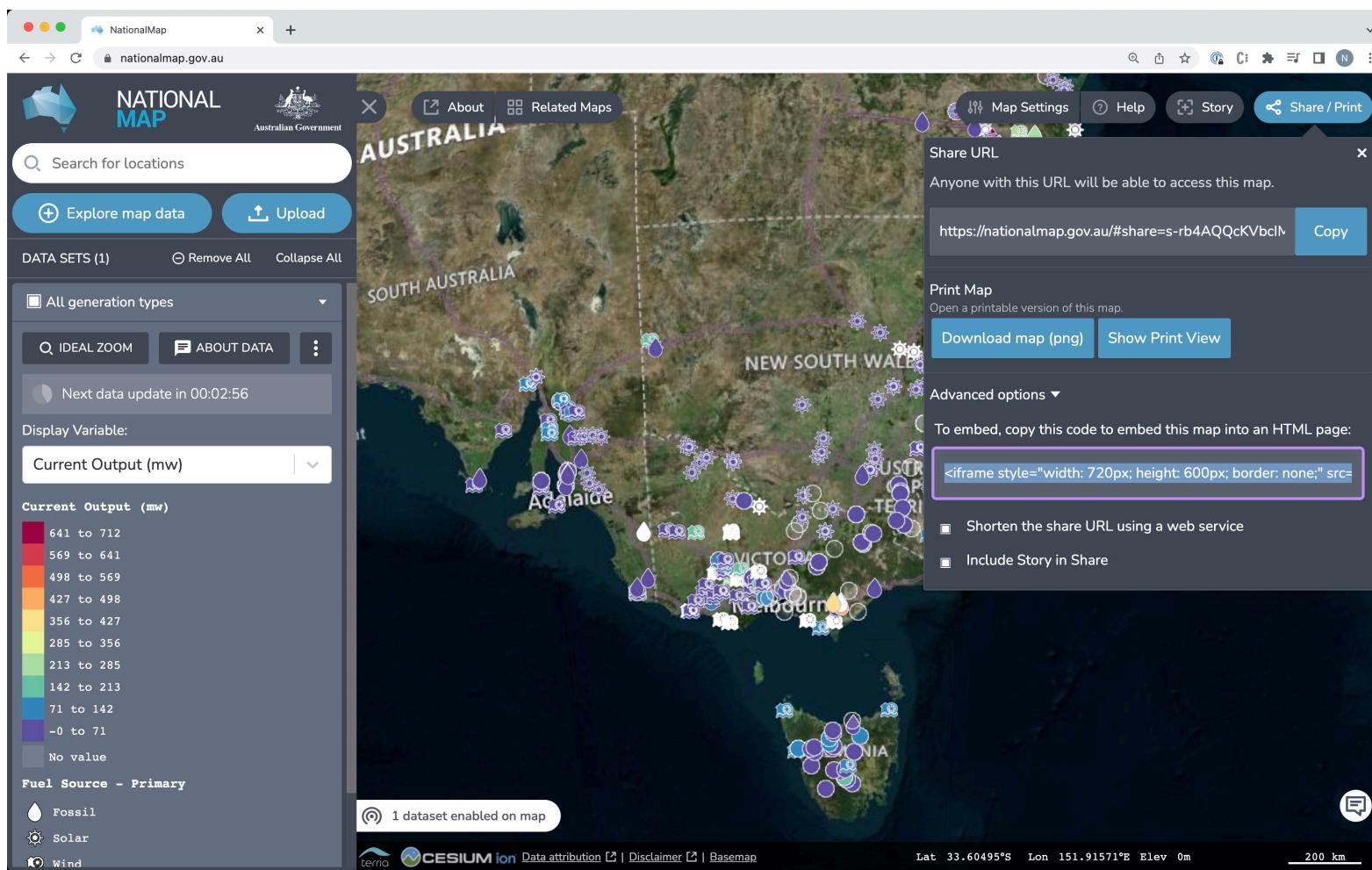
Share links

- Generates unique URL
- Saves all changes you have made (eg custom styling)



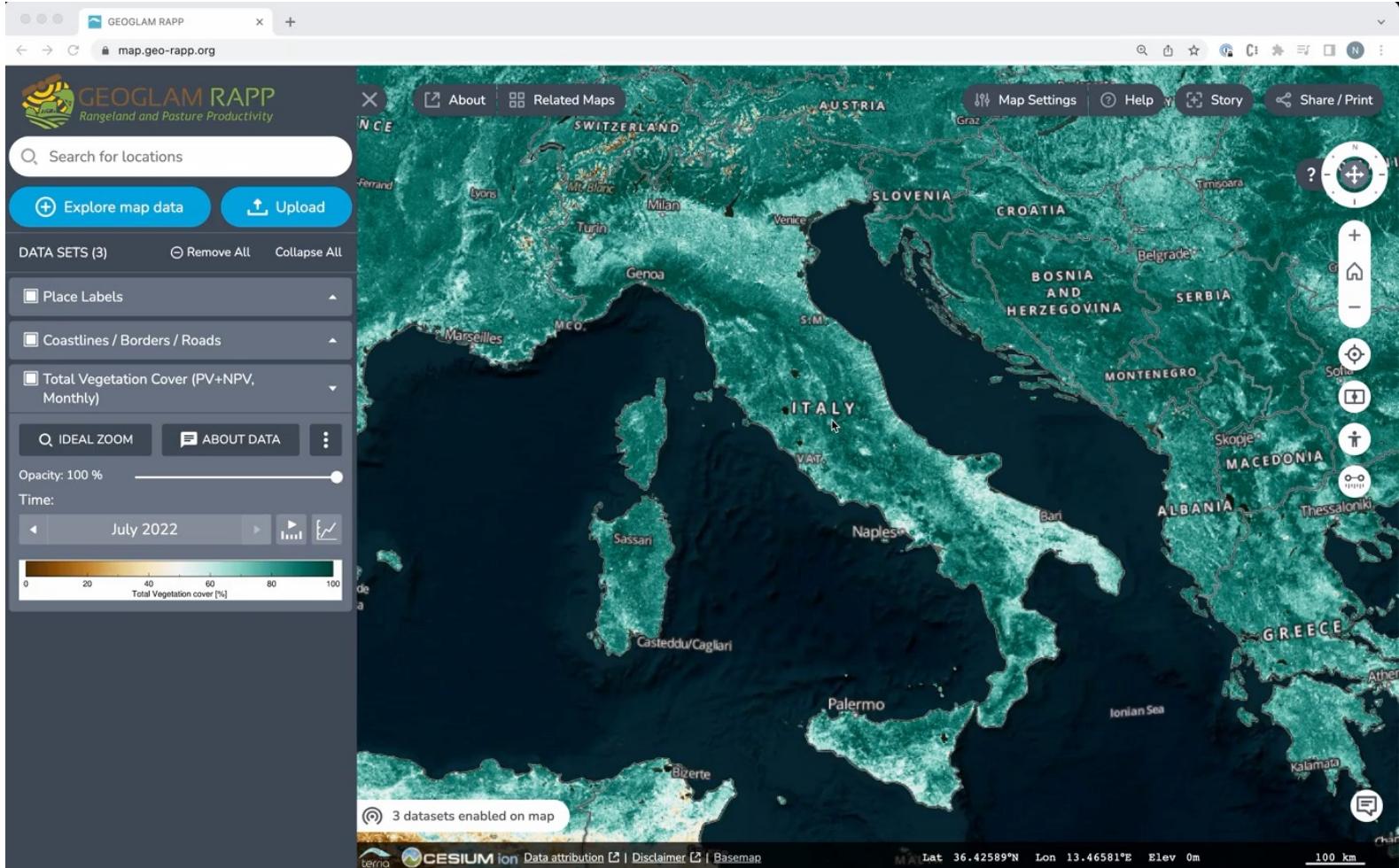
Embed

- Embeddable share link
- Embed into your own page



Stories

- Share link with multiple "scenes"





How is it useful to you?

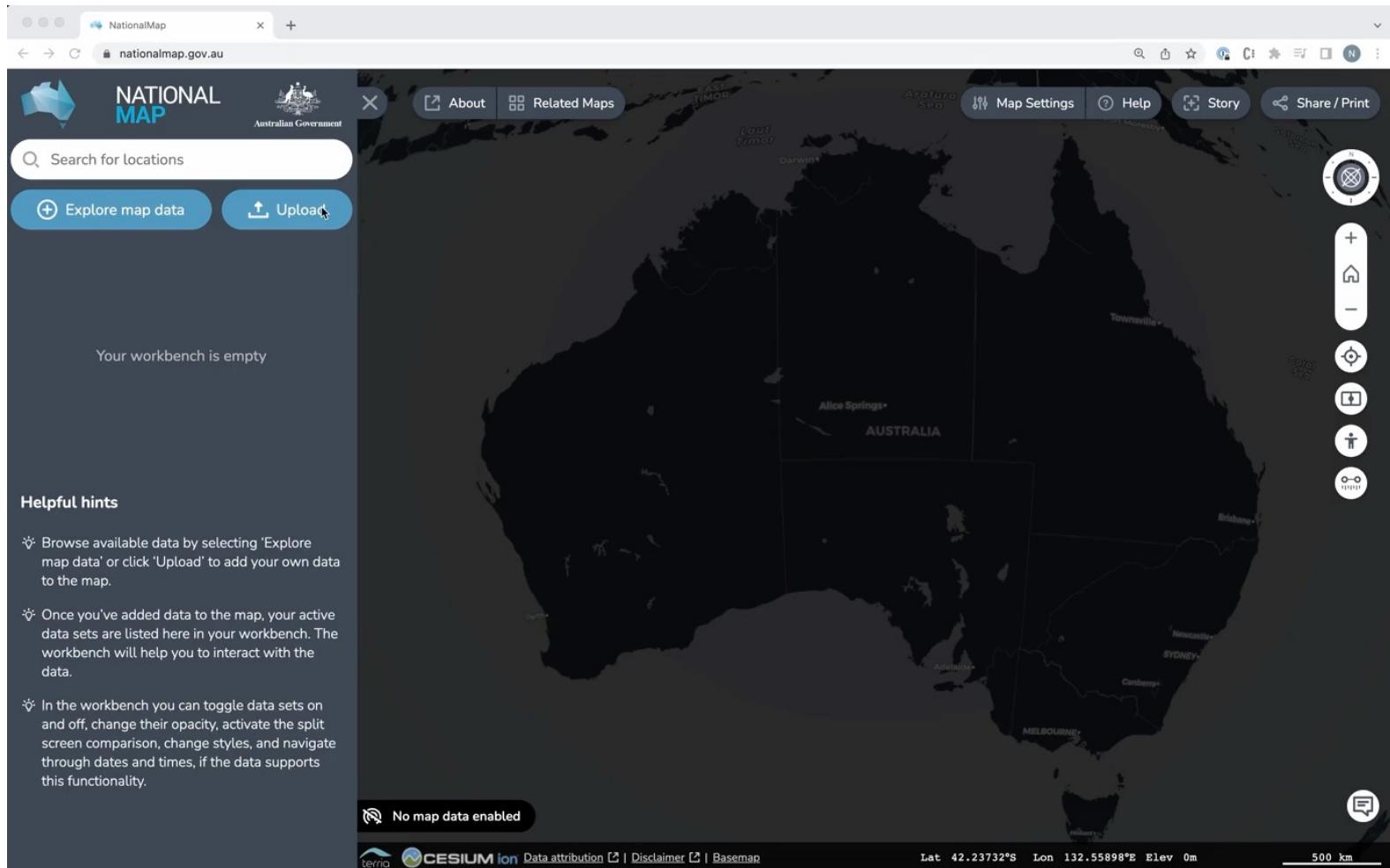
I don't live in Australia

What about my open data?

- Add your own data to our (or anyone's) Terria map
 - Open data portals (zero config*)
 - Drag and drop
- Host your own map
 - All our open maps are the same Terria with different configuration!

Open data portals

- Zero config*
- Each API behaves differently
- Some require additional config



The screenshot shows the NationalMap portal interface. At the top, there's a header with the "NATIONAL MAP" logo, the Australian Government crest, and links for "About", "Related Maps", "Map Settings", "Help", "Story", and "Share / Print". Below the header is a search bar with the placeholder "Search for locations" and two buttons: "Explore map data" and "Upload". A message says "Your workbench is empty". On the right, there's a sidebar with icons for "Help", "Story", "Share / Print", and various map controls like zoom, orientation, and data layers. The main area is a map of Australia with state boundaries and major cities labeled. A legend at the bottom left indicates "No map data enabled". The footer includes the "terria" logo, "CESIUM ion", and links for "Data attribution", "Disclaimer", and "Basemap". Coordinates and elevation information are also present at the bottom.

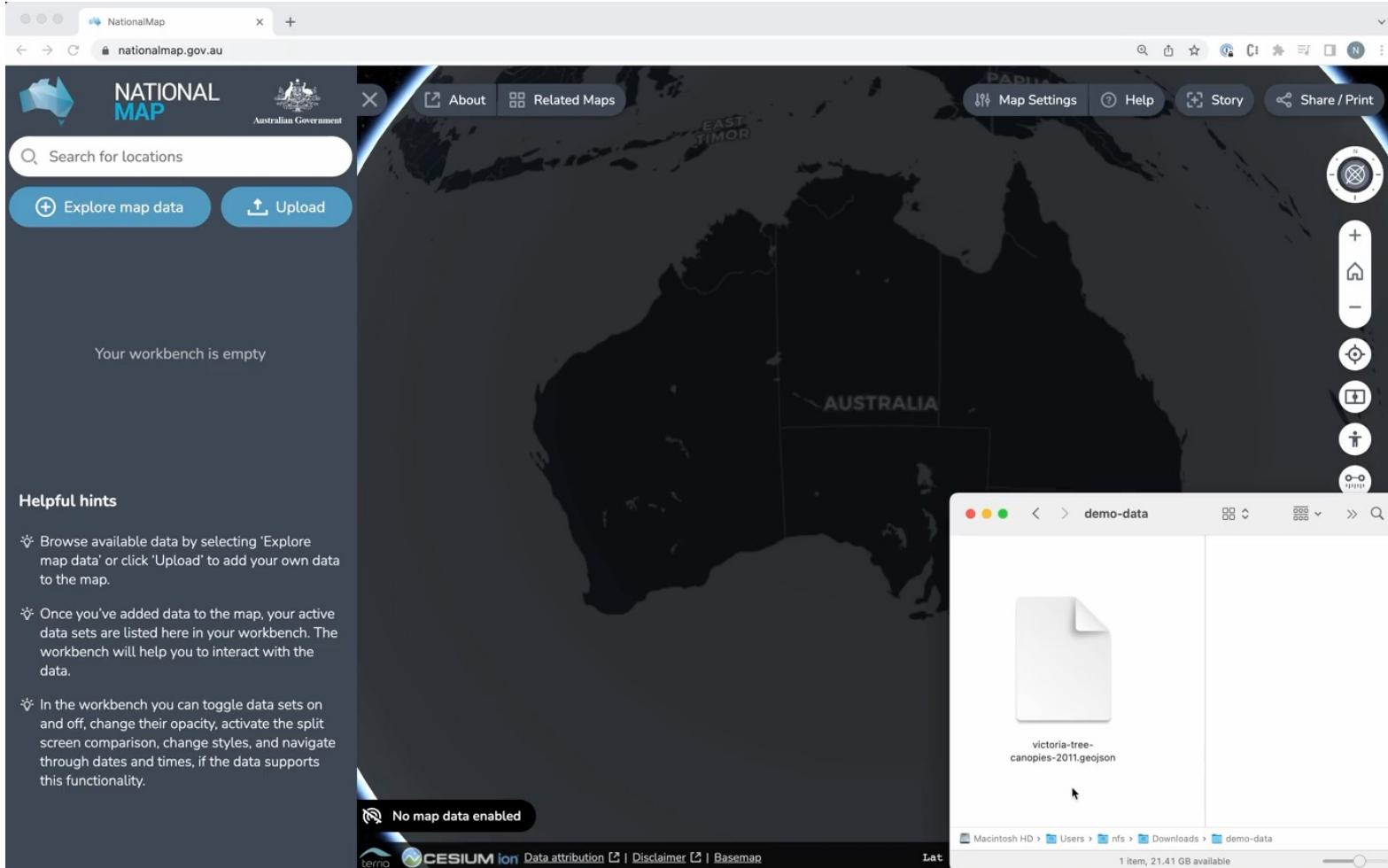
Drag and drop

Supported files

- GeoJSON
- SHP (zip)
- KML
- CSV
- CZML
- GPX
- GeoRSS
- GLTF*

Example

- **350MB
GeoJSON**



The image shows a screenshot of the NationalMap website (nationalmap.gov.au) and a file browser window.

NationalMap Website: The main interface features a search bar ("Search for locations"), buttons for "Explore map data" and "Upload", and a message stating "Your workbench is empty". A section titled "Helpful hints" provides instructions on how to use the platform. At the bottom, it says "No map data enabled". The map displays the coastline of Australia and parts of the surrounding regions, including Papua New Guinea and East Timor. The map includes various controls like zoom, pan, and orientation.

File Browser Window: A separate window titled "demo-data" shows a single file named "victoria-tree-canopies-2011.geojson". The path to the file is visible in the title bar: "Macintosh HD > Users > nfs > Downloads > demo-data". The status bar at the bottom indicates "1 item, 21.41 GB available".



Create your own map

All our open maps are the same Terria with different configuration!

github.com/TerriaJS/terriajs

Terria JSON configuration:

- JSON file
- Highly customisable
- Much much more functionality than presented to the user (eg Edit style)
- Still don't need to host your own map!
 - Drag and drop onto existing map



Extend Terria

- New plugin system
- Develop your own data sources
- Not today...

Future Plans

- Search datasets by location
- User workflows to add more complex data
 - Add more complex open data portals in web browser
 - Edit region mapping
- More advanced visualisation
 - 3D symbology
- 3D open data?
- Story v2.0
- Imagery Compare/Splitter v2.0
- Upgrade to TypeScript 4.x
- Mobile support...
- Improve documentation...



Fin

Get it touch

- terria.io
- github.com/TerriaJS/terriajs/discussions

Maps

- nationalmap.gov.au
- vic.digitaltwin.terria.io
- maps.dea.ga.gov.au
- maps.digitalearth.africa
- map.pacificdata.org
- map.geo-rapp.org