I would like to begin by acknowledging the Jagera and the Turrbal People as the Traditional Owners of the lands that we're meeting on today and pay my respect to their Elders past and present.

'Eternal Wisdom, Infinite Innovation'
artwork by Rachael Sarra, working with Gilimbaa.

Harmonizing Stable Isotope Data in Australia:
The isotopes.au Platform for Enhanced Data Sharing and Collaboration

Nina Welti | nina.welti@csiro.au

Australia's National Science Agency

Nina Welti
Lian Flick
Nicola Lynch
Christoph Gerber
Axel Suckow
Athina Puccini
Steve Szarvas
Yanfeng Shu
Regina Campbell
Alex Mustakov
Cath Hughes
Jagoda Crawford
Alex Leslie
Tim Stobaus
Helen Salouros
Mark Lewin
Fong Liu
Abhijit Paul
Geoff Fraser
Kathryn Waltenberg
Steph Hawkins

CSIRO
Australia's National Science Agency

Australian Government
ANSTO

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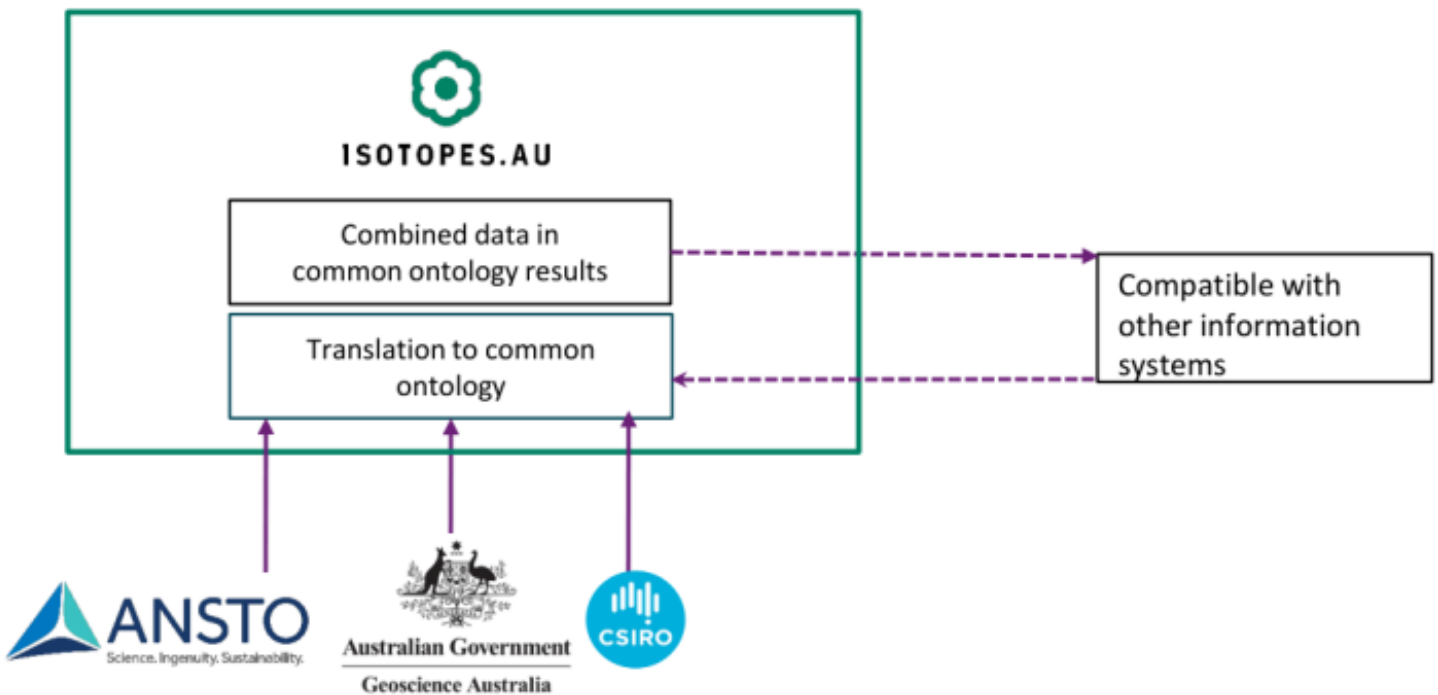
Department of Industry, Science and Resources
National Measurement Institute

Australian Government
Geoscience Australia

Our vision

Creating value for industry and a return on investment for the research organisations through repurposing the data

Decentralised data, increasing discoverability



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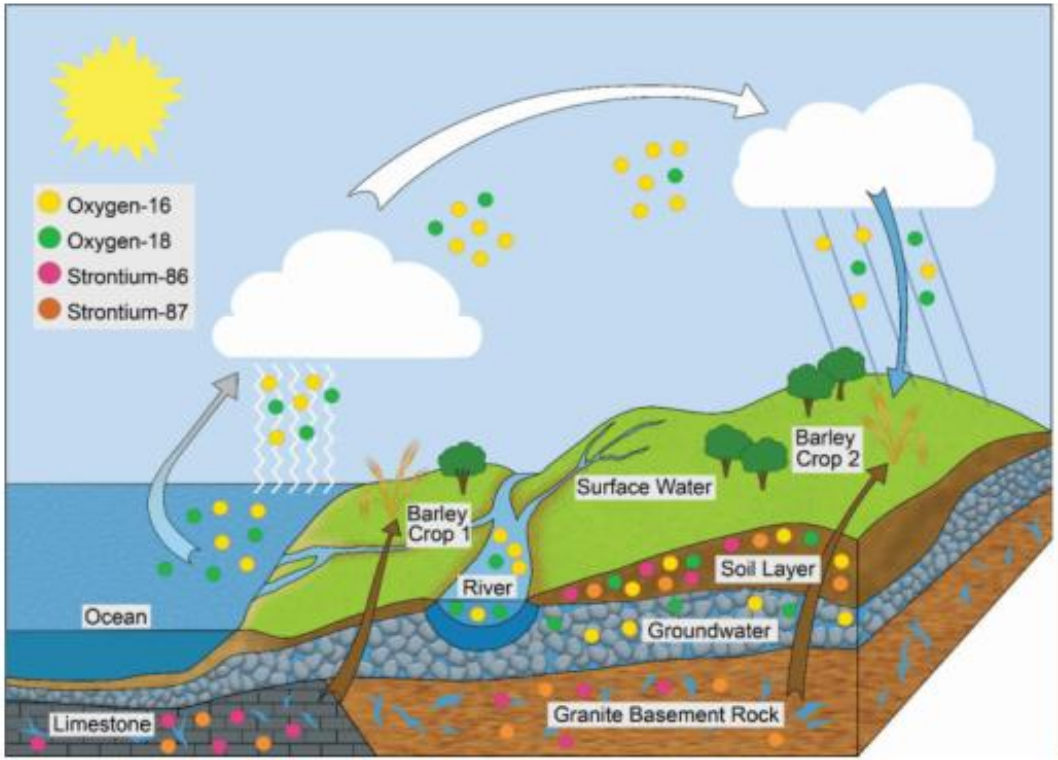
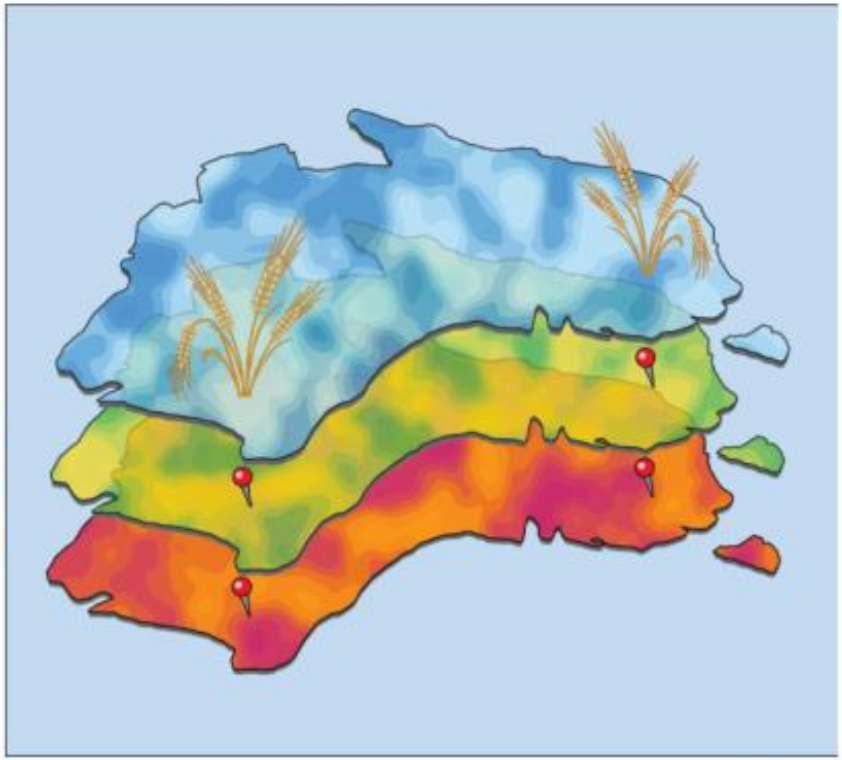
Stable isotopes trace cycles and process at multiple scales





Stable isotopes used broad and widely

WATER CYCLE PROCESSES

PAST & PRESENT CLIMATE

FOOD PROVENANCE & FORENSICS

BIOSECURITY

ISOTOPE-ENABLED CLIMATE MODELLING

GROUNDWATER & WATER STORAGE

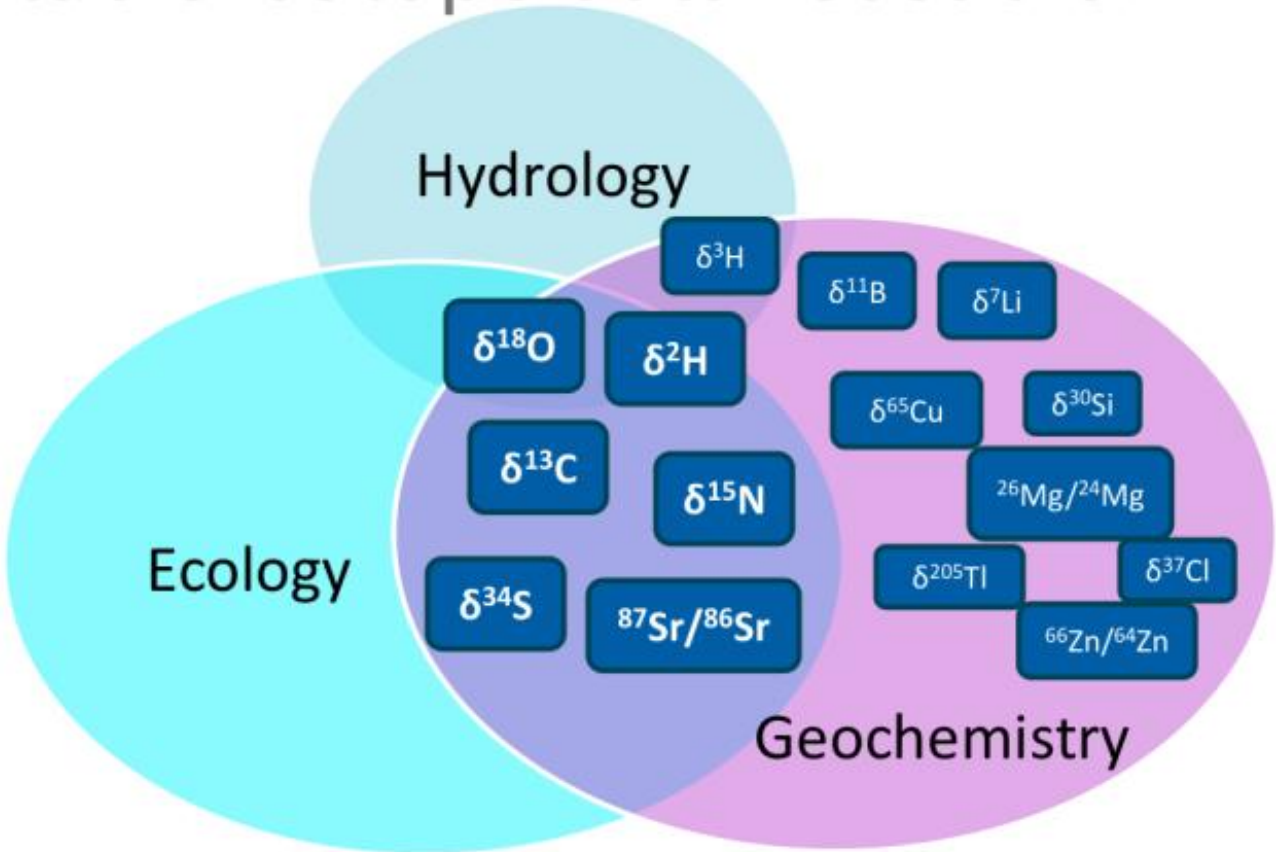
AGRICULTURAL & PLANT WATER USE

MINING IMPACTS ON WATER & SOIL

ECOLOGY & FOOD CHAINS

ISOSCAPES & ISOTOPE MODELS

But is stable isotope data reusable?



Why we came together

Australian national agriculture profile

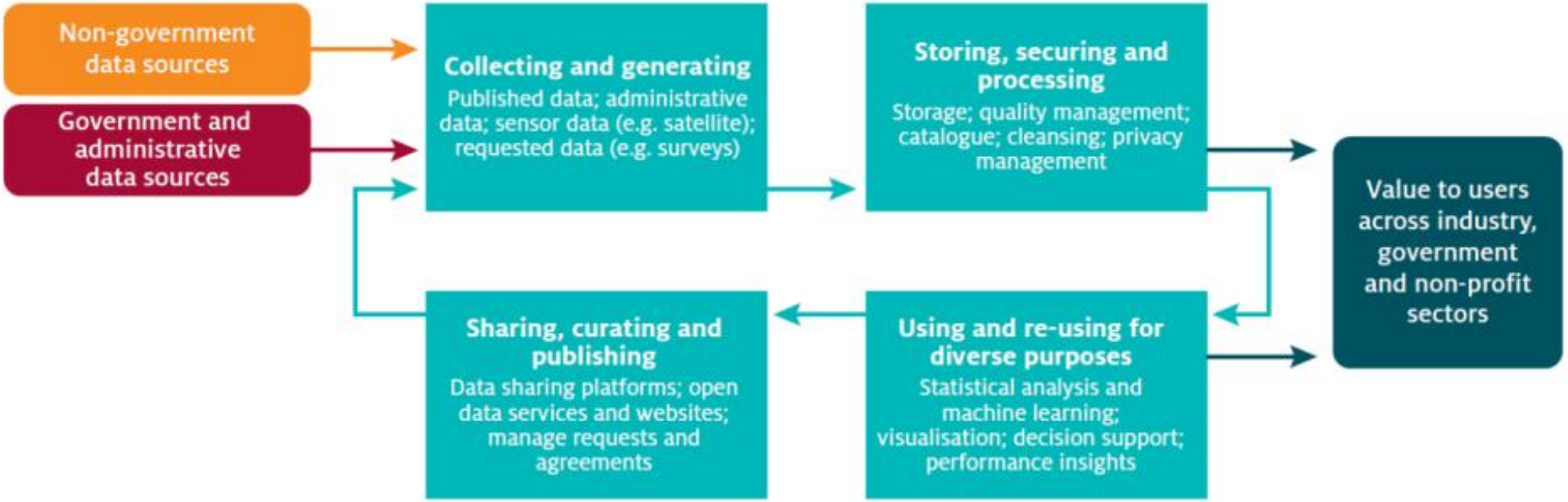
Implementing approaches and systems to show consumers and countries that Australian products are safe, clean, and sustainable from farm gate to dinner plate.

How to underpin and protect the value of Australian brands in local and export markets?

Can we enhance trust, customer confidence and public safety?

Connecting evidence-based trust

FIGURE 15 Australia's agricultural data ecosystem will need to be reinvented to realise the full benefits of new opportunities



Hatfield-Dodds, S, Hajkowicz, S, and Eady S 2021 Stocktake of megatrends shaping Australian agriculture: 2021 update, ABARES, Canberra. CC BY 4.0. https://doi.org/10.25814/w3be-an37.

The value of trusted evidence

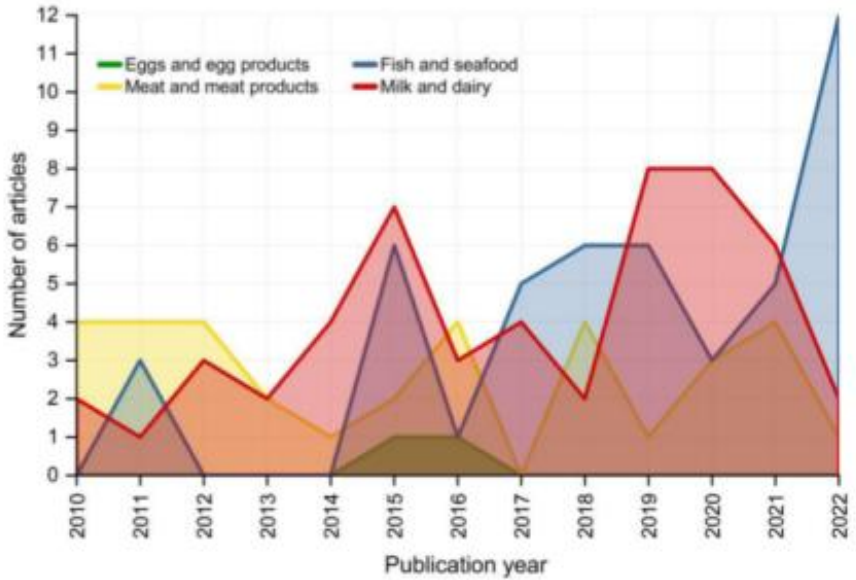
$570 million export revenue for red meat

Science, technology and infrastructure priorities

- Verify the biological and geographical origin of production
- Research and infrastructure to help establish and utilise data from production systems
- Design new systems-based compliance
- Conduct preventative risk assessments
- Support compliance infrastructure

Jarrett, Lisa et al. CSIRO; 2022. https://doi.org/10.25919/n510-rh64

Stable isotopes: tools for verification



Authenticity and traceability studies using stable isotopes for animal-based food products.

Two approaches

1. Compare unknown samples to reference libraries and datasets
2. Compare unknown samples to modelled products

Varrà, M. O. et al. (2023) Molecules, 28, 4300.

Co-creating a trusted resource for data

Moving From This	To That
Limited data sharing	Collective benefit, responsible and ethical use
Orphaned, unpublished, grey literature lost data	Reveals the volume and heterogeneity of available data
Organisational data governance	Multi-stakeholder data governance
No coordinated national strategy to fill data gaps	Visibility of data distribution enables data gaps to be targeted
Short term research investments, limited data generation	Realise the full potential value of R&D investment
Data management under resourced, beyond immediate needs	Multi- applications & users returns investment to R&D
Diversity of data structures, quality, and purposes	Federated data access retains authority to control data
Spreadsheet based approaches	Compatible, comparable, FAIR data

Who's problem are we solving?

Data manager

Carla is exhausted by using multiple different digital systems which are not fit for her purposes, and which do not interoperate. She also feels **disempowered by lack of control** over the use of her data by others.

Data aggregator

Roger is unable to create high quality national datasets due to changing requirements from policy makers and limited engagement from scientists in supplying data through national surveys. This **restricts the utility and increases resourcing required** to develop national datasets.

Data consumer

Omid finds there is a high cost / difficulty in providing a true systems level offering as **data products are not interoperable or compatible**, therefore they have to build bespoke mappings

Data producer

Rebecca finds discovering and accessing data to support her analysis is **time consuming, expensive** and sometimes unsuccessful leading to poor, unreliable or unusable outputs.

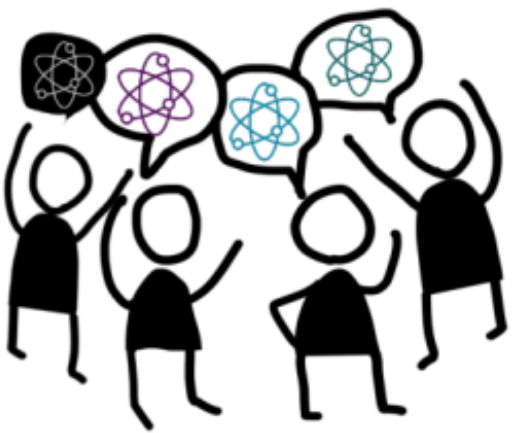
Science and User Group

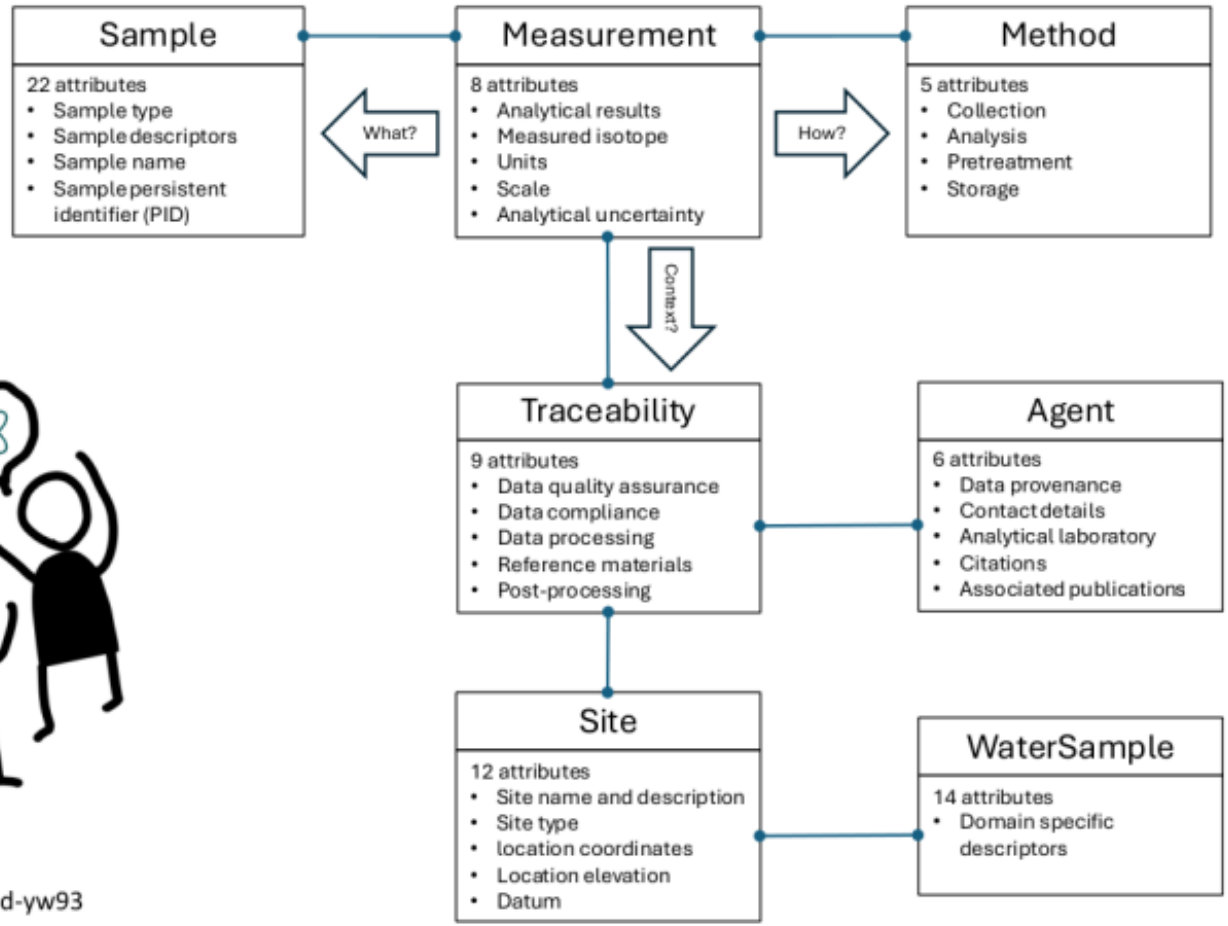
- Ryan McAllister – CSIRO, Environment Digital Lead
- Anthony Dosseto – University of Wollongong
- Georgy Falster – Australia National University
- Greg Skrzypek – University of Western Australia
- Justin Maroccia – Australia Farm Institute
- Nicole Stubing – FRDC

- Tony Hall – University of Adelaide *
- Brandon Mahan – University of Melbourne *

2-pronged solution:
Harmonisation and Interoperability

Standard ontology, common vocabulary





https://doi.org/10.25919/aa8d-yw93

Ontology design: reducing barriers

Required (14)	Recommended (12)	Optional (49)
• ANALYTE • ISOTOPE • PUBLICATION • SAMPLE_DATE_START • SAMPLE_ID • SAMPLE_PROJECT_DESCRIPTION • SAMPLE_PROJECT_IDENTIFIER • SAMPLE_TYPE • SCALE • SITE_LATITUDE • SITE_LONGITUDE • UNCERTAINTY_KIND • UNIT • VALUE • SITE_ELEVATION_AHD_M	• DATA_OWNER • REFERENCE_MATERIAL_USED • SAMPLE_PID • SAMPLE_SOURCE_TYPE • SAMPLE_SUBTYPE • SITE_DESCRIPTION • SITE_LAT_LONG_REFERENCE_SYSTEM • SITE_NAME • UNCERTAINTY • UNCERTAINTY_REFERENCE_MATERIAL • UNIT_UNCERTAINTY_REFERENCE_MATERIAL • VALUE_REFERENCE_MATERIAL	

https://doi.org/10.25919/aa8d-yw93

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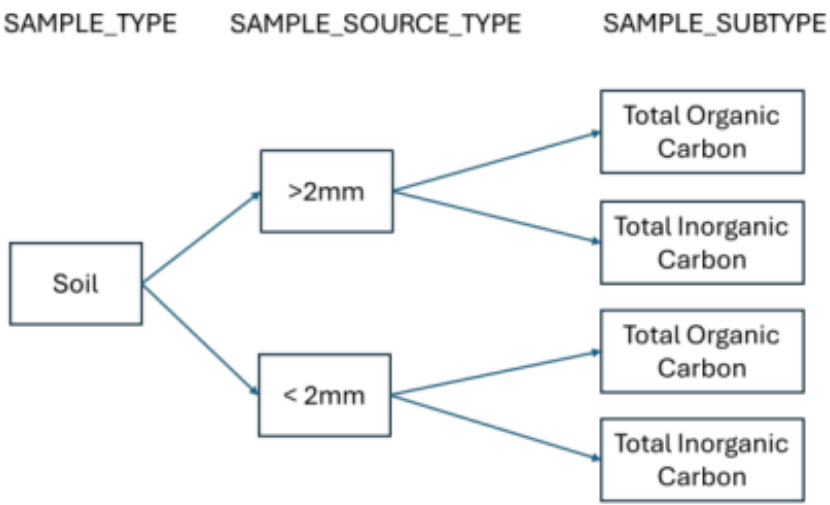
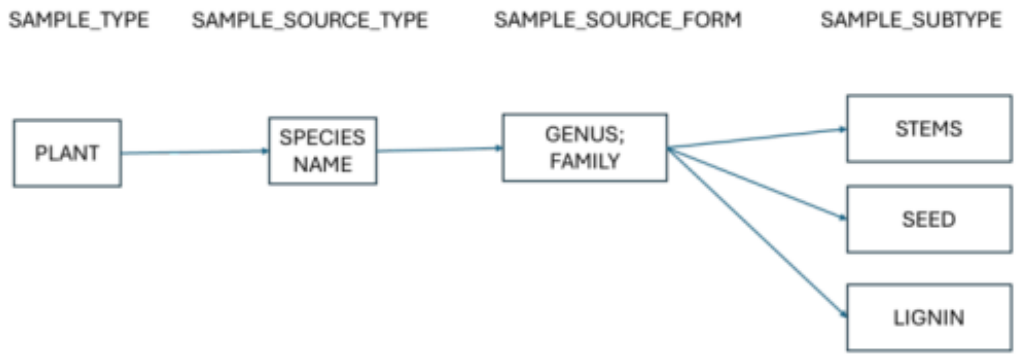
A simple tool for data management

Flat, flexible, FAIR





Designing a platform

PROVIDING A SHARED LANGUAGE FOR STABLE ISOTOPE DATA

Search Data Records

Balancing open data

- Data sensitivities varied: proprietary, sensitive, and confidential data to non-sensitive and non-commercial
- Utilizing existing data management infrastructure

Platform Criteria

- Partners retain ownership of data
- Ability to decide what data to make available and when to make it available
- Data translated to a common ontology
- Flexibility for future data sources to be added
- Find data via web user interface and/or connect to data via API

Platform Design Features

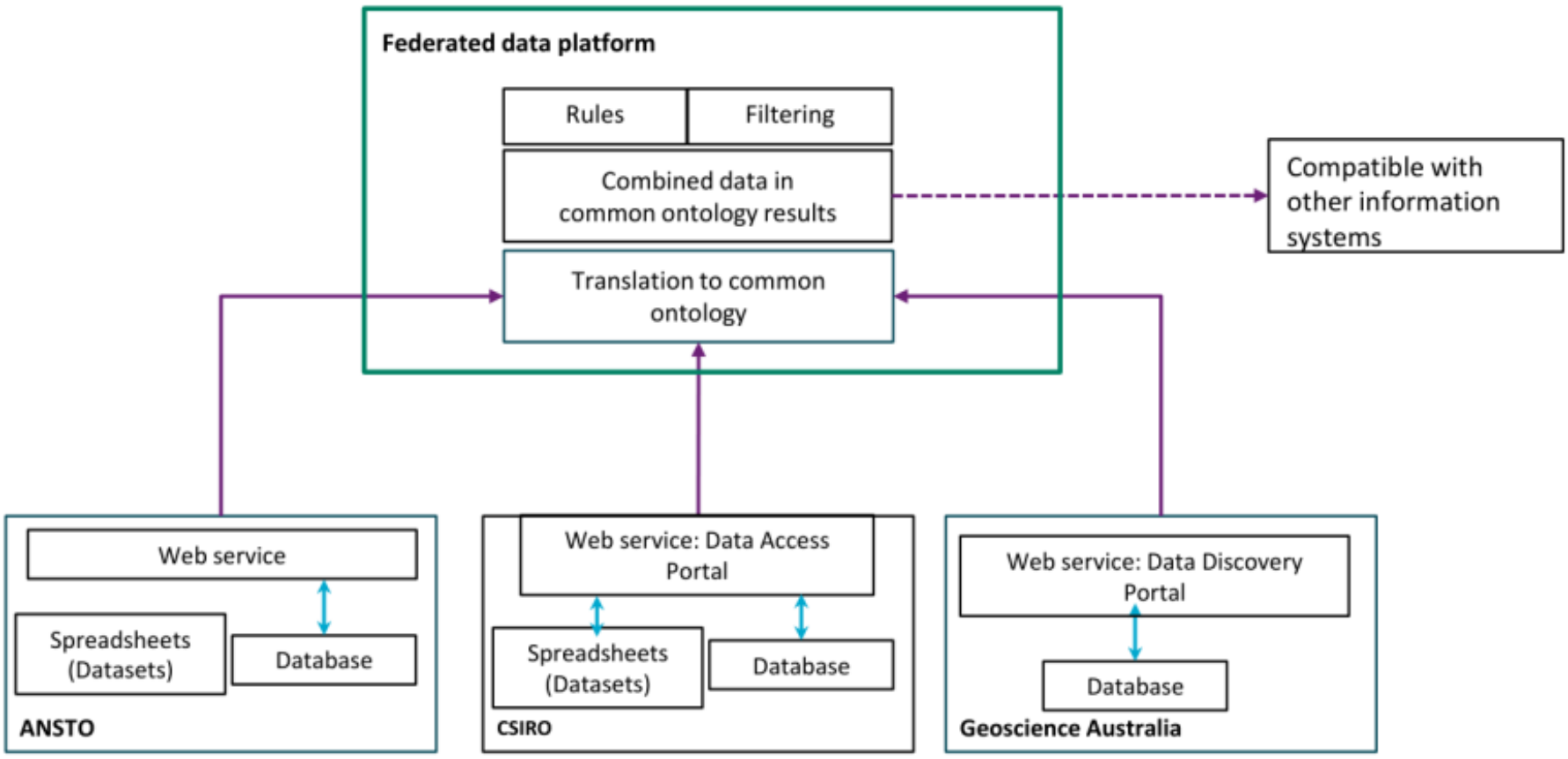
Functional Requirements

- Customer service
- Data traceability/lineage
- Federated data solution
- Feedback
- IP and Copyright Management
- Management, support and maintenance
- Payment system
- Reporting
- Source databases
- User Interface
- Unique reference identifier
- User access

Non-functional Requirements

- Availability, performance and scalability
- Feedback
- Management, support and maintenance
- Security management

Architecture



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PROVIDING A SHARED LANGUAGE FOR STABLE ISOTOPE DATA

Search Data Records

TRUST AND TRACEABILITY

955,525	3	5	33,993	2
DATA RECORDS	CONTRIBUTING ORGANISATIONS	NODES IN OUR NETWORK	PLATFORM GEOLOCATIONS	COUNTRIES IN OUR DATA


ISOTOPES.AU
Search Data Records
Download Data Template
/ Search
Samples: 1413
Add Keyword
Date
Sample 0
Elements 5
Models OFF
Selection
43 466 458 102
10 16 16 25
462 669 649 527
76 76
131 700 706 34
8 613 622 124
617 1,697 1,686 208
159 1,631 1,635 60
18
MAP LEGEND
Selected Elements
500km
mapbox

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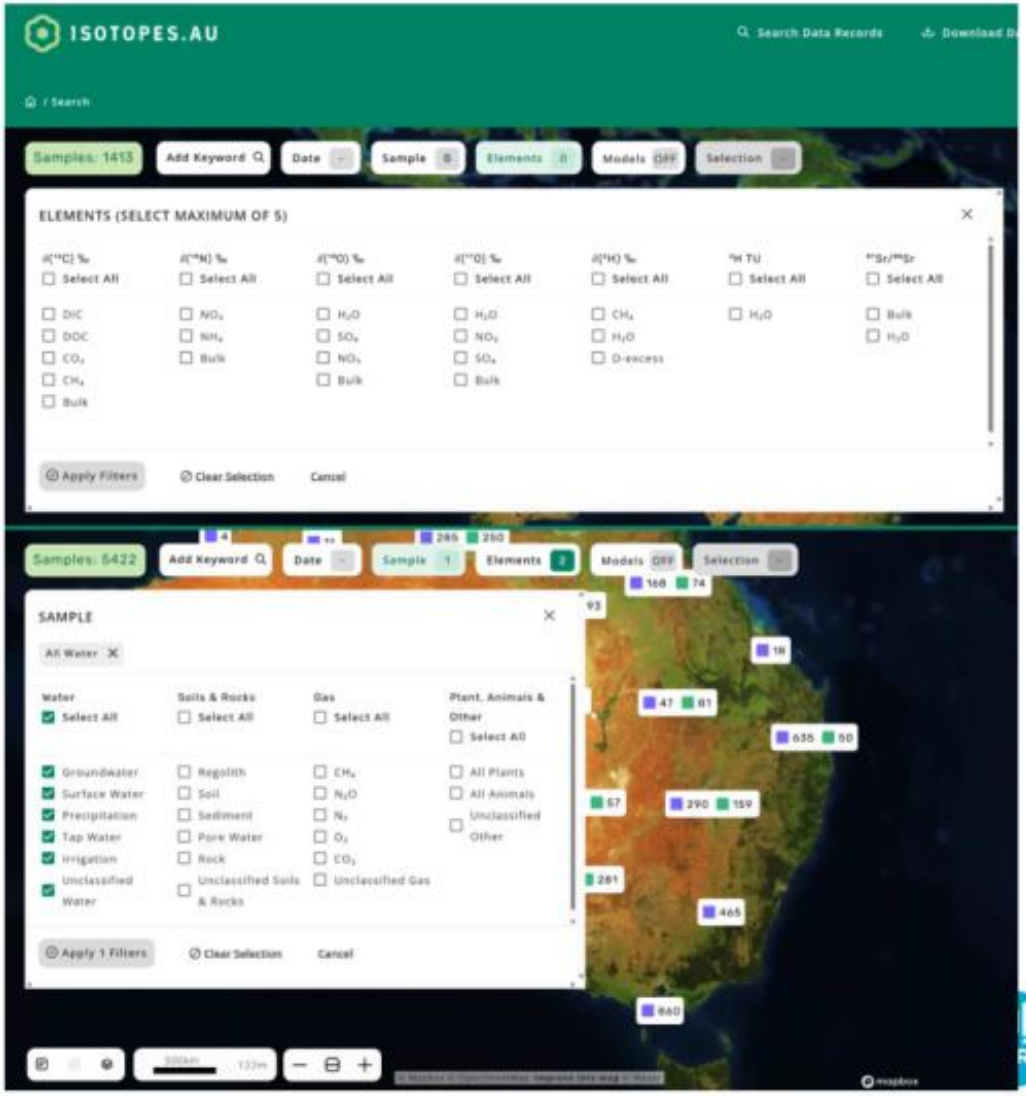
Platform Features

1. Spatial exploration, filtered search
2. Integration with other data platforms
3. Attribution and usage metrics
4. Registered users – permissioned rules
5. IUPAC complaint
6. Minimum data requirement
7. Exportable data output
8. Integration with lab operations

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59 57
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892 281
465
MAP LEGEND
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200km
75m
mapbox
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/ Search

Marked List 0

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List | Map

Displaying 1-10 of 464 Measurement Results

Rows per page: 10

Sample Project Identifier	Type	Source Type	Date	Lat.	Long.	Isotope	Analyte	Value	Actions
EFTF - Southern Stuart Corridor Gro...	Water	Groundwater	01/11/2018	-22.1	133.95	$\delta(^{13}C)$ ‰	Bulk	-8.05	...
EFTF - Southern Stuart Corridor Gro...	Water	Groundwater	01/11/2018	-22.1	133.95	$\delta(^{18}O)$ ‰	H_2O	-6.78	...
National Water Commission Palaeoval...	Water	Groundwater	02/10/2009	-22.87	130.21	$\delta(^{13}C)$ ‰	Bulk	-8.43	...
EFTF - Southern Stuart Corridor Gro...	Water	Groundwater	02/10/2018	-23.86	134.24	$\delta(^{13}C)$ ‰	Bulk	-7.49	...
EFTF - Southern Stuart Corridor Gro...	Water	Groundwater	02/10/2018	-23.86	134.24	$\delta(^{18}O)$ ‰	H_2O	-7.15	...
Bureau of Rural Sciences - Great Ar...	Water	Groundwater	03/05/1990	-25.41	135.28	$\delta(^{13}C)$ ‰	Bulk	-9.99	...
Bureau of Rural Sciences									

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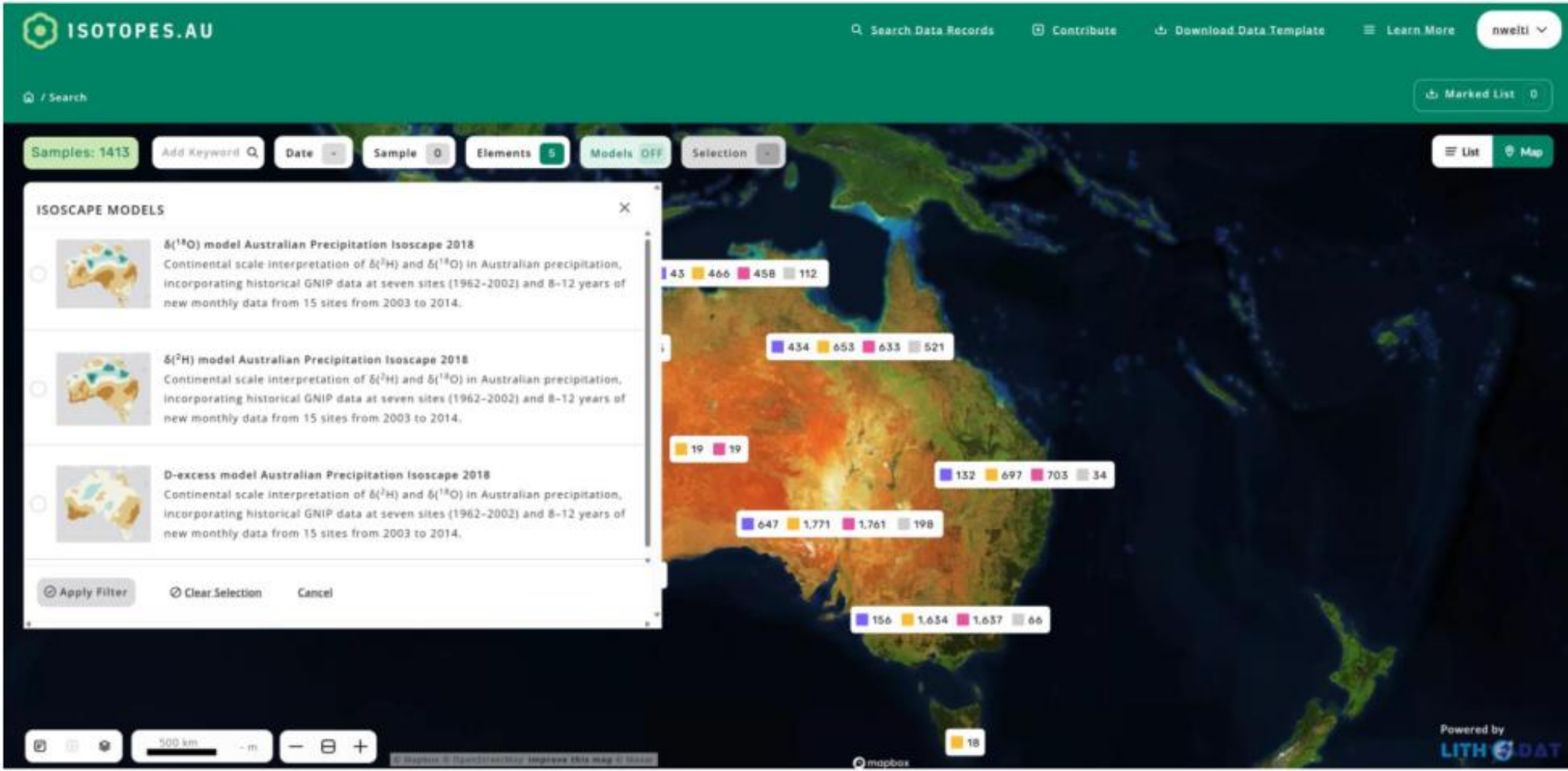
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/ Search
Marked List 0
Samples: 1413
Add Keyword
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Sample 0
Elements 5
Models OFF
Selection
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ISOSCAPE MODELS
δ(18O) model Australian Precipitation Isoscape 2018
Continental scale interpretation of δ(2H) and δ(18O) in Australian precipitation, incorporating historical GNIP data at seven sites (1962–2002) and 8–12 years of new monthly data from 15 sites from 2003 to 2014.
δ(2H) model Australian Precipitation Isoscape 2018
Continental scale interpretation of δ(2H) and δ(18O) in Australian precipitation, incorporating historical GNIP data at seven sites (1962–2002) and 8–12 years of new monthly data from 15 sites from 2003 to 2014.
D-excess model Australian Precipitation Isoscape 2018
Continental scale interpretation of δ(2H) and δ(18O) in Australian precipitation, incorporating historical GNIP data at seven sites (1962–2002) and 8–12 years of new monthly data from 15 sites from 2003 to 2014.
Apply Filter
Clear Selection
Cancel
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19 19
132 697 703 34
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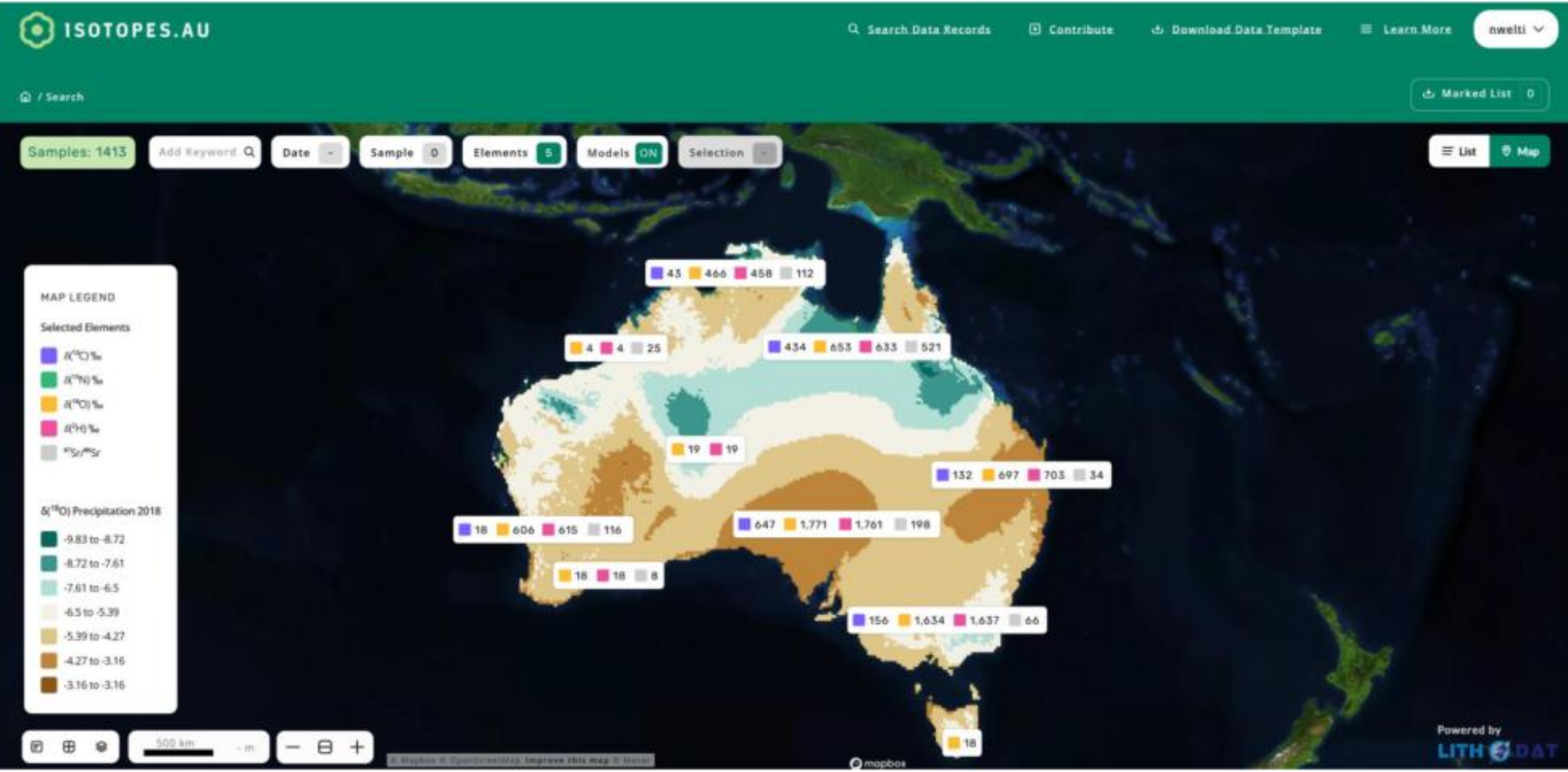
156 1,634 1,637 66
18
500 km
mapbox
Powered by


ISOTOPES.AU
Search Data Records
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/ Search
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Add Keyword
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Sample 0
Elements 5
Models ON
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δ(13C) ‰
δ(15N) ‰
δ(18O) ‰
δ(2H) ‰
87Sr/86Sr
δ(18O) Precipitation 2018
-9.83 to -8.72
-8.72 to -7.61
-7.61 to -6.5
-6.5 to -5.39
-5.39 to -4.27
-4.27 to -3.16
-3.16 to -3.16
43 466 458 112
4 4 25
434 653 633 521
19 19
132 697 703 34
18 606 615 116
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156 1,634 1,637 66
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500 km
mapbox
Powered by
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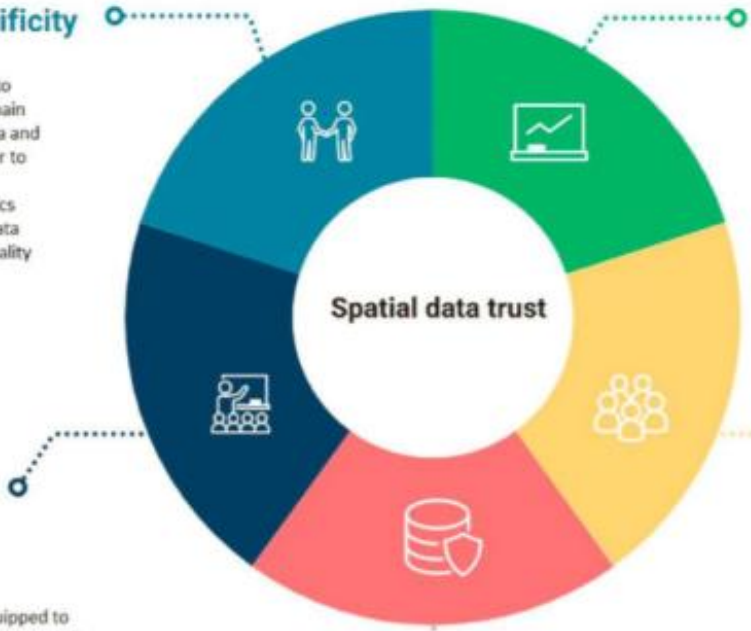
Features of federated platform



1 Domain specificity

Trustees are required to include significant domain expertise in spatial data and spatial analysis in order to adequately address particular characteristics associated to spatial data such as spatial data quality and location privacy.

2 Data quality

Trustees have to be equipped to support trustors in capturing and documenting the quality of entrusted spatial data, and beneficiaries will require support in assessing fitness-for-use of that data in their specific applications.

3 Data privacy

The provision of agreed rules, policies, and processes for deposit, access, monitoring, management, anonymization, and auditing of personal location data.

4 Data sovereignty

The ability to establish and protect data sovereignty, including Indigenous data sovereignty.

5 Data value

The ability to leverage spatial domain knowledge and create a data governance model that helps unlock otherwise unrealized value in spatial data sets.

Radosevic, N. et al. (2023)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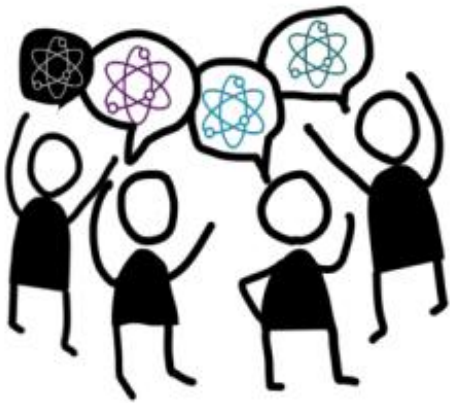
Waterisotopes.org
ISOBANK
Atlas of Living Australia
ala.org.au
tern
EcoPlots
Ecosystem Research Infrastructure
EcoCommons
data.gov.au
ISOTOPES.AU
Soil and Landscape Grid of Australia

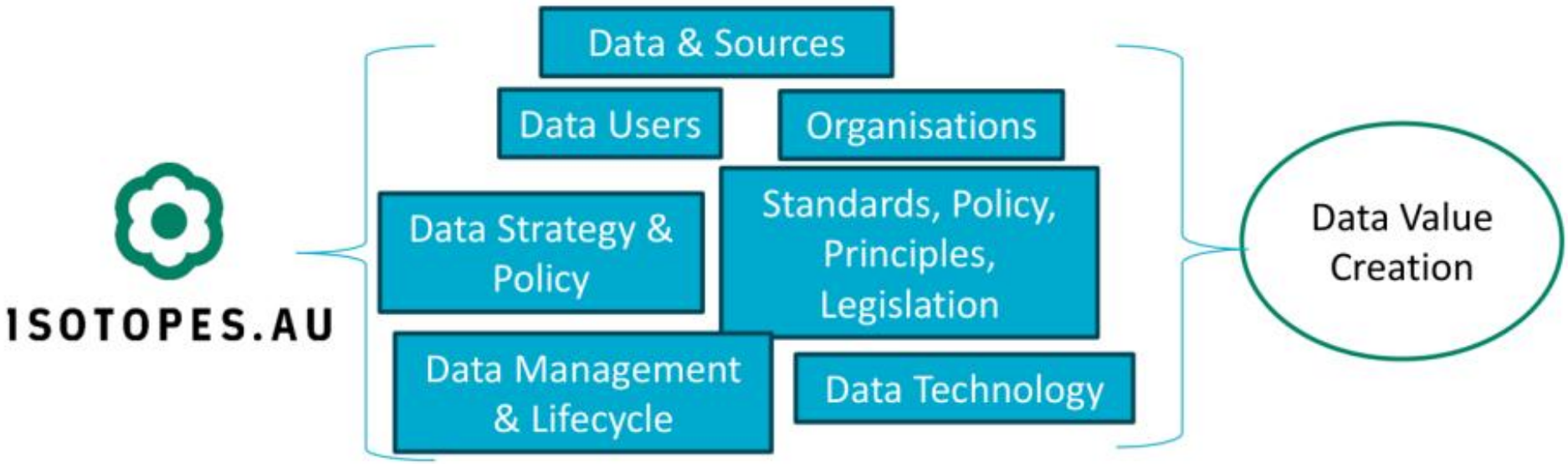
Our contributions

- Taking away the pain of collation
- Created a trusted network



Adapted from Kebede, et al. (2024)

Where to next?



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