

Sharing Australia's Nationally Significant Terrestrial Ecosystem Data: a collaboration between TERN and ANDS

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Abstract— Collection based approaches are commonly used in libraries for collections of physical and electronic resources. However nationally significant collections of research data are new development, one that is increasing importance to researchers. Bringing together datasets of national significance and making them openly accessible will enable to address some of the critical questions facing our society. In ecosystem domain, this will enable us to understand more about causes and effects of changes in the ecosystem. An implementation case study based on TERN's OzFlux data collections as a national collection program initiated by ANDS is presented. This paper demonstrates how the Terrestrial Ecosystem Research Network (TERN) and the Australian National Data Service (ANDS) are working together to identify and publish nationally significant ecosystem data collections to enhance discoverability, accessibility and re-use.

Keywords—eResearch, national collection; terrestrial ecosystem data;

I. INTRODUCTION

Australia is geographically one of the largest countries in the world and 12th largest by economy. It is also one of the least densely populated countries in the world. These characteristics pose unique challenges in the global economy to be competitive, and to improve and sustain quality of life for its citizens. Much of the Advancement of the Australian economy is due to the investment by successive governments in research and development, innovation and skill development [1].

In the last decade, Australia's government under the National Collaborative Research Infrastructure Strategy (NCRIS) has funded collaborative research infrastructure facilities to address some of the nation's social, economic and environmental challenges. The significant investment on eResearch related infrastructure is summarized in three parts:

- Foundational eResearch access infrastructure, which includes AARNet (Australia's Academic and Research Network) to provide national and globally advanced network connectivity, AAF (Australian Access Federation) to provide single authentication and access for Australian researchers.

- Multi-use eResearch service infrastructure, which includes: ANDS (Australian National Data Service) for data management; RDSI (Research Data Storage Infrastructure) for data storage; NeCTAR (National eResearch Collaboration Tools and Resources) for research cloud and various supercomputing centers (e.g. NCI, Pawsey) for data computation and modeling.
- Discipline oriented research-supporting infrastructure, which includes, but is not limited to: TERN (Terrestrial Ecosystem Research Network) to collect terrestrial and ecosystem data; AURIN (Australian Urban Research Infrastructure Network) to collect social and built environment and urban data; IMOS (Integrated Marine Observation System) to collect and publish ocean related data [2].

The third category of eResearch related infrastructure has enabled researchers to collate, produce, co-ordinate and publish larger and more complex data than ever before. This data deluge has provided an opportunity to address some of the cross-domain research of national and international significance. However, managing, accessing and re-using these datasets require improved data management practices, curation methodologies, accessibility and resource sharing tools [3, 4]. Several national and international initiatives were started to address some of these issues at general and domain-specific level and publish open access data [5-7].

ANDS has undertaken a major initiative to provide a comprehensive view across Australia's research data [8]. This paper describes ANDS and TERN collaboration to make Australia's nationally significant terrestrial ecosystem data collated by TERN Initiative discoverable under ANDS initiated National Collection Program. The following is an outline of the paper: Section II gives an overview of ANDS and TERN. Section III provides an insight into ANDS National Collection. Section IV provides a detailed case study of developing TERN national collection and implementing and sharing TERN OzFlux national collections. The conclusion and future work is in section V.

II. OVERVIEW OF ANDS AND TERN

A. Overview of Australian National Data Service (ANDS)

The Australian National Data Service (ANDS) is funded by the Australian Government through the NCRIS and the Education Investment Fund Super Science Initiative [9]. Monash University leads the ANDS partnership with the Australian National University and CSIRO (Commonwealth Scientific and Industrial Research Organization).

With the development of ICT technologies and advances in data collection methods and sensors, researchers are producing larger and more complex datasets than ever before, so it is a “critical” task to effectively manage and share these data [10]. ANDS focuses on addressing these issues by leading the creation of a cohesive national collection of research resources and a richer data environment that will:

- Make better use of Australia’s research outputs
- Enable Australian researchers to easily publish, discover, access and reuse data
- Enable new and more efficient research

The general ANDS vision is to encourage more Australian researchers to reuse research data more often. Specifically, ANDS aims to enable four transformations:

- To transform data that are unmanaged to well managed collections.
- To transform data that are disconnected to collections that are widely connected
- To transform data that is invisible to easily findable collections
- To transform data that is single use to reuseable collections.

The ANDS is creating the Australian Research Data Commons – a meeting place for researchers and data, to provide: A set of data collections that are shareable; descriptions of those collections; an infrastructure that enables populating and exploiting the commons; connections between the data, researchers, research, instruments and institutions.

Research Data Australia (<http://researchdata.ands.org.au>) is the key web-based “discovery” service developed by ANDS, which aims to provide rich connections between data, projects, researchers, institutions, and promote visibility of Australian research data collections in search engines (e.g. Google, and Bing).

Research Data Australia uses RIF-CS (Registry Interchange Format – Collections and Service) as the default schema (<http://www.ands.org.au/guides/rif-cs-awareness.html>). RIF-CS is based on the ISO 2146:2010 Registry Services for Libraries and Related Organizations Standard [11], but RIF-CS is not a full binding to the standard. In fact, RIF-CS only includes those elements of ISO 2146 which are necessary to describe a collection. For

example, there are four main entities or registry objects in RIF-CS:

- **Collection:** is an aggregation of physical or digital resources, which has meaning in a research context. This context includes the research process itself, any resources that support that process, and the linked scholarly communications cycle with its research outputs of publications and published data.
- **Party:** describes a person, group or role related to an activity, to the creation, update, or maintenance of a collection, or to the provision of a service.
- **Activity:** is an undertaking or process related to the creation, update, or maintenance of a collection. An activity record usually describes a project (a piece of work that creates research data).
- **Service:** is to provide context for the collections it registers, and to enable discovery of related collections, rather than to serve as an exhaustive registry of research services.

B. Overview of TERN

The Terrestrial Ecosystem Research Network (TERN), also funded by the Australian Government National Collaborative Research Infrastructure Strategy (NCRIS) and Education Investment Fund (EIF) is developing data infrastructure to enable ecosystem researchers to collect, contribute, store, share and integrate data across different ecosystem domains for the needs of national and international research activities. The strategic goal of TERN is to provide open access to Australia’s ecosystem science research data and contribute to the deeper understanding and long-term sustainable management of Australia’s ecosystems. This initiative has enabled a coordinated approach to transform how the ecosystem science community collects, stores, shares, re-uses and analyses heterogeneous datasets of various spatial and temporal scales to harness their collective power.

Due to the complexity and diversity of information collected by ecosystem science community, TERN operates as a network of facilities that contributes to achieving TERN’s goal. The Facilities are run in partnership with educational and research Institutes (see details in Figure 1).

TERN is composed of eight Facilities, which harvest data from different disciplines across the ecosystem domain. Following is the brief overview of TERN Facilities:

- The AusCover Facility provides Australian biophysical map and remote sensing time-series data products, and associated field calibration and validation data at continental scales.
- The OzFlux Facility measures, collects, curates and publishes key energy, water and carbon dioxide fluxes data from flux towers across Australia. These datasets are used for wide range of ecosystem science and modelling applications.

- The Multi-Scale Plot Network (MSPN) is one of the biggest Facilities in TERN. Through sub-facilities AusPlots, Long-Term Ecological Research network (LTERN) and Australian Supersite Network (ASN), it provides access to current as well as historical information like flora, fauna and biophysical processes from plots, sites, and transects across all Australian ecosystems.

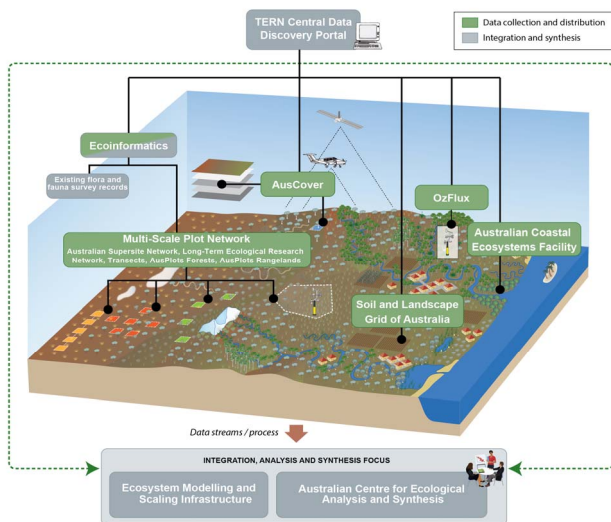


Fig. 1. Overview of TERN and Facilities operation

- The Soil and Landscape Grid of Australia provides high-spatial resolution grids containing key soil attributes and landscape features across Australia. Most of the data products are continental scale.
- The Australian Coastal Ecosystem Facility harvests and publishes key datasets of Australian coastal ecosystem.
- The Eco-informatics Facility is developing key infrastructure, the Australian Ecological Knowledge and Observation System (ÆKOS) to enable storage, sharing, integration and visualisation of ecological plot data. Datasets collected by LTERN and Ausplots sub-facilities of MSPN are also published via ÆKOS.
- The eMAST facility will create and develop an operational research infrastructure enabling datasets from different TERN facilities to be integrated and applied to benchmarking, improving and applying ecosystem models on different applications.
- The ACEAS facility links ecosystem scientists and environmental managers to improve our understanding and management of Australian ecosystems.

The diversity in the datasets acquired and managed by TERN facilities mandates that each facility uses different formats, structures and delivery mechanisms to store and disseminate datasets. In certain facilities, user communities will have preferences about the data and metadata formats, and delivery mechanisms based on community standards. Therefore, facilities have developed their own data management framework that will give access to data and

related metadata for scientists, policy makers and public. For example, the AusCover facility stores data in a Climate and Forecast (CF) compliant NetCDF (Network Common Data Form) format and publishes via THREDDS/OPeNDAP server, and the GeoNetwork metadata catalogue is used to harvest and publish metadata based on ISO 19115 standards [12]. Coastal Facility also uses similar technology to describe and publish most of the coastal related datasets.

The Eco-informatics facility has taken a completely different approach by developing ÆKOS (<http://portal.aekos.org.au>). The ÆKOS is based on semantic technologies with data described with rich contextual information in a structured manner and is mapped to an ontological model. This approach enables to capture as much information as possible related to data. Rich contextual information will enable data users to make an informed decision about the suitability of data for their re-use purposes.

The TERN Data Discovery Portal (TDDP) (<http://portal.tern.org.au>) provides an aggregated view of data and makes all TERN related datasets discoverable under a single platform, based on open-source code developed by ANDS. The TDDP is a metadata catalogue of research data built by regularly harvesting metadata records from all the TERN facility data infrastructure using Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH), a lightweight harvesting protocol for sharing metadata between services. The metadata information available in the TERN portal consists of descriptive information about the datasets, information about data custodians, data access and licensing information and links to respective facility metadata catalogue to view detail metadata and access to corresponding data.

III. ANDS NATIONAL COLLECTIONS

National Collections is one of ANDS funded programs, which brings a focus on Australia's data assets nationally and internationally and aims to enable new and more complex research questions to be addressed. The ANDS National Collection program works closely with Australian Universities, public sector and national research facilities to identify nationally significant collections and publish them to ANDS Research Data Australia.

The value of establishing national collections of research data is considerable and addresses many nationally significant data needs. One is to have collections of data that enable big problems to be addressed, often by investigating "survey" questions. Another is to have a reference collection that enables researchers to compare their results with a standard. A further need is to have a locus where of all research data of a particular form can be explored. By bringing together 'like' data and highlighting collections of national significance, ANDS supports research through the improvement of its discoverability and subsequent potential for reuse. This consolidation also has the potential for showcasing valuable holdings globally and increasing the potential attractiveness of Australian research environment.

A. *What is a National Collection?*

An ANDS national collection is a research data asset that is significant and valued by the Australian research community and widely used by the research community.

Inspired by the Dutch Data Seal of Approval [13], ANDS supports national collections that have some of the following desirable characteristics:

1. The collection is well described.
2. Data is accessible to the Australian research community.
3. Data is available through open licensing.
4. The collection is easily cited.
5. The collection is well curated.
6. The collection is well preserved.

B. *Why describe a National Collection?*

A collection based approach is commonly used in libraries to introduce focus and applicability into the presentation of material. This approach will enable ANDS to partner with institutions for better understanding of data and the research environment in which it is created and used to develop the data descriptions that enable it to be presented in meaningful contexts. For example, the ANDS national collections program will work with institutions to bring nationally significant datasets together; describe it in a way that enables flexibility in presentation; and highlight it for discovery and reuse.

Describing a national collection at ANDS Research Data Australia will: improve discoverability and browsability; spotlight important and significant data; provide a holistic picture of data on any given topic.

C. *What are the benefits to researchers*

Working closely with researchers to properly identify and store nationally significant research data asset, describe it in a way that enables flexibility in presentation and highlight it for discovery will provide the following benefits to researchers:

- Enhanced reputation for creator and owner
- More comprehensive view of a research topic
- Access to authoritative collections
- Bring data and related services together
- Security of ongoing and reliable access to data

D. *What are the benefits to institutions*

Partnership with Australian institutions to identify nationally significant data assets and make sure institutional national collections can be well managed to enable data reuse, will bring the following benefits to institutions:

- Enhanced reputation for organisations
- Enhanced reuse of organisational data assets
- Enabling an organisation to align its data assets with nationally significant research challenges

- Show case data outputs from national initiatives and collaborations.

E. *What distinguishes national collections from other collections in Research Data Australia?*

National collections will also be displayed at ANDS Research Data Australia (in the same way as other collections), but are likely to also have most of the following advantages:

- Extensively connected: a national collection usually focuses on a specific research theme, so collection contributors are across the boundaries of universities, public sector agencies and national research facilities.
- Richly described: each national collection record normally will have four types of metadata [14]: metadata for discovery, metadata for assessment of value; metadata for access and metadata for reuse.
- Well curated: national collection data assets will be stored at institutional data repository/government funded storage agency (e.g. RDSI-Research Data Storage Infrastructure) to enable data discovery and retrieval, quality maintenance, value adding and provide for re-use over the time.
- In high demand: national collections will aggregate relevant research theme data together to be easily accessible. Therefore, they are likely to be highly demanded.
- Comprehensive view of data on a given topic: bringing a relevant research theme data together to form a national collection can provide researchers a more complete picture of data on given topic. This will enable new and more complex research questions to be addressed.
- Availability of tools and compute services with the collection. It is preferred to have data related services sit near the data asset, particularly for data that is too large to easily be moved. For example, national collection data assets can be stored at RDSI (<http://rdsi.uq.edu.au>) node; collection level metadata will be discovered at ANDS Research Data Australia and commonly used data analysis and visualization toolkits will be hosted at NeCTAR (<http://www.nectar.org.au>) cloud. These will be interconnected in a way that lets users compute over discovered data without being aware of the locations of the individual infrastructure elements

F. *What types of national collections?*

NSF (National Science Foundation) uses the following typology for data collections [15]: (1) Reference data collections are intended to serve large segments of the research community. (2) Community data collections serve a single discipline community. (3) Research data collections are the products of one or more focused research projects and typically contain data that are subjects to limited processing or curation.

Inspired by NSF data collection topology, ANDS divides national collections in two types:

- Curated by a single institutions. This type of national collection is collected and maintained by a single institution and can be seen as a significant institutional data asset. For example, “the Australian biological collections”, which is purely curated by CISRO.
- Distributed across multiple institutions. This type of national collection pulls together collections from a number of institutions. One approach is from national collaborative initiatives. For example, TERN has eight facilities to collect terrestrial and ecosystem data, but each facility has its own hosting organization. The other approach is to form a research topic (e.g. Climate Change, Urban Water) by bringing “likely” data asset from different institutions.

IV. CASE STUDY: TERN NATIONAL COLLECTION

A. Overview of TERN data collection

Ecosystem is a collaborative science with direct interaction between earth and life science, and dynamics around the interaction [16]. Hence data collections published by TERN can be classified into ecological and biogeophysical data. Ecological data mainly focus on Flora and Fauna in a geographical area. Biogeophysical data deal with interaction of biological, geological and physical processes [17]. Data collections from Eco-informatics and MSPN Facilities are predominately ecological data whereas data from AusCover, OzFlux, Soil and landscape grid of Australia and Australian coastal ecosystem are predominantly biogeophysical. This classification has been made to create more coherent data collections to improve accessibility and discoverability. The following are some of the ecological datasets currently available for access under the TERN initiative:

- Plants and species distribution survey information from 15,000 site plots covering most of South Australia contributed by the Department of Environment, Water and Natural Resources, South Australian state of Australia.
- Vegetation distribution survey information from 8500 site plots covering large parts of Queensland contributed by the Department of Science, Information Technology, Innovation and the ARTS, Queensland, Australia
- Vegetation and species distribution survey data from Ravensthorpe Range from 200 site plots covering in the southwest corner of Western Australia in one collection from Department of Agriculture, Fisheries and Forestry
- Australian Ground Cover Reference Sites Data with 200 sites covering Australia in 6 collections contributed from the Australian Bureau of Agriculture and Resource Economics and Sciences (ABARES)
- TERN AusPlots Rangelands has contributed vegetation and soil information from 54 site plots covering Australia’s rangeland bioregions. TERN Australian Supersite Network (ASN) has published data collections from more than 10 different supersites across Australia.

- Synthesis data products developed by the working groups from ACEAS, which includes impact of land use and management practices on vegetation transformation of specific sites across Australia.

Apart from the above, following are some of the biogeophysical datasets currently published under the TERN initiative include:

- 41 satellite and remote sensing data products on continental scale relevant to land cover, ecosystem variables, vegetation indices, leaf area index, fractions of photosynthetically active radiation, fire, atmosphere and meteorology.
- 20 flux tower datasets spanning across all the states of Australia. Data from another 8 flux towers will be made available soon. 13 data products of continental-scale land surface slope and topographic position.

In coming years there will be substantial increase in the datasets available from TERN initiative and will be discoverable from TDDP and RDA.

B. Identification of TERN National Collections

TERN considers any data can be a part of national collection if it is “parts of a whole” collection, which is of significant national importance. To accommodate the views of domain experts in identifying national collection, TERN is in the process of constituting a committee of experts from both the ecology and biogeophysical domain to identify datasets of national importance among its vast data collections.

The data collections in TERN vary widely in terms of temporal and spatial scale. The satellite and remote sensing datasets has larger spatial coverage (continental scale) and generally are gridded datasets. These datasets are strong candidates as national collections due to the coverage in terms of space and time.

Most of the datasets collected and published by TERN can be considered as national collections based on the criteria set by ANDS. One of the uniqueness of ecosystem science is that every dataset is unique in the context of space and time. Often researchers will be working in a small plot of land with diverse ecosystem variability. These datasets may not be considered as significant if viewed in a silo but if the dataset is part of a network collecting similar datasets, the usability of data substantially improves to address macro-scale environment and ecological problems [18].

C. OZFLUX NATIONAL COLLECTION

The OzFlux facility is part of a global network of flux towers called FluxNet (www.fluxnet.ornl.gov), which is a network of 500 flux towers across the world. This provides an opportunity to measure the carbon exchange in atmosphere at global scale. Hence it is easy to infer that flux datasets are of national importance and any data published by OzFlux Facility is of national importance if not international. The wider accessibility of carbon and flux data collections would enable scientists to study the variation of

climate variables at global scale with the change in carbon exchange in the atmosphere.

Datasets from individual flux towers cover small area and phenomenon in the environment is measured at smaller (30 minutes) time-interval leading to the generation of large datasets. These observations have a significant impact when harness with similar datasets from other flux towers. For example, a Flux tower collects flux and meteorological information in a localised or micro-environment. However, being part of continental scale network of flux towers, the combined power of flux information can be harnessed to study the change in atmosphere carbon across the continent. The network will also enable to develop and implement standardised methods and techniques to capture, process, store, quality control and publish data.

Wider sharing of data has already enabled flux community to develop data products that are universally useful in the community. This has also enabled the development of standardized data capture and processing techniques that can be incorporated across all flux towers. All this will leads to a standardize the observations measured across all the flux towers so that homogeneous datasets are created from different flux stations, which would enable to study differences and improve data synthesis activities across different flux towers.

The ANDS National Collection program desirable characteristics (described in Section III) were applied for OzFlux data collection to check whether all desired characteristics are met:

- *The collection is well described:* OzFlux datasets are well described at the collection level with detail metadata description including site information, phenomenon measured, quality control processes.
- Data is accessible to the Australian research data: All OzFlux data collections are accessible to national and international research communities. OzFlux data collections are discoverable from TERN Data Discovery Portal and ANDS Research Data Australia.
- Data is available through open licensing: Data from OzFlux is available through TERN-BY-SA (<http://tern.org.au/datalicence/TERN-BY-SA/1.0/>) licence adhering to the TERN licensing framework. TERN had to develop a suite of licenses for datasets where copyright doesn't subsist with the data [19]. These suites of licenses are a variant of Creative Commons Australia v3.0. For datasets where copyright subsists, Creative Commons Australia v3.0 can be used.
- The collection is easily cited: The OzFlux data collections have citation information and a Handle System is used as a persistent identifier.
- *The collection is well curated:* Data collection is automated and processing techniques are standardised across all flux towers. The data collection will undergo four levels of quality control processes. The data is stored in a Network Common Data Form (NetCDF) format with metadata about the variables. All data from

different level of quality control stages are available for re-use.

- *The collection is well preserved:* The OzFlux data collection is hosted at Monash eResearch Centre and soon to be migrated to RDSI; the data is discoverable from Research Data Australia (ANDS developed discovery service for research data) as well as the TERN Data Discovery Portal.

The OzFlux data collections clearly met the ANDS desired characteristics to be considered for national collection. Hence the entire OzFlux data collections are considered to be part of national collection program.

D. Implementation

ANDS and TERN are working closely together to identify national collections and publish the same under national collection program. One of the first candidates to consider for national collection in TERN was the OzFlux data collection. These data collections are not only national but also are of international importance. National collections are presented in research data Australia for wider use in Australia and around the world.

ANDS Research Data Australia used RIF-CS as the default schema (as discussed in Section II), so the first task is to represent OzFlux into RIF-CS including describing or representing four RIF-CS registry objects. The description of relationship between collection and related registry objects will create rich contextual information for all collections and ensure discoverability.

Data collected from each flux tower is defined as collection. This decision was made based on the discussion with the flux community. TERN initiative is described as Activity in RIF-CS registry object, because TERN and its facilities are funded to accomplish certain tasks in limited time duration with the involvement of ecosystem science community. Hence, the OzFlux Facility is defined as Activity. People responsible to collect or own data are described as party:people and organisation with which people are associated is described as party:group. Finally, software infrastructure used to publish OzFlux data and metadata are described as service. Relationships between four RIF-CS registry objects are given in Figure 2.

TERN has developed a model to represent TERN national collection at ANDS Research Data Australia. All data collections of national significance published under TERN initiative will be part of TERN national collection. The TERN national collection (Collection), which is an output of TERN (Activity), has two sub-collections biogeophysical and ecological data. Each of these collections is part of the data collections published by the TERN Facilities (Activity) and are supported by software infrastructure (Service). The collection has relationship with people (party:person) and organization (party:group). The Figure 3 shows the representation of TERN national collection in RIF-CS schema and the relationship between different entities.

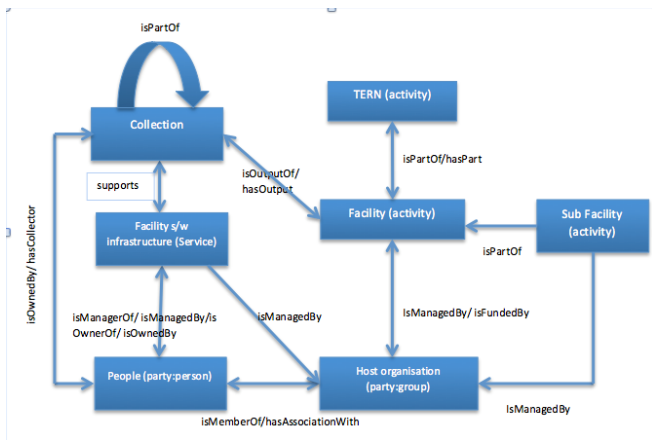


Fig. 2. Links and relationship between RIF-CS Activity, Party, Collection and Service records from TERN Context

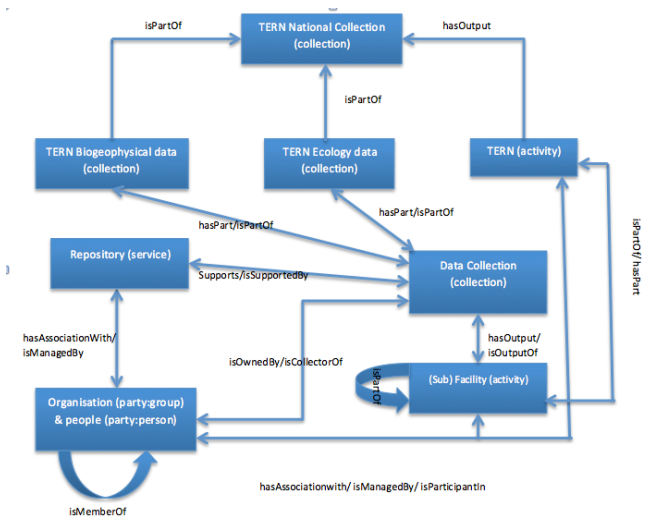


Fig. 3. Representation of TERN National Collection in RIF-CS

Figure 4 shows a screen-shot of TERN national collection at Research Data Australia, which has a brief overview of TERN on the left panel and detailed “connections” on the right panel, which includes: access methods, contact details, rich connections (related collections, research groups, activities and services). Figure 5 shows a screen-shot of TERN biogeophysical data collection at Research Data Australia, which also listed OzFlux related collections under collection structure.

V. CONCLUSION AND FUTURE WORKS

In this paper, we demonstrate a case study of how ANDS and TERN collaborate together and share nationally significant terrestrial and ecosystem data.

What will be the impact of national collections such as OzFlux data Collections? A range of possible synthesis questions is under investigation. One which is being worked on at present is whether temporal variations in animal populations coincide with variations in modelled Global Primary Productivity (GPP)/Net Primary Productivity (NPP)/Net Ecosystem Exchange (NEE). Another relates to the question of how best to model canopy cover across

Australia. If we model each canopy as a single leaf, how many leaves do we need to cover Australia? This is at the proof of concept stage. A longer-term question that would draw on a wide range of data is investigating what are the drivers of spatial and temporal variability in GPP/NPP/NEE over Australian ecosystems?

In support of these kinds of questions, the TERN national collection will be populated with more collections once TERN start identifying more datasets of national significance from the data collections being published under the initiative. The ANDS national collection program will also enhance the credibility of the datasets, the methodologies used in the data collection and the processing techniques used in the data curation. It also improves the possibility of collaboration with the people or organization involved in the national collection.

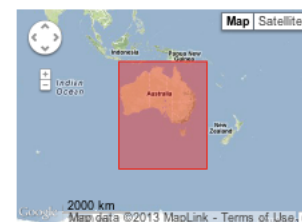
Terrestrial Ecosystem Research Network Collection

The Terrestrial Ecosystem Research Network (TERN) collection consists of datasets from different ecosystem science disciplines. The collection covers the Australian geographic region and includes flux of carbon dioxide and water vapour, time series of satellite image maps of biophysical properties and ground data, plot-based ecological data, national survey datasets for flora and fauna, national soil attribute and terrain datasets and a range of coastal ecosystem datasets.

Collection Structure

- Terrestrial Ecosystem Research Network Collection
- TERN Ecology Data Collection
- TERN Biogeophysical Data Collection

Spatial Coverage:



Subjects

Field of Research
0501

Access

<http://portal.tern.org.au/hom...>

Licence

TERN-BY; TERN-BY-SA; TERN-BY-ND
<http://www.tern.org.au/datalicence>

Rights statement

Access rights
<http://www.tern.org.au/datalicence>

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Connections

Research Groups
Monash University
University of Adelaide
University of Queensland



Activities

TERN
Terrestrial Ecosystem Research Network
Collections
TERN Ecology Data Collection
TERN Biogeophysical Data Collection
Services
TERN Data Discovery Portal

Fig. 4. TERN national collections at ANDS Research Data Australia (<http://demo.ands.org.au/terrestrial-ecosystem-research-network-collection>).

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TERN Biogeophysical Data Collection

The TERN Biogeophysical data collection consists of datasets related to exchange of energy, water, and momentum with the atmosphere. The datasets largely concern soil physics, radiative transfer, hydrology and meteorology. The datasets are ground-based and satellite remote sensing spatially covering entire Australia.

Collection Structure

- Terrestrial Ecosystem Research Network Collection
 - TERN Ecology Data Collection
 - TERN Biogeophysical Data Collection**
 - Adelaide River OzFlux tower site
 - Daly Uncleared OzFlux tower site
 - Howard Springs OzFlux tower site
 - Dry River OzFlux tower site
 - Sturt Plains OzFlux tower site

Spatial Coverage:



Subjects

Field of Research

0501

Access

<http://portal.tern.org.au/>

Licence



TERN-BY; TERN-BY-SA; TERN-BY-ND

<http://www.tern.org.au/datal-cence>

Rights statement

Access rights

<http://www.tern.org.au/datal-cence>

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Connections

Research Groups



CSIRO

Collections

Adelaide River OzFlux tower site

Daly Uncleared OzFlux tower site

Howard Springs OzFlux tower site

Dry River OzFlux tower site

Sturt Plains OzFlux tower site

View All 7 Collections

Activities



TERN
Terrestrial Ecosystem Research Network

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Fig. 5. OzFlux national collection as subset of TERN biogeophysical data collection (<http://demo.ands.org.au/tern-biogeophysical-data-collection>)

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