Australian National Soil Information System

- ANSIS delivers soil data from
  - private parties
  - research institutes
  - government agencies

- These are managed in different ways and for different purposes

- Must be harmonised for ANSIS
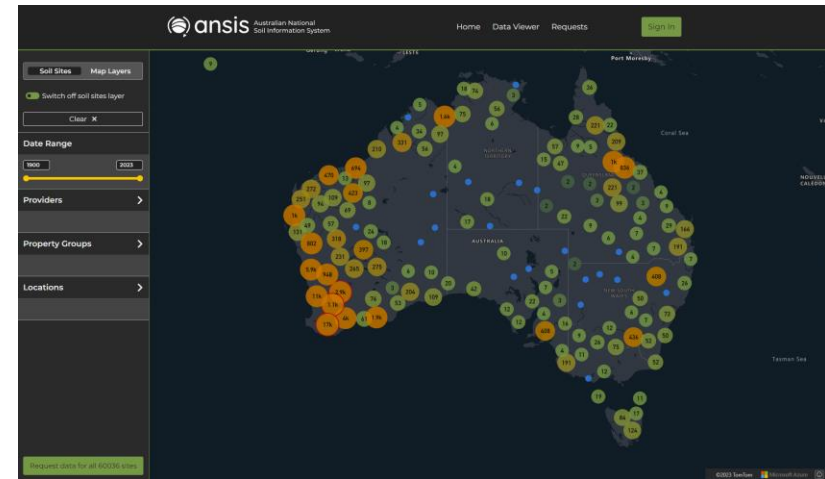
Sub-theme 1.2:
Soil Data Standardization And Harmonization

Innovative technology, soil information modelling and distributed query allow delivery of nationally standardised soil site and analytical data through a well-governed Australian national soil information system (ANSIS)

Peter Wilson - Commonwealth Scientific And Industrial Research Organisation (CSIRO), Australia
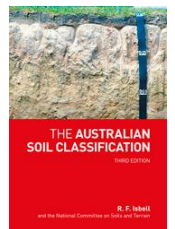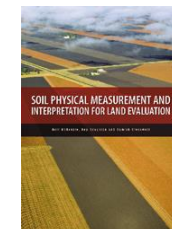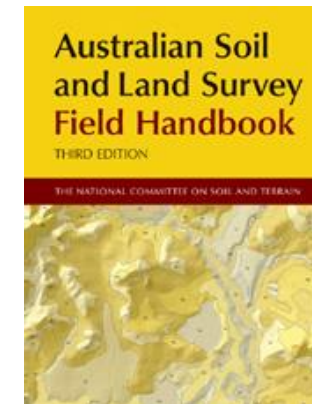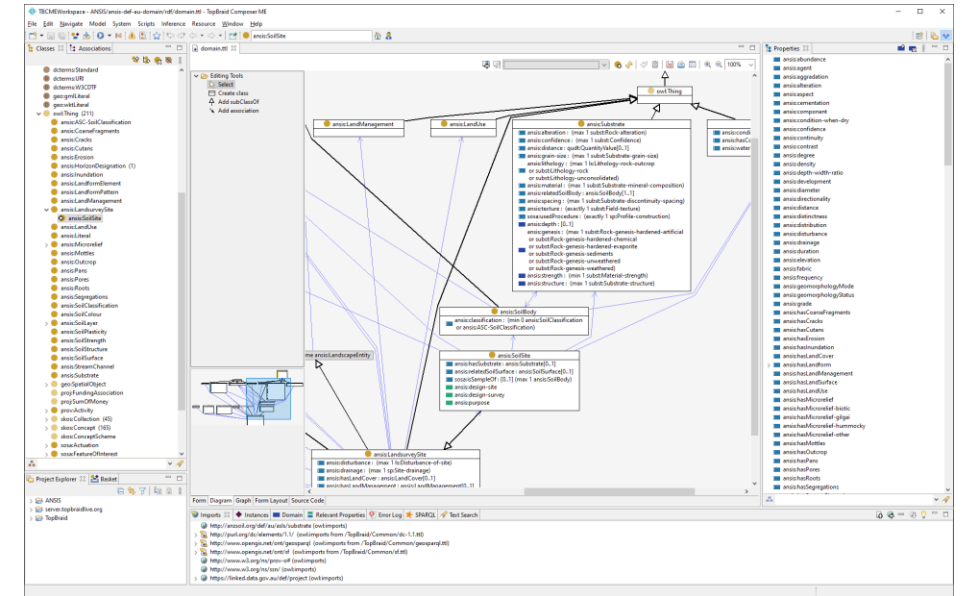
ANSIS information models for harmonization

- Need a common information model to which the provider data can be mapped
  - Ontology: a conceptual view of soils

- Need schema for implementation and data delivery formats
  - JSON Schema: a physical data model for soils

ANSIS Soil Ontology

- Defined according to
  - a scientific understanding of soils
  - nationally agreed practices for sampling and describing them

- Based on other environmental models
  - Terrestrial Ecosystem Research Network
  - Global Soil Information System
  - ANZSoilML
  - multi-national soil and environmental data exchange experiments

- But prioritises the work of the Australian soil community
  - e.g. the Australian Soil and Land Survey Field Handbook

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ANSIS Soil Ontology

- Developed using Semantic Web modelling languages and tools
  - Web Ontology Language (OWL)
  - Resource Description Framework (RDF)

- Concepts from Australian soil community publications

… something new, something borrowed …

ANSIS Soil Ontology Primer

ANSIS Soil Ontology Primer

- Extensive use of controlled vocabularies and structured values
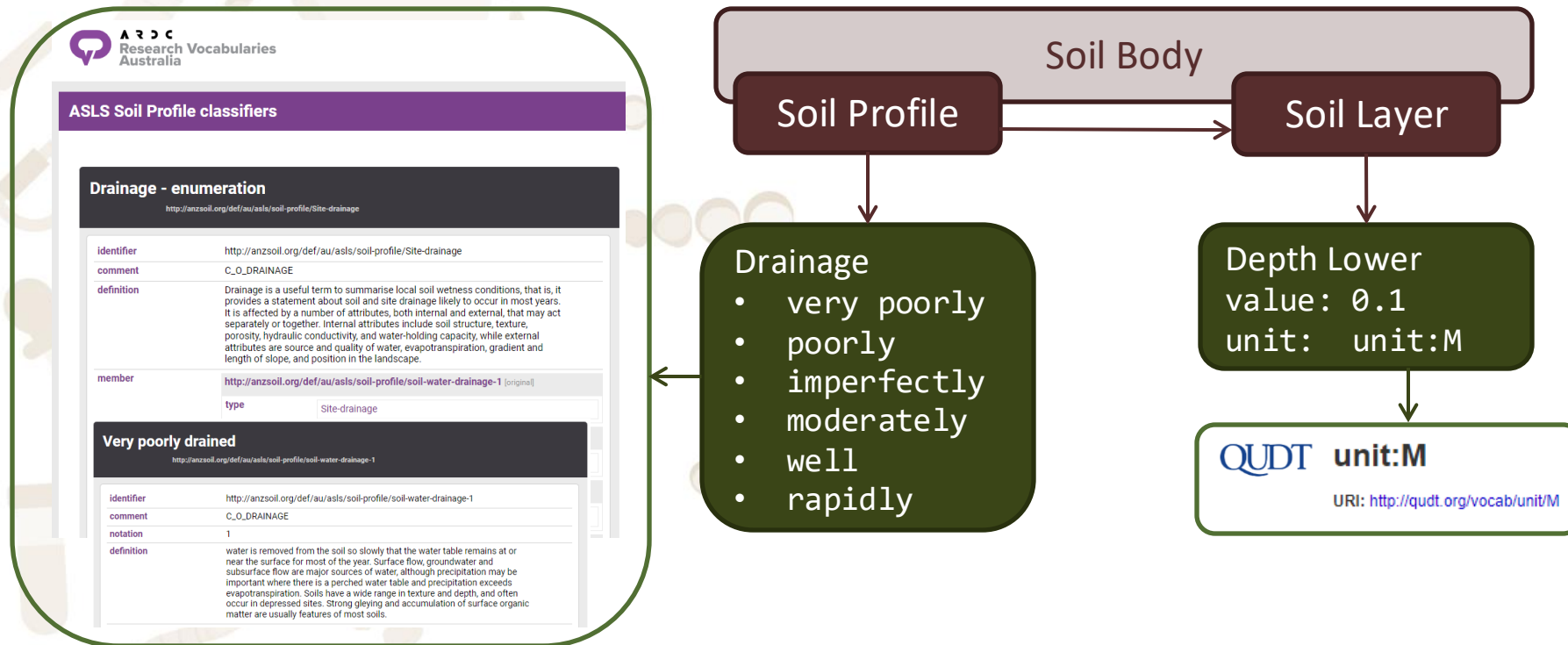
Observable Properties

- Asserted Properties
  - names; identifiers; projects

- Observed Properties ... AKA Soil Properties
  - value estimated by a particular sensor (includes people) according to a method
  - matrix colour; drainage; total Carbon; ...

- ISO/OGC Observations and Measurements
  - Observation event/activity metadata

Extensions to the Semantic Sensor
Network Ontology
OGC® W3C

Open
Geospatial
Consortium   Key topics ↓   About ↓   Innovation ↓   Standards ↓
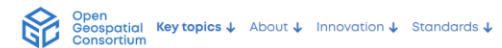
Home / Standards / Observations and Measurements

**Observations and
Measurements**

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Observations

ansis:drainage
    hasResult: *sp:soil-water-drainage-3*

ansis:slope
    hasResult:
        value: *42*
        unit: *unit:DEG*
    usedProcedure: *lf:slope-evaluation-A*

ansis:cationExchangeCapacity
    hasResult:
        value: *42*
        unit: *unit:CentiMOL-PER-KiloGM*
    usedProcedure: *scm:15I4*
    resultTime: *2023-01-26T07:50:00Z*

*http://anzsoil.org/def/au/asls/soil-profile/*soil-water-drainage-3

sp:soil-water-drainage-3
    prefLabel: *imperfectly drained*

*http://anzsoil.org/def/au/asls/landform/*slope-evaluation-A

lf:slope-evaluation-A
    prefLabel: *Abney level or clinometer*
                   and tape

*http://anzsoil.org/def/au/scm/*15I4

scm:15I4
    prefLabel: *CEC measurement – titration*
                of NH+4 and Cl-

Observable Properties and Methods

ANSIS JSON Schema

- Converted the ontology into a JSON Schema
  - Rules for the structure and content of JSON documents
- Complimentary schema, not a replacement
- Constrains options in the ontology
  - Manageable 'graph'

- Why?
  - Consistent patterns for structure of data from an API/web service
  - Uses more widely available technology
  - (Slightly) less intimidating than an ontology

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FOLDERS

ANSIS (WORKSPACE)
- code

ansis-def-au-schema-json > schema > domain > 2023-06-30 > {} entities.json > ...

ANSIS Soil Domain Entity Schema

JSON Schema Location: entities.json

JSON Schema definitions of the complete list of entities (features in GIS speak) defined in or imported by the ANSIS Domain Ontology.

Instances of entities can be created/validated using the entity-instance and entity-instance-collection schema.

Core Entities

Core entities are those primary soil and sample entities that are provided, queried and downloaded in ANSIS.

ansis:SoilSite

ANSIS Soil Site. A site where samples, observations, and treatments of soil are carried out.

Property	Value Count	ANSIS Preferred	Type	Vocabulary	Description [*Comment*]
aspect	0..*		qudt:QuantityValue; sosa:ObservableProperty		Direction or azimuth that a terrain surface faces.
depthFreeWater	0..*		qudt:QuantityValue; sosa:ObservableProperty		Depth to free water at the site of soil observation, either above or below the soil surface, excluding litter and living vegetation. Positive values indicate water above the soil surface. Negative values indicate water below the soil surface.
designSite	0..1	Y	ansis:Classification		Overall design of sampling at the site e.g. ASLS, grid, transect.
designSurvey	0..1	Y	ansis:Classification		Overall design of soil or landscape survey e.g. free, grid, stratified, miscellaneous.
disturbance	0..1		skos:Concept; sosa:ObservableProperty	Disturbance of site	Disturbance of site.
drainage	0..1	Y	skos:Concept; sosa:ObservableProperty	Soil Water Drainage	Drainage of site or profile.

"depth": {

in Ontology.",

l surface of entity.",

ity",

erty",

"BoundaryDistinctness": {
    "$anchor": "boundary-distinctness",
    "@id": "sp:Boundary-distinctness",
    "title": "Boundary distinctness",
    "description": "Distinctness of the boundaries between horizons",
    "type": "string",
    "oneOf": [
        {
            "const": "sp:horizon-boundary-distinctness-A",
            "description": "Abrupt"
        },
        {
            "const": "sp:horizon-boundary-distinctness-C",
            "description": "Clear (horizon boundary distinctness)"
        },
        {
            "const": "sp:horizon-boundary-distinctness-D",
            "description": "Diffuse (horizon boundary distinctness)"
        },
        {
            "const": "sp:horizon-boundary-distinctness-G",
            "description": "Gradual (horizon boundary distinctness)"
        },
        {
            "const": "sp:horizon-boundary-distinctness-S",
            "description": "Sharp (horizon boundary distinctness)"
        }
    ]
},
"BoundaryShape": {

asResult"],

: {"$ref": "./qudt.json#Quanti

on#ObservableProperty"}

ation",

erty",

ion.",

asResult"],

: {"$ref": "./enum.json#inundation-depth"}

on#ObservableProperty"}

"depthFreeWater": {

ed material.",

162   "relatedLayer": {
163   "type": "array",
164   "items": {"$ref": "./properties.json#relatedLayer-object"}
165   },

TIMELINE

OUTLINE

OPEN EDITORS
- entities.json ansis-def-au-schema-json • schema\d... 1

```
{
    "$schema": "https://anzsoildata.github.io/def-au-schema-json/schema/domain/2023-06-30/ansis.json",
    "data": {
        "id": "some-system-id",
        "type": "ansis:SoilSite",
        "ansisType": [ ···
        ],
        "relatedActivity": [
            {
                "id": "some-soilsitetype-id",
                "type": "ansis:SiteVisit",
                "startedAtTime": "2020-02-02",
                "endedAtTime": "2020-02-02",
                "relatedActivity": [
                    {
                        "id": "some-sampling-id",
                        "type": "sosa:Sampling",
                        "hasResult": [
                            {
                                "id": "some-soilsample-id",
                                "type": "ansis:SoilSample",
                                "isSampleOf": [ ···
                                ],
                                "relatedProfile": [ ···
                                ],
                                "ansisType": { ···
                                },
                                "component": { ···
                                },
                                "depthLower": {
                                    "hasResult": {
                                        "value": 0.42,
                                        "unit": "unit:M"
                                    }
                                },
                                "depthUpper": {
                                    "hasResult": {
                                        "value": 0.24,
                                        "unit": "unit:M"
                                    }
                                },
                                "hasGeometry": { ···
                                },
                                "hasResult": {
                                    "chemical": {
                                        "type": "ansis:SoilChemicalObservations",
                                        "cationExchangeCapacity": [
                                            {
                                                "hasResult": {
                                                    "value": 0.1,
                                                    "unit": "unit:CentiMOL-PER-KiloGM"
                                                },
                                                "usedProcedure": "scm:15B1",
                                                "resultTime": "2001-12-17T09:30:47.0",
                                                "qualityOfObservation": null
                                            },
                                            {
                                                "hasResult": {
                                                    "value": 0.1,
                                                    "unit": "unit:CentiMOL-PER-KiloGM"
                                                },
                                                "usedProcedure": "scm:15E1",
                                                "resultTime": "2001-12-17T09:30:47.0",
                                                "qualityOfObservation": null
                                            }
                                        ],
                                        "effectiveCationExchangeCapacity": [
                                            {
                                                "hasResult": {
                                                    "value": 0.1,
                                                    "unit": "unit:CentiMOL-PER-KiloGM"
```

```
[
    {
        {
            "$schema": "https://anzsoildata.github.io/def-au-schema-json/schema/digital-soil-mapping/2023-06-30/dsm-simple.json",
            "hasGeometryX": 24,
            "hasGeometryY": -42,
            "hasGeometrySRID": 4283,
            "hasGeometry": "SRID=4283;POINT(24 -42)",
            "depthLower": 0,
            "depthUpper": 0,
            "depthUnit": "unit:M",
            "observedProperty@id": "ansis:slope",
            "hasResult": 24,
            "hasResultUnit": "unit:DEG",
            "usedProcedureId": "ansis-x:clinometer",
            "isSampleOfType": "ansis:LandformElement",
            "sourceObservationId": "observation-a"
        },
        {
            "$schema": "https://anzsoildata.github.io/def-au-schema-json/schema/digital-soil-mapping/2023-06-30/dsm-simple.json",
            "hasGeometryX": 24,
            "hasGeometryY": -42,
            "hasGeometrySRID": 4283,
            "hasGeometry": "SRID=4283;POINT(24 -42)",
            "depthLower": 0,
            "depthUpper": 0.1,
            "depthUnit": "unit:M",
            "observedProperty@id": "ansis-x:sand",
            "hasResult": 42,
            "hasResultUnit": "unit:PERCENT",
            "isSampleOfType": "ansis:SoilHorizon",
            "sourceSampleId": "https://example.ansis.net/id/sample/a",
            "sourceObservationId": "observation-b"
        },
        {
            "$schema": "https://anzsoildata.github.io/def-au-schema-json/schema/digital-soil-mapping/2023-06-30/dsm-simple.json",
            "hasGeometryX": 24,
            "hasGeometryY": -42,
            "hasGeometrySRID": 4283,
            "hasGeometry": "SRID=4283;POINT(24 -42)",
            "depthLower": 0,
            "depthUpper": 0.1,
            "depthUnit": "unit:M",
            "observedProperty@id": "ansis-x:silt",
            "hasResult": 24,
            "hasResultUnit": "unit:PERCENT",
            "isSampleOfType": "ansis:SoilHorizon",
            "sourceSampleId": "sample-a",
            "sourceObservationId": "observation-c"
        }
    }
]
```

Open Geospatial Consortium

Features

Approved Standard ✓

OGC API - Features - Part 1: Core and Part 2: Coordinate Reference Systems by Reference are both publicly available.

More Info   GitHub repo

{json:api}

A SPECIFICATION FOR BUILDING APIS IN JSON

View the specification   Contribute on GitHub

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	hasGeometryX	hasGeometryY	hasGeometrySRID	hasGeometry	depthLower	depthUpper	depthUnit	observedProperty@id	hasResult	hasResultUnit	usedProcedureId	isSampleOfType	sourceObservationId
2	24	-42	4283	SRID=4283;POINT(24 -42)	0	0	unit:M	ansis:slope	24	unit:DEG	ansis-x:clinometer	ansis:LandformElement	observation-a
3	24	-42	4283	SRID=4283;POINT(24 -42)	0	0.1	unit:M	ansis-x:sand	42	unit:PERCENT	undefined	ansis:SoilHorizon	observation-b
4	24	-42	4283	SRID=4283;POINT(24 -42)	0	0.1	unit:M	ansis-x:silt	24	unit:PERCENT	undefined	ansis:SoilHorizon	observation-c
5													

ANSIS Information Model Documentation

https://ansis.net/data/

Conclusion

- Information models ensure scientifically robust harmonisation and delivery of consistent data.

- They support versatile data products that anticipate multiple ways of using the data, including
  - profile reports,
  - GIS layers, or
  - DSM-ready tables of data.

- ANSIS users will have unprecedented access to an Australia-wide soil dataset supporting robust modelling, research, and policy and decision making

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Acknowledgements

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