



Landcare Research
Manaaki Whenua



An Oceania perspective on Global Soil Data Standards

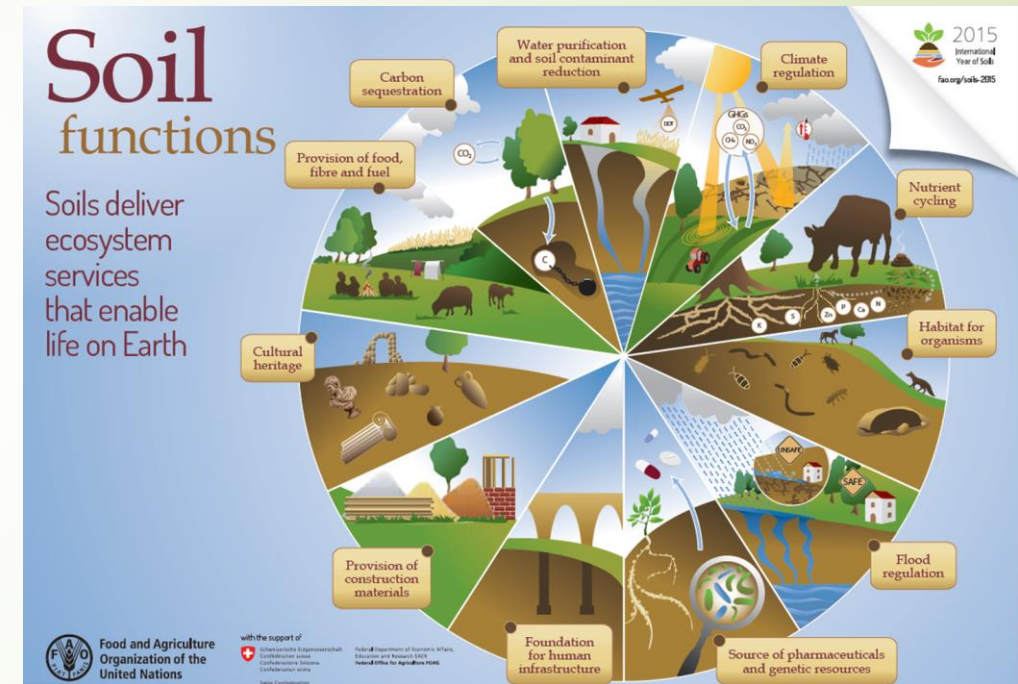
RDA/IGAD Barcelona Spain 3-7 April 2017

Peter Wilson, CSIRO Australia, Manager National Soil Information

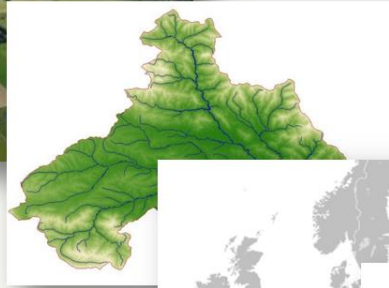
David Medyckyj-Scott, Landcare Research NZ, RPAL Data Stewardship & Information Services

Soil and Agriculture

- FAO estimate a 70% increase in food production is required to feed 9 billion people by 2050*
- But only 3% of the earth's surface is arable soil
- Good soil management = improved crop productivity with environmental sustainability

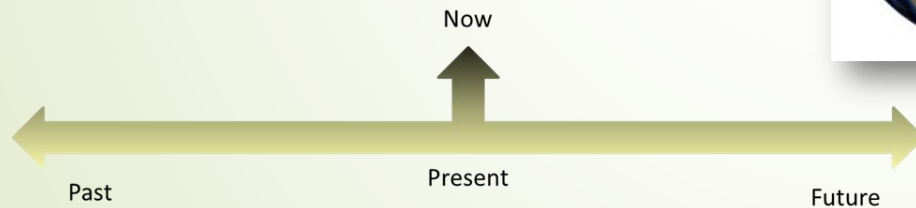


* Source: United Nations Population Division, *World Population Prospects: The 2006 Revision*.



All scales

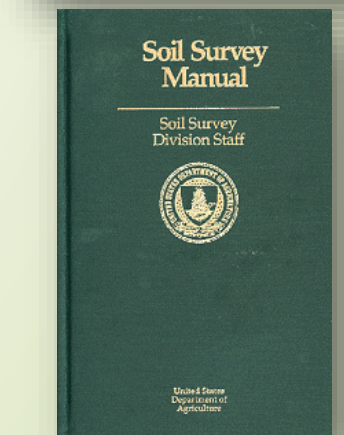
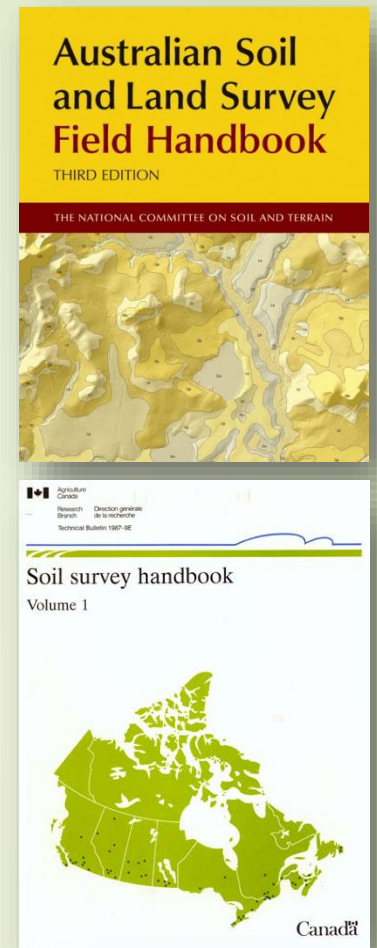
We need data!!



- Diversity of data sources makes integration and harmonisation difficult
- Need for harmonization of methods and terminology (GSP Pillar 5)
- Soil data needs to be easily accessible, freely available and in formats that can be readily used for a wide range of purposes (GSP Pillar 4)

Progressing soil data standards

- Strong collaboration at technical levels
- Recognised 'standards' exist for soil description and analysis
 1. Global Soil Map – product specification
 2. Global Soil Partnership
 - Pillar 4 (global soil info system)
 - Pillar 5 (harmonisation – including data exchange, vocabularies)
 3. IUSS Working Group on Soil Information Standards
 4. OGC Soil Interoperability Experiment



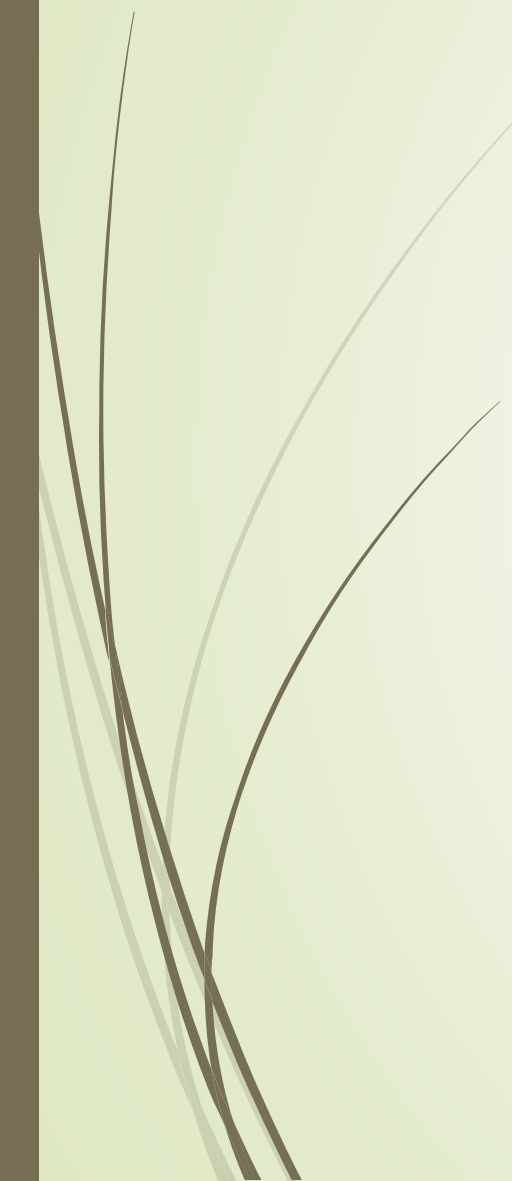


IUSS WGSIS and global standards

- Australia and New Zealand Soil Mark-up Language (ANZSoilML)
- e-SOTER Soil and Terrain Mark-up Language (SoTerML)
- INSPIRE D2.8.III.3 Data Specification on Soil (INSPIRE Soil)
- ISO 28258:2013 Soil quality – Digital exchange of soil-related data (ISO SoilML) **Up for revision**
- IUSS/ISO ‘Wageningen Proposal’ (a variation of 4 with reference to 1, 2 and 3)
- SoilEML – created in OGC Soil Interoperability Experiment



OGC Soil Interoperability Experiment

- Focus: development and testing of a Soil Markup Language, a GML compatible encoding for soil features
 - Participants: IE Initiators (CSIRO, Landcare Research, ISRIC) plus a number of other agencies e.g. USDA, USGS
 - 4 use cases: soil data integration & publication, soil sensor data, soil property modelling and predictions, pedo-transfer functions
 - Followed a set of design principles e.g. re-use existing models wherever possible
 - Deployment of set of demonstrators using WFS, SOS, and WPS that used a IE GML schema developed in the IE
 - Engineering Report
- 

New Zealand implementation

- National Soil Data Repository (WFS)
- Business to business systems (WFS)
- Vocabulary and linked data services

S-MAP ONLINE | Maps | Factbooks | Data Provenance | Terms of Use | Help

SEARCH: Search a location

LAYERS:

- Context layers
- WFS
- Soil Moisture - Muller
- Climate To soil Soil & C
- Soil Drainage
- Soil Properties & Lab
- Basemap

SOIL SUMMARY

Location: Christchurch

Soil name	Area %	Area (ha)	Confidence
Soil 1 (0a-1)	50	25,120	LOW
Soil 1 (0a-10)	30	15,134	MEDIUM
Soil 2 (0a-7)	20	10,288	HIGH

S-map Soil Report

Report generated: 1-Jun-2012 from <https://www.landcare.govt.nz/smap/>

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks.

Kaipoi Kaka2 (40% of the mapunit at location (S10505), 1467162), Confidence: Low

Key physical properties

Property	Value
Depth class (eligibility)	Moderately Deep (45 - 60 cm)
Texture profile	Clay Loam
Potential rooting depth	Unlimited
Rooting barrier	No significant barrier within 1 m
Topsoil moisture	Stoniness
Topsoil clay range	12 - 28 %
Drainage class	Imperfectly drained
Aeration in root zone	Moderately limited
Permeability profile	Moderate Over Field
Depth to slowly permeable horizon	No slowly permeable horizon
Permeability of slowest horizon	Moderate (4 - 72 mm/h)
Profile total available water	0-100cm: High (187 mm)
Top 60 cm available water	0-60cm: Very high (130 mm)
Top 30 cm available water	0-30cm: High (87 mm)
Dry bulk density, topsoil	1.20 (g/cm ³)
Dry bulk density, subsoil	1.30 (g/cm ³)
Depth to bed rock	No bed rock within 1 m
Depth to soft rock	No soft rock within 1 m

Key chemical properties

Property	Value
Topsoil cation exchange	Medium (33%)

OVERSEER values

NDR Viewer | Getting Started | Search | Data Provenance

Search: NDR Search (e.g. 10010001)

Clear Filters

New Zealand Soil Classification

- Organic Soil
- Granular Soil
- Raw Soil
- Isosolic Soil
- Orthic Soil
- Standard Soil

Total in map view: 1411

Site Report

Site Number: SB10000 | Described By: DML | Date Observed: 10-Jun-1985 | Latitude: 41.5810 | Longitude: 174.9412

Locality

Landform

element	value
landform	hill
landform:is	slope shape
landform:is:is	convex
landform:is:is:is	is moderately dissected hill
landform:is:is:is:is	slope facet
landform:is:is:is:is:is	shoulder
landform:is:is:is:is:is:is	Coloured
landform:is:is:is:is:is:is:is	slope angle
landform:is:is:is:is:is:is:is:is	33°
landform:is:is:is:is:is:is:is:is:is	humosity
landform:is:is:is:is:is:is:is:is:is:is	slope aspect
landform:is:is:is:is:is:is:is:is:is:is:is	33°
landform:is:is:is:is:is:is:is:is:is:is:is:is	vegetation type
landform:is:is:is:is:is:is:is:is:is:is:is:is:is	Drained scrub

Soil Classification

Classification	Value
New Zealand Soil Series	TATA
New Zealand Soil Classification	Moderate Yellow (0a), Soil
New Zealand Soil Classification	Yellow brown earth

Soil Profile

Depth (m)	Soil Colour
0 - 11.40 (0a)	10YR 5/6
11 - 37.00 (0a)	10YR 5/6
37 - 52.00 (0a)	10YR 5/6
52 - 75.00 (0a)	10YR 5/6
75 - 95.00 (0a)	10YR 5/6
95 - 111.00 (0a)	10YR 5/6
111 - 140.00 (0a)	10YR 5/6

Chemical Analysis

Horizon	Sample Interval	pH _{PO4}	pH _{NCL}	pH _{NaF}	Carbon	Nitrogen	P Acid Soluble	Phosphorus	P Organic	P Total	P Nitrogen
A0 (Mha)	0-11	4.9	3.7	8.2	3%	0.21%	20mg/kg	20mg/kg	130mg/kg	140mg/kg	50%
B0 (Mha)	11-37	5	3.6	8.9	2%	0.09%	10mg/kg	40mg/kg	40mg/kg	100mg/kg	49%
B1 (Mha)	37-52	4.9	3.8	8.7	3.2%	0.06%	10mg/kg	10mg/kg	10mg/kg	140mg/kg	64%
B2 (Mha)	52-75	4.8	3.8	8.9	0.76%	0.04%	10mg/kg	70mg/kg	10mg/kg	100mg/kg	42%
B3 (Mha)	75-95	4.8	3.8	8.6	0.44%	0.02%	10mg/kg	10mg/kg	10mg/kg	140mg/kg	47%
C1 (Mha)	95-111	4.7	3.7	8.4	0.31%	0.02%	10mg/kg	10mg/kg	10mg/kg	140mg/kg	40%
C2 (Mha)	111-140	4.6	3.6	9.1	0.27%	0.00%	20mg/kg	10mg/kg	70mg/kg	100mg/kg	40%

Double Element Analysis

Horizon	Sample Interval	CEC	Exchange Ca	Exchange Mg	Exchange K	Exchange Na	NCL Extractable Al
A0 (Mha)	0-11	23.0meq/kg	4.87meq/kg	0.63meq/kg	0.53meq/kg	0.6meq/kg	2.50meq/kg
B0 (Mha)	11-37	20.9meq/kg	2.34meq/kg	2.37meq/kg	0.40meq/kg	0.37meq/kg	9.60meq/kg
B1 (Mha)	37-52	19.3meq/kg	0.55meq/kg	1.05meq/kg	0.33meq/kg	0.28meq/kg	9.30meq/kg
B2 (Mha)	52-75	18.2meq/kg	0.45meq/kg	0.69meq/kg	0.33meq/kg	0.30meq/kg	9.50meq/kg
B3 (Mha)	75-95	18.0meq/kg	0.53meq/kg	0.55meq/kg	0.30meq/kg	0.27meq/kg	8.00meq/kg
C1 (Mha)	95-111	13.9meq/kg	0.05meq/kg	0.55meq/kg	0.36meq/kg	0.36meq/kg	9.90meq/kg
C2 (Mha)	111-140	14.6meq/kg	0.57meq/kg	0.62meq/kg	0.33meq/kg	0.45meq/kg	10.40meq/kg

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Start of Editor | Register

OVERSEER[®] Nutrient Budget

A farm-level Decision Support System used to achieve on management of nutrients and greenhouse gas emissions. It is widely used throughout New Zealand by farmers and their advisors and is also used for policy support.

[Login here](#)

Nutrient budgets for many enterprises

- Cattle
- Sheep
- Goats
- Wool
- Vegetables
- Wool
- Wool
- Wool

Budgets for wide range of nutrients

- N, P, K and S
- Ca, Mg, Na and Zn
- and
- and

Calculates maintenance requirements

- Fertiliser nutrients
- Lime

Estimate on-farm losses of nutrients

- N leaching and run-off
- P run-off and soil erosion
- Greenhouse gas emissions: CH₄, N₂O, CO₂

OVERSEER Quick Start Guide | Code of Practice for Nutrient Management | Code of Practice Fact Sheets

Common Vocabulary Services

- UK Government Linked Data Registry at CSIRO and LR

CSIRO Linked Data Registry

URI: http://registry.it.csiro.au/sandbox/soil-data-ie/def/voc/drainage/_mw

Entry: moderately well drained

URI: <http://registry.it.csiro.au/sandbox/soil-data-ie/def/voc/drainage/mw>

A. Soils that have a horizon between 60 and 90 cm of the mineral soil surface with 50% or more low chroma mottles on cut faces or ped faces, or B. Soils that have a horizon between 30 and 90 cm of the mineral soil surface with 2% or more redox segregations.

description	A. Soils that have a horizon between 60 and 90 cm of the mineral soil surface with 50% or more low chroma mottles on cut faces or ped faces, or B. Soils that have a horizon between 30 and 90 cm of the mineral soil surface with 2% or more redox segregations.
label	moderately well drained
notation	M
notation	mw
type	Concept

Links
.. none found

LANDCARE RESEARCH
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Linked Data Registry

URI: https://data.scinfo.org.nz/lab/soil/def/_nzsc#

Register: New Zealand Soil Classification

URI: https://data.scinfo.org.nz/lab/soil/def/_nzsc#

This is an experimental version of the New Zealand Soil Classification to see how this registry can be used to publish soil taxonomies. It will be removed at some stage so don't use this for real work.

Contents (tree view)

- Brown Soil Brown Soils usually contain 2:1 clay minerals. Secondary iron oxide...
 - Acid Brown Soil Other Brown Soils that have ei
 - Mottled Acid Brown Soil Other soils that ha
 - Mottled-placic Acid Brown Soil Acid Brown
 - Peaty Acid Brown Soil Acid Brown Soils that
 - Placic Acid Brown Soil Other soils with a pla
 - Typic Acid Brown Soil Other soils.
 - Firm Brown Soil Other Brown Soils that have a
 - Allophanic Brown Soils Allophanic Brown Soils
 - Orthic Brown Soil Other Brown soils.
 - Sandy Brown Soils Sandy Brown Soils occur in s

definition	Brown Soils usually contain 2:1 clay minerals. Secondary iron oxides tend to be evenly dispersed through the soil and give a yellowish brown colour to the upper part of the B horizon. Base saturation values are usually moderate to very low.
description	Brown Soils usually contain 2:1 clay minerals. Secondary iron oxides tend to be evenly dispersed through the soil and give a yellowish brown colour to the upper part of the B horizon. Base saturation values are usually moderate to very low.
label	Brown Soil
narrower	Orthic Brown Soil Allophanic Brown Soils Acid Brown Soil Firm Brown Soil Oxidic Brown Soil Sandy Brown Soils
notation	B
preflabel	Brown Soil
same as	140044
top concept of	New Zealand Soil Classification
type	Concept

Links

Has narrower concept

- Acid Brown Soil
- Firm Brown Soil
- Allophanic Brown Soils
- Orthic Brown Soil
- Sandy Brown Soils
- Oxidic Brown Soil

Is same as

- 140044


Top concept of

- New Zealand Soil Classification



Lessons and needs

- Technology is available to implement a standard
- Keeping pace with the rapid developments in IT, while maintaining the stability needed by standards
- Data challenge is mapping to a standard without loss of information. One that is:
 - not hideously complicated with massive payloads
 - supports fit-for-purpose views of data
- Need a model that can evolve with new types of soil data
- Need standards to develop in related domains e.g. vegetation, landscapes, climate

- 
- Developing standards is time consuming and expensive
 - Work is fragmented and under resourced
 - Internationally, it's unclear who should be doing this
 - There is duplication of effort
 - We need to engage further with the global soil community to reconcile existing models
 - Capability and capacity are generally low in soil agencies
 - Modelling methodology is unfamiliar to soil scientists
 - Those implementing systems lack right technical expertise
 - Assumes open access to data and good governance

Oceania regional plans

- Further refine ANZSoilML to consider broader region (SW Pacific) leading to OceaniaSoilML (?)
- Develop vocabulary services and harmonization of terms
- Evolve data services e.g. SoilGrid for New Zealand
- Develop a SW Pacific Soil Portal for discovery, visualisation and access
- Demonstration application development and integration of soil data services with other platforms – e.g. farm management systems
- Seek broader regional implementation through GSP Oceania Partnership – including Indonesia, PNG, Guam (USA) and Sth Korea

OGC TC, New Zealand December 2017
inc. Agricultural Data Industry Day



Next steps for a Global Standard?

- ▶ We need a globally developed, managed (governance), accepted and implemented soil data exchange model with associated semantic information and usable interfaces
- ▶ Technology is available to implement such a standard
- ▶ Leverage don't re-invent
 - ▶ e.g. O&M, Time-series Profile of O&M, GeoscienceML
 - ▶ Only extend standards when it is impossible to describe domain specific things ... soil and soil horizons
- ▶ Need support for a domain-driven model development group and a technology/ implementation group (both for providing data and consuming data)
- ▶ Need to agree who is performing what role
- ▶ Need to resource those providing their expertise



OGC – ISO and GSP/RDA/GODAN

- Opportunity for an OGC Standards Working Group to further progress Soille outcomes
- Liaison and joint standard with ISO TC190 (revision of 28258)
- Coordination and governance through GSP Pillar 5 and the IUSS WGSIS
- Implementation via RDA and GODAN network