OGC Environmental Data Standards for Monitoring and Mapping

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INTRODUCTION

- What is the OGC and WSMA*?
- Earth science (and Agriculture) Working Groups
- When one bureaucracy isn’t enough – the OGC and ISO and W3C
- Overview by example – OGC Soil Data Interoperability Experiment
- Coming soon – a peak over the horizon
- Why participation is valuable for New Zealand

* Why So Many Acronyms
THE OPEN GEOSPATIAL CONSORTIUM (OGC)

• ‘The Open Geospatial Consortium (OGC) is an international industry consortium of over 529 companies, government agencies and universities participating in a consensus process to develop publicly available interface standards.’

  From: http://www.opengeospatial.org/ogc

• New Zealand members:
  – Hawkes Bay RC, Horizons RC, Land Information NZ, Manaaki Whenua, Ministry for the Environment, NIWA

• Consensus driven specification of standards for:
  – the behaviour and implementation of data services (interoperable communication protocols)
  – data formats (geography mark-up language; GeoPackage)
  – the structure of data describing real world things (hydrological features, observation and sampling data, aviation data ...)
  – best practices for applying and using standards
  – policies and tools for testing and endorsing compliance with the standards

• Standardisation by innovation and doing
  – heavy emphasis on large scale Testbeds and focused Interoperability Experiments
IMPORTANT WORKING GROUPS

• Hydrology Domain Working Group
  - WaterML 2.0 suite of standards for surface water, groundwater, monitoring standards

• Geoscience Domain Working Group
  - GeoSciML (geology)

• Met-ocean Domain Working Group

• Sensor Web Enablement Working Group
  - Sensor Observation Services, SensorThings API (IoT enablement)

• Observations and Measurements Standards Working Group
  - Collaboration with ISO/TC 211 – Geographic Information Standards
  - Used by all environmental working groups

• Time Series Standards Working Group
  - Builds on work by Observations and Measurements (O&M 2.0) and Hydrology (WaterML 2.0, part 1) WGs

• Agriculture Domain Working Group
  - Soil data standards. Industry focus, strong affinity with environmental WGs
IMPORTANT PARTNERSHIPS

- ISO Technical Committee 211 - Geographic information/Geomatics
  - Foundation standards of the geospatial web (ISO19100 series)
  - Developed in partnership with the OGC
  - Published as ISO Standards (user pays) and OGC Specifications (free)

- World Wide Web Consortium (W3C)
  - Spatial Data on the Web Working Group
  - Geospatial data for the masses, but with a semantic web twist
  - Best practices for the publication of spatial data on the web
  - Ontologies for observations and sampling (SOSA) and time (OWL Time)
  - New work on uncertainty, data publication/catalogues
EXAMPLE - OGC INTEROPERABILITY EXPERIMENTS

• Interoperability Experiments – standardization by doing

• ‘Brief, low-overhead, formally structured and approved initiatives led and executed by OGC members to achieve specific technical objectives’
  From: http://www.opengeospatial.org/ogc/programs/ip

• Should lead to the formation of a Standards Working Group that moves the IE results to a formal specification

• New Zealand involvement:
  - Groundwater Interoperability Experiment
  - Soil Data Interoperability Experiment
  - Linked Environmental Features Interoperability Experiment (ELFIE)
  - Borehole Interoperability Experiment (new)
SOIL DATA INTEROPERABILITY EXPERIMENT

• Started by the IUSS Working Group on Soil Information Standards

• OGC Initiators
  - CSIRO (AU)
  - Manaaki Whenua (NZ - Initiative Manager and Technical Lead)
  - ISRIC World Soil Information (NL)

• Active Participants
  - Federation University of Australia (AU)
  - USDA Natural Resource Conservation Service (US)
  - Agribiology and Pedology Research Centre (IT)
  - USGS (US)
  - Horizons Regional Council (NZ)
  - Tumbling Walls (US)

• Reconcile five existing standards ...

... into a single standard ...
• Not quite ... point to prove ... can use existing standards
SOIL DATA IE USE CASES

• Use Case 1: soil data integration & publication
  
  *Publication of heterogeneous soil data from different databases at different agencies*

• Use Case 2: soil sensor data
  
  *Publication of data from sensors monitoring dynamic soil properties*

• Use Case 3: soil property modelling and predictions
  
  *Provision of high resolution estimates of functional soil properties generated using digital soil mapping techniques – e.g. GlobalSoilMap project soil property predictions*

• Use Case 4: pedo-transfer functions
  
  *Process observed and interpreted soil properties using of pedo-transfer functions - algorithms that calculate additional interpreted soil properties*
SOIL IE EXCHANGE STANDARD

- Reviewed five existing standards
  - Australia and New Zealand Soil Mark-up Language
  - e-SOTER Soil and Terrain Mark-up Language
  - INSPIRE D2.8.III.3 Data Specification on Soil
  - ISO 28258:2013 Soil quality – Digital exchange of soil-related data
  - IUSS/ISO ‘Wageningen Proposal’ (effort to reconcile 1. and 4.)

- No clear candidate from this work

- Back to basics using as much existing work as possible
- Don’t bind the information model too tightly to technology
  - Abstract and implementation specifications
SOIL OBSERVATIONS

ISO19156/OGC10-004r3 - Observations and Measurements
SOIL SENSORS

OGC15-043r3 – Timeseries Profile of Observations and Measurements

- SF_SpatialSamplingFeature
- Monitoring Feature:: MonitoringFeature
- OM_Process
- Procedures:: ObservationProcess
- CM_DispersiveObservation
- «FeatureType»
- Timeseries Observation:: TimeseriesObservation
- CM_DispersiveObservation
- «FeatureType»
- Timeseries (Domain Range) Observation:: TimeseriesDomainRangeObservation
- SF_SpatialSamplingFeature
- «FeatureType»
- Monitoring Feature:: MonitoringFeature
- OM_Process
- Procedures:: ObservationProcess
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- «FeatureType»
- Timeseries Observation:: TimeseriesObservation
- CM_DispersiveObservation
- «FeatureType»
- Timeseries (Domain Range) Observation:: TimeseriesDomainRangeObservation

Graph showing soil moisture percentage over time.
SOIL DESCRIPTIONS

OGC16-088r3 - OGC Soil Data Interoperability Experiment

Podzol Soil (Z) [NZSC]

texture
bulk density
organic carbon
particle size distribution
...

Ah
E
Bh
C
SOIL IE IMPLEMENTATION

Vocabularies
Soil Taxonomies
Observable Properties

Registry

Soil Data

WFS

PID Service

HTTP URIs (conneg)

WPS

Execute PTFs

SOS

Sensor Data

SensorThings API

Missed opportunity ...

Maps

WCS

WMS

Gridded Data
DEMONSTRATION – SOIL TIME SERIES DATA

Properties:
- Soil Moisture
- Soil Temperature
- Rainfall

Contributors:
- Manaaki Whenua (NZ)
- Horizons RC (NZ)
- USGS (US)
DEMONSTRATION – SOIL PROPERTY SURFACES

• Contributors
  – CSIRO Land and Water (AU)
  – Federation University of Australia (AU)
DEMONSTRATION - SOIL DESCRIPTIONS

• Use Cases One and Four
  - Field observations
  - Sampling
  - Laboratory analyses
  - Pedo-transfer functions

• Contributors
  - Manaaki Whenua (NZ)
  - CSIRO Land and Water (AU)
  - Federation University of Australia (AU)
  - ISRIC World Soil Information (NL)
Entry: moderately well drained


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.

Definition

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
RESULTS

- Created a simple *information model* of soils data
- *Harmonised* the structure and some content of soils data between agencies
- Brought data from different soil agencies together in applications for users (*service-driven interoperability*)
- Provided a way to describe and organise soil concepts, features, methods, etc (*semantics*)

- Started a conversation with Dave Blodgett at the USGS

How do we link together all of our environmental data?
How do we do it in a way that is ‘the HTML for environmental data’?
What does that even mean – Byron Cochrane will tell you ...
COMING SOON

• WFS (Web Feature Service) 3.0
  – Complete redefinition of the specific to align with the modern web
  – OpenAPI; JSON; REST
  – Open development process with strong developer focus - https://github.com/opengeospatial/WFS_FES
  – If successful will influence the entire OGC standards baseline

• Observations and Measurements 3.0
  – Part of scheduled ISO review process
  – Great opportunity to apply what we have learned from nearly a decade of implementation

• Borehole Interoperability Experiment
  – Consolidate multiple community models for the description of bore/drillhole sampling features

• Greater integration of Semantic Web technologies and practices
  – Controlled vocabularies, Linked Data, machine learning
BENEFITS TO NEW ZEALAND

• Provides standards that New Zealand can use for environmental data infrastructures

• The work has been done for us, but is not imposed on us ...

• Open membership means we can (and do) influence the work

• Standards have been implemented by other, equivalent, communities
  - US National Water Model
  - Canadian Groundwater Information Network (wet GIN)
  - US Geoscience Information Network (dry GIN)
  - Australian Geoscience Information Network (hot GIN?)
  - AuScope earth science infrastructure
  - Australian Integrated Marine Observing System (IMOS)

• Communities that are keen to work with us ...
THANK YOU

(EASY) QUESTIONS?