IUB)
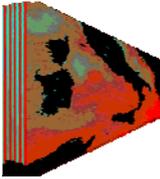
Towards a Standard for Interoperable Earth System Raster Services

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Roadmap

- Value-Added Geo Raster Services – why that?
- OGC:
  - Web Coverage Service (WCS)
  - Web Coverage Processing Service (WCPS)
- Implementation Aspects
- Status and Future Work

Disclaimer:
my opinions, not necessarily those of OGC nor IUB
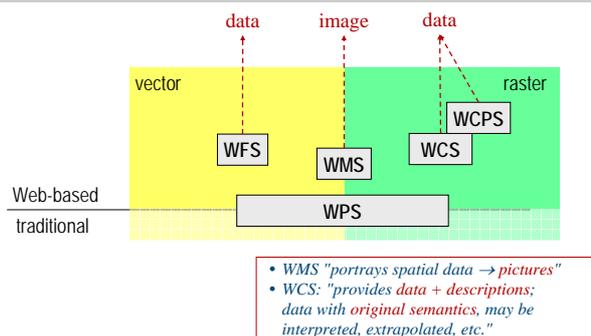

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Interoperable Geo Services: The Big Pic

- OGC (Open GeoSpatial Consortium) driving open, interoperable geo service standards
  - Liaisons with ISO TC 211, OASIS, CGI/IUGS; ...
  - consensus body
  - Specs tested before released (eg, testbeds)
- "OGC appears so complex!"
  - technical progress, complexity of subject !
  - family of modular standards ("Service Implementation Specifications"), based on OWS Common
- Raster groups:
  - WCS.RWG (Web Coverage Service Revision Working Group)   -- WCS
  - Coverage WG   -- all coverage related

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(Part of) The OGC Quilt

- WMS *"portrays spatial data → pictures"*
- WCS: *"provides data + descriptions; data with original semantics, may be interpreted, extrapolated, etc."*

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Increasing Outreach

- Earth system models
  - Oceans; cryosphere; land; atmosphere; solid earth; biosphere
- Many scientific/engineering domains interested, such as:
  - Geodesy/mapping
  - Geology, geophysics, geochemistry
  - Meteorology, climate modelling
  - Oceanography, cryo research
  - Civil engineering: life sciences; ...
- Tasks
  - Manage observations (including simulations)
  - Keep available for assessment and decision support

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Web Coverage Service (WCS) v1.1

- Coverage = 2/3/4-D "space-varying phenomenon"
  - On principle very general, in practice: raster
  - Coverage = Array + ID + extent + CRS + null value(s) + interpolation method(s)
  - Cell ("pixel") type =   single band,
                                  or list of simple bands,
                                  or list of sub-structured bands
- Request structure:
  - GetCapabilities: service description + coverage offering overview
  - DescribeCoverage: detailed coverage description
  - GetCoverage: get me the data!
- Last TC, Oct 2006: OK for member vote
  - remedied inconsistencies; complete description; easier to use

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Why More Than WCS?

- (1) further server-side processing desired
  - WCS change requests
  - Ex: NDVI from multi/hyperspectral imagery
- (2) adding functions in an ad-hoc manner not feasible
  - Open-ended list – which functions to choose?
  - Overall coherence?

WCPS

- Approach: extend WCS with coverage expression language
  → Web Coverage Processing Service (WCPS)
- WPCS Coverage = WCS Coverage
  - + explicit axis semantics: *x / y / temporal / elevation / other*
  - > 4D possible
- Request = expression over coverage(s)
  - Subsetting, scaling, cell-wise combination, ...; reprojection; format converters
  - Function nesting → unlimited complexity
  - Declarative = what, not how
  - safe in evaluation

WCPS: Request Structure

- Request types: GetCapabilities, DescribeCoverage, **ProcessCoverage**

```
for var in ( coverageList )
[ where condition(var) ]
return processingExpr(var)
```

- Ex:

```
for c in ( A, B, C )
where max_cells( c.red > 127 )
return
    encode( c.red + c.nir,
            "tiff"
          )
```
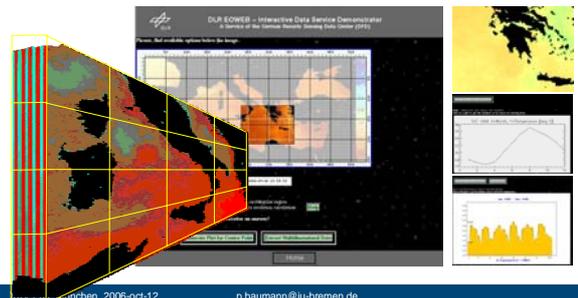
→ (tiff_A, tiff_C)

- Expressive power: statistics, convolutions, filter kernels, summarization, ...

Sample 3-D Service

DLR-DFD: eoweb.dlr.de [Diedrich et al 2001]
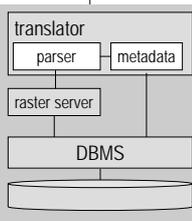based on rasdaman

WCPS Reference Implementation

WCPS client
- visual client
- pure Web client

Java 1.5;
Swing, Jgraph

WCPS server
- translator
  - parser
  - metadata
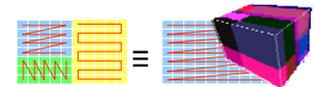- raster server
- DBMS

Java 1.5;
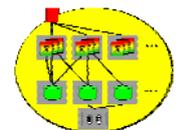Tomcat, Xerces, JAXB

rasdaman

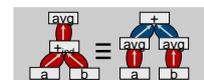PostgreSQL

Some Optimisations

- multidimensional tiling
- Hardware / software parallelization
- Query optimization (rewriting)

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Conclusion

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- WCPS = WCS + server-side processing
  - Expression language for complex requests
  - Flexible server-side extraction and analysis

- Clear semanti
  - Declarative, safe
  - Increased interope

- Concepts imple
  - Reference implementation
  - GALEON OGCnetwork

- Next steps
  - Best Practice → Draft Standard (end of 2006?)
  - Real-life application & evaluation

*Thank you
for your attention!*

...questions, comments?

Conceptual GetCov Request Evaluation

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perform coordinate transformation, including needed spatial
scaling, into target CRS using resampling (using spatial
interpolation as specified)
↓
perform spatial subsetting
↓
perform temporal subsetting
↓
perform range subsetting
↓
perform data format encoding
(may involve implicit range interpolation and, hence,
accuracy loss, depending on the format chosen)
↓
output resulting coverage samples

*Not necessarily
most efficient,
nor reality*

Oracle 10g/11g

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- GeoRaster
  - response to ESRI's ArcSDE 8
  - only 2D geo raster images
  - Not integrated with SQL

- Functionality:
  - Non-transparent image pyramids
  - Subsetting, component extraction
  - reprojection?

- Optimizability???

```
declare
    g sdo_georaster;
    b blob;
begin
    select raster into g
    from uk_rasters
    where id = 4;
    dbms_lob.createTemporary(b,true);
    sdo_geor.getRasterSubset(
        georaster => g,
        pyramidlevel => 0,
        window =>
         sdo_number_array(0,0,699,899),
        bandnumbers => '0',
        rasterBlob => b);
end;


select g.0[0:699,0:899]
from   uk_rasters as g
where  oid(g) = 4
```