ISO, OGC, INSPIRE
zu viele Geo Standards oder zu wenige?

IINTERGEO
Hannover, 2012-oct-09

Peter Baumann

Jacobs University | rasdaman GmbH
Bremen, Germany
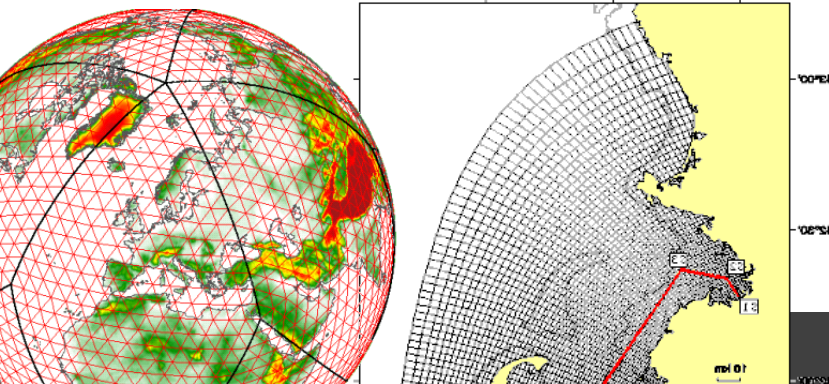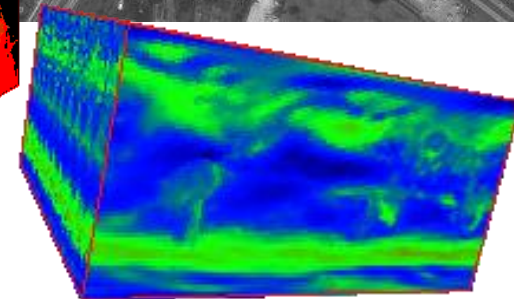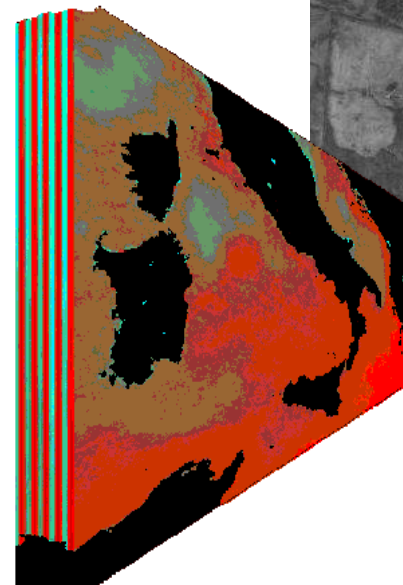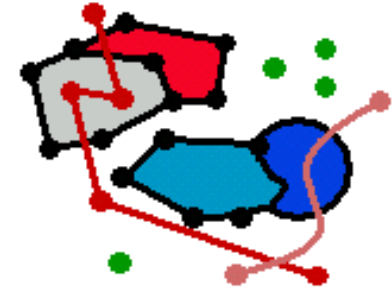p.baumann@jacobs-university.de

[Dilbert]

Motivation

- Coverages represent increasingly important information source
  - Major contribution to Big Data
  - High variability: different dimensions, contents, context, ...

- INSPIRE Annex II & III: "coverages ev'rywhere":
  - heavily contain coverage types:
    Elevation, Land cover, Orthoimagery, Meteo, Ocean, …

- Open Geospatial Consortium leads geo interoperability standardization
  - Coverages addressed since ~2001
  - Stakeholder experience in all coverage app domains:
    remote sensing, metocean, aviation, ...

- ...so where do we stand?

Feature and Coverage Data Standards

- Core element in OGC: geographic feature
  - = abstraction of a real world phenomenon
  - associated with a location relative to Earth

- Special kind of feature: coverage
  - = space-time varying multi-dimensional phenomenon
  - Typical representative: raster image
  - ...but there is more!

- Often, coverages are Big Data

Central OGC Service Standards

data   images   data   data

feature **coverage** **meta**

FE

WFS-T

WFS

WMS

WCPS

WCS-T

WCS

CQL

CS-T

CS-W
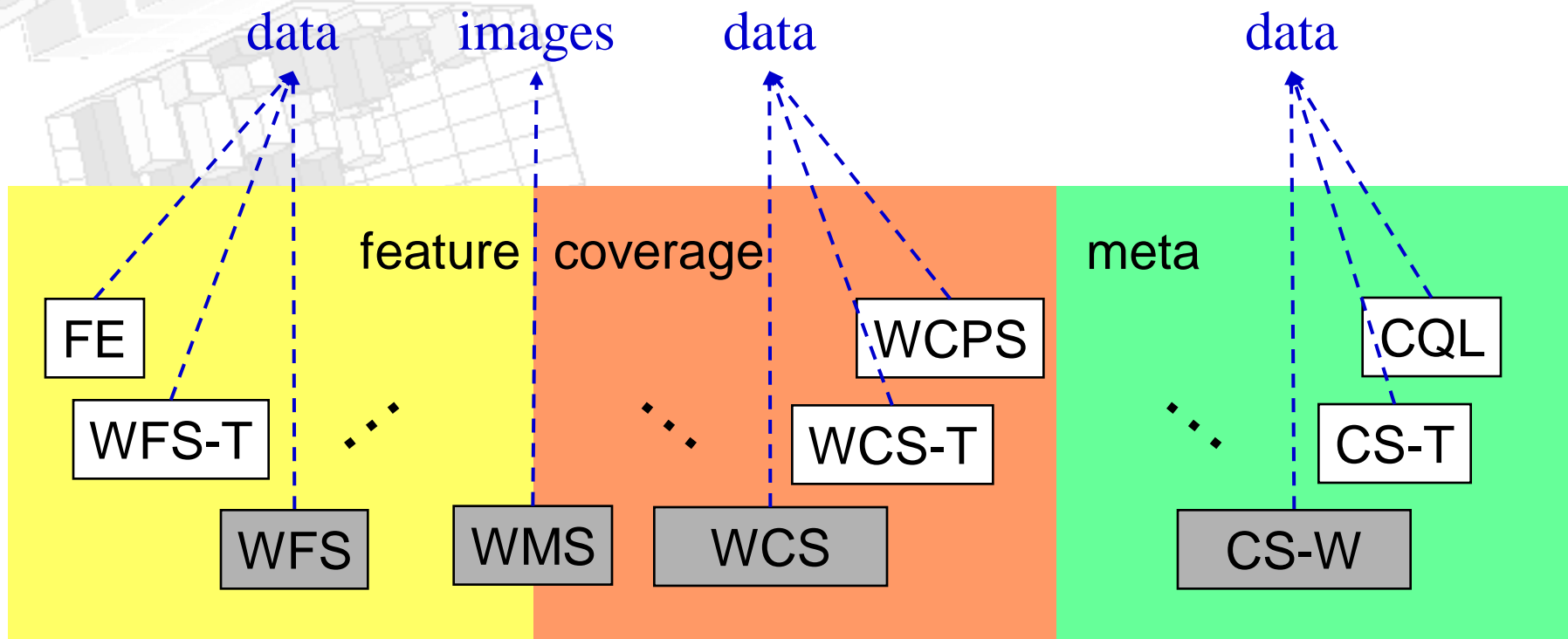
- WMS "portrays spatial data" → pictures
- WCS "provides data + descriptions; data with original semantics, may be interpreted, extrapolated, etc."
[09-110r4]

WCS 2.0 Design Goals

WCS history:

- WCS 1.0.0: first try; rather general, in places fuzzy -> not interoperable
- WCS 1.1.2: more exact, heavy-weight -> less accepted, few implementations
- ...so how to do better?

■ Model extension

- GML harmonization & unifying, service independent coverage model
- Increased domain support: web mapping, EO, atmospheric & ocean research, geology, aviation, aerosol chemistry, sensor coverage data, …
- Beyond raster: curvi-linear grids, more general meshes, …
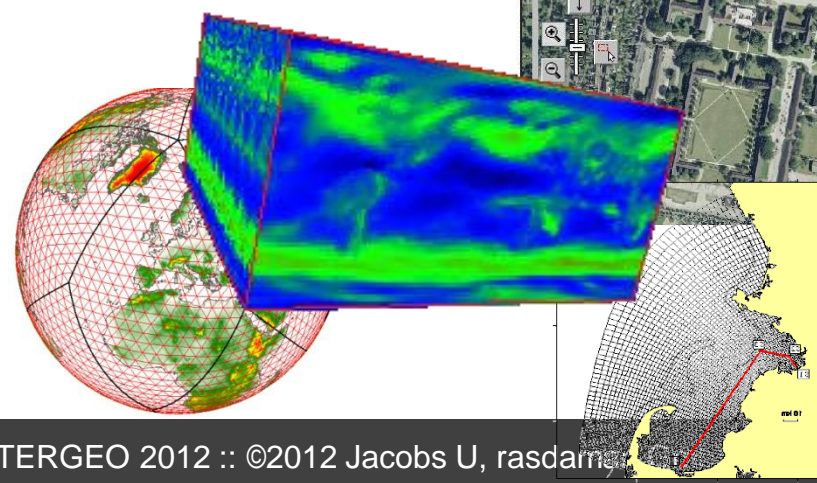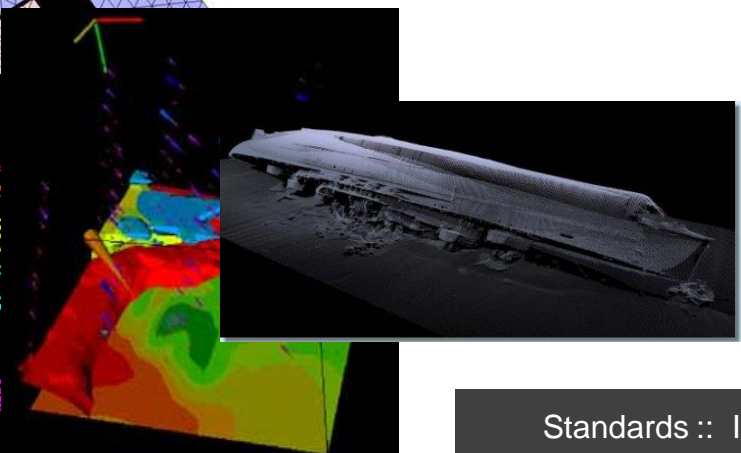- N-D coverages
- But: coherent with ISO 19123

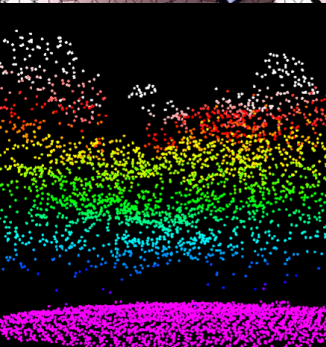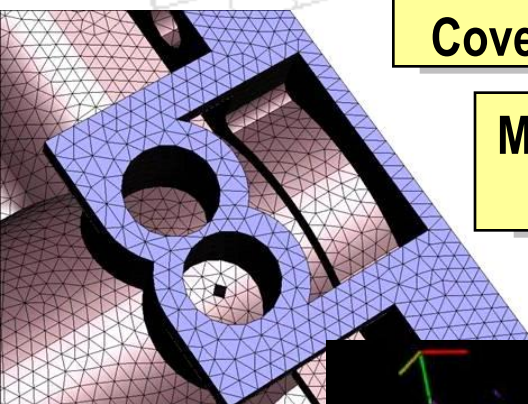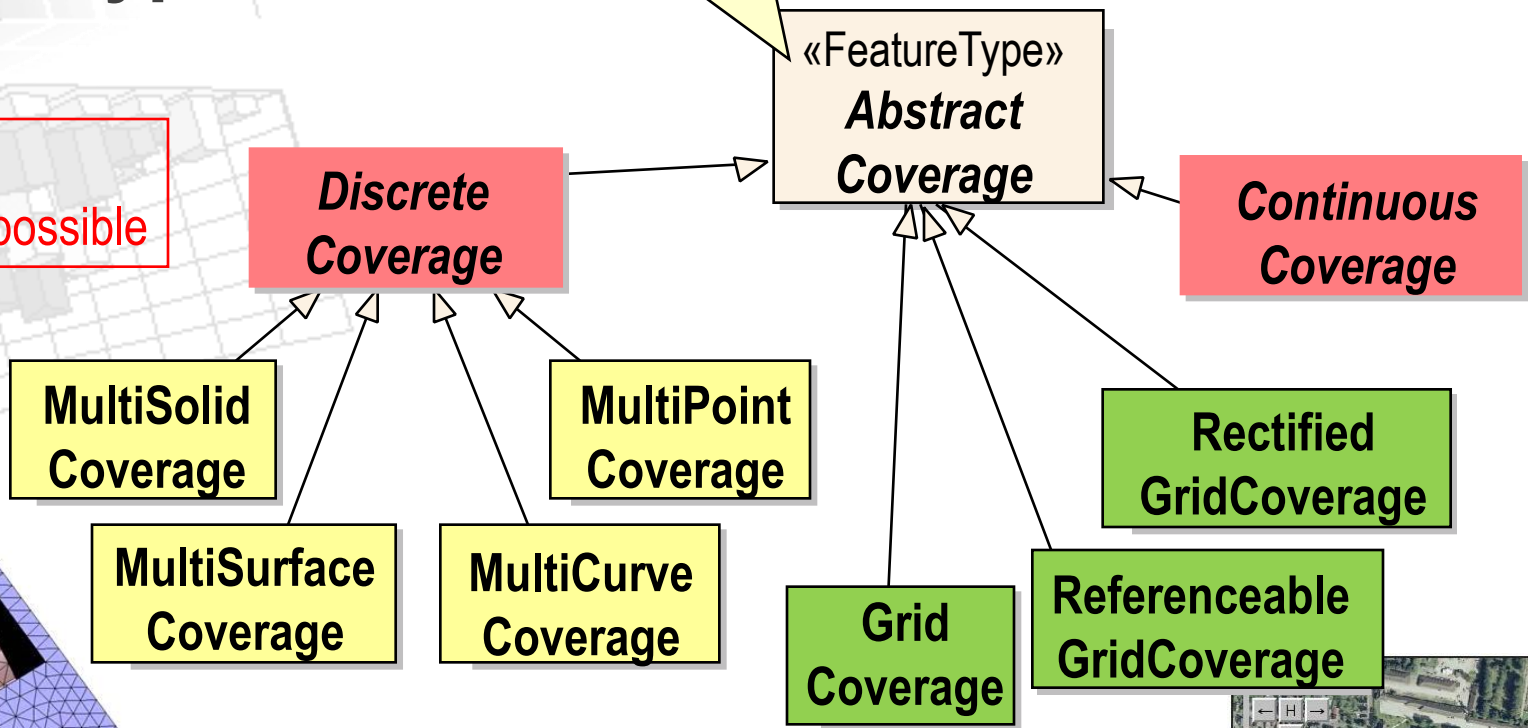### ■ Engineering aspects

- Separate data model from service model
- Concise semantics
- Improved testability
- Core/extension modularization
- Crisp & easy to handle for implementers
- Allow for efficient & scalable implementations

Coverage Types

as per GML 3.2.1

«FeatureType»
Abstract Coverage

all n-D
New subtypes possible

Discrete Coverage

Continuous Coverage

MultiSolid Coverage

MultiPoint Coverage

Rectified GridCoverage

MultiSurface Coverage

MultiCurve Coverage

Grid Coverage

Referenceable GridCoverage

Coverage Definition

From GML 3.2.1

ISO 19123
is **abstract**
→ many different
implementations
possible
→ *not per se
interoperable*

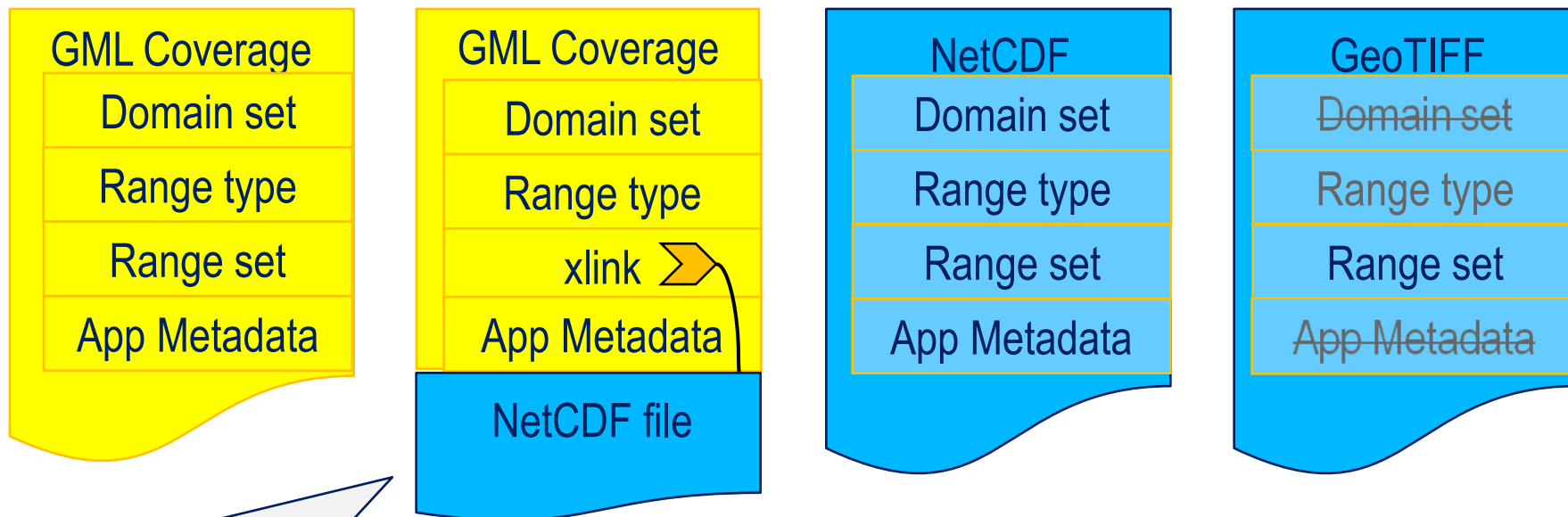OGC coverage std
is **concrete** and
interoperable

class GML 3.2.1 Application Schema for Coverages

«FeatureType»
GML::Feature

Has predefined hook
for metadata

«FeatureType»
Coverage

domainSet

rangeType

rangeSet

«Union»
GML::DomainSet

«type»
SWE Common::DataRecord

«Union»
GML::RangeSet

[OGC 09-146r2]

Coverage Encoding

- **Pure GML**: complete coverage represented by GML

- **Special Format**: other suitable file format (ex: MIME type "image/tiff")

- **Multipart-Mixed**: multipart MIME, type "multipart/mixed"

GML Coverage
Domain set
Range type
Range set
App Metadata

GML Coverage
Domain set
Range type
xlink
App Metadata
NetCDF file

NetCDF
Domain set
Range type
Range set
App Metadata

GeoTIFF
~~Domain set~~
Range type
Range set
~~App Metadata~~

INSPIRE currently working on similar mechanism

Coverage Metadata

- Coverage has slot „metadata"
  - Embed/link any kind of metadata

- WCS will deliver data + metadata
  - without knowing contents

- Can be linked with catalog-based metadata search

```
-<wcseo:RectifiedDataset
  gml:id="MER_FRS_1PNPDE20060822_092058_000
  xsi:schemaLocation="http://www.opengis.net/w
  /1.0/wcsEOAll.xsd">
  +<gml:boundedBy></gml:boundedBy>
  +<gml:domainSet></gml:domainSet>
  +<gml:rangeSet></gml:rangeSet>
  +<gmlcov:rangeType></gmlcov:rangeType>
 -<gmlcov:metadata>
   -<wcseo:EOMetadata>
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     xsi:schemaLocation="http://www.opengis.
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     +<om:resultTime></om:resultTime>
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      <om:result/>
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    </eop:EarthObservation>
   +<wcseo:lineage></wcseo:lineage>
   </wcseo:EOMetadata>
  </gmlcov:metadata>
</wcseo:RectifiedDataset>
```

Inset: INSPIRE Time Handling

- OGC Coverages: time just another axis

- INSPIRE (WaterML): timseries = time slices
  - WaterML extended: scalars → images
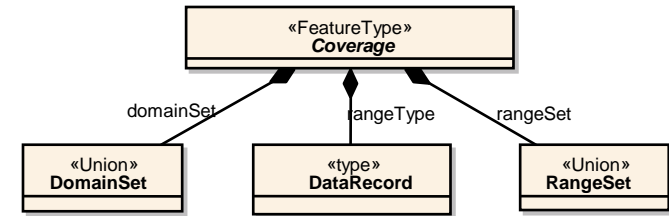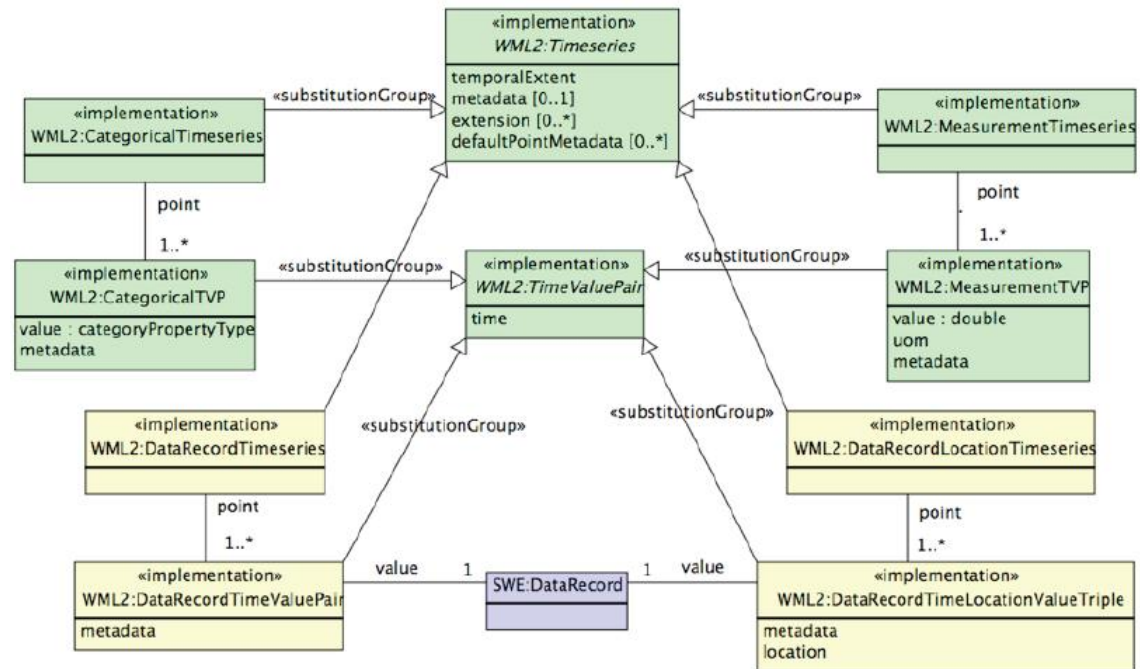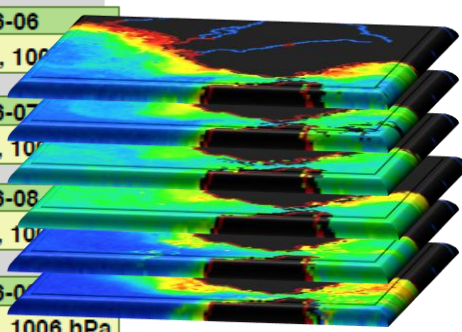
Inset: INSPIRE Interleaved Representation

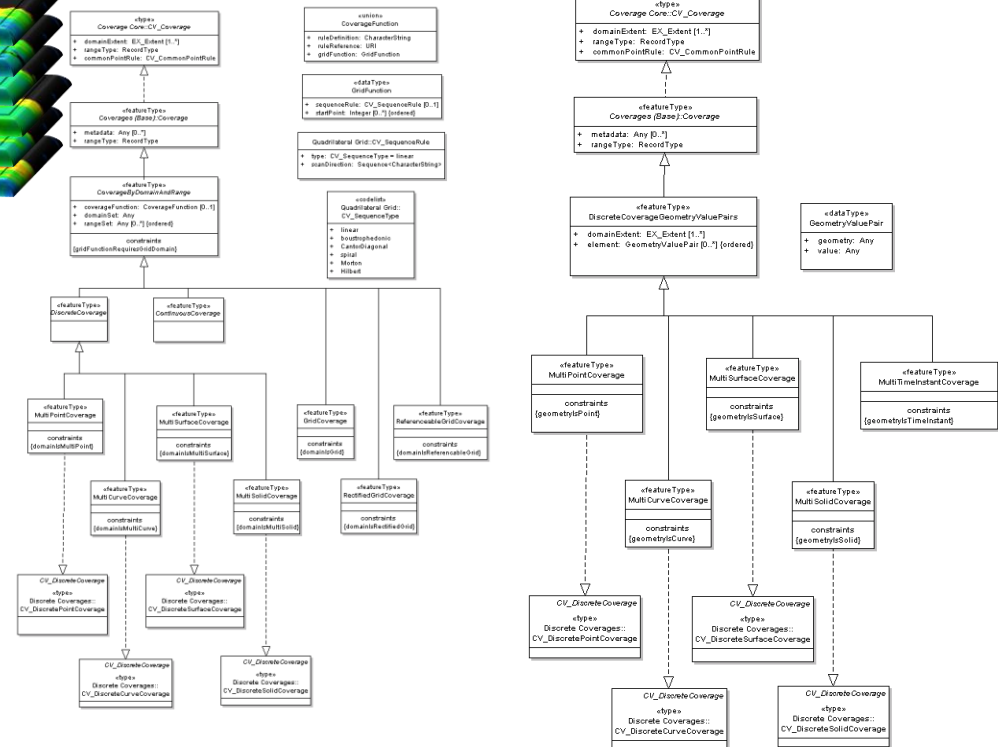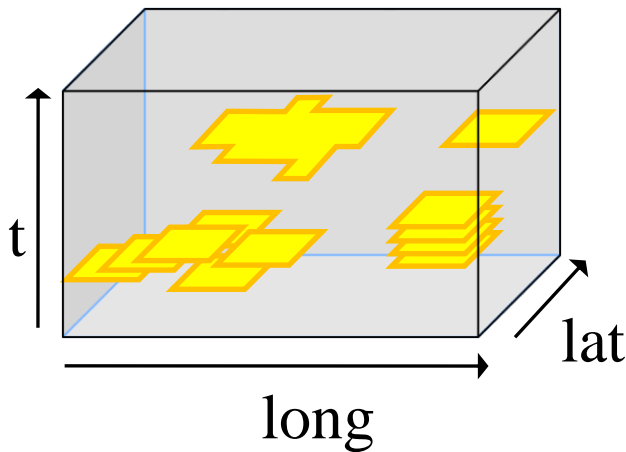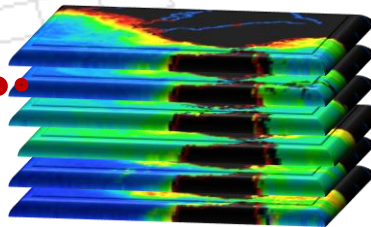- OGC Coverages: separate model from encoding

- INSPIRE: two new coverage types composed:
  - „as known"
  - „interleaved"

- OGC timeseries:
 simple, integrated, flexible

Inset: INSPIRE -- Summary of Issues

- Recombining, mixing with new constituents → new "coverage" types
  - not semantically interoperable with OGC coverages

- Modeling of interleaved data inadequate on conceptual, rather than encoding level
  - different classes → impact on other, unrelated capabilities of the data type chosen
  - addresses only very specific case (time), not general interleaving (any axis, subsets)
  - pattern may not solve streaming

- timeseries handling is unnecessarily complicated

- unclear: multi-dimensional CRSs; bindings to non-GML data formats; arbitrary user-defined metadata

- AFAIK not proven by implementation, while GMLCOV is (incl testing)

- unclear how INSPIRE "coverages" can be serviced

Web Coverage Service (WCS)

- Core: Simple & efficient access to multi-dimensional coverages
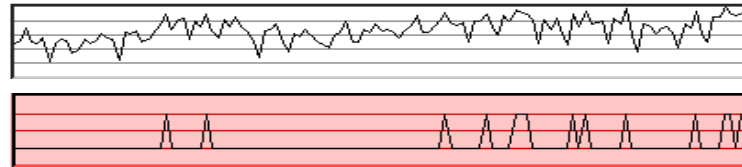
- subset =   trim | slice
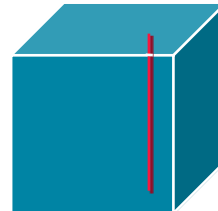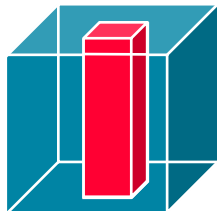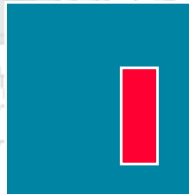
- WCS Extensions for additional functionality facets
  - "band extraction", scaling, reprojection, interpolation, query language, ...

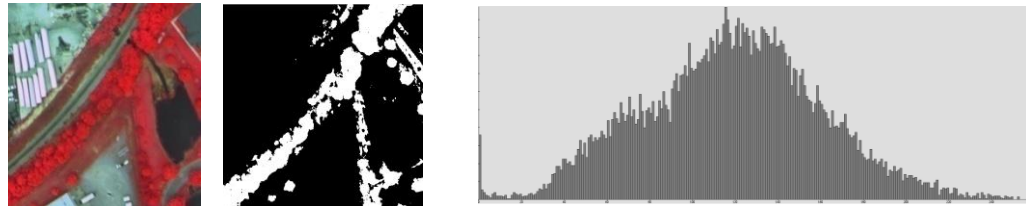- Application Profiles define domain-oriented bundling

WCS Query Extension:
Web Coverage Processing Service (WCPS)

Raster Query Language: ad-hoc navigation, extraction, aggregation, analytics
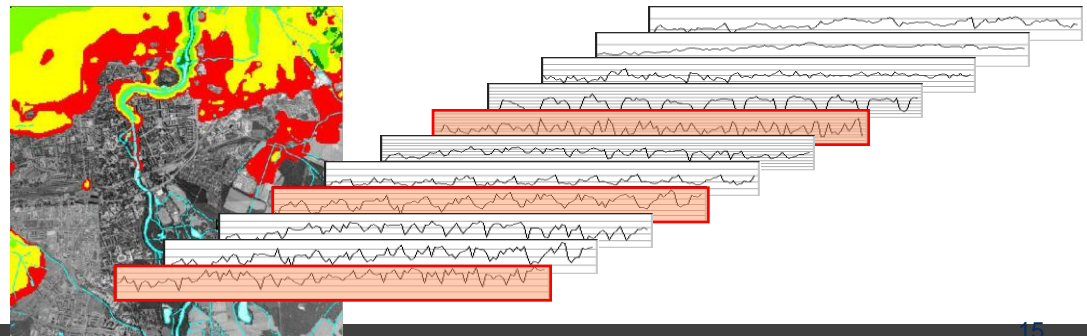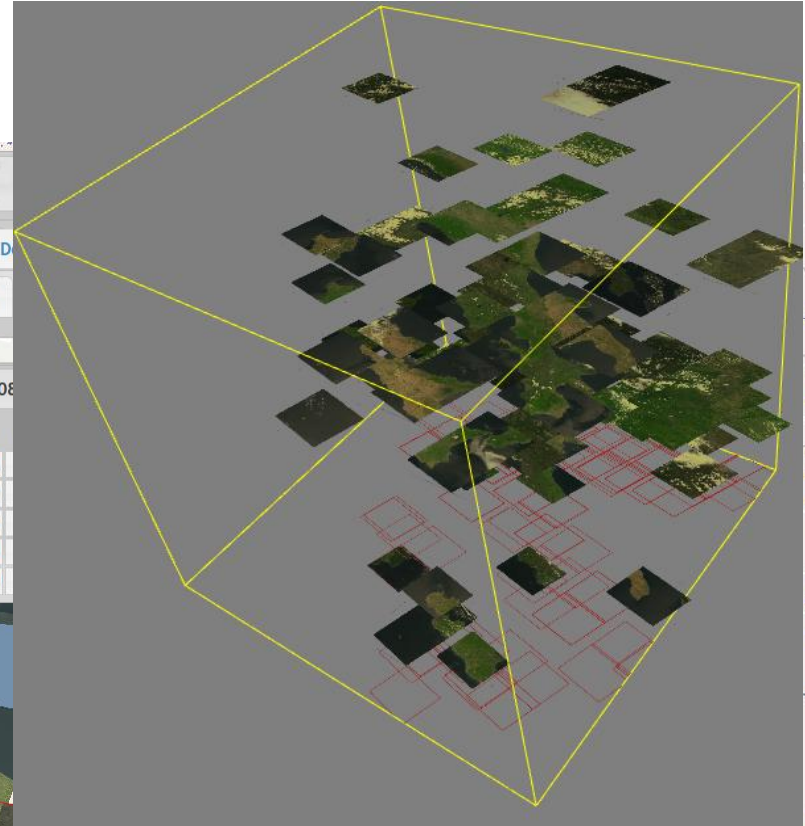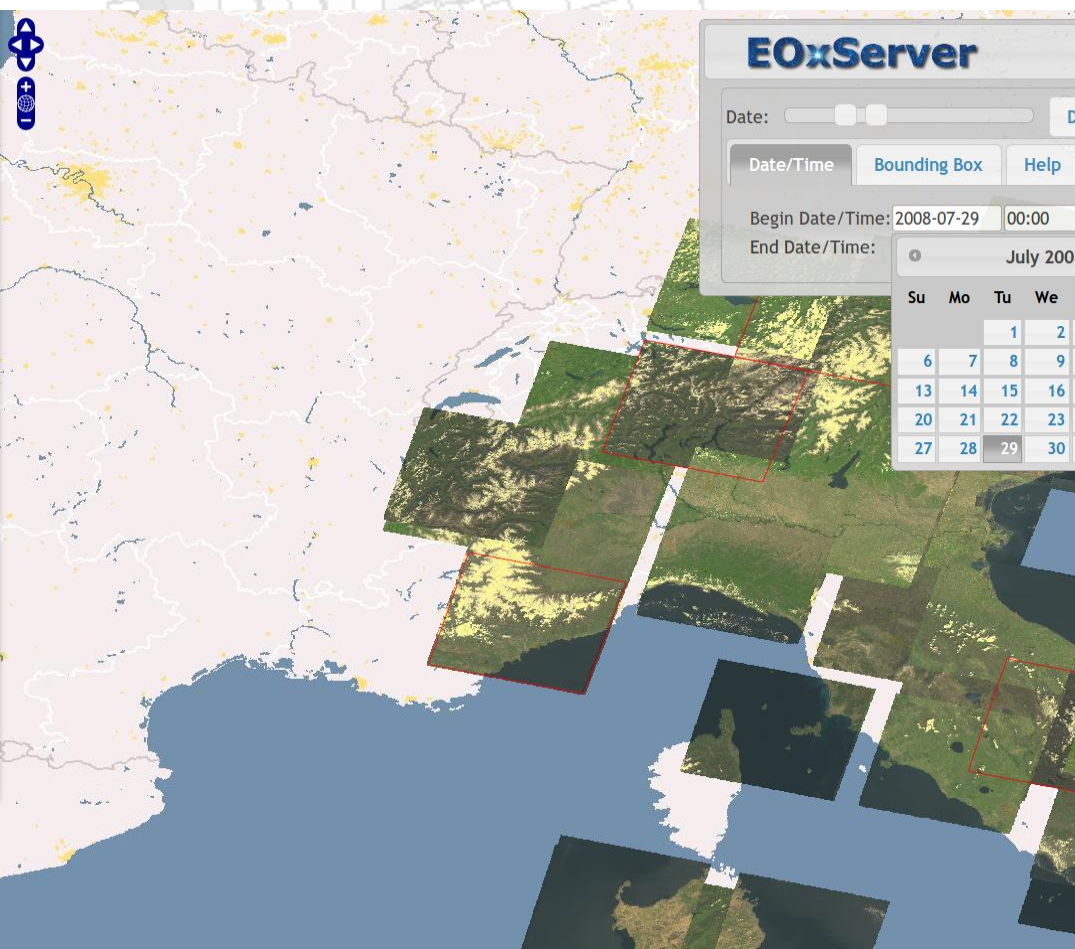
- Time series

- Image processing

- Summary data

- Sensor fusion
  & pattern mining

- current value is 8220.0;
- average over all values up to now currently is 7461.7692307692305.

EarthServer: 2D/3D Web clients

Strictly W3C standards (incl X3D)

Conclusion

- **Sensor, image, model, and statistics data = Big Data in geo services**
  - Petrol industry has „more bytes than barrels"
  - Open standards indispensable for rapid, reliable, affordable decision support

- ISO 19123 / OGC AT 6: abstract concepts

- OGC W*S: concrete, interoperable interfaces, in line with ISO
  - spatio-temporal coverages – a unified data toolkit for all domains
  - Web Coverage Service suite – from simple download to flexible queries
  - www.ogcnetwork.net/wcs

- INSPIRE: similar concepts, sometimes diverging interfaces