

Beyond Rasters: Introducing The New OGC Web Coverage Service 2.0

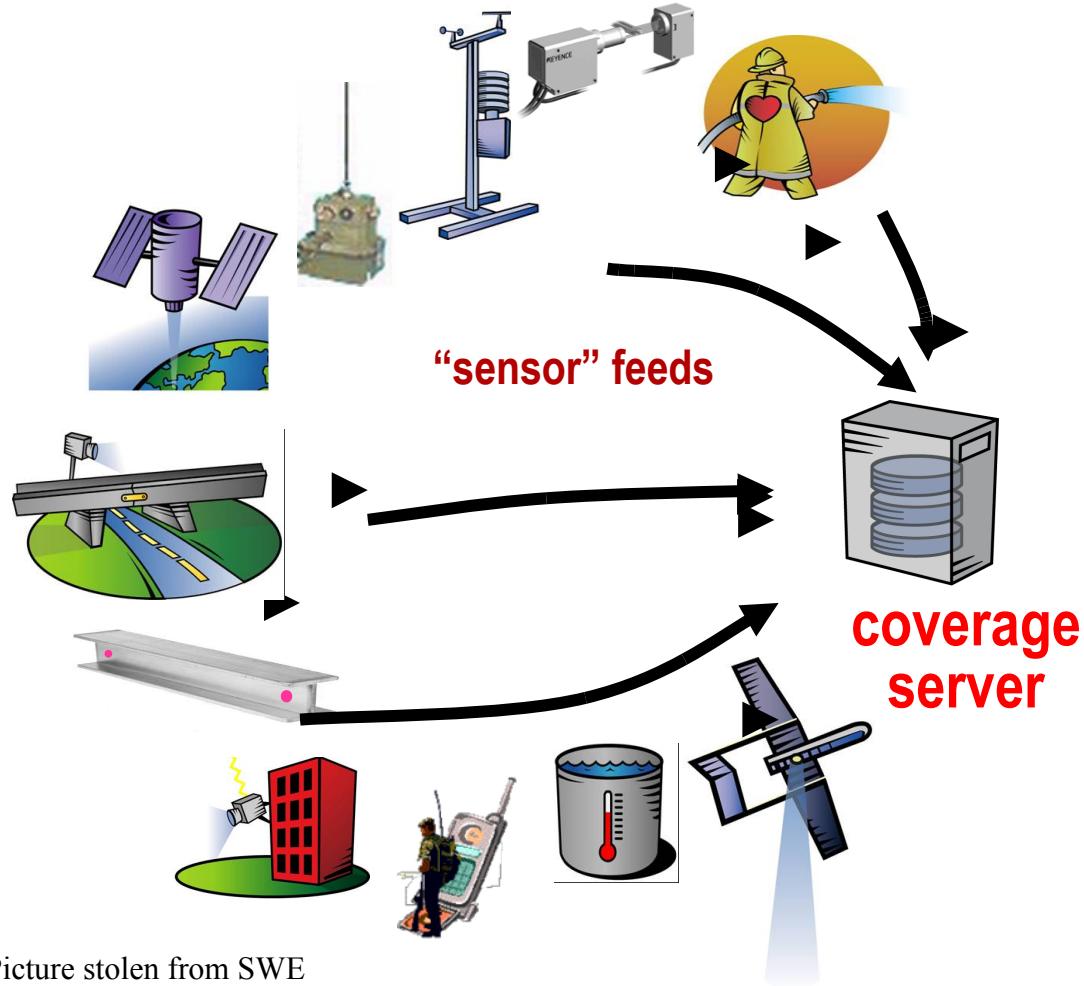
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rasdaman GmbH

Jacobs University Bremen

- International, multi-cultural
 - 1,300+ students, 101 nations, 75% non-German
 - English official language on campus
- Smart Systems Computer Science Graduate Program
 - AI, machine learning, robotics, databases, Web services, distributed systems, graphics, visualization, ...
- Large-Scale Scientific Information Systems research group
 - focus: large-scale n-D raster services and beyond
 - theory, practice, application, standardization
 - www.jacobs-university.de/lisis

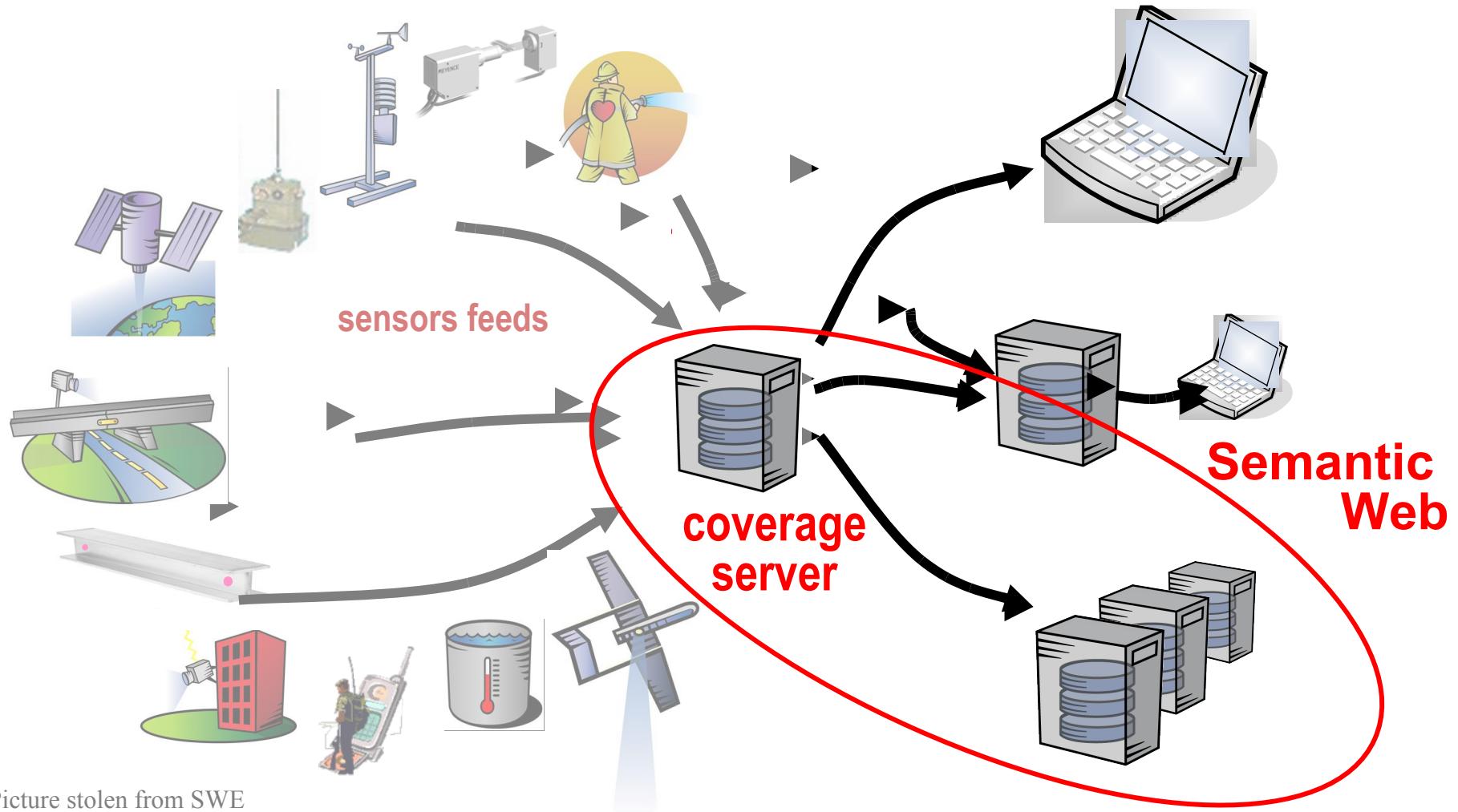


Facing the Data Tsunami



Picture stolen from SWE

Taming the Data Tsunami

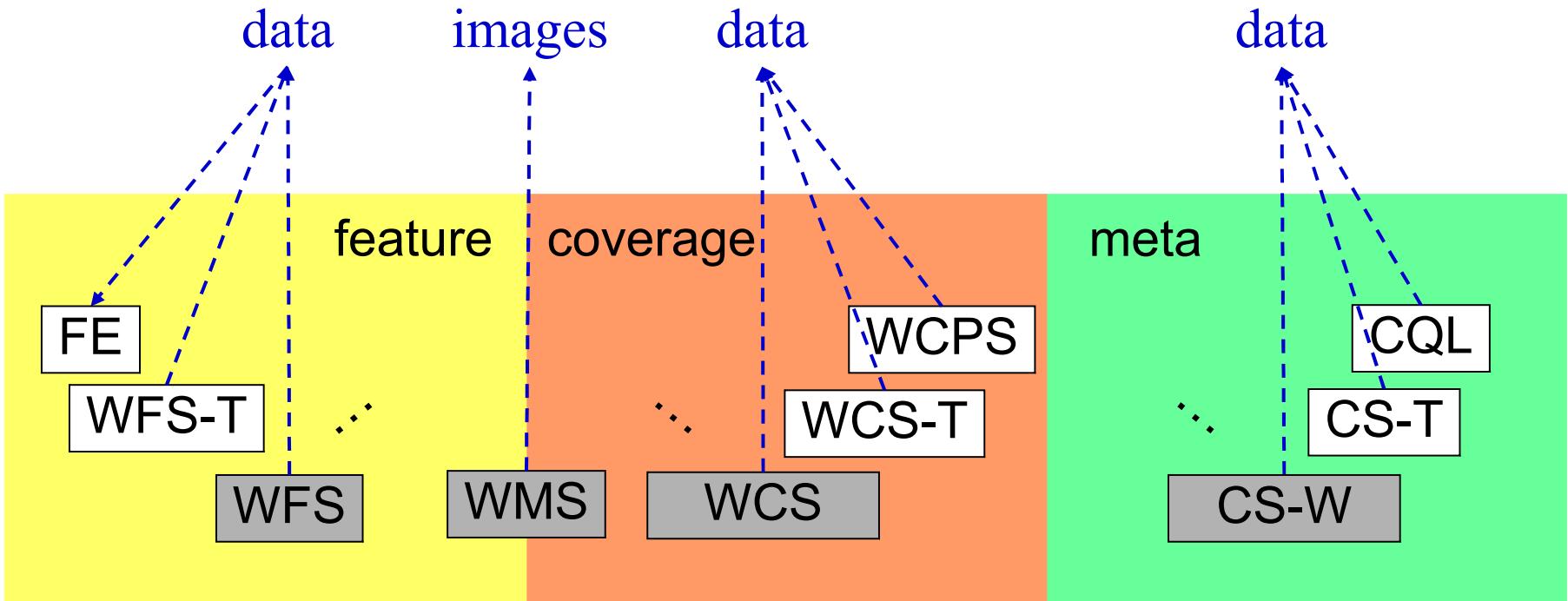


Picture stolen from SWE

Introduction

- Open GeoSpatial Consortium (OGC, www.opengeospatial.org) drives **geo service standards**
 - In collaboration with ISO, W3C, OASIS Open, ...
- Coverage = n-D "**space-time-varying phenomenon**" [ISO 19123, OGC AT6]
 - *coverage: space, time → value set*
- **Web Coverage Service (WCS)**: access to coverages & subsets thereof
 - deliver data suitable for further processing
 - Suite of core + extensions,
scalable in functionality

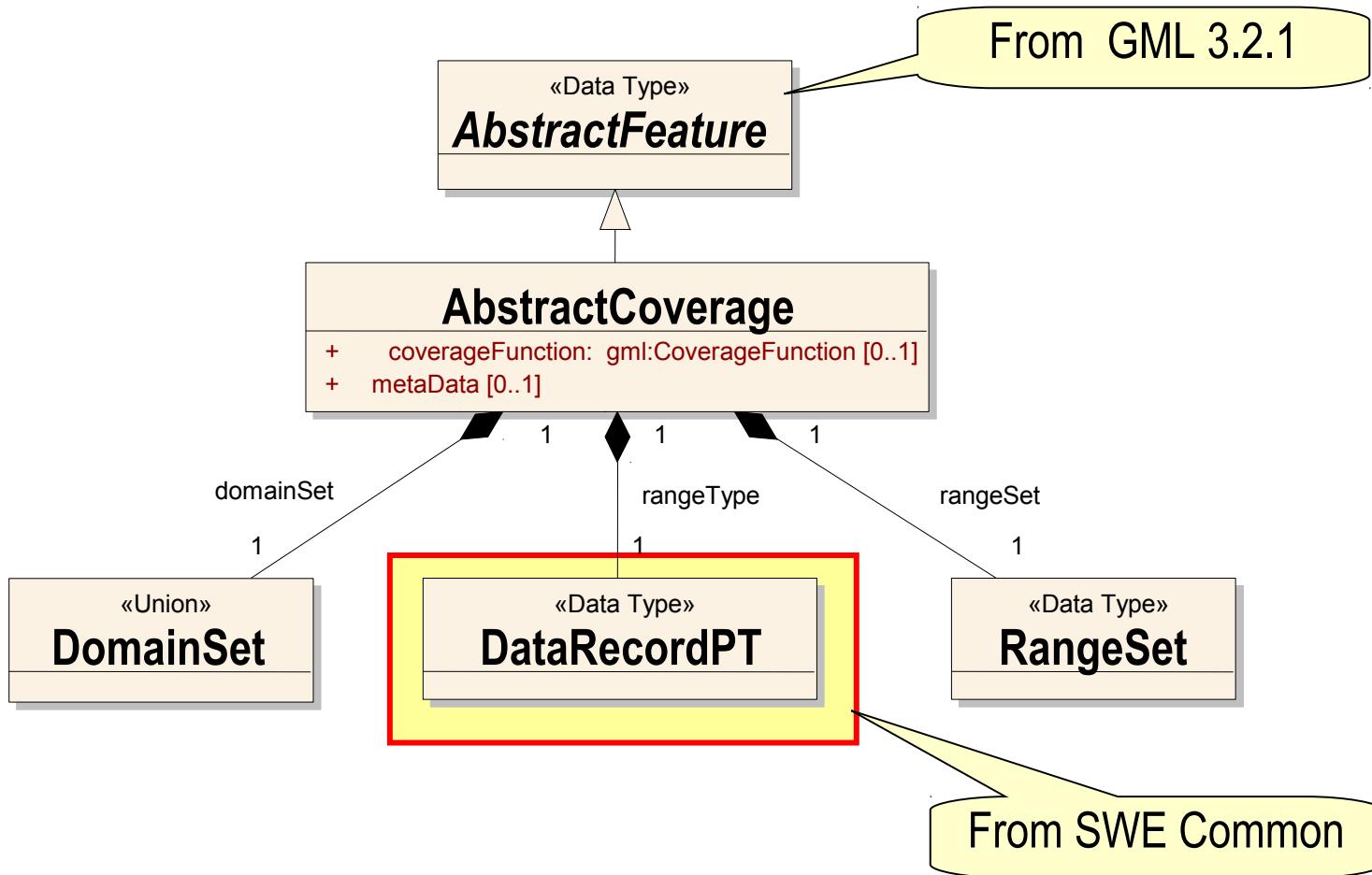
(Part of) The OGC Quilt



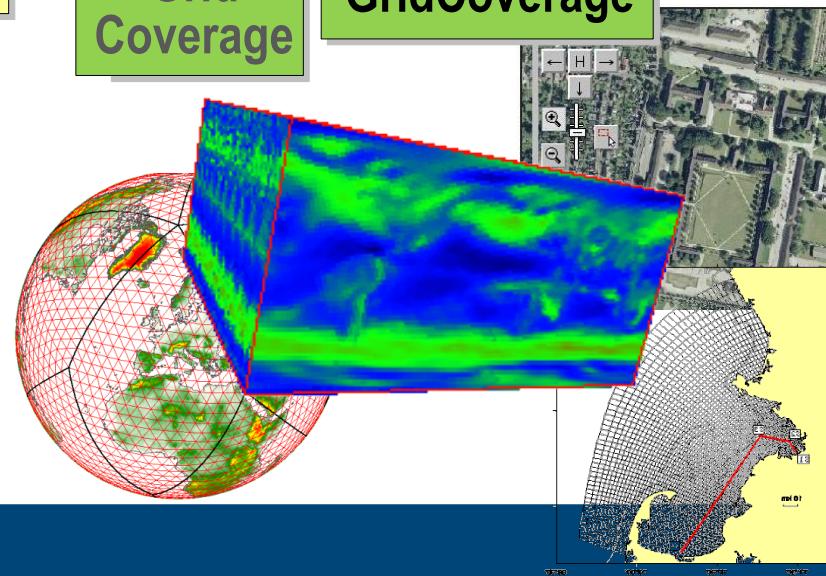
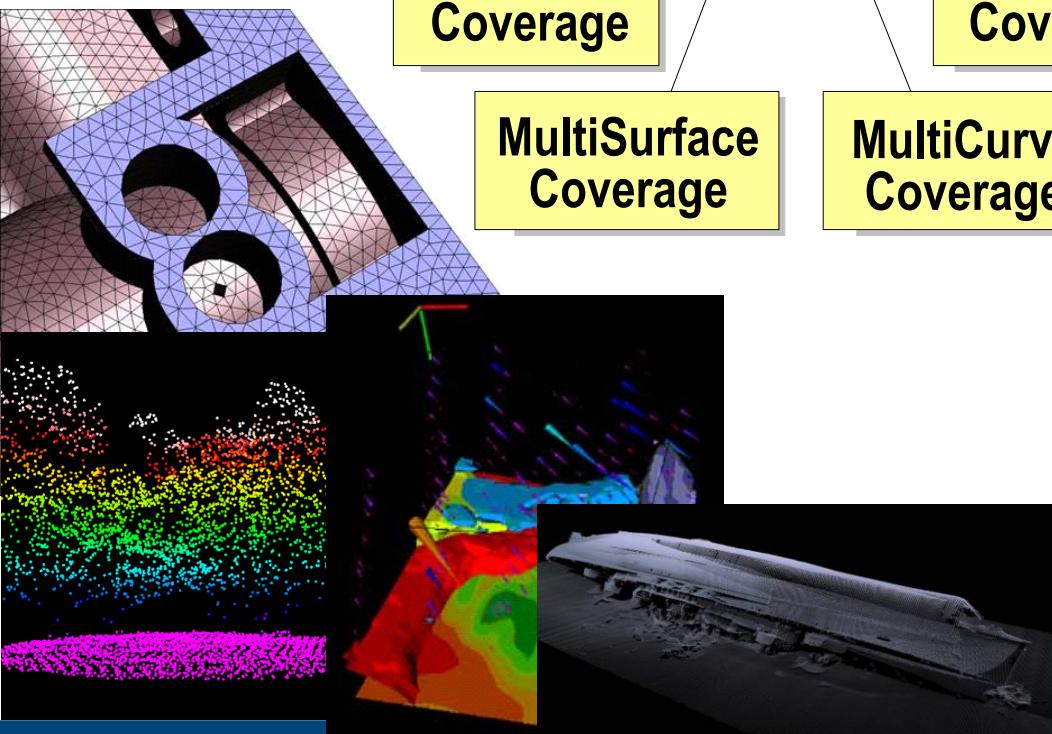
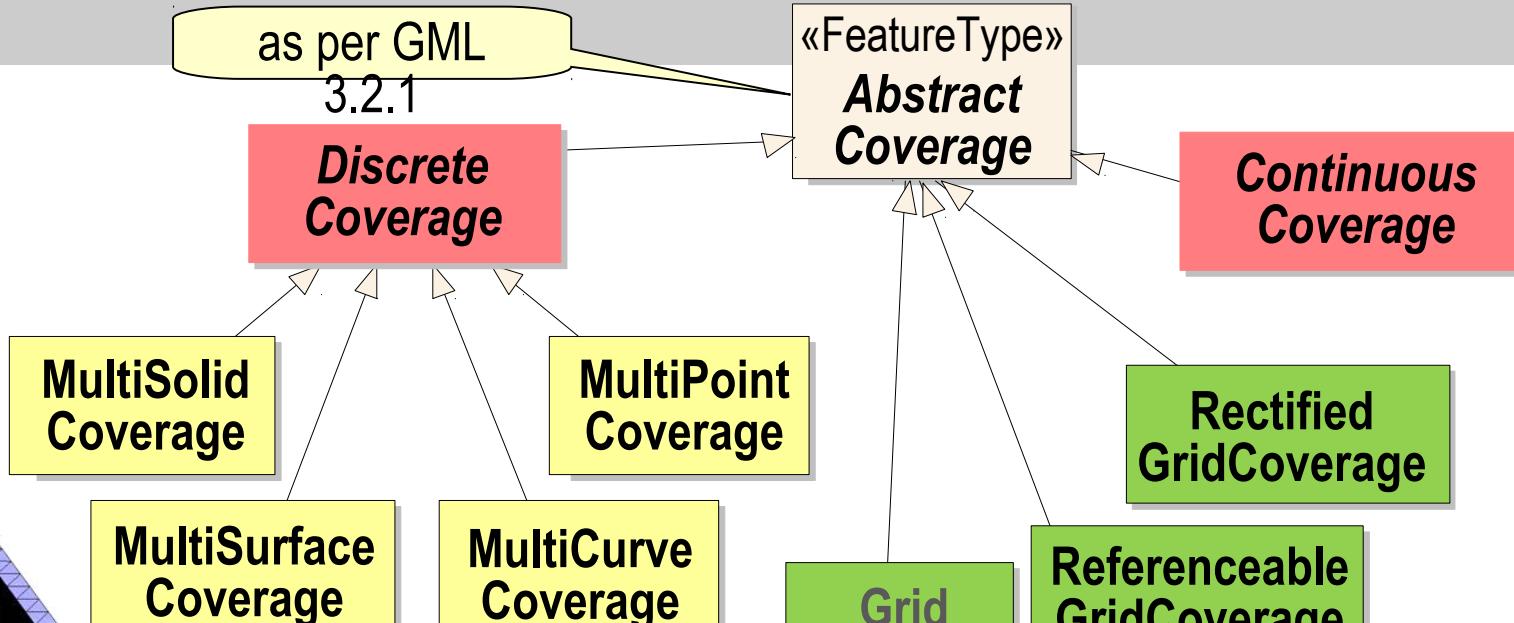
WCS 2.0 Design Goals

- 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

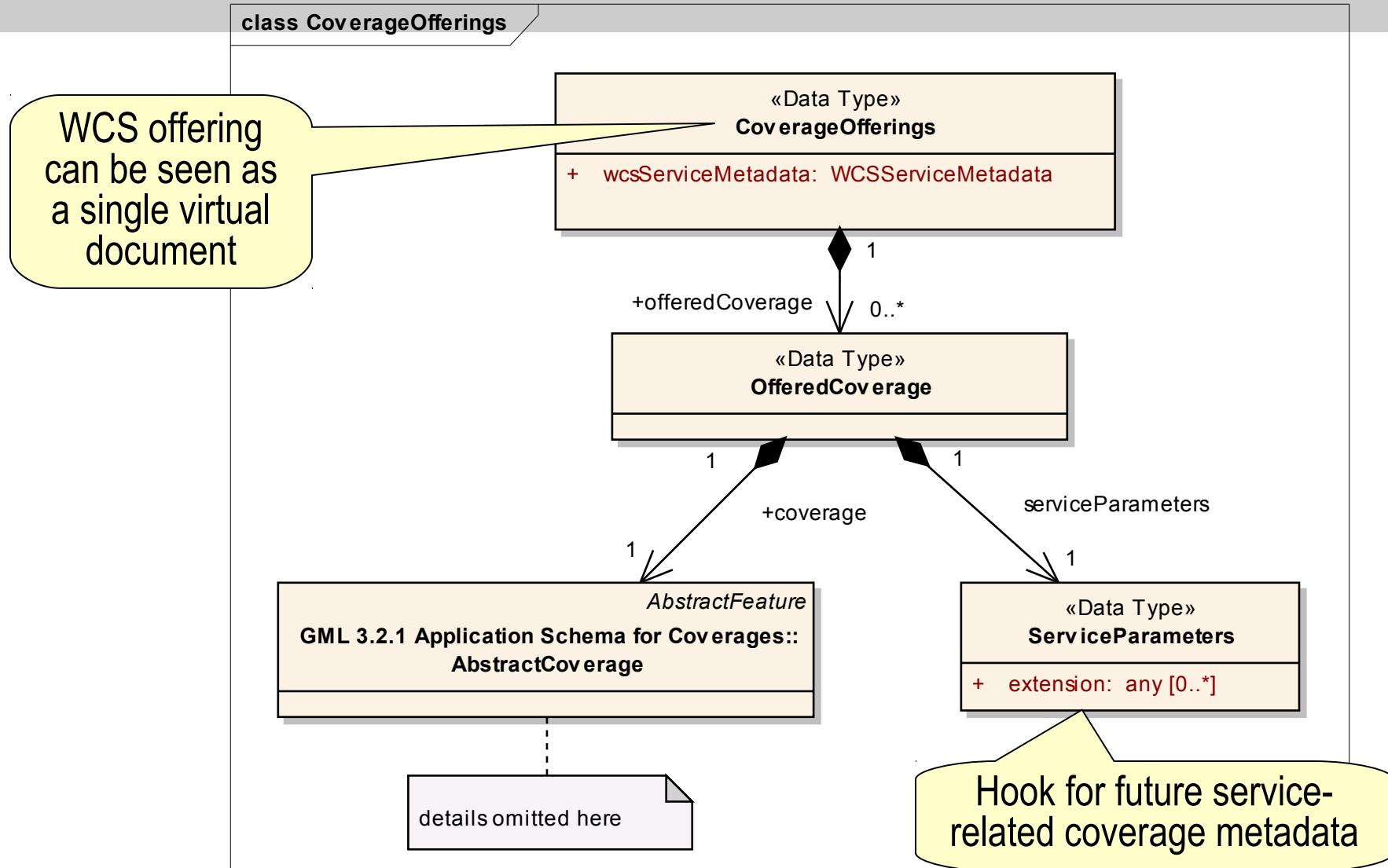
Coverage Definition



Coverage Subtypes

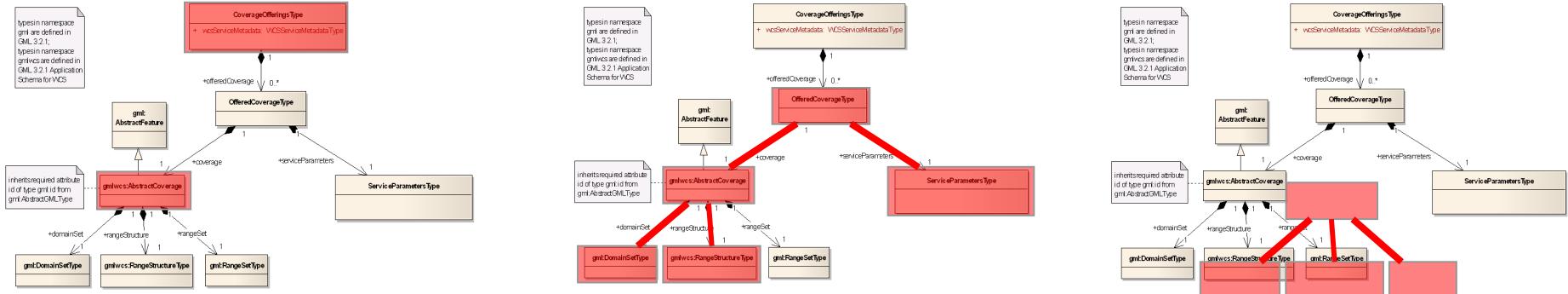


WCS Core Service Model: Data



WCS Core Service Model: Ops

- **GetCapabilities** What service extensions? What coverages?
- **DescribeCoverage** coverage metadata
- **GetCoverage** coverage, or subset thereof
- ...now concisely defined as pruning from coverage offerings



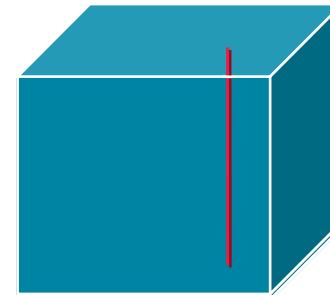
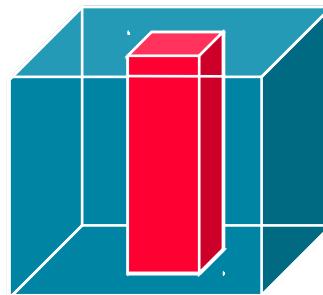
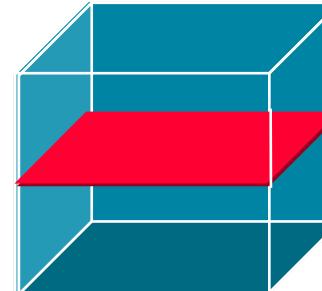
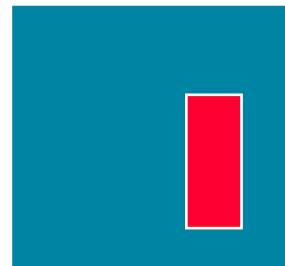
WCS Core Functionality

In Core, simple data access (more in extension packages):

subset =

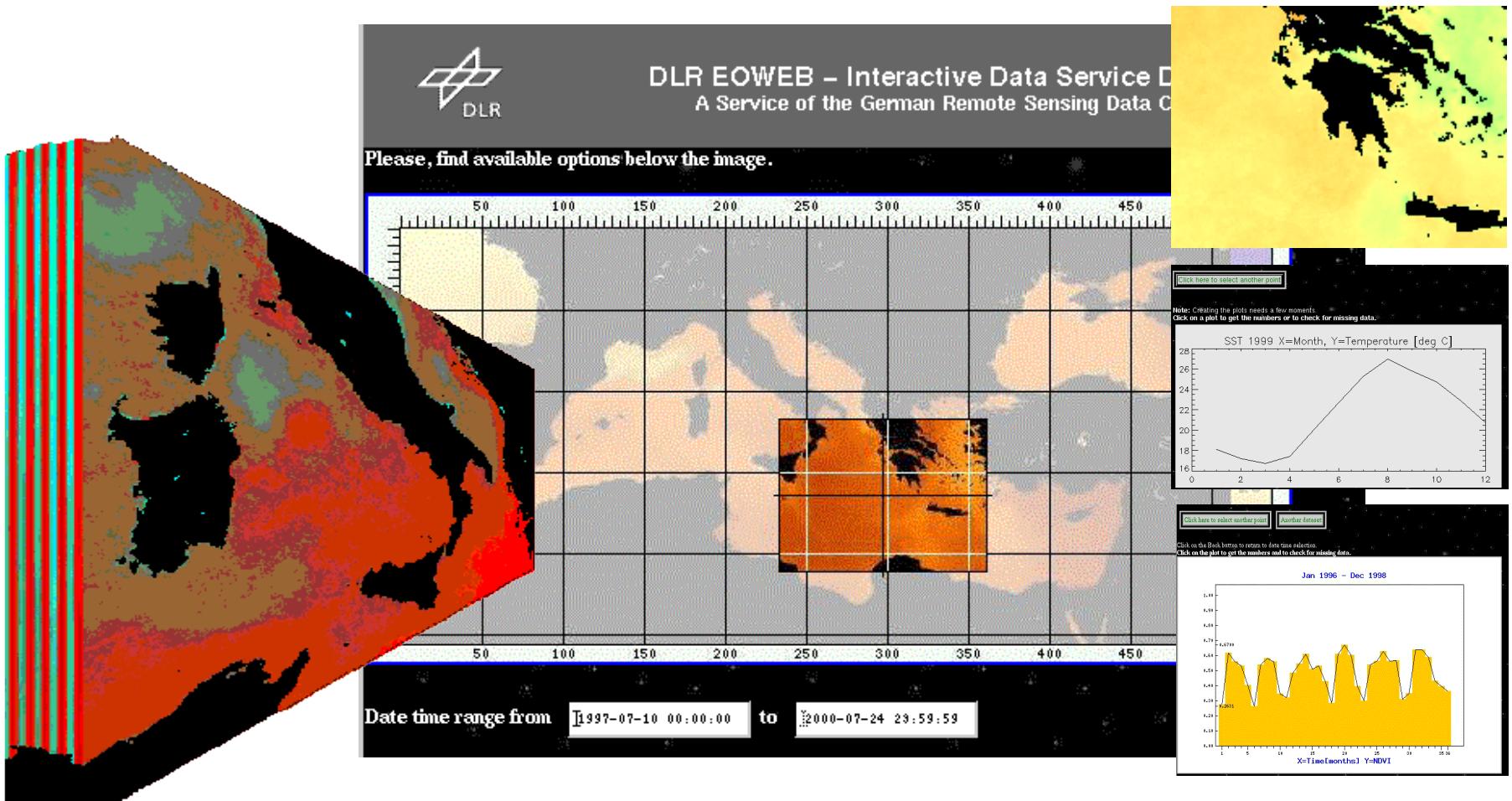
trim

| slice



Use Case: Satellite Time Series

[DFD-DLR, Diederich et al, 2001]



Web Coverage Processing Service

- OGC WCPS standard = aka “XQuery for multi-dimensional **coverages**”
 - Bridges WCS & WPS
 - Ex:

```
for $c in ( Modis1, Modis2, Modis3 ),  
      $m in ( MyMask )  
where  
    avg( $c.red * $m ) > 127  
return  
  encode( $c.red / $c.nir, "tiff" )
```

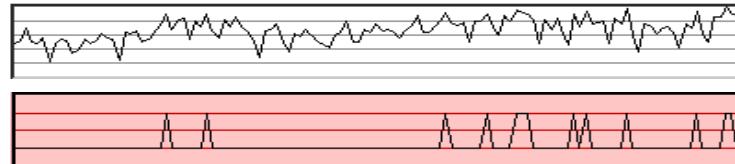
(tiff₁,
tiff₃)

- Function nesting → unlimited complexity, formal algebraic semantics
- Expressive power: image & signal processing, statistics

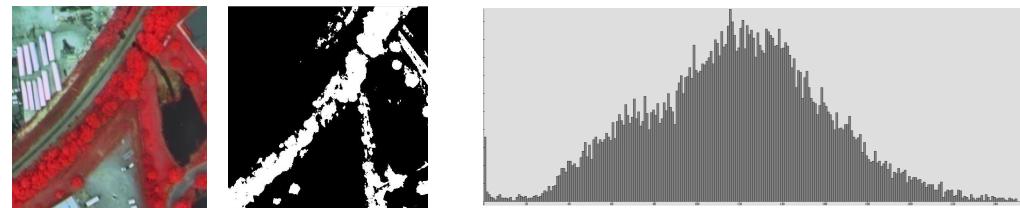
WCPS Use Case Scenarios

ad-hoc navigation, extraction, aggregation, analytics:

- Time series



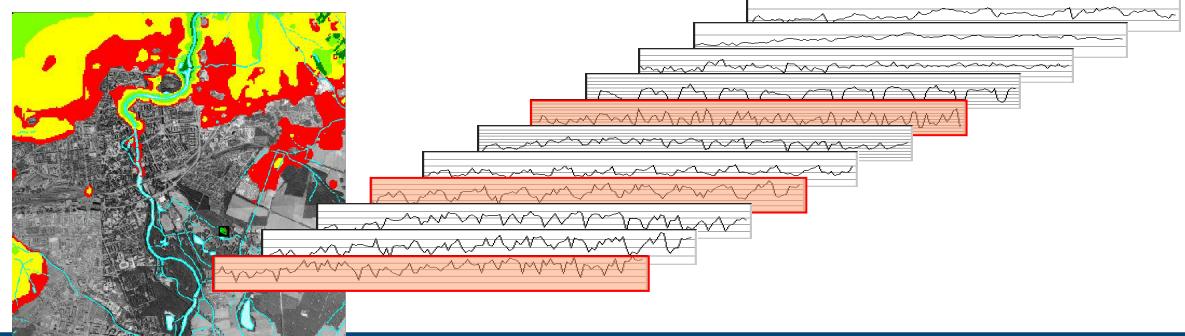
- Image processing



- Summary data

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

- Sensor fusion
& pattern mining



Outlook: Application Profiles

- = domain-oriented combination of extensions
- Under work: **Earth Observation Application Profile**
 - EO-specific focus: only 2-D gridded coverages
 - Core + at least these extensions:
 - *Scaling & interpolation*
 - *EPSG CRSs*
 - at least one of: *GeoTIFF, NetCDF, JPEG2000*
 - at least one of: *Get/KVP, SOAP*
 - Plus extra definitions: EO-specific metadata
- Further possible Application Profiles:
 - metocean
 - sensor

Reflection: Mission Accomplished?



- Goals
 - Crisp 14 reqs coverage structure, 42 reqs core achieved
 - Modular achieved conceptually, new coverage types need practical evaluation
 - Beyond raster GML, WCS ok; WPS, O&M/SWE under work
 - Harmonization
 - Formal semantics partially
- Challenges
 - Underlying OWS Common allows many variants, difficult for clients
 - ...and is loose in metadata: can be a remote catalog, but structure undefined
 - How to model extensibility, yet remain type safe

Conclusion

- Coverages fundamental geo data structure
 - All **earth science** disciplines, large part of **sensor** data
- **WCS 2.0** (adopted August 2010): beyond rasters, all GML coverage types
 - www.opengeospatial.org/standards/wcs
- NASA: WCPS as on-board interface for EO-1
 - satellite can answer ad-hoc raster queries
- See also:
 - Our group: www.jacobs-university.de/lsis
 - Our n-D raster server: www.rasdaman.org
 - WCS 2.0 demo at www.earthlook.org

