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CSML 3: Climate Science Modelling Language - MetOcean DWG

76th OGC Technical Committee

Bonn, Germany

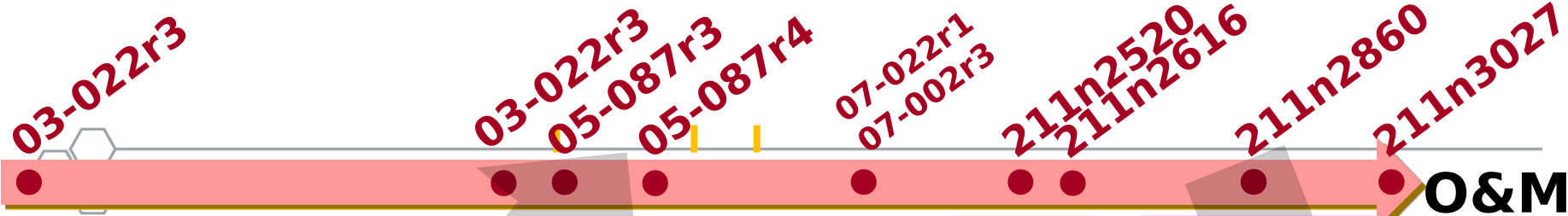
Dominic Lowe, Andrew Woolf

March 1-4th, 2011

CSML: Background



- Climate Science Modelling Language.
 - A set of GML-based 'Feature Types' to describe the types of geometric data objects used in Climate Sciences – Grids, profiles, point obs.
 - Originally Developed as part of the NERC DataGrid Project.
 - Jointly with British Atmospheric and Oceanographic Data Centres and others.
 - Developed in parallel with some ideas in O&M (e.g. sampling features).
 - Now in 3rd iteration as a profile of O&M – *a set of specialised Observation classes*.
 - Draft OGC Best Practice Paper (Pending docs: 11-021)



No significant discussion of sampling

Informative 'Site' introduced with association to 'Specimen'. Subty 'Station', 'Profile', 'SurfaceOfInterest', 'SolidOfInterest'

'Site' renamed 'Sampling Feature', with 'relatedObservation' association to Observation

Normative clause on 'Sampling features' introduced

v1.0: Part 1 (Observation Schema) and Part 2 (Sampling Features: Sampling {Point, Curve, Surface, Solid})

ISO NWIP Obs & Meas

ISO/CD 19156

Final ISO/CD 19156. Introduces 'Sampling Coverage Observation'

Votes result for ISO/DIS 19156

NDG Data Model v0.1

NDG Data Model v0.3

CSML v0.1

CSML v2

CSML v3

CSML

Very abstract, but using ISO TC211: Variable, Array, Coordinates, GranuleDescriptor

Six feature types introduced as specialised coverages: NDG{Point, Profile, Grid} {Series}Feature. Used 'composite domain pattern' (reference+complement).

Rename d to CSML

Composite pattern removed, 13 more explicit feature types introduced. Compliant with O&M (CSML feature of interest, with CSML coverage result).

Based on ISO 19156 (O&M) 'Sampling Coverage Observation'; alignment with CDM

NetCDF-Java v2.2

"Using Records in NetCDF-3"

"CDM Point Feature Types"
"CDM Feature Types"
Observation Conventions

CDM

'Scientific Data Types': GeoGrids, PointData

Point, Station, Trajectory, Sounding data

Point, Station, Profile, Station Profile, Trajectory, Section

Added Grid, Radial, Swath

New global attribute CF:featureType - Point, Time Series, Trajectory, Profile, Profile Time Series, Trajectory of Profiles

Met Office workshop

AGU 2006

Abingdon 'FTs' workshop



CSML = Reusable features.



Set of Feature Types for the Climate Sciences developed at STFC/BADC

Weakly typed: e.g. Profiles, PointSeries, GridSeries.
Not:
"OceanSalinityDepthProfile"

UML model
GML
Application
Schema



csml:ProfileFeature
(e.g. CTD cast **OR** RadioSonde)

- + location
- + time
- + domain (*heights, pressure levels*)
- + rangeset (*measured values*)
- + phenomena (*salinity, temperature*)

- + **operation**ExtractProfile(...)
- + **operation**ExtractPoint(...)



Oceanography



Atmospheric
Science

CSML 2 implementations



The screenshot shows the 'The QUEST Portal' interface for data visualization. At the top, there's a navigation bar with links: Home, FAQ, Data Portal, Data Visualisation, Guidance, rworldmap, and Graph Plotting. The main content area is titled 'Data Visualisation' and includes a note about supported browsers. A central map displays a global temperature distribution with a color scale from blue (-50C) to red (40C). A red dashed box highlights a region in the North Atlantic. To the right of the map is a 'Selection Description' panel with input fields for Domain (62.4 N, -33.8 W, 116.4 E, 1.1 S) and buttons for 'Reset selection', 'Download Data', and 'Generate Figure' (with a 'PNG' dropdown). Below the map are three panels: 'Dataset' (listing various climate datasets like 'observed_climatologies' and 'CRU Climatology'), 'Layer' (showing 'observed_climatologies_cru_v3_clim10_tmx' selected), and 'Properties' (displaying metadata for the selected layer, including URL, Layer Name, and Layer Abstract, along with a 'PNG' dropdown and 'Get Figure' button).

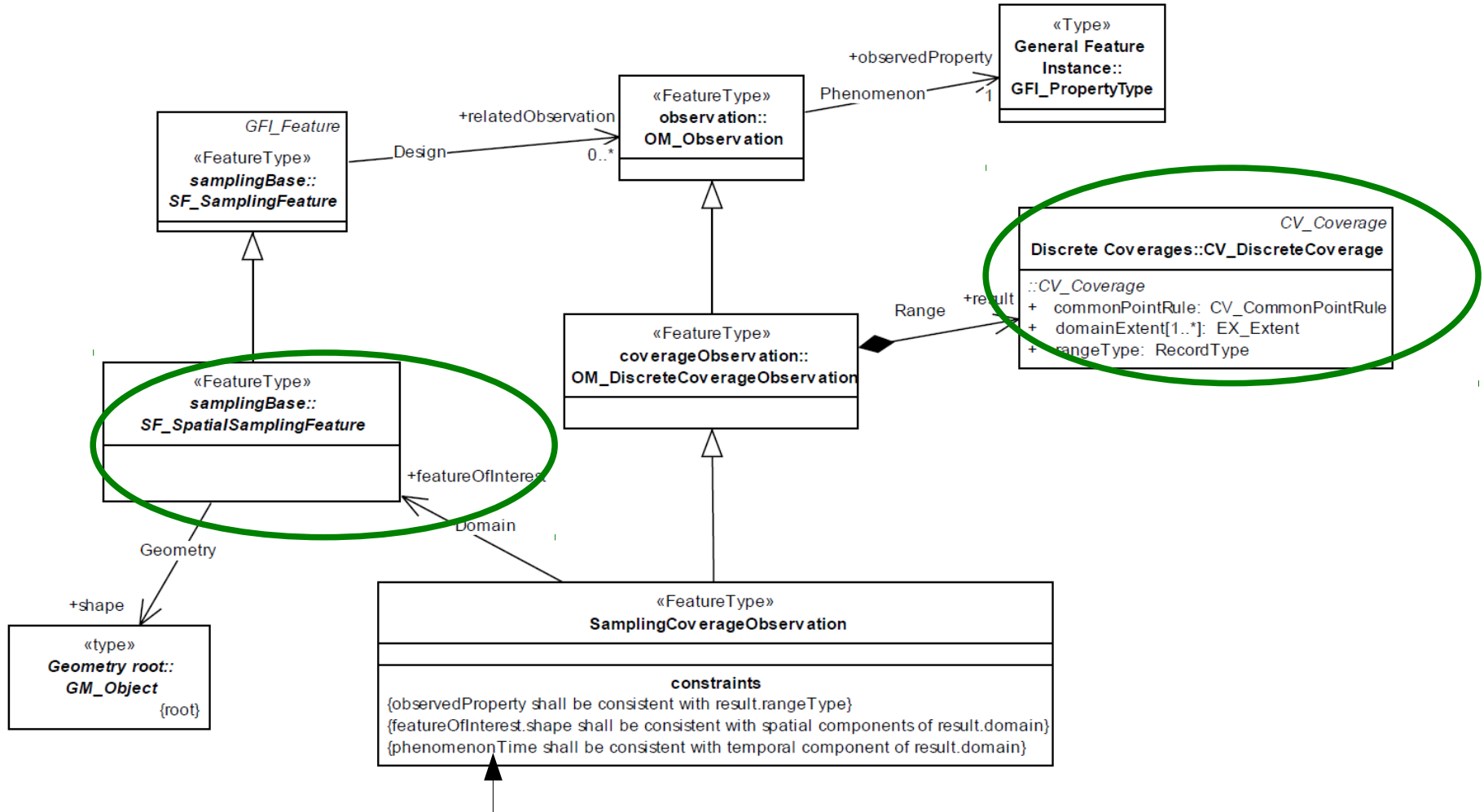
- * **Operational data portal at Centre for Environmental Archive.**
 - **Reads CSML XML files and associated NetCDF at the backend**
 - **Data Scientists can add datasets by using 'csmlscan' tool to create CSML Feature Types**

Aims of CSML 3



- To provide a core, re-usable, data model for meteorology and oceanography (and more..?) which:
 - Reflects existing community practice – 'grids, points etc'
 - Is based on ISO 19156 (CSML 2 was only *aligned* with O&M)
 - Is aligned with binary CF NetCDF and associated CDM etc.
 - Has a primary implementation as a GML Application Schema (but not exclusive).
 - Extend to support requirements from existing CSML users – WXXM (Aviation)
 - Provide a candidate core model for MetOcean DWG
 - Provide candidate model for INSPIRE Ocean and Atmos/Met themes.

19156 Sampling Coverage Obs. (informative)



19156 Annex D – CSML-like pattern.



ISO/DIS 19156

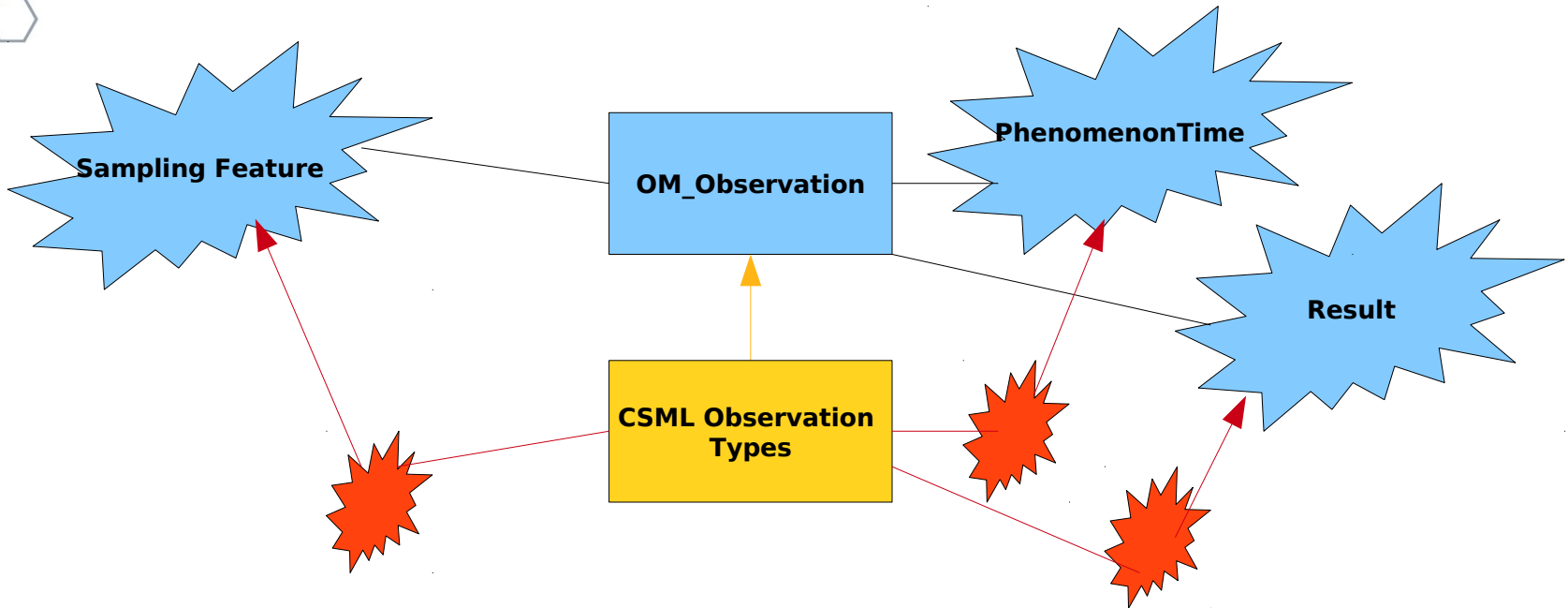
Table D.1 — Examples of coverage results for different sampling regimes

Observation class	Example	Spatial sampling feature	Coverage result
Profile	Expendable bathythermograph observation of seawater temperature	SF_SamplingCurve	<ul style="list-style-type: none"> one-dimensional grid at fixed (x,y,t) within four-dimensional (x-y-z-t) CRS grid axis aligned with CRS z-axis
ProfileTimeSeries	Radar wind profiler measurement	SF_SamplingCurve	<ul style="list-style-type: none"> two-dimensional grid at fixed (x,y) within four-dimensional (x,y,z,t) CRS grid axes aligned with CRS z- and t-axes
Trajectory	Pollutant concentration from mobile air quality sensor	SF_SamplingCurve	<ul style="list-style-type: none"> one-dimensional grid within four-dimensional (x-y-z-t) CRS
Section	Vertical profiles of water current measurements taken by an acoustic doppler current profiler towed along a ship's track	SF_SamplingSurface	<ul style="list-style-type: none"> two-dimensional grid within four-dimensional (x-y-z-t) CRS one grid axis aligned with CRS z-axis
GridTimeSeries	Time-series of 3-D velocity field from a finite-difference seismic model	SF_SamplingSolid	<ul style="list-style-type: none"> four-dimensional grid within four-dimensional (x-y-z-t) CRS

CSML 3 implements specialised observation classes.

Constraints.

Application schema + Schematron to profile general O&M model



Different CSML Observation classes (point, grid, profile etc) have different constraints:

Type of 'result' (different coverage /dimensions)

Type of 'phenomenonTime': TM_Period/TM_Instant

Type of 'samplingFeature': SF_SamplingPoint, SF_SamplingCurve etc

Classes: GML Application Schema

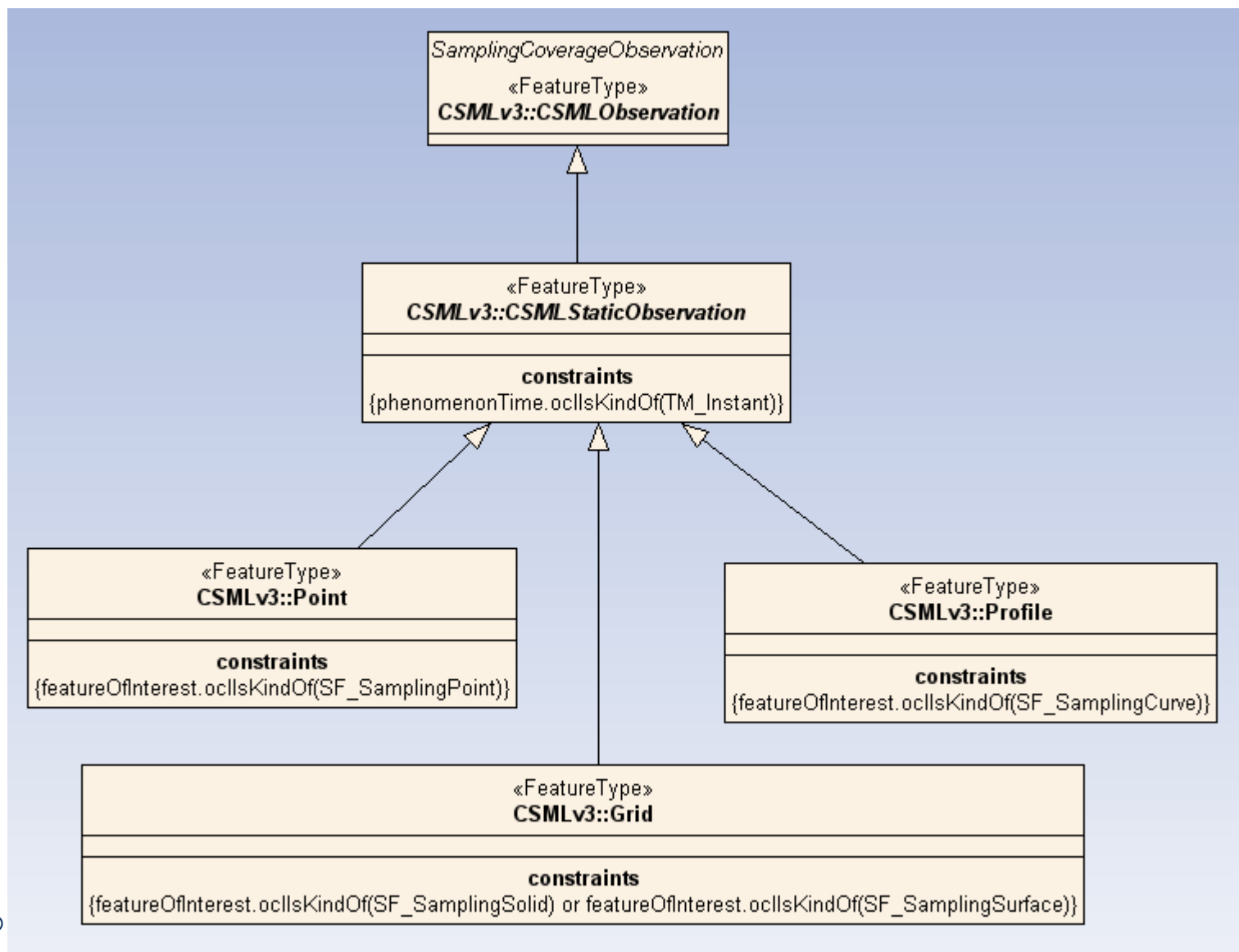
Constraints: Schematron

CSML 3: 'Static' Observation types

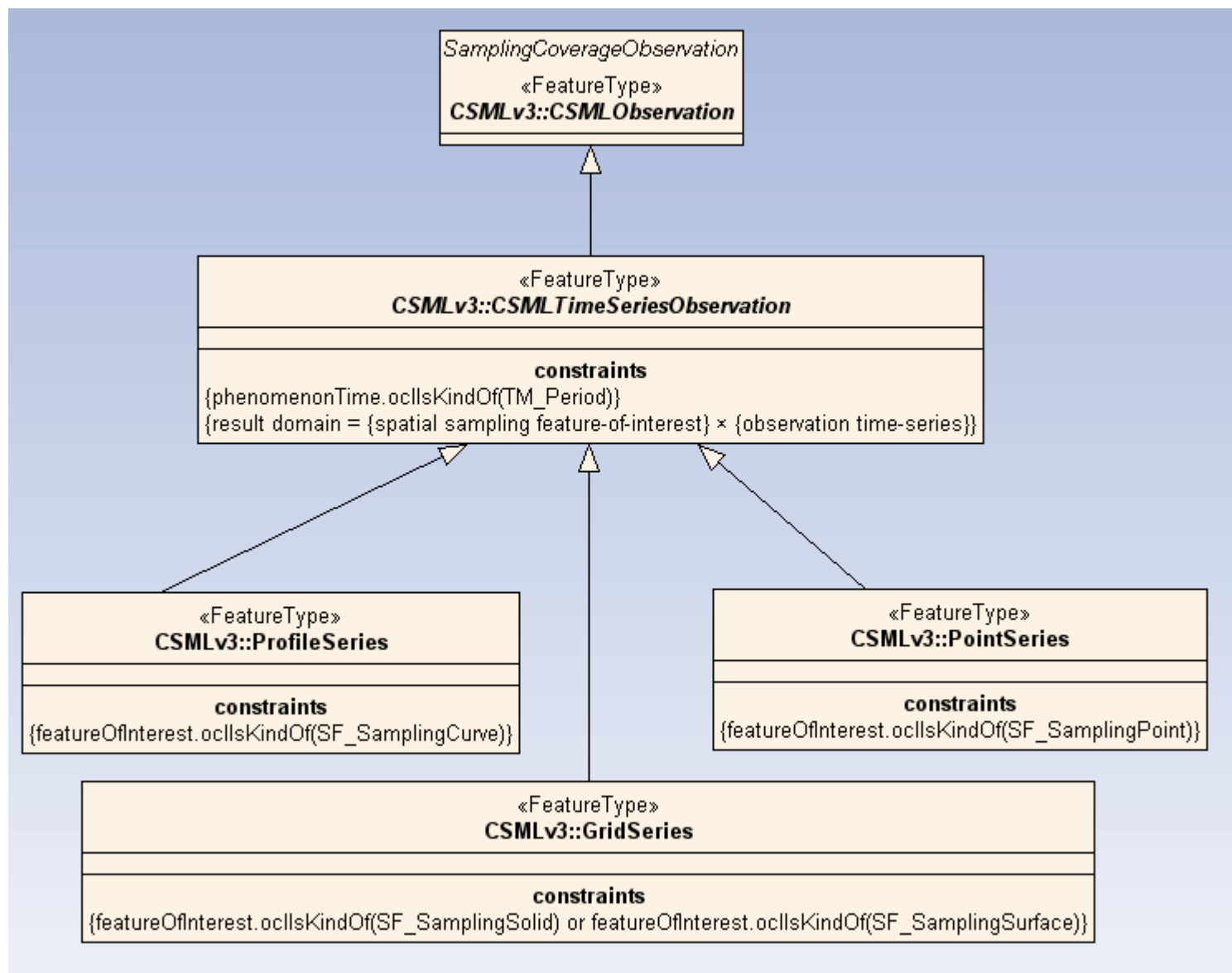


Constraints
On :

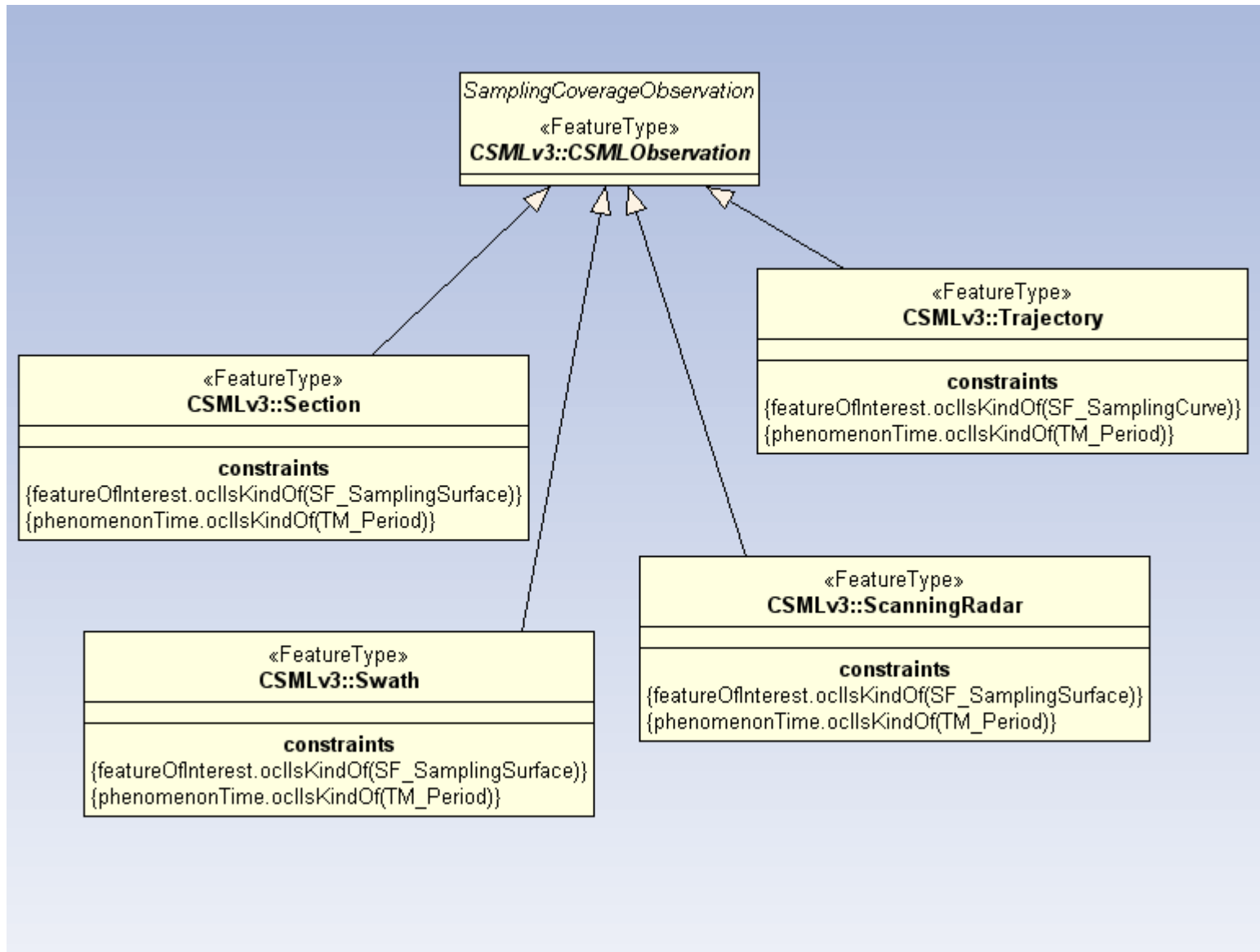
Phenomenon Time
Sampling Feature
Result



'Time Series' Observation types



Other Observation types



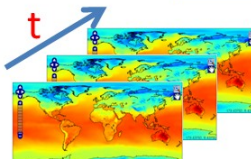
CSML 3 Feature Types – Unidata CDM



CSML	CF/CDM
Point	Point
PointSeries	StationTimeSeries
Trajectory	Trajectory
Profile	Profile
ProfileSeries	StationProfile


CSML	CF/CDM
Swath	Swath
ScanningRadar	StationaryRadialSweep
Section	Collection of Profiles
Grid	Grid (single time)
GridSeries	Grid

GridSeries		
based on	SF_SamplingSolid	
phenomenonTime	TM_Period	
	CV_DiscreteGridPointCoverage	
coverage result	grid dimension	four
	external CRS	four (x-y-z-t)
	alignment	-



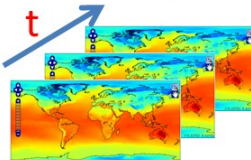
Time-series of gridded parameter fields. E.g. Numerical weather prediction model

ProfileSeries		
based on	SF_SamplingCurve	
phenomenonTime	TM_Period	
	CV_DiscreteGridPointCoverage	
coverage result	grid dimension	two
	external CRS	four (x-y-z-t)
	alignment	z-, t- axes




Time-series of profiles on fixed vertical levels at a fixed location. E.g. vertical radar timeseries

GridSeries		
based on	SF_SamplingSolid	
phenomenonTime	TM_Period	
	CV_DiscreteGridPointCoverage	
coverage result	grid dimension	four
	external CRS	four (x-y-z-t)
	alignment	-



Time-series of gridded parameter fields. E.g. Numerical weather prediction model

ProfileSeries		
based on	SF_SamplingCurve	
phenomenonTime	TM_Period	
	CV_DiscreteGridPointCoverage	
coverage result	grid dimension	two
	external CRS	four (x-y-z-t)
	alignment	z-, t- axes

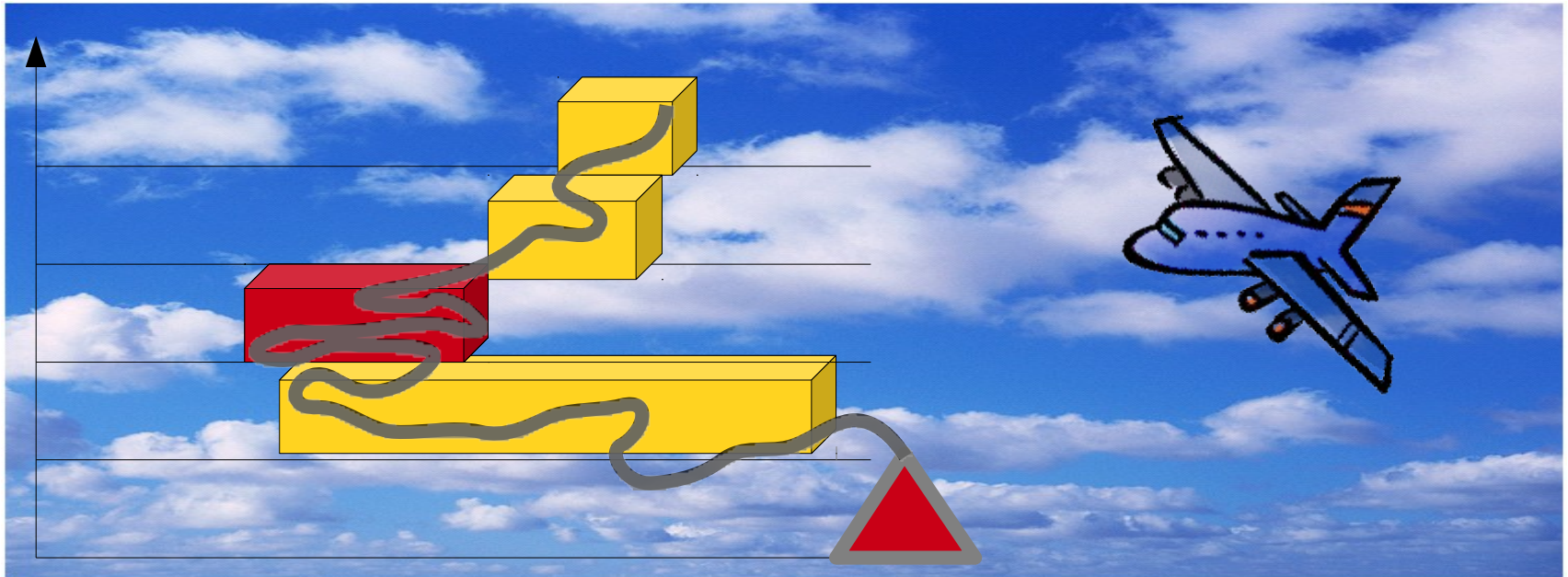


Time-series of profiles on fixed vertical levels at a fixed location. E.g. vertical radar timeseries

CSML 3: New requirements.



- Exeter 2010 3rd workshop on OGC/GIS in Meteorology
- Requirement for 'volume' and 'surface' coverage-based feature types from Aviation (WXXM) community.
 - e.g. Regions with dangerous concentration of volcanic ash, mapped onto flight levels.



Current Status of CSML 3



- Public SVN repository
 - _ <http://proj.badc.rl.ac.uk/svn/csml/CSML3>
 - UML
 - Auto-generated XML Schemas
- OGC Draft Best Practice Paper (Woolf, Lowe)
 - 11-021 CSML: Sampling Coverage Observations for the Met/Ocean Domain. *Please read and comment.*
 - Currently all coverage types use ReferenceableGrid – should simplify for simple types – e.g point/pointseries (as in CSML 2)
- New Feature types:
 - _ To do – specifically WXXM requirements
- Schematron:
 - To do next!