Powered by standards – new data tools for the climate sciences

Dr Andrew Woolf (Andrew.Woolf@stfc.ac.uk)
STFC Rutherford Appleton Lab, UK

EGU General Assembly, Vienna, Splinter Session SPM23, 22-Apr-2009
The ECMWF ERA-40 Re-Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

**badc.nerc.ac.uk air_potential_temperature GridSeries (xypt)**

**European Synoptic stations**

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.

**badc.nerc.ac.uk air_temperature PointSeries (xyzt)**
ERA40
The ECMWF ERA-40 Re-Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

European Synoptic stations
Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.
**ERA40**

The ECMWF ERA-40 Re-Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

badc.nerc.ac.uk  
**air_potential_temperature**  
GridSeries (xypt)

ISO 19115 MD_Keywords

**European Synoptic stations**

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.

badc.nerc.ac.uk  
**air_temperature**  
PointSeries (xyzt)
The ECMWF ERA-40 Re-Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

**European Synoptic stations**

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.

badc.nerc.ac.uk  
**air_temperature**  
**PointSeries (xyzt)**

badc.nerc.ac.uk  
**air_potential_temperature**  
**GridSeries (xypt)**

ISO 19115 MD_Keywords

ISO 19115 EX_Extent

1957-2002

1990-1996
The ECMWF ERA-40 Re-analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

ISO 19126 ("Feature concept dictionary and registers")
ISO 19135 ("Procedures for item registration")

European Synoptic stations

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.
<table>
<thead>
<tr>
<th>Item Identifier</th>
<th>Item Class</th>
<th>Name</th>
<th>Status</th>
<th>Date Accepted</th>
<th>Date Amended</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>theme</td>
<td>Coordinate reference systems</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>theme</td>
<td>Geographical and systems</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>theme</td>
<td>Elevation</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>theme</td>
<td>Land cover</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>theme</td>
<td>Orthophotography</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>theme</td>
<td>Geology</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>theme</td>
<td>Statistical units</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>theme</td>
<td>Buildings</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>theme</td>
<td>Soil</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>theme</td>
<td>Land use</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>theme</td>
<td>Human health and safety</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>theme</td>
<td>Utility and governmental services</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>theme</td>
<td>Environmental monitoring facilities</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>theme</td>
<td>Production and industrial facilities</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>theme</td>
<td>Agricultural and aquaculture facilities</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>theme</td>
<td>Population distribution — demography</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>theme</td>
<td>Area management/restriction/management</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>theme</td>
<td>Natural risk zones</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>theme</td>
<td>Atmospheric conditions</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>theme</td>
<td>Meteorological geographical features</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>theme</td>
<td>Oceanographic geographical features</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>theme</td>
<td>Sea regions</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>theme</td>
<td>Bio-geographical regions</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>theme</td>
<td>Habitats and biotopes</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>theme</td>
<td>Species distribution</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>theme</td>
<td>Energy resources</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>theme</td>
<td>Mineral resources</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>spatial object type</td>
<td>Administrative unit upper level</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>spatial object type</td>
<td>Administrative unit lower level</td>
<td>valid</td>
<td>05-Dec-08</td>
<td></td>
</tr>
</tbody>
</table>
The ECMWF ERA-40 Re-Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

**European Synoptic stations**

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.
The ECMWF ERA-40 Re-analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

**ERA40**

1957-2002

European Synoptic stations

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.

ISO 19115 MD_ReferenceSystem

**Geology**

temperature
The ECMWF ERA-40 Re-analysis project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

ISO 19115 MD_ReferenceSystem

**European Synoptic stations**

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.

ISO 19111-2 ("Spatial referencing by coordinates – Part 2: Extension for parametric values")
ISO 19111-2

• Proposed by UK as NWIP late 2006
• DIS voted for publication this year!
ISO 19111-2

- **datum**: parameter or set of parameters that define the position of the origin, the scale, and the orientation of a coordinate system (ISO 19111)

- **parametric datum**: datum describing the relationship of a parametric coordinate system to an object. **NOTE**: The object is normally the Earth. (ISO 19111-2)

- Could have been more imaginative with parametric datum!
  - e.g. full atmospheric density field...
**ERA40**

The ECMWF ERA-40 Re-Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

```
badc.nerc.ac.uk  air_potential_temperature  GridSeries (xypt)
```

**ISO 19115 MD_ContentInformation**

**European Synoptic stations**

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.

```
badc.nerc.ac.uk  air_temperature  PointSeries (xyzt)
```
The ECMWF ERA-40 Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

**ERA40**

**featureCatalogue:** CSML

**featureType**

1957-2002

badc.nerc.ac.uk

**air_potential_temperature**

GridSeries (xypt)

**ISO 19115 MD_ContentInformation**

**European Synoptic stations**

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.

badc.nerc.ac.uk

**air_temperature**

PointSeries (xyzt)
The ECMWF ERA-40 Re-analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

**European Synoptic stations**

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.

ISO 19110 ("Methodology for feature cataloguing")...
Climate Science Modelling Language (CSML)

Abstract CSML Feature

```
CV_Coverage
Discrete Coverages::CV_DiscreteCoverage
+ locate(DirectPosition*) : Set<CV_GeometryValuePair>
```

Coverage Types::

```
CSMLCoverage
+ value
+ domainSet
```

+ rangeSet: Record [0..*]

```
Domain geometries::
CSMLCoverageDomain
+ value
+ domainSet
```

```
AnyDefinition
«ObjectType»
Phenomenon
```

```
RaggedSectionFeature
```

```
ProfileFeature
```

```
ProfileSeriesFeature
```

```
GridFeature
```

```
ScanningRadarFeature
```

```
Science & Technology Facilities Council
```
An Observation is an Event whose result is an estimate of the value of some Property of the Feature-of-interest, obtained using a specified Procedure.
ISO 19110 Feature Catalogue

• EU FP6 project ‘MOTIIVE’
  – developed ebRIM-based Feature Catalogue

OGC 07-172, ‘Feature Type Catalogue Extension package’ link
ISO 19110 Feature Catalogue

- EU FP6 project ‘MOTIIVE’
  - developed ebRIM-based Feature Catalogue

OGC 07-172, ‘Feature Type Catalogue Extension package’ link
ISO 19110 Feature Catalogue

- EU FP6 project ‘MOTIIVE’
  - developed ebRIM-based Feature Catalogue

OGC 07-172, ‘Feature Type Catalogue Extension package’ link
The ECMWF ERA-40 Re-Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

**European Synoptic stations**

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.
The ECMWF ERA-40 Re-Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

ISO 19115 CI_OnlineResource

applicationProfile: WFS
linkage: right click/copy

European Synoptic stations

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.
Open tool xxx

- Lowe & Woolf: EGU2009-10927, 18:30 Thursday
Open tool xxx

Data service

URL: http://mywfs.org/request=GetCapabilities

• http://portal.opengeospatial.org/files/?artifact_id=31487
• Lowe & Woolf: EGU2009-10927, 18:30 Thursday
Open tool xxx

Available Feature Types

someFC:FTxxx
CSML:GridSeries

• http://portal.opengeospatial.org/files/?artifact_id=31487
• Lowe & Woolf: EGU2009-10927, 18:30 Thursday
Open tool xxx

FTxxx queries

queryA
queryB
queryC

featId: 1cf576b7
param1: 25.3
param2: intersect

http://portal.opengeospatial.org/files/?artifact_id=31487
Lowe & Woolf: EGU2009-10927, 18:30 Thursday
Open tool xxx

CSML:GridSeries queries

subsetProfile
subsetPointSeries
subsetProfileSeries

atLocOf: 12ace5b9

• http://portal.opengeospatial.org/files/?artifact_id=31487
• Lowe & Woolf: EGU2009-10927, 18:30 Thursday
WFS - encoding

- ISO/TS 19129 “Imagery, gridded and coverage data framework”

Distinguishes *logical content* from *exchange format* and *mappings* between them (*GML* can mediate)

- Application schema also for coverage-based data
Encoding

• Model (‘GML wrapper’):
  – GML feature ‘skeleton’ (e.g. CSML)
  – Binary file ‘flesh’ (e.g. netCDF)
  – xlink for mappings
    • xlink:href = file resource
    • xlink:role = nature of resource (‘CF-netCDF’)
    • xlink:arcrole = nature of xlink (‘embed content’)

• OGC 07-083: “Use of xlink in GML – Profile for file-based data content” link
• INSPIRE D2.7: “Guidelines for the encoding of spatial data”, Annex C (Encoding of file-based data) link
Encoding

• What about irregular grids?
  – Need GML implementation of ISO 19123 CV_ReferenceableGrid
    • OGC 06-160: our original proposal
    • OGC 07-040: Galdos alternative
    • OGC 07-112: combined proposal [link]
    • Compatible with CF-netCDF ‘coordinate variables’
  – Currently being considered by GML SWG
Climatological parameters?

• SWE Common ‘Property model’
Climatological parameters?

- SWE Common ‘Property model’

```class Figure: phenomenon
PropertyType
ConstrainedPropertyType
+ singleConstraint: TypedValue [0..*]
+ otherConstraint: CharacterString [0..*]

CompoundPropertyType
+ dimension: Integer

PropertyTypeSeries
+ constraintList: Sequence<TypedValue> [1..*]
+ otherConstraint: CharacterString [0..*]

CompositePropertyType

PropertyType
```

otherConstraint for statistical operator (e.g. *point*, *sum*, *mean*, *maximum*, *minimum*, *mid_range*, *standard_deviation*, *variance*, *mode*, and *median*)
Climatological parameters?

- SWE Common ‘Property model’
Climatological parameters?

- E.g. January 2007 maximum temperature

```xml
<swe:ConstrainedPhenomenon gml:id="Jan2007MaxTemp">
  <gml:identifier codeSpace="http://ndg.nerc.ac.uk">January 2007 maximum temperature</gml:identifier>
  <swe:base xlink:href="urn:ndg:cf:air_temperature"/>
  <swe:otherConstraint>maximum</swe:otherConstraint>
  <swe:singleConstraint>
    <swe:TypedValue>
      <swe:property codeSpace="http://ndg.nerc.ac.uk">time</swe:property>
    </swe:TypedValue>
  </swe:singleConstraint>
</swe:ConstrainedPhenomenon>
```
Climatological parameters?

- E.g. January 2007 maximum temperature

```
<swe:ConstrainedPhenomenon gml:id="Jan2007MaxTemp">
  <gml:identifier codeSpace="http://ndg.nerc.ac.uk">January 2007 maximum temperature</gml:identifier>
  <swe:base xlink:href="urn:ndg:cf:air_temperature"/>
  <swe:otherConstraint>maximum</swe:otherConstraint>
  <swe:singleConstraint>
    <swe:TypedValue>
      <swe:property codeSpace="http://ndg.nerc.ac.uk">time</swe:property>
    </swe:TypedValue>
  </swe:singleConstraint>
</swe:ConstrainedPhenomenon>
```
Climatological parameters?

- E.g. January 2007 maximum temperature

```xml
<swe:ConstrainedPhenomenon gml:id="Jan2007MaxTemp">
  <gml:identifier codeSpace="http://ndg.nerc.ac.uk">January 2007 maximum temperature</gml:identifier>
  <swe:base xlink:href="urn:ndg:cf:air_temperature"/>
  <swe:otherConstraint>maximum</swe:otherConstraint>
  <swe:singleConstraint>
    <swe:TypedValue>
      <swe:property codeSpace="http://ndg.nerc.ac.uk">time</swe:property>
    </swe:TypedValue>
  </swe:singleConstraint>
</swe:ConstrainedPhenomenon>
```

**Air temperature** constrained by **maximum** operator.
Climatological parameters?

- E.g. January 2007 maximum temperature

```xml
<swe:ConstrainedPhenomenon gml:id="Jan2007MaxTemp">
  <gml:identifier codeSpace="http://ndg.nerc.ac.uk">January 2007 maximum temperature</gml:identifier>
  <swe:base xlink:href="urn:ndg:cf:air_temperature"/>
  <swe:otherConstraint>maximum</swe:otherConstraint>
  <swe:singleConstraint>
    <swe:TypedValue>
      <swe:property codeSpace="http://ndg.nerc.ac.uk">time</swe:property>
    </swe:TypedValue>
  </swe:singleConstraint>
</swe:ConstrainedPhenomenon>
```

air temperature constrained by maximum operator over January 2007
Climatological parameters?

• What about ‘climatological calendars’?
  – induce a ‘multi-component’ range
    • summer (DJF), autumn (MAM), winter (JJA), spring (SON)
    • Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
    • 00:00, 01:00, 02:00, 03:00, ..., 21:00, 22:00, 23:00
  – how to model them?
    • TM_OrdinalReferenceSystem with set of component
      TM_OrdinalEras for climatological intervals
    • TM_OrdinalEras topologically connected

http://portal.opengeospatial.org/files/?artifact_id=25716
ERA40
The ECMWF ERA-40 Re-Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project (1979-1993). The broad objectives and partner organisations are presented in the ERA-40 background information.

badc.nerc.ac.uk  air_potential_temperature  GridSeries (xypt)

European Synoptic stations
Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.

badc.nerc.ac.uk  air_temperature  PointSeries (xyzt)
The ECMWF ERA-40 Re-Analysis Project consists of a number of climate datasets spanning the period mid-1957 to August 2002 using a consistent model. The data overlaps with the earlier ECMWF ERA-15 Re-analysis project. The broad objectives and partner organisations are presented in the ERA-40 background information.

**European Synoptic stations**

Hourly Surface data from 141 European stations for the period 1990-1996. Parameters include temperature, wind, rainfall, cloud cover etc.

badc.nerc.ac.uk  
air_temperature  
PointSeries (xyzt)

applicationProfile: WMS  
linkage: right click/copy
View services

- **Non-standard slices:**
  - vertical
    - `BBOX=110,-45,190,-45,1000,1000&ELEVATION=100/950`
  - Hovmöller
    - `BBOX=110,-45,190,-45,1000,1000&TIME=2004-08-01/2004-08-31`
### 3. GET MAP OPERATION

#### 3.1. Get Map Request

#### 3.1.1. Get Map request parameters

The Get Map request parameters listed in Table 5 shall be provided.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layers</td>
<td>List of layer names to be included in the map.</td>
</tr>
<tr>
<td>Styles</td>
<td>List of style to be used for each layer.</td>
</tr>
<tr>
<td>Coordinate Reference System</td>
<td>Coordinate Reference System of the map.</td>
</tr>
<tr>
<td>Bounding box</td>
<td>The 4 corner Coordinate of the two dimensional map for the selected Dimension pair and in the selected Coordinate Reference System</td>
</tr>
<tr>
<td>Image width</td>
<td>The map width in pixels</td>
</tr>
<tr>
<td>Image height</td>
<td>The map height in pixels</td>
</tr>
<tr>
<td>Image format</td>
<td>The output image format.</td>
</tr>
<tr>
<td>Language</td>
<td>language to be used for the response</td>
</tr>
<tr>
<td>Dimension Pair</td>
<td>The two dimensional axis to be used for the map</td>
</tr>
<tr>
<td></td>
<td>For example a geographical dimension and time</td>
</tr>
</tbody>
</table>
View services

• INSPIRE draft IR

Our comments on v2:
Suggest adding the following text: “For three-dimensional and/or temporally-varying data, the view service shall support geometry selection over a vertical or temporal axis. NOTE: The WMS interface allows such geometry selection. E.g. a vertical slice can be generated using the ELEVATION parameter and a BBOX such as BBOX=X,y0,X,y1 (for a y-z slice); an x-t slice could be generated, for instance, using TIME=t1/t2 and BBOX=x0,Y,x1,Y.”

<table>
<thead>
<tr>
<th>INSPIRE</th>
<th>Reference: D3.7.2 Draft Implementing Rule View Service v3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008-10-29</td>
</tr>
</tbody>
</table>

2.3.3 Temporal data dimension
Following Article 8.2.d of the directive, the View Service shall address the temporal aspect of the data. Therefore for data themes with a temporal component the View Service shall allow visualizing the temporal dimension. Different ways of supporting are possible (using the time line to browse through temporal snapshots of 2-D representations of the data theme, allowing time slices along the x-t, y-t or the z-t axis and presenting the result as a 2-D representation...).

2.3.4 Other dimensions selection and display
For three-dimensional data, the View Service shall support selection over a third dimension axis.
Summary

• Powerful new functionality becoming available through standards
  – metadata interoperability
  – data interoperability
    • common data model
    • common query model
    • standardised encodings
  – service interoperability
Questions?

• D Lowe et. al., “Standards Challenges in the Climate Sciences”, AGU Fall Meeting, San Diego, Dec 2006., *Eos Trans. AGU, 87*(52), Fall Meet. Suppl., Abstract IN43C-0916
• A Woolf et. al., “Data integration with the Climate Science Modelling Language”, *Adv. in Geosci.* **8**(1), 83-90 (2006)