



Enhanced Support of OGC's
Web Coverage Service
(WCS) in MapServer 6.0

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Outline

- Short Overview WCS Standard
- Tips, Tricks, and Examples for Real-world Usage
 - MapServer Configuration
 - WCS Requests/Responses
- Related & Future Work
 - OGC CITE Testing
 - EO-WCS

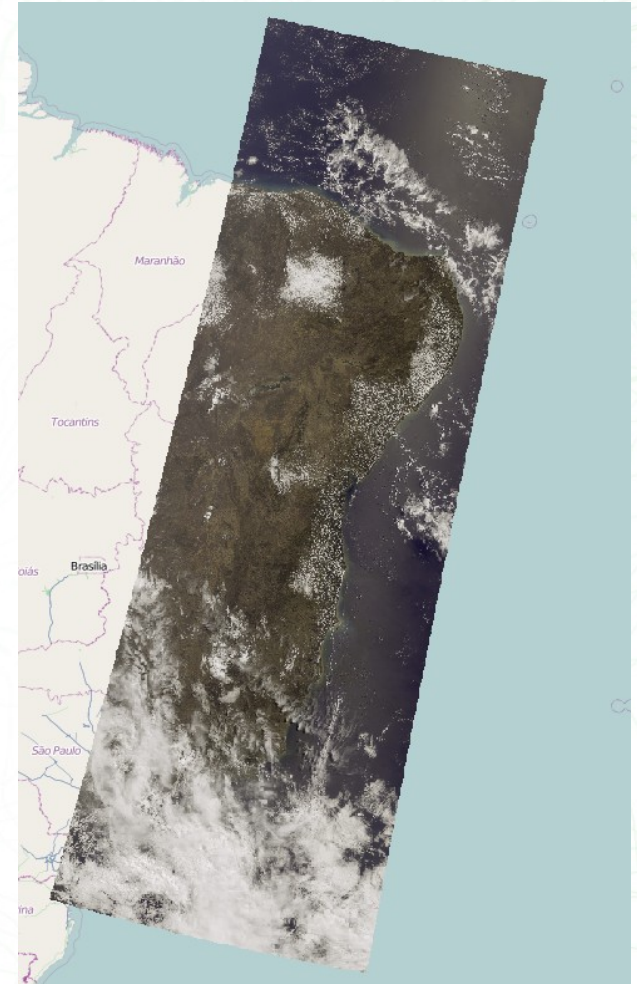
Short Overview WCS Standard

- OGC mandated standard; latest version 2.0
- Access to coverage data; rasters in MapServer
- 3 request types
 - GetCapabilities
 - DescribeCoverage
 - GetCoverage
- WCS 2.0
 - New: Adopts harmonized GML coverage model
 - New: Uses core and extensions model



Demo Data

- ENVISAT MERIS Scene
 - Provided by ESA 
 - 15 bands
 - float32



MapServer Configuration

- http://mapserver.org/ogc/wcs_server.html
- Requires PROJ.4, GDAL, and libxml2
- Mapfile Configuration
 - Layer <> Coverage
 - Mandatory settings
 - Metadata
 - Output-format declaration

LAYER

NAME demo_coverage

TYPE raster

DUMP TRUE

DATA some.tif

PROJECTION

"init=EPSG:4326"

END

METADATA

...

END #METADATA

END #LAYER

METADATA

```
"ows_extent" "-49.4558220 -29.1119298 -31.5993389 3.4252470"  
"wcs_size" "639 1165"  
"ows_srs" "EPSG:4326 EPSG:3035"  
"wcs_label" "Test label"  
"wcs_formats" "GEOTIFF_float PNG"  
"wcs_nativeformat" "GeoTIFF"  
"wcs_description" "Test description"  
"wcs_imagemode" "FLOAT32"  
"wcs_bandcount" "15"  
"wcs_rangeset_axes" "Band1 Band2 ..."  
"wcs_rangeset_name" "ENVISAT MERIS"  
"wcs_rangeset_label" "Bands"  
"wcs_rangeset_description" "Bands from ENVISAT MERIS"  
END #METADATA
```

...

"wcs_bandcount" "15"

"wcs_band_names" "Band1 Band2 ..."

"wcs_band_interpretation" "Default interpretation"

"wcs_band_uom" "W.m-2.Sr-1"

"wcs_band_definition" "DefaultDefinition"

"wcs_band_description" "Bands from ENVISAT MERIS"

"wcs_interval" "-3.4028e+38 3.4028e+38"

"wcs_significant_figures" "12"

"wcs_nilvalues" "0"

"wcs_nilvalues_reasons" "<http://www.opengis.net/def/nil/OGC/0/unknown>"

"Band1_band_interpretation" "This is some interpretation"

"Band1_band_uom" "SomeUOM"

"Band1_band_definition" "SomeDefinition"

"Band1_band_description" "This is some description"

"Band1_interval" "0 255"

Output-format Declaration

```
OUTPUTFORMAT  
NAME GEOTIFF_float  
DRIVER "GDAL/GTiff"  
MIMETYPE "image/tiff"  
IMAGEMODE FLOAT32  
EXTENSION "tif"  
END
```

Output-format Declaration

```
OUTPUTFORMAT
NAME GEOTIFF_int
DRIVER "GDAL/GTiff"
MIMETYPE "image/tiff; bits=16"
IMAGEMODE INT16
FORMATOPTION "COMPRESS=LZW"
FORMATOPTION "TILED=YES"
EXTENSION "tif"
END
```

Output-format Declaration

```
OUTPUTFORMAT  
NAME AAIGRID  
DRIVER "GDAL/AAIGRID"  
MIMETYPE "image/x-aaigrid"  
IMAGEMODE FLOAT32  
FORMATOPTION "DECIMAL_PRECISION=4"  
EXTENSION "grd"  
END
```

Output-format Declaration

```
OUTPUTFORMAT  
NAME PNG  
DRIVER "AGG/PNG"  
MIMETYPE "image/png"  
IMAGEMODE RGB  
EXTENSION "png"  
END
```

GetCapabilities

```
http://someurl/wcs_demo?  
SERVICE=WCS&  
VERSION=2.0.0&  
REQUEST=GetCapabilities
```

```
<wcs:GetCapabilities  
  xmlns:wcs="http://www.opengis.  
  net/wcs/2.0" service="WCS"  
  version="2.0.0" />
```

GetCapabilities Response

```
<wcs:Capabilities
xmlns:wcs="http://www.opengis.net/wcs/2.0"
xmlns:ows="http://www.opengis.net/ows/2.0"
xmlns:ogc="http://www.opengis.net/ogc"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:gmlcov="http://www.opengis.net/gmlcov/1.0"
xmlns:swe="http://www.opengis.net/swe/2.0"
xsi:schemaLocation="http://www.opengis.net/wcs/2.0
http://schemas.opengis.net/wcs/2.0/wcsAll.xsd "
version="2.0.0" updateSequence="2011-09-08T16:30:00Z">
```

```
<wcs:Capabilities version="2.0.0" ...>
  <ows:ServiceIdentification>
    <ows:Title>Demonstration for FOSS4G 2011</ows:Title>
    <ows:Abstract>Abstract</ows:Abstract>
    <ows:Keywords>
      <ows:Keyword>WCS</ows:Keyword>
      <ows:Keyword>FOSS4G</ows:Keyword>
    </ows:Keywords>
    <ows:ServiceType codeSpace="OGC">OGC
WCS</ows:ServiceType>
    <ows:ServiceTypeVersion>2.0.0</ows:ServiceTypeVersion>
```

...

```
<ows:Profile>http://www.opengis.net/spec/WCS/2.0/conf/core</ows:Profile>
```

```
<ows:Profile>http://www.opengis.net/spec/WCS_protocol-binding_get-kvp/1.0/conf/get-kvp</ows:Profile>
```

```
<ows:Profile>http://www.opengis.net/spec/WCS_protocol-binding_post-xml/1.0/conf/post-xml</ows:Profile>
```

```
<ows:Profile>http://www.opengis.net/spec/WCS_service-model_crs-predefined/1.0/conf/crs-predefined</ows:Profile>
```

```
<ows:Profile>http://www.placeholder.com/IMAGECRS</ows:Profile>
```

```
<ows:Profile>http://www.opengis.net/spec/WCS_encoding_geotiff/1.0/conf/geotiff</ows:Profile>
```

```
<ows:Profile>http://www.placeholder.com/GML_and_GeoTIFF</ows:Profile>
```

```
<ows:Profile>http://www.opengis.net/spec/WCS_service-model_scaling+interpolation/1.0/conf/scaling+interpolation</ows:Profile>
```

```
<ows:Profile>http://www.opengis.net/spec/WCS_service-model_band-subsetting/1.0/conf/band-subsetting</ows:Profile>
```


...

```
<ows:Fees>NONE</ows:Fees>
<ows:AccessConstraints>NONE</ows:AccessConstraints>
</ows:ServiceIdentification>
<ows:ServiceProvider>
  <ows:ProviderName>OSGeo</ows:ProviderName>
  <ows:ProviderSite xlink:type="simple"
xlink:href="http://someurl/wcs_demo" />
  <ows:ServiceContact>
    <ows:IndividualName>...</ows:IndividualName>
    <ows:PositionName>...</ows:PositionName>
    <ows:ContactInfo>
      ...
    </ows:ContactInfo>
    <ows:Role>staff</ows:Role>
  </ows:ServiceContact>
</ows:ServiceProvider>
```

...

```
<ows:OperationsMetadata>
  <ows:Operation name="GetCapabilities">
    <ows:DCP>
      <ows:HTTP>
        <ows:Get xlink:type="simple"
xlink:href="http://someurl/wcs_demo?" />
        <ows:Post xlink:type="simple"
xlink:href="http://someurl/wcs_demo?">
          <ows:Constraint name="PostEncoding">
            <ows:AllowedValues>
              <ows:Value>XML</ows:Value>
            </ows:AllowedValues>
          </ows:Constraint>
        </ows:Post>
      </ows:HTTP>
    </ows:DCP>
  </ows:Operation>
```

...

```
<wcs:ServiceMetadata />
<wcs:Contents>
  <wcs:CoverageSummary>
    <wcs:CoverageId>demo_coverage</wcs:CoverageId>
  <wcs:CoverageSubtype>RectifiedGridCoverage</wcs:CoverageSubtype>
  </wcs:CoverageSummary>
  <wcs:CoverageSummary>
    <wcs:CoverageId>demo_coverage_2</wcs:CoverageId>
  <wcs:CoverageSubtype>RectifiedGridCoverage</wcs:CoverageSubtype>
  </wcs:CoverageSummary>
</wcs:Contents>
</wcs:Capabilities>
```

DescribeCoverage

```
http://someurl/wcs_demo?  
SERVICE=WCS&  
VERSION=1.0.0&  
REQUEST=DescribeCoverage&  
COVERAGE=demo_coverage
```

DescribeCoverage

```
http://someurl/wcs_demo?  
SERVICE=WCS&  
VERSION=1.1.0&  
REQUEST=DescribeCoverage&  
IDENTIFIER=demo_coverage
```

DescribeCoverage

```
http://someurl/wcs_demo?  
SERVICE=WCS&  
VERSION=2.0.0&  
REQUEST=DescribeCoverage&  
COVERAGEID=demo_coverage
```

```
<wcs:DescribeCoverage  
xmlns:wcs="http://www.opengis.net/wcs/2.0"  
version="2.0.0" service="WCS">  
  <wcs:coverageid>demo_coverage</wcs:coverageid>  
</wcs:DescribeCoverage>
```

DescribeCoverage Response

```
<wcs:CoverageDescriptions ...>
  <wcs:CoverageDescription gml:id="demo_coverage">
    <gml:boundedBy>
      <gml:Envelope
srsName="http://www.opengis.net/def/crs/EPSG/0/4326"
axisLabels="lat long" uomLabels="deg deg"
srsDimension="2">
        <gml:lowerCorner>-49.455822
-29.1119298</gml:lowerCorner>
        <gml:upperCorner>-31.5993389
3.425247</gml:upperCorner>
      </gml:Envelope>
    </gml:boundedBy>
    ...
  </wcs:CoverageDescription>
</wcs:CoverageDescriptions>
```

...

```
<wcs:CoverageId>demo_coverage</wcs:CoverageId>
<gml:domainSet>
  <gml:RectifiedGrid dimension="2"
gml:id="grid_demo_coverage">
  <gml:limits>
    <gml:GridEnvelope>
      <gml:low>0 0</gml:low>
      <gml:high>638 1164</gml:high>
    </gml:GridEnvelope>
  </gml:limits>
  <gml:axisLabels>lat long</gml:axisLabels>
  <gml:origin>
    <gml:Point gml:id="grid_origin_demo_coverage"
srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
      <gml:pos>-49.455822 3.425247</gml:pos>
    </gml:Point>
  </gml:origin>
```


...

```
<gml:domainSet>  
  <gml:RectifiedGrid>
```

...

```
    <gml:offsetVector
```

```
      srsName="http://www.opengis.net/def/crs/EPSG/0/4326">0.0  
      27944 0</gml:offsetVector>
```

```
    <gml:offsetVector
```

```
      srsName="http://www.opengis.net/def/crs/EPSG/0/4326">0  
      -0.027929</gml:offsetVector>
```

```
    </gml:RectifiedGrid>
```

```
  </gml:domainSet>
```

```
<gmlcov:rangeType>
  <swe:DataRecord>
    <swe:field name="Band1">
      <swe:Quantity definition="DefaultDefinition">
        <swe:description>Test description</swe:description>
        <swe:nilValues>
          <swe:NilValues>
            <swe:nilValue reason="http://www.opengis.net/def/
nil/OGC/0/unknown">0</swe:nilValue>
          </swe:NilValues>
        </swe:nilValues>
        <swe:uom code="W.m-2.Sr-1"/>
        <swe:constraint>
          <swe:AllowedValues>
            <swe:interval>-3.4028e+38
3.4028e+38</swe:interval>
            <swe:significantFigures>12</swe:significantFigures>
          </swe:AllowedValues>
        </swe:constraint>
      </swe:Quantity>
    </swe:field>
  </swe:DataRecord>
</gmlcov:rangeType>
```

....

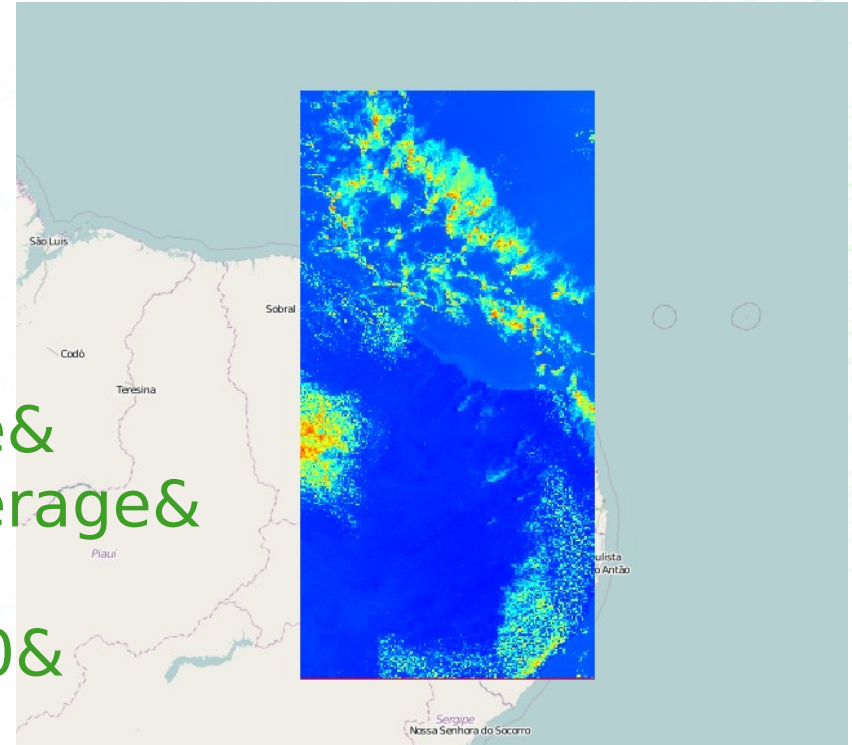
```
...
<wcs:ServiceParameters>
<wcs:CoverageSubtype>RectifiedGridCoverage</wcs:CoverageSubty
pe>
  <wcs:SupportedCRSs>
<wcs:SupportedCRS>http://www.opengis.net/def/crs/EPSSG/0/4326</w
cs:SupportedCRS>
<wcs:SupportedCRS>http://www.opengis.net/def/crs/EPSSG/0/3035</w
cs:SupportedCRS>
<wcs:NativeCRS>http://www.opengis.net/def/crs/EPSSG/0/4326</wcs:
NativeCRS>
  </wcs:SupportedCRSs>
  <wcs:SupportedFormats>
    <wcs:SupportedFormat>image/tiff</wcs:SupportedFormat>
    <wcs:SupportedFormat>image/png</wcs:SupportedFormat>
  </wcs:SupportedFormats>
</wcs:ServiceParameters>
</wcs:CoverageDescription>
</wcs:CoverageDescriptions>
```

Coverage Retrieval via GetCoverage

- Domain sub-setting in pixel or spatial coordinates
- Band sub-setting
- multipart/mixed responses including the GML coverage description
- Resizing
- Reprojecting
- Interpolation
- Protocol binding: KVP and XML/POST

Domain sub-setting

```
http://someurl/wcs_demo?  
SERVICE=WCS&  
VERSION=1.0.0&  
REQUEST=GetCoverage&  
COVERAGE=demo_coverage&  
FORMAT=image/tiff&  
BBOX=300,400,400,700&  
RESX=1&RESY=1&  
CRS=ImageCRS
```



Domain sub-setting

http://someurl/wcs_demo?

&SERVICE=WCS

&VERSION=1.1.0

&REQUEST=GetCoverage

&IDENTIFIER=demo_coverage

&FORMAT=image/tiff

&BOUNDINGBOX=300,400,400,700,

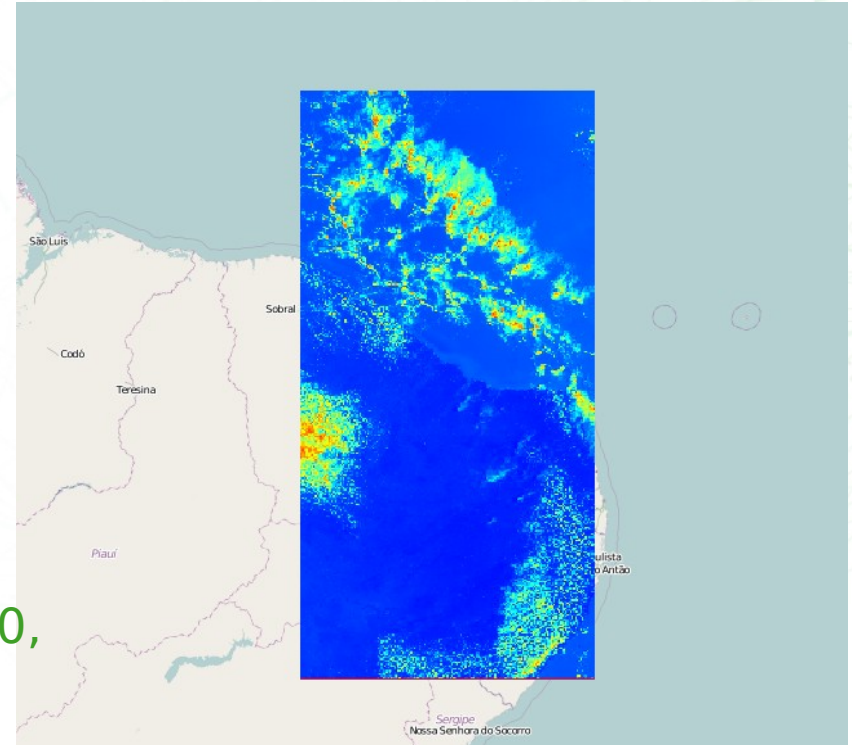
urn:ogc:def:crs:OGC::imageCRS

&GridCS=urn:ogc:def:crs:OGC::imageCRS

&GridType=urn:ogc:def:method:WCS:1.1:2dGridIn2dCrS

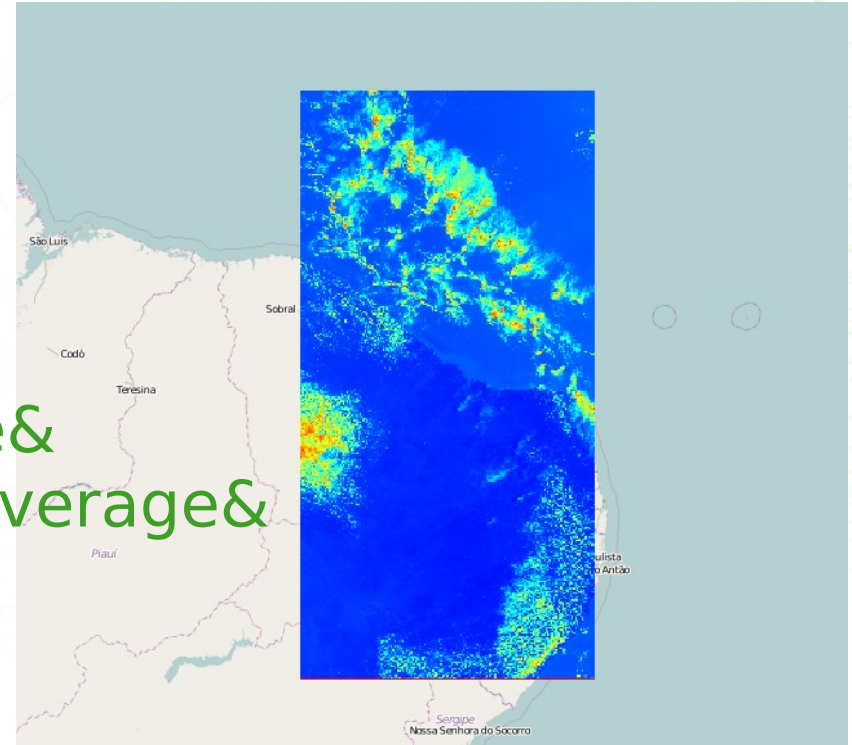
&GridOrigin=300,400

&GridOffsets=1,-1



Domain sub-setting

```
http://someurl/wcs_demo?  
SERVICE=WCS&  
VERSION=2.0.0&  
REQUEST=GetCoverage&  
COVERAGEID=demo_coverage&  
FORMAT=image/tiff&  
SUBSET=x(300,400)&  
SUBSET=y(400,700)
```



```
SUBSET=long,http://www.opengis.net/def/crs/EPSSG/0/4326(-40,-35)&  
SUBSET=lat,http://www.opengis.net/def/crs/EPSSG/0/4326(-10,0)
```

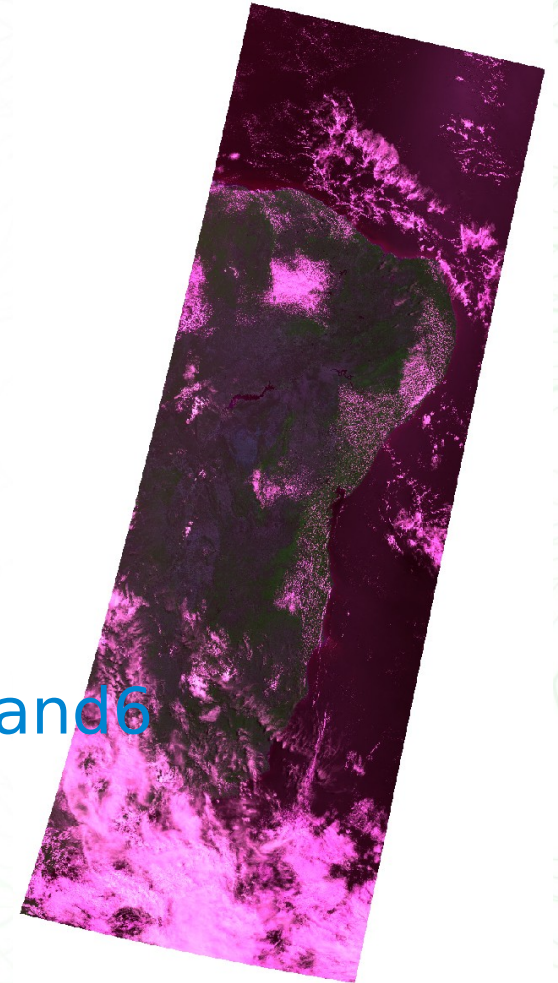
XML/POST binding

```
<wcs:GetCoverage
xmlns:wcs="http://www.opengis.net/wcs/2.0"
service="WCS" version="2.0.0">
  <wcs:Format>image/tiff</wcs:Format>
  <wcs:CoverageID>grey</wcs:CoverageID>
  <wcs:DimensionTrim>
    <wcs:Dimension>x</wcs:Dimension>
    <wcs:TrimLow>300</wcs:TrimLow>
    <wcs:TrimHigh>400</wcs:TrimHigh>
  </wcs:DimensionTrim>
</wcs:GetCoverage>
```


Band sub-setting

```
http://someurl/wcs_demo?  
SERVICE=WCS&  
VERSION=2.0.0&  
REQUEST=GetCoverage&  
COVERAGEID=demo_coverage&  
FORMAT=image/png&  
RANGESUBSET=Band4,Band15,Band6
```

```
RANGESUBSET=4,15,6
```



multipart/mixed Request

```
http://someurl/wcs_demo?  
SERVICE=WCS&  
VERSION=2.0.0&  
REQUEST=GetCoverage&  
COVERAGEID=demo_coverage&  
FORMAT=image/tiff&  
MEDIATYPE=multipart/mixed
```

multipart/mixed Responses

--WCS

Content-type: text/xml

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<gmlcov:RectifiedGridCoverage ... gml:id="demo_coverage">
  <gml:boundedBy>...</gml:boundedBy>
  <gml:domainSet>...</gml:domainSet>
  <gml:rangeSet>
    <gml:File>
      <gml:rangeParameters xlink:href="coverage/out.tif"
xlink:role="image/tiff" xlink:arcrole="fileReference"/>
      <gml:fileReference>coverage/out.tif</gml:fileReference>
      <gml:fileStructure/>
      <gml:mimeType>image/tiff</gml:mimeType>
    </gml:File>
  </gml:rangeSet>
  <gmlcov:rangeType>...</gmlcov:rangeType>
</gmlcov:RectifiedGridCoverage>
```

Content-Type: multipart/mixed; boundary=wcs

--WCS

Content-type: text/xml

...

--WCS

Content-Type: image/tiff

Content-Description: coverage data

Content-Transfer-Encoding: binary

Content-ID: coverage/out.tif

Content-Disposition: attachment; filename=out.tif

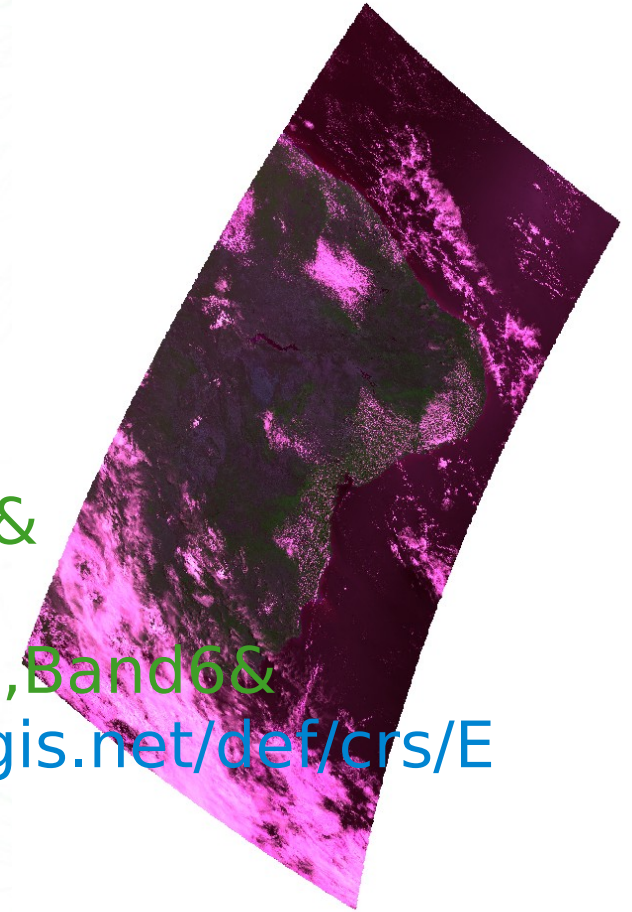
...

--WCS--

Reprojecting

```
http://someurl/wcs_demo?  
SERVICE=WCS&  
VERSION=2.0.0&  
REQUEST=GetCoverage&  
COVERAGEID=demo_coverage&  
FORMAT=image/png&  
RANGESUBSET=Band4,Band15,Band6&  
OUTPUTCRS=http://www.opengis.net/def/crs/EP  
SG/0/3035
```

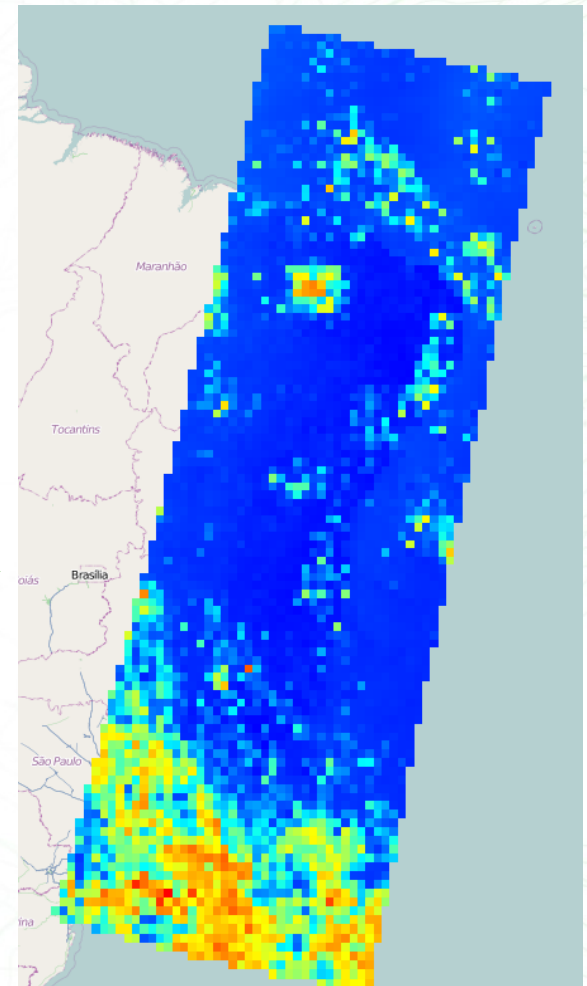
```
SUBSET=x,http://www.opengis.net/def/crs/EP  
SG/0/3035(-3000000,0)
```



Resizing

```
http://someurl/wcs_demo?  
SERVICE=WCS&  
VERSION=2.0.0&  
REQUEST=GetCoverage&  
COVERAGEID=demo_coverage&  
FORMAT=image/tiff&  
SIZE=x(64)&  
SIZE=y(117)
```

```
RESOLUTION=x(0.279)&  
RESOLUTION=y(0.279)
```



Interpolation

http://someurl/wcs_demo?

SERVICE=WCS&

VERSION=2.0.0&

REQUEST=GetCoverage&

COVERAGEID=demo_coverage&

FORMAT=image/tiff&

SIZE=x(64)&

SIZE=y(117)&

INTERPOLATION=NEAREST

INTERPOLATION=AVERAGE or BILINEAR



Related & Future Work

- OGC CITE testing
- Implementation of future extensions e.g. WCS-T
- Further coverage types
e.g. ReferenceableGridCoverage?
- WCS 2.0 Clients e.g. in GDAL
- Support INSPIRE download service?



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Related & Future Work: EO-WCS

- WCS 2.0 – Earth Observation Application Profile
- OGC candidate specification
- Adds EO metadata and spatio-temporal search on it with new operation DescribeEOCoverageSet
- Data structures:
 - Dataset = 2D "horizontal" EO Coverage
 - StitchedMosaic = homogeneous grouping; coverage itself
 - DatasetSeries = heterogeneous grouping

Related & Future Work: EO-WCS

- **EOxServer** <http://eoxserver.org>
- MIT-style license
- Written in Python
- Based on MapServer, Django, GDAL, SpatialLite or PostGIS, and PROJ.4.
- Adopts MapServer policies & procedures