



 Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Verkeer en Waterstaat

OGC Services for the KNMI precipitation radar

Demonstration of data exchange
between RIVM and KNMI using
OGC services

Maarten Plieger
Royal Netherlands Meteorological Institute (KNMI)
plieger@knmi.nl

Use of GIS/OGC standards in meteorology - 24 November 2009

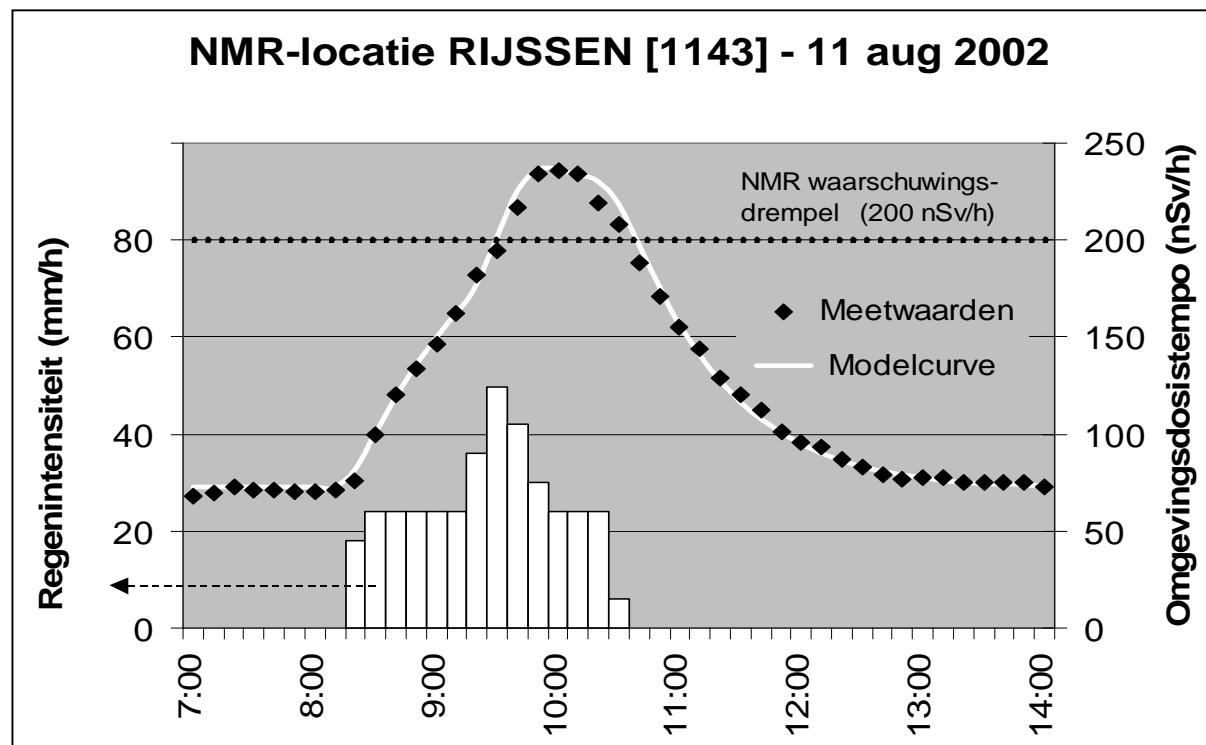


Introduction

- Problems and goals
- OGC Web Services
- ADAGUC data format (NetCDF4 CF)
- ADAGUC server
- Processing chain
- Usage statistics
- Conclusion



"Evaluation of elevated radiation levels can be improved by the incorporation of real time precipitation information"



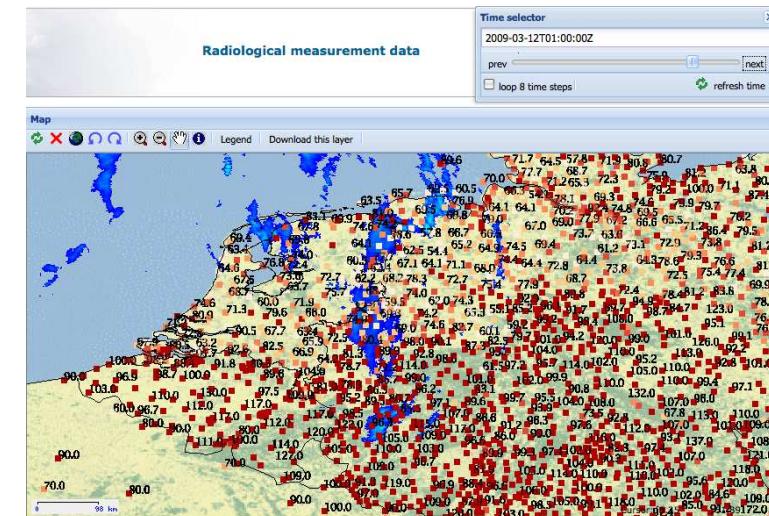
*Analysis of deposition after nuclear accidents:
highly influenced by precipitation*



Deliver precipitation radar through web services

From KNMI to RIVM
...and to the rest of the world

*as demonstration



Raymond Sluiter, **Maarten Plieger**, John van de Vegte (KNMI - Infra R&D)
Marnix de Ridder, Wouter Boasson (RIVM - LSO)



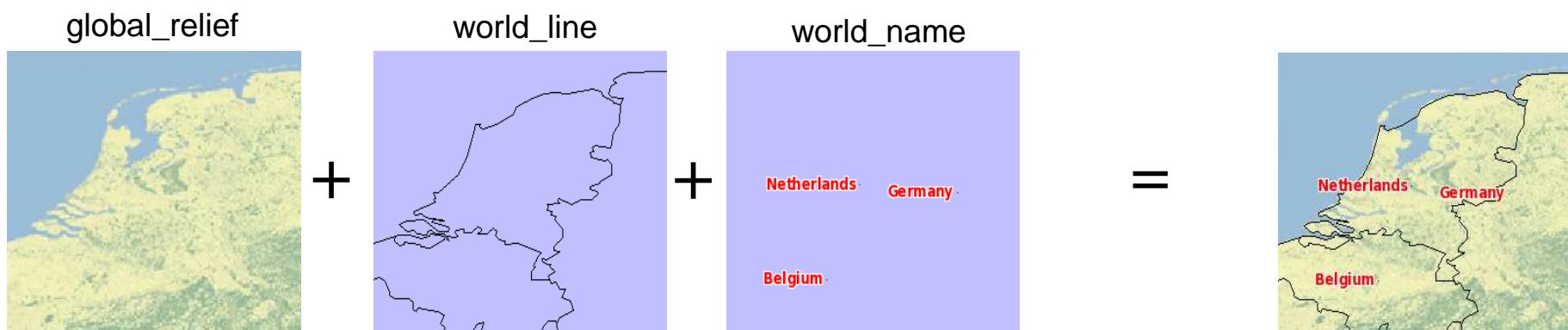
Introduction to OGC services

- OGC – Open Geospatial Consortium (www.opengeospatial.org)
 - >370 organizations
 - standards for geospatial content and services
 - GIS data processing and data sharing
- For ADAGUC
 - (Atmospheric Data Access for the Geospatial User Community):
 - Web Map Service (WMS) - for images
 - Web Feature Service (WFS) - for vector data
 - Web Coverage Service (WCS) - for raster data
- WMS is primarily for visualization
- WFS and WCS are for retrieval of data



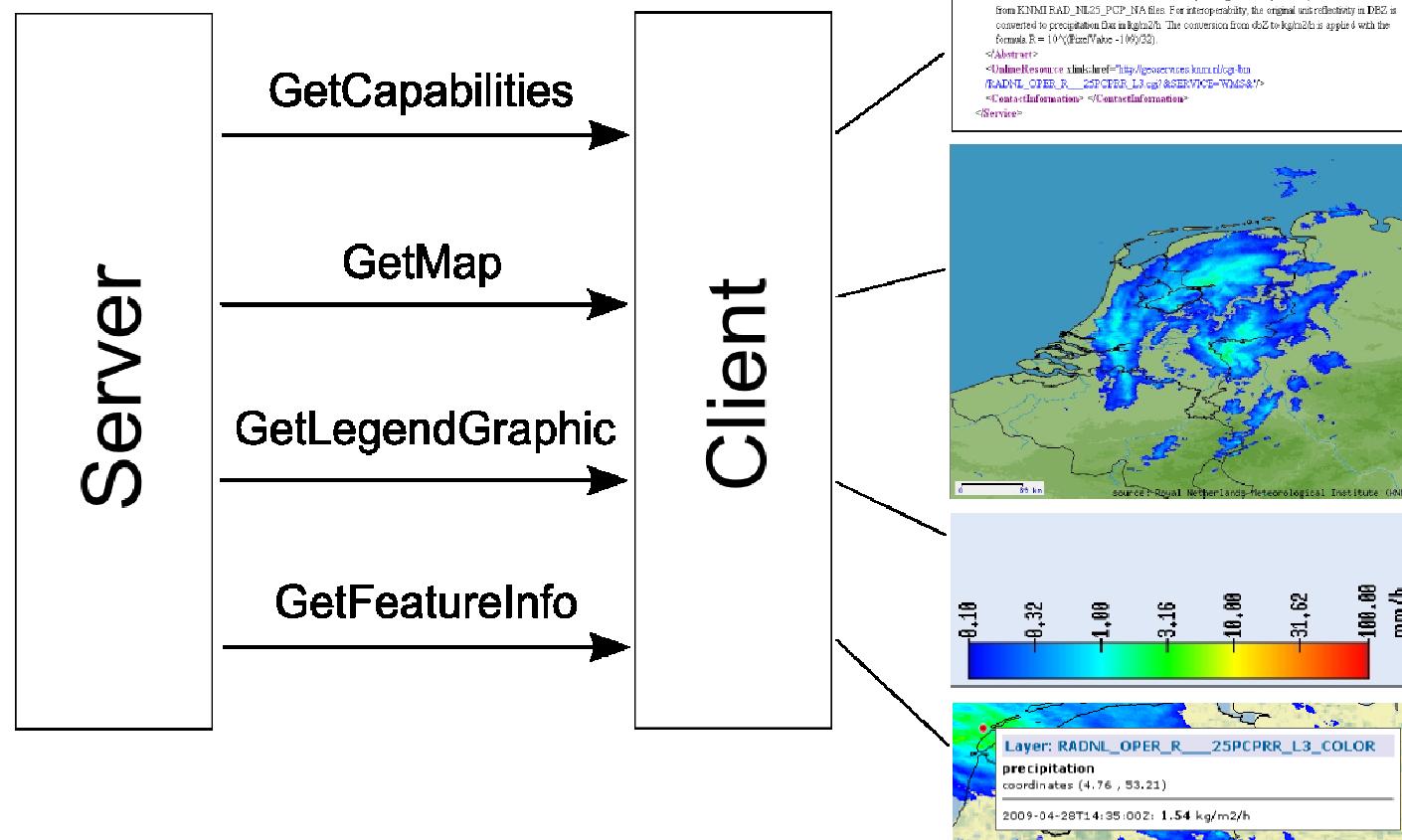
Web Mapping Service - WMS

- Visualization of data
- Select layer, region, width, height, format and a projection
- Server will format, reproject and rescale data to proper dimensions
- Images from different servers with different sizes, regions and projections can be combined



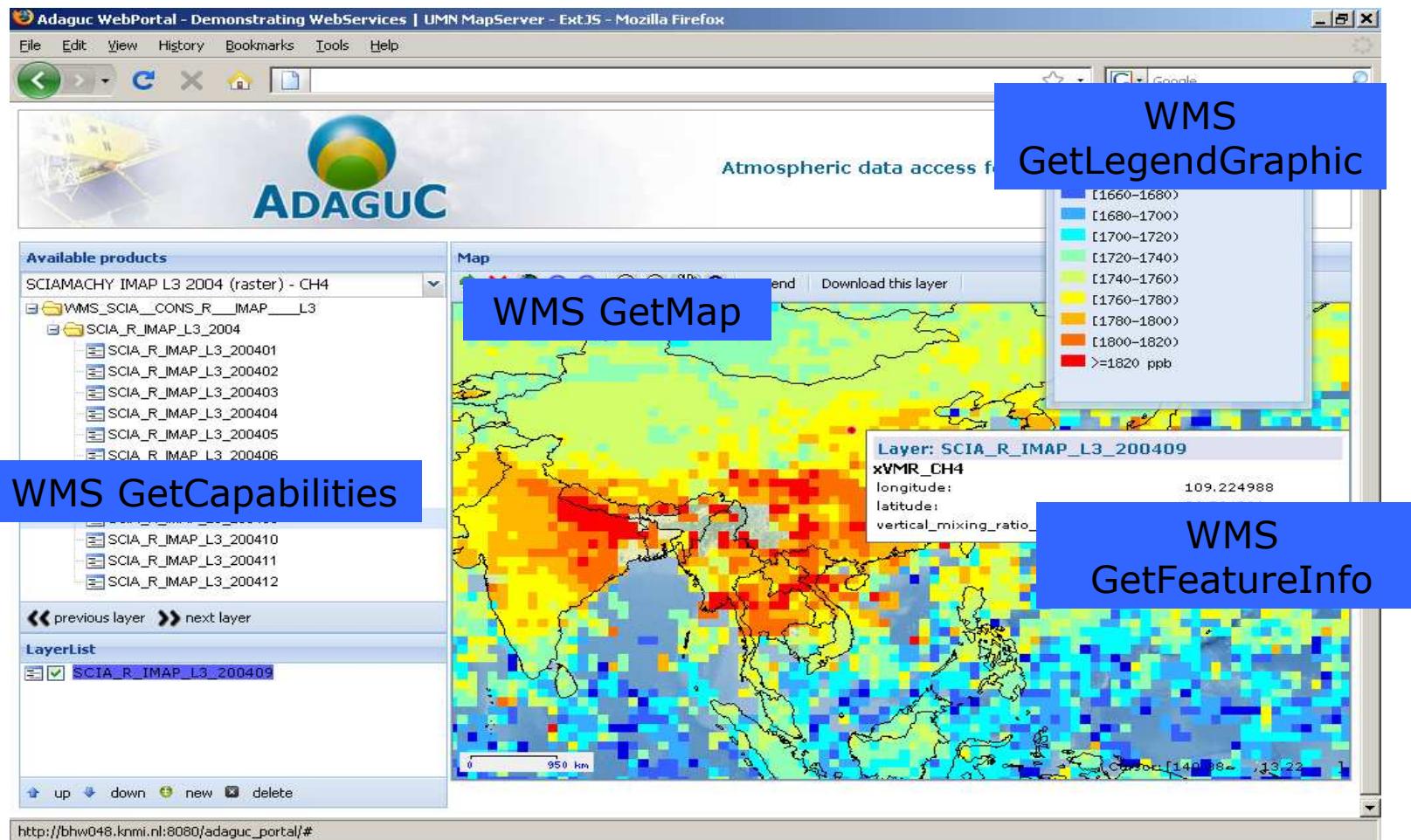


WMS Requests - overview





WMS Requests - ADAGUC Web Portal

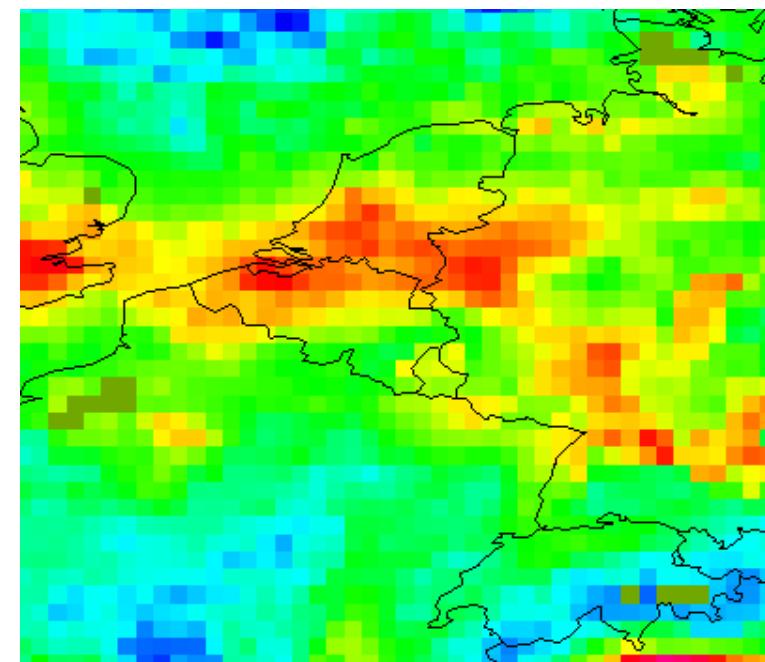
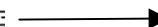




Web Coverage Service - WCS

- Web Coverage Service version 1.x is similar to WMS version 1.x
 - Used for returning observations in a regular spaced grid
 - Provides data in geotiff, ascii, netcdf, etc...

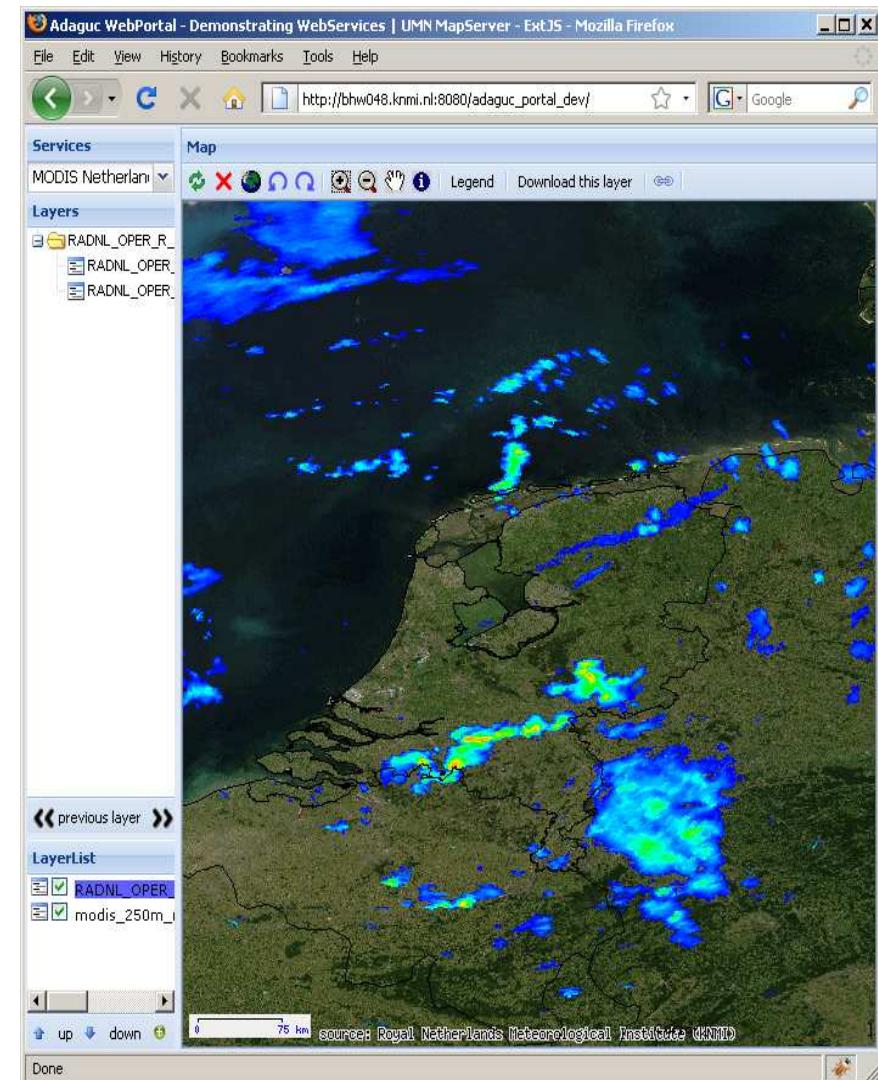
```
80 69 68 59 64 68 68 51 55 70 72 60 49 45 56 50 46  
34 26 46 52 59 67 45 41 36 48 66 54 53 55 42 38 38  
33 10 52 56 48 69 39 35 27 19 16 13 35 40 32 34 43  
61 51 54 77 81 65 39 34 54 51 54 40 17 24 35 34 9  
61 56 43 39 40 40 31 17 19 38 39 41 27 7 3 15 22 1  
41 49 58 54 41 18 20 29 47 48 40 53 57 38 25 27 25  
38 41 54 70 72 38 36 33 38 43 44 36 40 57 61 49 39  
20 17 36 48 45 37 45 47 49 46 42 35 36 29 33 42 38  
35 41 36 44 48 35 41 47 48 42 40 31 43 47 43 42 33  
49 44 32 43 52 50 52 48 35 41 31 23 26 33 36 36 33  
54 48 32 34 34 36 48 42 32 26 21 30 39 36 32 45 45  
40 37 33 44 47 43 41 39 28 27 22 26 47 58 58 35 29  
35 45 46 41 38 40 40 44 47 44 32 29 41 36 34 29 27  
38 38 41 37 41 41 39 38 41 45 33 38 49 51 45 35 28  
47 42 44 43 42 34 31 37 36 41 35 33 44 47 47 46 40  
17 30 26 31 40 36 23 30 32 43 48 44 45 41 23 26 40  
38 40 44 39 36 33 26 36 46 48 50 44 30 31 32 27 20  
42 36 39 44 41 42 39 39 46 38 48 54 51 47 46 42 25  
49 30 33 41 42 38 42 45 34 21 23 14 25 36 39 56 63  
47 41 35 29 36 50 45 38 39 29 37 48 42 44 33 27 30  
47 46 46 35 28 36 42 39 56 54 34 32 34 44 49 40 22  
40 39 48 48 29 12 24 38 49 54 43 25 23 35 45 42 26
```





KNMI Precipitation radar

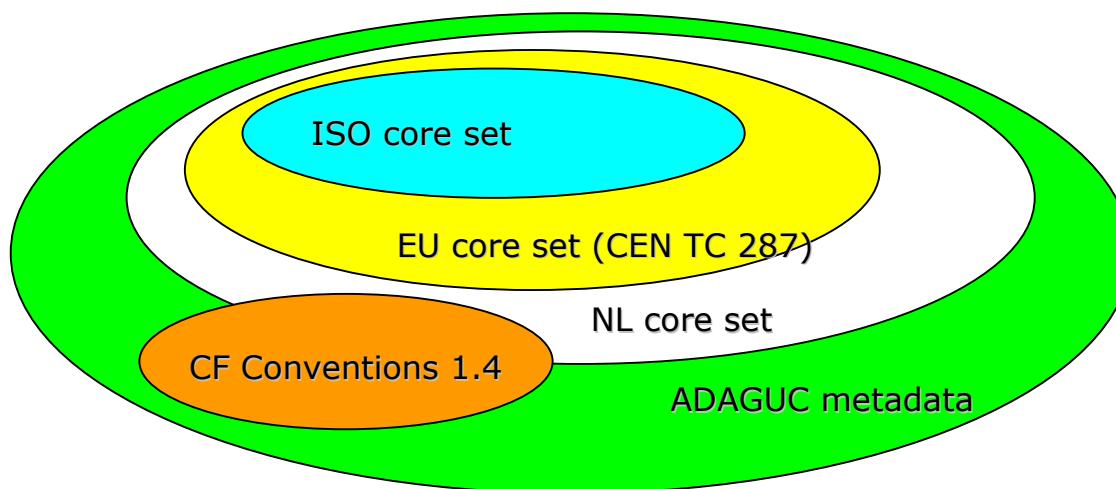
- Properties of RAD NL25PCP data:
 - HDF5 data files
 - Polar stereographic projection
 - Dimensions: 700 x 765 grid cells
 - Five minute time interval
 - Continuous stream
 - Near real time
- Requirements of the data server:
 - WMS / WCS time dimension
 - Dynamic update of the services





The ADAGUC file standard

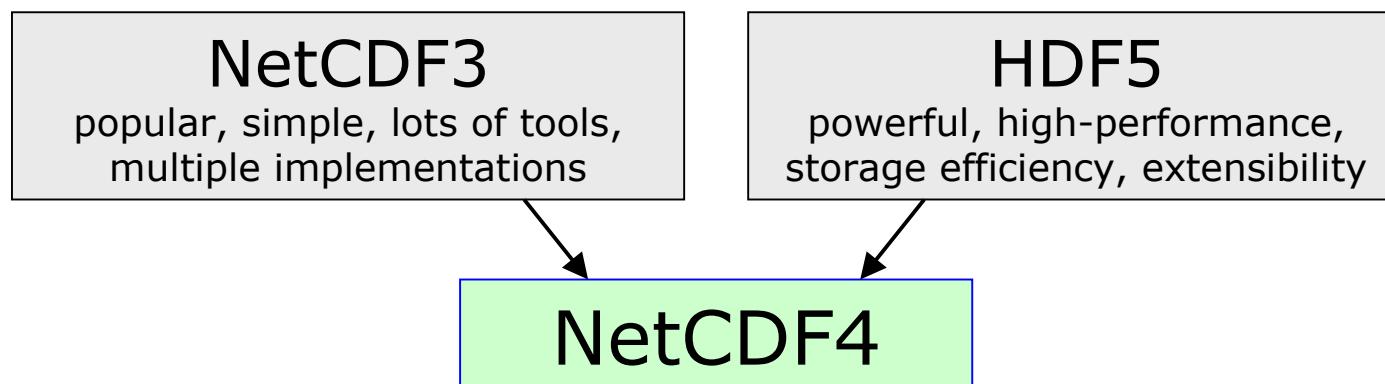
- Uses the NetCDF4 file format
- Metadata conventions:
 - INSPIRE compliant: ISO-19115,
 - NL kernset Metadata Standard
 - Climate and Forecast metadata conventions 1.4





Network Common Data Form 4 (NetCDF 4)

- Joint project between Unidata and HDF Group
- NetCDF 4 uses HDF5 as the storage layer of NetCDF
- Programming interfaces are backward compatible with the NetCDF3 programming interface

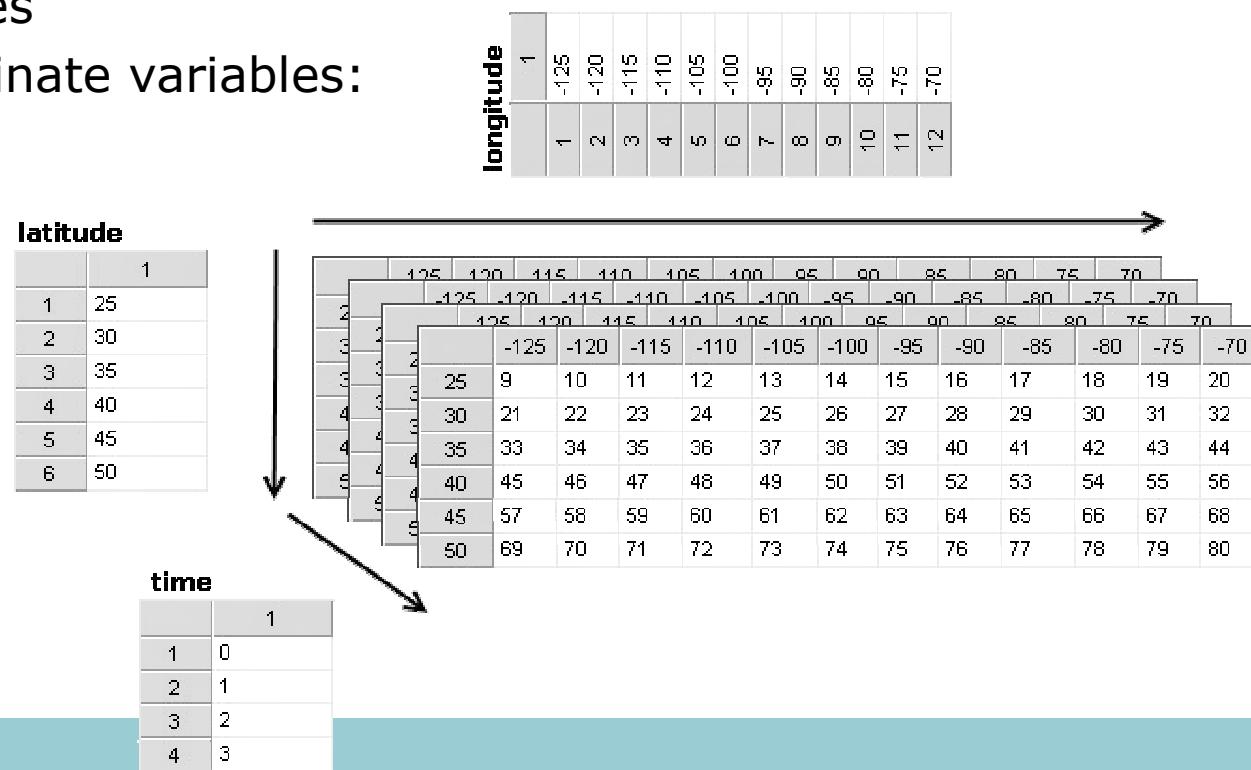


Best of both formats combined!



Climate & forecast (CF) conventions

- Standard names, standard units...
- Identify and compare data
- Locate data in space–time and as a function of other independent variables
- Coordinate variables:





ADAGUC Server

- Developed for making the KNMI precipitation radar available in OGC services
 - Suitable for all raster ADAGUC files (and certain NetCDF-CF files)
- Features:
 - WMS 1.0 and WMS 1.1.1 (visualization)
 - WCS 1.0 (data)
 - OGC WMS and WCS time dimension
 - Real-time update of data
 - Proj.4 projection strings in requests
 - Output in any format supported by GDAL
 - Animated gif
- Uses PostgreSQL database to keep track of available data
- Written in C++
- Configurable by using XML files



PostgreSQL to keep track of files

- Query:

```
select path from radnl_oper_r__25pcprr_13_knmi where time = '2009-04-05T17:25:00Z';
```

- Result of query:

```
/data/data2/storage/permanent/adaguc/RADNL_25PCPRR//1.0/2009/04/05/RADNL_OP  
ER_R__25PCPRR_L3__20090405T172500_20090405T173000_0001.nc  
(1 row)
```



WMS time dimension

- GetCapabilities fragment:

```
<Dimension name="time" units="ISO8601" />
<Extent name="time"
  default="2009-11-22T22:00:00Z"
  multipleValues="1"
  nearestValue="0">
  2009-03-27T13:50:00Z/2009-11-22T22:00:00Z/PT5M
</Extent>
```

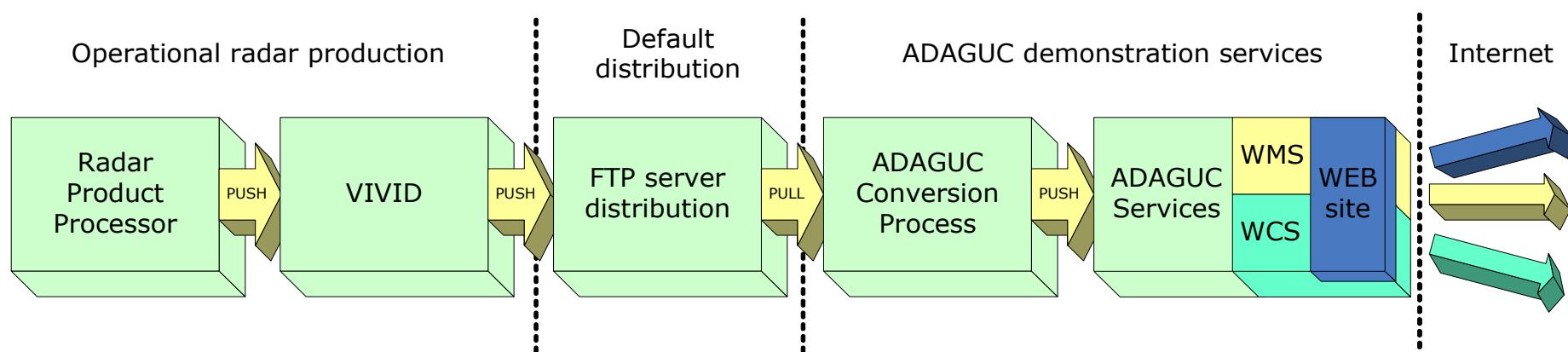
- GetMap fragment:

- &time=2009-10-01T12:05:00Z



Processing chain – from HDF5 to OGC services

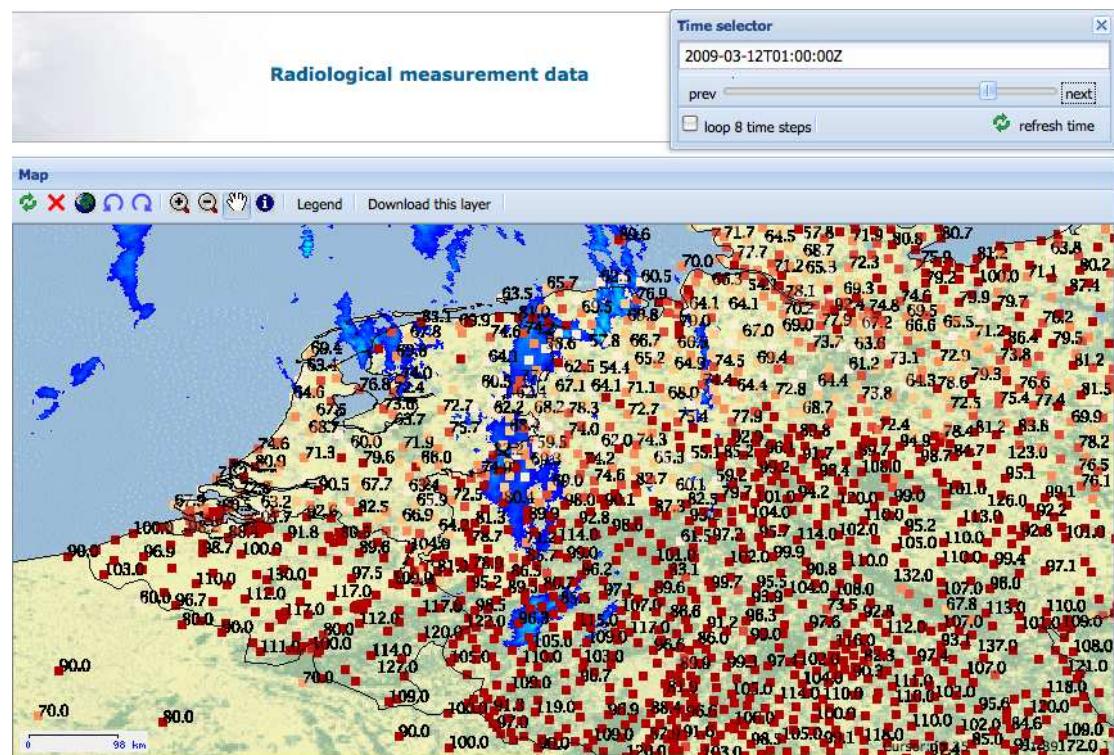
- Data converter in the NADC system:
 - KNMI HDF5 format → ADAGUC NetCDF4 format
 - Conversion from DBZ to mm/hour (CF metadata convention)
- NADC distributes the converted files to the ADAGUC web server
 - The PostgreSQL database is periodically updated with new radar files (cron)
 - The ADAGUC services use the database to specify the time range and to find the data files





Results

- KNMI Precipitation radar available using OGC services in real time
- ADAGUC web portal implemented at RIVM
- WMS is publicly available
- WCS only for RIVM and KNMI
- View measurements from the Nationaal Meetnet Radioactiviteit (NMR) in combination with the KNMI precipitation radar (RIVM only)



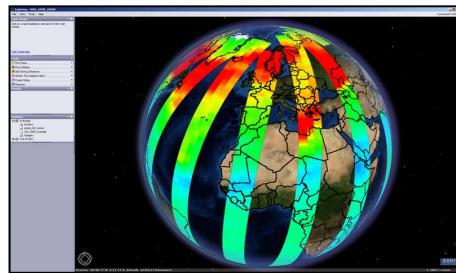


Statistics - Links from external pages

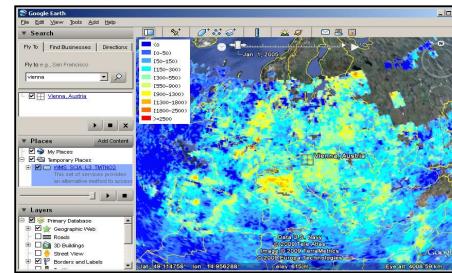
http://arcgis93.esri.nl/javaScriptAPI/wms/neerslagradar.html	247
http://arcgis93.esri.nl/flexviewer_wms/index.swf	190
http://bhw048.knmi.nl:8080/interpol/test.html	140
http://bhw143.knmi.nl:8085/HIM/	138
http://gistst03-s/adaguc_portal/	124
http://bhw143.knmi.nl/~vreedede/zichtkaart/AVW2.html	124
http://www.luchtvaartmeteo.nl/HIM/AVW2.html	111
http://www.esri.com/259CF16C-D2DD-4DFB-9B3D-C8EF74F95D6A	98
http://www.nationaalgeoregister.nl/geonetwork/srv/nl/main.home	90
http://www.esri.com/FF61B984-CF5B-4D03-B8C3-FEEE8E996A1F	86
http://intlvx.knmi.nl:8080/HIM/AVW2.html	80
http://www.esri.com/B8E15BA5-8388-4634-9C14-E6EB5C2F83FA	74
http://www.esri.com/8B7790DB-4278-41A4-A327-A9741B046C01	55
http://geoservices.falw.vu.nl/adaguc_portal_dev/	53
http://gistst03-s.rivm.nl/adaguc_portal/	47
http://geoservices.falw.vu.nl/adaguc_portal_new/	47
http://esribx0183/flexviewer_asr/index.swf	47
http://arcdemo/flexviewer_rotterdam/index.swf	45



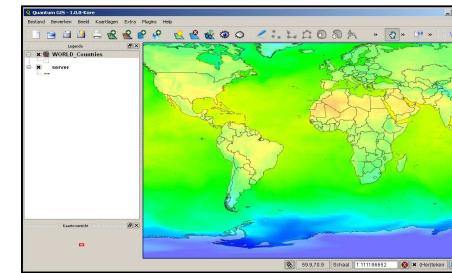
Other ADAGUC data in GIS programs



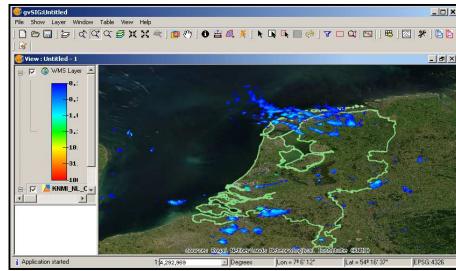
ArcGIS Explorer



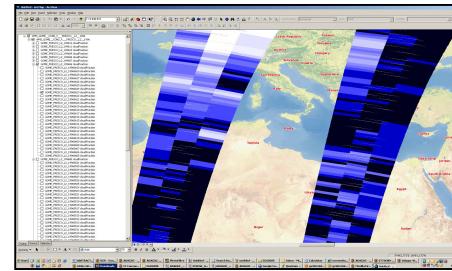
Google Earth



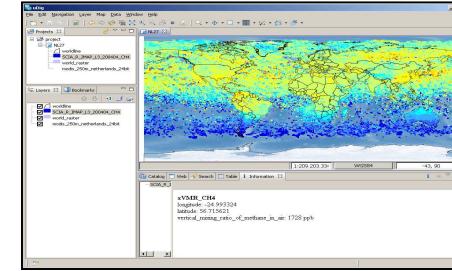
Quantum GIS



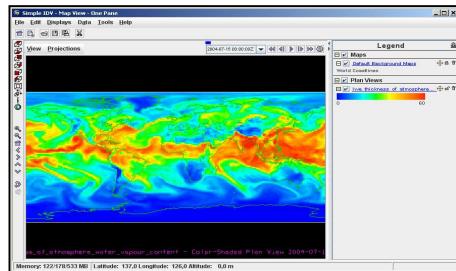
gvSIG



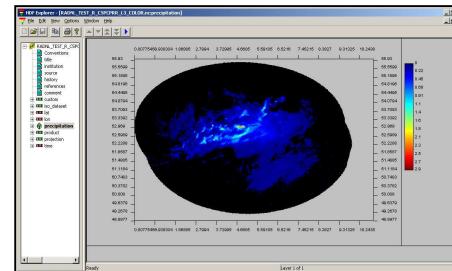
ArcGIS Desktop



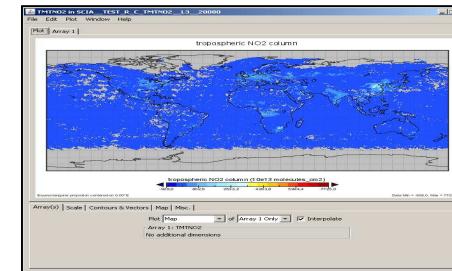
UDIG



IDV



HDF Explorer



NASA'S Panoply

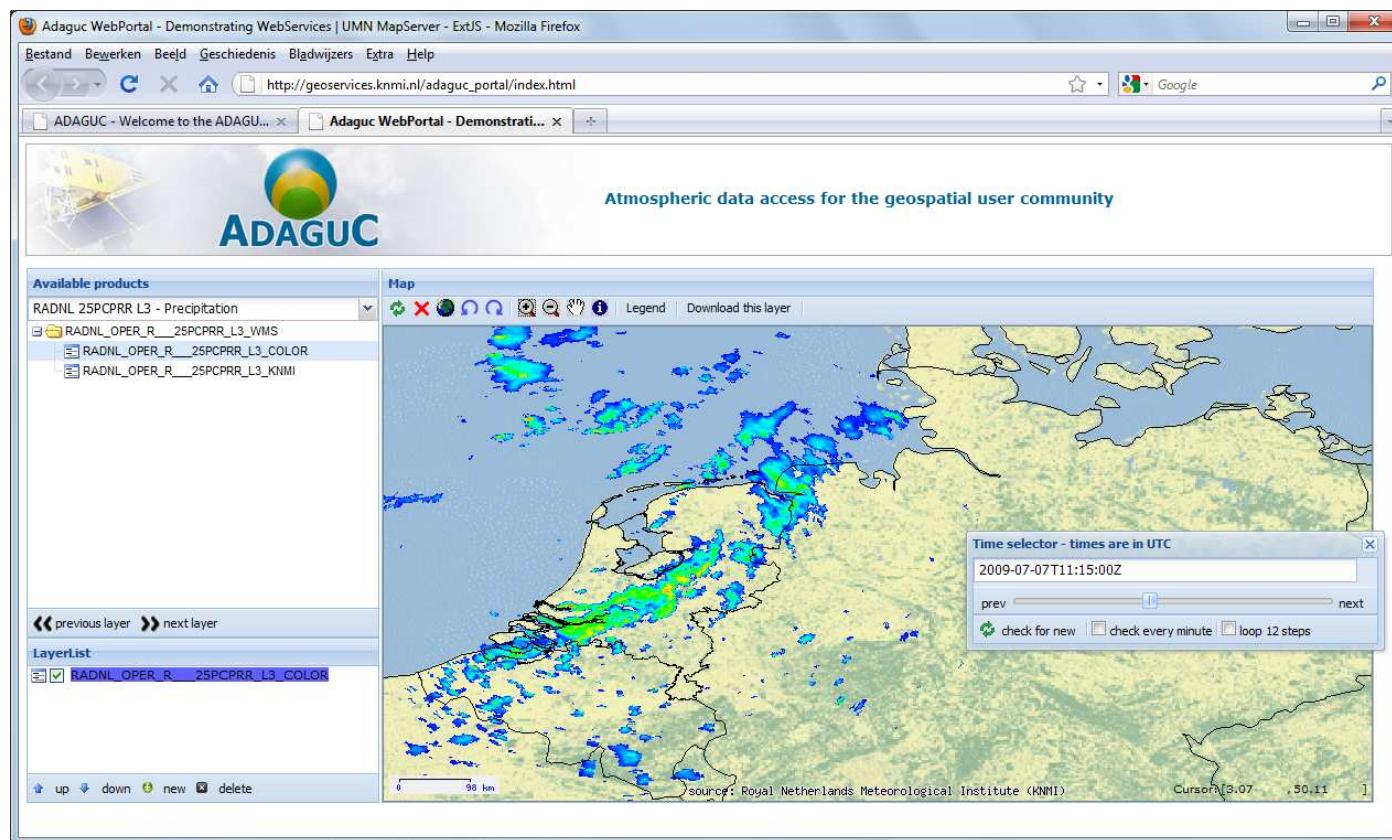


Conclusion

- Precipitation radar is available as OGC WMS and OGC WCS service
- ADAGUC server implemented with support for WMS and WCS
- Custom web portal built with support for WMS time using ExtJS and custom mapping component
- Gained experience with WMS and WCS time dimensions
- Efficient implementation of the file conversion and data distribution thanks to NADC
- The radar service is used internally and externally
- RIVM is happy !



Questions?



<http://adaguc.knmi.nl>