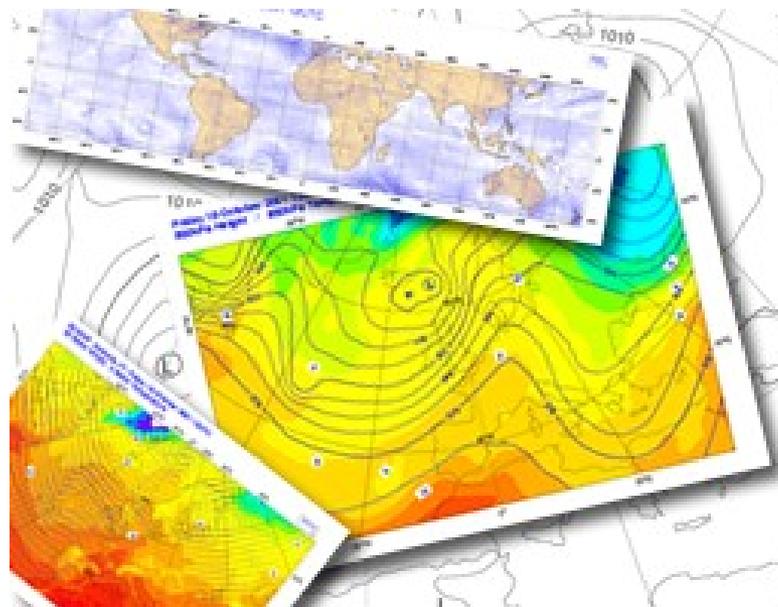# Mapping meteorological data beyond the meteorological domain

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Meteorological Visualisation Section

ECMWF

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# Meteorological maps

- **Who is interested in meteorological maps?**
  - Decision makers (fire services, civil protection)
  - Universities and schools

- **What are the challenges for a meteorological graphical software such as Magics?**

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What is Magics?

- **Graphics library to visualise meteorological data**

- **Meteorological- and object-oriented design; flexible to cope with model changes and new types of data**

- **Outputs are high quality technical maps**

  - **For forecasters, decision makers and researchers**

- **Various APIs: Fortran, C, Python, MagML/JSON**

- **Used in *Metview* and *ecCharts***

- **Freely available under Apache license**

- **Tested on various UNIX derivates**

- **Used in many weather services**
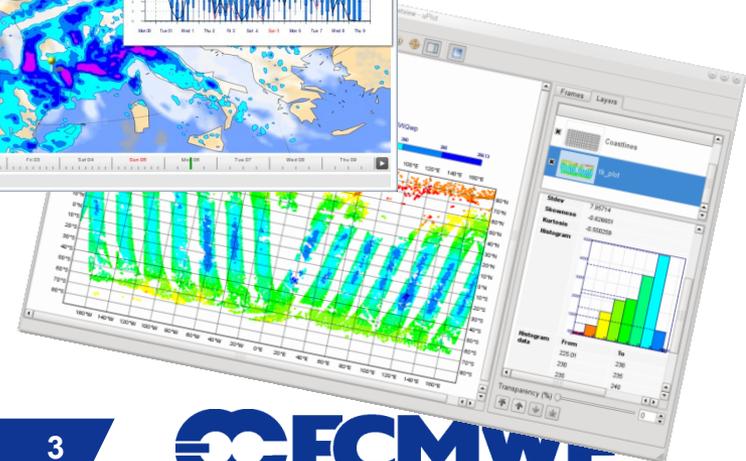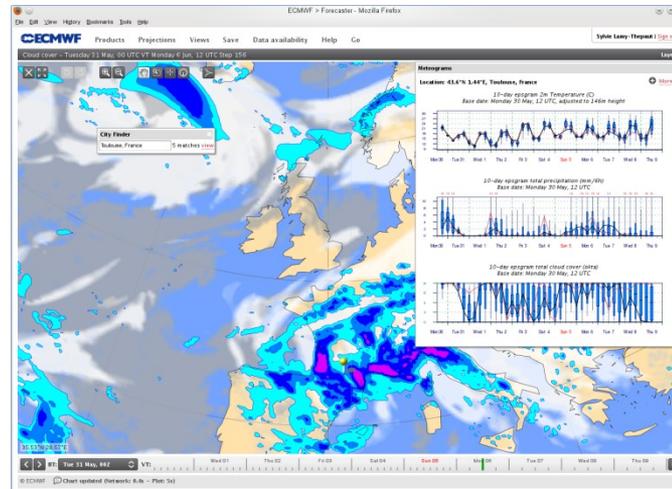
Magics black box

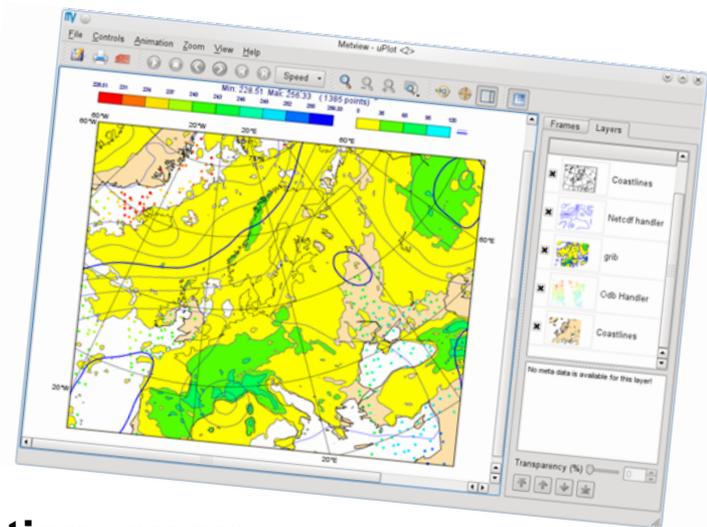- ## An Object-oriented approach :

  - **Each action or concept comes with a long list of parameters**

  - **The user defines and combines these actions and concepts to get a plot.**
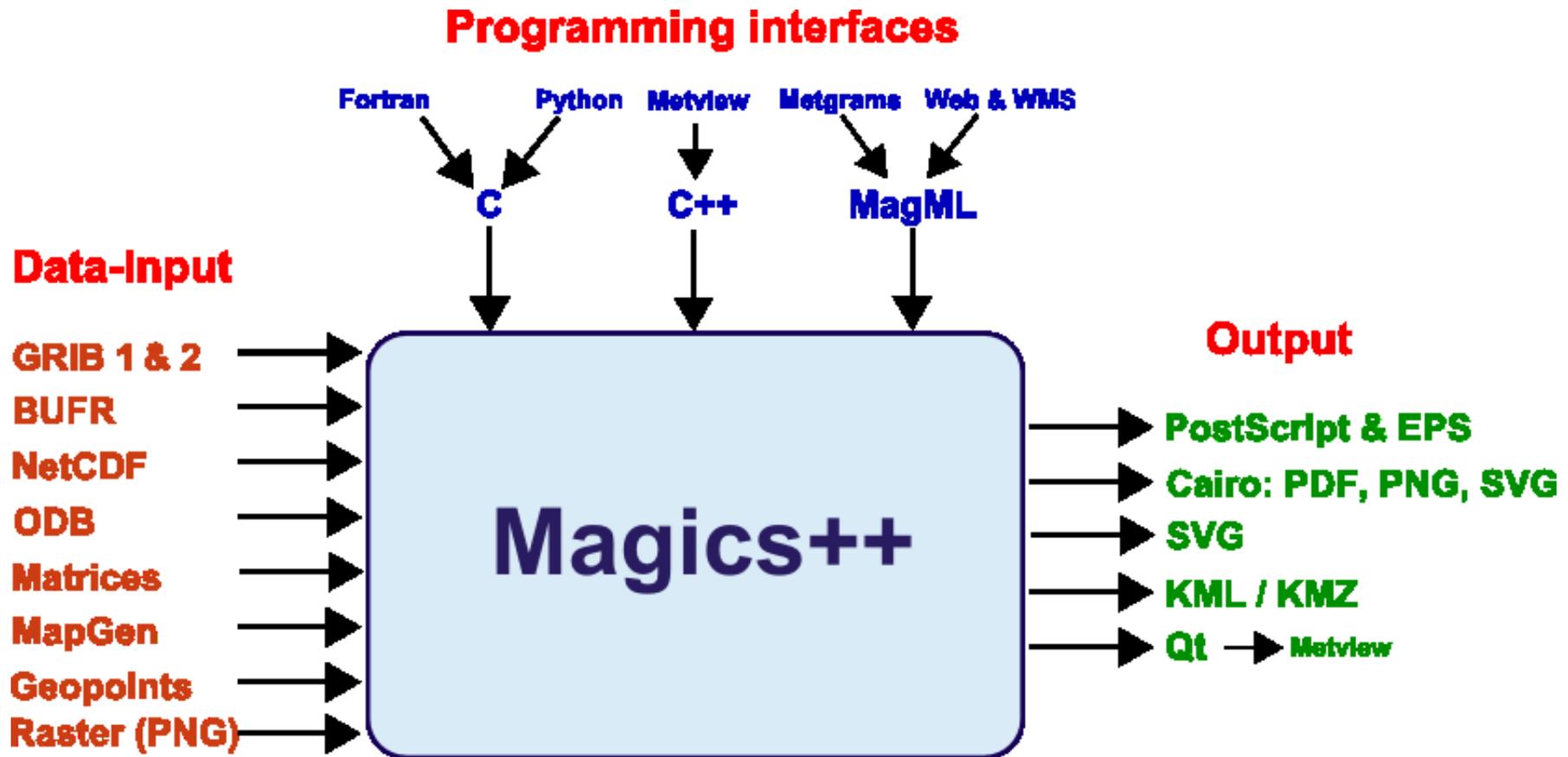
- ## Main concepts:

  - **Output : png/ps**

  - **Layout : dimensions**

  - **Geography : projection**

- ## Main Actions routines:

  - **Data Input: grib/NetCDF/BUFR**

  - **Visualisation: contouring, observation, curve**

  - **Foreground/background: Coastlines, grid**

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Magics black box

Programming interfaces

Fortran   Python   Metview   Metgrams   Web & WMS

C   C++   MagML

Data-Input

- GRIB 1 & 2
- BUFR
- NetCDF
- ODB
- Matrices
- MapGen
- Geopoints
- Raster (PNG)

Magics++

Output

- PostScript & EPS
- Cairo: PDF, PNG, SVG
- SVG
- KML / KMZ
- Qt → Metview

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What can Magics do?

- **High quality contouring**
  - **Automatic adaptation of the interpolation according to the displayed area**
  - **Multi-threading**
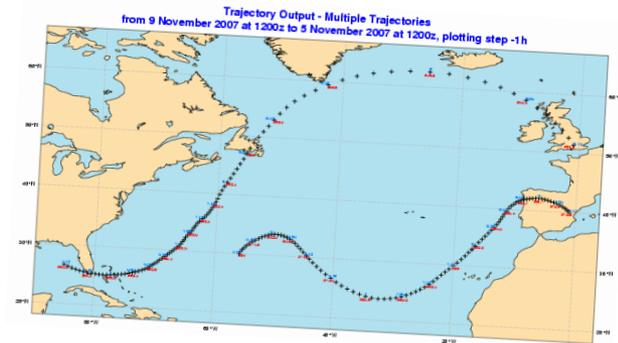 - **Experimentation on the boost-geometry library**
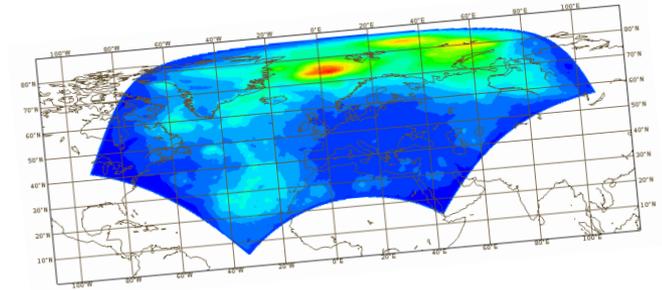
- **Automatic and user specified titles**
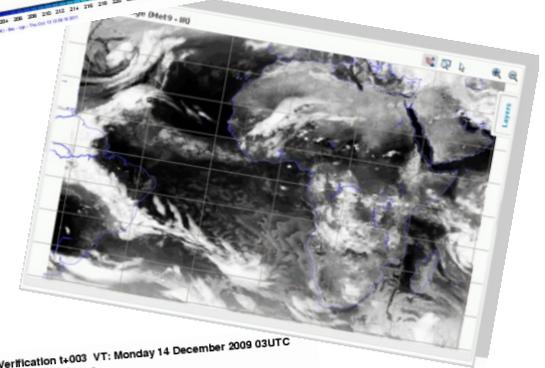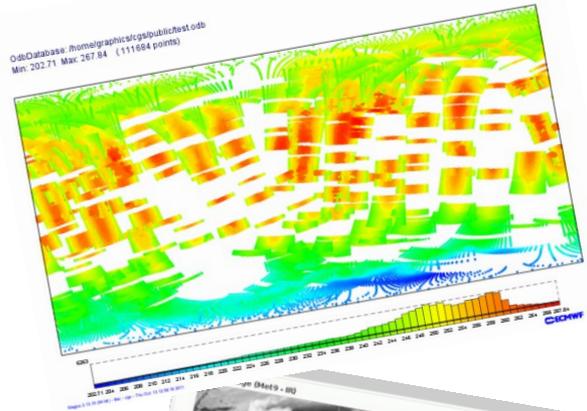 - **Use of the html convention to offer standard ways to specify titles**

   <grib_info key='param'/>
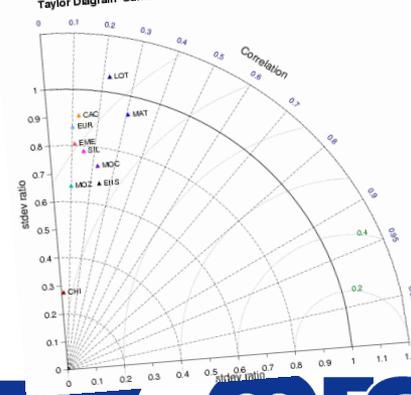
  <netcdf_info attribute='name'/>

What can Magics do?

Automatic legends

- **Histogram-style legend**

WMO observation plotting

- **Close cooperation with Meteo-France**
- **Using BUFR or Ascii format**

Display of satellite data

- **Close cooperation with INPE/CPTEC**

Supports geographical and Cartesian projections

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Making maps accessible to other domains?

- **We introduced a object-oriented python interface**

  - **Metview-like**

  - **Easy way for non-meteorologist to plot grib/netcdf but also numpy arrays.**

```python
import Magics.macro as magics

#Setting the output

output = magics.output(output_formats= ['kml '], output_name="z500")

#Setting the coordinates of the geographical area

north= magics.mmap(subpage_map_projection="polar_stereographic")

#Definition the input data

z500 =  magics.mgrib(grib_input_file_name="z500.grb")

#Define the contour attributes

Contour = magics.mcont(contour_line_colour="red")

#plot instruction

Magics.plot(output, north, z500, contour, magics.mcoast()
```

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Making maps accessible to other domains?

- **Use formats which can be easily integrated**

- **KML for Google Earth**
  - **Packaged in KMZ**
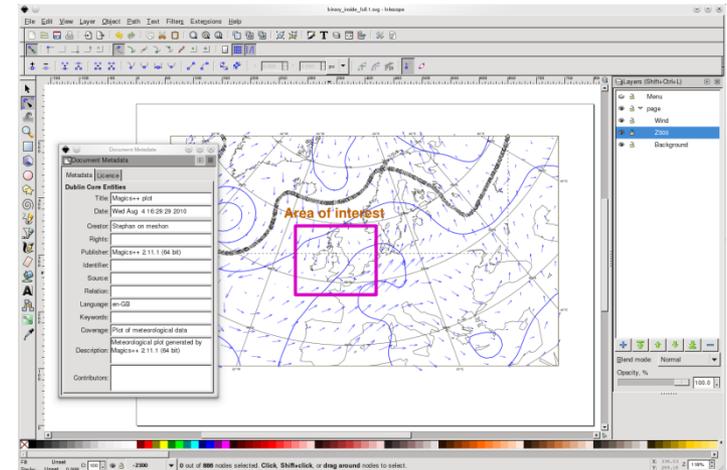 - **Supports animations**

- **PNG & SVG for web**
 - **In combination with JavaScript it allows to build advanced web interfaces → ecCharts**

- **PostScript, EPS, SVG**
 - **Vector formats for high quality publications**

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Making maps accessible to other domains?

- **Meteorology has been living in its own world**

- **The interoperability implies to use standards conventions for geographical projections.**

  - **We will offer the possibility to choose from a set of Proj4 definitions in our next release.**
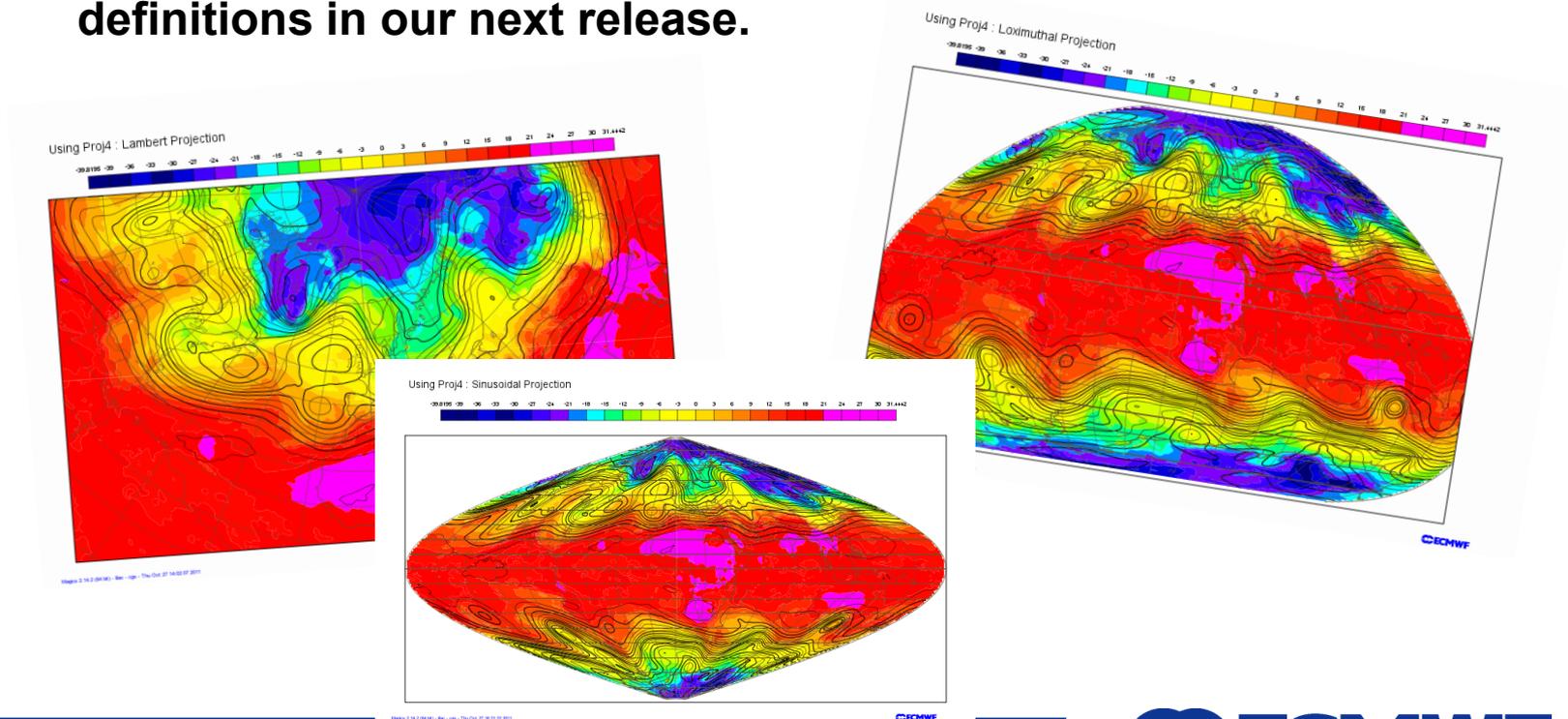
Making maps accessible to other domains?

▶ **We need some geographical information to set meteorological data in their geographical context:**

   ▶ **We have added boundaries, cities and rivers to our pcoast action routine.**

   ▶ **Was hard to find a source which kept up-to-date and was not restricted by license issues**

   ▶ **Since version 2.14 Magics uses http://www.naturalearthdata.com, which is maintained mainly by the Washington Post**
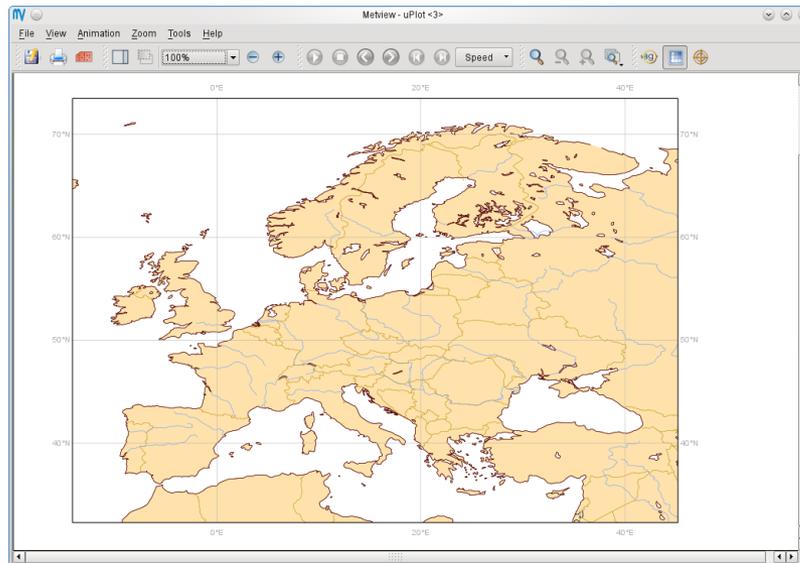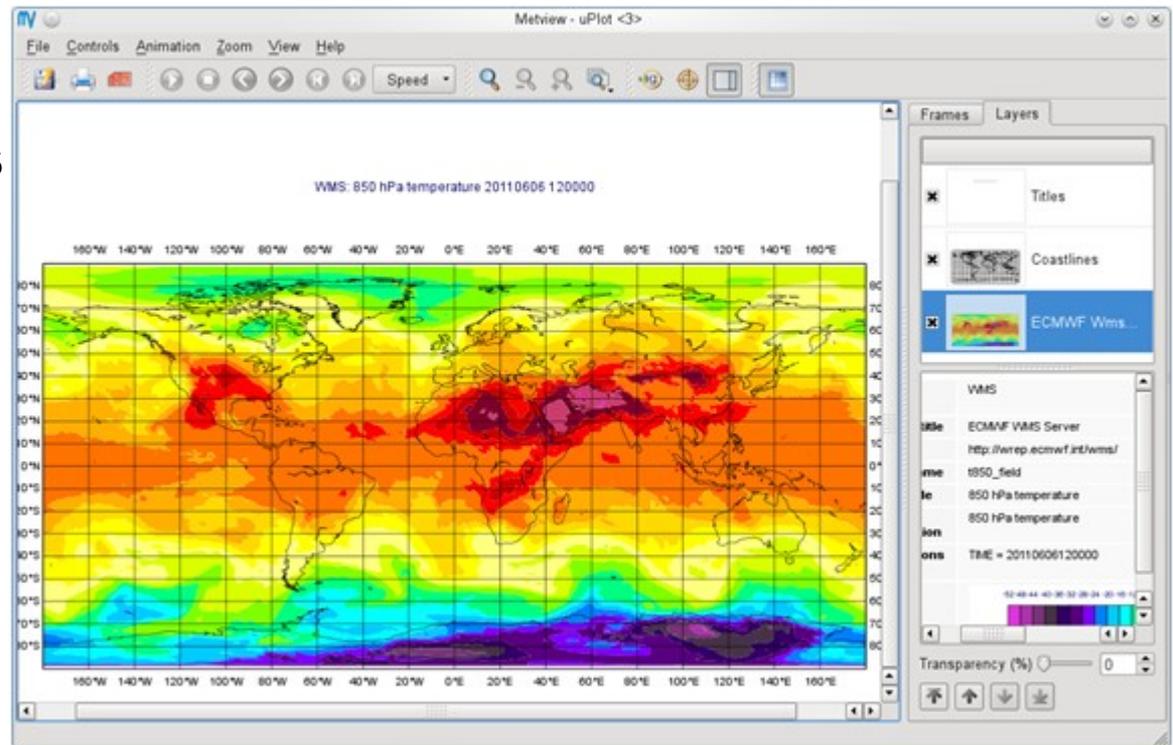
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Making maps accessible to other domains?

OGC is a well established standard body in the GIS community

WMS-standard is an easy way to make maps accessible.

- ▶ **Magics++ is tuned for this task and is used in ECMWF's WMS server**

- ▶ **Styling through SLD could be an option**

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What are our concerns?

- **Is it useful, if not even misleading, to use a higher resolution for context information than the meteorological data mapped?**

- **Interpolation and re-projection have to be used very carefully when overlaying.**

- **The respect of WMO convention in plotting observations is very important.**

- **Styling is also a very important aspect.**

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Conclusion

▶ **The maps generated by Magics follow common conventions**

  ▶ **Thanks to Proj4**

  ▶ **Well support formats**

▶ **By using well established code and data from FOSS GIS community we save resources and are more compliant**

  ▶ **Natural Earth**

▶ **For more information about Magics see**

  http://www.ecmwf.int/publications/manuals/magics/

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