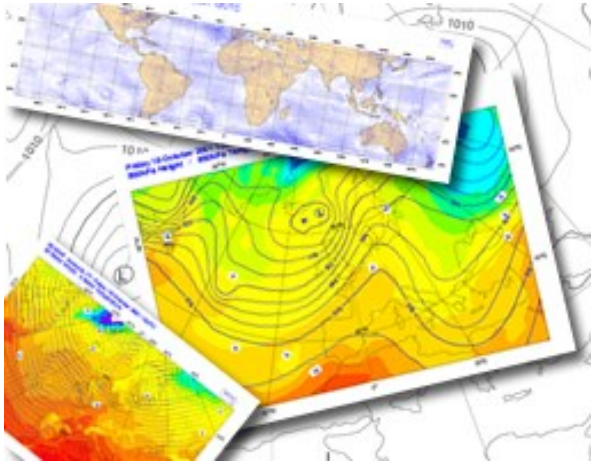
Magics Training course

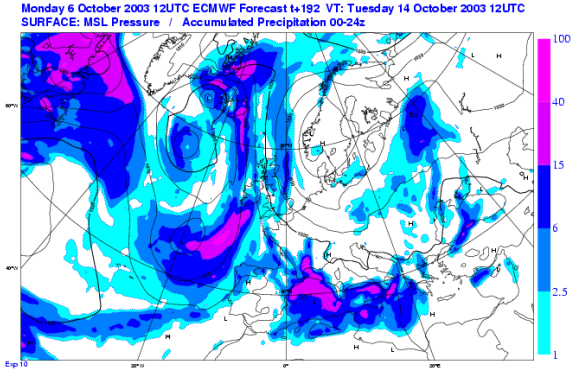


Sylvie Lamy-Thépaut **Stephan Siemen**

Meteorological Visualisation Section

ECMWF

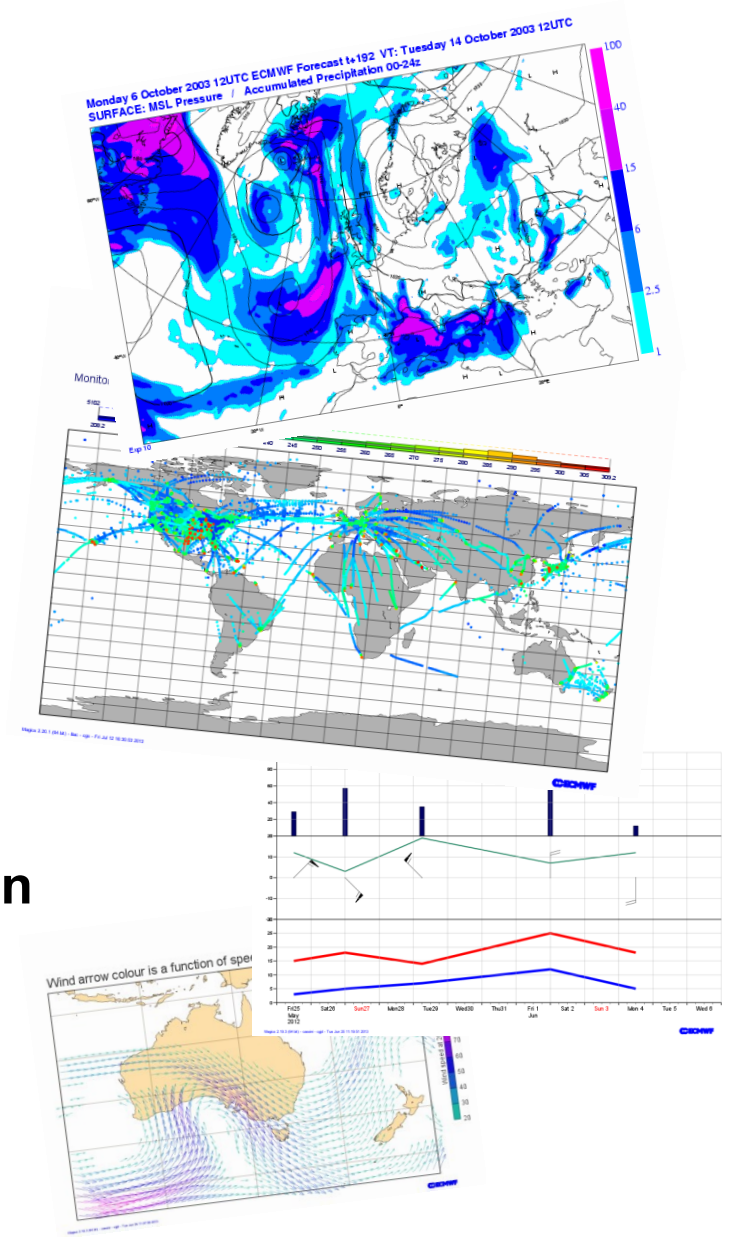
Objectives of this course



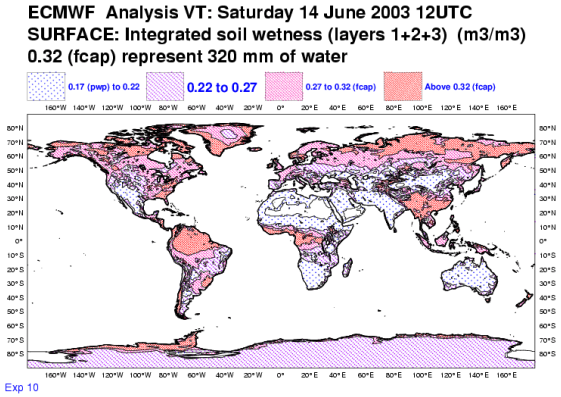
- Giving you an overview of possibilities of the Magics graphics library
- Show you ways of using the documentation and find help
- Giving you good templates for your work
- Introduce the Magics team … us ☺

Magics

- **Overview : What can it do?**
  - **Magics helps you to create your meteorological visualisations**
- **What is Magics?**
  - **Magics is a library**
    - ➔ How to use it?
    - ➔ How the different APIs work?
      - **Scripting language: Python**
    - ➔ How to use Magics outputs?



Magics overview



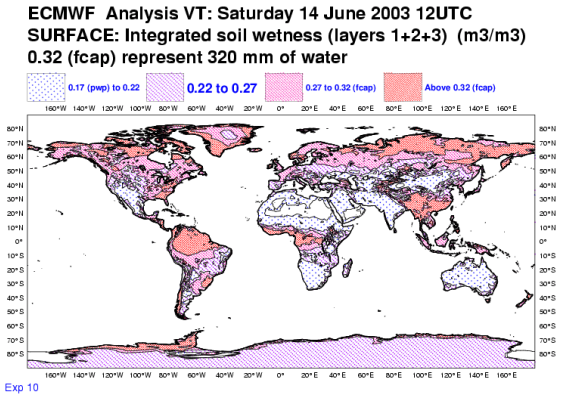
- **Magics is meteorologically-oriented**
  - ➔ GRIB
  - ➔ BUFR
  - ➔ Specific Visualisation
- **Magics provides 3 simple APIs**
  - ➔ Fortran / C
  - ➔ Python
  - ➔ MagML / MagJSon
- **Magics provides a small set of actions**
  - ➔ Contouring, Symbol, graph, wind plotting
- **And a large set of parameters for each action**
  - ➔ Large set of parameters
  - ➔ Small number of

  Fortran callable subroutines

Visit to MetOps room

- We will now have a tour of the MetOps room
- The room contains a small sample of plots generated every day at ECMWF with Magics/Metview
- If you find types of maps interesting for your work, please free to ask us how you can try to generate the map(s) yourself

What can you do with Magics?



Magics is output-oriented

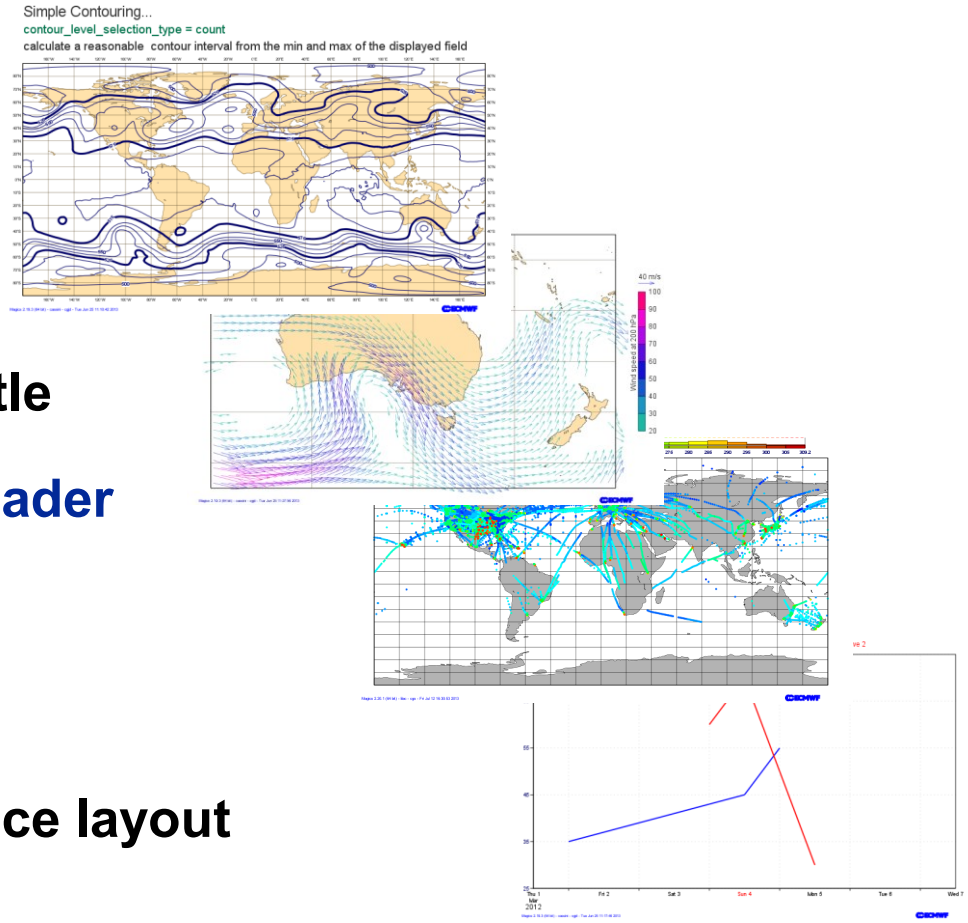
- You define your Geographical Area and Projection.
  - e.g. Stereographic Polar, Cylindrical
- You import some data to plot

  They will be re-projected to your selected area
  - GRIB, matrix (z, but also u/v)
  - NetCDF Data.
- You design you visualisation
  - Type, Colour, Style

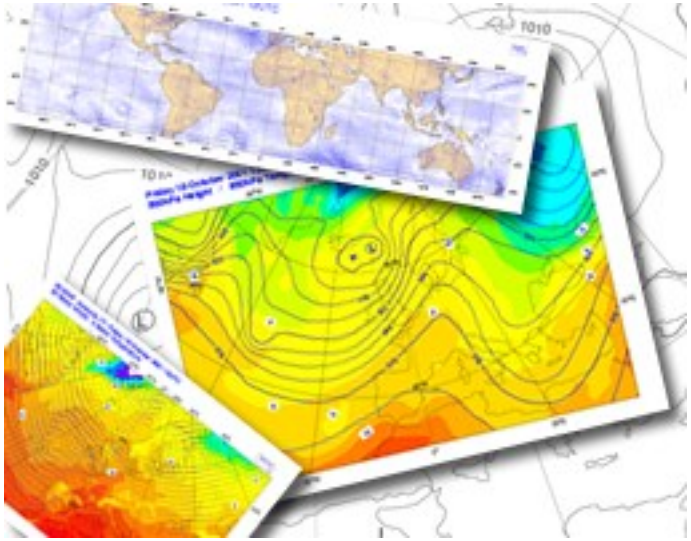
What can you do with Magics?

- Contour fields
- Add Wind arrows or flags
- Add Symbols
- Add Text and/or automatic title

  From the GRIB or BUFR Header
- Create a nice legend
- Display Axes and Graphs
- Organise your plots with a nice layout



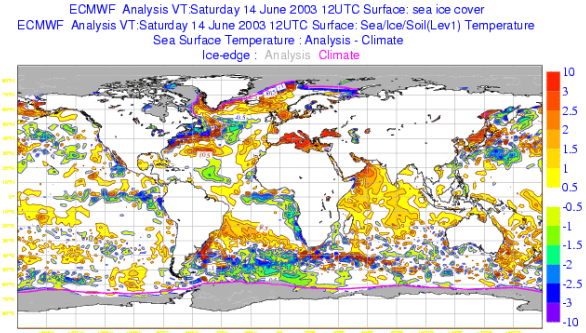
Magics



Magics

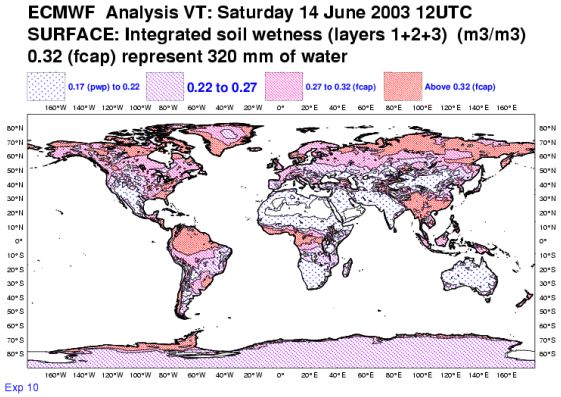
- This training course will give you the basis for your own future Magics programs.
- We mainly use the Python interface
- The Magics API contains too many parameters to be handled in detail within 2 days. That is why we concentrate on giving you templates for basic Magics programs. From them, you can build complex plots.
- The course will mostly be exercises in which you can learn how to write programs on your own with the help of the online documentation.
- Please do not hesitate to ask any questions!!!

MAGICS - History



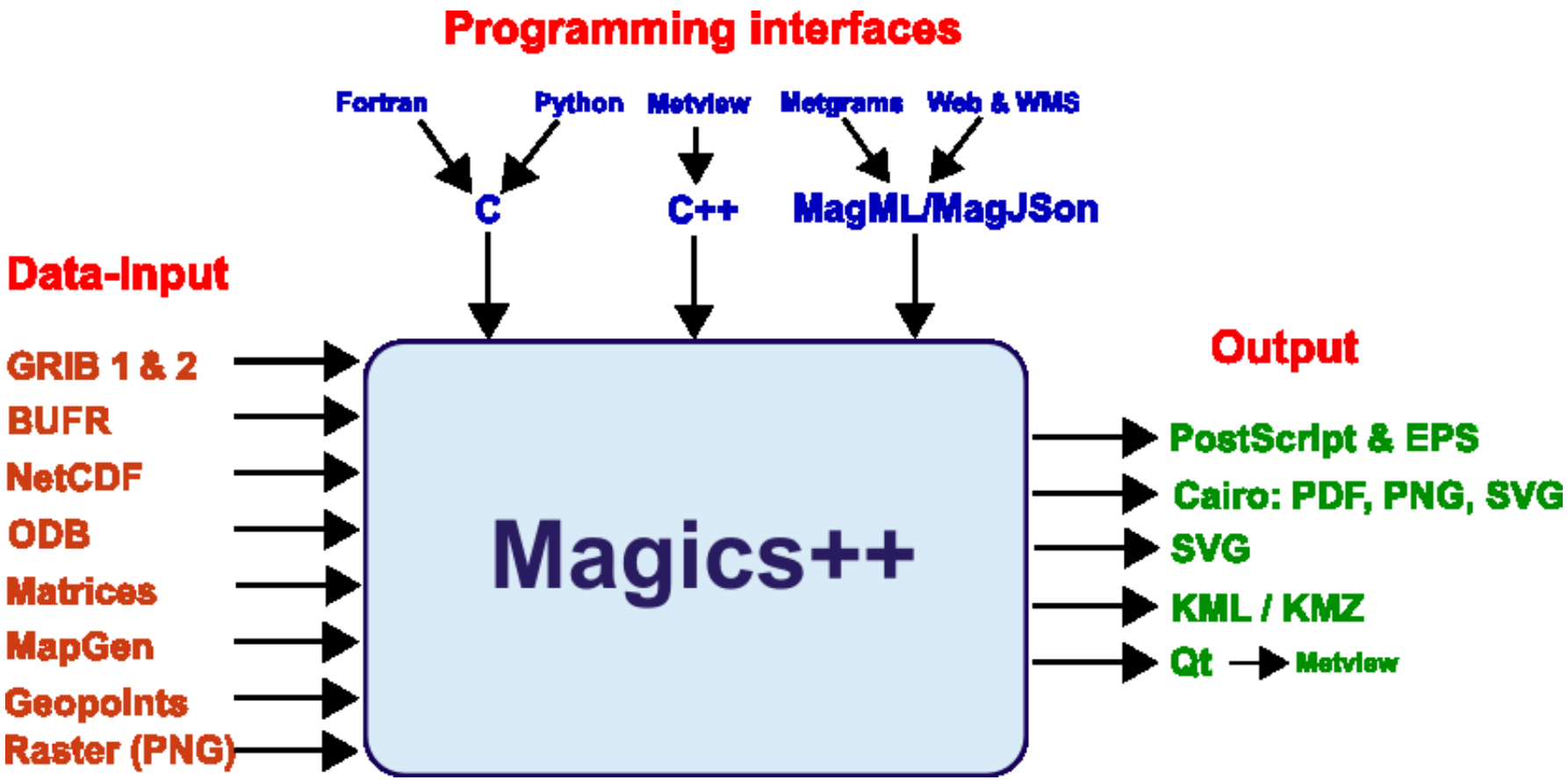
- 1983 - Development started
- Meteorological Applications Graphics Integrated Colour System
- MAGICS is a Fortran library
- MAGICS is installed in more than 30 member states and countries
- MAGICS is used by *Synergie* (Météo-France)
- MAGICS is the graphical kernel of Metview
- 2004 – (Re-)Development of Magics++ started
  - ♦ Graphical kernel of Metview 4 & ECMWF web products

Magics - Overview

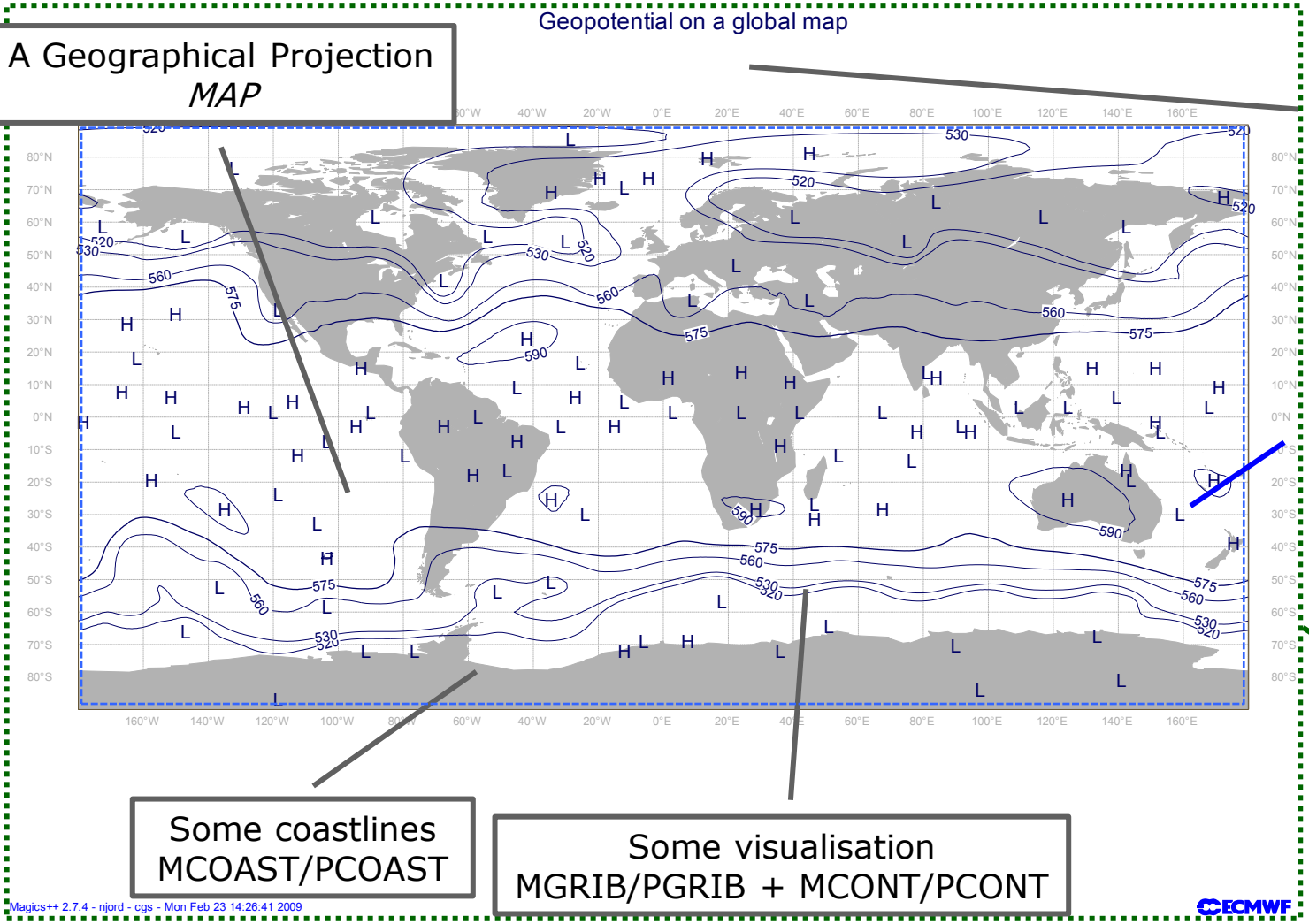


- Magics++ is a rewrite of MAGICS using C++ instead of Fortran
- Magics++ is (mostly) backwards compatible to MAGICS
- Magics++ makes it easier to add new features
- New APIs: C, Python, and MagML
- New output formats: PDF, EPS, PNG, SVG, KML
- New data input: GRIB 2, NetCDF, CSV/MapGen, ODB access
- New contouring

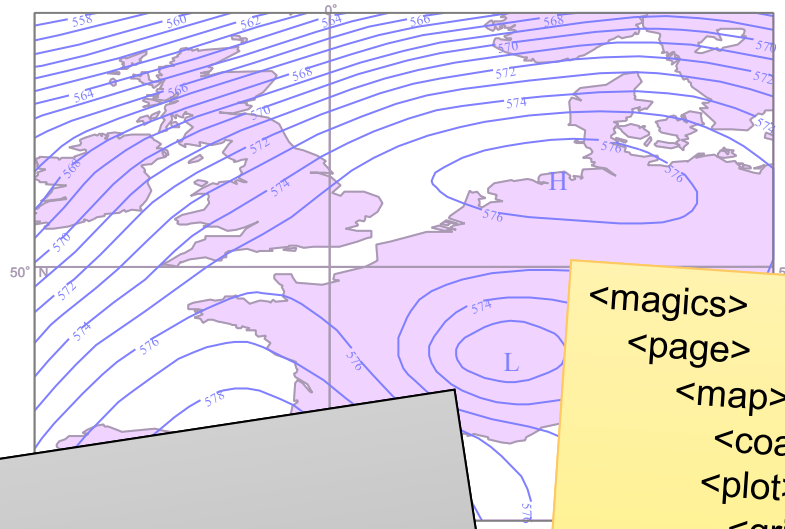
Magics++ architecture



What does a Magics plot consist of?



The 3 simple APIs




```
call popen
call pcoast
call psetc('grib_input_file_name', 'grib.grb')
call pgrib
call psetc('contour_line_colour', 'blue')
call pcont
call pclose
```

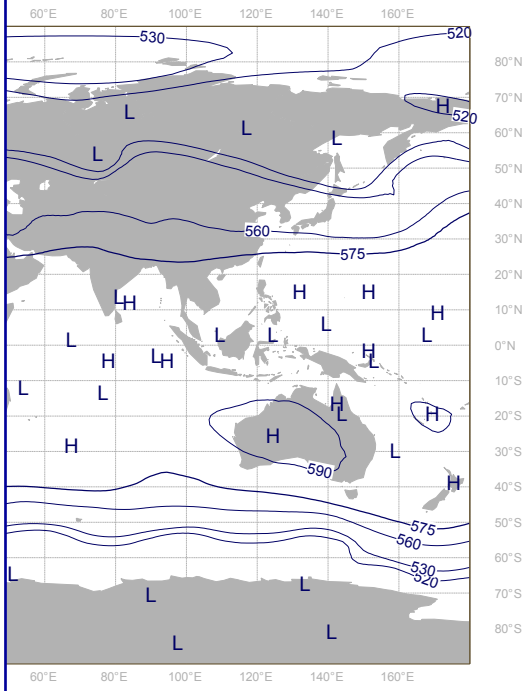
```
<magics>
  <page>
    <map>
      <coastlines/>
      <plot>
        <grib grib_input_file_name = 'grib.grb/>
        <contour  contour_line_colour =  'blue/>'
      </plot>
    </map>
  </page
</magics>
```

```
grib = mgrib(grib_input_file_name = 'grib.grb')
contour = mcont(contour_line_colour =  'blue')
coast =  coast()
plot(coast, grib, contour)
```

Main concepts of Magics

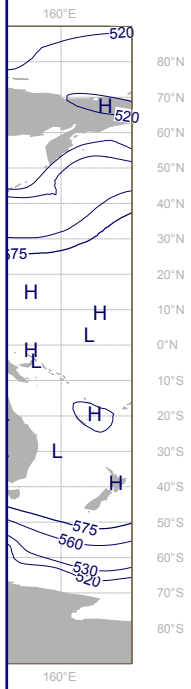
Fortran Interface

```
call popen
call psetc('map_coastline_land_shade', 'on')
call pcoast
call psetc('grib_input_file_name', 'z500.grb')
call pgrib
call psetc('contour_line_colour', 'navy')
call pcont
call pclose
```



Main concepts of Magics

```
<magics>
  <page>
    <map>
      <coastlines map_coastline_land_shade='on'/>
      <plot>
        <grib grib_input_file_name='z500.grb'/>
        <contour contour_line_colour='navy'/>
      </plot>
    </map>
  </page>
</magics>
```



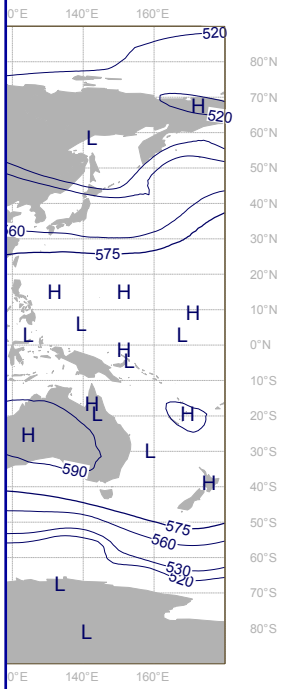
What is MagML/MagJSON?

- MagML/MagJSON is a description language based on XML/JSON
  - Tags, as in HTML <magics>, <page>, …
  - Hierarchical structure
  - Can be handled/processed by any XML tools/packages
    - ➔ JavaScript/AJAX, XSLT
- It is descriptive - only simple data processing possible
  - No ‘if-else’, loops or bindings to programming languages
  - It allows variables!

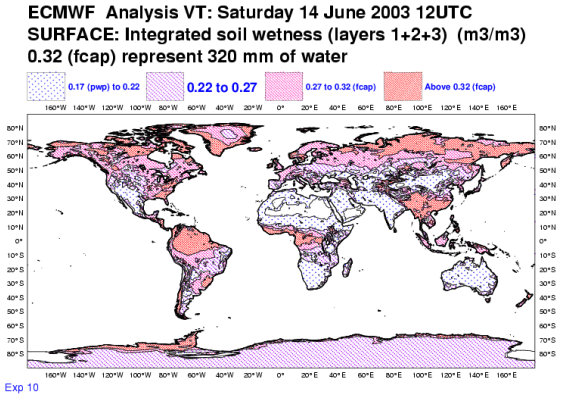
Main concepts of Magics

PYTHON Interface

```
coast = mcoast(
        map_coastlines_shade_on='on' )
grib = mgrib(
        grib_input_file_name='z500.grb')
contour = mcont(
        contour_line_colour='navy')
plot(coast, grib, contour)
```

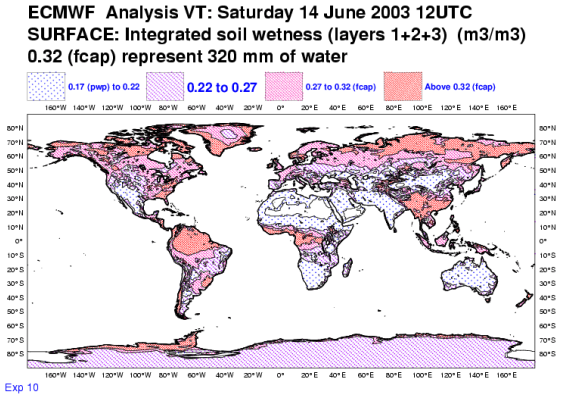


Metview-like python interface

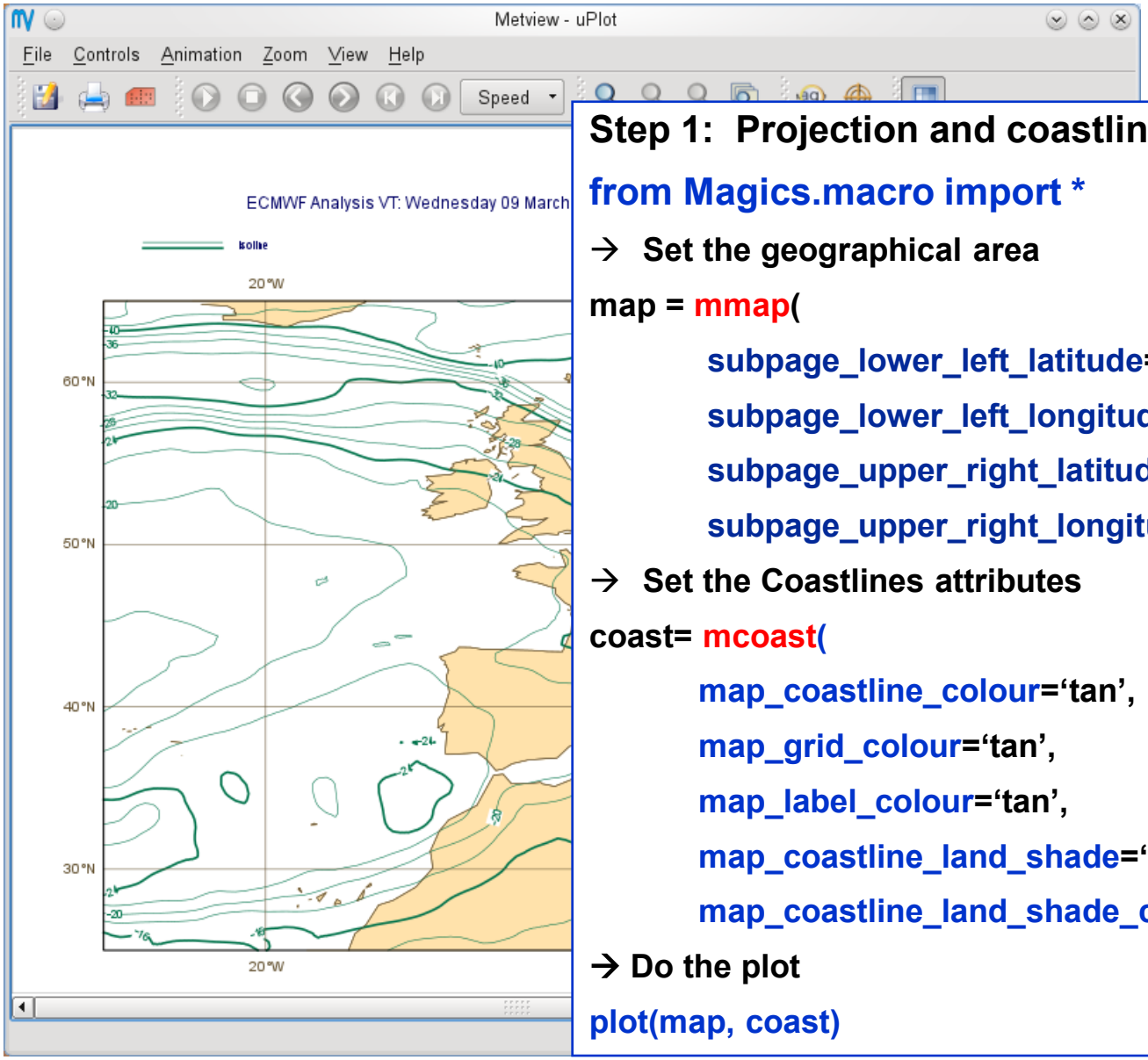


- **New higher level python module**
  - ➔ Very similar to the Metview Macro
  - ➔ Can be easily embedded in a more complex python script
- **Comes with a basic set of Objects…**
  - ➔ To setup the projection
    - ♦ **mmap**
  - ➔ To load data
    - ♦ **mgrib, mnetcdf …**
  - ➔ To perform visual actions
    - ♦ **mcoast, mcont, mwind, …**
  - ➔ To create a new page
    - ♦ **page**

Metview-like python interface



- Each object has a large set of parameters …
- An Python object has the same parameters as its equivalent C/Fortran action routine (same name, same default)
  - mcoast→pcoast , mgrib→pgrib, mcont→pcont
  - The ‘m’ prefix is for the compatibility with Metview Macro.
- The parameters are only set for the relevant object.
- The method *plot* will perform the plot, and call the action routines sequentially.



Step 1: Projection and coastlines

```
from Magics.macro import *
```

→ Set the geographical area

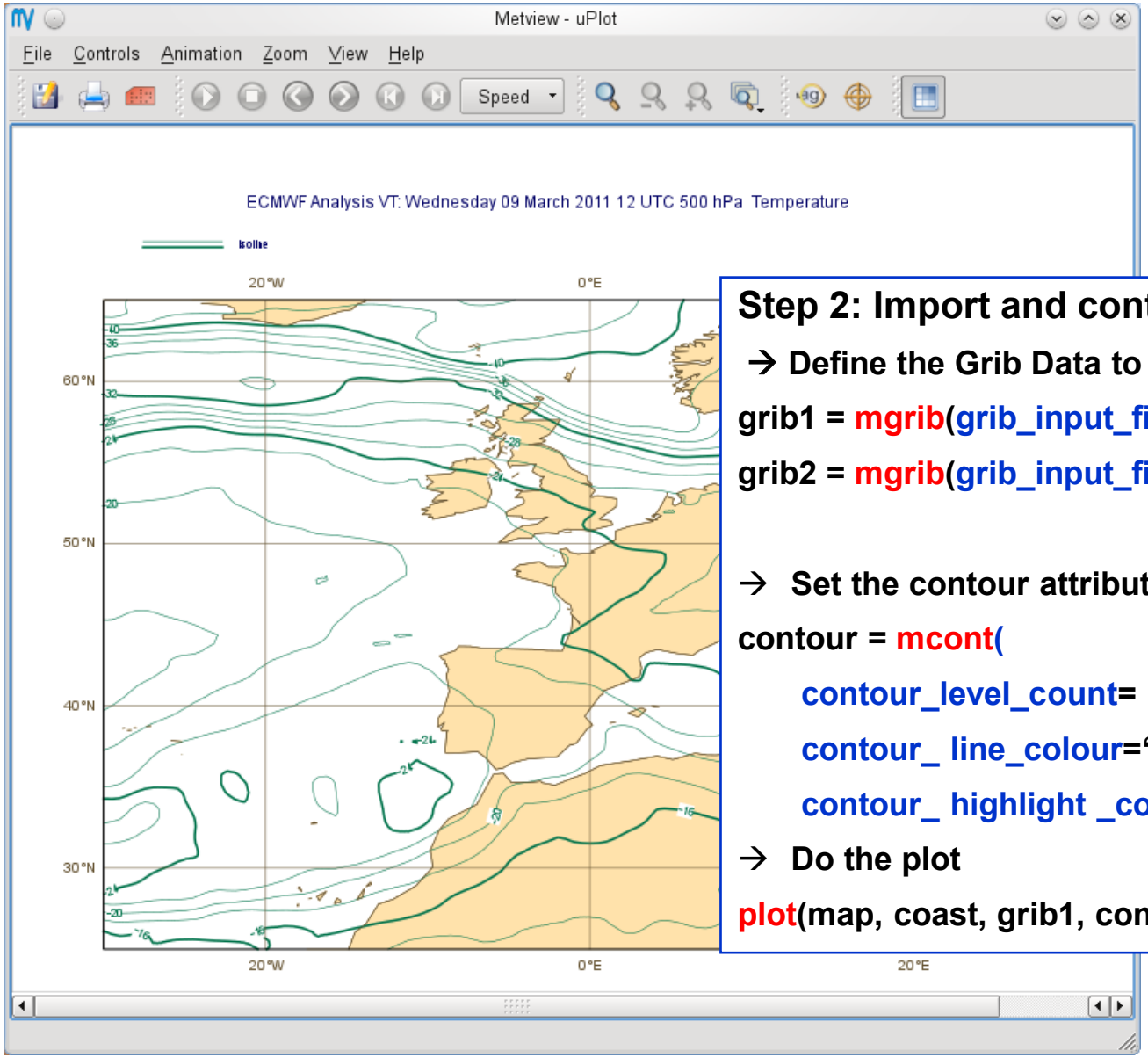
```
map = mmap(
        subpage_lower_left_latitude=25.,
        subpage_lower_left_longitude=-30.,
        subpage_upper_right_latitude=65.,
        subpage_upper_right_longitude=25.)
```

→ Set the Coastlines attributes

```
coast= mcoast(
        map_coastline_colour='tan',
        map_grid_colour='tan',
        map_label_colour='tan',
        map_coastline_land_shade='on',
        map_coastline_land_shade_colour='cream')
```

→ Do the plot

```
plot(map, coast)
```



Step 2: Import and contour the GRIB

→ Define the Grib Data to plot

```
grib1 = mgrib(grib_input_file_name='t500.grb')
grib2 = mgrib(grib_input_file_name='z500.grb')
```

→ Set the contour attributes

```
contour = mcont(
      contour_level_count= '20',
      contour_ line_colour='evergreen',
      contour_ highlight _colour='evergreen')
```

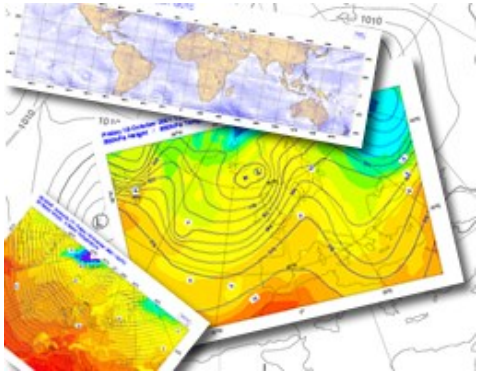
→ Do the plot

```
plot(map, coast, grib1, contour, grib2, contour)
```

How to interpret your Magics++ Python script?

- Setup Magics once per shell: use magics++
- Create your Python script
  - Use an editor (*vi*, xemacs, *nedit, kwrite*) to write your Magics object
- Interpret your script
  - python *mymagics.py*
- View your result - Use a postscript viewer : *gv*, *display*
- Modify your script if necessary …

How to use the tutorial?



How to use the tutorial?

- The tutorial contains exercises, clues and solutions.

  https://software.ecmwf.int/wiki/display/MAGP/Magics+Tutorial

- For each new concept, you will find a link to the complete Magics documentation.
- The Basics
  - Edit and save your python script → Ex: magics.py
  - Run → python magics.py
  - Visualise the result :
    - → Use gv for postscript file and xv for a png file

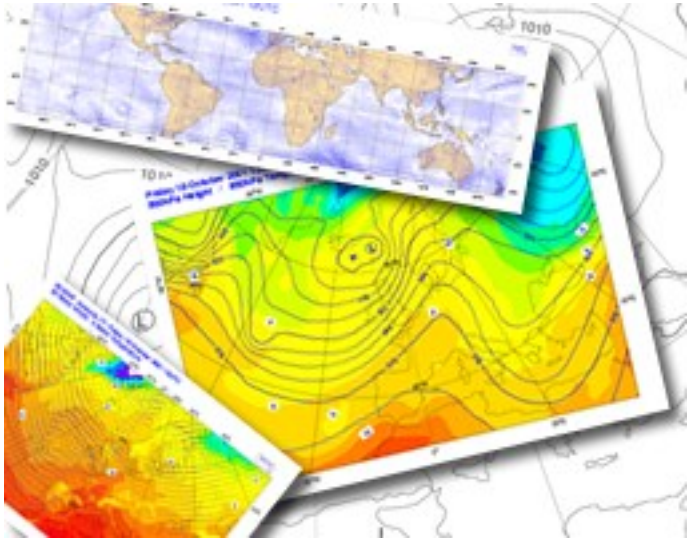
Few things to know about Python

- **Interpreter**
- **We use 2.x versions with NumPy**
- **Be careful:**
  - **Indent sensitive (avoid tabs)**
  - **If a Magics parameter is expecting a float, put a .**

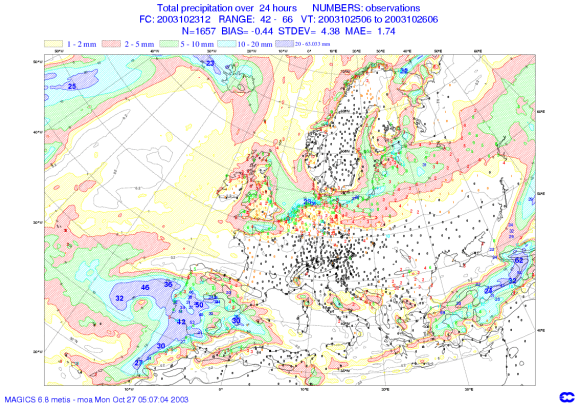
    → contour_reference_level = 2.

    (If you forget Magics will ignore the setting)
  - **1 / 2 = 0 !!! → 1.0 / 2.0 = 0.5**

More on Coastlines

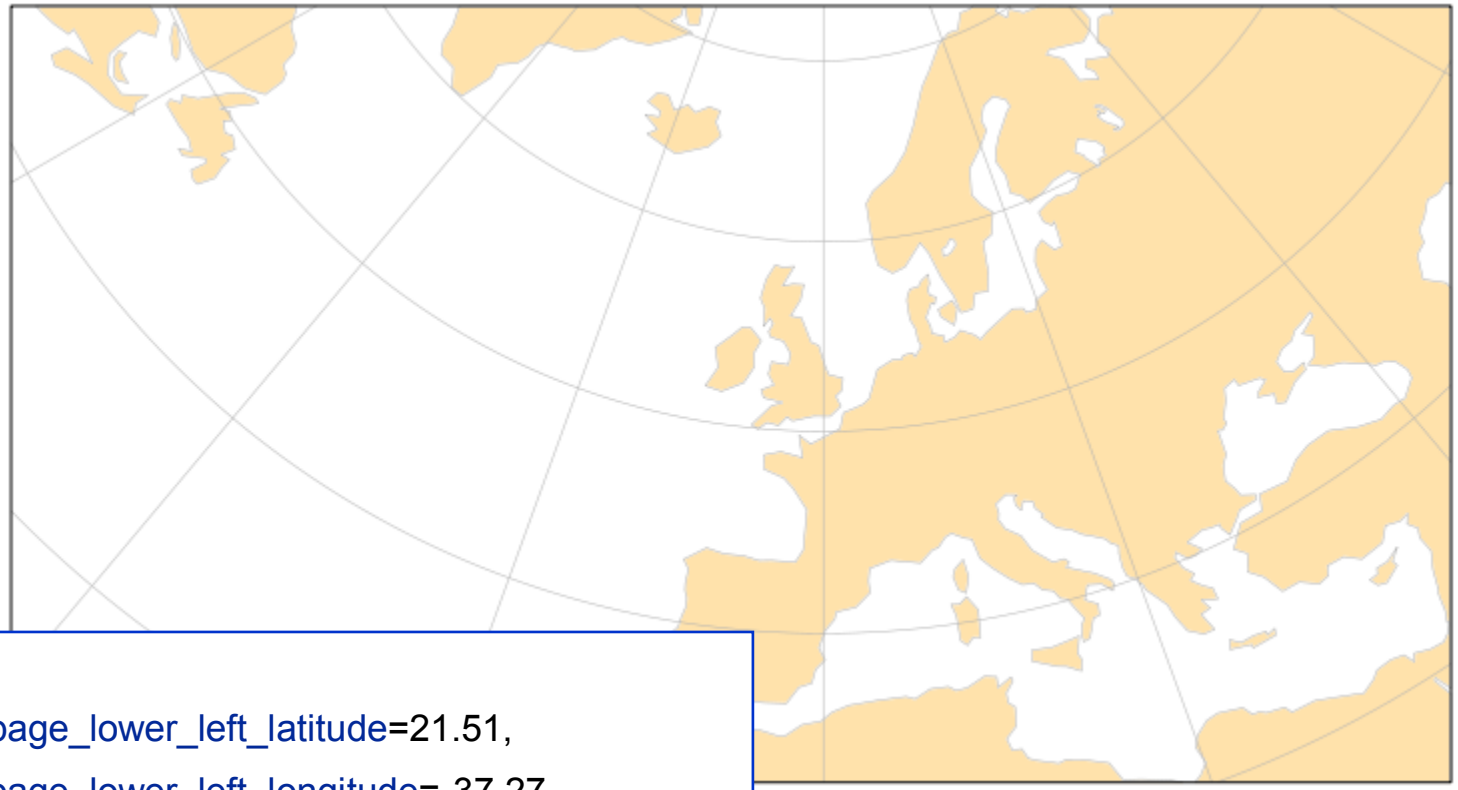


A Bit More on Coastlines



- Selection of the projection
  - Polar stereographic, Mercator, cylindrical
- Selection of the Geographical Area
- Definition of the coastlines and grid attributes
- Land and/or Sea Shading

Setting projection and area

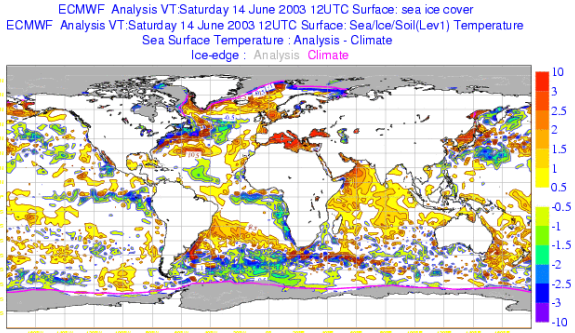


```
mmap(
        subpage_lower_left_latitude=21.51,
        subpage_lower_left_longitude=-37.27,
        subpage_upper_right_latitude=51.28,
        subpage_upper_right_longitude=65.,
        subpage_map_projection='polar_stereographic')
```

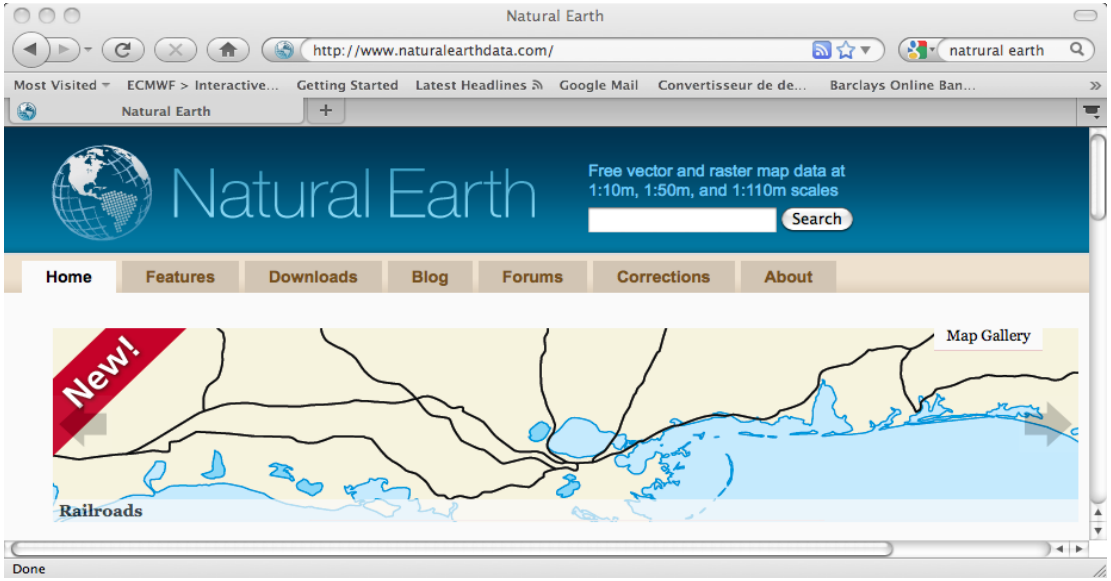
Setting land shading

```
coast = mcoast(
                map_coastline_colour='grey',
                map_coastline_land_shade='on',
                map_coastline_land_shade_colour='cream',
                map_coastline_sea_shade='on',
                map_coastline_sea_shade_colour='white')
```

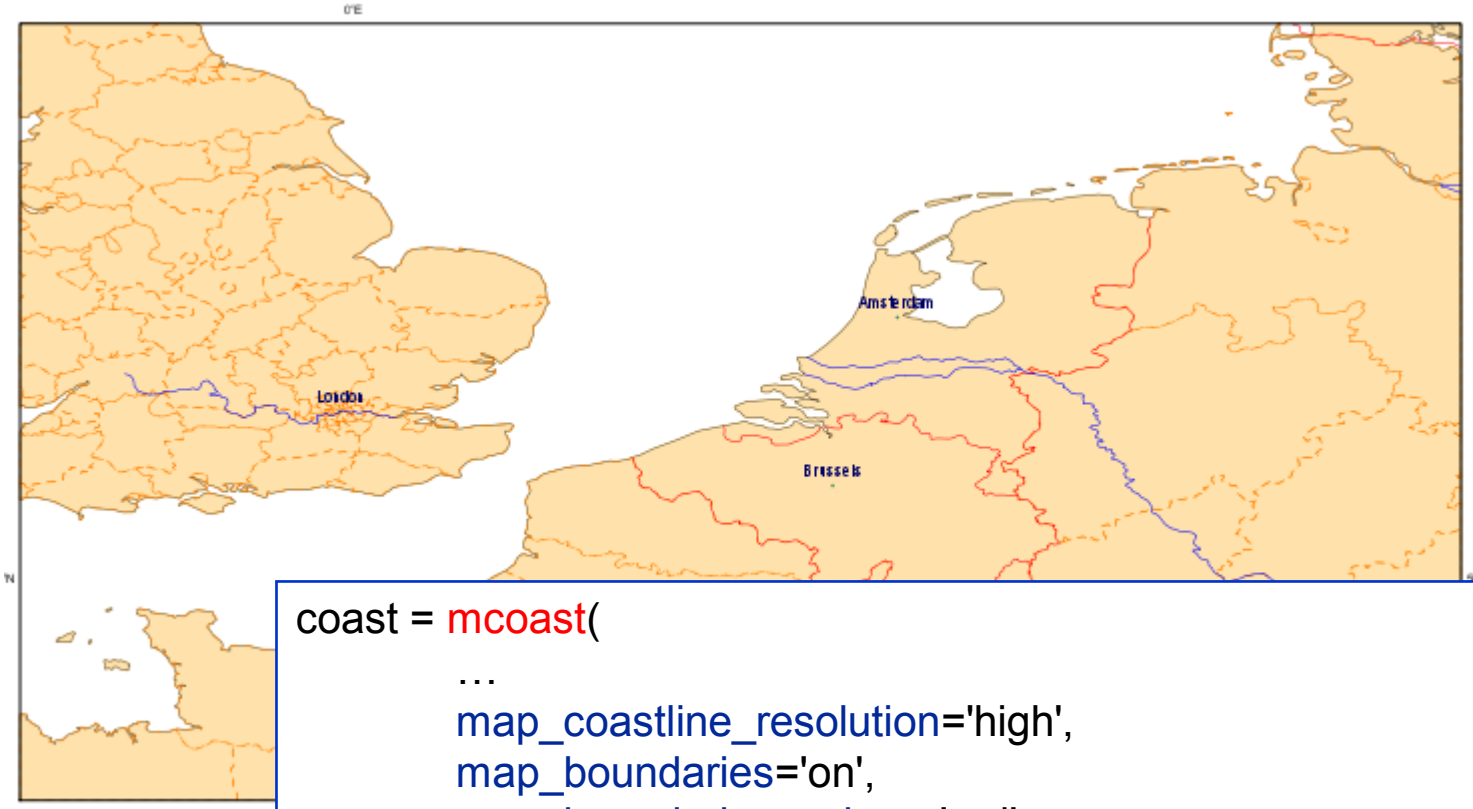
Coastlines and boundaries ...



- Boundaries can now be plotted with Magics
- Our dataset comes from Natural Earth (Washington Post)



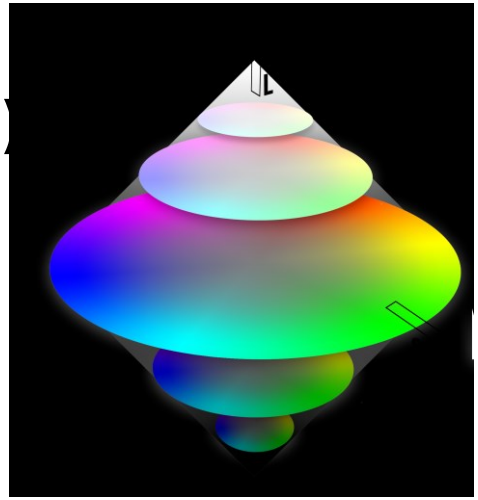
Coastlines and Boundaries



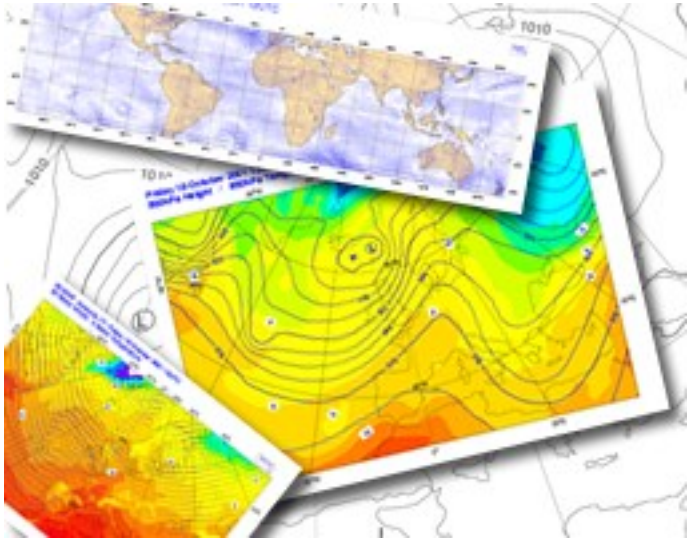

```
coast = mcoast(
            …
            map_coastline_resolution='high',
            map_boundaries='on',
            map_boundaries_colour='red',
            map_administrative_boundaries='on',
            map_administrative_boundaries_countries_list=['FRA', 'DEU', 'GBR'],
            map_administrative_boundaries_colour='orange',
            map_cities='on',
            map_rivers='on', )
```

How to set colours

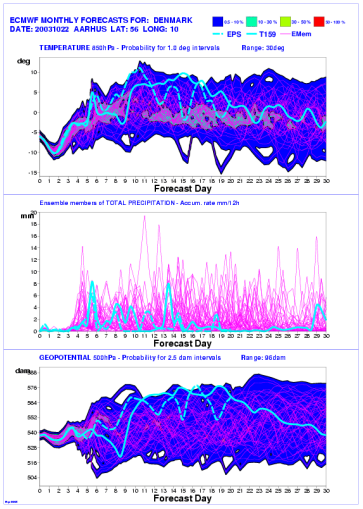
- Three ways of setting colours
- By name: “black”, “green”, “tangerine”
- RGB: “RGB(0.2 , 0.6 , 0.1)” (Red, Green & Blue components)
  - Also in hex notation: “#ff0000” (red)
  - Transparency expressed as rgba: “RGB(0.2 ,0.6,0.1,0.5)”
- HSL: “HSL(270.0 , 0.6 , 0.1)”
  (Hue, Saturation & Lightness)



Data Input



A bit more on data Input



- Fields
  - GRIB 1 & 2, netCDF, arrays
  - Regular grid, Gaussian grid
  - Stretched and rotated grid (work in progress)
- Observations
  - BUFR
  - Observational DataBase (ODB)

How to deal with GRIB data : PGRIB/MGRIB

- Decode GRIB code
- Scale meteorological fields

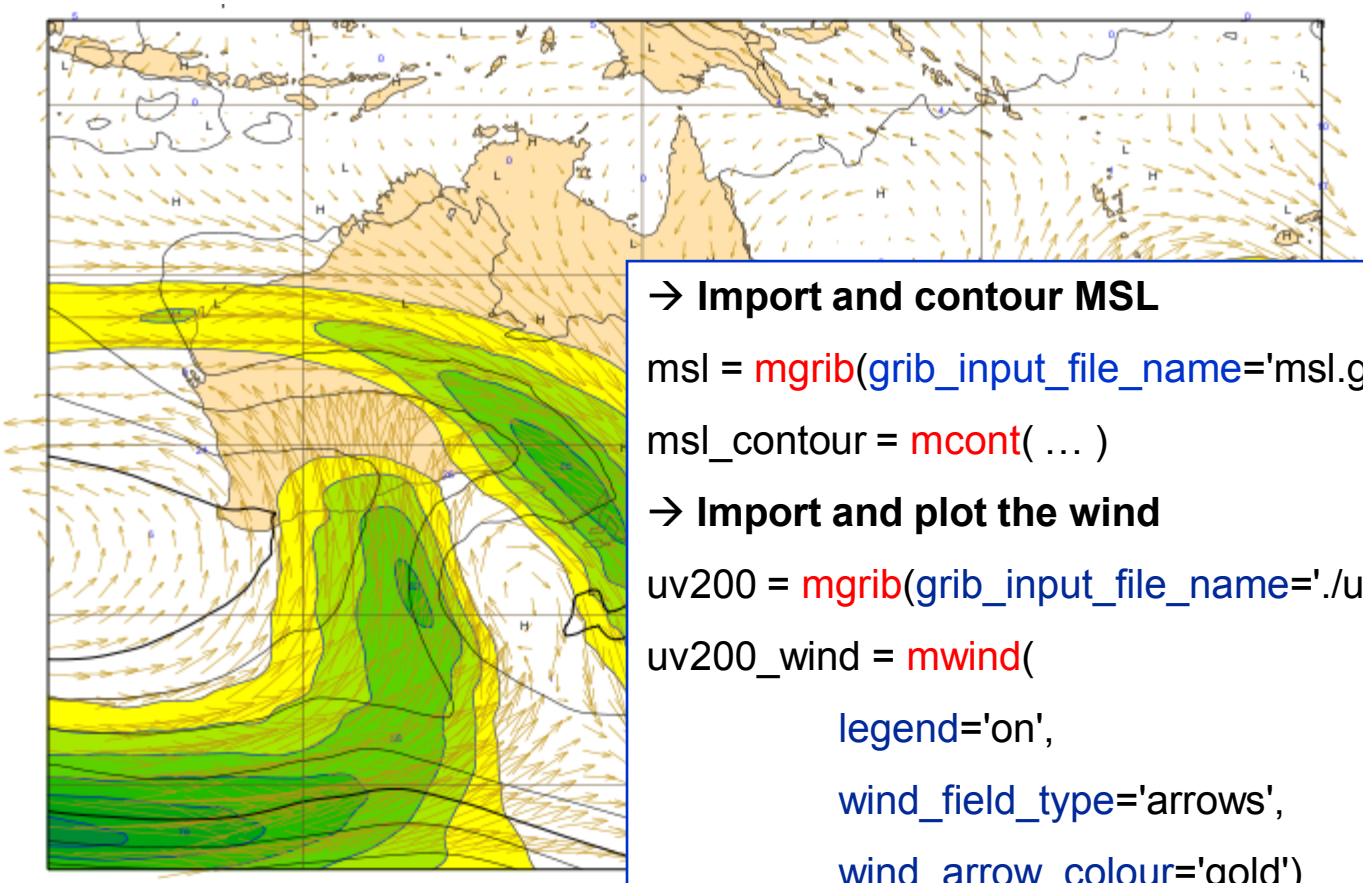
```
data = mgrib(grib_input_file_name='tempe.grb')
```

The file tempe.grb will be loaded in memory

The geo-localisation will be analysed

The values will be scaled to celsius

Importing data example



→ **Import and contour MSL**

```
msl = mgrib(grib_input_file_name='msl.grb', grib_id='z500')
msl_contour = mcont( … )
```

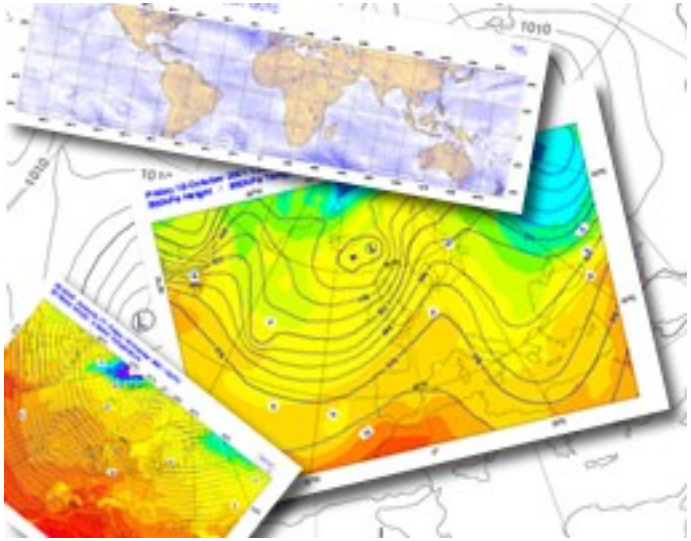
→ **Import and plot the wind**

```
uv200 = mgrib(grib_input_file_name='./uv200.grb', grib_id='uv200')
uv200_wind = mwind(
                legend='on',
                wind_field_type='arrows',
                wind_arrow_colour='gold')
```

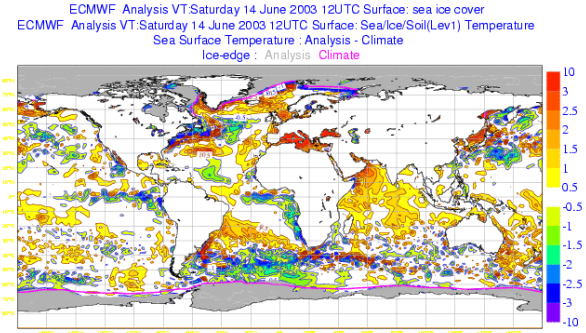
→ **Display these layers**

```
plot(…, uv200, uv200_wind, msl, msl_contour, …)
```

Contouring and shading



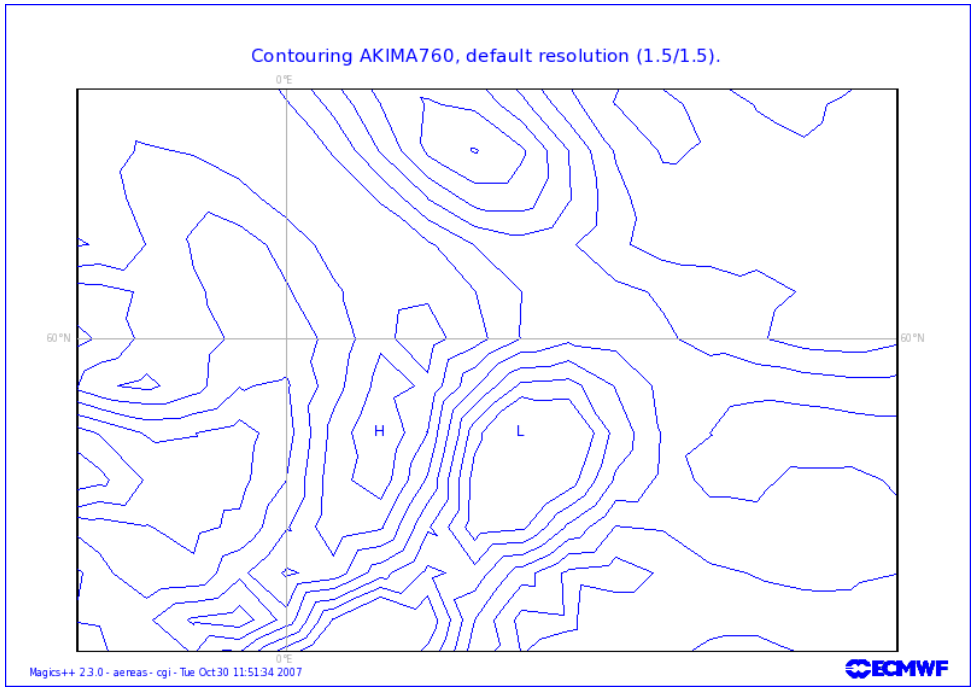
More on Contouring

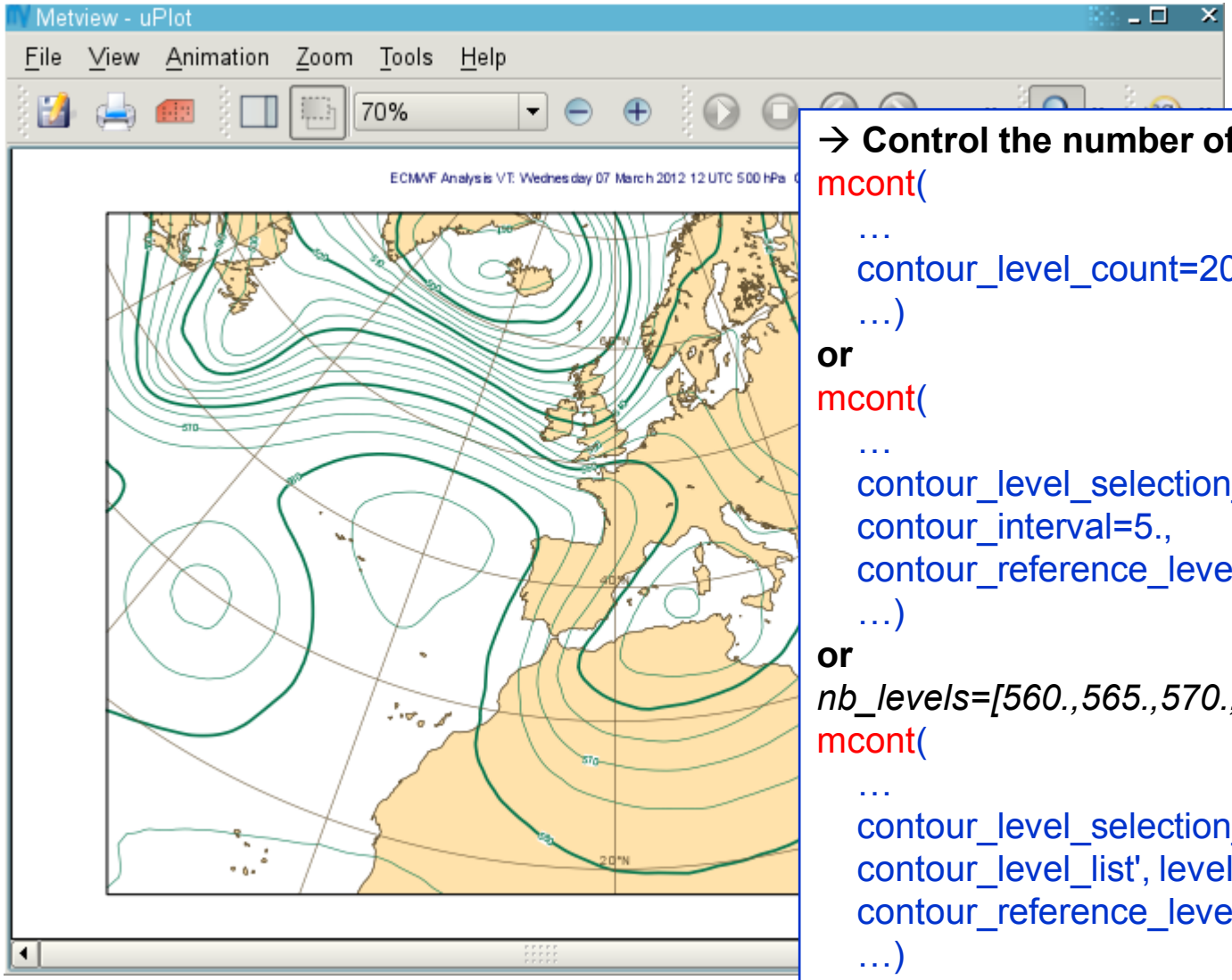


- Method
  - Akima + Linear (variable resolutions)
- Action Routine PCONT
  - Fortran: CALL PCONT
  - Python: mycont = mcont()
- Contour parameters
- Contour Shading

Contouring based Akima

- Algorithms developed by Hiroshi Akima - documented in the ACM Transactions on Mathematical Software
- INPE/CPTEC (Brazil) has successfully implemented a C++ version
- Accuracy is configurable by the user, although Magics++ will always choose sensible automatic values by default





→ **Control the number of isolines**

```
mcont(
    …
    contour_level_count=20,
    …)
```

or

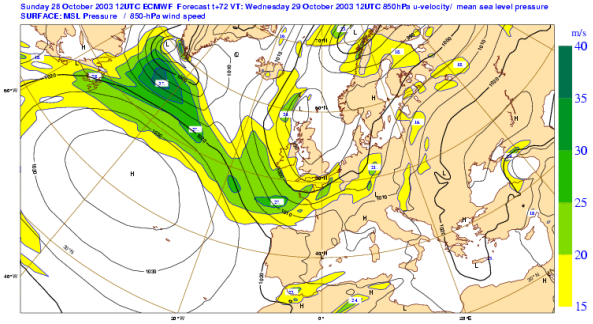
```
mcont(
    …
    contour_level_selection_type='interval',
    contour_interval=5.,
    contour_reference_level=560.,
    …)
```

or

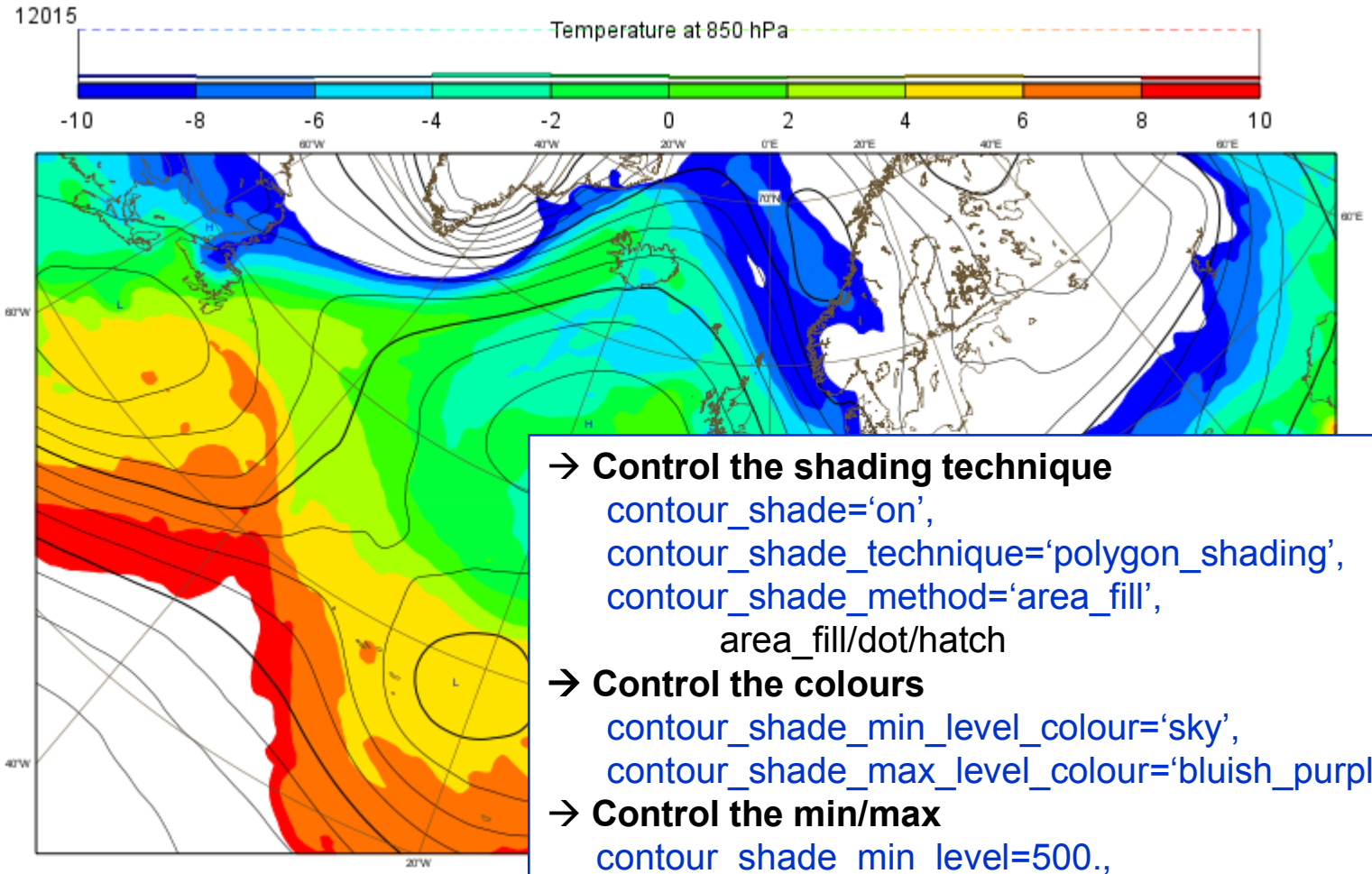
nb_levels=[560.,565.,570.,580.]

```
mcont(
    …
    contour_level_selection_type='level_list',
    contour_level_list', levels=nb_levels,
    contour_reference_level=560.,
    …)
```

More on contouring: shading



- **Shading techniques**
  - **Techniques:**
    - ➔ POLYGON
      - **DOT,**
      - **AREA_FILL,**
      - **HATCH**
    - ➔ CELL_SHADING
    - ➔ MARKER_SHADING
    - ➔ GRID_SHADING



→ **Control the shading technique**

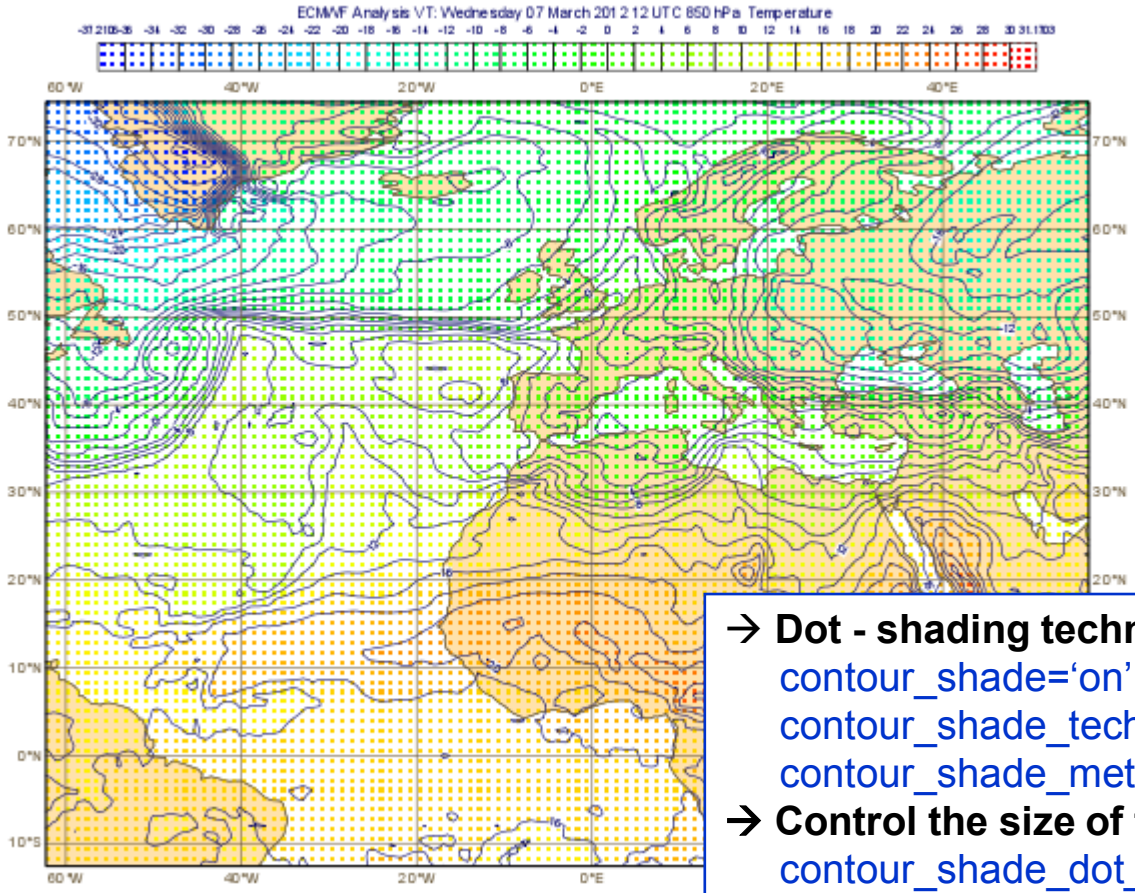
contour_shade='on',
contour_shade_technique='polygon_shading',
contour_shade_method='area_fill',
area_fill/dot/hatch

→ **Control the colours**

contour_shade_min_level_colour='sky',
contour_shade_max_level_colour='bluish_purple',

→ **Control the min/max**

contour_shade_min_level=500.,
contour_shade_max_level=560.,



→ **Dot - shading technique**

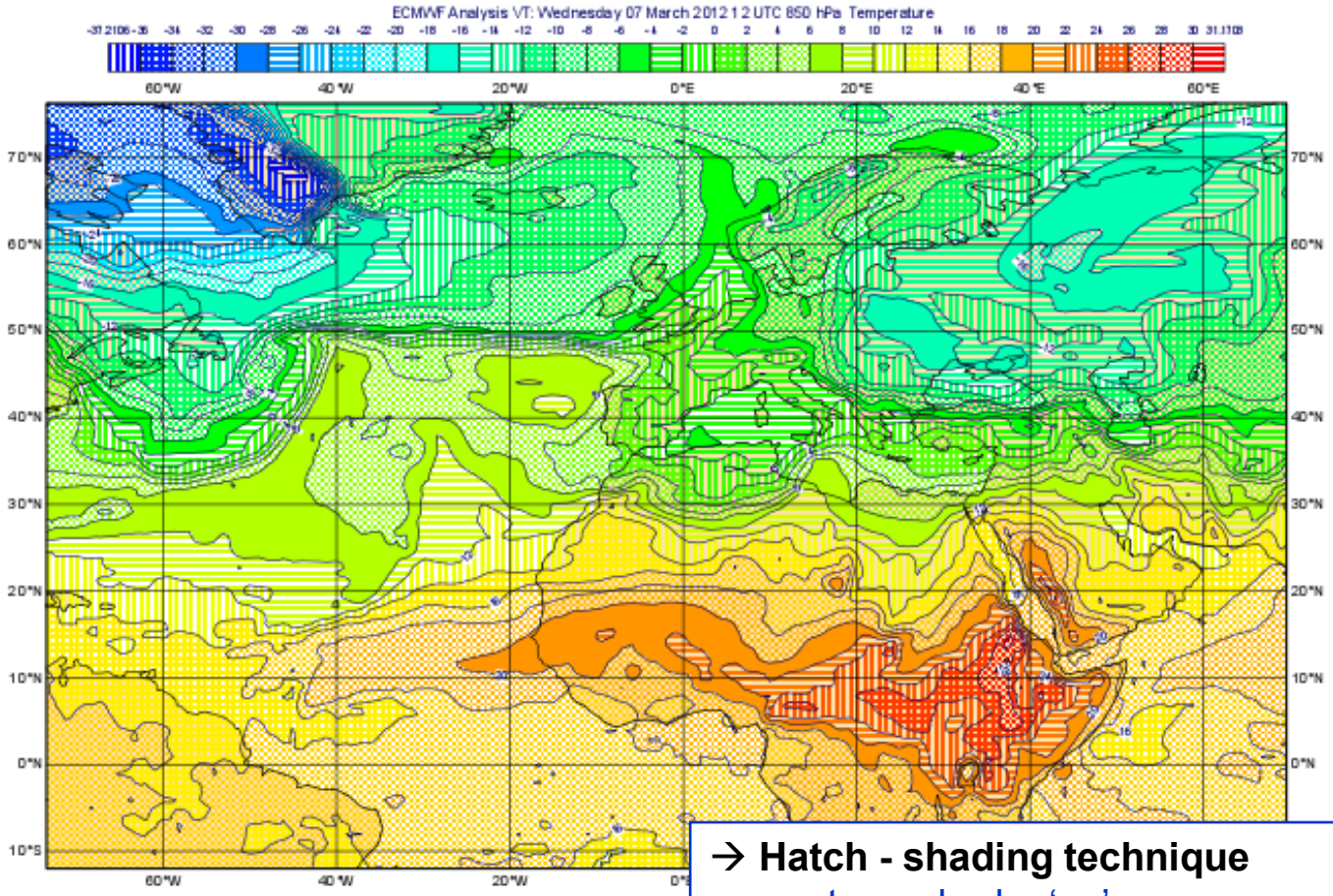
contour_shade='on',
contour_shade_technique='polygon_shading',
contour_shade_method='dot',

→ **Control the size of the dots**

contour_shade_dot_size=0.1,
contour_shade_min_level_density=25,
contour_shade_max_level_density=25,

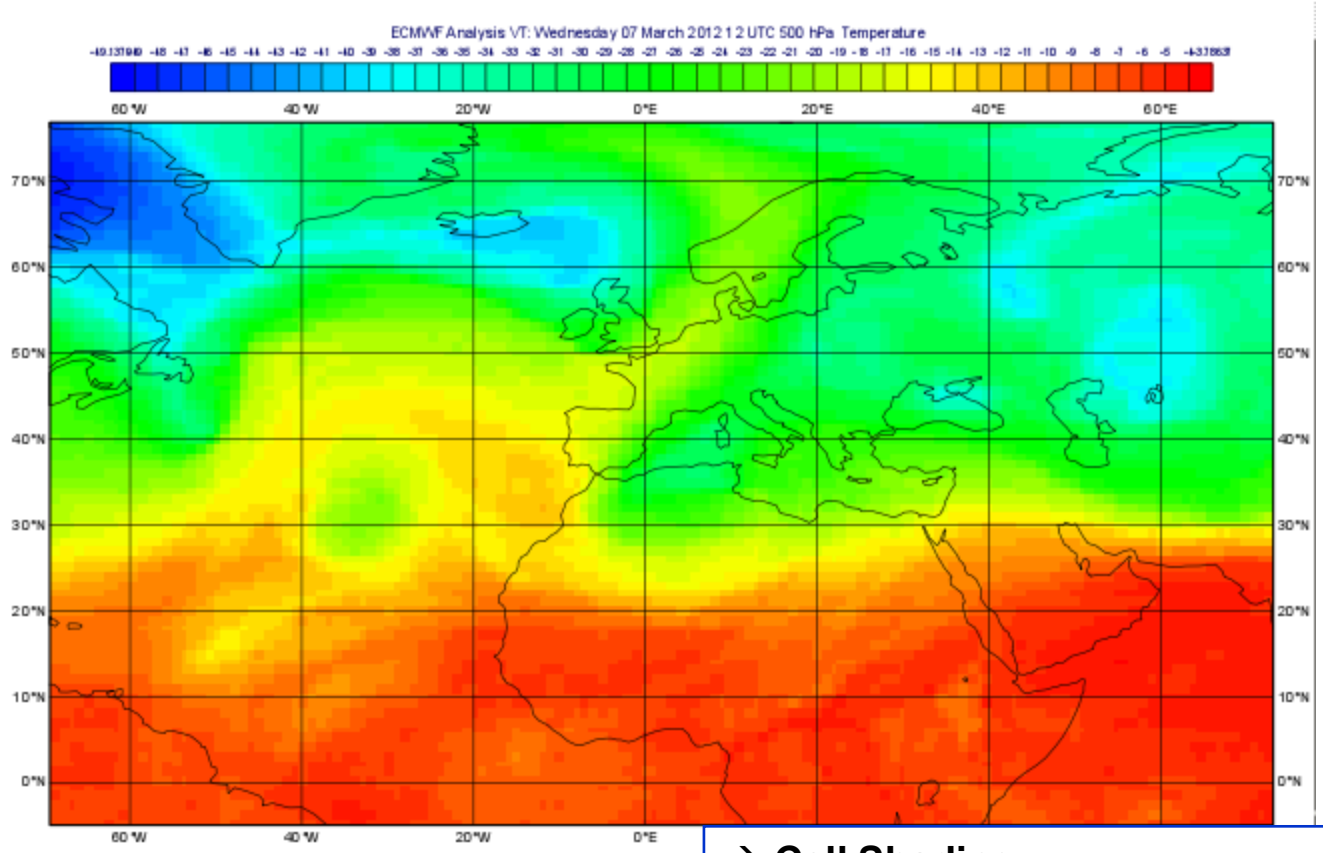
→ **Add a legend**

legend='on',
legend_display_type='continuous',



→ **Hatch - shading technique**

contour_shade='on',
contour_shade_technique='polygon_shading',
contour_shade_method='hatch',

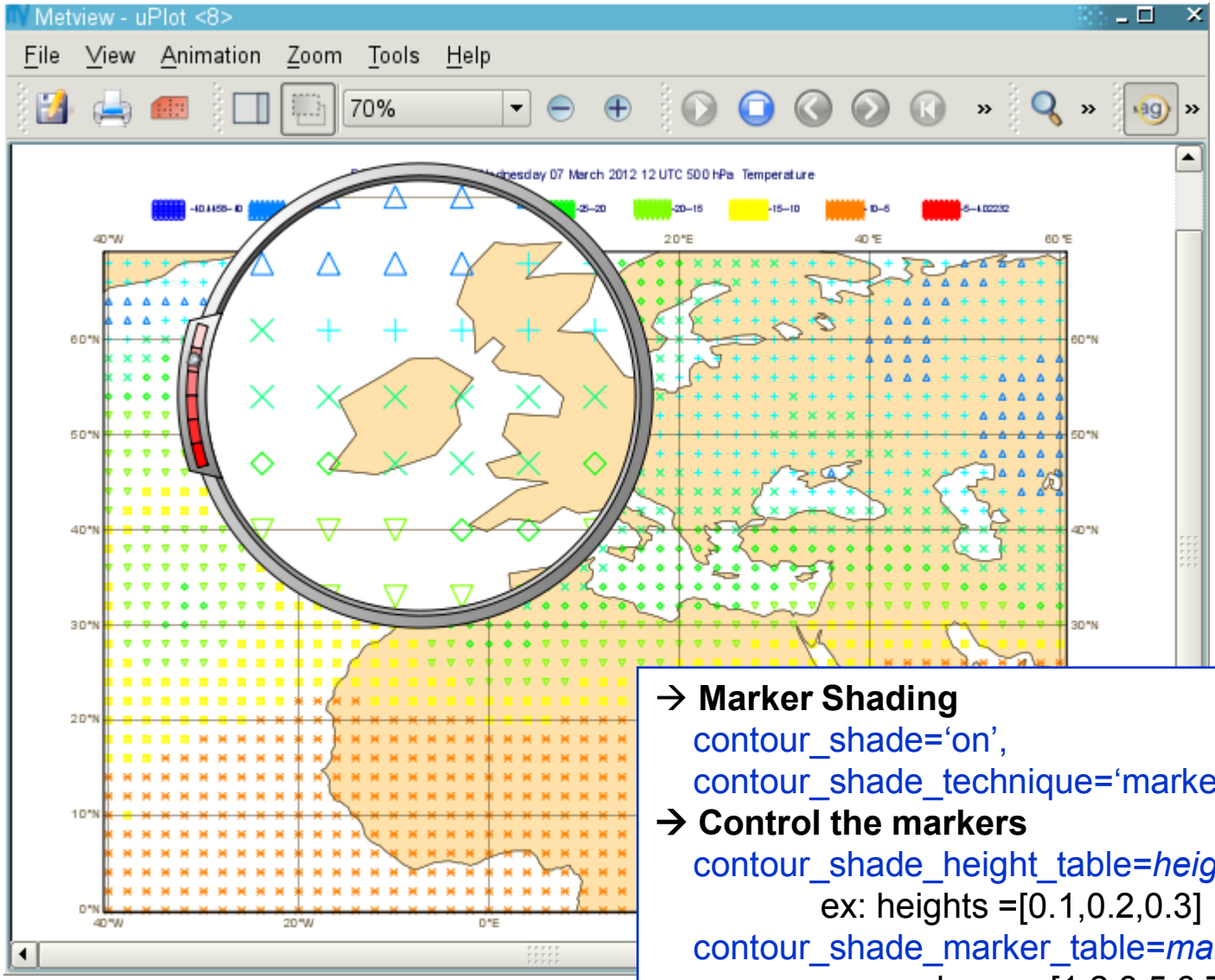


→ **Cell Shading**

contour_shade='on',
contour_shade_technique='cell_shading',

→ **Control the resolution**

contour_shade_cell_resolution=5.,



→ **Marker Shading**

contour_shade='on',

contour_shade_technique='marker',

→ **Control the markers**

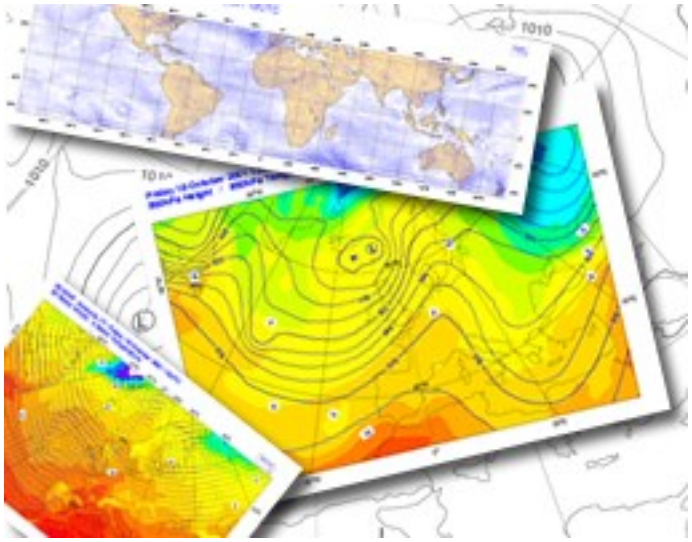
contour_shade_height_table=*heights*,

ex: heights =[0.1,0.2,0.3]

contour_shade_marker_table=*markers*

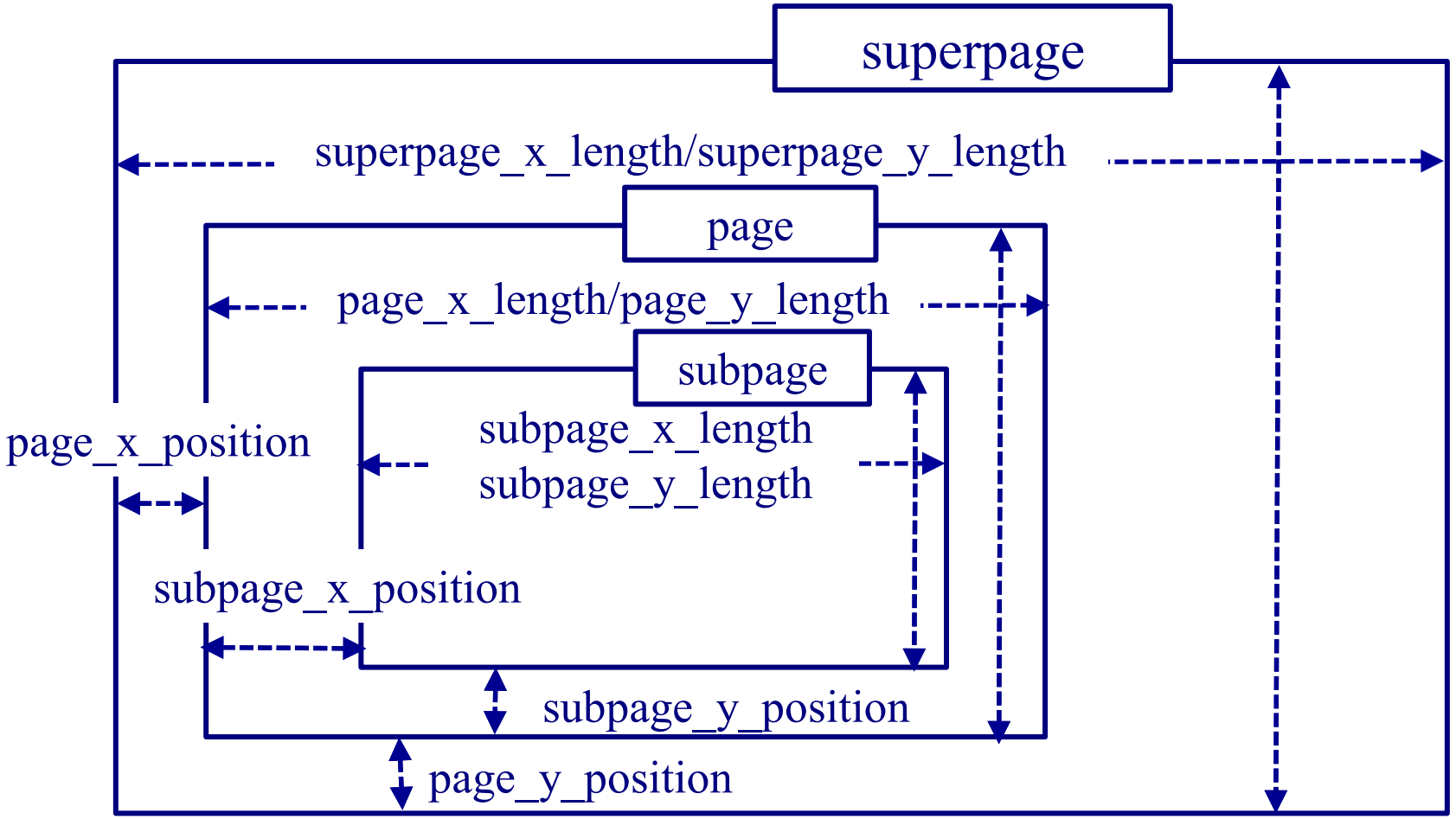
ex: markers = [1,2,3,5,6,7,8,9,10]

Layout – Text - Legend



Layout

- 3 main concepts : superpage/page/subpage



Layout → things to remember

- **The layout and projection settings are done during the call to the first action-routine.**
- **The instantiation of a page object will create a new page.**

```
page(page_x_length =14., page_y_length=10.,
     page_x_position=15., page_y_position=10.5,
     subpage_x_position=0.5,  subpage_y_position=0.5,
     subpage_x_length=12.,  subpage_y_length=8.)
```

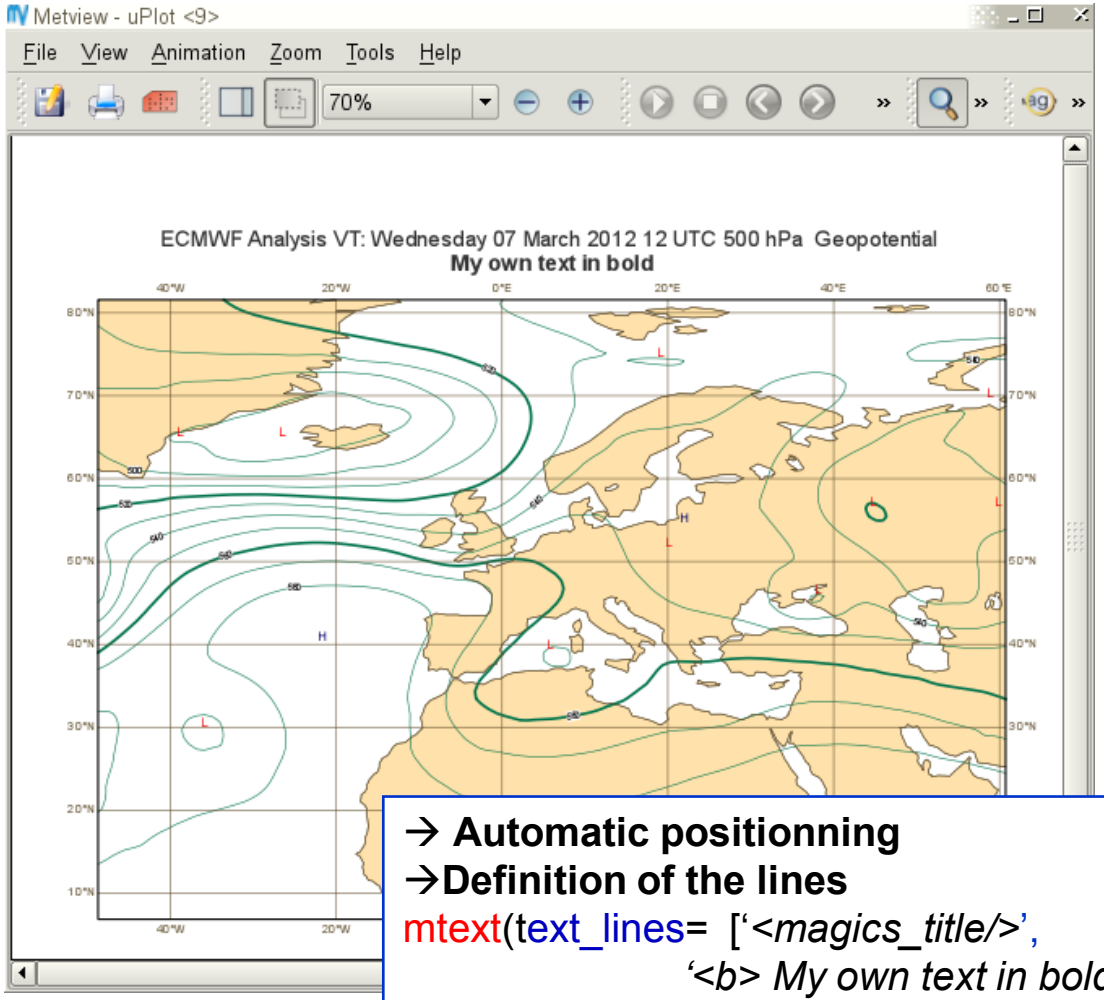
- **The dimensions are in cm.**
- **The subpage is the area where the plot will be rendered: There is always a projection attached to it : geographical or Cartesian.**

Text setting and formatting

- The position of a the text can be
  - automatic (attach to the top of the subpage)
  - positional (text_x_position, text_y_position text_x_length, text_y_length)
- The text is passed as an array of strings.

Text setting and formatting

- Basic html formatting can be used
  - My text : bold
  - My text : colour and font-size
  - _{My text}: subscribed
  - ^{My text}: superscripted
- Some tags allow to extract and use metadata from the grib headers (using the grib_api keys, or magics_specific keys)
  - <grib_info key='param'/> (name, base_date valid_date)
  - <magics_title/> will create an automatic title.



→ **Automatic positionning**

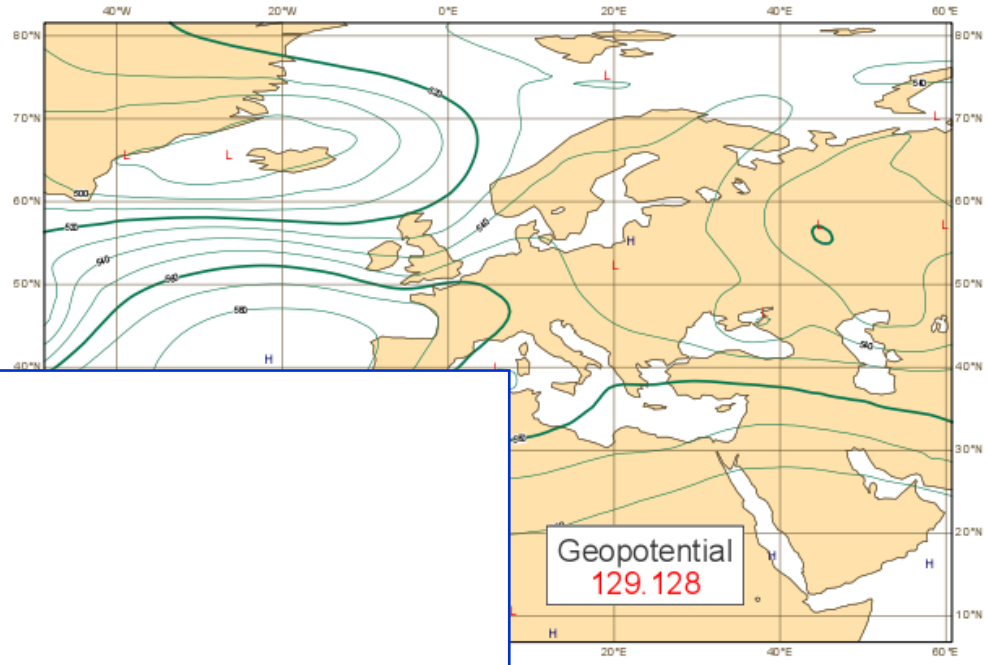
→**Definition of the lines**

mtext(text_lines= [‘*<magics_title/>*’,

‘ My own text in bold ’])

automatic title build from the GRIB header

user text with basic HTML formatting



→User-defined position

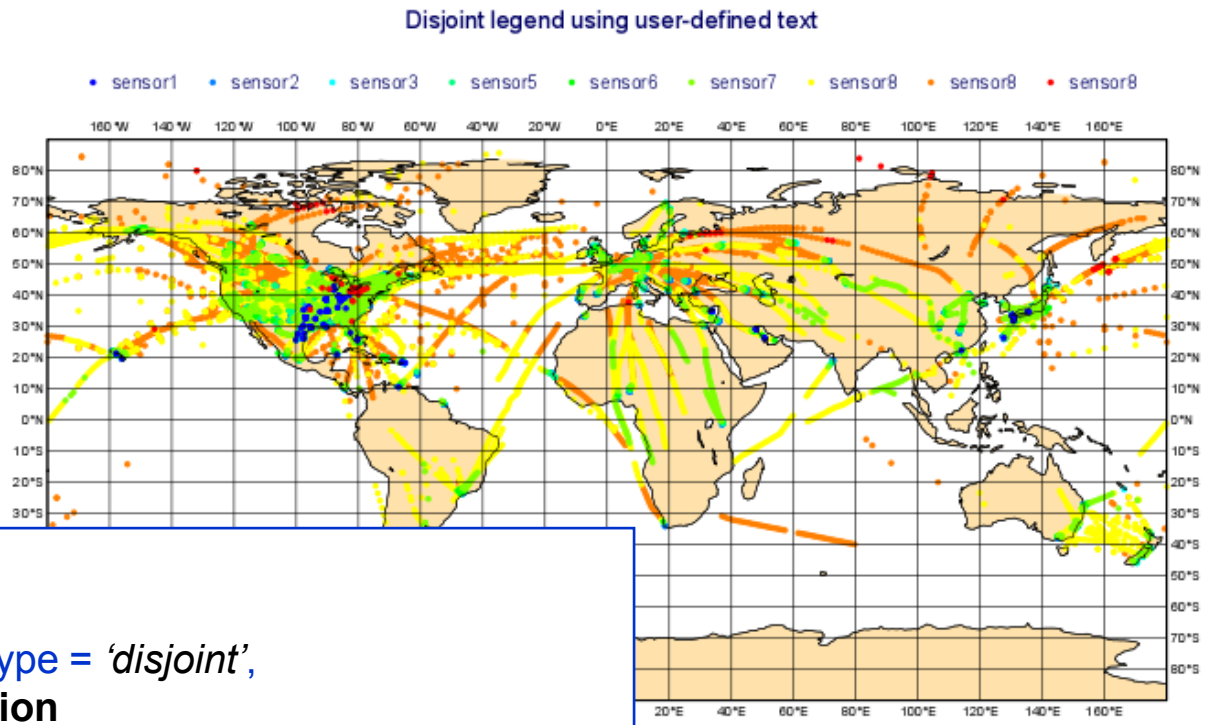
mtext(text_mode= *'positional'*,
text_box_x_position= *15.*,
text_box_y_position= *2.*,
text_box_x_length= *5.*,
text_box_y_length= *2.*,
dimensions in cm from the bottom-left corner
text_box_blanking= *'on'*,
text_border= *'on'*,
text_border_colour= *'charcoal'*,

→Definition of the lines

text_lines= [*'<grib_info key="name"/>'*,
extract information from the GRIB header using GribAPI keys
* '<grib_info key="param"/>'*']
adding basic HTML formatting

Legend

- **As a text, the legend (legend_text_mode) can be :**
  - **automatic**
    - ➔ attach to the top of the subpage, below the automatic title
  - **positional**
    - ➔ legend_x_position/legend_y_position /legend_x_length/legend_y_length
- **The legend (legend_display_type) can be**
  - **disjoint**
  - **continuous**
  - **histogram**



→**Legend definition**

mlegend(legend = *'on'*,

legend_display_type = *'disjoint'*,

→**User-defined text definition**

legend_text_composition= *'user_text_only'*)

legend_user_lines= *['sensor1',…,sensor8']*

legend_text_font_size=*0.4*,

legend_text_colour= *'navy'*,

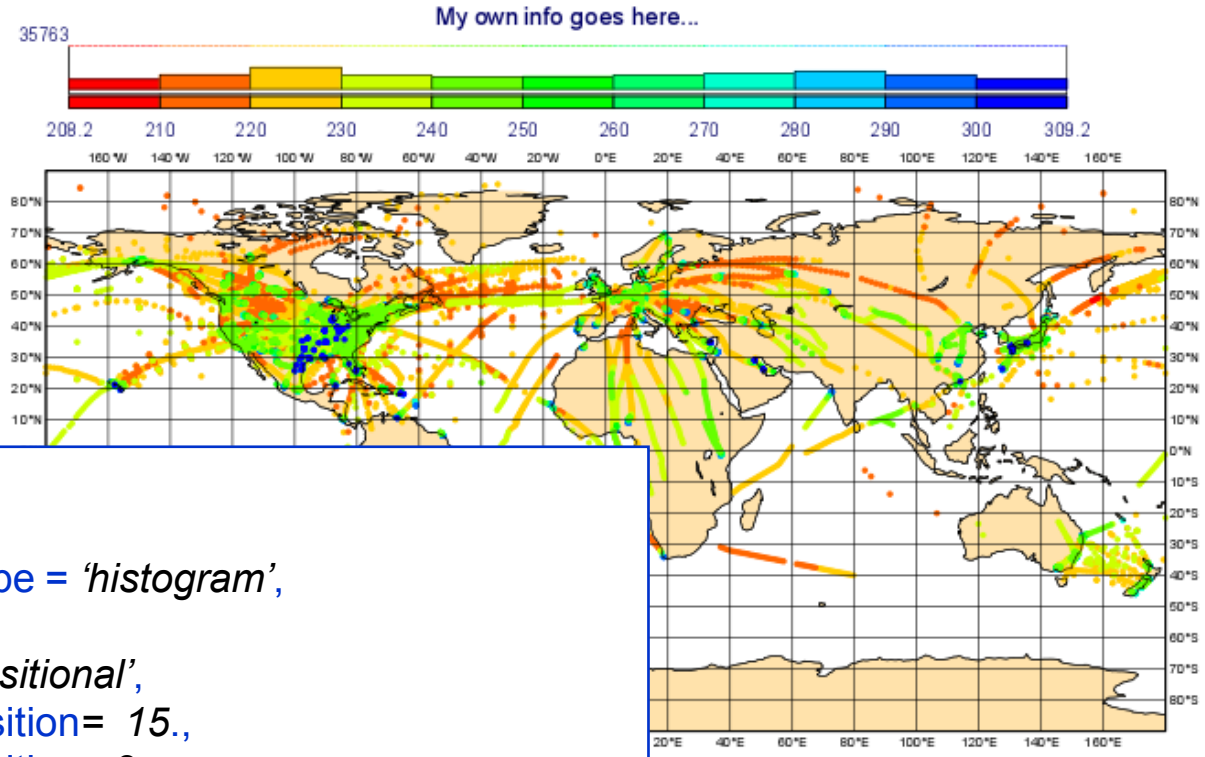
→**Definition of the title**

legend_title'= *'on'*,

legend_title_text' =

'Disjoint legend …')

using basic HTML formatting



→**Legend definition**

mlegend(legend =*'on'*,

legend_display_type = *'histogram'*,

→**User-defined position**

legend_mode= *'positional'*,

legend_box_x_position= *15.*,

legend_box_y_position= *2.*,

legend_box_x_length= *5.*,

legend_box_y_length= *2.*,

dimensions in cm from the bottom-left corner

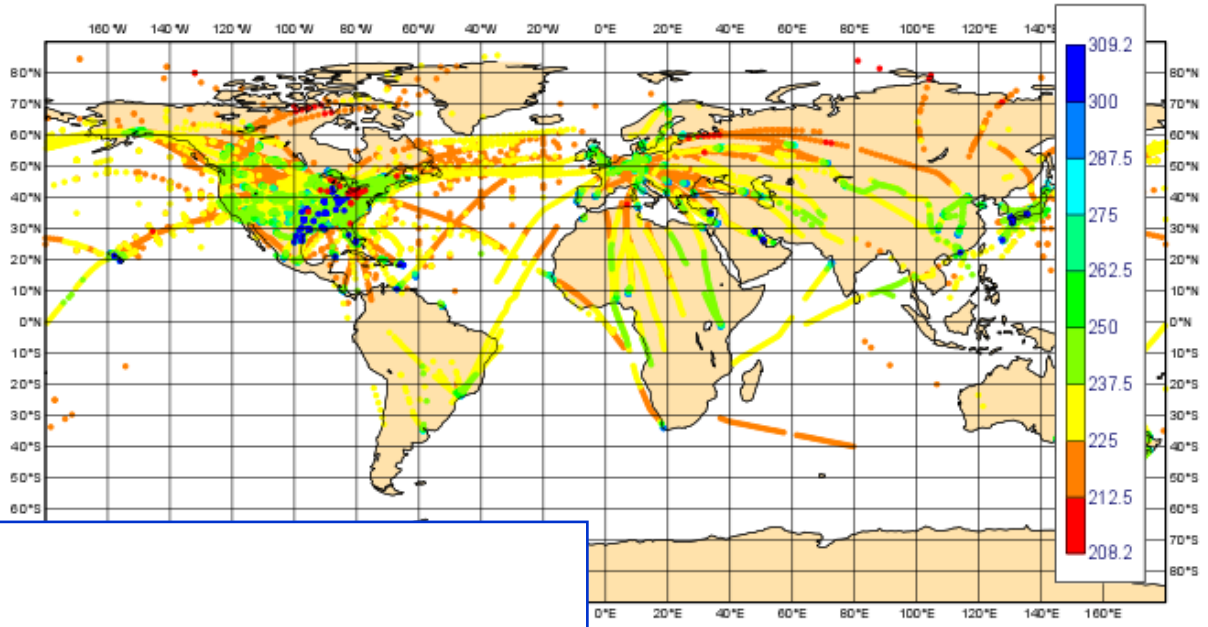
→**Definition of the title**

legend_title= *'on'*,

legend_title_text' =

'My own info goes here…')

using basic HTML formatting



→Legend definition

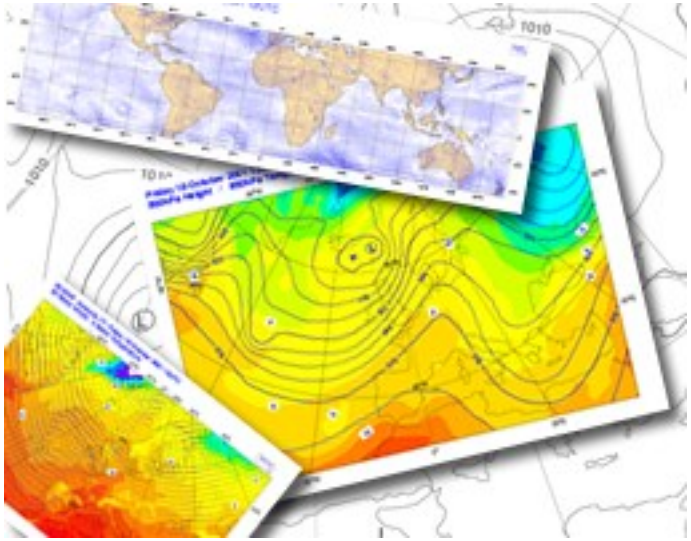
mlegend(legend = *'on'*,
legend_display_type = *'continuous'*,

→User-defined position (vertical)

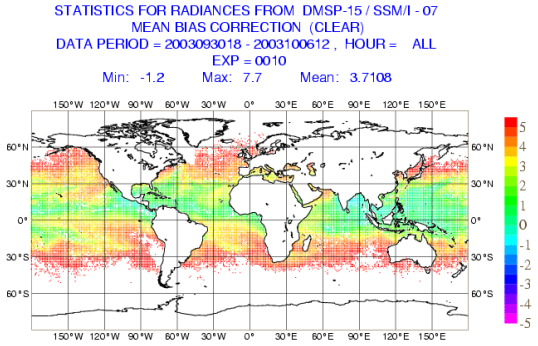
legend_mode= *'positional'*,
legend_box_x_position= *25.*,
legend_box_y_position= *1.5*,
legend_box_x_length= *2.*,
legend_box_y_length= *13.*)

Dimensions in cm from the bottom-left corner
The number of rows and columns can be adjusted.

Magics outputs



Working with Magics output

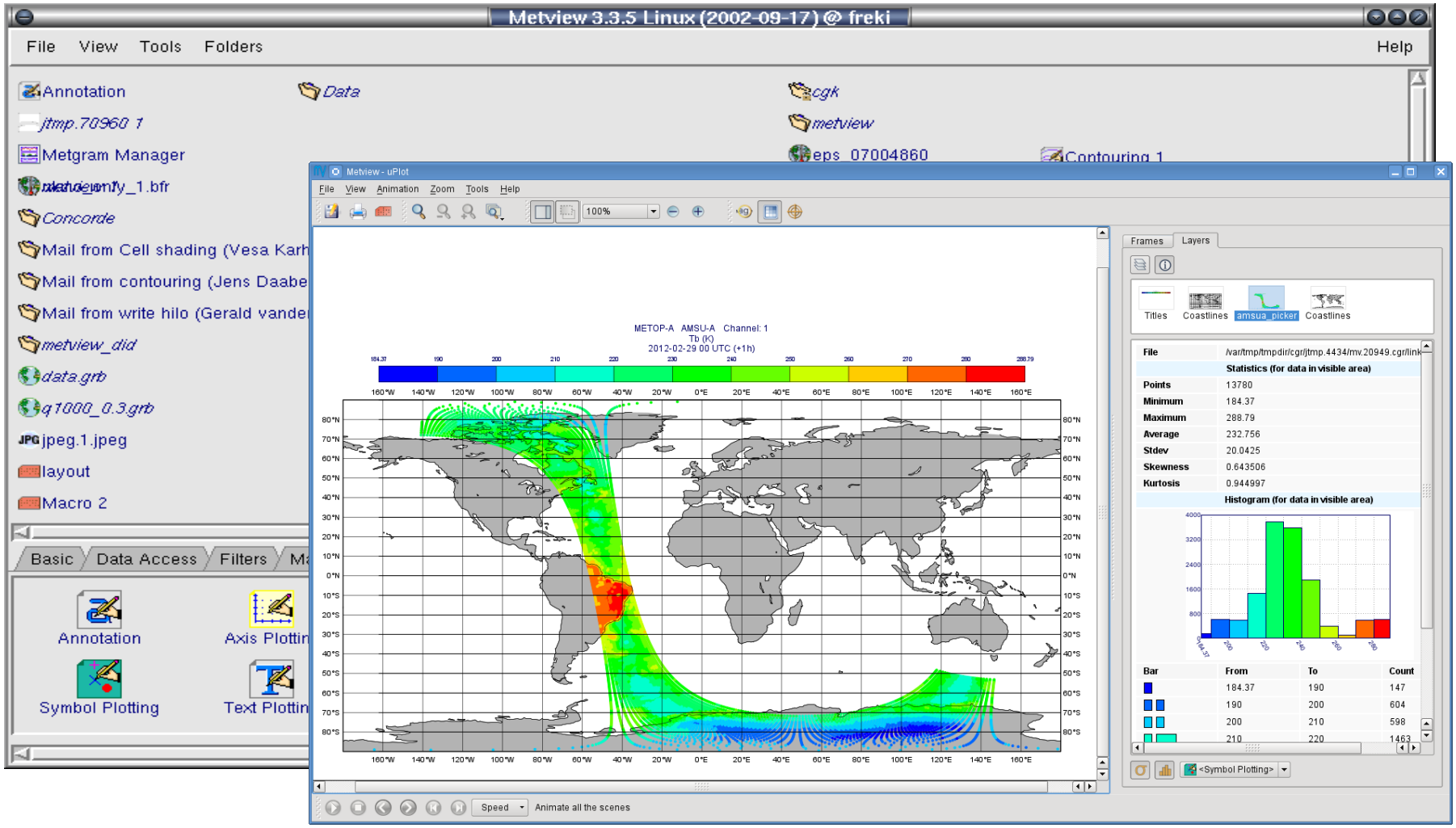


- Magics has many output formats:

  (depending on the installation)

  - Vector formats → PostScript (for printers), EPS, PDF, SVG
  - Raster formats → PNG
  - Animated formats → Qt for Metview, KML for Google Earth
- PostScript is the default and most reliable output format
- PNG, as a raster format, has not as good quality as vector formats
- SVG is a web vector format which is becoming increasing popular (HTML5)
- Some formats only support transparent colours

Magics Qt output → Metview



Viewing and processing Magics output

- The output files can be viewed with:

  PostScript : Ghostview (*gv*), *okular*

  PNG : *display*, web browser

- Files (especially PostScript) can be easily compressed and uncompressed by *gzip* and *gunzip*. This can save a lot of disk space and speeds up network transfers (email)!!!
- Output files can be processed by many standard tools, such as *xv*, *display* and any web browser.
- Especially powerful is a free package called *ImageMagick*. It contains many tools to process images.

http://www.imagemagick.org

Magics++ - defining output

- **File naming:**

  Python: `output(output_name='example_name')`

  will result in names as *example_name.ps* **or** *example_name.1.png***. The file extension is added automatically by the driver.**

- **Formats which have one page per file (like PNG) get also a number:**

  wind.1.svg, wind.2.svg

Defining output size

- **For most drivers size is set through**

  superpage_x_length & superpage_y_length

  (default: A4 landscape)

- **For some raster drivers (i.e. PNG)**

  output_width (default: 800 pixels)

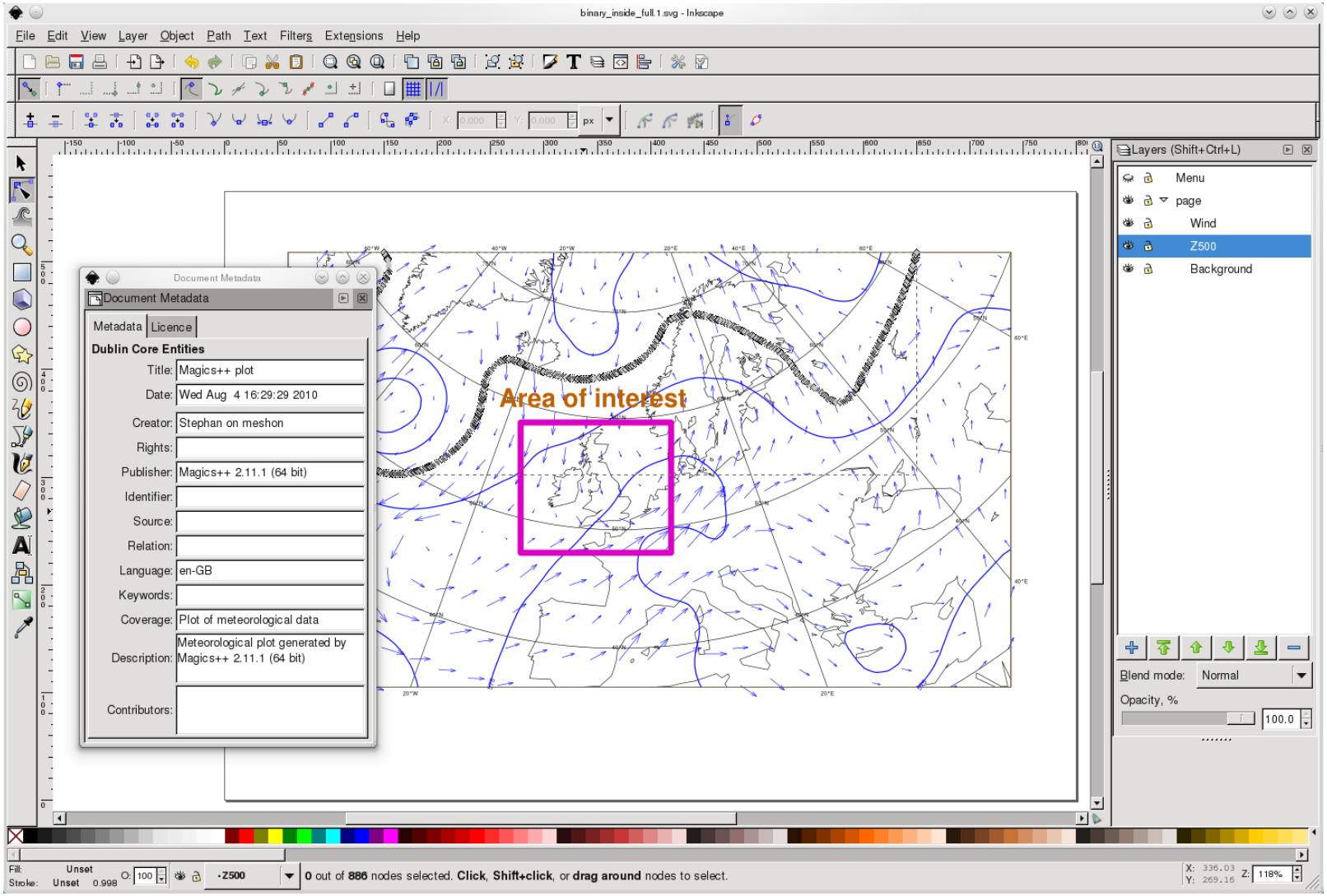
  (where the ratio of superpage gives height)

- **KML is very special!**
  - **Does not have an output size**
  - **Only works when Cylindrical projections is set!**

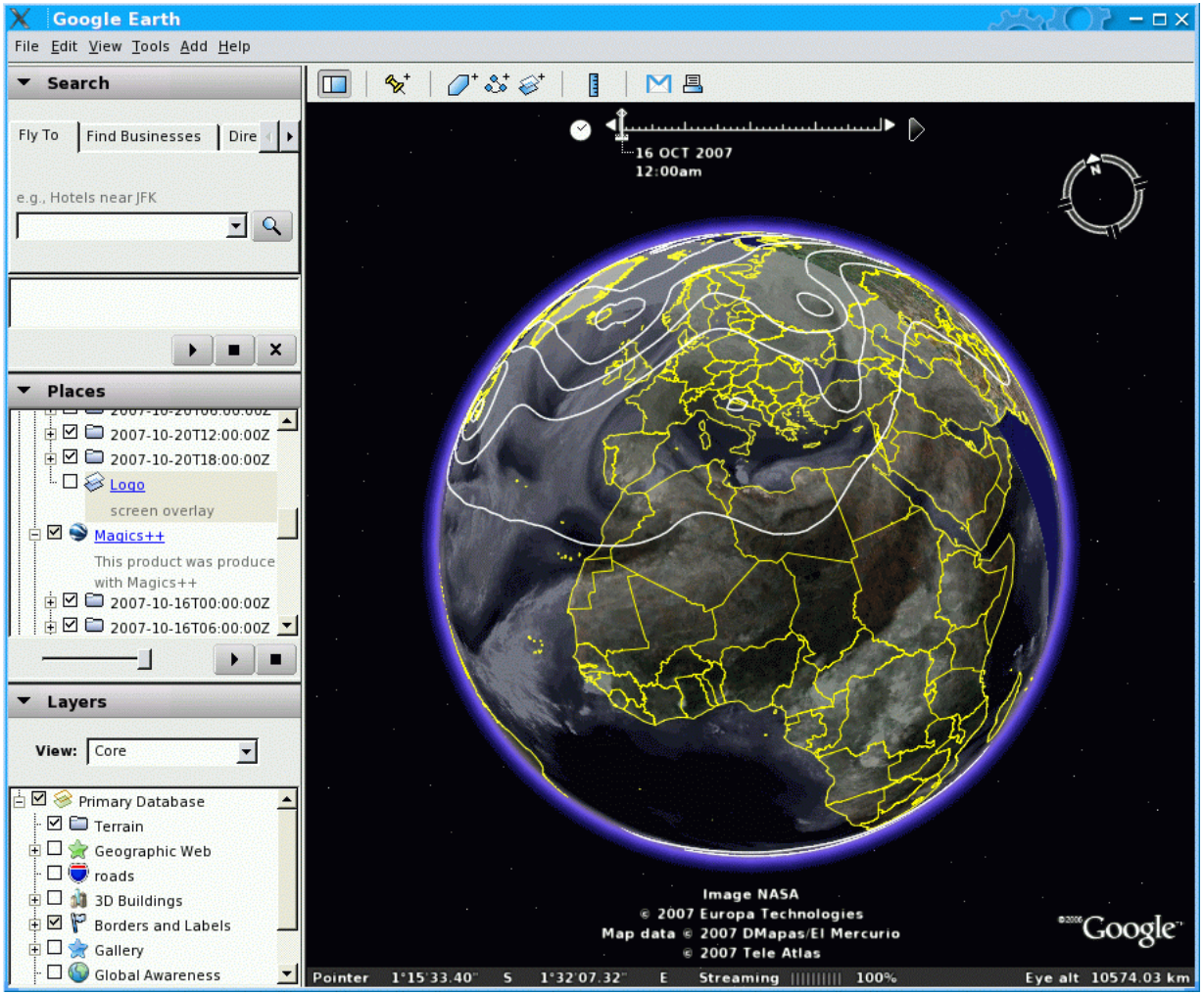
Magics++ - new formats

- EPS/PDF
  - Addition to PostScript output to support inclusion in documents (Word, Latex) and on the web
- SVG
  - Vector format for web/printing (HTML5)
  - Human readable and supports interactivity
- KML
  - For use in Google Earth and Google Maps
  - Still in the beginning (no legend, no wind flags/arrows)

Magics++ : SVG output

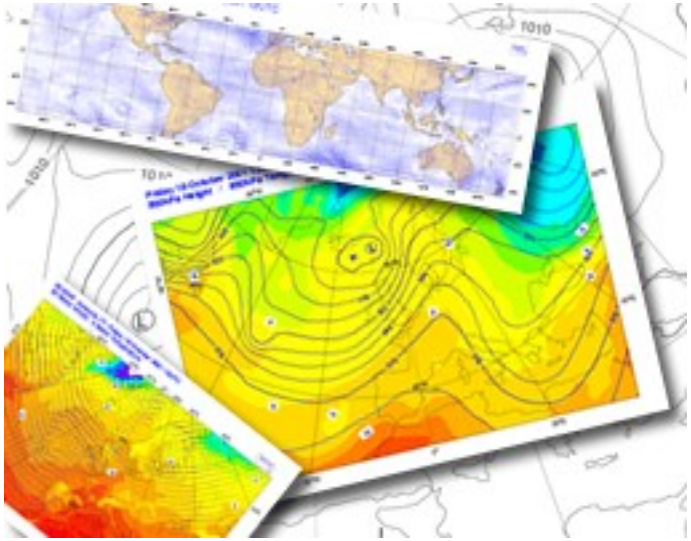


Magics++ : KML output

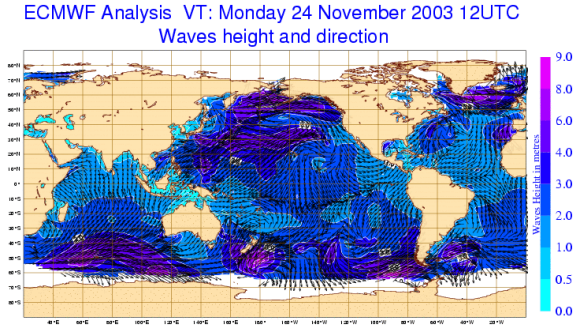


(Works not for all types of data/projections)

Wind Plotting



More on Wind Plotting

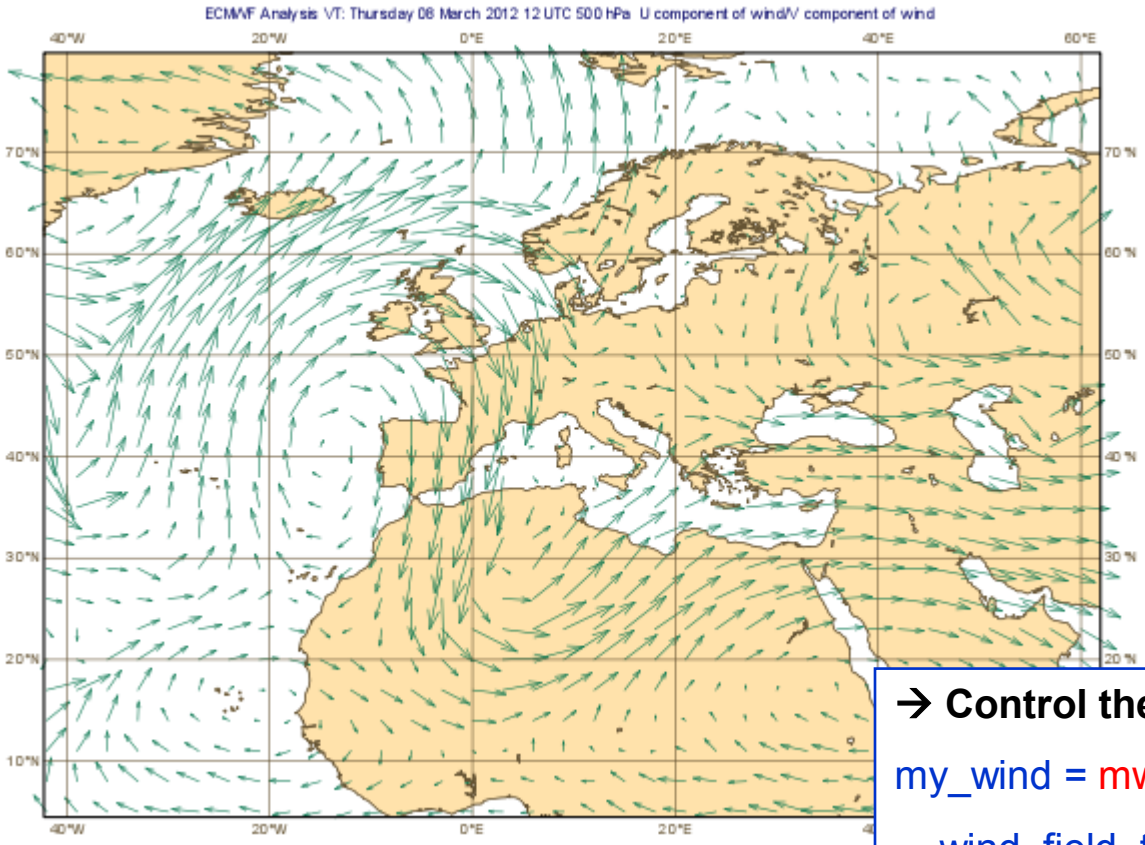


- **Wind field :**
  - **U/V velocity components**
  - **Speed and direction**
  - **→ Set mode through 'GRIB_WIND_MODE'**
- **Wind plotting**
  - **Wind arrows**
  - **WMO standard wind flags**
  - **→ Set type through 'WIND_FIELD_TYPE'**

More on Wind plotting

- The projection of wind fields is done automatically
- There is no interpolation.
- A thinning process may be applied
- User has control over:
  - Colour
  - Thickness
  - Minimum/maximum speed
  - Calm indicator

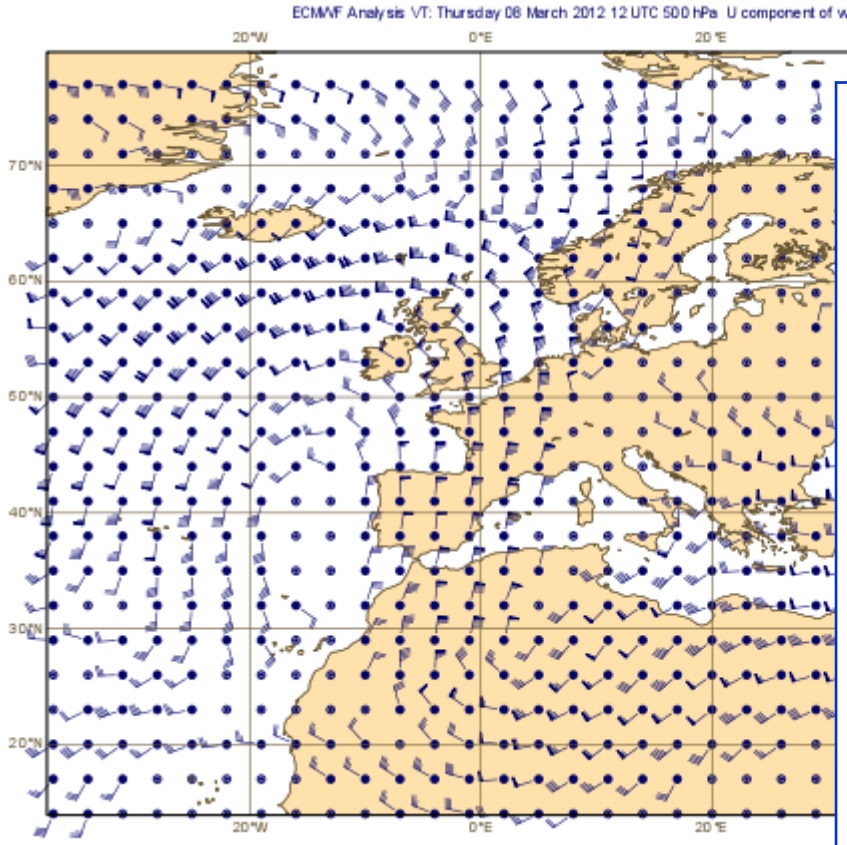
Wind arrows example



→ **Control the wind plotting**

```
my_wind = mwind(
    wind_field_type='arrows',
                **arrows**/flags
    wind_arrow_colour='evergreen')
```

Wind flag example



→ **Control the wind flags**

```
my_wind = mwind(
    wind_field_type='flags',
    wind_flag_colour='navy',
    wind_flag_thickness=1.5,
    wind_flag_origin_marker='dot',
```

→ **Control some global attributes**

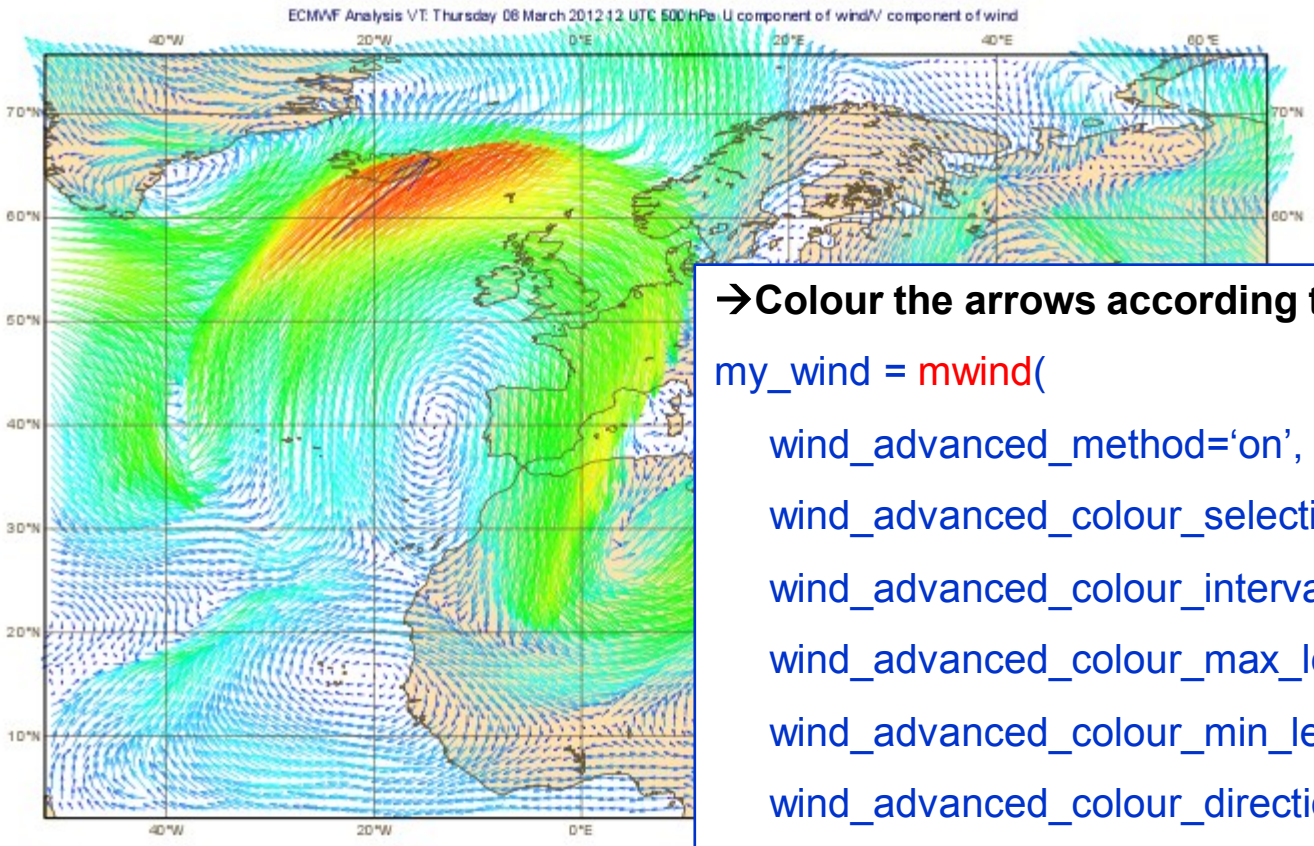
```
    wind_thinning_factor=3.,
```

Control calm wind and min/max (m/s)

→ **Values are given in m/s BUT displayed in knots (according to WMO standard)**

```
    wind_flag_calm_below=1.5,
    wind_flag_min_speed=1.,
    wind_flag_max_speed=10.)
```

Advanced wind plotting



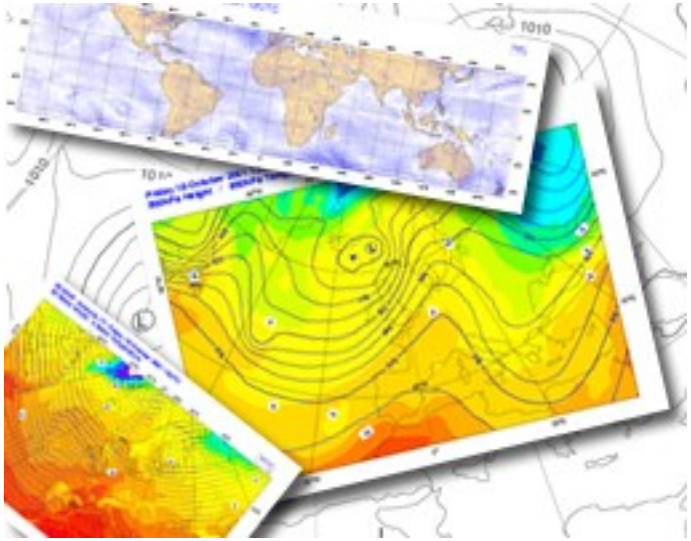
→Colour the arrows according to the wind speed

```
my_wind = mwind(
    wind_advanced_method='on',
    wind_advanced_colour_selection_type='interval',
    wind_advanced_colour_interval=2.,
    wind_advanced_colour_max_level_colour='red',
    wind_advanced_colour_min_level_colour='blue',
    wind_advanced_colour_direction='clockwise',
```

→Control some global attributes

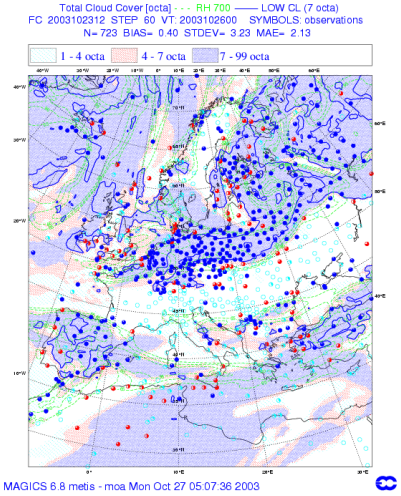
```
    wind_arrow_unit_velocity=25.,
    wind_thinning_factor=1.)
```

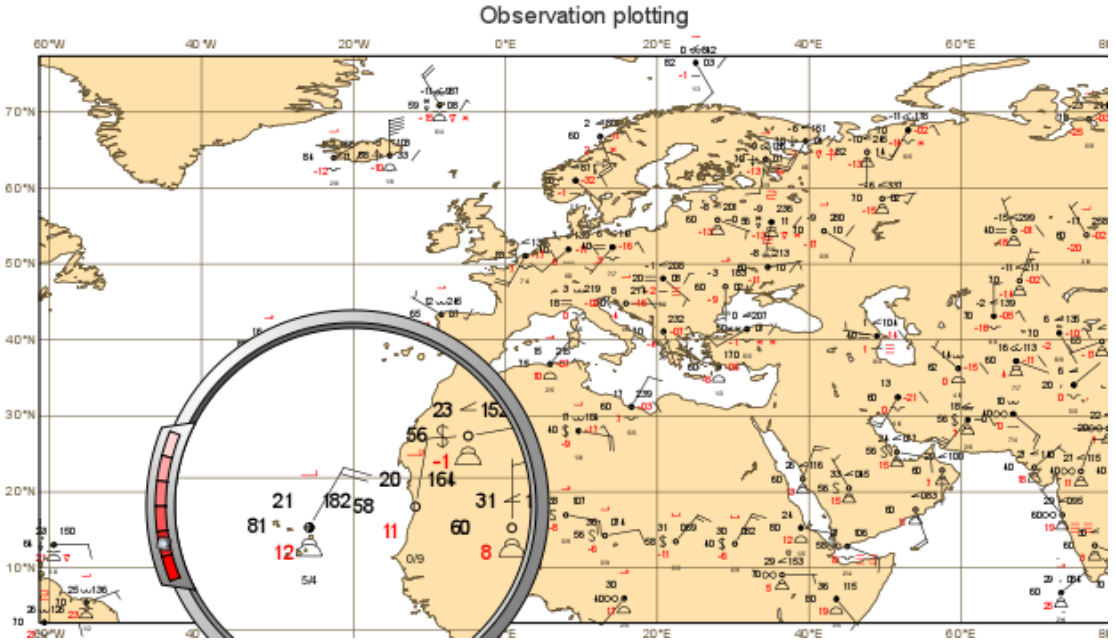
Observations and symbol plotting



More on Observations

- Magics++ supports basic observation plotting
  - Synop
- WMO plotting standards.
- WMO BUFR code

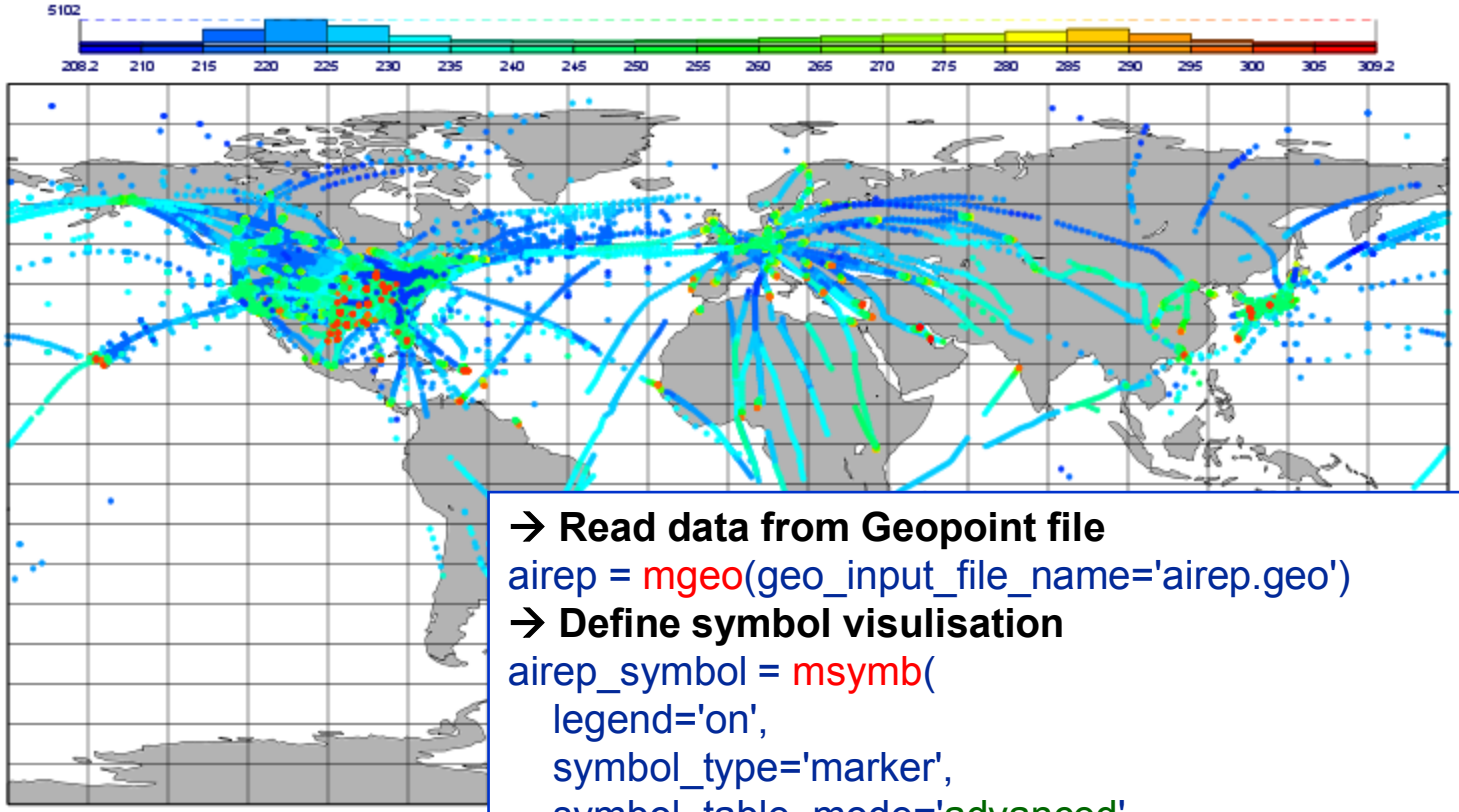




Symbol plotting

- Magics has many options to plot symbols representing data, such as observations
- Magics++ improves the handling of large amounts of data coming from satellites stored in ODB
- Valid inputs:
  - **Arrays of values**
    - → x_values/y_values
  - **Geopoints files**
    - → Ascii files (Metview)
  - **ODB**

Monitoring of airep data



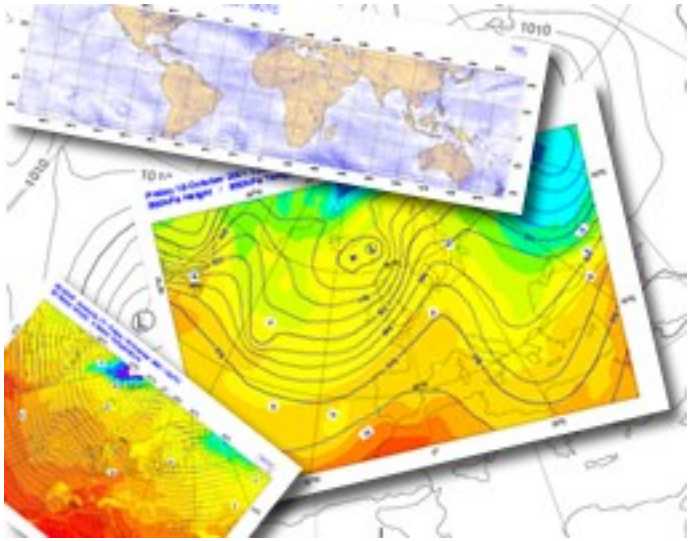
→ **Read data from Geopoint file**

```
airep = mgeo(geo_input_file_name='airep.geo')
```

→ **Define symbol visulisation**

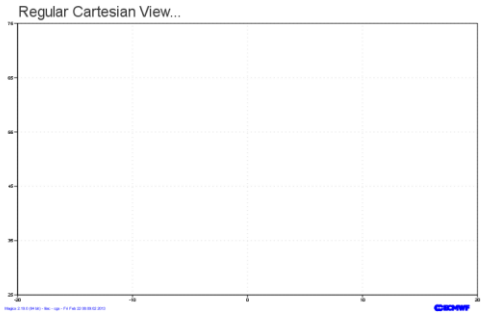
```
airep_symbol = msymb(
    legend='on',
    symbol_type='marker',
    symbol_table_mode='advanced',
    symbol_advanced_table_selection_type='interval',
    symbol_advanced_table_interval=5.,
    symbol_advanced_table_min_level_colour='blue',
    symbol_advanced_table_max_level_colour='red',
    symbol_advanced_table_colour_direction='clockwise',
    symbol_marker_index=15)
```

Cartesian projection
and
Graph Plotting



Cartesian View

- **A Cartesian view is defined by 2 axis i.e. 2 calls to *paxis*.**




```
mmap(subpage_map_projection = 'cartesian',
        subpage_x_axis_type='regular',
        subpage_x_min = -20,  subpage_x_max=20,
        subbpage_y_axis_type='regular',
        subpage_y_min = -20,  subpage_y_max=20)
```

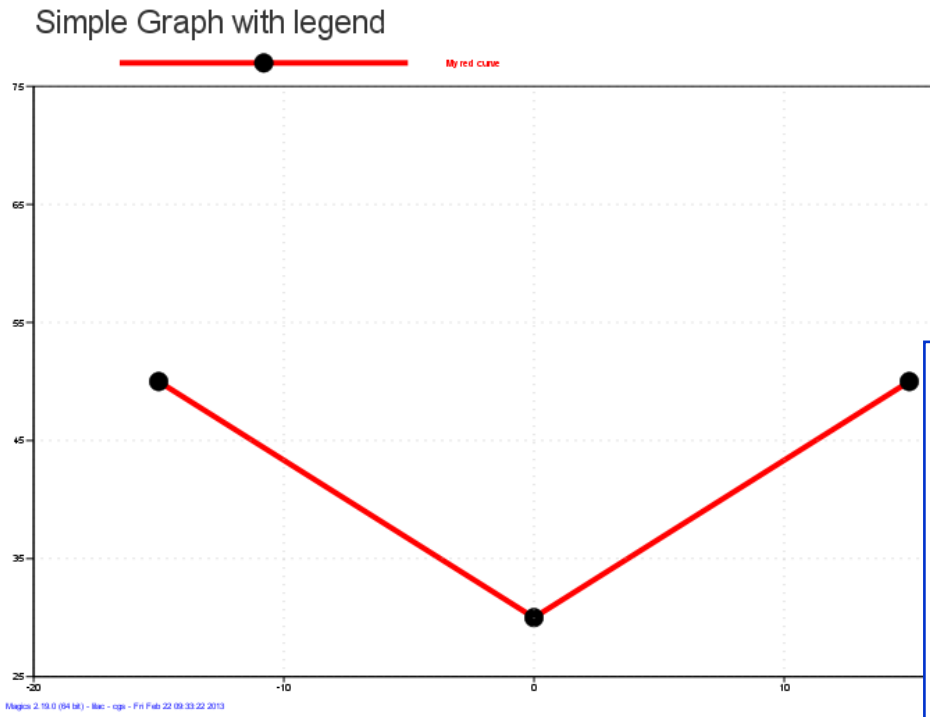
- **The setting should follow these basic rules**

→First step : define the horizontal axis

```
horizontal = maxis(axis_orientation='horizontal')
```

→Second step : define the vertical axis

```
vertical = maxis(axis_orientation='vertical')
```



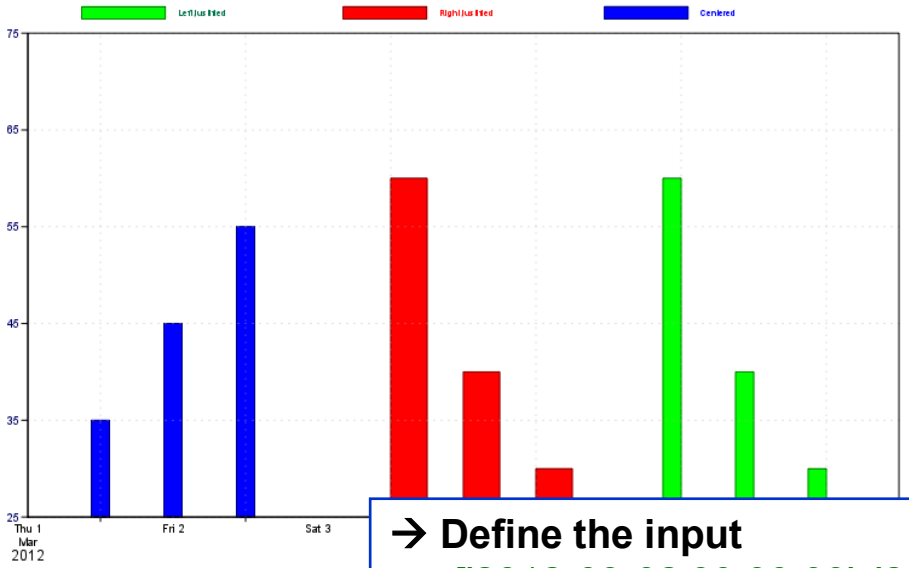
→ **Define the input**

```
x = numpy.array([-15., 0., 15.])
y = numpy.array([50., 30., 50.])
input = minput(input_x_values = x,
               input_y_values = y,
```

→ **Define the graph**

```
graph = mgraph(
    graph_line_colour='red',
    graph_line_thickness=8,
    graph_symbol='on',
    legend='on',
    legend_user_text="My red curve",
    graph_symbol_marker_index=15,
    graph_symbol_colour='black',
    graph_symbol_height=1.)
```

Bar Justification



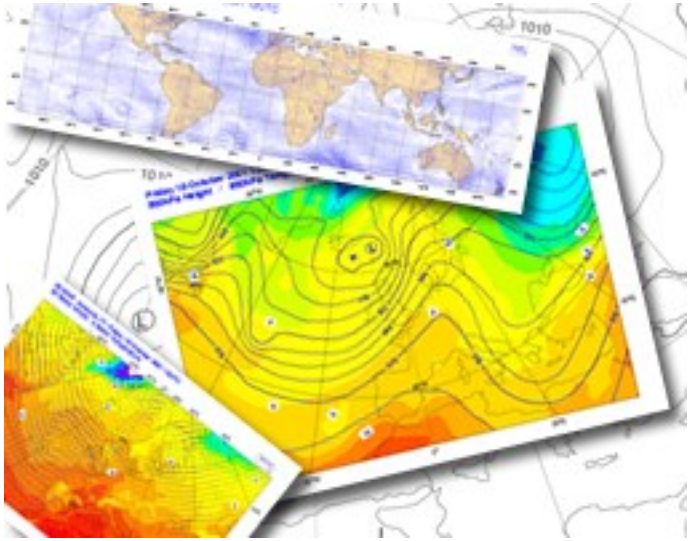
→ **Define the input**

```
x = ['2012-03-02 00:00:00', '2012-03-02 12:00:00', '2012-03-03 00:00:00']
y = numpy.array([35., 45., 55.])
input = minput(  input_x_values= x,
                 input_y2_values= y,
                  input_y_values= [0.] * len(y),
```

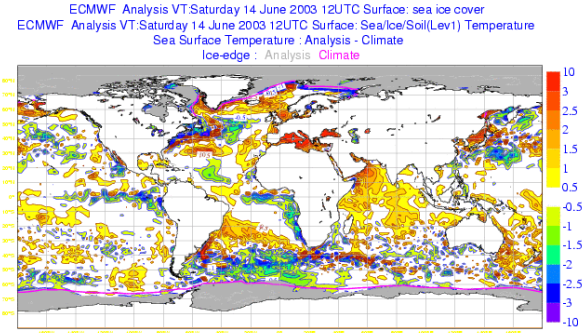
→ **Define the graph**

```
centre = mgraph(
    graph_type='bar',
    graph_bar_justification='centre',
    graph_bar_colour='blue',
    graph_bar_width=3 * 3600.,
    legend='on',
    legend_user_text="Centered")
```

Wrap-up



Where to find information?



- On the Magics web site, you will find:
  - Gallery of examples
  - Tutorial
  - Reference manual
  - Magics change history
  - Information about input and output formats
  - Links to Newsletter article about Magics

https://software.ecmwf.int/magics

Contacting the Magics developers

- We encourage users to contact us to give feedback.
- If you send emails to magics@ecmwf.int to ask for help please provide us with this information:
  - A clear subject line (e.g. “Logo looks upside down”)
  - A short description of your system (e.g. ‘uname -a’ and compilers used)
  - A time frame which a problem needs to be fixed
  - Please compress large files (gzip / bzip)
- Currently we aim for two major releases a year and you might have to wait for the next release to get an update

Getting Magics++

- **Download free (under Apache license) from**

  https://software.ecmwf.int/magics/Releases

- **Installation Guide at**

  https://software.ecmwf.int/magics/Installation+Guide

  ./configure ; make ; make check ; make install

How to compile and execute your Magics++ program at home?

- Magics++ provides a script called magics-config to help you setting up your environment and compile Magics programs.
- The script is installed in $prefix/bin .
- Setup Magics once per shell: magics-config --print-setup
- Compile and link using
  - gfortran test.f -o ftest `magics-config --f90libs`
  - gcc test.c -o ctest `magics-config --cxxincludes --clibs`

  or even

  - magics-config --compile=myprogram.f (only for pure Magics programs!)

How to compile and execute your Magics++ program at ECMWF ?

- Setup Magics once per shell: use magics++
- Create your Fortran program
  - Use an editor (*vi*, xemacs, *nedit, kwrite*) to write your Magics calls
- Compile and link
  - ➔ **Linux:** *pgf90 –o myMagics myMagics.f $MAGPLUSLIB_SHARED*
- Run your program
- View your result - Use a PostScript viewer : *gv*, display
- Modify your program if necessary …

Any questions / suggestions?

Any questions and suggestions are welcome!

Contact us via email:

magics@ecmwf.int

Visit our webpage:

https://software.ecmwf.int/magics