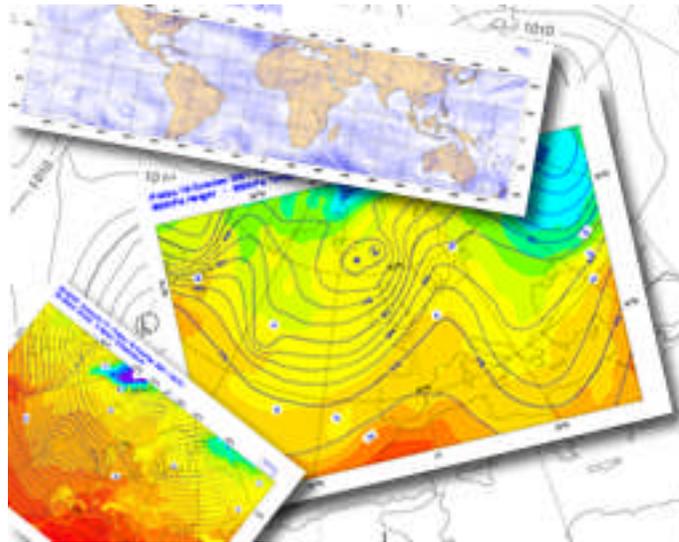


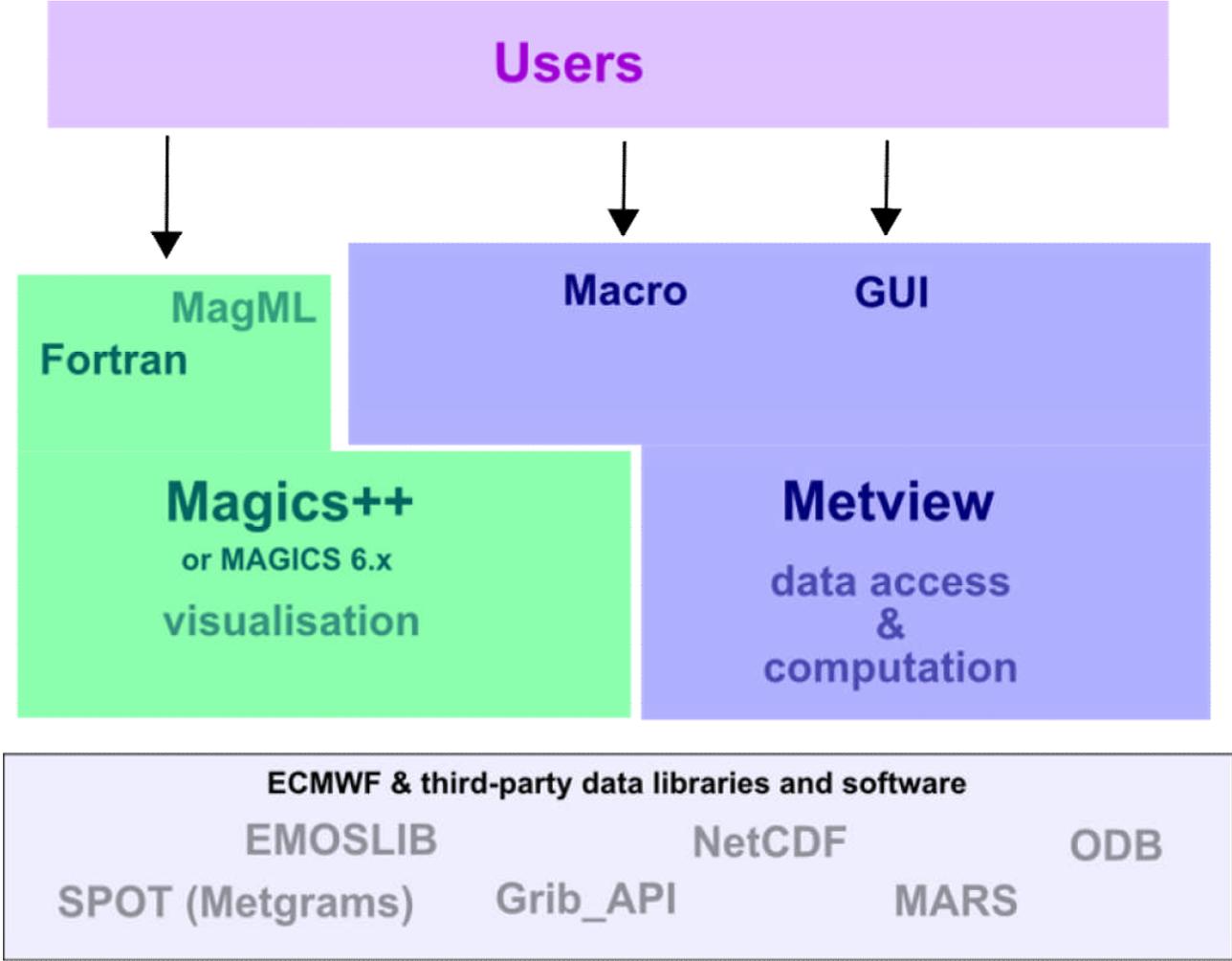
Visualisation tools at ECMWF



Stephan Siemen
Graphics Section
ECMWF

Overview

- **MAGICS**
- **Magics++**
- **Metview**



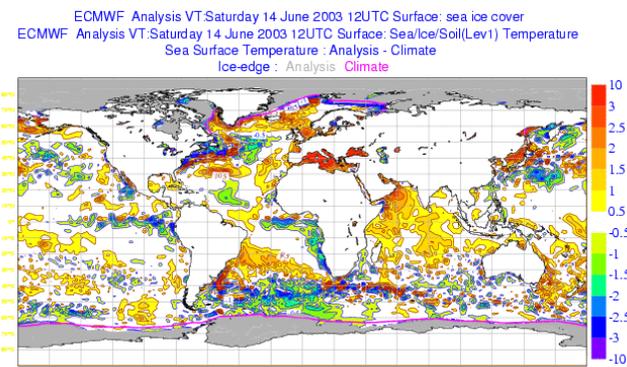
Data



Advantages of in-house development

- **Faster adoption of new formats (e.g. Grib2) and changes in forecast models (e.g. resolution) and making these available to ECMWF users and customers as these become available**
- **Full control of development**
- **Debugging possible of whole application development**
- **Expertise in issues surrounding data reading, visualisation and presentation of results**
- **Teaching of software through experts**
- **Independence from third-party licences**

MAGICS overview



- **Meteorological Applications Graphics Integrated Colour System**
- **MAGICS is a Fortran library**
- **MAGICS is used operationally for over 20 years in more than 30 member states and countries**
- **MAGICS is used by Synergie (Météo-France)**
- **MAGICS is the graphical kernel of Metview**
- **Daily production of thousands of operational plots**

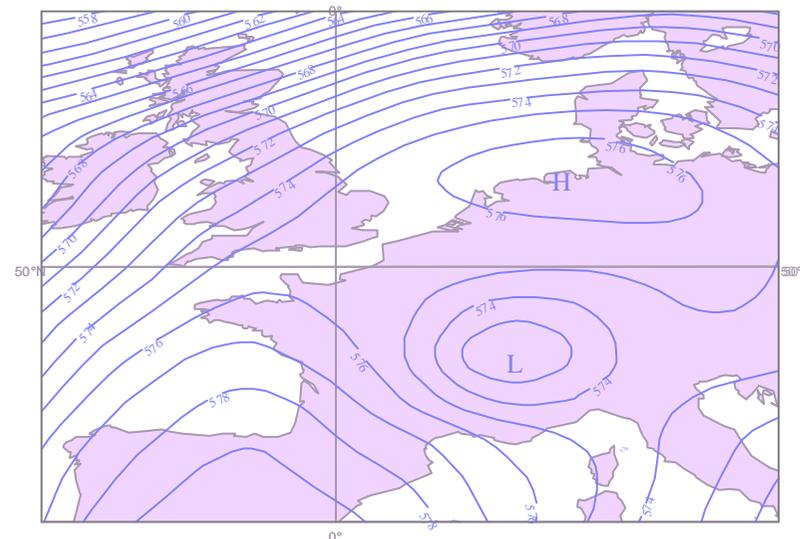
MAGICS overview

- **Magics is meteorologically-oriented**

- GRIB
- BUFR
- Weather statistics and verification

- **Magics provides a simple API**

- Large set of parameters
- Small number of FORTRAN callable subroutines



What can you do with Magics?

- Define your Geographical Area and Projection.

- e.g. Polar Stereographic, Cylindrical

- Import data

- GRIB, matrix (z, but also u/v)
- BUFR for Observations

- Add Text and/or automatic title

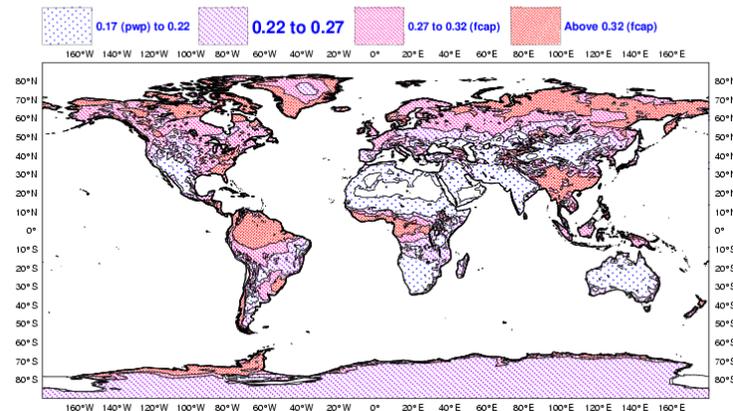
From the Grib or Bufr Header

- Create a legend

- Plot contours

- High quality contouring

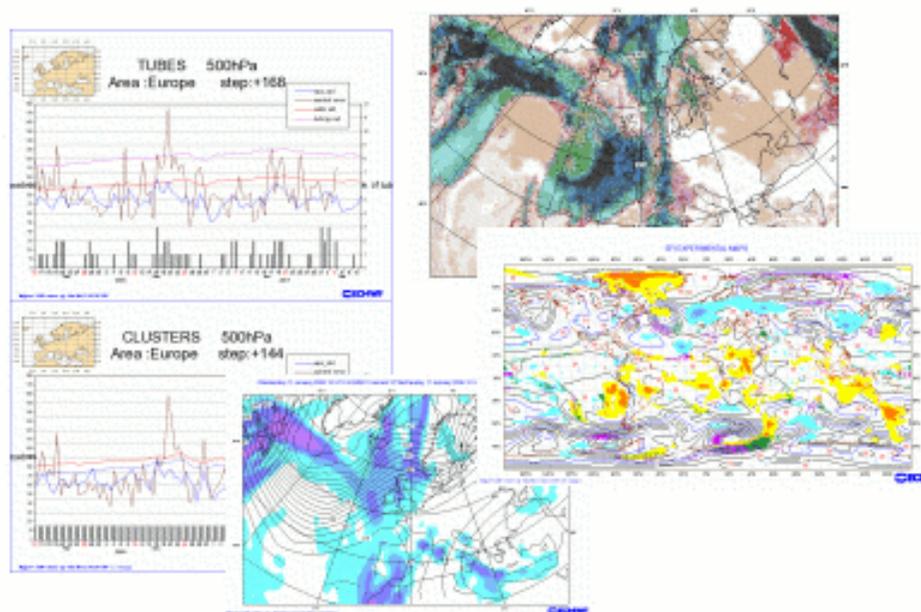
ECMWF Analysis VT: Saturday 14 June 2003 12UTC
SURFACE: Integrated soil wetness (layers 1+2+3) (m3/m3)
0.32 (fcap) represent 320 mm of water



Exp 10

What can you do with Magics?

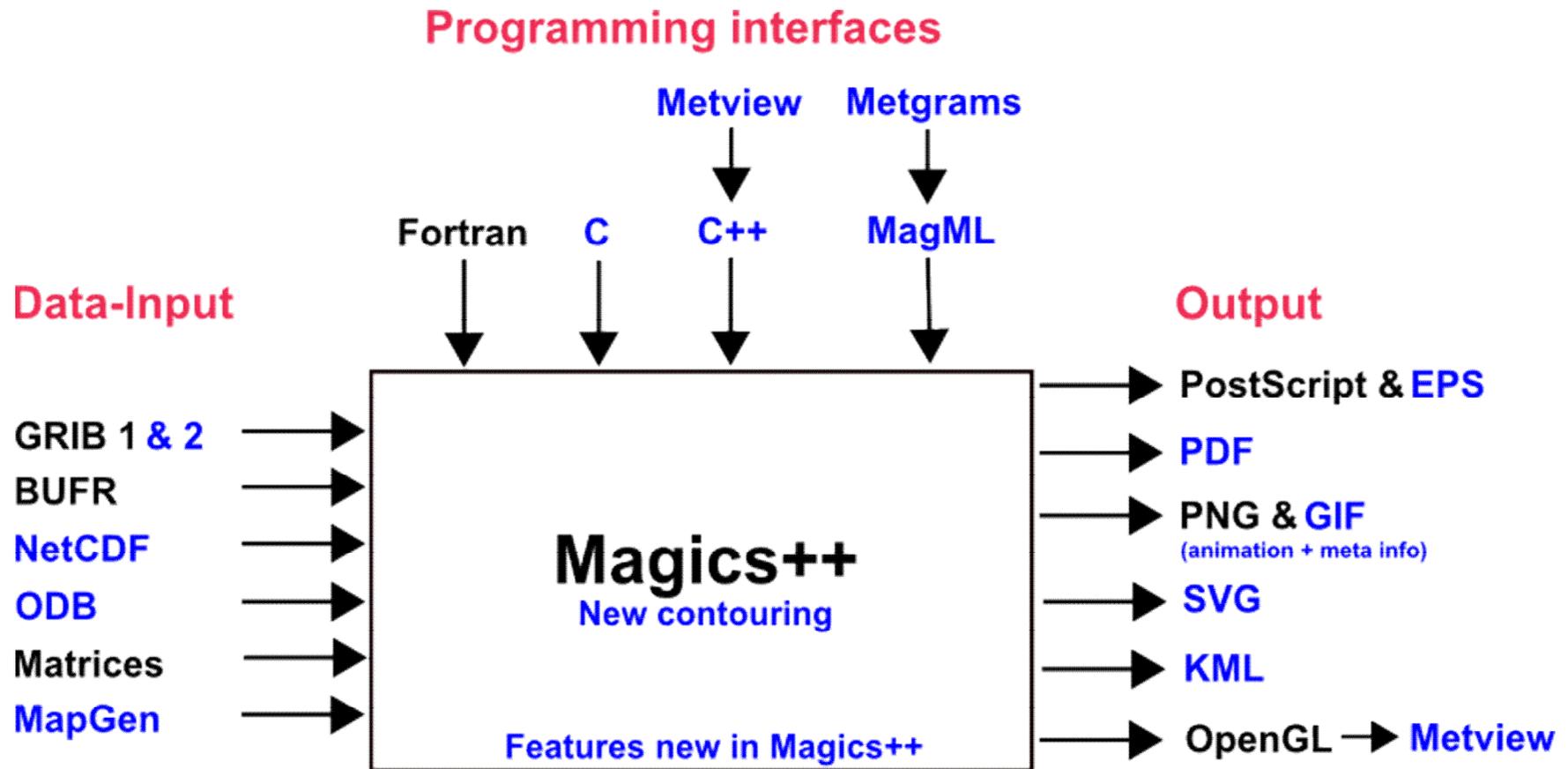
- Display wind fields
 - Arrows, flags or isotachs
- Display Observations
 - Follow WMO representation
- Plot Symbols
- Display Axes and Graphs
- Display satellite images
- Organise plots with layouts



Magics++ overview

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

MAGICS / Magics++



Magicst++ - new focus

- Focus shifts away from paper to screen and web displays
- Multiple output formats in a single run
ease setup and save computer resources (time)
- New web based formats: GIF (animated), PNG, SVG, PDF
and KML
- Easy to extend current driver (raster+meta) or add a new
driver (KML)
- Raster file *meta data* can support web applications by
providing info such as Lat/Lon re-projection, title, dates
and validity

Magics++ - MagML

- XML based format to describe Magics++ plots
- Main aim is the large scale automatic production of plots
- Descriptive, not procedural
- No need for (re-)compilation
- Interpreter can be easily called in user code
- Description close to Metview's icon convention
- Can be integrated into more complex XML request descriptions

Ideal as backend for web interfaces with static layout and visual properties but changing data

MagML – code example

```
<magics version='2.0'>
```

```
  <drivers name='tigge-plot'>
```

```
    <gif_animation />
```

```
    <ps />
```

```
  </drivers>
```

```
...
```

```
<page>
```

```
  <gribloop path='/tmp/tigge/plot/plot:temperature:850:pl.grib'>
```

```
    <map width='50%'>
```

```
      <cylindrical />
```

```
      <layer>
```

```
        <grib />
```

```
        <contour use_id='contour' />
```

```
      </layer>
```

```
      <coastlines />
```

```
      <text />
```

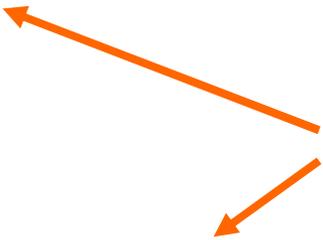
```
    </map>
```

```
  </gribloop>
```

```
</page>
```

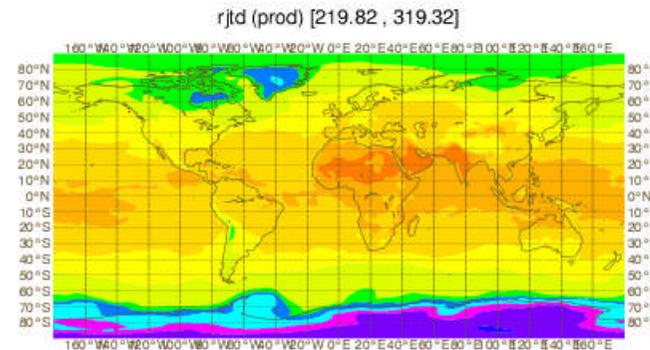
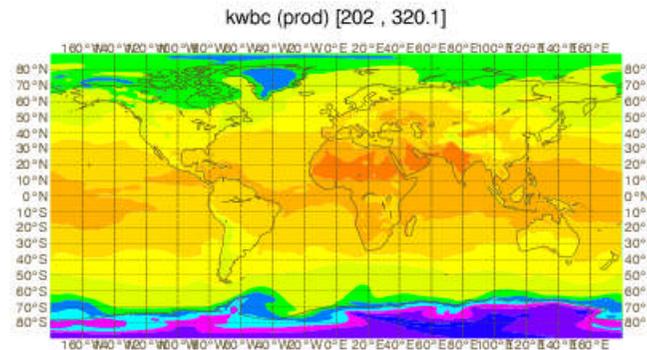
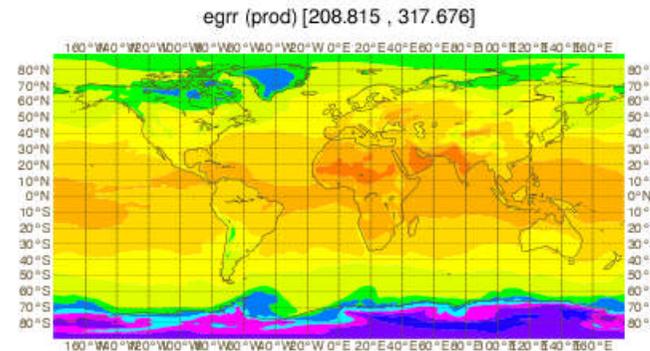
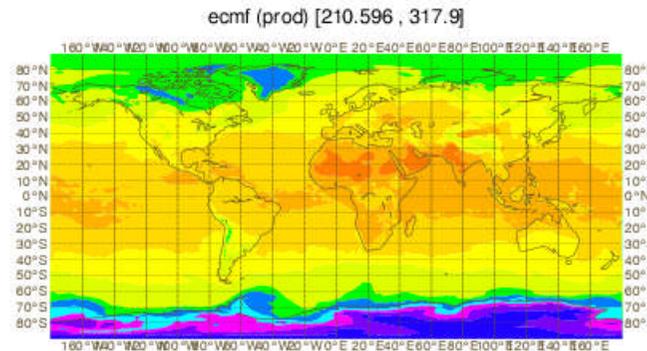
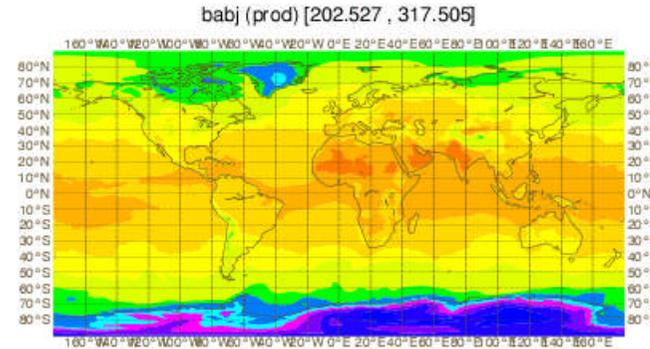
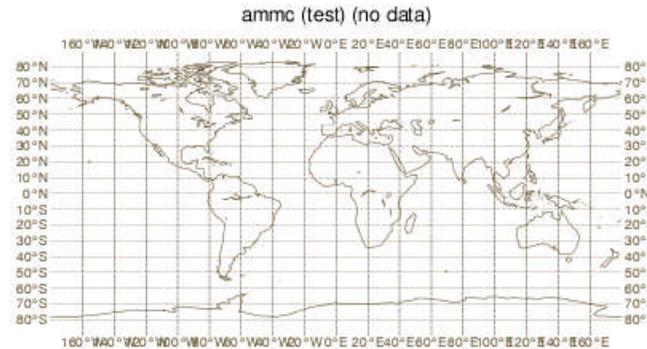
```
</magics>
```

Can be given as input variables



Magics++ - Automatic production

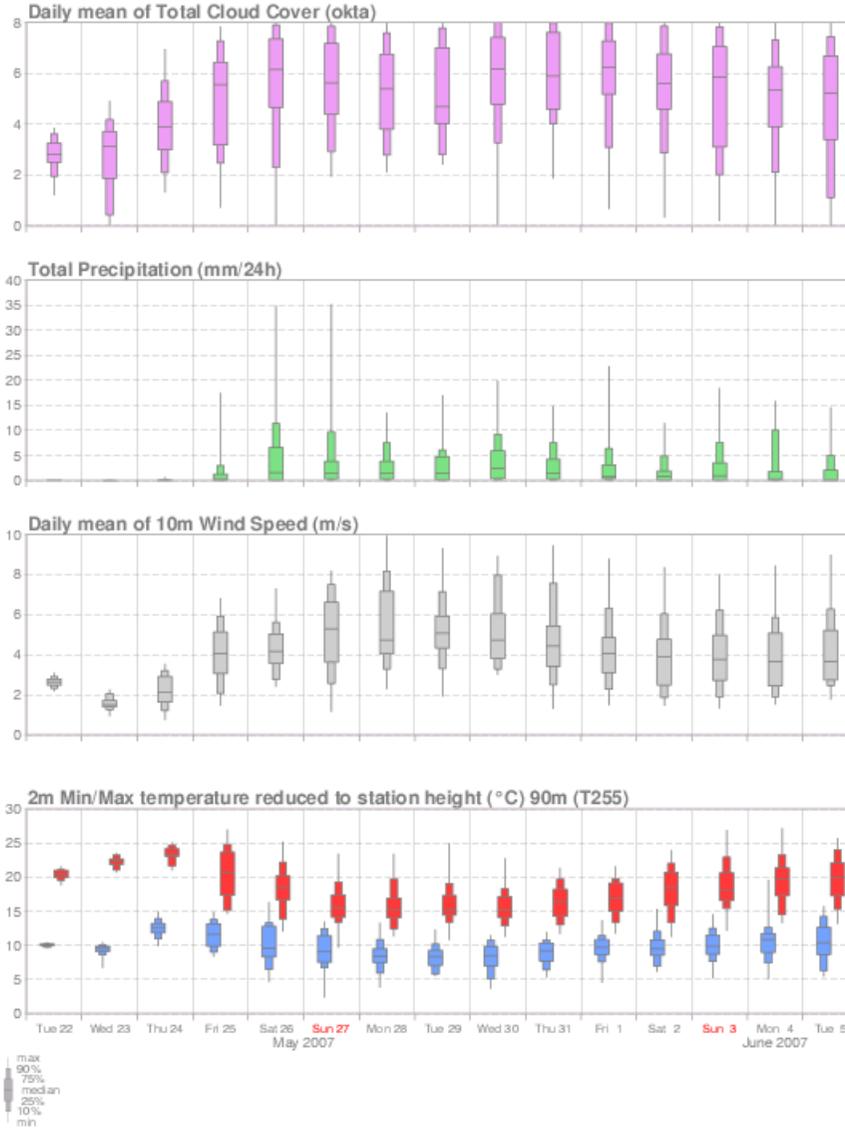
Used in
monitoring
TIGGE's Grib 2
data using
MagML



Magics++ Metgrams

Used to produce
the new 15 day
VarEPS metgram

EPS Meteogram
Reading (48m) 51.58° N 1° W
Extended Range Forecast based on EPS Distribution Tuesday 22 May 2007 00 UTC

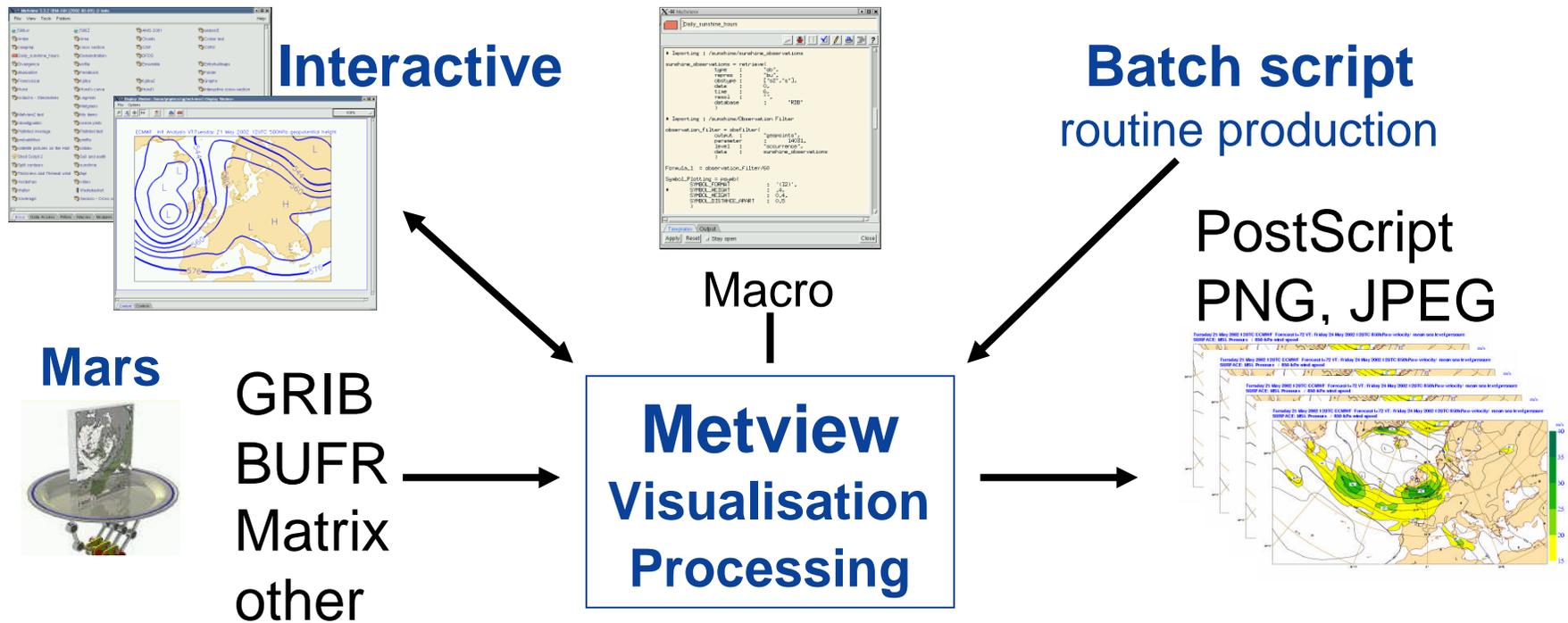


Magics++ 1.3.5

ECMWF

Metview

- ECMWF's meteorological data visualisation and processing tool
- Complete working environment for the operational and research meteorologist



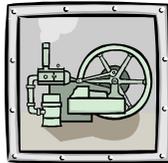
Metview - strengths

- **Easy to learn and use**
- **Users like short menus**
- **Icon concept reflects meteorological content**
- **Icons allow Drag & Drop which speeds up development**
- **Icons and Macro objects are the same – future Macros can be easily prototyped in the GUI**
- **Default behaviour can be easily customised, and templates of icons exchanged between Metview users**
- **Continuous development**
 - **Driven by very active user community inside and outside ECMWF**
 - **New features through Magics++**

Metview Principles

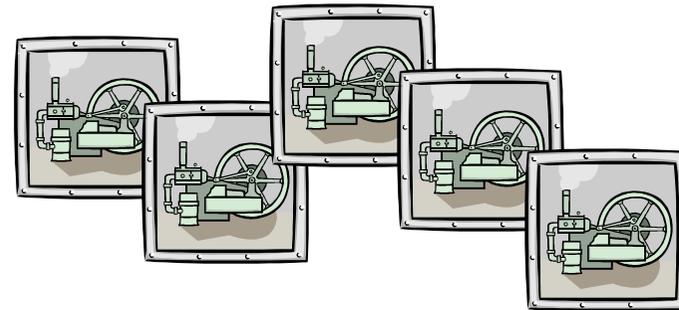
- **First Metview Principle:**

“Everything in Metview is an Icon”

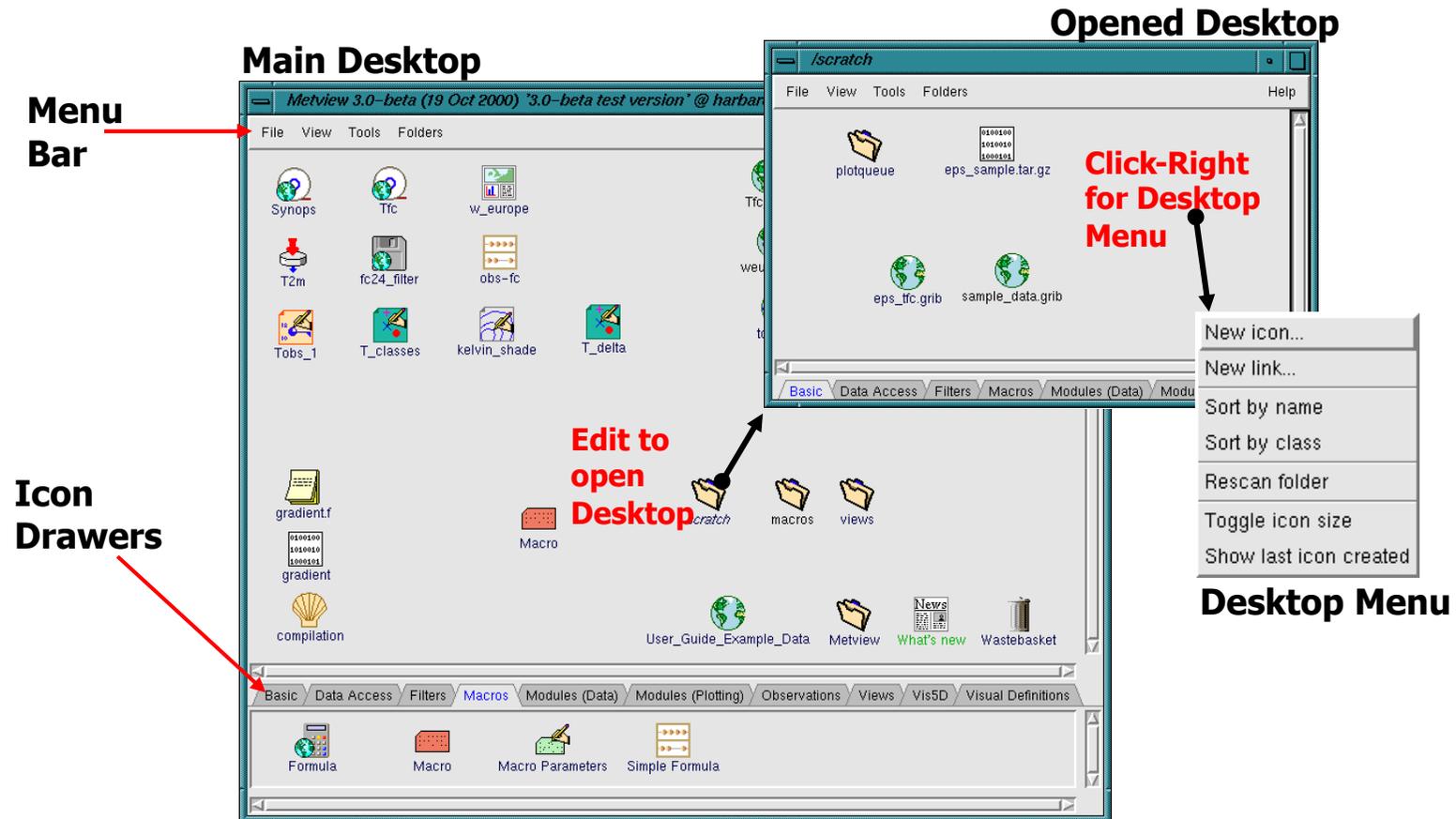


- **Second Metview Principle:**

“Every Metview Task is a sequence of actions on icons”



Metview user interface



Metview Icon Editors (2)

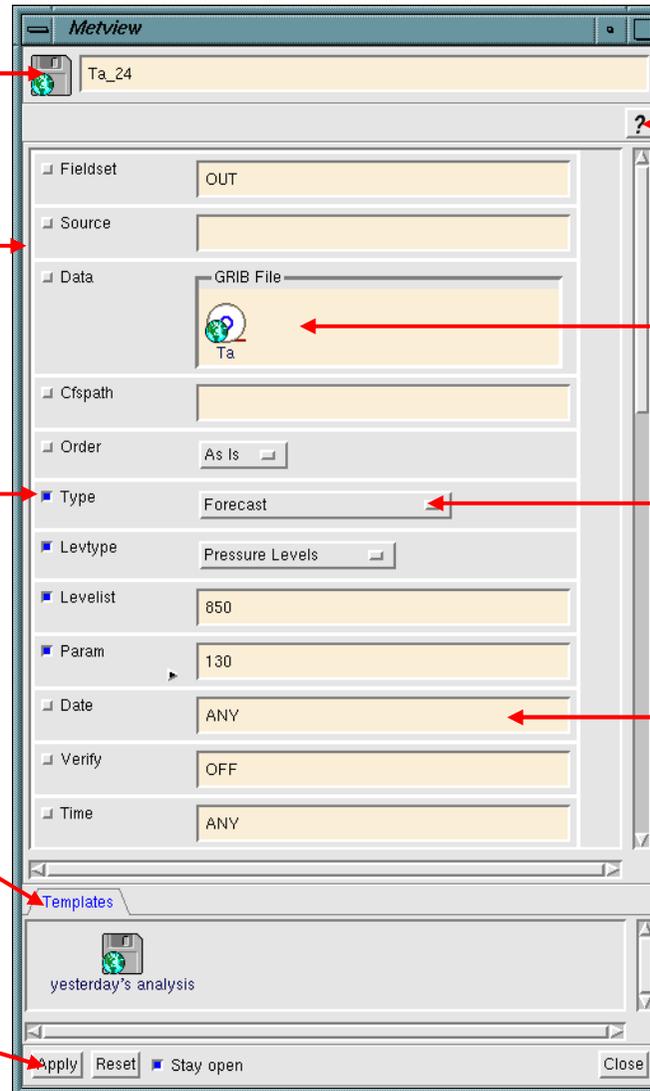
Icon Id
(click to see contents
in plain text format)

Input area

**Input element:
Check Button**

**Templates Drawer:
Stores predefined
(frequently used)
icons**

Save/Exit area



**Help Button (linked
to HTML Help Pages)**

**Input element:
Icon Field**

**Input element:
Option Menu**

**Input element:
Alphanumeric Field**

Metview - Display Window

Menu Bar →

Command Buttons ('Tool Tip Help' when pointing to) →

Frame Menu (Click-Right) →

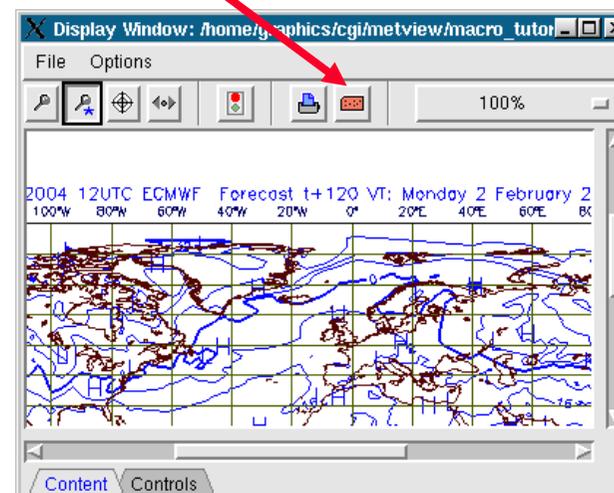
Content Tab
Controls Tab →

Plot Size Control → 100%

The screenshot displays the Metview software interface. At the top, a menu bar contains 'File' and 'Options'. Below it is a toolbar with icons for navigation and printing. A 'Plot Size Control' dropdown is set to '100%'. The main area is divided into several panels: a large 'Cross section of temp 20020227 1200 step 96 Expver 1' plot with a vertical axis from 10 to 1000 and a horizontal axis from 30°W to 30°E; a 'Vertical profile of temp 20020227 1200 step 96 Expver 1 point (51.0,1.0)' plot with a vertical axis from 10 to 1000 and a horizontal axis from -4 to 4; and three smaller maps at the bottom showing temperature anomalies over Europe. A context menu is open over the top-left map, listing options: Show Coords, Zoom In, Zoom Out, Zoom Reset, Change Geography, Save Geography, Scroll ←, Scroll →, Scroll by screen, and WYSIWYG Text. At the bottom, there are 'Content' and 'Controls' tabs.

Creating a Macro Program

- Create a complex layout interactively then press a button to save it as a macro
- Icons can be dropped into the Macro Editor – equivalent code is generated automatically
- Code can be written from scratch – extensive set of built-in functions is available



- ▶ Interactive icon interface can be used to *prototype* an application, which then can be saved as a Macro to run operationally in batch mode.

Icon properties ↔ Macro

The image shows two windows side-by-side. The left window is the Metview GUI for the 't2m_shade' icon. The right window is a terminal window showing the macro code for the same icon.

Metview GUI (Left Window):

- Icon: t2m_shade
- Contour Shade Reduction Method: Pre Calculation
- Contour Shade Min Level: 1.0E21
- Contour Shade Max Level: 1.0E21
- Contour Shade Colour Method: Calculate
- Contour Shade Min Level Colour: Blue
- Contour Shade Max Level Colour: Red
- Contour Shade Colour Direction: Clockwise
- Contour Shade Colour List: None
- Contour Shade Colour Table: None
- Contour Shade Height Table: None
- Buttons: Apply, Reset, Stay open

Terminal Window (Right Window):

```
File Edit Search Preferences Shell Macro Windows Help
/home/graphics/cgi/metview/Tests/plot_2m 478 bytes L: 3 C: 0
# Importing : /Tests/t2m_shade
[t2m_shade = pcont.
(
  contour : "off",
  contour_level_selection_type : "interval",
  contour_interval : 1.0,
  contour_shade : "on",
  contour_shade_technique : "cell_shading",
  contour_shade_min_level_colour : "blue",
  contour_shade_max_level_colour : "rose",
  contour_shade_colour_direction : "clockwise",
  contour_hilo : "off"
)
```

Metview Macro – inline Fortran & C

```
File Edit Search Preferences Shell Macro Windows Help
/metview/macro_tutorial/prop/gradient_ex 325 bytes L: 17 C: 0
extern gradientb(f:fieldset) "fortran" inline

PROGRAM GRADIENTB
PARAMETER (ISIZE=50000)
...
...
C GET FIRST ARGUMENT AS A FIELDSET.
CALL MGETG(IGRIB1, ICNT)
...
end inline

#-----
q = retrieve( param : "q";
             ... )
q = gradientb(q)
```

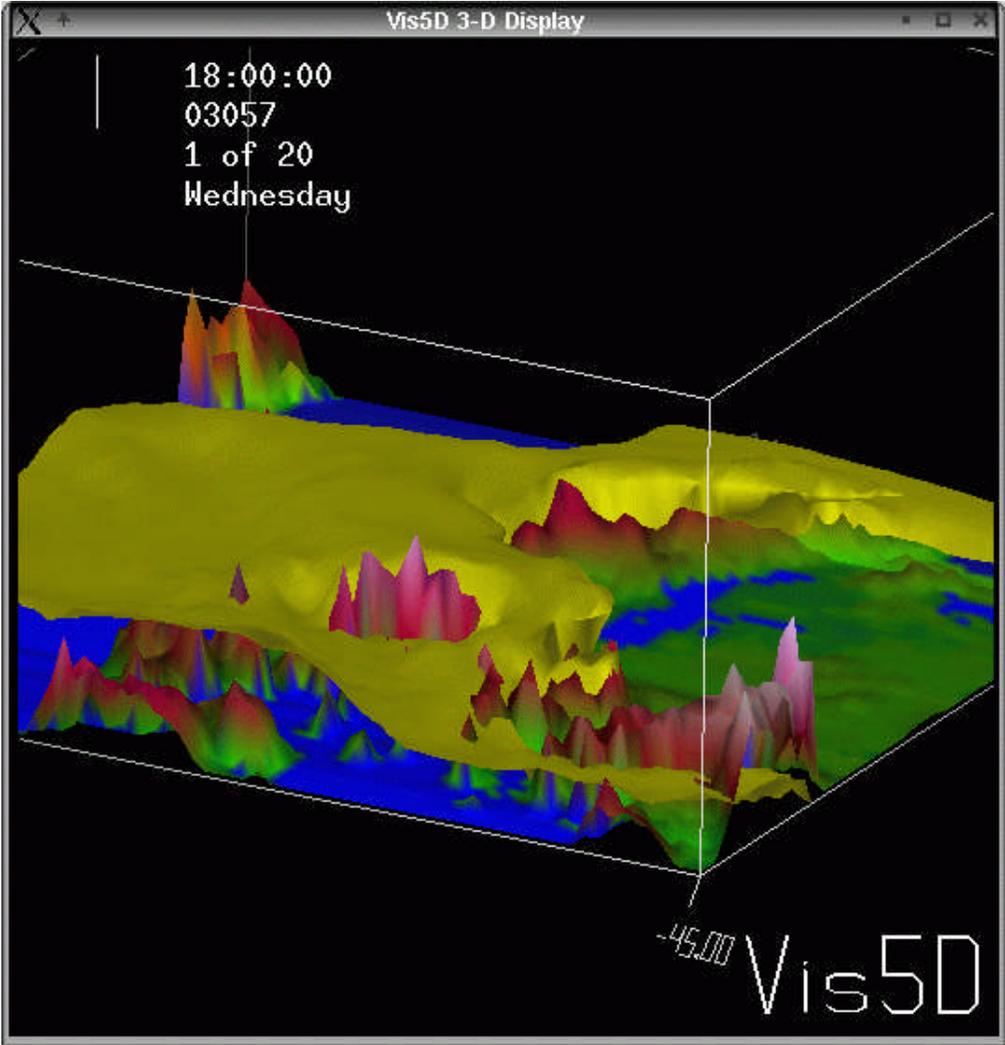
Graphics/cgi/metview/Process@1793/q_advection_allinone, line 259:18

100%

s VT:Sunday 4 June 2006 12UTC 700hFc **u-velocity

Content Controls

3D Visualisation – Vis5D



Summary

- **Metview**

- Yearly release cycle
- Next export version 3.10 planned for 4Q2007

- **MAGICS**

- Still maintained but no major releases planned (last version is 6.11)

- **Magics++**

- Magics++ 2.1.1 export version just released
- Quick release cycle as new features get implemented
- Free under the Apache licence

For more information and to keep up-to-date with developments, please visit our webpage or subscribe to our RSS at

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

<http://www.ecmwf.int/publications/manuals/metview>