

Metview – Training Course



The screenshot displays the Metview software interface. On the left, a map window shows a weather forecast for Europe with a circular region of interest around 40°E. In the center, a data table window displays a list of parameters and their values. On the right, a statistics window shows the following code and output:

```
# retrieve some data
f1 = retrieve (date : -1, levels : 1000, grid : [1.5, 1.5])
f2 = retrieve (date : -2, levels : 1000, grid : [1.5, 1.5])

# perform some calculations for comparison
cv_f1f2 = covar_a (f1, f2)
cv_f1f1 = covar_a (f1, f1)
cv_f2f2 = covar_a (f2, f2)
var_f1 = var_a (f1)
var_f2 = var_a (f2)

corr_manual = cv_f1f2 / (sqrt(cv_f1f1) * sqrt(cv_f2f2))
corr_manual2 = cv_f1f2 / (sqrt(var_f1) * sqrt(var_f2))
corr_builtin = corr_a (f1, f2)

Choosing RETRIEVE (MARS)
covar of f1 and f2 = 707195.562425
corr_manual = 0.876684930973
corr_manual2 = 0.876684930973
corr_builtin = 0.876684930973
```

Program finished (OK) : 4.078 s [Finished at 14:05:55] | L 14, C 27

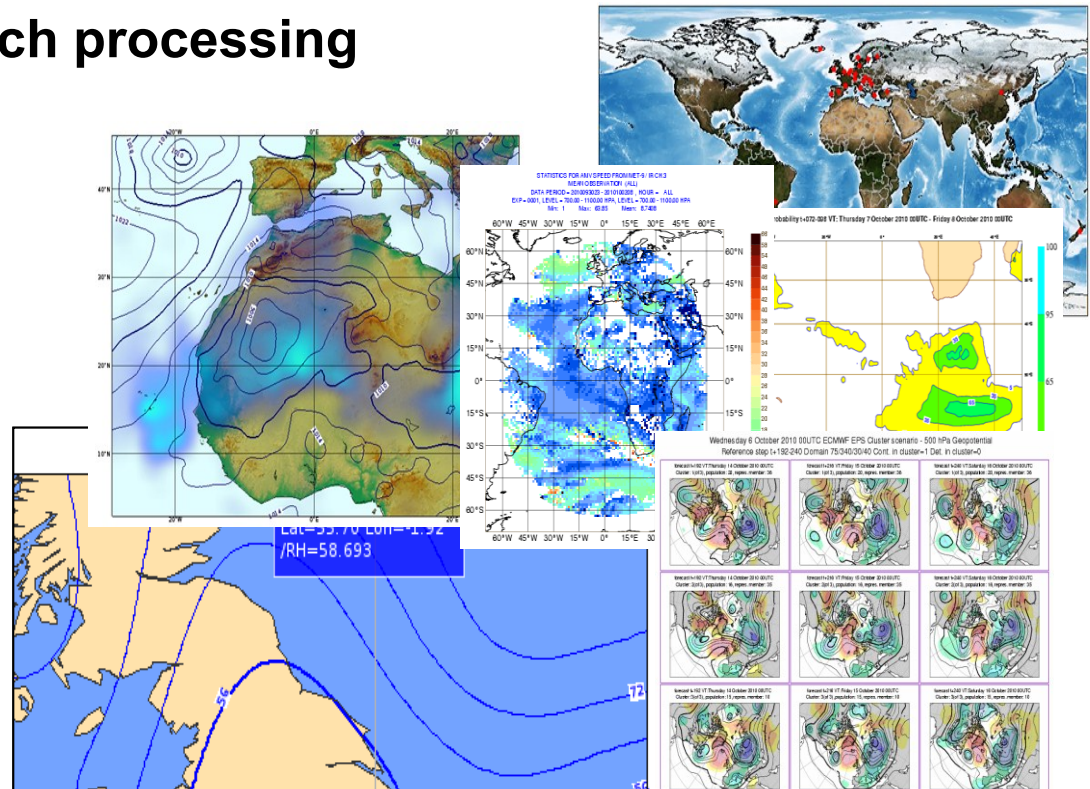
Fernando Ii, Iain Russell, Sándor Kertész
Meteorological Visualisation Section

ECMWF



Outline

- ▶ Introduction
- ▶ Interactive usage
- ▶ Macro language & batch processing



Metview: meteorological workstation

- ▶ Working environment for Operational and Research Meteorologists
- ▶ Desktop plotting + data processing software

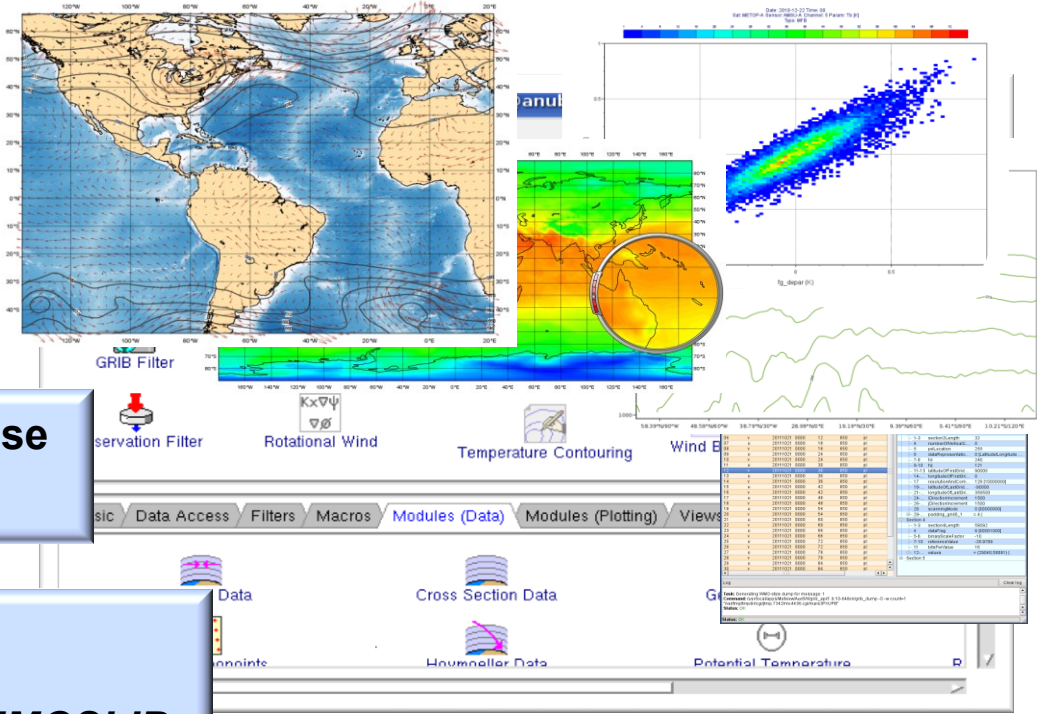
Co-operative project:



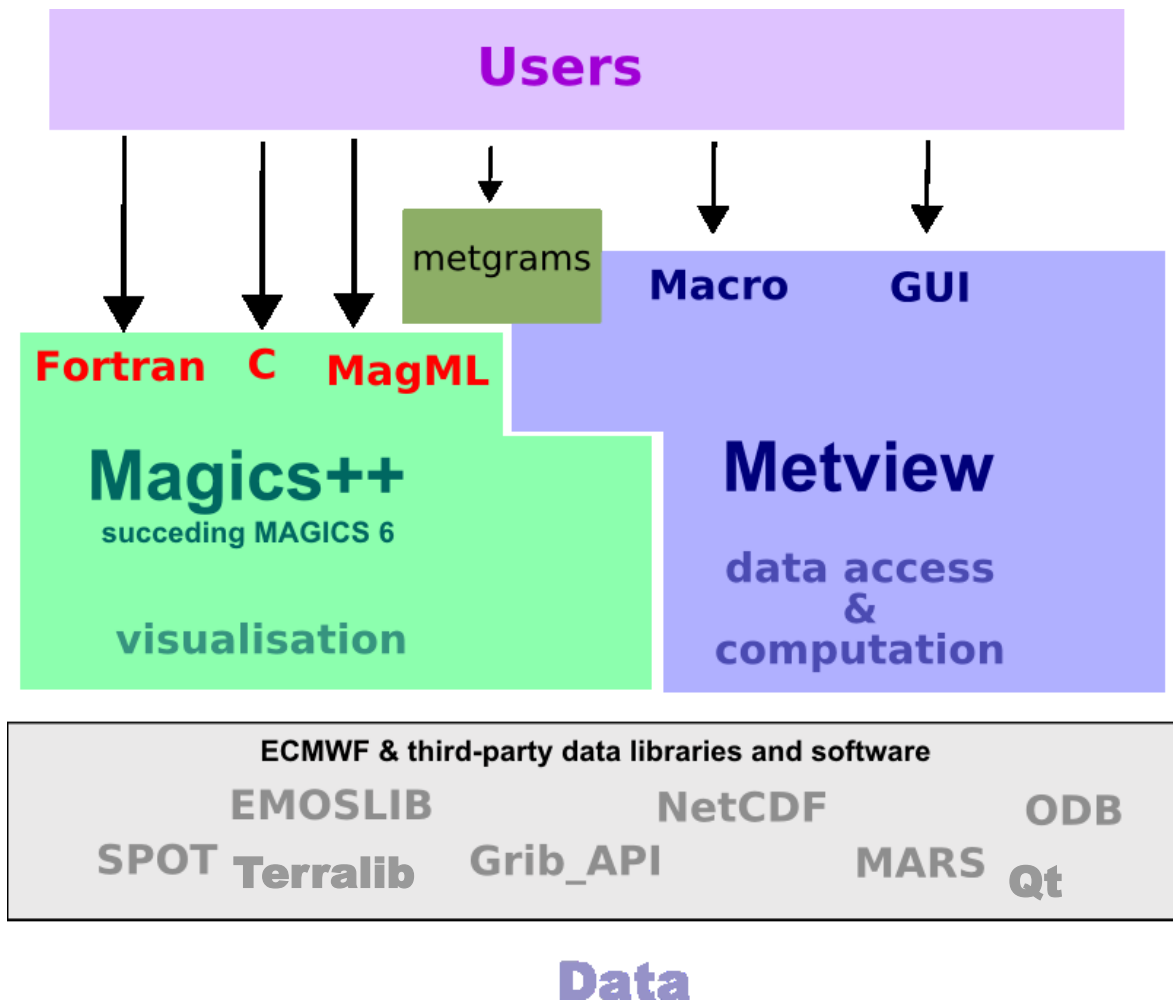

(Brazil)

Freely available under Apache license
(since August 2012)

Built on core ECMWF technologies:
MARS, GRIB_API, Magics, ODB, EMOSLIB



Metview: software relationship

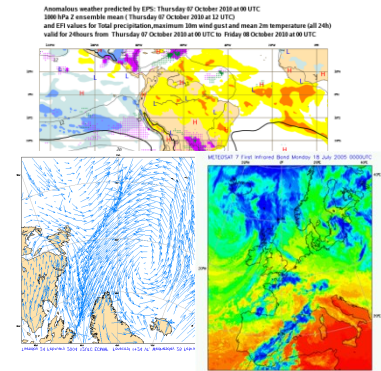


Metview history (summary)

- ▶ Announced at first EGOWS in June 1990 (Oslo)

Metview

There are plans to develop a general and unique system for the visualization of meteorological data at ECMWF which should serve the scientist and the operational analyst alike. The Metview concept will provide a standard framework within which applications relating to the retrieval, processing and visualization of meteorological data can be implemented, and will enable both Operations and research



- ▶ First prototype in 1991
- ▶ First operational version in 1993
- ▶ OpenGL graphics introduced in 1998
- ▶ New user interface in 2000
- ▶ Magics++ and Qt introduced in 2010

INPE

Metview 1.0

Metview 2.0

Metview 3.0

Metview 4.0

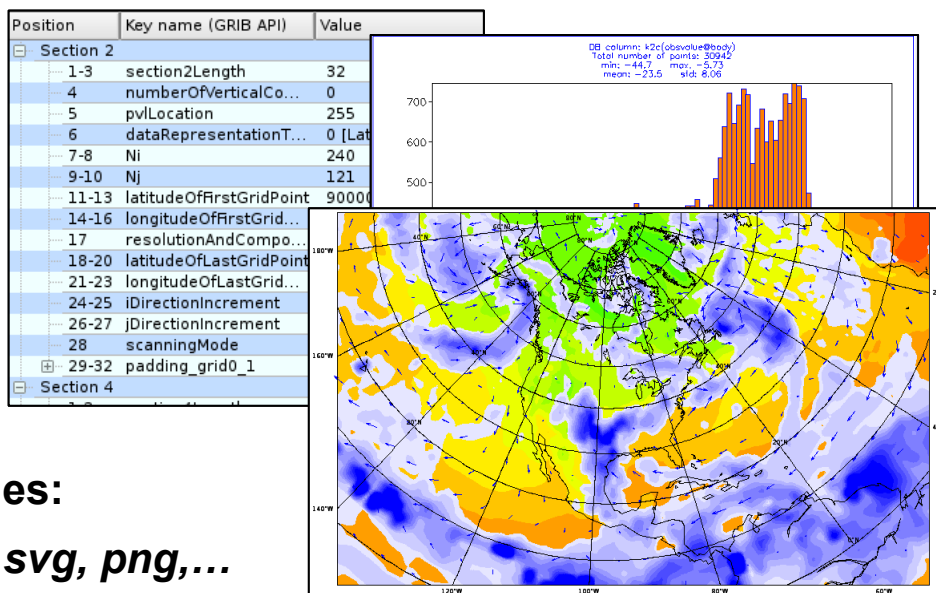
What can Metview do?

► Data:

- Access
- Examine
- Manipulate
- Plot / Overlay

- Generate graphics files:

ps, eps, kml, svg, png,...



- Can be run interactively or in batch

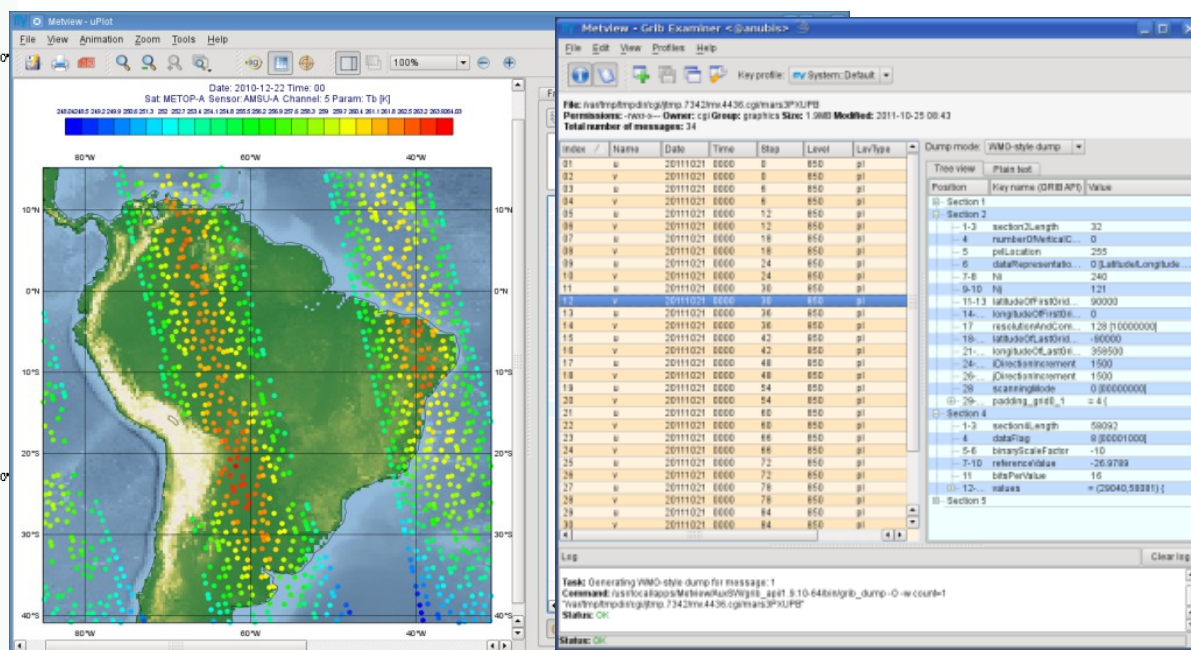
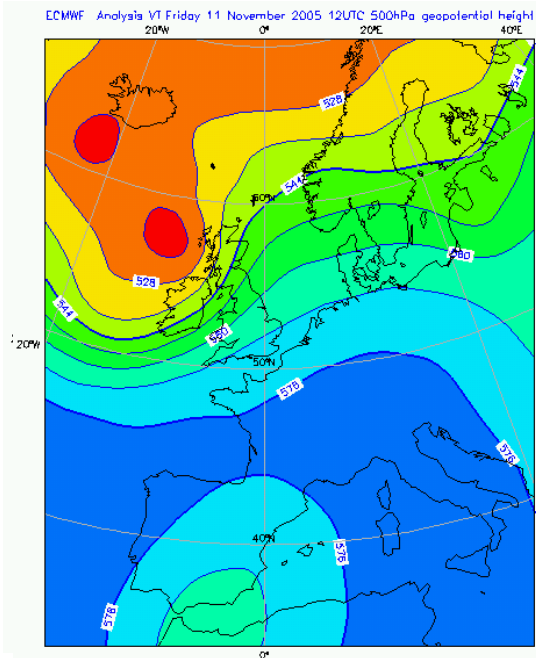
- Runs self-contained standalone

- From laptops to supercomputers
- No special data servers required (but easily connected to MARS or local databases)

Main features

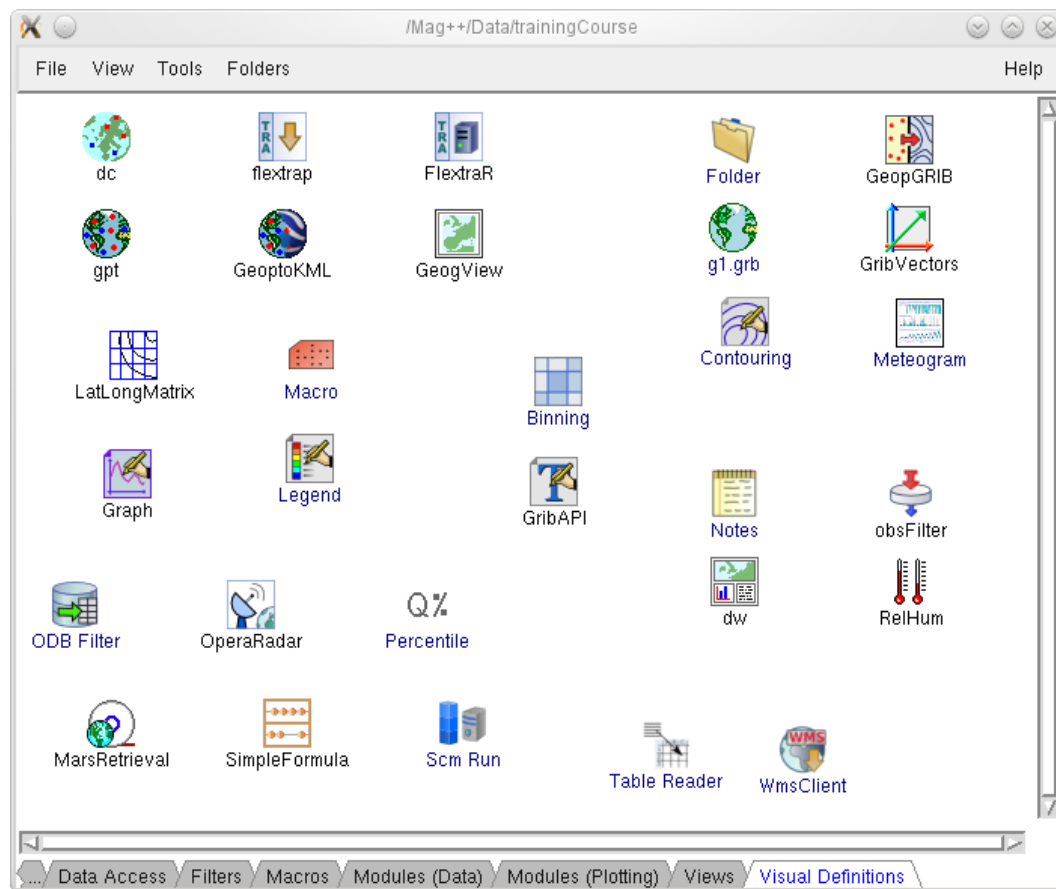
1) Data handling

- ▶ Supports a variety of data types (meteorological and non-meteorological)
- ▶ Rich set of modules and functions for data manipulation



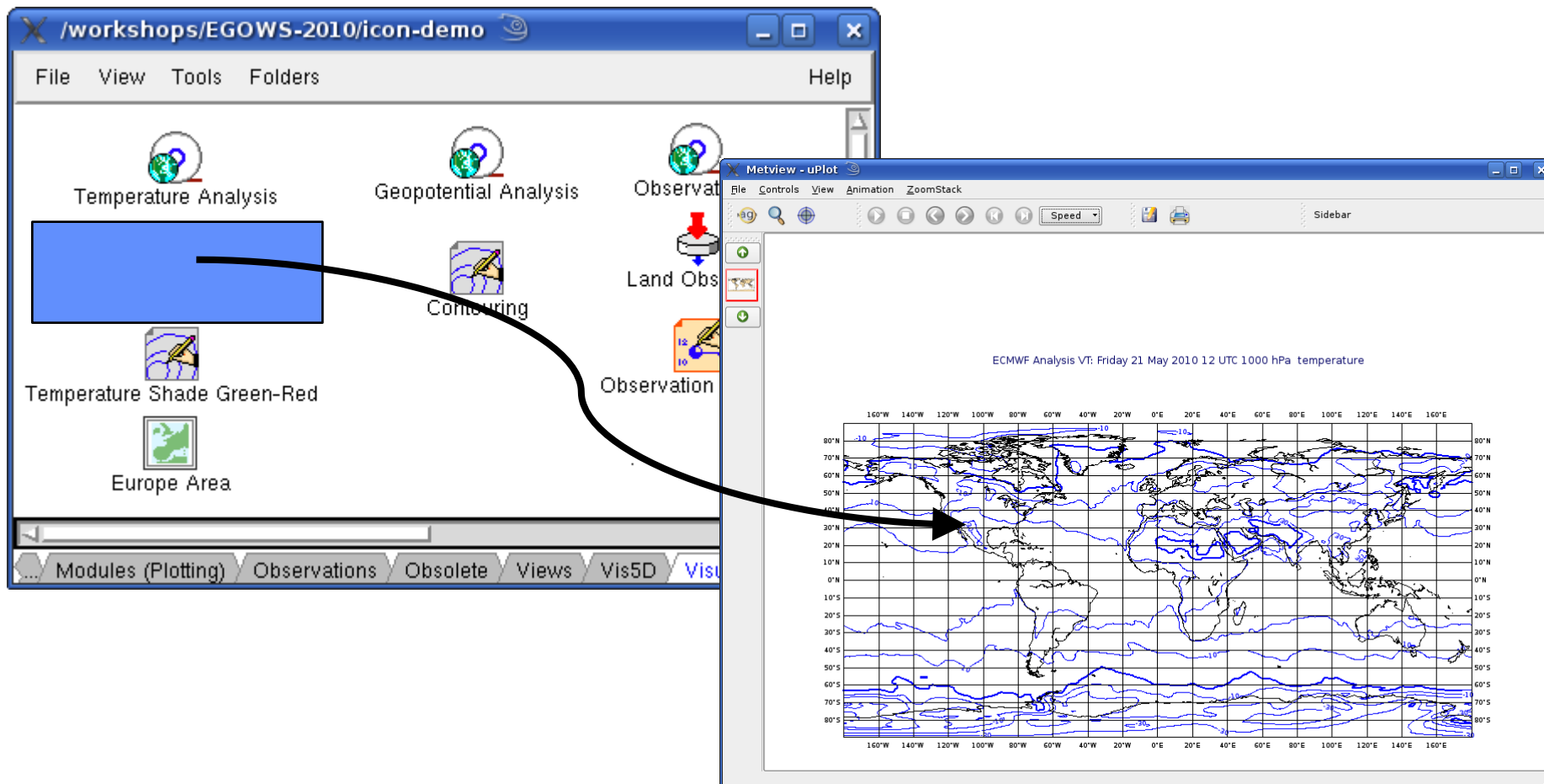
Main features

2) Icon-based interface



Main features

3) Drag and Drop support



Main features

4) Macro language

- ▶ Powerful meteorologically oriented language
- ▶ Simple script language + modern computer language
- ▶ Extensive list of functions
- ▶ Interfaces with Fortran/C/C++ code
- ▶ Outputs:
 - ▶ Derived data
 - ▶ Multiple plots
- ▶ Customised editor
- ▶ Run in batch or interactive modes

```
# Read a grib file
temp = read ( "/home/graphics/temp.grb" )

# Re-scaling field
if threshold > 0 then
    temp = temp - 273.5
    a = integrate ( temp )
end if

# Compute the gradient
q = gradientb ( temp )

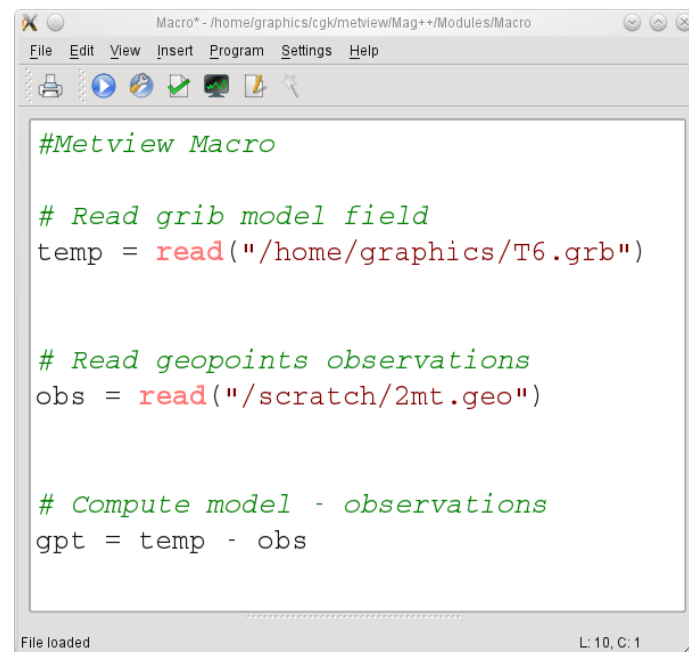
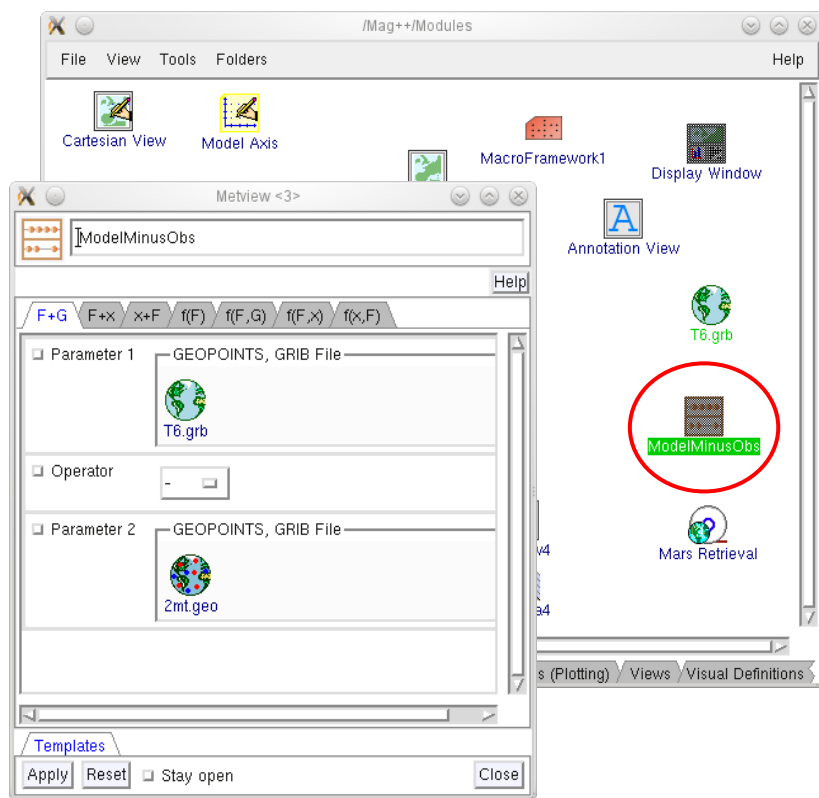
# Save field
write ( "/home/graphics/gradient.grb" , q )

# Plot field
plot ( [ps,svg], q )
```

Main features

5) Strong synergy between Icons & Macros

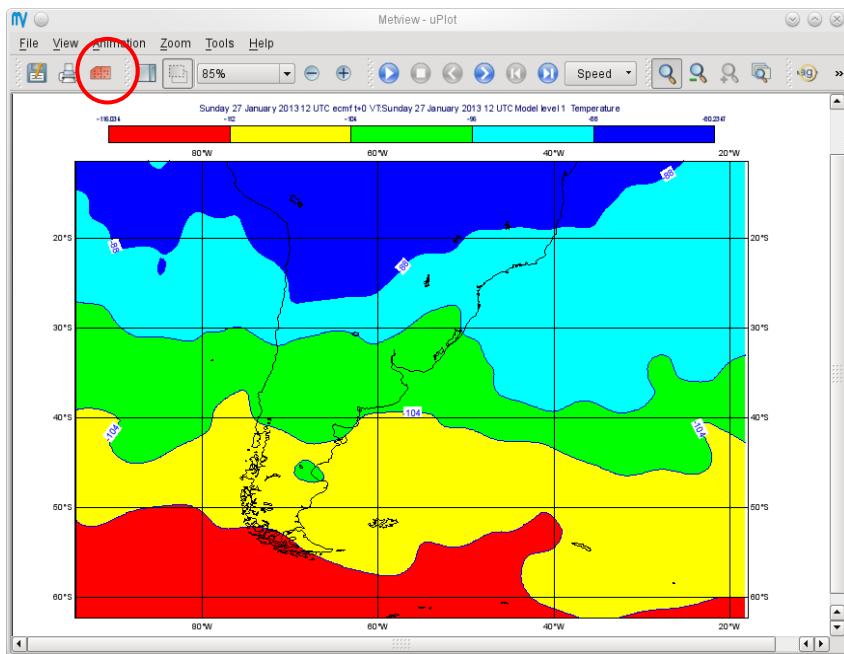
- ▶ Every icon can be translated into a Macro command



Main features

5) Strong synergy between Icons & Macros

- ▶ Plots can be translated into a Macro program



```
File Edit View Insert Program Settings Help
```

```
# Metview Macro

# Importing T91_grb
temp = read ( "/home/graphics/cgk/T91.grb" )

cont4 = mcont(
  LEGEND                      : "ON",
  CONTOUR_LEVEL_SELECTION_TYPE : "INTERVAL",
  CONTOUR_LABEL_TEXT          : "",
  CONTOUR_SHADE                : "ON",
  CONTOUR_SHADE_METHOD        : "AREA_FILL"
)

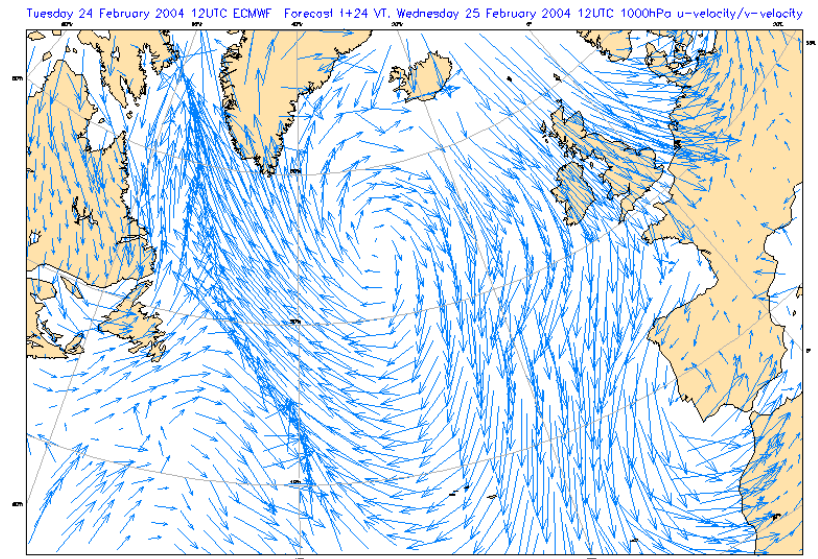
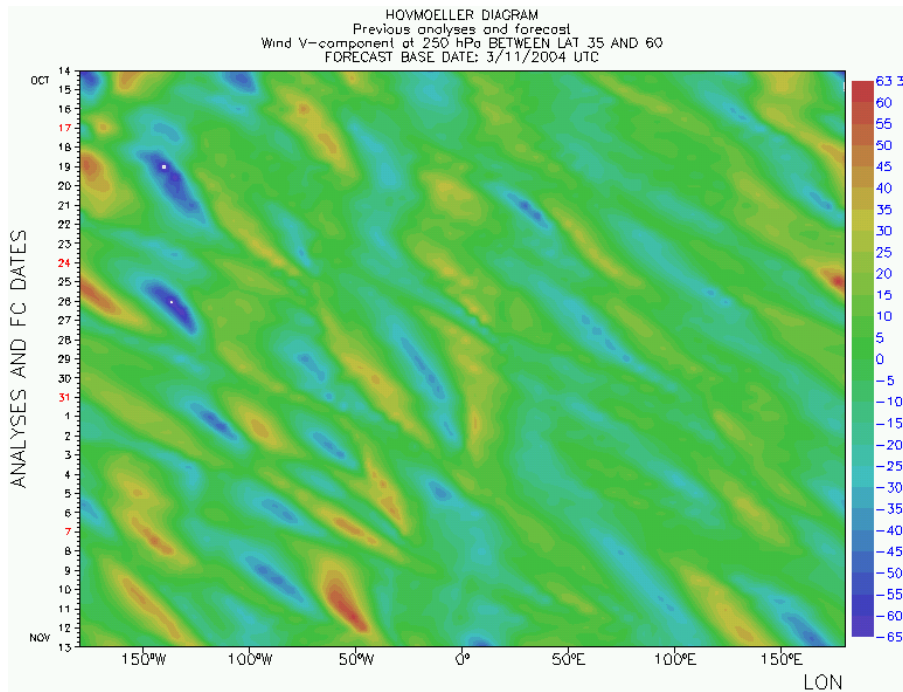
# Plot command
plot ( temp, cont4 )
```

File saved L: 16, C: 1

Main features

6) Can produce a variety of meteorological charts

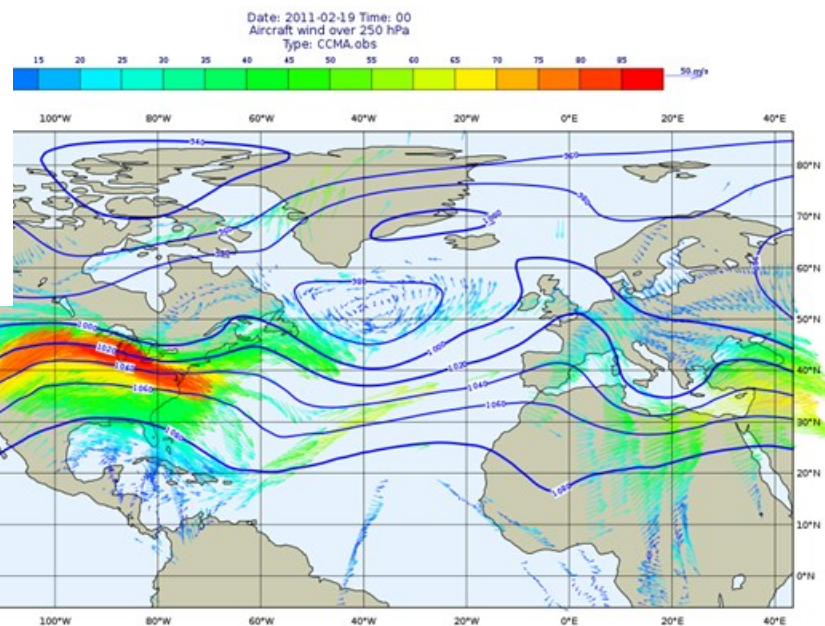
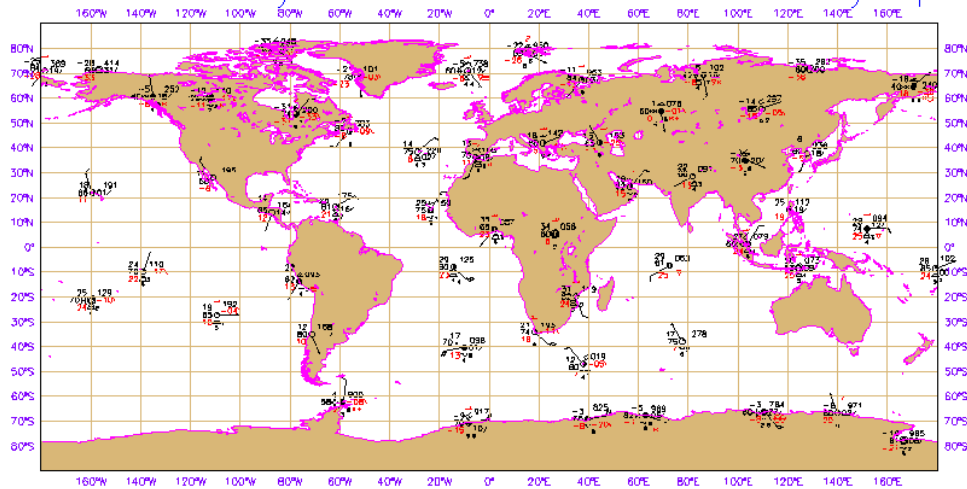
- ▶ Rich set of visualisation attributes



Main features

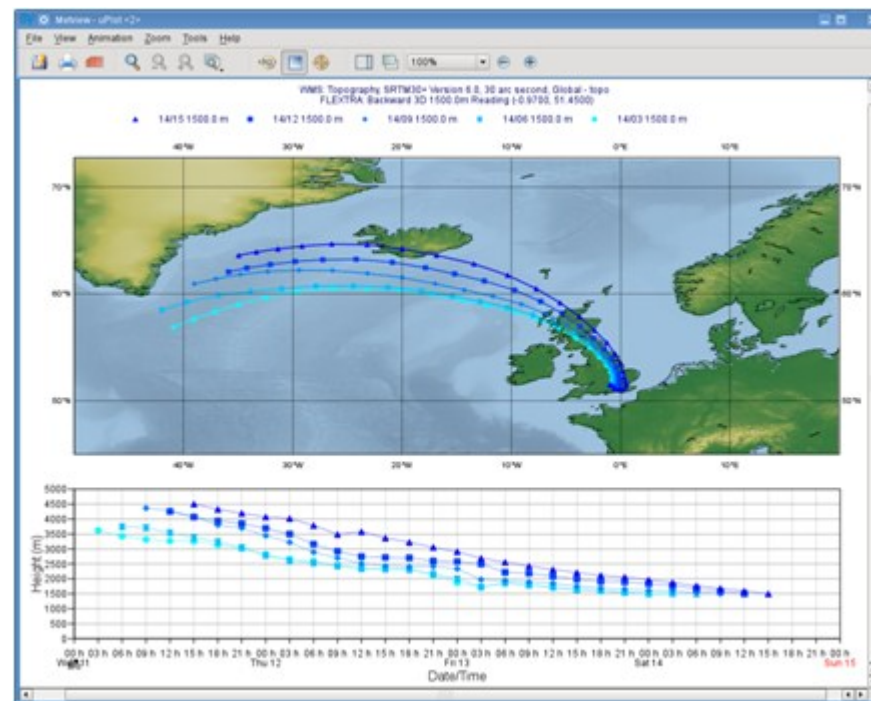
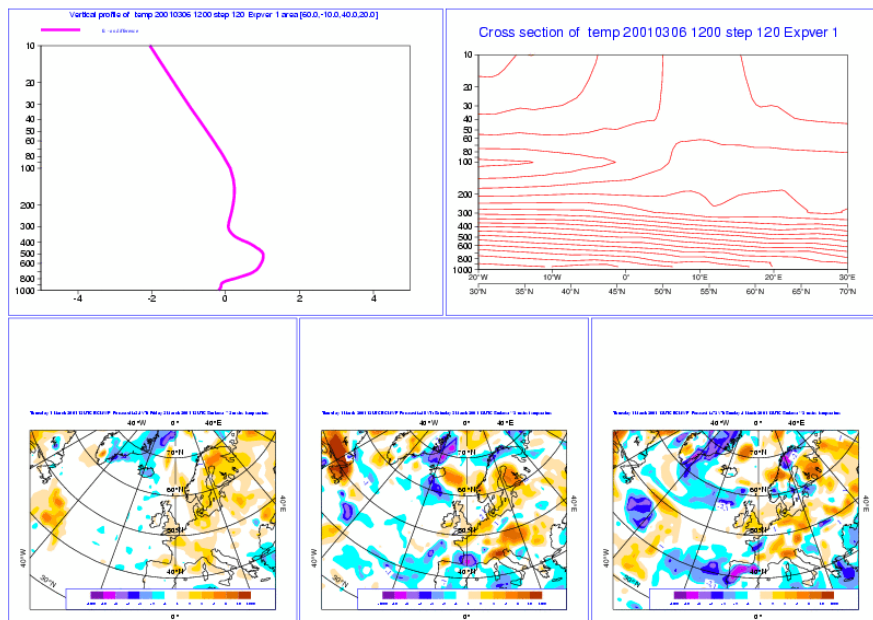
6) Can produce a variety of meteorological charts

Obs: Sunday 3 March 2002 12UTC Surf:synop



Main features

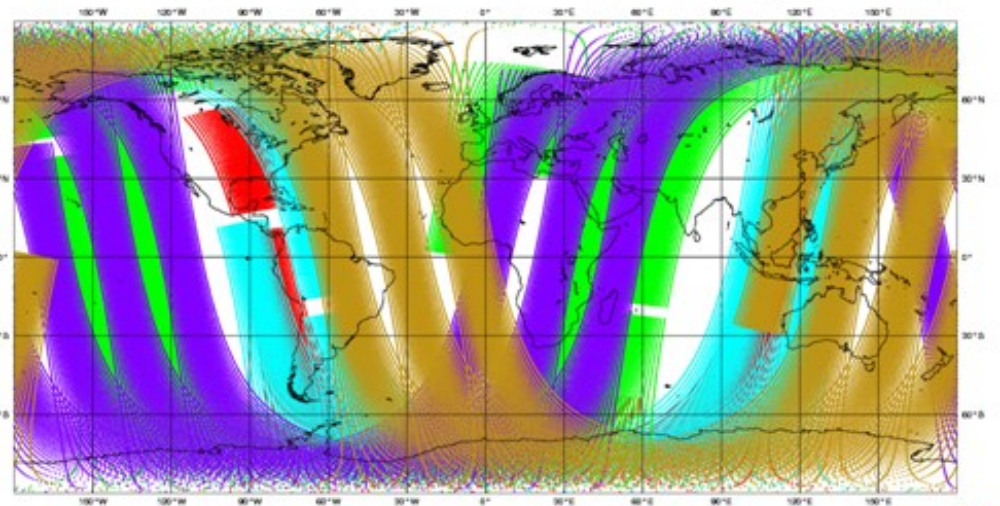
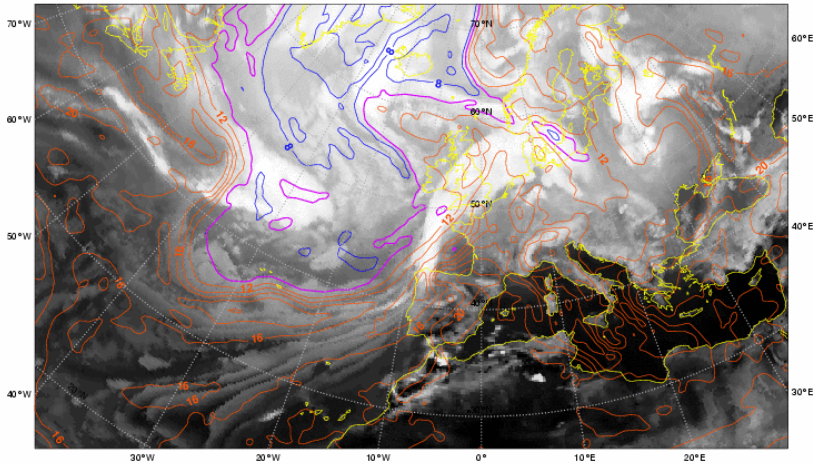
6) Can produce a variety of meteorological charts



Main features

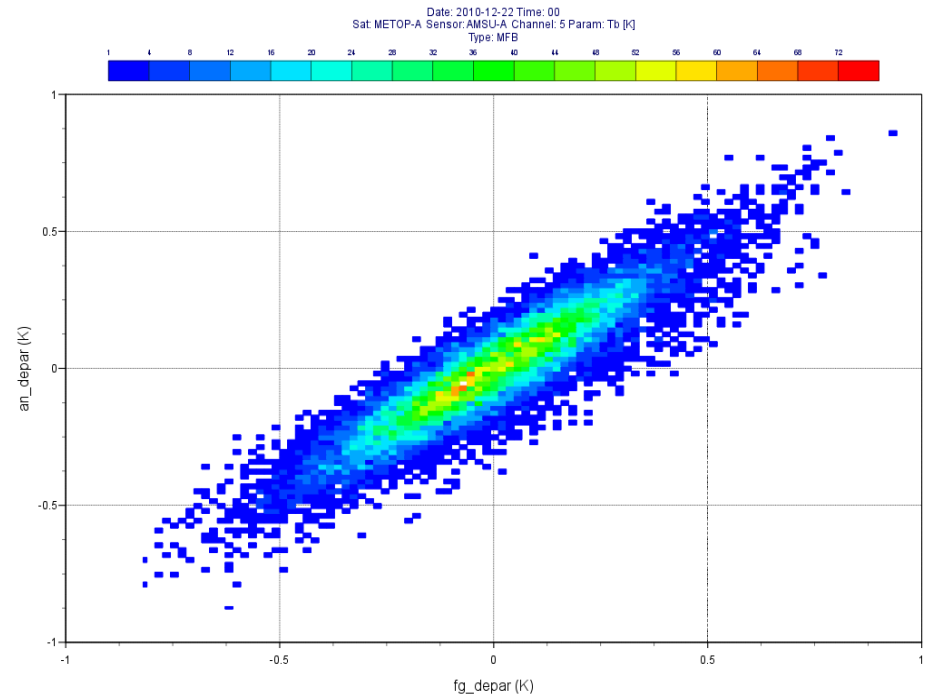
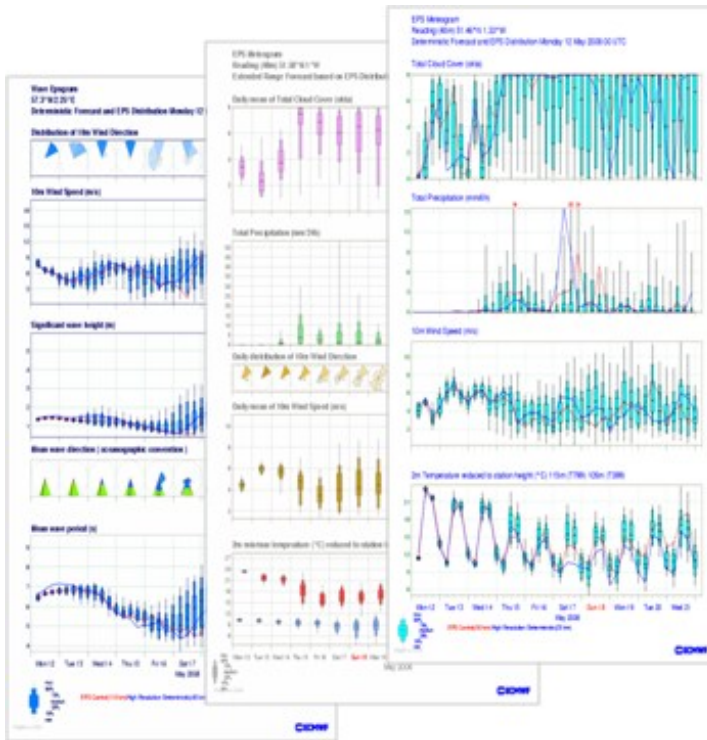
6) Can produce a variety of meteorological charts

Monday 27 July 2009 00UTC © ECMWF 140 VT: Monday 27 July 2009 00 UTC
 Model simulated METEOSAT 9 SEVIRI (Channel 9 IR10.8) Brightness Temperature and 850 hPa wet bulb pot. temp.



Main features

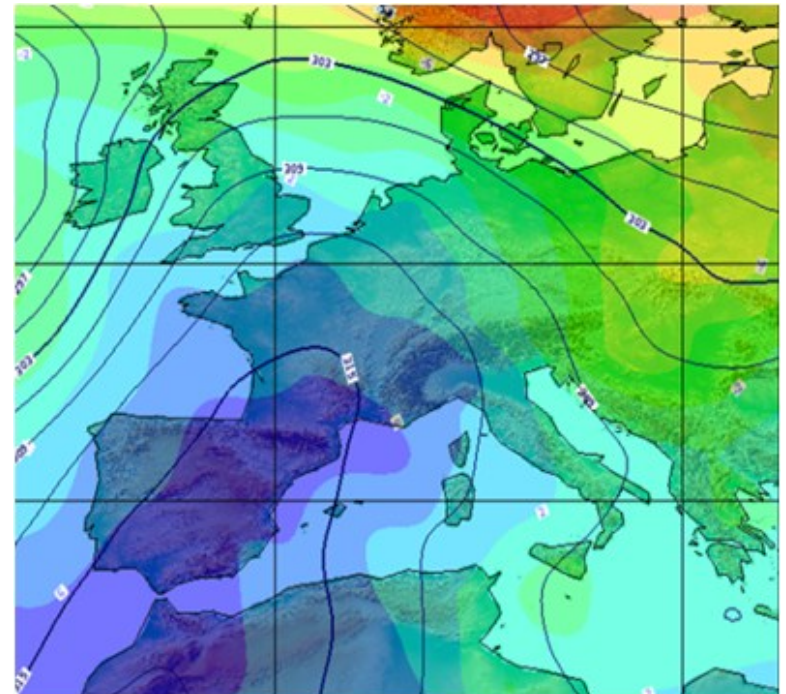
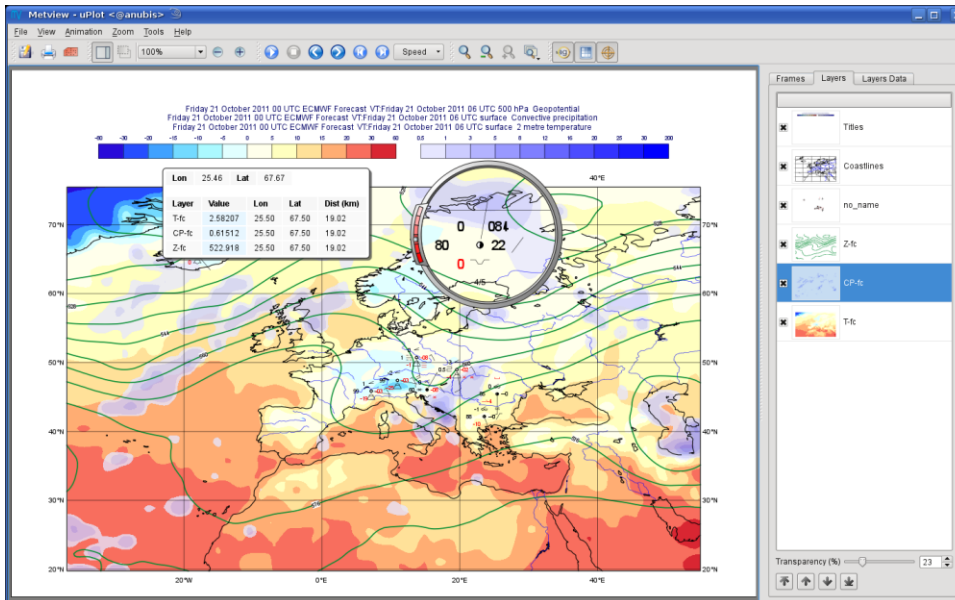
6) Can produce a variety of meteorological charts



Main features

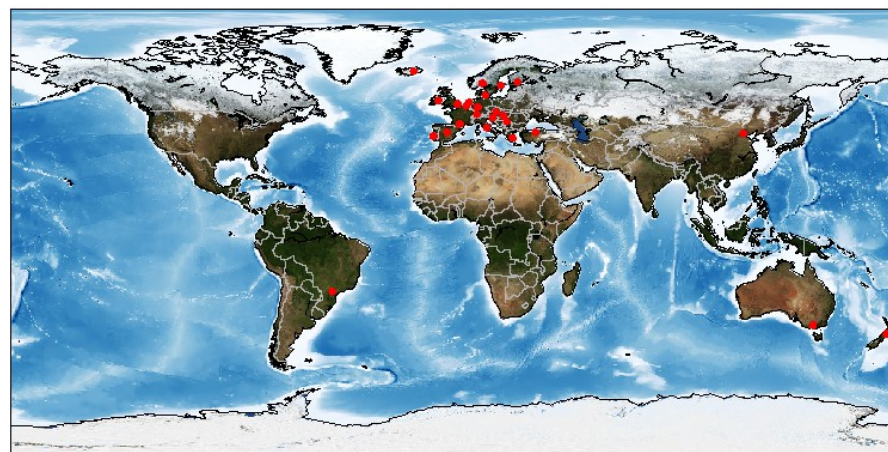
6) Can produce a variety of meteorological charts

- ▶ Easy to overlay different data sets



Who uses Metview?

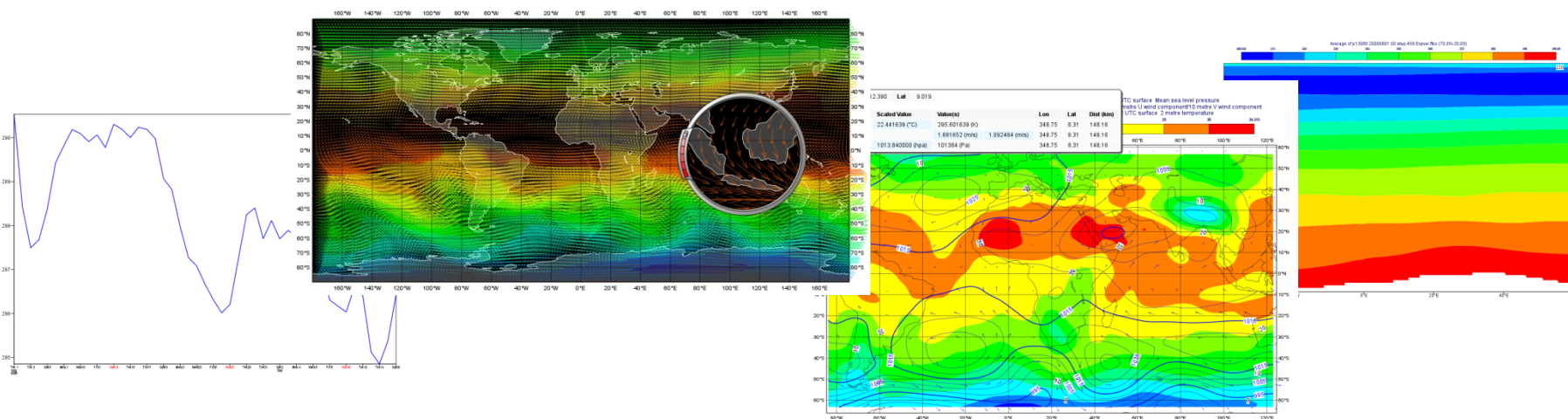
- ▶ Used internally at ECMWF by researchers and operational analysts
 - ▶ To assess the quality of Observations/Forecast
 - ▶ To develop new (graphical) products
 - ▶ For general research activities
- ▶ Member States (local installations and remotely on our *ecgate* server)
- ▶ Other national weather services and Universities
- ▶ Commercial customers of ECMWF products



OpenIFS support in Metview

- ▶ OpenIFS: “... to provide research institutions with a portable, easy-to-use version of the ECMWF IFS model. “
- ▶ Presents an opportunity to extend the Metview community
- ▶ All the Metview functionality works with the OpenIFS output
- ▶ Examples icons are available from:

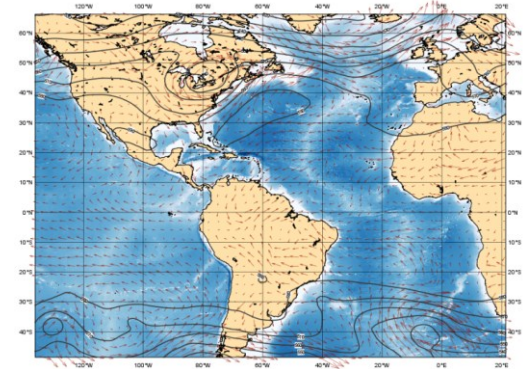
<https://software.ecmwf.int/wiki/display/OIFS/Using+MetView+with+OpenIFS>



Metview releases

▶ Metview at ECMWF

- ▶ `metview4` : stable user version
- ▶ `metview4_new` : test version
- ▶ available on `ecgate`



▶ Metview outside ECMWF

- ▶ export version: 4.3.7, released 2013-03-11
- ▶ available for download

For more information ...

email us:

🖱 **Metview:** metview@ecmwf.int

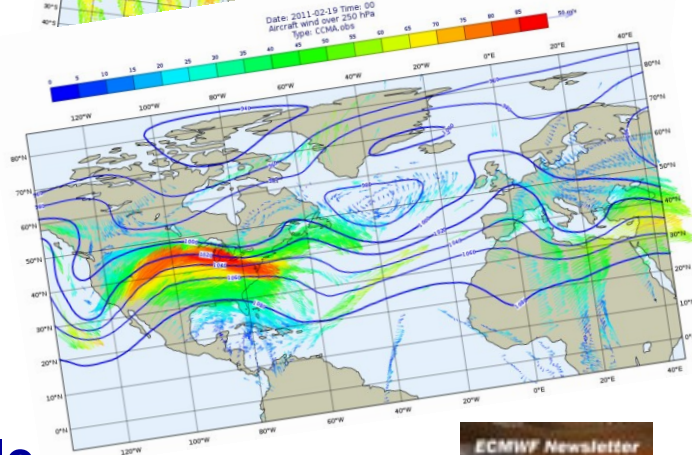
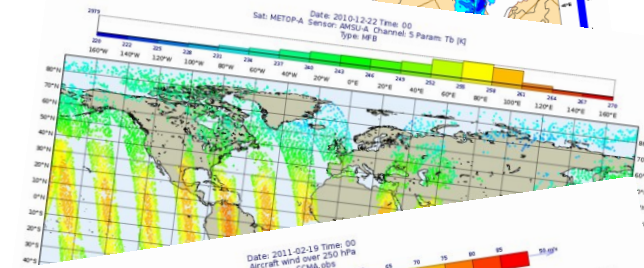
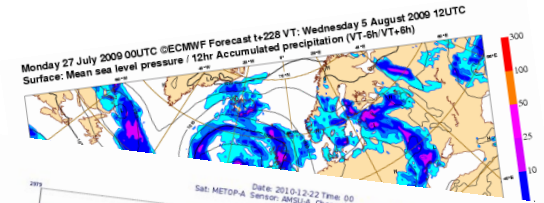
visit our web pages:

🖱 <https://software.ecmwf.int/metview>

➤ **Download**

➤ **Documentation and tutorials available**

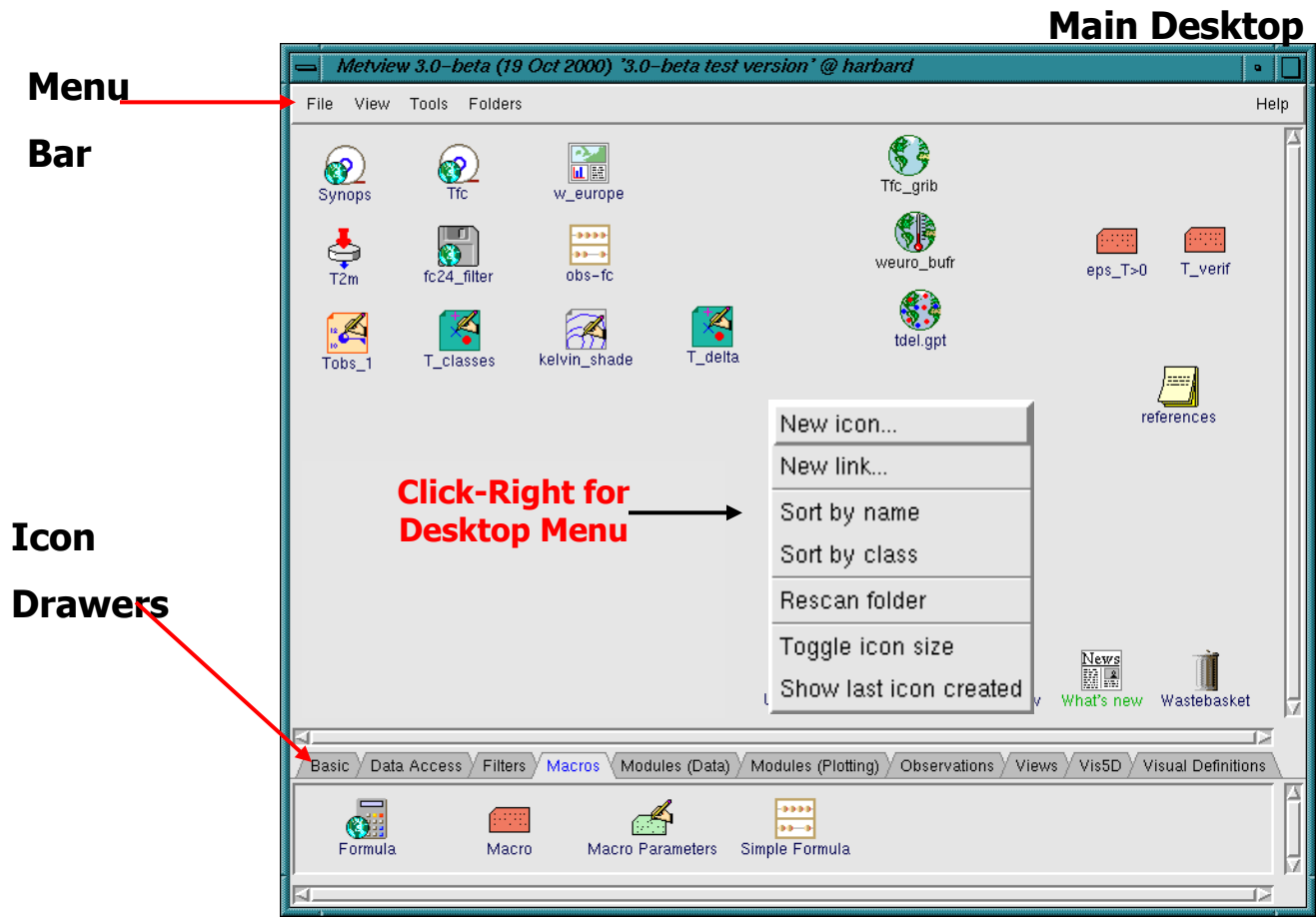
➤ **Metview articles in recent ECMWF newsletters**



Metview Tutorial: Interactive Usage

- ▶ **Part 1: Introduction**
- ▶ Part 2: Visualising your Data
- ▶ Part 3: Data
- ▶ Part 4: Visual Definitions, Views and Layouts
- ▶ Part 5: Visualisers, Drops, Overlay and Icons
- ▶ Part 6: Data Overlay, Metview Applications and Tools

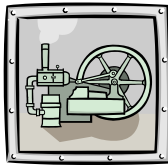
Metview Desktop (MetviewUI)



Metview Principles

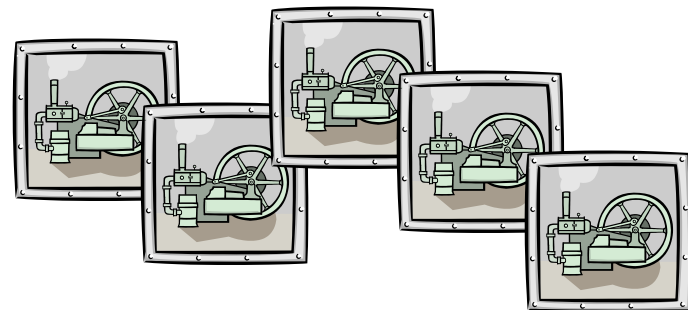
- **First Metview Principle:**

“Everything in Metview is an Icon”



- **Second Metview Principle:**

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



Icon Standard Editor

Input area →

Input element: Toggle option →

Input element: Colour Menu →

Input element: Option Menu →

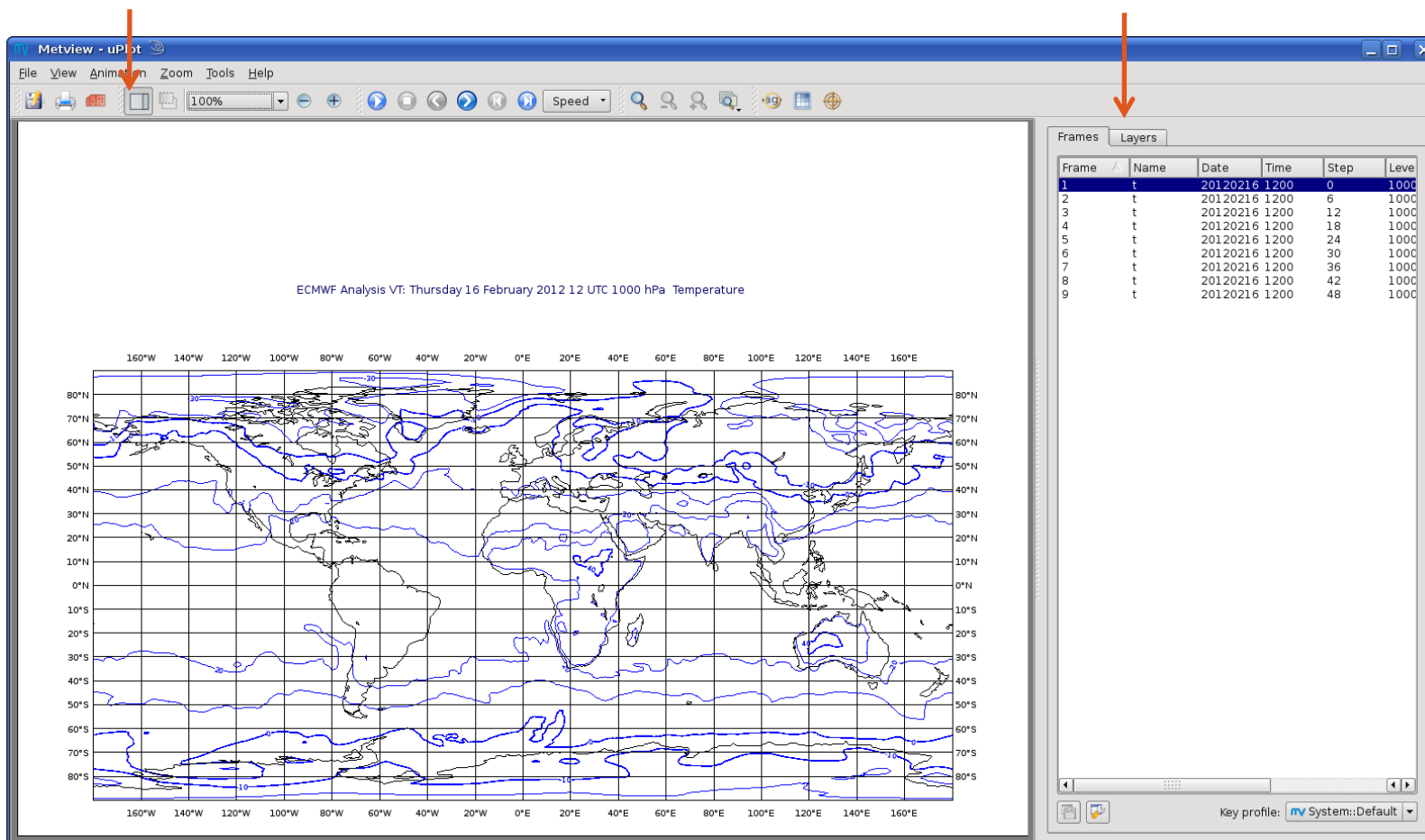
Input element: Alphanumeric Field (must hit *Enter* key) →

Save/Exit area →

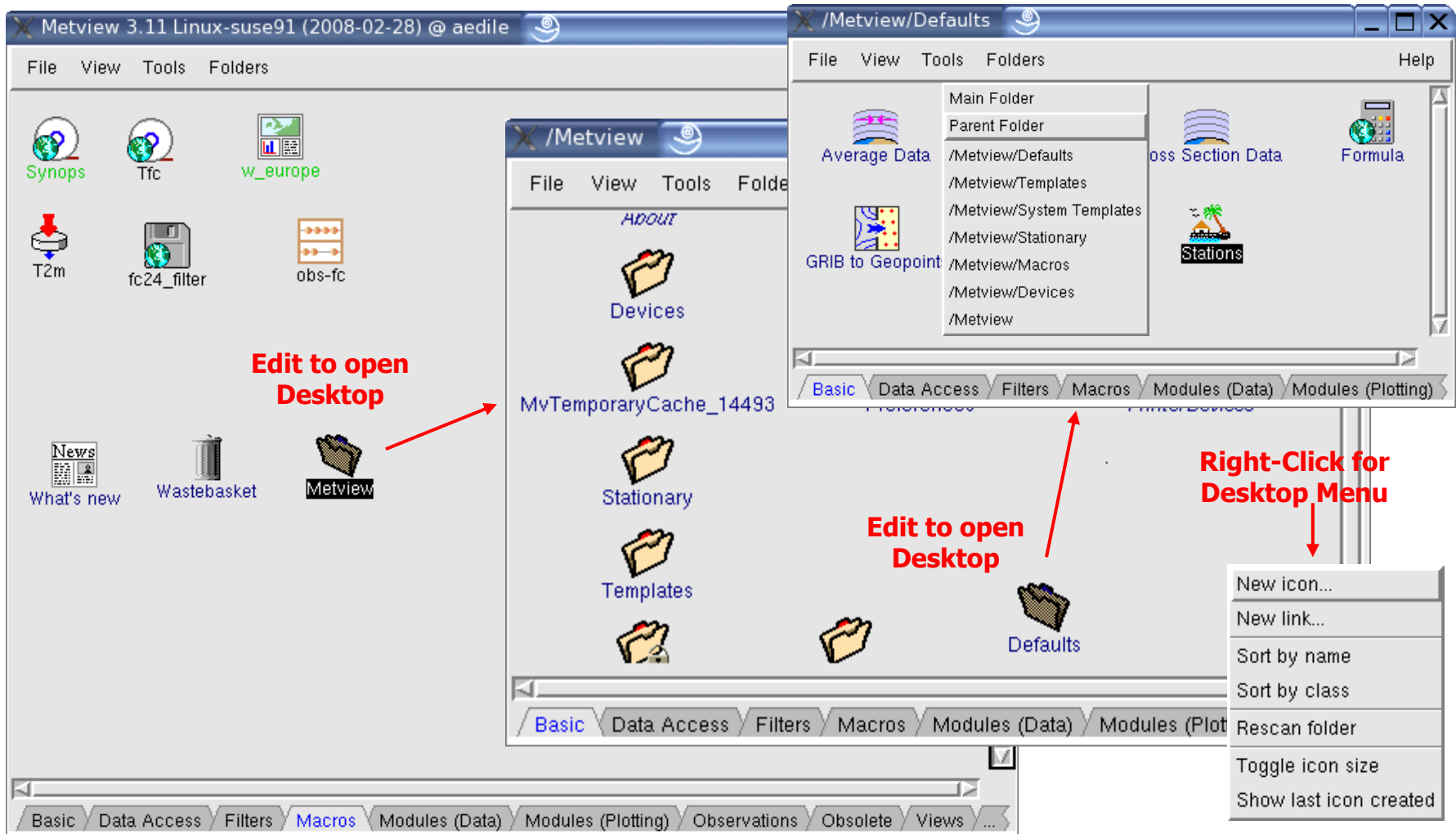
Display Window

Toolbars

Tabs

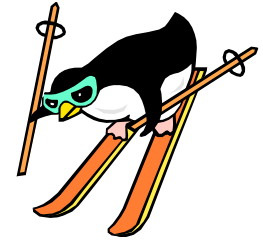


Organising folders



Desktop Behaviour (1)

mv⁴



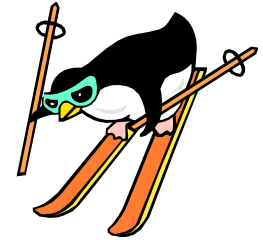
▶ KDE settings relevant to Metview:

1) Change the window behaviour

- ▶ KDE menu (icon at bottom-left)
- ▶ System Settings
- ▶ Window behaviour
- ▶ Window behaviour
- ▶ Set *Focus stealing prevention level* to “None”
- ▶ Set *Policy* to “Focus Follows Mouse”
- ▶ Disable *Click raises active window*
- ▶ Apply and close the dialog

Desktop Behaviour (2)

mv⁴



2) Change the desktop behaviour

- ▶ KDE menu (icon at bottom-left)
- ▶ System Settings
- ▶ Desktop
- ▶ Screen Edges
- ▶ Disable the settings
 - ▶ *Maximise windows by dragging...*
 - ▶ *Tile windows by dragging....*
- ▶ Apply and close the dialog

Starting Metview



- ▶ To start Metview, please type the following command from an *xterm*:

metview4_new &

- ▶ Please minimise the *xterm* but do not close it

Metview Tutorial: Interactive Usage

- ▶ Please do Part 1 of the Tutorial

Part 1 – Additional Notes

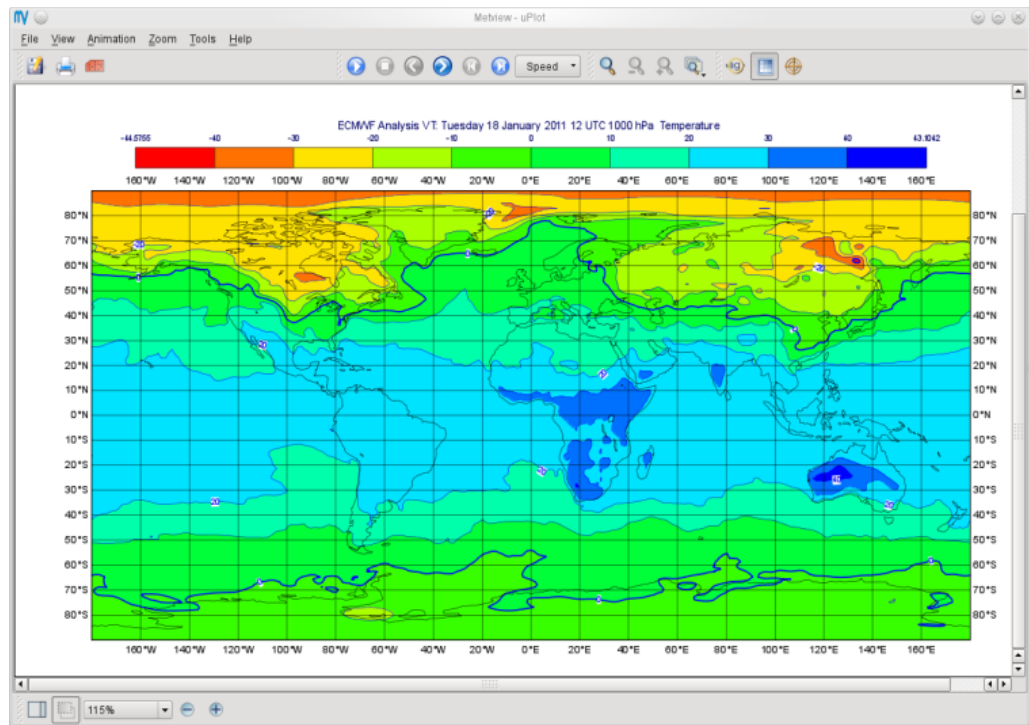
- ▶ **Metview scans its open folders for new files every 15 seconds**
- ▶ **‘rescan folder’ forces an immediate rescan**
- ▶ **Deleted icons go into the Wastebasket – right-click, Empty to finally delete icons from there**
- ▶ **Window resizing control in the ToolBar**

Metview Tutorial: Interactive Usage

- ▶ Part 1: Introduction
- ▶ **Part 2: Visualising your Data**
- ▶ Part 3: Data
- ▶ Part 4: Visual Definitions, Views and Layouts
- ▶ Part 5: Visualisers, Drops, Overlay and Icons
- ▶ Part 6: Data Overlay, Metview Applications and Tools

Data visualisation

- ▶ **Modifying visual definition**
 - ▶ Contouring
 - ▶ Legend
 - ▶ Title
- ▶ **Inspect data values**
- ▶ **Organisation of icons**



Metview Tutorial: Interactive Usage

- ▶ If you have not already done so at the end of Part 1:
 - ▶ get the rest of the icons and data we will need:
 - ▶ ensure that you have created the folder called 'course', because this is where the files will be copied!
 - ▶ from a terminal command line:

```
~trx/mv_data/get_data
```

- ▶ Please do Part 2 of the Tutorial

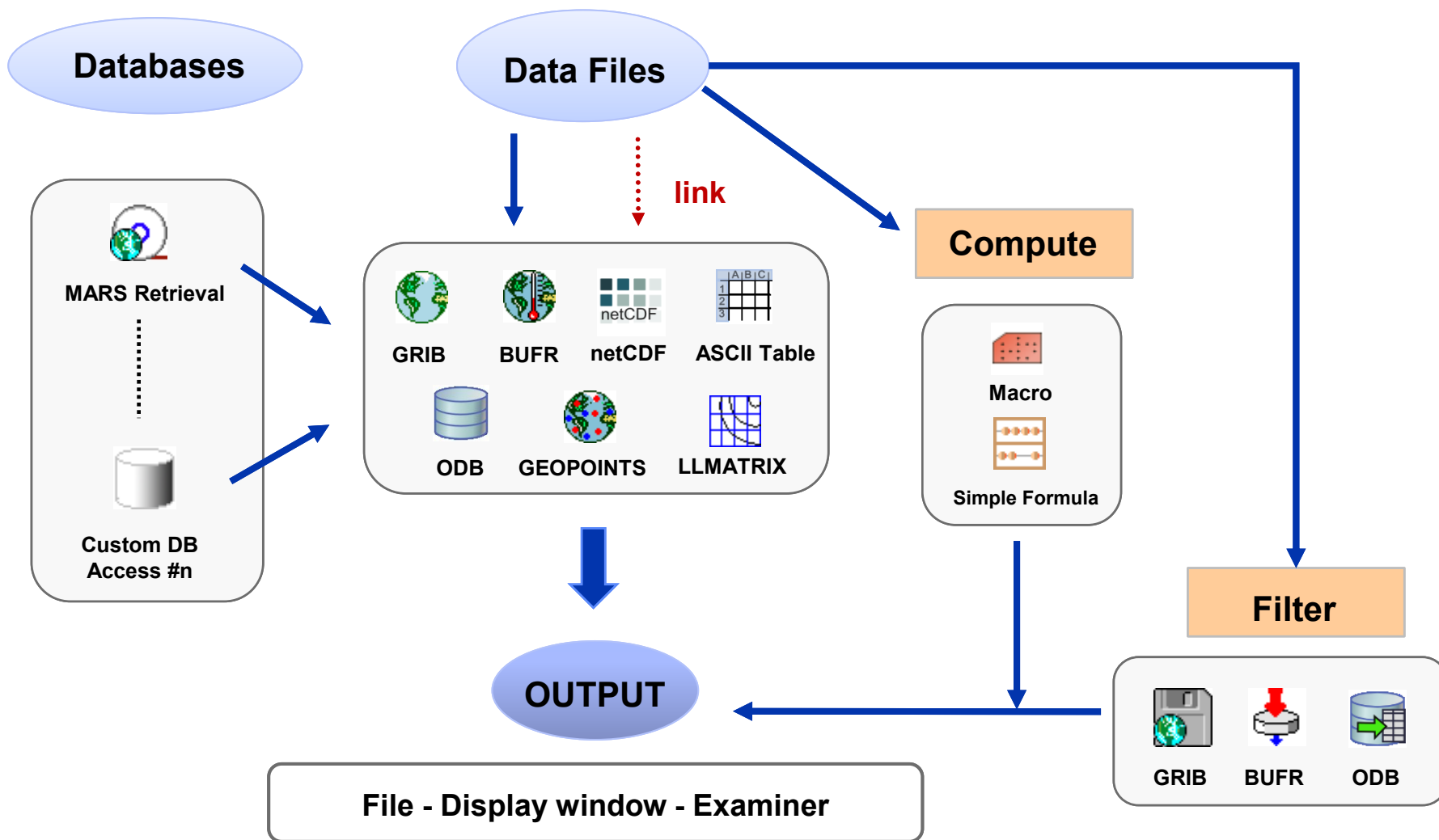
Part 2 – Additional Notes

- ▶ Put frequently used icons into their own drawer
- ▶ Not all icons are in icon drawers – some more recent ones are only in the New Icon menu
- ▶ Contouring often has automatic unit conversion – can be deactivated in the *Contour* icon
- ▶ Cursor data – shows both scaled and non-scaled values
- ▶ Layer meta-data reflects the selected area

Metview Tutorial: Interactive Usage

- ▶ Part 1: Introduction
- ▶ Part 2: Visualising your Data
- ▶ **Part 3: Data**
- ▶ Part 4: Visual Definitions, Views and Layouts
- ▶ Part 5: Visualisers, Drops, Overlay and Icons
- ▶ Part 6: Data Overlay, Metview Applications and Tools

Data handling



Metview Tutorial: Interactive Usage

- ▶ Please do Part 3 of the Tutorial

Part 3 – Additional Notes (1)

- ▶ What data is stored in MARS?
 - ▶ WebMars catalogue: www.ecmwf.int/services/archive/
- ▶ MARS **language syntax**
 - ▶ List of values: 0/12/24/36/48
 - ▶ Range of values: 0/TO/48/BY/12
- ▶ MARS **date format**
 - ▶ Specific dates, e.g. 20090303
 - ▶ Relative dates, e.g. -1 (yesterday)

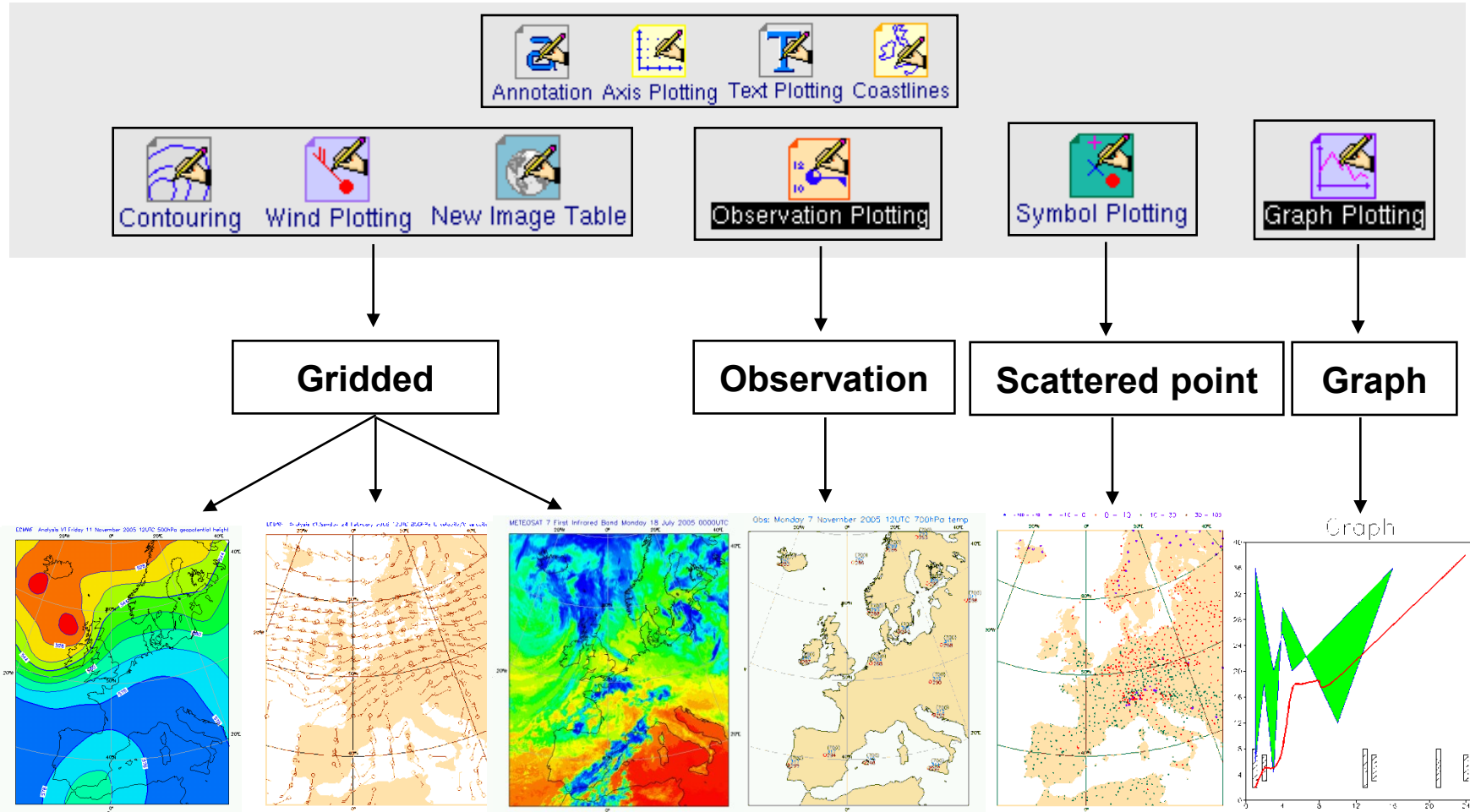
Part 3 – Additional Notes (2)

- ▶ Use action **save** from the icon menu to get a local copy of data files
- ▶ If an icon goes red, then check the output messages
- ▶ Icons can be input to other icons, thus forming a chain
- ▶ GRIB computations (e.g. via the Simple Formula icon) yield derived fields. **GRIB scaling** is **off** by default for these fields in the Contouring icon!

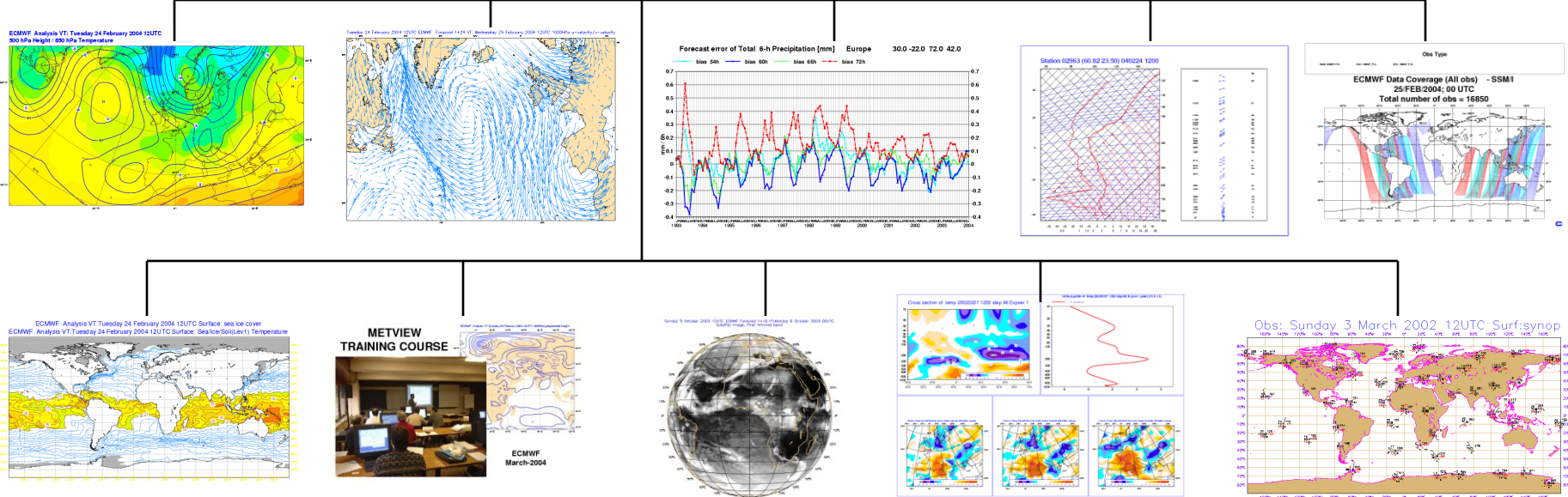
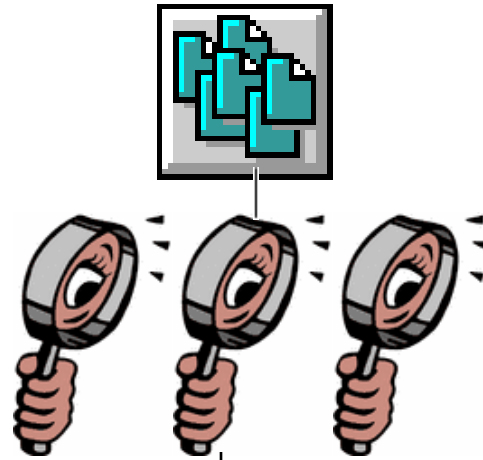
Metview Tutorial: Interactive Usage

- ▶ Part 1: Introduction
- ▶ Part 2: Visualising your Data
- ▶ Part 3: Data
- ▶ **Part 4: Visual Definitions, Views and Layouts**
- ▶ Part 5: Visualisers, Drops, Overlay and Icons
- ▶ Part 6: Data Overlay, Metview Applications and Tools

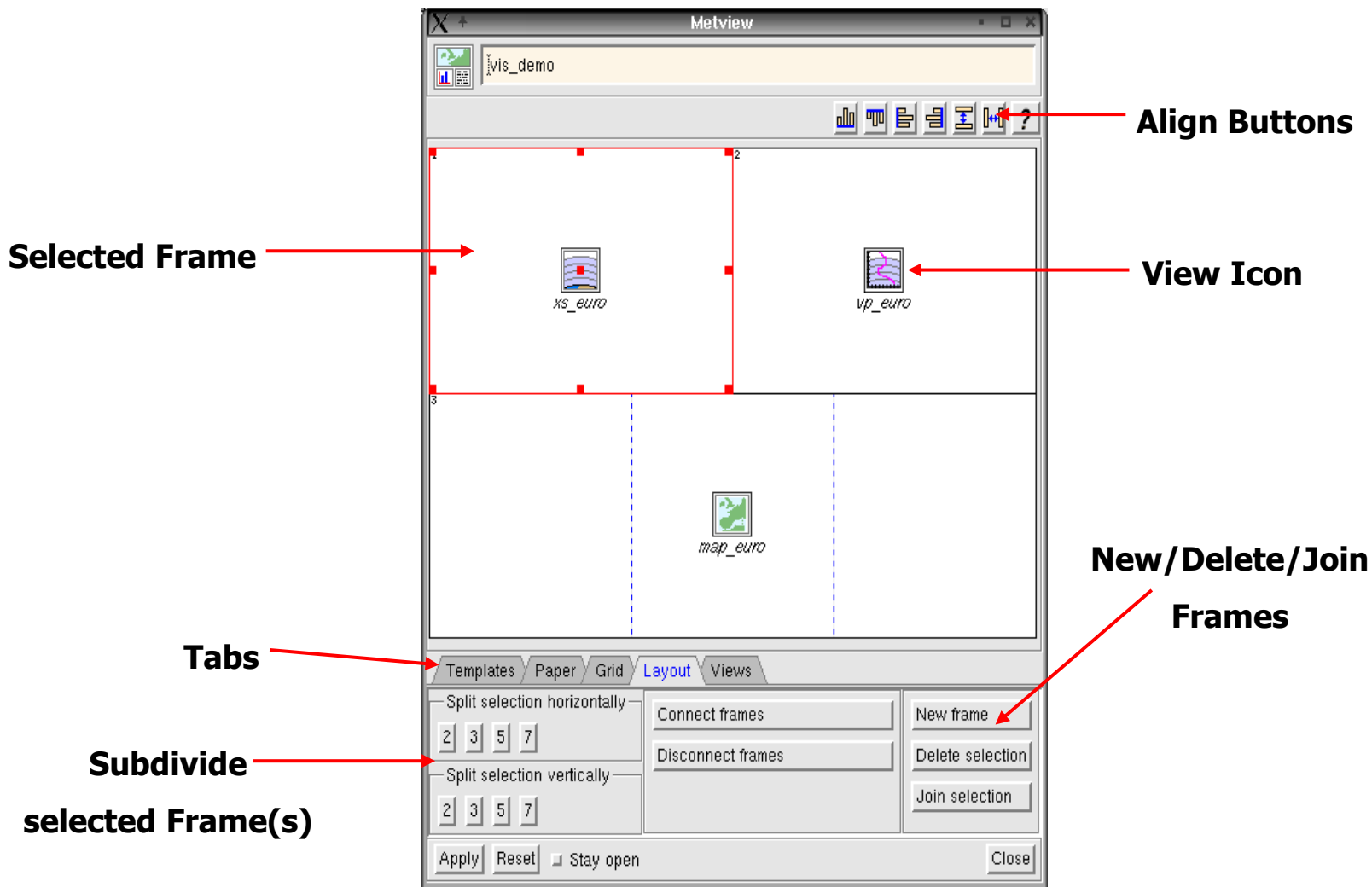
Visual Definition (*visdef*)



The VIEW concept



Display Window icon – layout editor



Metview Tutorial: Interactive Usage

- ▶ Please do Part 4 of the Tutorial

Part 4 – Additional Notes

- ▶ Put frequently used icons into their own drawer
- ▶ Dot/hatch shading can be used to ‘mimic’ transparency in postscript
- ▶ Many options are common to all views (position, ...)

Metview Tutorial: Interactive Usage

- ▶ Part 1: Introduction
- ▶ Part 2: Visualising your Data
- ▶ Part 3: Data
- ▶ Part 4: Visual Definitions, Views and Layouts
- ▶ **Part 5: Visualisers, Drops, Overlay and Icons**
- ▶ Part 6: Data Overlay, Metview Applications and Tools

Icon Drop Rules

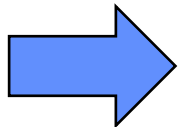
- ▶ Icon drop is easy but can be ambiguous because...
 - ▶ Should I drop *data* and *visdef* together, or in sequence?
 - ▶ How do I apply multiple *visdef* icons?
 - ▶ ...jointly drop them, or in sequence?
 - ▶ *How do I contour overlaid fields?*
- ▶ Luckily Metview has some intelligence → use the Icon Drop Rules

Data Overlay

- ▶ Multi-data visualisations, e.g. T+Z,...
 - ▶ When are different data overlaid in the same plot?
- ▶ Default data overlay rules
- ▶ Need more control? – Use the [Data Overlay Control](#)

Visualisers

- ▶ GRIB is 'easy' to plot
 - ▶ Standardised meta-data – geographic coordinates, resolution, etc
- ▶ Some other formats (e.g. netCDF) are more versatile and can contain matrices, scattered points, multiple variables, etc
 - ▶ users need to tell us what to plot



visualiser icons

Metview Tutorial: Interactive Usage

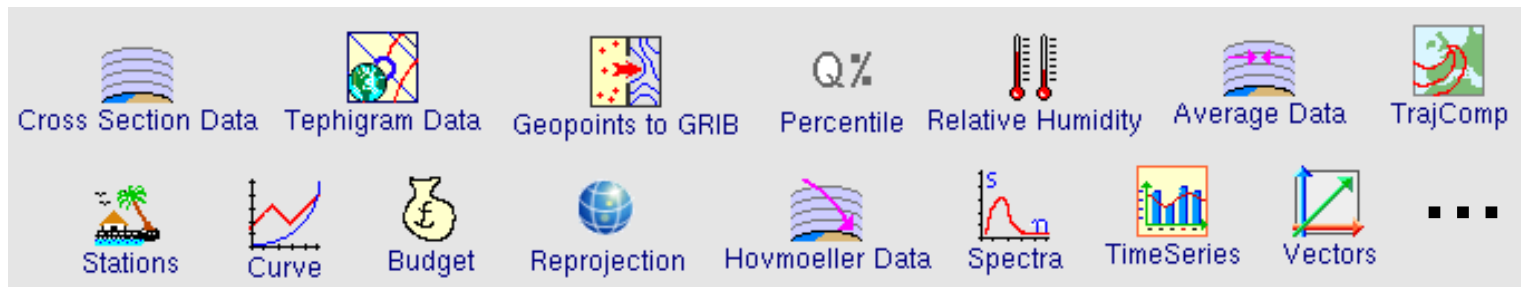
- ▶ Please do Part 5 of the Tutorial

Metview Tutorial: Interactive Usage

- ▶ Part 1: Introduction
- ▶ Part 2: Visualising your Data
- ▶ Part 3: Data
- ▶ Part 4: Visual Definitions, Views and Layouts
- ▶ Part 5: Visualisers, Drops, Overlay and Icons
- ▶ **Part 6: Metview Applications and Tools**

Metview Applications

► Large set of applications:



► Create intermediate data → input to another application

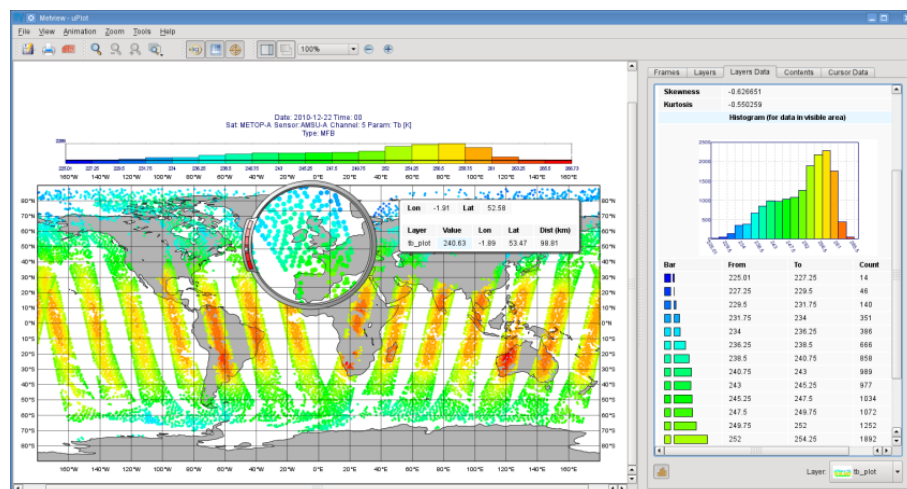
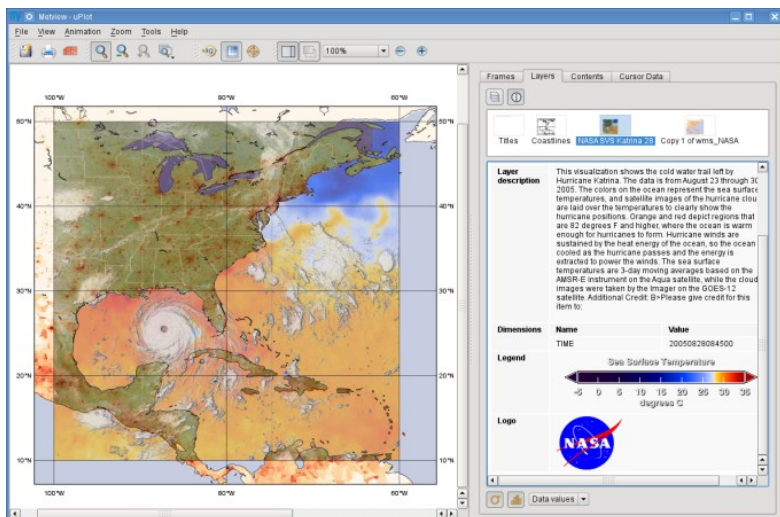
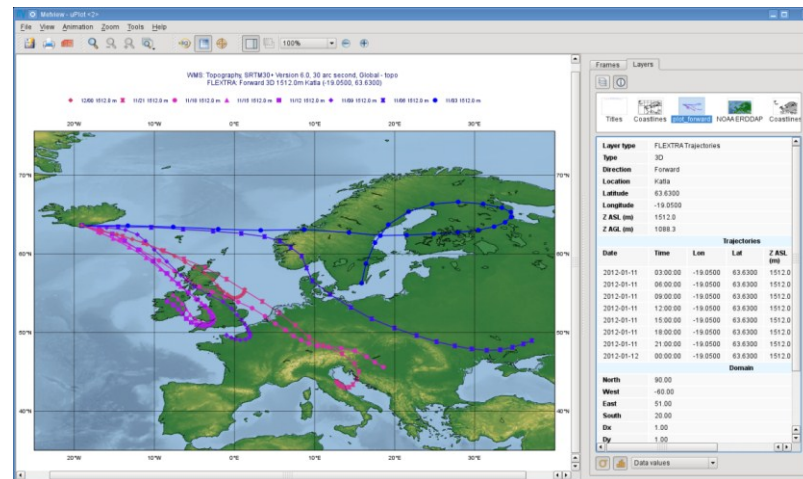
► No application for your needs?

► Write a Metview Macro

Metview Applications: Tutorials

▶ Tutorials available for:

- ▶ WMS
- ▶ ODB
- ▶ FLEXTRA



<https://software.ecmwf.int/metview>

Metview Tools

mv⁴



- ▶ **Mail** - exchange icons
 - ▶ You can send Metview icons by email
- ▶ **Icon Inbox**
 - ▶ Articles and example icons
 - ▶ Also for reading Metview Mail
- ▶ **Monitor** – to monitor and control tasks
 - ▶ Check the progress of long tasks
 - ▶ Abort a misbehaving Metview process
- ▶ **Station** – search Station Database
 - ▶ Access Metview database of 10,000 WMO stations

Metview Tutorial: Interactive Usage

- ▶ Please do Part 6 of the Tutorial