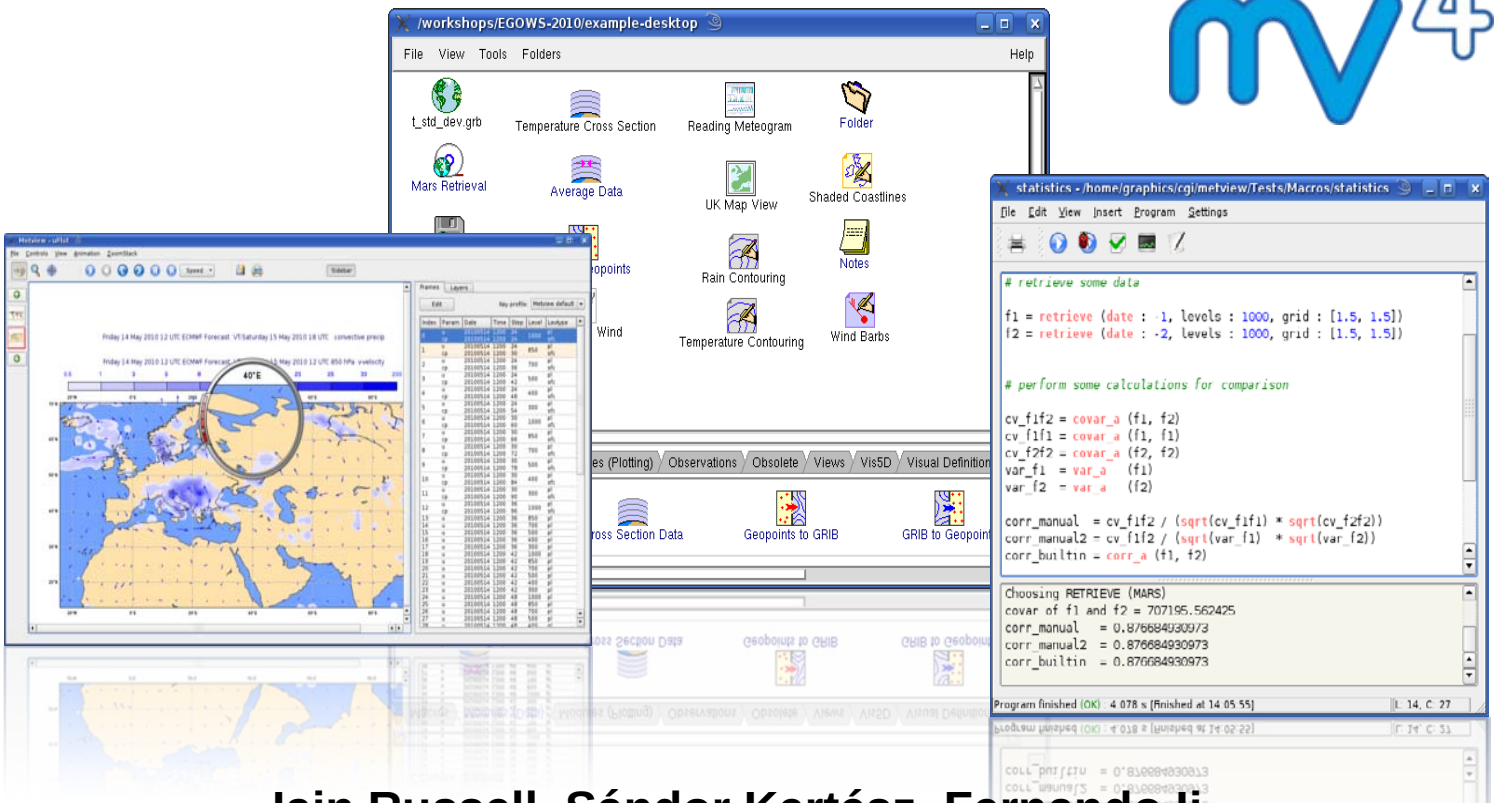
Metview – Training Course



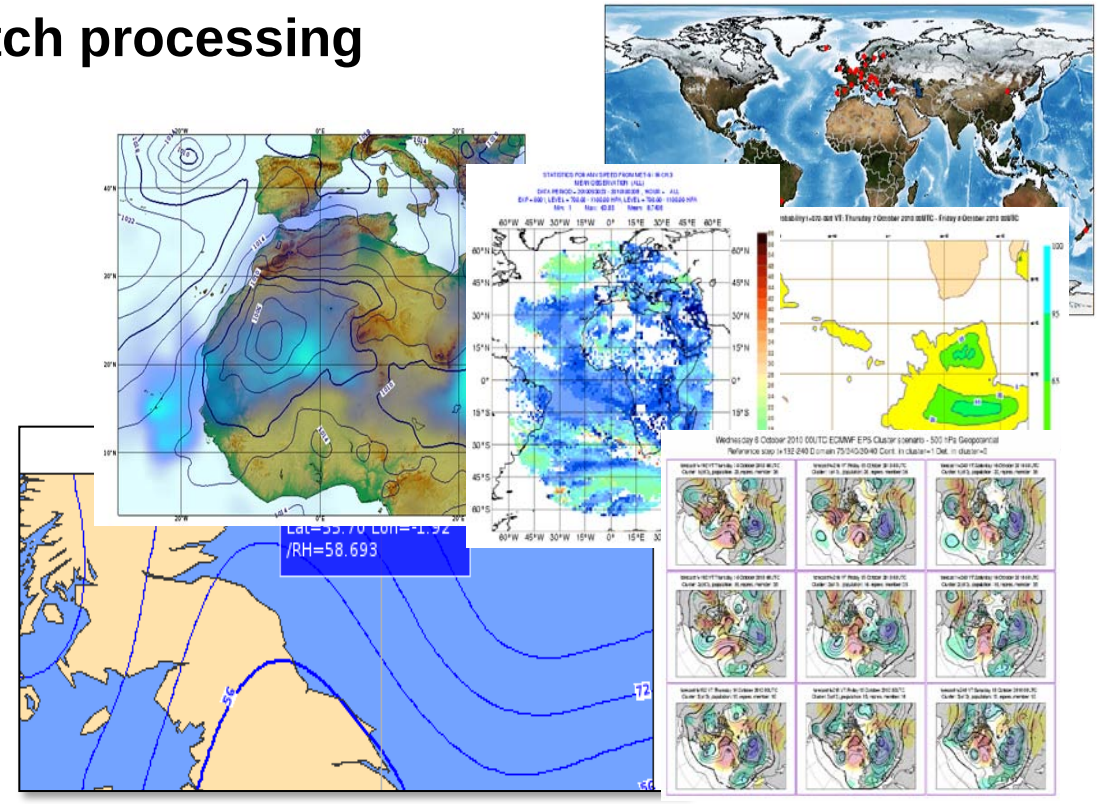
Iain Russell, Sándor Kertész, Fernando Ii

Meteorological Visualisation Section

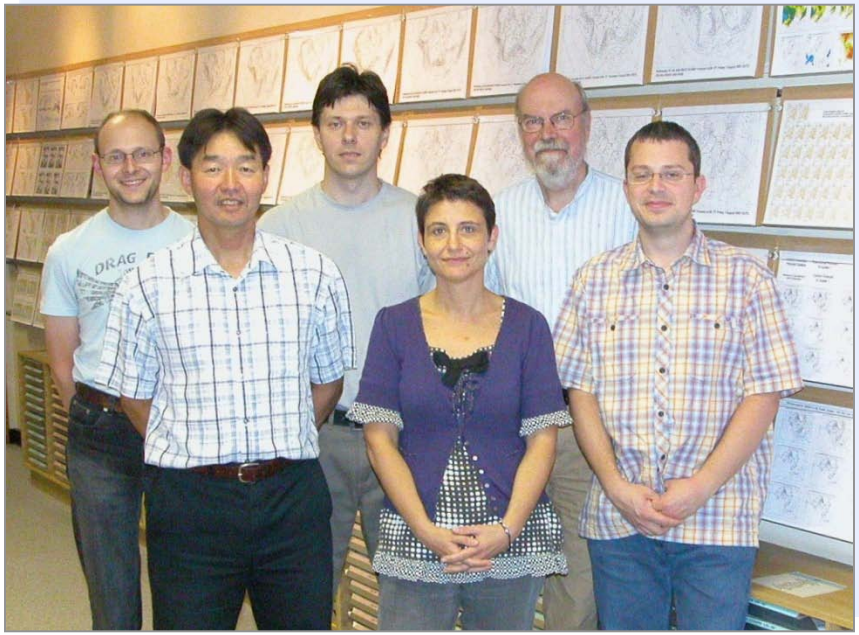
ECMWF

Outline

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



The Magics/Metview team



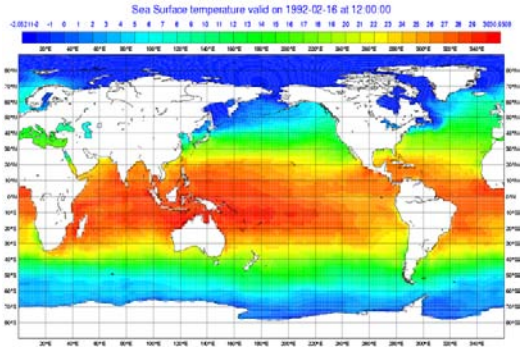
- ECMWF
  - Research Department
  - Operations Department
    - Meteorological Division
      - Meteorological Visualisation Section

What are our missions?

- **We are here to help researchers and analysts to access, manipulate and visualise a wide variety of meteorological data**

- **We develop and maintain :**
  - **A graphical package with various APIs : Magics**
  - **A desktop based application : Metview**
  - **Interpolation: tools for field regridding and sub-area extraction**

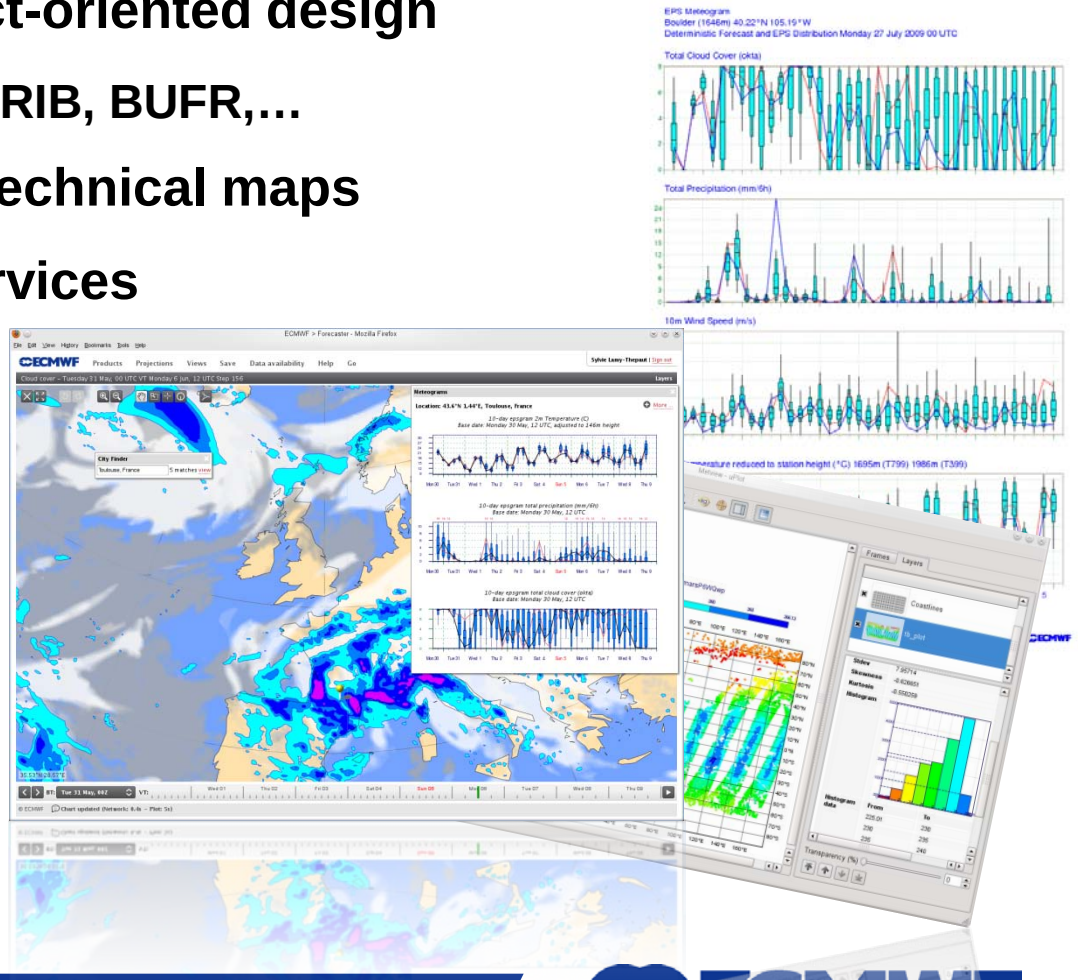
- **We participate in the web project**
  - **Easy description and production of plots**



- **To do that, we use**
  - **Unix platforms**
  - **Mostly C++ language**
  - **Perforce for versioning**

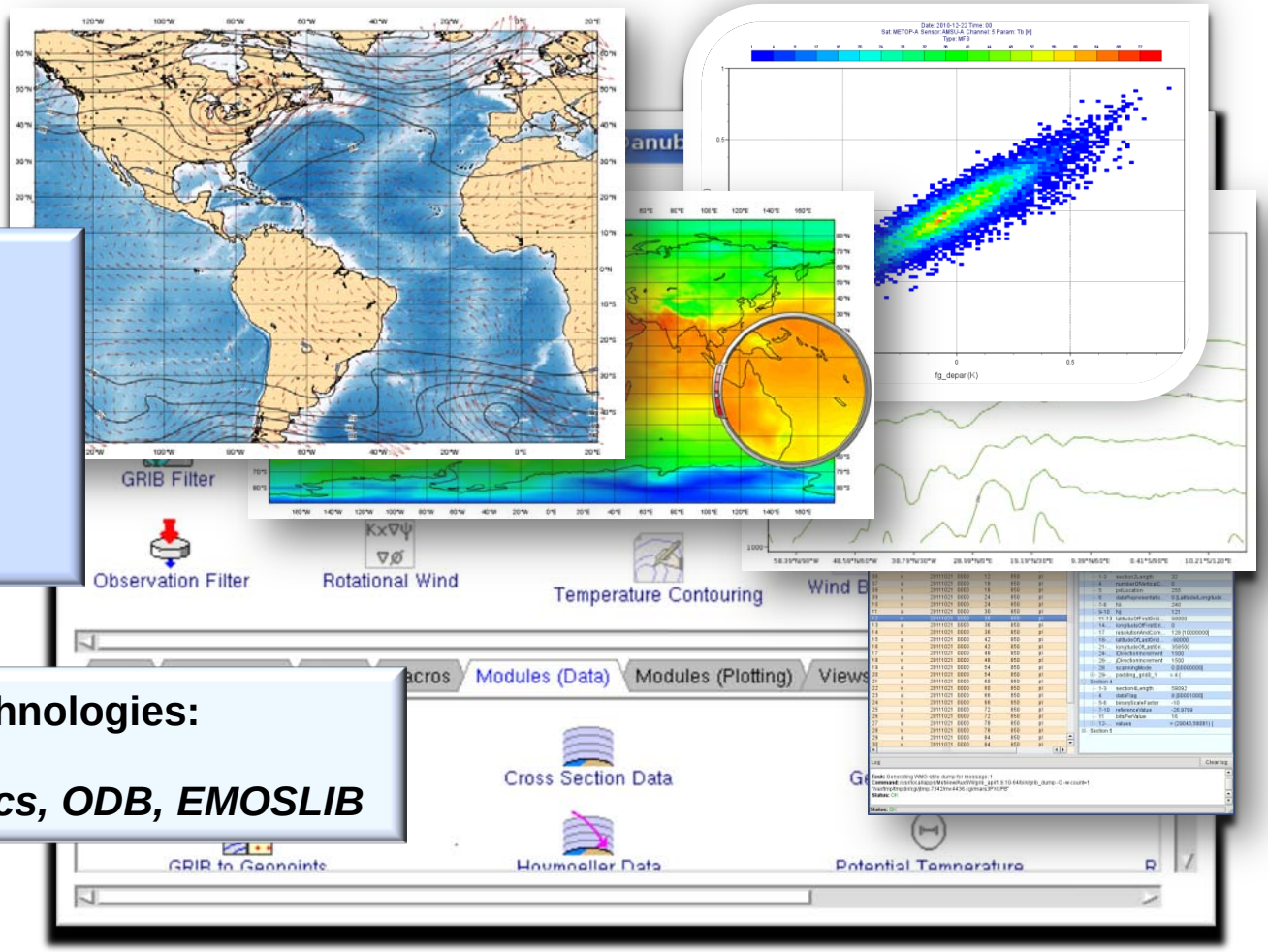
Magics: graphical package

- Graphics library to visualise meteorological data
- Meteorological- and object-oriented design
  - Specific visualisation, GRIB, BUFR,…
- Outputs are high quality technical maps
- Used in many weather services
- Various APIs: Fortran, C, Python, MagML/JSON
- Freely available under Apache license



Metview: meteorological workstation

- **Working environment for Operational and Research Meteorologists**
- **Runs on Unix**



Co-operative project:

ECMWF

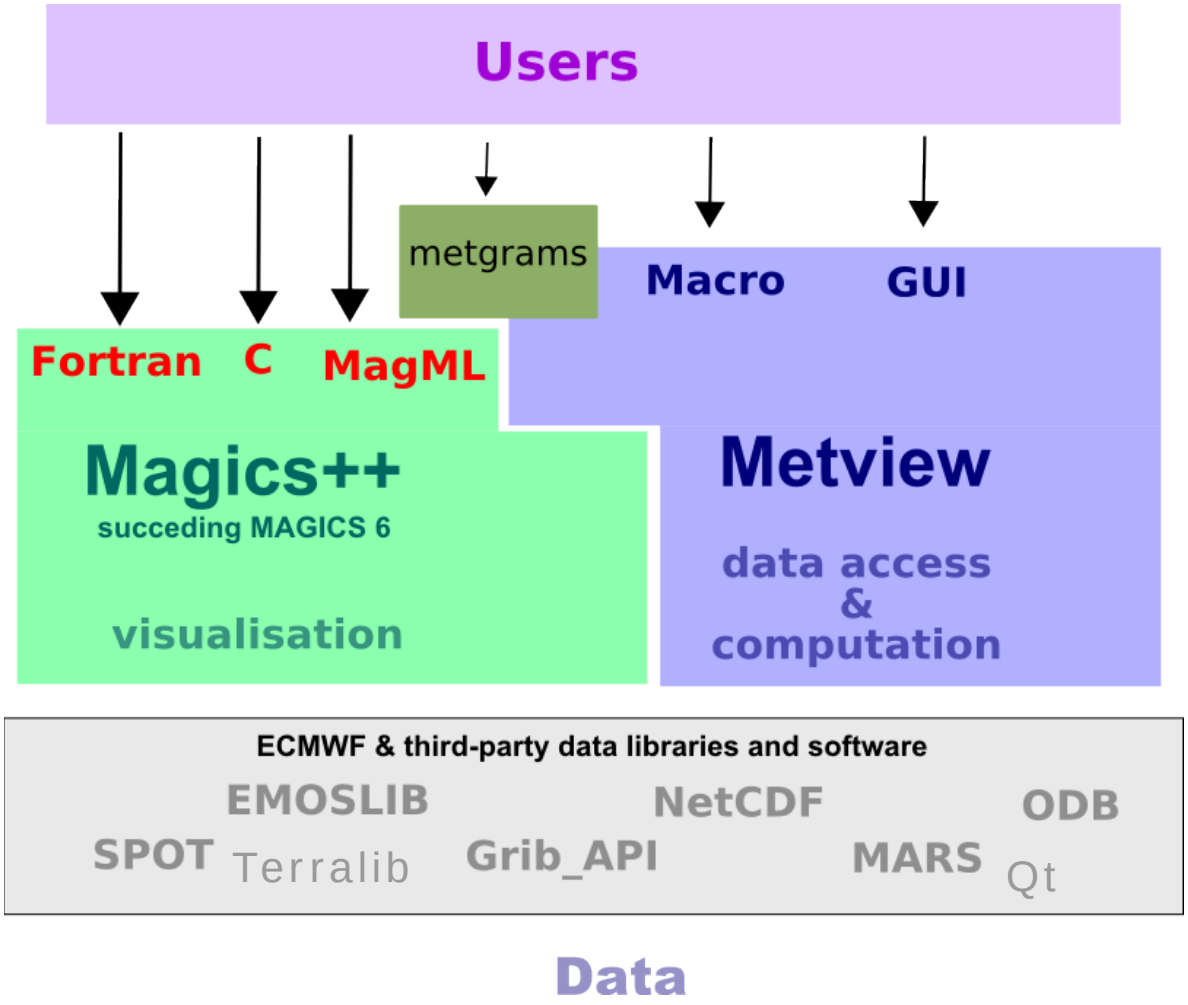
INPE (Brazil)

Built on core ECMWF technologies:

MARS, GRIB_API, Magics, ODB, EMOSLIB

ECMWF

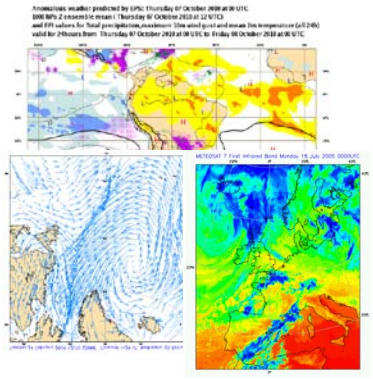
Software organisation



Metview history (summary)

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

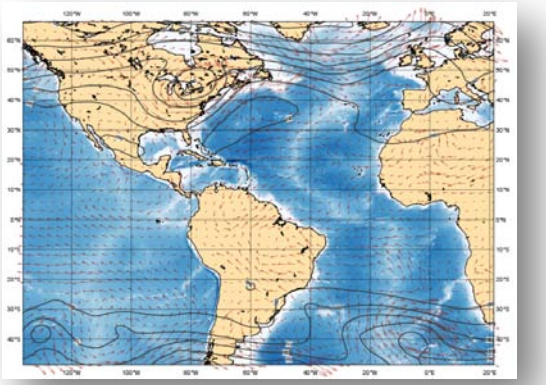
> *Metview*
> *There are plans to develop a general and unique system for the visualization of meteorological data at ECMWF which should serve the scientist and the operational analyst alike. The Metview concept will provide a standard framework within which applications relating to the retrieval, processing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



- **First prototype in 1991** — ***INPE***
- **First operational version in 1993** — ***Metview 1.0***
- **OpenGL graphics introduced in 1998** — ***Metview 2.0***
- **New user interface in 2000** — ***Metview 3.0***
- **Magics++ and Qt introduced in 2010** — ***Metview 4.0***

Metview releases

- **Metview 3**
  - **export version: 3.12.3, released 2011-08-22**
  - **no longer developed, but still maintained**
  - **under ECMWF license**



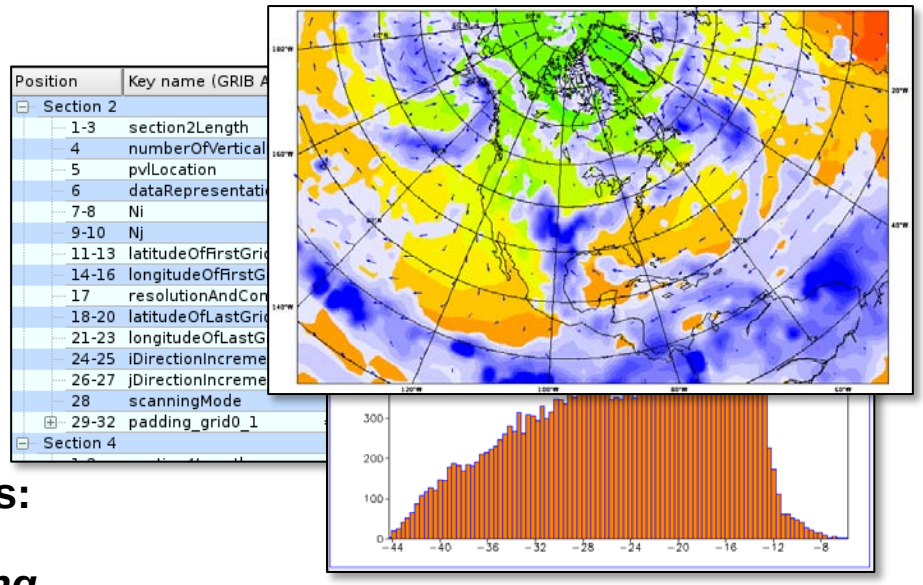
- **Metview 4**
  - **export version: 4.1.3, released 2011-11-21**
  - **under ECMWF license**
  - ***BUT from version 4.3 onwards Metview will be Open Source under Apache License***

- **For this training course we will use Metview 4.2.2**
  - **development version – feedback welcome**

What can Metview do?

- **Data:**
  - **Access**
  - **Examine**
  - **Manipulate**
  - **Plot / Overlay**
    - **Generate graphics files:**

      ps, eps, kml, svg, png,…

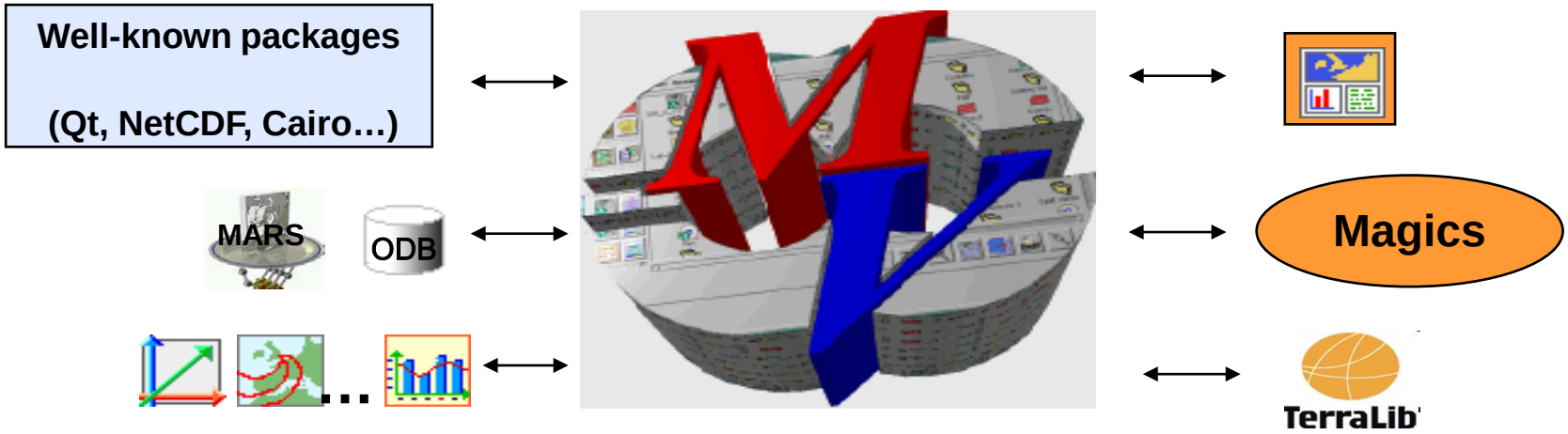


- **Can be run interactively or in batch**

- **Runs self-contained standalone**
  - **From laptops to supercomputers**
  - **No special data servers required**

Main features

- **Strength: its flexible service oriented architecture allows to easily overlay various types from various data sources**
- **Can interact with other established meteorologically oriented software and GIS systems**



Main features

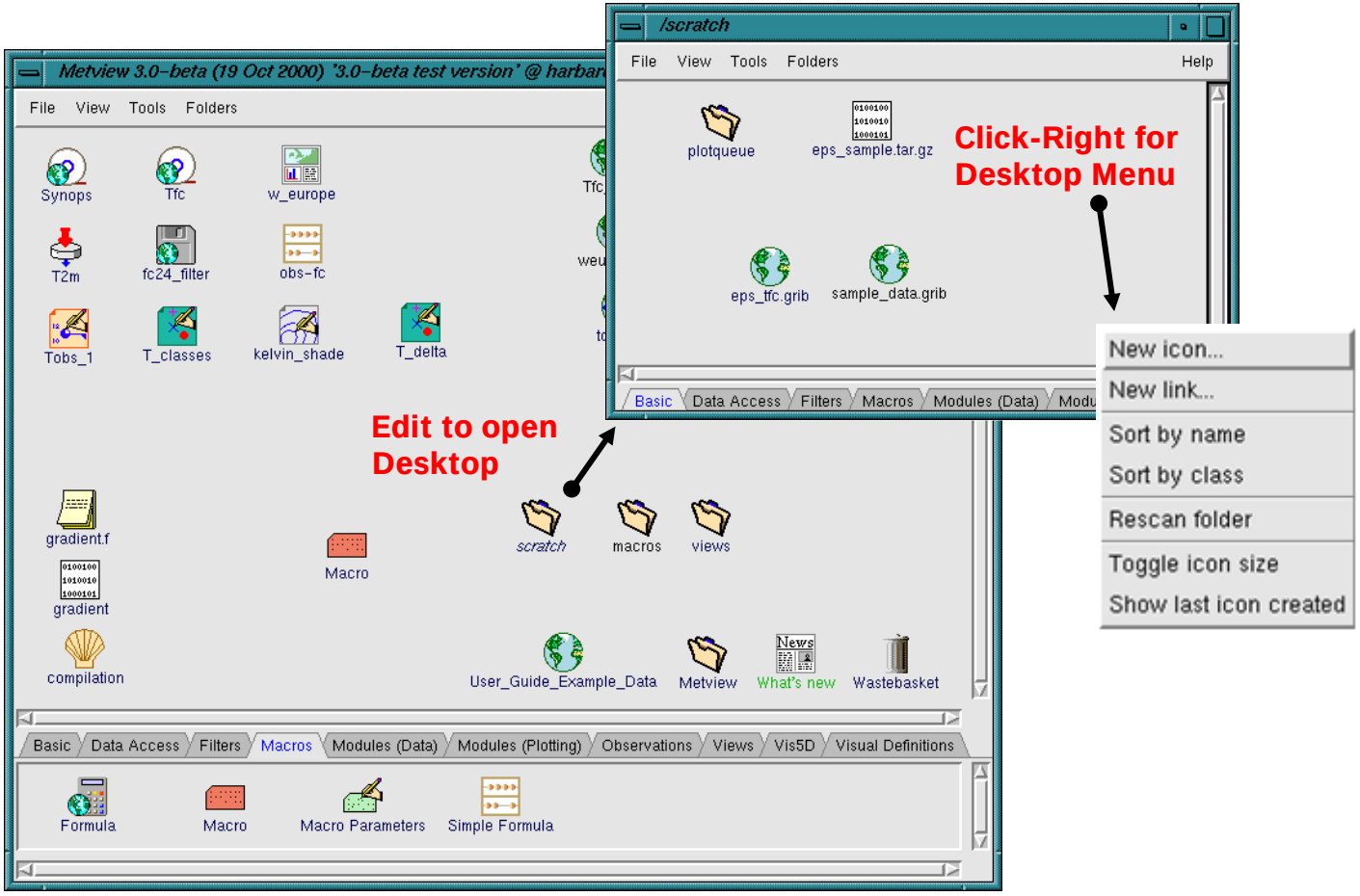
- **Interactive and batch modes**
- **Macro language**
  - **Powerful meteorologically oriented language**

```
# Initialize variables
path = "/home/graphics/cgk/"
fn_out = path & "mgrib.grib"

# Retrieve data
data_org = retrieve(
           levelist : 1000,
           param    : 't'
         )

 # Compute scores
for p1 = 1 to nlat do

     if v[p1] < missing then
         val = v[p1]
     else
         val = missing
     end if

     write(f,newline)
 end for
```

- **Simple script language + modern computer language**
- **Extensive list of operators/functions**
- **Macro programs: interactive or batch mode**
- **Interfaces with user's Fortran/C/C++ programs**

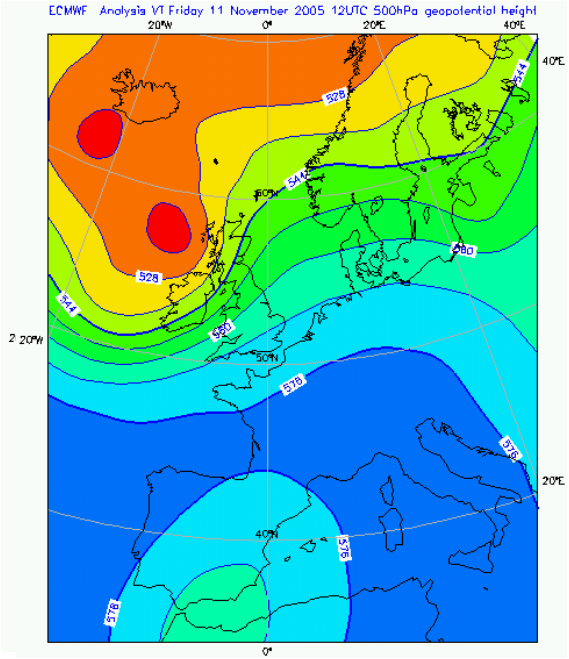
Main features

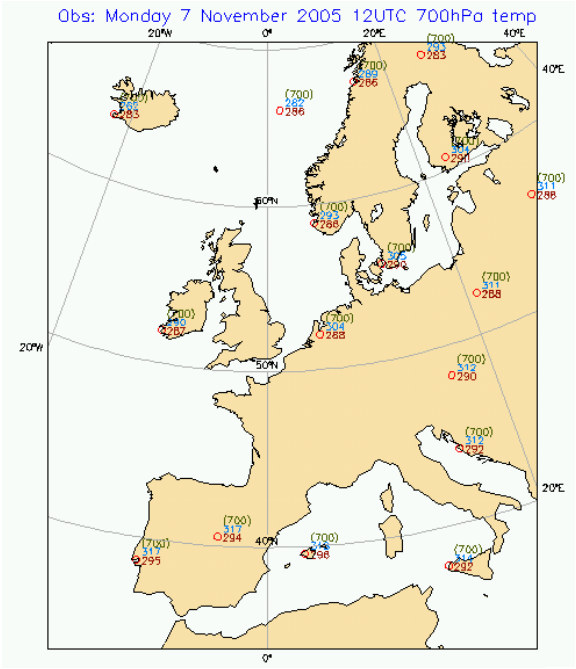
- **Icon-based interface**

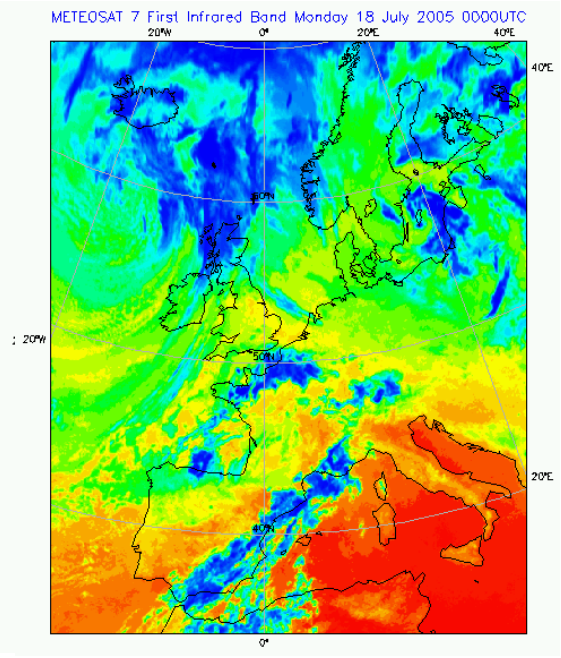


Main features

- **Handles a variety of data**
- **Rich set of visualisation attributes**

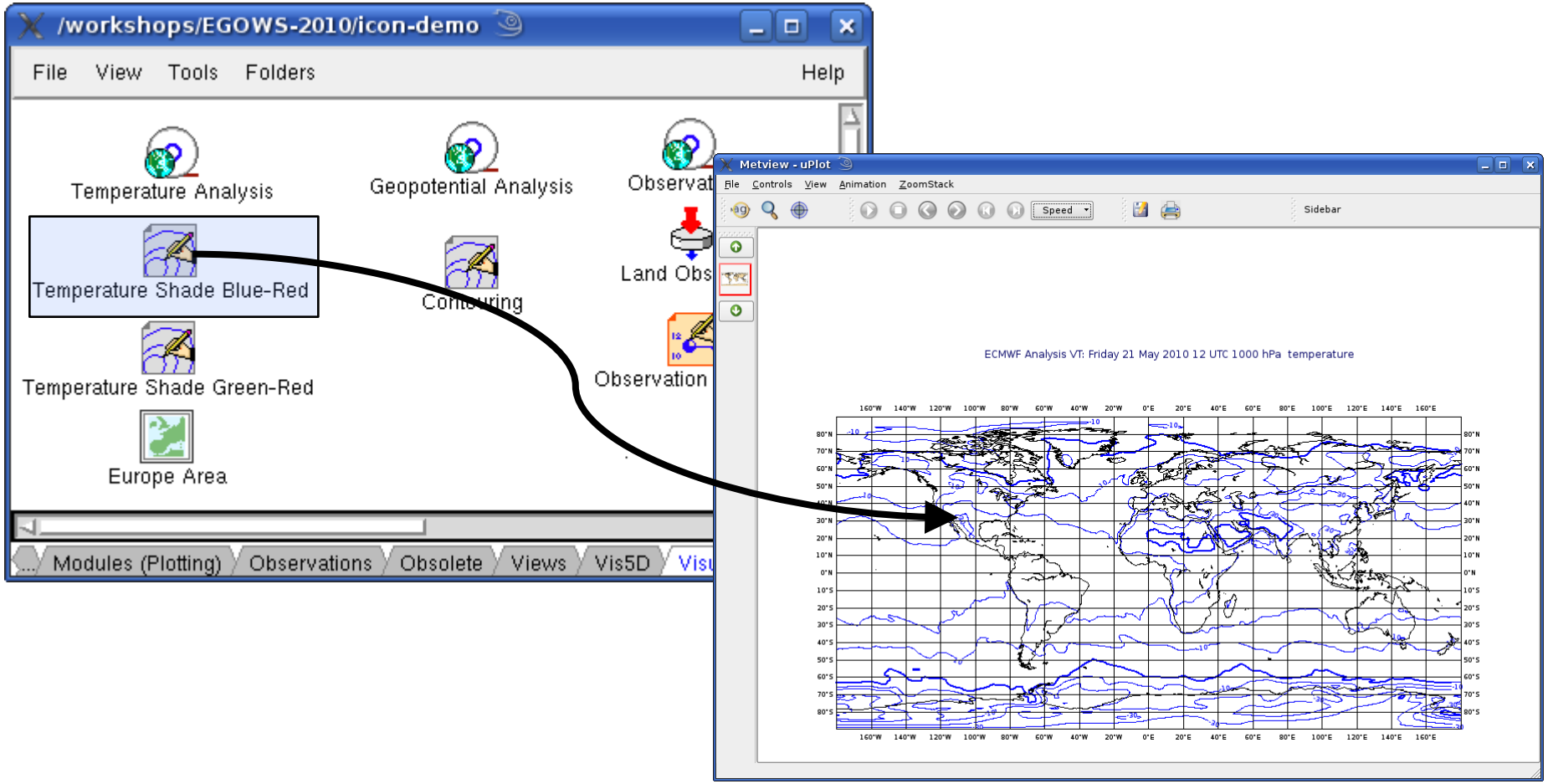






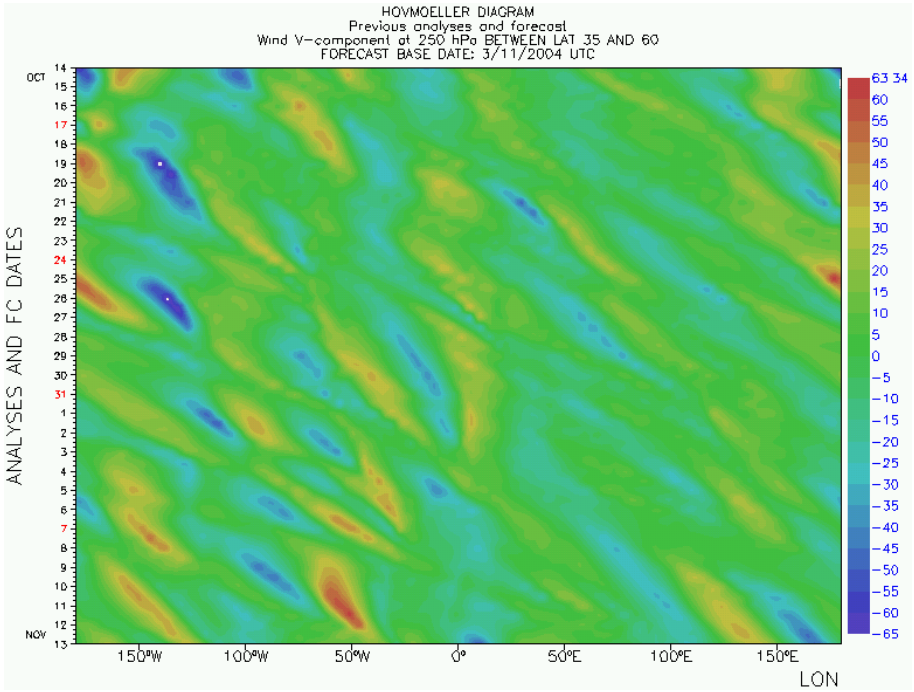
Main features

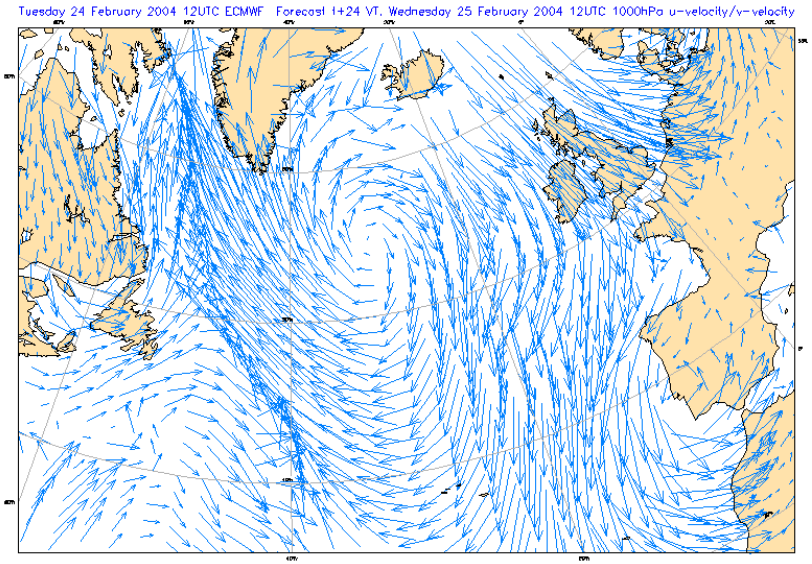
- **Drag and Drop support**



Main features

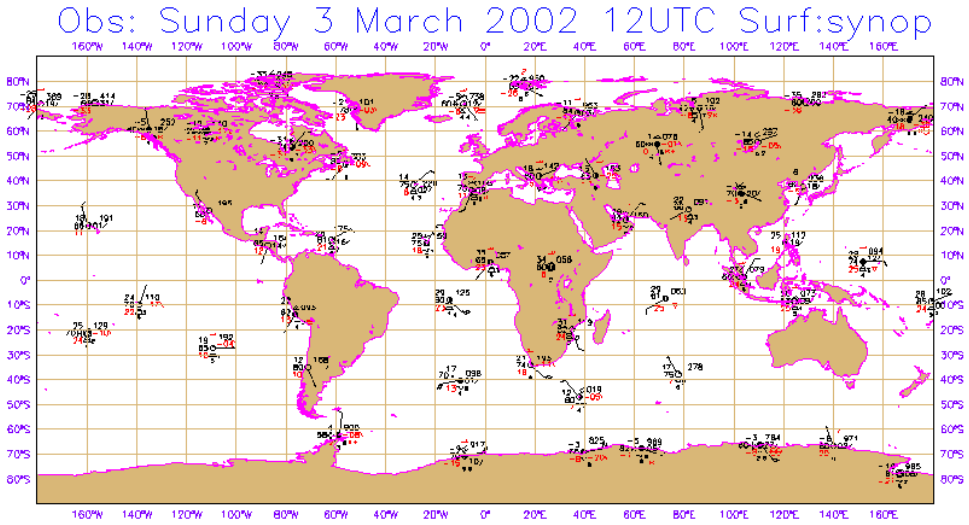
- **Can produce a variety of meteorological charts**

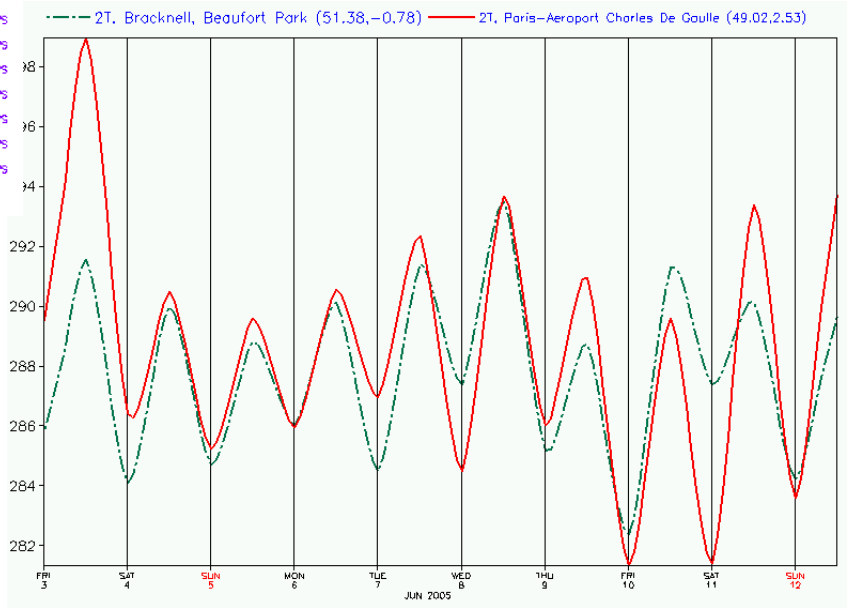




Main features

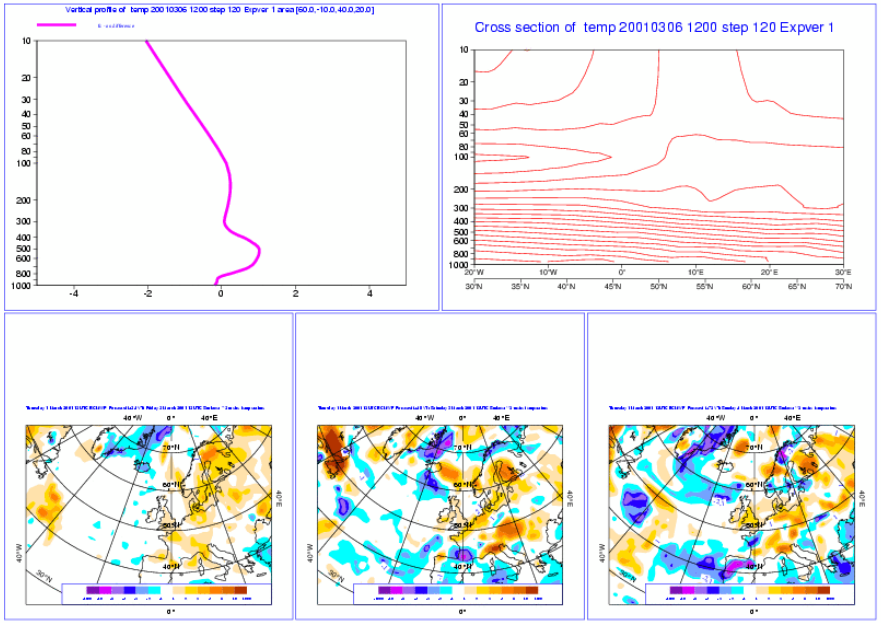
- **Can produce a variety of meteorological charts**

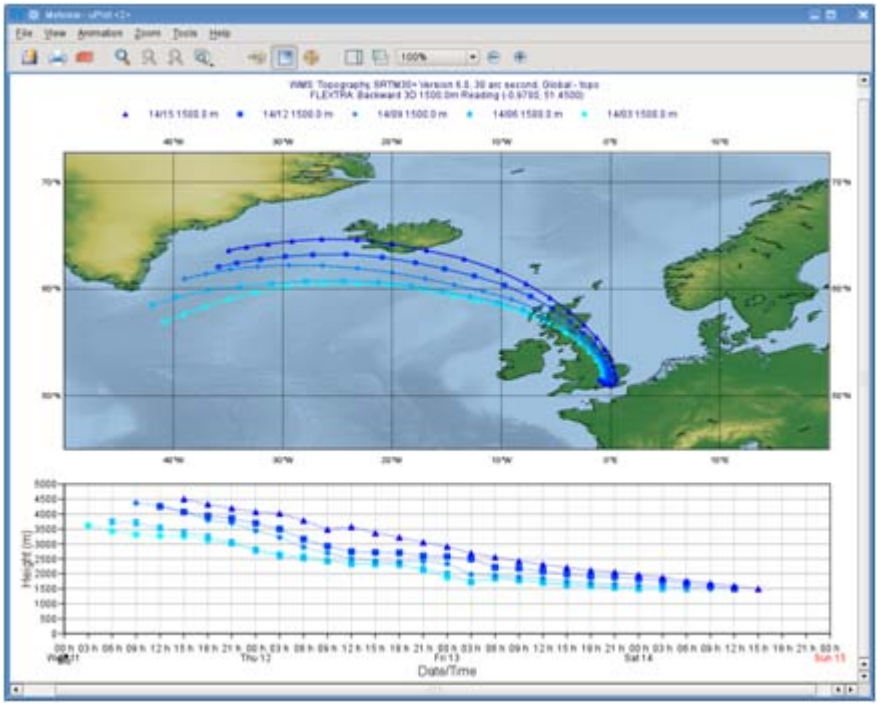




Main features

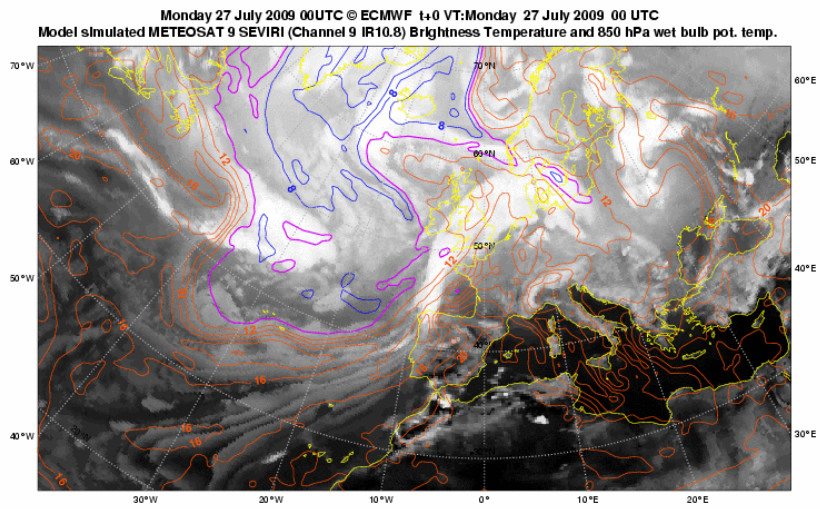
- **Can produce a variety of meteorological charts**

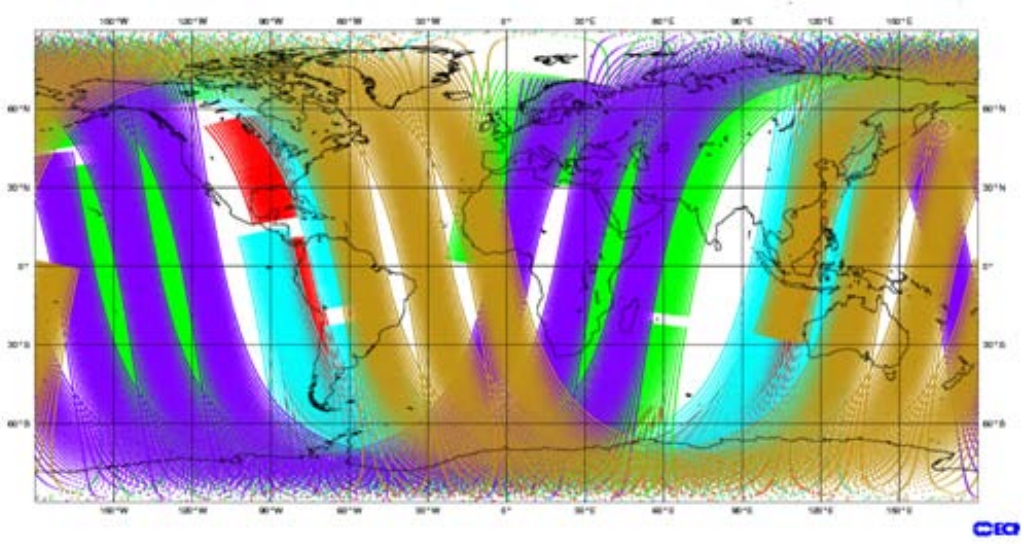




Main features

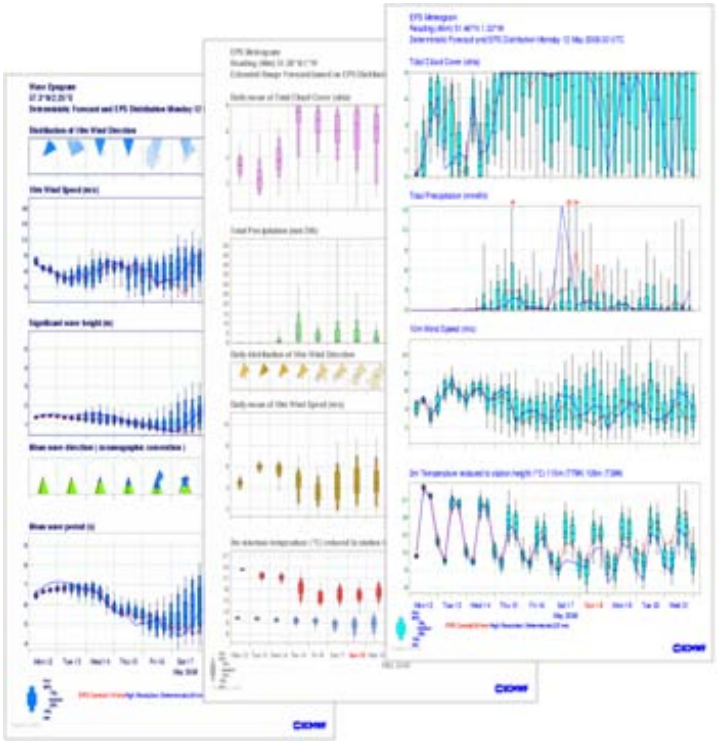
- **Can produce a variety of meteorological charts**

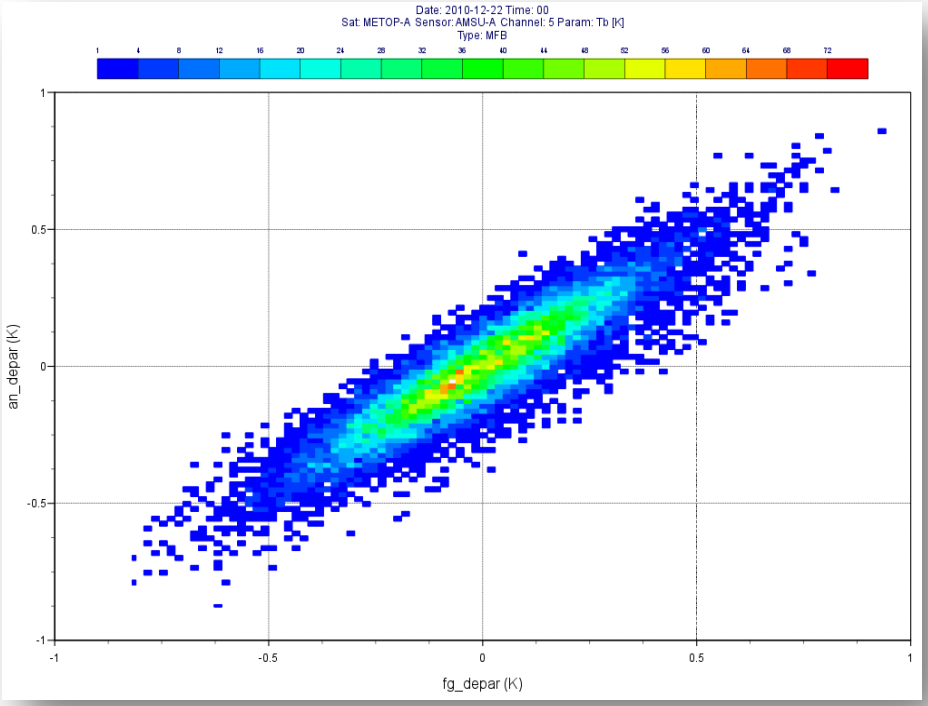




Main features

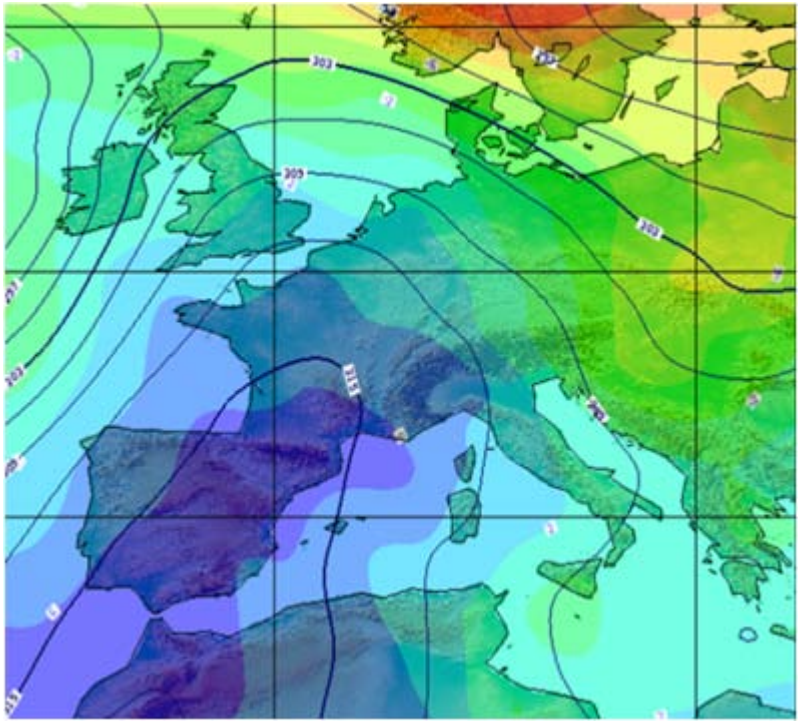
- **Can produce a variety of meteorological charts**

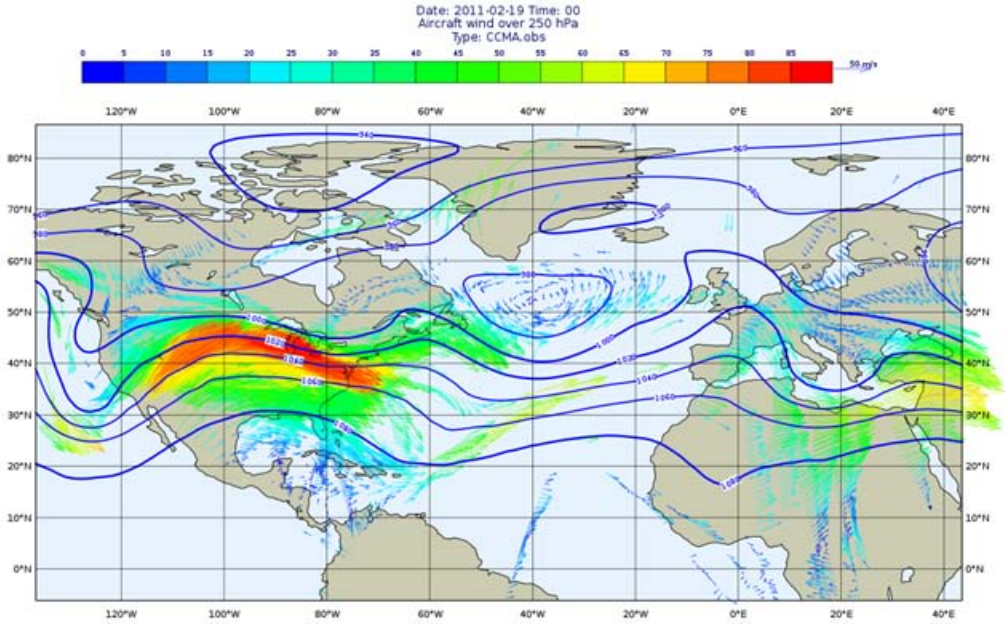




Main features

- **Can produce a variety of meteorological charts**
- **Easy to overlay different data sets**

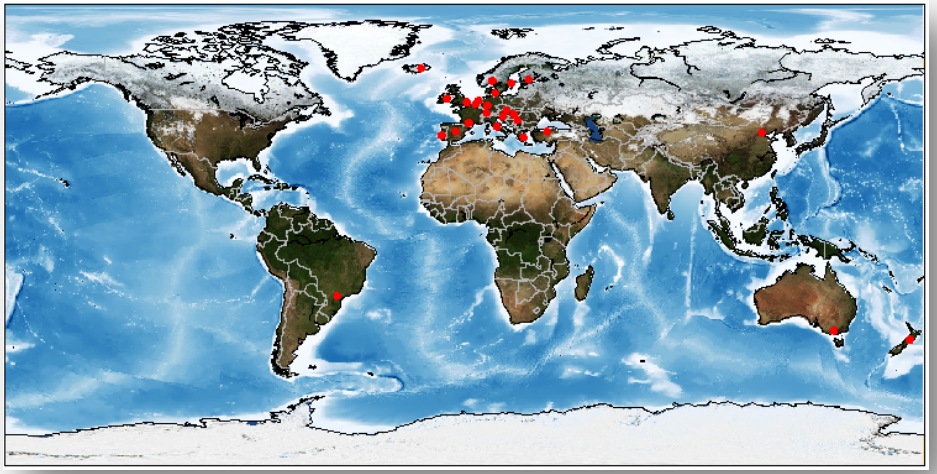




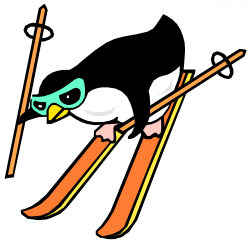
Who uses Metview?

- **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**



Desktop Behaviour (1)

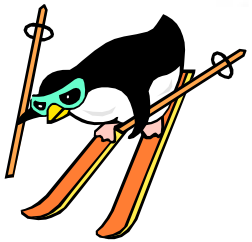


- **KDE settings relevant to Metview:**

1) Change the window behaviour

- **KDE menu (icon at bottom-left)**
- **System Settings**
- **Window behaviour**
- **Set Policy to “Focus Follows Mouse”**
- **Disable “Click raises active window”**
- **Apply and close the dialog**

Desktop Behaviour (2)



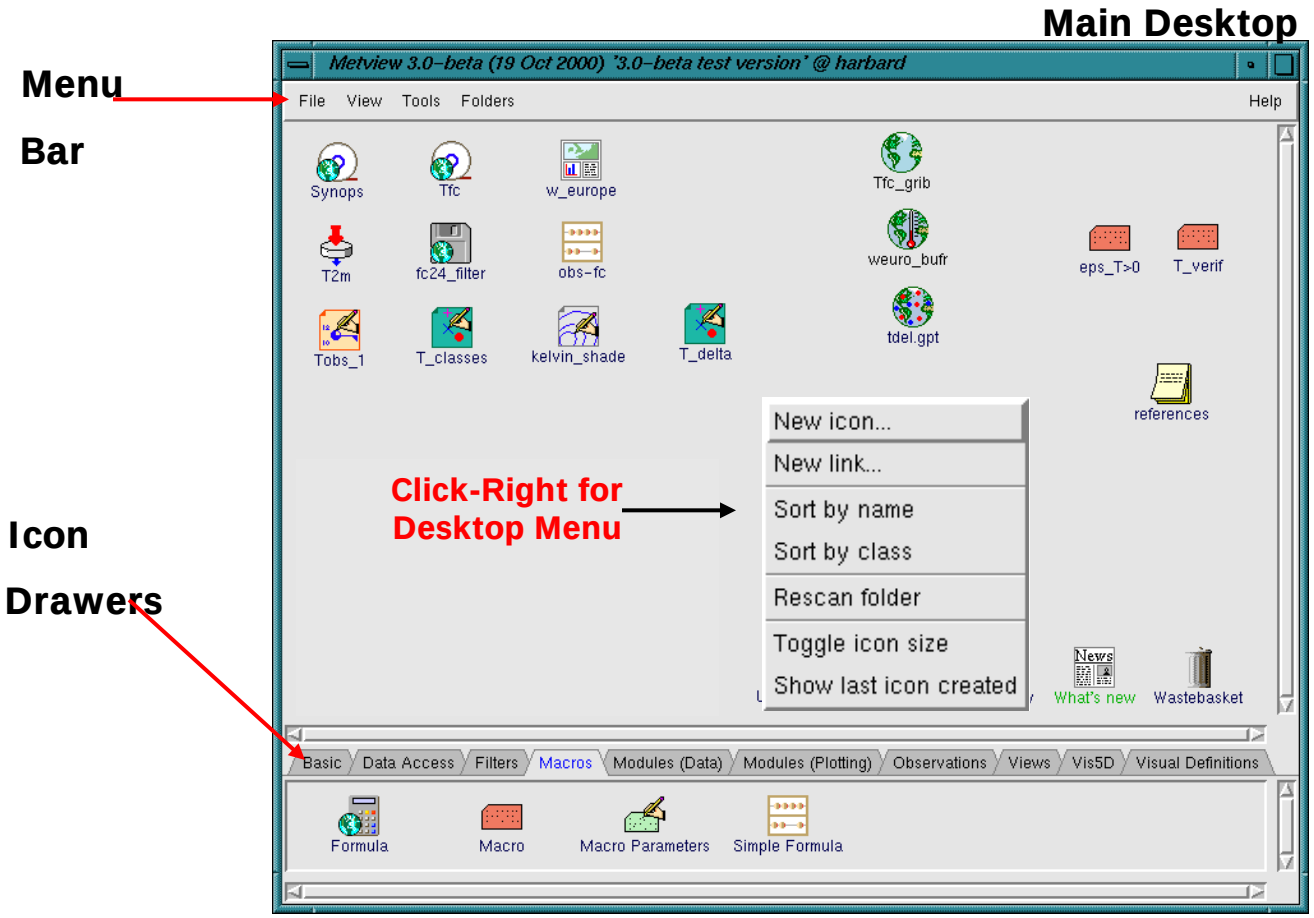
2) Change the desktop behaviour

- 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

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

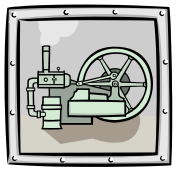
Metview Desktop (MetviewUI)



Metview Principles

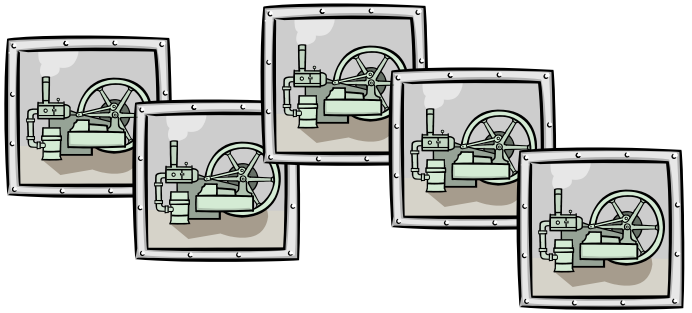
- **First Metview Principle:**

  "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

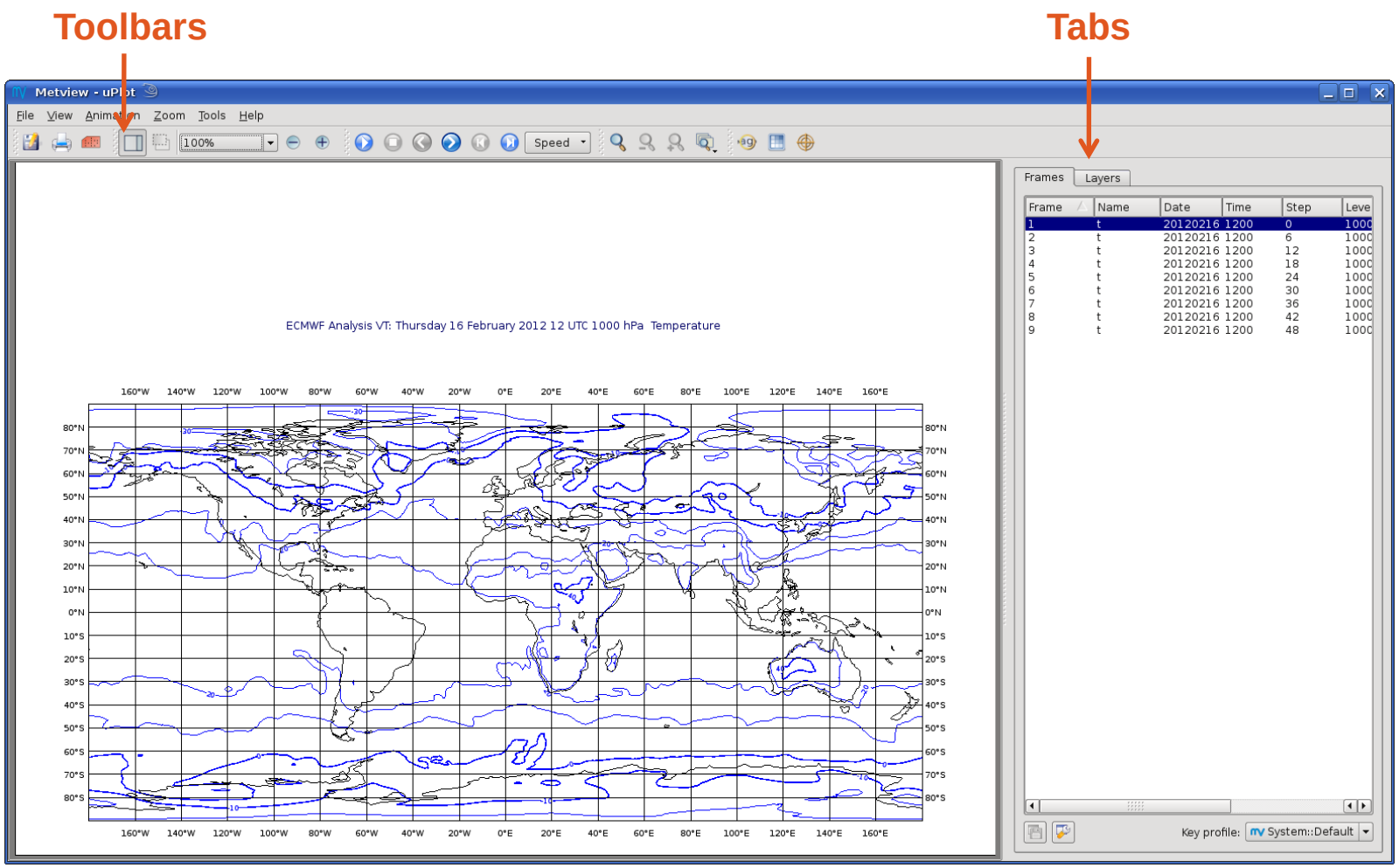
Input element: Colour Menu

Input element: Option Menu

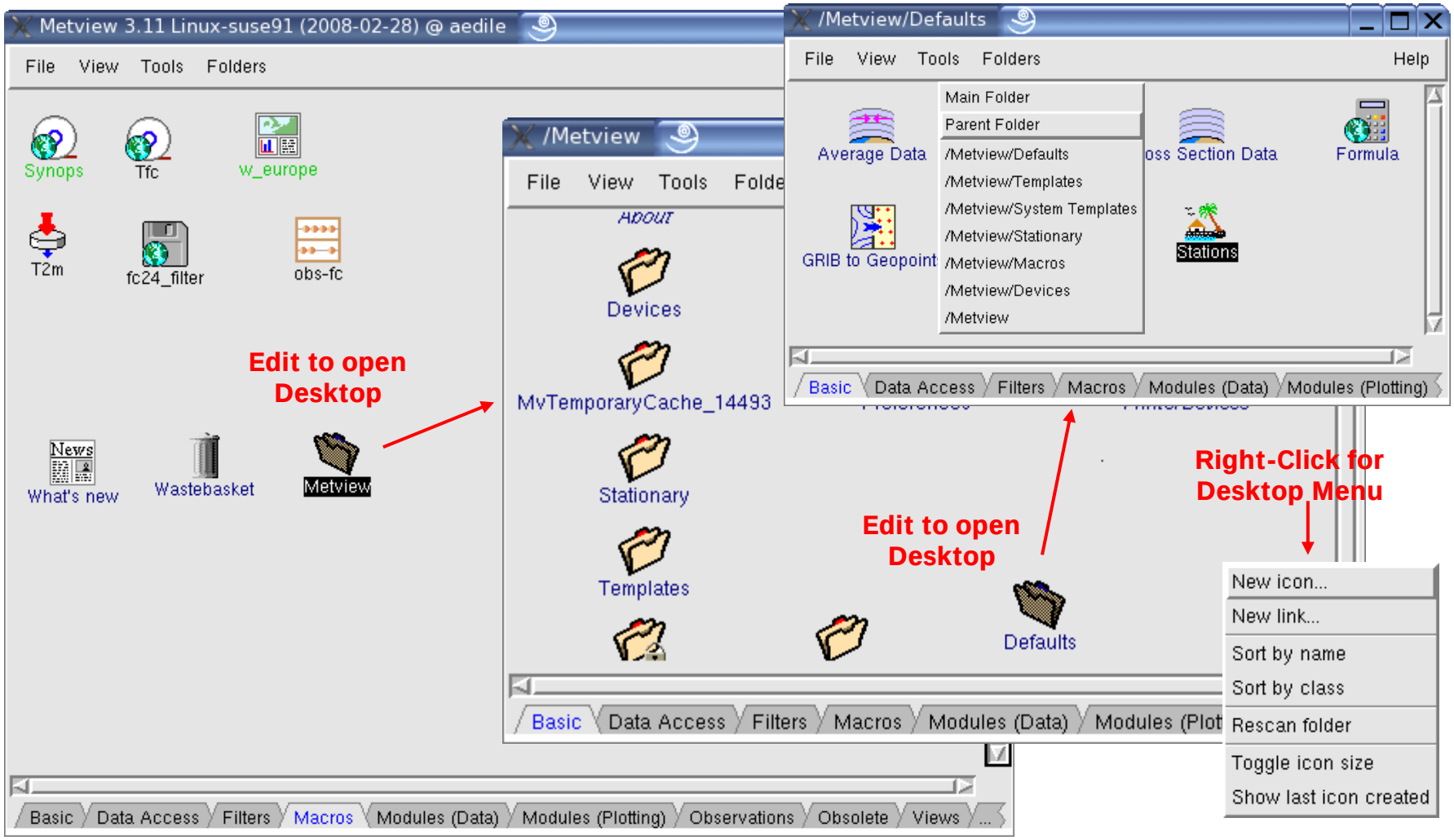
Input element: Alphanumeric Field (must hit *Enter* key)

Save/Exit area

Display Window



Organising folders



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

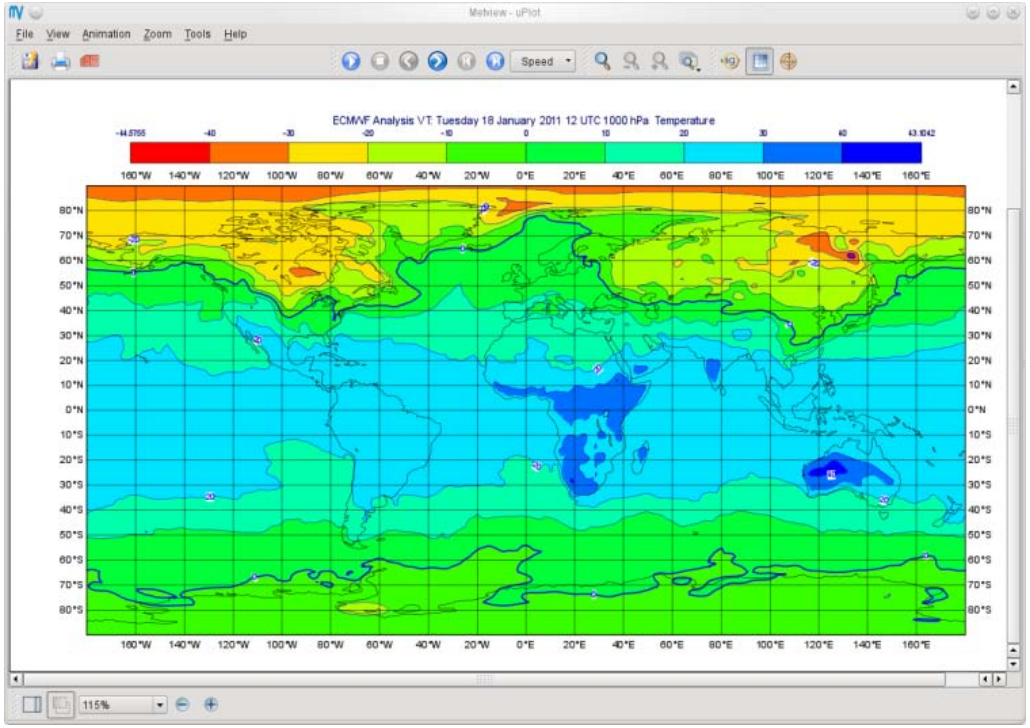
- **Metview scans its open folders for new files every 15 seconds**
- **‘rescan folder’ forces an immediate rescan**
- **Deleted icons go into the Wastebasket – right-click, Empty to finally delete icons from there**
- **Window resizing control in the ToolBar**

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**

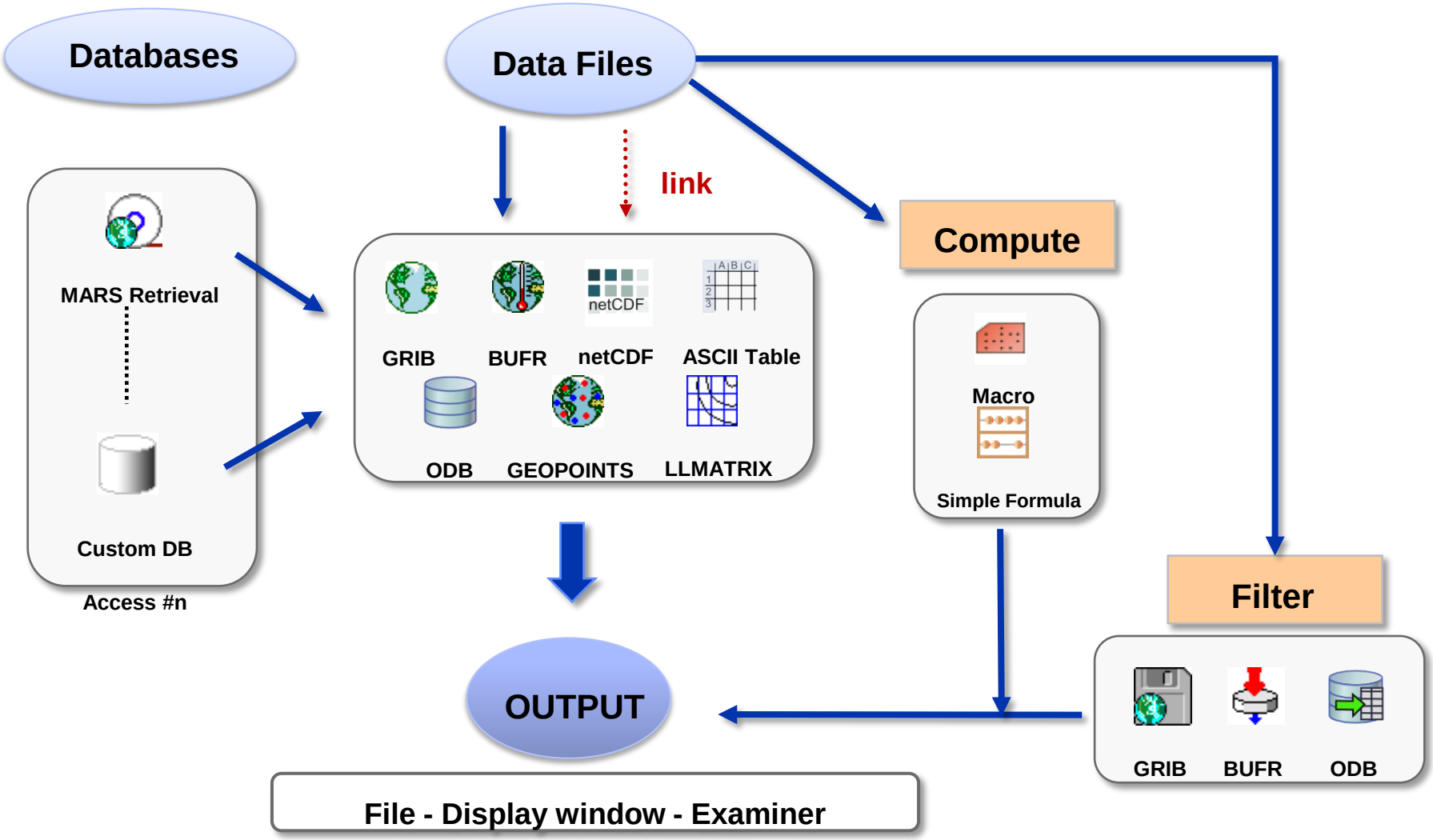
Part 2 – Additional Notes

- **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)**

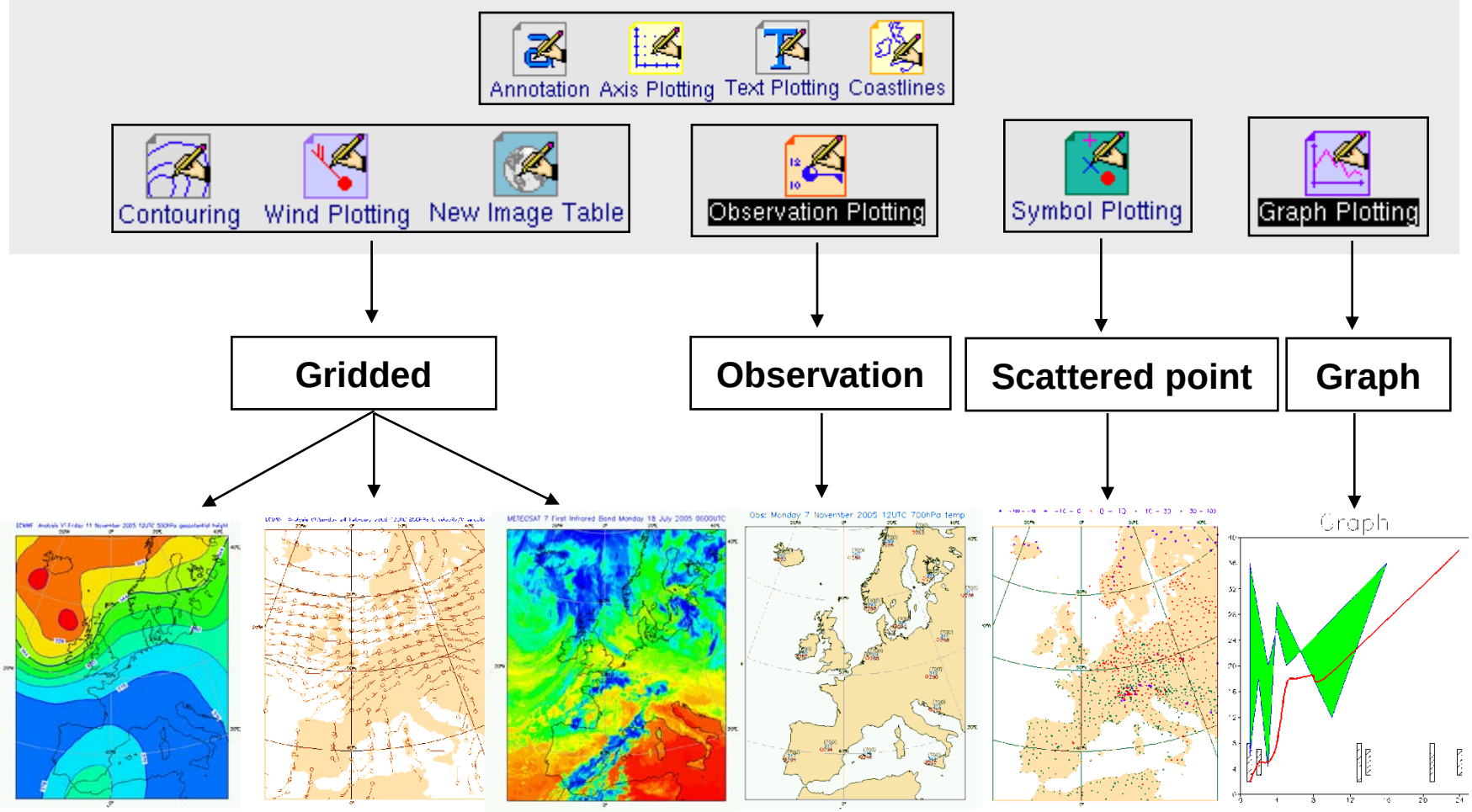
Part 3 – Additional Notes (2)

- **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!**

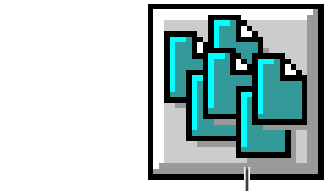
Metview Tutorial: Interactive Usage

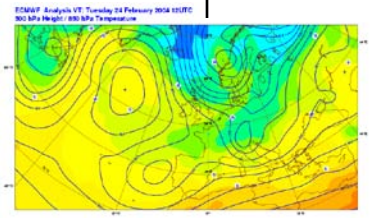
- Part 1: Introduction
- Part 2: Visualising your Data
- Part 3: Data
- **Part 4: Visual Definitions, Views and Layouts**
- Part 5: Visualisers, Drops, Overlay and Icons
- Part 6: Data Overlay, Metview Applications and Tools

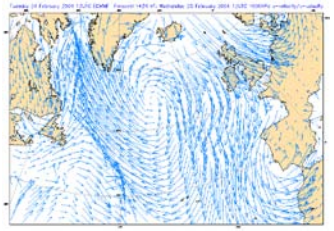
Visual Definition (*visdef*)

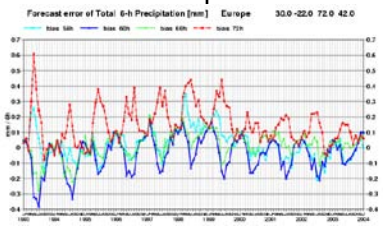


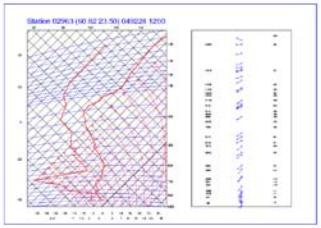
The VIEW concept

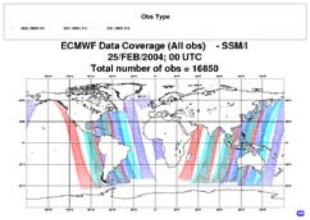


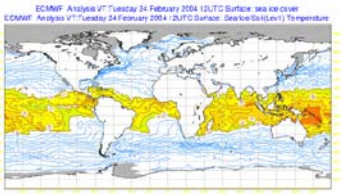


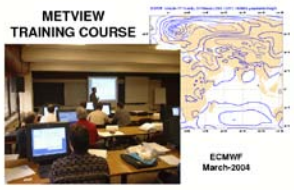


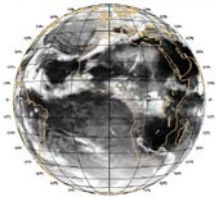


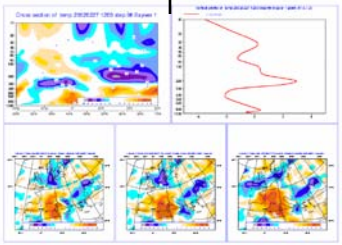


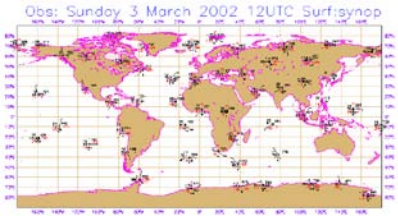




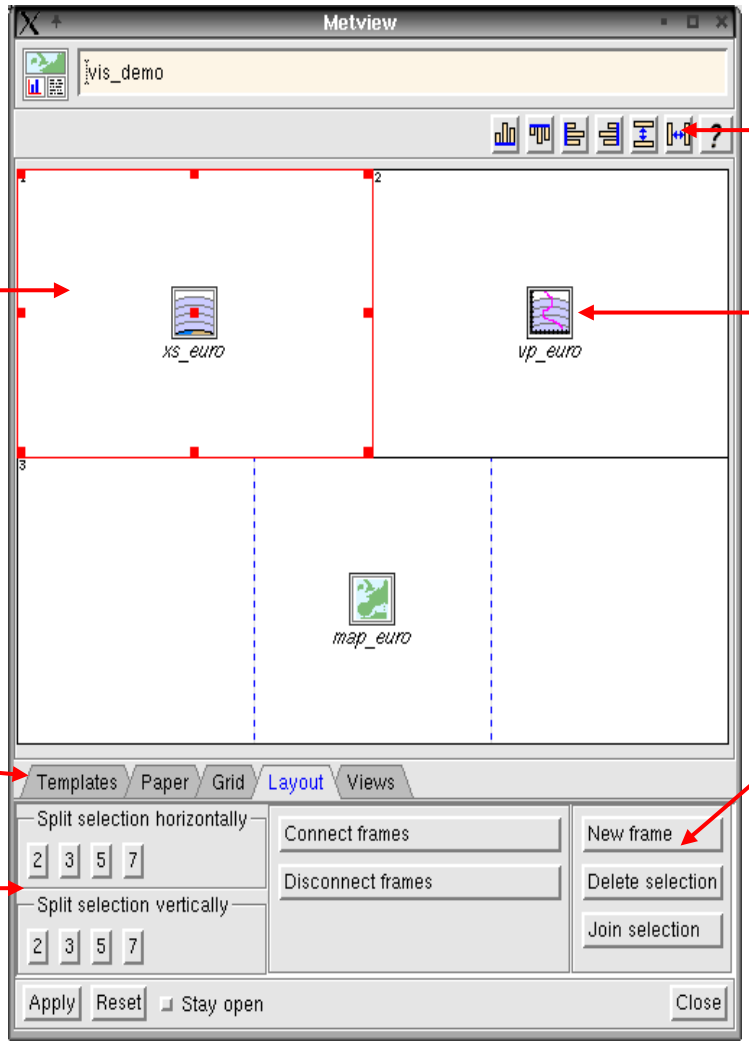








Display Window icon – layout editor



Align Buttons

Selected Frame

View Icon

New / Delete / Join Frames

Tabs

Subdivide selected Frame(s)

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

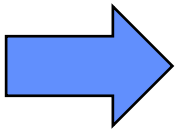
- **Icon drop is easy but can be ambiguous because…**
  - **Should I drop *data* and *visdef* together, or in sequence?**
  - **How do I apply multiple *visdef* icons?**
    - **…jointly drop them, or in sequence?**
  - ***How do I contour overlaid fields?***
- **Luckily Metview has some intelligence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

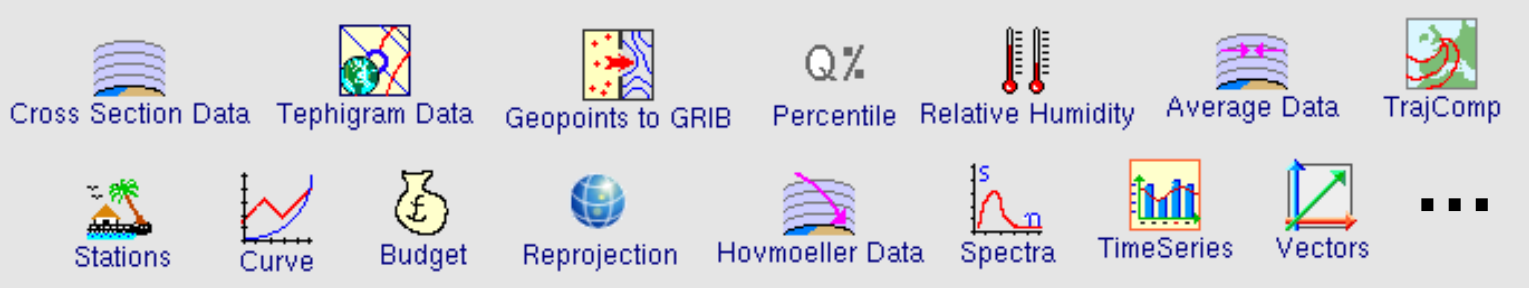
- **Please do Part 5 of the Tutorial**

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:**

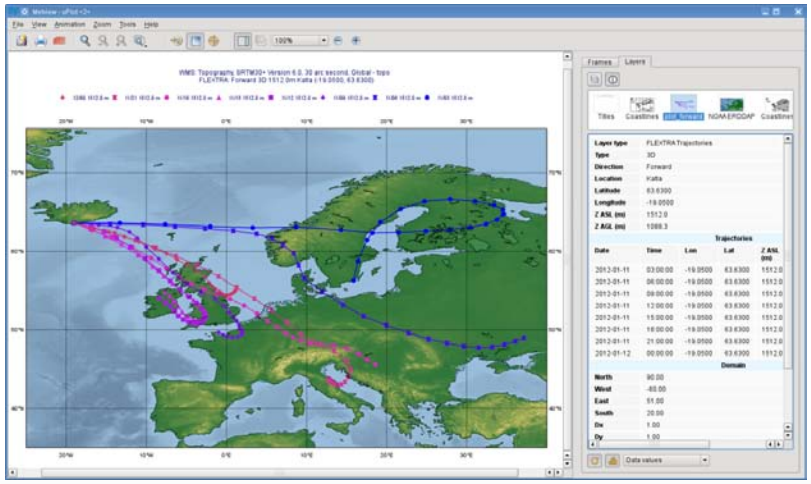


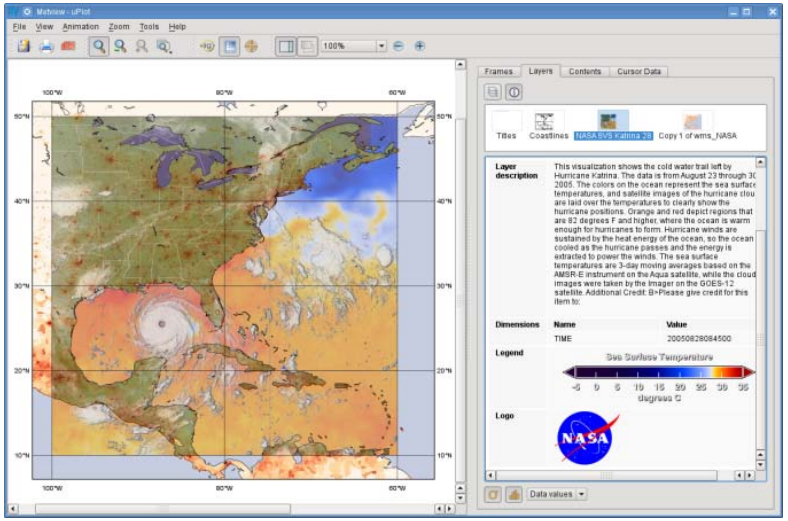
- **Create intermediate data ➔ input to another application**

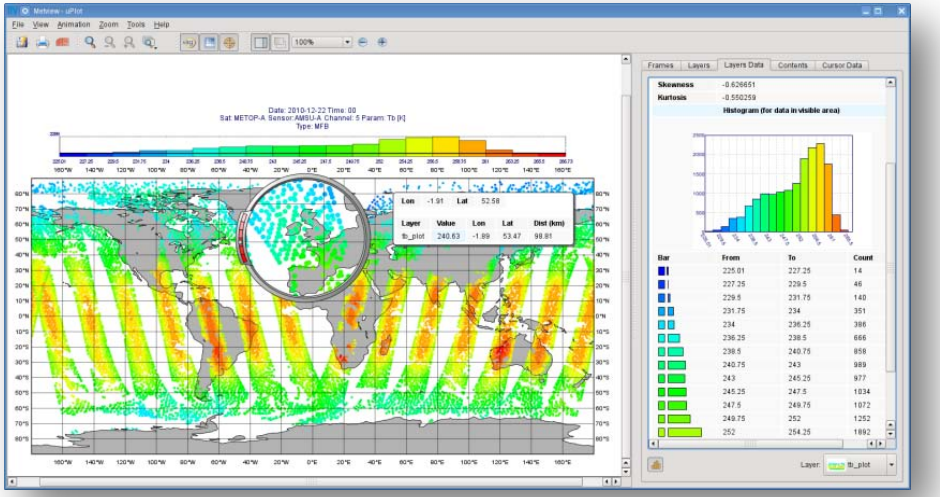
- **No application for your needs?**
  - **Write a Metview Macro**

Metview Applications: Tutorials

- **Tutorials available for:**
  - **WMS**
  - **ODB**
  - **FLEXTRA**







http:://www.ecmwf.int/publications/manuals/metview/documentation.html

Metview Tools

- **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**