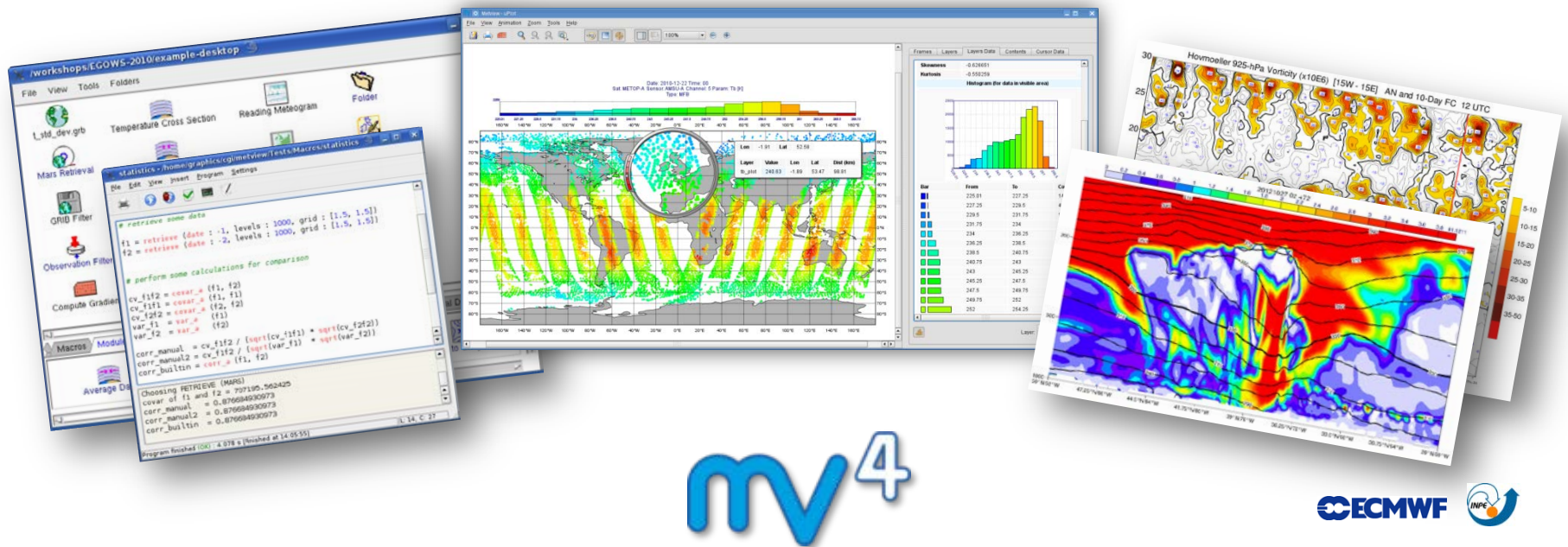


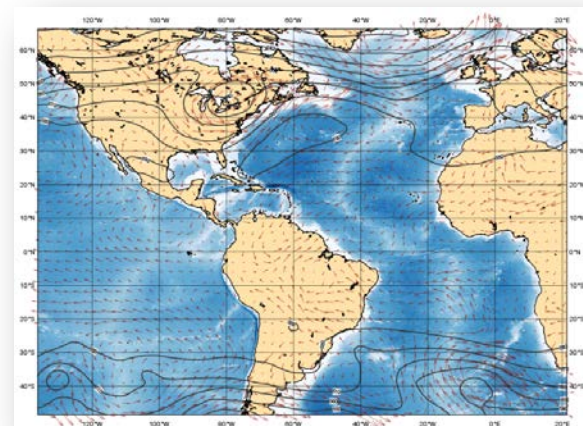
Metview 4: Providing enhanced interaction with meteorological models



Fernando li, Iain Russell, Sándor Kertész
Development Section - ECMWF

What is Metview?

- Working environment for operational and research meteorologists
- Retrieve/manipulate/visualise meteorological data
- Allows analysts and researchers to easily build products interactively and run them in batch mode



Built on core ECMWF technologies:

MARS, GRIB_API, Magics, ODB, Emoslib

- Since August 2012 Open Source under Apache Licence 2.0
 - *Increased interest from research community*
- Metview is a co-operation project with INPE (Brazil)



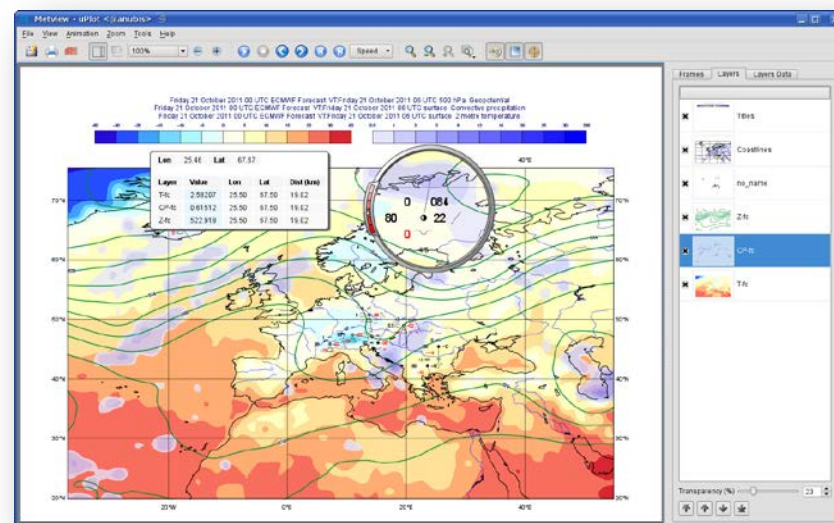
What is Metview?

- **Service Oriented Architecture**

- **Data:**

- Access
- Examine
- Manipulate
- Plot
- Overlay

GRIB
BUFR
NetCDF
ODB
Geopoints
ASCII



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

- **Can be easily installed and runs self-contained standalone**

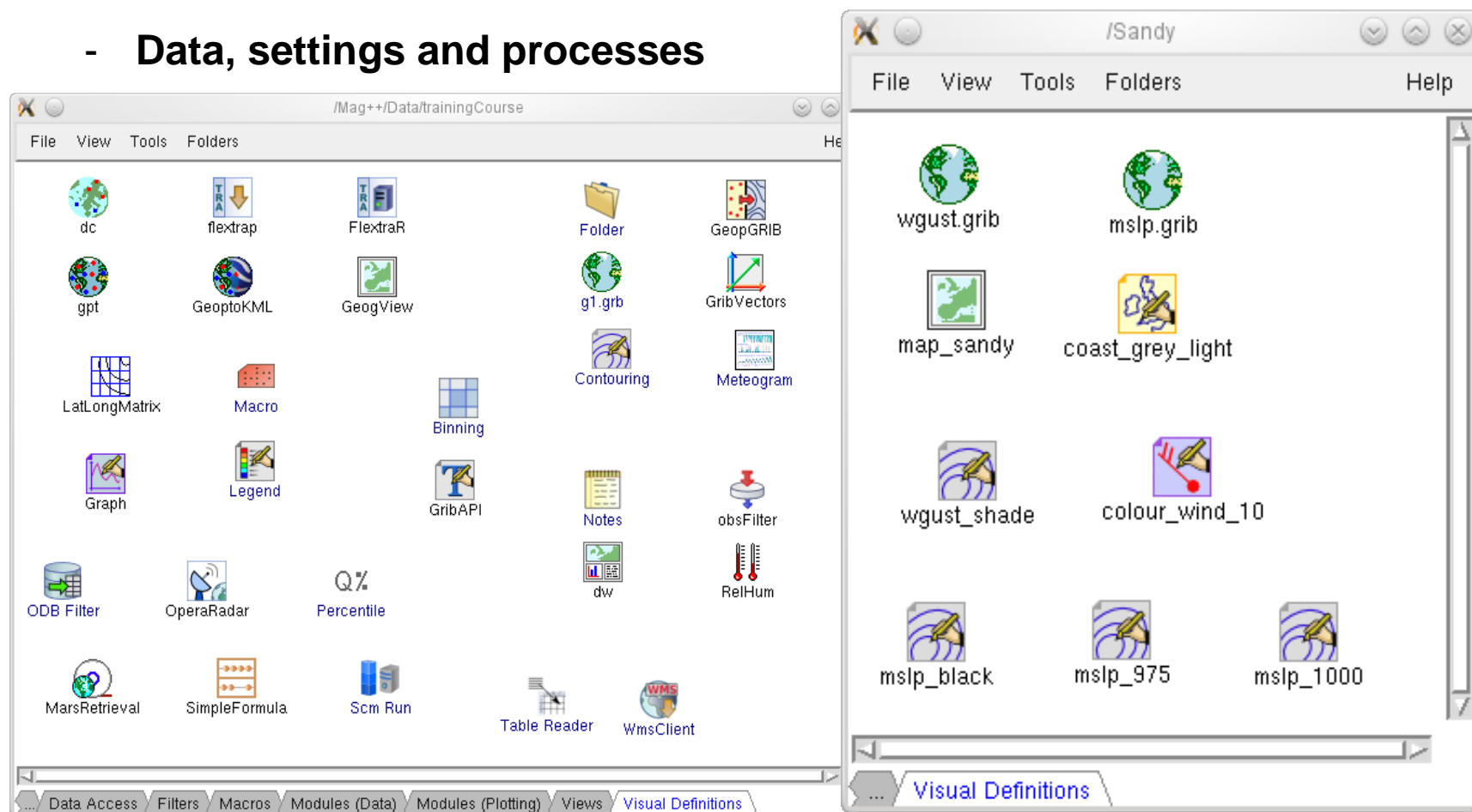
- From laptops to supercomputers
- No special data servers required

Metview's main features

Icon-based interface

- **Everything is represented by an icon**

- **Data, settings and processes**



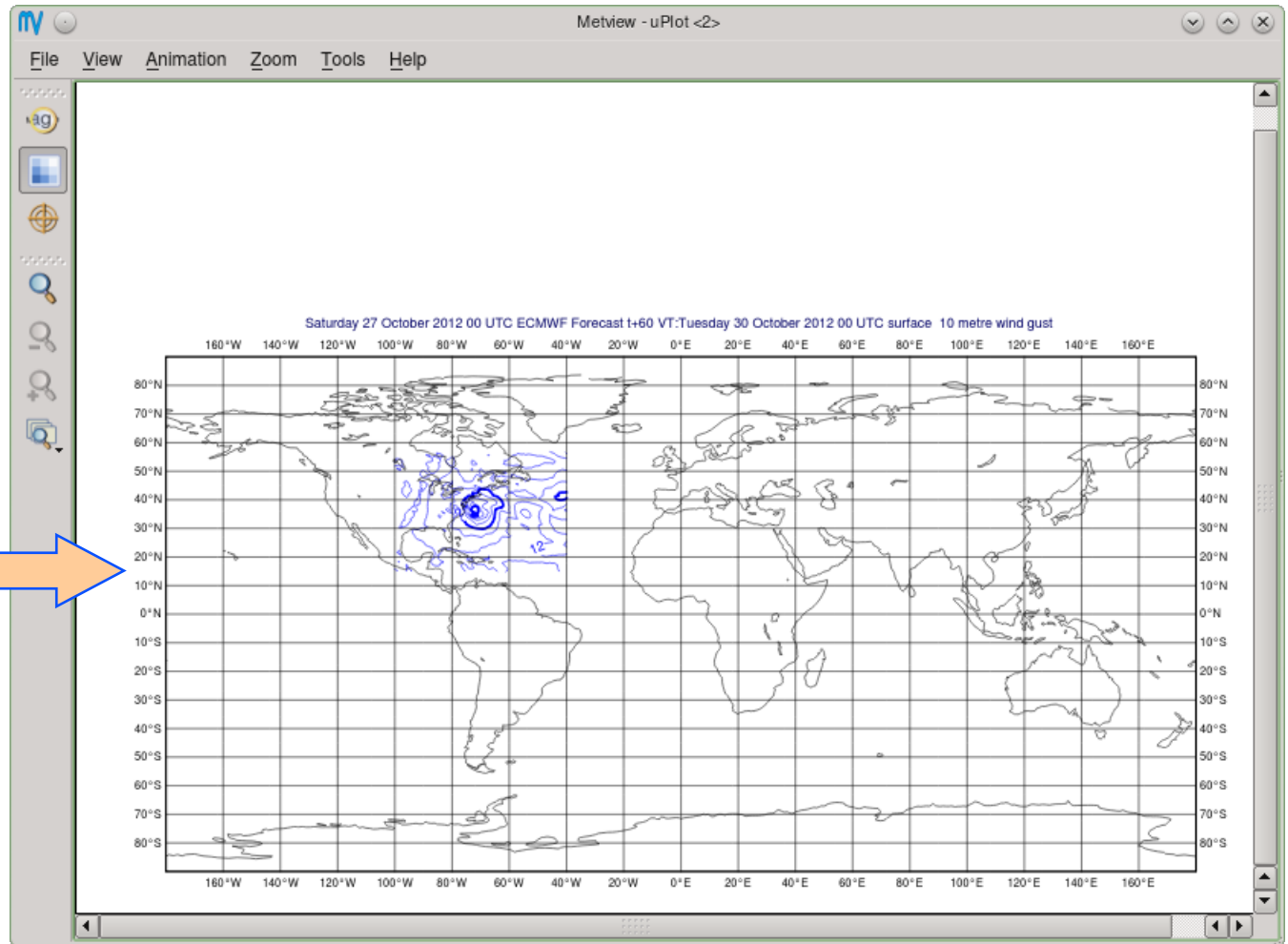
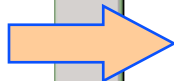
Visualisation

GRIB file



wgust.grib

- execute
- visualise
- examine
- save
- analyse
- edit
- duplicate
- delete
- empty
- output

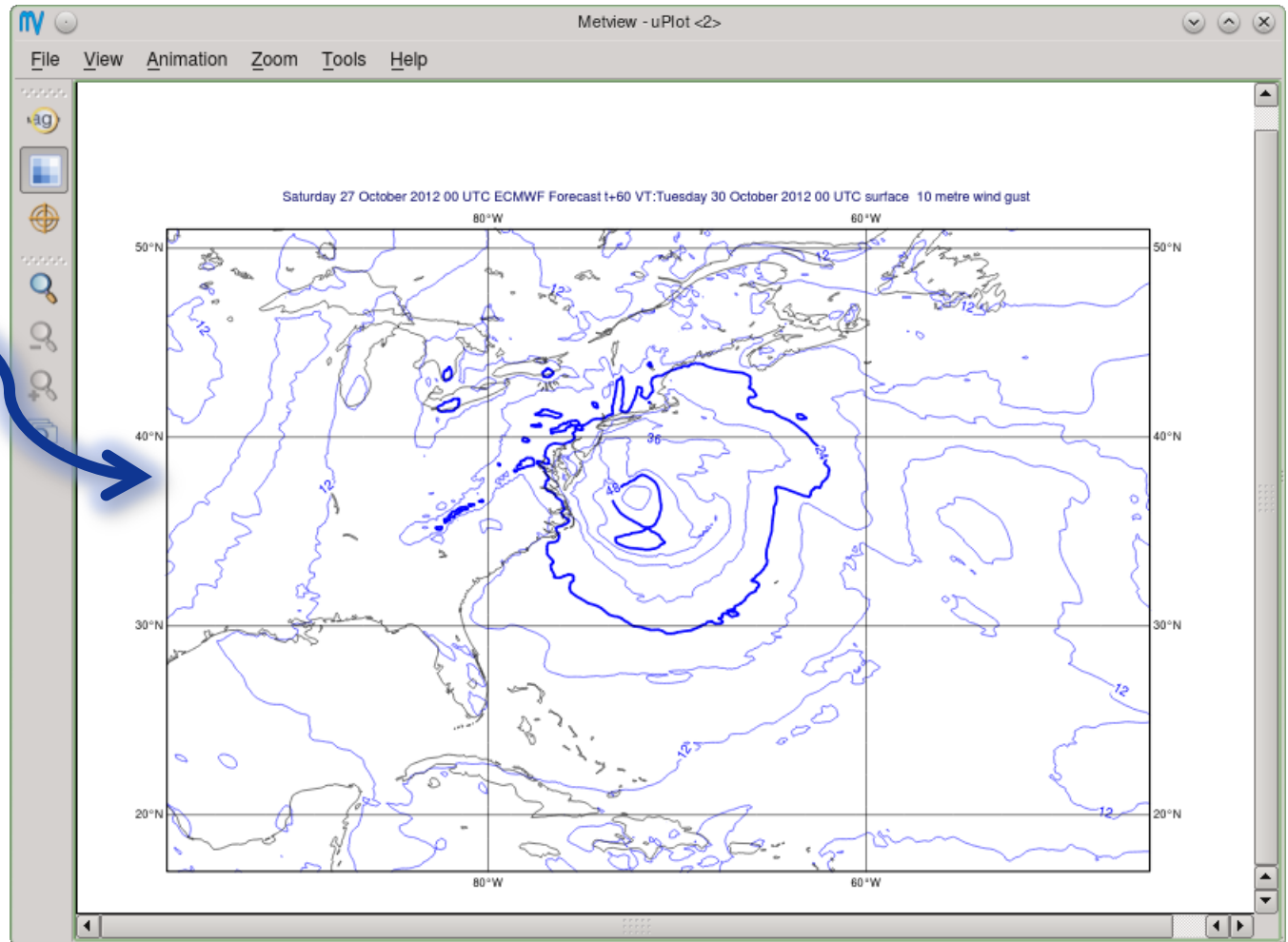


Drag and Drop

Map view



map_sandy

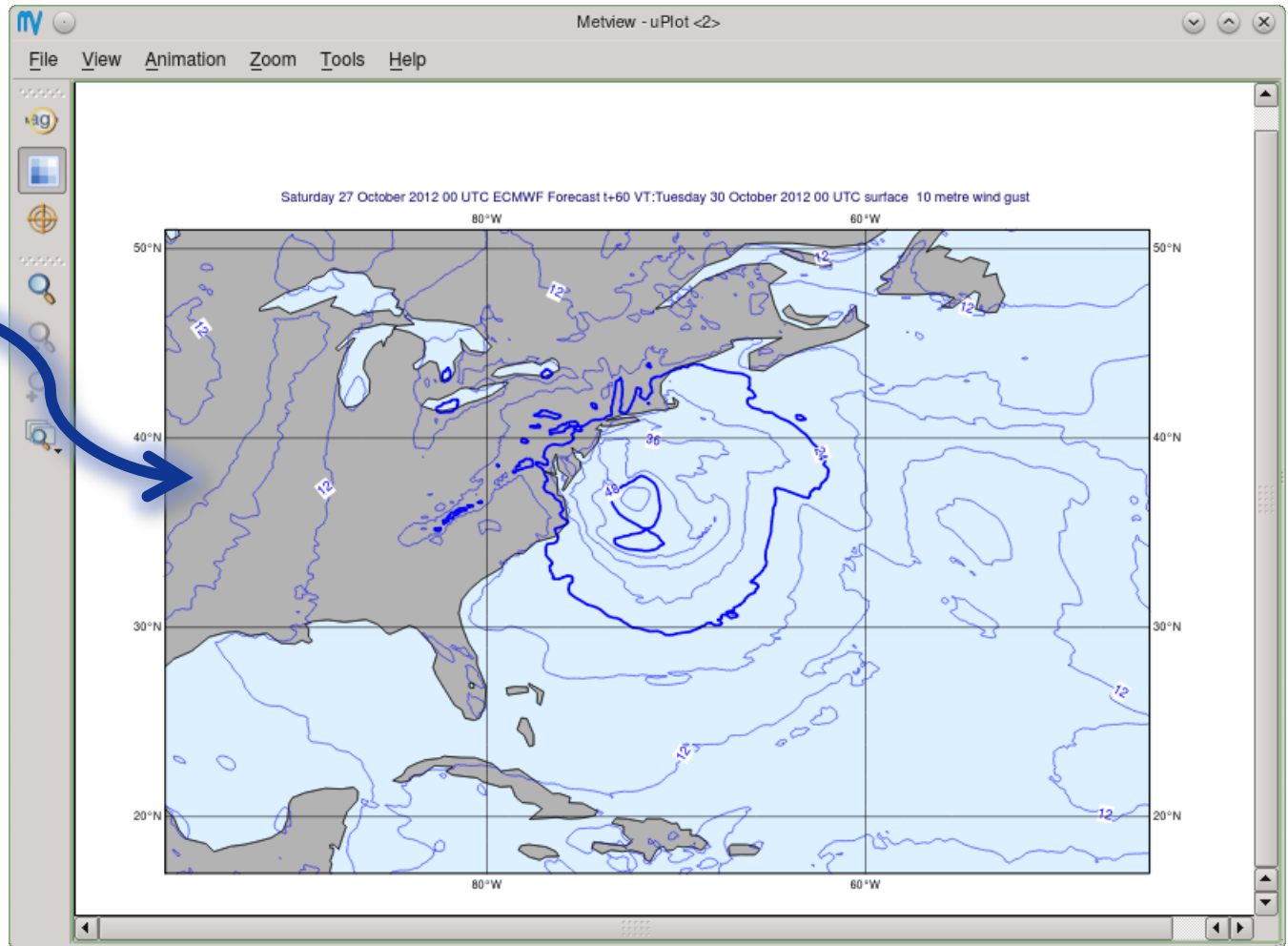


Drag and Drop

Coastlines



coast_grey_light

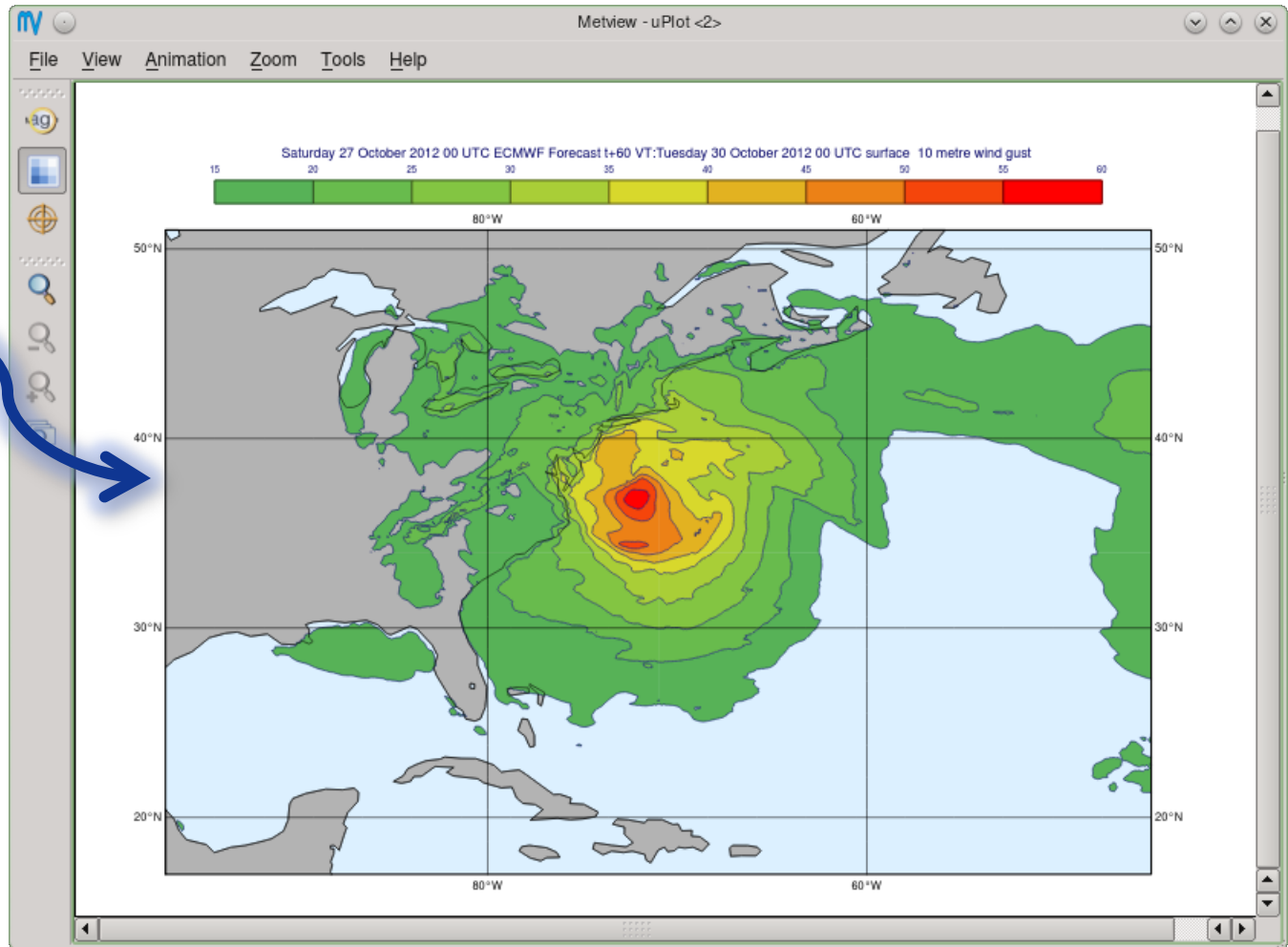


Drag and Drop

Contour shading



wgust_shade



Drag and Drop - Overlay

Overlay works for all the data types!

MSLP (GRIB)



mstp.grib



mstp_black

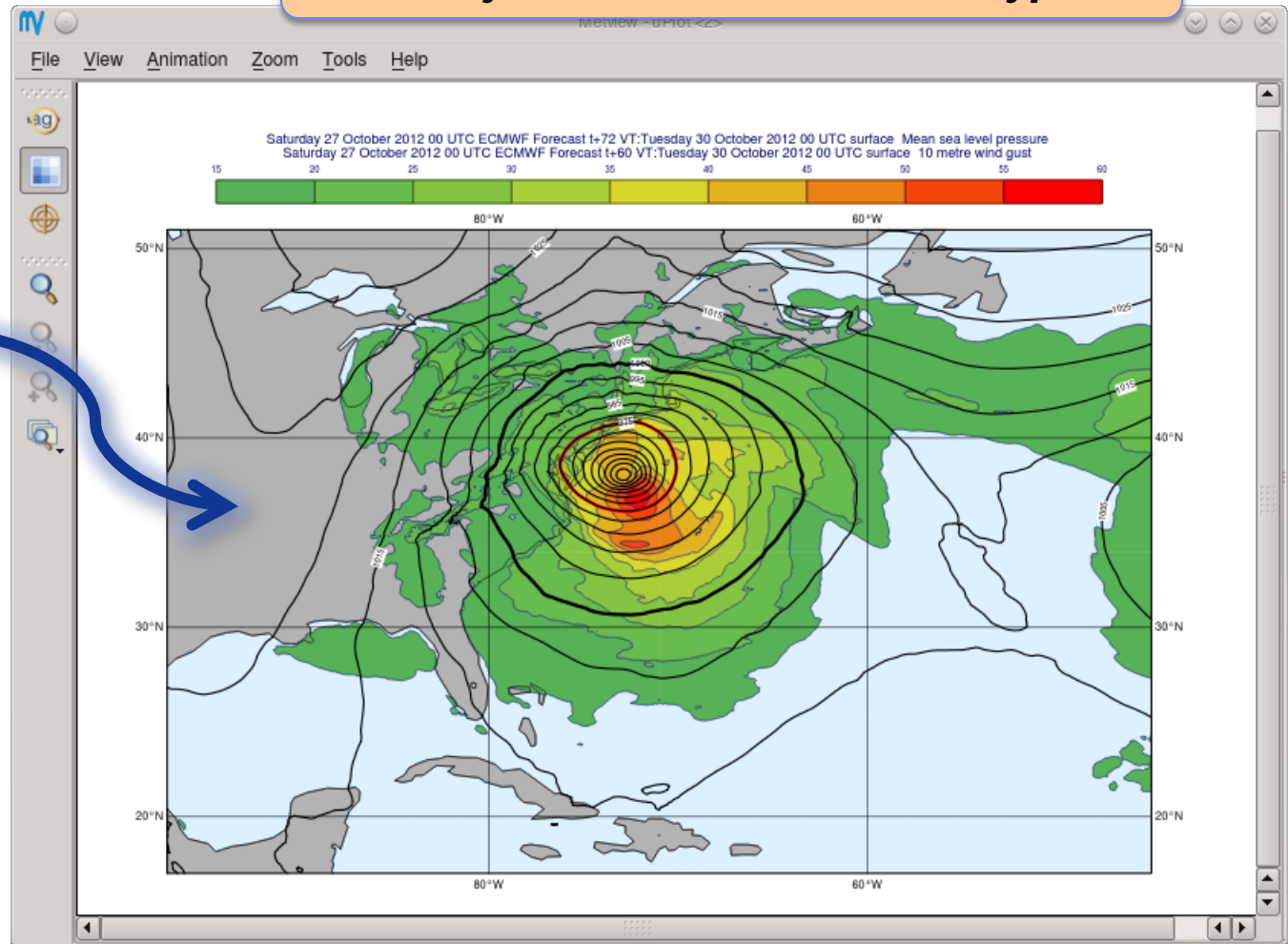


mstp_975

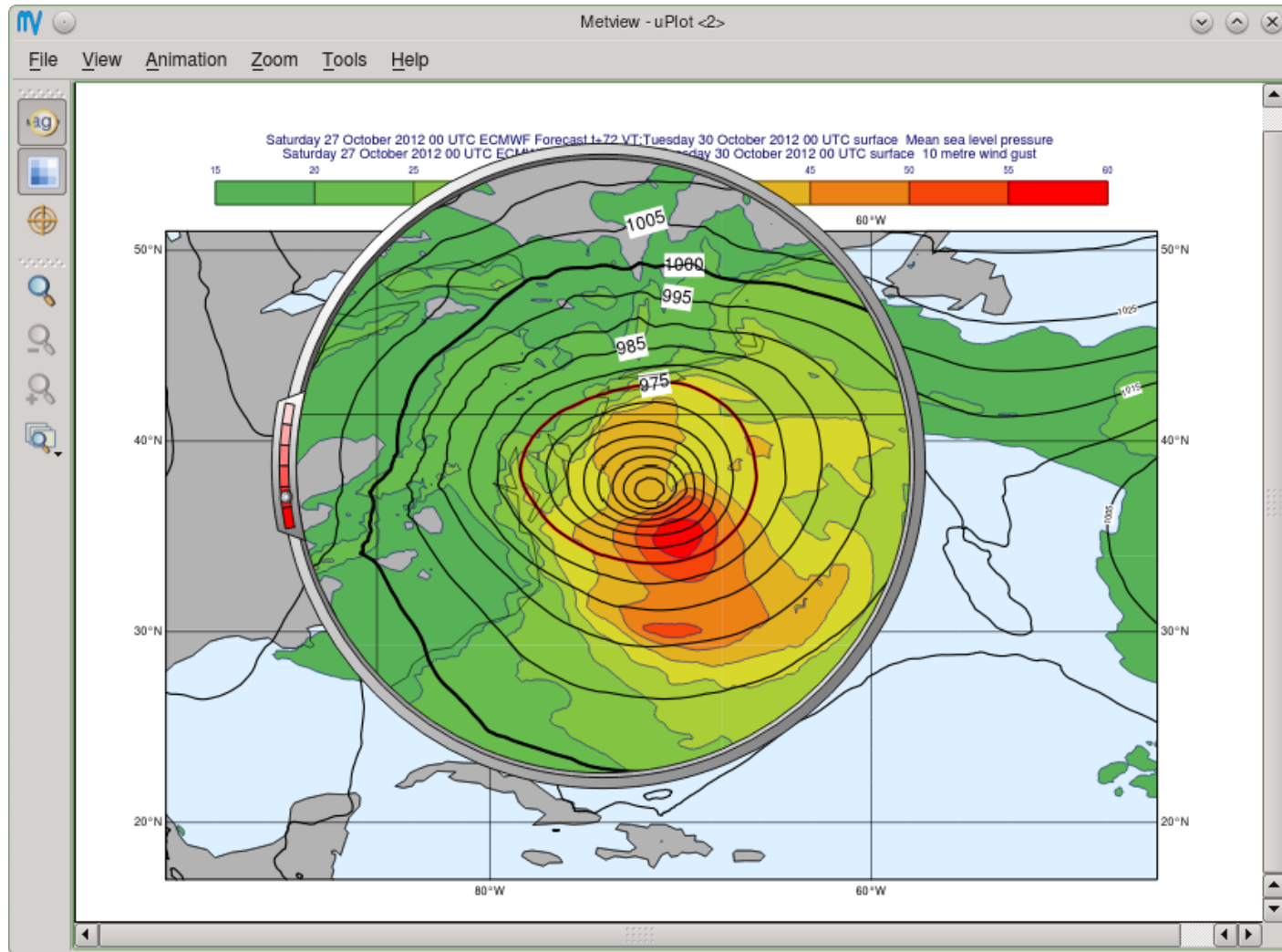


mstp_1000

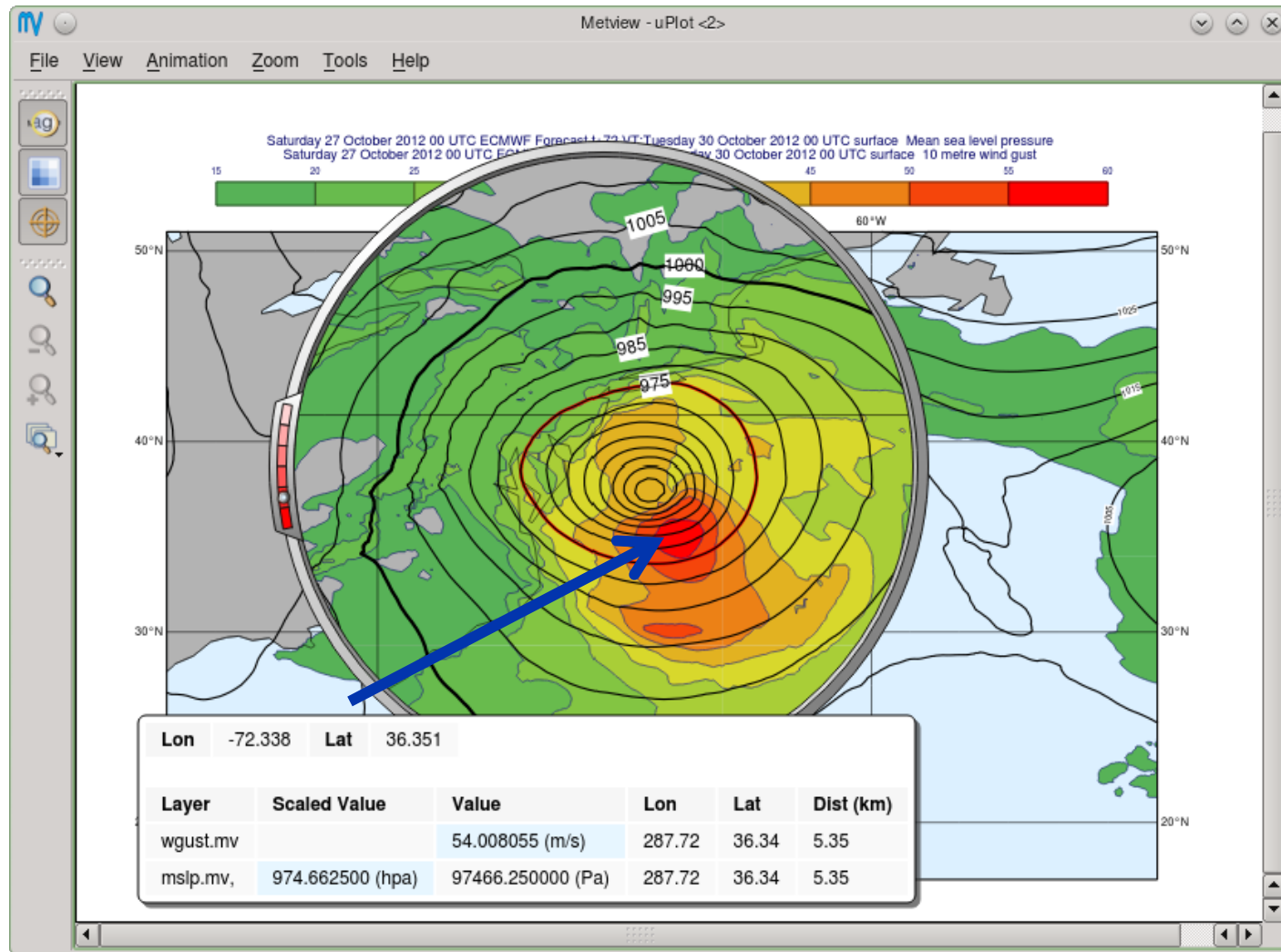
Contouring



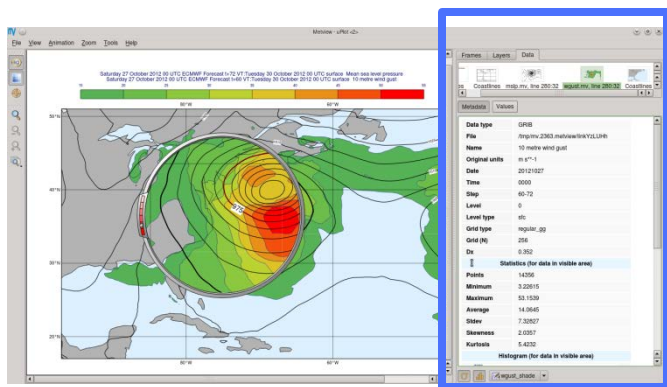
Display Window - Magnifier



Display Window - Cursor Data



Display Window - Layer Metadata



Sidebar with various tabs

Data type	GRIB
File	/tmp/mv.2363.metview/linkYzLUHh
Name	10 metre wind gust
Original units	m s** -1
Date	20121027
Time	0000
Step	60-72
Level	0
Level type	sfc
Grid type	regular_gg
Grid (N)	256
Dx	0.352

Statistics (for data in visible area)	
Points	14356
Minimum	3.22615
Maximum	53.1539
Average	14.0645
Stdev	7.32827
Skewness	2.0357
Kurtosis	5.4232

Histogram (for data in visible area)

Bar	From	To	Count
█	15	20	2638
█	20	25	739
█	25	30	355
█	30	35	240
█	35	40	245
█	40	45	123
█	45	50	62
█	50	55	34

Macro language

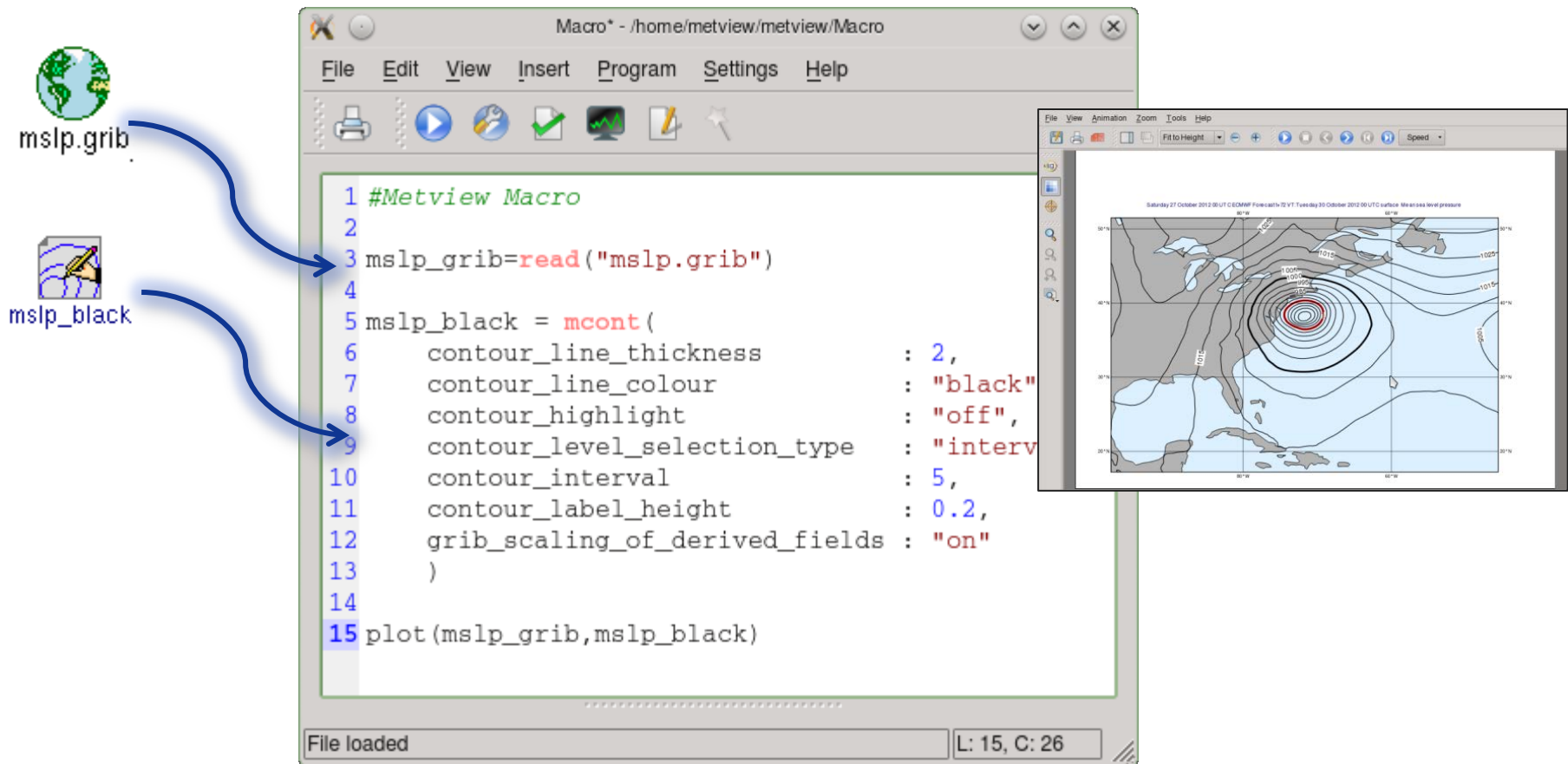
- Powerful high-level meteorologically oriented script language
- All Metview tasks can be written or saved as macros, and run in batch or interactive modes
- Interfaces with Fortran/C/C++ code
- Outputs:
 - derived data
 - interactive plotting window
 - graphics formats (e.g. PS, PNG, SVG, KML, PDF)

```
# Read a grib file  
temp = read ( "/home/graphics/temp.grb" )  
  
# Re-scaling field  
if threshold > 0 then  
    temp = temp - 100  
    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 )
```


Metview Macro drag and drop

Strong synergy between Icons & Macros

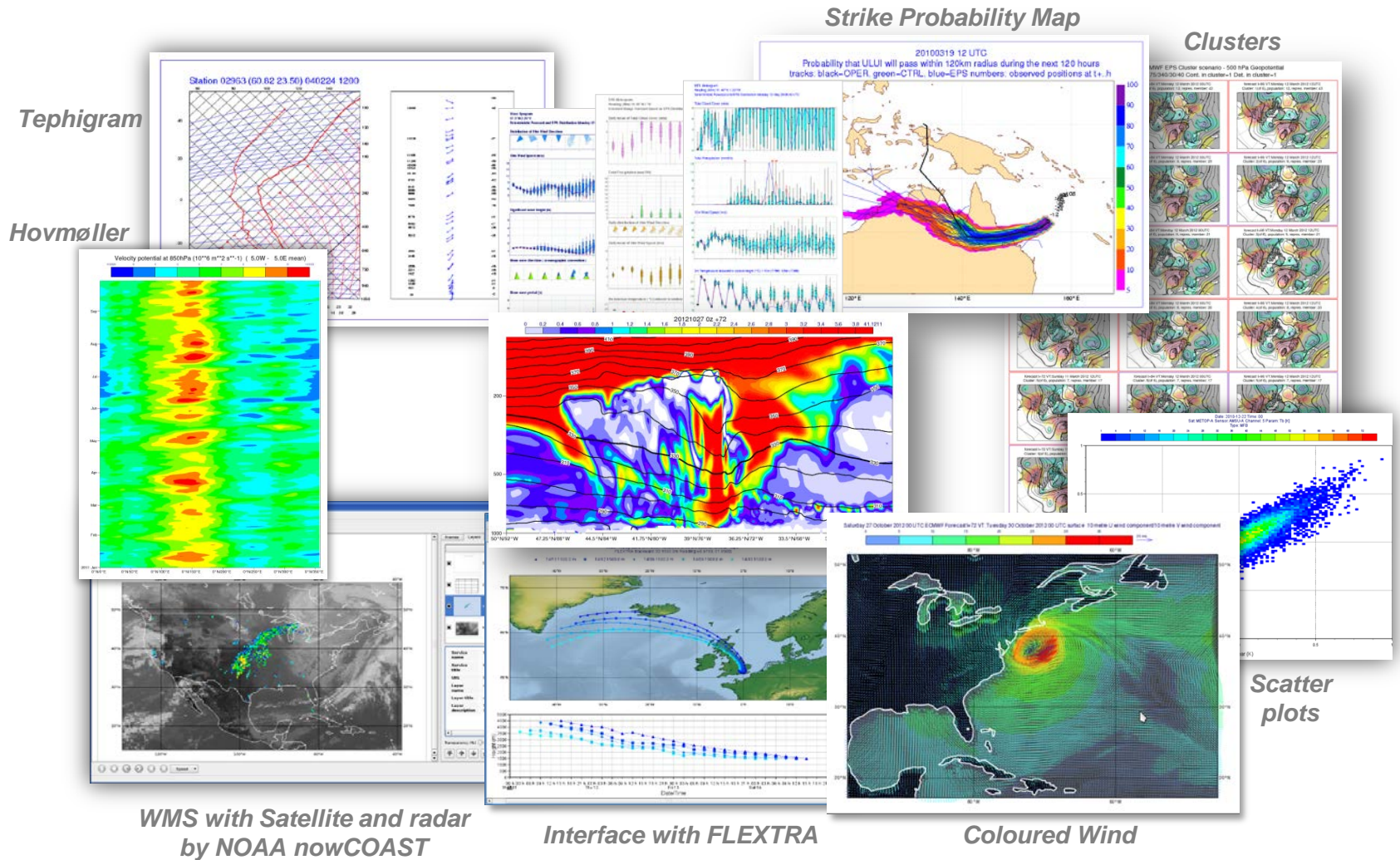
- Every icon can be translated into a Macro command



```
Macro* - /home/metview/metview/Macro
File Edit View Insert Program Settings Help
[Icons]
1 #Metview Macro
2
3 msslp_grib=read("msslp.grib")
4
5 msslp_black = mcont(
6     contour_line_thickness      : 2,
7     contour_line_colour        : "black"
8     contour_highlight           : "off",
9     contour_level_selection_type : "interval"
10    contour_interval            : 5,
11    contour_label_height        : 0.2,
12    grib_scaling_of_derived_fields : "on"
13 )
14
15 plot(msslp_grib,msslp_black)
File loaded [L: 15, C: 26]
```

The diagram illustrates the process of translating icons into macro commands. On the left, two icons are shown: a globe icon labeled 'msslp.grib' and a pencil icon labeled 'msslp_black'. Blue arrows point from these icons to the corresponding lines in a macro editor window. The macro editor window shows a script with 15 lines of code. Line 3 reads 'msslp_grib=read("msslp.grib")', and line 5 starts a function call 'msslp_black = mcont(' with various parameters. Line 15 is 'plot(msslp_grib,msslp_black)'. To the right, a separate window displays a meteorological plot of sea level pressure contours over a region, showing a low-pressure system with concentric contours.

Large variety of meteorological charts



Metview's interface with meteorological models

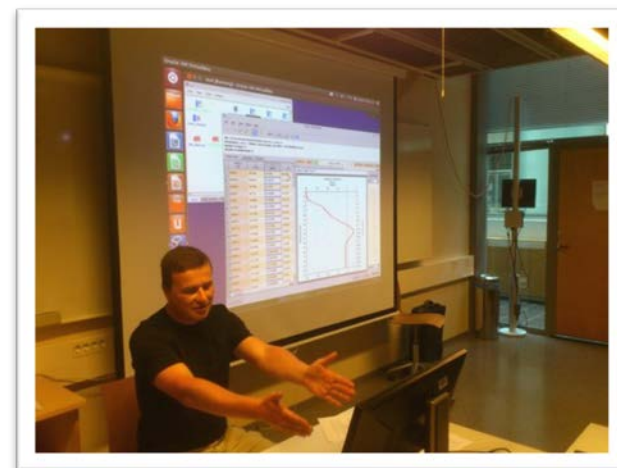
OpenIFS with Metview



- **Portable, easy-to-use version of the ECMWF IFS model**

- Reduced version of IFS
- Based on previous operational model
- Started Dec 2011
- In development phase

- **For training and academic research**



→ **Metview: ideal application for analysing and displaying OpenIFS output GRIB files**

- **Metview was used in OpenIFS training course in Helsinki (June 2013)**

OpenIFS support in Metview

- All the Metview functionality works with the OpenIFS output
- Examples icons are available from:

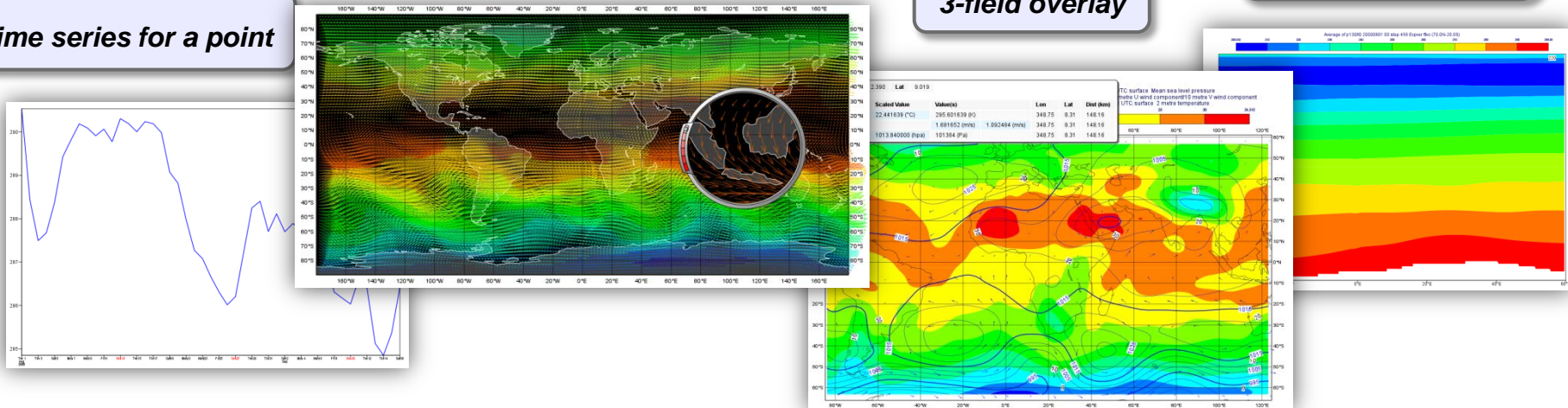
<https://software.ecmwf.int/wiki/display/OIFS/Using+MetView+with+OpenIFS>

*Wind vectors coloured
by another field*

*Shaded lat/lon-level
cross section*

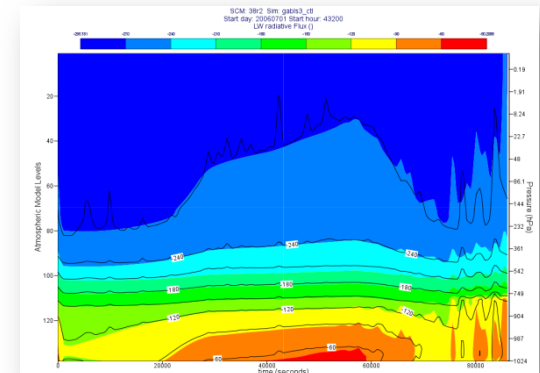
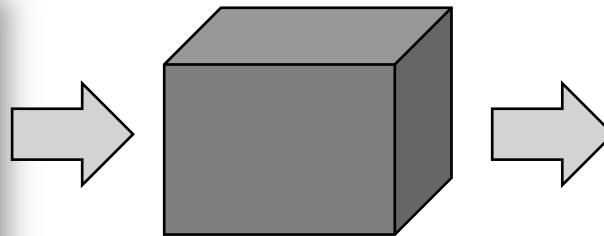
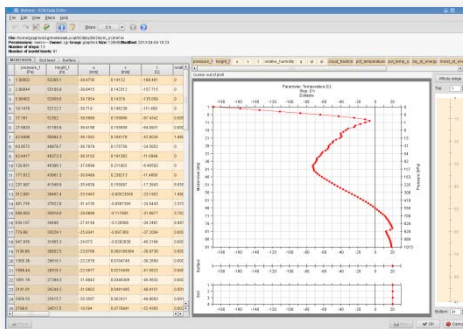
Time series for a point

3-field overlay



Interfacing external models

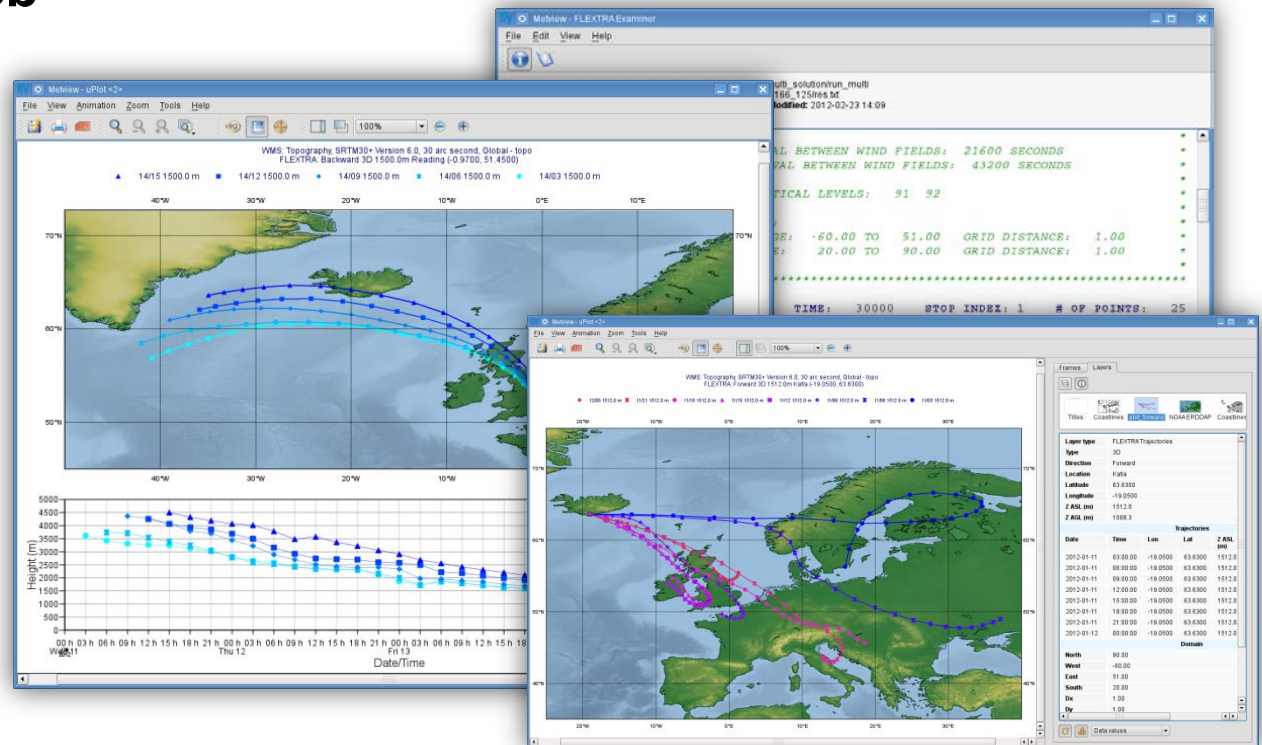
- Researchers use various smaller, more specific models for their research
- These models are seen by Metview as a 'black box'
 - Metview prepares the input
 - Metview runs (external) model executable
 - Metview handles (visualises) the output



- This concept works easily with Metview's service-oriented architecture (SOA)

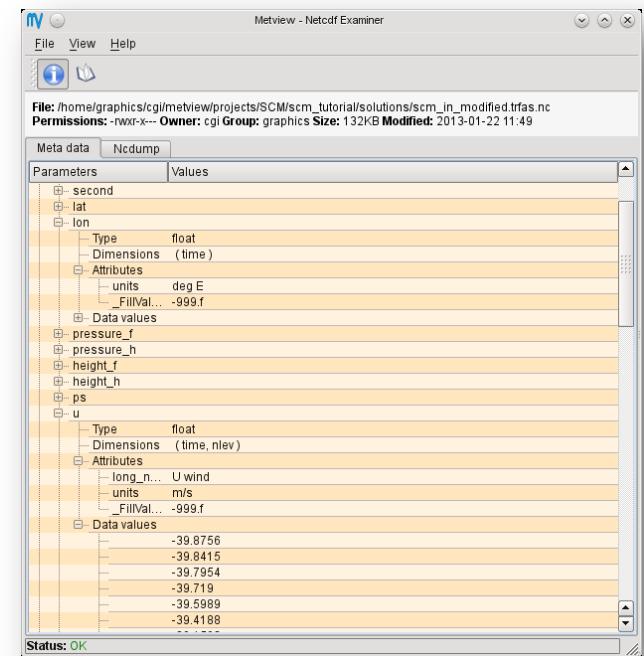
Metview - Trajectories

- Metview has been interfaced with FLEXTRA via modules which:
 - prepare the data, run the calculation by *FLEXTRA* and display the results
- Detailed description can be found in Newsletter article and tutorial on the web
- We are currently integrating the dispersion model *FLEXPART* in similar fashion



IFS Single Column Model (SCM)

- **Simplistic approach: simulate IFS for a single grid point**
 - **Useful tool to study the physics in more detail**
 - **Allows to study subset of processes or single process only**
 - **Very useful for comparing different models or different versions of the same model**
 - **Computationally cheap**
- **Ideal for interactive research work with Metview**
- **Metview was used in the “Parameterisation of diabatic and subgrid processes” training course at ECMWF (April 2013)**



SCM-Metview : Modifying an input data file

- Custom editor for SCM input netCDF files

The screenshot displays the Metview - SCM Data Editor interface. On the left, a sidebar shows the file 'scm_in.trf.nc' under 'Data Access'. The main window features a menu bar (File, Edit, View, Steps, Help) and a toolbar. Below the menu, a file information section shows the path, permissions, owner, size, and modification date. A table of model levels is displayed, with columns for pressure, height, and various meteorological parameters. A blue callout box labeled 'Vertical level 'zoom'' points to a plot on the right. The plot shows 'Parameter: Temperature [C]' versus 'Model level (eta)' and 'Pressure (hPa)'. The plot is zoomed in on the vertical axis, showing a red curve representing temperature profiles. A blue callout box labeled 'Editable table and curve' points to the table. The interface includes a 'Save' button and a 'Cursor out of plot' warning.

Model levels	pressure_f [Pa]	height_f [m]	u [m/s]	v [m/s]	t [C]	relati
1	1.00002	53206.1	-39.8756	0.14122	-188.481	0
2	2.99044	53100.9	-39.8415	0.142312	-157.715	0
3	5.68402	52958.6	-39.7954	0.14379	-135.069	0
4	10.1478	52722.7	-39.719	0.146238	-111.406	0
5	17.161	52352	-39.5989	0.150086	-87.4342	0.005
6	27.6833	51795.9	-39.4188	0.155858	-64.0931	0.000
7	42.8498	50994.3	-39.1592	0.164178	-42.6026	1.860
8	63.9572	49878.7	-38.7979	0.175756	-24.5052	0
9	92.4417	48373.3	-38.3103	0.191382	-11.6999	0
10	129.851	46396.1	-37.6699	0.211903	-6.46503	0
11	177.812	43861.3	-36.8489	0.238213	-11.4666	0
12	237.997	41548.9	-35.4639	0.155997	-17.3943	8.056
13	312.091	39467.4	-33.5443	-0.00523556	-23.1952	1.680
14						
15						
16						
17	779.88	33024.1	-25.9341	-0.097369	-37.2004	0.000
18	947.056	31665.3	-24.673	-0.0282836	-40.2184	0.000
19	1136.88	30602.5	-23.8768	0.000189384	-39.9738	0.000
20	1350.38	29616.1	-23.2579	0.0104748	-39.2609	0.000
21	1588.44	28516.1	-22.5677	0.0219436	-41.0522	0.000
22	1851.79	27299.3	-21.8043	0.0346309	-45.5632	0.000
23	2141.01	26244.2	-21.0602	0.0481495	-48.9151	0.001
24	2456.53	25415.7	-20.3567	0.062421	-49.8003	0.001
25	2798.6	24517.5	-19.594	0.0778941	-52.4305	0.002

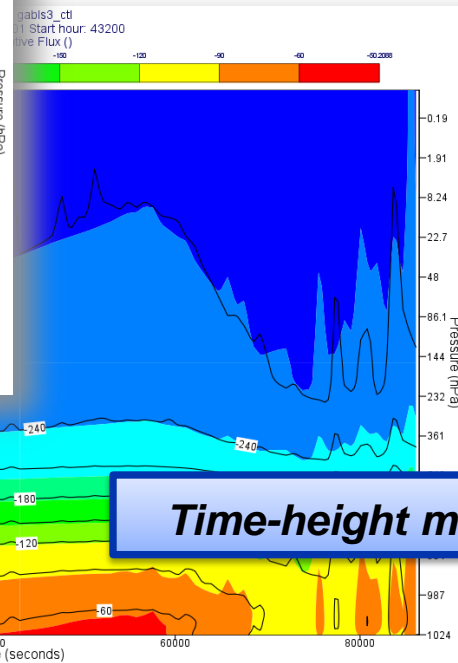
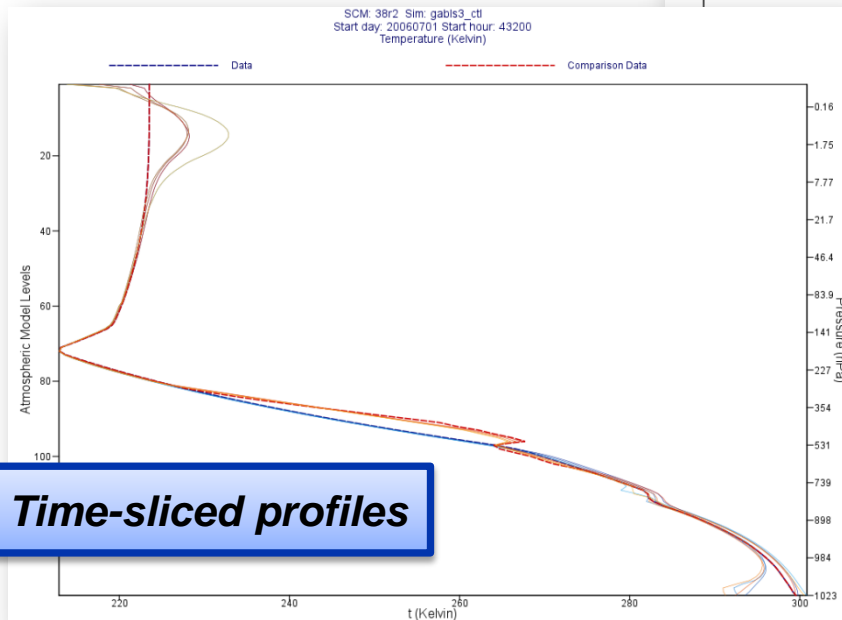
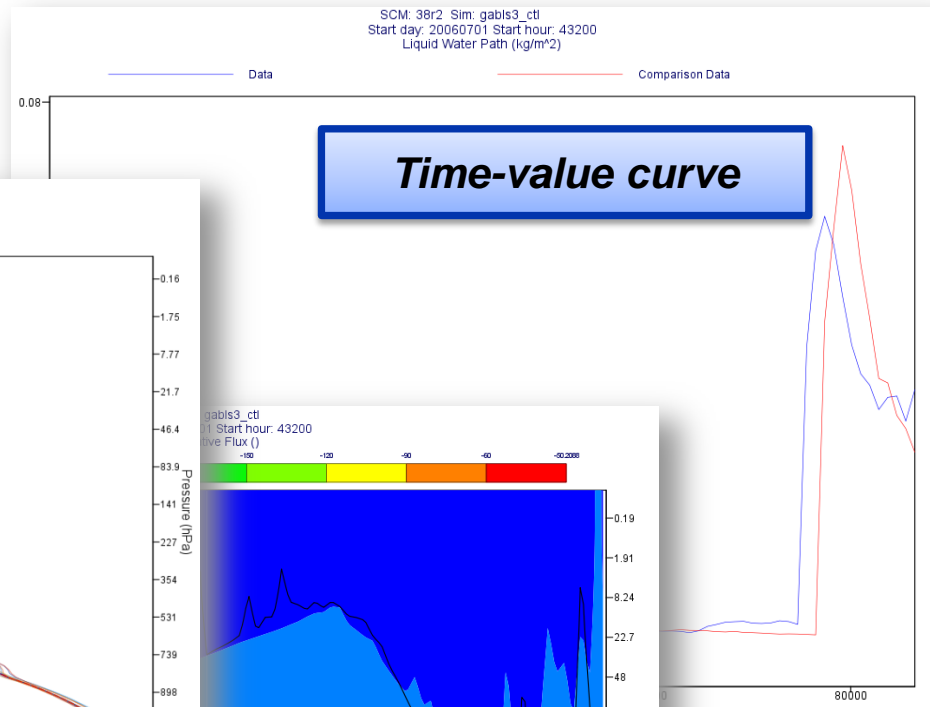
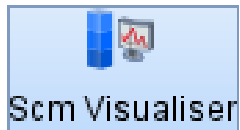
SCM-Metview : Running the model

- **SCM Run icon:**

- allows users to specify how to configure and run the model
- runs the model and caches the result



SCM-Metview : Visualising the result

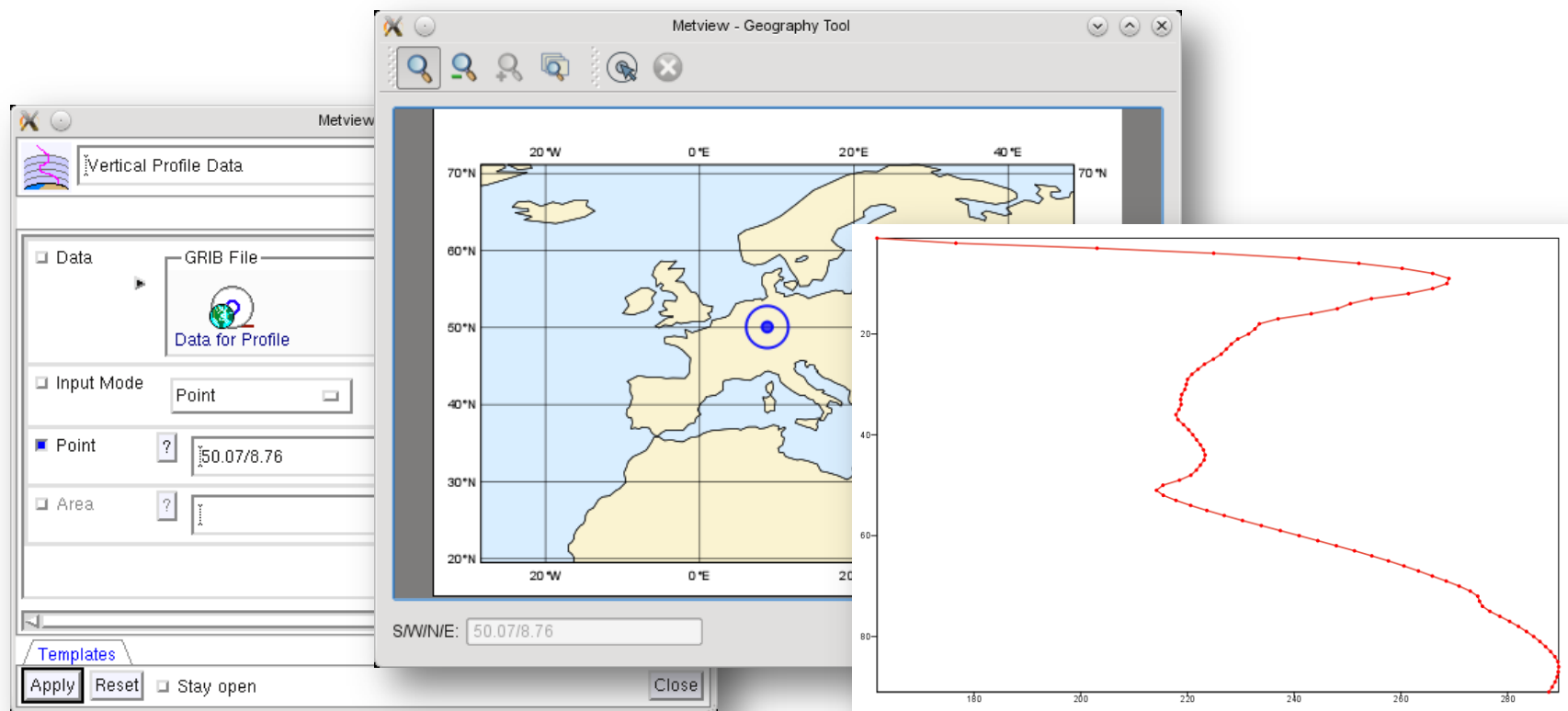


RTTOV Introduction

- **A fast radiative transfer model**
- **Models infra-red and microwave satellite radiometers**
- **Inputs:**
 - Atmospheric profile of temperature and gas concentrations
 - Surface / cloud / satellite properties
- **Outputs:**
 - Top of atmosphere radiances / brightness temperatures for each simulated sensor channel
 - Jacobian matrix – shows which atmospheric layers are most sensitive to changes in the input profile for each channel
- **Metview was used in “ECMWF/EUMETSAT NWP-SAF Satellite data assimilation” training course at ECMWF (July 2013)**

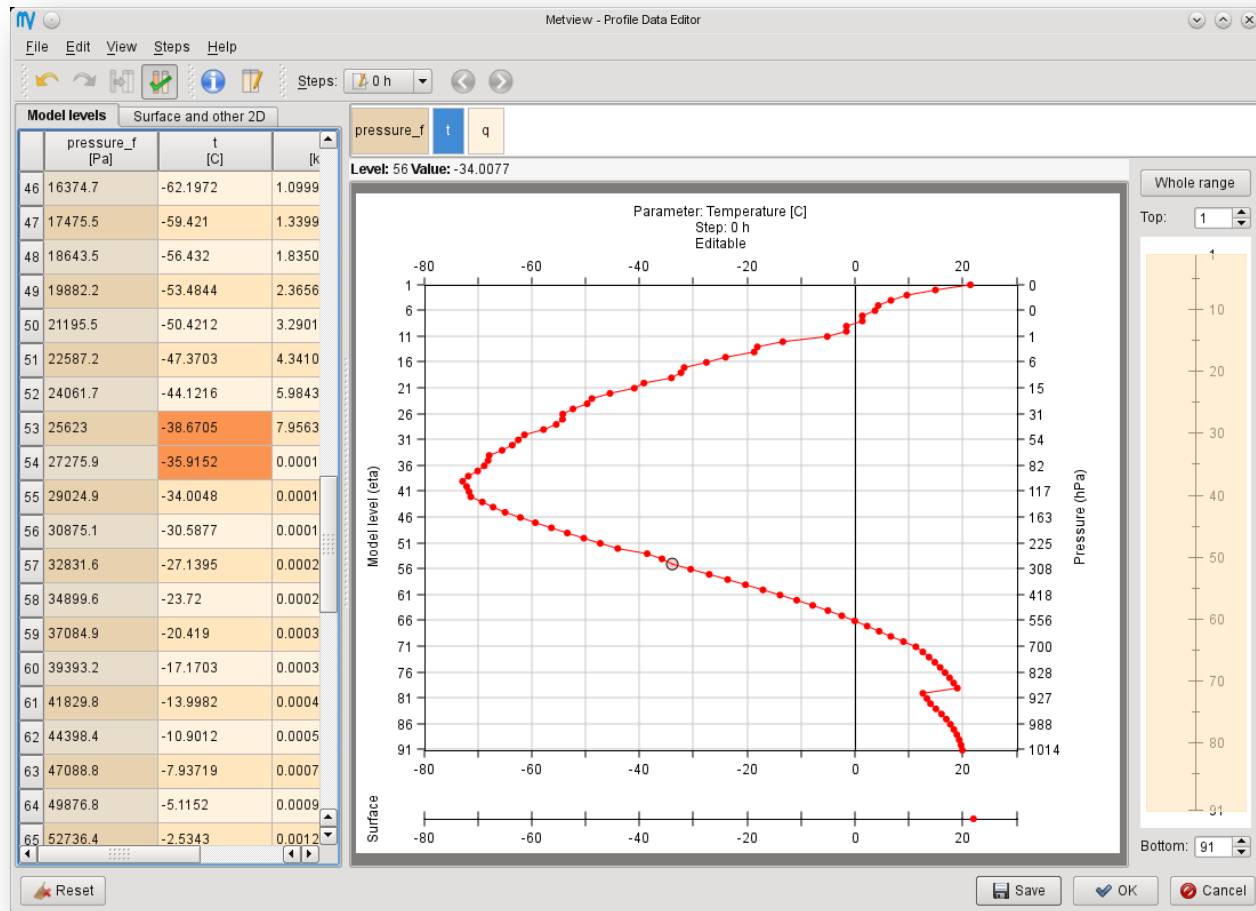
RTTOV-Metview : Input Data Generation

- Retrieve data from MARS and extract profiles (using existing modules)



RTTOV-Metview : Input Data Inspection

- The SCM editor can also be used for RTTOV data



RTTOV-Metview : Running the Model

● RTTOV Run icon:

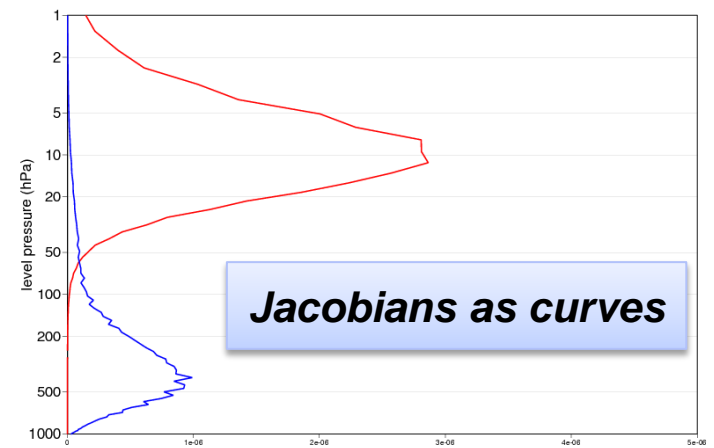
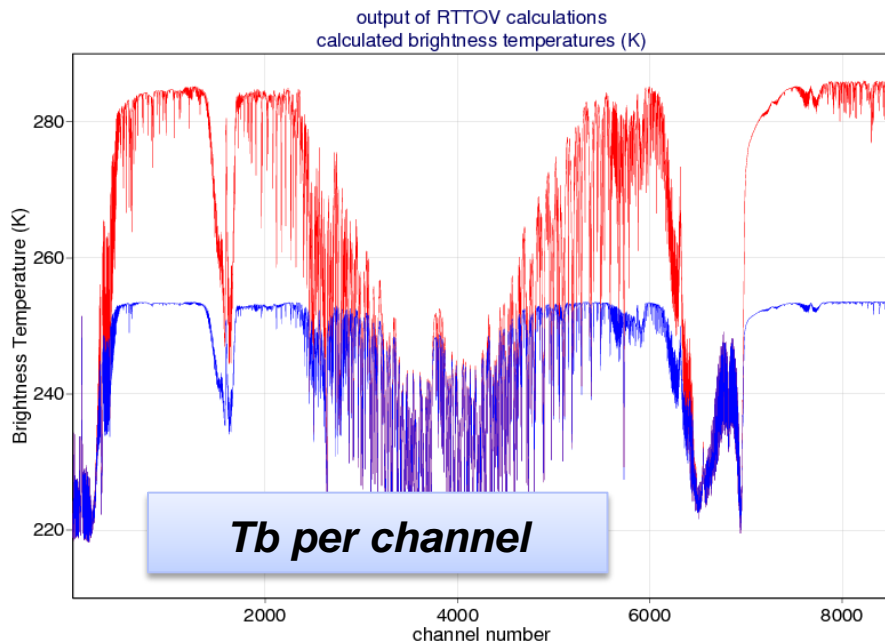
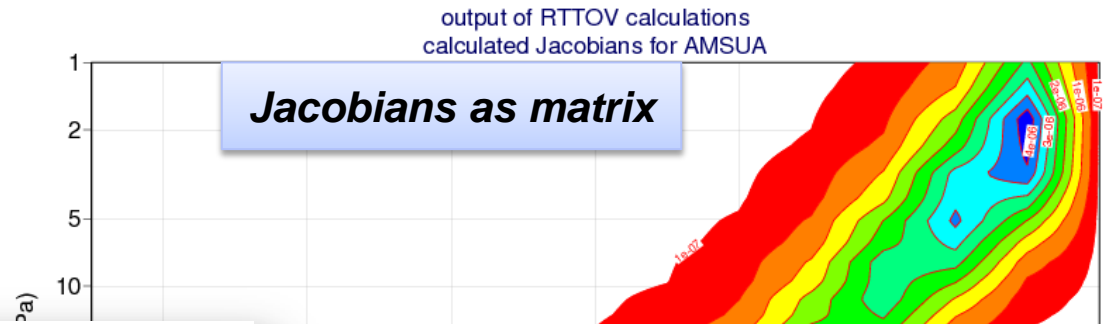
- allows users to specify how to configure and run the model
- runs the model and caches the result



RTTOV-Metview : Visualising the result

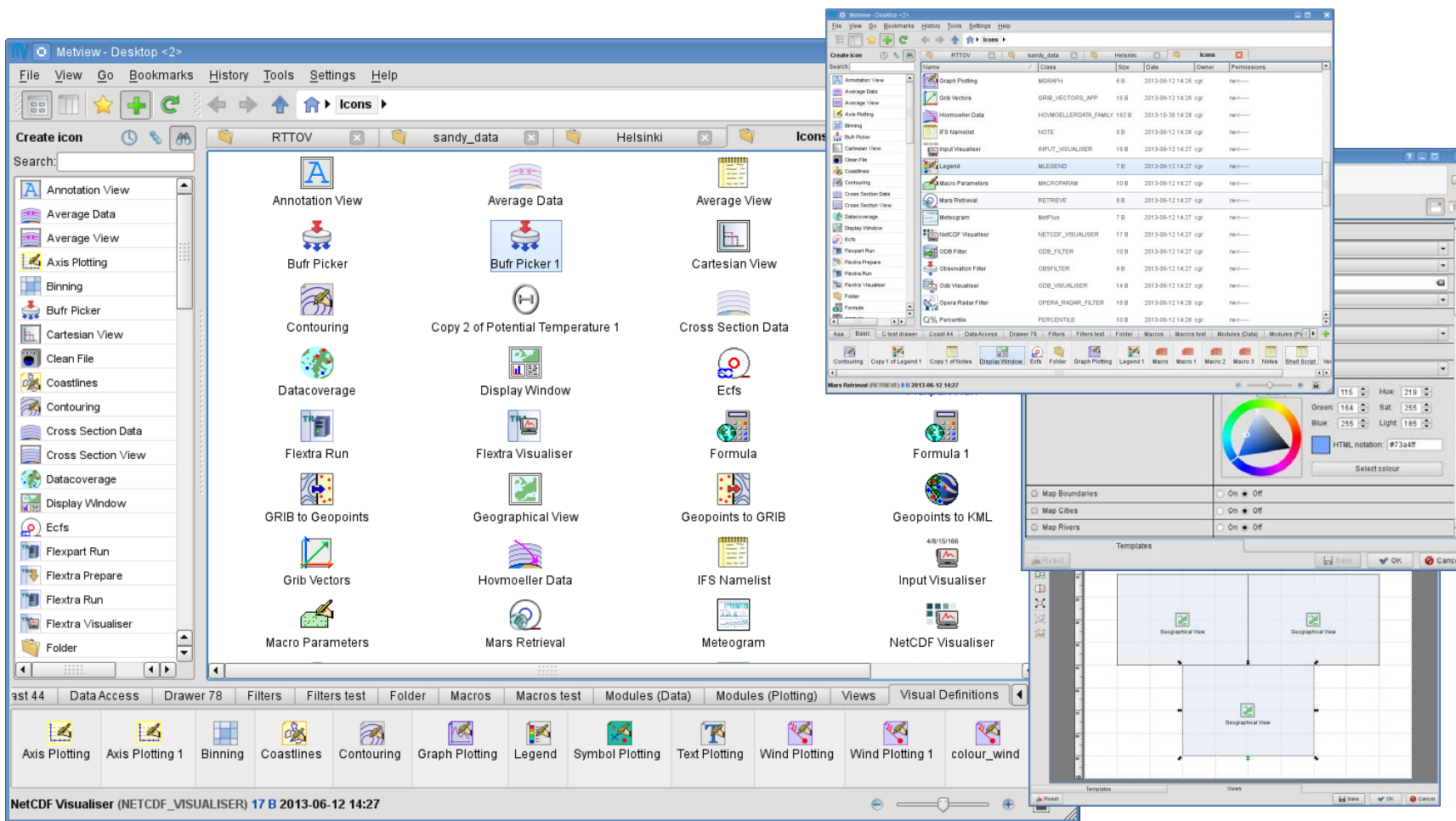


Rttov Visualiser



Future developments (1)

- New Qt based desktop (alpha version stage)



Future developments (2)

● Short term

- Thermodynamic diagrams
- More clients for OGC web services formats (SOS, WaterML)
- Integrate ECMWF's new interpolation package
- Exploring interfaces to 3D packages (e.g. Vapor)
- New MARS client access through MARS web-api
 - External users can directly access ECMWF's MARS

● Long term

- Python based Macro Language
- Combine experience of WREP (ecCharts) with long-term experience of Metview to produce a common architecture

For more information ...

email us:

🖱 **Metview:** **metview@ecmwf.int**

visit our web pages:

🖱 **<http://software.ecmwf.int/metview>**

➤ **Download**

➤ **source tarball or virtual machine**

➤ **Documentation and tutorials available**

➤ **Metview articles in ECMWF newsletters**

