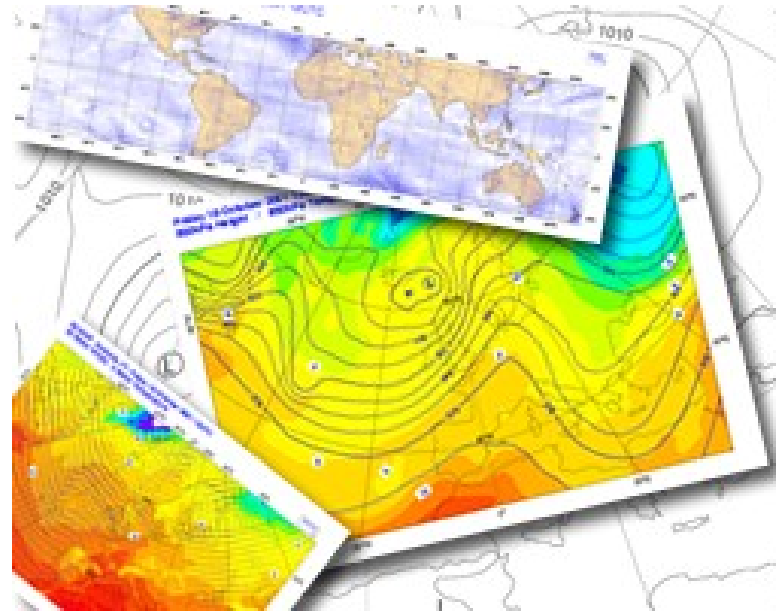


# Metview 4: Enhanced functionalities for observation monitoring



*Iain Russell, Sándor Kertész*  
*Meteorological Visualisation Section*  
*ECMWF*

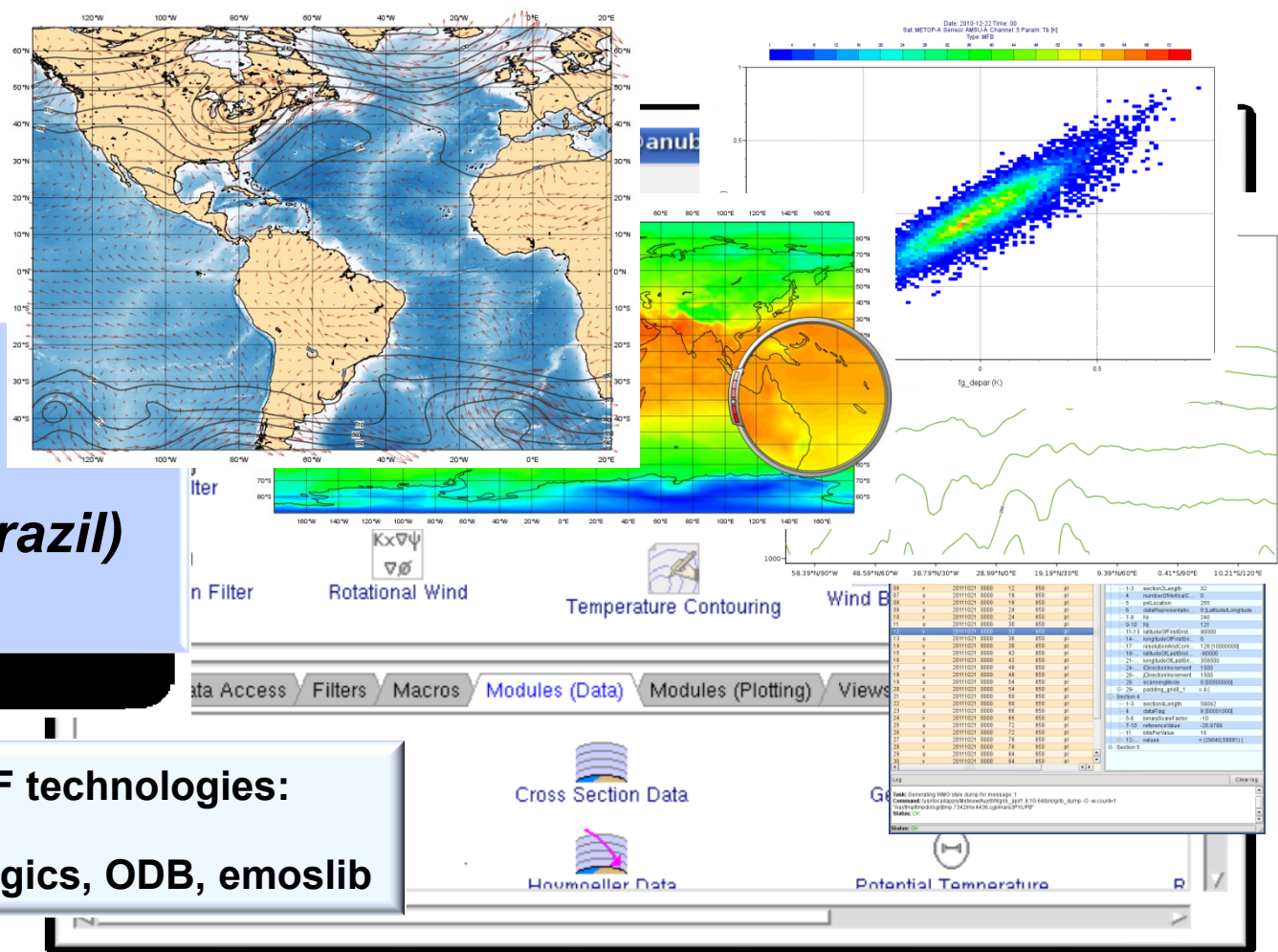
# What is Metview?



- ▶ Working environment for Operational and Research Meteorologists
- ▶ Runs on UNIX

Co-operative project:

**ECMWF**  
**INPE/CPTEC (Brazil)**  
**Météo-France**



Built on core ECMWF technologies:  
Mars, GRIB\_API, Magics, ODB, emoslib

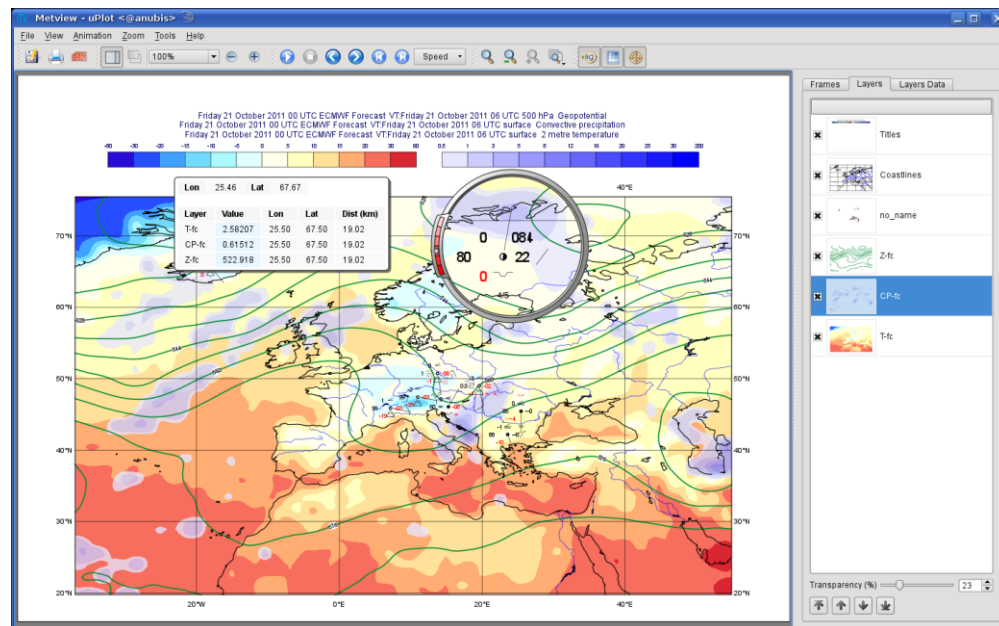


# What is Metview?

## ▶ 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

# Interactive Interface

The image displays the Metview 4 interactive interface. On the left, a control panel contains several icons representing different data and visualization options. On the right, a global map shows the results of a data query. Arrows indicate the mapping between the control panel icons and the map features.

Control Panel Icons (from top to bottom):

- Temperature (Temper)
- Execution (execut)
- List (lis)
- Input (in)
- Output (output)
- Delete (delete)
- Input (input)
- Output (output)

Map Title: ECMWF Analysis V6: Friday 21 May 2010 12 UTC 1000 hPa temperature

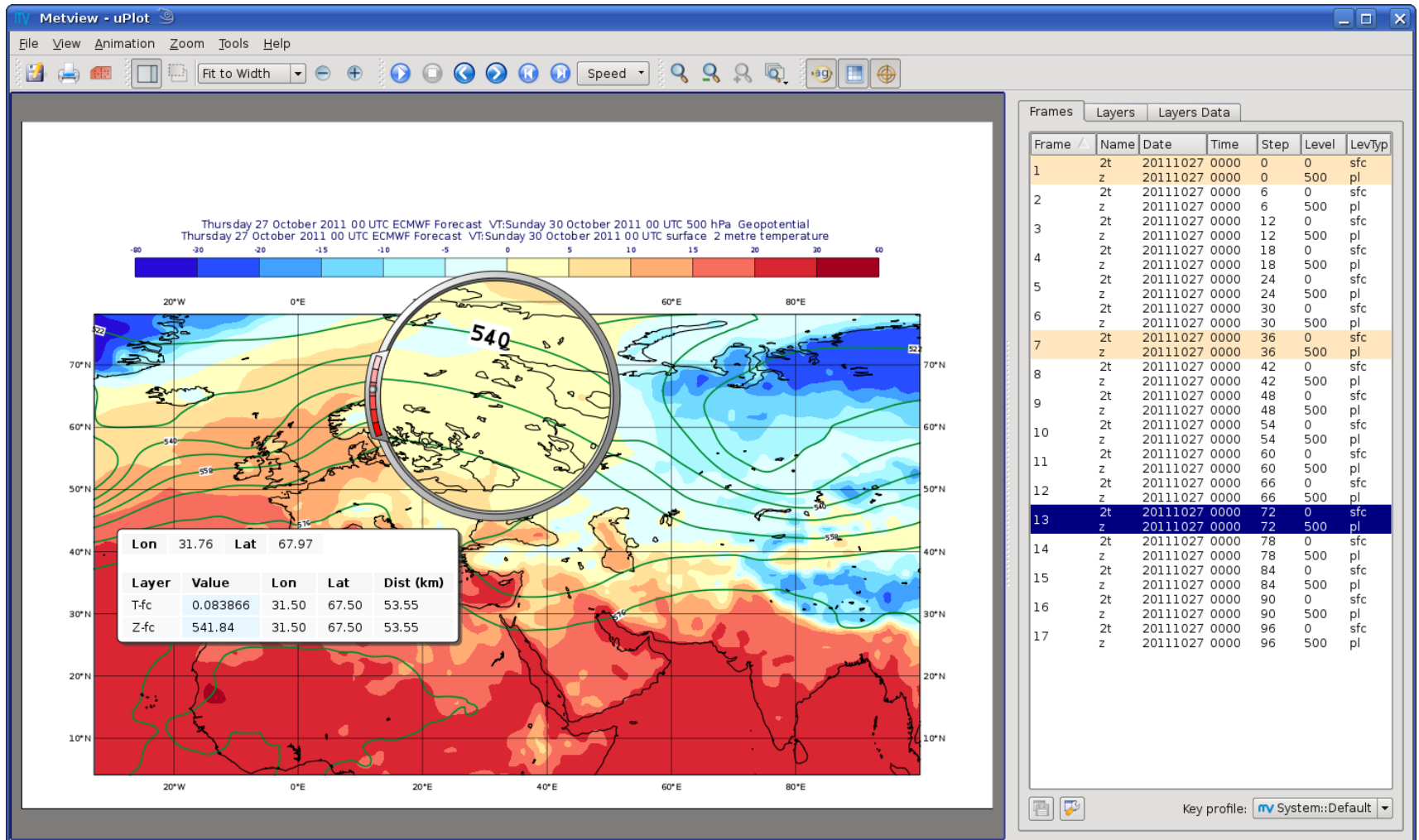
Map Coordinates: 160°W to 160°E, 80°N to 80°S

- Icon-based interface
- Everything is represented by an icon (data, actions, visualisation attributes)

# Display Window (1)

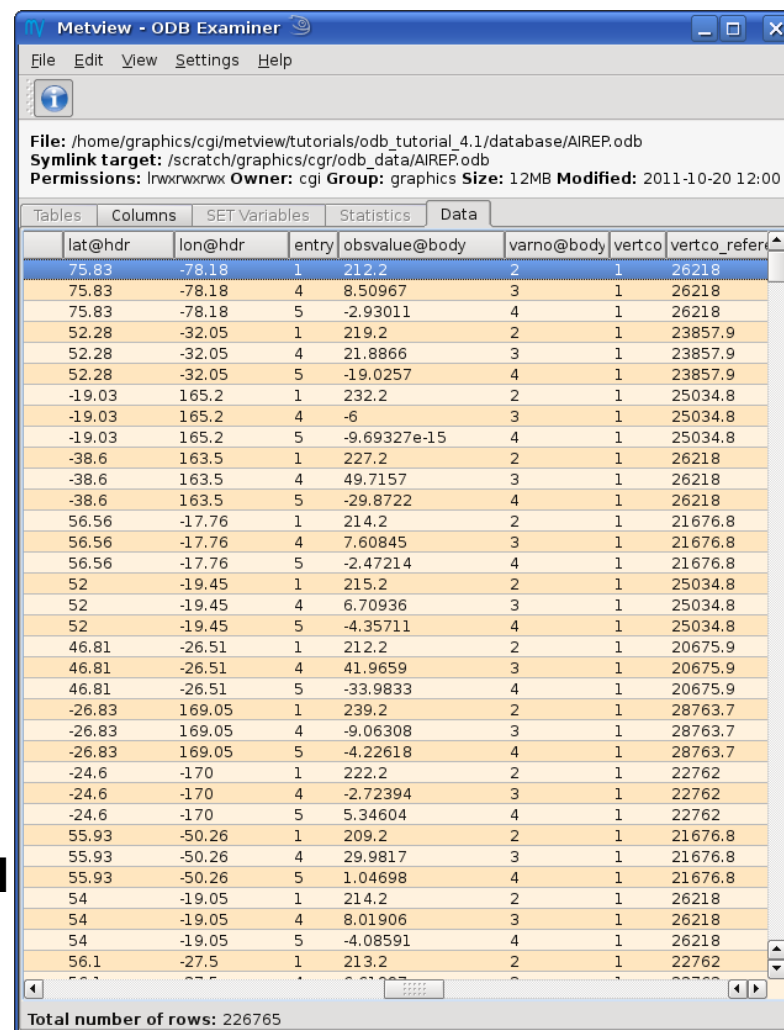
- ▶ Built with Qt, uses Magics for plotting (Qt does the rendering)
- ▶ In addition to plotting, the Display Window can help investigation of data, e.g.
  - ▶ Magnifying glass
  - ▶ Cursor data display
  - ▶ Configurable frame list

# Display Window (2)



# What is ODB?

- ▶ ODB: Observational DataBase
- ▶ Database software developed at ECMWF for the storage and retrieval of high-volume observational data
- ▶ Viewed as data columns
- ▶ Can use ODB/SQL to query data
- ▶ Will replace BUFR observation feedback in MARS\* from 15<sup>th</sup> November 2011
  - ▶ \* MARS is ECMWF's meteorological data archive



Metview - ODB Examiner

File Edit View Settings Help

File: /home/graphics/cgi/metview/tutorials/odb\_tutorial\_4.1/database/AIREP.odb  
Symlink target: /scratch/graphics/cgr/odb\_data/AIREP.odb  
Permissions: lrwxrwxrwx Owner: cgi Group: graphics Size: 12MB Modified: 2011-10-20 12:00

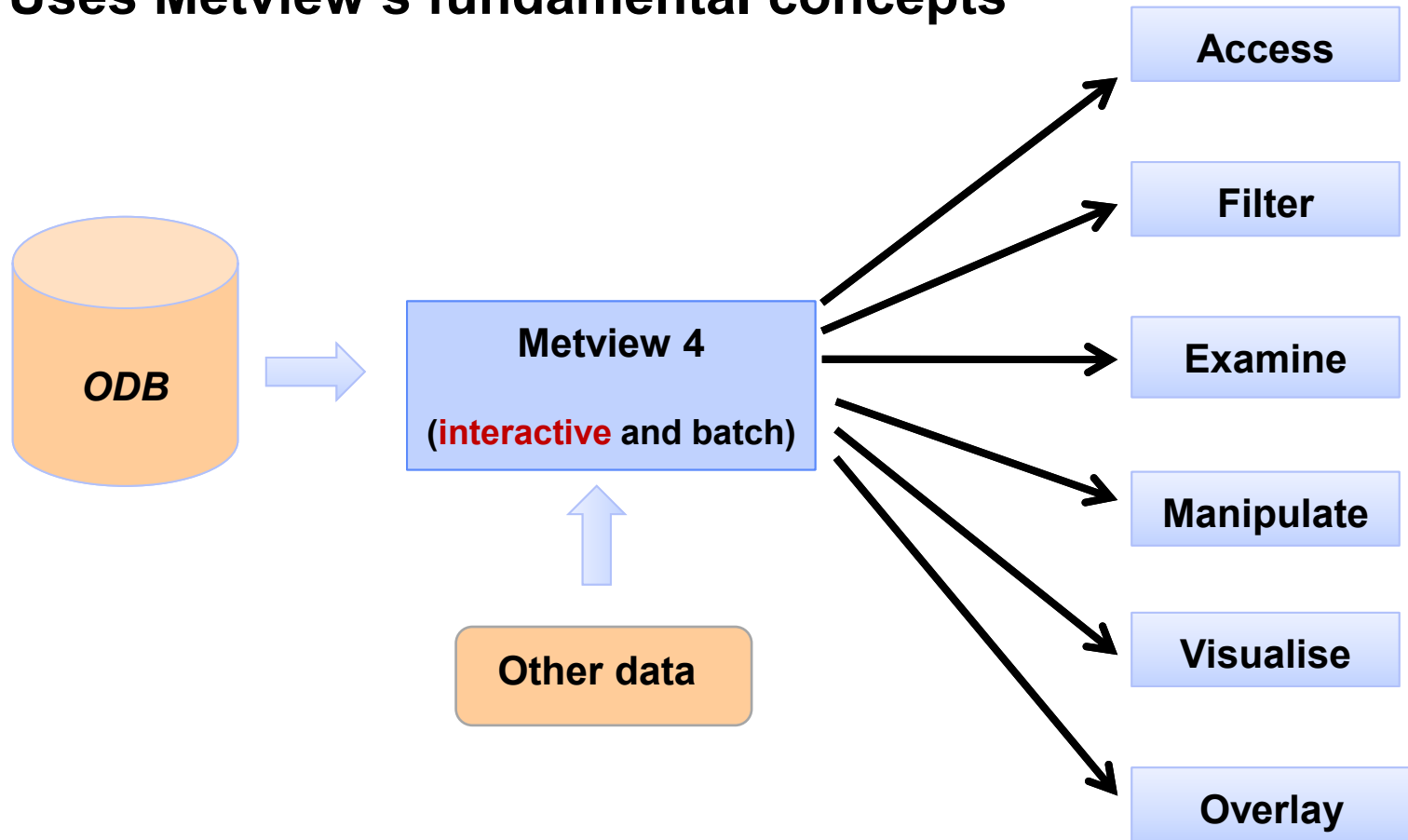
Tables Columns SET Variables Statistics Data

	lat@hdr	lon@hdr	entry	obsvalue@body	varno@body	vertco	vertco_refer
	75.83	-78.18	1	212.2	2	1	26218
	75.83	-78.18	4	8.50967	3	1	26218
	75.83	-78.18	5	-2.93011	4	1	26218
	52.28	-32.05	1	219.2	2	1	23857.9
	52.28	-32.05	4	21.8866	3	1	23857.9
	52.28	-32.05	5	-19.0257	4	1	23857.9
	-19.03	165.2	1	232.2	2	1	25034.8
	-19.03	165.2	4	-6	3	1	25034.8
	-19.03	165.2	5	-9.69327e-15	4	1	25034.8
	-38.6	163.5	1	227.2	2	1	26218
	-38.6	163.5	4	49.7157	3	1	26218
	-38.6	163.5	5	-29.8722	4	1	26218
	56.56	-17.76	1	214.2	2	1	21676.8
	56.56	-17.76	4	7.60845	3	1	21676.8
	56.56	-17.76	5	-2.47214	4	1	21676.8
	52	-19.45	1	215.2	2	1	25034.8
	52	-19.45	4	6.70936	3	1	25034.8
	52	-19.45	5	-4.35711	4	1	25034.8
	46.81	-26.51	1	212.2	2	1	20675.9
	46.81	-26.51	4	41.9659	3	1	20675.9
	46.81	-26.51	5	-33.9833	4	1	20675.9
	-26.83	169.05	1	239.2	2	1	28763.7
	-26.83	169.05	4	-9.06308	3	1	28763.7
	-26.83	169.05	5	-4.22618	4	1	28763.7
	-24.6	-170	1	222.2	2	1	22762
	-24.6	-170	4	-2.72394	3	1	22762
	-24.6	-170	5	5.34604	4	1	22762
	55.93	-50.26	1	209.2	2	1	21676.8
	55.93	-50.26	4	29.9817	3	1	21676.8
	55.93	-50.26	5	1.04698	4	1	21676.8
	54	-19.05	1	214.2	2	1	26218
	54	-19.05	4	8.01906	3	1	26218
	54	-19.05	5	-4.08591	4	1	26218
	56.1	-27.5	1	213.2	2	1	22762

Total number of rows: 226765

# Observation Monitoring in Metview

- Uses Metview's fundamental concepts





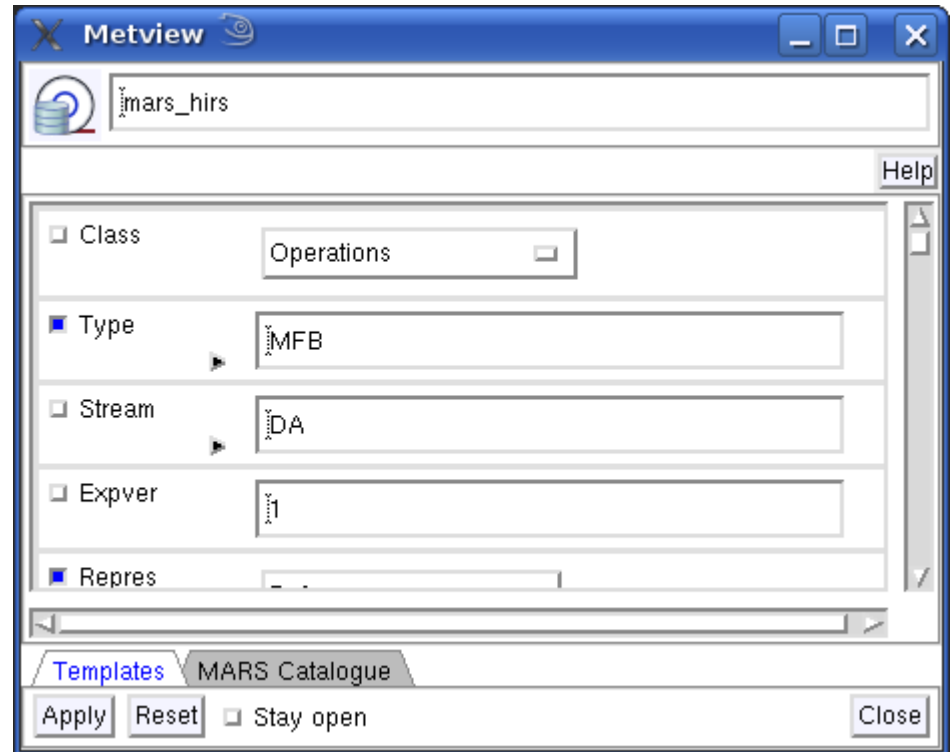
# ODB Access

## ▶ Metview can access ODB data through:

▶ the file system



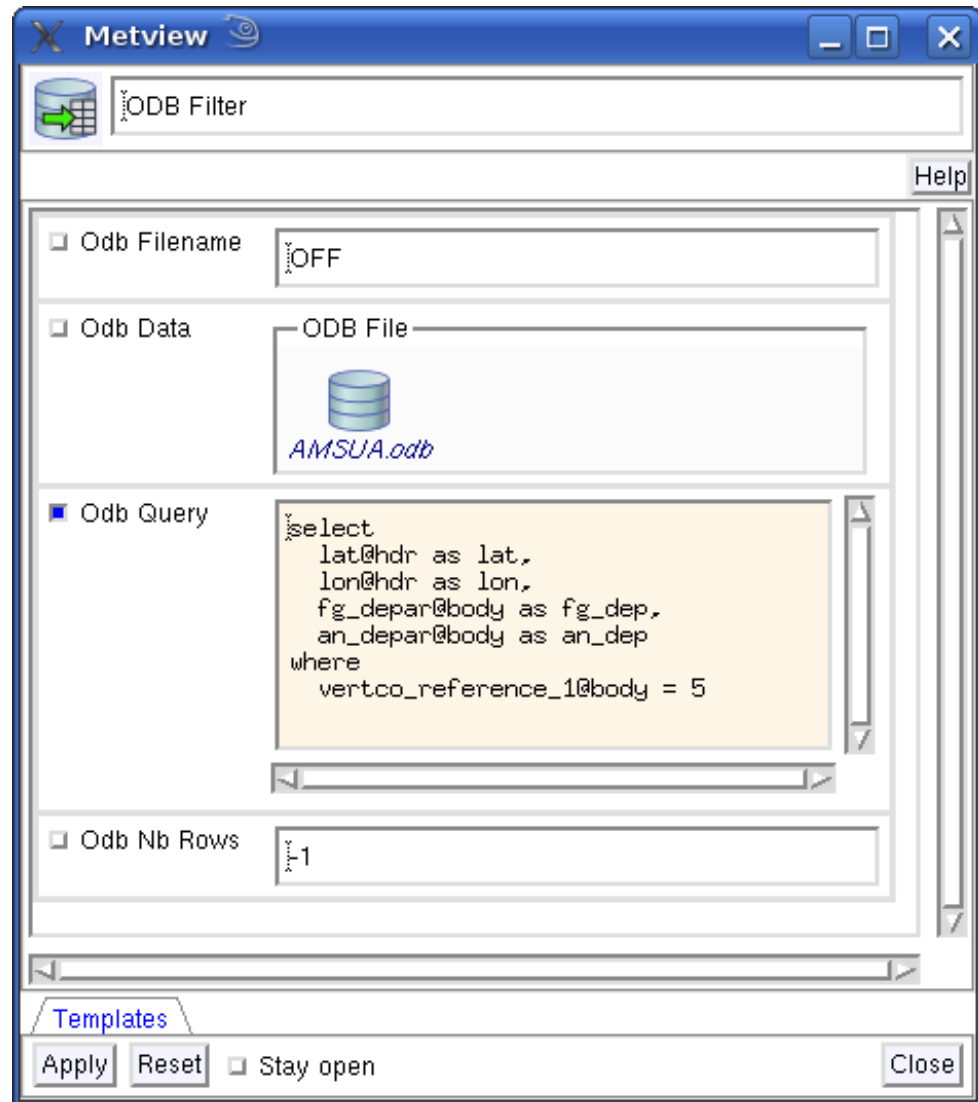
▶ or through MARS  
- can use GUI to construct retrieval query



# ODB Filter



- ▶ Can use ODB / SQL query to select and manipulate data



# ODB Examiner



▶ Right-click | Examine

Columns

File: /home/graphics/cgi/metview/tutorials/odb\_tutorial\_4.1/filter\_solution/AMSUA.odb  
Symmlink target: /scratch/graphics/cgr/odb\_data/AMSUA.odb  
Permissions: lrwxrwxrwx Owner: cgi Group: graphics Size: 17MB Modified: 2011-10-20 12:00

Name	Type	Constant	Min	Max
an_depar@body	float	n	-3.47203	3.95354
an_sens_obs@body	float	y	0	0
andate@desc	int	y	20101222	20101222
antime@desc	int	y	0	0
biascorr@body	float	n	-0.739071	4.33658
biasctrl@body	float	n	-0.737179	4.35366
bufirtype@hdr	int	y	3	3
class@desc	string	y	N/A	N/A
codetype@hdr	int	y	210	210
datastream@sat	int	n	0	1
date@hdr	int	n	20101221	20101222
datum_anflag@body	bitfield	n	N/A	N/A
datum_event1@body	bitfield	y	N/A	N/A
datum_rdbflag@body	bitfield	y	N/A	N/A
datum_status@body	bitfield	n	N/A	N/A
active	Pos: 00 Width: 1 bit			
blacklisted	Pos: 03 Width: 1 bit			
passive	Pos: 01 Width: 1 bit			
rejected	Pos: 02 Width: 1 bit			
entryno@body	int	n	3	14
expver@desc	string	y	N/A	N/A
fc_sens_obs@body	float	y	0	0
fg_depar@body	float	n	-3.34557	3.28031
fg_error@errstat	float	n	0.0603554	3.8495
final@update_1	float	n	-2.14748e+09	-2.14748e+09
final@update_2	float	n	-2.14748e+09	-2.14748e+09

File: /home/graphics/cgi/metview/tutorials/odb\_tutorial\_4.1/database/AIREP.odb  
Symmlink target: /scratch/graphics/cgr/odb\_data/AIREP.odb  
Permissions: lrwxrwxrwx Owner: cgi Group: graphics Size: 12MB Modified: 2011-10-20 12:00

lat@hdr	lon@hdr	entry	obsvalue@body	varno@body	vertco	vertco_refer
75.83	-78.18	1	212.2	2	1	26218
75.83	-78.18	4	8.50967	3	1	26218
75.83	-78.18	5	-2.93011	4	1	26218
52.28	-32.05	1	219.2	2	1	23857.9
52.28	-32.05	4	21.8866	3	1	23857.9
52.28	-32.05	5	-19.0257	4	1	23857.9
-19.03	165.2	1	232.2	2	1	25034.8
-19.03	165.2	4	-6	3	1	25034.8
-19.03	165.2	5	-9.69327e-15	4	1	25034.8
-38.6	163.5	1	227.2	2	1	26218
-38.6	163.5	4	49.7157	3	1	26218
-38.6	163.5	5	-29.8722	4	1	26218
56.56	-17.76	1	214.2	2	1	21676.8
56.56	-17.76	4	7.60845	3	1	21676.8
56.56	-17.76	5	-2.47214	4	1	21676.8
52	-19.45	1	215.2	2	1	25034.8
52	-19.45	4	6.70936	3	1	25034.8
52	-19.45	5	-4.35711	4	1	25034.8
46.81	-26.51	1	212.2	2	1	20675.9
46.81	-26.51	4	41.9659	3	1	20675.9
46.81	-26.51	5	-33.9833	4	1	20675.9
-26.83	169.05	1	239.2	2	1	28763.7
-26.83	169.05	4	-9.06308	3	1	28763.7
-26.83	169.05	5	-4.22618	4	1	28763.7
-24.6	-170	1	222.2	2	1	22762
-24.6	-170	4	-2.72394	3	1	22762
-24.6	-170	5	5.34604	4	1	22762
55.93	-50.26	1	209.2	2	1	21676.8
55.93	-50.26	4	29.9817	3	1	21676.8
55.93	-50.26	5	1.04698	4	1	21676.8
54	-19.05	1	214.2	2	1	26218
54	-19.05	4	8.01906	3	1	26218
54	-19.05	5	-4.08591	4	1	26218
56.1	-27.5	1	213.2	2	1	22762

Total number of rows: 226765

# ODB Data Manipulation (1)

- ▶ ODB Filter (through ODB / SQL) provides some opportunity for manipulation (e.g. simple mathematical operators)



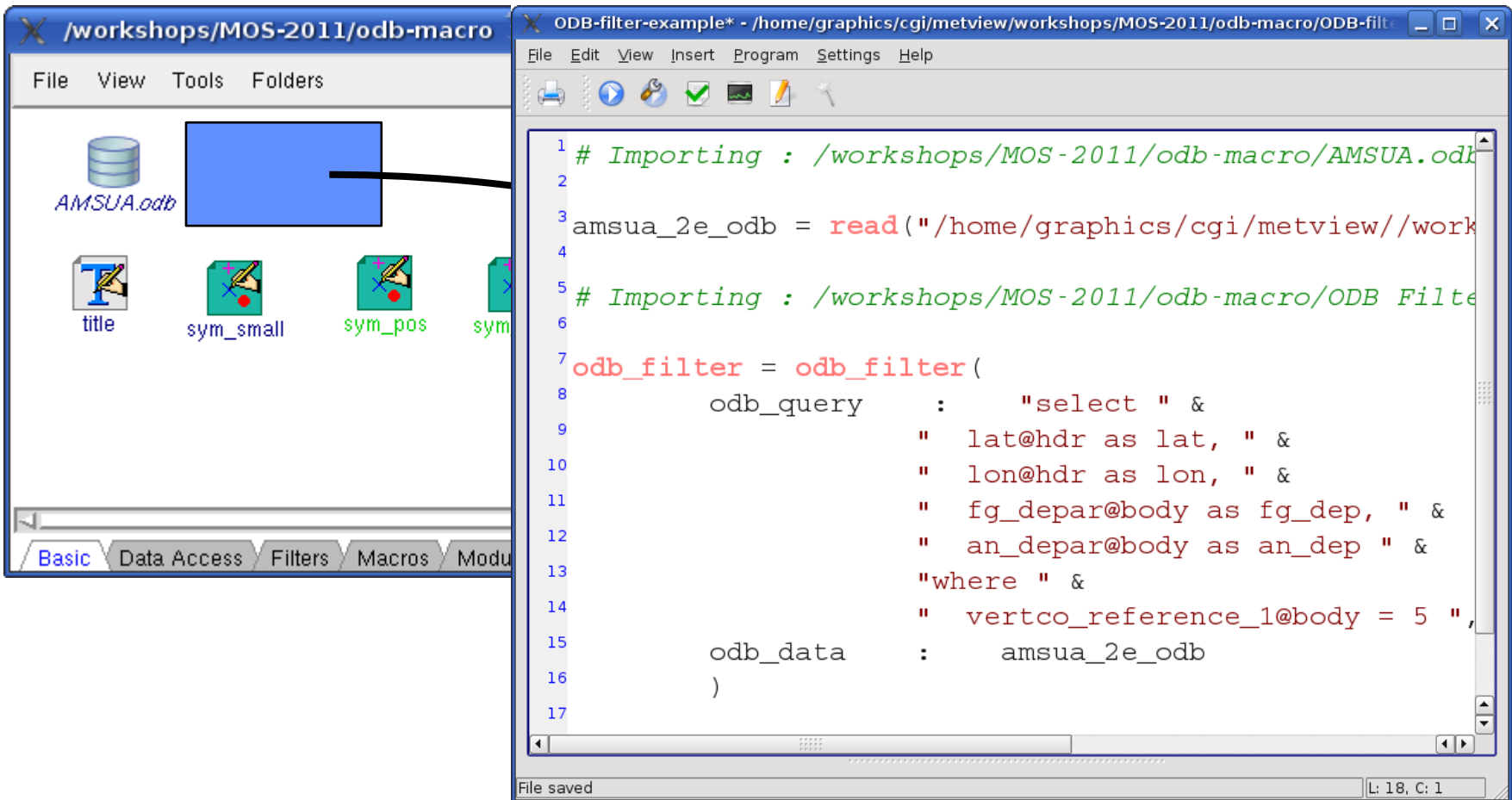
- ▶ For more advanced manipulation or combination with other data sources use Metview's Macro language



- ▶ a powerful high-level meteorologically oriented script language (extendable with user C++/Fortran code)
- ▶ all Metview tasks can be written or saved as macros, and run in batch or interactively
- ▶ can produce derived data and/or plots

# ODB Data Manipulation (2)

## ► Convert icons into Macro code – drag & drop



The image shows two windows from the Metview software. The left window, titled `/workshops/MOS-2011/odb-macro`, displays a file explorer with several icons: `AMSUA.odb` (database icon), `title` (text icon), `sym_small` (symbol icon), `sym_pos` (symbol icon), and `sym` (symbol icon). A blue rectangular selection box is drawn around the `AMSUA.odb` icon, and a black arrow points from this box to the right window. The right window, titled `ODB-filter-example* - /home/graphics/cgi/metview/workshops/MOS-2011/odb-macro/ODB-filt`, shows a code editor with the following macro code:

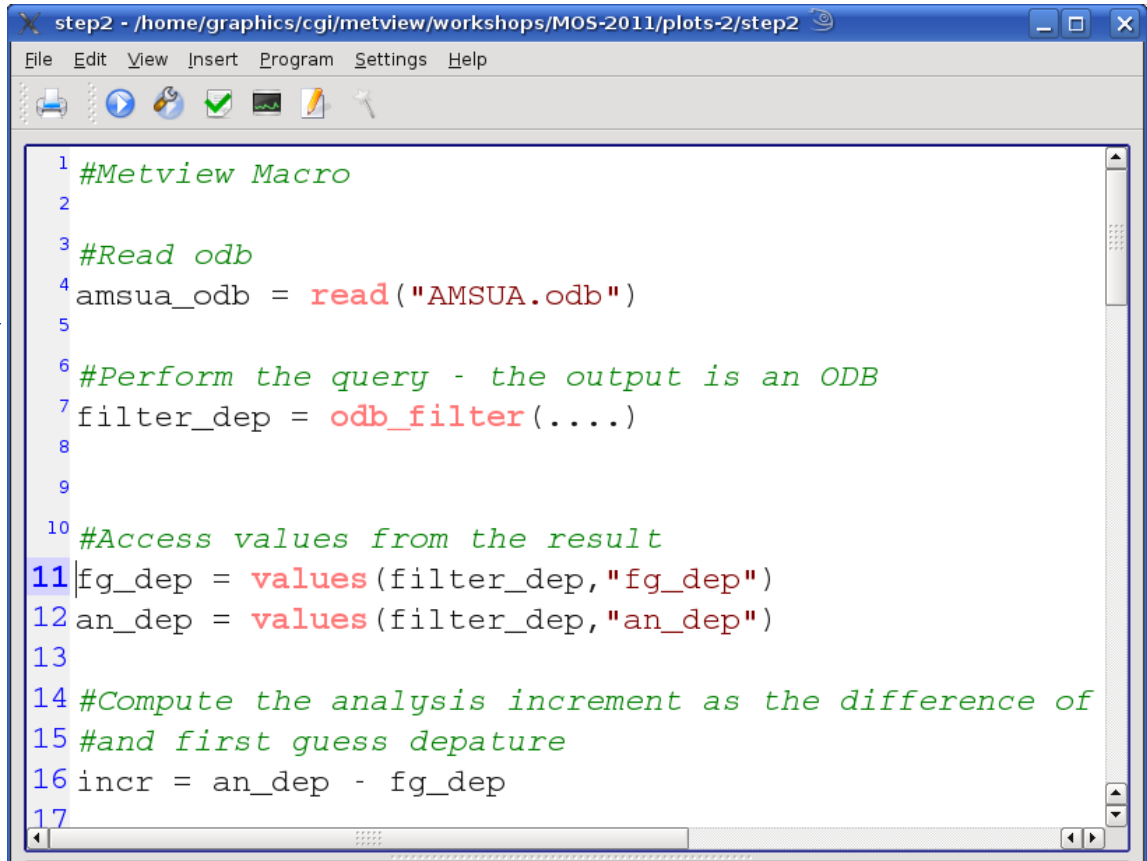
```
1 # Importing : /workshops/MOS-2011/odb-macro/AMSUA.odb
2
3 amsua_2e_odb = read("/home/graphics/cgi/metview/work
4
5 # Importing : /workshops/MOS-2011/odb-macro/ODB Filter
6
7 odb_filter = odb_filter(
8     odb_query      :      "select " &
9                     " lat@hdr as lat, " &
10                    " lon@hdr as lon, " &
11                    " fg_depar@body as fg_dep, " &
12                    " an_depar@body as an_dep " &
13                    "where " &
14                    " vertco_reference_1@body = 5 ",
15    odb_data        :      amsua_2e_odb
16 )
17
```

The status bar at the bottom of the right window indicates "File saved" and "L: 18, C: 1".

# ODB Data Manipulation (3)

► ODB columns can be read into *vector* variables in Macro  
`v1 = values(odb, 'fg_dep')`


► Can then perform manipulations on these vectors, e.g.  
`v3 = v1 + v2`  
`mx = maxvalue(v)`



```
step2 - /home/graphics/cgi/metview/workshops/MOS-2011/plots-2/step2
File Edit View Insert Program Settings Help

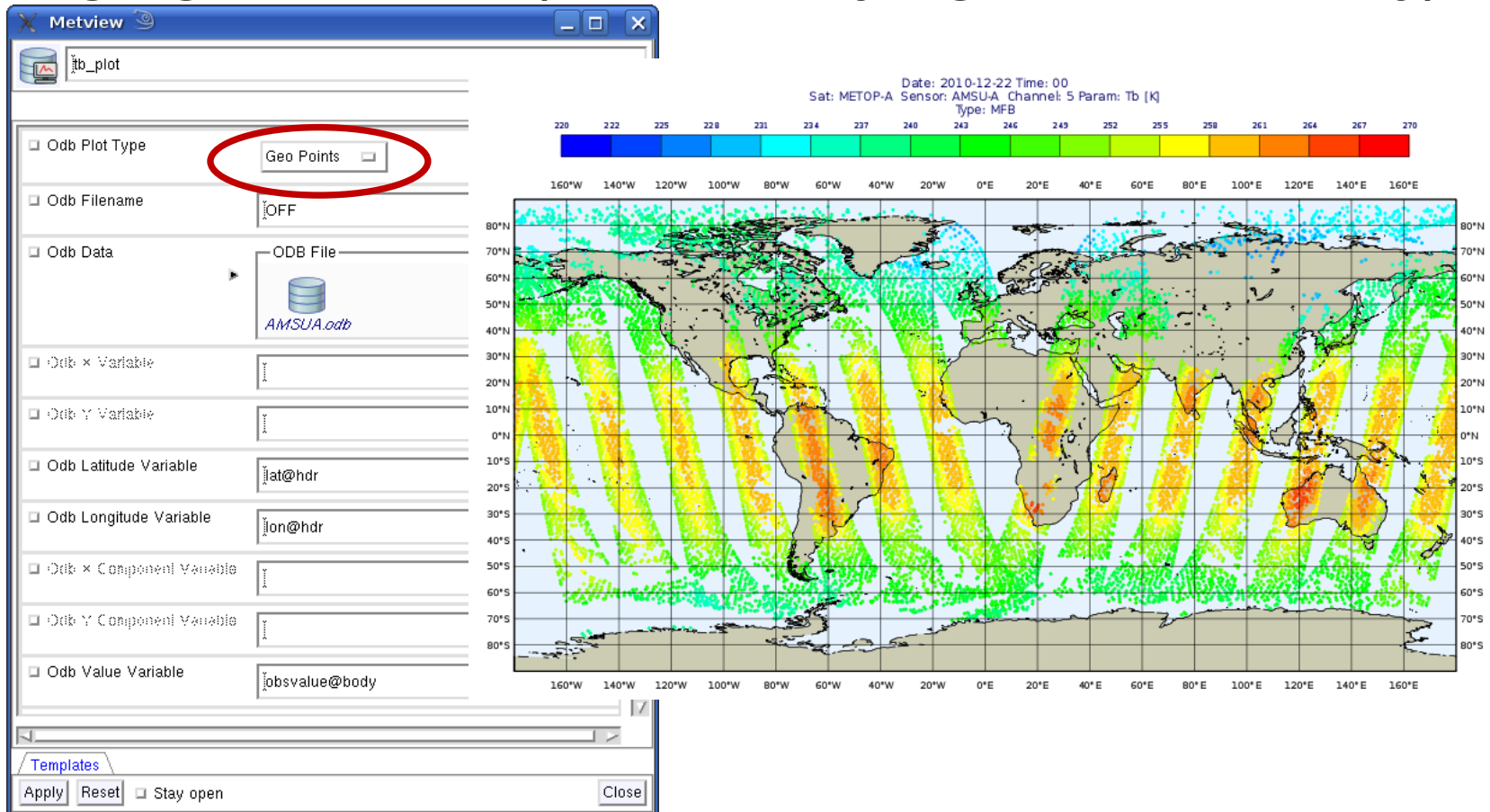
1 #Metview Macro
2
3 #Read odb
4 amsua_odb = read("AMSUA.odb")
5
6 #Perform the query - the output is an ODB
7 filter_dep = odb_filter(....)
8
9
10 #Access values from the result
11 fg_dep = values(filter_dep, "fg_dep")
12 an_dep = values(filter_dep, "an_dep")
13
14 #Compute the analysis increment as the difference of
15 #and first guess departure
16 incr = an_dep - fg_dep
17
```

# ODB Visualisation

- ▶ Some formats, such as GRIB, are easy to visualise in Metview: just right-click | Visualise
- ▶ That's because they are quite specific and have enough standardised meta-data for a program to understand how they should be plotted
- ▶ ODBs can contain large numbers of columns
  - ▶ Which ones do we want to plot?
  - ▶ How do we want to plot them – on a map, as a scatter plot, as a matrix?
- ▶ Use the ODB Visualiser icon 
- ▶ Offers various ways to interpret and visualise the data
  - ▶ Metview also offers Visualiser icons for NetCDF, ASCII tables and user-input lists of data; this is a new concept in Metview 4

# ODB Visualisation example (1)

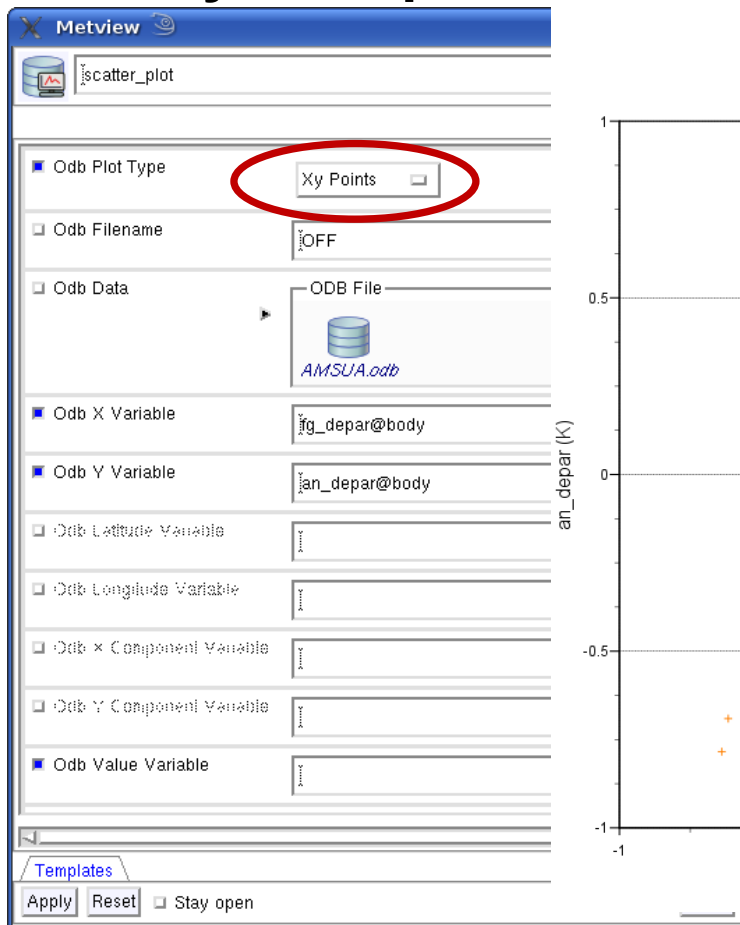
- ▶ Example: brightness temperature as scattered geographical plot (colours & styling added separately)



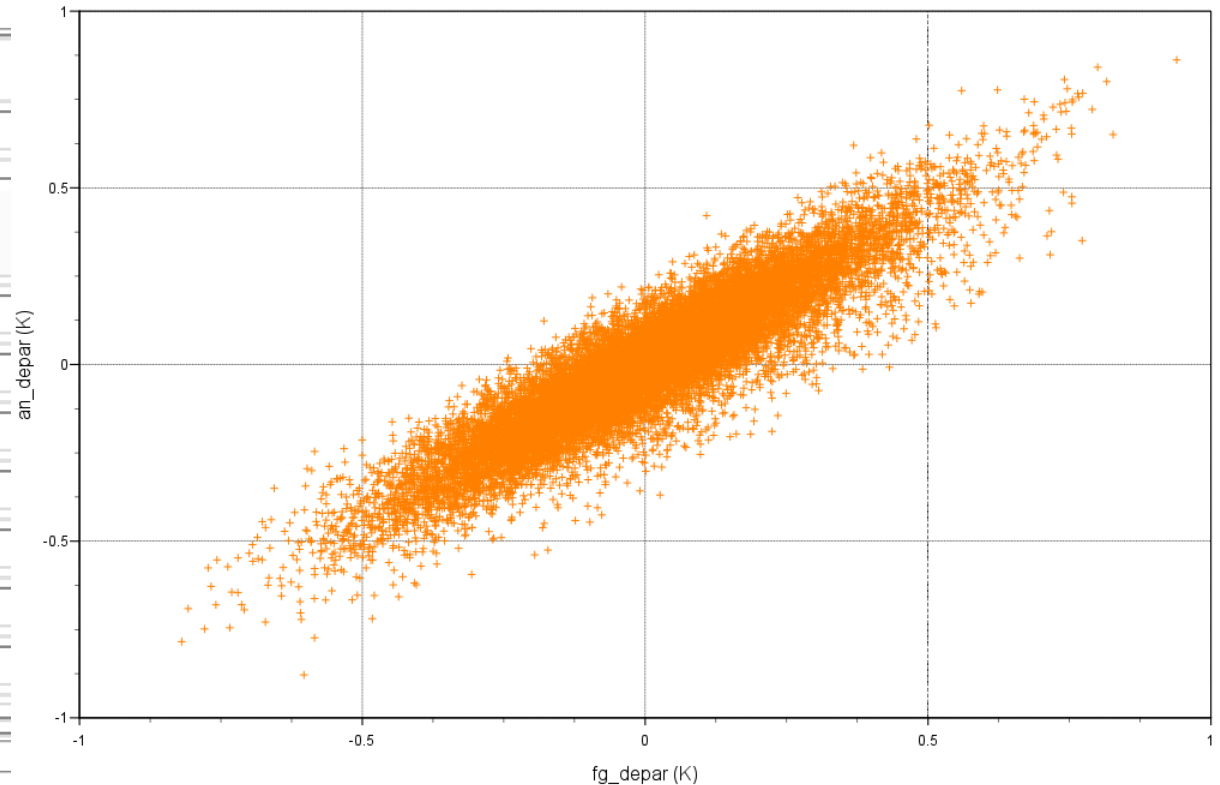


# ODB Visualisation example (2)

- ▶ Example: scatterplot of first guess departure against analysis departure

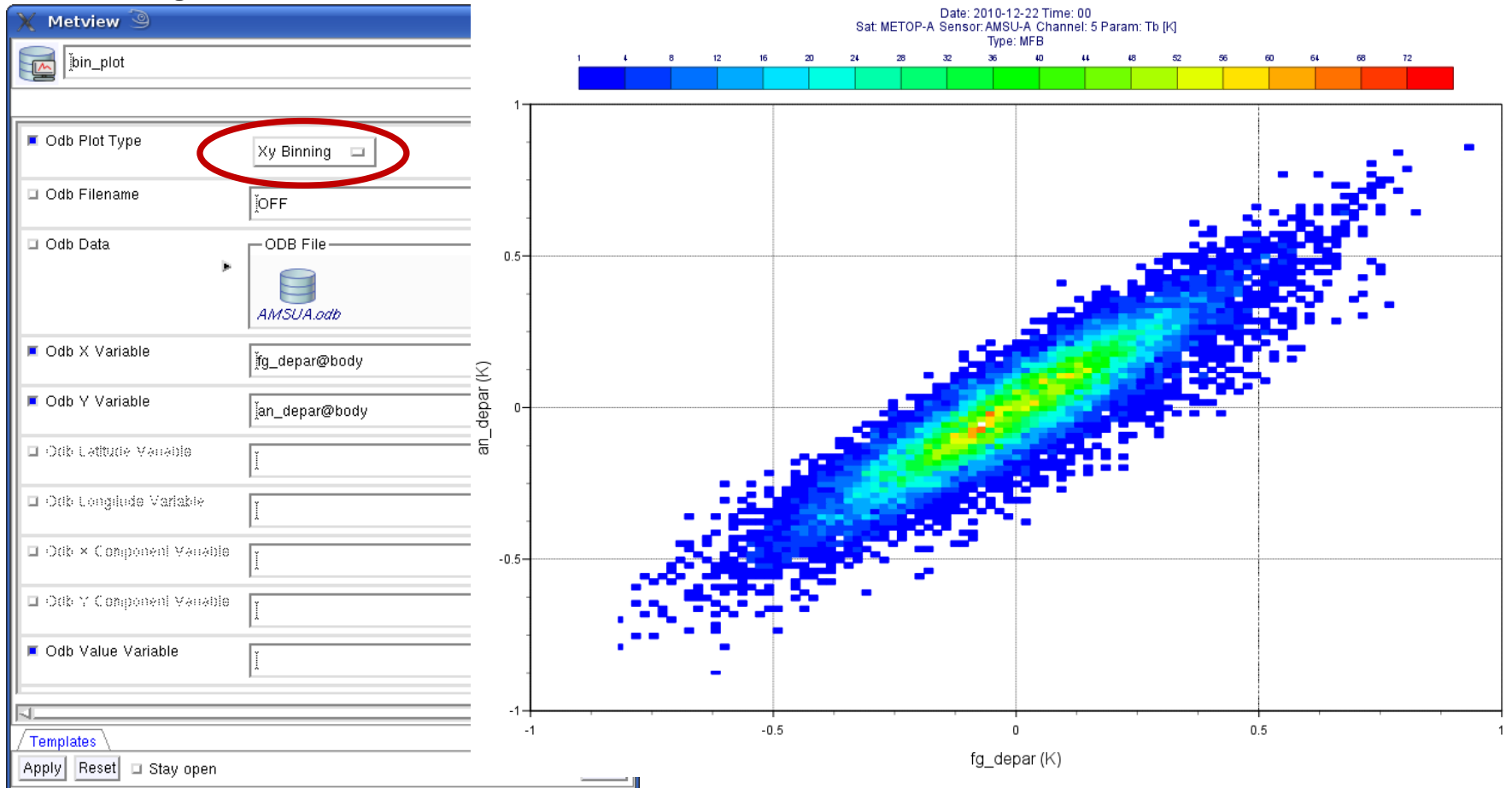


Date: 2010-12-22 Time: 00  
Sat: METOP-A Sensor: AMSU-A Channel: 5 Param: Tb [K]  
Type: MFB



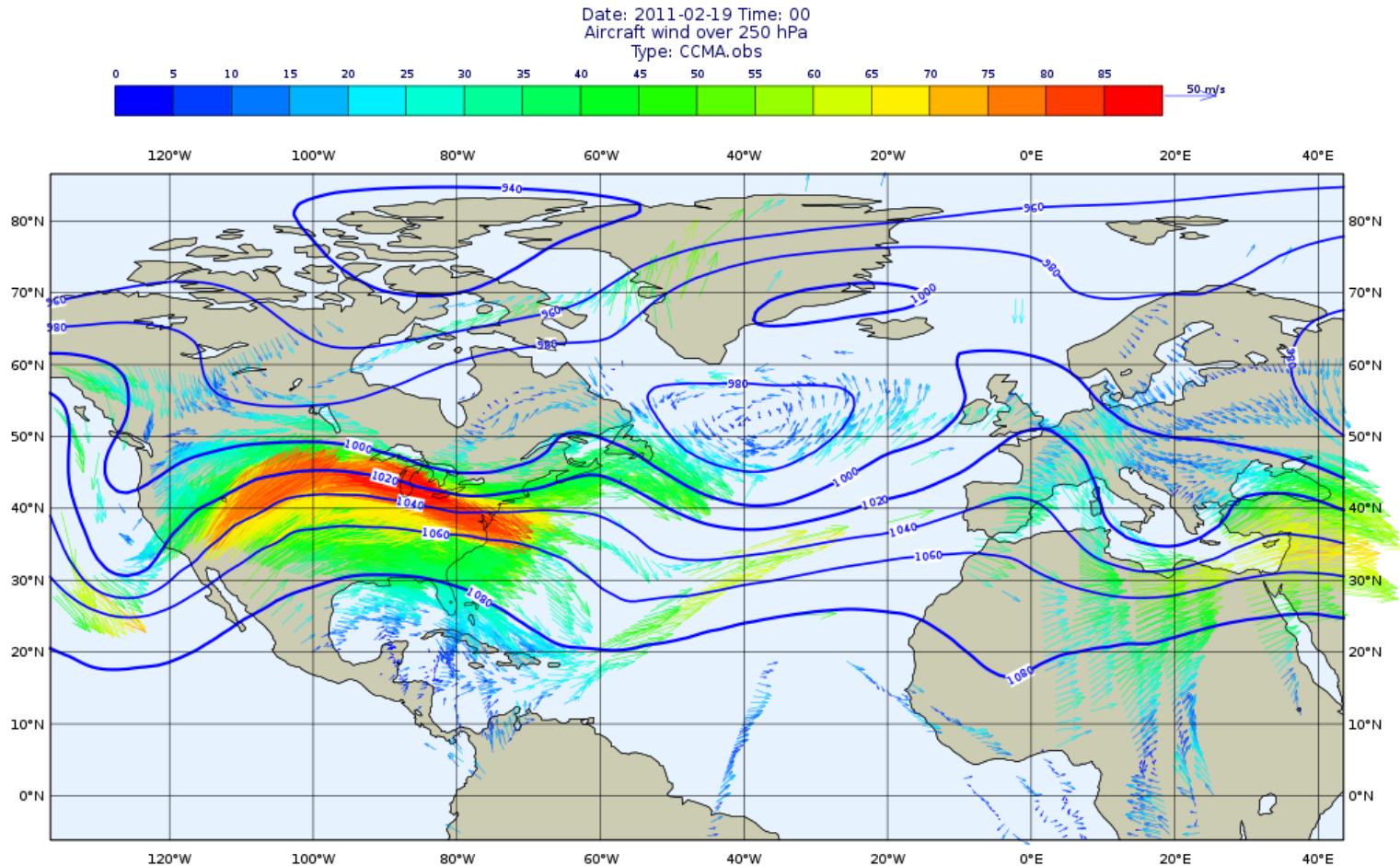
# ODB Visualisation example (3)

- ▶ Example: binned plot of first guess departure against analysis departure



# ODB Visualisation example (4)

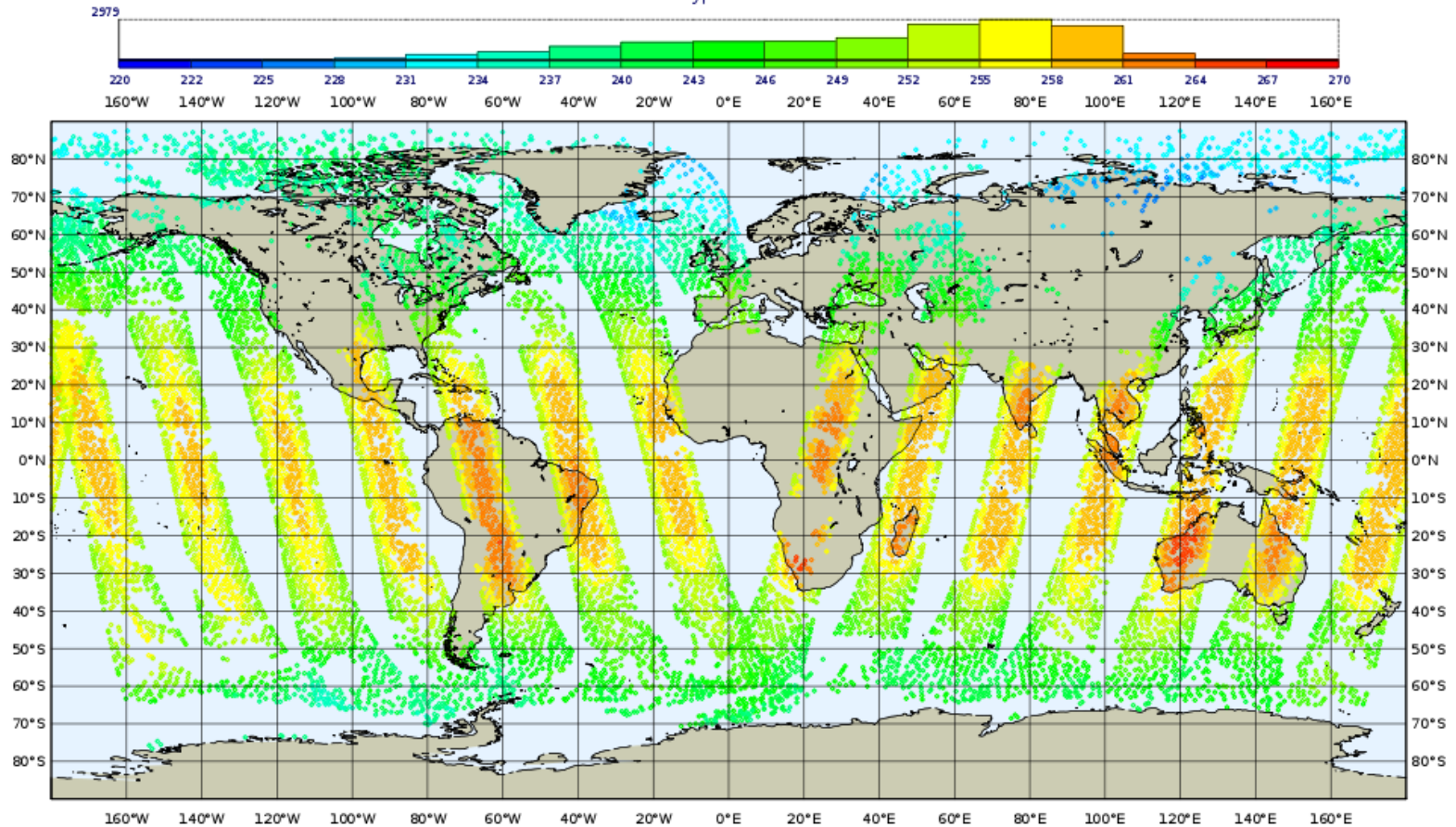
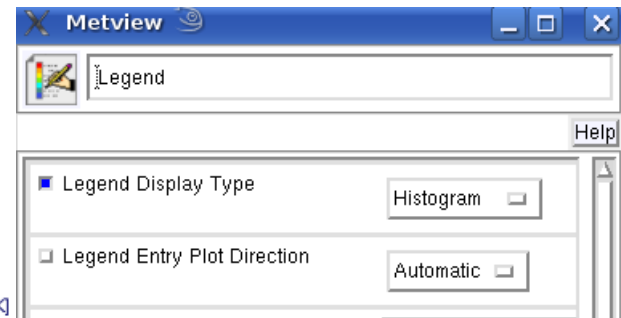
## ► ODB wind data with geopotential field from MARS



# Histogram legend

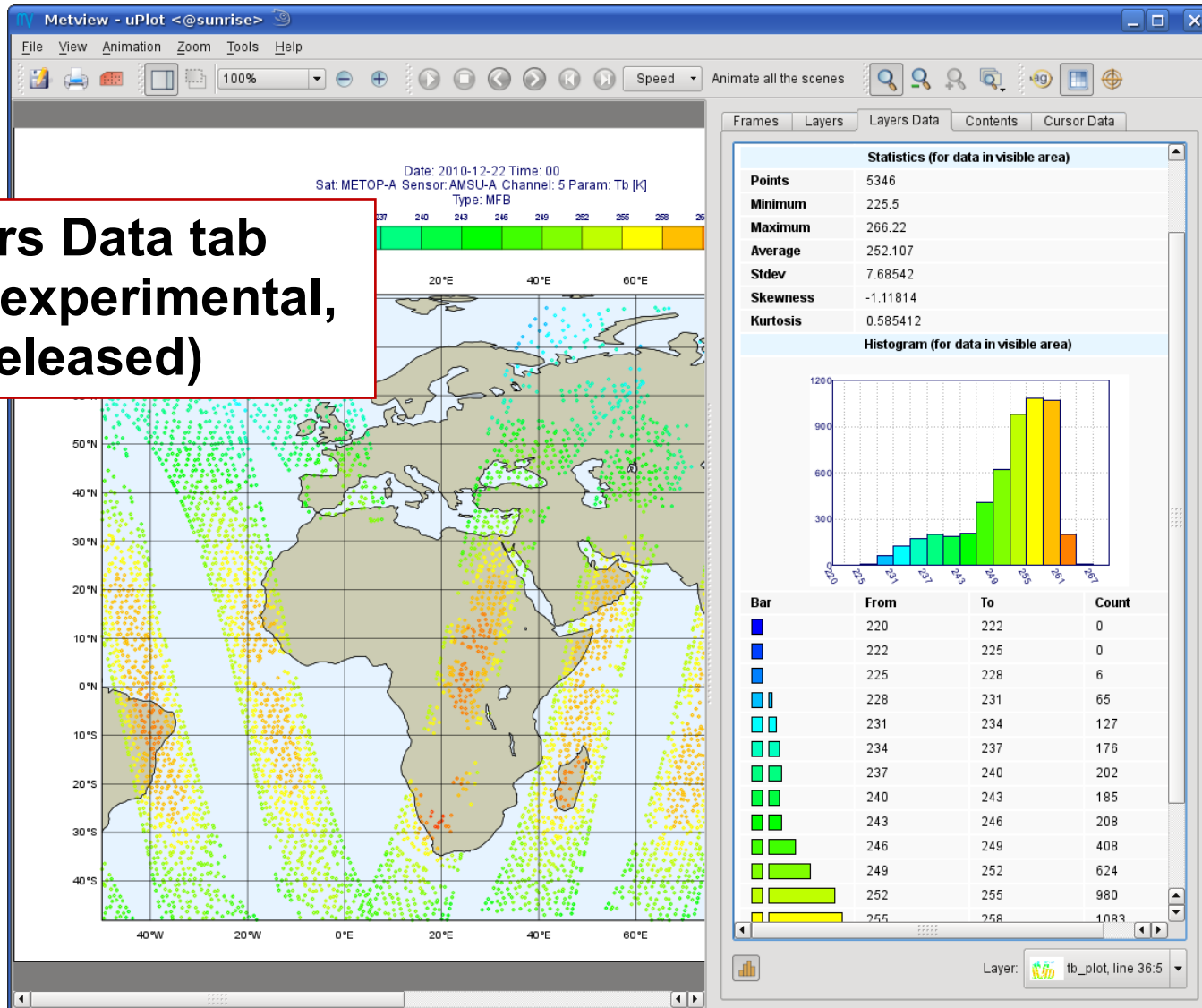
## ► New Magics feature

Date: 2010-12-22 Time: 00  
Sat: METOP-A Sensor: AMSU-A Channel: 5 Param: Tb [K]  
Type: MFB



# Layer meta-data

► Layers Data tab  
(still experimental,  
not released)





# Metview 4 / ODB - Next Steps

- ▶ 10 Get more user feedback
- ▶ 20 Respond
- ▶ 30 goto 10

# For More Information...

email us:

 [metview@ecmwf.int](mailto:metview@ecmwf.int)

visit our web pages:

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

subscribe to our RSS feed:

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

Questions?