NWP : An Introduction to Metview for Data Analysis in Python

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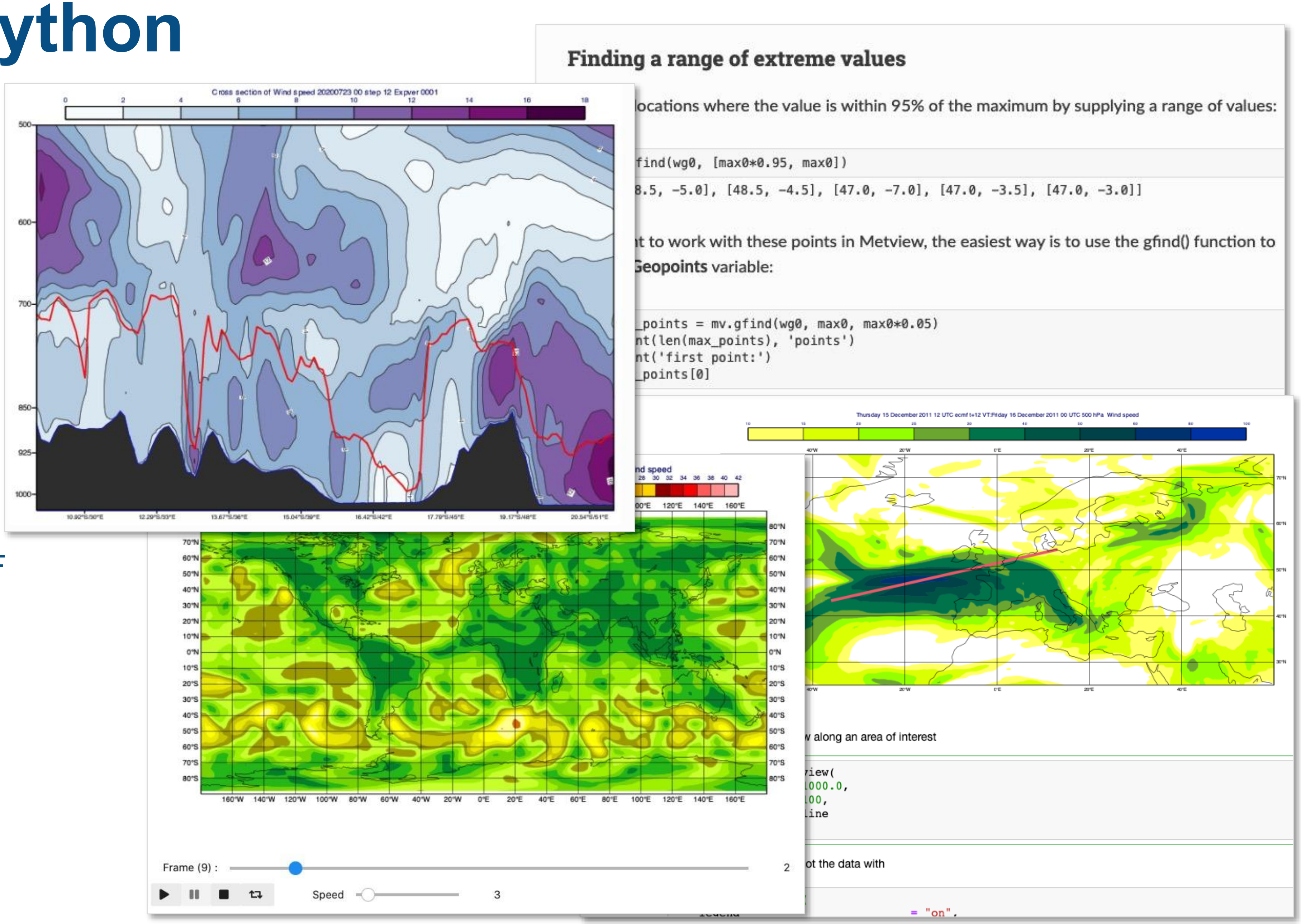
ECMWF



Finding a range of extreme values

locations where the value is within 95% of the maximum by supplying a range of values:

```
find(wg0, [max0*0.95, max0])
```

```
8.5, -5.0], [48.5, -4.5], [47.0, -7.0], [47.0, -3.5], [47.0, -3.0]]
```

t to work with these points in Metview, the easiest way is to use the gfind() function to **Geopoints** variable:

```
_points = mv.gfind(wg0, max0, max0*0.05)
nt(len(max_points), 'points')
nt('first point:')
_points[0]
```

v along an area of interest

```
view(
1000.0,
100,
line
```

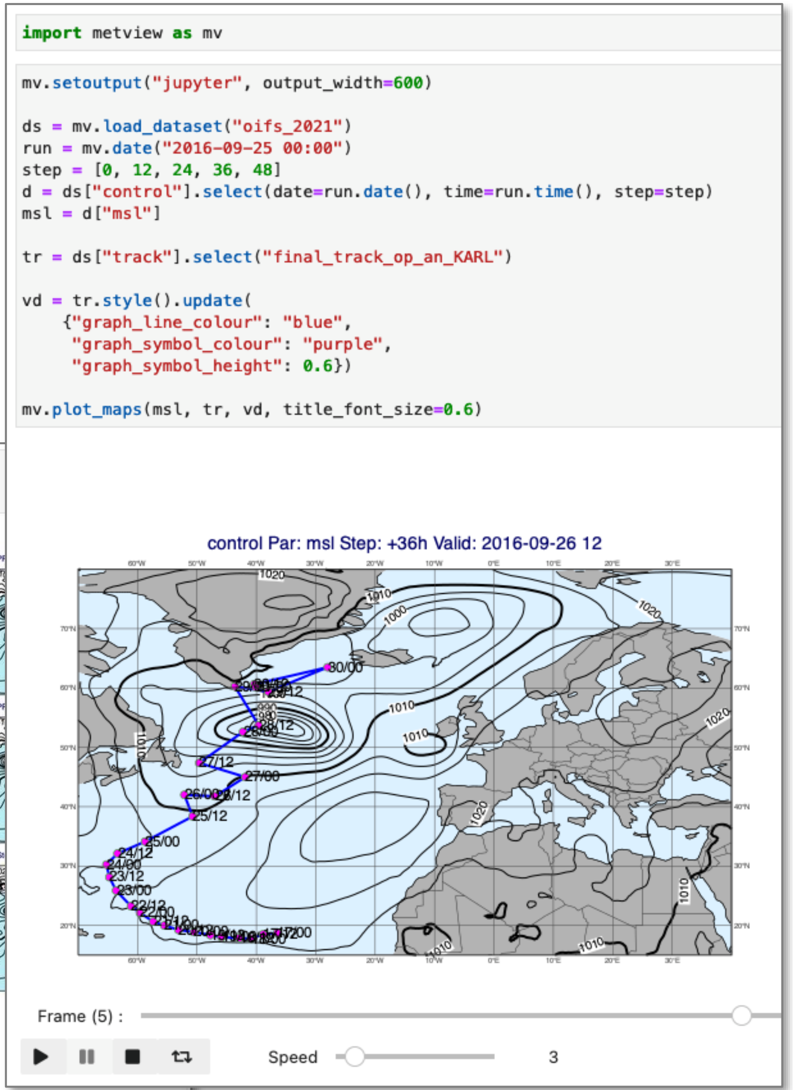
ot the data with

```
                  = "on",
```

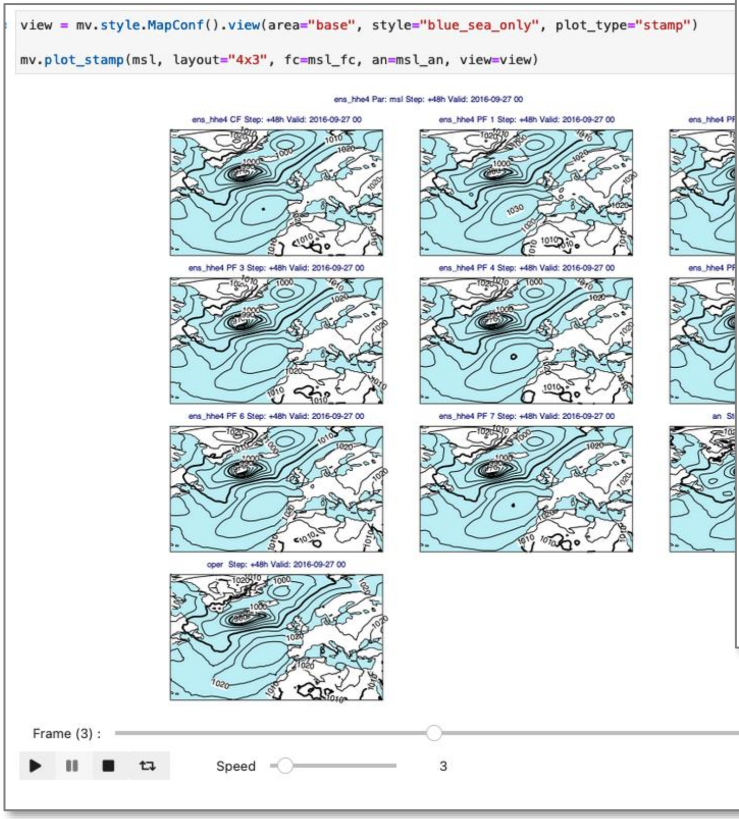
Cross section of Wind speed 20200723 00 step 12 Expver 0001
Thursday 15 December 2011 12 UTC ecmf t+12 VT:Friday 16 December 2011 00 UTC 500 hPa Wind speed
nd speed
Frame (9) :
2
Speed
3

Outline

- What is Metview
- User interface
- Python interface
- How to obtain / install
- Practical exercise using Jupyter notebooks

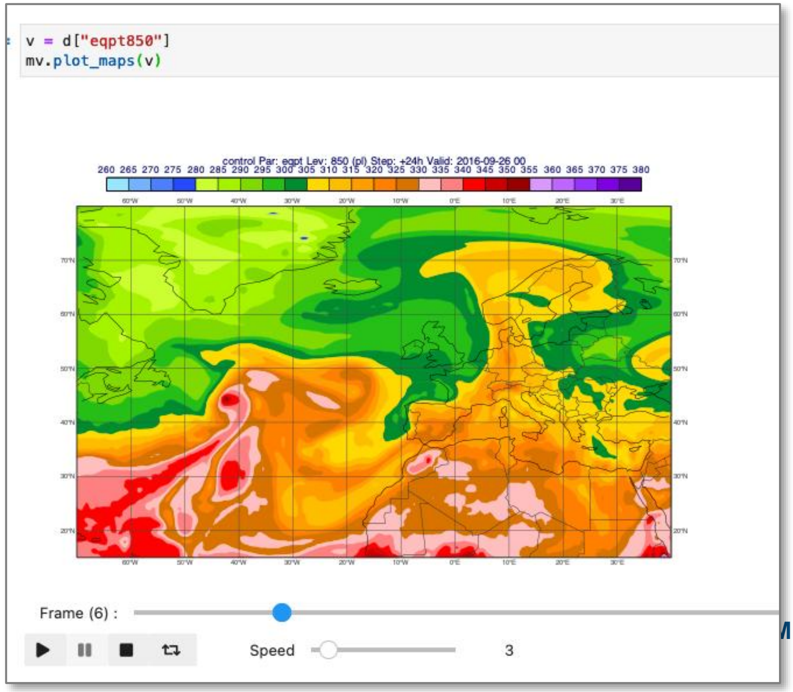


```
import metview as mv

mv.setoutput("jupyter", output_width=600)

ds = mv.load_dataset("oifs_2021")
run = mv.date("2016-09-25 00:00")
step = [0, 12, 24, 36, 48]
d = ds["control"].select(date=run.date(), time=run.time(), step=step)
msl = d["msl"]

tr = ds["track"].select("final_track_op_an_KARL")

vd = tr.style().update(
    {"graph_line_colour": "blue",
     "graph_symbol_colour": "purple",
     "graph_symbol_height": 0.6})

mv.plot_maps(msl, tr, vd, title_font_size=0.6)
```



```
view = mv.style.MapConf().view(area="base", style="blue_sea_only", plot_type="stamp")

mv.plot_stamp(msl, layout="4x3", fc=msl_fc, an=msl_an, view=view)
```

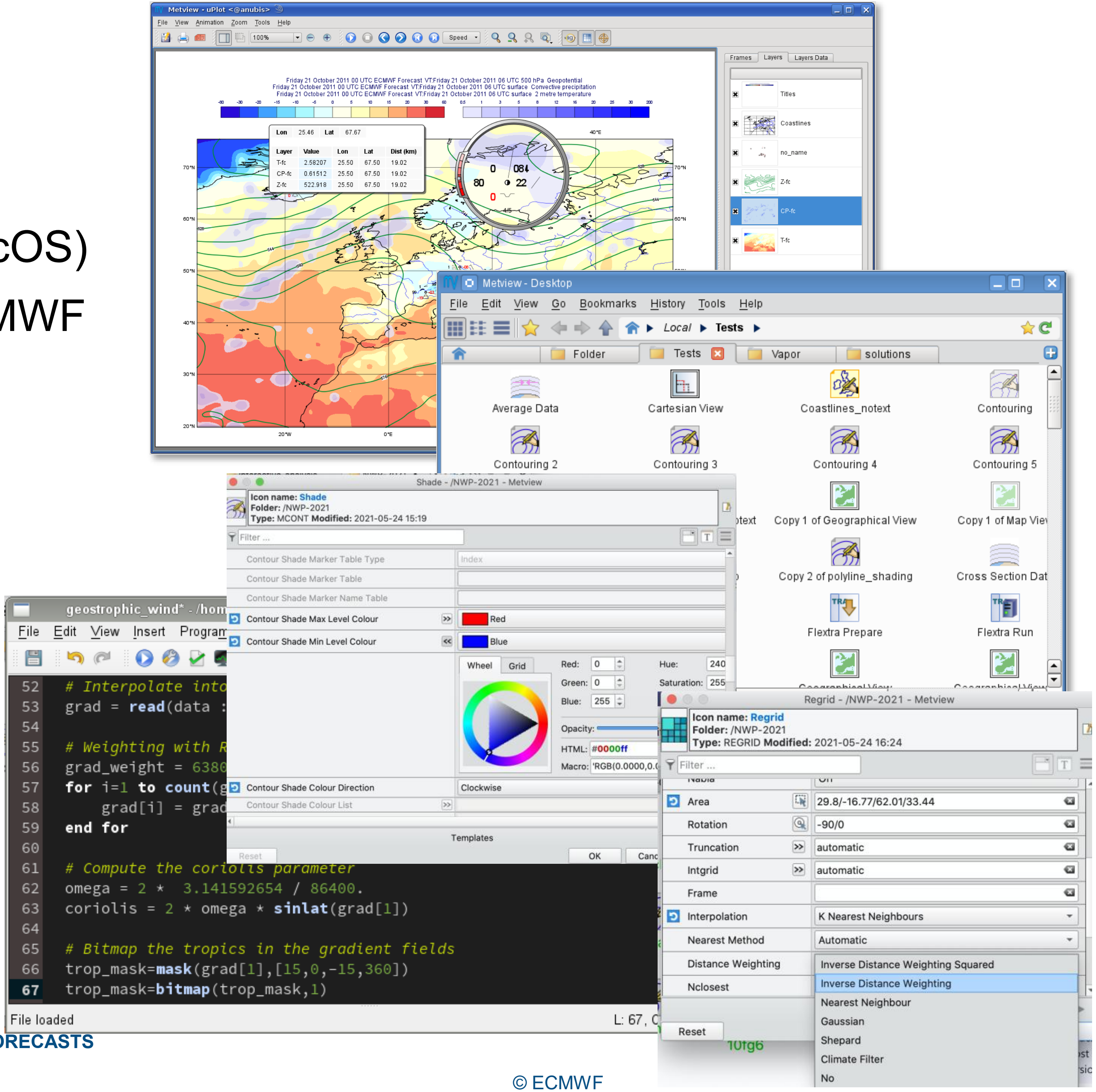
ens_hhe4 Par: msl Step: +48h Valid: 2016-09-27 00
ens_hhe4 CF Step: +48h Valid: 2016-09-27 00
ens_hhe4 PF 1 Step: +48h Valid: 2016-09-27 00
ens_hhe4 PF 3 Step: +48h Valid: 2016-09-27 00
ens_hhe4 PF 4 Step: +48h Valid: 2016-09-27 00
ens_hhe4 PF 6 Step: +48h Valid: 2016-09-27 00
ens_hhe4 PF 7 Step: +48h Valid: 2016-09-27 00
oper Step: +48h Valid: 2016-09-27 00
Frame (3) :
2
Speed
3



```
v = d["eqpt850"]
mv.plot_maps(v)
```

What is Metview?

- Workstation software, runs on UNIX, from laptops to supercomputers (including macOS)
- Developed at ECMWF, built on other ECMWF libraries
- Open source, Apache 2.0 license
- Data access
- Data processing
- Data visualisation
- Icon based user interface
- Powerful scripting languages - Macro and [Python](#)



```
# Interpolate into
grad = read(data :

# Weighting with R
grad_weight = 6380
for i=1 to count(g
    grad[i] = grad
end for

# Compute the coriolis parameter
omega = 2 *  3.141592654 / 86400.
coriolis = 2 * omega * sinlat(grad[1])

# Bitmap the tropics in the gradient fields
trop_mask=mask(grad[1],[15,0,-15,360])
trop_mask=bitmap(trop_mask,1)
```

Shade - /NWP-2021 - Metview

Icon name: Shade
Folder: /NWP-2021
Type: MCONT **Modified:** 2021-05-24 15:19

Contour Shade Marker Table Type	Index
Contour Shade Marker Table	
Contour Shade Marker Name Table	
Contour Shade Max Level Colour	🟥 Red
Contour Shade Min Level Colour	🟦 Blue
Contour Shade Colour Direction	Clockwise
Contour Shade Colour List	

Wheel Grid — Red: 0 Green: 0 Blue: 255 Hue: 240 Saturation: 255 Opacity: HTML: #0000ff Macro: 'RGB(0.0000,0.0

Templates — Reset OK Canc

Regrid - /NWP-2021 - Metview

Icon name: Regrid
Folder: /NWP-2021
Type: REGRID **Modified:** 2021-05-24 16:24

Area	29.8/-16.77/62.01/33.44
Rotation	-90/0
Truncation	automatic
Intgrid	automatic
Frame	
Interpolation	K Nearest Neighbours
Nearest Method	Automatic
Distance Weighting	Inverse Distance Weighting
Nclosest	

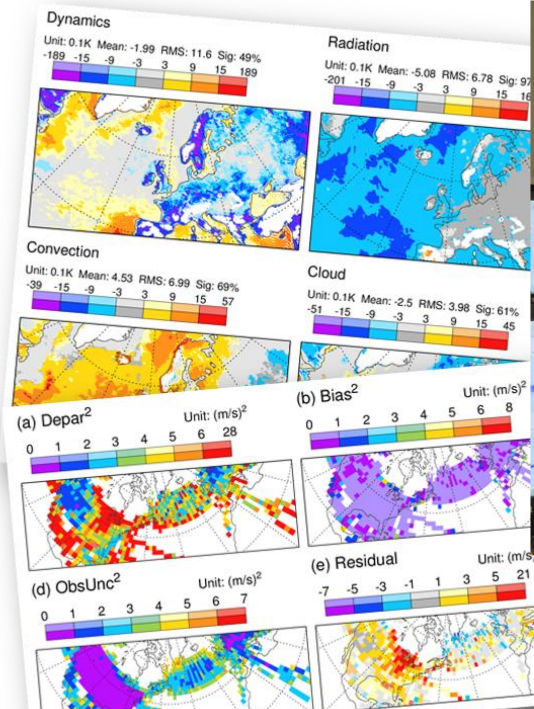
Inverse Distance Weighting Squared
Inverse Distance Weighting
Nearest Neighbour
Gaussian
Shepard
Climate Filter
No
Reset

ECMWF EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

Over 30 years of Metview so far

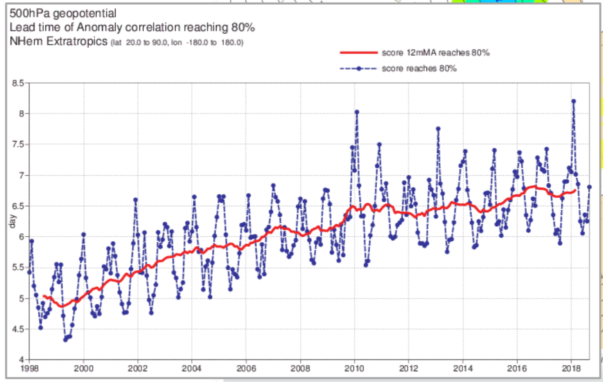
- Serving users of ECMWF data since 1993

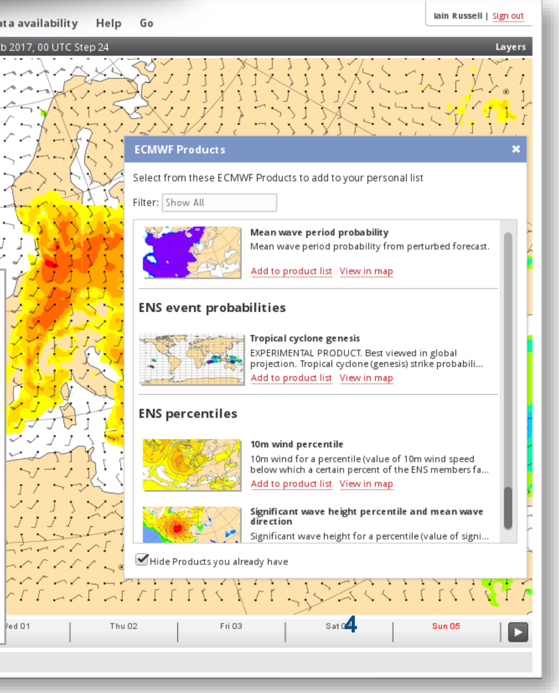
- Used daily by many analysts and researchers
  - inside and outside ECMWF
  - also by commercial users of our data


Dynamics
Unit: 0.1K Mean: -1.99 RMS: 11.6 Sig: 49%
Radiation
Unit: 0.1K Mean: -5.08 RMS: 6.78
Convection
Unit: 0.1K Mean: 4.53 RMS: 6.99 Sig: 69%
Cloud
Unit: 0.1K Mean: -2.5 RMS: 3.98 Sig: 61%
(a) Depar²
(b) Bias²
(d) ObsUnc²
(e) Residual
Unit: (m/s)²

- Some large developments, e.g. the Diagnostics Toolbox, OpenIFS workshops, Quaver (verification package) are based on top of Metview

- ecCharts is based on Metview's architecture and takes it onto the web


500hPa geopotential
Lead time of Anomaly correlation reaching 80%
NHem Extratropics (lat 20.0 to 90.0, lon -180.0 to 180.0)



Total precipitation probability - Monday 27 Feb 2017, 00 UTC VT Tuesday 28 Feb 2017, 00 UTC Step 24

ECMWF Products

Select from these ECMWF Products to add to your personal list

Filter: Show All

Mean wave period probability
Mean wave period probability from perturbed forecast.

ENS event probabilities

Tropical cyclone genesis
EXPERIMENTAL PRODUCT. Best viewed in global projection. Tropical cyclone (genesis) strike probabili...

ENS percentiles

10m wind percentile
10m wind for a percentile (value of 10m wind speed below which a certain percent of the ENS members fa...

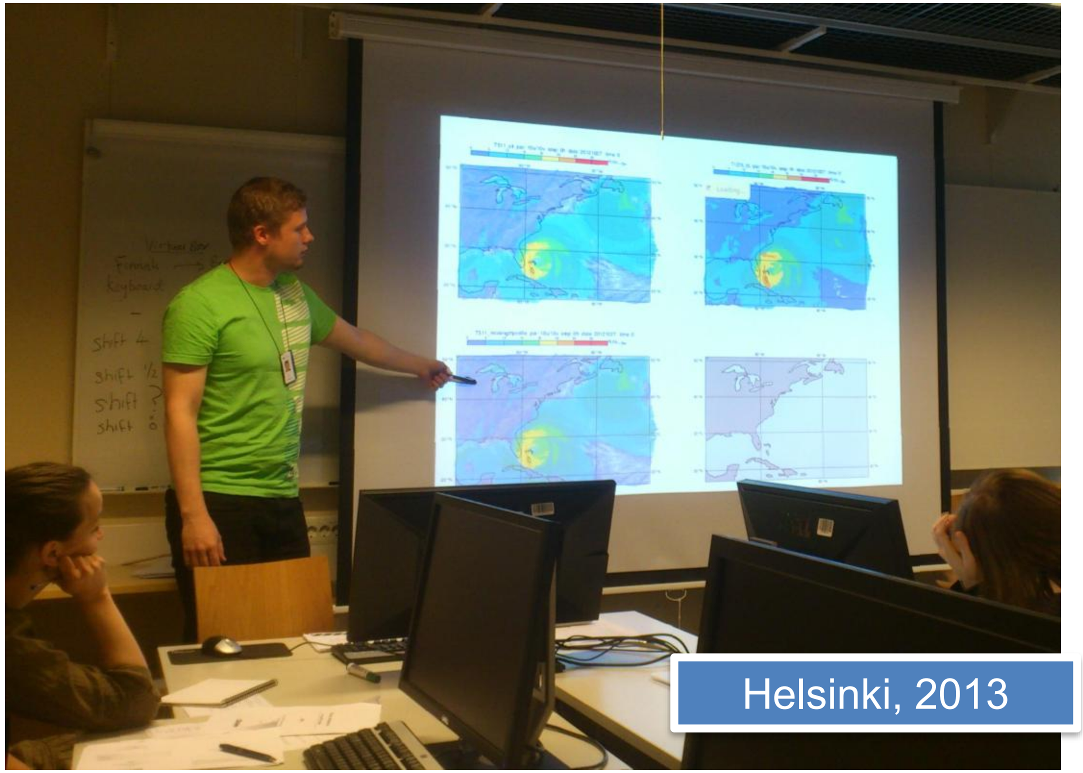
Significant wave height percentile and mean wave direction
Significant wave height for a percentile (value of signi...

☑ Hide Products you already have

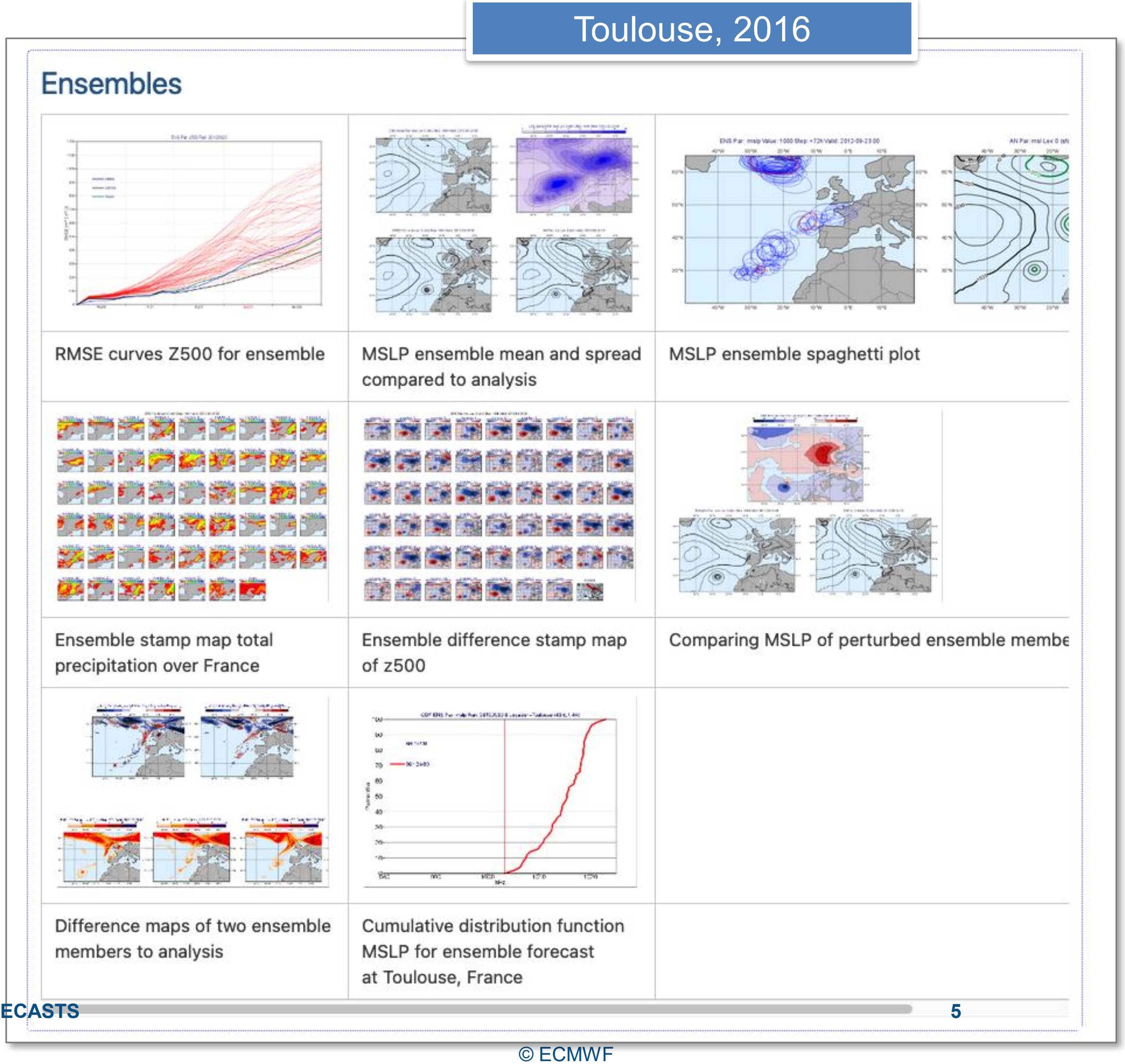
© ECMWF Chart updated (Network: 0.2s - Plot: 2.5s)

Metview and OpenIFS

- In previous OpenIFS user workshops case studies were based on custom Metview Macro libraries; now we use Metview Python



Helsinki, 2013

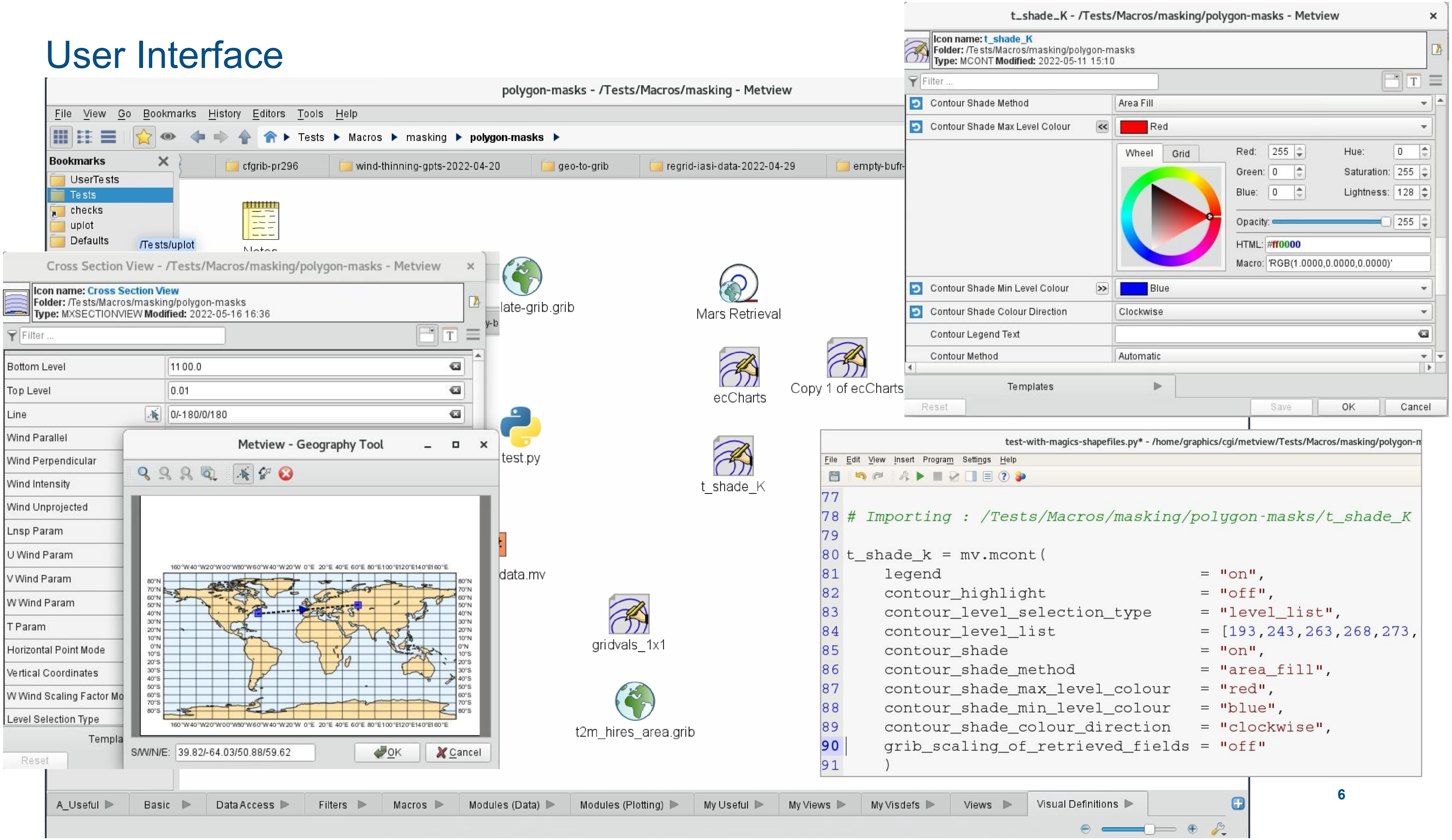


Toulouse, 2016

Ensembles

RMSE curves Z500 for ensemble	MSLP ensemble mean and spread compared to analysis	MSLP ensemble spaghetti plot
Ensemble stamp map total precipitation over France	Ensemble difference stamp map of z500	Comparing MSLP of perturbed ensemble membe
Difference maps of two ensemble members to analysis	Cumulative distribution function MSLP for ensemble forecast at Toulouse, France	

User Interface


polygon-masks - /Tests/Macros/masking - Metview
File View Go Bookmarks History Editors Tools Help
Tests ▶ Macros ▶ masking ▶ polygon-masks ▶
Bookmarks
UserTests
Tests
checks
uplot
Defaults
/Tests/uplot
cfgrib-pr296
wind-thinning-gpts-2022-04-20
geo-to-grib
regrid-iasi-data-2022-04-29
empty-bufr-
Notes
late-grib.grib
Mars Retrieval
ecCharts
Copy 1 of ecCharts
test.py
t_shade_K
data.mv
gridvals_1x1
t2m_hires_area.grib
A_Useful ▶
Basic ▶
Data Access ▶
Filters ▶
Macros ▶
Modules (Data) ▶
Modules (Plotting) ▶
My Useful ▶
My Views ▶
My Visdefs ▶
Views ▶
Visual Definitions ▶
Cross Section View - /Tests/Macros/masking/polygon-masks - Metview
Filter ...
Templa
Reset
Metview - Geography Tool
OK
Cancel
t_shade_K - /Tests/Macros/masking/polygon-masks - Metview
Filter ...
Wheel
Grid
Templates ▶
Reset
Save
OK
Cancel
test-with-magics-shapefiles.py* - /home/graphics/cgi/metview/Tests/Macros/masking/polygon-m
File Edit View Insert Program Settings Help

Icon name: Cross Section View
Folder: /Tests/Macros/masking/polygon-masks
Type: MXSECTIONVIEW **Modified:** 2022-05-16 16:36

Bottom Level	1100.0
Top Level	0.01
Line	0/-180/0/180
Wind Parallel	
Wind Perpendicular	
Wind Intensity	
Wind Unprojected	
Lnsp Param	
U Wind Param	
V Wind Param	
W Wind Param	
T Param	
Horizontal Point Mode	
Vertical Coordinates	
W Wind Scaling Factor Mo	
Level Selection Type	

S/W/N/E: 39.82/-64.03/50.88/59.62

Icon name: t_shade_K
Folder: /Tests/Macros/masking/polygon-masks
Type: MCONT **Modified:** 2022-05-11 15:10

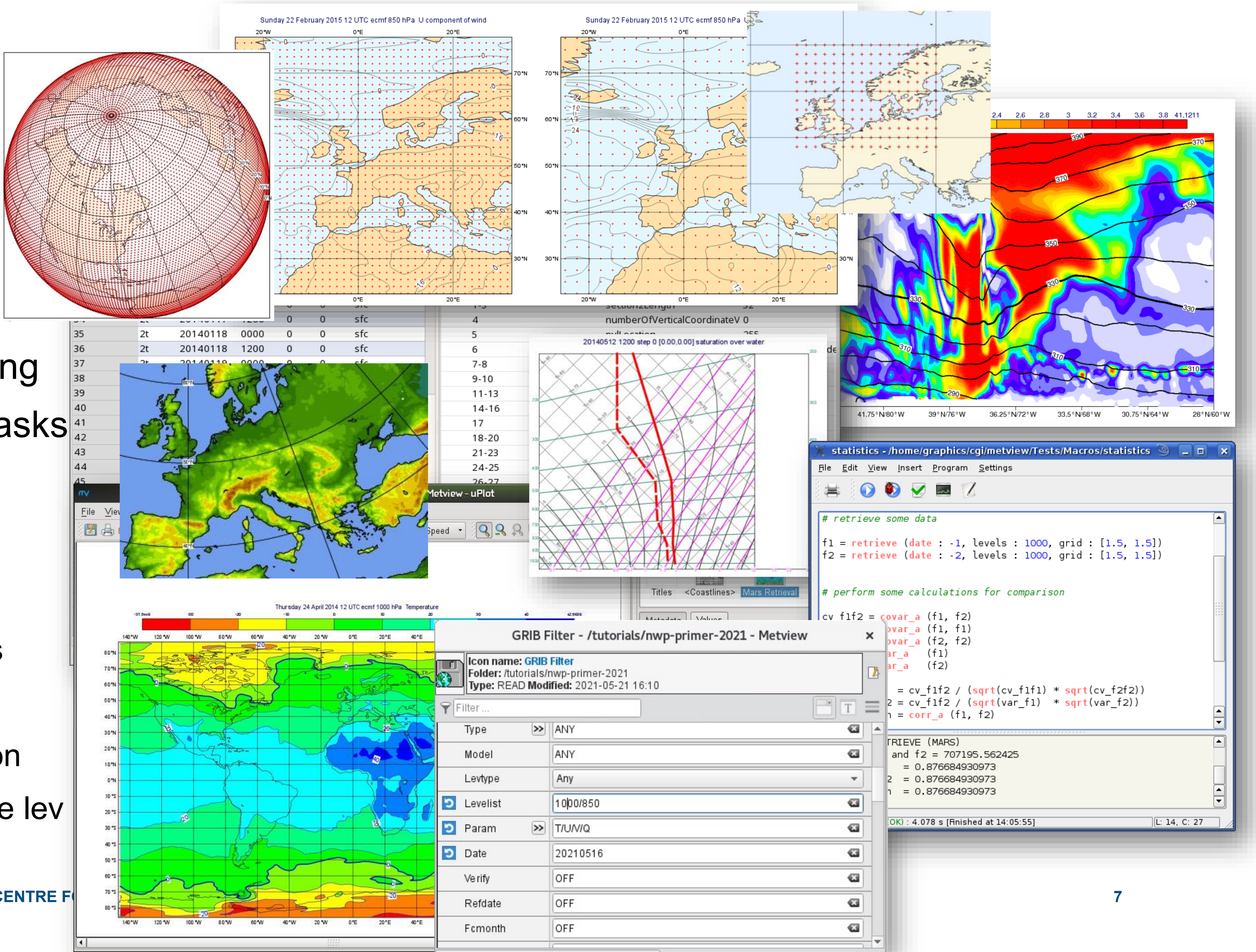
Contour Shade Method	Area Fill
Contour Shade Max Level Colour	Red
Contour Shade Min Level Colour	Blue
Contour Shade Colour Direction	Clockwise
Contour Legend Text	
Contour Method	Automatic

Red: 255 Green: 0 Blue: 0
Hue: 0 Saturation: 255 Lightness: 128
Opacity: 255
HTML: #ff0000
Macro: 'RGB(1.0000,0.0000,0.0000)'

```

# Importing : /Tests/Macros/masking/polygon-masks/t_shade_K

t_shade_k = mv.mcont(
    legend                             = "on",
    contour_highlight                  = "off",
    contour_level_selection_type       = "level_list",
    contour_level_list                 = [193,243,263,268,273,
    contour_shade                      = "on",
    contour_shade_method               = "area_fill",
    contour_shade_max_level_colour     = "red",
    contour_shade_min_level_colour     = "blue",
    contour_shade_colour_direction     = "clockwise",
    grib_scaling_of_retrieved_fields = "off"
    )
```

Metview + GRIB

- Plot
- Examine
- Filter
- Spectral transform
- Regridding, cropping
- Missing values, masks
- Maths, Boolean
- Specialised:
  - Cross section
  - Thermodynamics
  - Gradient
  - Vertical integration
  - Model to pressure lev
  - Etc


Sunday 22 February 2015 12 UTC ecmf 850 hPa U component of wind
Sunday 22 February 2015 12 UTC ecmf 850 hPa
20140512 1200 step 0 [0.00,0.00] saturation over water
Thursday 24 April 2014 12 UTC ecmf 1000 hPa Temperature
41.75°N/80°W
39°N/76°W
36.25°N/72°W
33.5°N/68°W
30.75°N/64°W
28°N/60°W
35 2t 20140118 0000 0 0 sfc
36 2t 20140118 1200 0 0 sfc
numberOfVerticalCoordinateV 0
Metview - uPlot
Titles
<Coastlines>
Mars Retrieval
File
Edit
View
Insert
Program
Settings

statistics - /home/graphics/cgi/metview/Tests/Macros/statistics

```
# 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)
          ovar_a (f1, f1)
          ovar_a (f2, f2)
          ar_a   (f1)
          ar_a   (f2)

   = cv_f1f2 / (sqrt(cv_f1f1) * sqrt(cv_f2f2))
  2 = cv_f1f2 / (sqrt(var_f1)  * sqrt(var_f2))
  n = corr_a (f1, f2)
```

```
TRIEVE (MARS)
 and f2 = 707195.562425
     = 0.876684930973
2    = 0.876684930973
n    = 0.876684930973
```

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

GRIB Filter - /tutorials/nwp-primer-2021 - Metview

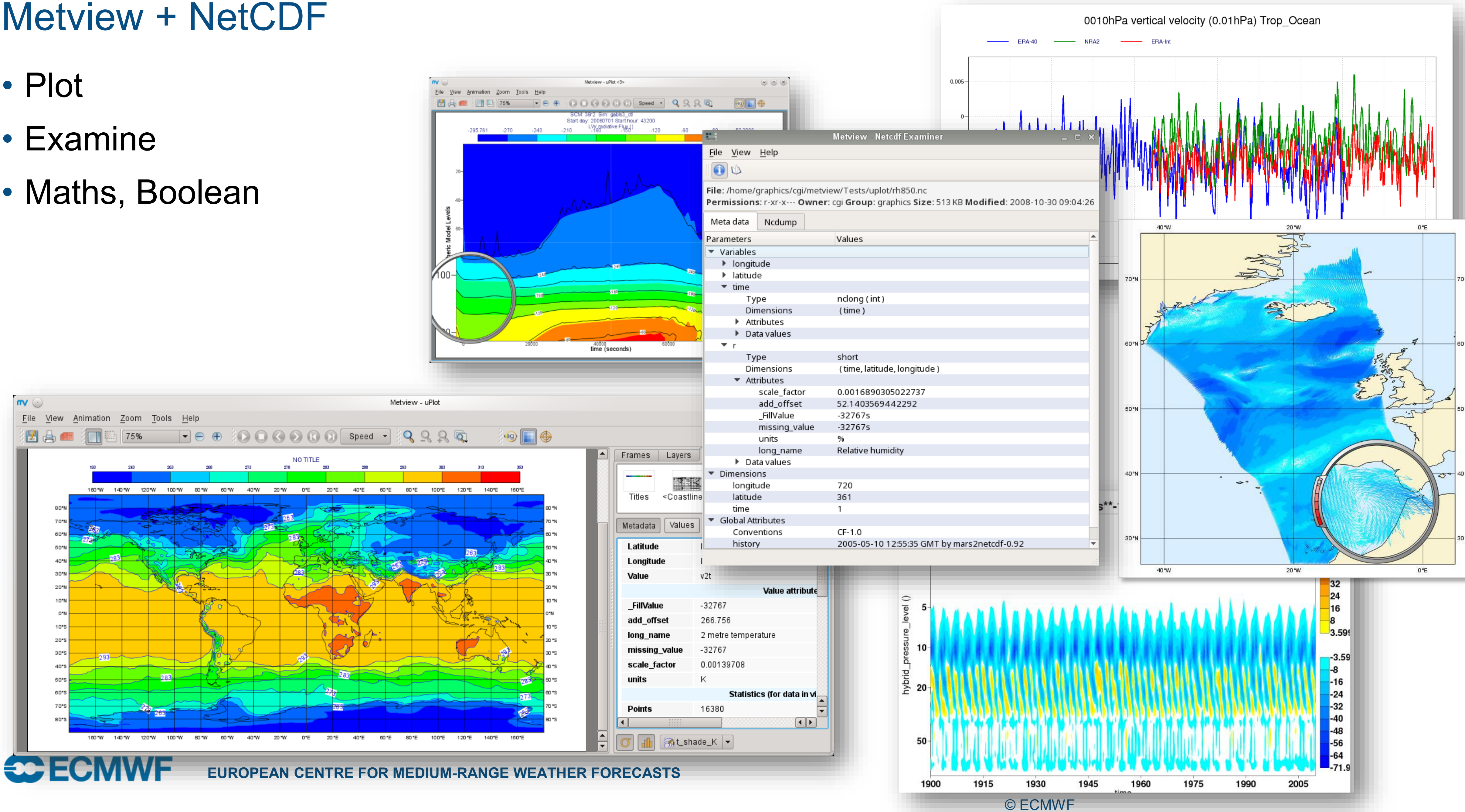
Icon name: GRIB Filter
Folder: /tutorials/nwp-primer-2021
Type: READ **Modified:** 2021-05-21 16:10

Filter ...

Type	ANY
Model	ANY
Levtype	Any
Levelist	1000/850
Param	T/U/V/Q
Date	20210516
Verify	OFF
Refdate	OFF
Fcmonth	OFF

Metview + NetCDF

- Plot
- Examine
- Maths, Boolean



Metview - Netcdf Examiner

File View Help

File: /home/graphics/cgi/metview/Tests/uplot/rh850.nc
Permissions: r-xr-x--- **Owner:** cgi **Group:** graphics **Size:** 513 KB **Modified:** 2008-10-30 09:04:26

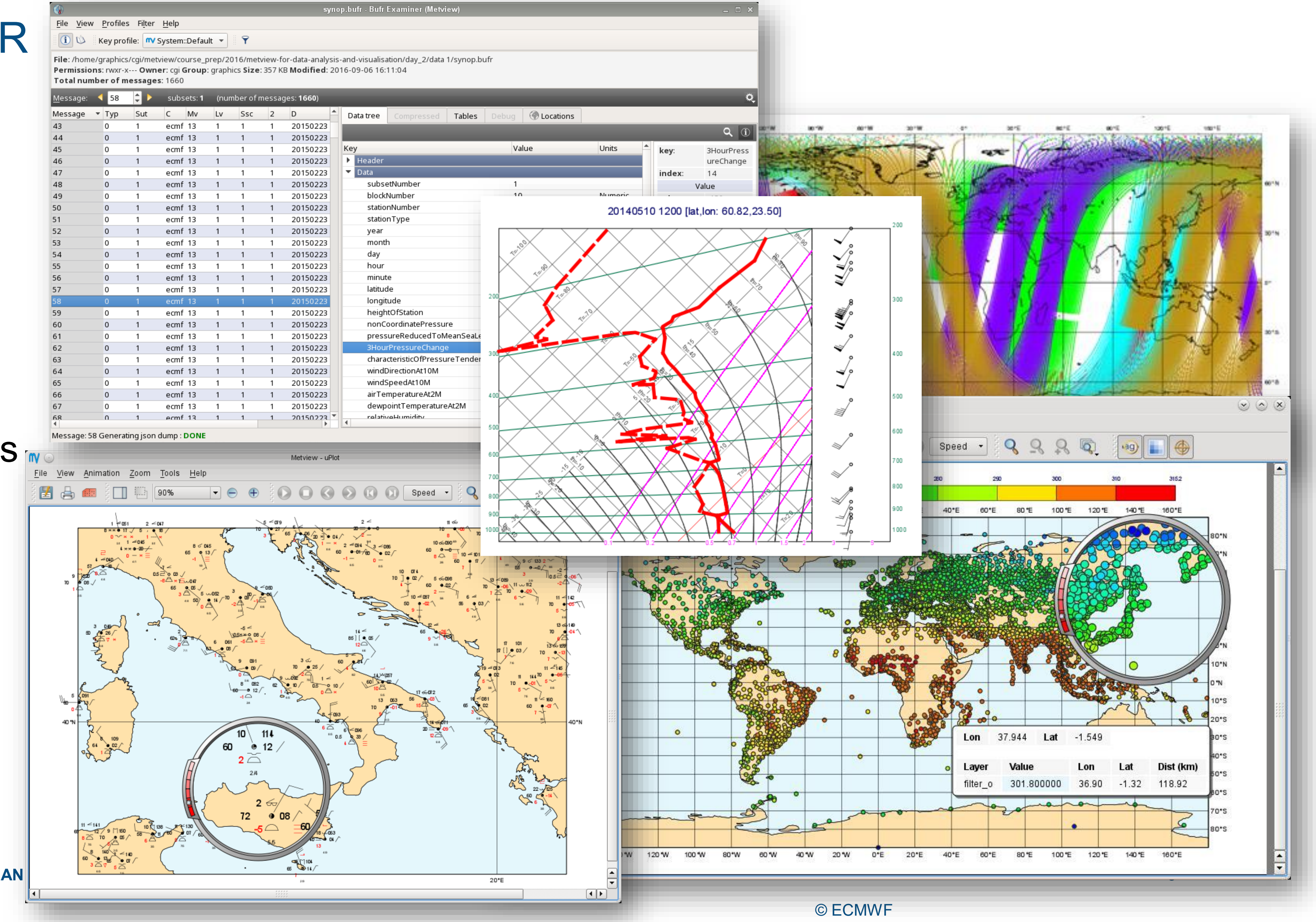
Meta data | Ncdump

```
Parameters                 Values
▾ Variables
   ▸ longitude
   ▸ latitude
   ▾ time
        Type               nclong ( int )
        Dimensions         ( time )
      ▸ Attributes
      ▸ Data values
   ▾ r
        Type               short
        Dimensions         ( time, latitude, longitude )
      ▾ Attributes
           scale_factor    0.0016890305022737
           add_offset      52.1403569442292
           _FillValue      -32767s
           missing_value   -32767s
           units           %
           long_name       Relative humidity
      ▸ Data values
▾ Dimensions
     longitude             720
     latitude              361
     time                  1
▾ Global Attributes
     Conventions           CF-1.0
     history               2005-05-10 12:55:35 GMT by mars2netcdf-0.92
```

Latitude	
Longitude	
Value	v2t
	Value attribute
_FillValue	-32767
add_offset	266.756
long_name	2 metre temperature
missing_value	-32767
scale_factor	0.00139708
units	K
	Statistics (for data in vi
Points	16380

Metview + BUFR

- Plot
- Examine
- Filter
- Extract values
- Convert to Geopoints
- Thermodynamics



synop.bufr - Bufr Examiner (Metview)

Key profile: System::Default

File: /home/graphics/cgi/metview/course_prep/2016/metview-for-data-analysis-and-visualisation/day_2/data 1/synop.bufr
Permissions: rwxr-x--- **Owner**: cgi **Group**: graphics **Size**: 357 KB **Modified**: 2016-09-06 16:11:04
Total number of messages: 1660

Message: 58 subsets: **1** (number of messages: **1660**)

Message	Typ	Sut	C	Mv	Lv	Ssc	2	D
43	0	1	ecmf	13	1	1	1	20150223
44	0	1	ecmf	13	1	1	1	20150223
45	0	1	ecmf	13	1	1	1	20150223
46	0	1	ecmf	13	1	1	1	20150223
47	0	1	ecmf	13	1	1	1	20150223
48	0	1	ecmf	13	1	1	1	20150223
49	0	1	ecmf	13	1	1	1	20150223
50	0	1	ecmf	13	1	1	1	20150223
51	0	1	ecmf	13	1	1	1	20150223
52	0	1	ecmf	13	1	1	1	20150223
53	0	1	ecmf	13	1	1	1	20150223
54	0	1	ecmf	13	1	1	1	20150223
55	0	1	ecmf	13	1	1	1	20150223
56	0	1	ecmf	13	1	1	1	20150223
57	0	1	ecmf	13	1	1	1	20150223
58	0	1	ecmf	13	1	1	1	20150223
59	0	1	ecmf	13	1	1	1	20150223
60	0	1	ecmf	13	1	1	1	20150223
61	0	1	ecmf	13	1	1	1	20150223
62	0	1	ecmf	13	1	1	1	20150223
63	0	1	ecmf	13	1	1	1	20150223
64	0	1	ecmf	13	1	1	1	20150223
65	0	1	ecmf	13	1	1	1	20150223
66	0	1	ecmf	13	1	1	1	20150223
67	0	1	ecmf	13	1	1	1	20150223
68	0	1	ecmf	13	1	1	1	20150223

Key	Value	Units
Header		
Data		
subsetNumber	1	
blockNumber	10	Numeric
stationNumber		
stationType		
year		
month		
day		
hour		
minute		
latitude		
longitude		
heightOfStation		
nonCoordinatePressure		
pressureReducedToMeanSeaLe		
3HourPressureChange		
characteristicOfPressureTender		
windDirectionAt10M		
windSpeedAt10M		
airTemperatureAt2M		
dewpointTemperatureAt2M		
relativeHumidity		

key: 3HourPressureChange
index: 14

Message: 58 Generating json dump : DONE

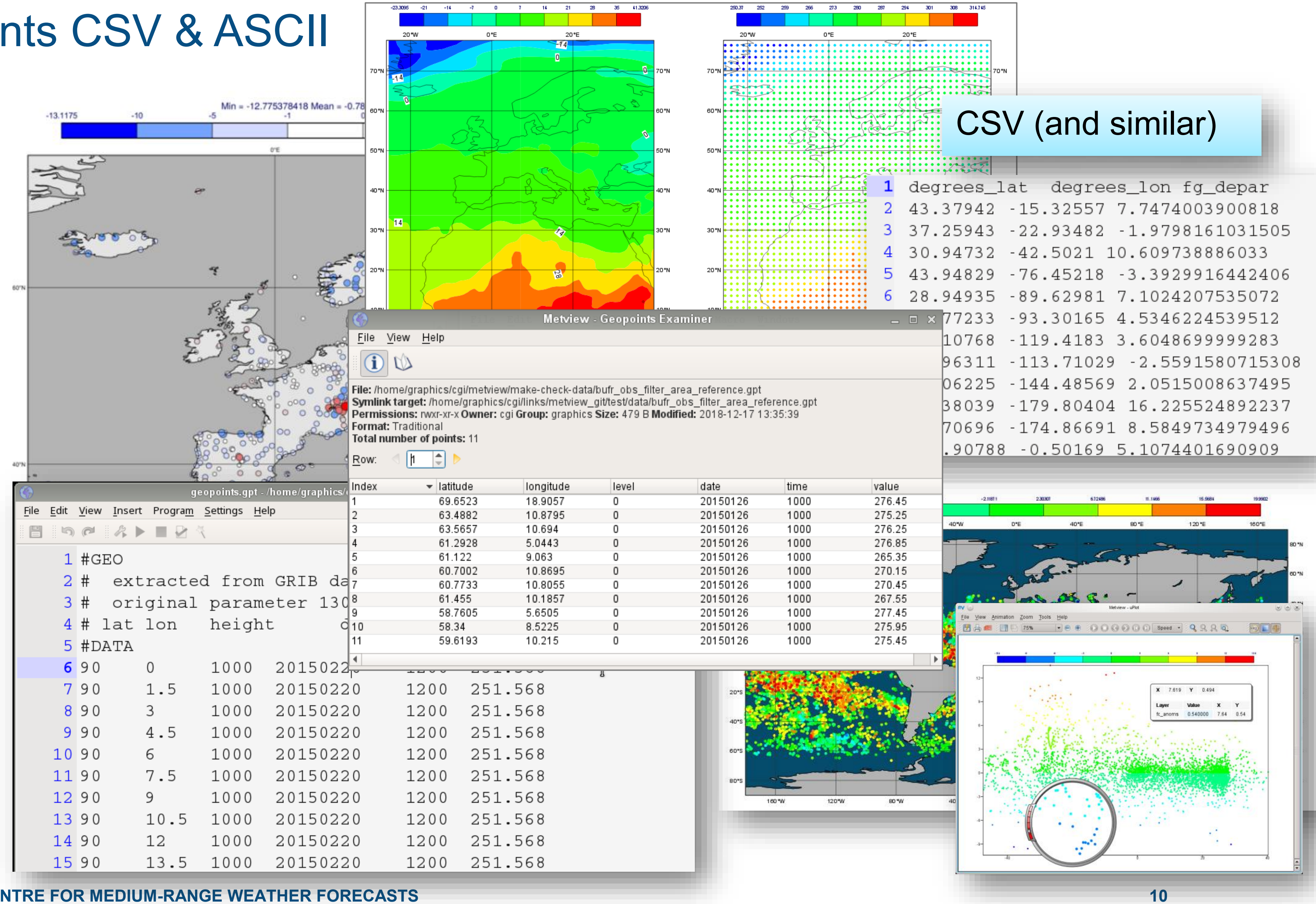
20140510 1200 [lat,lon: 60.82,23.50]

Lon 37.944 Lat -1.549

Layer	Value	Lon	Lat	Dist (km)
filter_o	301.800000	36.90	-1.32	118.92

Metview + Geopoints CSV & ASCII

- Geopoints – geo-located values
- Plot
- Examine
- Filter
- Maths, Boolean
- Geo functions
- Convert between GRIB, BUFR and Geopoints
- Can also read CSV



CSV (and similar)

```
degrees_lat  degrees_lon fg_depar
43.37942 -15.32557 7.7474003900818
37.25943 -22.93482 -1.9798161031505
30.94732 -42.5021 10.609738886033
43.94829 -76.45218 -3.3929916442406
28.94935 -89.62981 7.1024207535072
77233 -93.30165 4.5346224539512
10768 -119.4183 3.6048699999283
96311 -113.71029 -2.5591580715308
06225 -144.48569 2.0515008637495
38039 -179.80404 16.225524892237
70696 -174.86691 8.5849734979496
.90788 -0.50169 5.1074401690909
```

Metview - Geopoints Examiner

File: /home/graphics/cgi/metview/make-check-data/bufr_obs_filter_area_reference.gpt
Symlink target: /home/graphics/cgi/links/metview_git/test/data/bufr_obs_filter_area_reference.gpt
Permissions: rwxr-xr-x **Owner:** cgi **Group:** graphics **Size:** 479 B **Modified:** 2018-12-17 13:35:39
Format: Traditional
Total number of points: 11

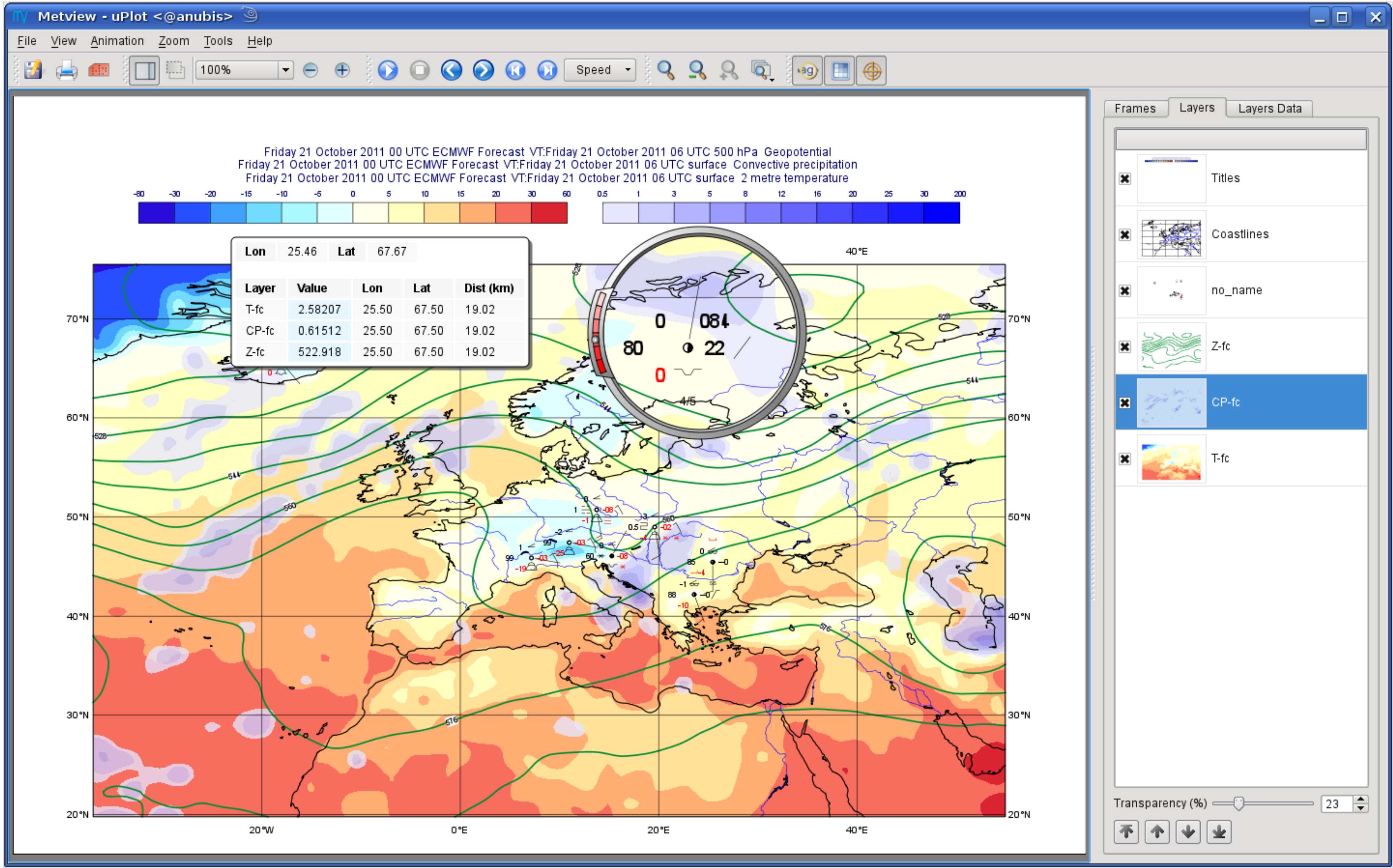
Row: 1

Index	latitude	longitude	level	date	time	value
1	69.6523	18.9057	0	20150126	1000	276.45
2	63.4882	10.8795	0	20150126	1000	275.25
3	63.5657	10.694	0	20150126	1000	276.25
4	61.2928	5.0443	0	20150126	1000	276.85
5	61.122	9.063	0	20150126	1000	265.35
6	60.7002	10.8695	0	20150126	1000	270.15
7	60.7733	10.8055	0	20150126	1000	270.45
8	61.455	10.1857	0	20150126	1000	267.55
9	58.7605	5.6505	0	20150126	1000	277.45
10	58.34	8.5225	0	20150126	1000	275.95
11	59.6193	10.215	0	20150126	1000	275.45

geopoints.gpt - /home/graphics/

```
#GEO
#  extracted from GRIB da
#  original parameter 130
# lat lon    height      d
#DATA
90     0     1000  2015022
90     1.5   1000  20150220    1200  251.568
90     3     1000  20150220    1200  251.568
90     4.5   1000  20150220    1200  251.568
90     6     1000  20150220    1200  251.568
90     7.5   1000  20150220    1200  251.568
90     9     1000  20150220    1200  251.568
90     10.5  1000  20150220    1200  251.568
90     12    1000  20150220    1200  251.568
90     13.5  1000  20150220    1200  251.568
```

Visualisation - Overlay



Friday 21 October 2011 00 UTC ECMWF Forecast VT:Friday 21 October 2011 06 UTC 500 hPa Geopotential
Friday 21 October 2011 00 UTC ECMWF Forecast VT:Friday 21 October 2011 06 UTC surface Convective precipitation
Friday 21 October 2011 00 UTC ECMWF Forecast VT:Friday 21 October 2011 06 UTC surface 2 metre temperature

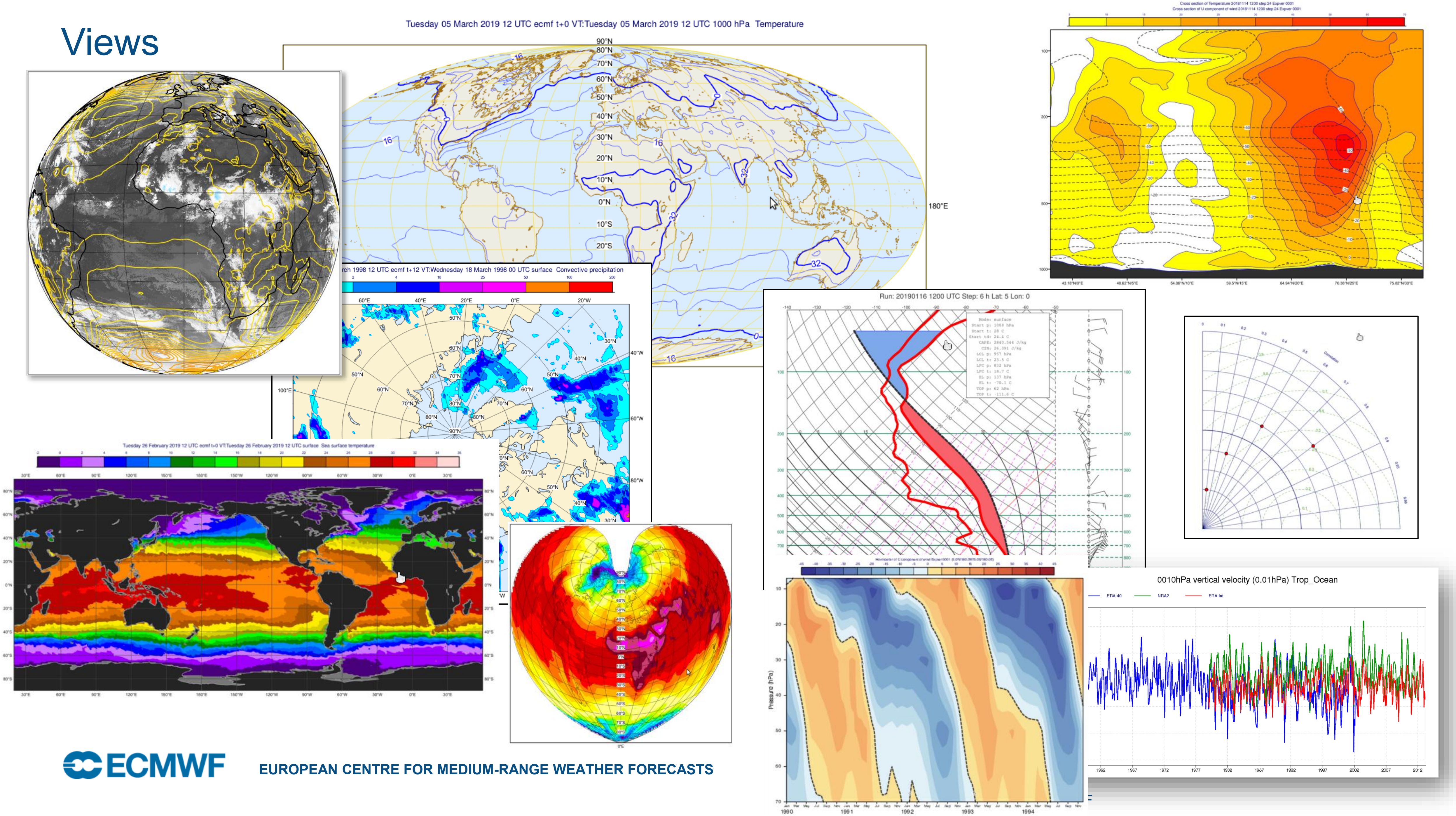
Lon	25.46	Lat	67.67

Layer	Value	Lon	Lat	Dist (km)
T-fc	2.58207	25.50	67.50	19.02
CP-fc	0.61512	25.50	67.50	19.02
Z-fc	522.918	25.50	67.50	19.02

100%

Transparency (%) 23

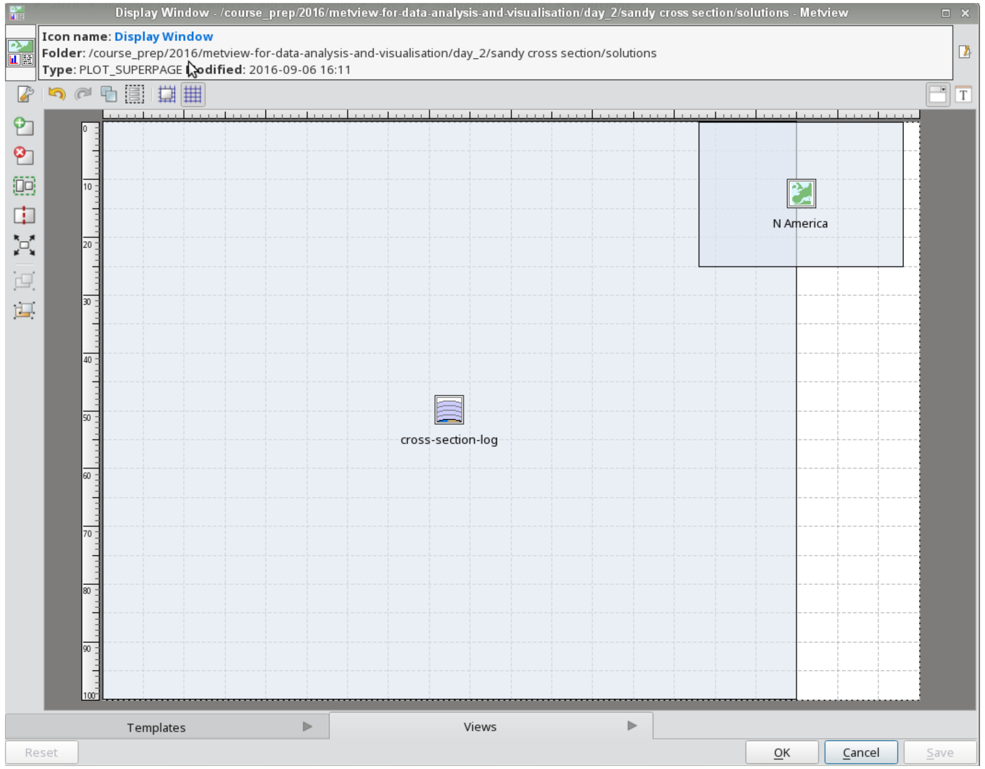
Views



ECMWF EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

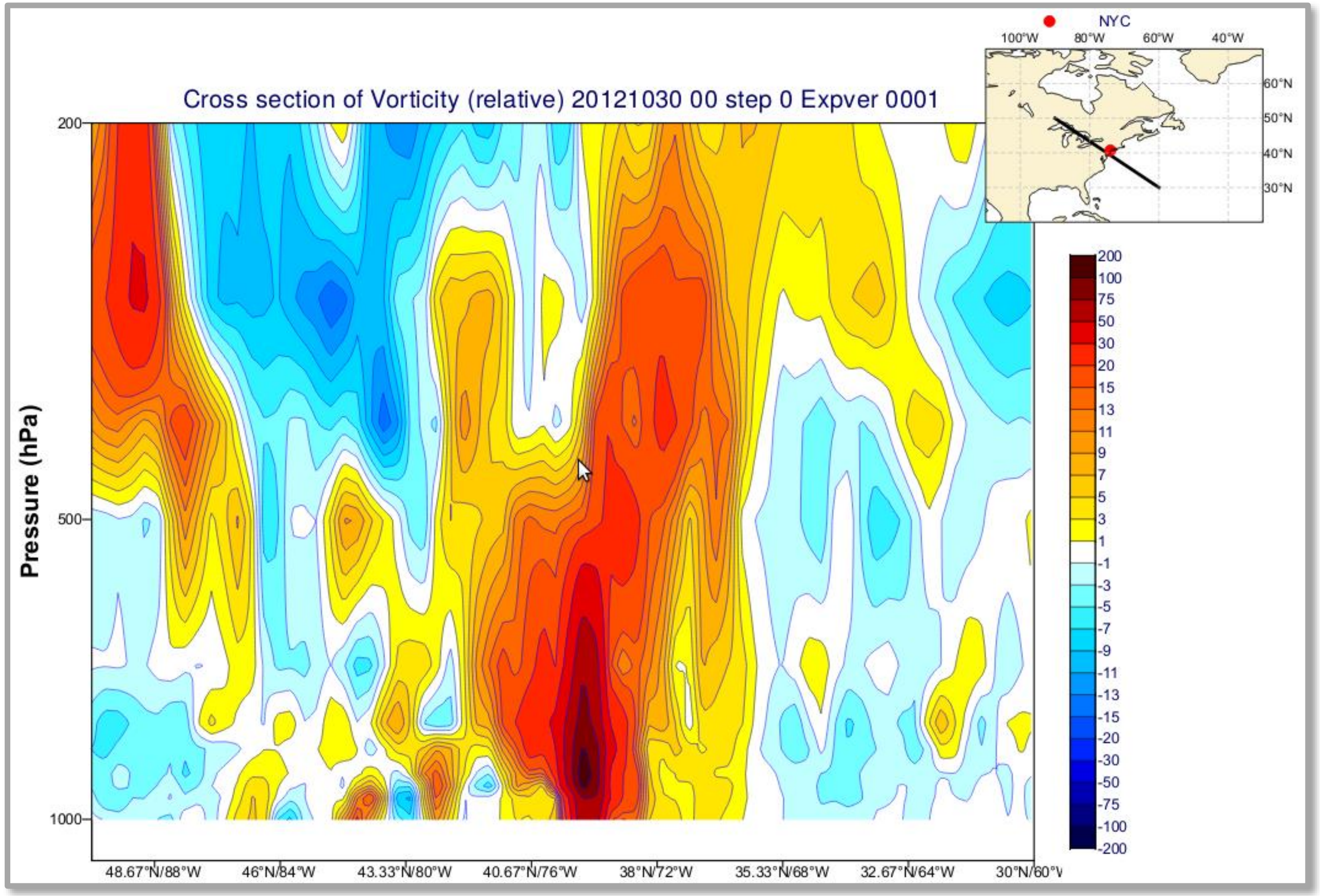
Visualisation - Layout

Layout editor allows any number of different views to be combined



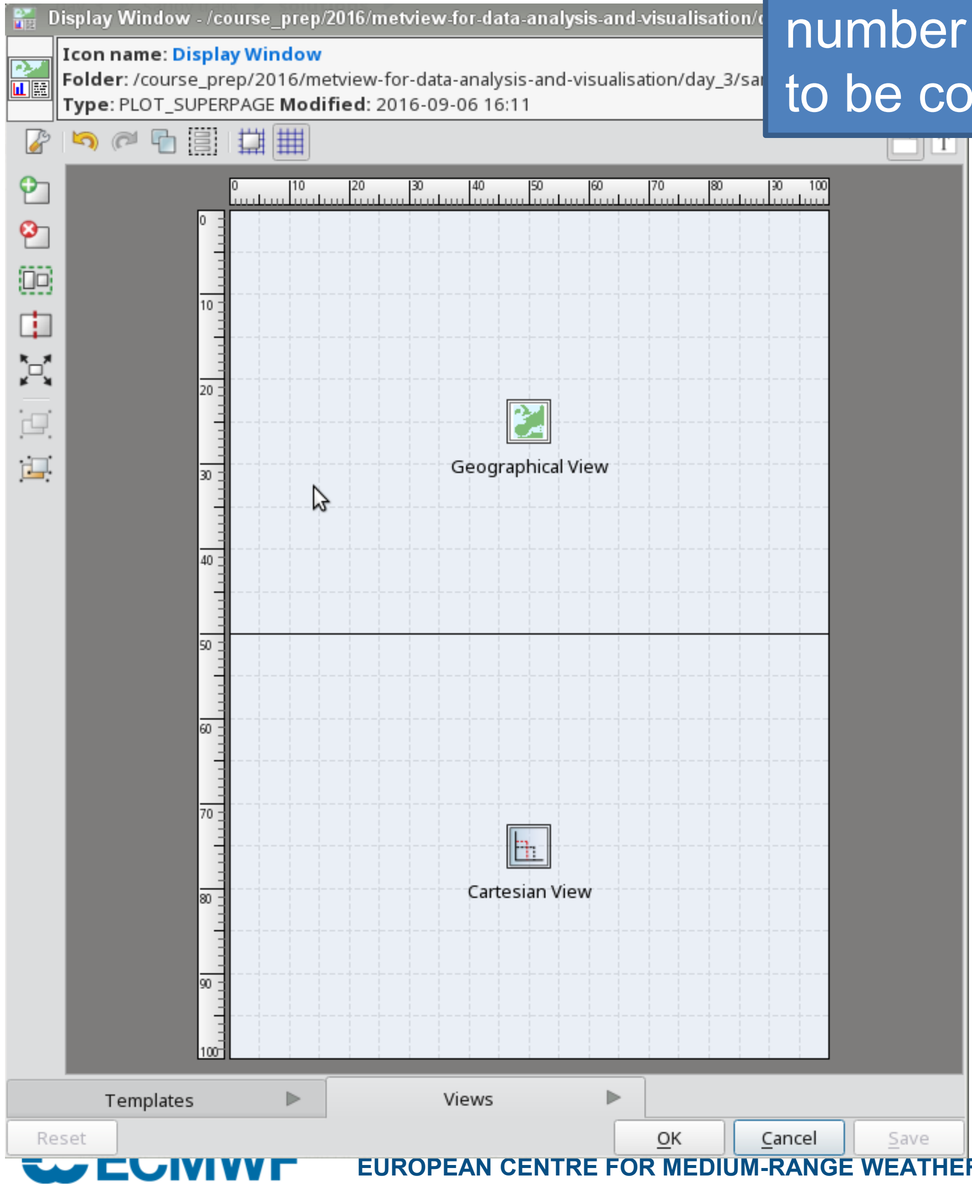
Display Window - /course_prep/2016/metview-for-data-analysis-and-visualisation/day_2/sandy cross section/solutions - Metview

Icon name: Display Window
Folder: /course_prep/2016/metview-for-data-analysis-and-visualisation/day_2/sandy cross section/solutions
Type: PLOT_SUPERPAGE **Modified:** 2016-09-06 16:11



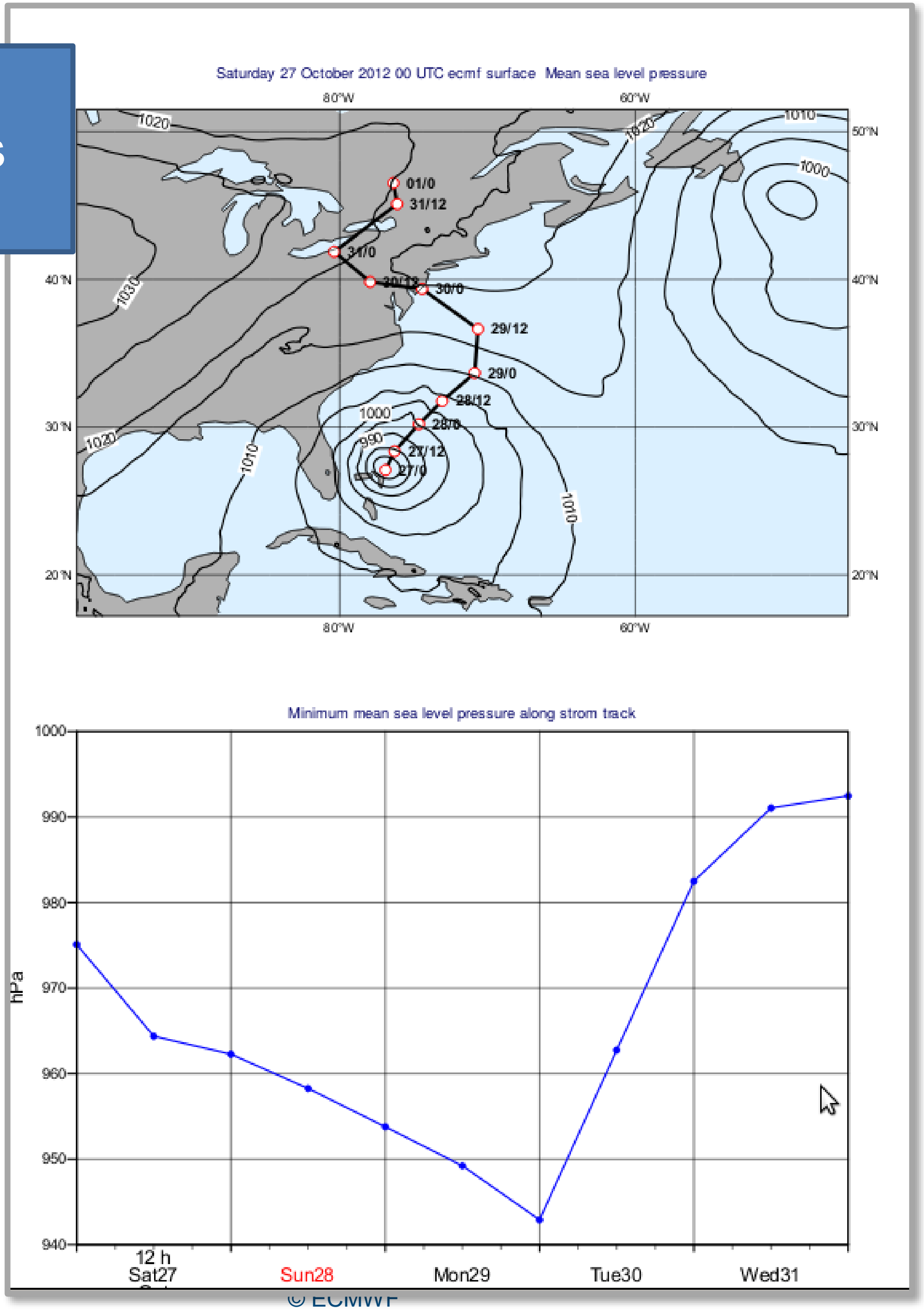
Visualisation - Layout

Layout editor allows any number of different views to be combined



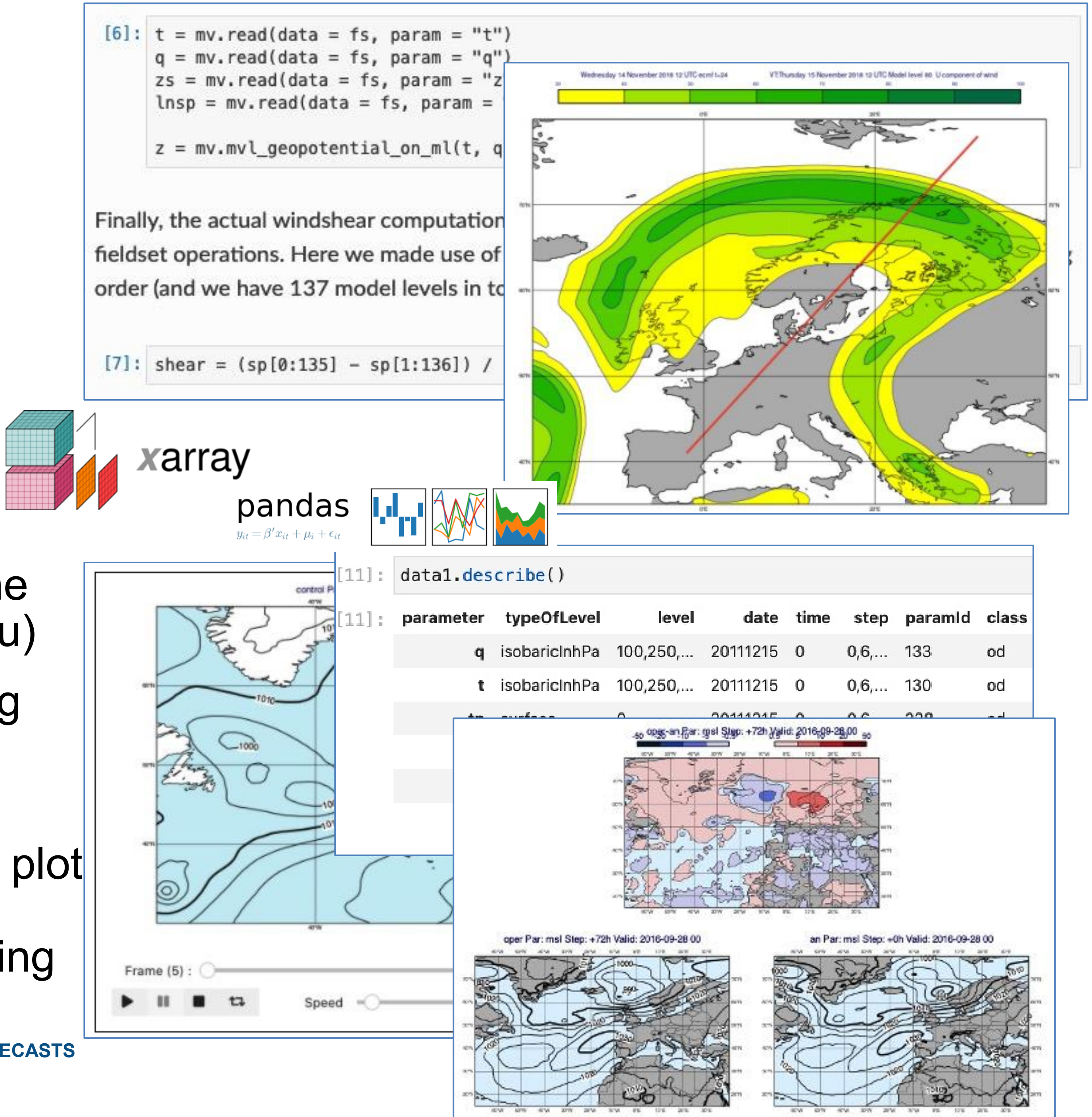
Display Window - /course_prep/2016/metview-for-data-analysis-and-visualisation/

Icon name: Display Window
Folder: /course_prep/2016/metview-for-data-analysis-and-visualisation/day_3/sa
Type: PLOT_SUPERPAGE **Modified:** 2016-09-06 16:11



Metview's Python interface

- Gives access to Metview's data retrieval, processing and visualisation capabilities in Python
- GRIB data is loaded as a *Fieldset*
- Can also return data as numpy, pandas and xarray
- Works with the user interface or standalone (UI can even generate Python code for you)
- New features include an interactive plotting widget and data overview functions
- We will use some new helper functions designed to give one-line access to useful plot layouts and styles ; also *datasets* – combination of data and pre-prepared styling



```
[6]: t = mv.read(data = fs, param = "t")
     q = mv.read(data = fs, param = "q")
     zs = mv.read(data = fs, param = "z
     lnsp = mv.read(data = fs, param =

     z = mv.mvl_geopotential_on_ml(t, q
```

Finally, the actual windshear computation
fieldset operations. Here we made use of
order (and we have 137 model levels in to

```
[7]: shear = (sp[0:135] - sp[1:136]) /
```

```
[11]: data1.describe()
```

[11]:

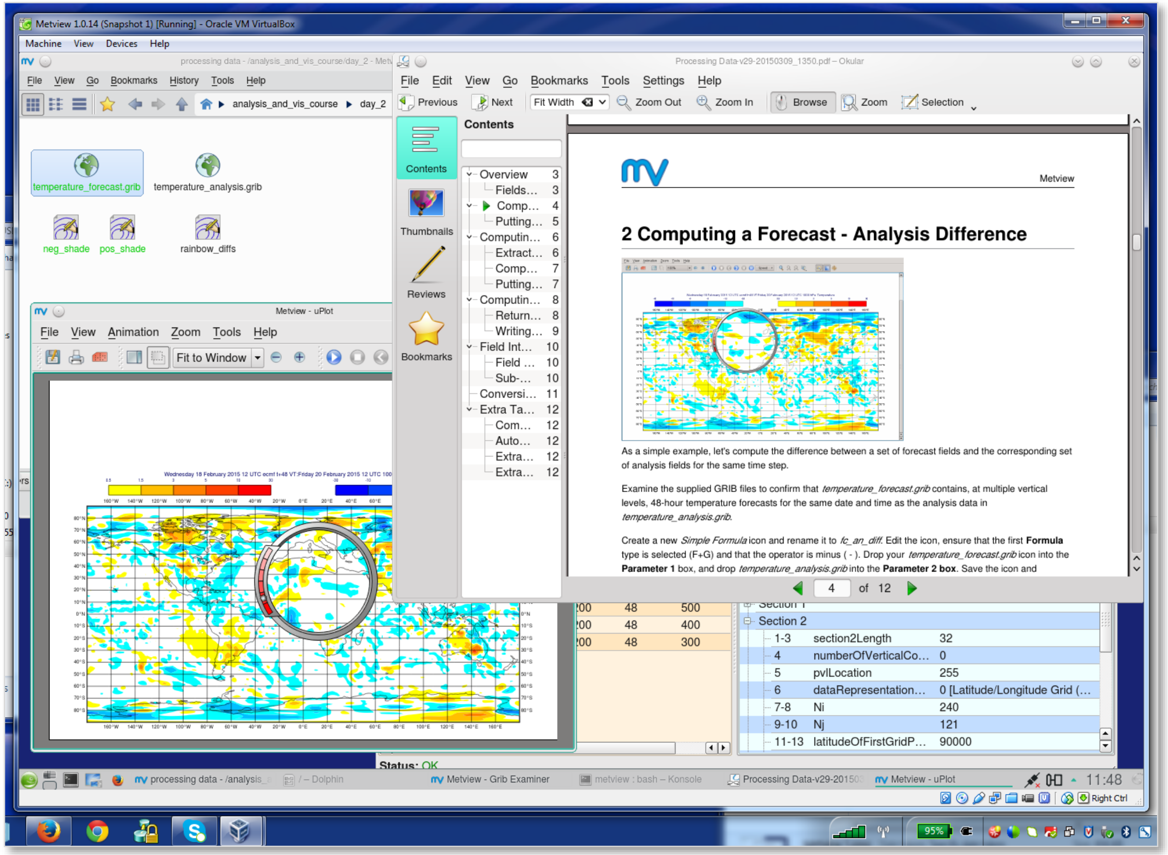
parameter	typeOfLevel	level	date	time	step	paramId	class
q	isobaricInhPa	100,250,...	20111215	0	0,6,...	133	od
t	isobaricInhPa	100,250,...	20111215	0	0,6,...	130	od

xarray
pandas
$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$
control P
1010
1000
Frame (5) :
Speed
oper-an Par: msl Step: +72h Valid: 2016-09-28 00
oper Par: msl Step: +72h Valid: 2016-09-28 00
an Par: msl Step: +0h Valid: 2016-09-28 00

Metview availability

- Available for Linux and macOS
- Inside ECMWF
  - `module load ecmwf-toolbox ; metview`
- Conda

  -
    ```
    conda install metview        -c conda-forge
    conda install metview-batch  -c conda-forge
    conda install metview-python -c conda-forge
    ```
- Homebrew
  - `brew install metview`
- Build from source
- The Metview Python interface can be installed separately if not in conda:
  - `pip install metview`


Metview 1.0.14 (Snapshot 1) [Running] - Oracle VM VirtualBox
Machine View Devices Help
File View Go Bookmarks History Tools Help
analysis_and_vis_course ▸ day_2
temperature_forecast.grib
temperature_analysis.grib
neg_shade
pos_shade
rainbow_diffs
Metview - uPlot
File View Animation Zoom Tools Help
Fit to Window
Processing Data-v29-20150309_1350.pdf – Okular
File Edit View Go Bookmarks Tools Settings Help
Previous Next Fit Width Zoom Out Zoom In Browse Zoom Selection
Contents
Thumbnails
Reviews
Bookmarks
Status: OK
processing data - /analysis...
Metview - Grib Examiner
metview : bash – Konsole
Processing Data-v29-201503...
Metview - uPlot
11:48
Right Ctrl

Metview

2 Computing a Forecast - Analysis Difference

As a simple example, let's compute the difference between a set of forecast fields and the corresponding set of analysis fields for the same time step.

Examine the supplied GRIB files to confirm that *temperature_forecast.grib* contains, at multiple vertical levels, 48-hour temperature forecasts for the same date and time as the analysis data in *temperature_analysis.grib*.

Create a new *Simple Formula* icon and rename it to *fc_an_diff*. Edit the icon, ensure that the first **Formula** type is selected (F+G) and that the operator is minus (-). Drop your *temperature_forecast.grib* icon into the **Parameter 1** box, and drop *temperature_analysis.grib* into the **Parameter 2 box**. Save the icon and

4 of 12

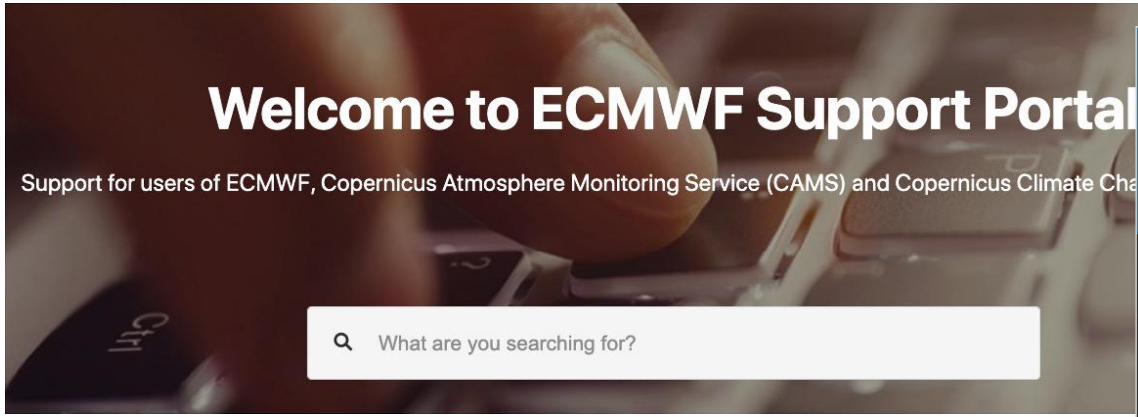
200	48	500
200	48	400
200	48	300

Section 1
Section 2

1-3	section2Length	32
4	numberOfVerticalCo…	0
5	pvlLocation	255
6	dataRepresentation…	0 [Latitude/Longitude Grid (…
7-8	Ni	240
9-10	Nj	121
11-13	latitudeOfFirstGridP…	90000

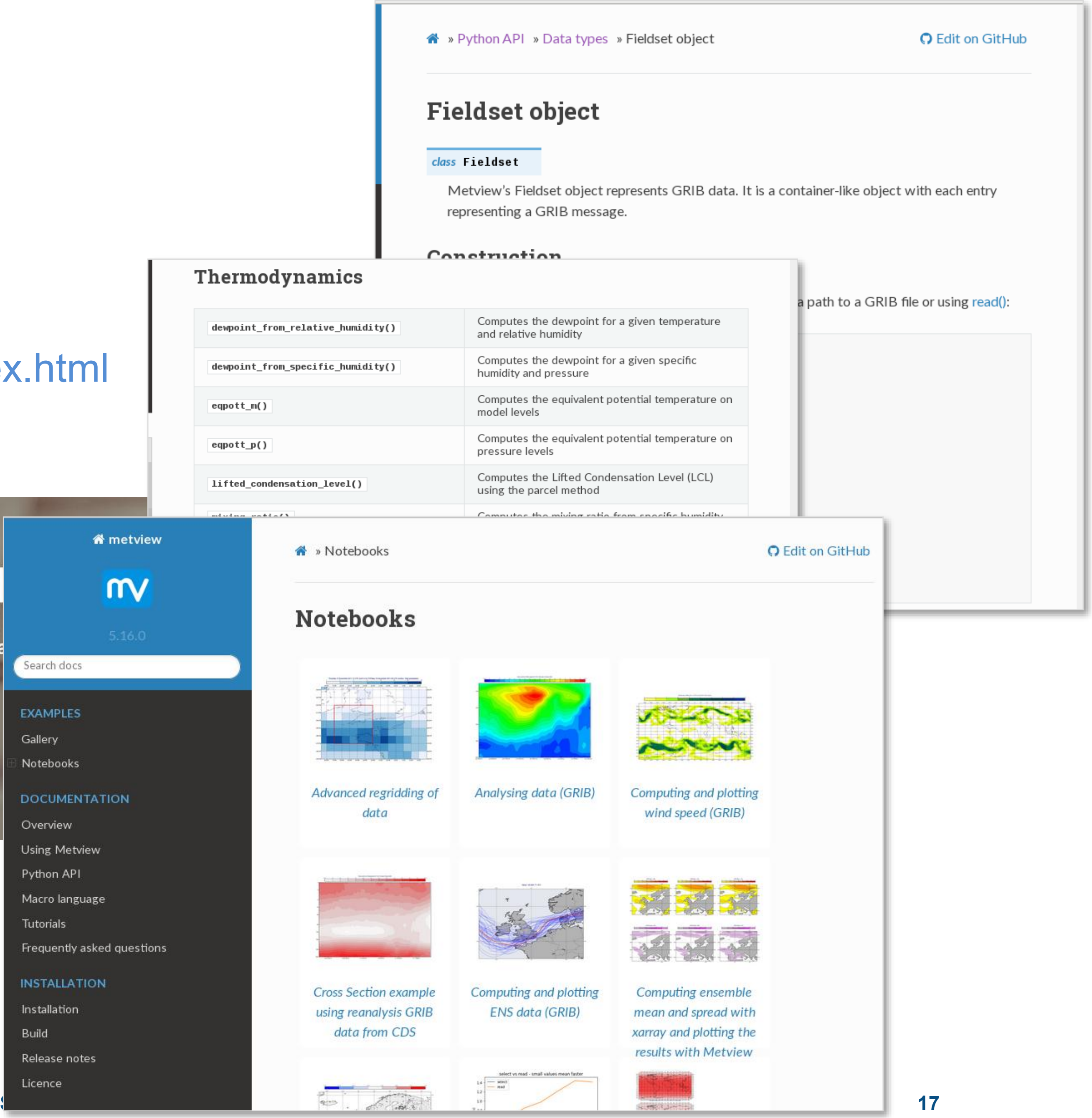
For more information…

- Ask for help:
  - https://www.ecmwf.int/en/support
- Visit our web pages:
  - https://metview.readthedocs.io/en/latest/index.html



Welcome to ECMWF Support Portal

Support for users of ECMWF, Copernicus Atmosphere Monitoring Service (CAMS) and Copernicus Climate Cha



» Python API » Data types » Fieldset object

Edit on GitHub

Fieldset object

`class Fieldset`

Metview's Fieldset object represents GRIB data. It is a container-like object with each entry representing a GRIB message.

Construction

a path to a GRIB file or using read():

Thermodynamics

`dewpoint_from_relative_humidity()`	Computes the dewpoint for a given temperature and relative humidity
`dewpoint_from_specific_humidity()`	Computes the dewpoint for a given specific humidity and pressure
`eqpott_m()`	Computes the equivalent potential temperature on model levels
`eqpott_p()`	Computes the equivalent potential temperature on pressure levels
`lifted_condensation_level()`	Computes the Lifted Condensation Level (LCL) using the parcel method
`mixing_ratio()`	Computes the mixing ratio from specific humidity

» Notebooks

Edit on GitHub

Notebooks

- Advanced regridding of data
- Analysing data (GRIB)
- Computing and plotting wind speed (GRIB)
- Cross Section example using reanalysis GRIB data from CDS
- Computing and plotting ENS data (GRIB)
- Computing ensemble mean and spread with xarray and plotting the results with Metview

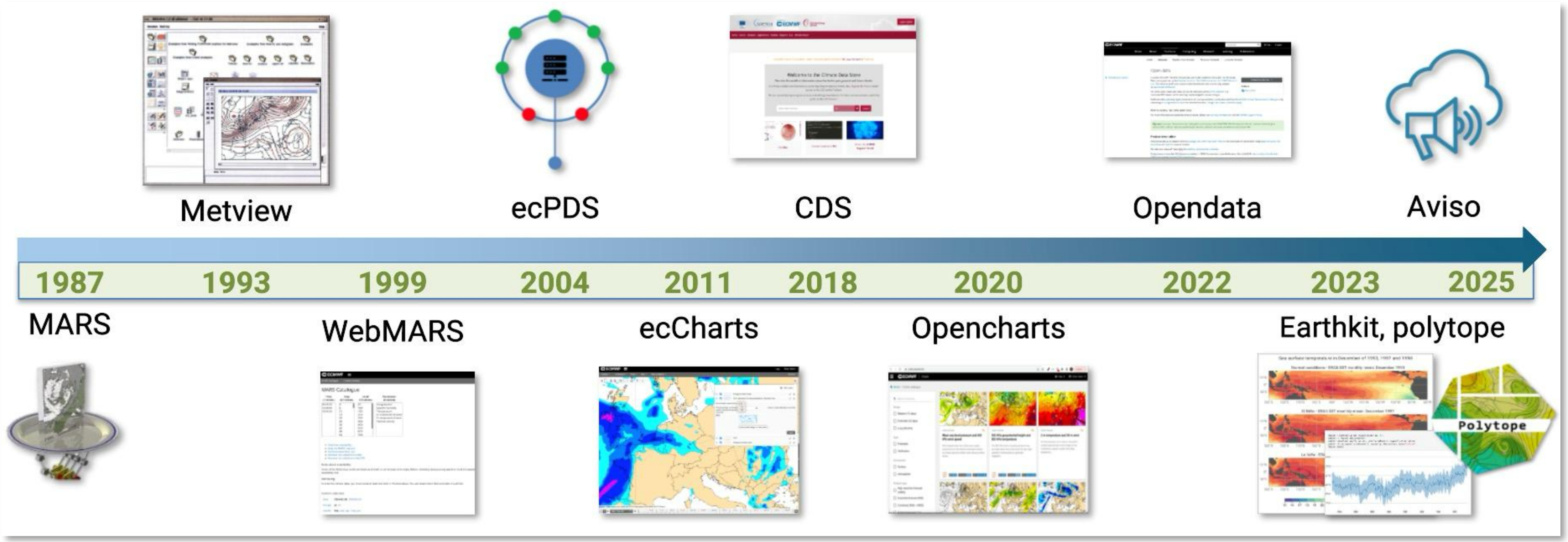
Questions?

Practical session

Inside Jupyterlab browser:
home/Metview_hands_on/Metview_Introduction.ipynb

Preview of what's coming

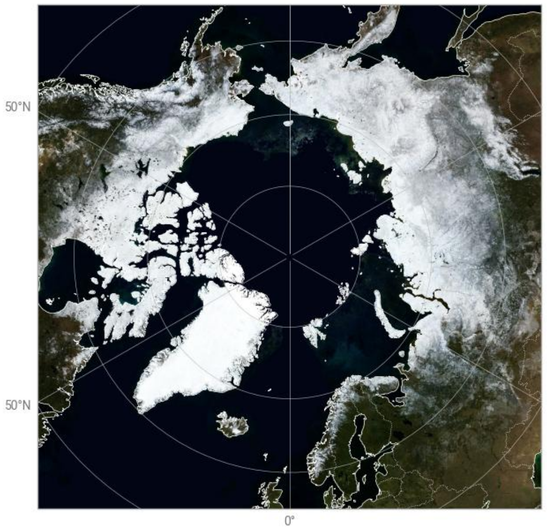
- Metview was one of the first pieces of software developed at ECMWF to support its NWP models
- More recent developments have focused on Open Development, greater componentisation, better use of 3rd-party libraries, performance on modern hardware (e.g. GPUs, avoid disk access when possible)



Preview of what’s coming - Earthkit

- Earthkit
  - New set of high-level scalable, interoperable, focused Python components
  - Suitable for use by our operational services and directly by researchers / analysts
  - Designed with Machine Learning / GPU / In-memory computations as first-class citizens
  - Designed with diskless data access in mind
  - Reduce boilerplate code
  - *Components are in different stages of maturity, but some are already well-tested and in operational use at ECMWF*

- Open Development
  - Highly collaborative both inside and outside ECMWF
  - All code is on GitHub, fully embracing Open Development



Earthkit and its Python components

earthkit data

earthkit geo

earthkit hydro

earthkit

https://earthkit.ecmwf.int/

earthkit plots

earthkit regrid

earthkit time

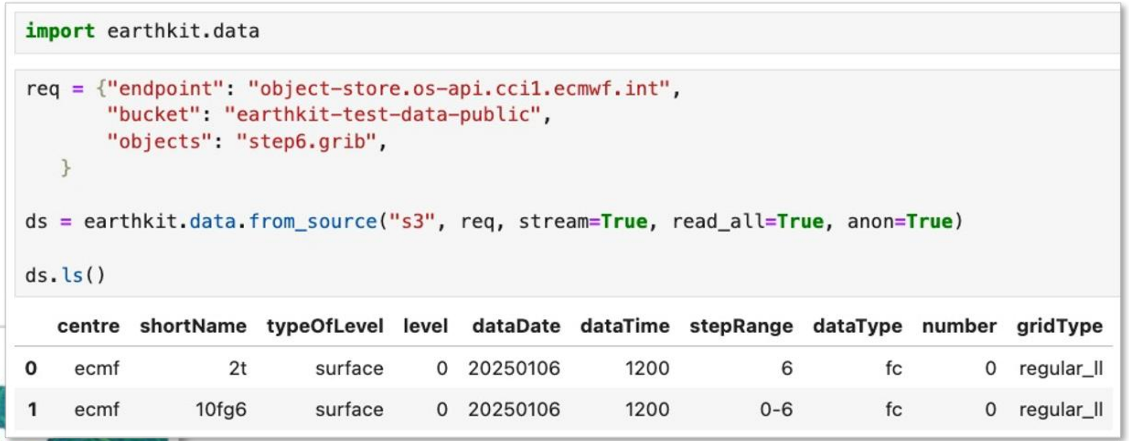
earthkit workflows

earthkit meteo

earthkit utils

earthkit transforms

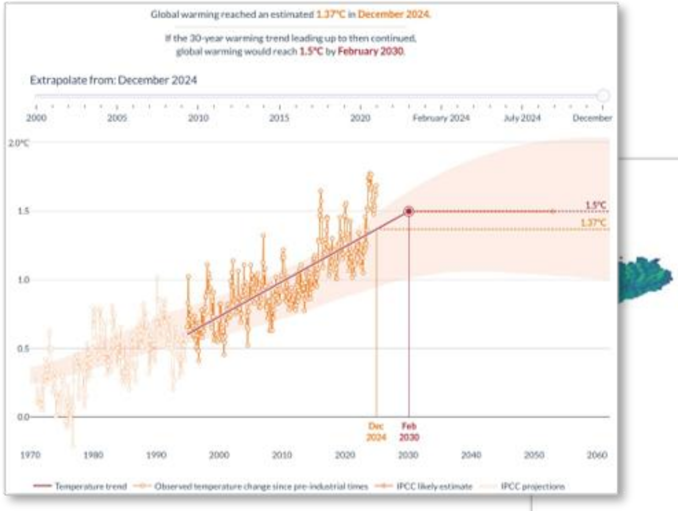
Earthkit examples

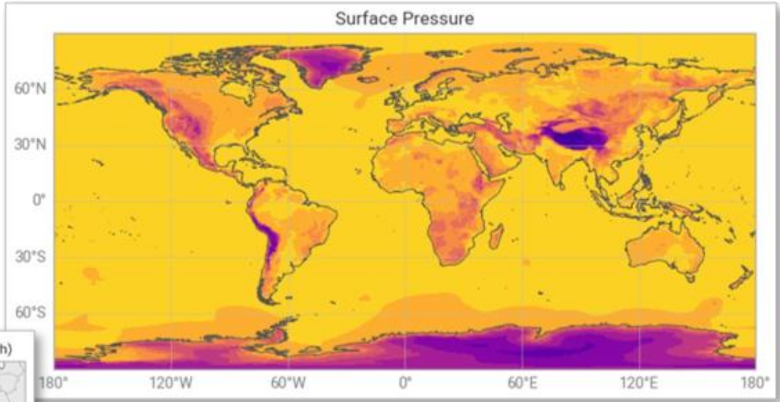


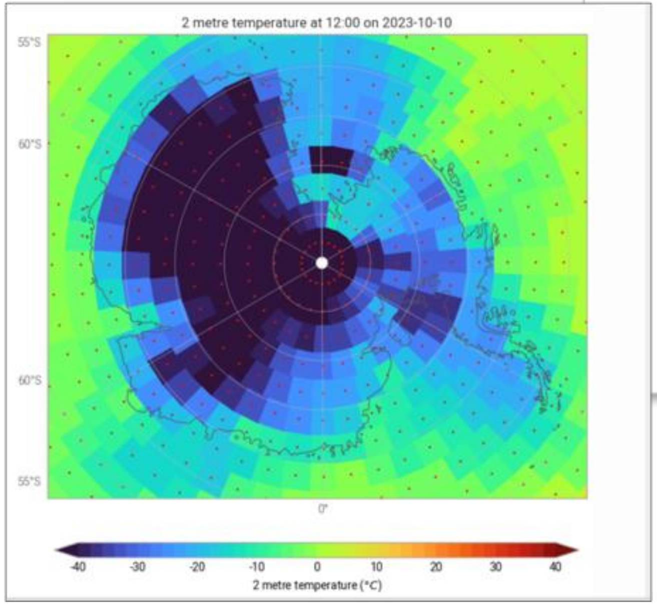
```
import earthkit.data
```

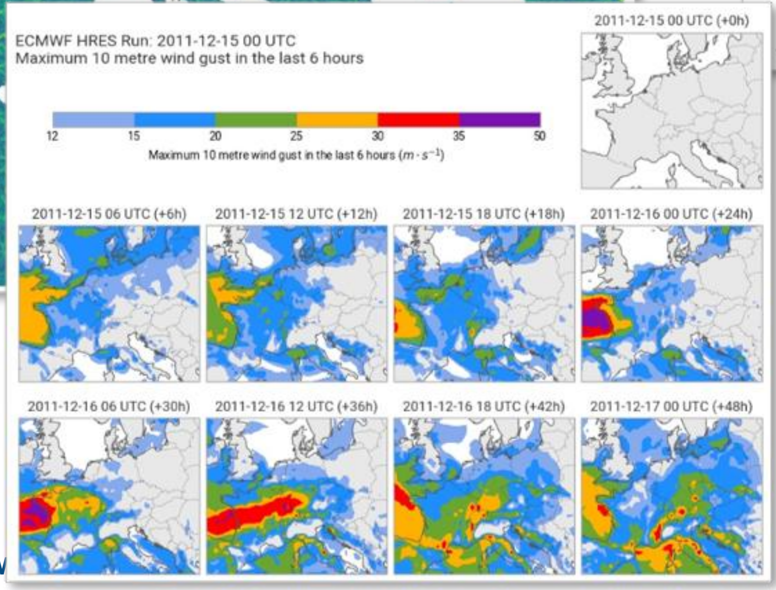
```
req = {"endpoint": "object-store.os-api.cci1.ecmwf.int",
       "bucket": "earthkit-test-data-public",
       "objects": "step6.grib",
   }

ds = earthkit.data.from_source("s3", req, stream=True, read_all=True, anon=True)

ds.ls()
```

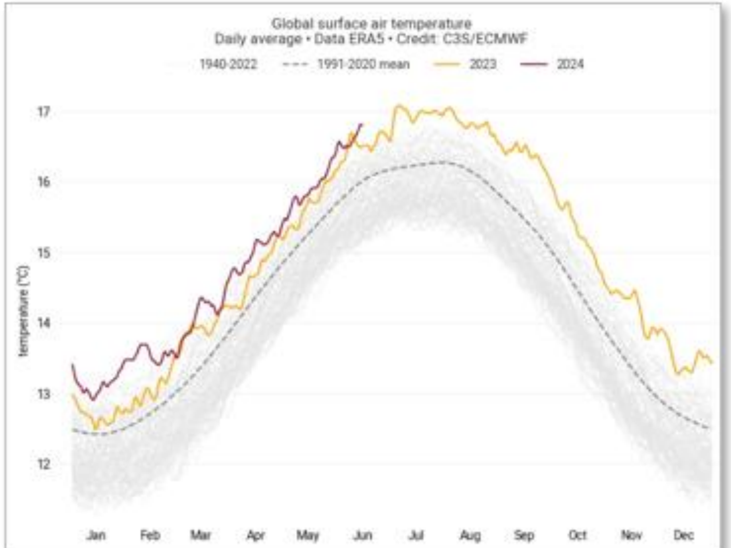
```
   centre  shortName  typeOfLevel  level  dataDate  dataTime  stepRange  dataType  number  gridType
0    ecmf         2t      surface      0  20250106      1200          6        fc       0  regular_ll
1    ecmf      10fg6      surface      0  20250106      1200        0-6        fc       0  regular_ll
```


Global warming reached an estimated 1.37°C in December 2024.
If the 30-year warming trend leading up to then continued, global warming would reach 1.5°C by February 2030.
Extrapolate from: December 2024
February 2024
July 2024
December
2.0°C
1.5°C
1.37°C
Dec 2024
Feb 2030
Temperature trend
Observed temperature change since pre-industrial times
IPCC likely estimate
IPCC projections


Surface Pressure
60°N
30°N
0°
30°S
60°S
180°
120°W
60°W
0°
60°E
120°E
180°


2 metre temperature at 12:00 on 2023-10-10
55°S
60°S
60°S
55°S
0°
-40
-30
-20
-10
0
10
20
30
40
2 metre temperature (°C)


ECMWF HRES Run: 2011-12-15 00 UTC
Maximum 10 metre wind gust in the last 6 hours
2011-12-15 00 UTC (+0h)
12
15
20
25
30
35
50
Maximum 10 metre wind gust in the last 6 hours (m · s⁻¹)
2011-12-15 06 UTC (+6h)
2011-12-15 12 UTC (+12h)
2011-12-15 18 UTC (+18h)
2011-12-16 00 UTC (+24h)
2011-12-16 06 UTC (+30h)
2011-12-16 12 UTC (+36h)
2011-12-16 18 UTC (+42h)
2011-12-17 00 UTC (+48h)


Global surface air temperature
Daily average • Data ERA5 • Credit: C3S/ECMWF
1991-2020 mean
temperature (°C)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec