

# New developments of Metview 5

EGOWS 2018, ECMWF

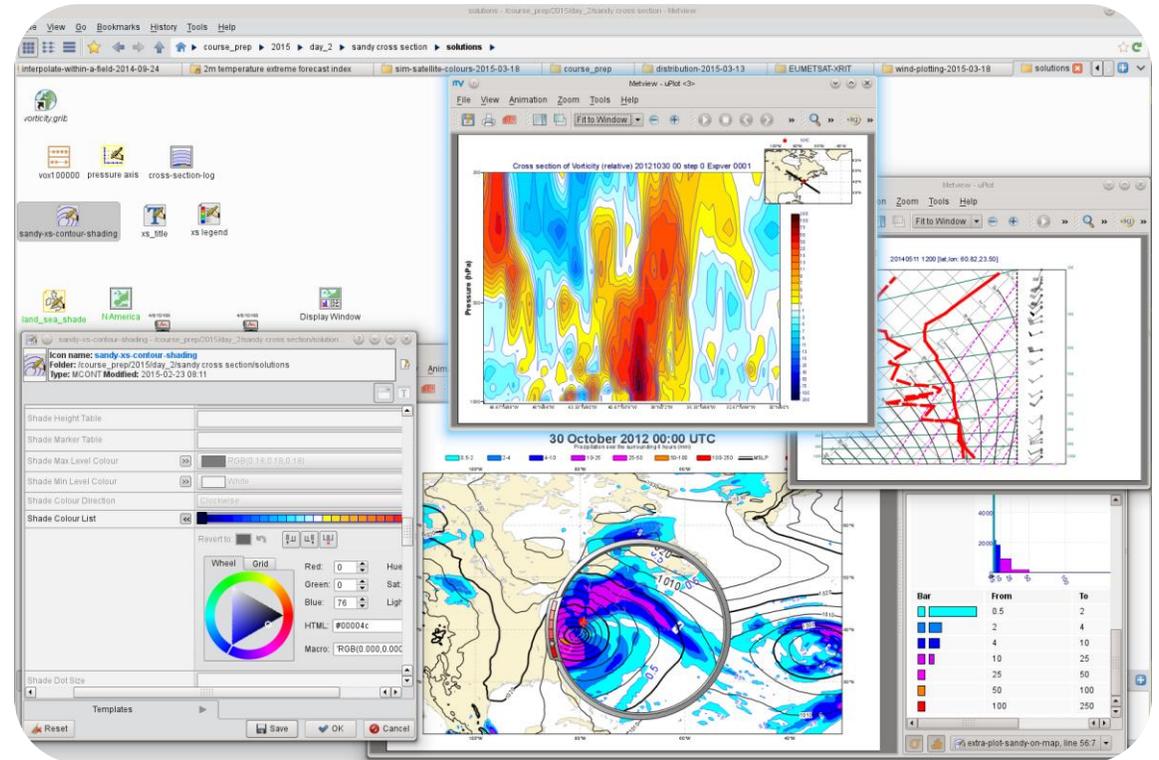
Sándor Kertész

Fernando Ii

Iain Russell

Stephan Siemen

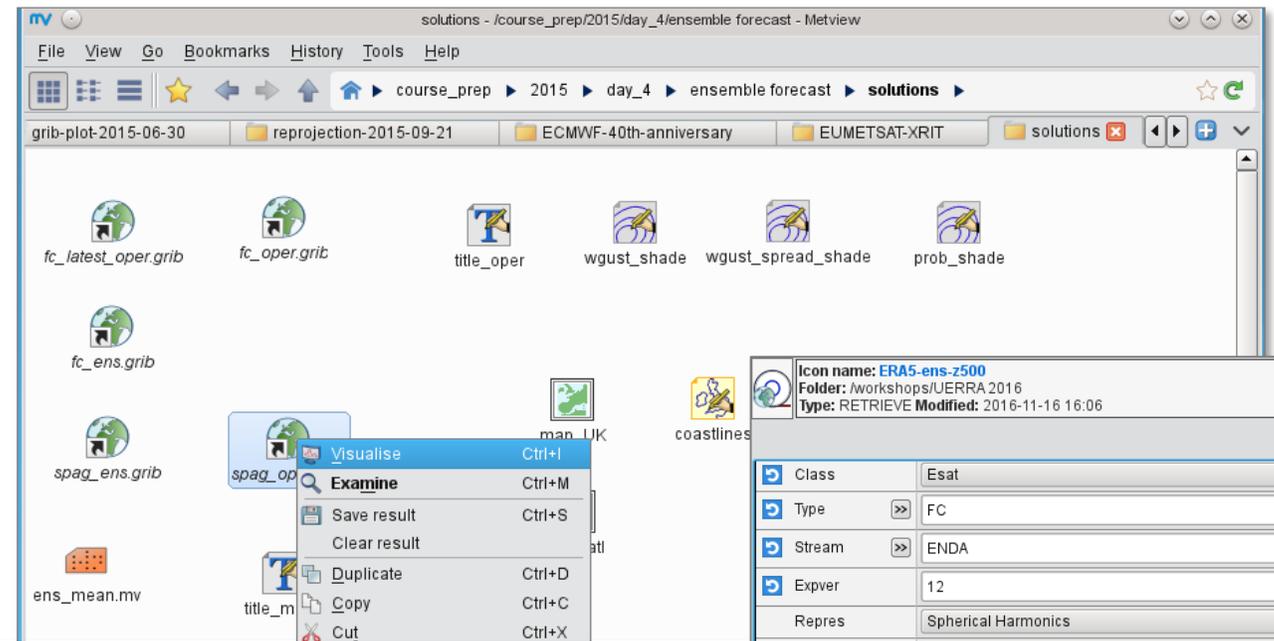
Development Section, ECMWF



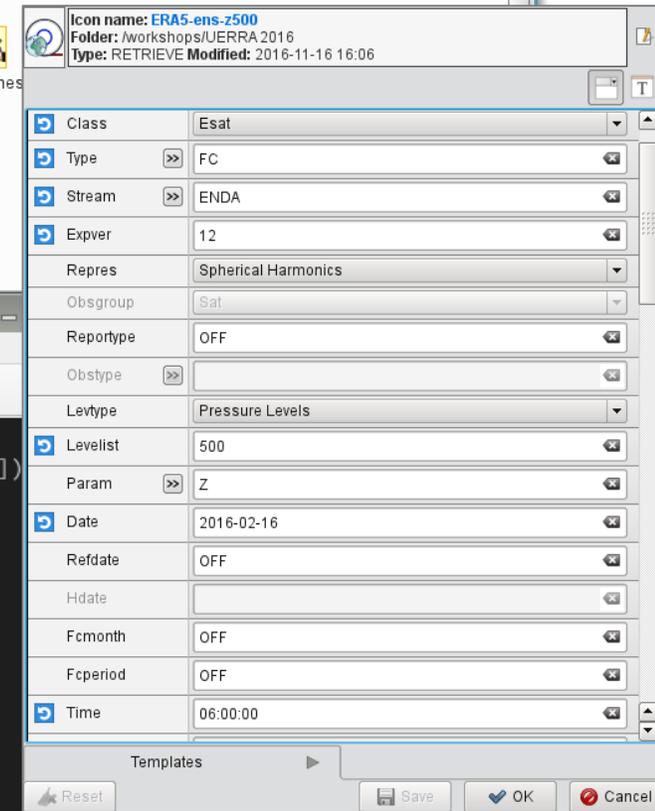


# What is Metview?

- Icon-based user interface
  - interactive investigation of data
  - icons represent data, settings and processes
  - icons can be chained together - output from one is input to another
- Powerful Macro and Python interface
  - more serious computations
  - batch or interactive usage



```
geostrophic_wind* - /home/graphics/cgr/metview/Local/Spectral_grad/geostrophic_wind
File Edit View Insert Program Settings Help
52 # Interpolate into a grid, omit the polar regions
53 grad = read(data : grad_sp, grid : [1.5,1.5], area : [-80,0,80,360])
54
55 # Weighting with R*cos(lat) to get the gradient in x and y
56 grad_weight = 6380000 * coslat(grad[1])
57 for i=1 to count(grad) do
58   grad[i] = grad[i] / grad_weight
59 end for
60
61 # Compute the coriolis parameter
62 omega = 2 * 3.141592654 / 86400.
63 coriolis = 2 * omega * sinlat(grad[1])
64
65 # Bitmap the tropics in the gradient fields
66 trop_mask=mask(grad[1],[15,0,-15,360])
67 trop_mask=bitmap(trop_mask,1)
```



## Metview 5

- First release in 2017 (latest one is 5.2.0)
- Several new features and improvements but no fundamental changes: same architecture, based on C++ and Qt
- One of the most important new features is the **Python interface** (see next talk from Iain Russell)



- This presentation will focus on the non-python related developments

# Improved plot layer management

- Possible to make changes to the plot “inline” in the plot window
- Can drop visual definition icons onto various levels in the plot hierarchy

The screenshot displays a weather plot interface with a map of Europe showing contour lines and a color scale. The interface includes a 'Layers' panel on the right, which is organized into three levels: Top Level, View Level, and Layer Level. The Top Level contains 'Symbol Plotting' and '<Coastlines'. The View Level contains 'coast\_dark(FG)' and 'coast\_dark(B)'. The Layer Level contains a hierarchy of layers: a checked 't500\_fc' layer with a contour icon, followed by two 't500\_fc' layers with globe icons, and a checked 'coast\_dark(BG)' layer with a map icon. A context menu is open over the 't500\_fc' layer with options: 'Edit in Plot', 'Save to Disk', and 'Remove from Plot'. A 'Properties' dialog box is also open, showing settings for 't\_cont 1' such as 'Contour Automatic Setting' (Off), 'Legend' (On), 'Contour' (On), 'Contour Line Style' (Solid), 'Contour Line Thickness' (1), 'Contour Line Colour Rainbow' (On), and various rainbow settings. The dialog box also includes 'OK', 'Cancel', and 'Save' buttons.

# Contouring



- Heavily-used but complicated editor/settings with over 100 parameters
- Motivation:
  - make the editing of contouring definitions simpler
  - use predefined settings
- Metview took advantage of new developments in Magics

Contour Label	<input checked="" type="radio"/> On <input type="radio"/> Off
Contour Label Type	NUMBER
Contour Label Text	
Contour Label Height	0.3
Contour Label Format	(AUTOMATIC)
Contour Label Blanking	<input checked="" type="radio"/> On <input type="radio"/> Off
Contour Label Font	Sansserif
Contour Label Font Style	Normal
Contour Label Colour	>> <input type="text"/> Contour Line Colour
Contour Label Frequency	2
<input checked="" type="checkbox"/> Contour Shade	<input checked="" type="radio"/> On <input type="radio"/> Off
<input checked="" type="checkbox"/> Contour Shade Technique	Marker
Contour Shade Colour Method	Calculate
<input checked="" type="checkbox"/> Contour Shade Colour Table	>>
Contour Shade Height Table	
Contour Shade Marker Table Type	Index
Contour Shade Marker Table	
Contour Shade Max Level Colour	>>  Blue
<input checked="" type="checkbox"/> Contour Shade Min Level Colour	>>  Purplish Red
Contour Shade Colour Direction	Anti Clockwise
Contour Shade Dot Size	0.02
Contour Shade Max Level Density	50.0

# Contouring - Colour gradients

- More sophisticated colour gradient definition
- Can use a single Contouring icon where multiple icons were needed in the past

## Contour colour gradients editor

Contour Gradients Colour List

Wheel Grid

Red: 0 Hue: 240

Green: 0 Saturation: 255

Blue: 255 Lightness: 128

Opacity: 255

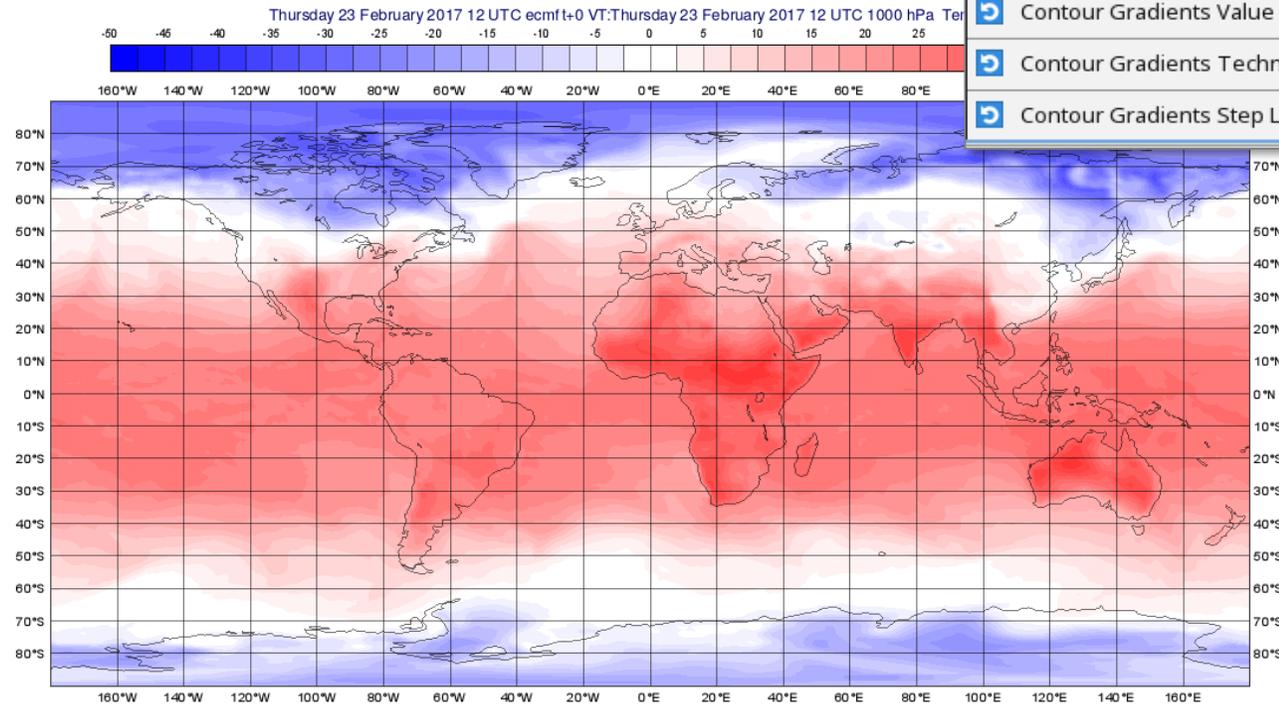
HTML: #0000ff

Macro: 'RGB(0.000,0.000,1.0000)'

Contour Gradients Value List: -50/0/50

Contour Gradients Technique List: linear/linear

Contour Gradients Step List: 20/20



# Contouring - Palettes

- Over 300 predefined palettes
- Palette browser in contouring editor

Contour palette browser

Contour Shade Palette Name << eccharts\_green\_brown\_20

Clear all filters

Name: ANY

Origin: ANY

Colour: ANY

Count: ANY

Parameter: ANY

Palette	Name
	eccharts_green_brown2_28
	eccharts_green_brown_13
	eccharts_green_brown_16
	eccharts_green_brown_20
	eccharts_green_brown_29
	eccharts_green_grey_10
	eccharts_green_magenta_6
	eccharts_green_magenta_transparent25_6
	eccharts_green_magenta_transparent50_6
	eccharts_green_magenta_transparent75_6

## Contour style browser

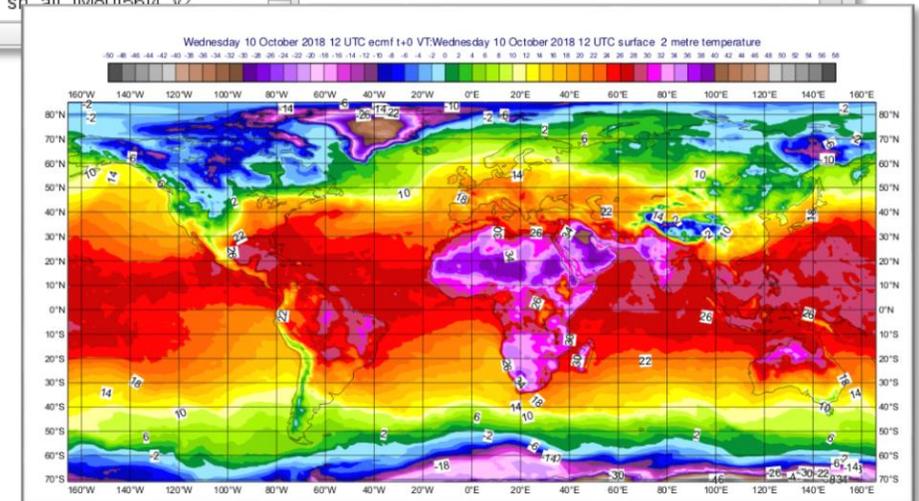
# Contouring - ecCharts Styles

- Predefined ecCharts contouring styles
- **Automatic mode:** style assigned to fields using data header (GRIB or NetCDF)
- **Manual mode:** contour style browser is available

Retrieving and plotting data in a few lines

```
grib = retrieve(param:'2t', levtype: "surface", grid:[1,1])  
  
cont = mcont(contour_automatic_setting : "style_name",  
             contour_style_name       : "sh_all_fm50t58i2",  
             legend                    : "on"  
)  
  
plot(grib, cont)
```

Contour style browser interface showing search filters and a list of matching styles. The selected style is 'sh\_all\_fm50t58i2'. The preview shows a contour plot of temperature over a geographical area.



# Reproducing ecCharts Layers

- ecCharts icon
- Twofold task:
  - Retrieving data from MARS and pre-processing for a given layer
  - Visualising data with one of the associated styles
- Works for past dates
- Can be saved into a script (Macro/Python) to study or modify settings



The screenshot displays the ecCharts interface with two main panels: 'Layer' and 'Style'.

**Layer Panel:** Shows a search for '925divergence'. The search filters are set to 'ANY'. A table lists available layers:

Preview	Name	Description
	850ws_spread	Ensemble spread for wind speed at 850 hPa. Ensemb...
	925divergence	925 hPa divergence
	925ws	Wind speed at 925 hPa
	cape	Convective available potential energy (CAPE) in i/kg

**Style Panel:** Shows a list of styles for the selected layer 'sh\_blured\_fm50t50lst\_cell'. The selected style is 'sh\_blured\_fm50t50lst\_cell'. The style details are:

**Style:** sh\_blured\_fm50t50lst\_cell

**Style Img:**

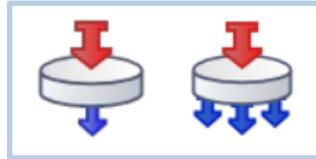
**Method:** Method : contour shade Level list : (-200/-100/-75/-50/-30/-20/-15/-13/-11/-9/-7/-5/-3/-1/1/3/5/7/9/11/13/15/20/30/50/75/100/200) Colour : Two ranges: blue & yellow-red Used for vorticity, divergence

**Configuration Panel:**

Expver	1
Date	20181010
Time	0000
Step	-5
Grid	1/1

# BUFR interface

- Migrated from BUFRDC to **ecCodes**
- Major internal change but the main interface remained the same
- Two icons to handle BUFR data: **Observation filter** and **BUFR picker**

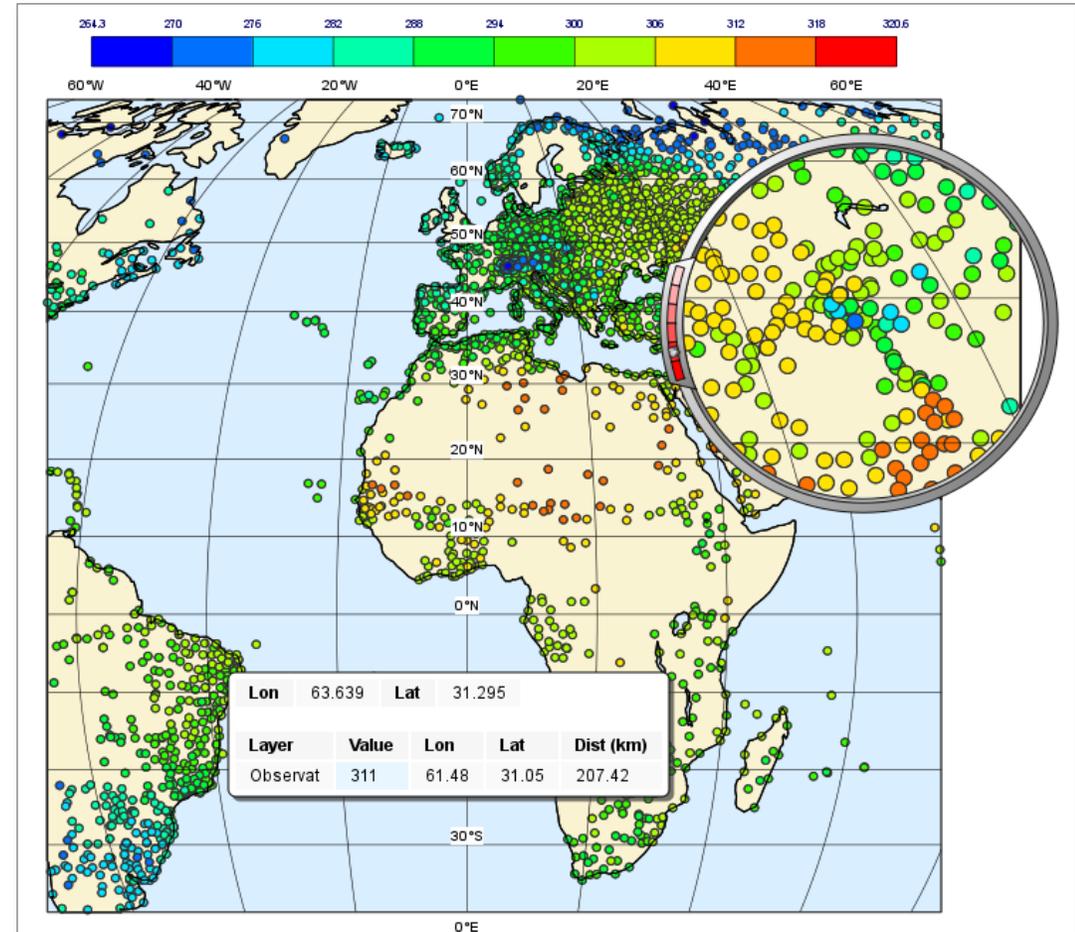


- Metview can filter/extract BUFR into **tabular data** suitable for visualisation and further processing
- New way to access parameters: BUFRDC used descriptors, ecCodes only works with keys e.g.

**Descriptor = 10051**

**Key = pressureReducedToMeanSeaLevel**

- For backward compatibility we still accept descriptors



# BUFR – New examiner

- Redesigned **BUFR examiner**

- inspect message structure and metadata
- filter and extract data

- Location preview

- Extracts all locations
- Interactive map: can go from point in map to data structure and vice versa

The screenshot displays the BUFR examiner interface with the following components:

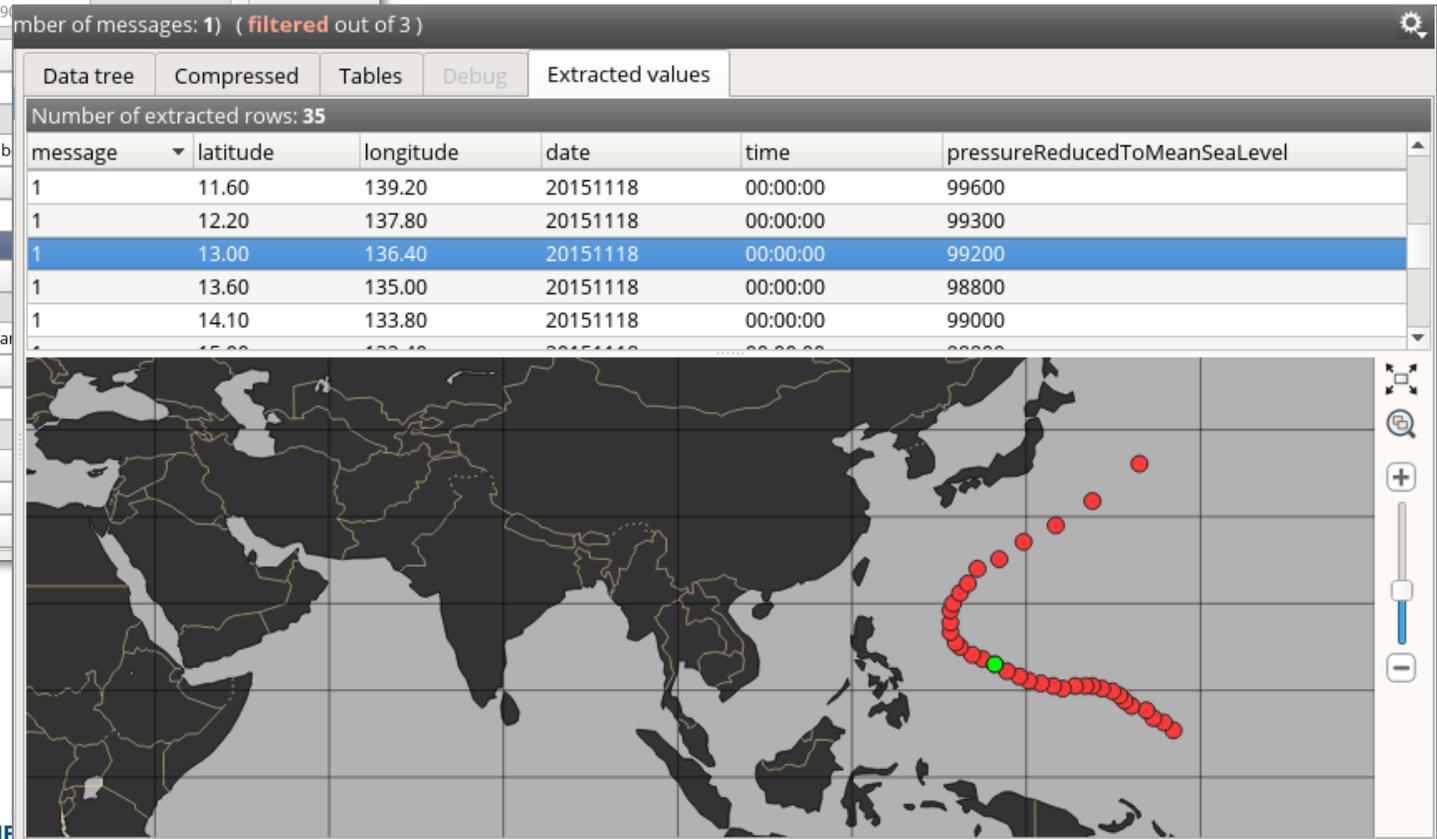
- File Information:** File: /home/graphics/cgr/metview/Local/BUFR/ECC/temp.bufr, Permissions: rwxr-x-- Owner: cgr Group: graphics Size: 486 KB Modified: 2016-03-15 14:55:55, Total number of messages: 420.
- Message Table (Top):** A table with columns Index, E, Typ, Sut, C, Sc, Mv, Lv, Ssc, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15. Row 1 is highlighted.
- Data Tree:** A tree view showing metadata fields like cloudAmount, heightOfBaseOfCloud, cloudType, delayedDescriptorReplicationFactor, pressure (99800 Pa), and verticalSoundingSignificance (4). The 'verticalSoundingSignificance' field is selected, showing its details in the right panel.
- Message Table (Bottom):** A table with columns Mv, Lv, Ssc, 2, D, T, Lat, Lon, Ident, Day. Row 13616 is highlighted.
- Location Table:** A table with columns Message, Subset, Rank, Latitude, Longitude. Row 13616 is highlighted.
- Map:** A map showing the location of station 13616 (marked with a red dot) over a geographical area.
- Right Panel:** Metadata details for 'verticalSoundingSignificance', including key, index (36), value (4), units (FLAG TABLE), bits (0000100), flag[5] (SIGNIFICANT LEVEL, TEMPERATURE AND/OR RELATIVE HUMIDITY), element (008001), category (08), code (001), and definition (WMO Representation).

# BUFR examiner – Filter and data extraction

- New **BUFR filter** merging the two existing ones (Observation filter and BUFR Picker) and using advanced features from ecCodes
- Will be available as an icon and command in Macro/Python

The screenshot shows the 'Filter message/subset by data' configuration window. It includes fields for Date mode (Window), Date (7), Time (ANY), Window (minutes) (0), Area (N: 90, W: -180, E: 180, S: -90), Identifier (WMO station), Identifier value (ANY), Custom condition count (1), Custom key 1 (ensembleMemberNumber), Custom operator 1 (=), Custom value 1 (2), Extract data as table (Extract values: On), Parameter count (1), Parameter 1 (pressureReducedToMeanSeaLevel), Parameter operator 1 (=), Parameter value 1 (ANY), Coordinate condition count (0), Extract mode (All), Extract coordinate (On), and Extract date/time (On). Buttons for 'Run filter', 'Clear options', 'Expand all', 'Expand edited', and 'Collapse all' are also visible.

Extracting MSLP along a tropical cyclone track for an ensemble member in an ENS forecast



# CodesUI

- The BUFR and GRIB examiners are released separately under the name of **CodesUI**
- CodesUI is a standalone software application with the minimum possible dependencies (ecCodes and Qt)

Pages / Metview

## CodesUI

Created by Sandor Kertesz, last modified on Mar 14, 2018

✓ **CodesUI** is an interactive application built on [ecCodes](#) to inspect

- WMO FM-92 **GRIB** edition 1 and edition 2 messages
- WMO FM-94 **BUFR** edition 3 and edition 4 messages.

With CodesUI it is possible to:

- inspect the overall structure of GRIB and BUFR files
- examine the data and metadata of the individual messages

For BUFR data these additional features are also available:

- filtering BUFR messages
- extracting tabular data from BUFR messages
- plotting BUFR observation locations on an interactive map

- FLEXPART
  - FLEXible PARTicle dispersion model
  - Metview supports version 9
- Metview can
  - prepare input data (from MARS or set of GRIB files)



- run a FLEXPART simulation



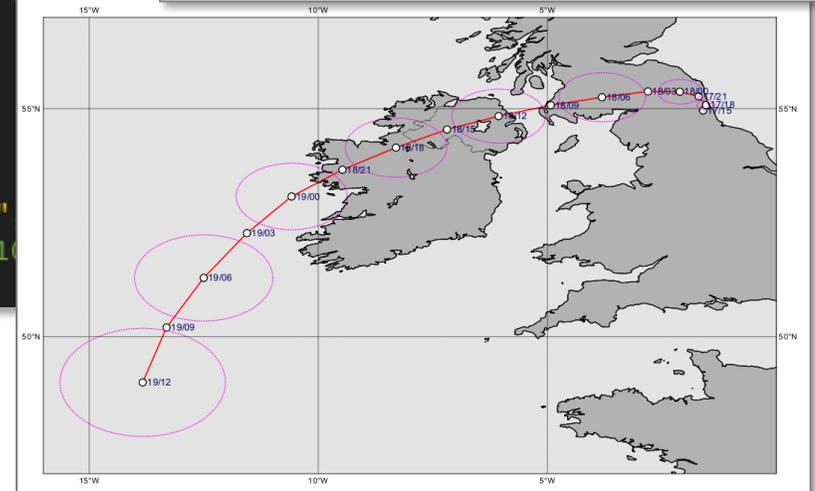
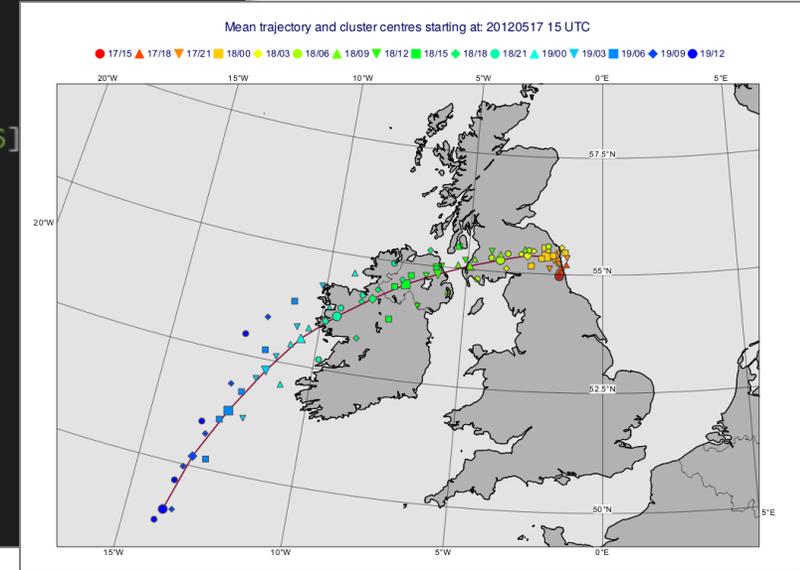
- process and visualise the output

```
#Define release
rel_volcano = flexpart_release(
  name      : "VOLCANO",
  starting_date  : 0,
  starting_time  : 15,
  ending_date   : 2,
  ending_time   : 12,
  area         : [63.63,-19.6,63.63,-19.6]
  top_level    : 9000,
  bottom_level : 1651,
  particle_count : 10000,
  masses       : 1000000
)

```

```
#Run flexpart (asynchronous call!)
r= flexpart_run(
  output_path : "result_fwd",
  input_path  : "../data",
  starting_date : 20120517,
  starting_time : 12,
  ending_date  : 20120519,
  ending_time  : 12,
  output_fields_type: "conc",
  output_flux  : "on",
  output_trajectory : "on",
  output_area  : [40,-25,66,10],
  output_grid  : [0.5,0.5],
)

```

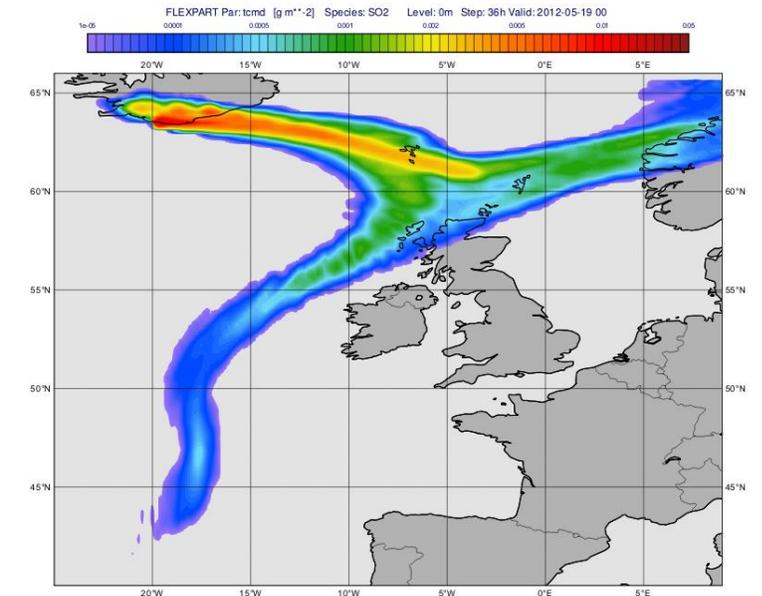
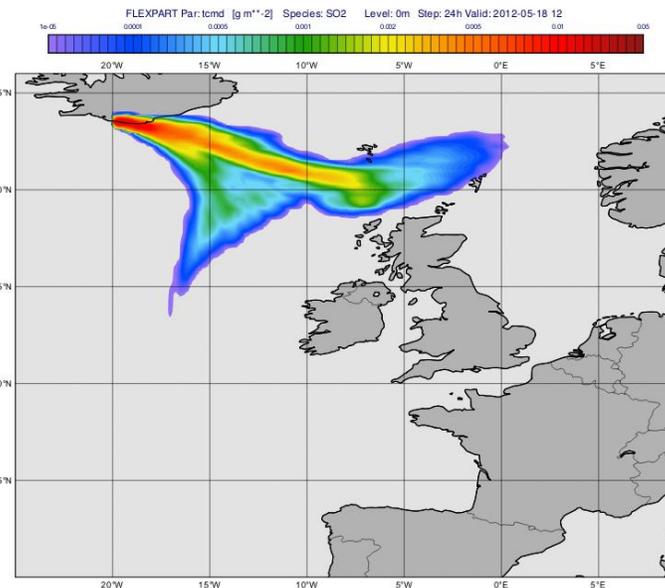
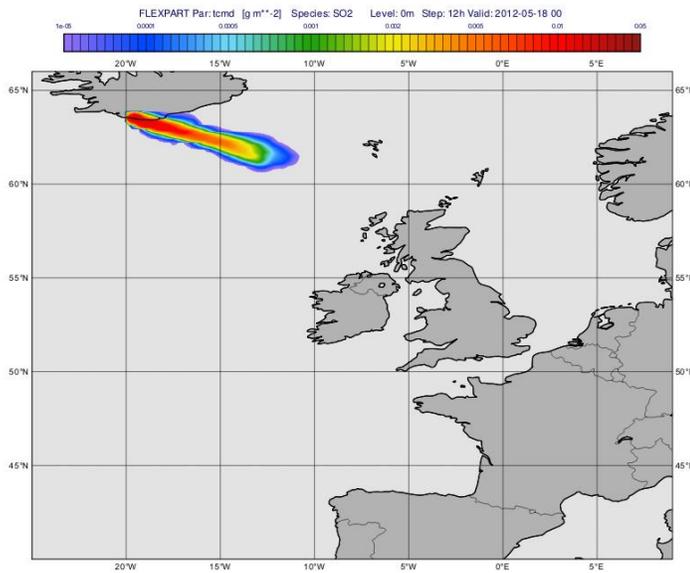


# FLEXPART - Gridded fields

## GRIB header for FLEXPART output

- Gridded output in custom binary format
- Metview automatically **converts it to GRIB** in the post-processing step (using local GRIB definitions)
- Standard GRIB based computations and visualisation

▶	Section 1		
▼	Section 2		
1-4	section2Length	82	
5	numberOfSection	2	
6-7	grib2LocalSectionNumber	1	[FLEXPART local definitions for Metview (grib2/grib
8-9	flexpartVersion	902	
10	speciesId	1	
11-20	speciesName	SO2	
21	numberOfReleases	1	
22	releaseNumber	1	
23-62	releaseName	VOLCANO	
63	numberOfAgeClasses	1	
64	ageClass	1	
65-68	ageClassBegin	0	
69-72	ageClassEnd	999999999	



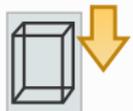
# Met.3D interface

- Met.3D

- Interactive 3D visualisation software
- Developed at the Technical University of Munich (TUM), Germany

- Metview can

- Prepare input GRIB data
- Start up Met.3D with some initial configurations



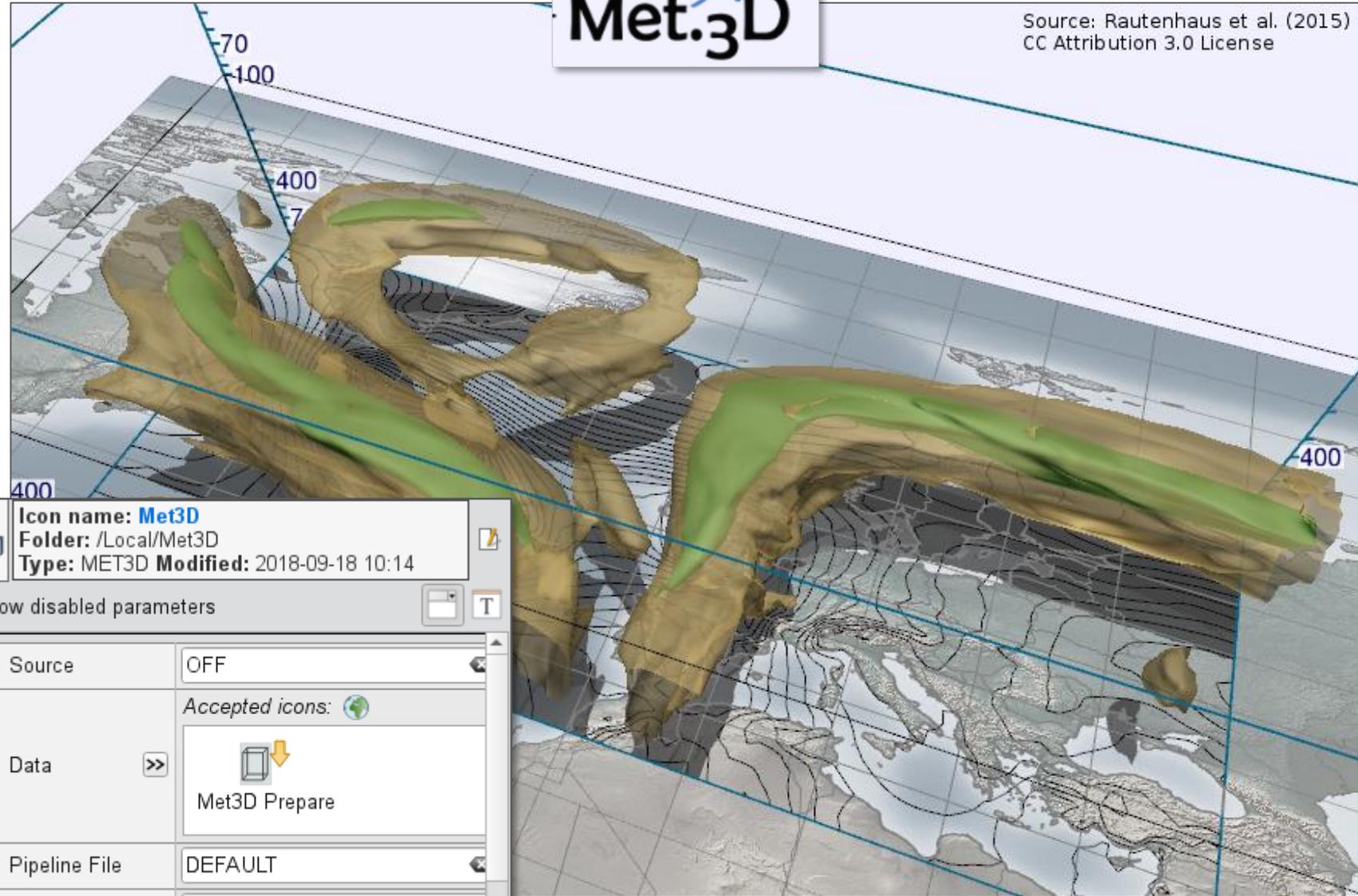
Met3D Prepare



Met3D



Source: Rautenhaus et al. (2015)  
CC Attribution 3.0 License



## Future plans

- Improve performance on HPC filesystems. Should make it easier for users to choose different **memory/disk strategies** for storing intermediate data steps.
- Redesign the Metview display window:
  - move from a complicated scene graph/vector graphics approach to a simple image based rendering
  - add more on-screen data analysis tools

## For more information...

- Email us:
  - [metview@ecmwf.int](mailto:metview@ecmwf.int)
- Visit our web pages:
  - <http://software.ecmwf.int/metview>
- Download: Metview source, source bundle, binaries)
- Documentation and tutorials available
- Metview articles in ECMWF newsletters

- See us at the exhibition tomorrow!

Questions?

