Using Metview
with
OpenIFS experiments

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This tutorial was tested with Metview version 4.3.10
and some features might not work for previous versions.

1 Preface

You need to enter folder 'openifs_study' to start working with the OpenIFS experiments. In this folder you will find a lot of other folders and some Metview macros as well. Macros are represented by this punchcard icon:

Macros are scripts written in the Metview Macro language to read, process and visualise data.

The macros stored in this folder contain important functions needed and used by other macros that you will work with. So please **do not modify and definitely do not delete these macros**! Also you should not change text file 'exp_lst.txt', which stores the list of the experiments.

2 Studying individual OpenIFS runs

In folder 'openifs_study' you will find a separate folder for each OpenIFS run and the high resolution analysis as well. The structure and content of these folders are almost identical so if you learn how to work with one of these you will be able to use the other ones as well.

Now please enter one of the experiment folders (e.g. T1279_ctl).

2.1 Map-based plots

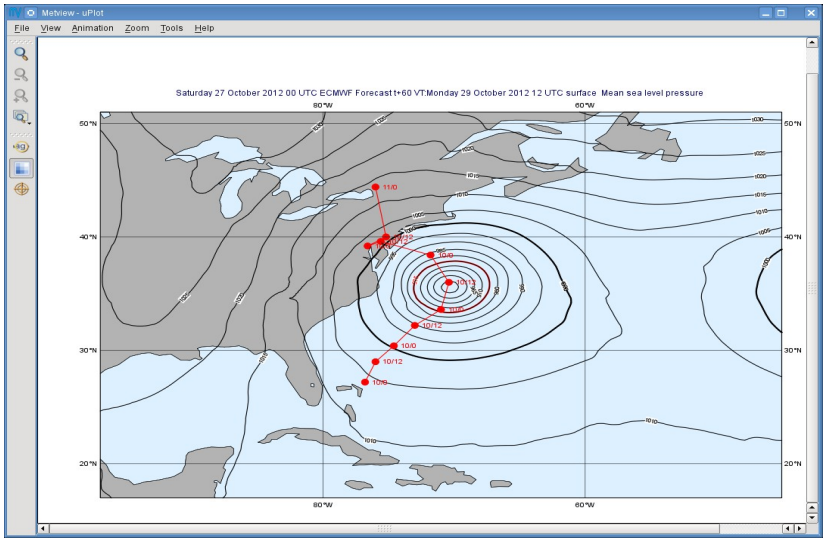
Map projection and coastlines

All map-based visualisation should start by visualising the 'map_sandy' *Geographical View* icon. Then you should drop all the icons to be visualised into the plot generated by this icon.

Strom track

Drop macro 'sandy_track.mv' into the plot to visualise the track of Hurricane Sandy.

The track was extracted from the given experiment by finding the location of the minimum MSLP in the storm area for each step. You can overlay it with any other fields. By default the storm track colour is set to 'red'. To change it just edit the macro and assign another value to variable **track_colour**.



Individual fields

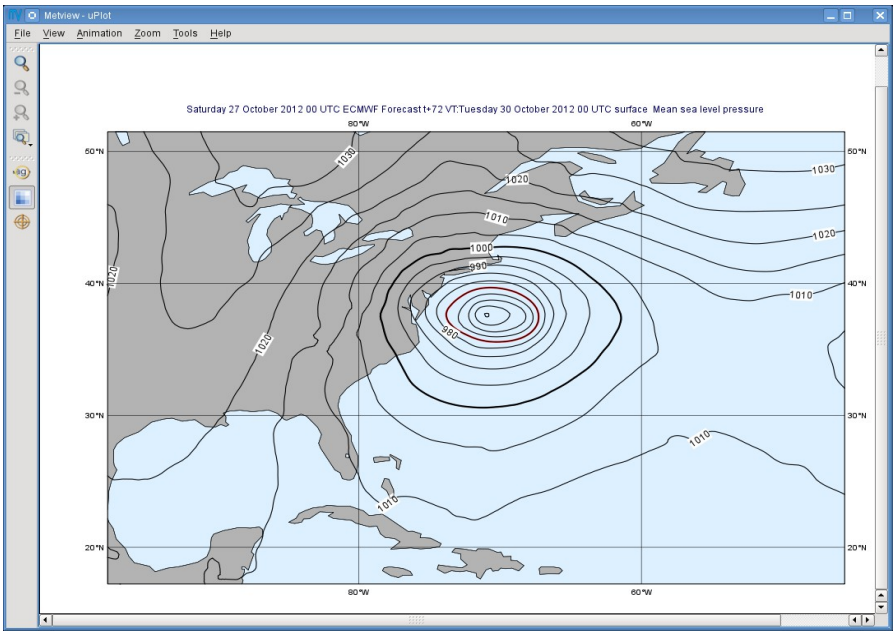
There is a macro prepared for each parameter in the folder (e.g. 'mslp.mv'). These macros extract the given parameter from the input GRIB files for all the forecast steps and concatenate these fields together into one GRIB file that they return back as a result (you can try right-click **examine** on them to see what GRIB files they produce). Therefore by dropping these macros into the plot you will get animation for the given parameter.

For the pressure level parameters you can change the selected level by editing the macro and assigning another value to variable **lev.**

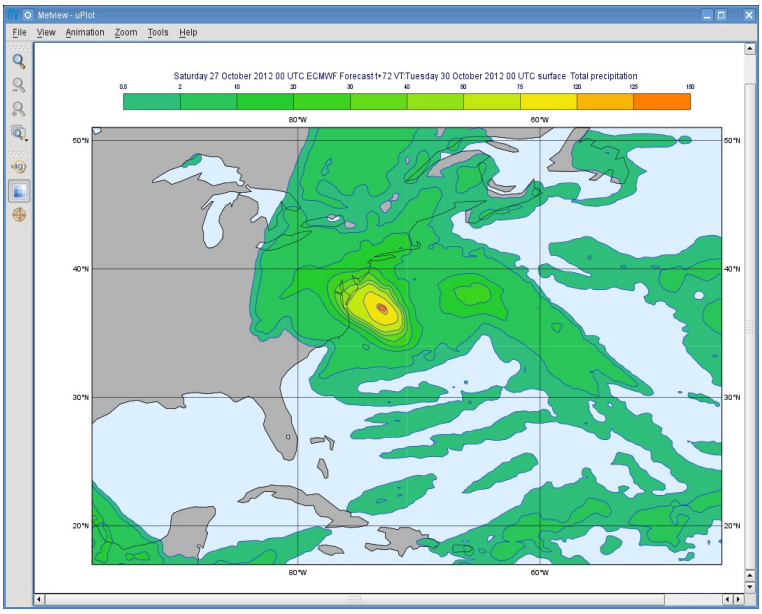
Next to each macro you will find a set of nice contouring or wind plotting icons that you can directly use to customise the plot.

The rest of this chapter contains a gallery of all these macros showing their corresponding visual definitions and the plots they can generate as well.

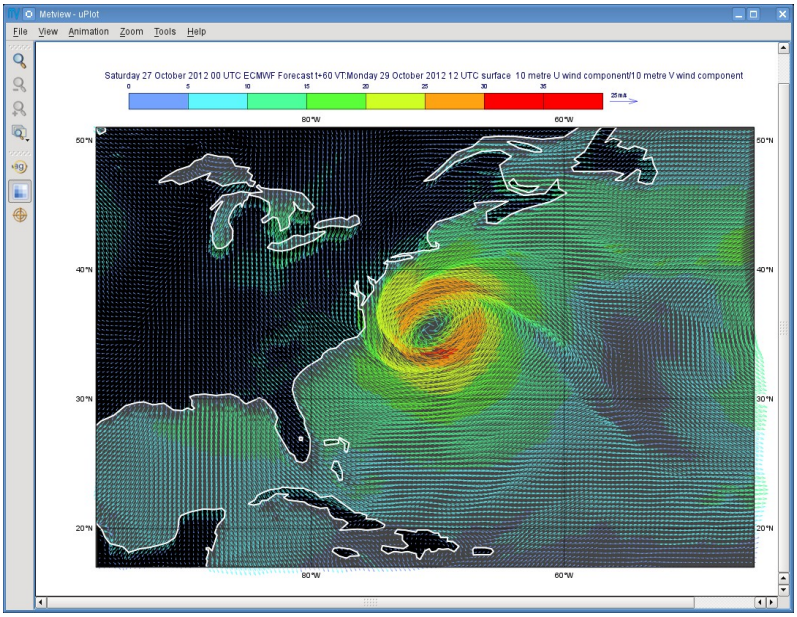
MSLP



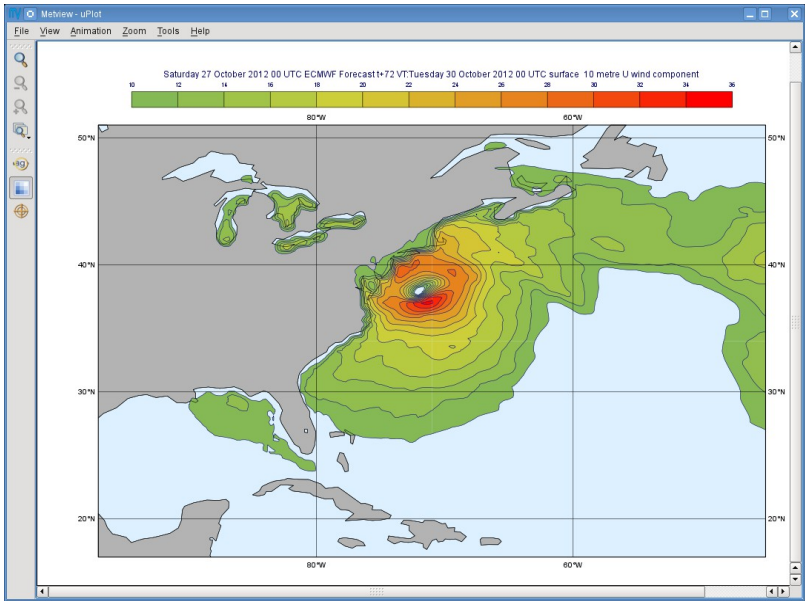
Precipitation 12h (total=tp, convective=cp or large scale=lsp)



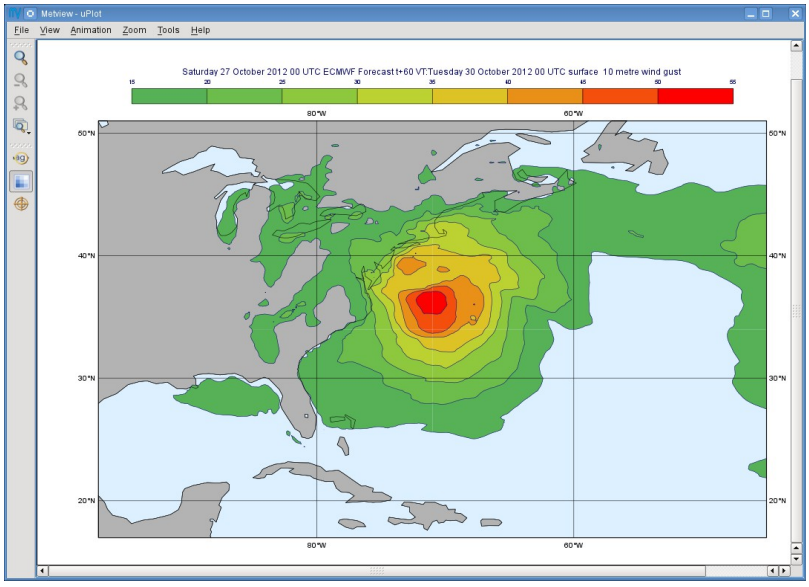
Wind 10m



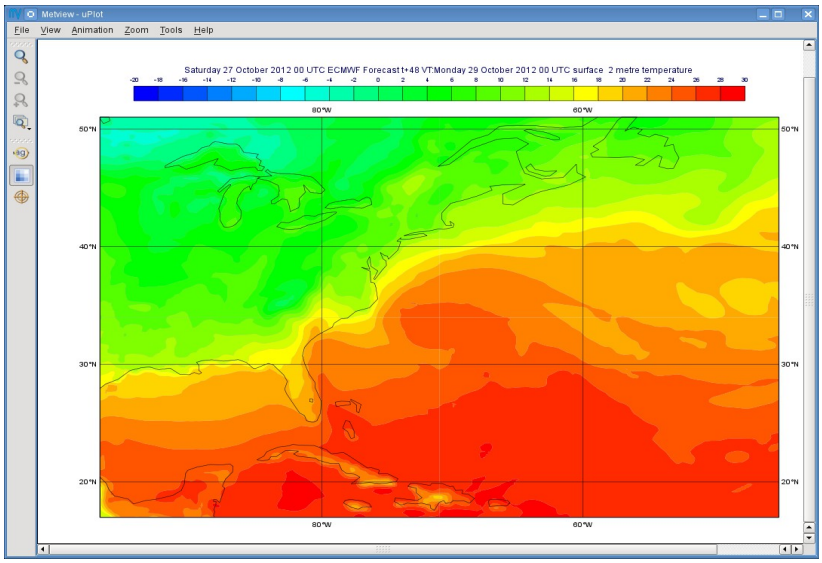
Windspeed 10m



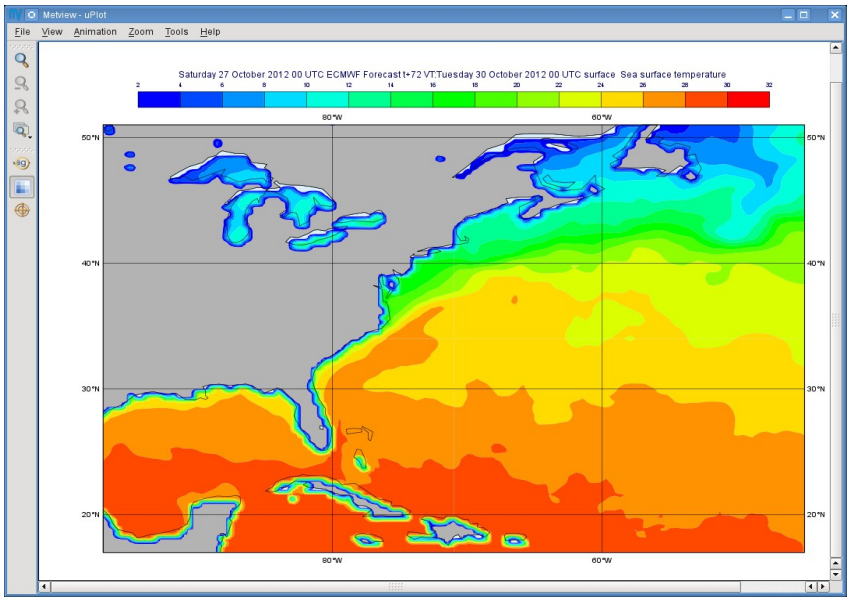
Windgust 10m



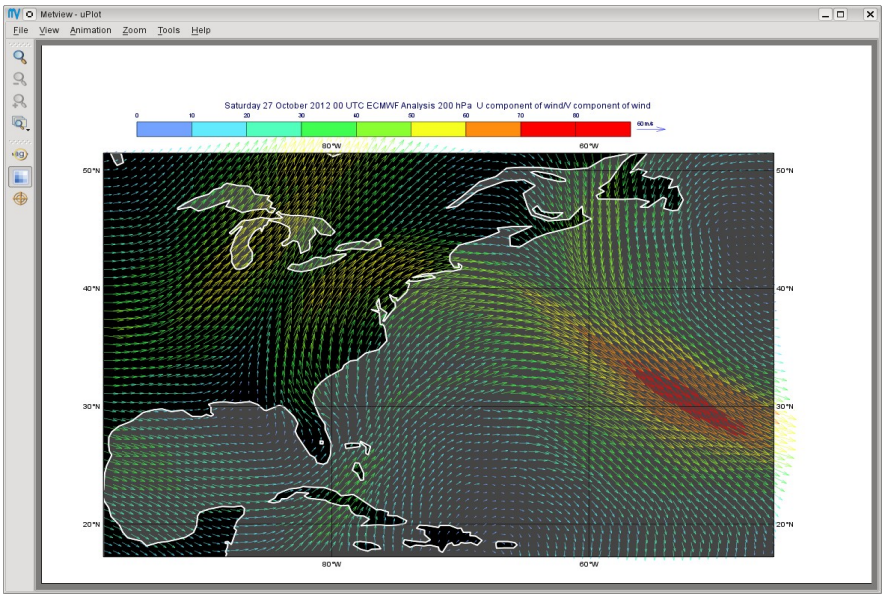
Temperature 2m



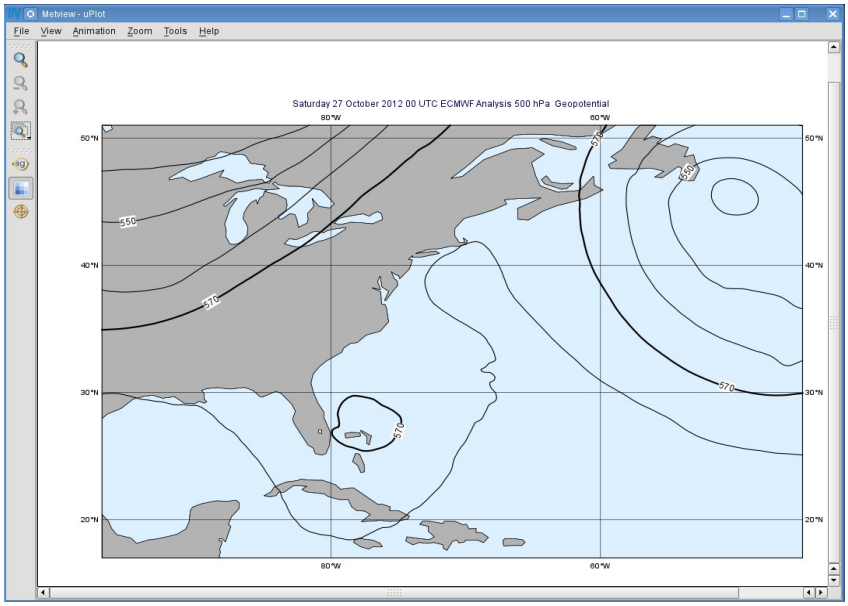
SST



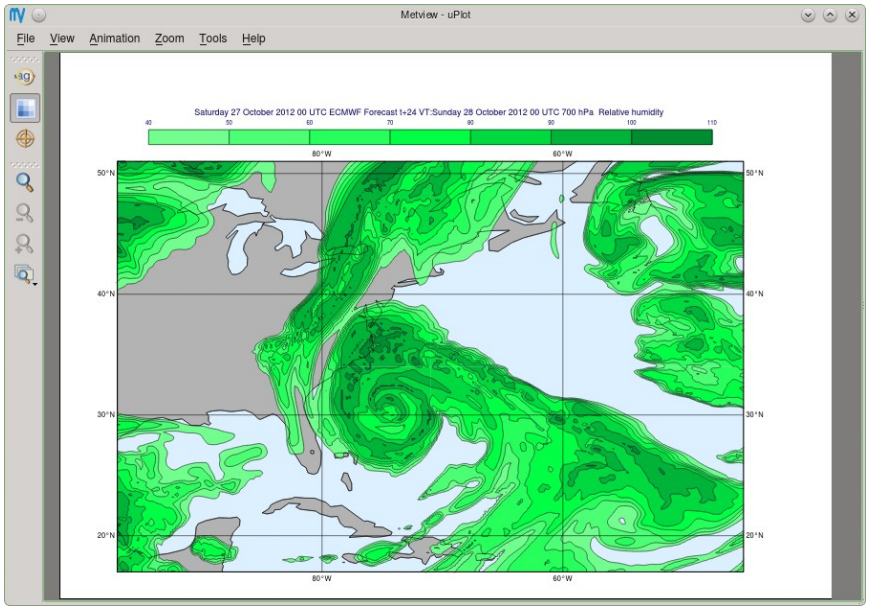
Wind 200 hPa (and 500 hPa)



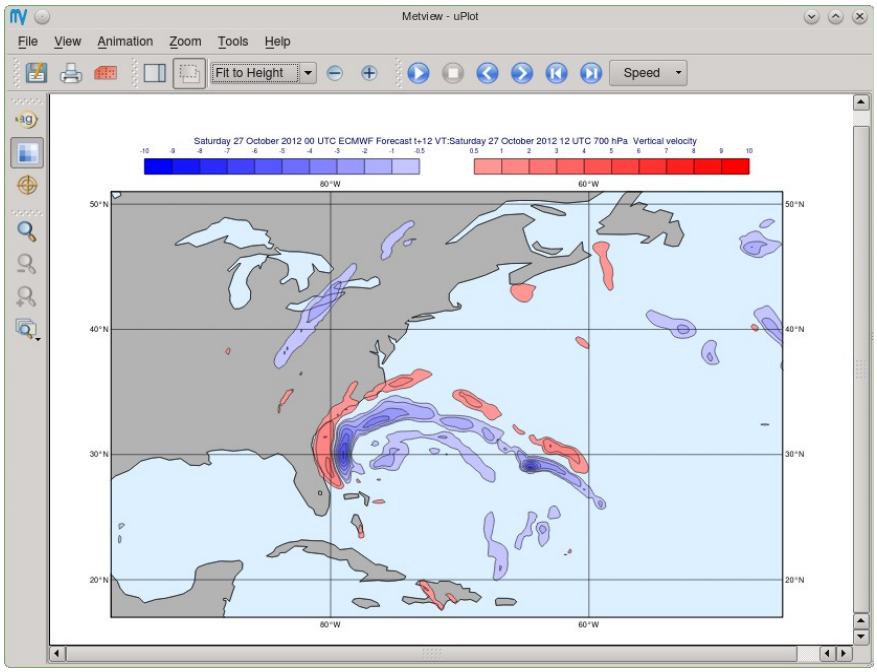
Z 500 hPa



RHU 700 hPa

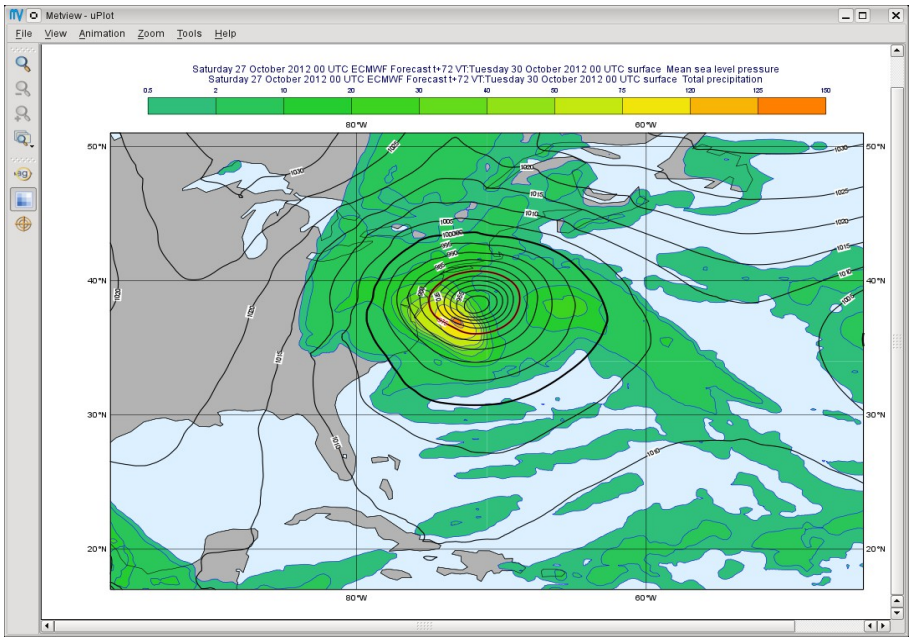


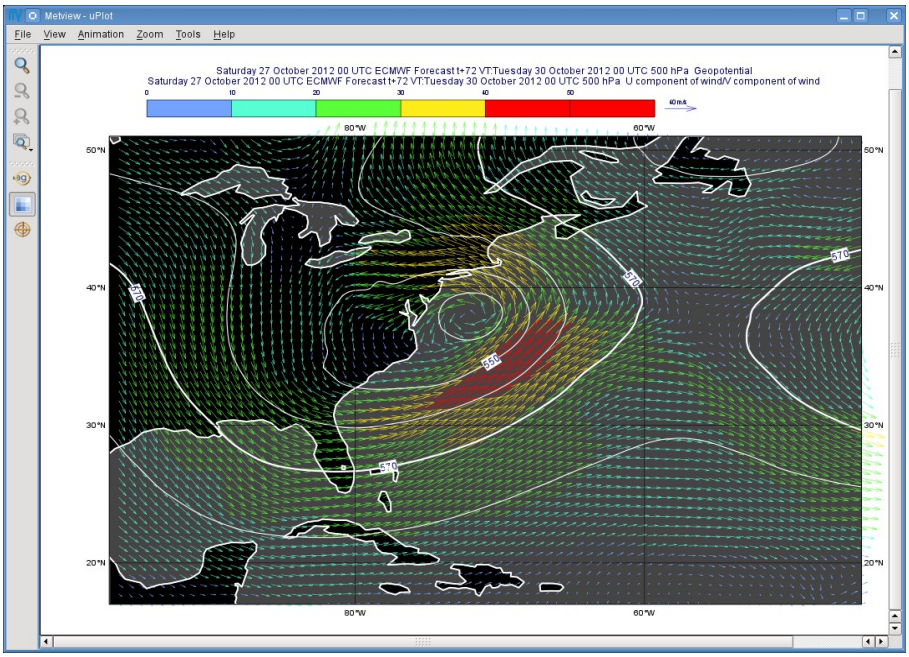
W 700 hpa



2.2 Overlay plots

Any two fields can be overlaid by simply dropping their macros (together with their visual definitions) one after the other into the same plot.



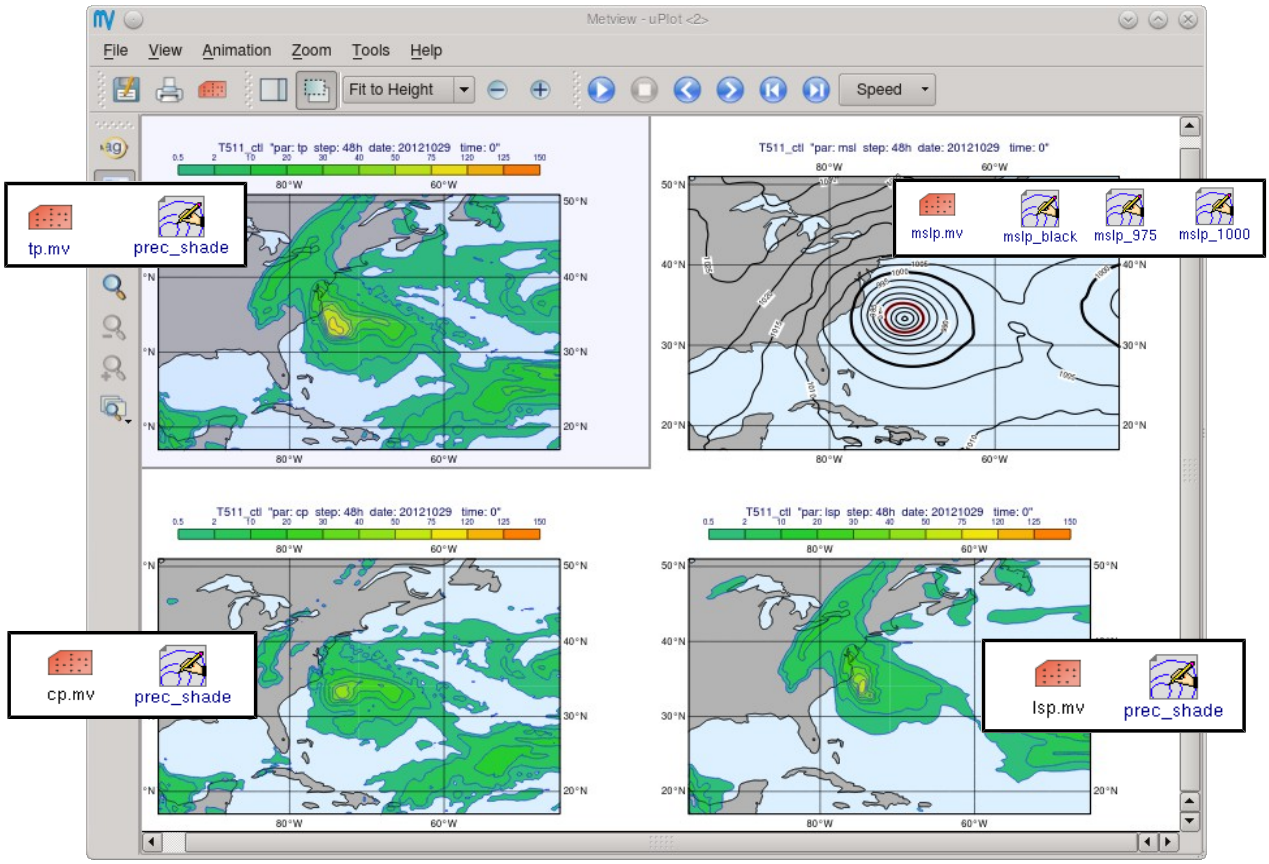


2.3 Multiple maps within one plot

There are some multiple-plot layout icons available in folder 'layouts' (inside your main 'openifs' folder).

If you visualise these icons you will get plots containing several maps. You can populate these maps exactly in the same way as you did for the individual maps. Then animation can work in a synchronous way: if you change the animation step in one of the plots the other plots will change it as well.

The snapshot below (together with the icons that were used to populate the maps) illustrates what kind of plots you can generate with this technique.



Please note that the automatically generated plot titles might appear to long for this kind of plots. You can shorten the title by dropping the 'short_title' *Text Plotting* icon (a customised one is available in each experiment's folder) into the plots.

2.4 Cross sections

Each experiment's folder contains a sub-folder called 'xs' populated with icons to create cross section plots.

Temperature cross section plots with macro

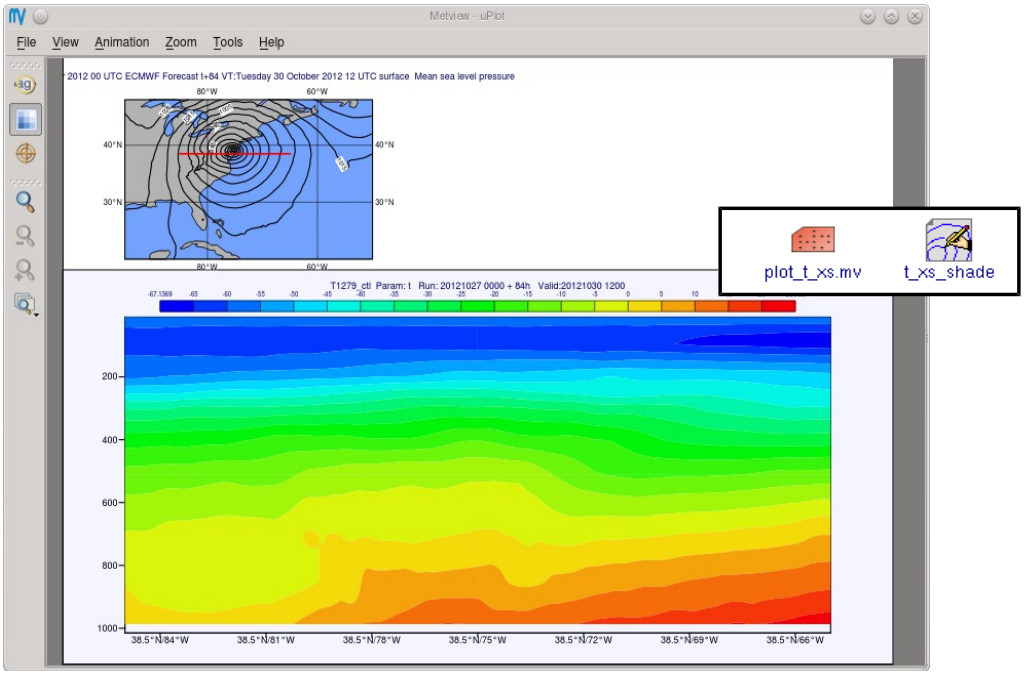
Edit macro 'plot_t_xs.mv'. At the top you will see parameters **line** and **step**, respectively. These define the cross section line and the forecast step (in hours) you want to investigate.

```
13
14 exp_label="T1279_ctl"
15 line=[38.5,-85,38.5,-65]
16 step=84
17
```

If you run this macro (by using the play button in the Macro Editor's toolbar or right-click **visualise**) you will get a plot with a map at the top and a cross section at the bottom. The map features the cross section line in red and the MSLP forecast valid for the given step. You can try to customise the cross section plot with the 't_xs_shade' *Contouring* icon.

Please note that when you visualise temperature cross sections the units are not converted automatically from Kelvin to Celsius (as it is done for the map-based plot), but it is done in the macro by this line of code:

```
25 grb = grb -273.16
```

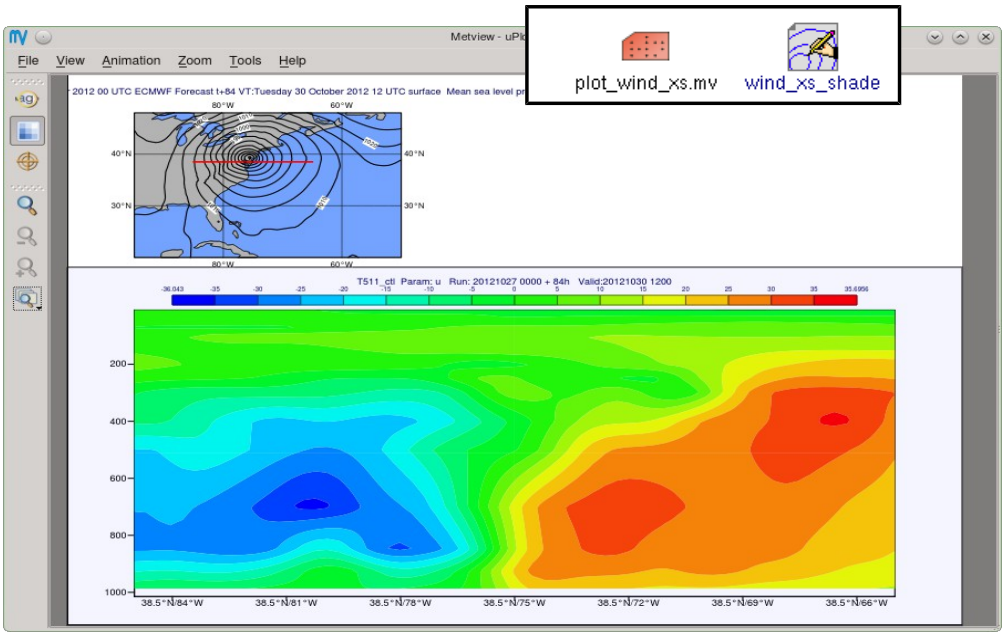


Potential temperature cross section plots with macro

Macros 'plot_theta_xs.mv' and 'plot_eq_theta_xs.mv' can generate cross sections for **potential temperature** and for **equivalent potential temperature**, respectively. These parameters are not available in our OpenIFS GRIB files but Metview can compute them by using the temperature and relative humidity fields (you can check the macro code to see how it is done).

Wind cross section plots with macro

Macro 'plot_wind_xs.mv' generates wind cross sections. It is derived by projecting the wind arrow onto the normal vector of the cross section plane and this projection (scalar value) is plotted as a contour plot.



Relative humidity cross section plots with macro

Relative humidity cross sections can be generated by the 'plot_rhu_xs.mv' macro.

Vertical velocity cross section plots with macro

Vertical velocity cross sections can be generated by the 'plot_w_xs.mv' macro.

2.5 Vertical profiles

Each experiment's folder contains a sub-folder called 'prof' populated with icons to create vertical profile plots.

Vertical profile view

In folder 'prof' you will find a *Vertical Profile View* icon.

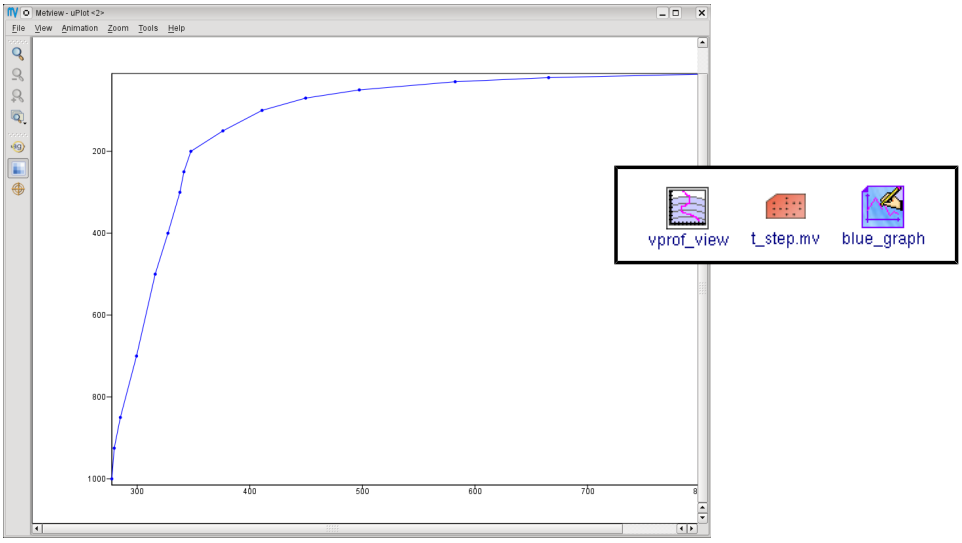
This icon defines the geographical location of the vertical profile. If you visualise it you can drop any GRIB files containing upper level data into it and a vertical profile will be automatically generated for you.

Vertical profile plots with macro

There is a set of macros available in this folder to extract all the pressure level fields for a given parameter and forecast step. For example macro 't_step.mv' returns the temperature fields. The forecast step (in hours) is defined by variable **step** in the macro.

```
14 exp_label="T1279_ctl"
15 step=84
```

If you visualise the *Vertical Profile View* icon and drop this macro into it you will get a vertical profile for temperature. Vertical profiles can be customised with *Graph Plotting* icons (e.g. with 'blue_graph').



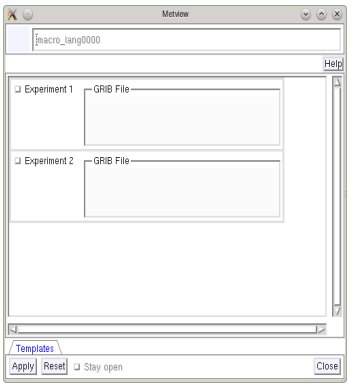
3 Comparing experiments

3.1 Difference plots

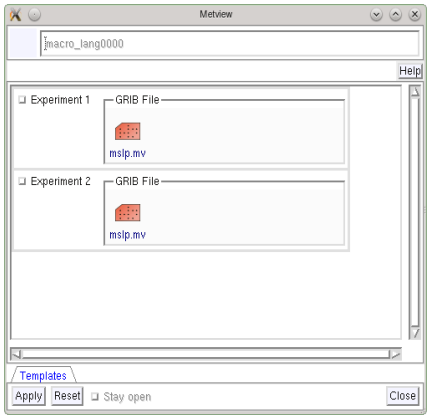
In folder 'diff_plots' (inside folder 'openifs') you will find icons to create difference plots. The macro you need to use here is 'plot_diff_map.mv'.

Comparing fields of the same resolution

If you right-click **execute** this macro you will see this user interface popping up:

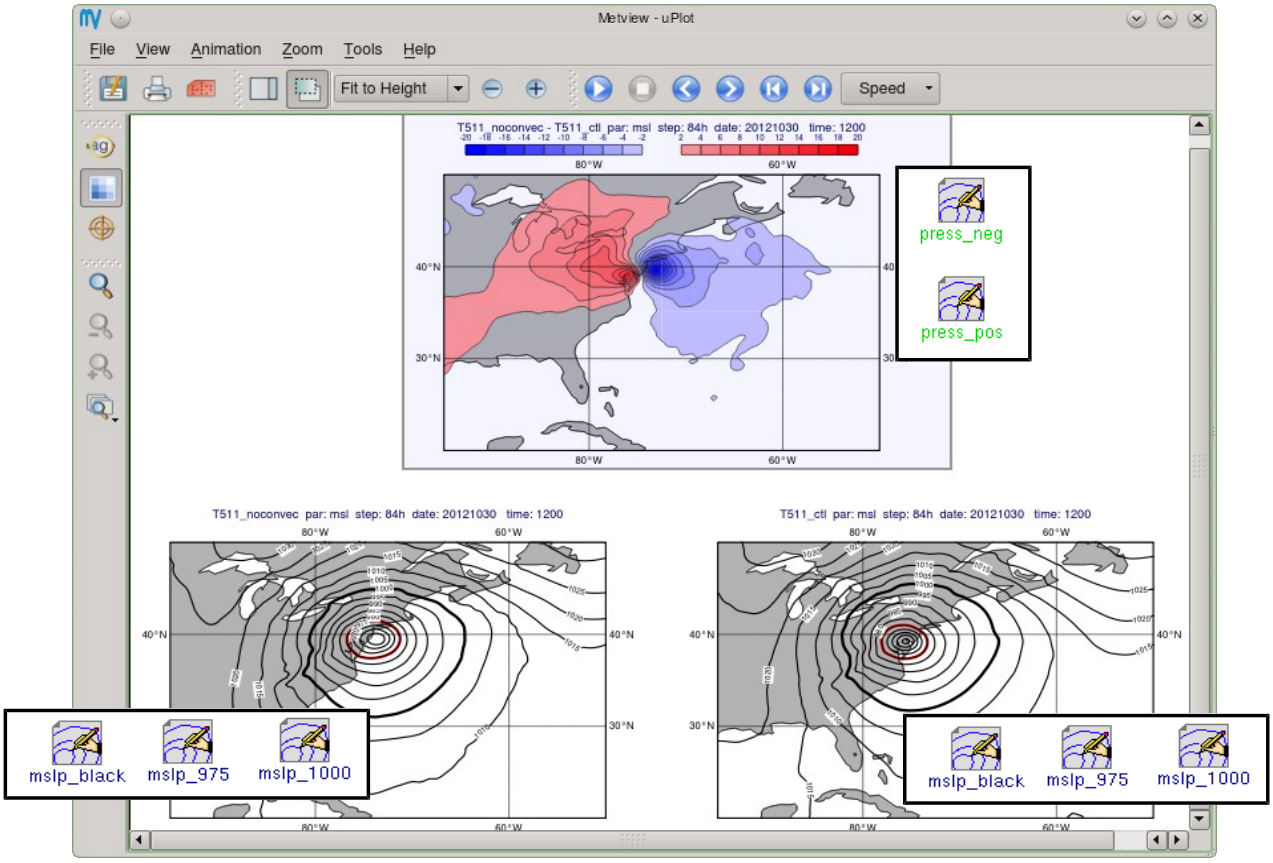


Now let us suppose that we want to compare the MSLP forecasts of the T1279_ctl and T1279_an experiments. Drop your 'mslp.mv' macro from folder 'T1279_an' into the **Experiment 1** field, and drop your 'mslp.mv' macro from folder 'T1279_ctl' into the **Experiment 2** field. Then click **Apply**.



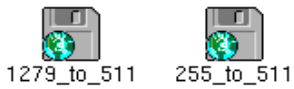
Soon a plot with three maps will appear. The map at the top contains the difference between the two experiments (in this case this is the analysis minus the control forecast), while the bottom left map contains the first experiment and the bottom right map contains the second experiment, respectively.

You can customise these plots in the same way as you learned for the individual maps. For the difference plot at the top there is a set of *Contouring* icons prepared in the folder for most of the parameters. For pressure you can try 'pres_neg' and 'pres_pos'; you need to drop these icons together into the difference plot to apply the settings in both icons to the plot. If you drop your MSLP contouring icons into the other two maps you will get something similar to this snapshot.

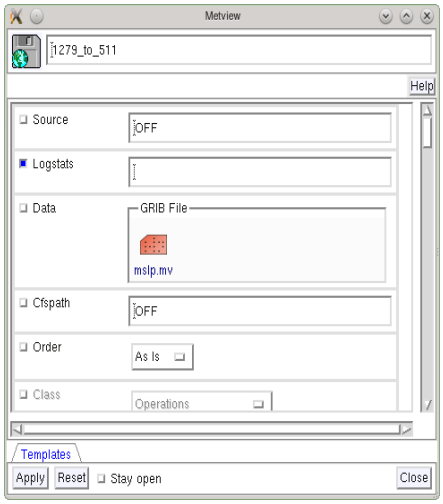


Comparing fields with different resolutions

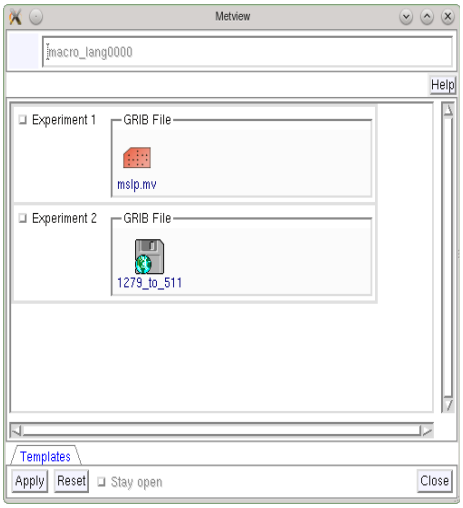
If you want to compare experiments with different resolutions, first you need to interpolate the higher resolution fields to the grid of the lower resolution fields or vice versa. There are two *GRIB Filter* icons called '1279_to_511' and '255_to_511' available in the folder for this purpose.



We will illustrate how they work by comparing the MSLP forecasts of experiment 'T1279_ctl' to that of 'T511_ctl. First, edit icon '1279_to_511' and drop your 'mslp.mv' macro from folder 'T1279_ctl' into the **Data** field then save your settings (click **Apply)**.



Second, **execute** your 'plot_diff_map.mv' macro and drop your 'mslp.mv' macro from folder 'T511_ctl' into the **Experiment 1** field, and drop your newly edited '1279_to_511' icon into the **Experiment 2** field. Then click **Apply**.



You will soon see the difference plot popping up. It will contain the difference between the two sets of fields computed at T511 resolution.

The other *GRIB Filter* macro in the folder is '255_to_511'. It can be used in a similar fashion to interpolate T255 grids onto the T511 resolution.

3.2 Storm track based computations

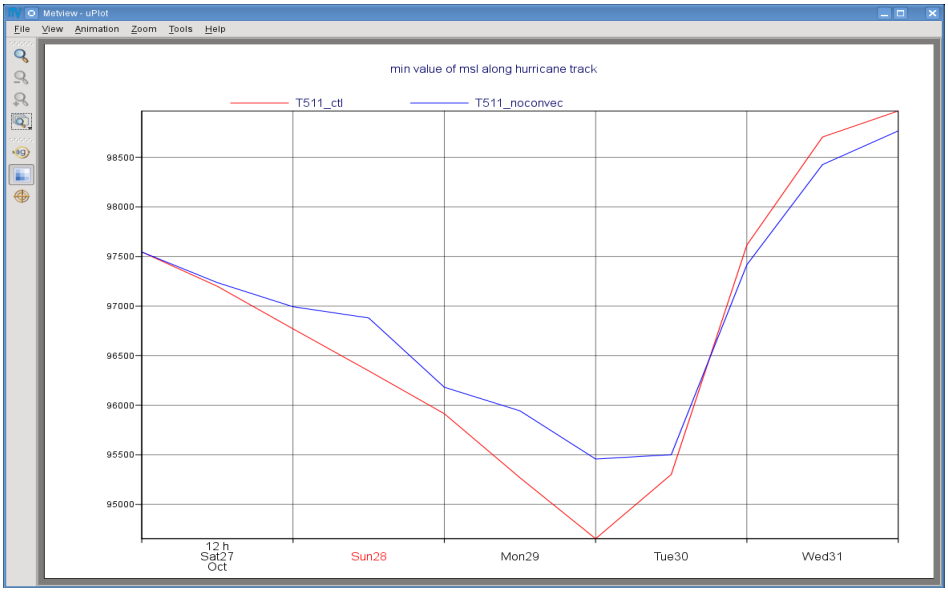
In folder 'track_plots' (inside folder 'openifs') you will find icons to perform computation along the storm tracks of different experiments. One of the macros you can use is 'plot_value_for_track.mv'.

plot_value_for_track.mv

This macro can compute the minimum or maximum values of a surface parameter along the storm track for a given set of experiments and plot them as time series. The parameter name, the type of the computation and the list of experiments can be changed via the **par**, **ext_type** and **exp_label_list** variables at the top of the macro.

```
15 par="msl"
16 ext_type="min"    # or max
17
18 #The list of experiments to be used
19 exp_label_list=["T511_ctl","T511_noconvec"]
```

If you run this macro you will get a plot like this.



There is another macro in the folder to compute and plot the maximum 10m wind speed along the track: it is 'plot_speed_for_track.mv'. It works in a similar as the previous one.