

Skyglow – formatting the plots

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1. How the plot is displayed

For the visualisation of the skyglow the GNUplot software (<http://gnuplot.info/>) is used. The GNUplot configuration files (all settings of the graph), named „sky_polar.plt“ „sky_polar_relative.plt“, „sky_hammer.plt“ and „sky_hammer_relative.plt“, are located in „programs/windows“ subdirectory. When Skyglow software calculates the project, these files are copied into the „results“-folder. GNUplot reads the local „*.plt“-files from „results“-folder and displays the plots, when the ‘Results’ menu items are selected.

2. Changing the default plot settings

As explained above, any change in „sky_polar.plt“ or „sky_hammer.plt“-files located in „programs/windows“ subdirectory affects all plots displayed in the future. So parameters written in these files are default values. The content of the „*.plt“-files is described later in more detail.

3. Changing the current plot settings

As explained above, the „*.plt“-files located in „results“-subdirectory are used for the displaying of the current plot – there contain current (local) settings of plots. These settings are used until you select “Results/Reset local plots settings...” menu item. If selected, “*.plt” files located in “results” subdirectory are replaced by these from “program/windows” subdirectory.

Both global and local plots settings are accessible also via “Results” menu items.

4. Replot of earlier computed data without GUI

The same method as described in the previous section can be used also for older results. Open the folder with older results, eventually modify any „*.plt“-file located therein, and double-click it.

5. Frequently asked modifications of the plots

We don't expect you to be a GNUplot-specialist. The “*.plt” files contain well-commented GNUplot commands, so it should be easy to understand and to modify them. Please consult the GNUplot user guide („Help/GNUplt help” menu item) if needed. In following sections we explain how to change some basic properties of the plot. We demonstrate settings on “sky_polar.plt” file. Setting in other files are similar.

Plot title and its position

Find lines (at the beginning of the file) starting with “splot” and change the **title** or the **position**:

```
splot "results_polar.dat" using 1:2:3 with lines title ""      #data
name and plot title, title can be changed

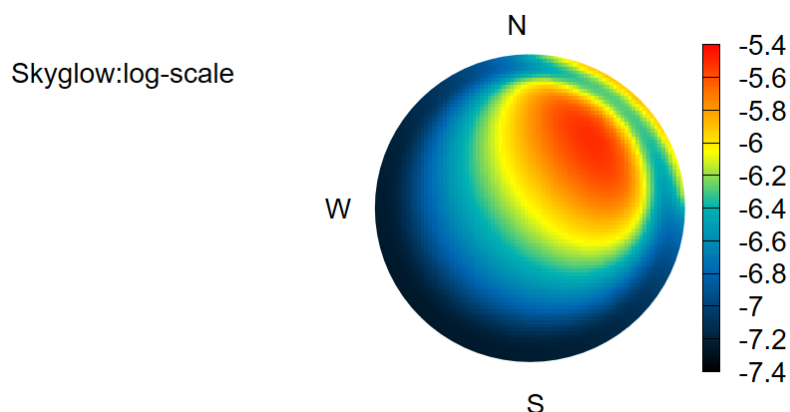
set title "Skyglow: log-scale" offset 0,1
```

Plot palette

Find line starting with “set palette” and activate (remove #-sign at the beginning of the line) one of the recommended **palettes**:

```
#set palette rgbformulae 7,5,15      #default color palette
(black-blue-red-yellow)
#set palette rgbformulae 8,9,10      #color palette for B&W
printing (blue-yellow)
#set palette rgbformulae 30,31,32     #another color palette for
B&W printing (black-blue-magenta-white)
#set palette defined (0 "black", 2 "blue", 4 "yellow", 6 "red")
#color palette (black-blue-yellow-red)
set palette defined (0 0 0 0, 1.8 0 0.4 0.7, 3 0 0.7 0.7 , 4 1 1 0,
6 1 0 0) #color palette (black-cyan-green-yellow-red)
#set palette gray negative            #inverted greyscale palette
#set palette gray                    #greyscale palette
```

The default palette looks as follows:



Isolines and isolines values

Find line starting with “set contour base” and activate (remove #-sign at the beginning of the line) if you want to have isolines in the plot.

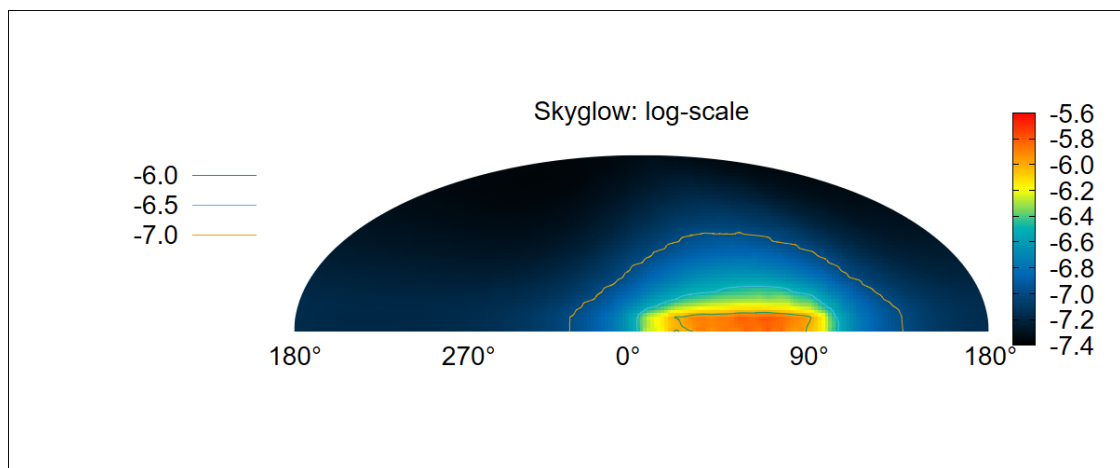
```
#set contour base    #comment this line (put # at the beginning) if  
no isolines are requested#set cntrparam levels 5
```

Find line starting with “set cntrparam levels” and activate (remove #-sign at the beginning of the line) one of the recommended set of **isolines values**. You can also write your own values of isolines:

```
#set cntrparam levels 5                                #aproximate number ...  
#set cntrparam levels discrete -15,-14,-13,-12,-11,-10,-9...  
set cntrparam levels discrete -15,-14.5,-14,-13.5,-13,-12.5,...  
                                -5.5,-5,-4.5,-4,-3.5,-3,-2.5,-2,...  
                                7,7.5,8,8.5,9,9.5,10    #more dense ...
```

The **decimal places** of numbers at **isolines** can be set using command

```
set cntrlabelformat '%.1f'
```



Fixed range of the colour scale

The colour scale is set automatically by default. In the case you need to plot more results using the same colour scale, find the line starting with “set cbrange”, activate the command (**remove #**) and modify the **scale range**:

```
#set cbrange [-9:-5]                                #uncomment (remove #) ...
```

Position of the key (legend) in the plot and the number format

Find the line starting with “set key”, **activate/modify** one of the recommended options. Standard positions are **left, right, top, bottom, lmargin, rmargin, tmargin, bmargin**:

```
set key lmargin                                #position of the ...  
#unset key                                    #hide legend  
#set key at -110,90                            #exact position ...
```

The number of decimal places shown in numbers in the key (legend, colorbox) can be changed freely. Find line starting with “set format cb” and modify the **number of decimal places**:

```
set format cb '%.1f' #f=floating format, ...
```

Modifying the size of the plot shown on the screen

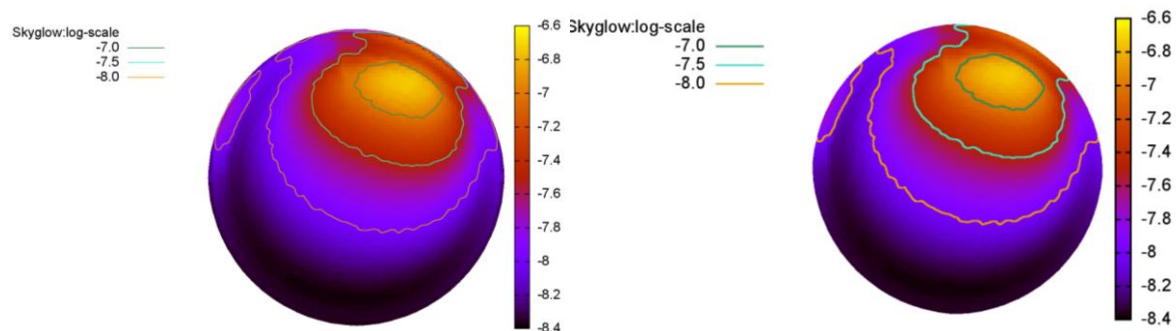
Find corresponding section at the begin of the file and feel free to modify the **size of the window**, the **size of the font**, or the **width of the isolines**:

```
#--following line controls the look of the plot on the screen ----
set term windows size 900,600 fontscale 1.0 linewidth 2 #size=...
```

Modifying the size of the colourful PNG plot written to the disk

Find corresponding section at the end of file and feel free to modify the **size (resolution) of the picture**, the **size of the font**, or the **width of the isolines**:

```
#--- Writes Portable Network Graphics (PNG) picture in full-colour...
set terminal png size 1800,1024 linewidth 4 font ',36' #as on...
set output 'results_polar.png' #picture filename
replot #write picture
unset output #close file
#--- End -----
```



How to change the color of the isolines

You can change the color of any line in the plot. Gnuplot uses lines of type 1, 2, 3, ... in that order.

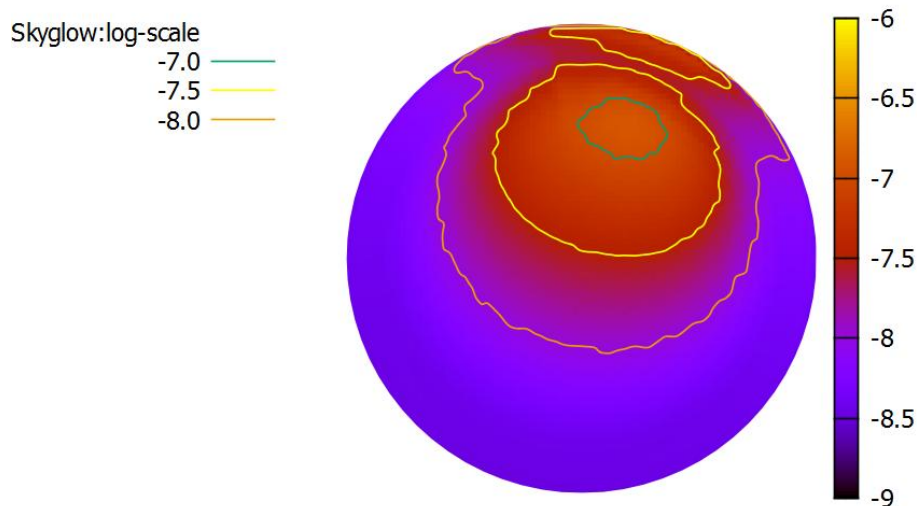
As an example, we change one of the isolines to yellow in the „sky.plt“-file by adding one line:

```
set contour base #comment this line (put # at the ...
#set cntrparam levels 5 #aproximate number of isolines ...
#set cntrparam levels discrete -15,-14,-13,-12,-11,-10,-9,-8,-7,-6,-5,-4, ...
set cntrparam levels discrete -15,-14.5,-14,-13.5,-13,-12.5,-12,-11.5,-11, ...
set cntrparam bspline #isolines draw method (linear, ...
set cntrparam order 10 #smoothness of the isolines (use ...
set linetype 3 linecolor rgb "yellow"
```

Besides the name of the color you can specify exact RGB composition of the color in the same way, as is commonly used in HTML:

```
set linetype 3 linecolor rgb "#FFFF00"
```

The results is here:



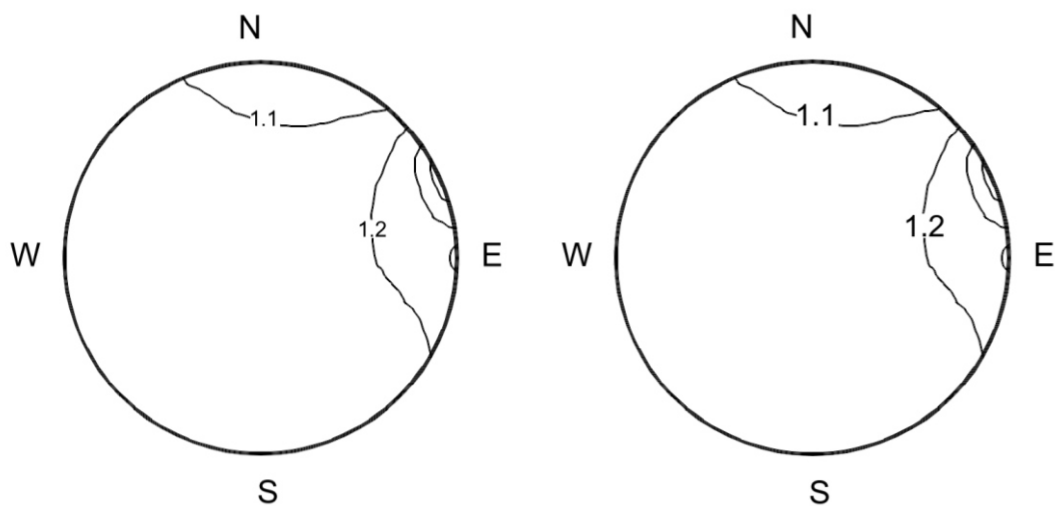
In the same way you can change the color of other isolines (lines 2 and 4 on the plot above).

How to change the labels of the isolines in relative B&W plots

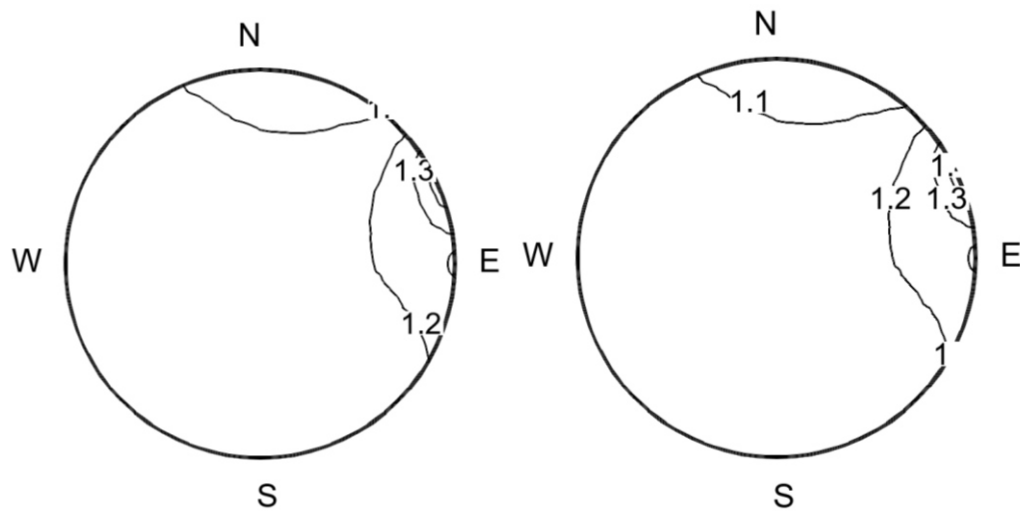
The **density** of labels, their **starting position** and the **size of numbers** can be set freely. Modify commands at the end of the PLT-file:

```
#--- Writes Portable Network Graphics (PNG) using black (labeled) isolines -----
set terminal png size 1800,1024 linewidth 3 font ",36"      #picture size, font...
...
set output 'results_polar_relative_bw.png'                #picture filename
...
set cntrparam point 1                                     #labels density on the isolines, use 1,2,3,...
set cntrlabelformat '%.1f' font ',24' start 50 interval -1 #no. of decimal ...
...
```

The right plot uses font size '34' instead of default value of '24':



The left figure uses start parameter ,10' instead of the default value of ,50'. The labels are placed closer to the begin of isolines and can be partly or fully hidden „behind the horizon“. The right figure uses the value of ,2' for the density of labels. As you can see, at 1.2-isoline two labels are visible (one is partly hidden):



In general, higher value of start-parameter moves the position of labels farther from the beginning of lines. For shorter isolines (at horizon, located close to the light source, denser isolines) it can lead to the situation, when no label is shown or is hidden. This can be desired effect, because the highly polluted region close to the horizon is usually not interesting and isolines are there too dense to be shown in the plot.

Please feel free to experiment with the labels to obtain a nice plot. Alternatively, use exported 'results_relative.dat'-file and create a plot in another professional plotting software.

Colour alternative to the isolines

To show the distribution of the skyglow in an easily readable form, it is not necessary to use isolines. Instead of them you can use "stepwise" color palette by adding one single row into the "sky.plt"-file:

Make following changes:

1. Activate (remove # at the begin) and modify the line in the "palette" section:

```
set palette maxcolor 6
set palette rgbformulae 7,5,15          #default color ...
#set palette rgbformulae 8,9,10        #color palette for B&W ...
```

2. Inactivate (add the # character) the isolines:

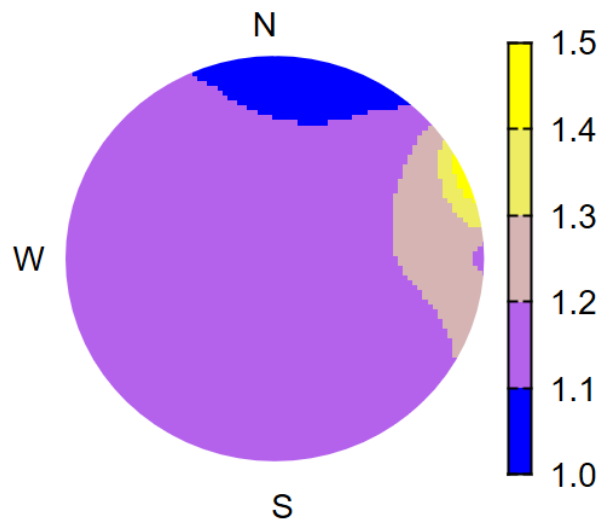
```
#set contour base                      #comment this lin...
```

3. Set fixed colour scale:

```
set cbrange [-9:-6]
```

The result looks as follows:

Skyglow: relative change

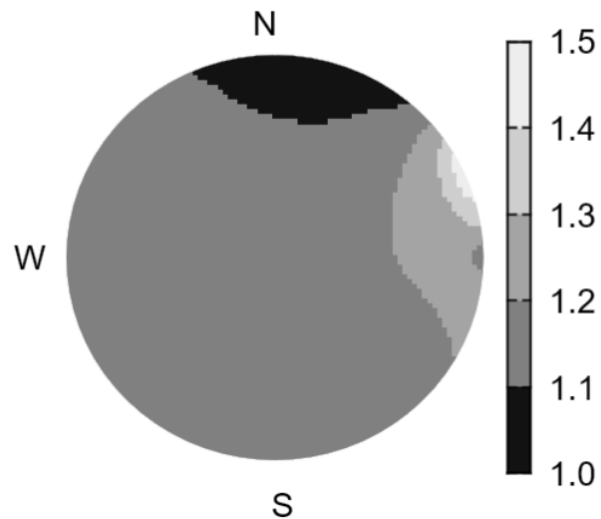


The trick is that we are using the color scale divided into 6 intervals, corresponding to the color scale $[-9:-6]$, interval length is 3) that can be easily divided into 6 intervals.

According to your color scale you can use other number of steps in the “set palette maxcolor” command.

Such plots are good-looking also in grayscale, if one of suitable color palettes is chosen:

Skyglow: relative change



The palette `set palette rgbformulae 8,9,10` was used and converted to grayscale.