# HOWTO g05: Plotting in GrafLab and the output variable

You will learn how to plot the results of the synthesis with GrafLab and about the GrafLab output variable.

Only synthesis at a grid can be plotted with GrafLab.

All the GrafLab input parameters are explained in ../docs/graflab.md.

```
clear; clc; init_checker();
```

## Plotting with "Mapping Toolbox"

Define the GrafLab input parameters.

```
GM                  = 3986004.415E+8;
R                   = 6378136.3;
nmin                = 0;
nmax                = 360;
ellipsoid           = 1;
GGM_path            = '../data/input/EGM96.mat';
crd                 = 0;
point_type          = 0;
lat_grd_min         = -90.0;
lat_grd_step        =   1.0;
lat_grd_max         =  90.0;
lon_grd_min         =   0.0;
lon_grd_step        = lat_grd_step;
lon_grd_max         = 360.0;
h_grd               =   0.0;
out_path            = '../data/output/howto-g05-mapping-toolbox';
quantity_or_error   = 0;
quantity            = 5;
fnALFs              = 1;
export_data_txt     = 1;
export_report       = 1;
export_data_mat     = 1;
display_data        = 1;   % Use Mapping Toolbox to plot the synthesis
graphic_format      = 6;
colormap            = 1;
number_of_colors    = 60;
dpi                 = 300;
status_bar          = 1;
```

Do the synthesis

```
tic
out_mt = GrafLab('OK', ...
    GM, ...
    R, ...
    nmin, ...
    nmax, ...
    ellipsoid, ...
    GGM_path, ...
```

```
    crd, ...
    point_type, ...
    lat_grd_min, ...
    lat_grd_step, ...
    lat_grd_max, ...
    lon_grd_min, ...
    lon_grd_step, ...
    lon_grd_max, ...
    h_grd, ...
    [], ...
    [], ...
    [], ...
    [], ...
    out_path, ...
    quantity_or_error, ...
    quantity, ...
    fnALFs, ...
    [], ...
    export_data_txt, ...
    export_report, ...
    export_data_mat, ...
    display_data, ...
    graphic_format, ...
    colormap, ...
    number_of_colors, ...
    dpi, ...
    status_bar);
time_mt = toc;
```

You may now open the following files to see the maps:

```
fprintf("""%s*.png"".\n", out_path);
```

The time needed to perform the synthesis and plot the results is:

```
fprintf("%0.1f sec.\n", time_mt);
```

Conclution: the plots are nice, but the plotting may be very slow for large grids.

## Plotting with the "imagesc" function

Update some of the GrafLab input paramaters.

```
display_data = 2;  % Use the "imagesc" function to plot the synthesis
out_path     = '../data/output/howto-g05-imagesc';
```

Do the synthesis

```
tic;
out_imgsc = GrafLab('OK', ...
    GM, ...
```

```
        R, ...
        nmin, ...
        nmax, ...
        ellipsoid, ...
        GGM_path, ...
        crd, ...
        point_type, ...
        lat_grd_min, ...
        lat_grd_step, ...
        lat_grd_max, ...
        lon_grd_min, ...
        lon_grd_step, ...
        lon_grd_max, ...
        h_grd, ...
        [], ...
        [], ...
        [], ...
        [], ...
        out_path, ...
        quantity_or_error, ...
        quantity, ...
        fnALFs, ...
        [], ...
        export_data_txt, ...
        export_report, ...
        export_data_mat, ...
        display_data, ...
        graphic_format, ...
        colormap, ...
        number_of_colors, ...
        dpi, ...
        status_bar);
    time_imagsc = toc;
```

You may now open the following files to see the maps:

```
fprintf("""%s*.png"".\n", out_path);
```

The time needed to perform the synthesis and plot the results is (compare the time with the Mapping Toolbox):

```
fprintf("%0.1f sec.\n", time_imagsc);
```

Conclusion: very simple plots, but also very fast plotting, even with large grids.

## Output variable from GrafLab

You may redirect the numerical outputs from GrafLab to a MATLAB variable. The output variable stores the numerical data used by GrafLab to prepare the "txt" and/or "mat" file(s). Note that the "out_path" must be specified, even if you do not export any data or plot.

Now, you may want to explore the GrafLab numerical outputs stored in the "out_mt" and "out_imgsc" variables.