

# Scientific colour maps

[Crameri \(2018\)](#)

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[www.fabiocrameri.ch/colourmaps](http://www.fabiocrameri.ch/colourmaps)

## Characteristics

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- Perceptually uniform ✓
- Perceptually ordered ✓
- Colour-vision-deficiency (CVD) friendly ✓
- Readable as black and white print ✓
- Provided in all major formats ✓

## Author

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## Contributors

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- Matteo Albano – *Conversion to .clr format and compatibility with QGIS* – [contact](#)
- Casper Pranger – *Mathematica compatibility* – [contact](#)
- Alexis Plunder – *Wider compatibility of .xml format* – [contact](#)
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- Philippe Rivi re – *Conversion instruction for d3* – [contact](#)
- Emilia – *Plotly versions* – [contact](#)
- Thomas Lin Pedersen – *The 'scico' package for use with R* – [contact](#)
- Paul Wessel – *Built-in version for 'GMT'* – [contact](#)
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- Chad Greene – *MatLab file exchange version* – [contact](#)
- Sean Trim – *Conversion to .pal format* – [contact](#)
- George Edward Campbell – *Conversion to .lut format* – [contact](#)
- Kirstie Wright – *User instruction for use with Petrel* – [contact](#)
- Jennifer Levett – *Conversion to SKUA-GOCAD .xcmap format* – [contact](#)

# Acknowledgement

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Please acknowledge the free use of the colour maps.

e.g., "Perceptually uniform colour maps are used in this study to prevent visual distortion of the data (Crameri 2018a,b)."

*Crameri, F. (2018a), Scientific colour-maps. Zenodo. <http://doi.org/10.5281/zenodo.1243862>*

*Crameri, F. (2018b), Geodynamic diagnostics, scientific visualisation and StagLab 3.0, Geosci. Model Dev., 11, 2541-2562, doi:10.5194/gmd-11-2541-2018*

## Instructions

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### Using the .mat format (MatLab)

Load the colour map into MatLab, either by adding the .mat file to the MatLab search path and using the command:

```
load('davos.mat');
```

or by specifying the full file path to the .mat file:

```
load('~/.work/Colormaps/davos.mat');
```

Then use it, for example, with:

```
figure(1)
colormap(davos)
colorbar
```

### Using the file-exchange app (MatLab)

A convenient MatLab package provided by Chad Greene containing the full scientific colour-map suite is available on [MatLab file exchange](#).

### Using the .cpt format (GMT)

The file davos.cpt can be resampled for a given z-value range with the Generic Mapping Tools (GMT; <http://gmt.soest.hawaii.edu/>) command "makecpt".

For example to resample for an array from -2000 to 2000 in 100 increments you could generate a new file

with:

```
$makecpt -Cdavos.cpt -T-2000/2000/100 > davos_resampled.cpt
```

## Using the .ct format (VisIt)

The file `davos.ct` can be imported to VisIt by placing the `.ct` file in the `.visit` directory, which can be found on macOS under e.g.,:

```
/Applications/VisIt.app/Contents/Resources/ ...  
... 2.12.3/darwin-x86_64/resources/colortables
```

The colour map should appear in the built-in list after VisIt has been restarted.

## Using the .mat format (Mathematica)

```
ColorMapSuitePath = "/Path/To/ColourMapSuite/";  
  
ColorMapSuite[name_String] := ColorMapSuite[name, -1]  
ColorMapSuite[name_String, el_] := With[{  
  list =  
    Transpose@{Subdivide[0, 1, 255],  
      RGBColor @@@  
        First@Import[  
          ColorMapSuitePath <> "/" <> name <> "/" <> name <> ".mat"]}  
    },  
  Blend[list, {##}][[el]]] &  
]
```

The function call `ColorMapSuite["name", i = -1]` returns a lambda function whose  $i$ th argument is used to define color (see the Manual for `ColorFunction` for details). `"name"` should be replaced with the name (in quotes) of the color scheme, e.g. `"davos"`. Be sure to set the variable `ColorMapSuitePath` to the path where your `ColorMapSuite` is installed.

General rules are:

- 1D plots of 1D functions/data: no (default) argument  $i$  suffices
- 2D plots of 2D functions/data: no (default) argument  $i$  suffices
- 3D plots of 2D functions/data: use  $i = 3$
- 3D plots of 3D functions/data: use  $i = 4$  (results might be worse than default Mathematica color functions, possibly due to lack of surface normal mapping)

```
ContourPlot[Sin[x] Sin[y], {x, 0, 2 Pi},  
{y, 0, 2 Pi}, ColorFunction -> ColorMapSuite["davos"]]
```

## Using the .xml format (QGIS)

Load the colour map into QGIS in:

```
Settings > Style manager > Import/Export > Import symbol(s) > select the xxx_QGIS.xml file.
```

## Using the .xcmap format (SKUA-GOCAD)

To import a colormap into a SKUA-GOCAD project, navigate to

```
File > Import > GOCAD Resources > Colormaps .
```

Alternatively, for advanced users, to include a colormap as a resource in all new projects, insert the .xcmap text into the *colormaps.xml* file located in `*/Gocad/lib/app-defaults` .

## Using the .txt format (Python)

### Step 1: Load colour-map data

Load the colour-map data into Python using `numpy.loadtxt()` :

```
import numpy as np
cm_data = np.loadtxt("CBname.txt")
```

### Step 2: Set up colour map

Use `matplotlib.colors.LinearSegmentedColormap()` to create a colour map that can be used with matplotlib.

```
from matplotlib.colors import LinearSegmentedColormap
CBname_map = LinearSegmentedColormap.from_list('CBname', cm_data)
```

### Complete example:

```
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.colors import LinearSegmentedColormap

cm_data = np.loadtxt("CBname_RGB(0-1).txt")
CBname_map = LinearSegmentedColormap.from_list('CBname', cm_data)

x = np.linspace(0, 100, 100)[None, :]
plt.imshow(x, aspect='auto', cmap=CBname_map)
plt.axis('off')
plt.show()
```

## Using the .py format (plotly)

Plotly versions of the scientific colour maps provided by Emilia are available at

<https://github.com/empet/scientific-colorscales>.

The plotly scientific colour maps (see the file `scicolorscales.py`) were created by converting the provided .py file of each colour map.

Direct applications and some scientific tests are illustrated in this Jupyter Notebook:

<http://nbviewer.jupyter.org/github/empet/scientific-colorscales/blob/master/Tests-for-scientific-colorscales.ipynb>.

## Using the .xml format (d3)

An instruction to convert the .xml format to d3's internal representation is provided by Philippe Rivière at

<https://beta.observablehq.com/@fil/colormaps>.

## Using the .pal format (Gnuplot)

Launch the Gnuplot shell and load the specific .pal file (e.g., `batlow`) into Gnuplot with:

```
user@computer gnuplot
gnuplot> load "batlow.pal"
```

## Using the .lut format (ImageJ/Fiji)

The .lut colour-map file (e.g., `batlow.lut`) can be imported to ImageJ or Fiji by placing it in the `luts` folder (to reveal folder location in Fiji: `File > Show Folder > LUTs`). Upon restart of ImageJ, the scientific colour map(s) should then be available under `Image > Lookup Tables`.

Alternatively, the colour-map .lut file may be applied using either (a) `File > Open`, (b)

`File > Import > LUT`, or (c) drag and drop the .lut file onto the ImageJ window. To view available LUTs: `Image > Color > Display LUTs`.

## Using the .alut format (Petrel)

To import colour maps, select the `templates` pane and `colour tables` folder.

Then select the folder to import into (or insert a new folder) and right click `import on selection`.

Select `colour tables (alut files) (*.alut)` to view and select all suitable colour maps for import.

Accept default settings `trim colour control points` and `trim opacity control points`

and finally use as any other colour table within Petrel.

## Using the scico package (R)

[scico](#) (<https://travis-ci.org/thomasp85/scico>; pronounced as "psycho") is a small package developed by Thomas Lin Pedersen that provides access to the scientific colour maps within R. It provides scales for [ggplot2](#) without requiring `ggplot2` to be installed.

[scico](#) can be installed from CRAN with `install.packages('scico')`. If you want the development version then install directly from GitHub:

```
# install.packages("devtools")
devtools::install_github("thomasp85/scico")
```

For further details and user instructions are included in a README file within [scico](#).

## Using the .gpl format (GIMP/Inkscape)

To import the .gpl palettes, launch GIMP and go to `Windows > Dockable Dialogs > Palettes` to open the Palettes dialog. Then right-click anywhere on the list of palettes and select `Import Palette`. In the *Import a New Palette* dialog, select the *Palette file* radio button and then the button just to the right of the folder icon.

Then, navigate to and select the desired .gpl file in the corresponding folder. Clicking the *Import* button will add the scientific colour map to the existing list of palettes.

## Software with built-in versions

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[StagLab](#) 3.0 and later

[GMT](#) 6.0 and later

[TopoToolbox](#) 2.2 and later

[SubMachine](#)

[Geoscience ANALYST](#) 2.80 and later

## References

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Included colour-map diagnostics are based on:

- Kovesi (2015), *Good Colour Maps: How to Design Them*, CoRR, abs/1509.03700, <http://arxiv.org/abs/1509.03700> and related MatLab functions available at <https://www.peterkovesi.com/matlabfns/index.html#colour>.

For further details see:

- Crameri, F. (2018), *Geodynamic diagnostics, scientific visualisation and StagLab 3.0*, *Geosci. Model Dev.*, 11, 2541-2562, [doi:10.5194/gmd-11-2541-2018](https://doi.org/10.5194/gmd-11-2541-2018)

## License

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