

# tofino

a perceptually uniform colour-map - [www.fabiocrameri.ch/tofino](http://www.fabiocrameri.ch/tofino)

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## Authors & Contributors

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- **Emilia** - Plotly versions - [contact](#)
- **Thomas Lin Pedersen** - The 'scico' package for use with R - [contact](#)

## Acknowledgement

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Please acknowledge the free use of the colour map.

e.g., "The perceptually uniform colour-map **tofino** is 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. Discuss., doi:10.5194/gmd-2017-328

## 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('tofino.mat');
```

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

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

Then use it, for example, with:

```
figure(1)
colormap(tofino)
colorbar
```

## Using the .cpt Format (GMT)

The file tofino.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 -Ctofino.cpt -T-2000/2000/100 > tofino_resampled.cpt
```

## Using the .ct Format (VisIt)

The file tofino.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. `"tofino"`. 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["tofino"]]
```

## 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("tofino.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  
tofino_map = LinearSegmentedColormap.from_list('tofino', cm_data)
```

### Complete example:

```
import numpy as np  
import matplotlib.pyplot as plt  
from matplotlib.colors import LinearSegmentedColormap  
  
cm_data = np.loadtxt("tofino_RGB(0-1).txt")  
tofino_map = LinearSegmentedColormap.from_list('tofino', cm_data)  
  
x = np.linspace(0, 100, 100)[None, :]  
plt.imshow(x, aspect='auto', cmap=tofino_map)  
plt.axis('off')  
plt.show()
```

## Using the .py Format (plotly)

Plotly versions of the scientific colour-maps are 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 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`.

## 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. Discuss.*, [doi:10.5194/gmd-2017-328](https://doi.org/10.5194/gmd-2017-328)

## License

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