

# How to appreciate, use, and choose Scientific Colour Maps

We provide a complete set of Scientific colour maps (SCM) that represent data without visual distortion and are intuitive and inclusive, even to colour-blind readers.

What is the problem?

How to appreciate SCMs

How to use SCMs

How to choose a specific SCM

Frequently asked questions (FAQs)

Contact and resources



# What is the problem?

*Click on it!* 

Due to historical usage and default colour palettes on visualisation software, colour maps that **distort data through uneven colour gradients** and **exclude readers with colour-vision-deficiencies** are still commonly used today.

In fact, the most-used colour map in presentations at the EGU General Assembly in 2018 - including Geodynamics sessions - was the one colour map that is most widely known to distort the data and misguide readers (see <https://betterfigures.org/2018/04/16/how-many-rainbows-at-egu-2018/>).



*Read more here.*

And it goes way beyond that: Major projects (including some worth billions of dollars) can be based on data that are often presented with distorting colour gradients, and critical national crisis management is still communicated without consideration for individuals with colour-vision deficiencies.

We believe that

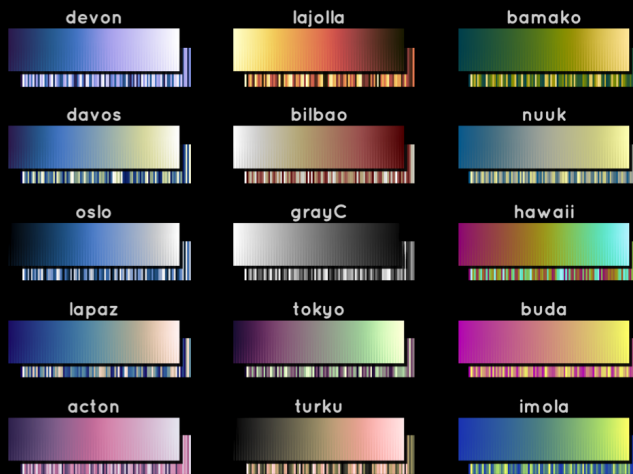
**distorting data and excluding readers does not belong in science.**

# How to appreciate SCMs

All Scientific colour maps are

- ✓ Perceptually uniform
- ✓ Perceptually ordered
- ✓ Colour-vision-deficiency friendly
- ✓ Readable as black-and-white print
- ✓ Provided in all major formats
- ✓ Citable & reproducible

## Sequential



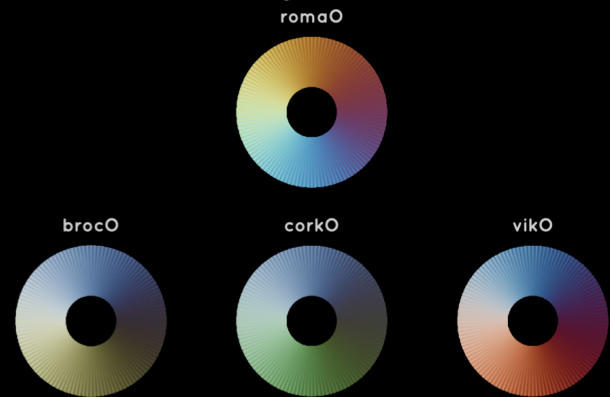
## Diverging



## Special



## Cyclic



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

**Scientific**  
Colour Maps

# How to use SCMs

The Scientific colour maps are

## ✓ Provided in all major formats

for MatLab, Python, R, GMT, QGIS, Ncview, Ferret, Plotly, Paraview, VisIt, Mathematica, Gnuplot, Surfer, d3, SKUA-GOCAD, Petrel, Fledermaus, Qimera, ImageJ, Fiji, Kingdom, Originlab, GIMP, Inkscape, and more...

## ✓ Built into truly scientific software

like **GMT** 6.0 or **TopoToolbox** 2.2 or **Geoscience ANALYST** 2.8 or **StagLab** 5.0  
ask your software developer: „Why not in your software?“

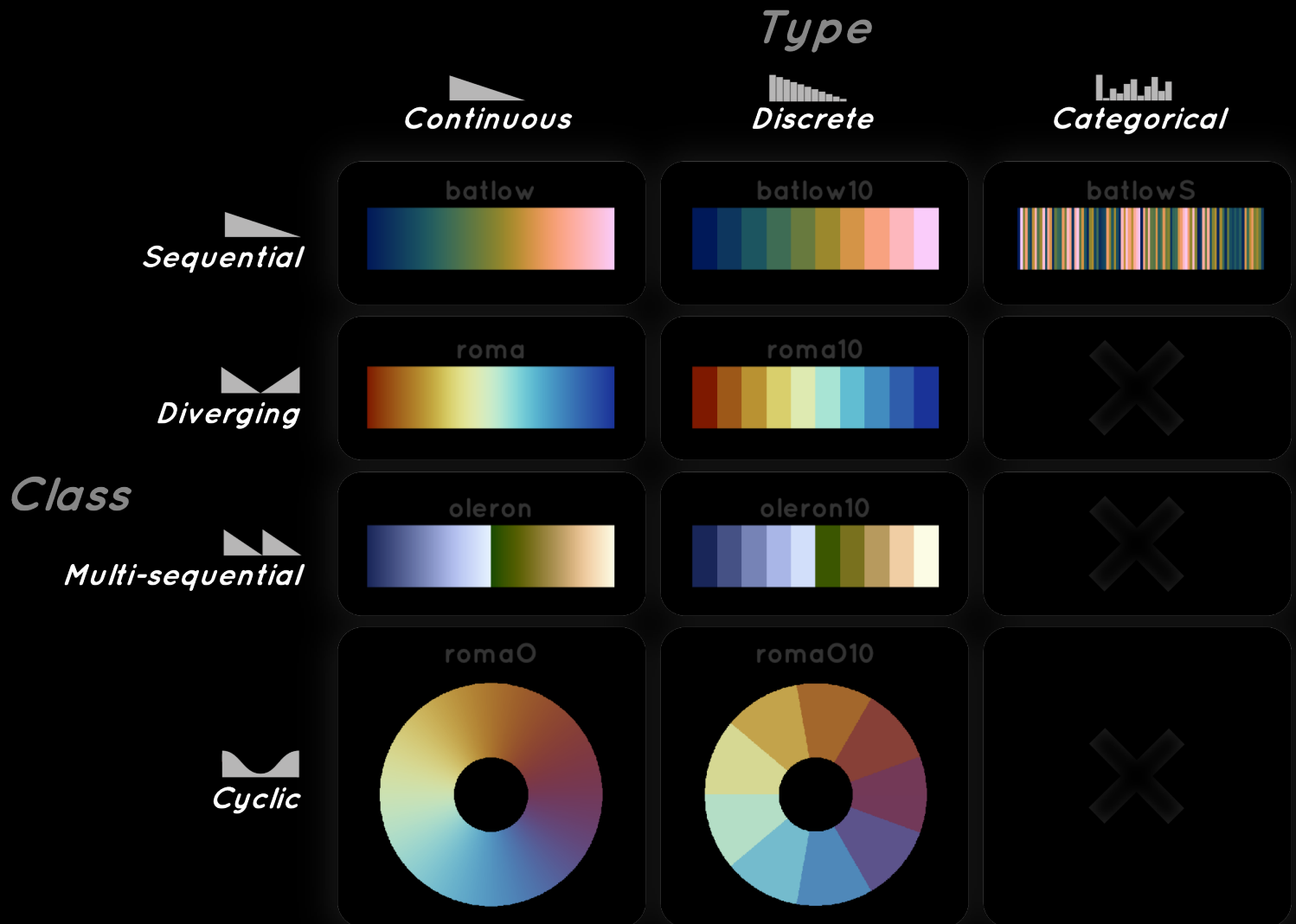
## ✓ Freely available, citable & reproducible

The Scientific Colour Maps are openly available from  
[www.fabiocrameri.ch/colourmaps](http://www.fabiocrameri.ch/colourmaps)  
and archived on Zenodo (DOI: 10.5281/zenodo.1243862).

→ see a detailed user guide here.

# How to choose a specific SCM

The Scientific colour maps offer various **classes** (*sequential*; *diverging*; *multi-sequential*; *cyclic*) and **types** (*continuous*; *discrete*; *categorical*) of colour maps. The use of a certain type and class has to reflect the nature of the data.



# Frequently asked questions (FAQs)

**Do I see more details with the unscientific colour map?**

*Small data variations can indeed be more clearly visible in some parts along an unscientific colour map but are, in turn, made invisible in other parts (e.g., greenish vs. reddish parts). It is exactly these unequal colour contrasts along the colour map that perceptually distort the underlying data.*

**But I am used to my unscientific colour map, can I just still use it?**

*No. Using unscientific colour maps is factually a blind interpretation of the data, and not - as it should be - a simple representation of data.*

**But I NEED more colours to display my complex data than is offered by the scientific options. Or don't I?**

*No. There are several Scientific Colour Maps like batlow ([www.fabiocrameri.ch/batlow](http://www.fabiocrameri.ch/batlow)) that contain variations of multiple colours and therefore feature a multitude of discernible colours.*

**Do perceptually uniform colour maps only feature two main colours (i.e., hues) and interpolate between them?**

*No. While there are of course some that do that (for good reason), there are also perceptually uniform colour maps like the Scientific colour maps that contain more than just one or two hues.*

**I find it is only possible to read out exact values from a contour plot when using rainbow, which has a higher colour contrast, doesn't it?**

*To make it easier to read out individual data values, a Scientific Colour Map in a discrete type should be used or, alternatively, separate indicators (like superposed contour lines) to interpret the data.*

# Contact and resources

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

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

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

Crameri, F., Shephard, G.E. Heron, P.J. (2020), Advantage, availability, and application of Scientific Colour Maps, *Nature Communications* (submitted)

#usebatlow

#endrainbow