

## Why do we need (to use) scientific colour maps?

What are *scientific* colour maps?  
 Scientific colour maps **represent** and thereby communicate our precious data.

What are *unscientific* colour maps?  
 Unscientific colour maps (mis)**interpret** and thereby miscommunicate our precious data.

*Unscientific* colour maps are currently the most used colour maps.

- Default in most visualisation programs
- By far the most presented colour maps at the EGU general assembly: see e.g., <https://betterfigures.org/2018/04/16/how-many-rainbows-at-egu-2018>

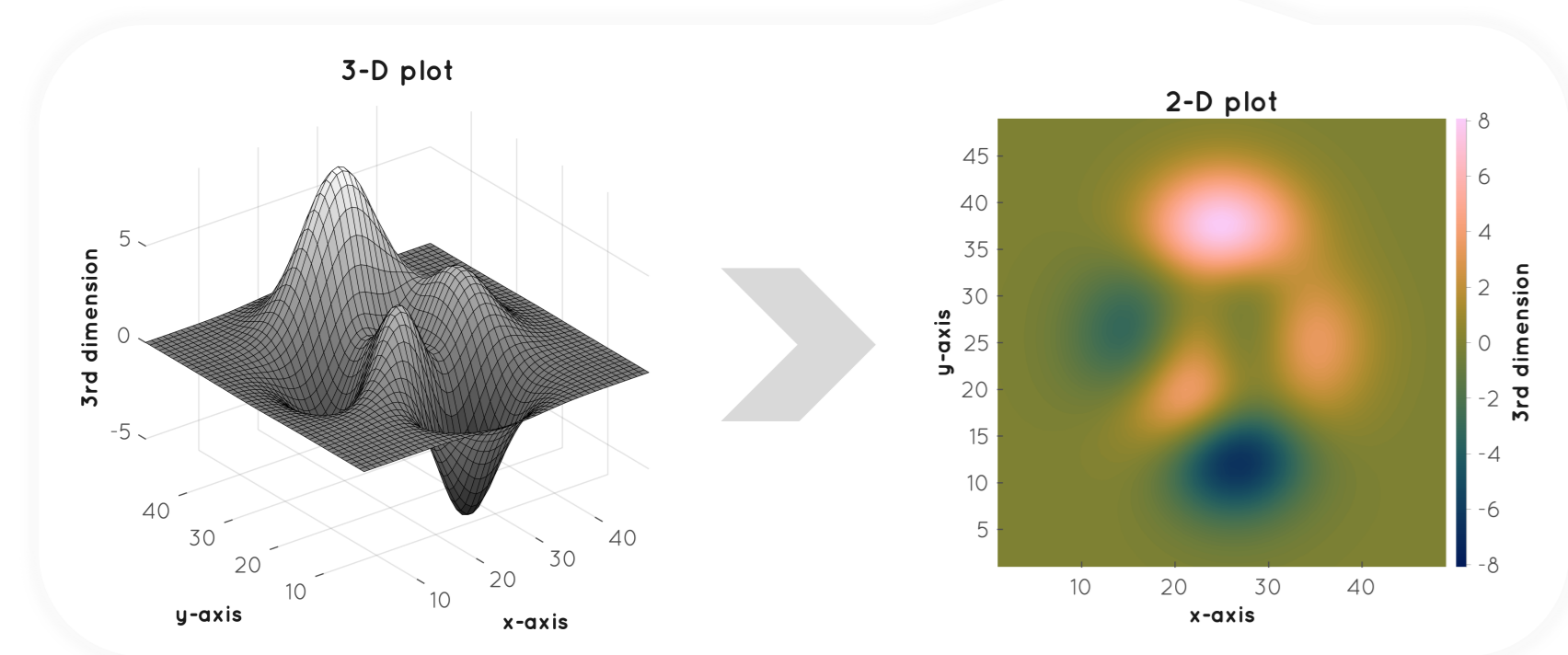
But *unscientific* colour maps are NOT for science. They are...

- **distorting** the data
- **unintuitive**
- excluding and **discriminating** people with colour-vision deficiencies
- not readable in black and white

↳ If you are not convinced, check out #batlowphil!

## What is a colour map?

Colour maps turn 3-D plots into 2-D plots by linking colours to data values via a colour bar, which is indeed an axis, like the x-axis.

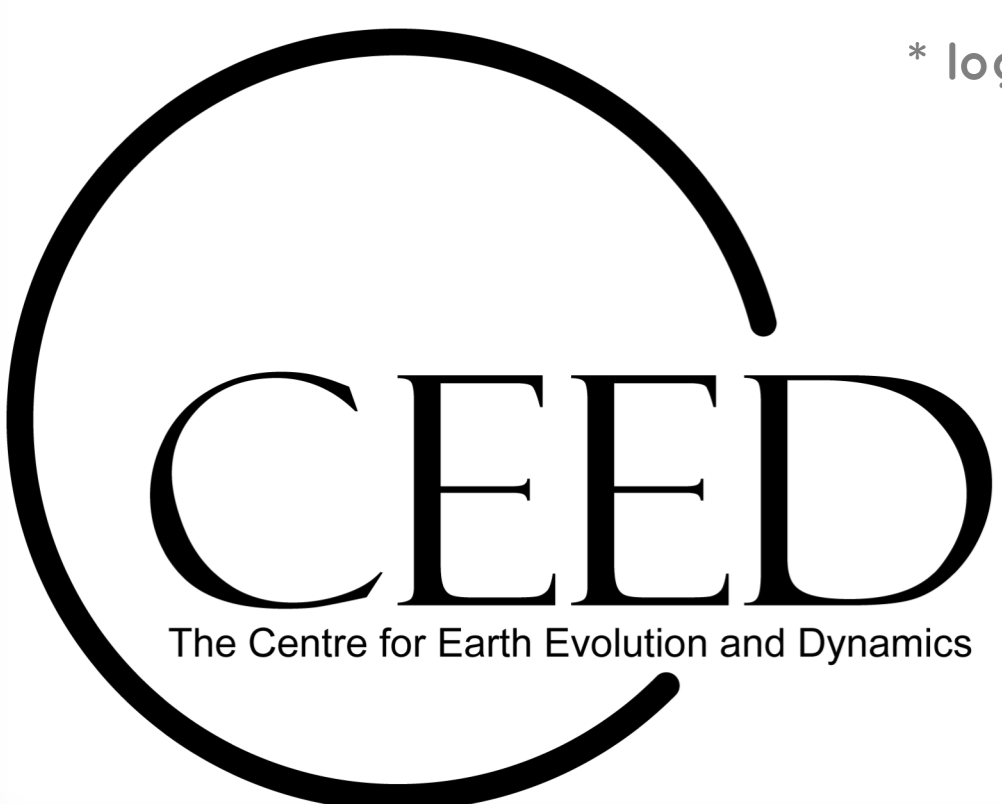


For the x-axis, a certain distance **represents** a certain variation in the data, no matter whether the variation occurs to large or small values\*.

The same should be true for the colour axis: A certain perceptual variation of colour **should represent** a certain variation in the data, no matter whether the variation occurs to large or small values\*.

Hence, the colour map needs to be perceptually uniform, or the data is distorted perceptually.

\* logarithmic axes being a special case



# Scientific Colour Maps

batlow  
a scientific colour map

## Reducing error across the geodynamics community

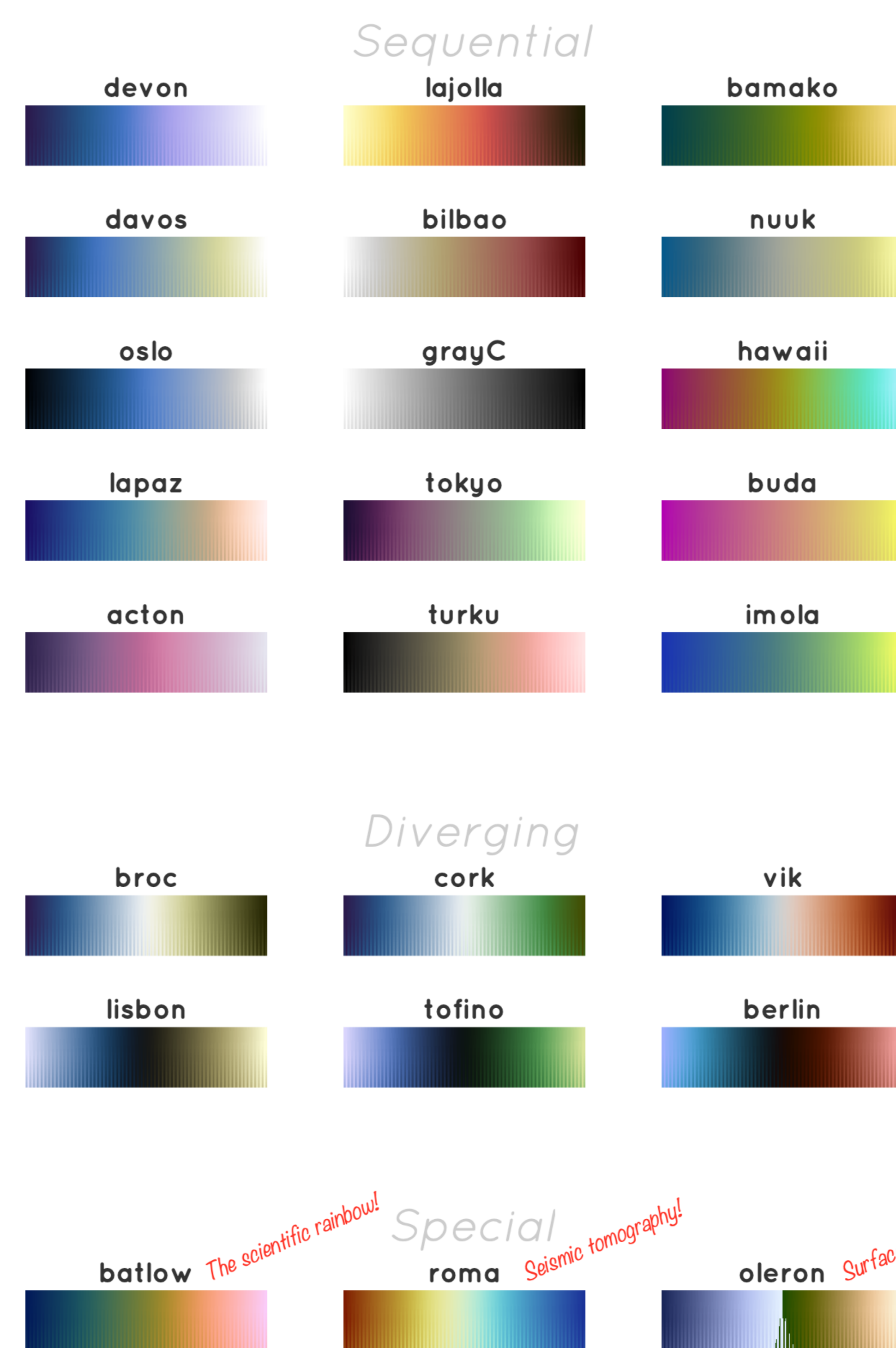
Fabio Crameri (@fcrameri)

Made by science,  
made for science

- ✓ Perceptually uniform  
i.e., NOT distorting the data
- ✓ Perceptually ordered  
i.e., intuitively readable
- ✓ Colour-vision-deficiency friendly  
i.e., NOT excluding certain readers
- ✓ Readable as black-and-white print  
i.e., convenient
- ✓ Available in all major data formats  
i.e., openly accessible
- ✓ Including diagnostics; peer-reviewed; citable  
i.e., tested and trustworthy

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



## Conclusion

Using scientific colour maps (i.e., **standardising them in software; recommending them for publications and presentations**) is currently likely *the* most effective way to reduce error across the geodynamics community.

## 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, therefore, 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'm used to my unscientific colour map, can I 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 how do I know which colour maps are scientific and which are not?  
 These are: [www.fabiocrameri.ch/colourmaps](http://www.fabiocrameri.ch/colourmaps).
- But I am not good with computers, should I still try to use them?  
 Using the scientific colour maps is straightforward. Clear instructions are provided in the **README file** that comes along with the scientific colour map bundle from [www.fabiocrameri.ch/colourmaps](http://www.fabiocrameri.ch/colourmaps).

## Less frequently asked questions (LFAQs)

- Why are scientific colour maps not the default in scientific visualisation software?
- Why are unscientific colour maps not pointed out in scientific peer reviews?
- Why do scientific journals and meeting organisers not suggest scientific colour maps in their author guidelines?

## Acknowledgement

Colour-map author  
 Fabio Crameri (@fcrameri)

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Colour-map diagnostics after  
 Kovari (2015), Good colour maps: How to design them, CoRR, abs/1509.03700  
 and  
<https://www.peterkovari.com/matlabfns/index.html#colour>



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

