Earth Stewardship Science Research Institute

Nelson Mandela Metropolitan University

A Discussion of choice of colourmaps in visualisation: Perceptual colourmaps and colourmaps for the colour-blind

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Abstract:

Poor choice of colourmaps within visualisation can lead to the creation of visual artifacts, which creates false interpretation of the visualisation, either by seeing edges that do not exist or by obscuring edges that do. Poor decisions, costing time, money or lives can result from seeing objects that are not in the data, or missing objects that are.

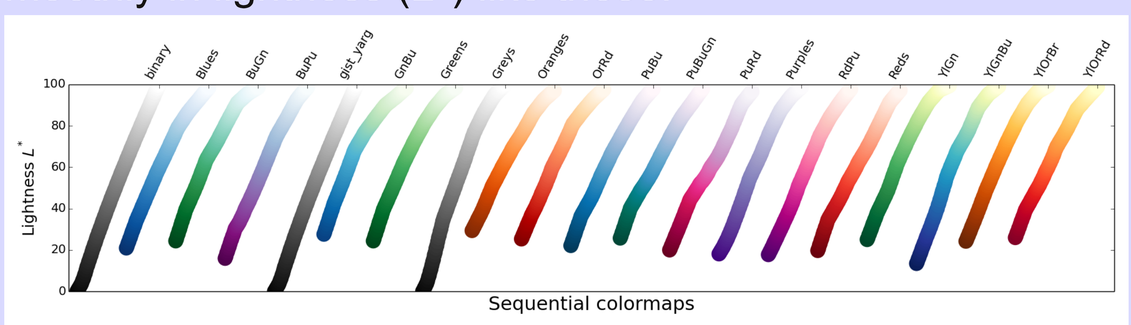
The use of perceptual colourmaps, where each change in colour is perceived smoothly can greatly enhance the ease of interpretation of a visualisation by removing ambiguity.

In addition, many default colourmaps do not allow for good understanding of the data by people suffering from colour-blindness. Suitable colour maps are available, and should be used where possible.

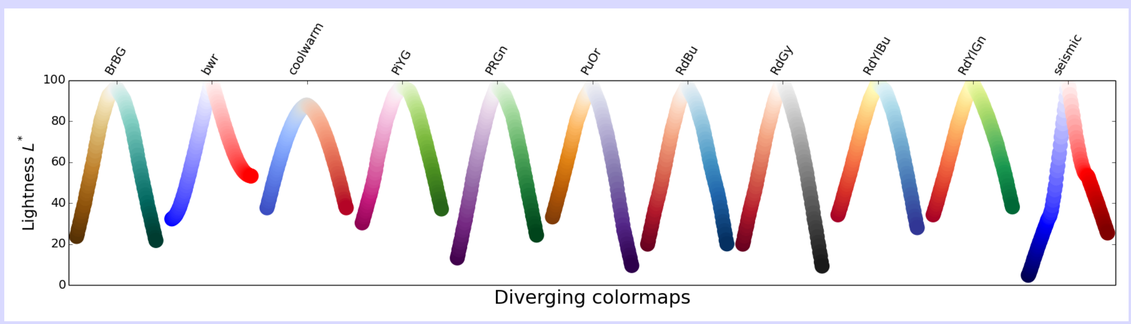
Perceptual Colour Maps:

Variation in lightness is the most important attribute for viewing a colour map accurately, with hue and saturation being less important. Different colour maps are best suited for different types of data, but this will not be discussed here.

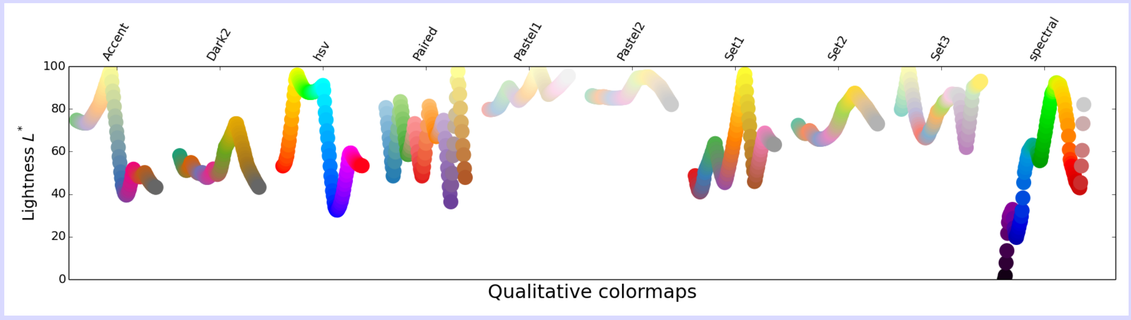
Good colour maps will generally increase or decrease smoothly in lightness (L*) like these:



For data varying from a central norm, diverging colour maps are used. Most of the ones shown below are good, varying smoothly from a central point:



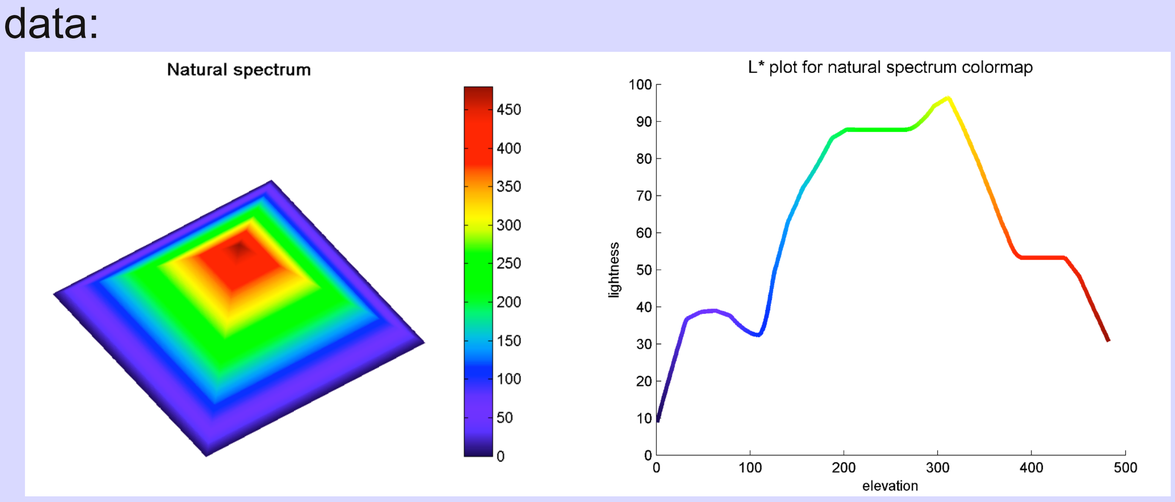
Unfortunately, many colour maps have erratic lightness variation. This can lead to sharp edges being perceived. Alternatively, flat areas of unchanging L* obscure fine detail.



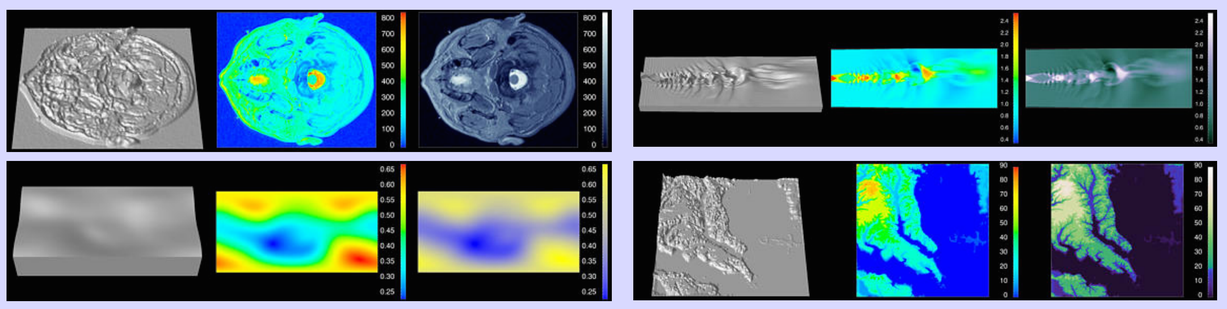
Choosing smooth colour maps will usually make your data easier to understand and, as a bonus, often make it look better.

Effects of Poor Colour Maps:

Usage of a poor colour map can lead to data being obscured or perceptual edges being introduced that do not exist in the data:



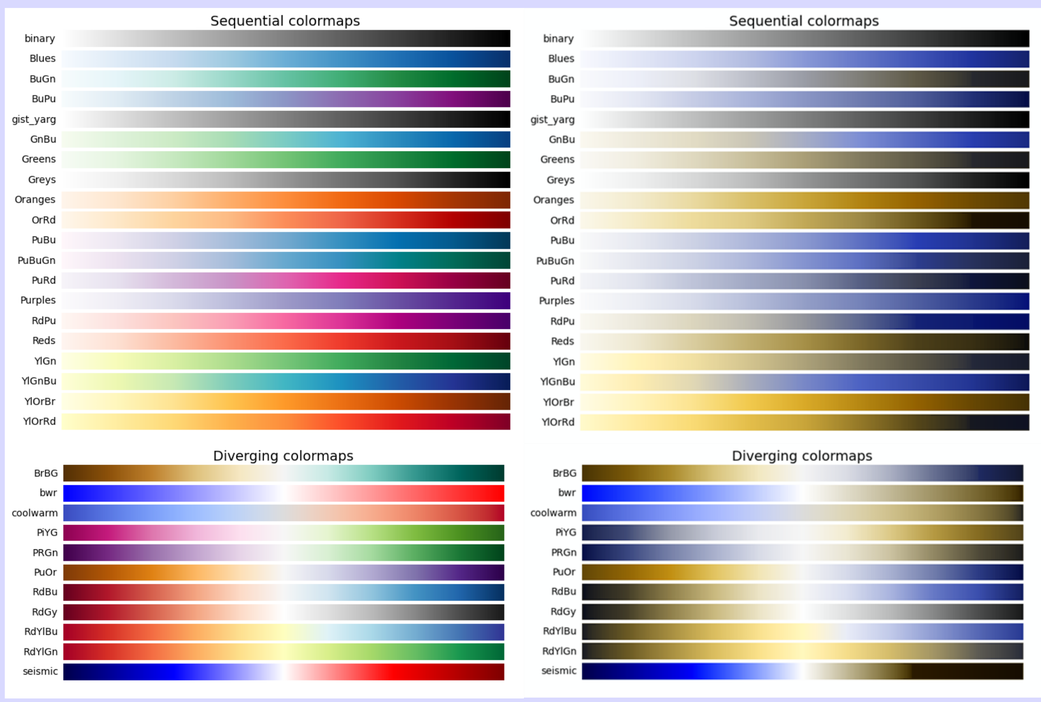
From Niccoli (2012): The pyramid should have smooth sides, but the choice of colour map (particularly the dark blue and bright green) introduced edges, due to the way certain colours are perceived. The graph on the right shows the variation in lightness is not smooth, which is a major contributor to this effect.



From Rogowitz and Treinish (1996): Comparison between greyscale, JET, and linear L* colourmaps. JET obscures much of the fine detail that is visible in the greyscale and linear L*. In some cases it introduces sharp edges where none are present in the data.

Colourblind-Safe Colour Maps

Almost 1 in 12 people suffer from some form of colour-blindness. In order to present data accurately, colours should be chosen that do not appear similar to colourblind people. The folowing images show the previously graphed colour maps and their appearance to deuteranopia sufferers.



Conclusion

The choice of colour map can greatly affect the ease of interpretation of visual data. This will lead to better interpretations and decisions to be made. Care should be taken when choosing one, since the default options in many visualisation programs are not particularly good.

The colour maps used on this poster and the graphs of each colour map compared to lightness are sourced from a presentation by Thyng (2014) and used with permission.

References:

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