How To Assess A Colormap

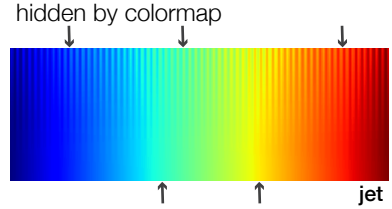
In a perceptually-uniform colormap, one step in the map is perceived by the viewer to be the same size as any other equally-sized step in the colormap, so that steps in data are mapped to equal steps in human perception.

A high frequency sine wave is overlaid on the colormaps. Each wave is equally visible across a perceptually-uniform colormap, demonstrating the **gray** colormap will display data without additions or obfuscation.

Consistent apparent size of high frequency wave across the colormap

After Kovesi 2015[1] *cmocean* **gray**

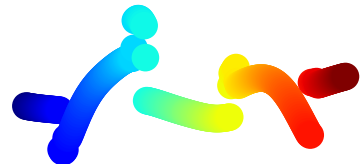
High frequency information hidden by colormap



jet

The derivative calculated in perceptually-uniform colorspace *CAM02-UCS* across each colormap. Any deviation from horizontal represents a perceptual jump.

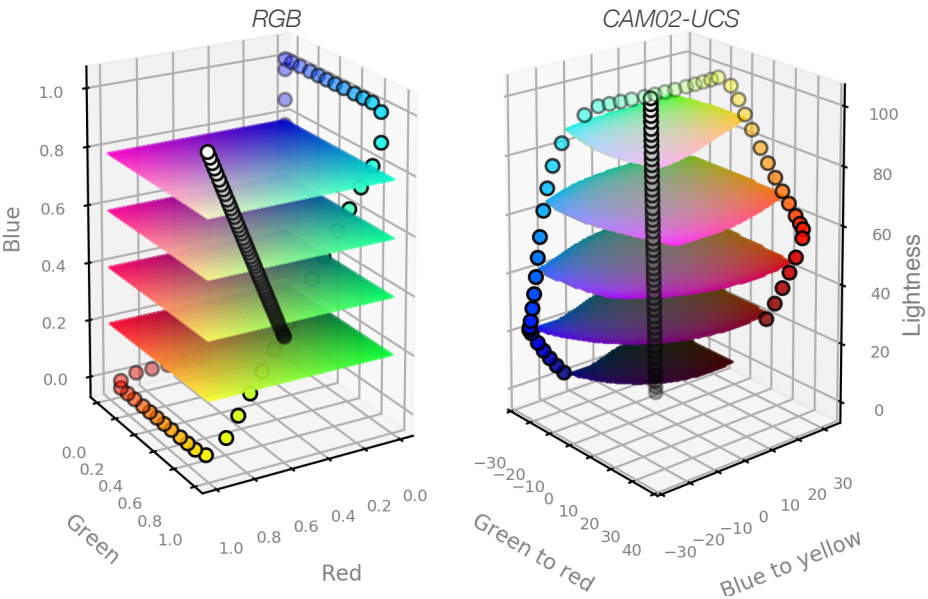
After *viscm* tool[2]



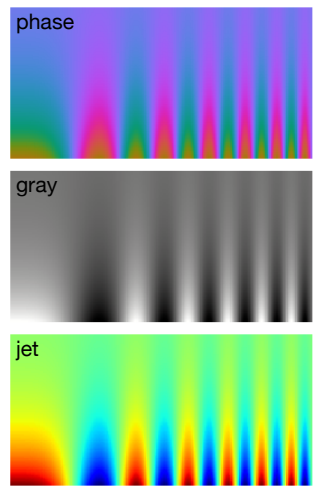
Jumps in perceptual uniformity cause apparent jumps in data

What Makes A Good Colormap

Created using perceptually-uniform colorspace



Use lightness to map form



Function from jakevdp.github.io/blog/2014/10/16/how-bad-is-your-colormap/

Colors in the jet colormap step uniformly through *RGB* colorspace *(left)*, but the colorspace is unrelated to how humans perceive colors. The special property about perceptually-uniform colorspace *CAM02-UCS (right)* is that two equal Euclidean distances in the colorspace give two equivalent perceptual jumps; that is, the changes in the colorspace are perceived as equally-sized by human eyes. Viewing **jet**'s uneven spacing in *CAM02-UCS* explains its perceptual jumps. Perceptually-uniform gray steps with equal distance up in lightness each step.

Human brains can best understand relative values when encoded as changes in lightness *(middle)*, not hue *(top)*[1]. For low frequency data, changes in color saturation work too, but often scientists want to see high frequency, potentially subtle details in data.

[1] Kovesi, Peter. "Good colour maps: How to design them." arXiv preprint arXiv:1509.03700 (2015).
[2] https://github.com/matplotlib/viscm