

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.

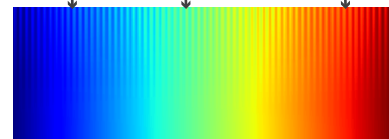
A high frequency sine wave is overlaid on two colormaps. Each wave will be equally visible across a perceptually-uniform colormap. Therefore, this colormap will display data without artificial additions, and without obfuscation.

Consistent apparent size of high frequency wave across the colormap



After Kovesi 2015¹ *cmocean gray*

High frequency information essentially erased by colormap

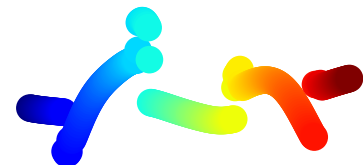


jet

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



After *viscm* tool²

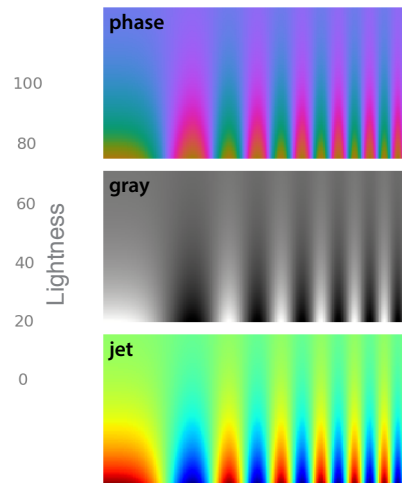
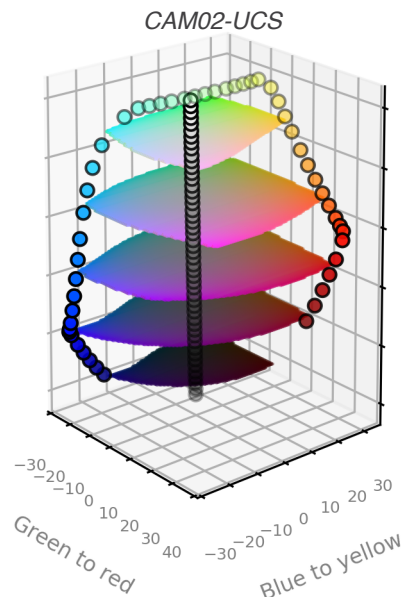
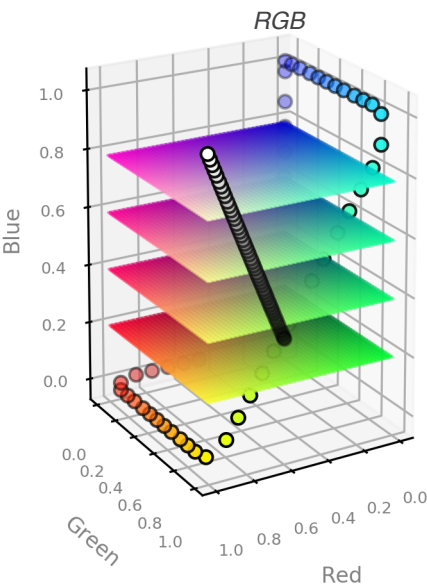


Jumps in perceptual uniformity cause apparent jumps in data

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>