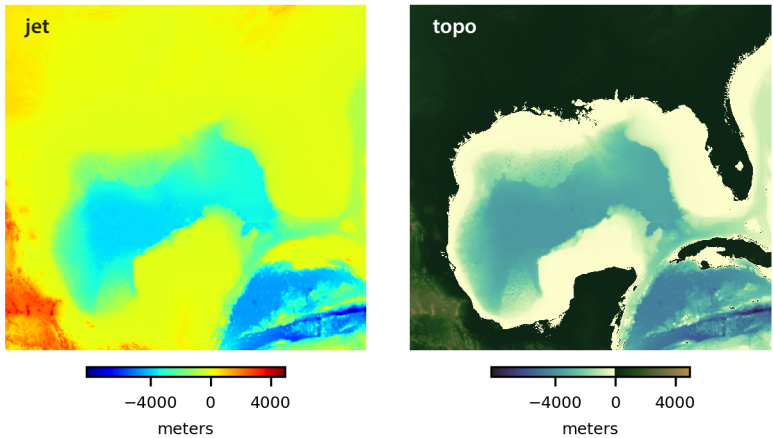


# WHY ARE COLORMAPS IMPORTANT?

A colormap maps data values to colors for visual representation. We want to most honestly and clearly represent data, and the colors chosen for mapping control the relationships in data we interpret.



After Rogowitz and Treinish<sup>1</sup>

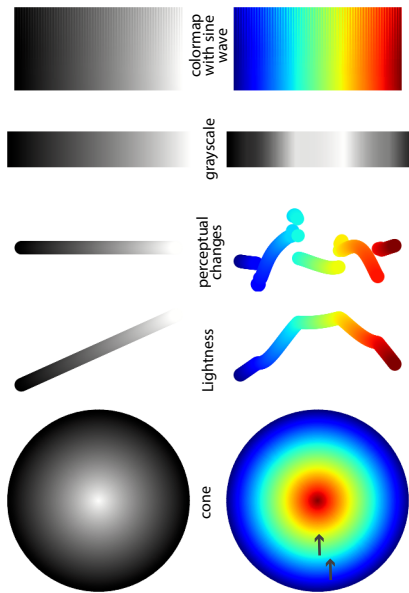
Left side is inscrutable but right side is instantly recognizable as water and land (around the Gulf of Mexico) based on the colormap and critical value.

## WHO SHOULD CARE ABOUT THIS?

- You have quantitative data and want to display its structure and form across a two dimensional plane
- You want to be able to see small, high frequency details in your data
- You want to see the data as accurately as possible
- You want other viewers to understand the data as easily as possible

## WHY NOT JET?

- Experts accustomed to **jet** made more mistakes interpreting a heart scan plotted with **jet** compared to another colormap<sup>2</sup>
- Conversion to grayscale loses ordering from hue, leaving only underordered lightness
- Perceptual jumps in colormap are arbitrarily located
- Jumps add fake gradients while obscuring details
- Information added by the colormap makes data look artificially banded
- **jet**-encoded data *are* easier for reading off numbers<sup>4</sup>
- Note that some plotting packages have replaced their default colormaps away from **jet**, recognizing that it is not a good default choice. Python plotting package Matplotlib's default is **viridis**, and MATLAB's is **parula**.

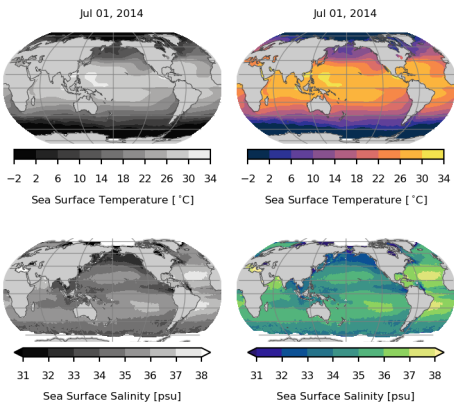


After Thyng, et al, 2016<sup>3</sup>.

## WHY NOT USE GRAYSCALE FOR EVERYTHING?

When in doubt, perceptually uniform grayscale is an excellent option. However, using color allows tailoring colormap to data:

- Sequential vs diverging data
- Match intuition with variable
- Have one colormap per variable to build recognition



<sup>1</sup> Rogowitz and Treinish, 1998. Why Should Engineers and Scientists Be Worried About Color.

<sup>2</sup> Borkin, M., K. Gajos, A. Peters, D. Mitsouras, S. Melchionna, F. Rybicki, C. Feldman, and H. Pfister. 2011. Evaluation of artery visualizations for heart disease diagnosis. *IEEE Transactions on Visualization and Computer Graphics*. 17(12):2479–2488, <http://dx.doi.org/10.1109/TVCG.2011.192>.

<sup>3</sup> Thyng, K.M., C.A. Greene, R.D. Hetland, H.M. Zimmerle, and S.F. DiMarco. 2016. True colors of oceanography: Guidelines for effective and accurate colormap selection. *Oceanography*. 29(3):9–13, <http://dx.doi.org/10.5670/oceanog.2016.66>.

<sup>4</sup> Spence, I., Kutlesa, N., & Rose, D. L. (1999). Using color to code quantity in spatial displays. *Journal of Experimental Psychology: Applied*, 5(4), 393–412.

<http://doi.org/10.1037/1076-898X.5.4.393>