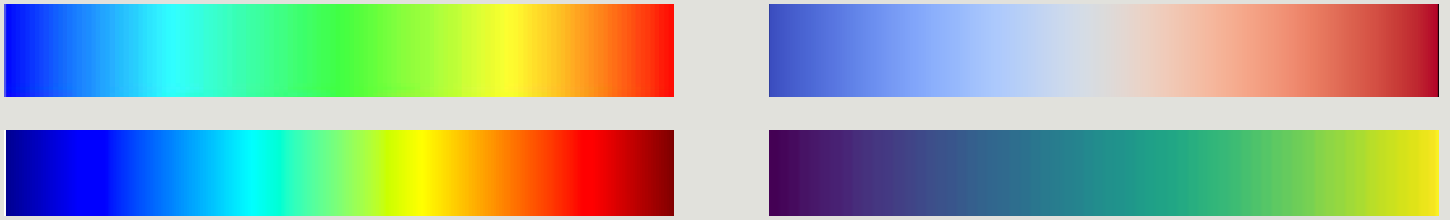
A bit of colormap background

so that we can move forward

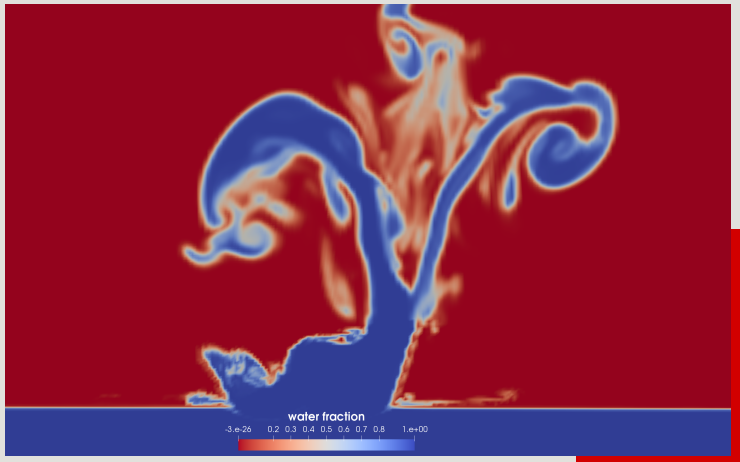
Colormap Defaults

Defaults are necessary and good for many purposes but data varies widely and one-size does not fit all. In this brief tutorial we provide alternatives that provide either more discriminatory power or redistribute the the contrast allocation to align with the data ranges of interest.

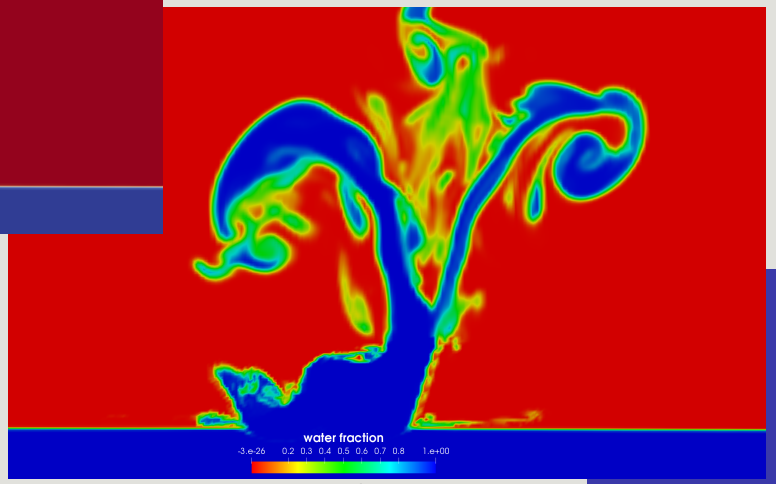


rainbow, top jet , bottom cool warm, top viridis, bottom

Most visualizations use one these defaults.

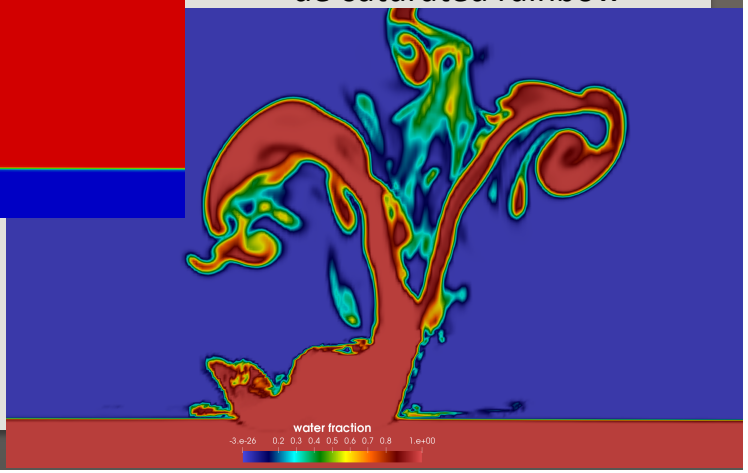


cool warm

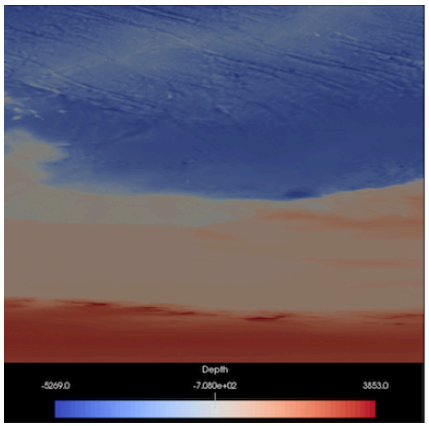


rainbow

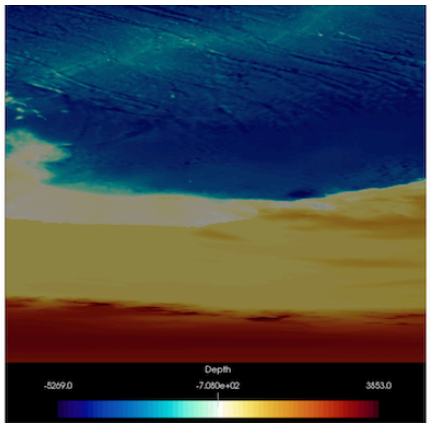
de-saturated rainbow



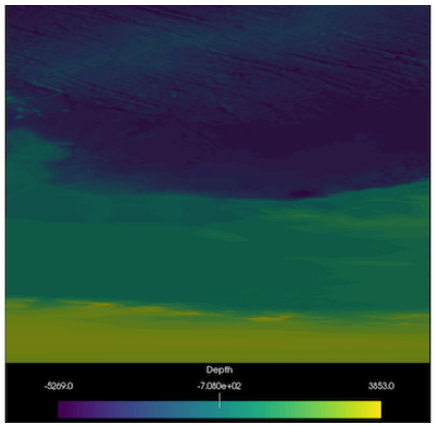
Other Common Colormaps



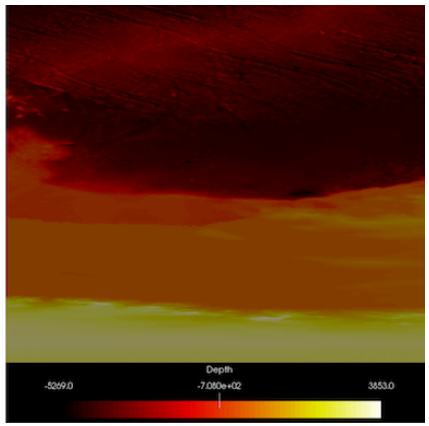
cool warm



blue-orange divergent

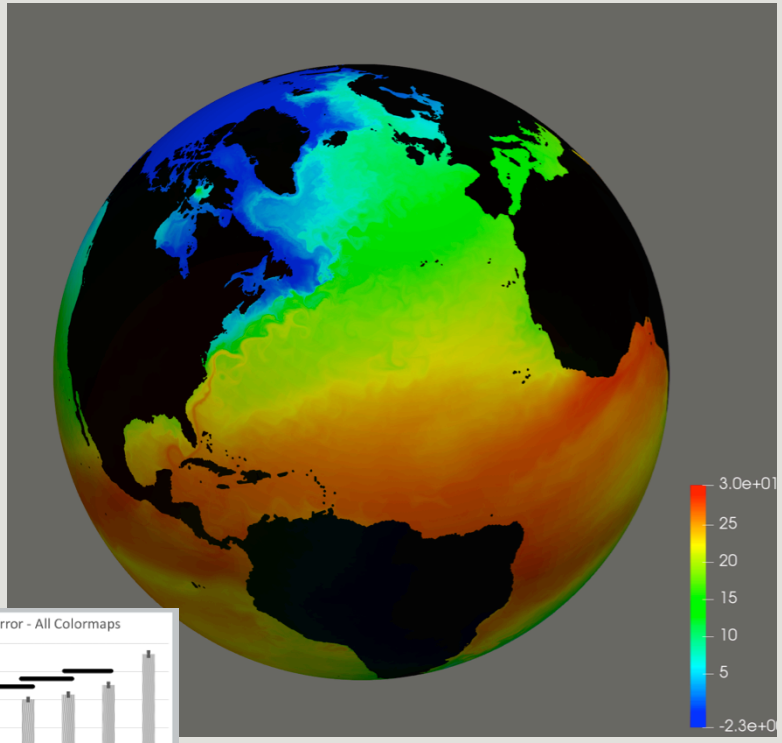


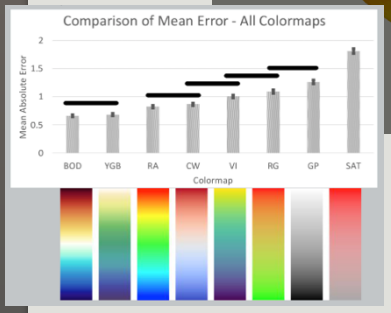
viridis



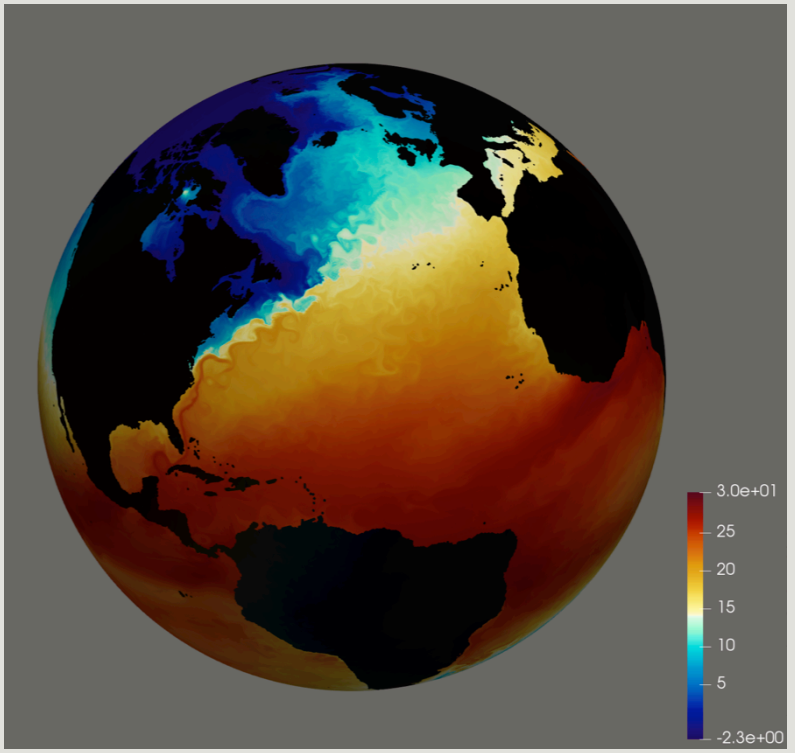
black-body

There are other options…



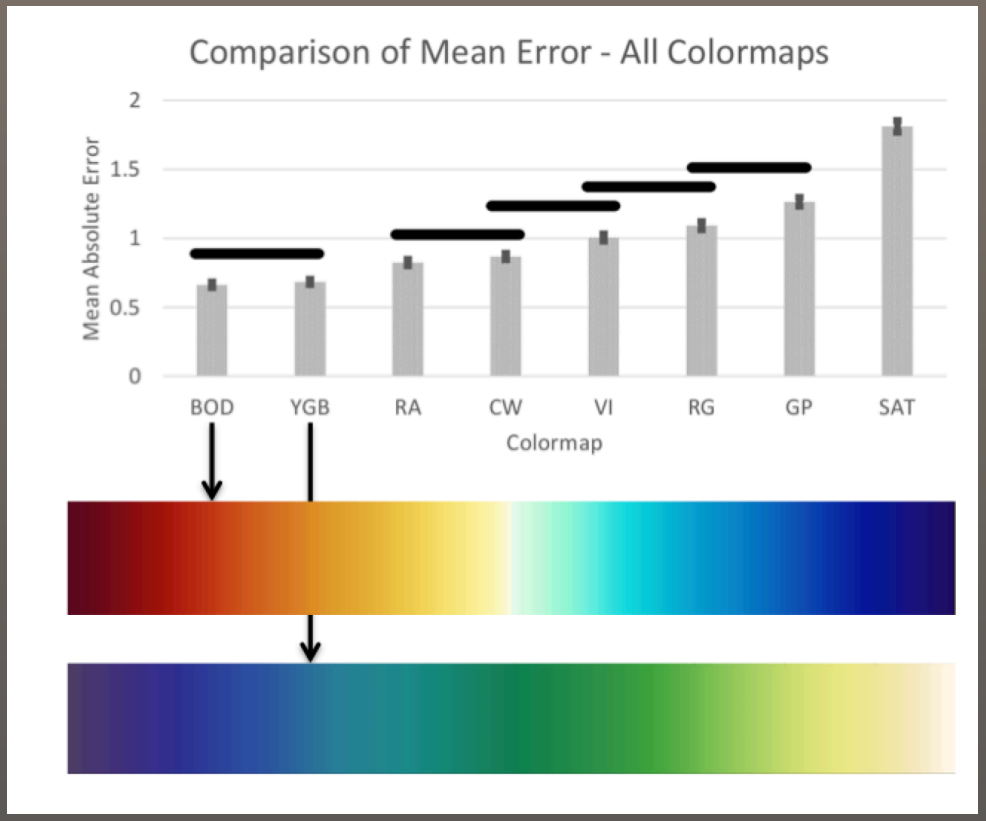


The user study shows that the blue-orange divergent has the highest resolution power of any of the commonly used options.



Tested options:

for discriminative or resolving power



Rankings

1 BOD

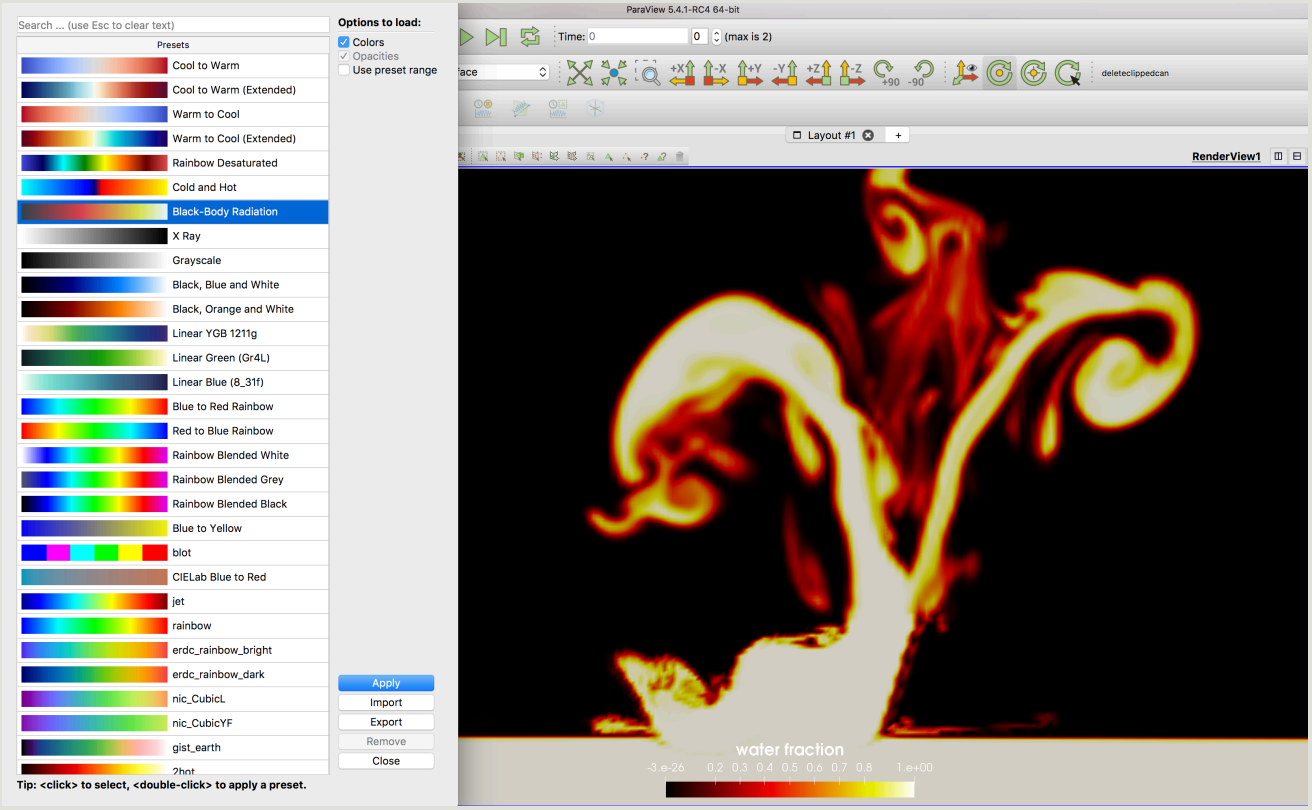
2 YGB

3 RA

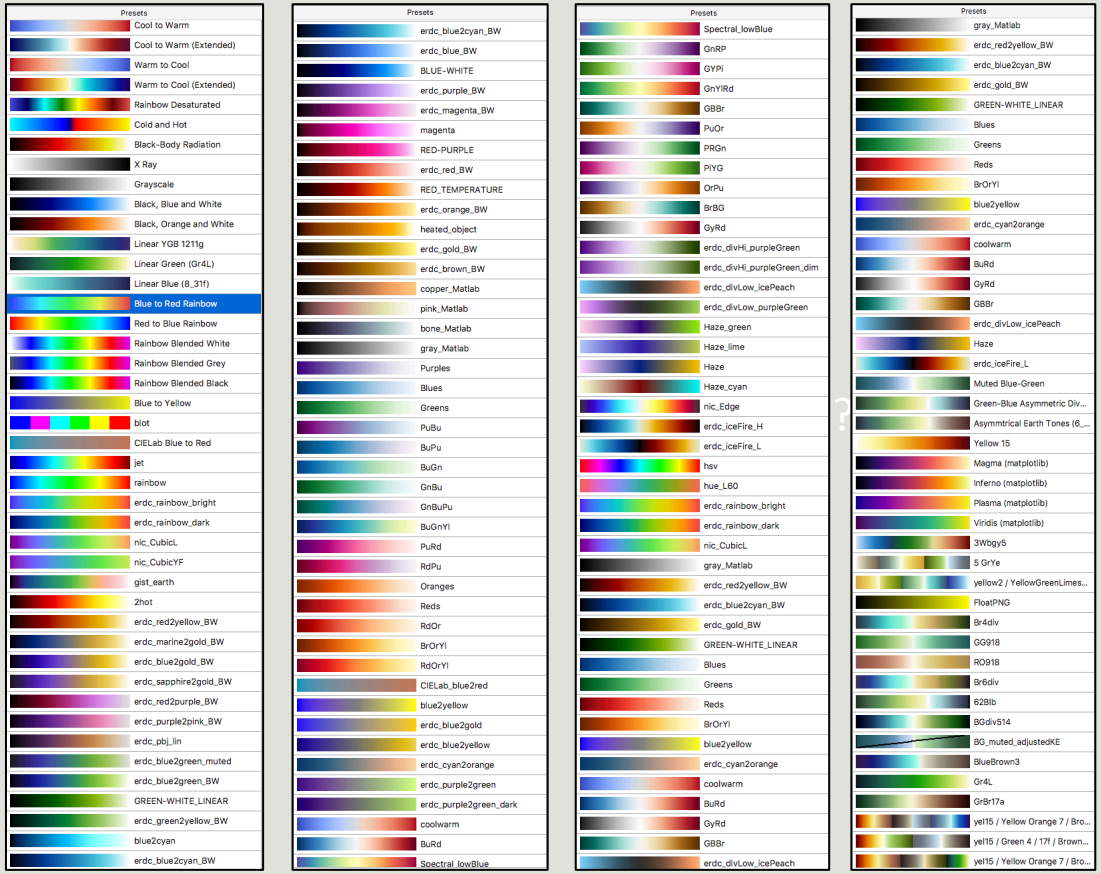
4 CW

5 VI

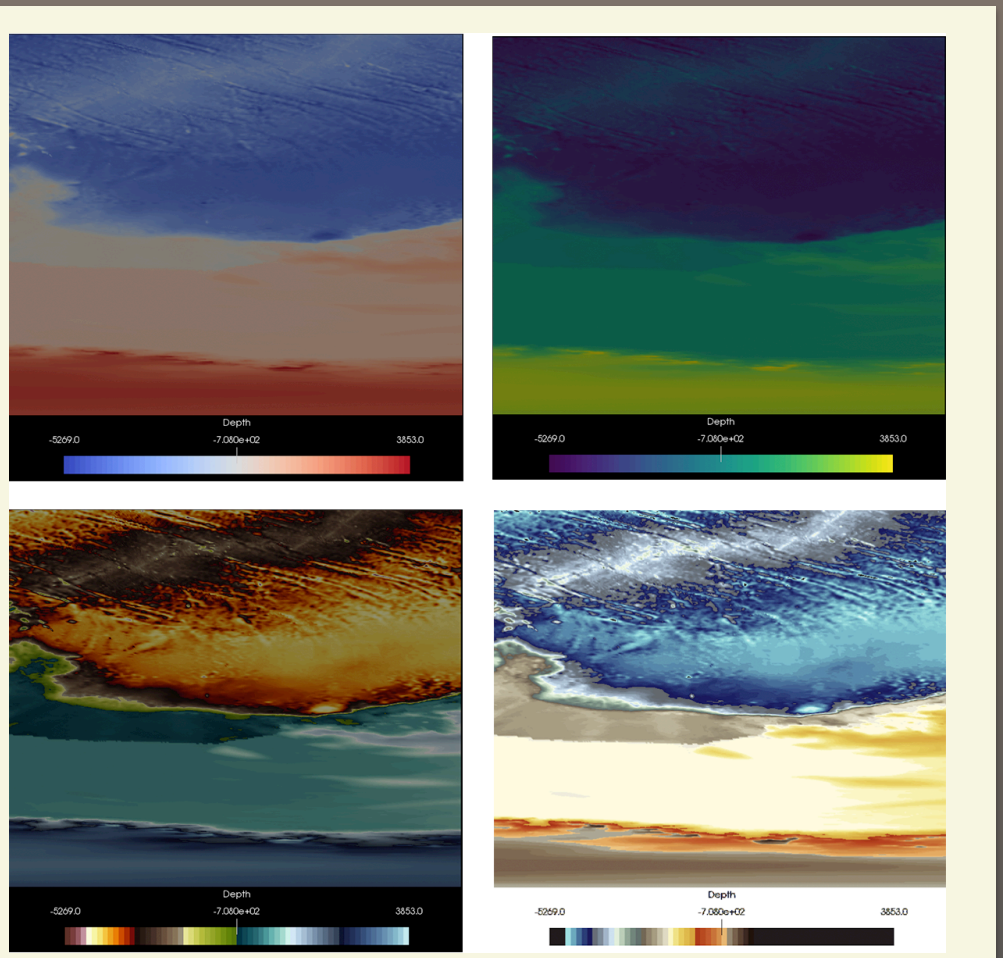
But there are other choices,



many, many other choices…..



which makes selection difficult.

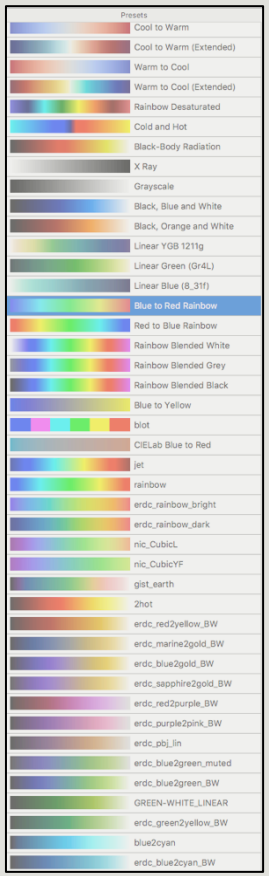


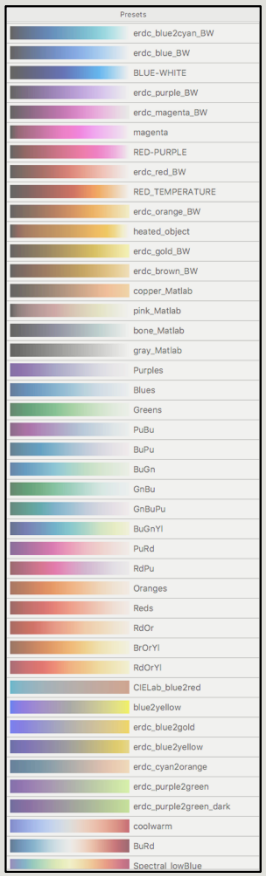
The most powerful means of obtaining intuitive discrimination with in your data is via luminance allocation.

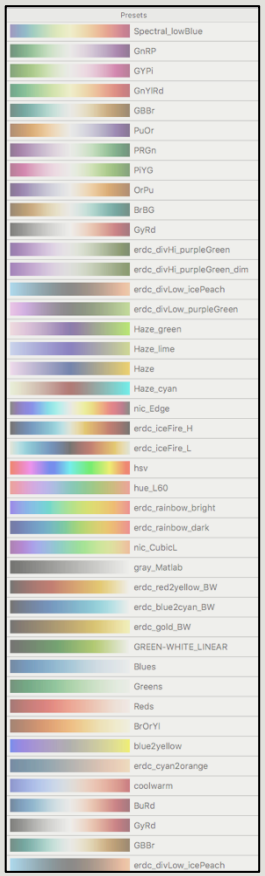
Luminance

the most powerful type of contrast
and the key to seeing your data

There are categories of colormaps based on the luminance distribution.

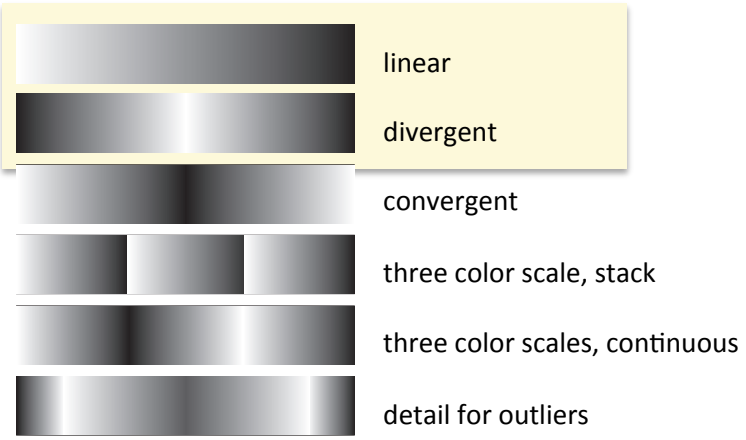




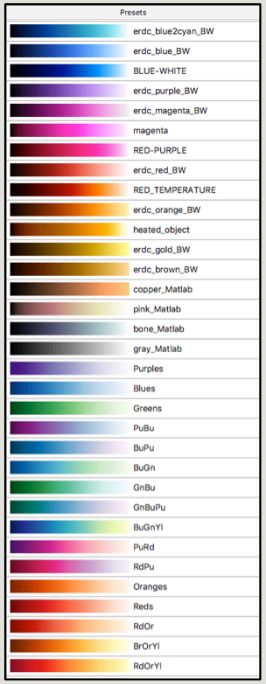


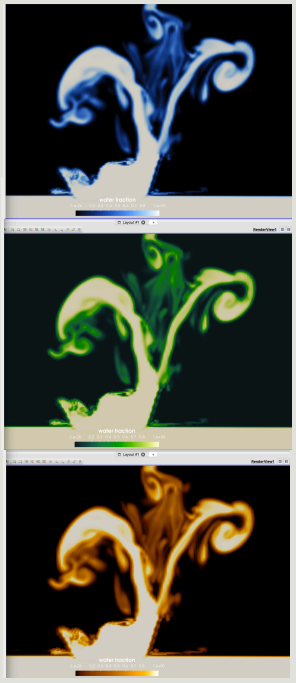
The key to revealing data is the allocation of contrast, primarily luminance, rather then the selection of a specific hue or color.

luminance distributions

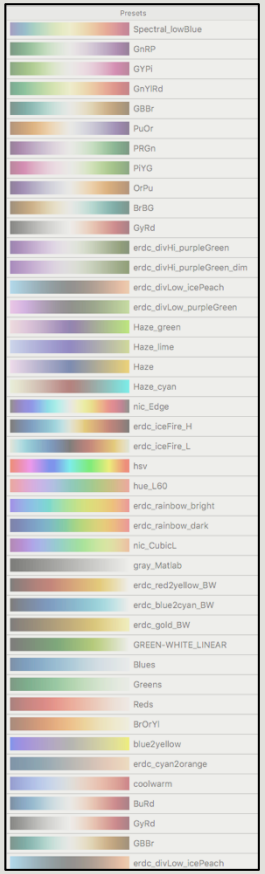


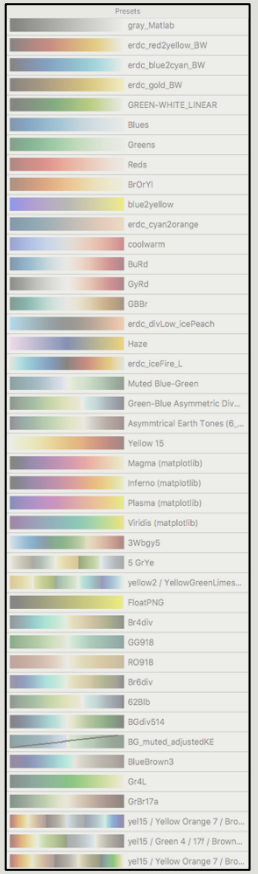
Linear colormaps differ in hue but convey similar information.





The above are different hues but similar information.

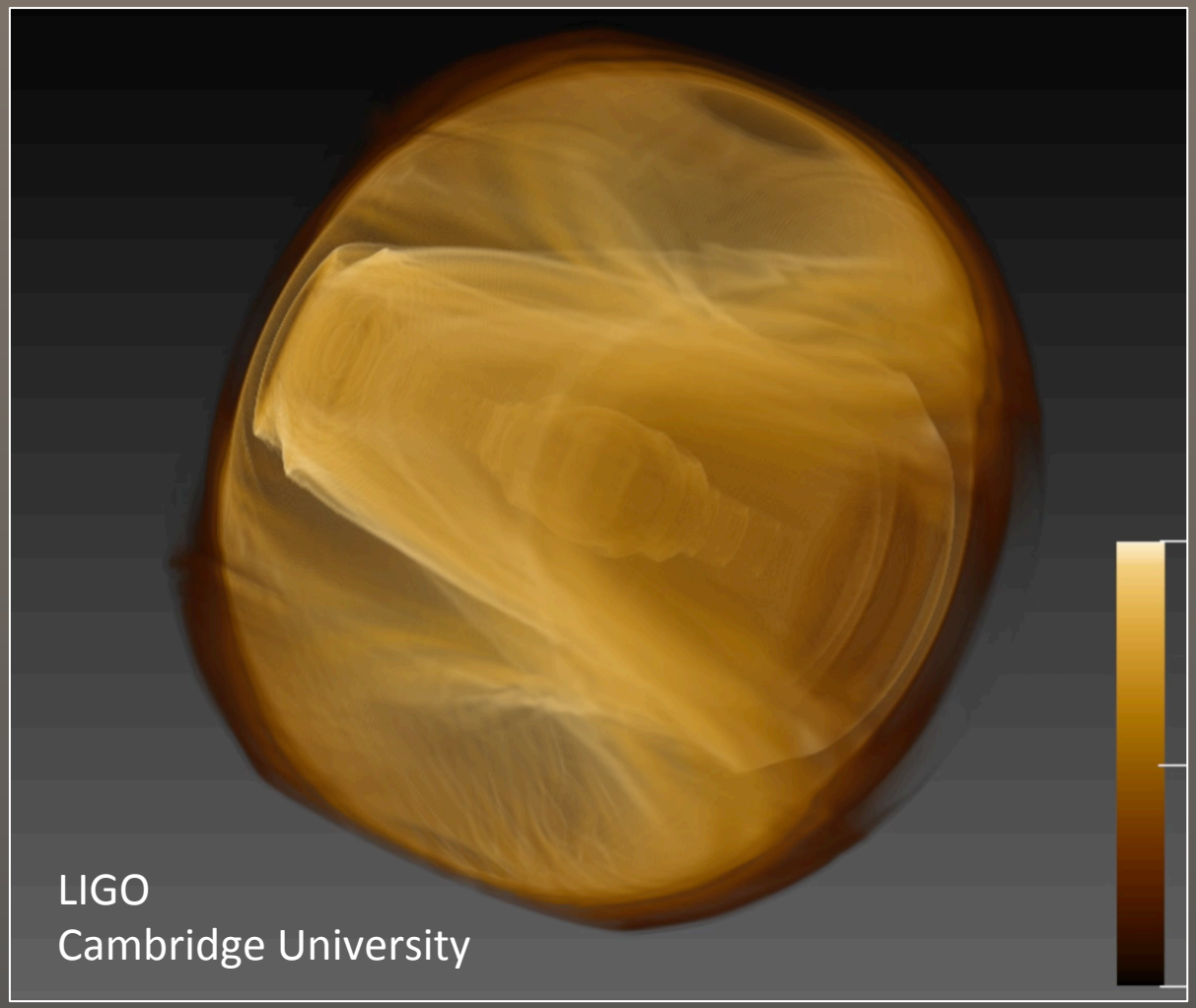




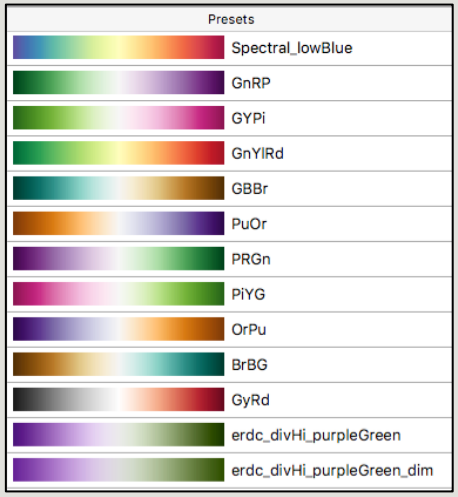
Simply

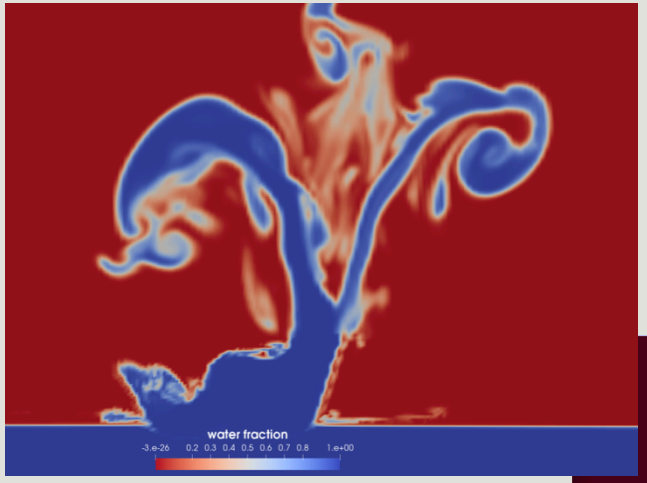
Luminance

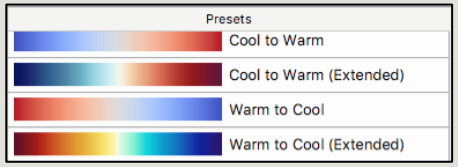
Contrast



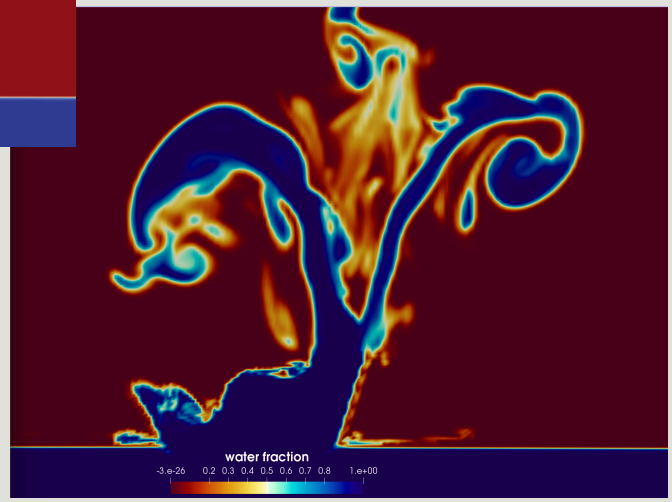
Divergent colormaps





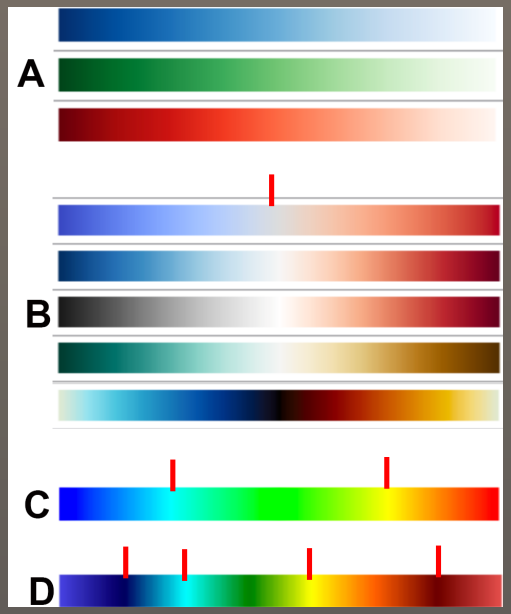


The most commonly used divergent colormaps.



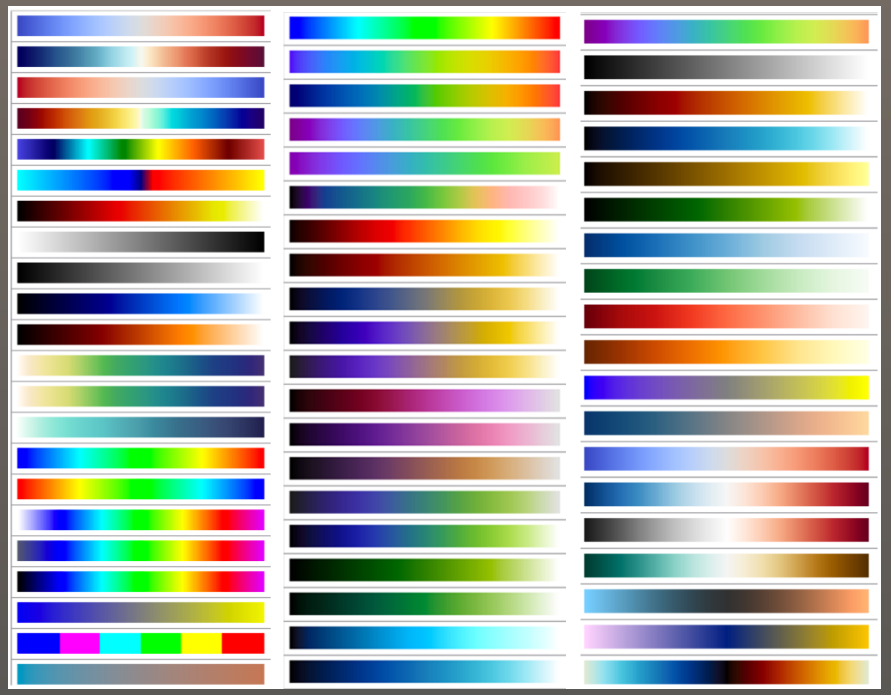
Divergent colormaps contain two hues ranges moving from dark to light and the first and light to dark in the second. The detail of the visualization will depend on the range of contrast across the two color scales, some divergent colormaps revealing more detail than others but the structure of the presentation is similar.

ParaView has 97 colormaps,
…of limited impact.

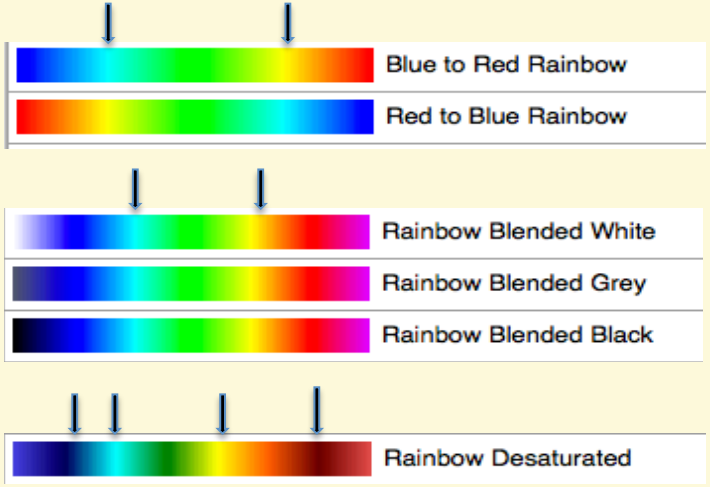


luminance distributions

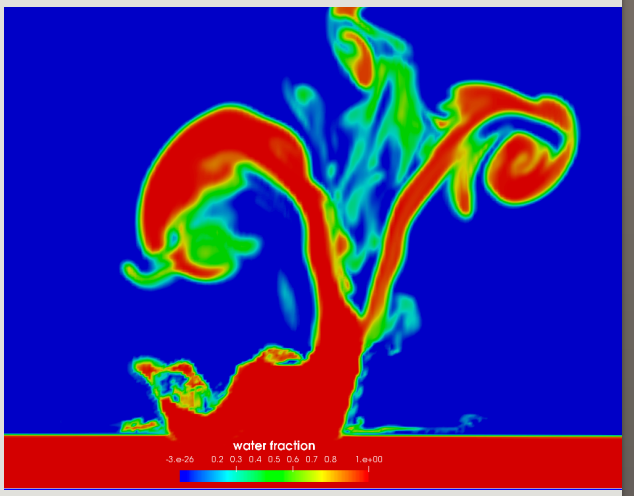
ParaView's colormap selections



Rainbow colormaps are popular because of the assumption that we can see more of our data.

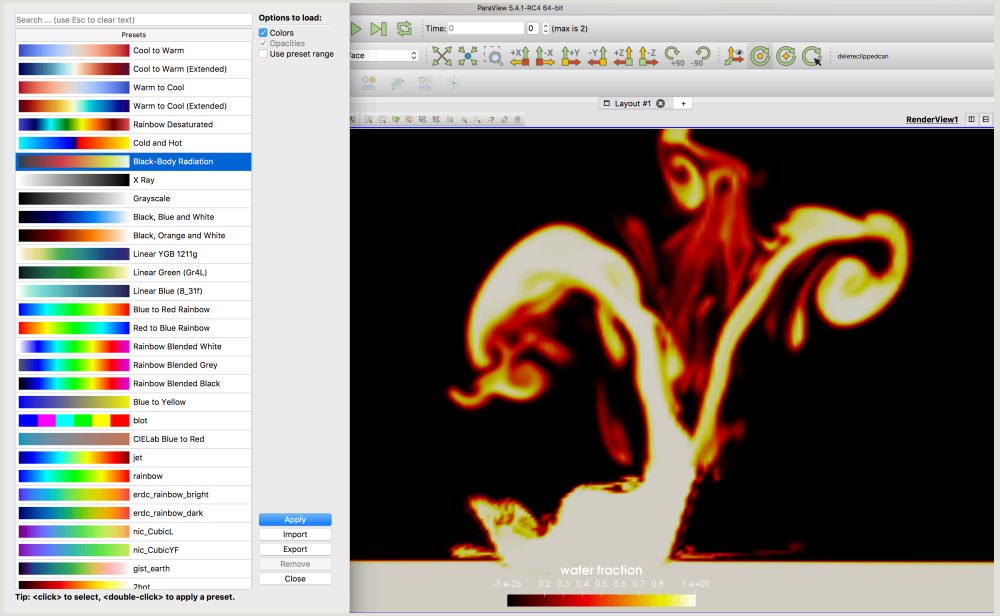


However testing has shown that this is not the case.

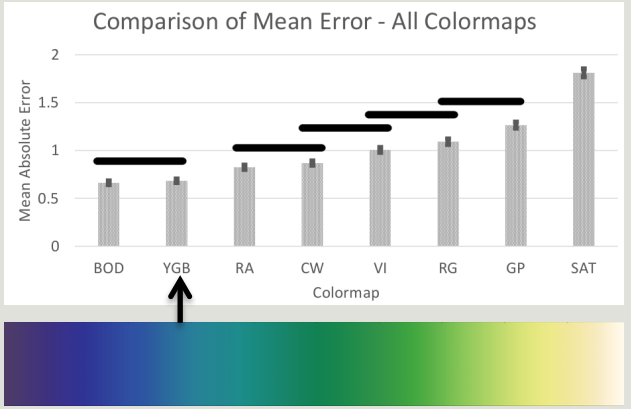


The problematic ubiquitous rainbow.

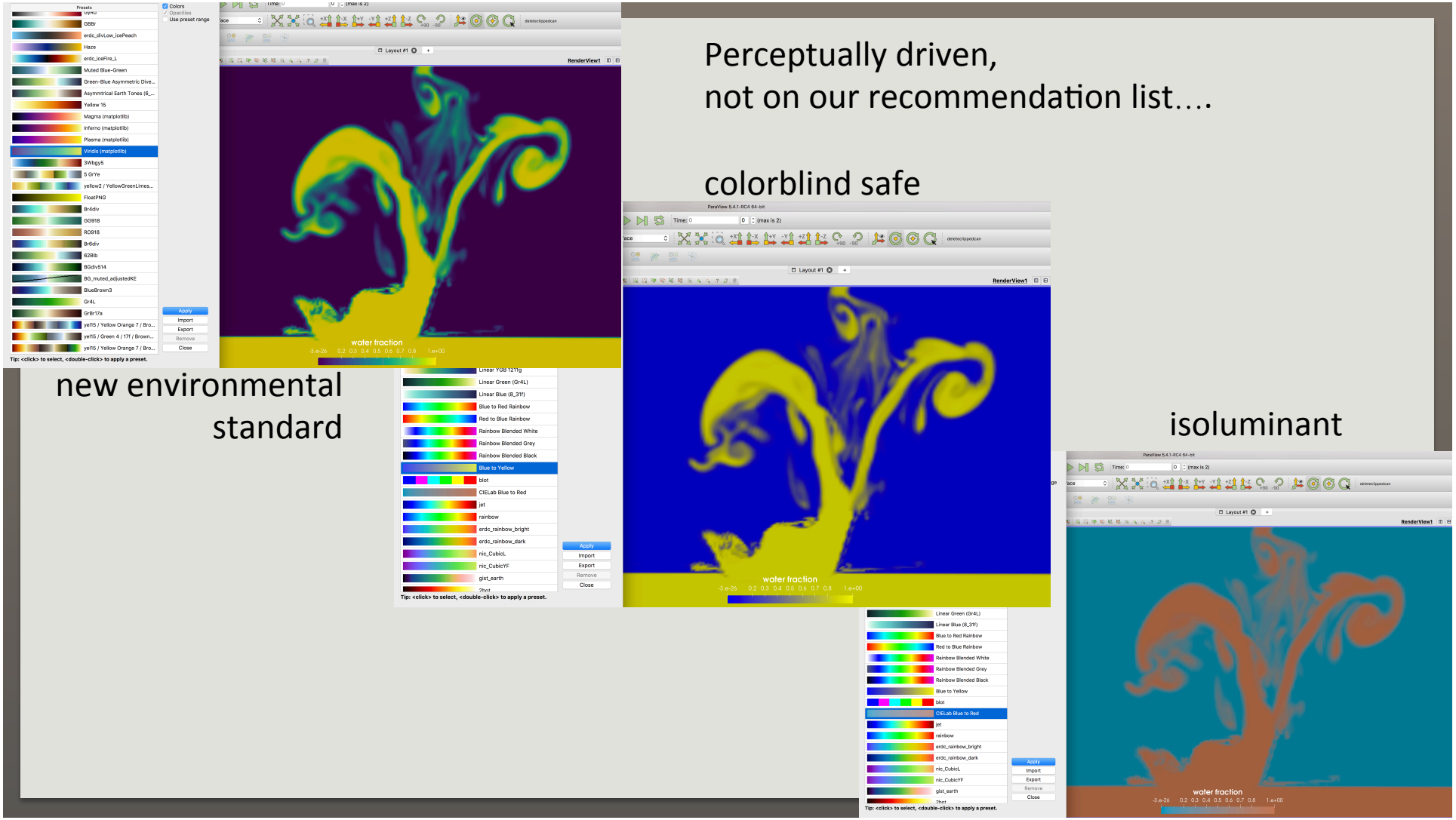
Colormaps
spanning **hue** and **value**



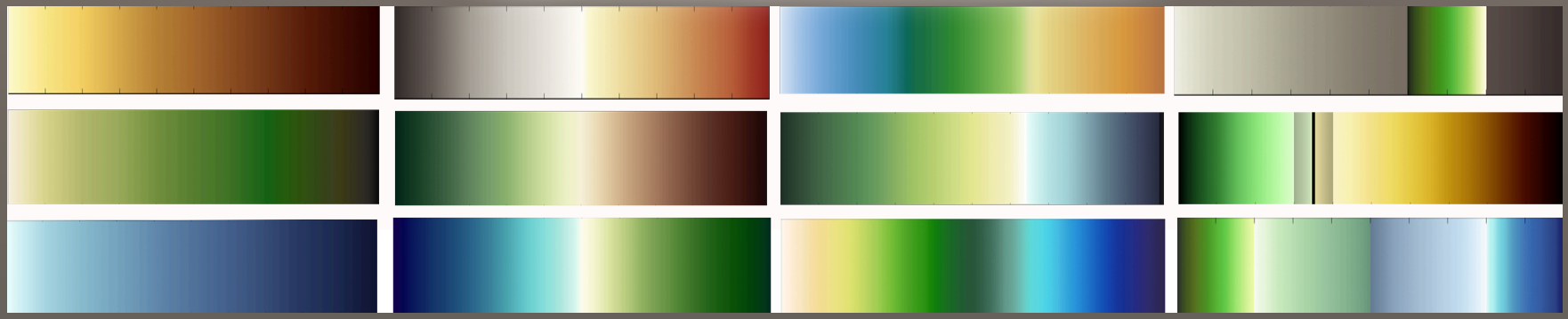
Black-body radiation
a good default.



blue-green-yellow,
spanning hue and value range


Perceptually driven,
not on our recommendation list….
colorblind safe
new environmental
standard
isoluminant
water fraction
Viridis (matplotlib)
Linear Green (Gr4L)
Linear Blue (8_31f)
Blue to Red Rainbow
Red to Blue Rainbow
Rainbow Blended White
Rainbow Blended Grey
Rainbow Blended Black
Blue to Yellow
blot
CIELab Blue to Red
jet
rainbow
erdc_rainbow_bright
erdc_rainbow_dark
nic_CubicL
nic_CubicYF
gist_earth
Apply
Import
Export
Remove
Close

Luminance Distribution



linear

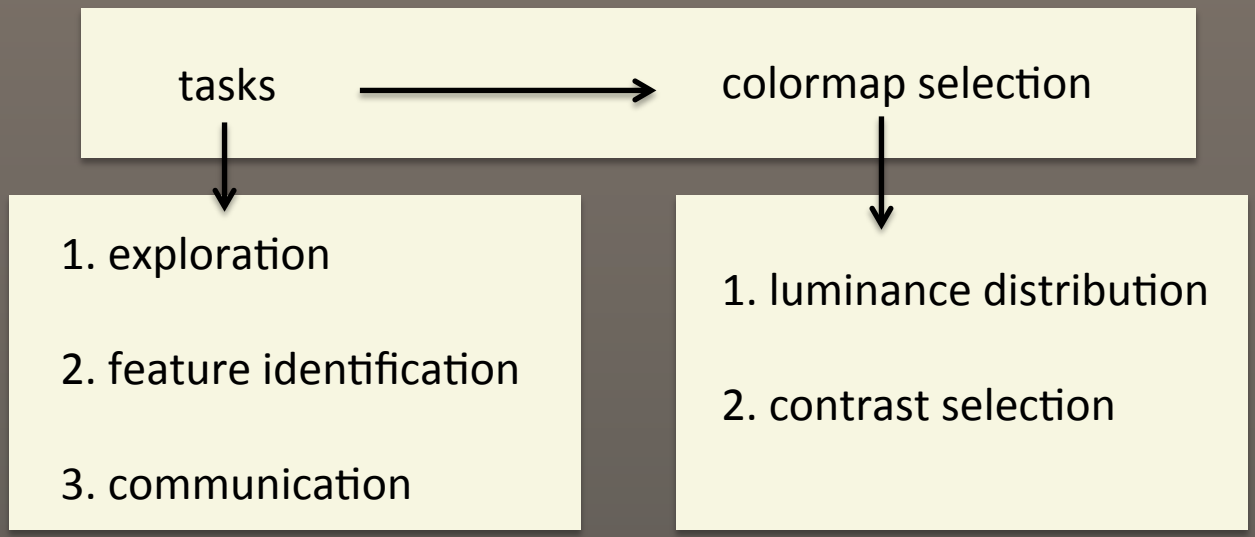
divergent

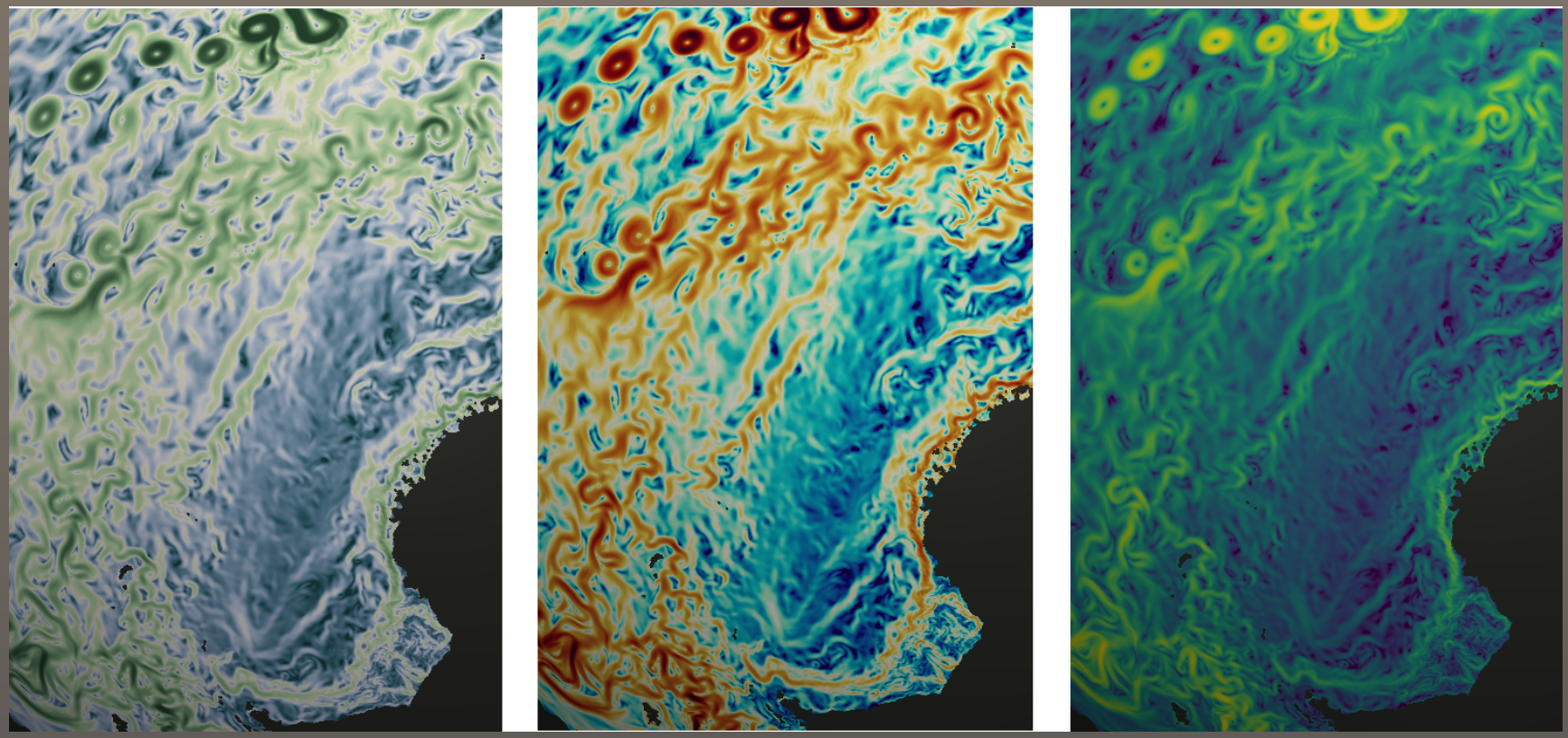
alternate luminance

structured colormaps

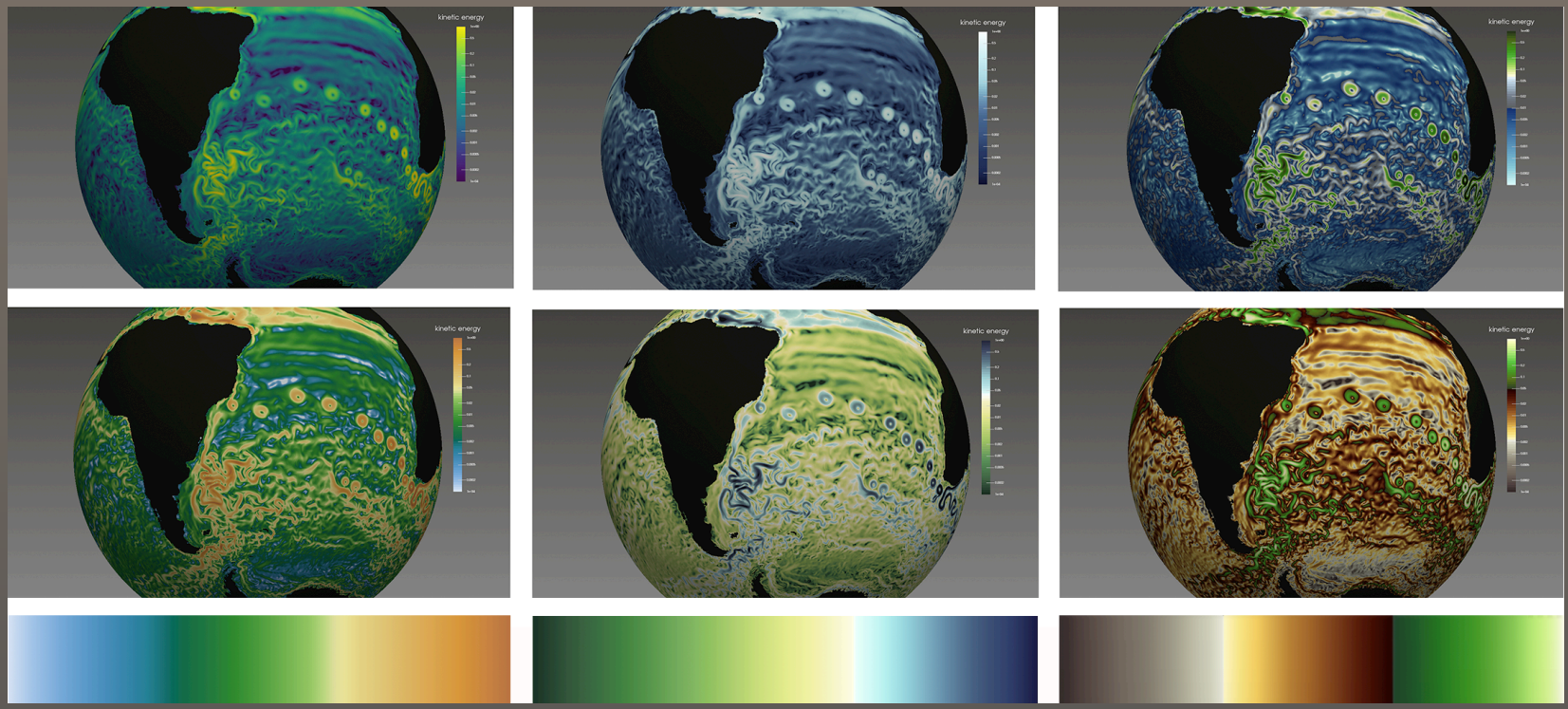
For focus and or resolution power,
match the luminance structure of your data and or areas of importance.

Follow the task…..

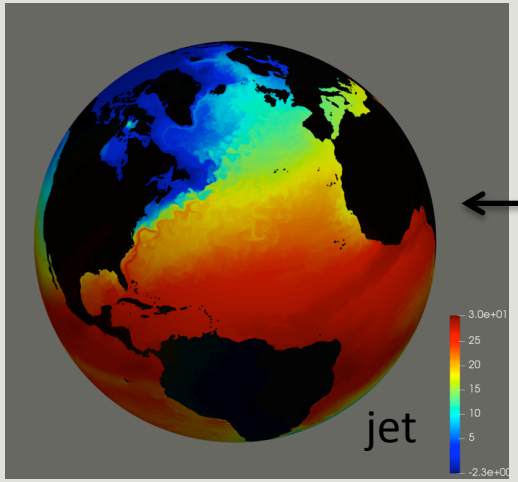


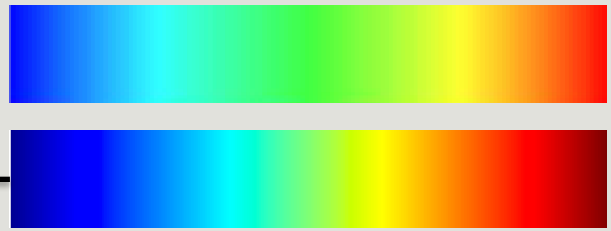

low value contrast
higher value contrast
lowest value contrast

Domain intuitive
Alternate luminance distributions

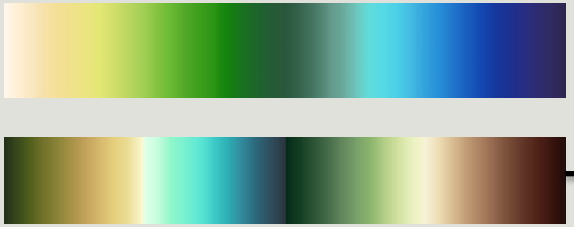


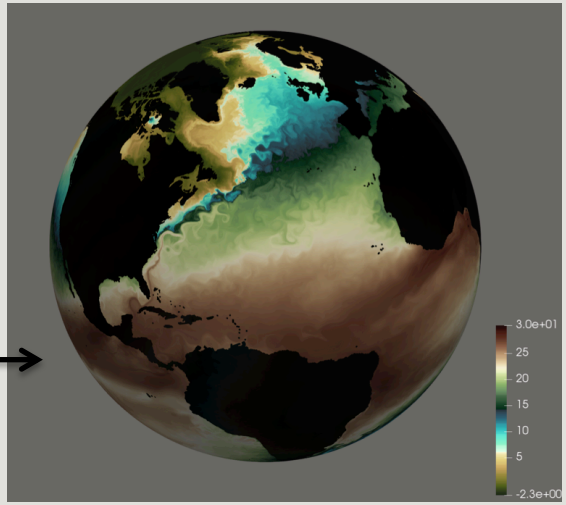
The upper set shows the ocean temperature in the rainbow and jet colormaps.





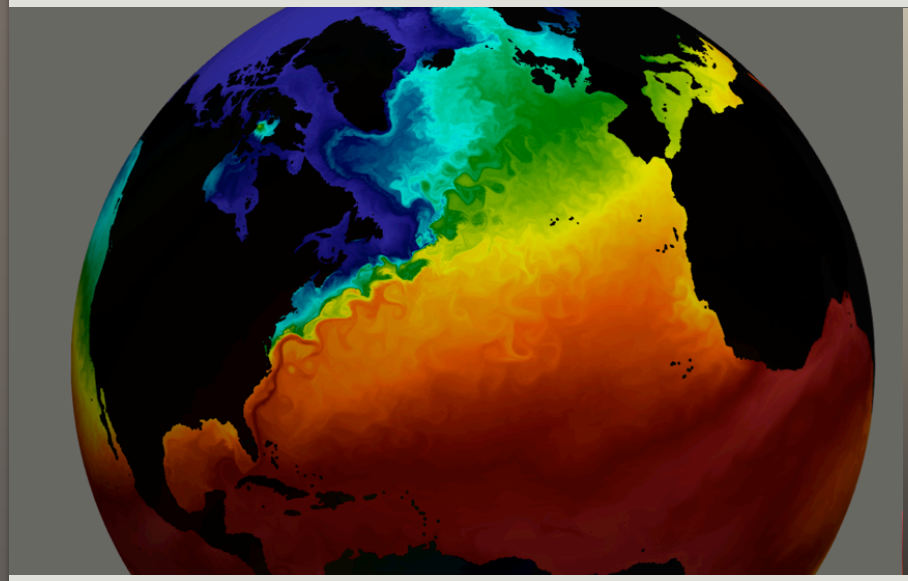
Both of these colormaps avoid the simultaneity contrast tension and prove better discriminatory power.

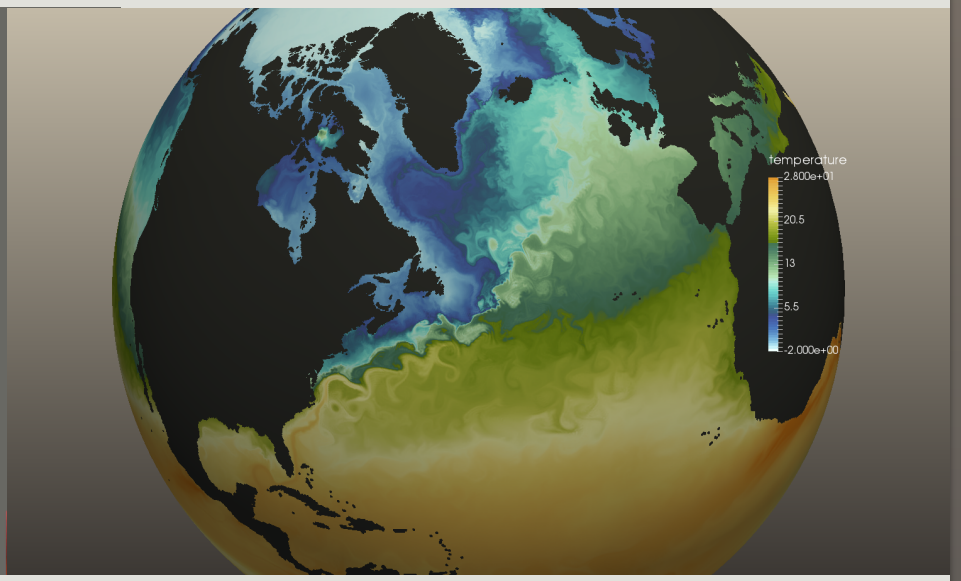




http://sciviscolor.org/home/colormaps/rainbow-alternatives/

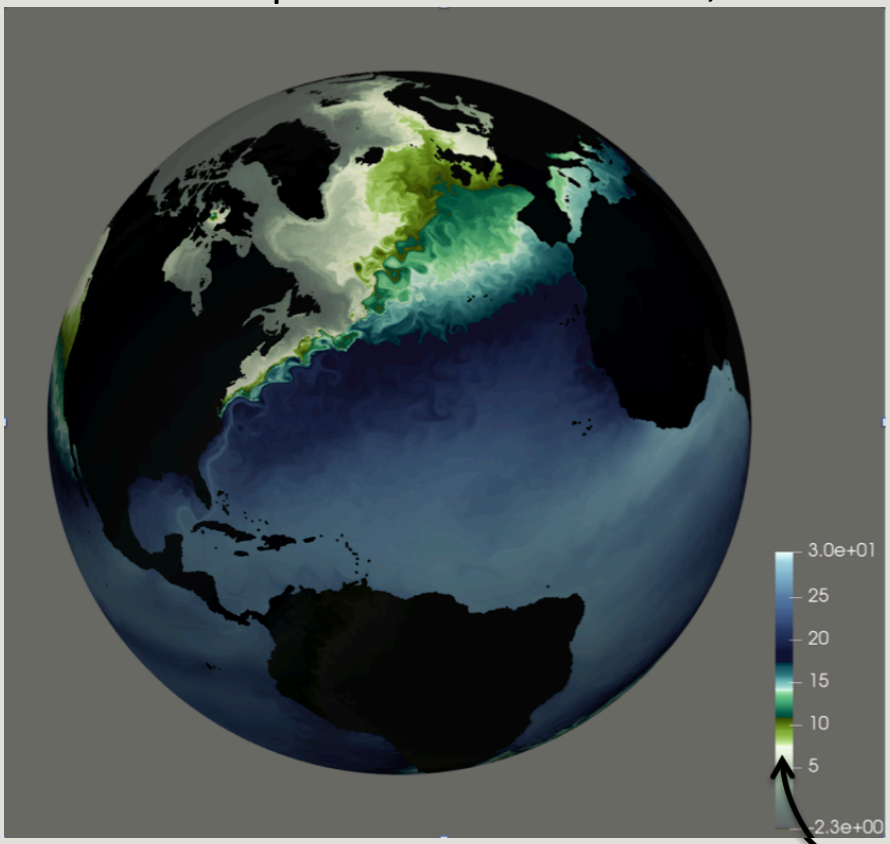
The de-saturated rainbow is often used by scientists desiring detailed renderings.
The saturated palette produces a subtle vibration and not optimal in many situations.

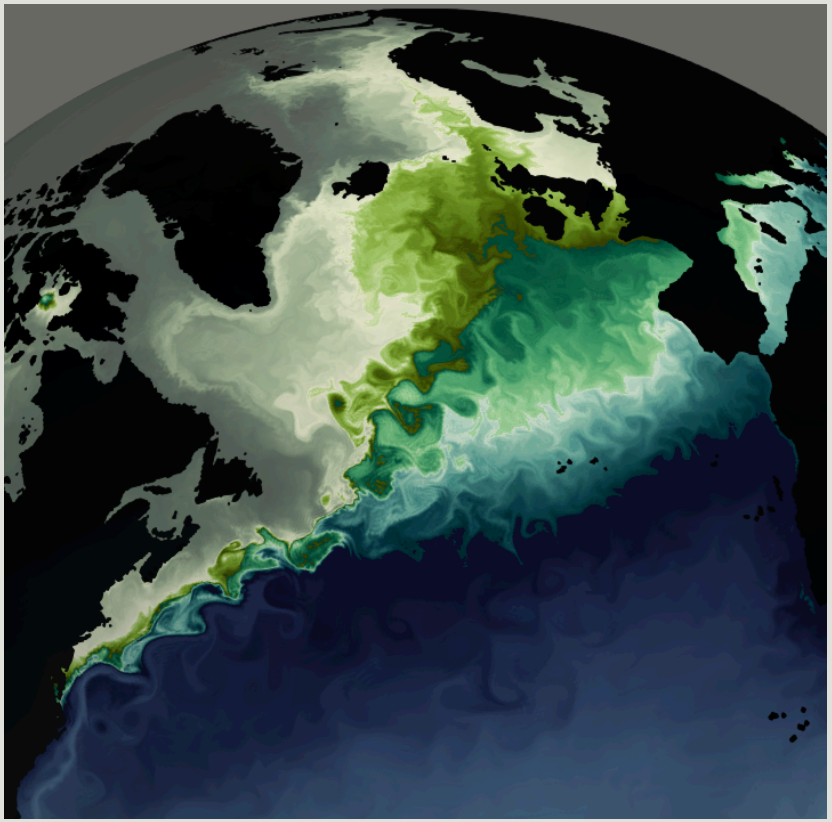




Alternatives include "wave" colormaps (l)
or custom maps are available on SciVisColor.org.

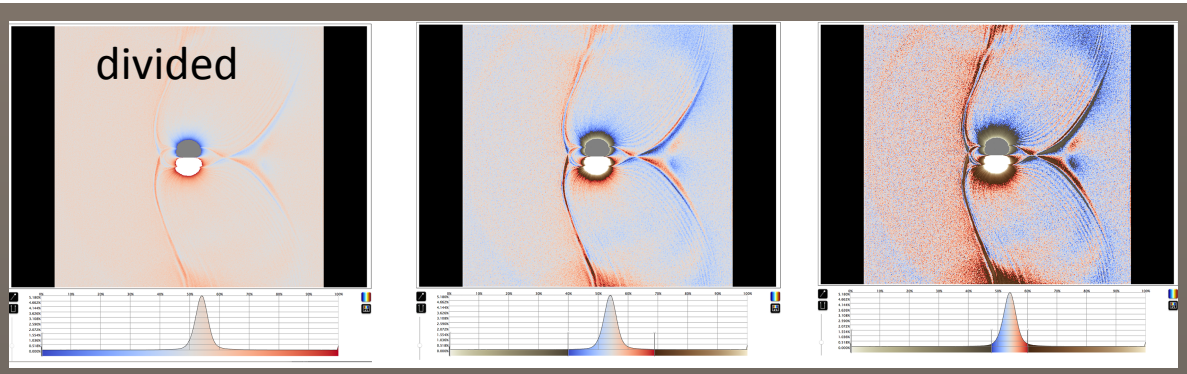
Contrast is the means by which color delivers information.
If there is a specific area of interest, condense the contrast to those areas.





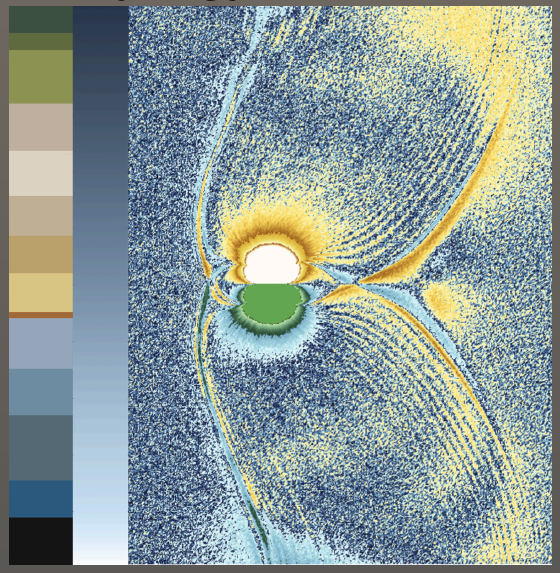
sciviscolor.org/home/colormoves

Resolution power concentrated into the regions of interest.

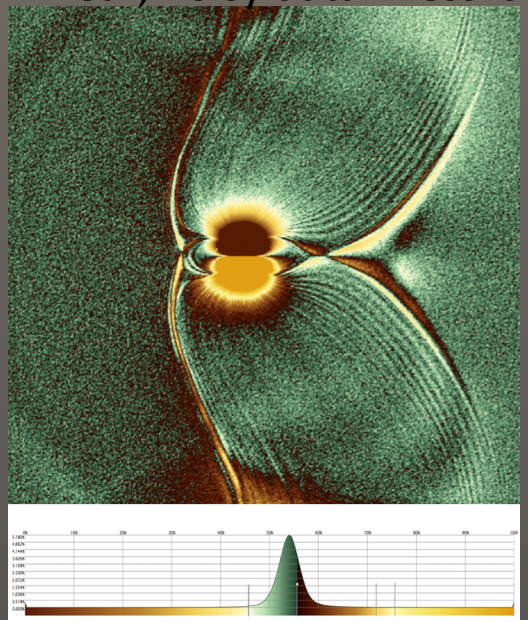


standard cool warm colormap -

unified

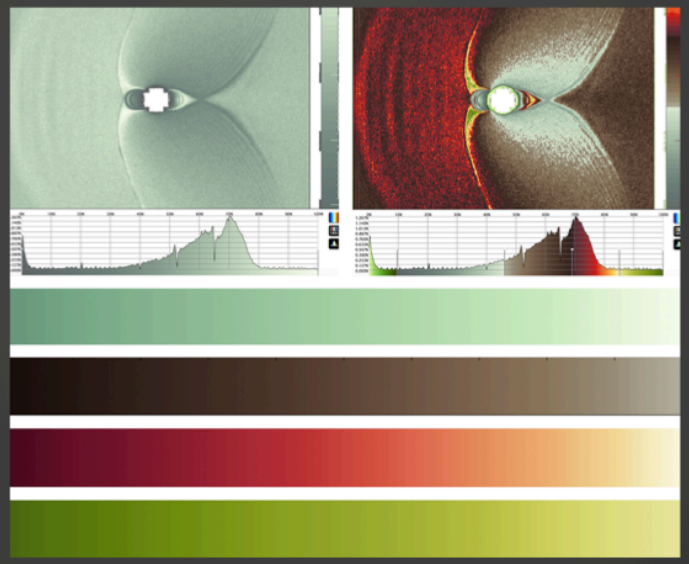


linear, noisy data – less is more

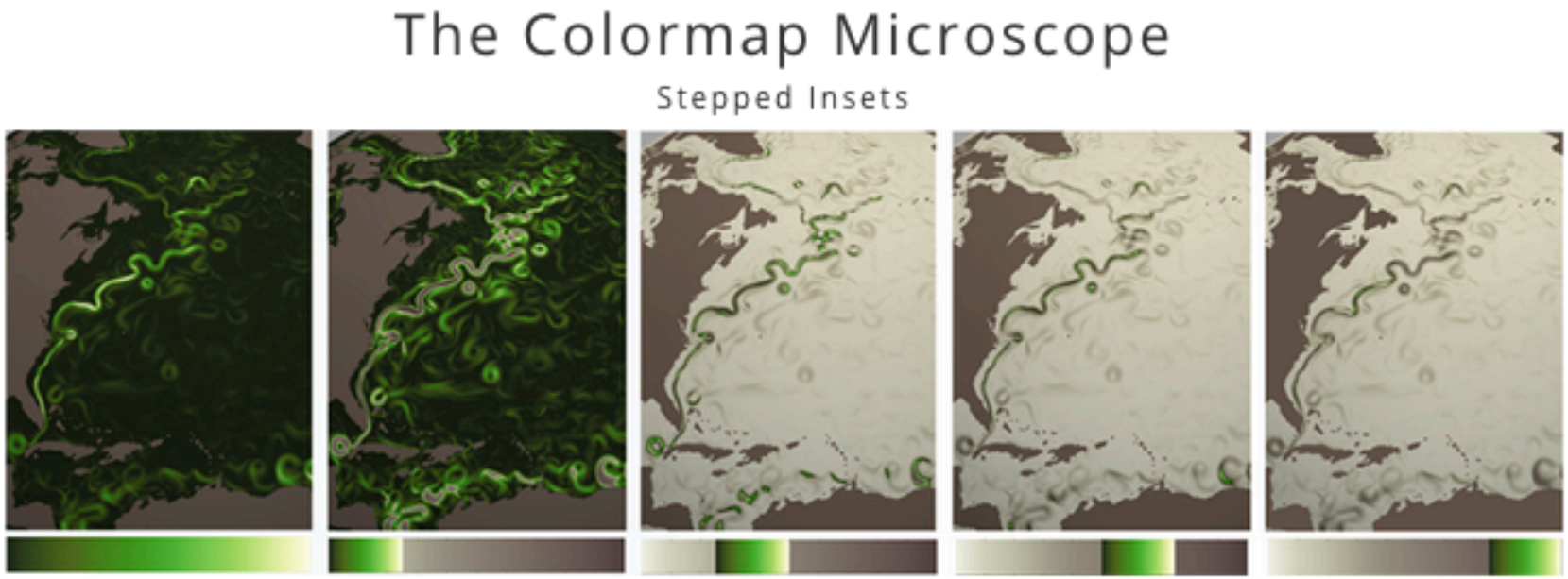


Aligning type of data to type of contrast

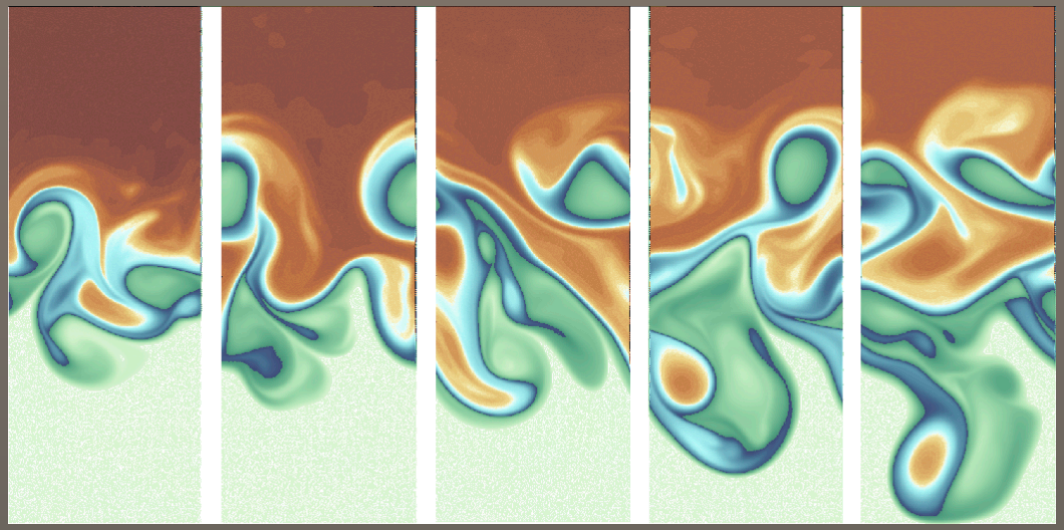
Constructing color palettes based on contrast theory

Colormap Properties		Colormap Usage
cool, light, muted		contextual data
neutral, dark, muted		least important data
warm, saturated hue-spanning		highlight larger areas of important data
cool, saturated, narrow hue		highlight small areas of important data

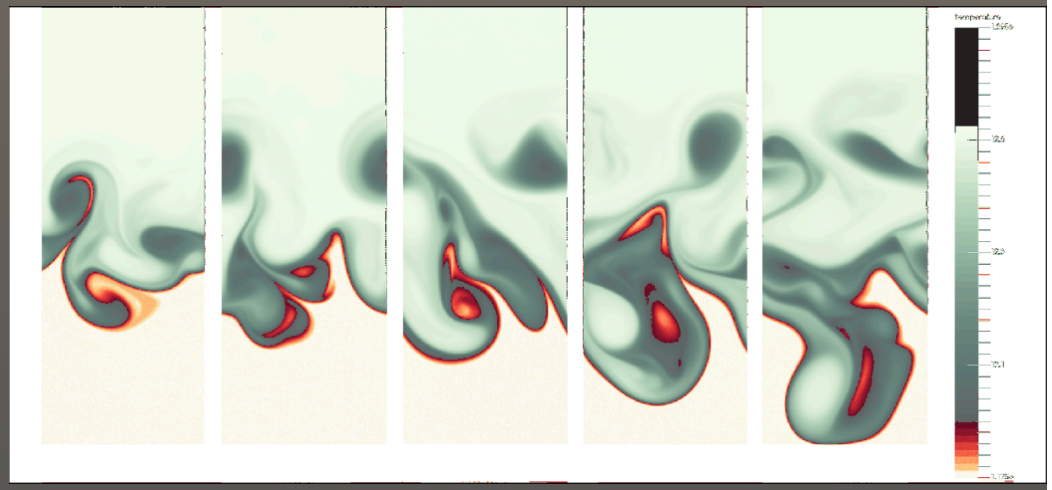
focusing contrast



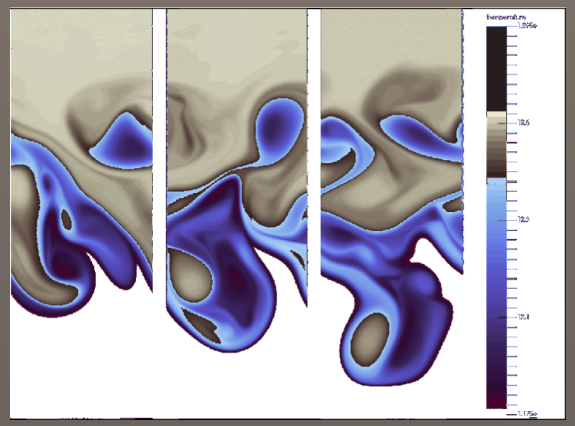
http://sciviscolor.org/home/colormaps/765-2/



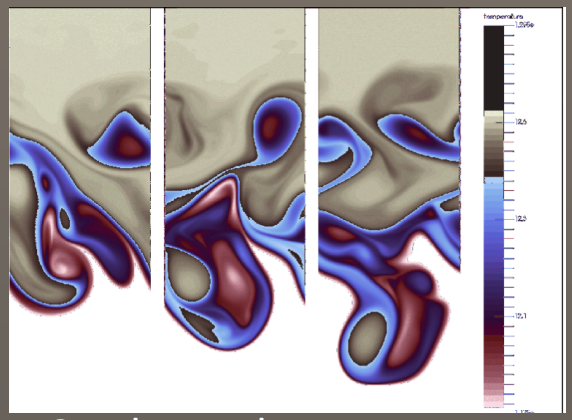
Focus contrast on a specific data range and track it over time.



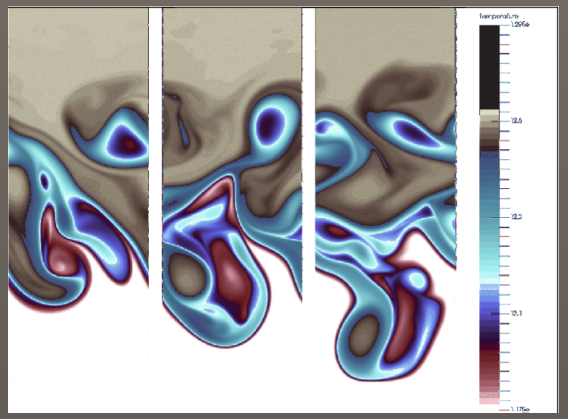
Cropped data range, with 2, 3 and 4 color scales



2 color scales



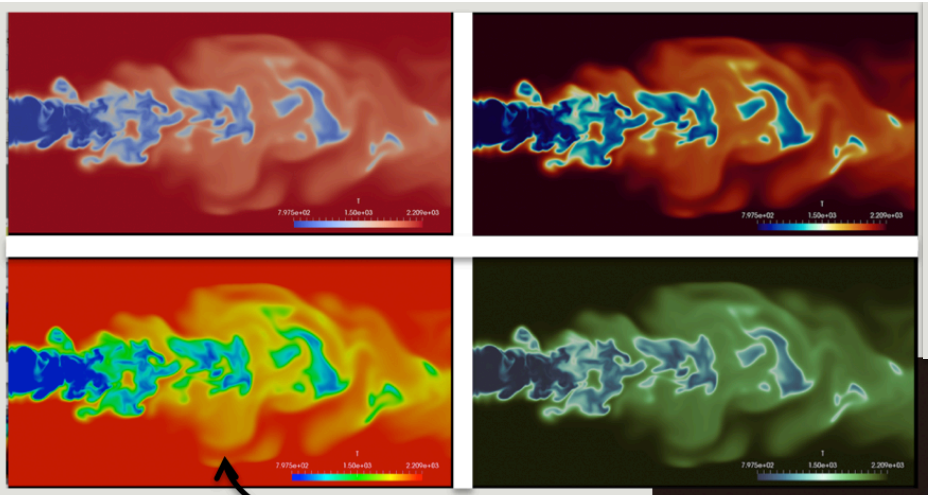
3 color scales



4 color scales

How much detail do you need?

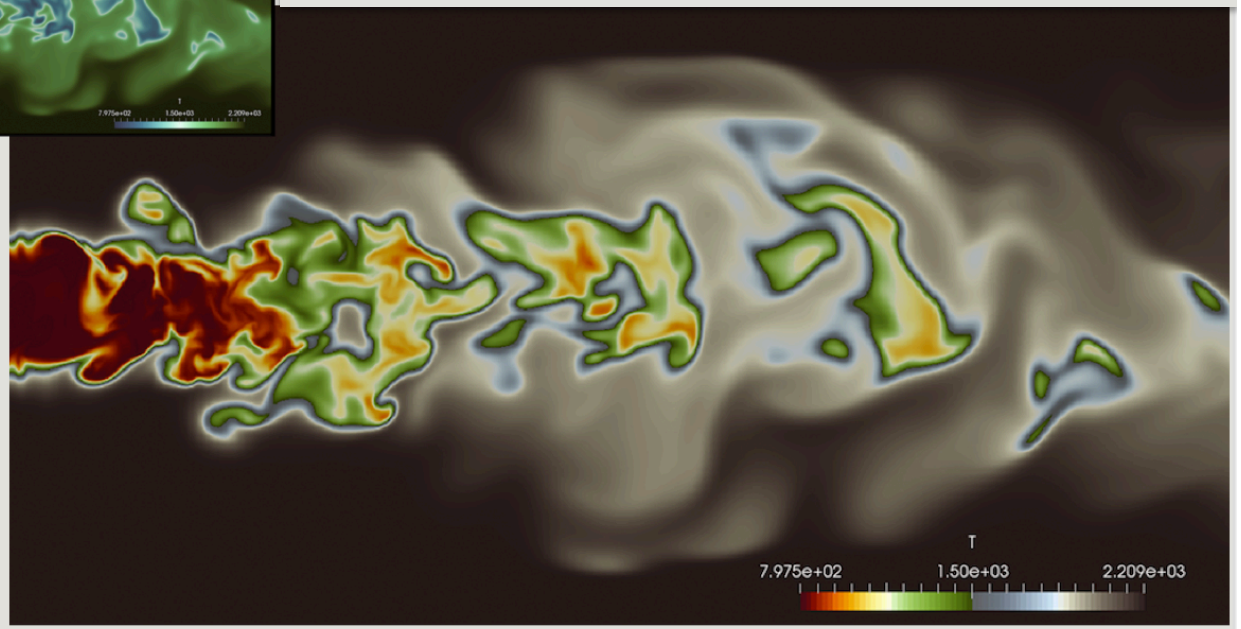
At what point does it stop adding value?



If you usually use one of these…..

Allocating the saturation and contrast to the important ranges of the data.

try a "wave" colormap



http://sciviscolor.org/home/colormaps/waves/

Characteristics of color scale

1. Saturated, full value range, wide hue range

2. Similar to #1 but blue in the low value

3. Mid-range hue span, saturated, almost full value range

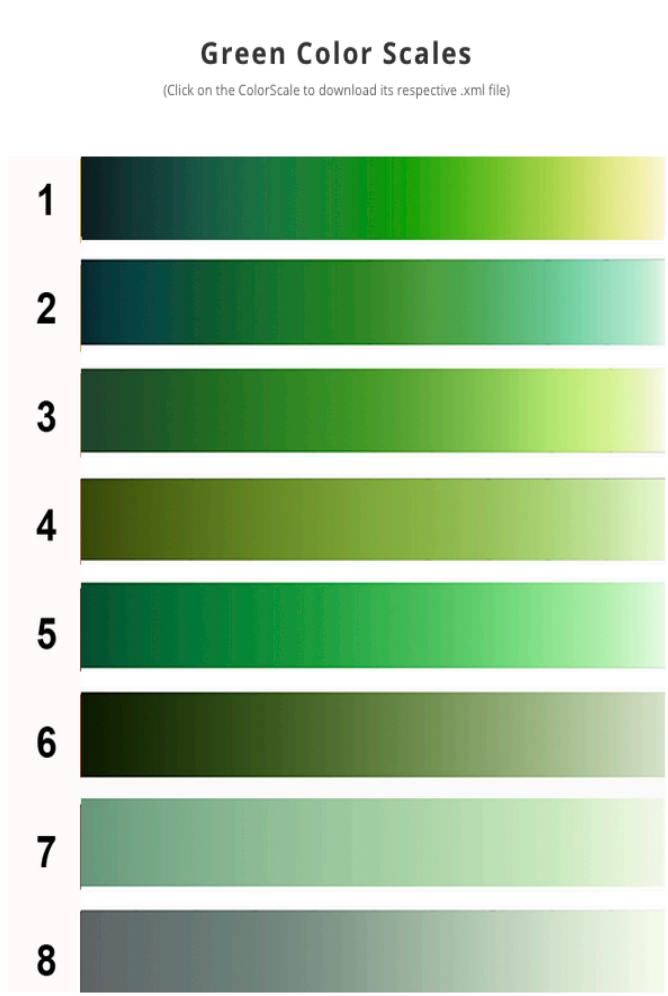
4. Narrow hue range (yellow- green) combines well with other scales

5. Bright, clear, single value, simple scale

6. Darker value range, single hue

7. Light value range, single hue, good for contrast but not detail.

8. Muted light value gray-green



Usage

1. important data

2. alternative for use with yellows.

3. accent

4. For multi-scale colormaps

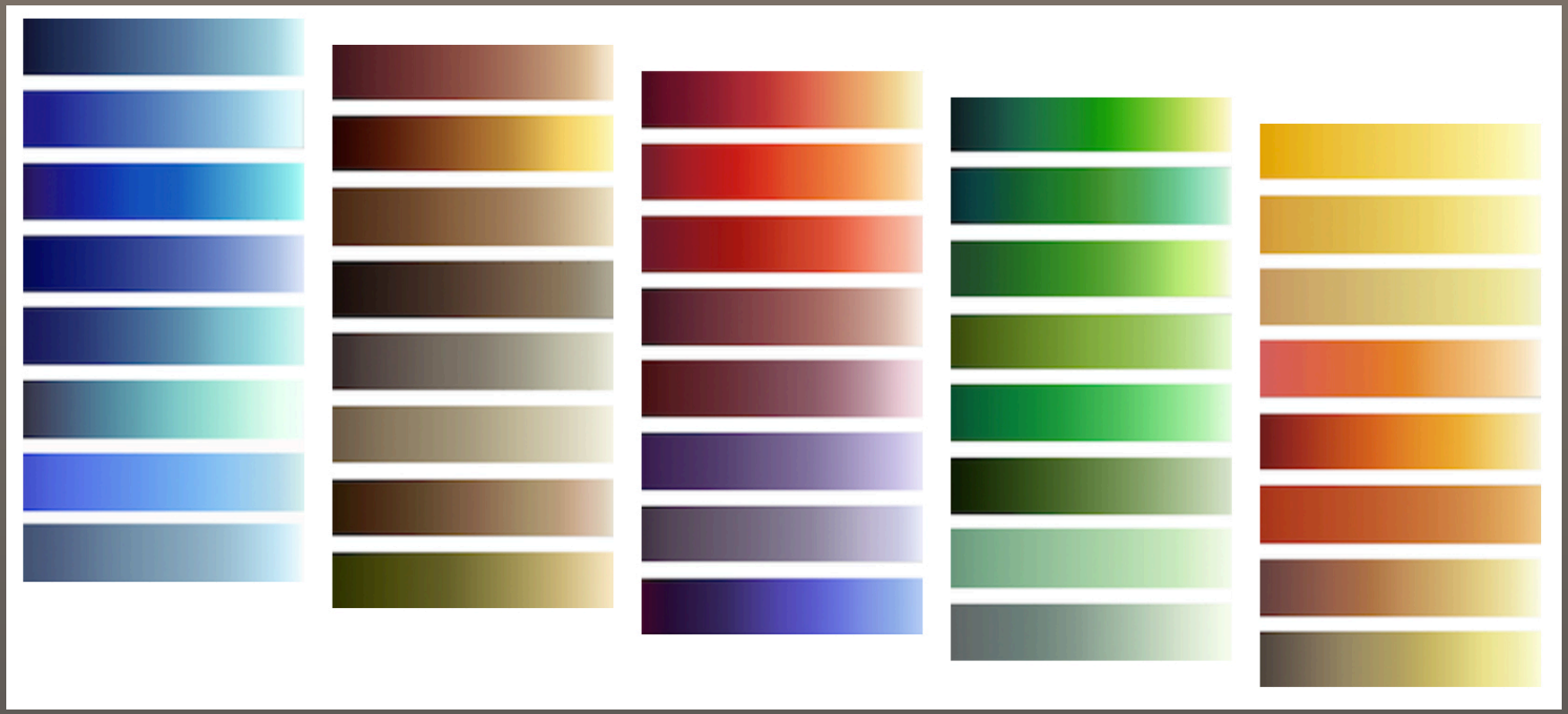
5. For multi-scale colormaps

6. receding context

7. context

8. lowest priority data

Color Scales



ColorMoves enables alignment of luminance with statistical distribution