



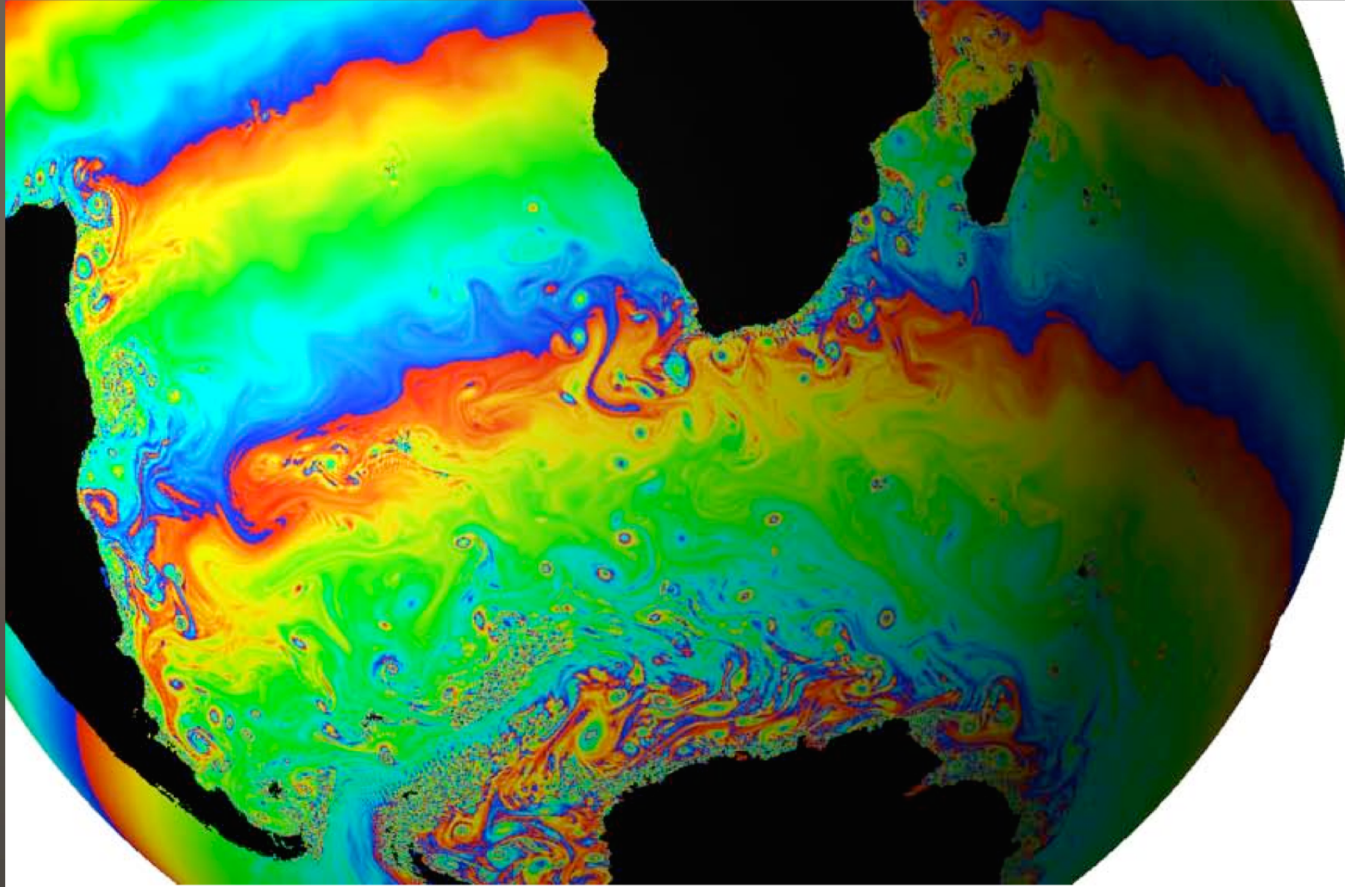
native habitat

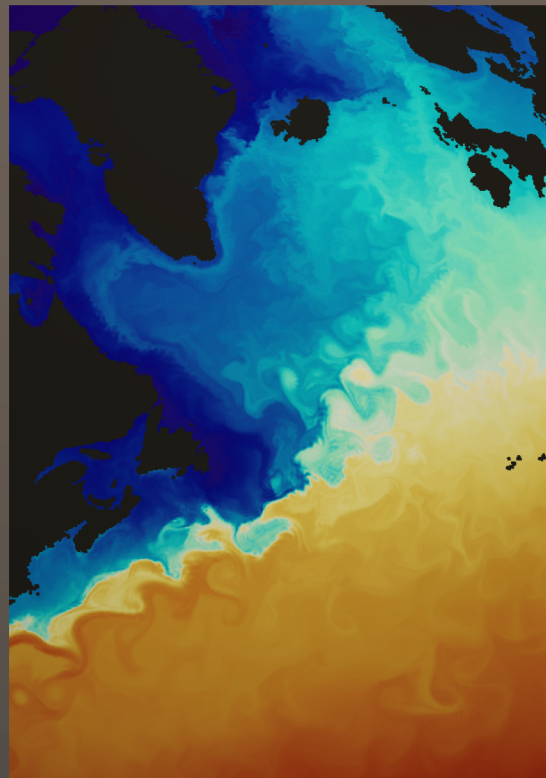
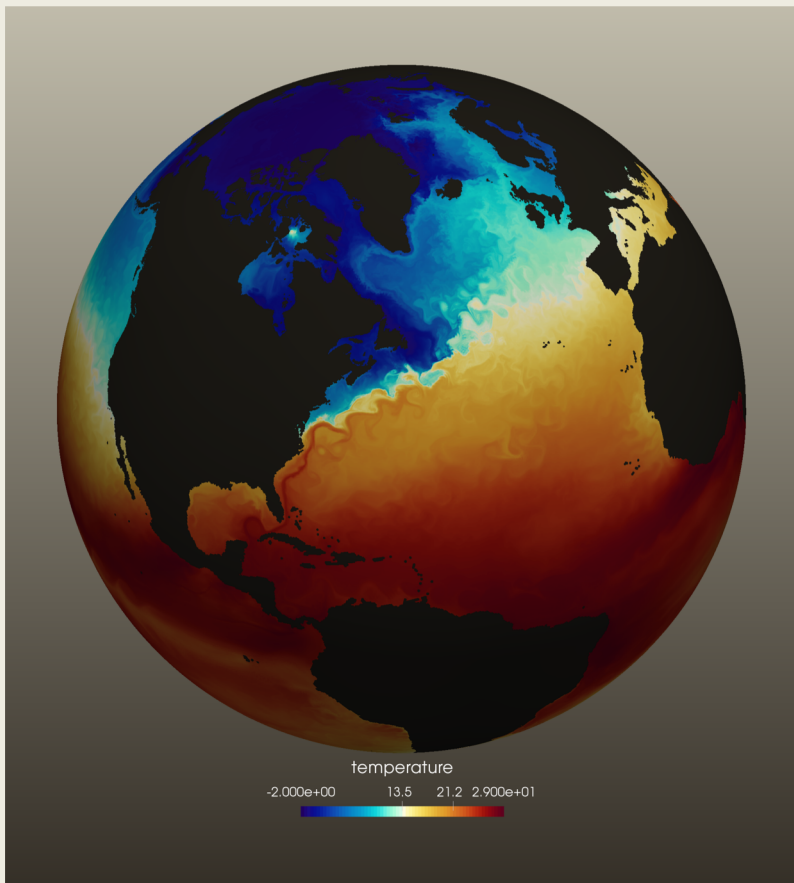
Francesca Samsel

Research Associate
Center for Agile Technology
University of Texas at Austin



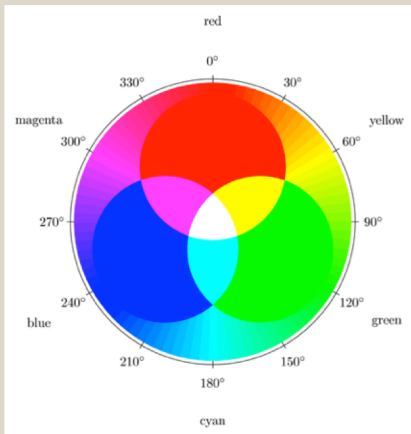
Why should you care?



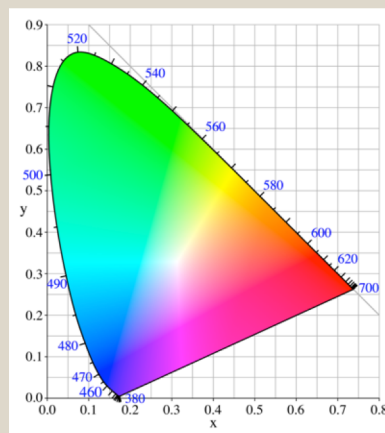


Why is color complicated?

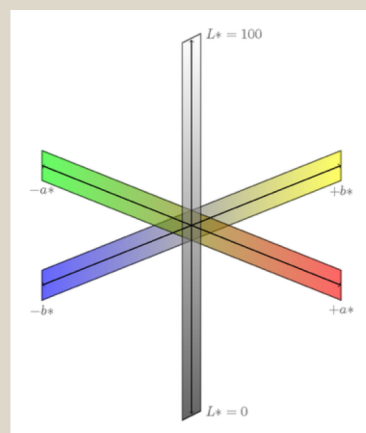
RGB and CIE LAB



RGB colorspace



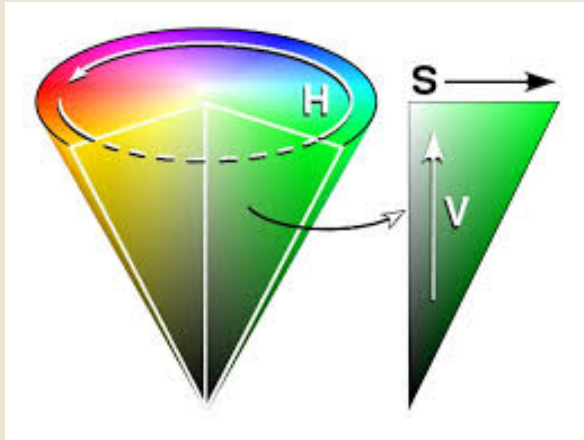
CIE LAB space



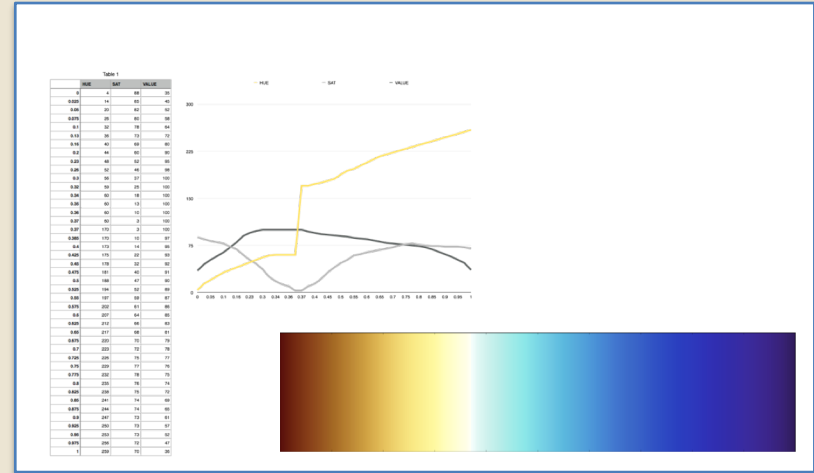
RGB is computer color space.

CIE LAB space, perceptual accurate, is *the best interpolation space*.

Why Hue, Saturation and Value the human color space



HSV, HSB colorspace



It provides the ability to make subtle adjustments in the human color language.
Hue, Saturation and Value -- The language of color theory.

Color Theory 101

color contrast types

1. hue
2. value
3. saturation
4. complimentary
5. cool warm
6. proportion
7. simultaneity

and....unifying contrast
analogous color

Color is complicated because
it is about the color relationships
not the color itself.



Advise:
Keep your color palettes simple...
or steal them from a pro.

The Rules:

Contrast hierarchy:

1. value / luminance
2. cool / warm
3. everything else

Your **background** choice is as important as your colormap.

Two types of contrast are stronger than one.

Cognitively you have a **contrast budget**.

Use only what you need and you will not go hungry.

Neutral colors are your friend.

It is about **contrast**, not **color**.

It is a matter of degree,
degree of contrast,
degree of intensity.

It is a matter of degree,
degree of contrast,
degree of intensity.

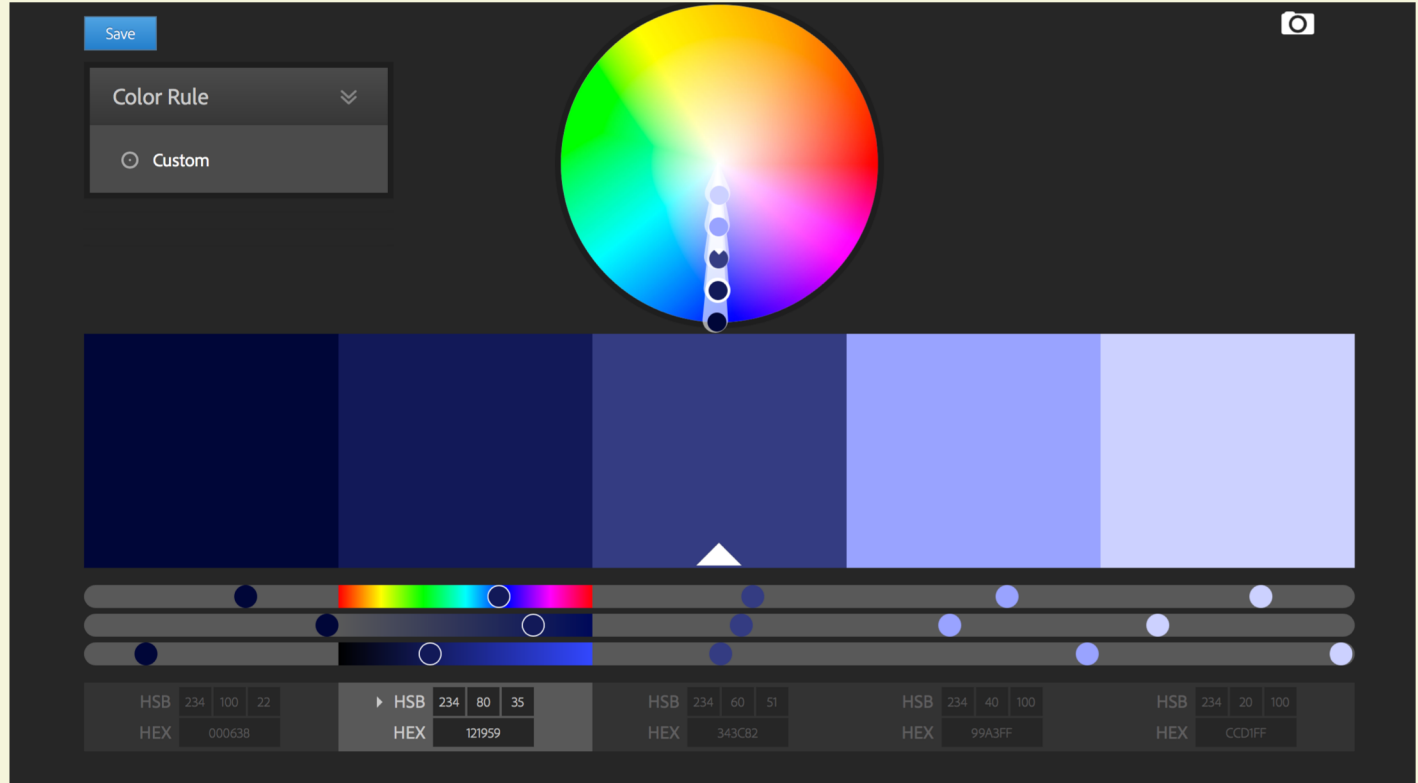
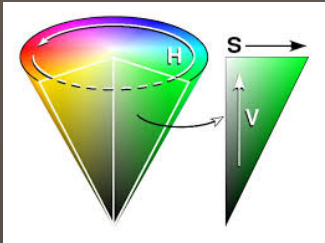


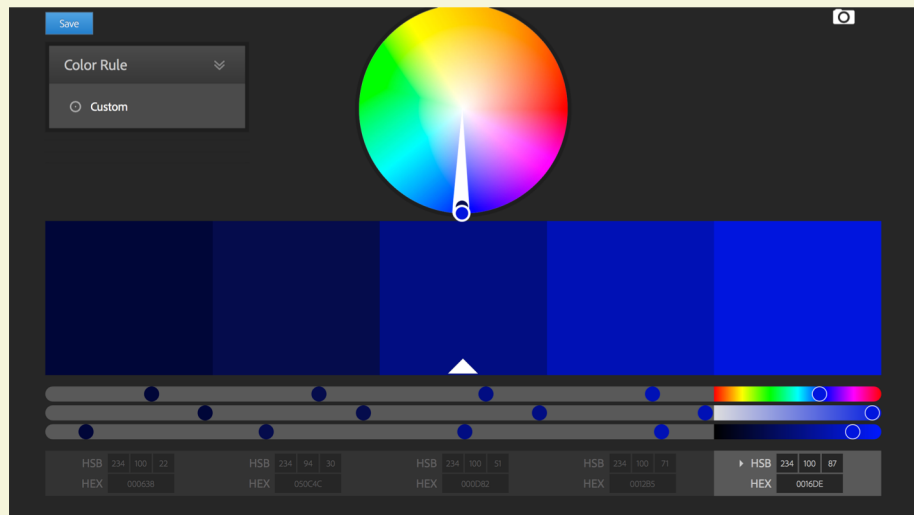
High intensity lowers the
potential range of contrast.
It is the budget issue.



Low intensity provides
wide range of contrast.

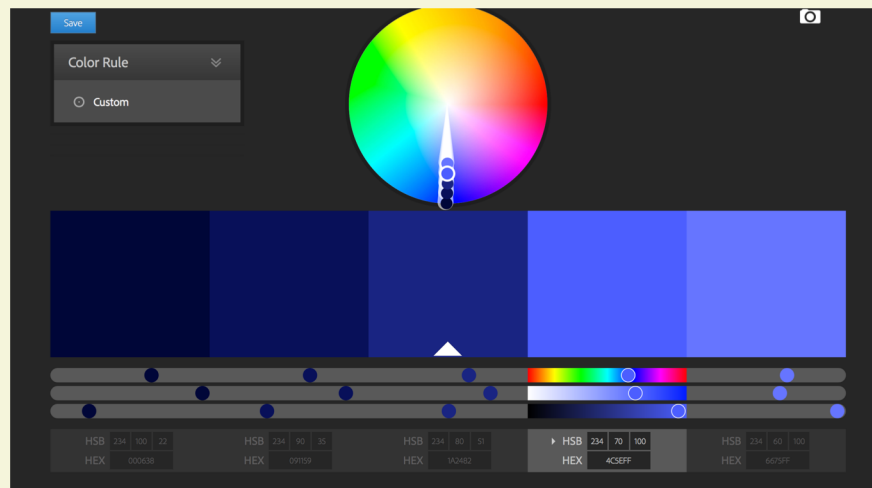
VALUE - light to dark, luminance





Full Saturation

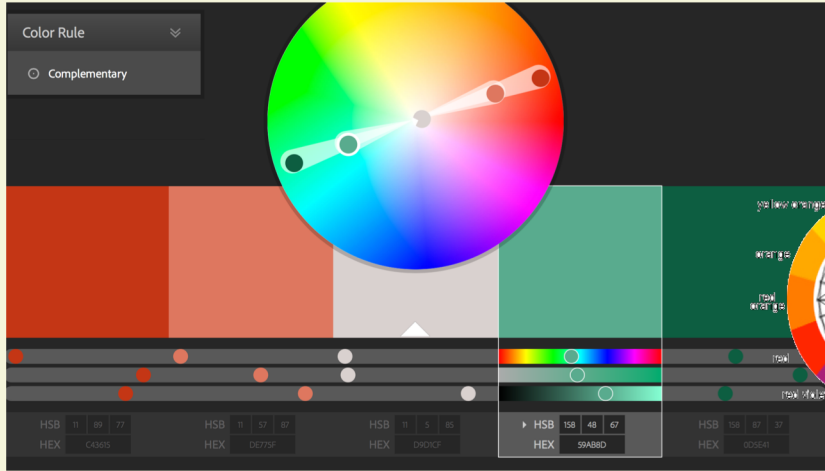
SATURATION
intensity, purity of color



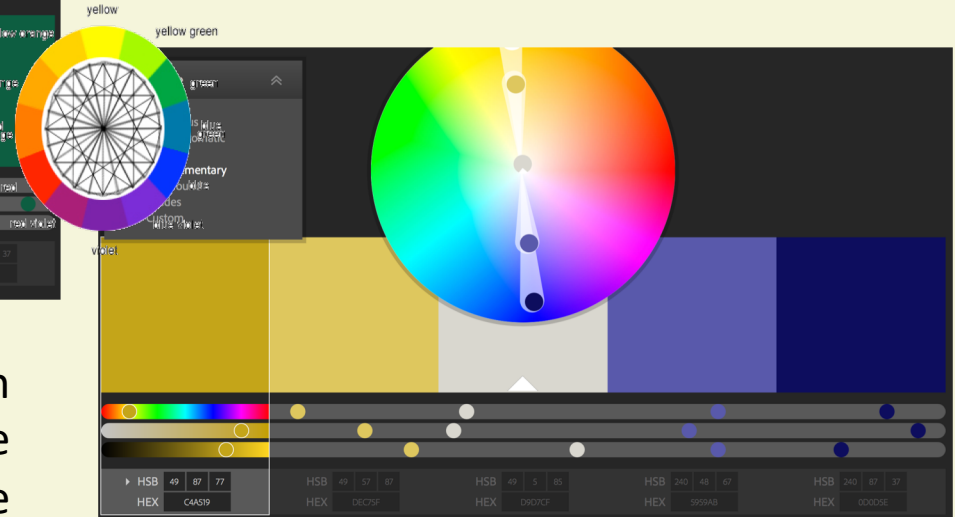
Full saturation, right,
reducing saturation to reduce value

Complimentary colors

opposite sides of the color wheel

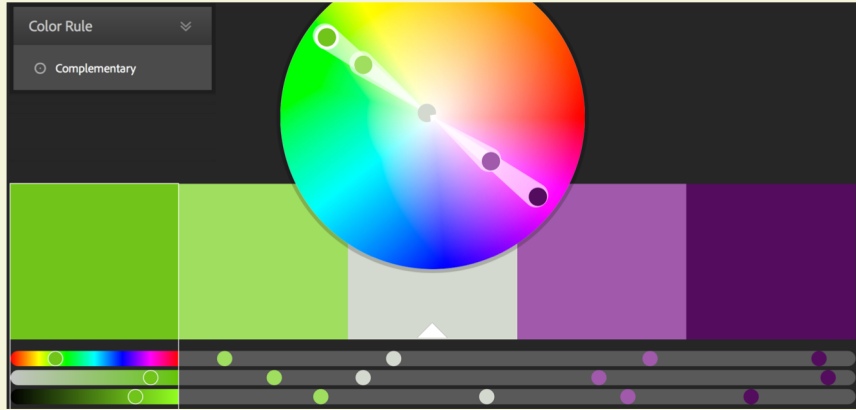


red – green
blue –orange
yellow - purple

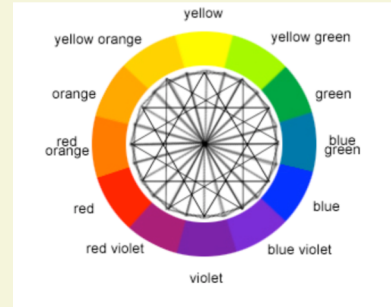


Complimentary colors

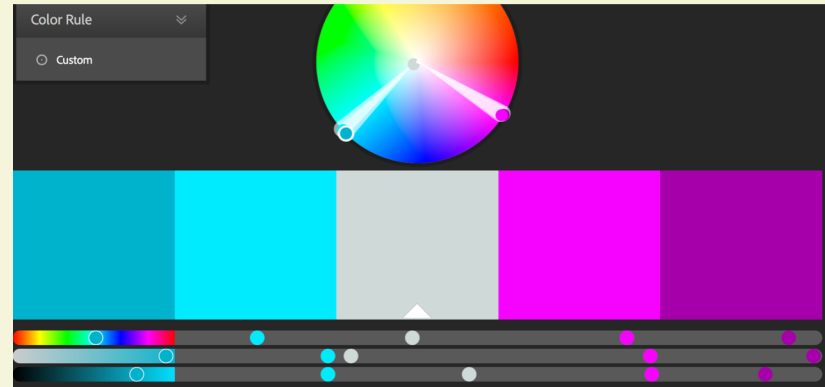
opposite sides of the color wheel



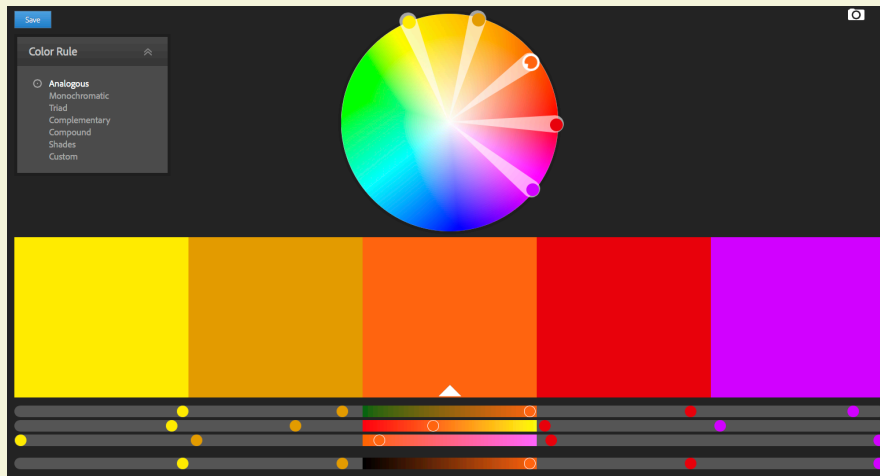
Except when....
you are using a digital color wheel



Because you have to squeeze in

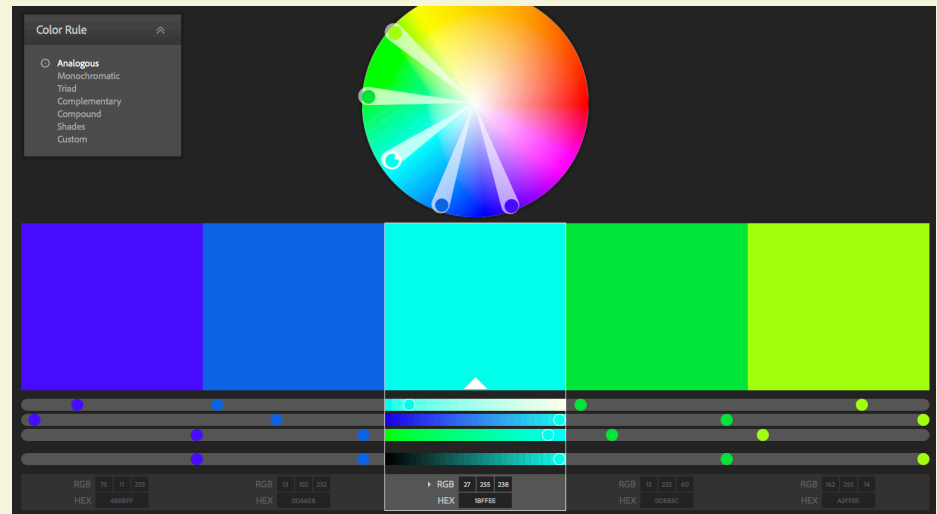


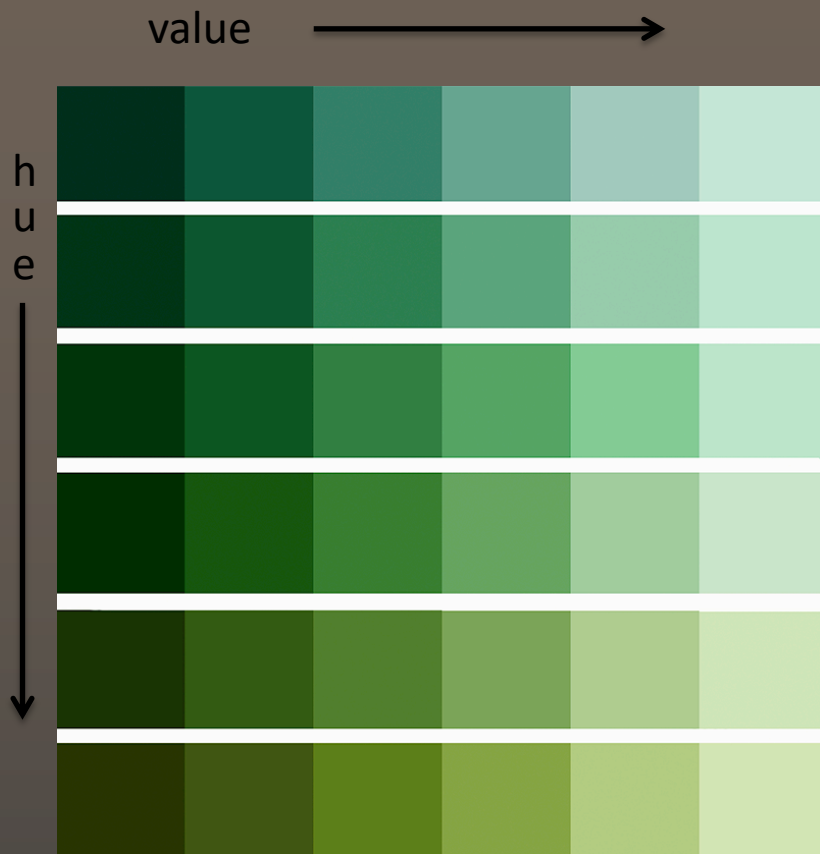
Turquoise and Fushia
somewhere



WARM

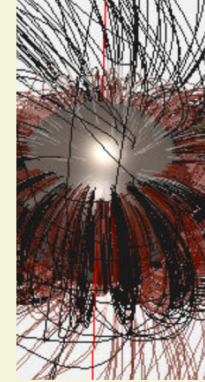
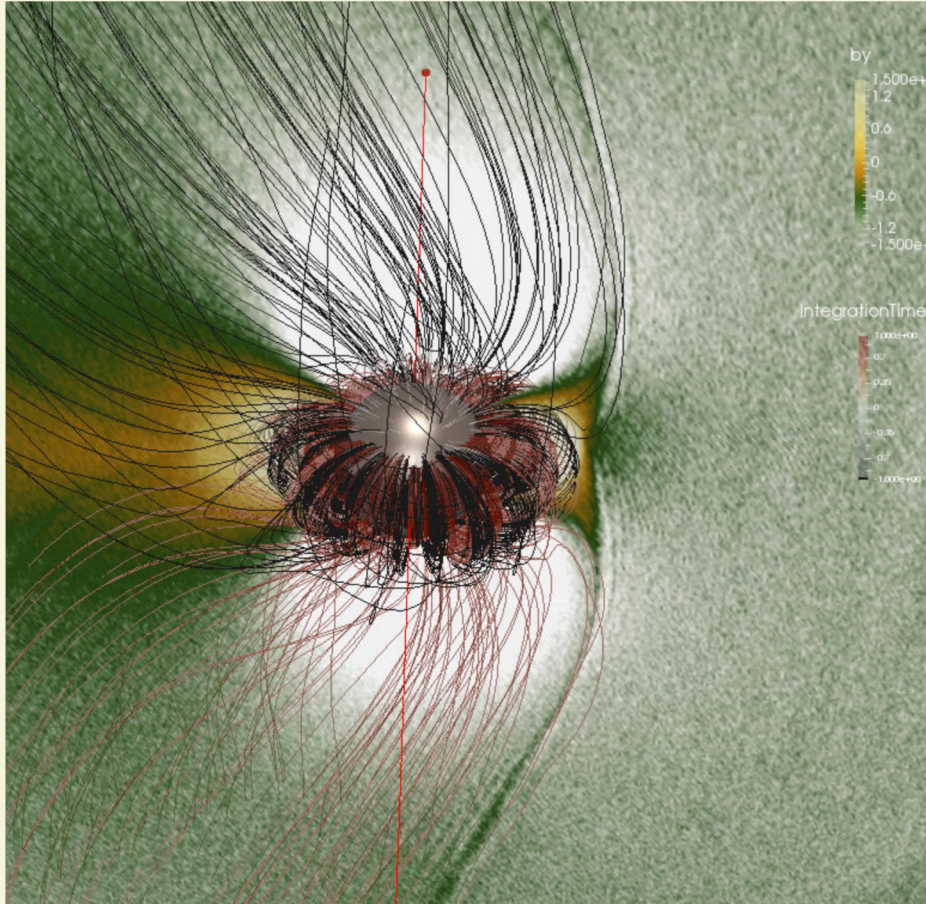
COOL





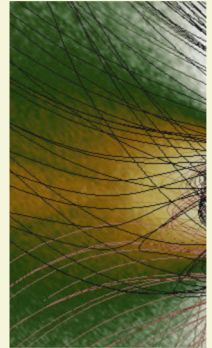
All of these characteristics
occur within hues as well.

Employing multiple types of contrast

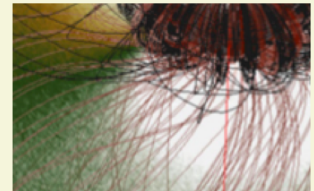


saturation
and
value

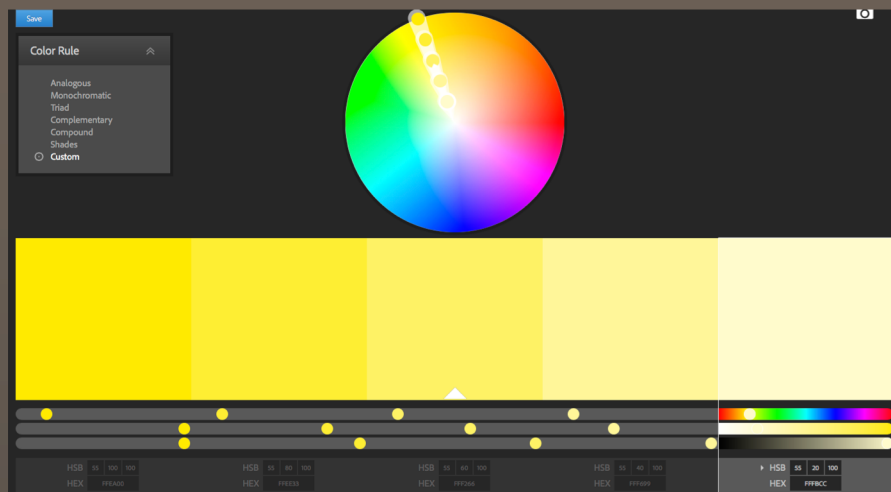
analogous
color



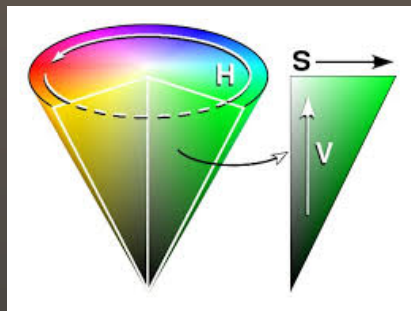
complimentary
color



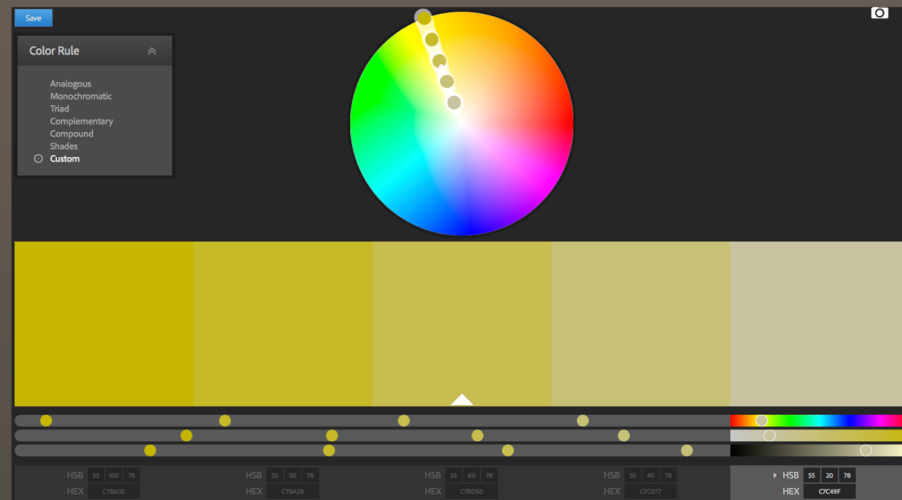
Saturation and Value are intertwined.



change in saturation and value.



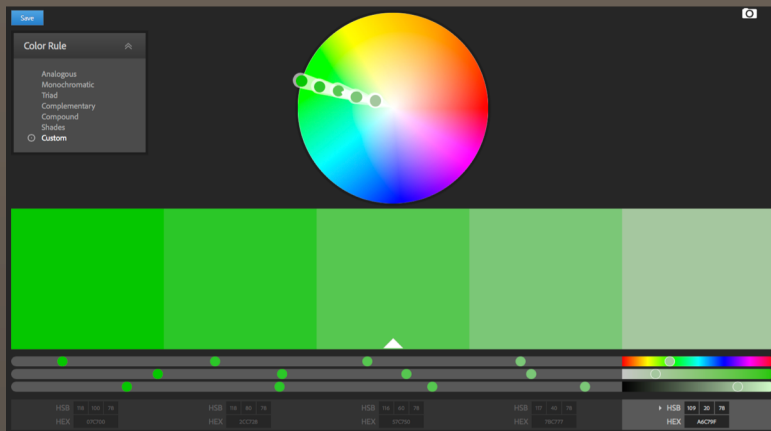
Yellow is tricky because the saturation is so strongly and influenced by value changes.



change in saturation level ONLY.

SATURATION

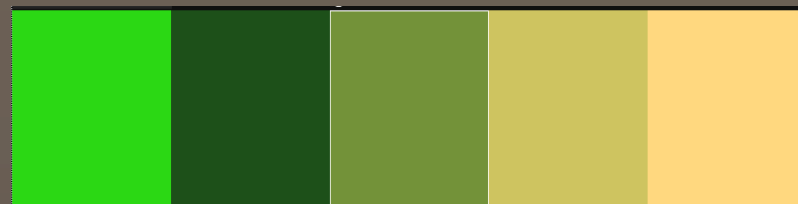
Saturation is
the amount of gray in the color.



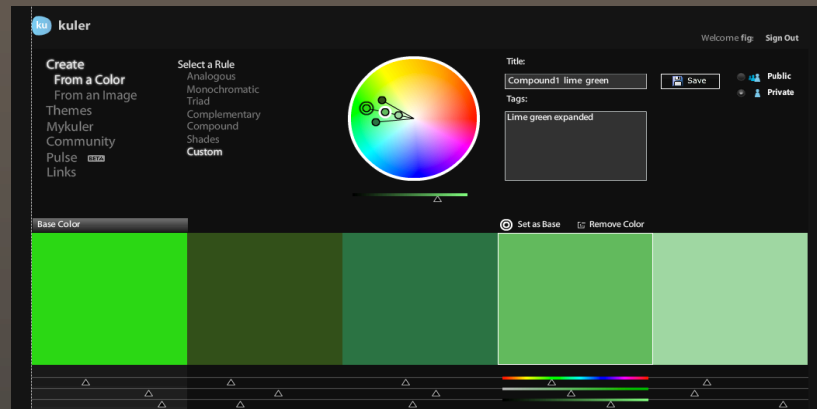
high saturation

low saturation

Weaving
contrast



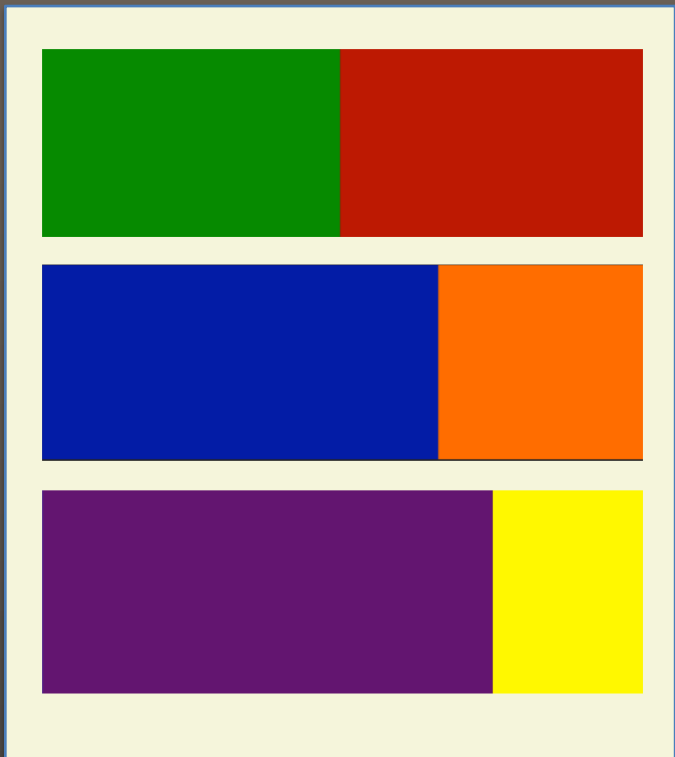
Saturation and Hue changes
hue change - green to yellow



WEAVING saturation and hue changes
yellow-green, blue-green, yellow-green, blue-green

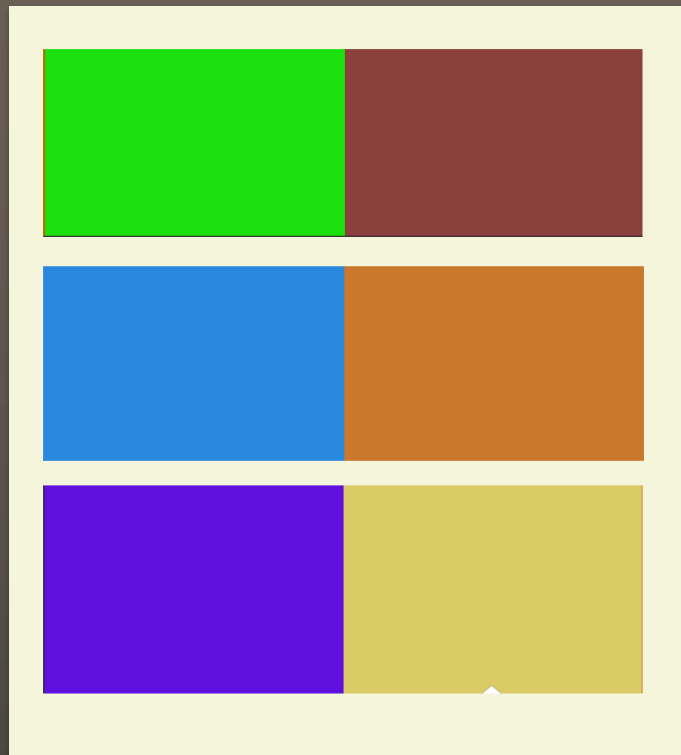
Proportion

Balancing the natural intensity of color

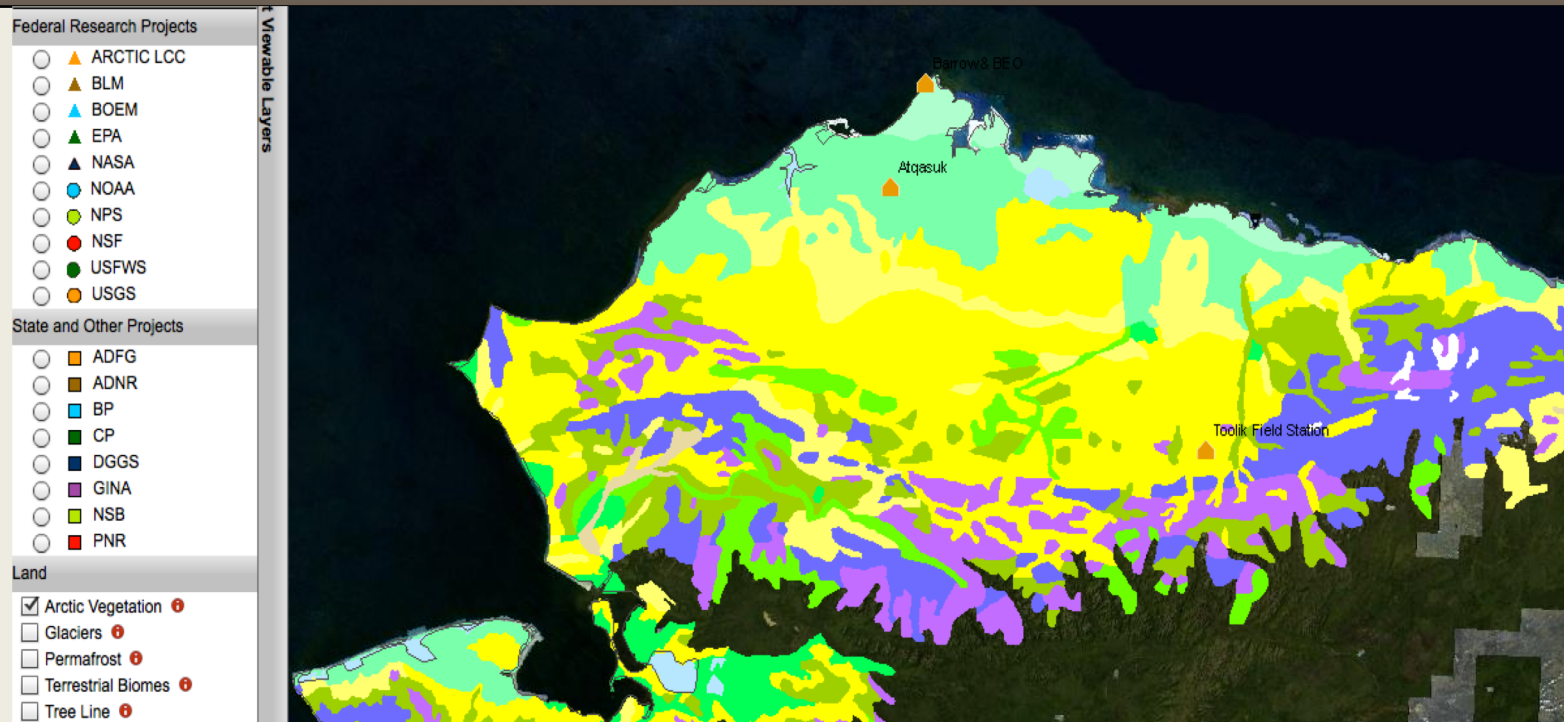


Theory is easy.

Think of it in terms of balancing
the volume of color to create harmony.
Harmony is good! Really!



Reality... not so much.



Barrow Alaska vegetation map

C. Tweedie, UTEP

Federal Research Projects

- ☐ ARCTIC LCC
- ☐ BLM
- ☐ BOEM
- ☐ EPA
- ☐ NASA
- ☐ NOAA
- ☐ NPS
- ☐ NSF
- ☐ USFWS
- ☐ USGS

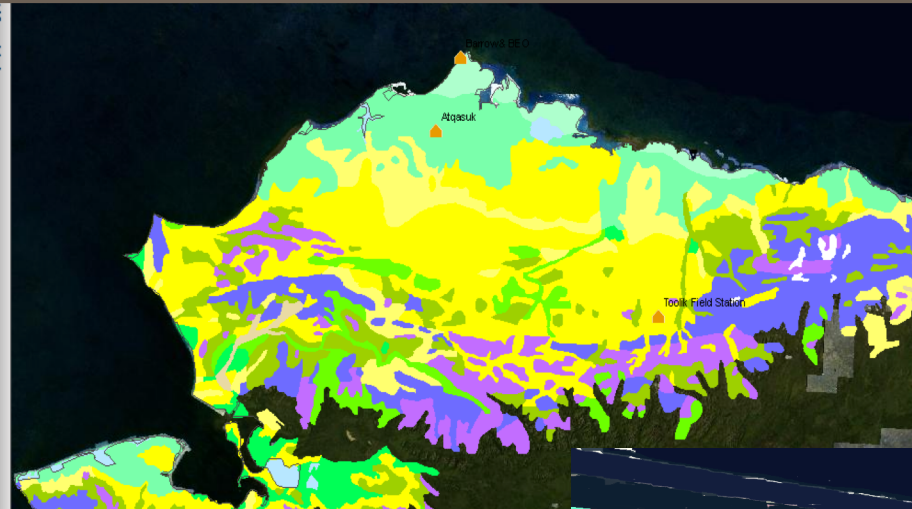
State and Other Projects

- ☐ ADFG
- ☐ ADNR
- ☐ BP
- ☐ CP
- ☐ DGGG
- ☐ GINA
- ☐ NSB
- ☐ PNR

Land

- ☒ Arctic Vegetation
- ☐ Glaciers
- ☐ Permafrost
- ☐ Terrestrial Biomes
- ☐ Tree Line

Viewable Layers

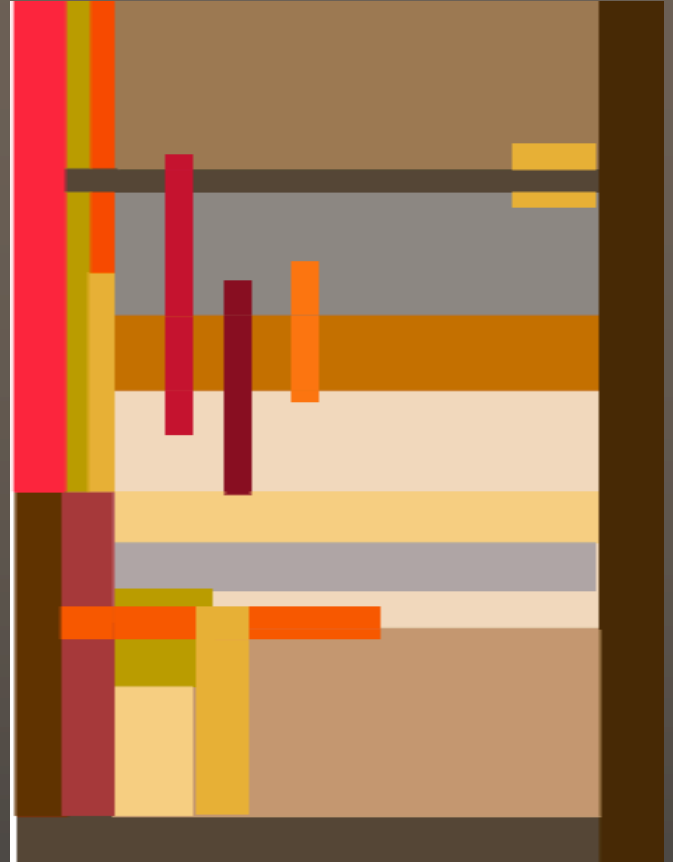


Simultaneity of Color

the problem child ...



A n environment for thinking ...



Clarity without cacophony, that's the goal.

Simultaneity of Color



Analogous Color

close on the color wheel



note the spiral ...

www.kuler.com

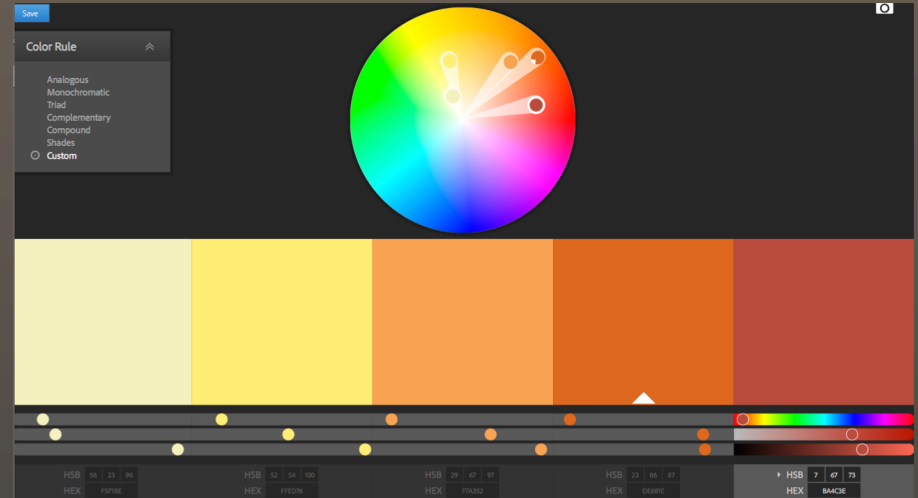
Analogous Color

close on the color wheel



Unified but higher contrast contrast

Combining harmony and contrast



Weaving the saturation levels
to increase contrast while controlling cacophony.



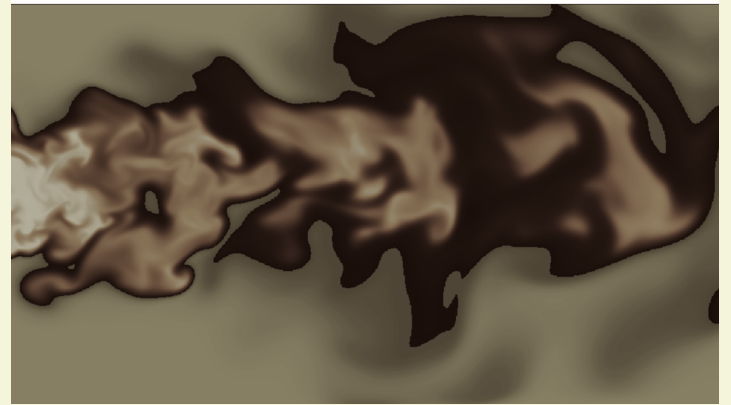
1



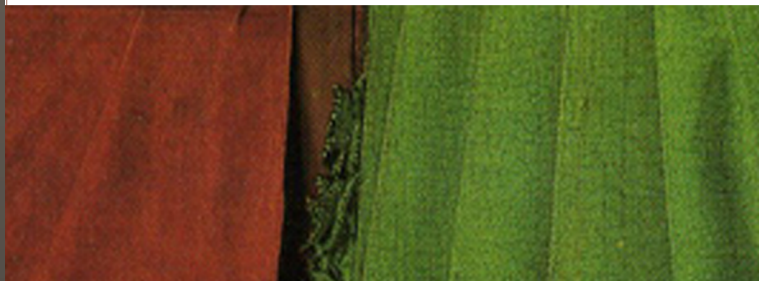
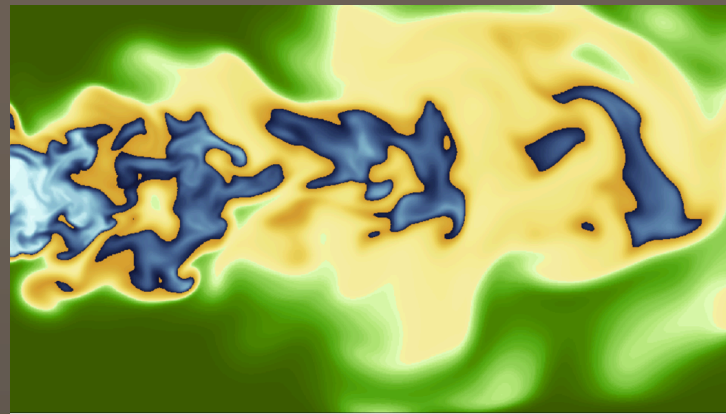
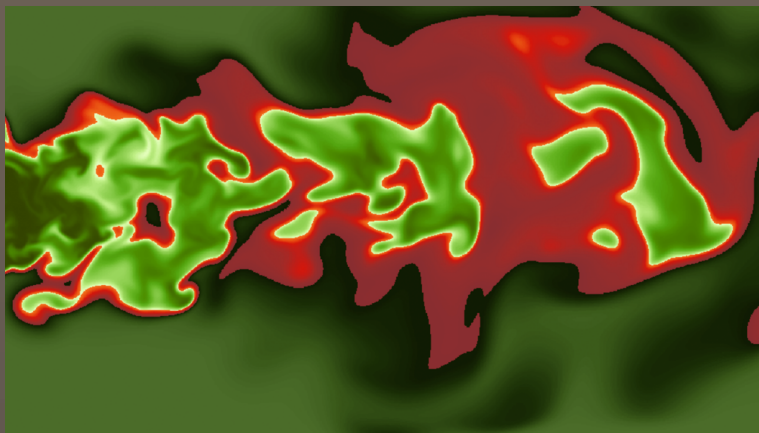
2



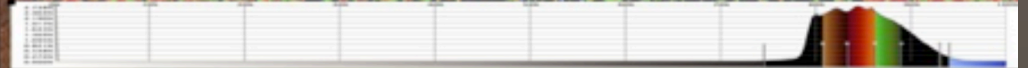
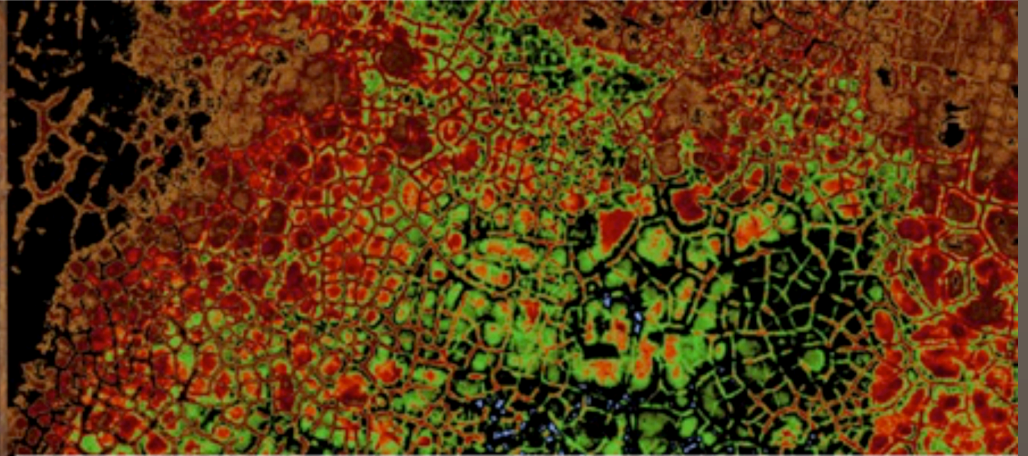
3



VanEyck



QUIZ! What type of contrast?



A

B

C

723027

953827

c7d2c6

eddfed

dbd7aa

7d542b

5e83cf

8fb764

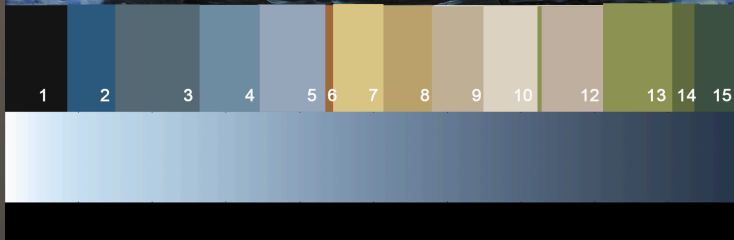
4f7e43

5e4b2a

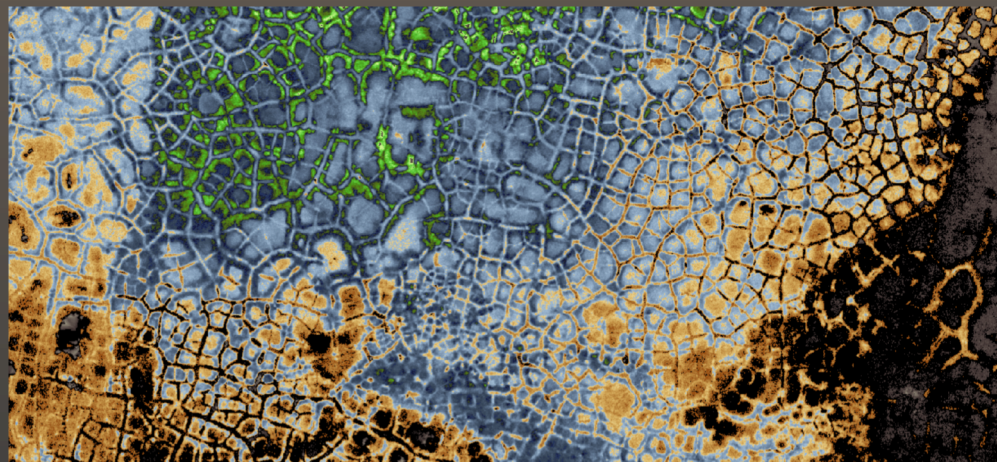
2d1e1a

10100e

Colormaps: A. VanEyck Brown, B. 1028gr2, c. yel15



Underlying contrast type?

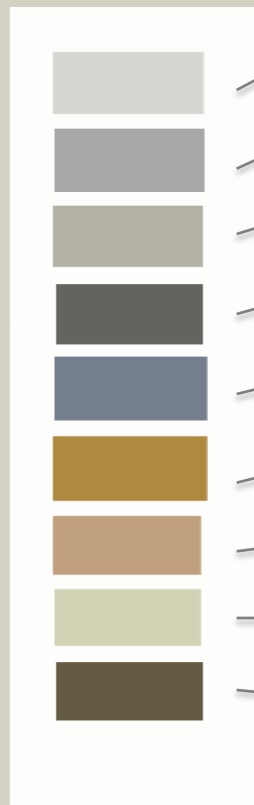


Neutrals

the power
of neutrals

a little color goes
a long way





neutral gray

cool gray

warm gray

dark warm gray

medium cool blue gray

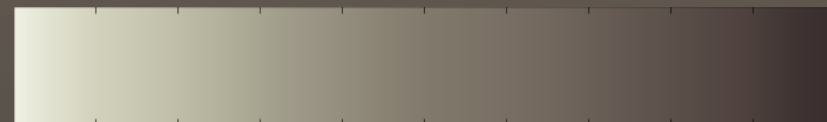
ochre

warm taupe

light cool gray taupe

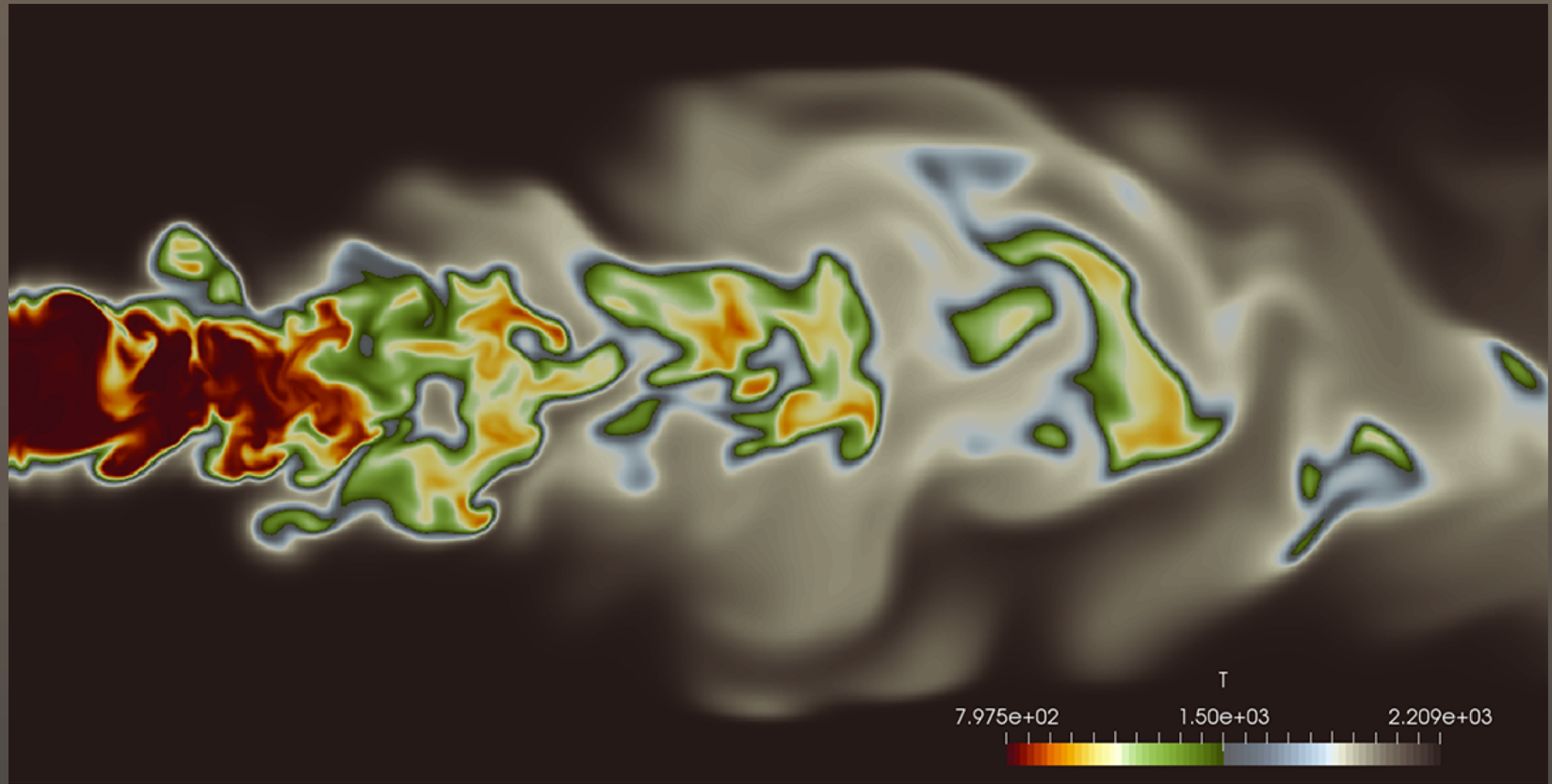
dark cool green gray

medium warm gray



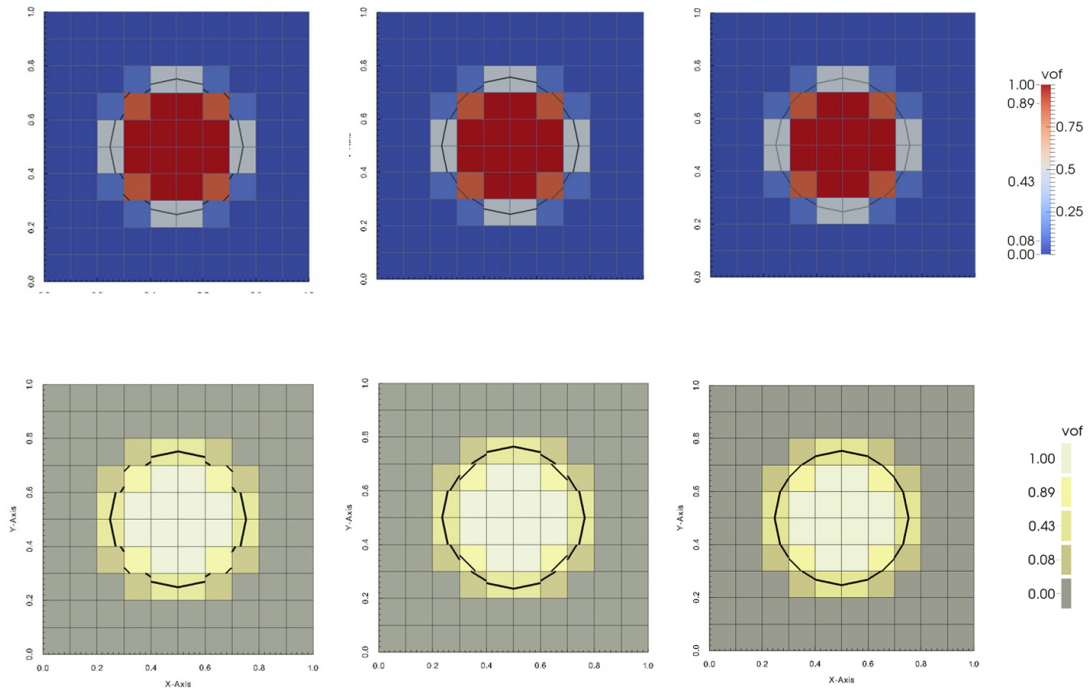
Grays frame the focus colors.

red is important, gray is not....



cool warm and muted cool warm

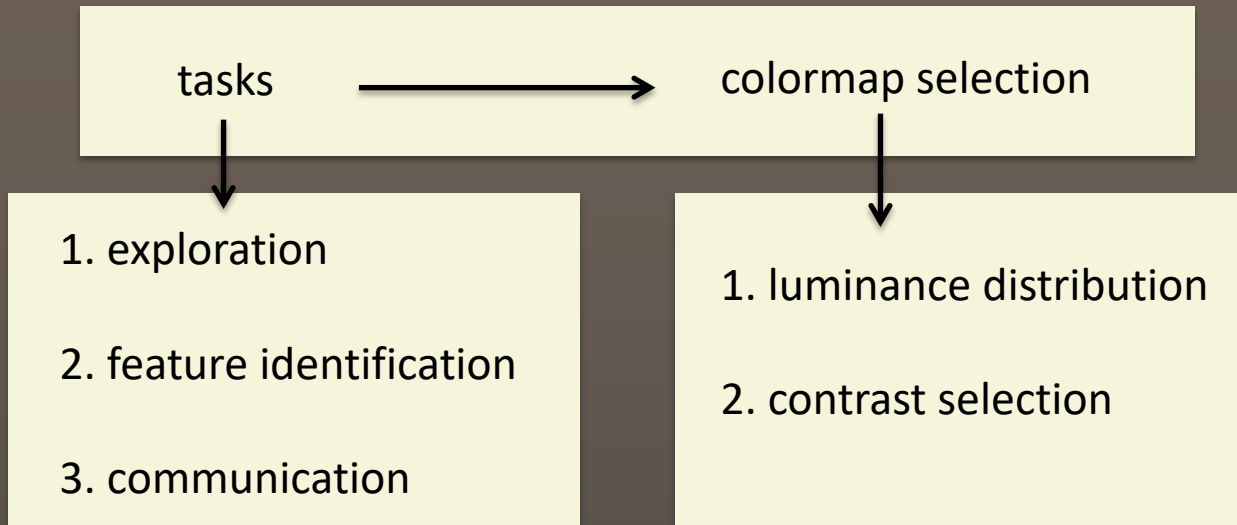
Let's get practical.



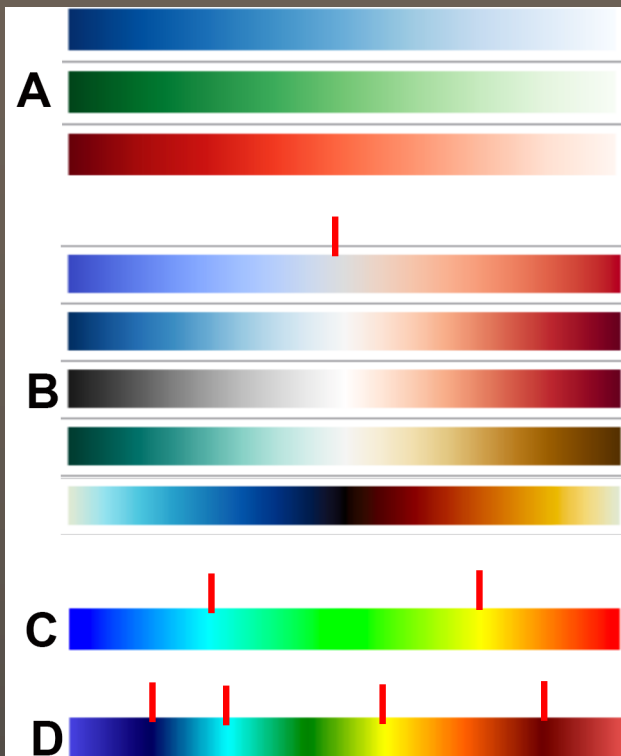
The important element is the position of the black line and how close it is to a true circle.
 The second most important is the position of line within the light blue, light red and light yellow squares

Place the contrast
where you need it,
 but watch the volume.

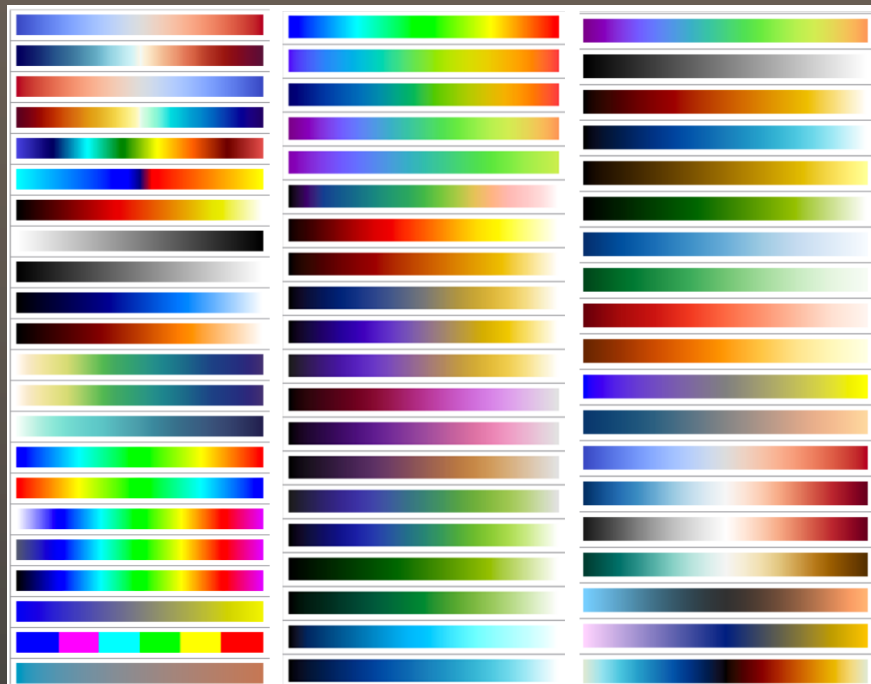
Follow the task.....



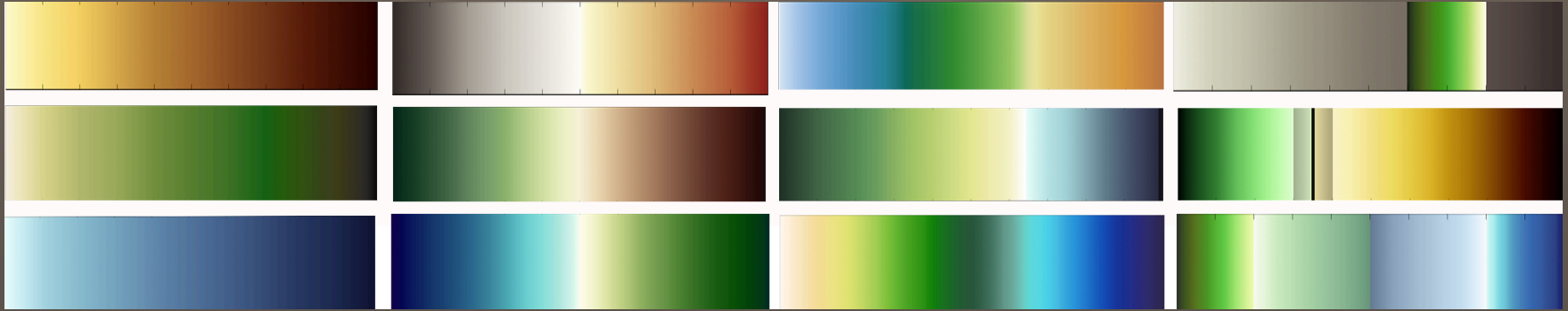
Luminance



Why ParaView's 97 colors
really provide to 4 to 5 options.



Luminance Distribution



linear

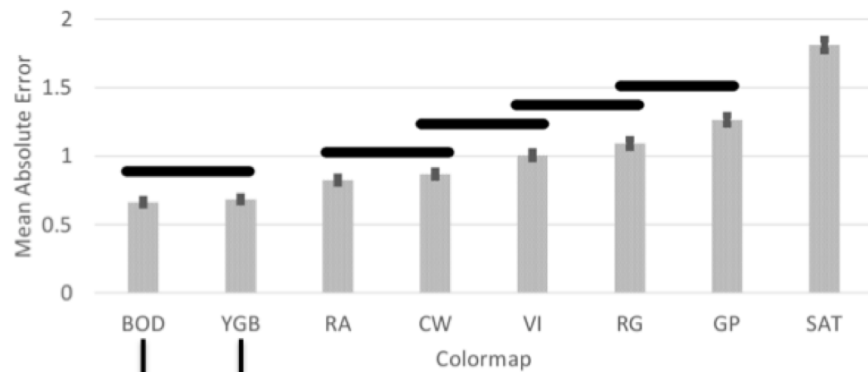
divergent

alternate luminance

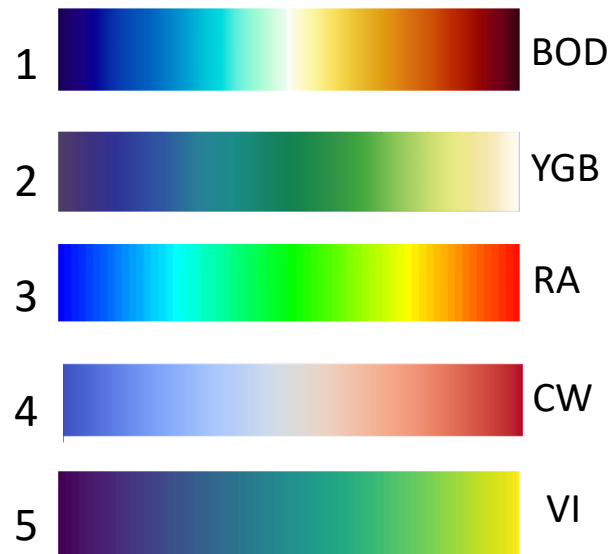
structured colormaps

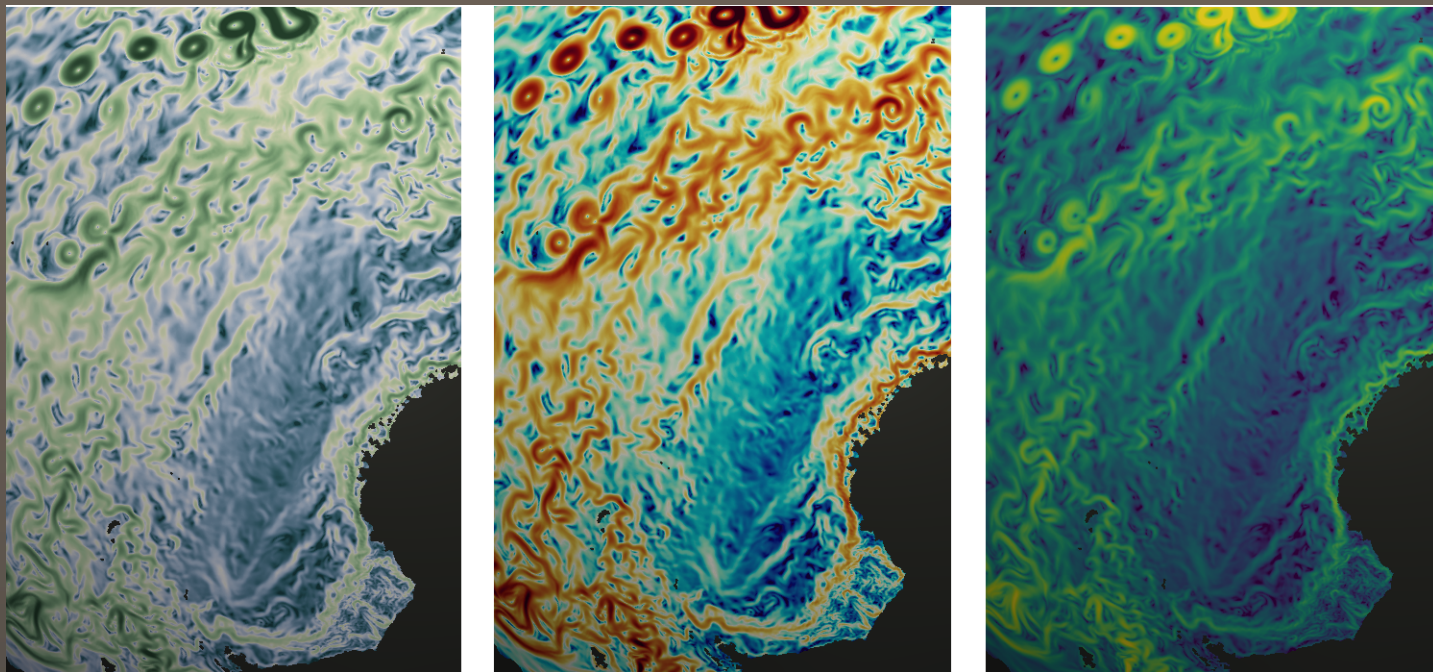
For focus and or resolution power,
match the luminance structure of your data and or areas of importance.

Comparison of Mean Error - All Colormaps



Discriminative Power



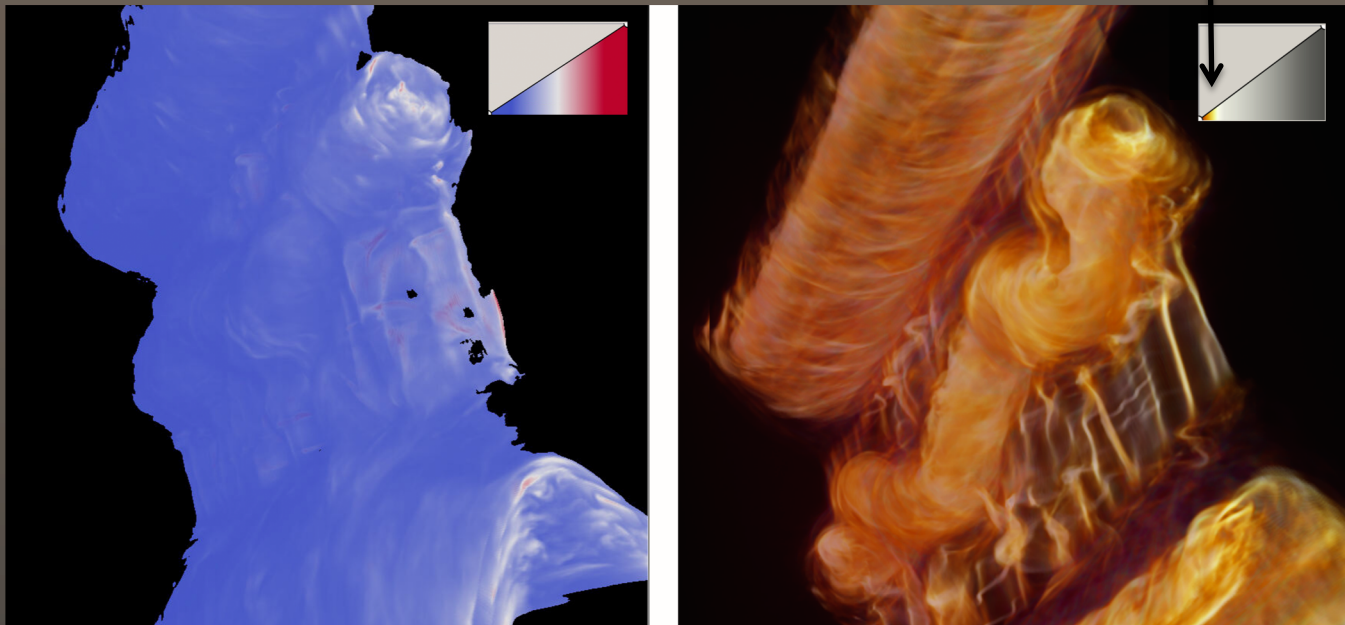


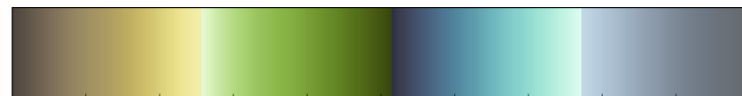
What is your task?

What is your goal?

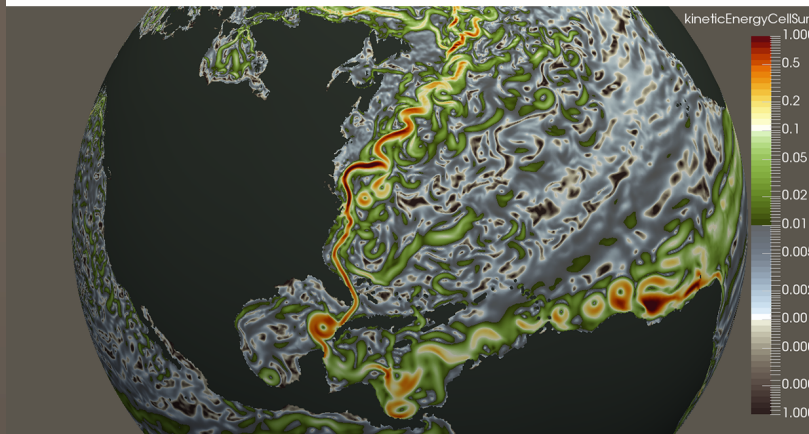
Contrast distribution

Aligning the contrast with the data

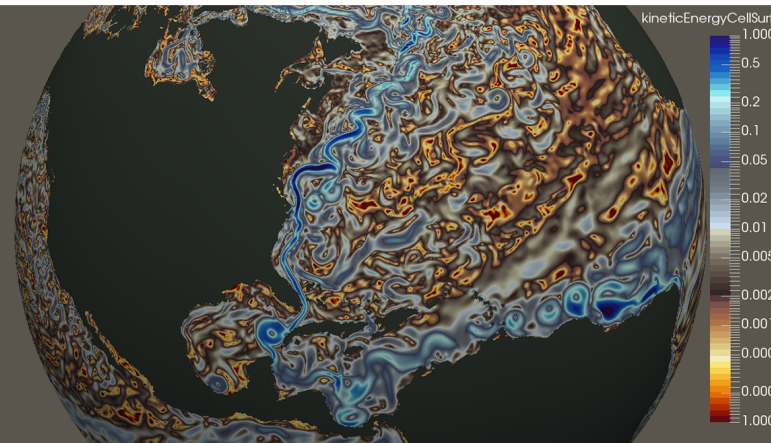




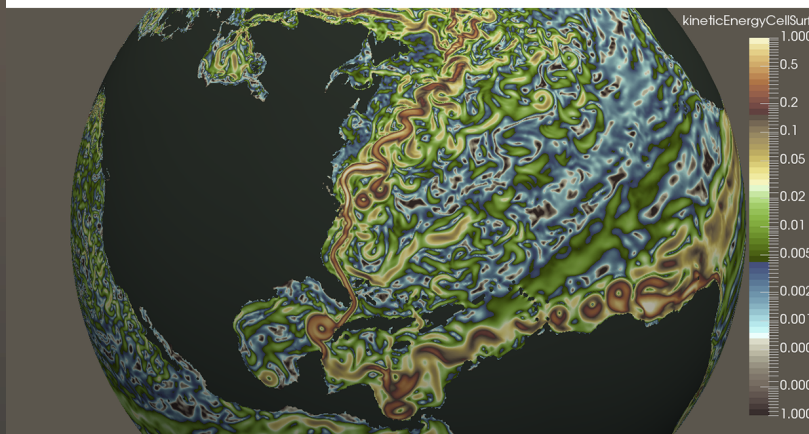
4 wave



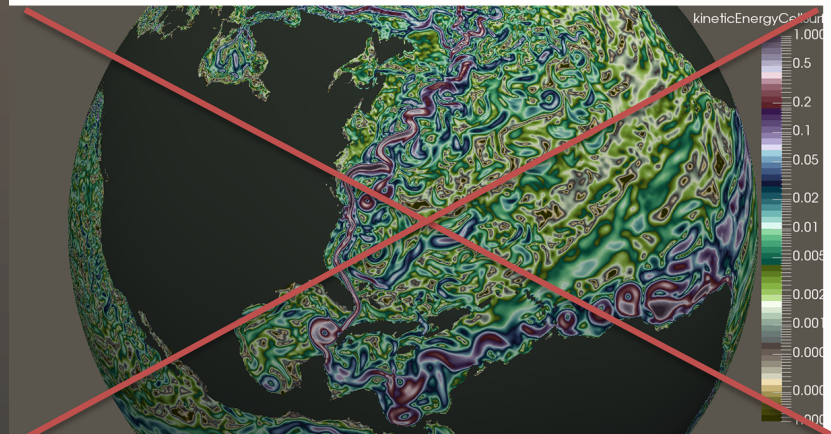
6 wave

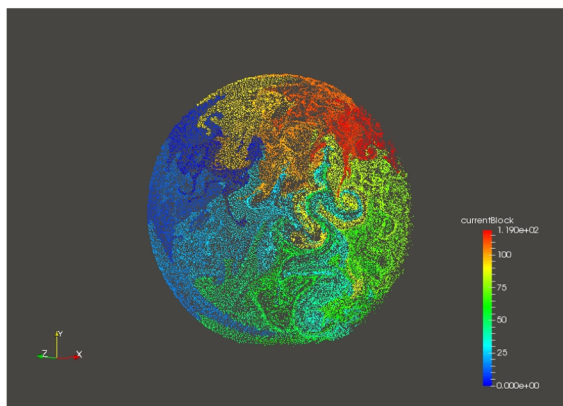
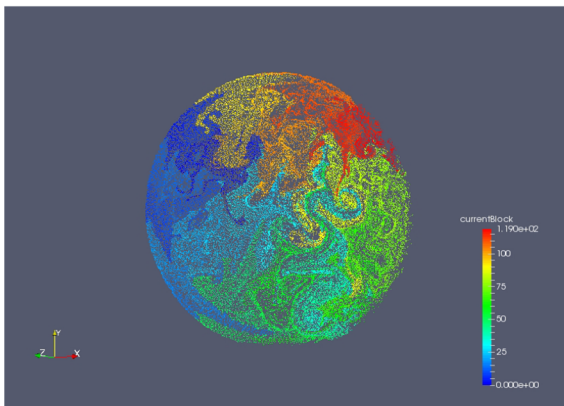


5 wave



10 wave

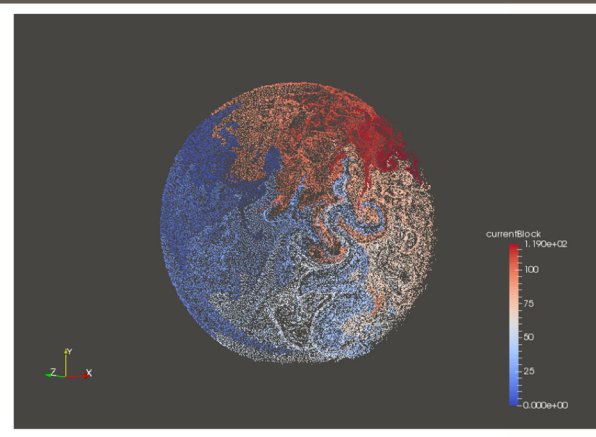
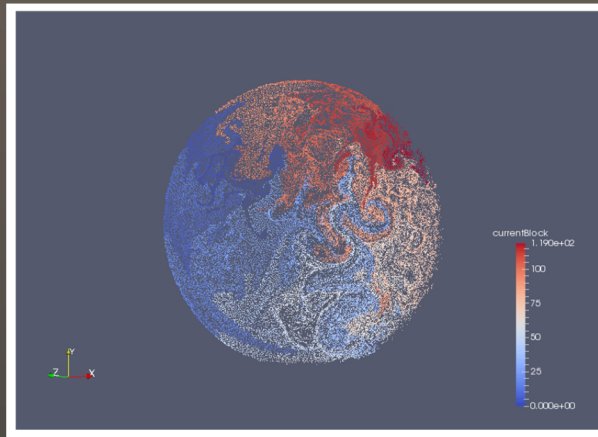




Change the Paraview
background default!
Your life and vis will be calmer.

RGB 107 107 107

The only difference is
the background color.

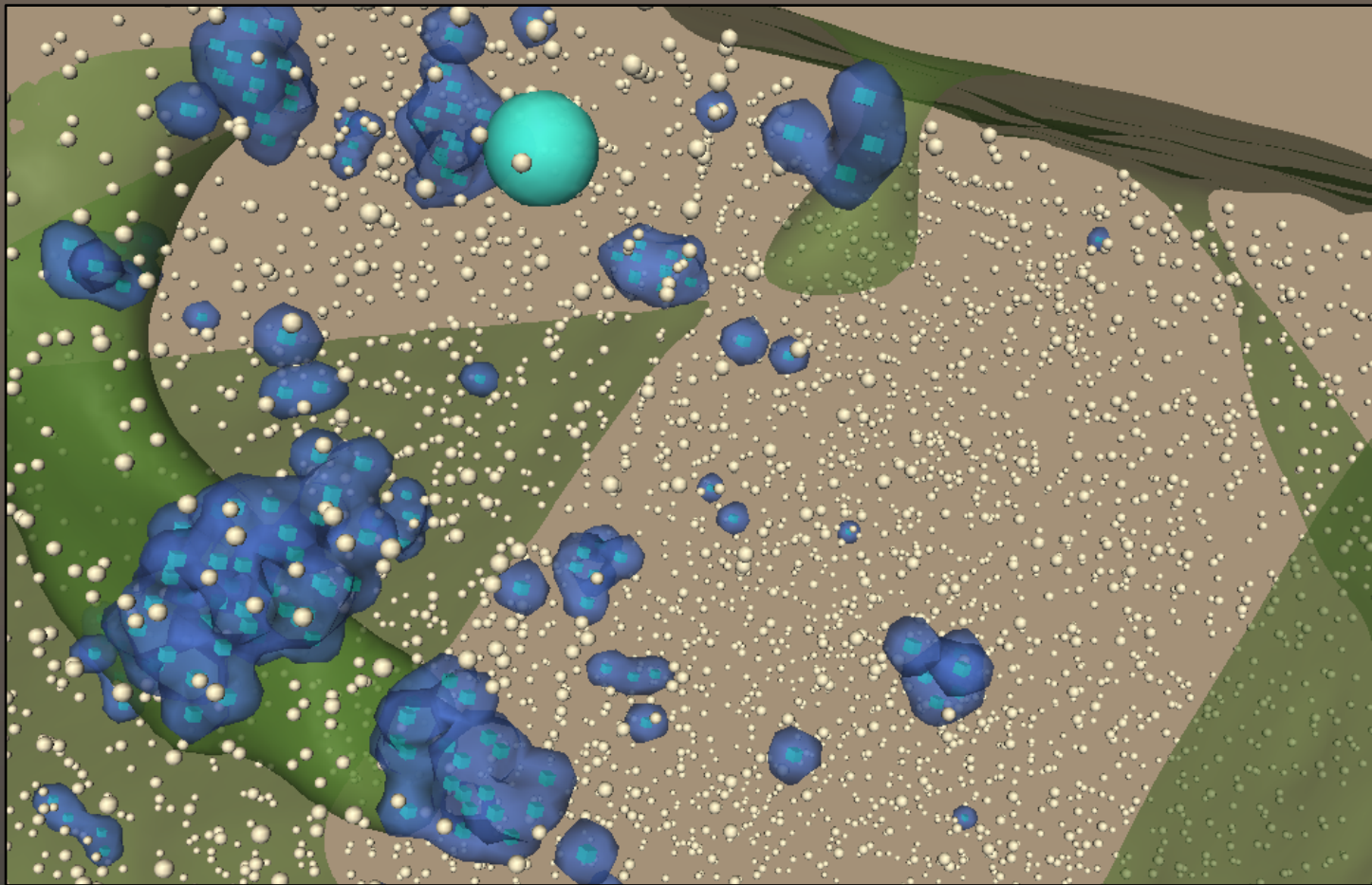


In general, cool colormaps such as the ParaView default,
need a warm background but in reality,
the ParaView background is almost always worse.

A few words about
Color Sets ...

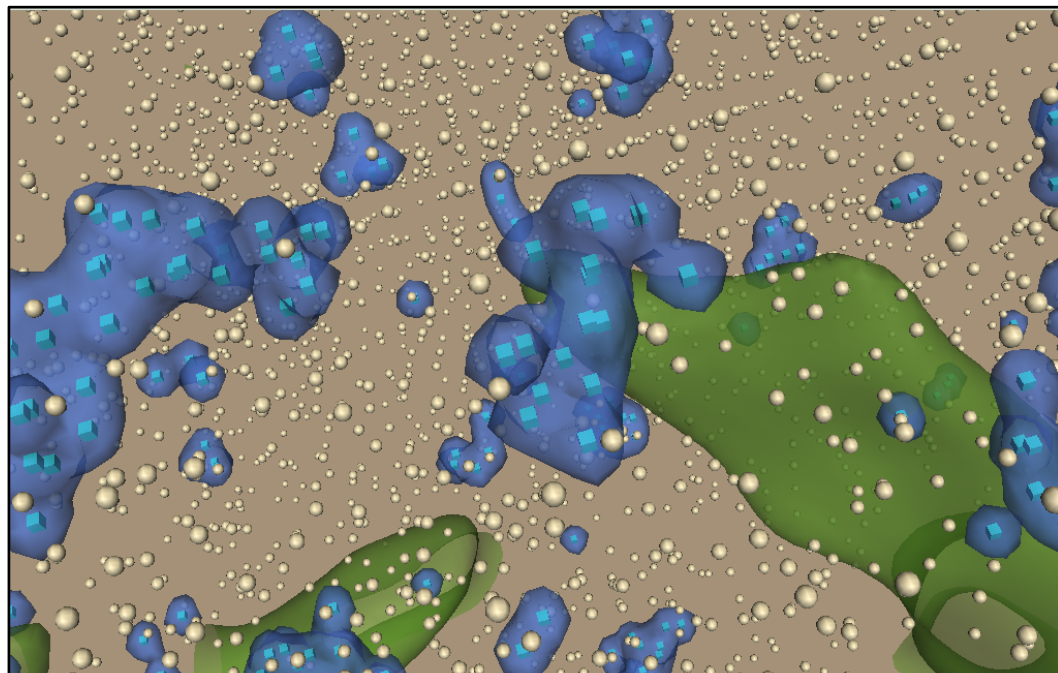
Color Hierarchy

Using color to
organize,
categorize
and direct attention



Color sets

Ready-made color sets?
at SciVisColor.org
of course!



100 126 187



101 137 54



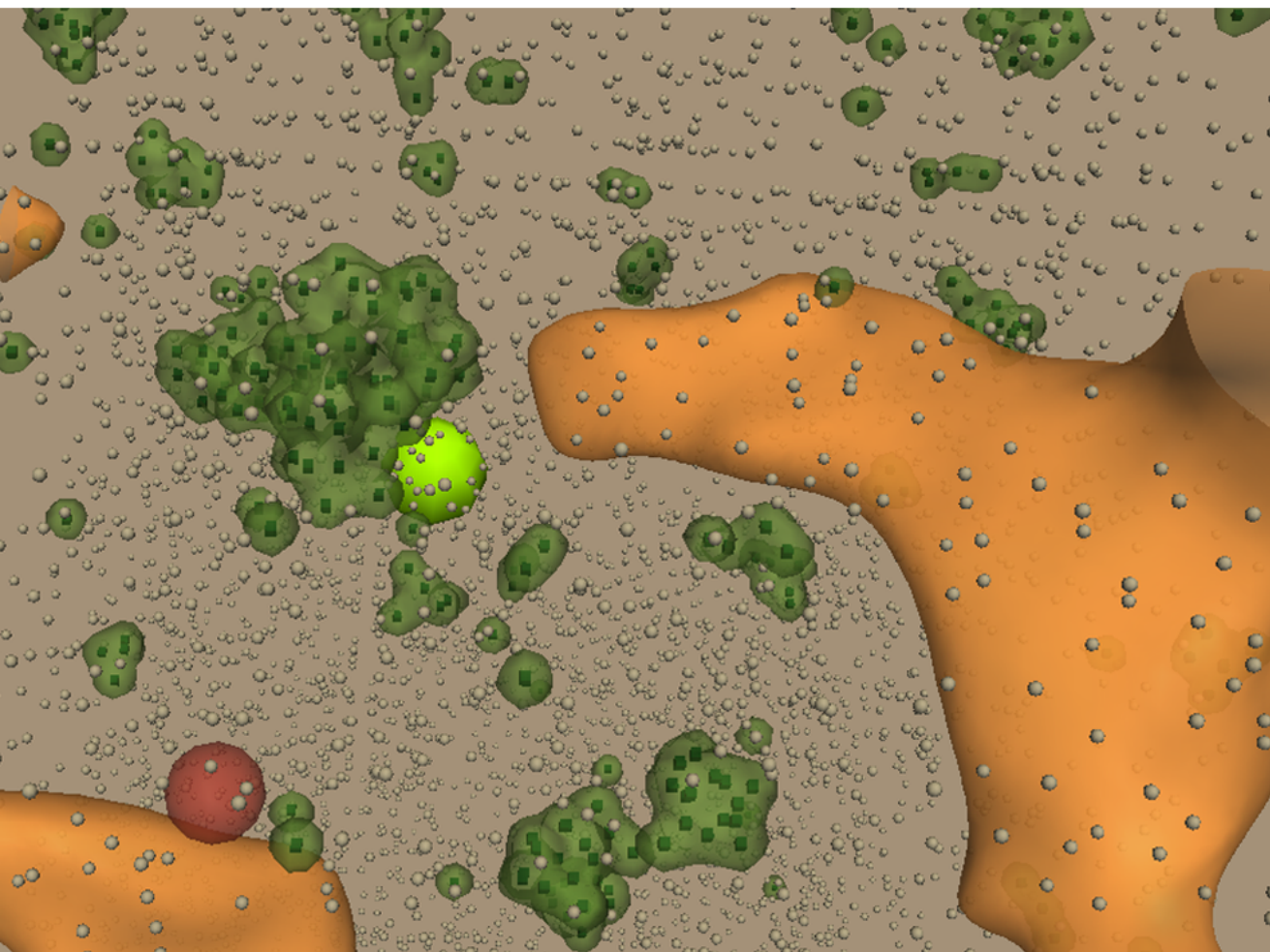
179 161 136



242 231 199



110 204 230



related



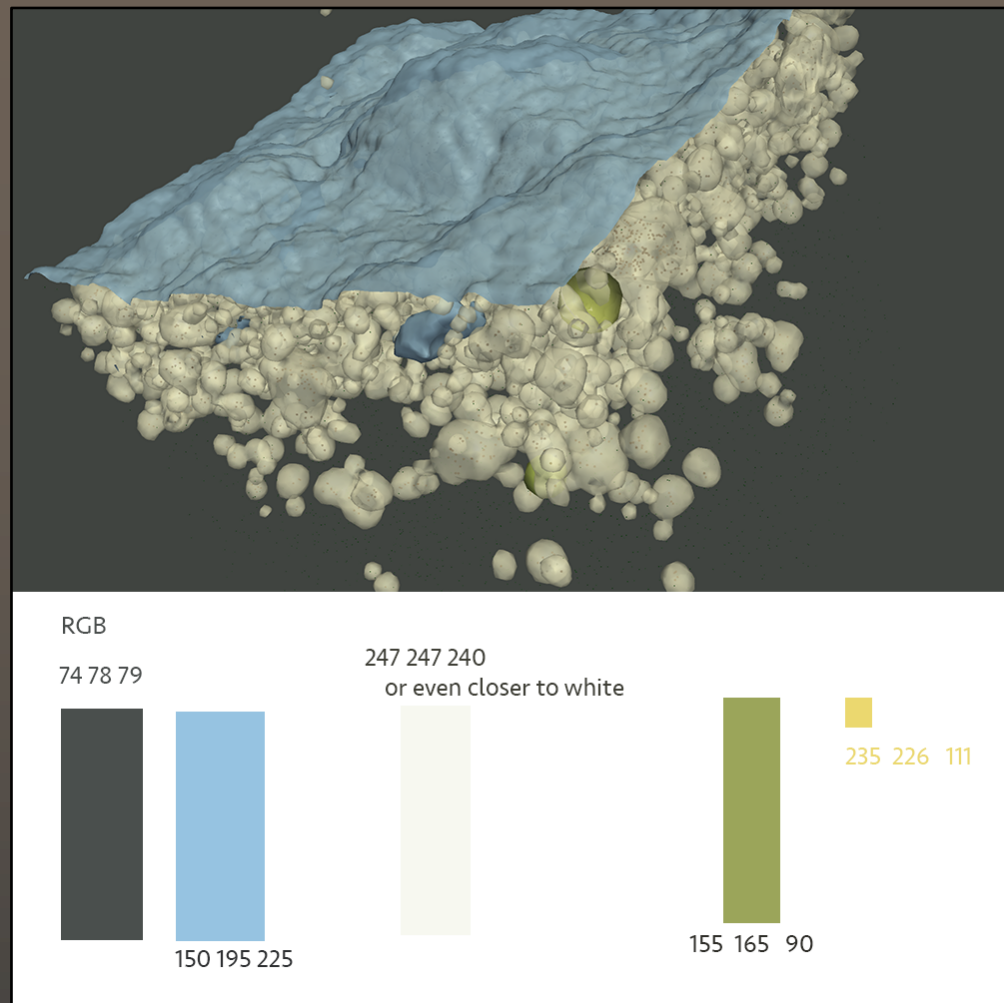
different



related

Visualization and Analysis of Large-Scale Atomistic Simulations of Plasma–Surface Interactions

Wathsala Widanagamaachchi, Karl D. Hammond,
Li-Ta Lo,³ Brian D. Wirth, Francesca Samsel,
Christopher Sewell, James Ahrens, Valerio Pascucci



Color Sets

f0e095

afd47e

72c3cf

455a9d

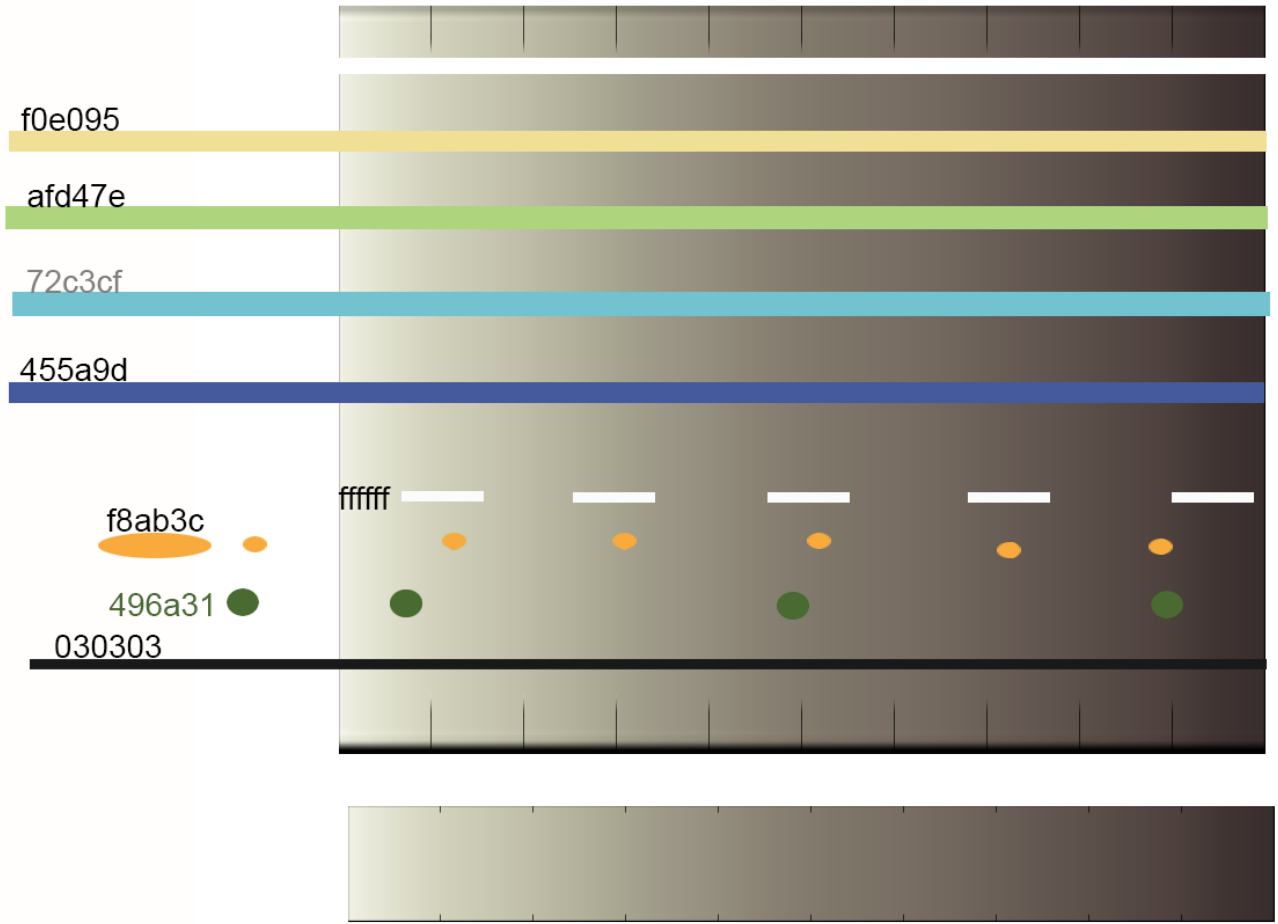
f8ab3c

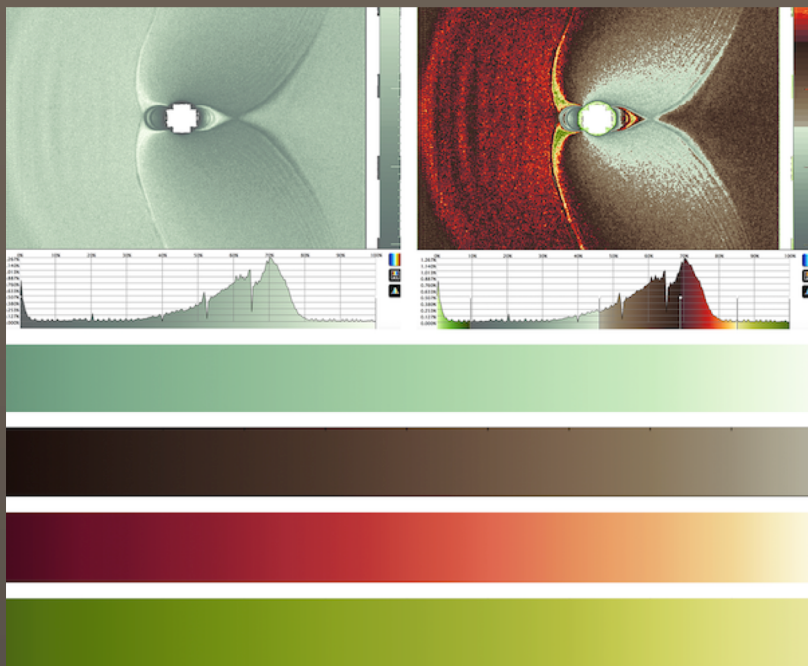
496a31

030303

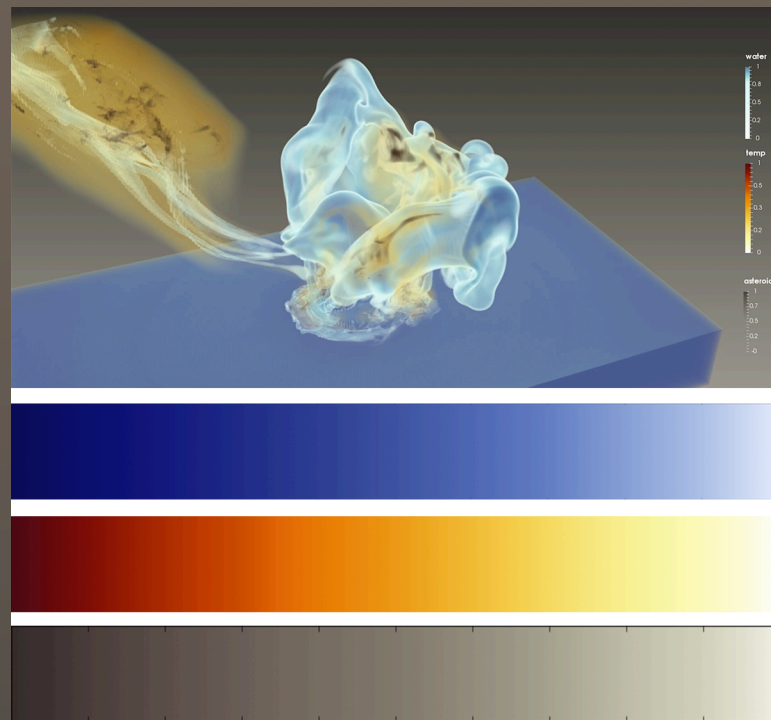
ffffff

Gray 5 colormap

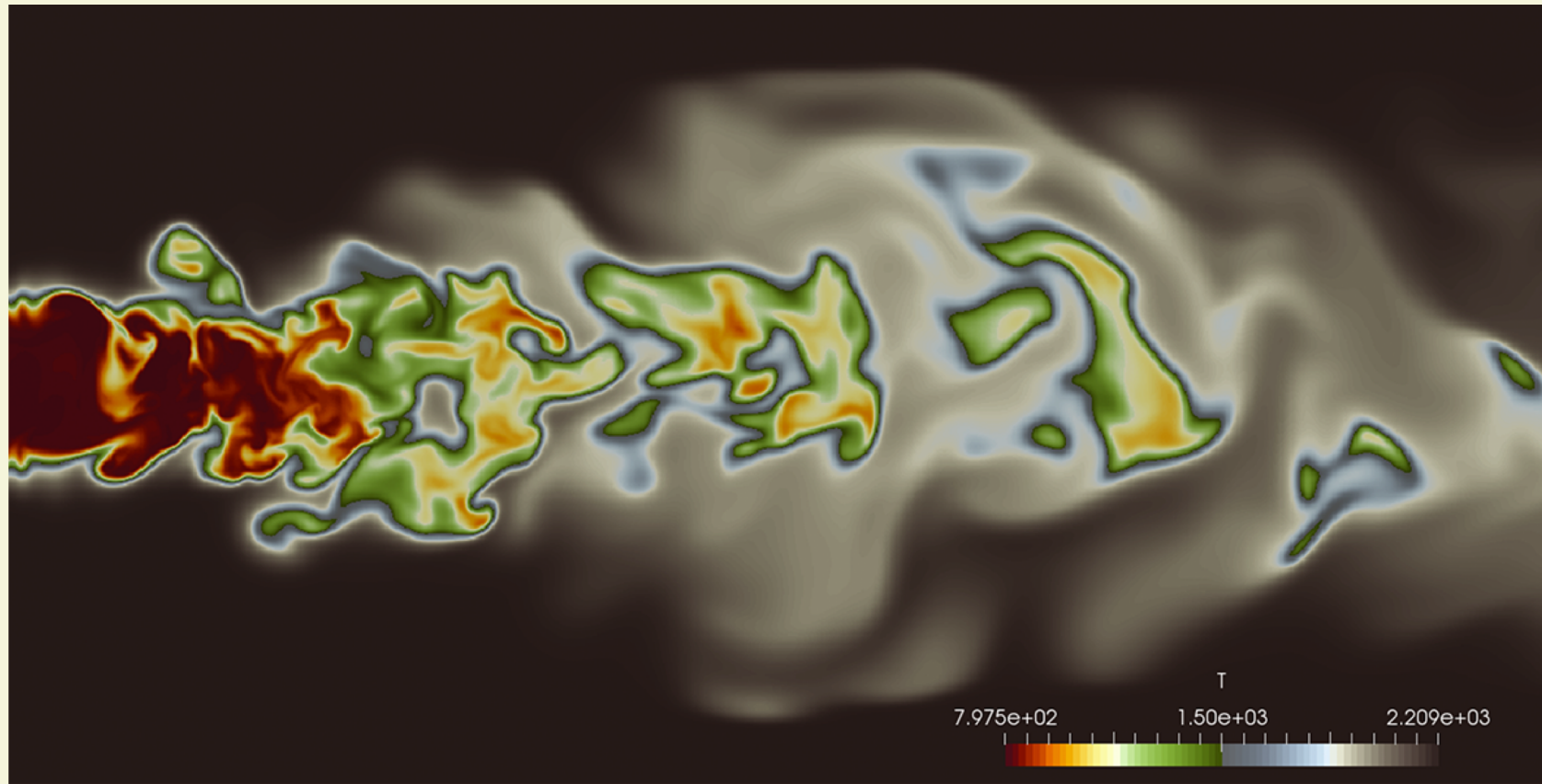




3D colorsets

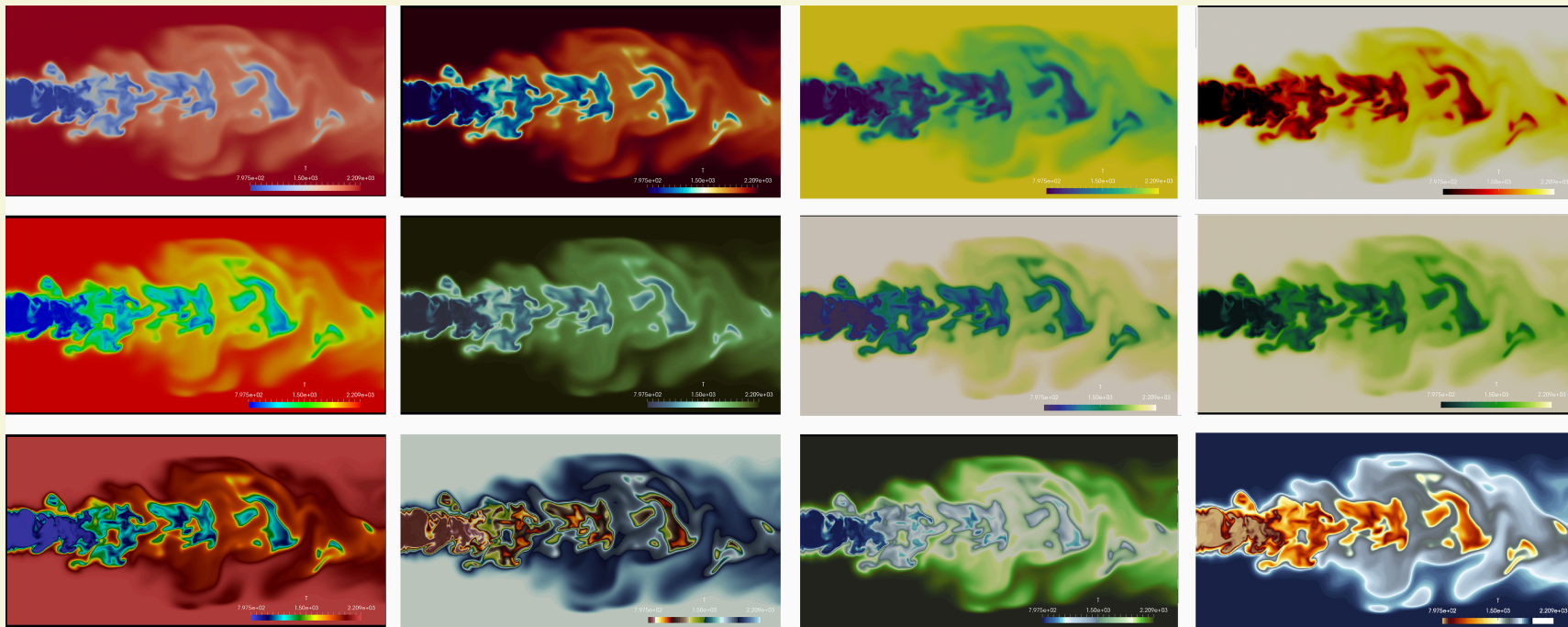


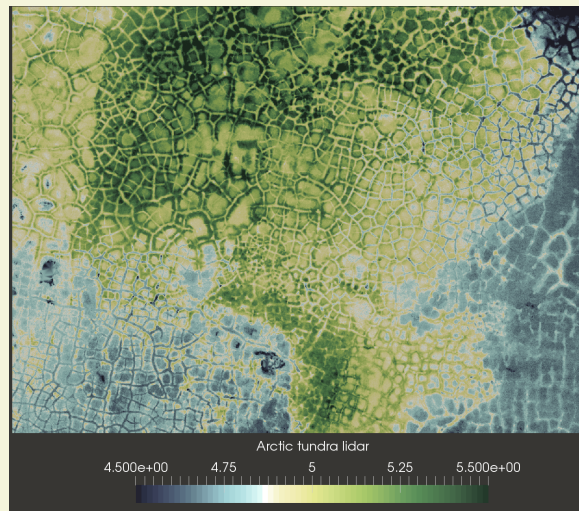
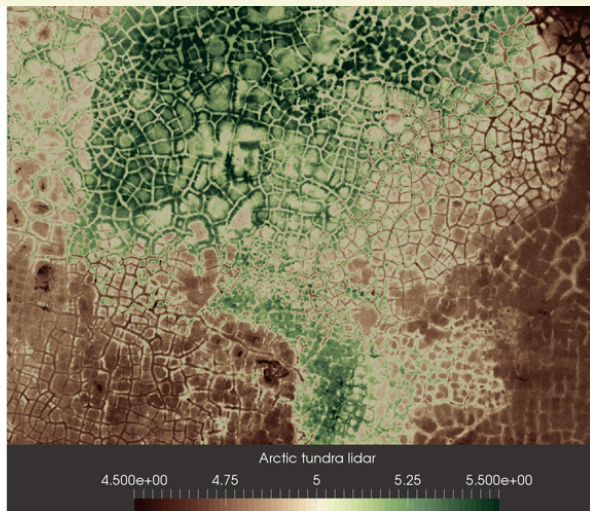
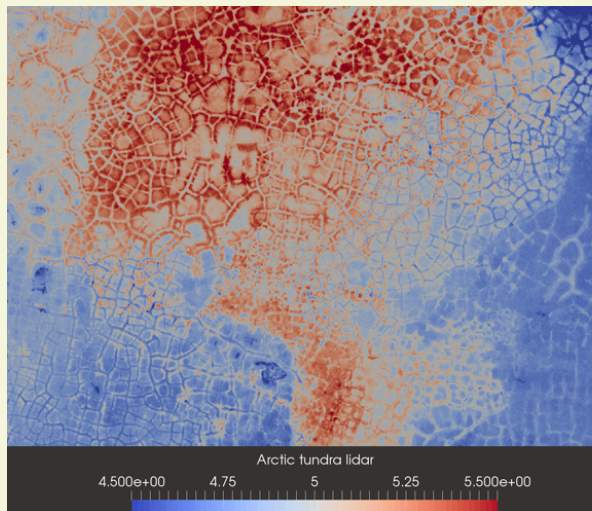
Blue2, yel15, gray5



Feel the Wave!

Comparisons

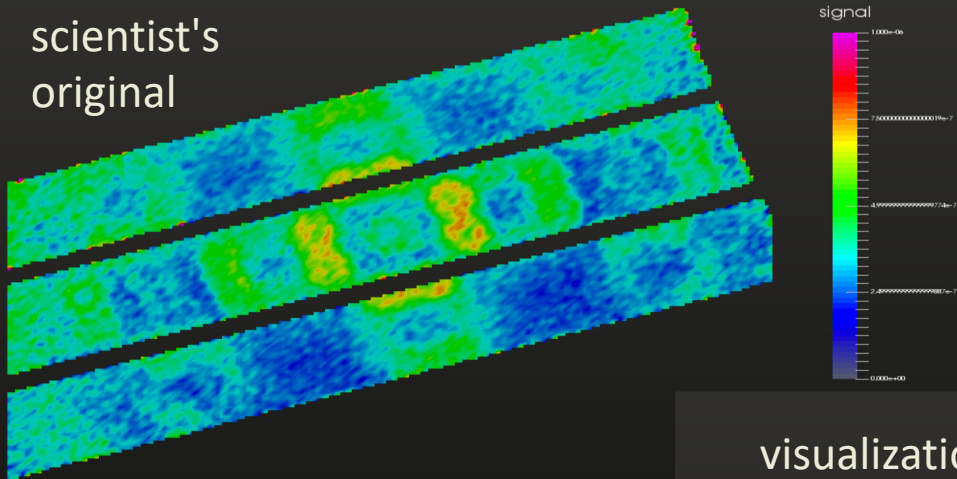




Intuition

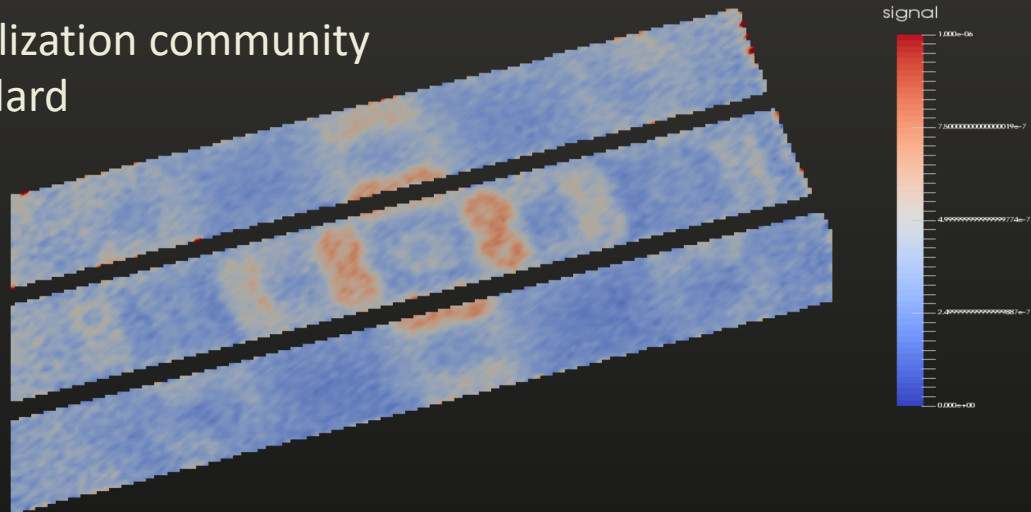
Why ColorMoves helps...

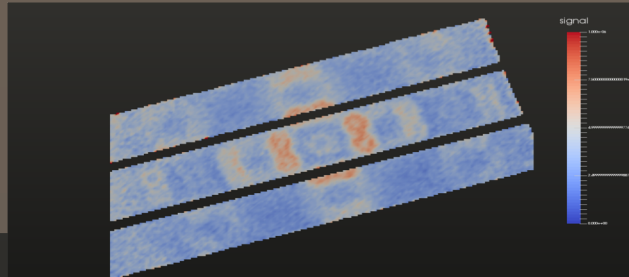
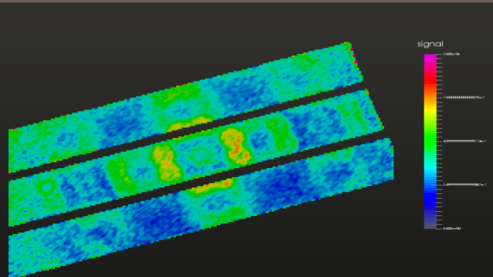
scientist's
original



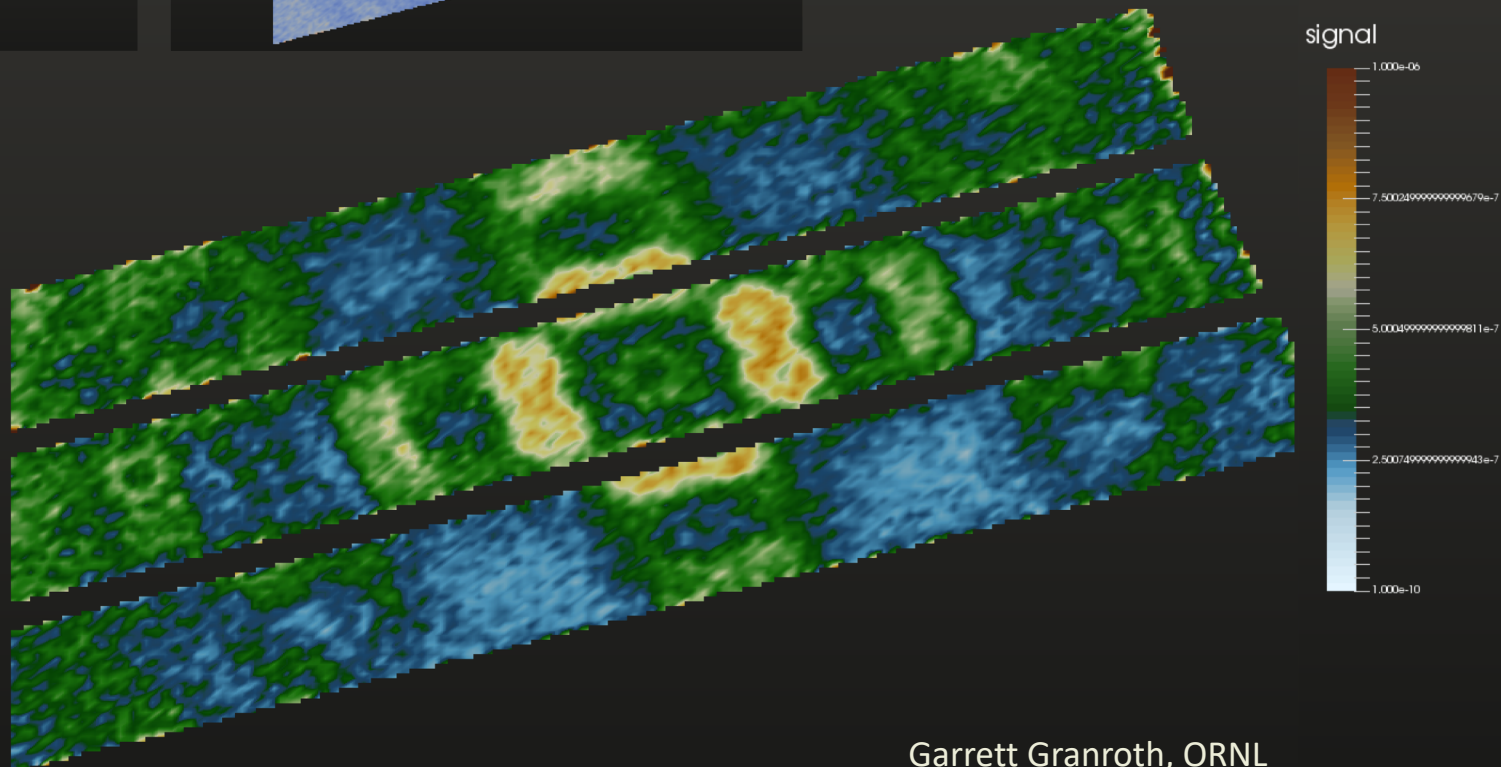
Our work starts with the
scientist and
their current needs.

visualization community
standard





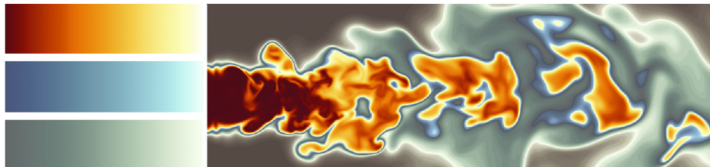
effective, quiet, harmony
exposing detail



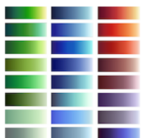
Garrett Granroth, ORNL

was very happy.

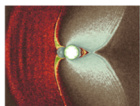
Sci Vis Color



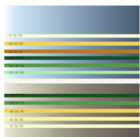
Colormaps, Color Tools and Color Strategies for Scientific Visualization



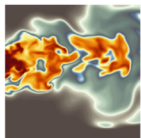
Color Maps



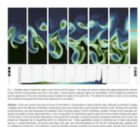
ColorMoves - ACES



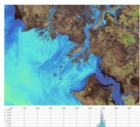
Color Sets



Color Strategies

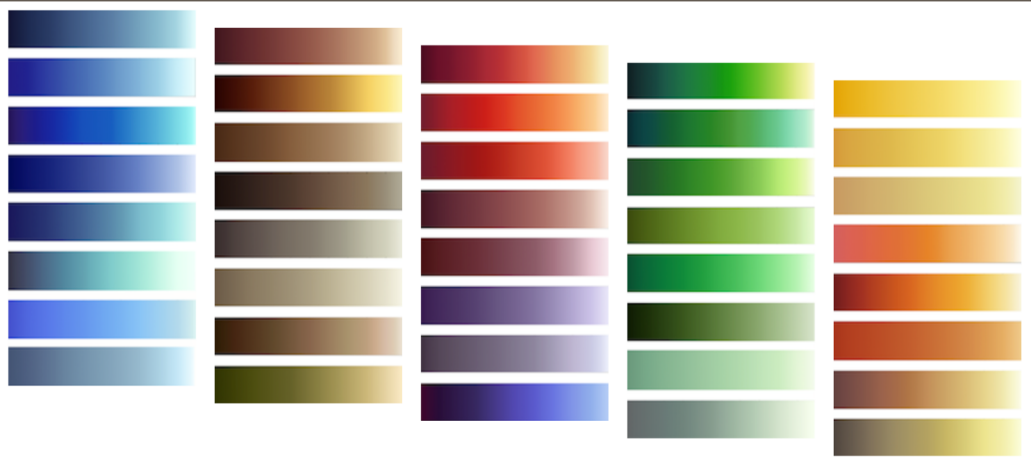


Publications & Projects

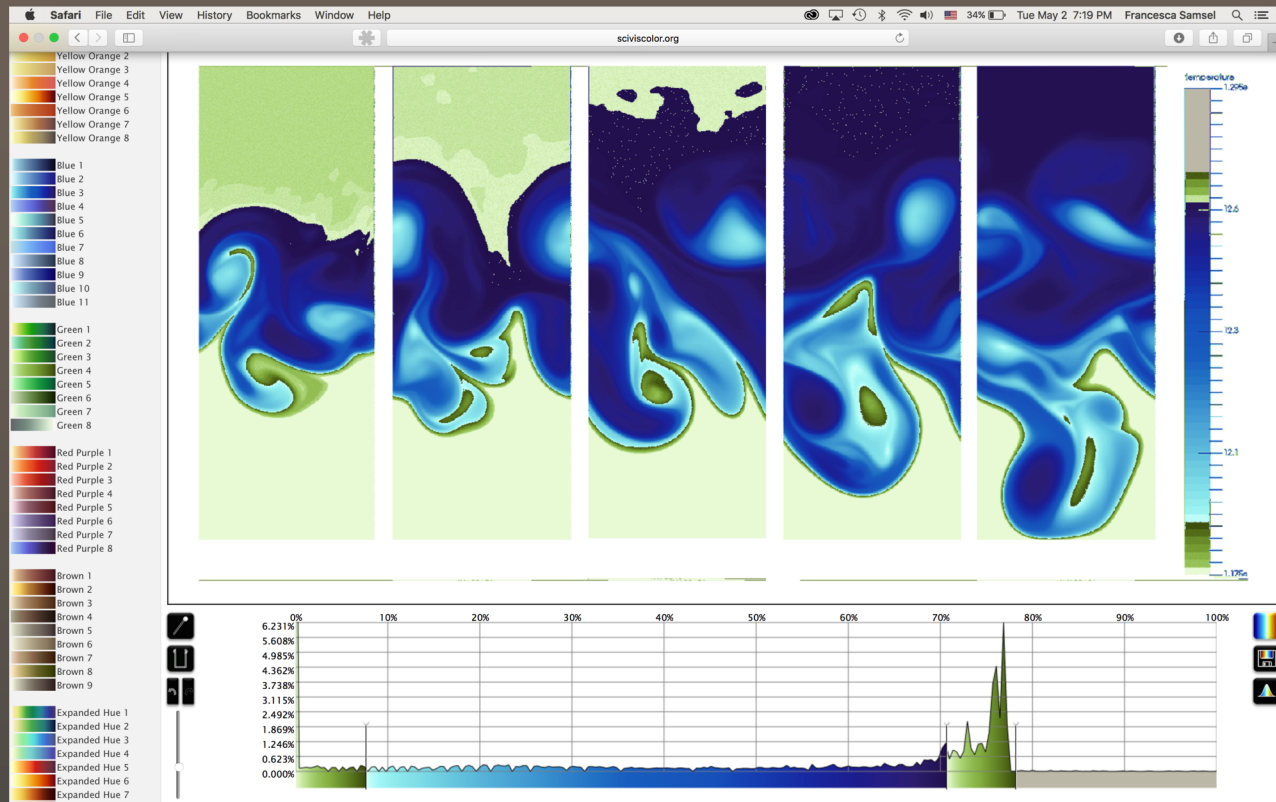


ColorMoves
The Environment

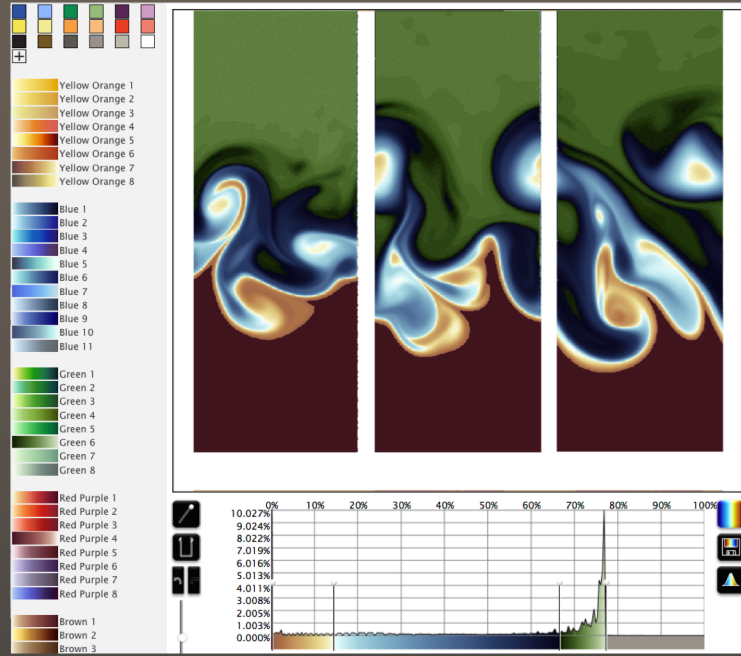
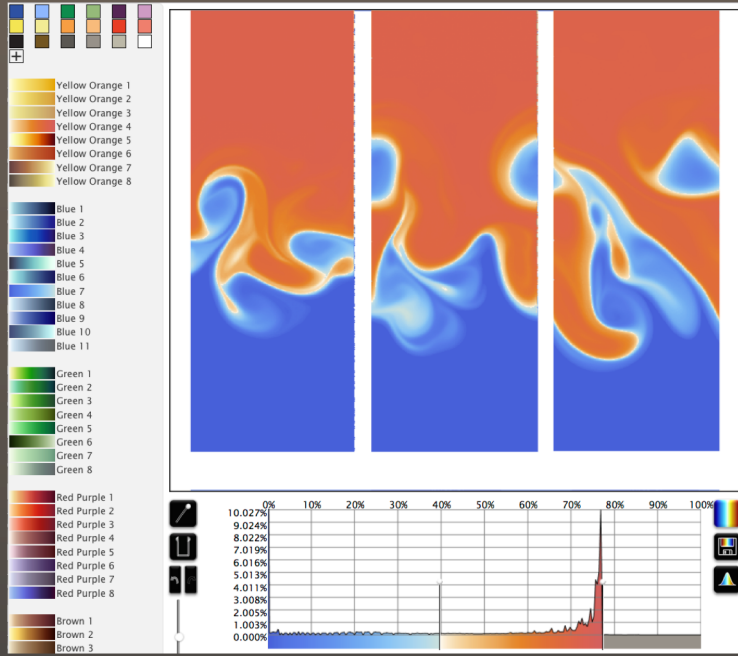
SciVisColor.Org



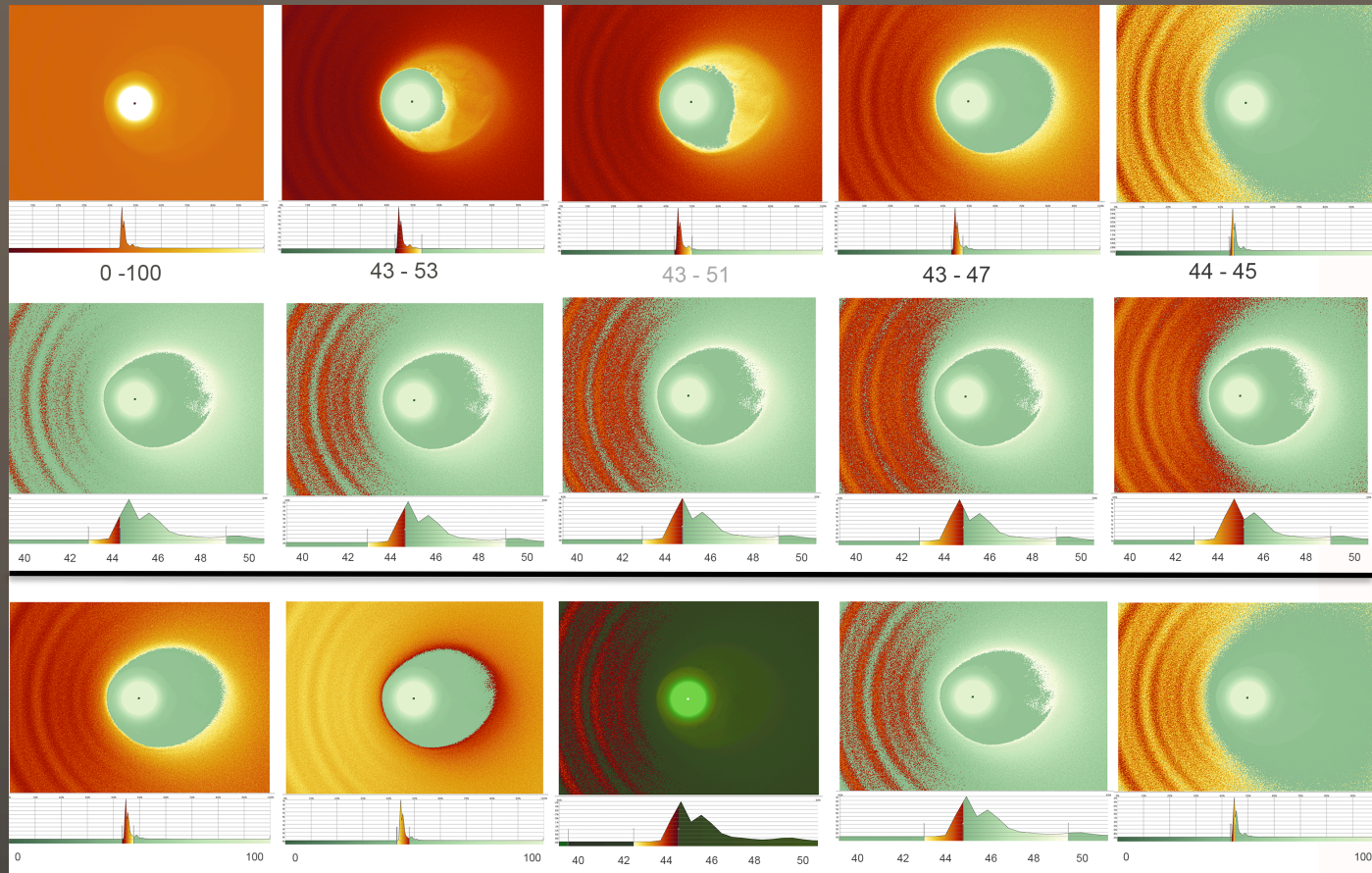
Time-varying data?
No problem.
We've got you covered!

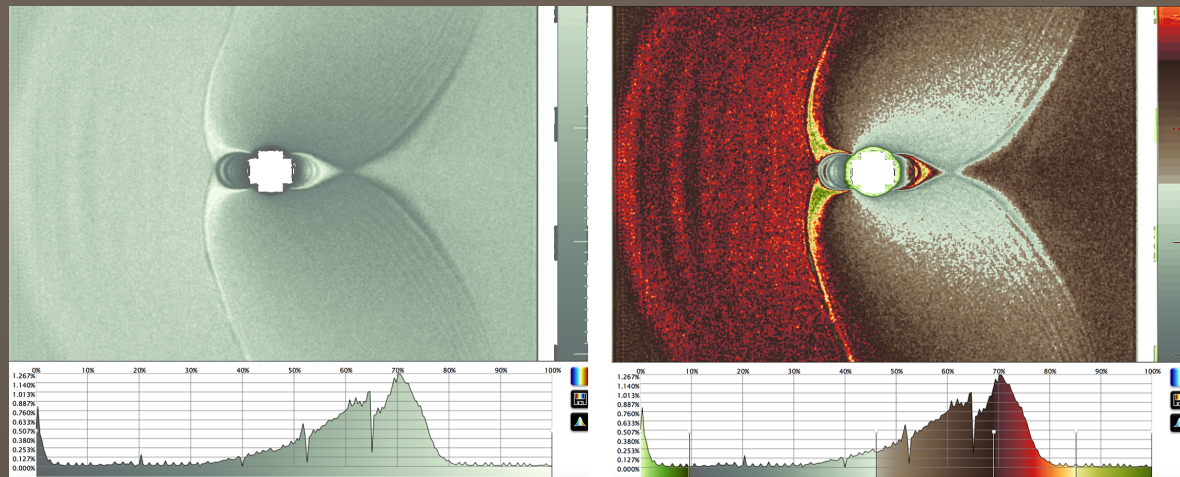


Effective *and* Affective Color

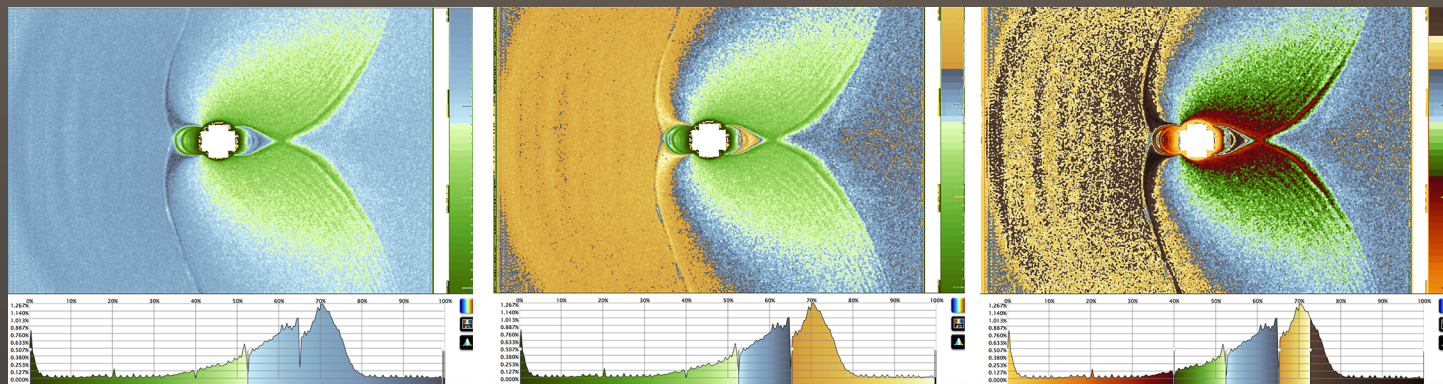


Data Range

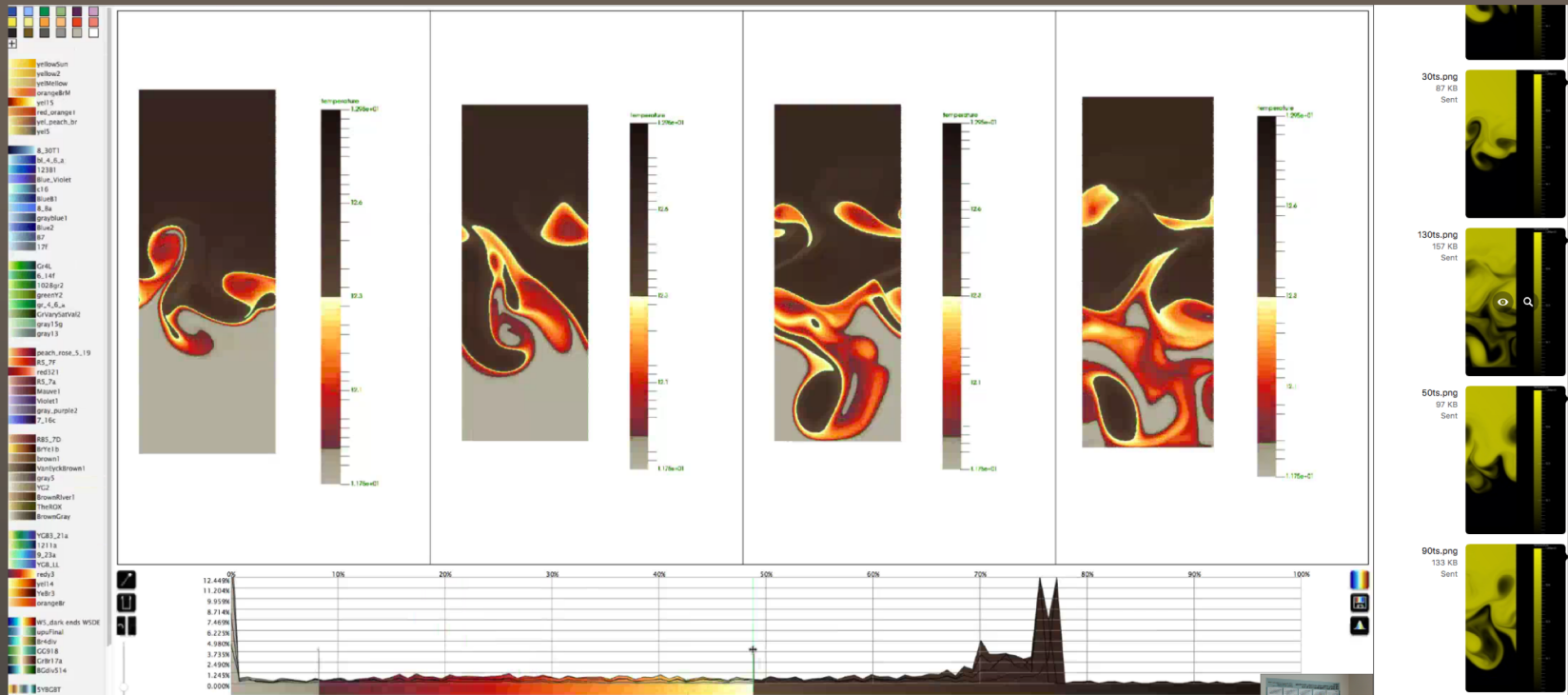




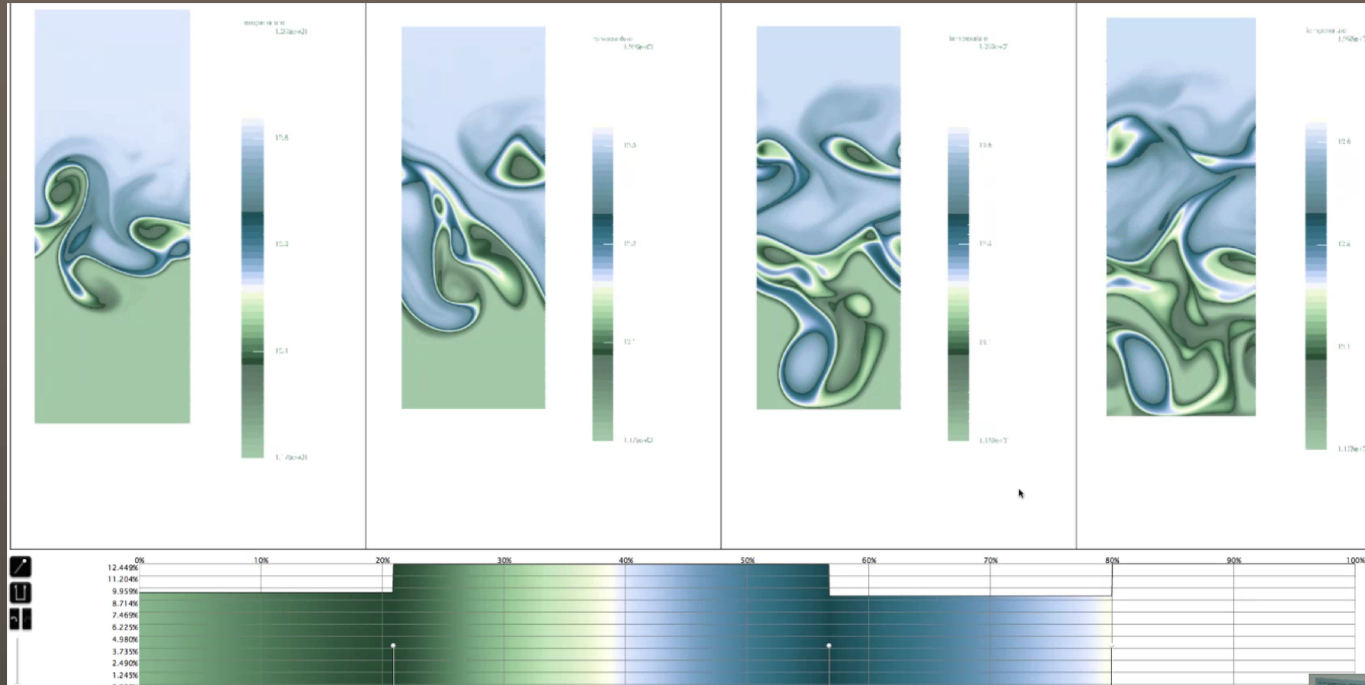
communication

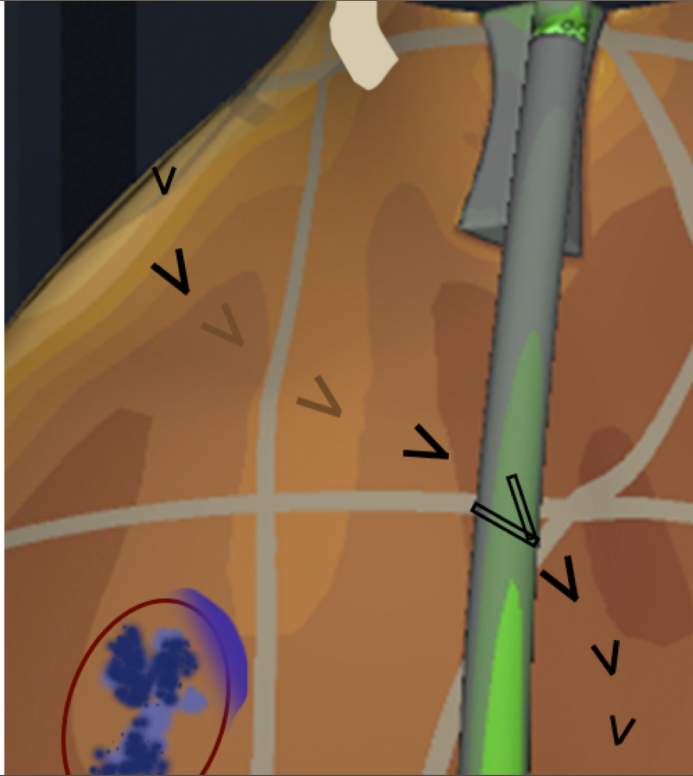


Good for working out colormaps for time-varying data.



Opacity function





QUIZ TIME!

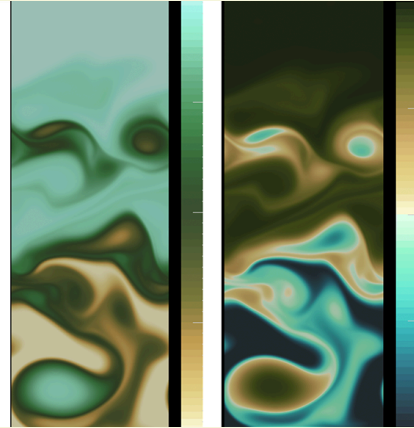
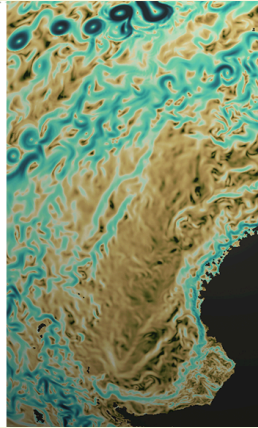
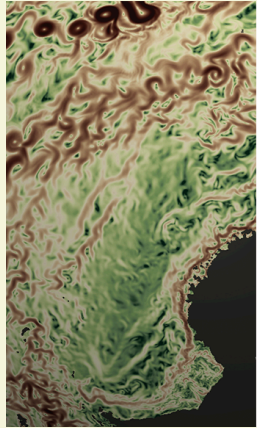
Can you name the types of contrast?



Seagrapes by Bruce Marsh



And then there is poetry....



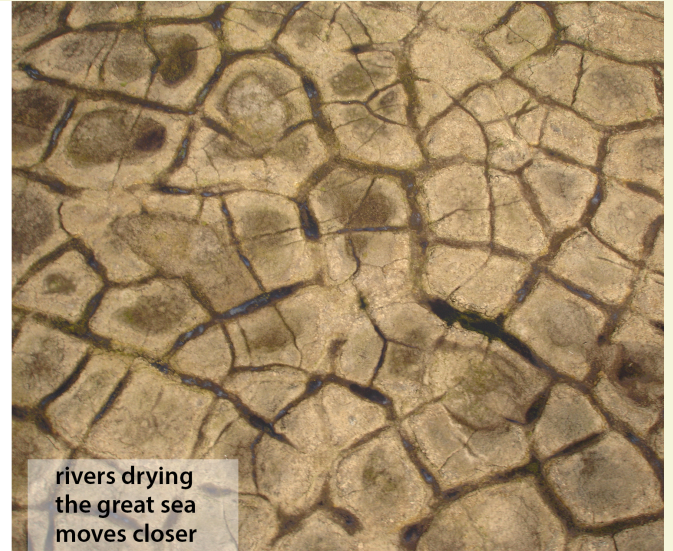
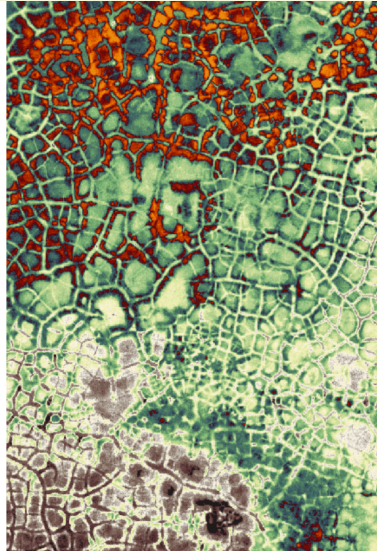
a little balance, a little poetry....



meandering paths
arrive
in the same ocean



tiny waterways cut
the land into polygons
on their way to the sea



rivers drying
the great sea
moves closer

Haikus by Michael G. Smith

Your friends:

SciVisColor.org

kuler from Adobe

ccctool.com

figs@cat.utexas.edu