native habitat

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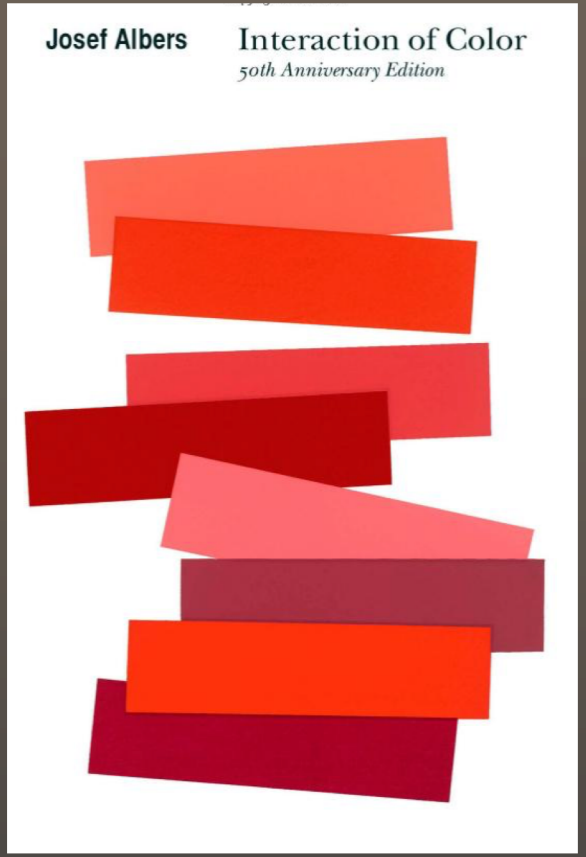
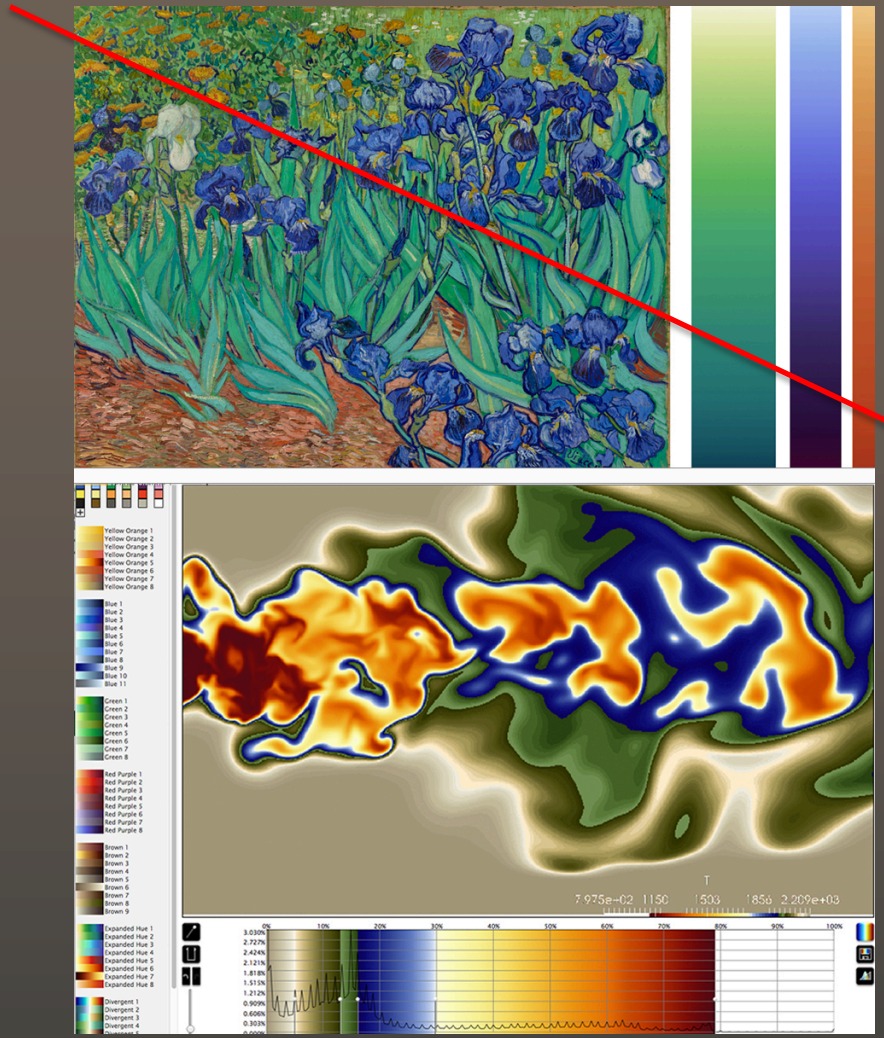
Color in scientific visualization
is complicated because

our perception of hues
is based on surroundings colors

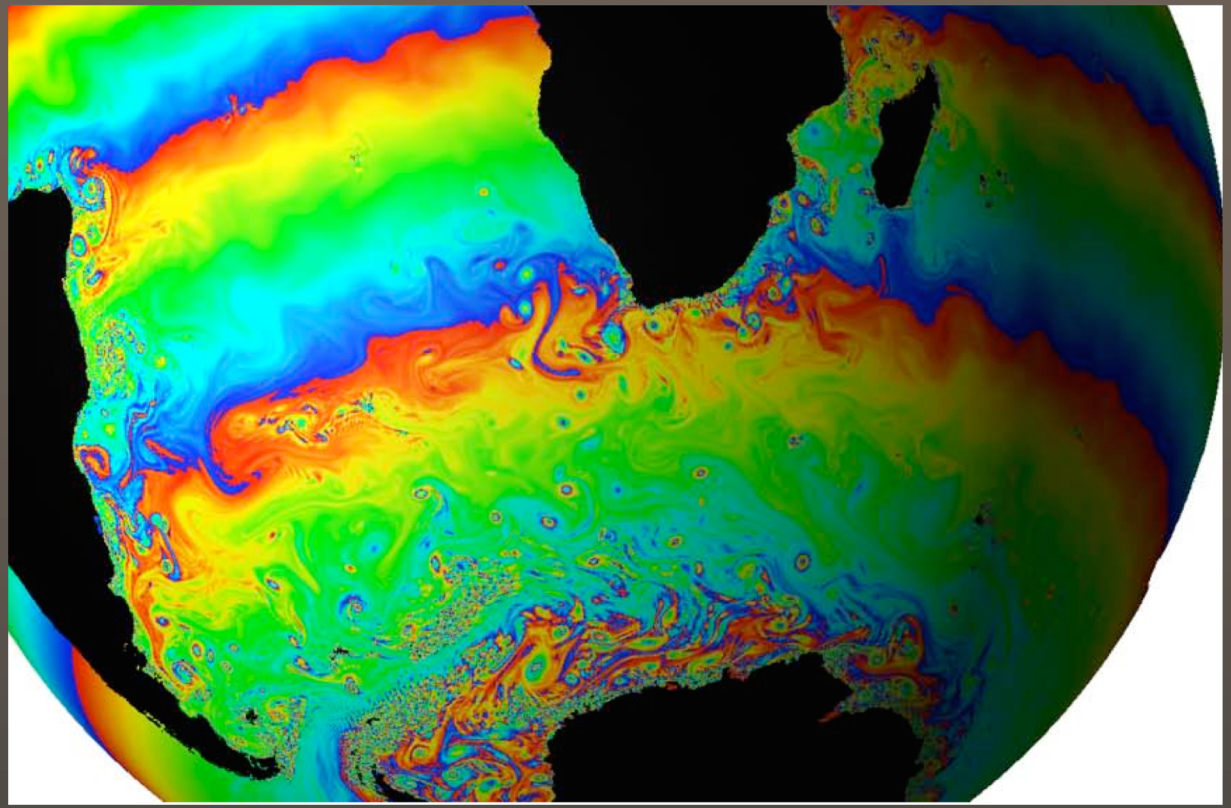
and in scientific visualization
the ***data distribution*** *determines*
the surrounding color,
not an artist.





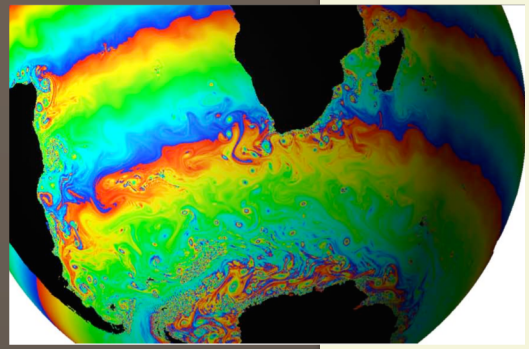
It is not about a pretty picture…
even if they are pretty.

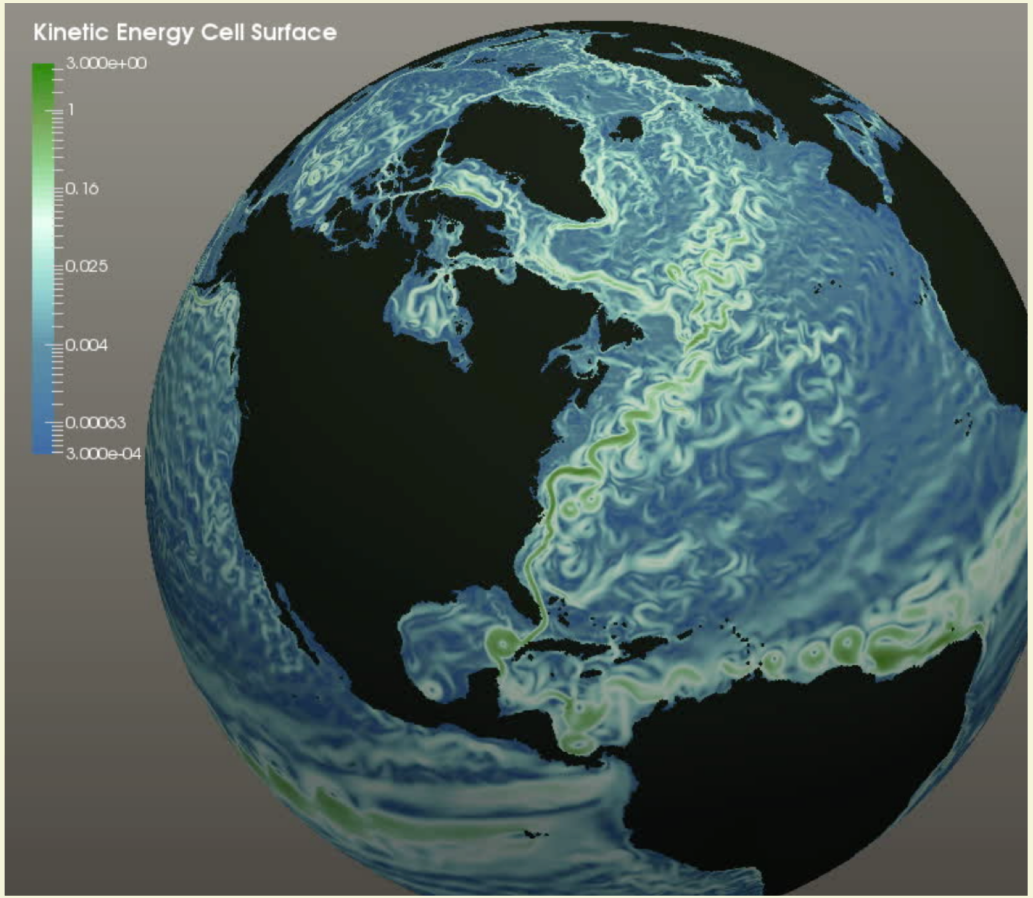
Did you ever wonder why we
are tuned into beauty?

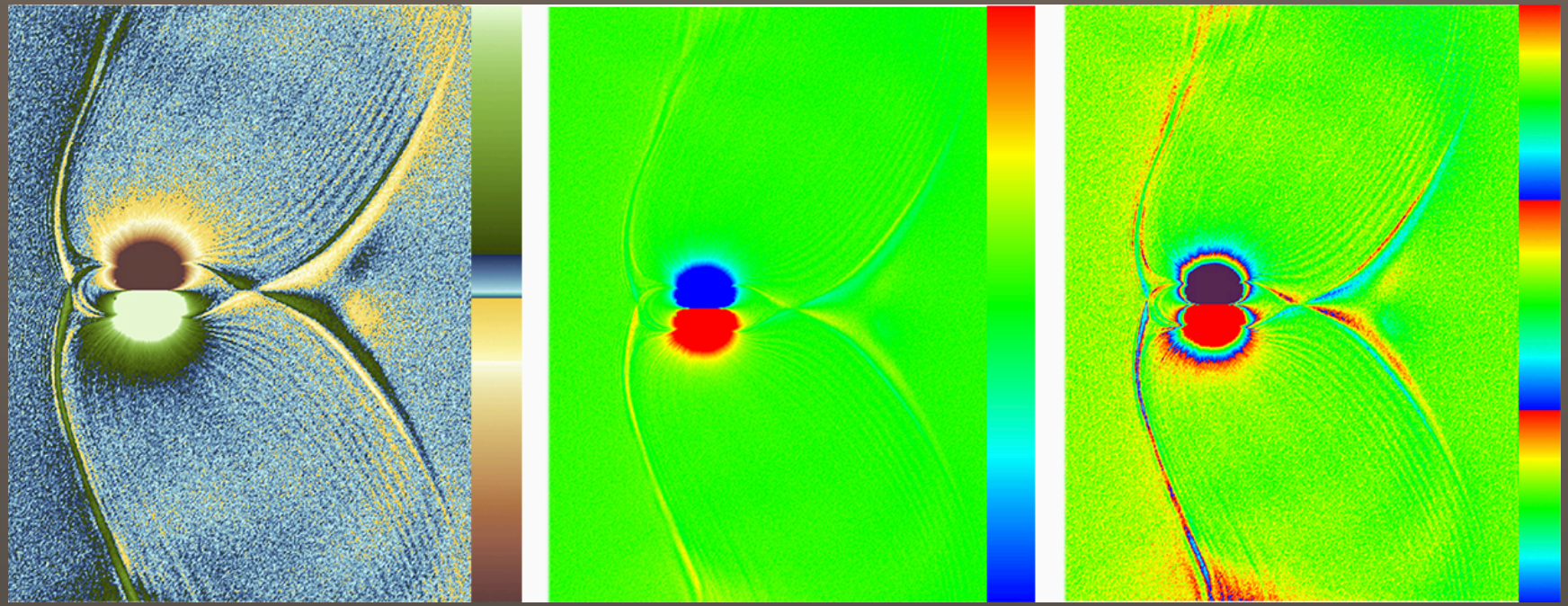


Less is more. Use only the color "volume" that you need.

MPAS, LANL

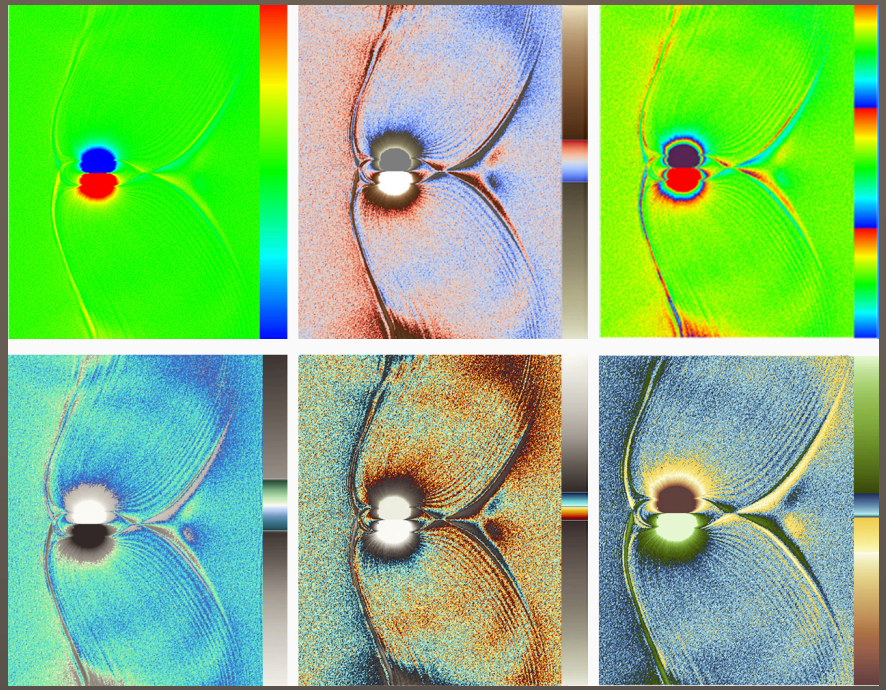



Kinetic Energy Cell Surface
3.000e+00
1
0.16
0.025
0.004
0.00063
3.000e-04

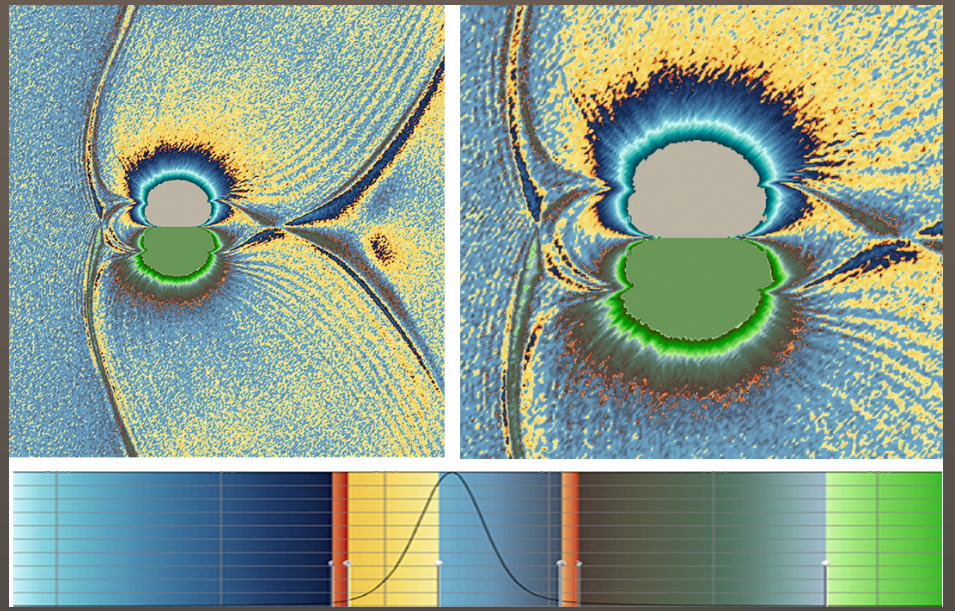


Creating

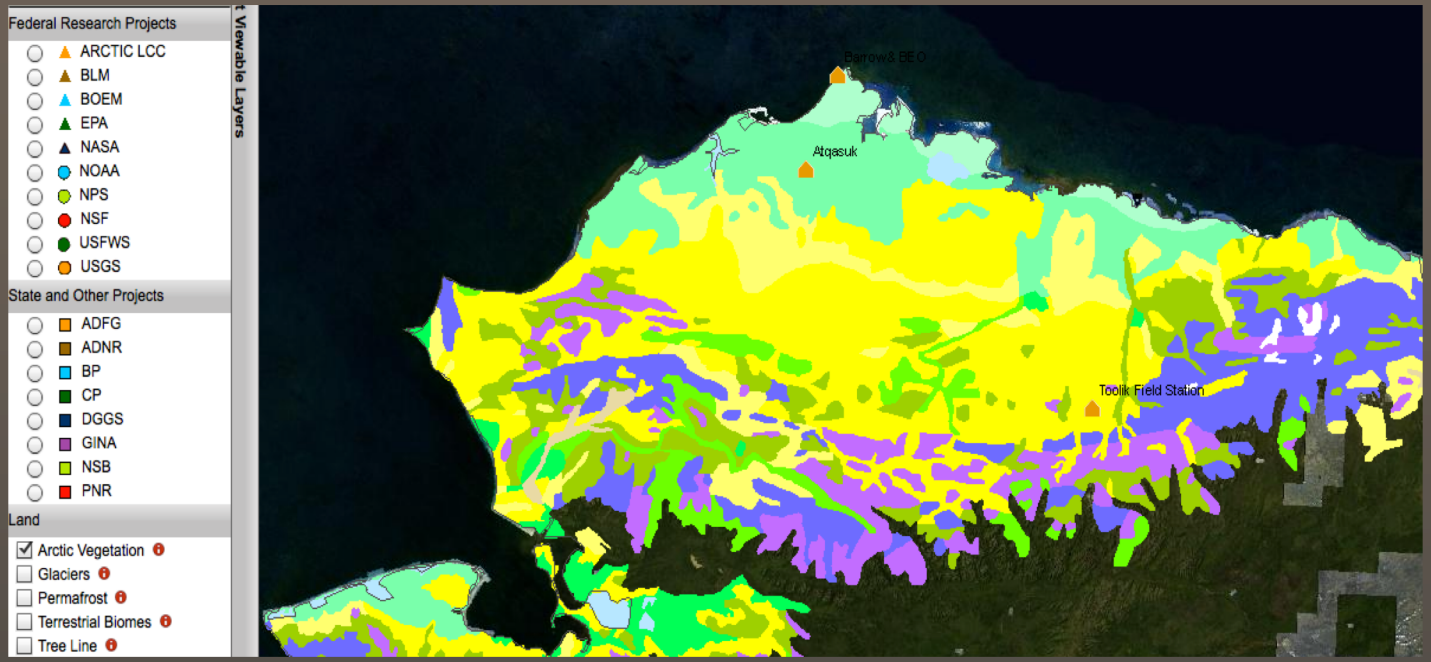
Clarity and Detail



Tuning your colormap to:
see **more data**;
more clearly and;
communicate to others
more **effectively and efficiently**.

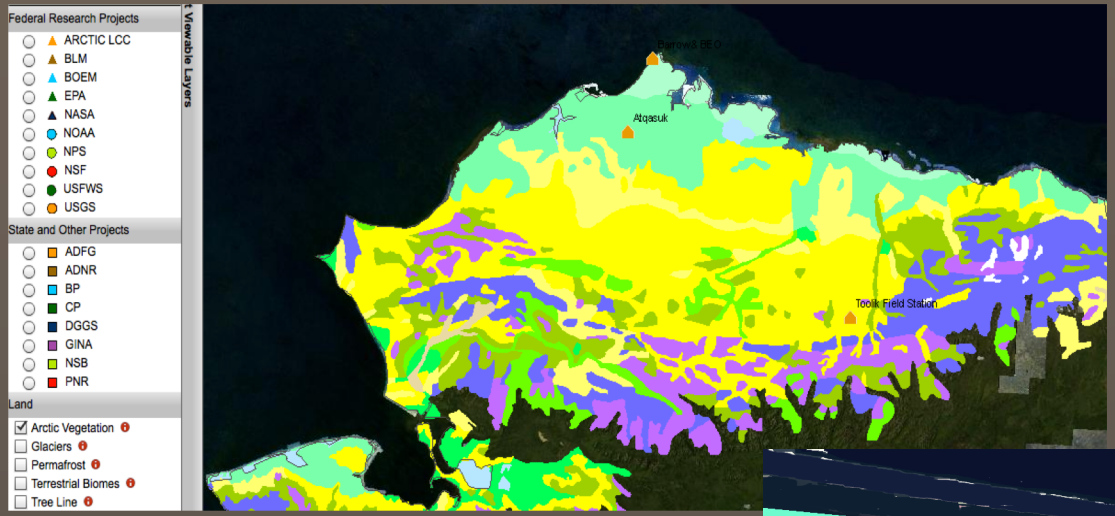


Arctic tundra vegetation distribution



C. Tweedie, UTEP

done by a good friend… but…

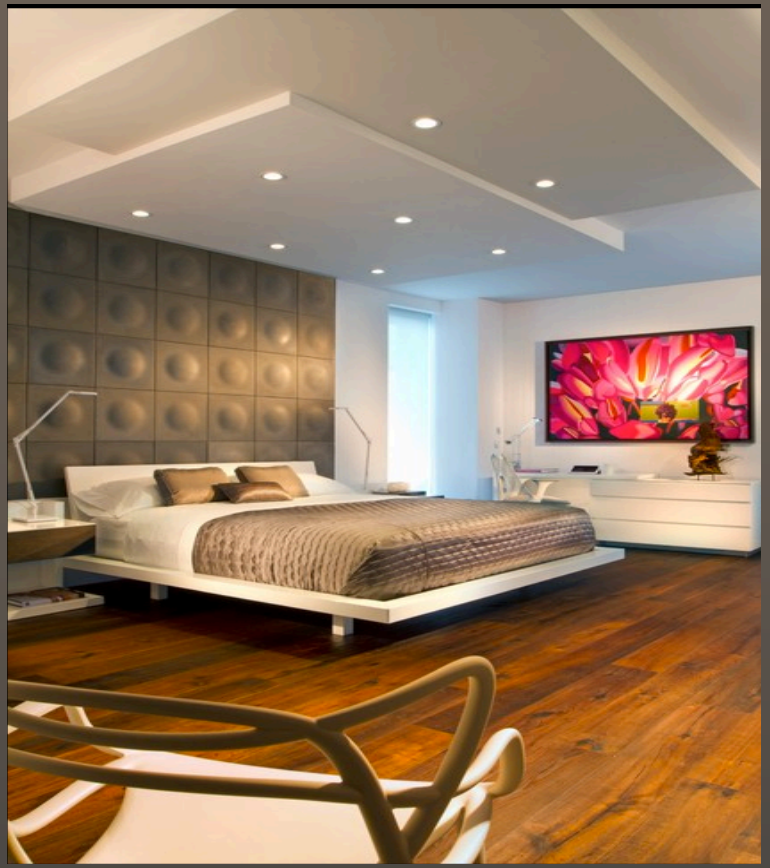


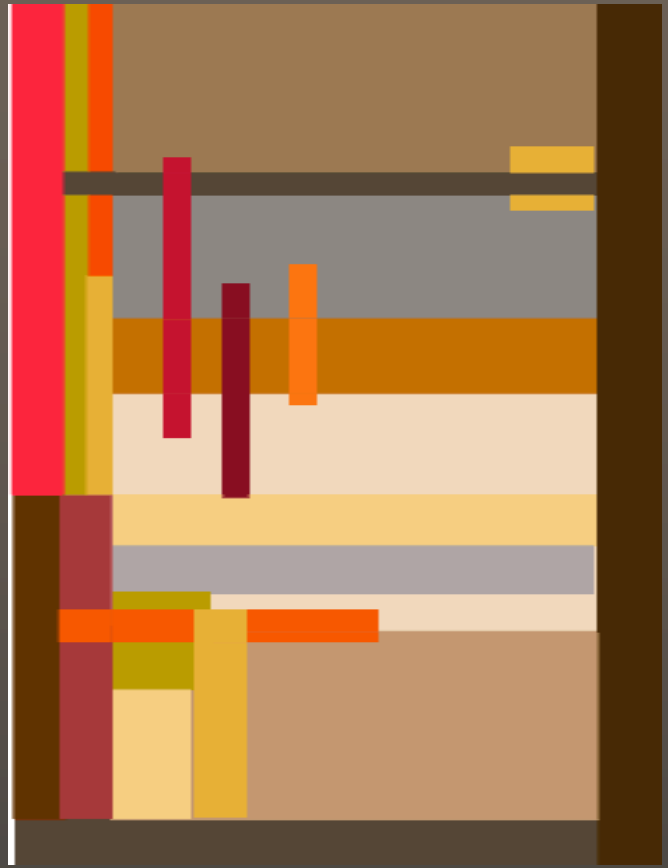
Data exploration

Simultaneity of Color

the problem child ...

A n environment for thinking …

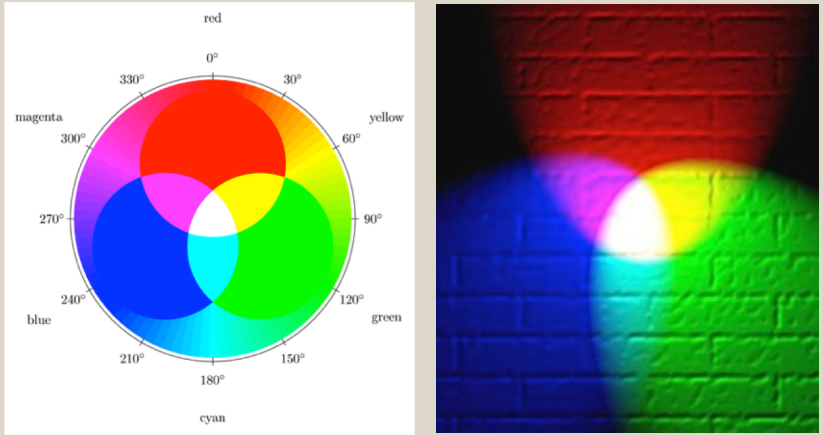




Clarity without cacophony, that's the goal.

Why is color complicated?

RGB and CIE LAB



RGB colorspace

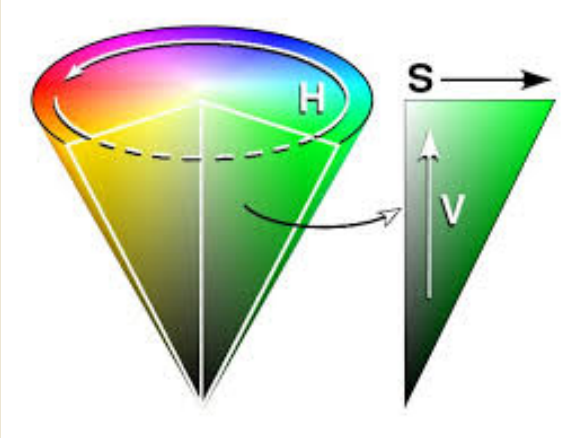
CIE LAB space

RGB is computer color space.

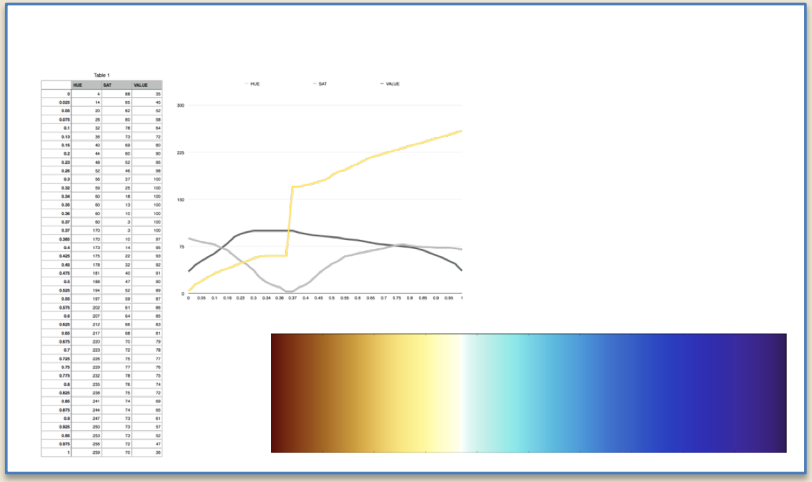
CIE LAB space, perceptual accurate, is *the best interpolation space*.

Why Hue, Saturation and Value

the human color space



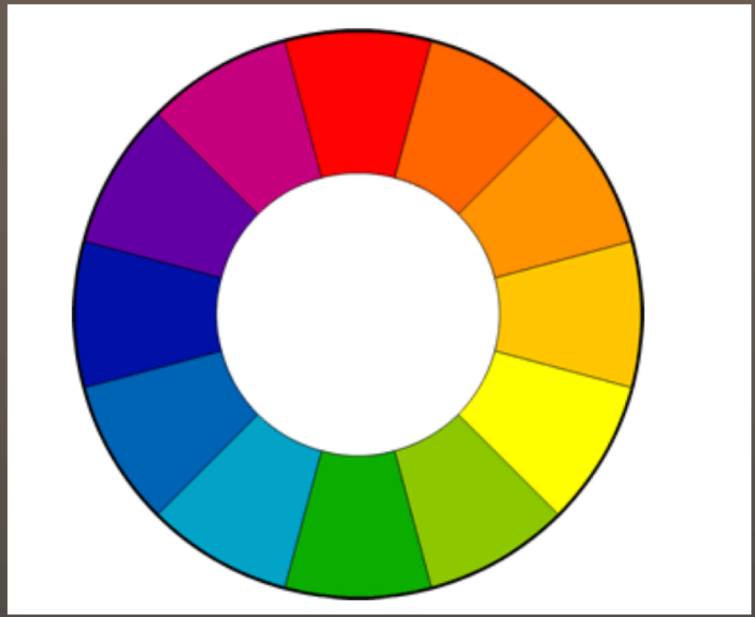
HSV, HSB colorspace



It provides the ability to make subtle adjustments in the human color language.

Hue, Saturation and Value -- The language of color theory.

Color **CONTRAST** Theory



color contrast types

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

and….unifying contrast
analogous color

Color **CONTRAST** Theory

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

The key is to understand
the types of contrast and
allocate the intensity of contrast.

HOWEVER, You have a contrast budget!

HOWEVER, You have a contrast budget!

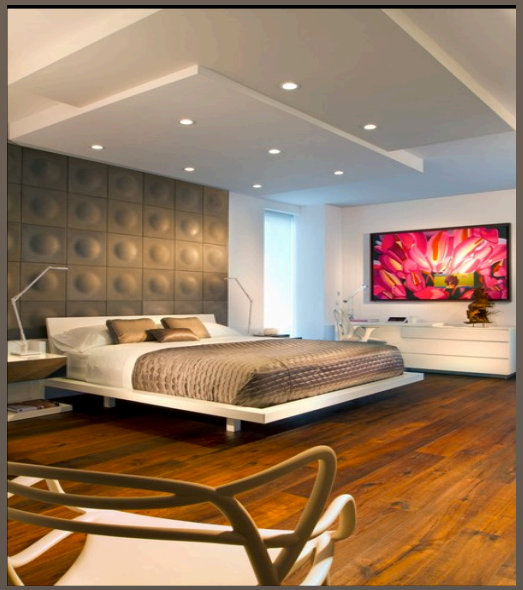
HOWEVER, You have a **contrast** budget!

Use it wisely.

Less is more.

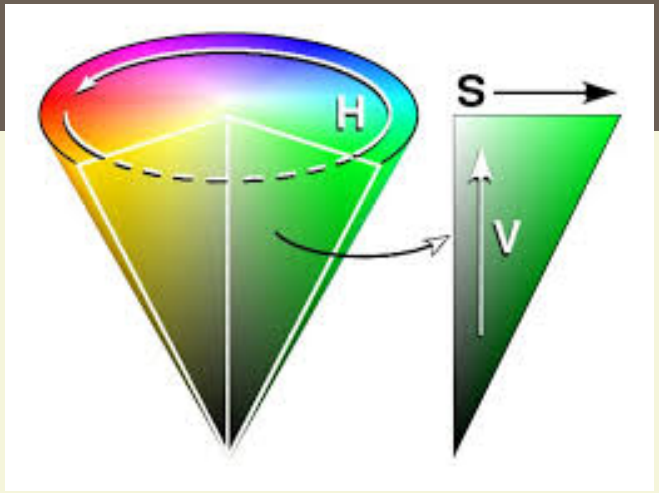
It is a matter of degree,
degree of contrast,
degree of intensity.

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



Low intensity provides
wide range of contrast.

Terms – Hue, Saturation, Value



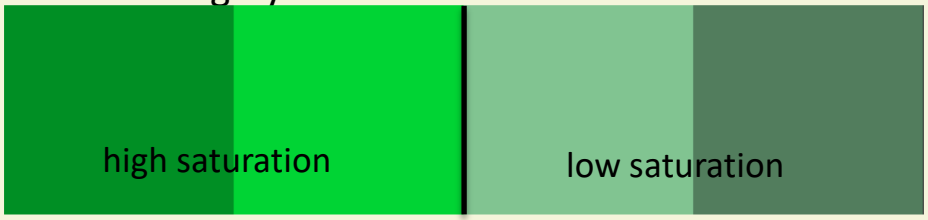
Hue

What "color" is it? Green, blue, red..

Saturation

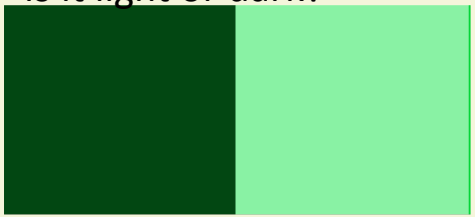
How pure is it?

How much gray does it have in it?



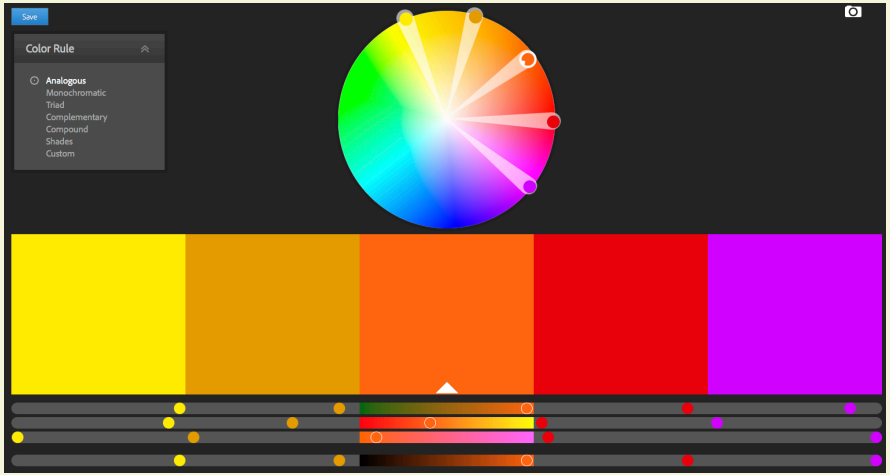
Value

Is it light or dark?



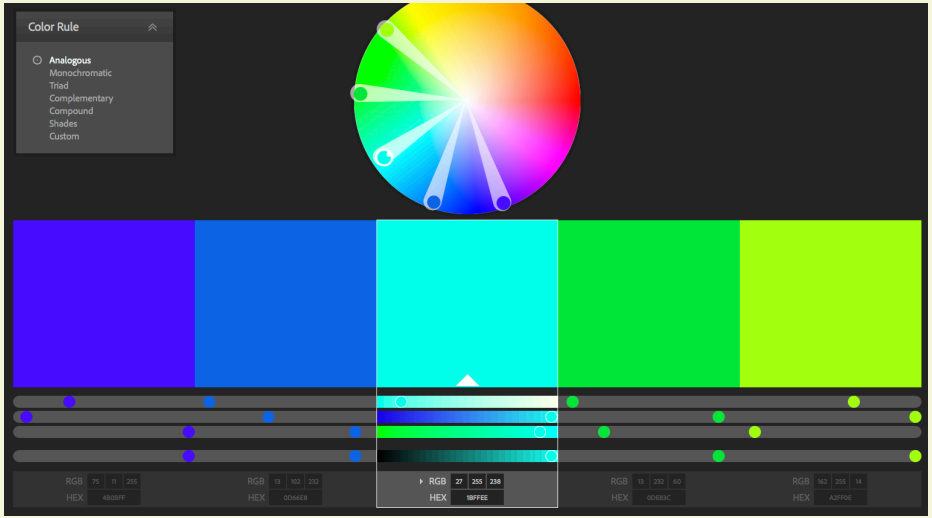
Value

light to dark


Save
Color Rule
Analogous
Monochromatic
Triad
Complementary
Compound
Shades
Custom

WARM

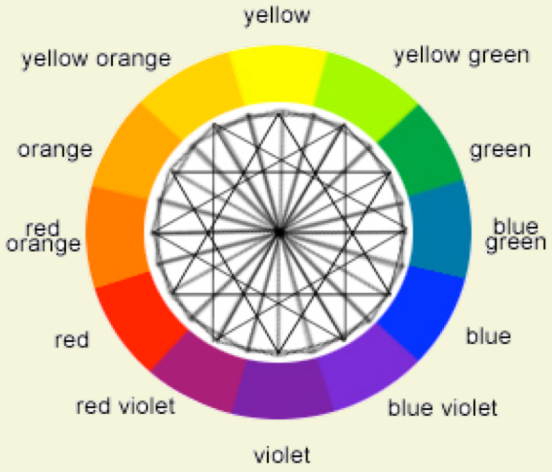
COOL

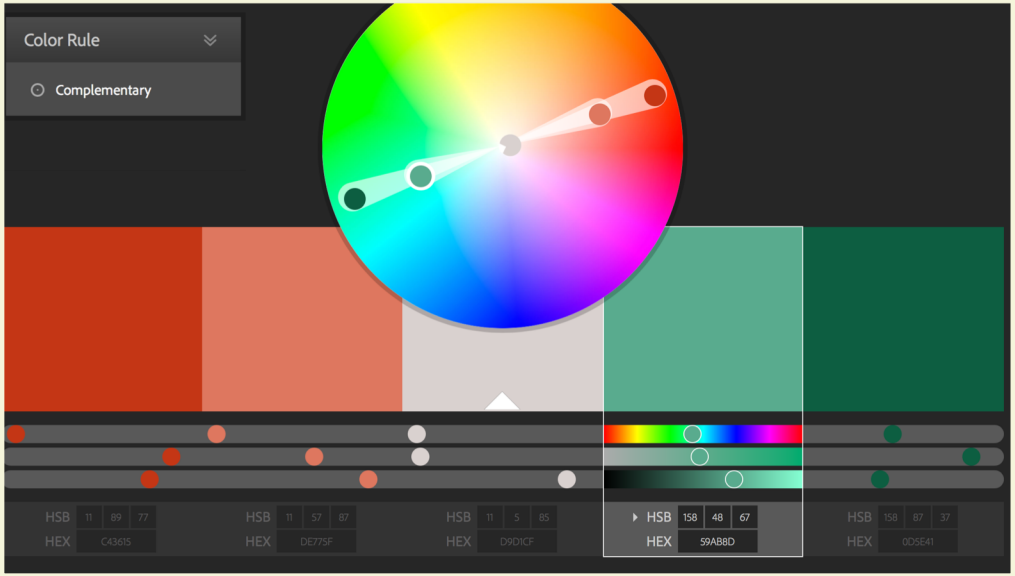

Color Rule
Analogous
Monochromatic
Triad
Complementary
Compound
Shades
Custom
RGB 27 255 238
HEX 1BFFEE

Complimentary colors

opposite sides of the color wheel… except in digital color…

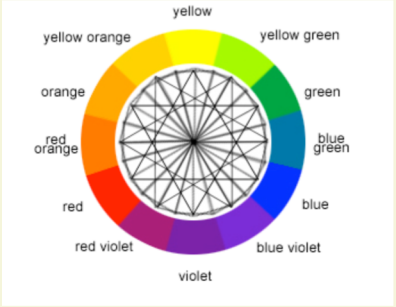
red – green
blue –orange
yellow - purple





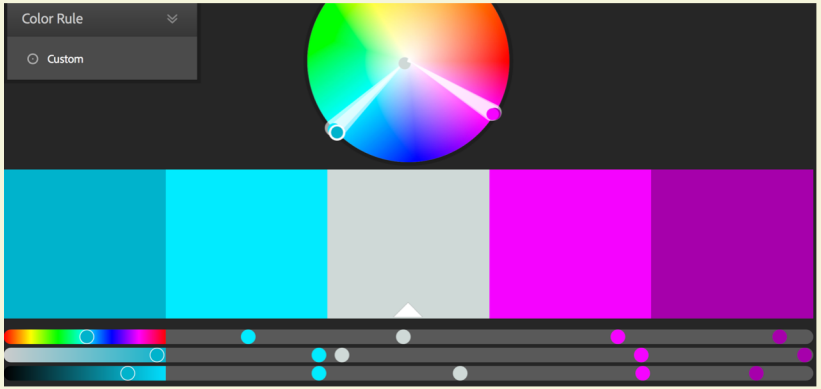
Complimentary colors

opposite sides of the color wheel



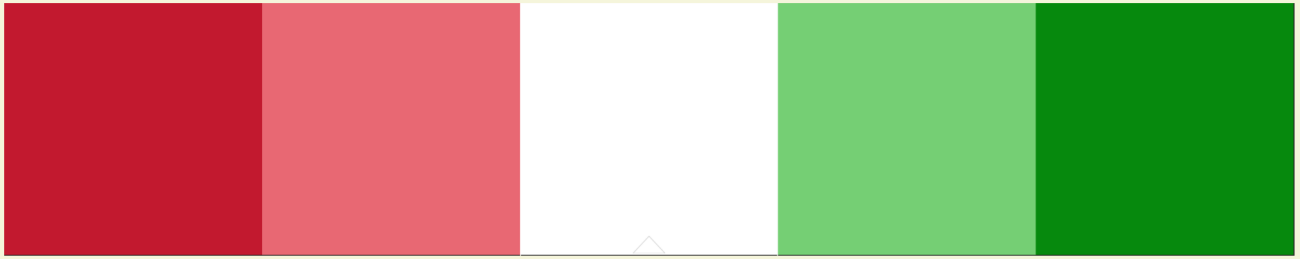
Except when….
you are using a digital color wheel

Because you have to squeeze in



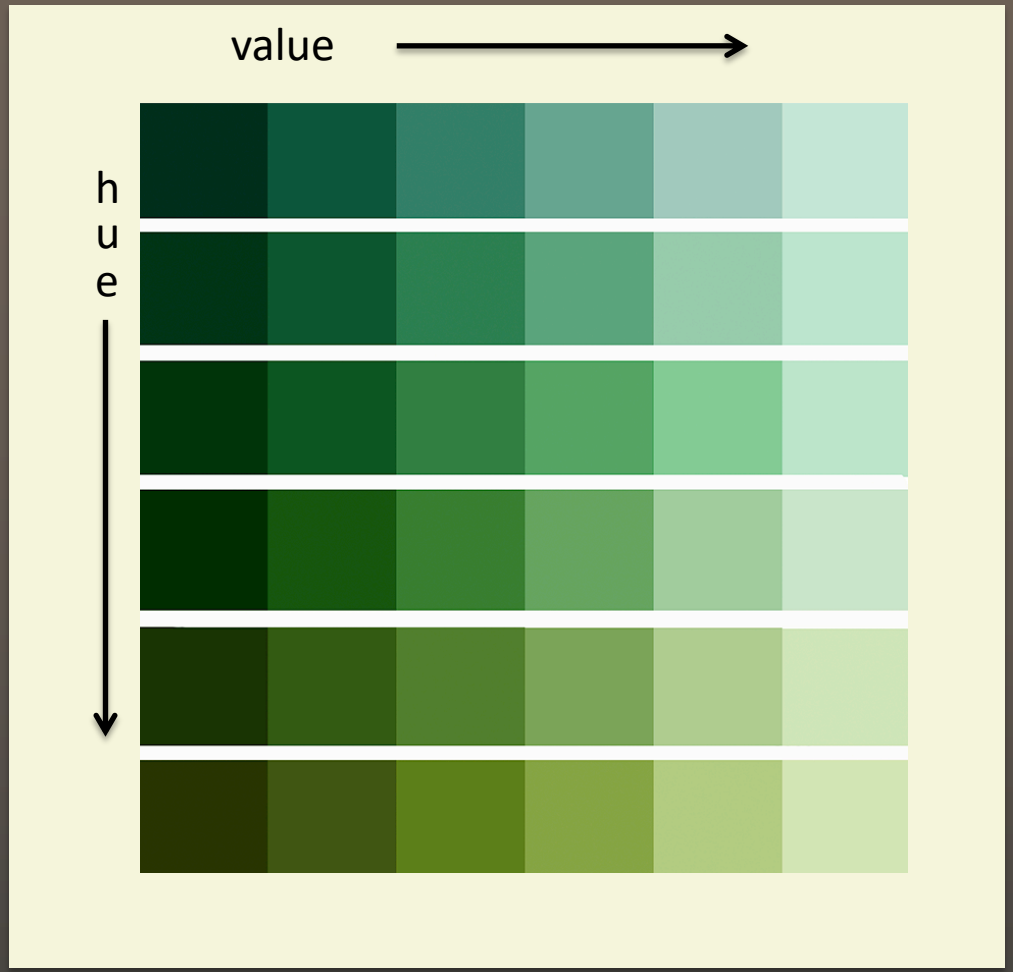
Turquoise and Fushia somewhere

Complimentary Colors



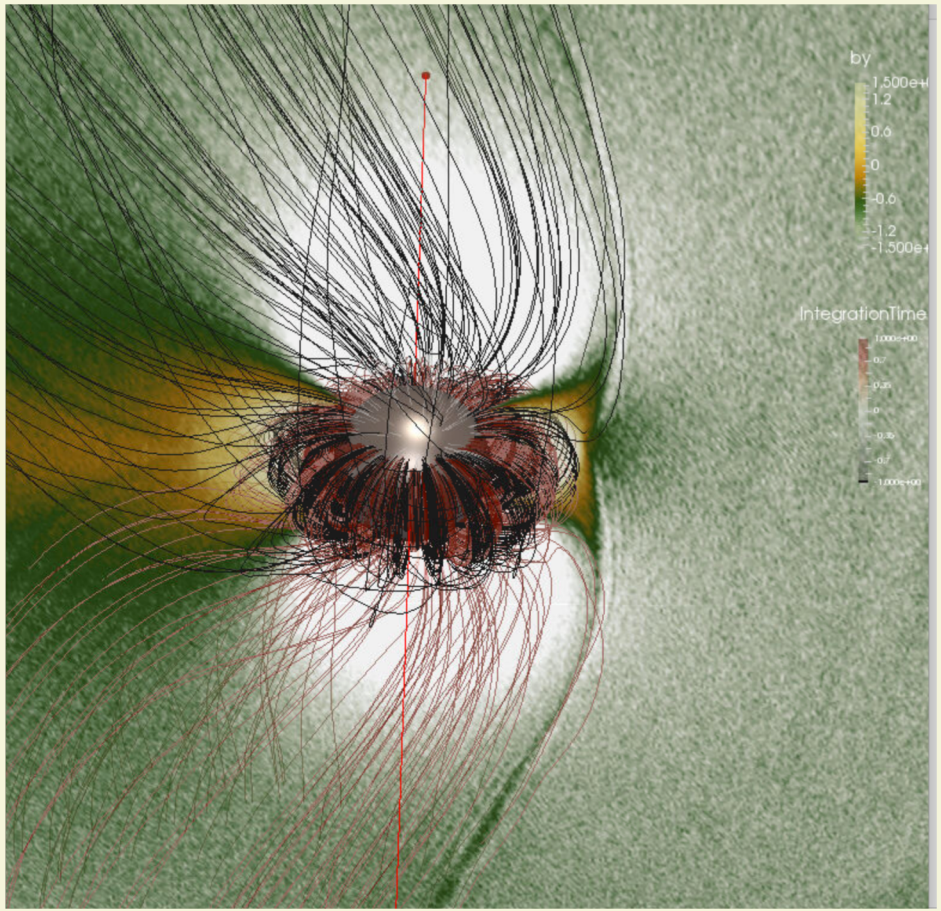
Analogous Colors

muted compliments



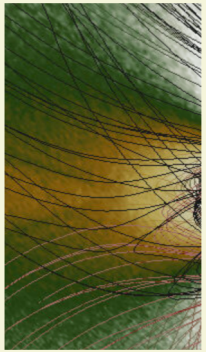
All of these characteristics occur within hues as well.

Employing multiple types of contrast

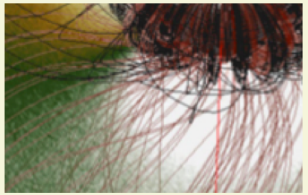


saturation
and
value

analogous
color



complimentary
color



Analogous Color

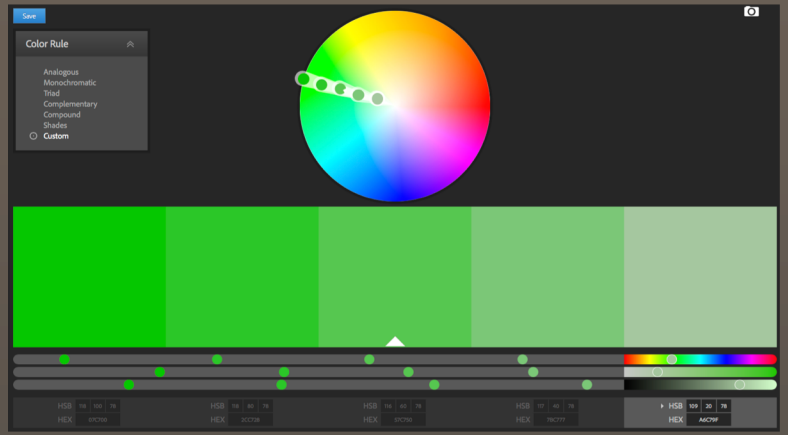
close on the color wheel

note the spiral …

www.kuler.com

SATURATION

Saturation is
the amount of gray in the color.

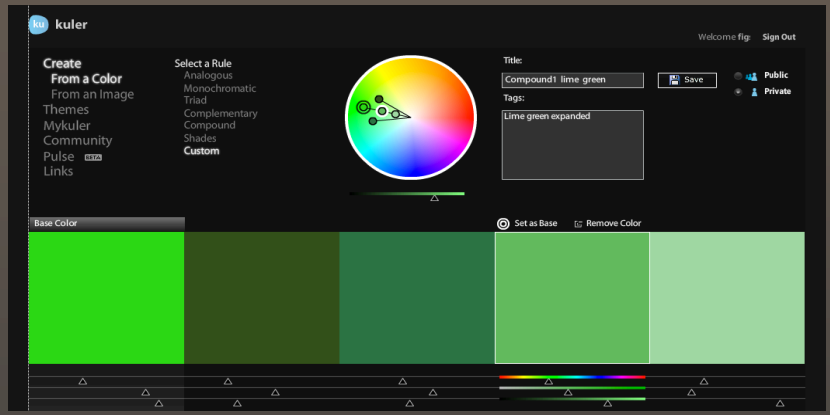


high saturation

low saturation

Saturation and Hue changes
hue change - green to yellow

Weaving
contrast



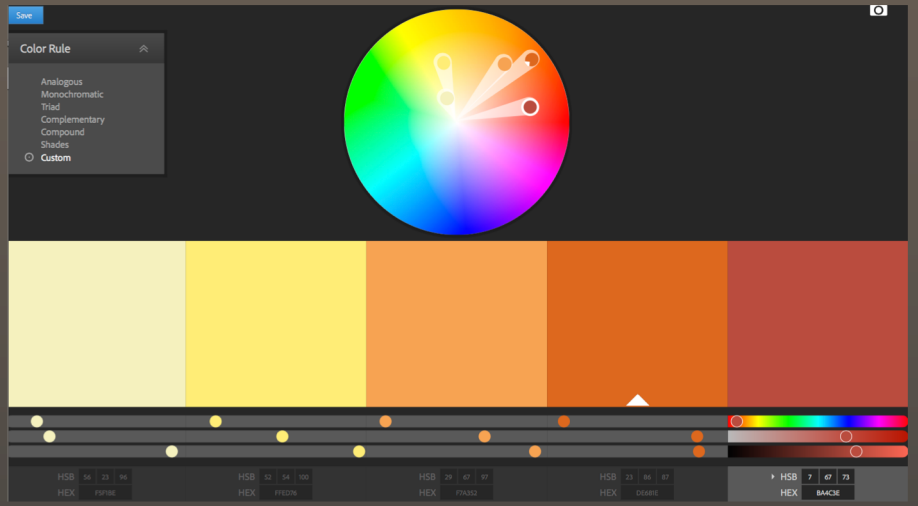
WEAVING saturation and hue changes
yellow-green, blue-green, yellow-green, blue-green

Analogous Color

close on the color wheel

Unified but higher contrast contrast

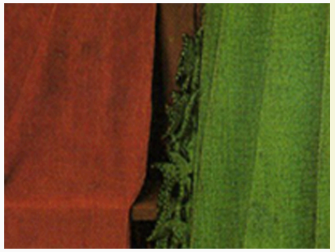
Combining harmony and contrast



Weaving the saturation levels
to increase contrast while contriolling cacophony.

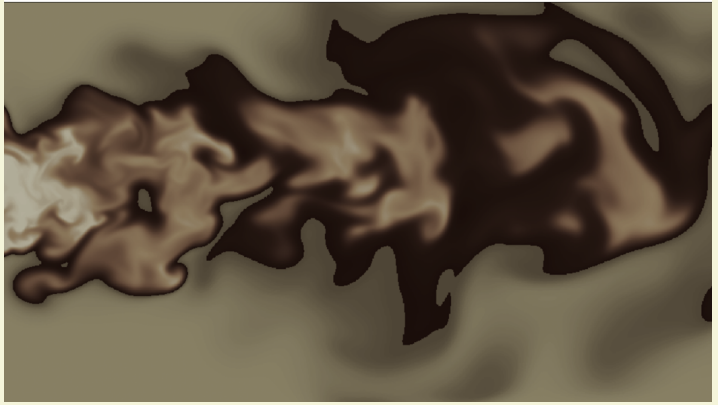
Simultaneity of Color

1

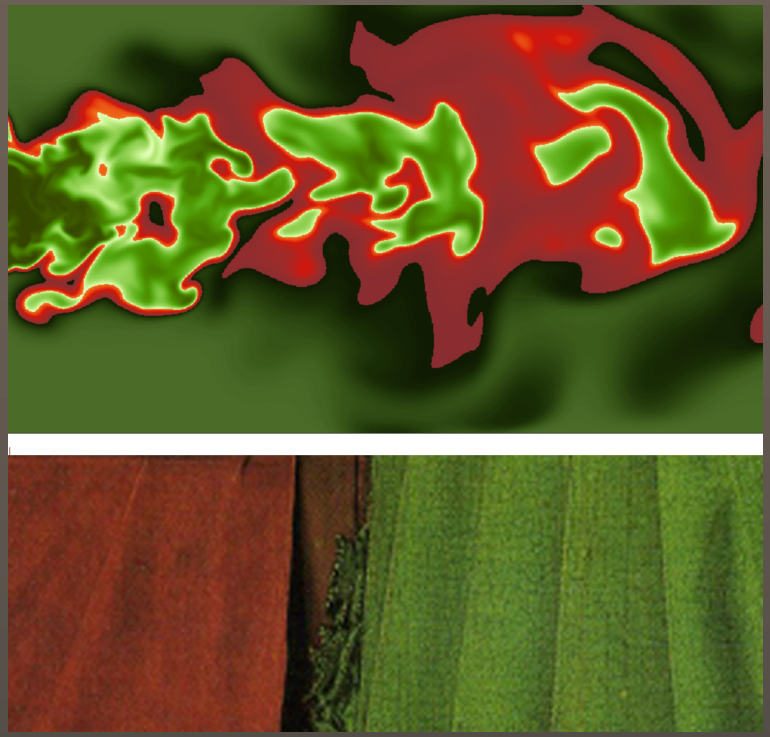


2

3



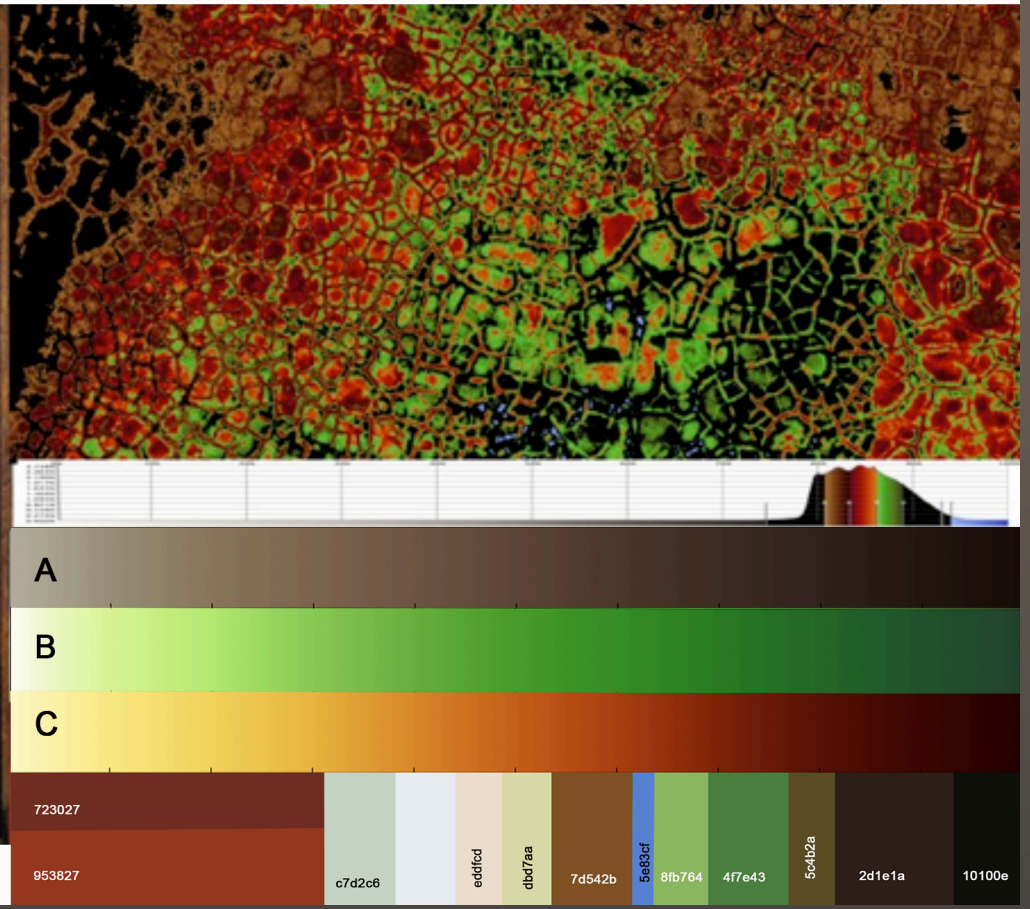
VanEyck



QUIZ! What type of contrast?

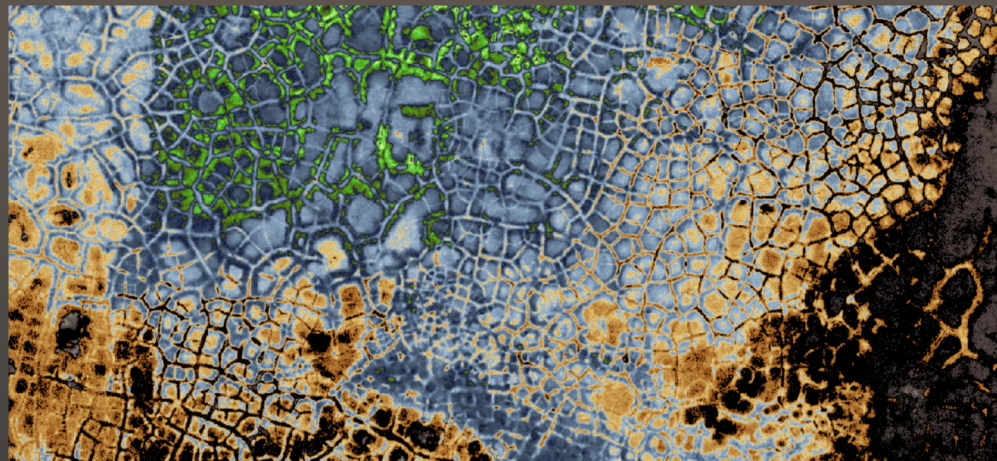
Jan van Eyck *Anolfini Wedding Portrait*

Arctic lidar data, C. Wilson



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

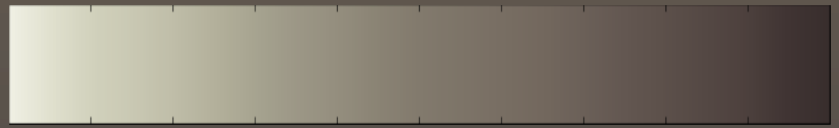
ochre

warm taupe

light cool gray taupe

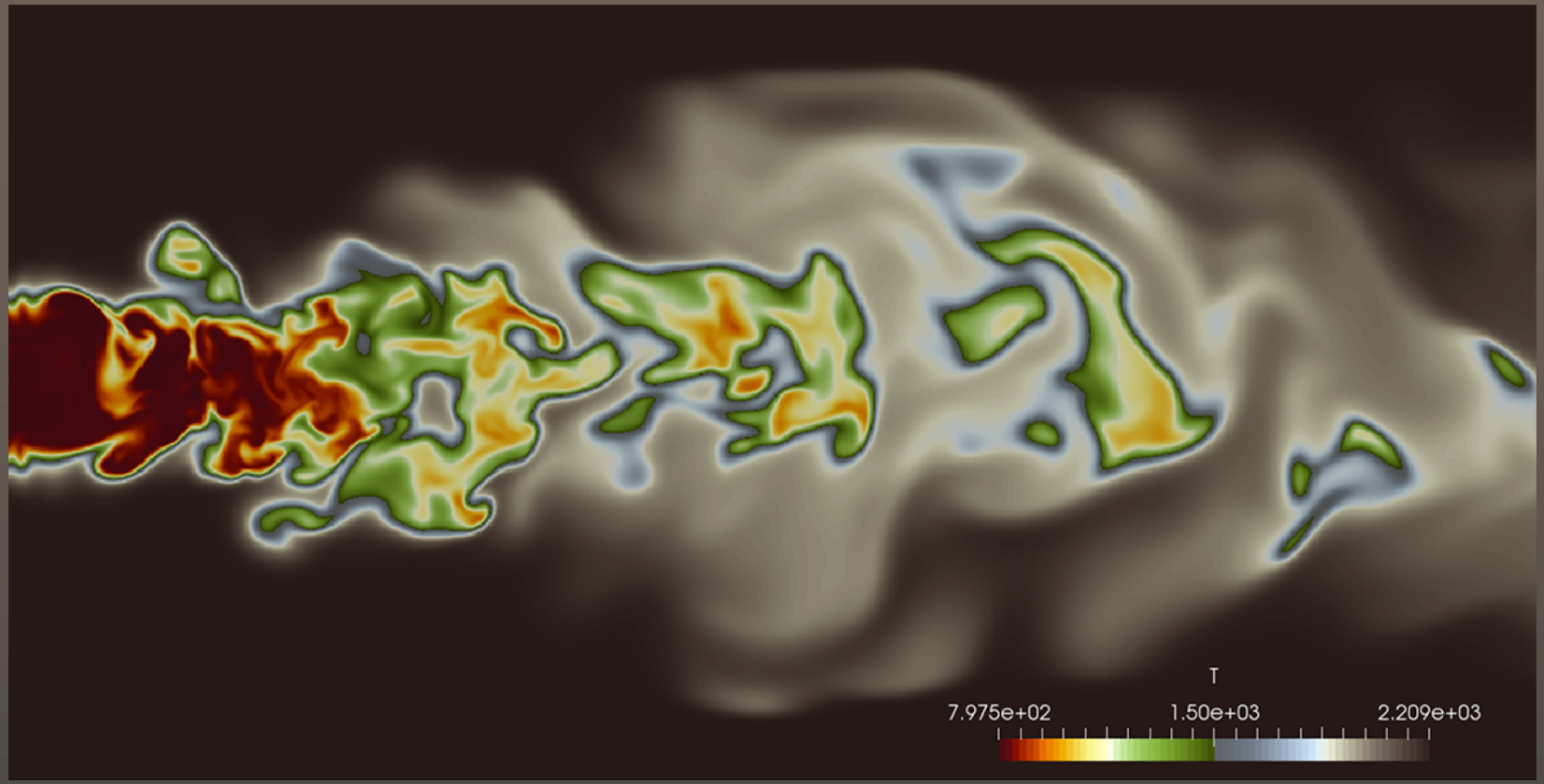
dark cool green gray

medium warm gray



Grays frame the focus colors.

red is important, gray is not….



cool warm and muted cool warm

The Rules:

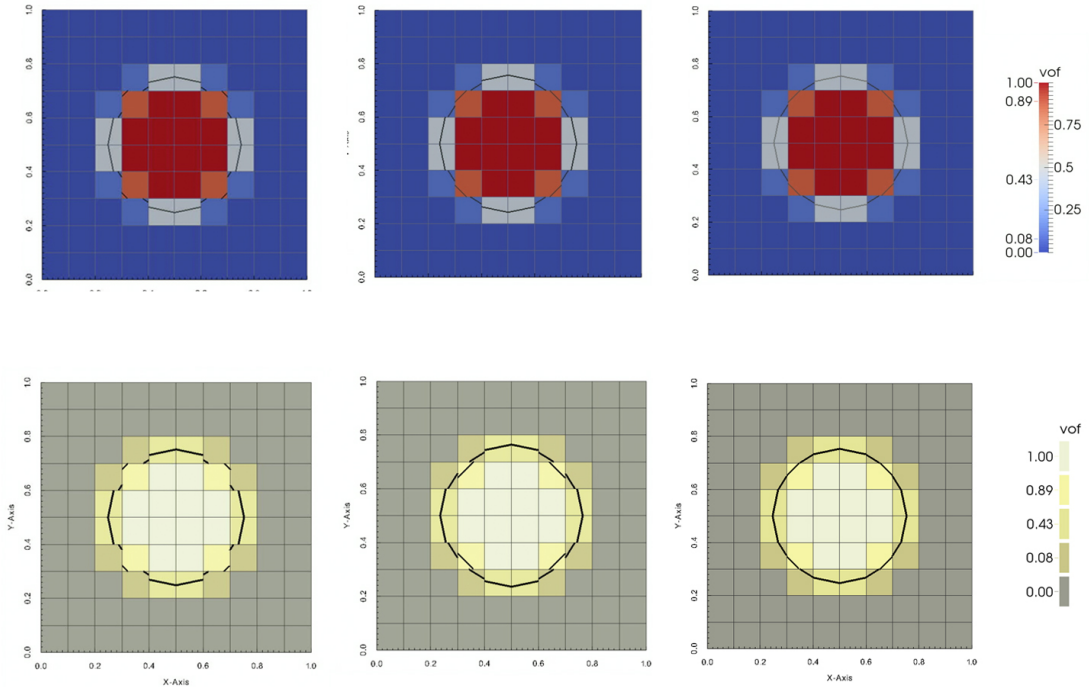
A. Contrast hierarchy:
1. value / luminance
2. cool / warm
3. everything else

B. Two types of contrast
are stronger than one.

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

D. Cognitively you have a **contrast budget**.
Use only what you need and you will not go hungry.
Neutral colors are your friend.

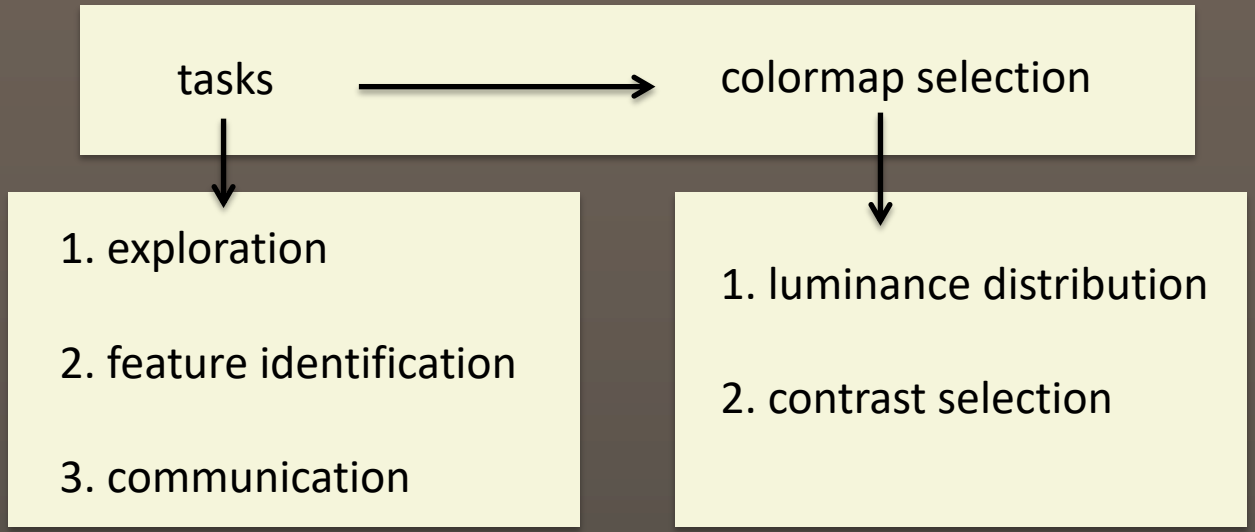
Let's get practical.



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

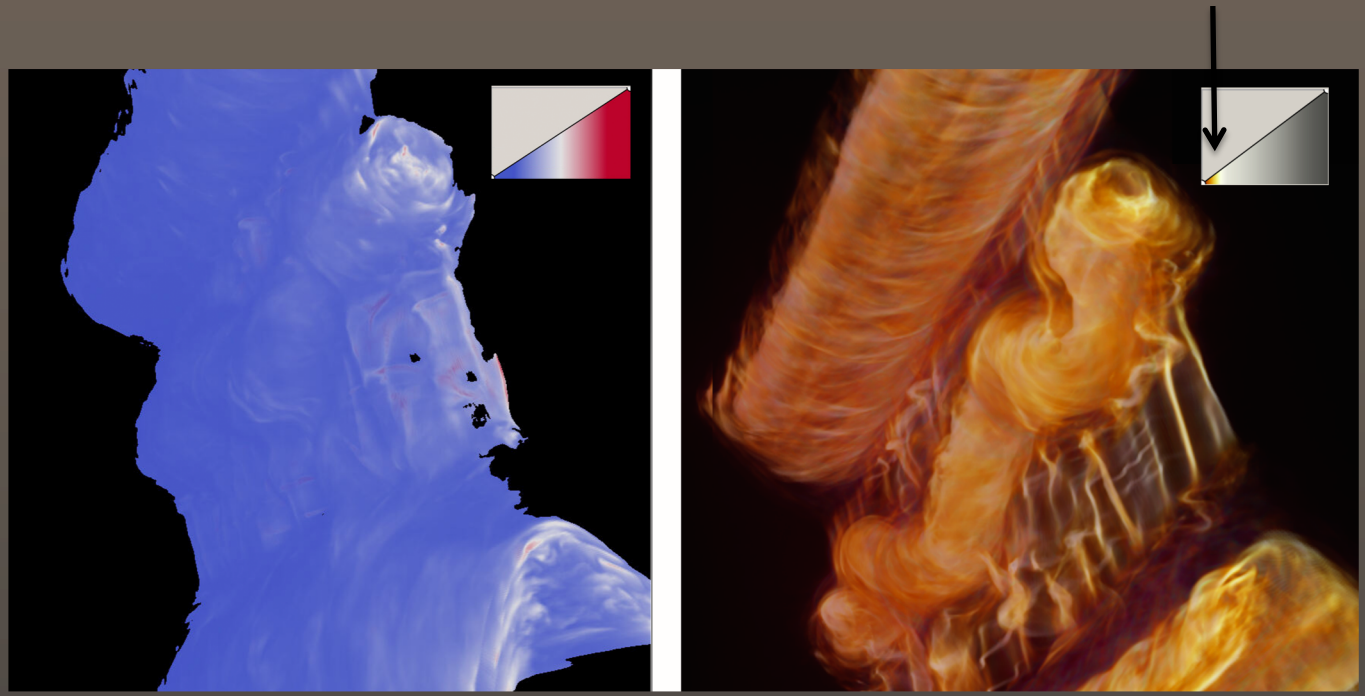
Place the contrast <u>where you need</u> it,
but watch the volume.

Follow the task…..

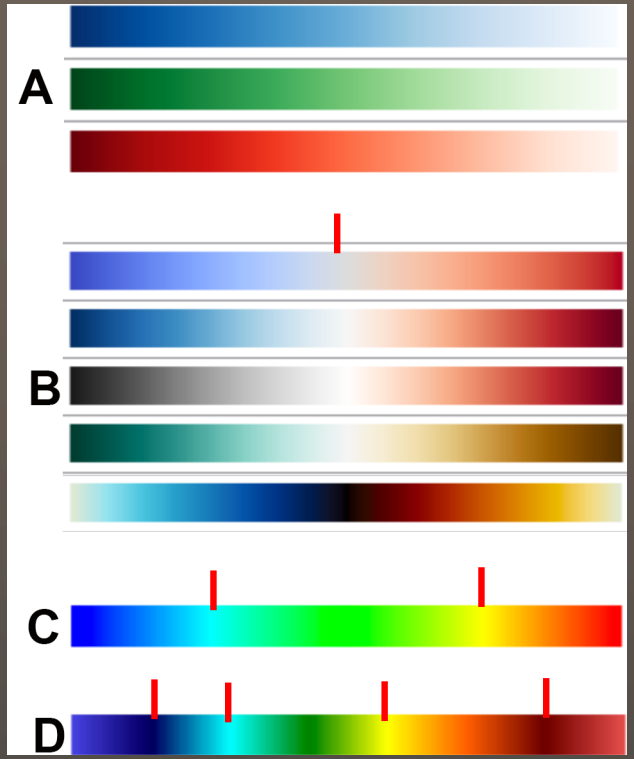


Contrast distribution

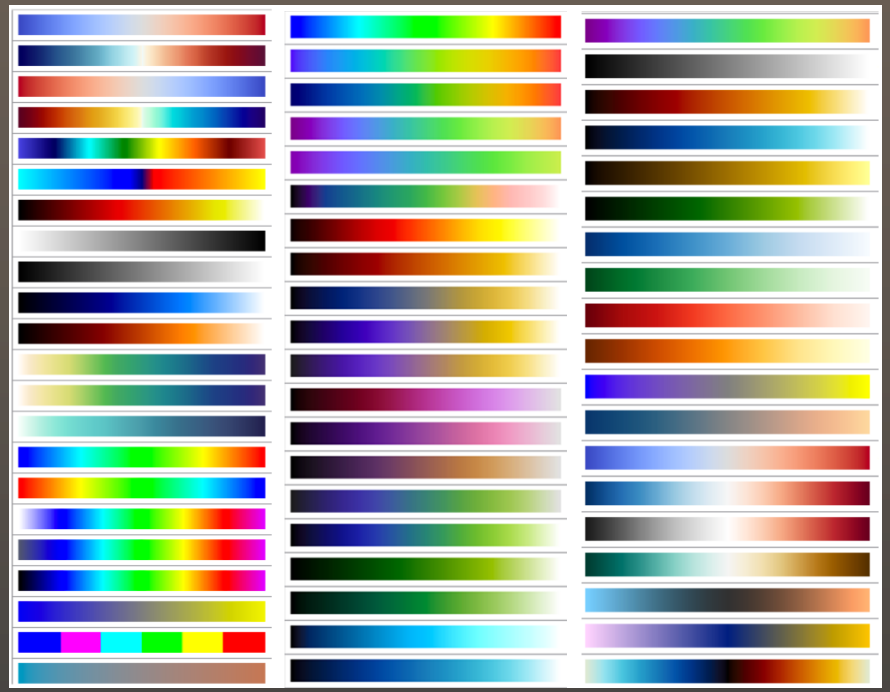
Aligning the contrast with the data



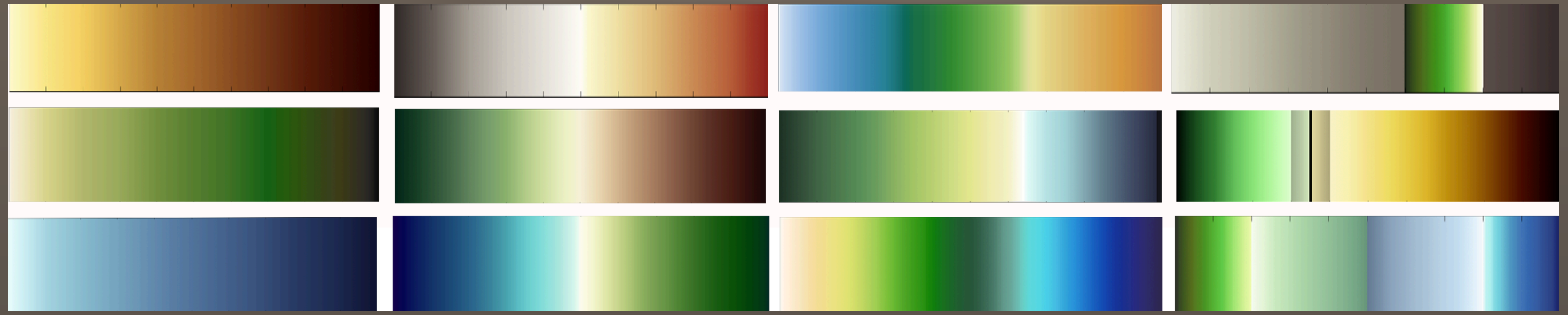
Luminance



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



Luminance Distribution



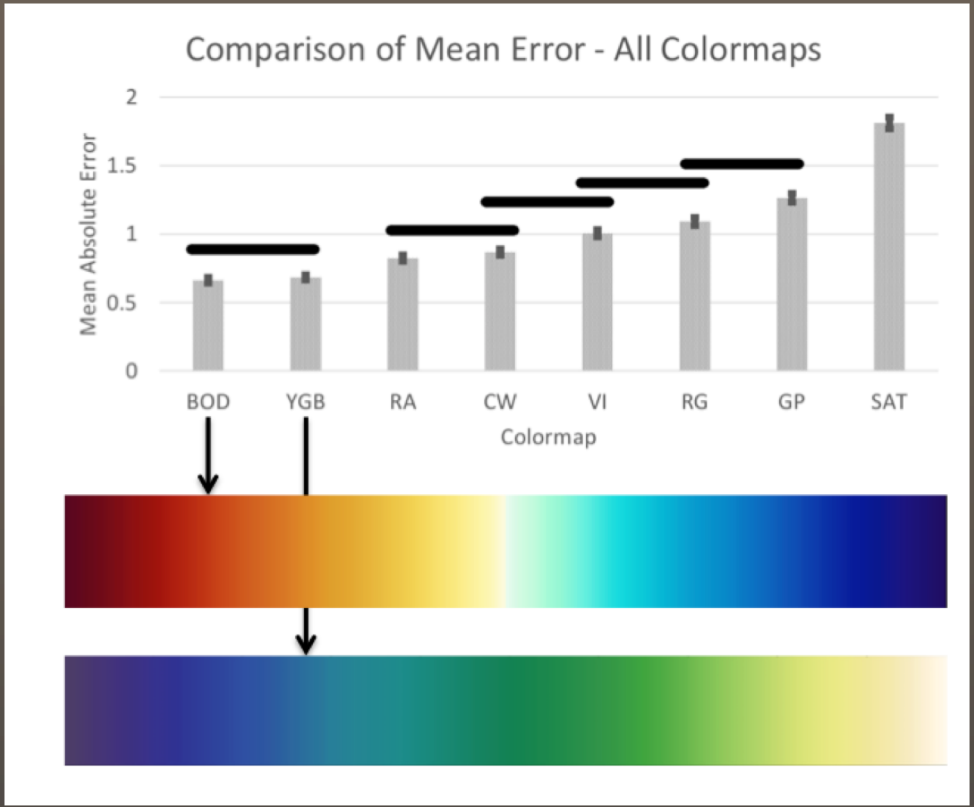
linear

divergent

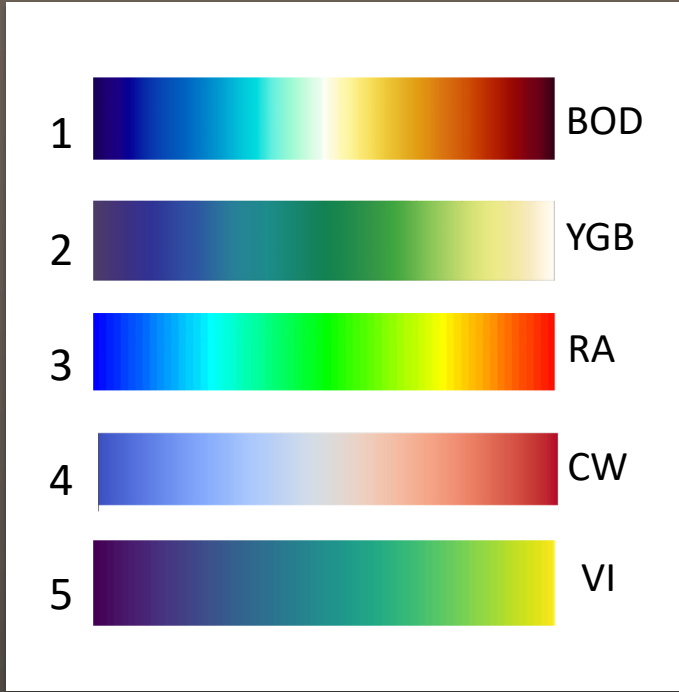
alternate luminance

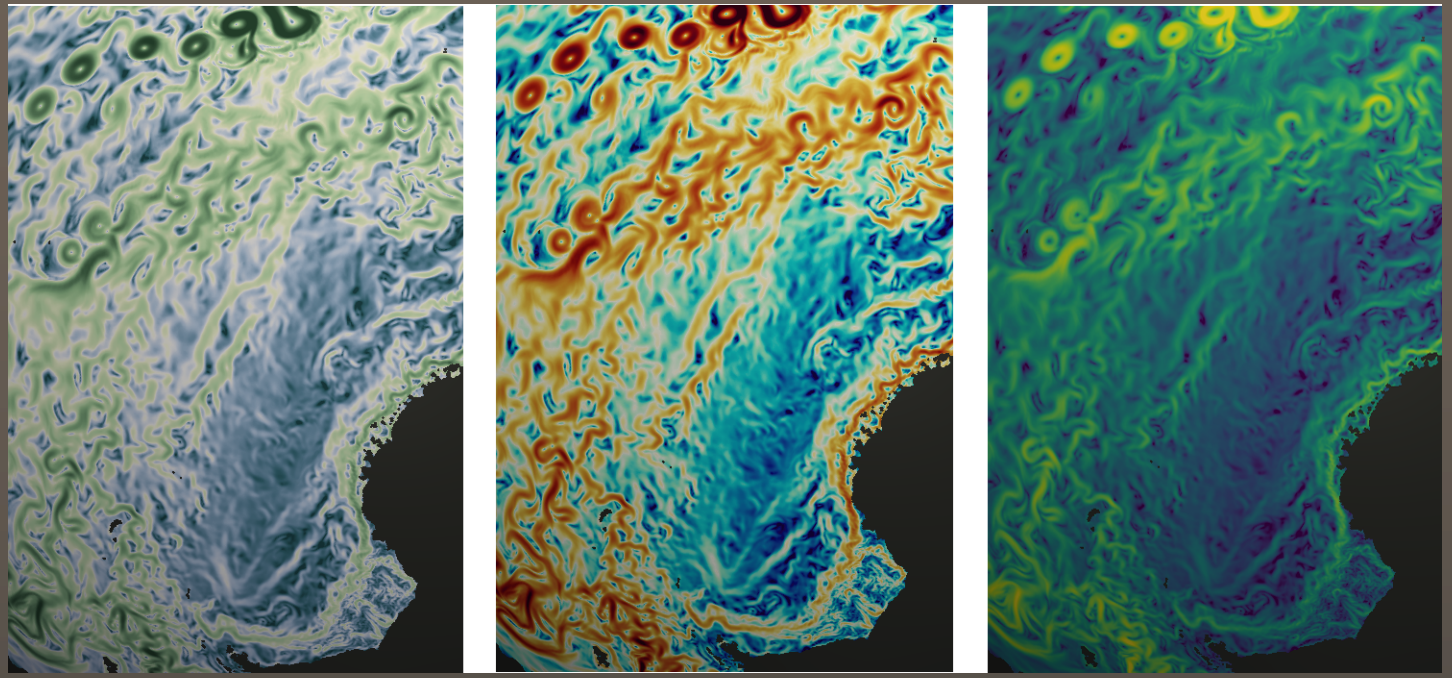
structured colormaps

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

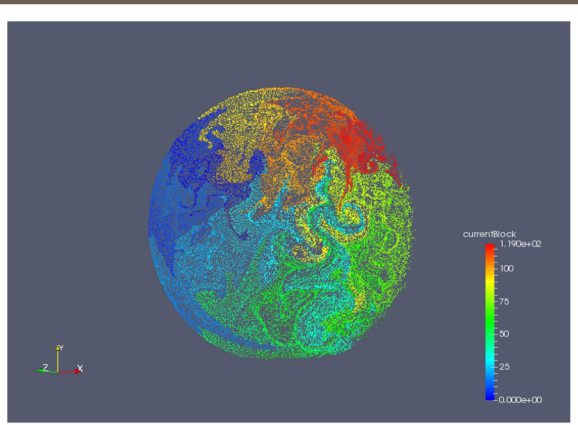


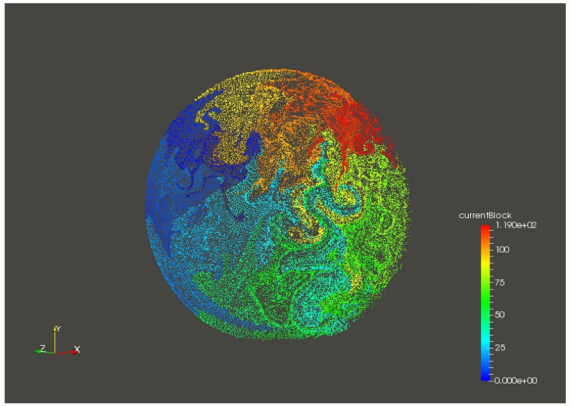
Discriminative Power





What is you task? What is your goal?



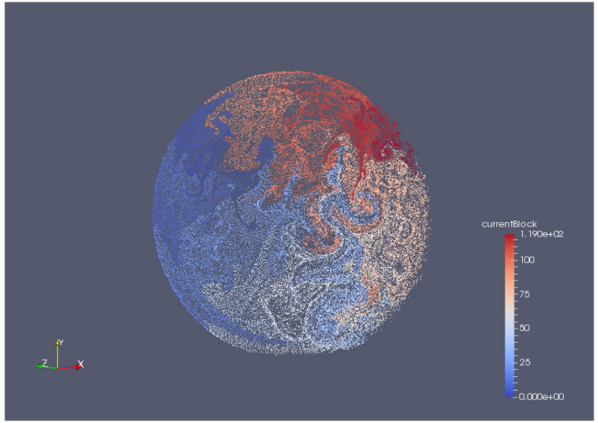


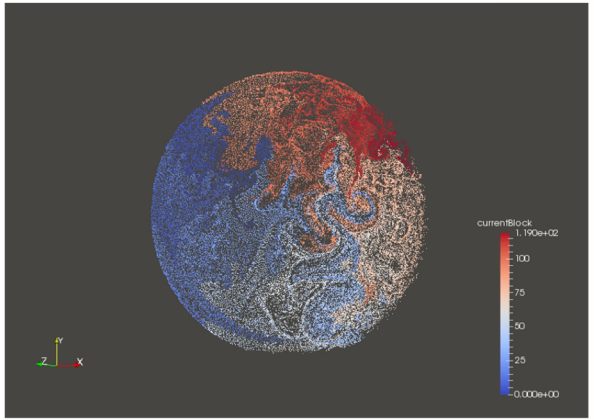
Change the Paraview background default!

Your life and vis will be calmer.

RGB 107 107 107

The only difference is the background color.



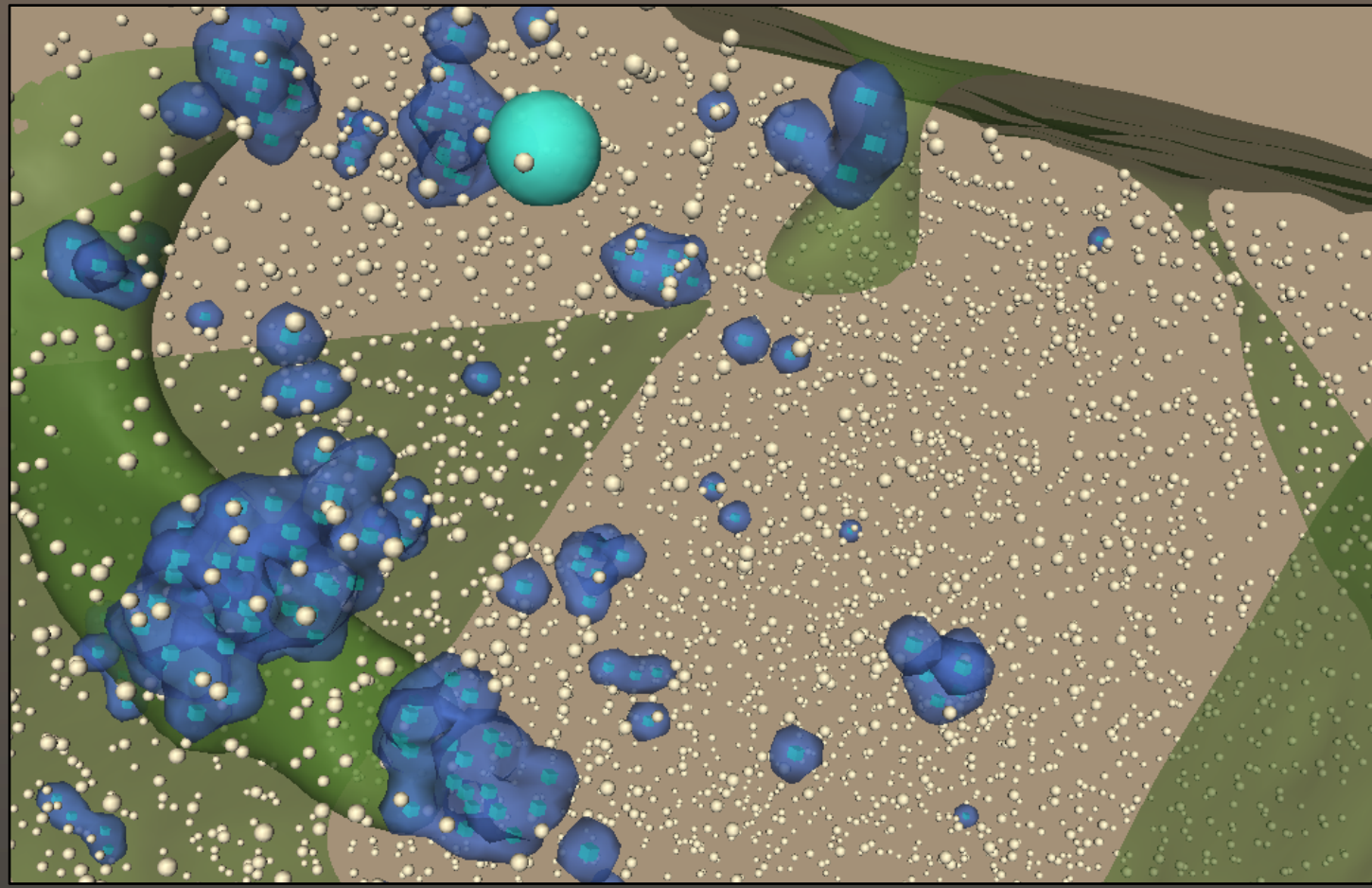


In general, cool colormaps such as the ParaView default,
need a warm background but in reality,
the ParaView background is almost always worse.

A few words about
Color Sets …

Color Hierarchy

Using color to organize, categorize and direct attention

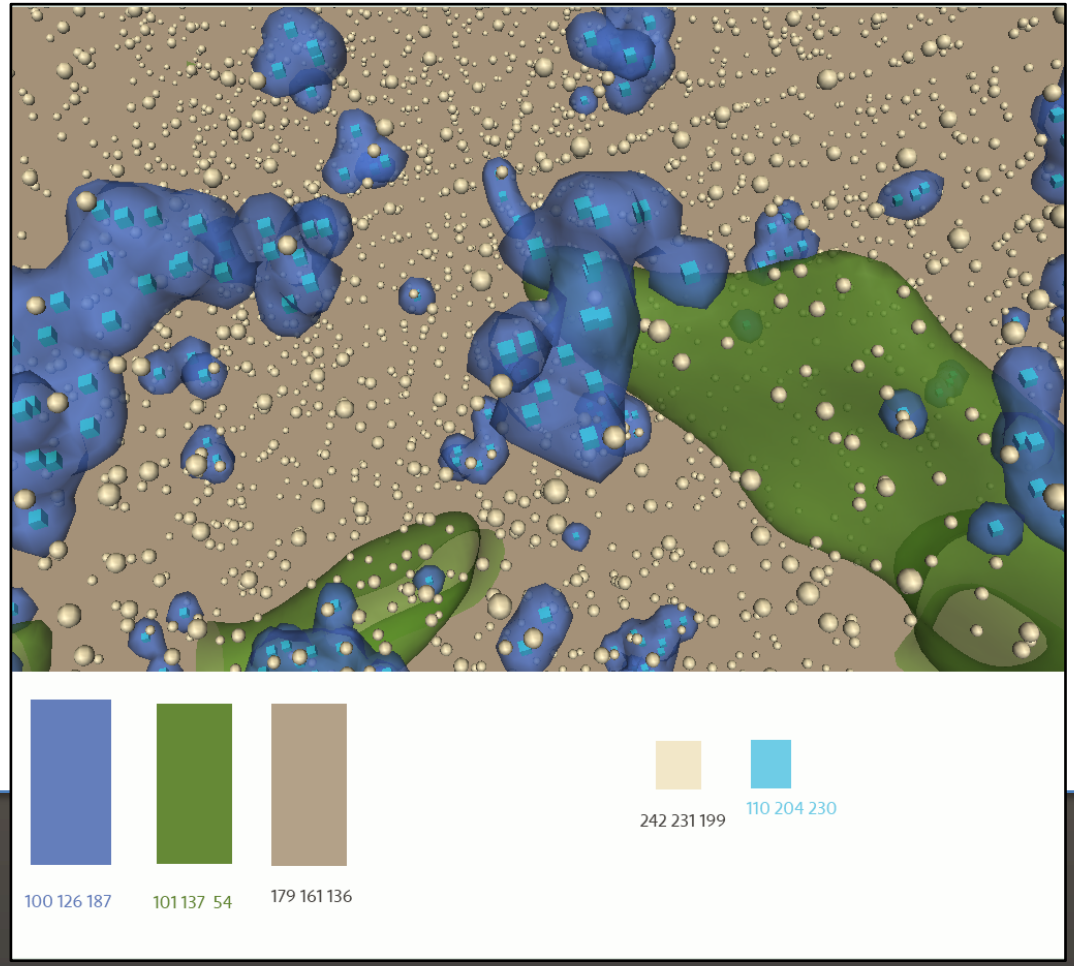


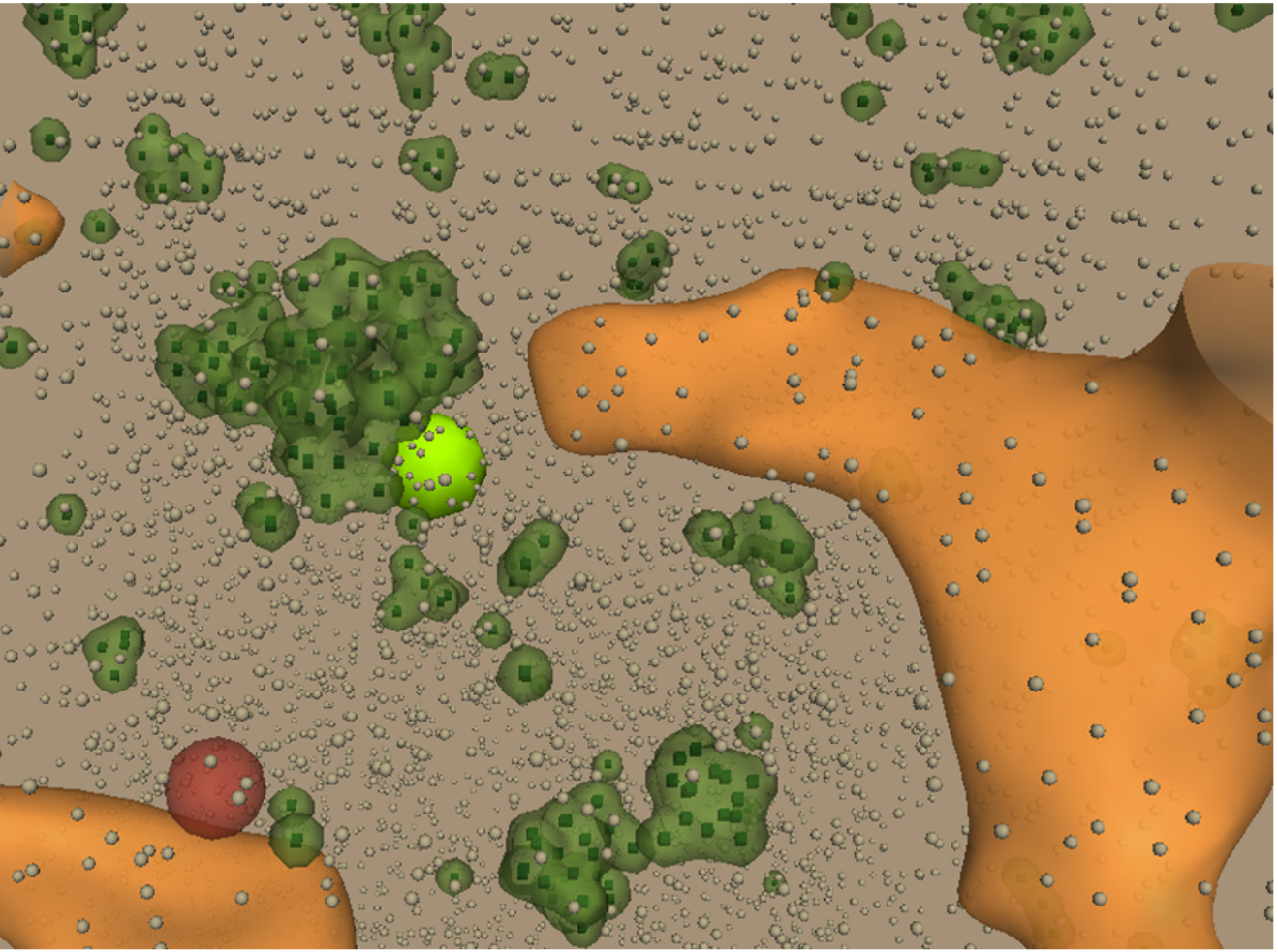
Color sets

Ready-made color sets?

at SciVisColor.org

of course!





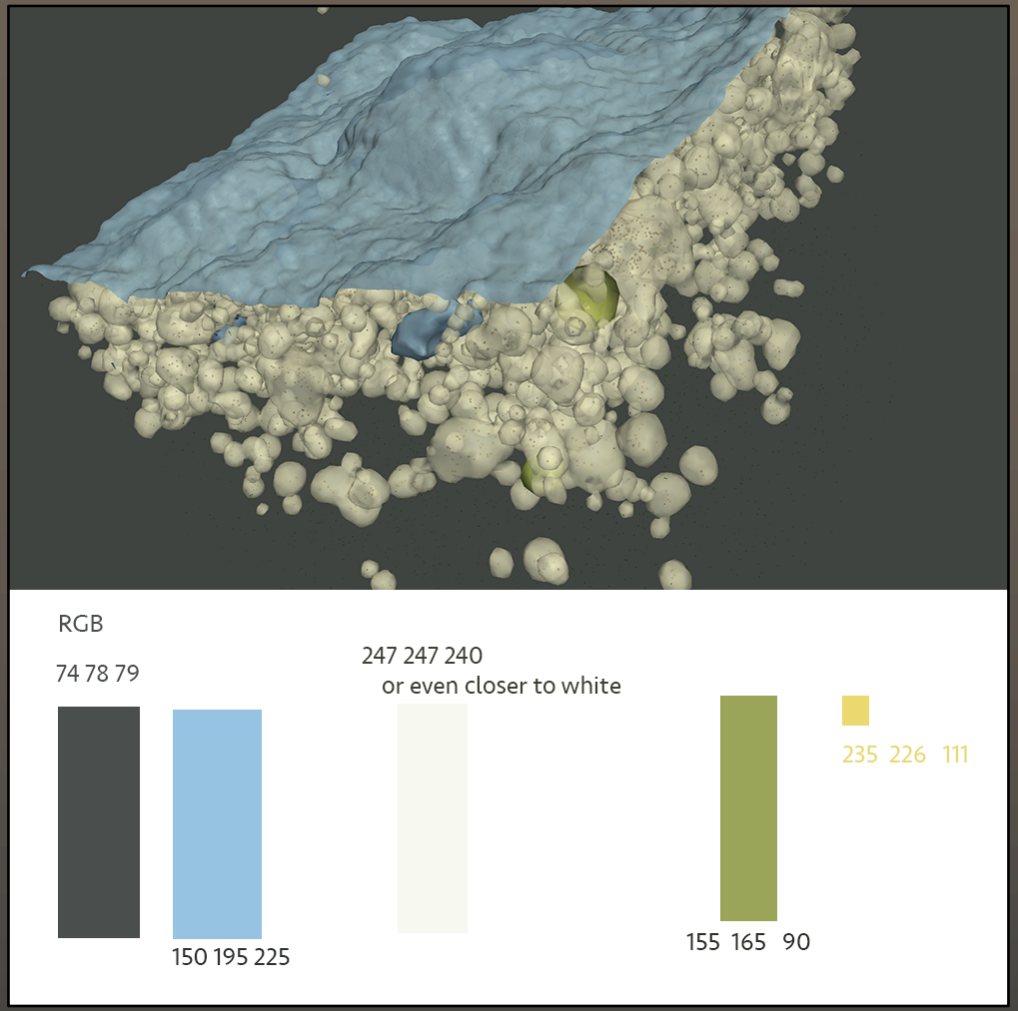
related

different

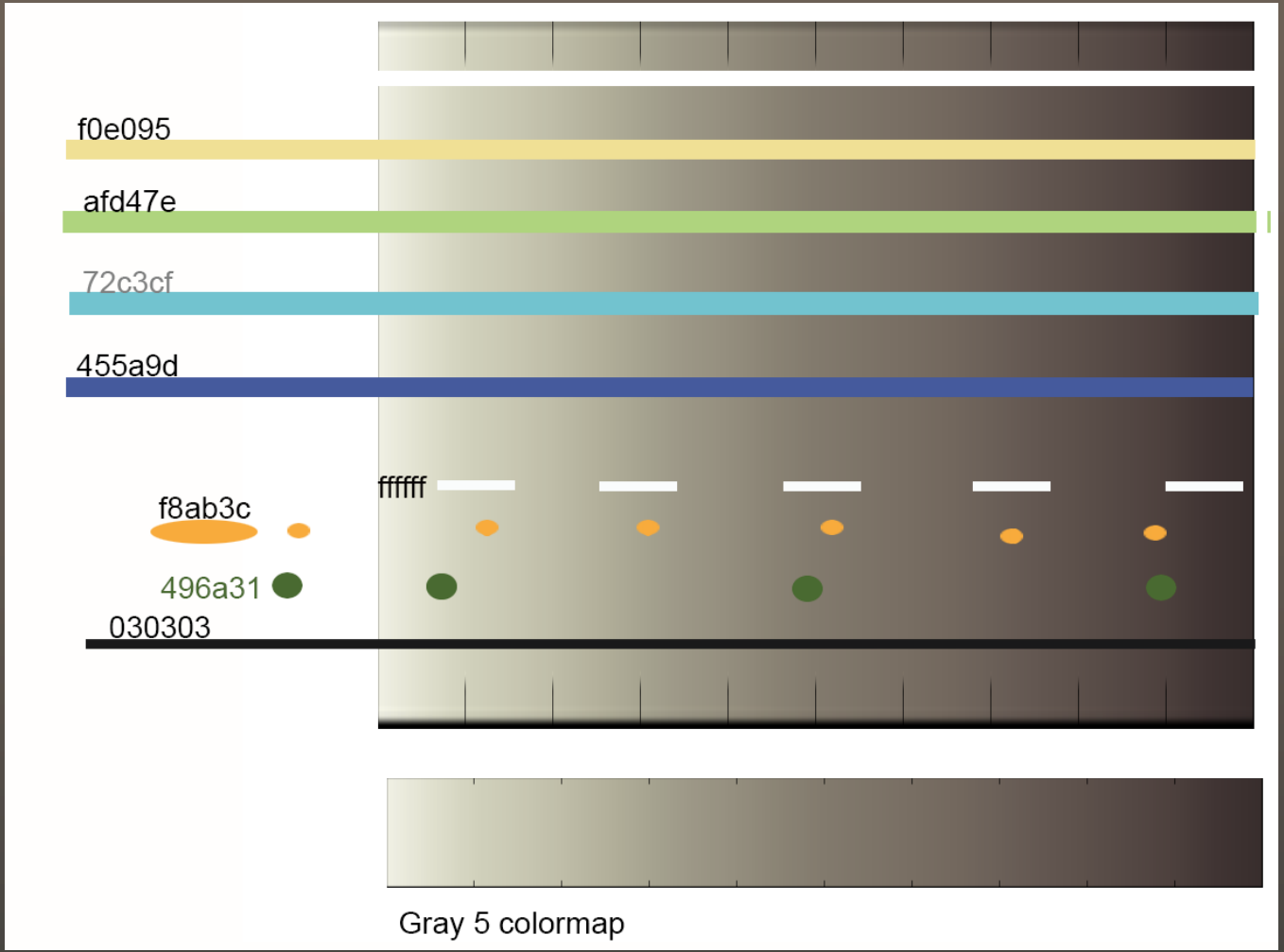
related

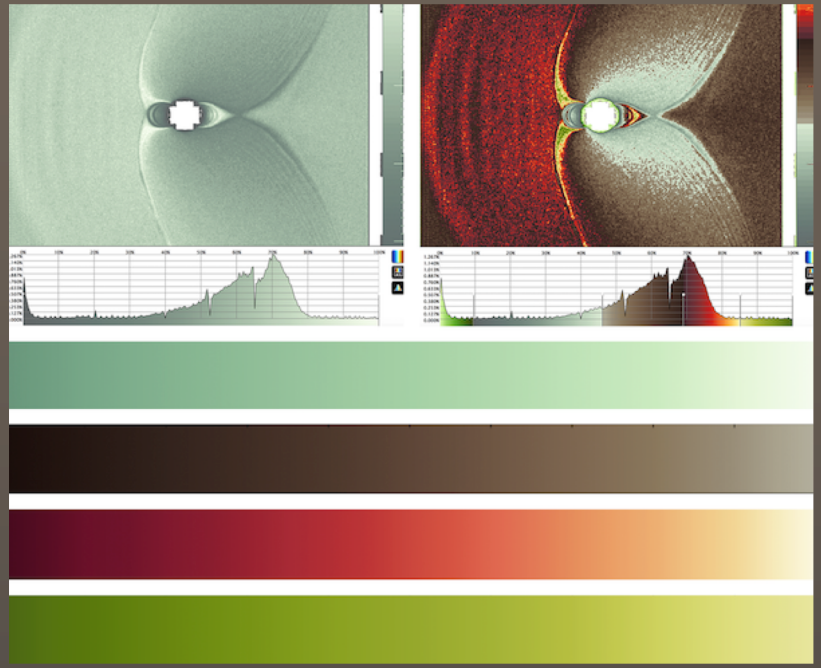
Visualization and Analysis of Large-Scale Atomistic Simulations of Plasma–Surface Interactions

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

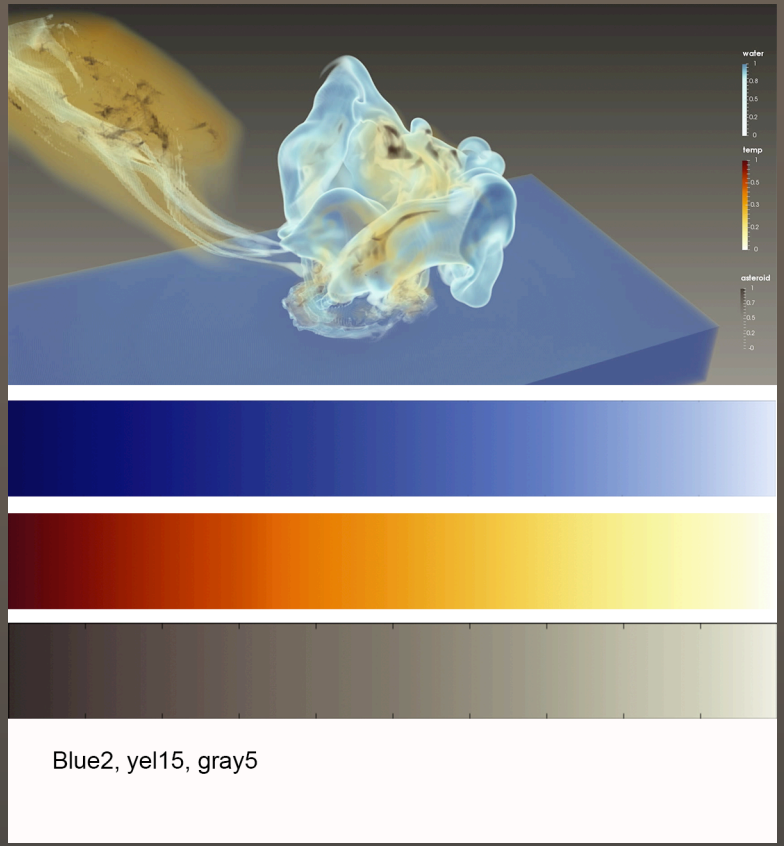


Color Sets

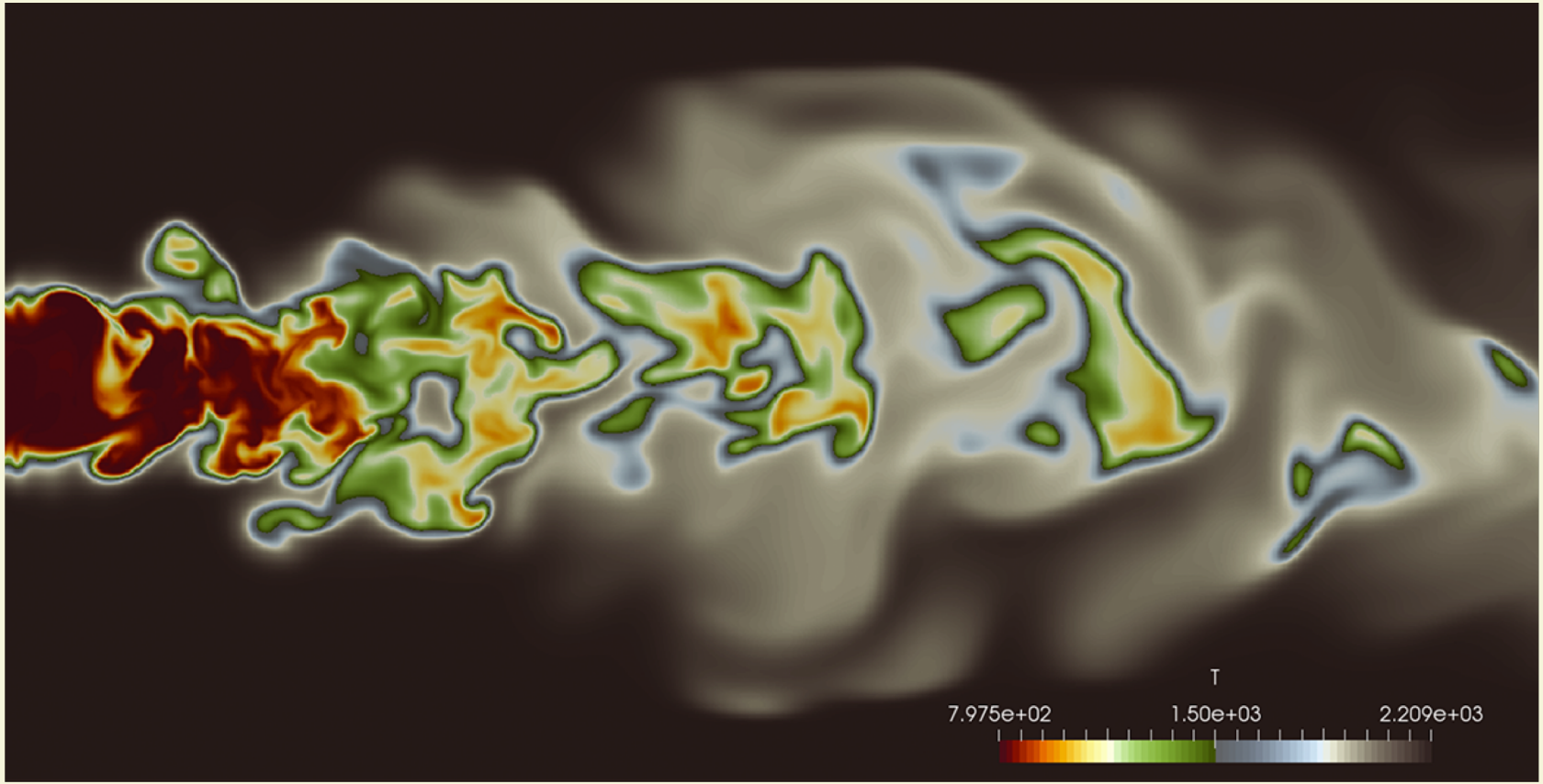

f0e095
afd47e
72c3cf
455a9d
ffffff
f8ab3c
496a31
030303
Gray 5 colormap



3D colorsets

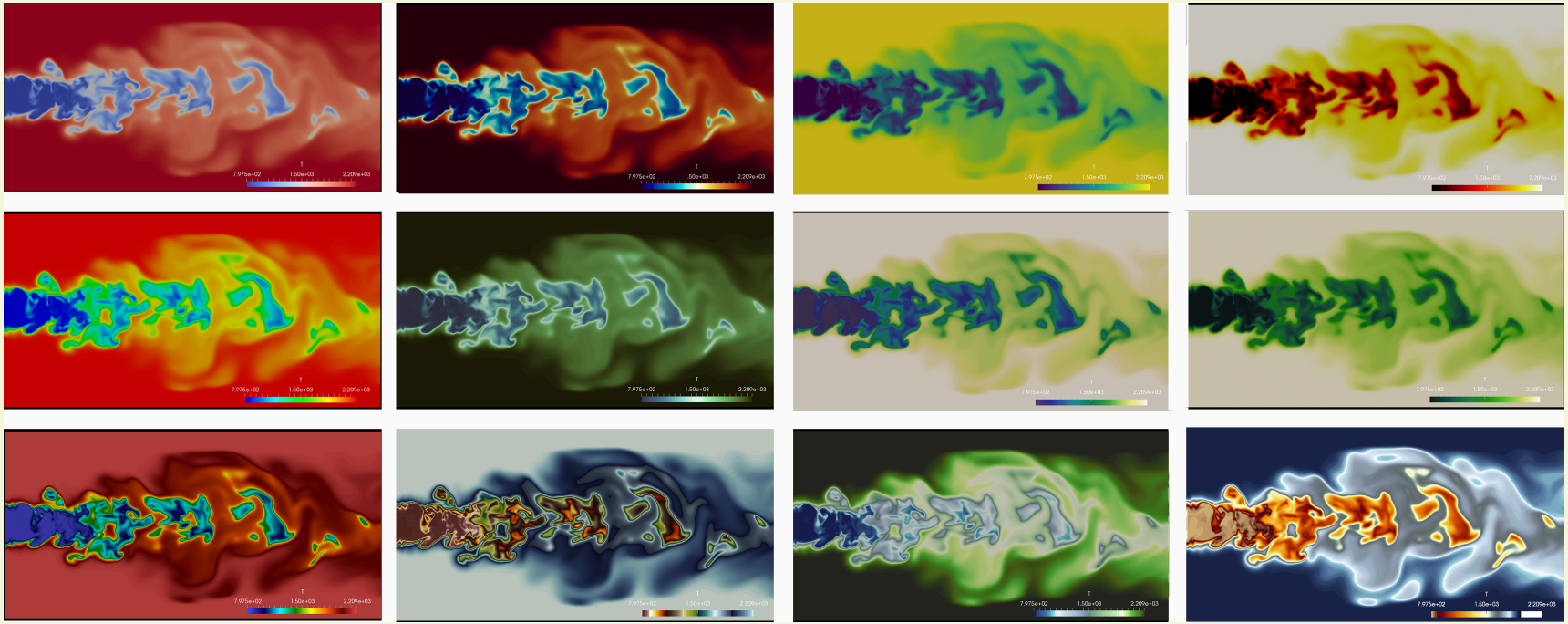


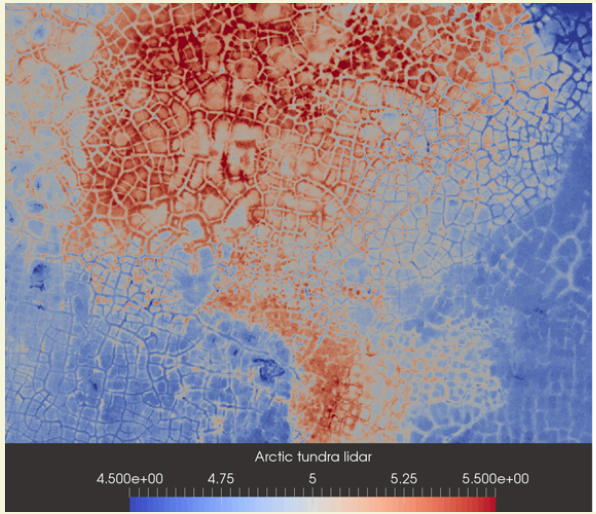
Blue2, yel15, gray5



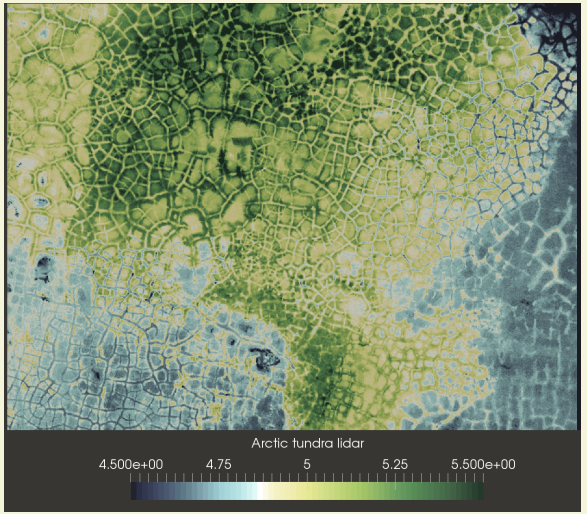
Feel the Wave!

Comparisons



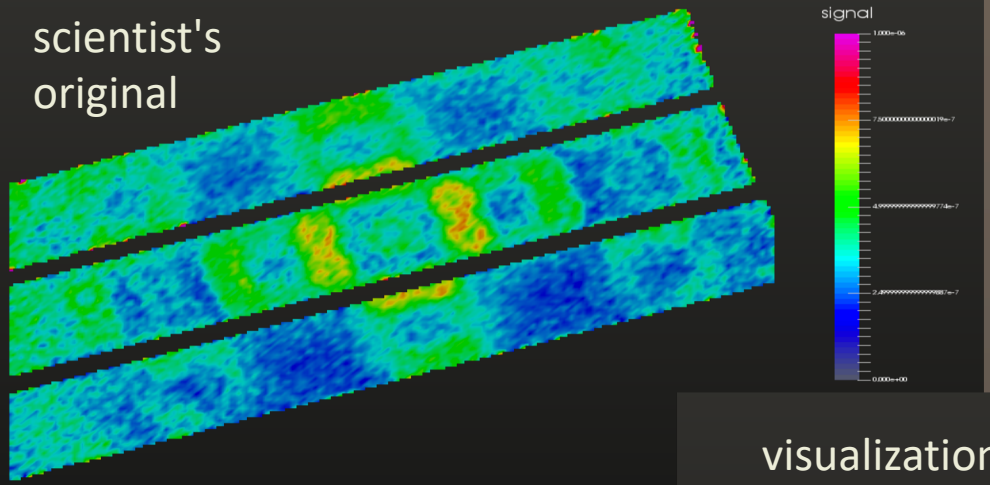

Arctic tundra lidar
4.500e+00
4.75
5
5.25
5.500e+00


Arctic tundra lidar
4.500e+00
4.75
5
5.25
5.500e+00


Arctic tundra lidar
4.500e+00
4.75
5
5.25
5.500e+00

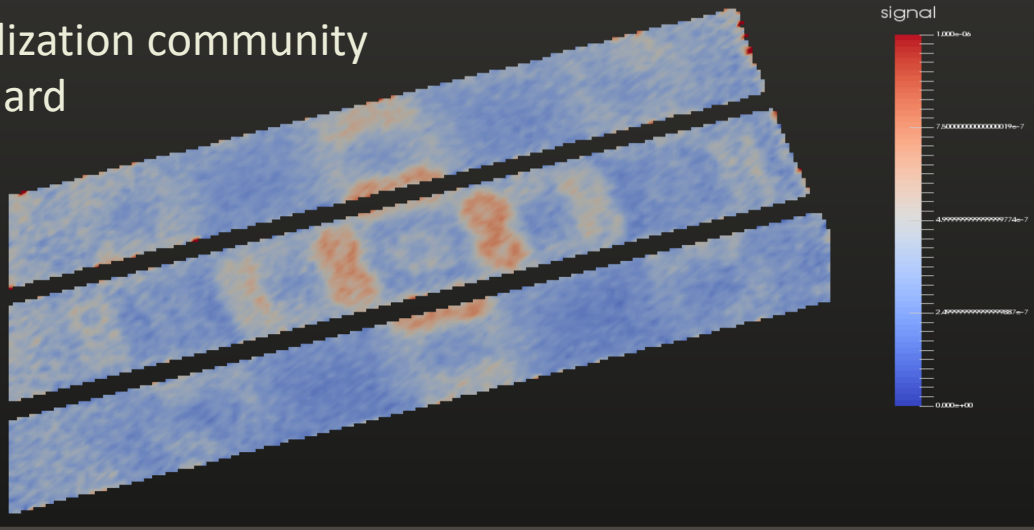
Intuition

scientist's original

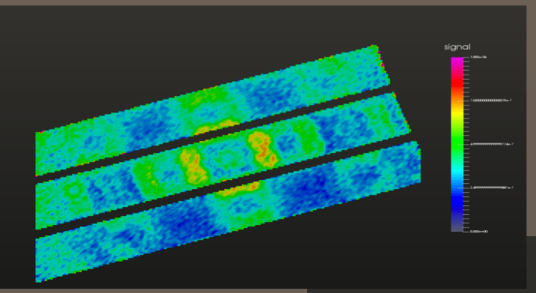


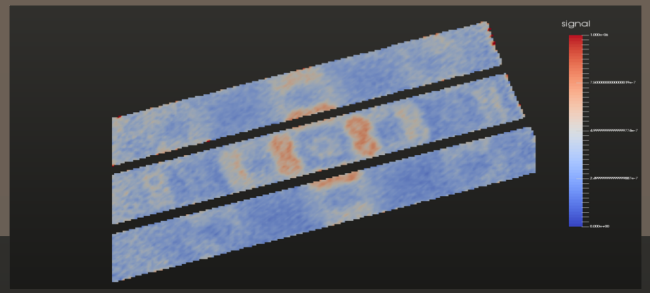
Our work starts with the scientist and their current needs.

visualization community standard



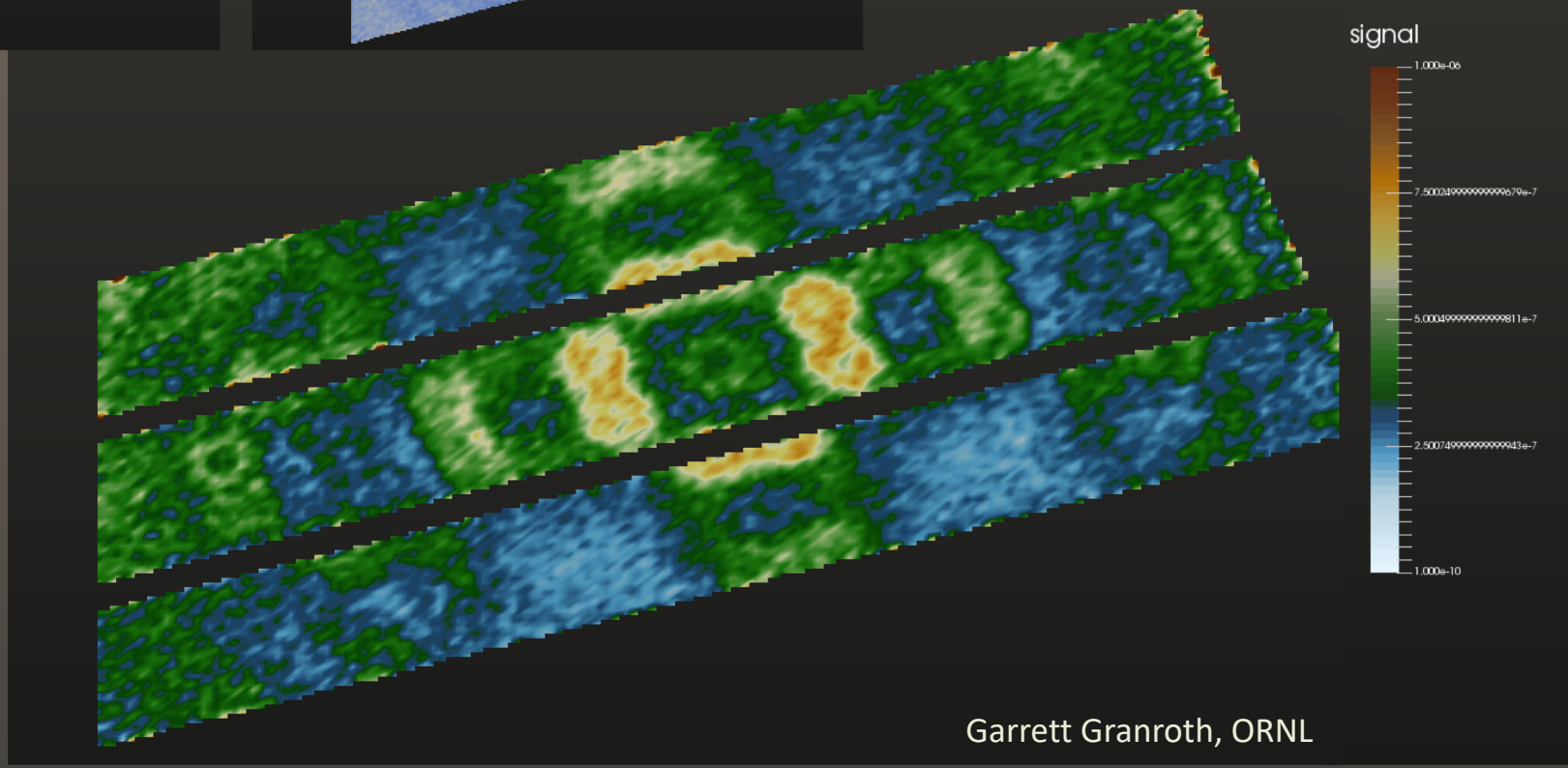
Garrett Granroth, ORNL





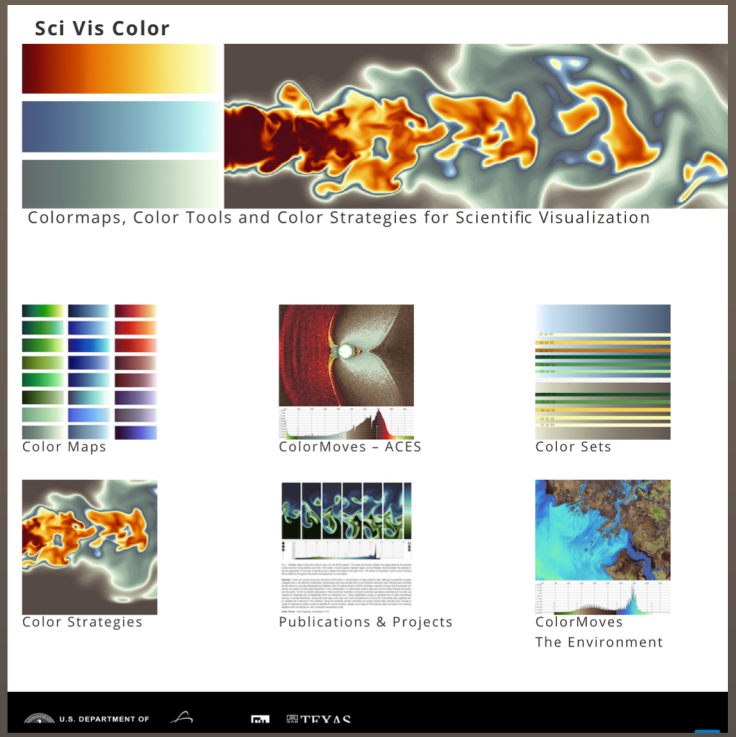
effective, quiet, harmony

exposing detail

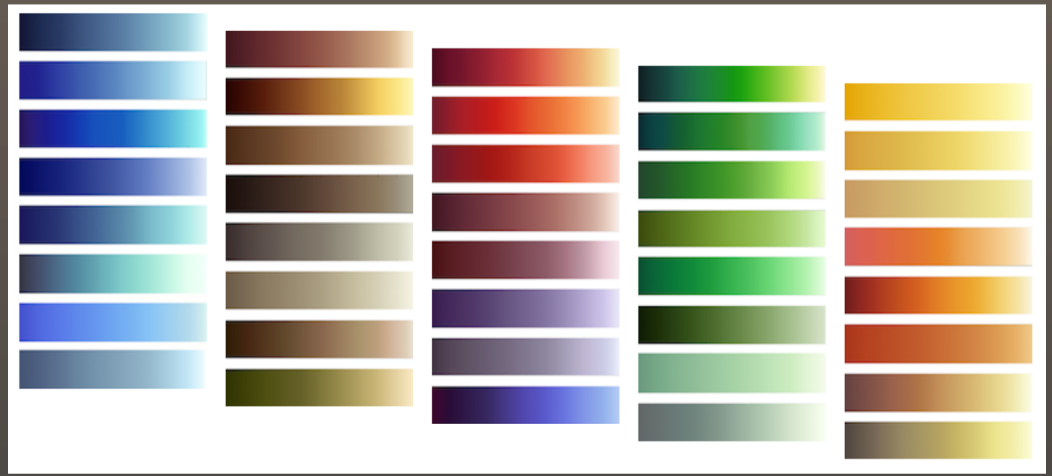


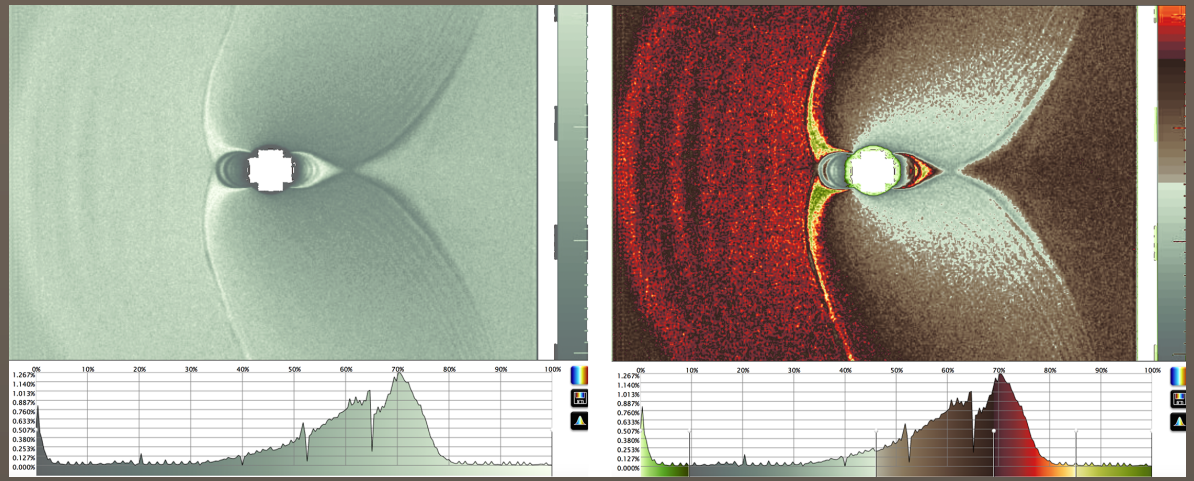
Garrett Granroth, ORNL

was very happy.

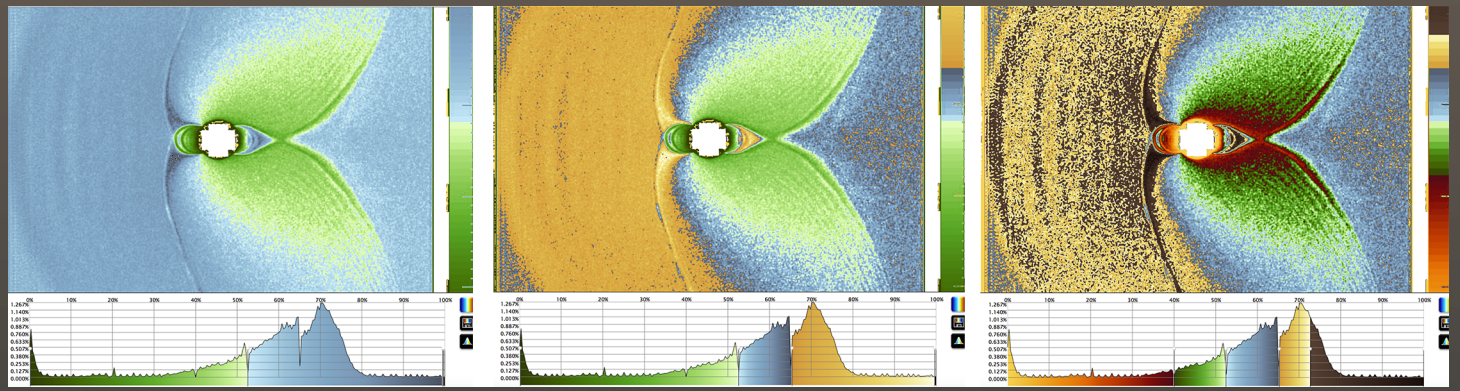


SciVisColor.Org

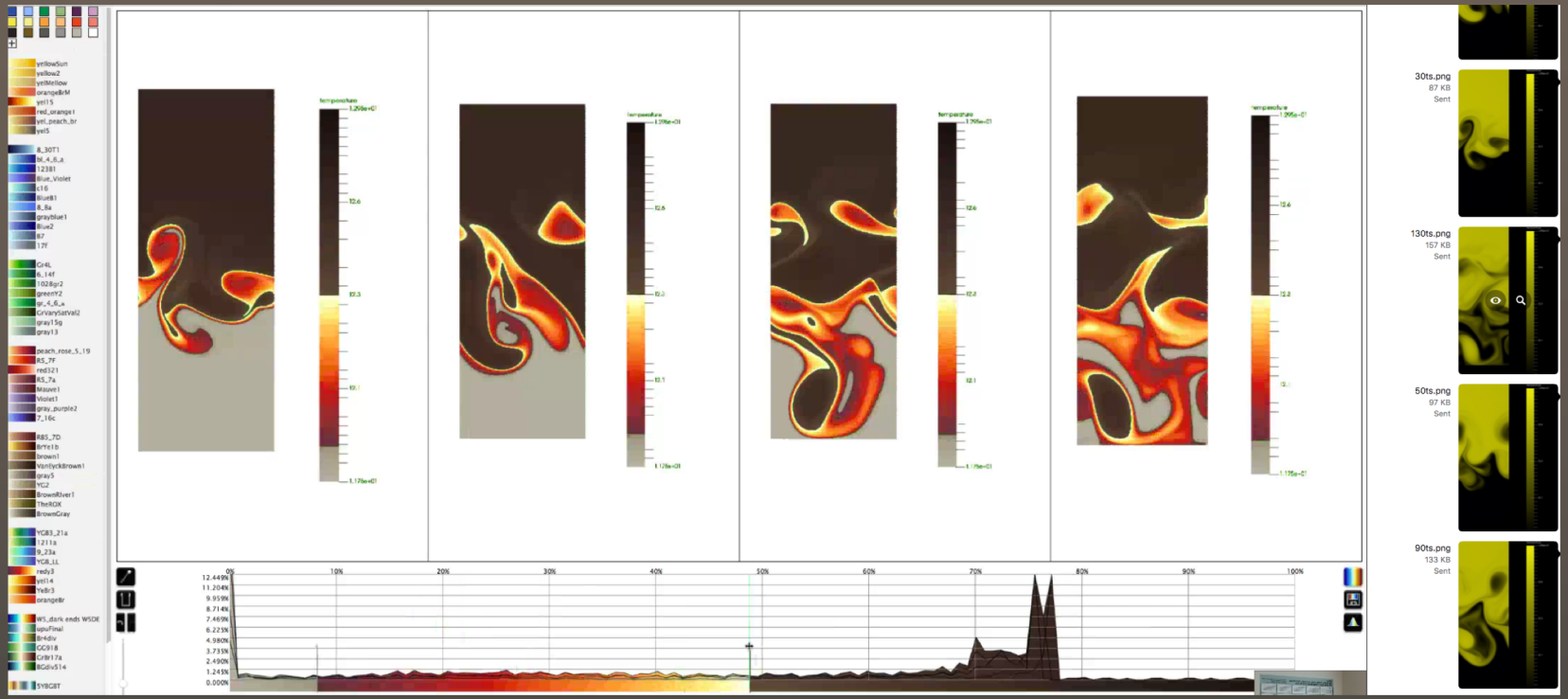


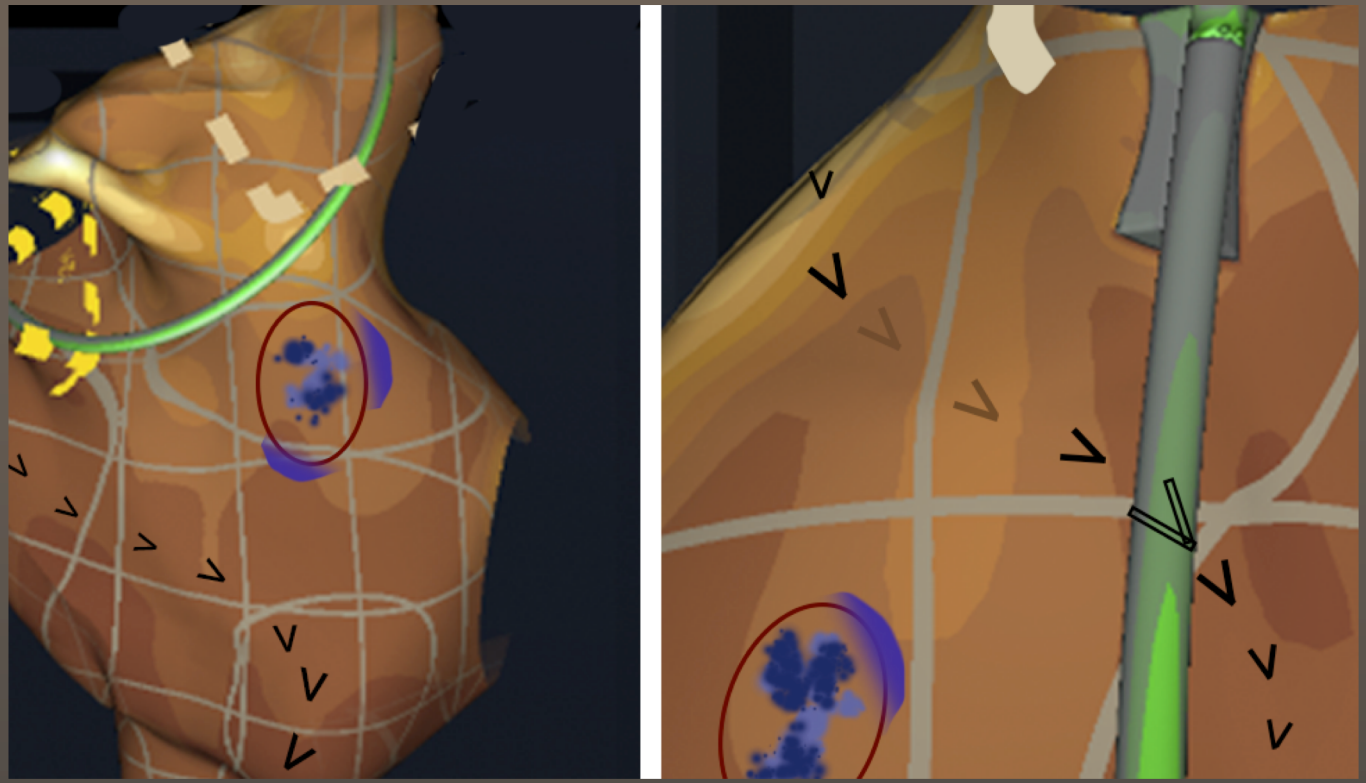


communication



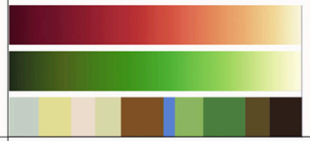
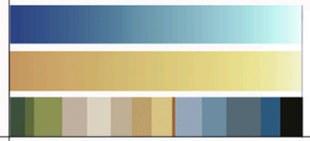
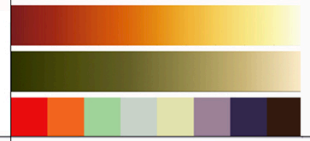
Good for working out colormaps for time-varying data.



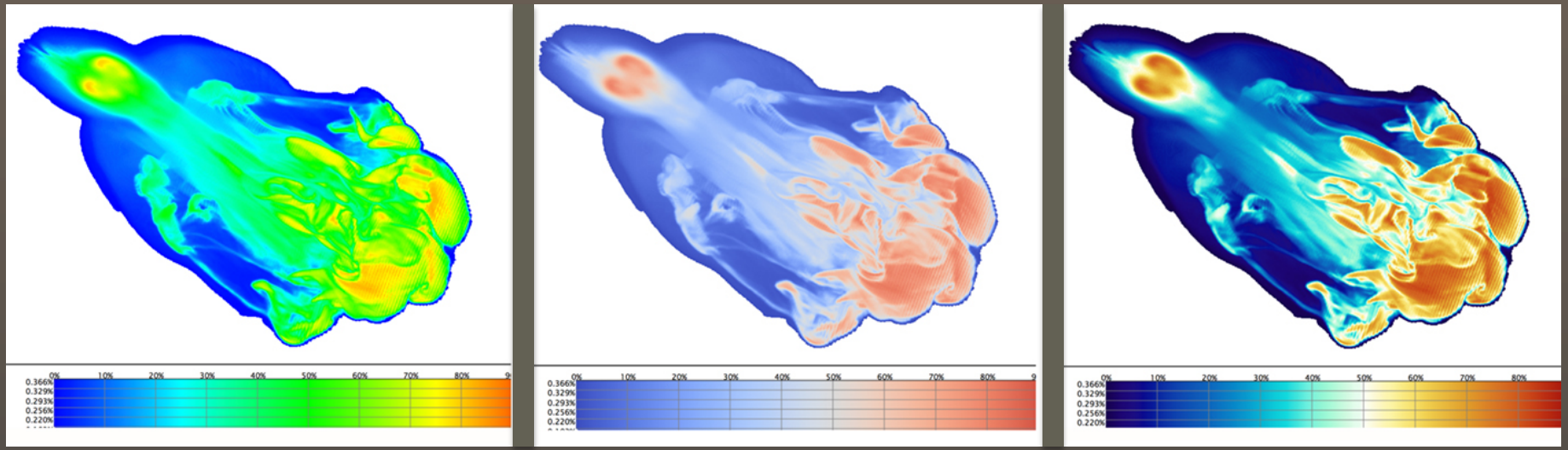


QUIZ TIME!

Can you name the types of contrast?

Artist	van Eyck	Manet	van Gogh	Picasso	Goya
					
data type	zero point data categorical data	continuous data noisy data	three categories	hierachies of importance	low detail data
task	communication feature id	exploration	communication	feature id communication	communication
affect	serious	calm	exciting		negative
color structure	categorical, context	equally important	two categories	hierachical importance	low levels of detail
color contrast	cool warm, saturation value, complimentary	analogous	secondary triad cool warm	cool warm, saturation hue	hue, saturation

And then there is one's funding….



…. and like it or not, impact matters.

Your friends:

SciVisColor.org

kuler from Adobe

figs@cat.utexas.edu

ccctool.com