Color theory - creating clarity without cacophony.

Feature resolution
Attention direction
Ease of exploration
Clear communication
Affective visualizations
Types of color contrast

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

Color CONTRAST Theory

- cool / warm
- complimentary
- analogous
Hue, Saturation and Value --
The language of color theory.
The human context for color.
Types of color contrast

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Color CONTRAST Theory

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

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

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Use it wisely.

**Less is more.**
Color contrast provides the content

M. Larsen, LLNL
Colors Interact
It is not the hues themselves but the relationships.
Tuning your colormap to:
see more data;
more clearly and;
communicate to others
more effectively and efficiently.
Simultaneity in discrete palettes
Creating an environment for contemplation

Contrast
providing clarity
without cacophony.
Neutral hues

A little color goes a long way

Grays frame the focal hues.
Focus Attention

Principles:

1. Value Contrast is the most powerful type of contrast.

2. Less is more. Use neutrals for contextual information.

Place the contrast where you need it, using only as much as you need.
Contrast Allocation
Place the contrast in the regions of interest.

Common default colormaps

Not all data benefits from a custom colormap, but some do. Be aware of the gains and loses.
Contrast in the Focal Areas

ColorMoves:
Interactive allocation of contrast

Finding the optimal data range

The interactivity enables the fidelity of control.

https://sciviscolor.org/ColorMoves
Hierarchy of Attention

1. Saturation levels direct attention

2. Hue contrast

1. focal area
2. relevant
3. contextual

To come: Addressing colorblindness
Three data categories:
1. Optimal location for algae growth
2. Algae will not grow
3. Open ocean
1. Value Contrast is the most powerful type of contrast.
2. Less is more.
   Use neutrals for contextual information.
Artists closely the location, proportion, distribution of hues and types of contrast to direct attention and convey content.

The Arnolfini Wedding Portrait
Van Eyck, 1491

Types of color contrast

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1. Value
2. Complimentary, Cool Warm
3. Analogous
4. Associative / Semantic
Analogous color Saturation and value

Complimentary color

Multiple types of contrast allocated for clarity
Align the contrast with the goals of the visualization, using only as much contrast as you need.

1. Value contrast is the strongest type of contrast and the most intuitive for scalar data.

2. Less is More.

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.
Recommended Starting Points

Wave colormaps - Providing a starting point

Internal confinement fusion

Matthew Larsen, LLNL
Colormap Selection

One-size does not fit all.

Software needs to offer more than defaults.
Tracking data over time

Selecting focal areas to track over time

M. Larsen

ColorMoves
SciVisColor.org
Cool - Warm Contrast

Use cool warm and value contrast to select background hues, neutrals are best.

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.
Hue Contrast

1. Primary hues provide the strongest contrast.
2. Hues have inherent hierarchy.

3-Dimensional Vis

contextual color

Focal point:
- Warm hue range
- High saturation
- Use of semantic color
3D Data, single variable

Many choices:
- volume,
- slices, isosurfaces
- streamlines
- opaque, transparent
glyphs or points

Start with
THE GOAL.

Experimenting with the opacity distribution is key.
Volume Rendering

Some colormaps work well for specific uses.

This colormap works well for many volume renderings because of the combination of multiple light hues and the intuitive continuous scale.
From the scientist...

Same data...
Employing volume rendering, opacity and color theory!

Galen Gisler, LANL
Beautiful?

There is a reason why we identify certain images, environments, etc., as beautiful.

It has to do with balance and harmony.

It engages and makes you want to linger.
2D representation of sampled Gulf of Mexico biogeochemistry data sampling enabling multiple volumetric data variables to be rendered clearly in a 3D representation
SciVisColor: Color Tools and Strategies for Scientific Visualization

SciVisColor.org
Constructing colormaps tuned to the data structures and visualization tasks.

Commonly used cool warm colormap
Exports .xml or .json
And .png of the colormap

Exporting from ColorMoves
Applying to data

ParaView color editor
Imports .xml
Moving forward.....

**Goals:**

Easy to use solutions.

Color flexibility incorporated into the visualization program.

Provide guidance.

Easy saving and storing of past colormaps and sets.

**Automating the color selection:**

many approaches, not much research.

specifically......
Color is powerful but complex. It is all about relationships.

How do you provide the ability to quickly and easily apply appropriate color maps and palettes internally within the visualization tool?

How do we help guide selection?

How do we provide enough but not too much flexibility?
Provide Context and Wonder

Topping
a shaky rise I see

translated the results
of a wrong kind of living
– new muddy lagoon,

your calved bergs blue messengers praying they are arks.

AGU funded work with Michael Smith, poet.

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SciVisColor.org