

Recommended Practices in WRF Visualization

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Overview

Tools

Color

Map Projections

Vapor Demo

NCAR
UCAR

Click to add footer

Overview

Tools

**That are free
That you can run
That you can can build**

Color

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UCAR

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Overview

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Color

**Color maps
General**

guidelines

Map Projections

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NCAR
UCAR

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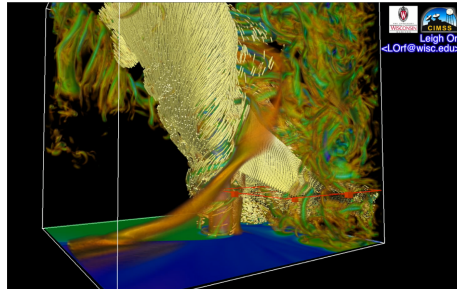
Vapor 2

Vapor 3

ParaView

VISIT

Blender



- Native support for WRF
- Interactive data model (VDC)
- Very feature rich

Tools

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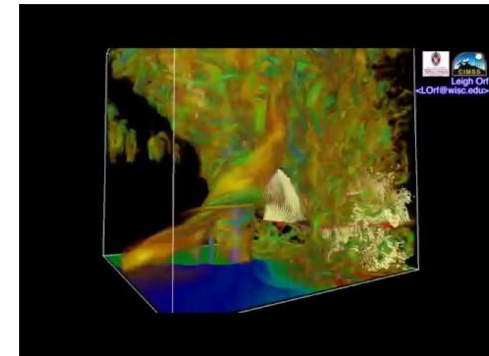
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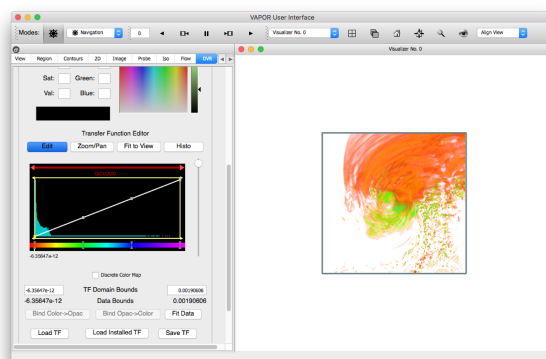
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Difficult User Interface

Tools

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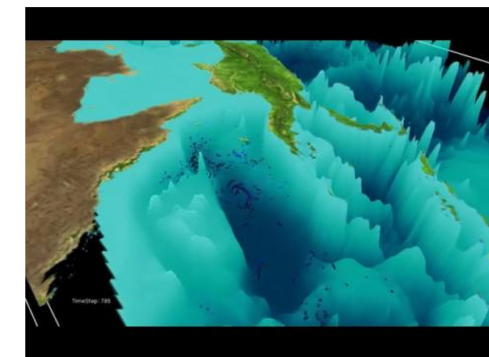
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Reinterpolated Grid :(

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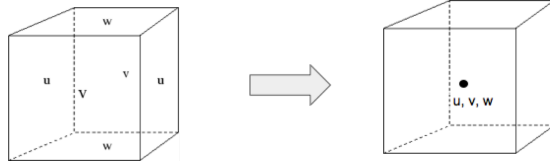
Vapor 2

Vapor 3

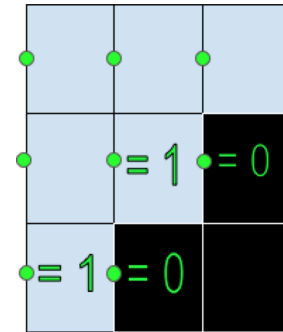
ParaView

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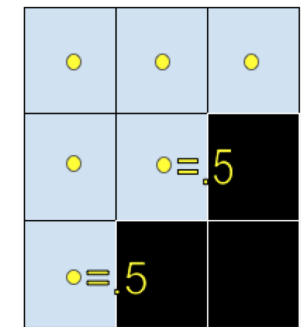
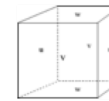
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Reinterpolated Grid :(



model output for U



Interpolation onto single grid

**u is now non-zero
at the boundary!**

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Download: <https://sgppearse.github.io/VAPOR-Sphinx/downloads.html>



- Caters to WRF and MPAS
- Intuitive UI
- Interactive
 - Data model (VDC)
 - Ray caster

Tools

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Vapor Demo

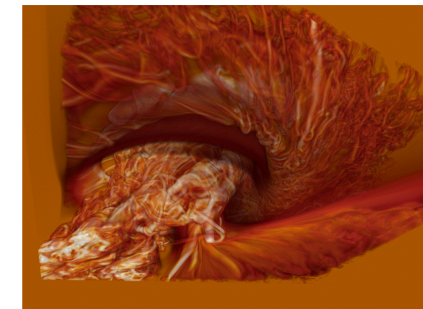
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To contribute:

- [www.github.com/NCAR/VAPOR](https://github.com/NCAR/VAPOR)
- Clone the repository
- Make a branch, and submit a PR

Tools

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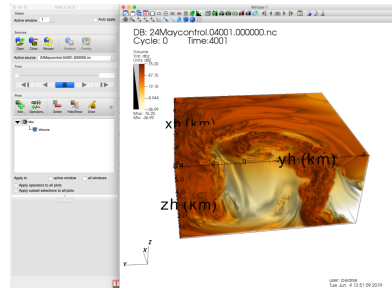
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- Support many grids and data formats
- Parallel rendering
- Distributed rendering
- Many volume rendering methods

Tools

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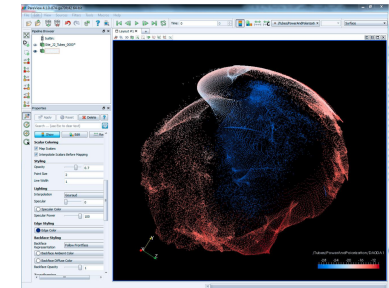
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- NVIDIA Index Volume Rendering
- Ospray
- Parallel rendering engine
- In-situ visualization

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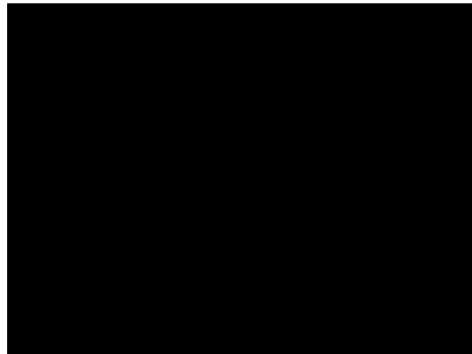
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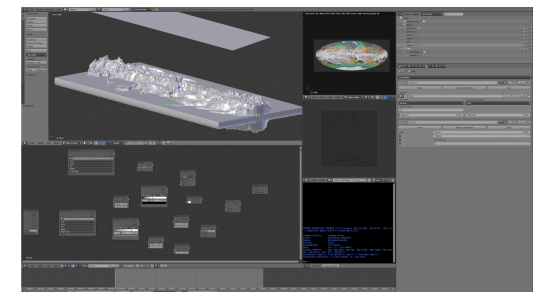
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Pros	Cons
Rich feature set Cinematic quality renderings OpenVDB Volume Rendering	Gargantuan UI Very steep learning curve No native support for NetCDF

Tools

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Map Projections Vapor Demo

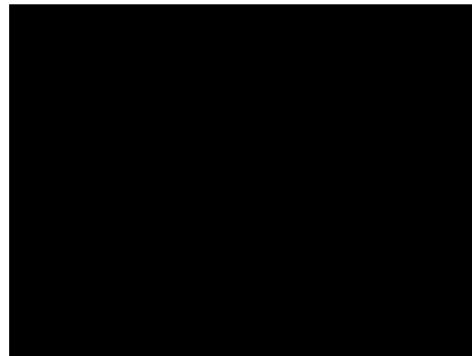
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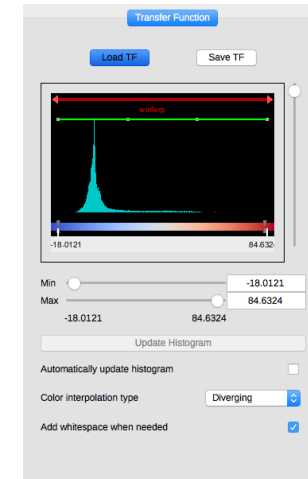
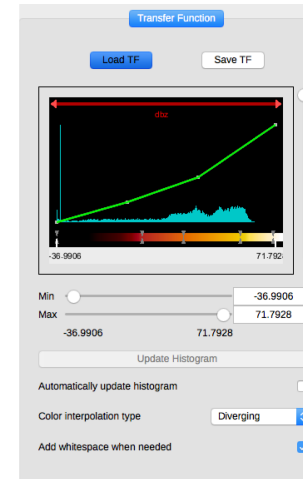


Warren Washington
Tyler Prize winning CESM simulation

Tools

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Hue = Color

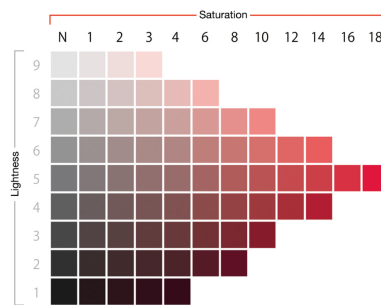
Saturation = Intensity of Color/Hue

Value = Intensity of light

Lightness

Brightness

Tone



Munsell chart

Tools

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Cynthia Brewer:
Professor of geography at Penn State

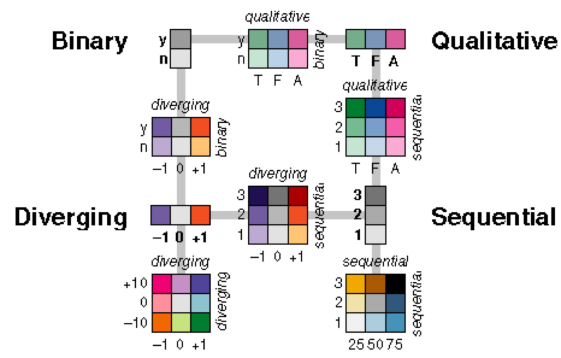
Design consultant for:

- US Census Bureau
- National Cancer Institute
- National Center for Health Statistics
- National Park Service



<http://colorbrewer2.org/>

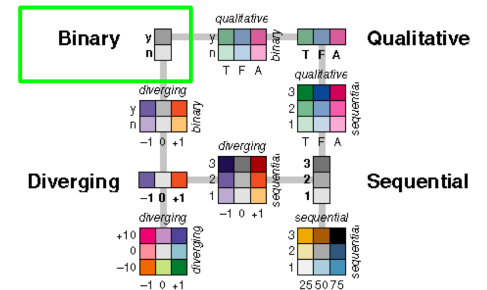
Tools Color Map Projections
Vapor Demo



Tools Color Map Projections
Vapor Demo

Binary schemes show differences that are divided into two categories.

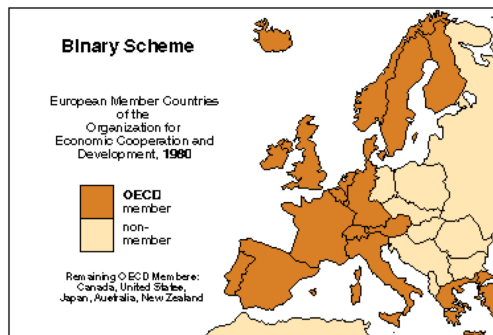
The difference between the two categories may be a lightness step.



Tools Color Map Projections
Vapor Demo

Binary schemes show differences that are divided into two categories.

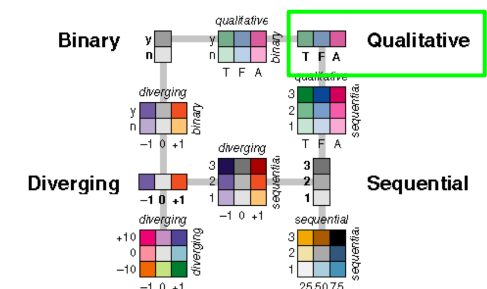
The difference between the two categories may be a lightness step.



Tools Color Map Projections
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Qualitative schemes use differences in hue to represent in kind.

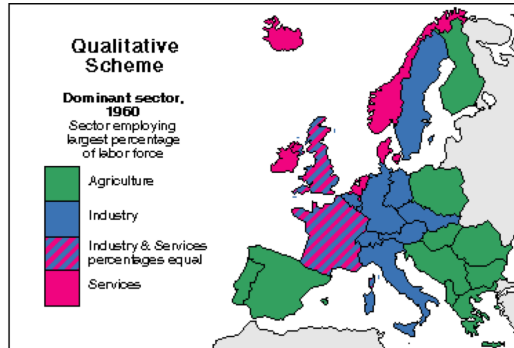
The lightness of the hues used for qualitative categories should be similar but not equal.



Qualitative:

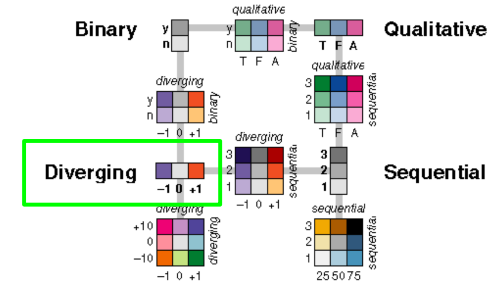
Assign the lightest, darkest, and most saturated hues in the scheme to categories that warrant emphasis on the map.

IE - Data about land use.

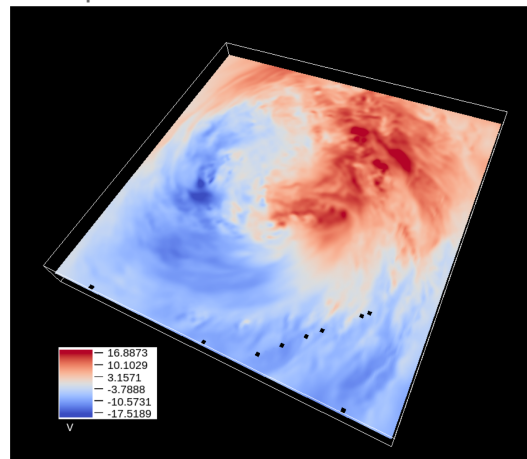
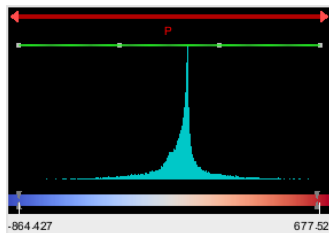


Diverging schemes emphasize the data's change outward from a critical midpoint.

These are based on two different hues that meet at the lightly colored midpoint.

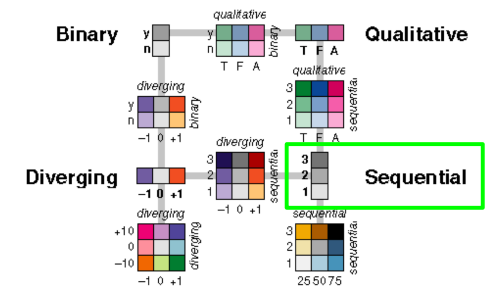


Modal distributions
almost always need to
be mapped with
diverging schemes.



Sequential data classes
are logically arranged
from high to low.

This sequence of categories should be represented by sequential lightness steps.

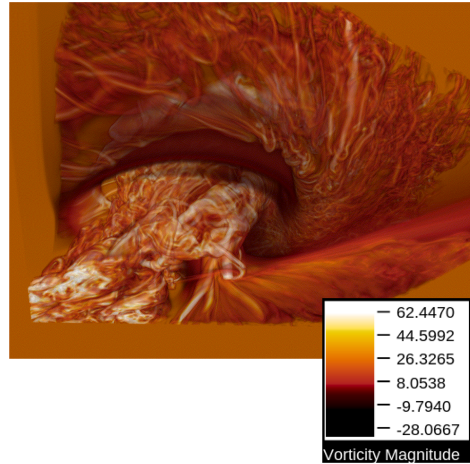
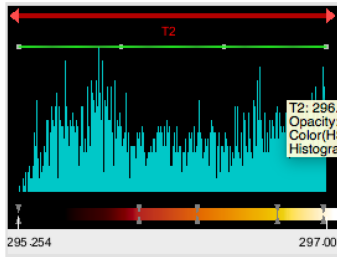


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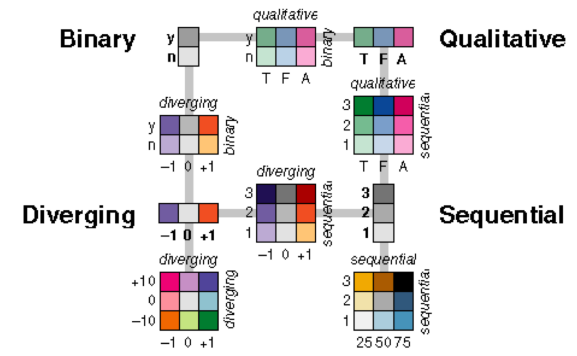
Sequential data classes are arranged from high to low. This should be represented by sequential lightness steps.



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<http://colorbrewer2.org/>

Tools

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Rainbow Color Map is Bad

Problem 1) The rainbow colors do not follow any natural perceived ordering.



Tools

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Rainbow Color Map is Bad

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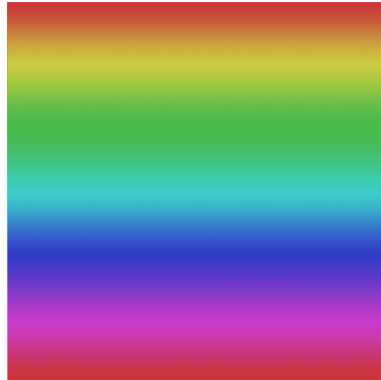
Tools

Color

Map Projections
Vapor Demo**Rainbow Color Map is Bad**

Problem 2) The perceptual changes in the rainbow colors are not uniform.

The colors appear to change much faster in the yellow region than the green region.



Mach Banding

Tools

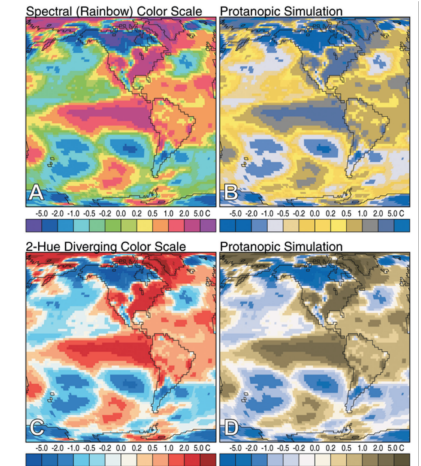
Color

Map Projections
Vapor Demo**Rainbow Color Map is Bad**

Problem 3) It is sensitive to deficiencies in vision.

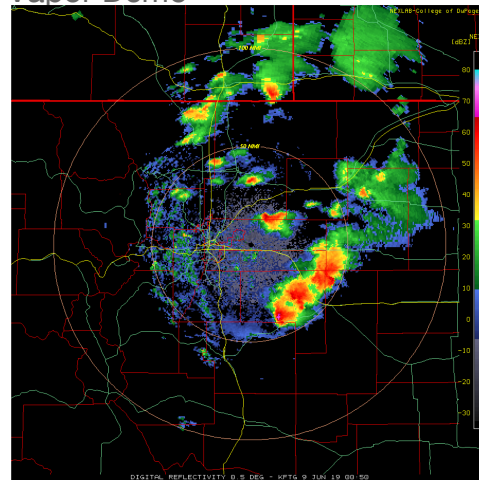
Roughly 5% of the population has deficiencies in distinguishing these colors (usually between green and red).

These viewers will misinterpret much of the color map



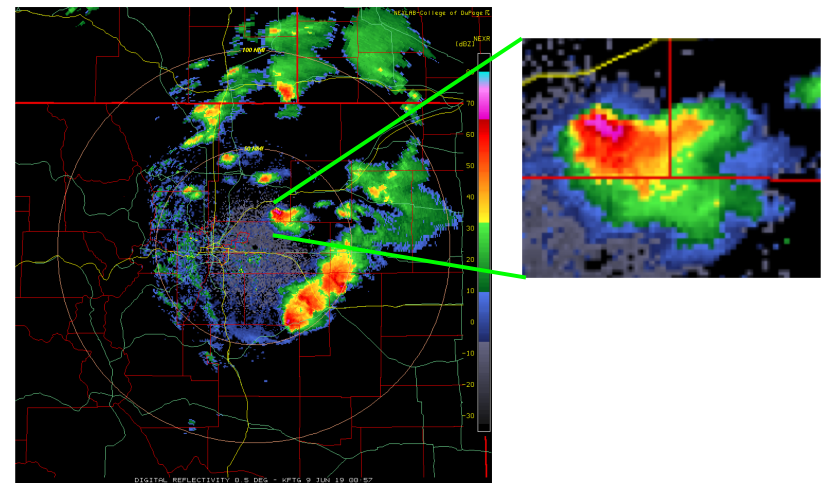
Tools

Color

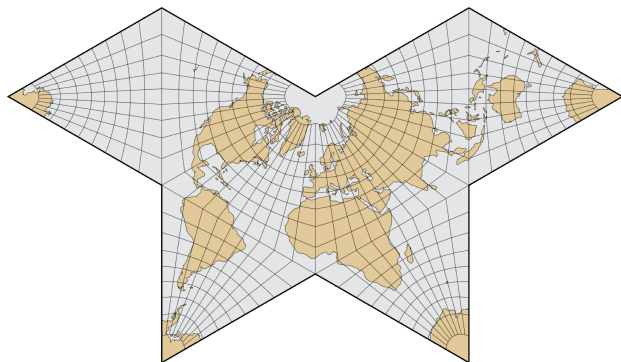
Map Projections
Vapor Demo
<https://weather.cod.edu/satrad/nexrad>

Tools

Color

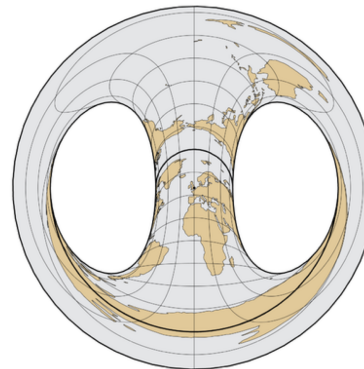
Map Projections
Vapor Demo

Tools Color **Map Projections**
Vapor Demo



Gnomonic Butterfly
Great Circle segments are straight lines

Tools Color **Map Projections**
Vapor Demo



Hammer Retroazimuthal

Tools Color **Map Projections**
Vapor Demo

If reprojecting your model data:

The input data should *also* be transformed in a spherical coordinate system before being used by WRF.¹

Reprojection can be done with:

- Vapor
- Python: Qhull library
- NCO: ncks operator

¹ Monaghan et al. 2012: Overlapping Interests: The Impact of Geographic Coordinate Assumptions on Limited-Area Atmospheric Model Simulation.

