Effective Visualization of Radar Data for Users Impacted by Color Vision Deficiency

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Color Vision Deficiency

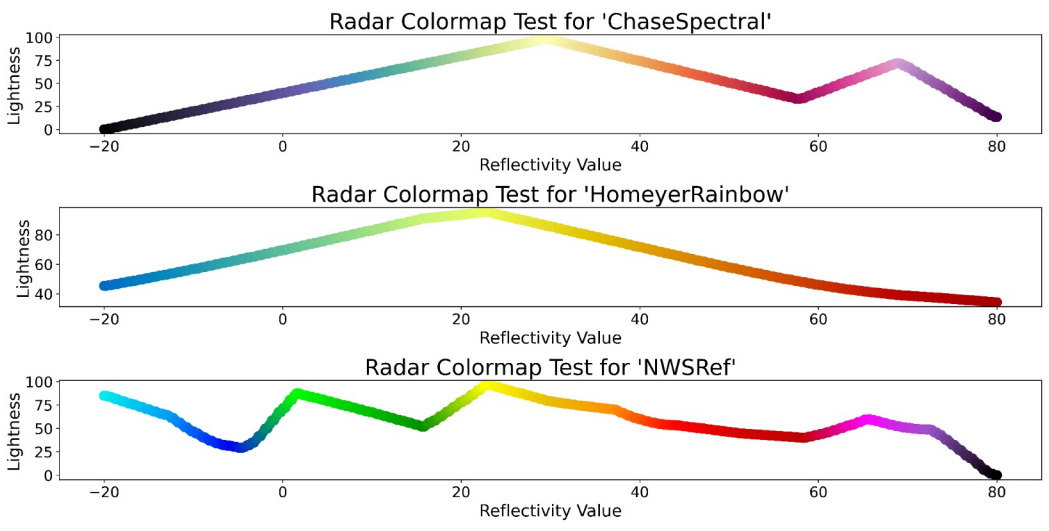
- Color Vision Deficiency (CVD) is a decreased ability to discern between particular colors.
- 8% of genetic males and 0.5% of genetic females have some form of CVD, with many in the radar community falling into this group.
- The four types of red-green CVD are deuteranomaly which makes green look more red, protanomaly which makes red look more green and less bright, and protanopia and deuteranopia which make green and red indistinguishable (Sharp et al. 1999; Neitz et al. 2011).
- There are also two types of blue-yellow CVD. Tritanomaly makes it difficult to distinguish between blue and green as well as between yellow and red. Tritanopia makes the individual less able to distinguish between blue and green, purple and red, as well as yellow and pink (Sharp et al. 1999; Neitz et al. 2011).
- Complete color blindness is also possible, but quite rare.

Current Radar Colormaps

- Perceptual uniformity is when changes in color and data values are weighted equally and thus do not create artificial structure (Crameri et al. 2020).

- Colormaps should also have perceptual order or lightness that increases linearly to avoid perception of artificial gradients and to ease comparison of significant values (Crameri et al. 2020).

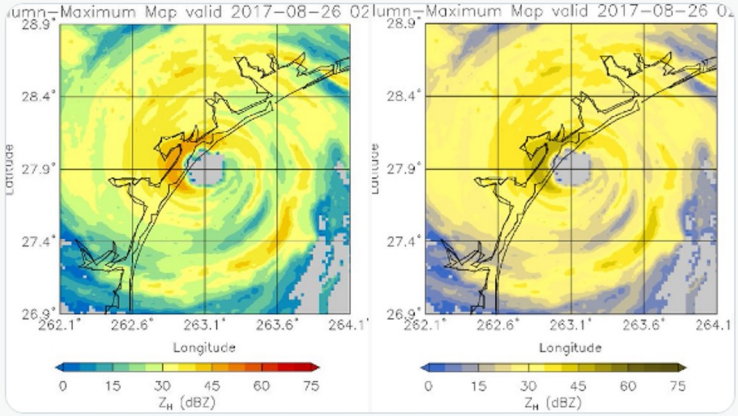
- The colormaps used in the radar community, such as the National Weather Service (NWS) reflectivity colormap, use uneven gradients and include green and red colors with similar lightness, which are not distinguishable for the majority of those with CVD.



From Twitter to GitHub a Discussion on CVD-friendly Colomaps

Cameron Homeyer
@AtmoScientist · **Follow**

As a follow up to yesterday's discussion, I took a crack at a perceptually uniform rainbow by navigating through the LUV space. I think it provides nice color and discrimination. First image is the original, second is through a color-blind lens. This may be a nice compromise...



11:04 AM · Feb 22, 2018

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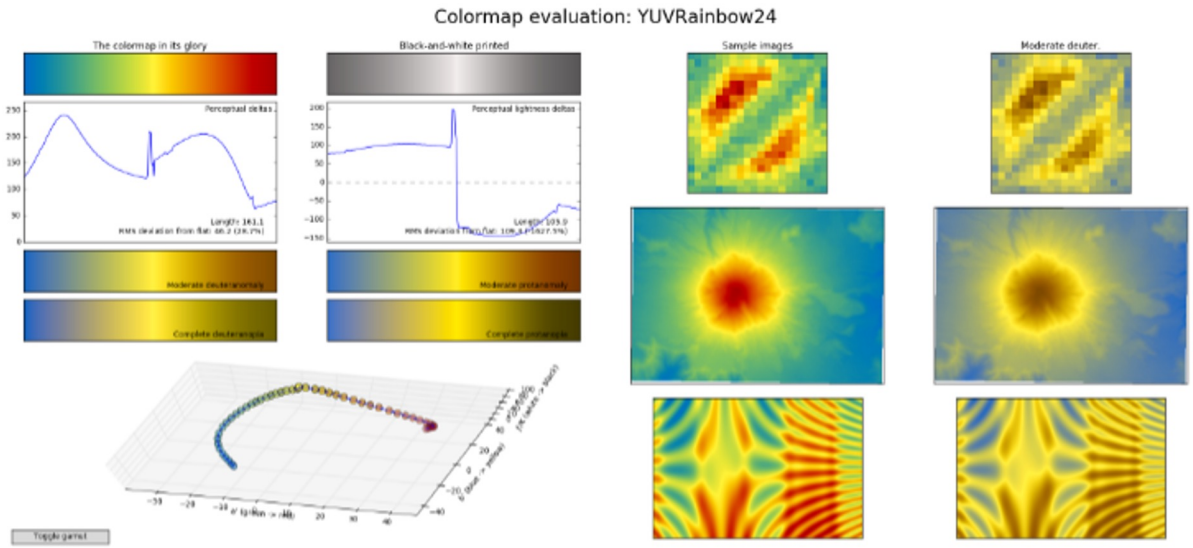
From Twitter to GitHub a Discussion on CVD-friendly Colomaps

rcjackson commented on Feb 28, 2018 — Member

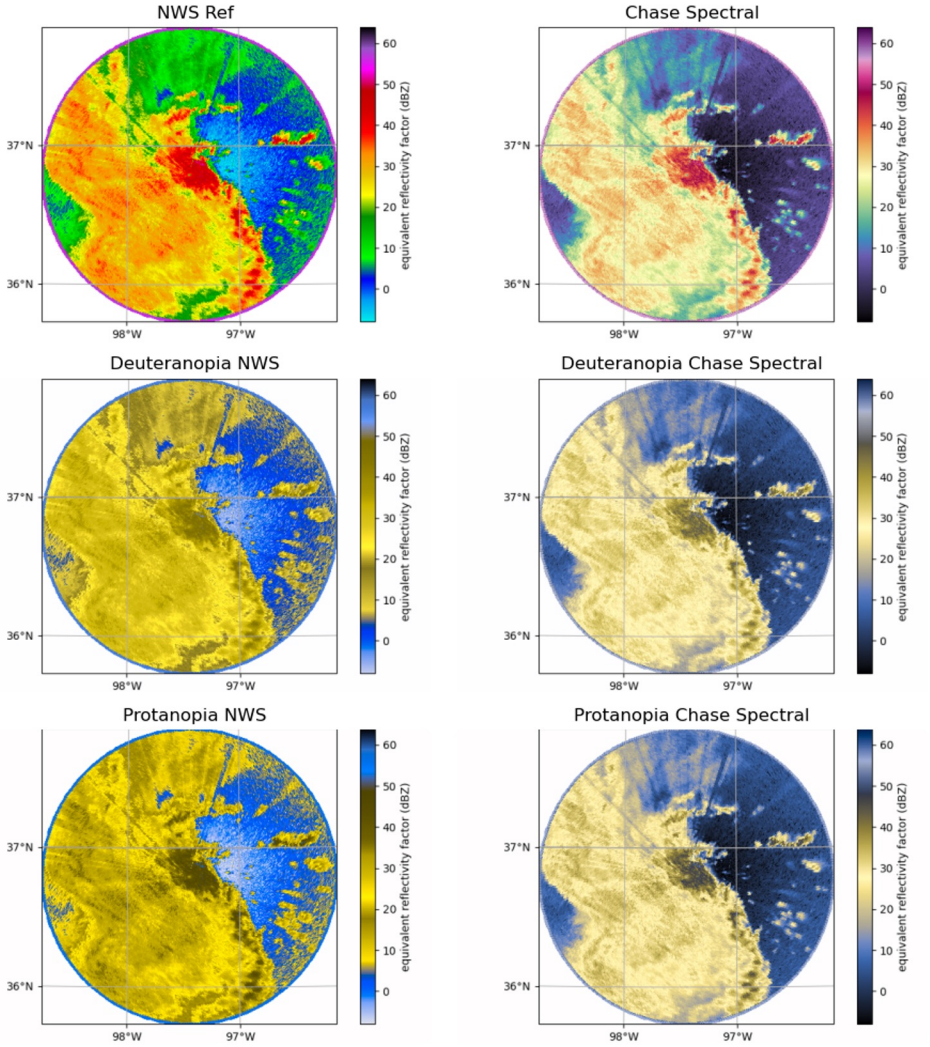


Seam is gone @CameronHomeyer

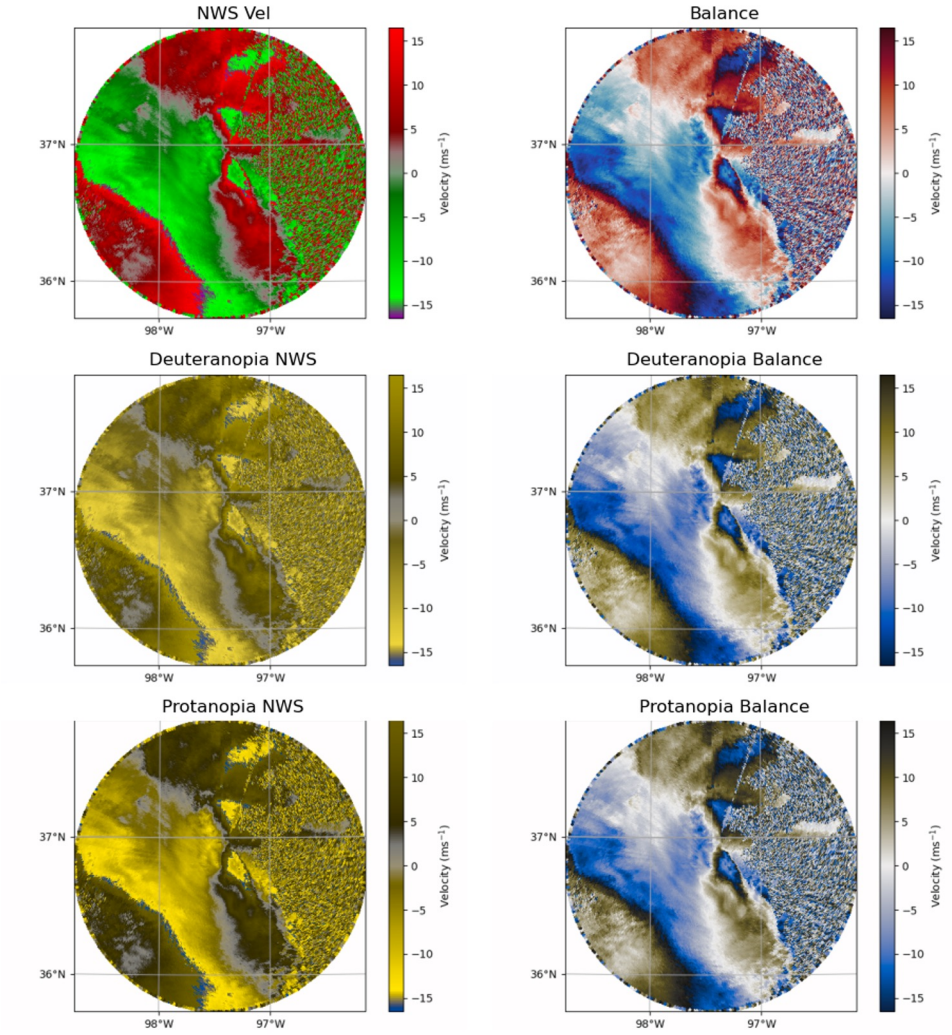
CameronHomeyer commented on Feb 28, 2018 • edited

Looks great @rcjackson! Thanks again for making this work. The green/yellow transition looks to be in the midpoint here, note that I've moved it to the two-fifths position in my updated version. Not a big issue, but useful when the reflectivity scale is 0-75 (my default). Could easily use this as is with a 0-60 range and get the same 30-dBZ transition

CVD-friendly Reflectivity Colormaps Comparison



CVD-friendly Velocity Colormaps Comparison

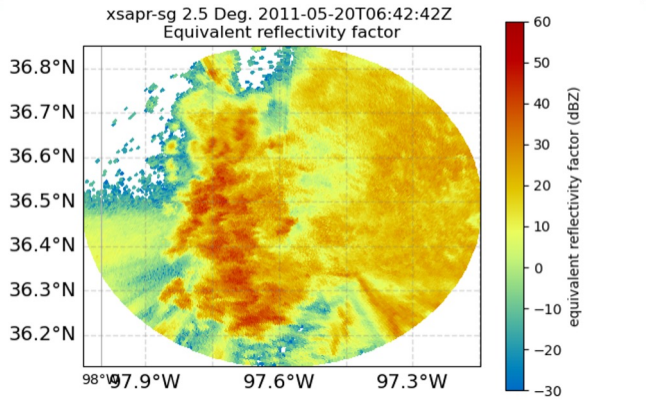


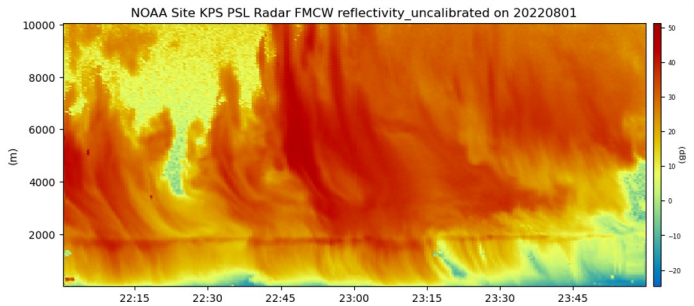
(Thyng et al. 2016)

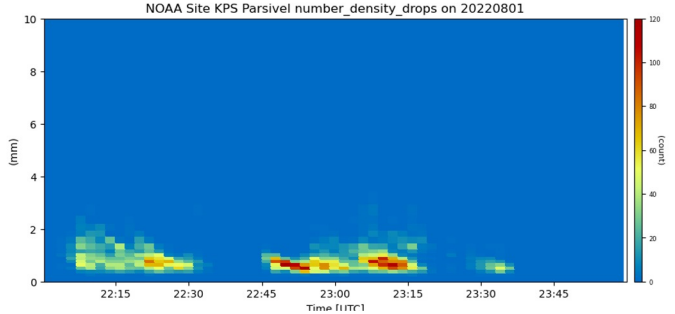
A Package for CVD-friendly Colormaps

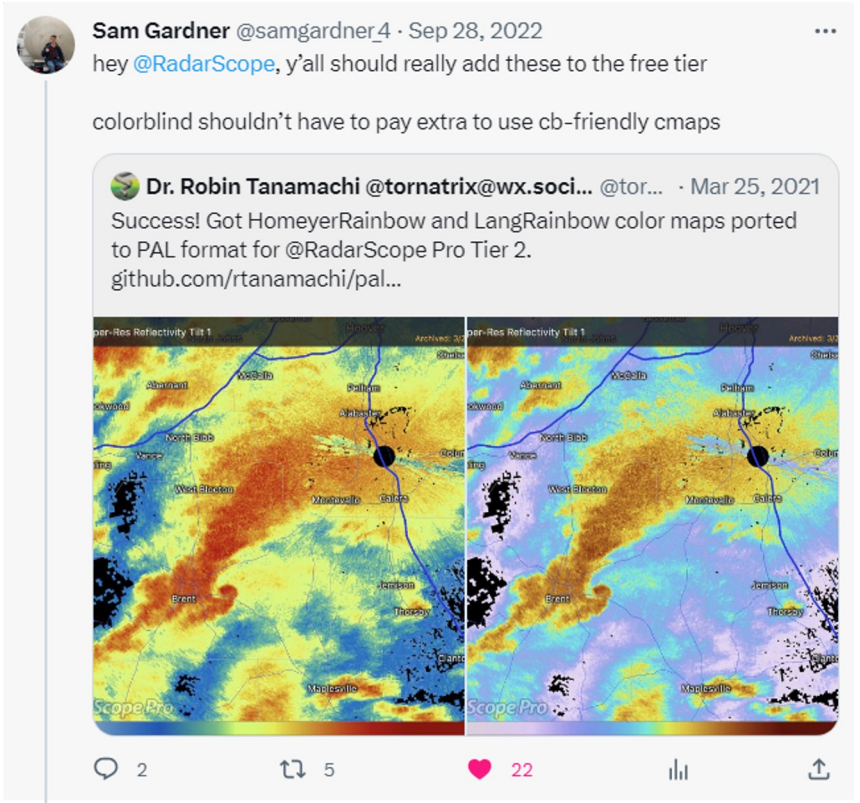
- After working with the community, multiple CVD-friendly colormaps were created.
- These colormaps were originally added to Py-ART.
- After some discussion, we realized the amount of individuals using the colormaps were growing and we needed a better place for these colormaps to reside.
- We created a package available on GitHub called cmweather to hold these CVD-friendly colormaps as well as other colormaps used within the atmospheric community.

A Package for CVD-friendly Colormaps



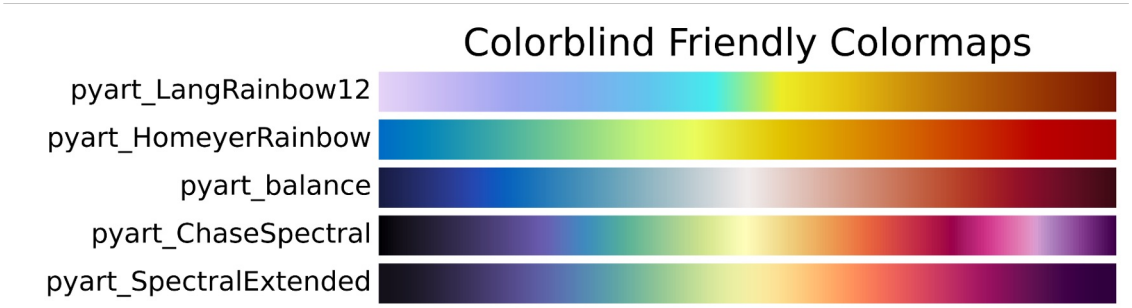






Future Plans

- Additionally testing on other weather events.
- Develop colormaps for other moments such as correlation coefficient etc.
- Paper in progress!
- Release cmweather on conda-forge and PyPI (soon)



Final Thoughts

- Our goal was to be more inclusive and have colormaps that could be used by the CVD community, while communicating the science accurately.
- We wanted these colormaps to be available for the community as a whole to use.
- Legacy colormaps will be still available such as NWS Ref etc in a lot of these open source packages.

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