

To: Reviewer No. 1

Re: Responses to Reviewer 1 (Dr. Fabio Crameri) Comments

Date: 19-Feb-2025

Dear Dr. Crameri,

Thank you for your constructive and beneficial but also thought-provokingly critical suggestions for revisions. Your suggestion (and explanation of why it was a major issue) to omit the "Turbo" colormap as well as the suggested idea (shared also by Reviewer 2) to alter Figure 1 and show colourblindness simulations of suggested colourmaps instead of multiple examples of the same colourmaps were particularly appreciated. I have revised the manuscript to follow your suggestions and edits, leading to improvements in content and clarity throughout. My responses are in **red text** with newly added or revised text in *italics* using **bold for emphasis**. I greatly appreciate your time and energy in reviewing our manuscript and providing your thoughtful perspective.

Sincerely,

Ben Hatchett

Reviewer 1 Summary: Inconsistencies and misuse of colour in pyrocartography (and beyond) is a major issue and needs to be tackled. This manuscript nicely tackles this problem and provides a clear solution to make understanding, communicating, and tackling fire hazard more accurate, effective, and accessible. I therefore think that it is a very valuable contribution to be published in Geoscience Communication. The article is clearly presented and only has some minor misrepresentation that I think should be fixed before publication.

Thank you for your positive remarks and for your highly constructive, thoughtful, and thorough review of the manuscript. All of this input improved the manuscript and I learned several new things.

I have one major issue: The colour map "Turbo" is presented and used as a perceptually uniform (and I guess colour blind friendly) colour map, which it is not. I think it should be omitted as a recommendation here (and elsewhere) to avoid further misconception about its properties. See a more detailed explanation below.

I appreciate the issue being raised about my initial misrepresentation of the 'Turbo' colormap. Following the reasoning provided by your comment, I have **removed the 'Turbo' colormap.**

I have one major suggestion: Would simulating and providing colour-vision deficient appearance (as is done for figure A1), and maybe even greyscale conversion, of figure 1 be useful for the purpose of the manuscript? – I think it would and attached some simulations (based on Brettel et al., 1997; happy to share adjusted figures for the author). That way, it would also become more clear that Turbo is not suited for a scientific application (repeated colours along the scale).

This is an excellent suggestion, which was also provided by reviewer 2, thus highlighting the value of performing the colourblindness simulation. I have followed this suggestion as it will

more strongly help to make the case of the manuscript as both reviewers noted. To keep the figure to a reasonable size, I opted to include the three colourmaps with no isochron (top row; given this is a noted suggestion in the main text) and with isochrons (next row) and show two colour-vision deficient appearances in the following two rows (deuteranopia and protanopia, respectively). Following the suggestion of reviewer 2, I include only one burn area (the Dixie Fire) in the main manuscript and moved the second example (the Rim Fire) to the appendix. I left out the greyscale simulation since the figures were becoming small but added a note to the text that the sequential maps work well for greyscale but the diverging Managua requires a fire origin and/or labeled isochrons to orient the direction of fire progression. New text:

”While the sequential colourmaps ”YlOrRd” and ”Batlow” print well in black and white, the diverging ”Managua” requires additional annotation (e.g., an origin point or labeled isochrons) to orient readers to the direction of fire progression.”

The new figures and their revised captions are shown on the next page:

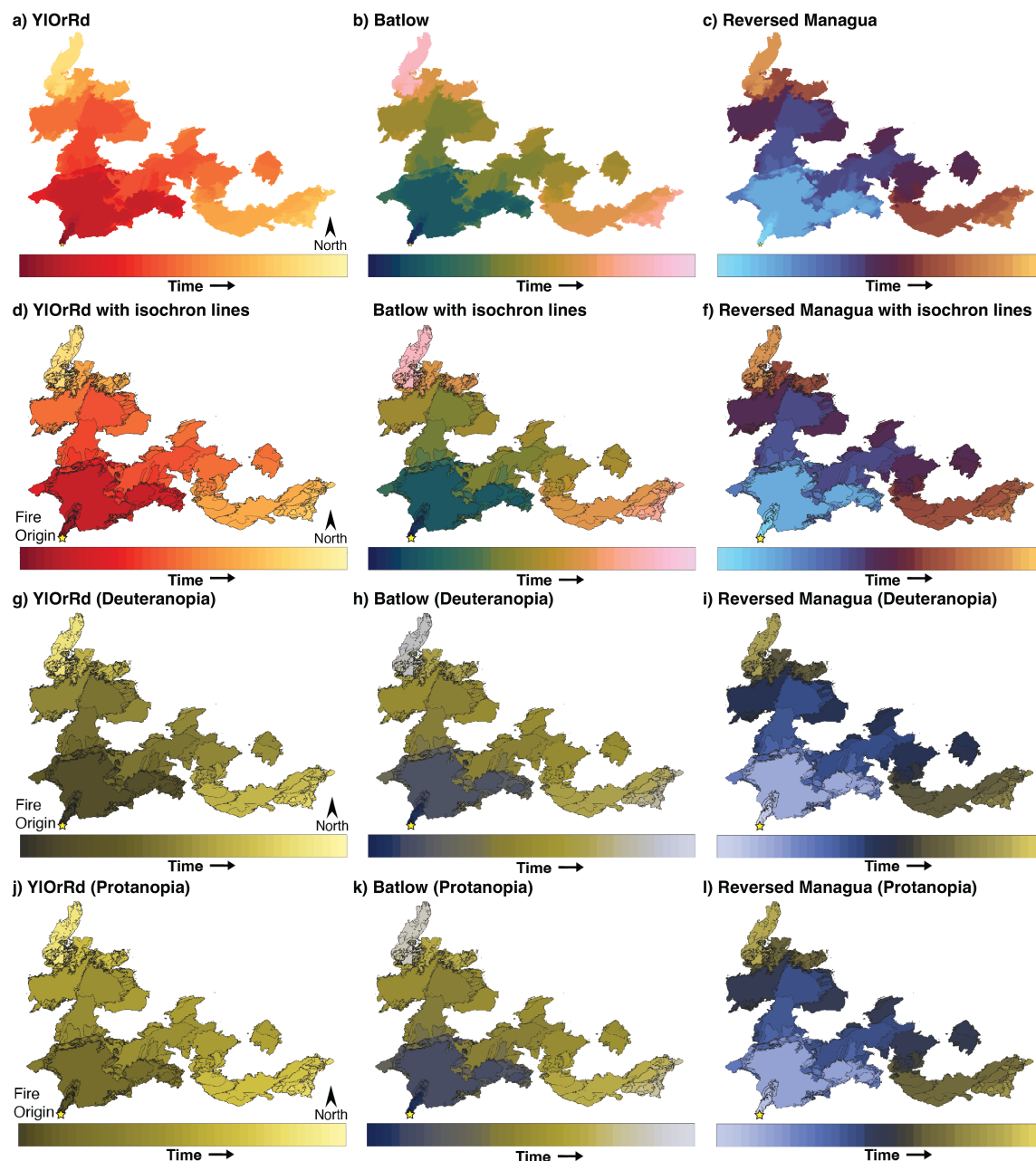


Figure 1: Revised Figure 1 (a-c) Daily fire progression maps of the 2021 Dixie Fire using three colourmaps that are accessible for colour vision deficient viewers and demonstrate a physically-intuitive sequential progression through time (i.e., older shown by cooler cooler colours and newer by warmer colours). (d-f) As in (a-c) but including isochrons. (g-i) Maps in (d-f) with deuteranopia (green-blind) colourblindness simulation. (j-l) Maps in (d-f) with protanopia (red-blind) colourblindness simulation. The yellow star denotes the fire origin location. ***Note the missing 'e)' label, I will fix this in the revised manuscript.**

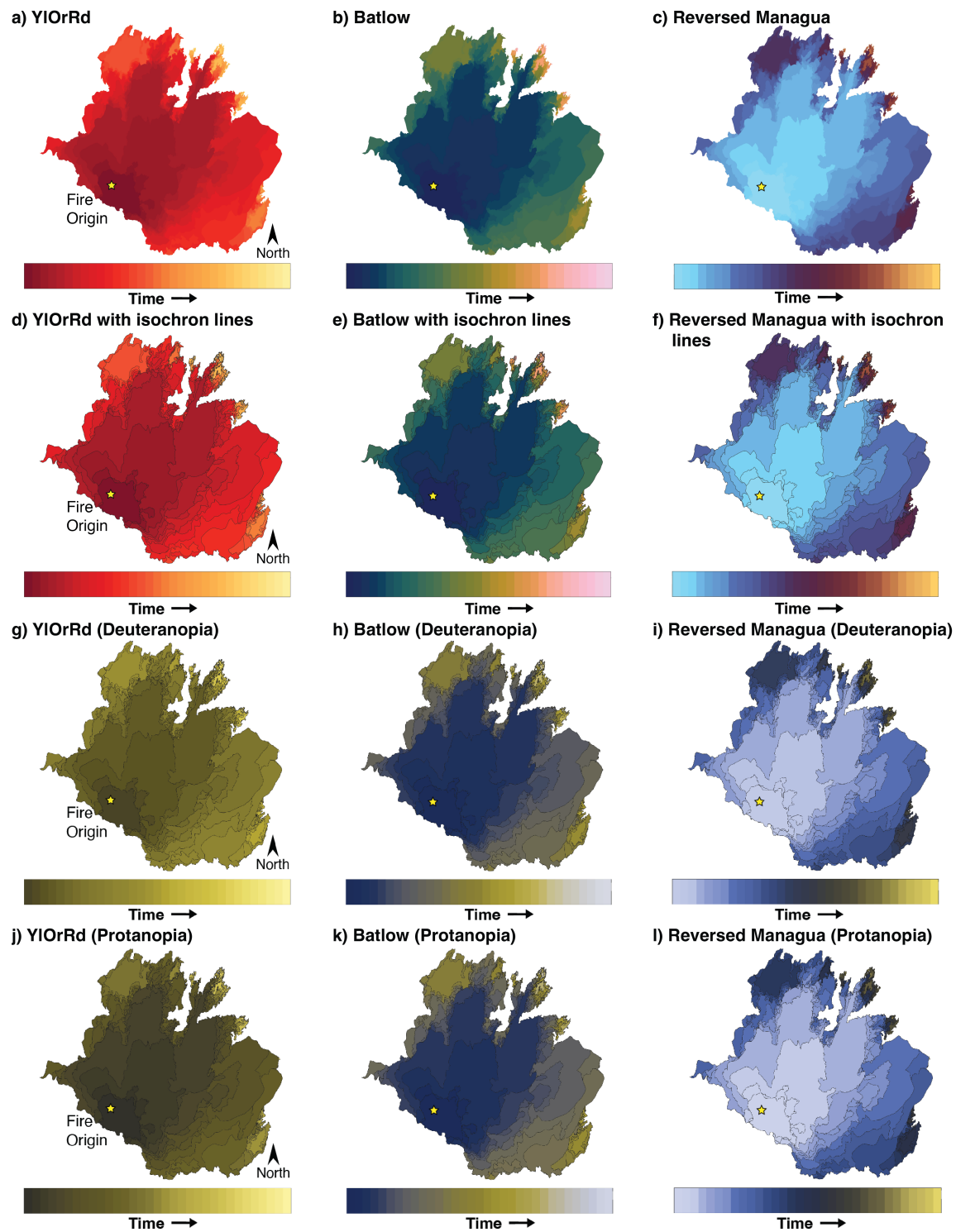


Figure 2: New Figure B1: (a-c) Daily fire progression maps of the 2013 Rim Fire using three colourmaps that are accessible for colour vision deficient viewers and demonstrate a physically-intuitive sequential progression through time (i.e., older shown by cooler cooler colours and newer by warmer colours). (d-f) As in (a-c) but including isochrons. (g-i) Maps in (d-f) with deuteranopia (green-blind) colourblindness simulation. (j-l) Maps in (d-f) with protanopia (red-blind) colourblindness simulation. The yellow star denotes the fire origin location.

Reviewer 1 Specific Comments:

Line 32: Please clarify what "non-colorsafe colormaps" means.

I apologize for the imprecise language here. I have modified the text to be consistent with the medical terminology for colorblindness (National Eye Institute of the National Institutes of Health, see: <https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/color-blindness> to now state these (currently recommended) maps "are potentially inaccessible for colour vision deficient users".

*...demonstrate known challenges in visual communication: the use of inconsistent (i.e., "standardised" is not defined explicitly) colourmaps **that are potentially inaccessible for colour vision deficient users** to portray fire progressions...*

Lines 45–47: To support these statements, we clarify the use of different colour gradient types in: Crameri, F., G.E. Shephard, and P.J. Heron (2024). Choosing suitable color palettes for accessible and accurate science figures. Current Protocols, 4, e1126. <https://doi.org/10.1002/cpz1.1126>

Thank you for the reference suggestion to shore up this statement. This reference also helped me point out the interesting case of "Managua", which may be an exception to the misuse of diverging maps for sequential processes (given it "diverges" logically from cool (blue) to warm (red) to hot (yellow)). Before this statement, I did revise the text to note a diverging map does need a temporal reference point (fire origin) to orient readers, especially if black and white is used (i.e., in printing). New text:

"The physically-intuitive nature of "Managua" (cool-to-warm-to-hot) also may allow it to show sequential fire progressions despite being a diverging colourmap and thus an exception to the guidance provided in Crameri et al., 2024)."

Line 47: Put the Buckley, 2017 reference into parentheses (i.e., "\citep{xxx}")– same problem in other instances, such as line 51

Changes made, thank you for catching this.

Lines 48–50: Good point!

Thanks! :-)

Line 50: "We" should be "I" for this single-author paper, shouldn't it?

Indeed, changes have been made here and in another instance.

Line 52: Turbo is NOT perceptually uniform. It is confused widely as such though. I guess there is less scrutiny for a colour map developed by a big company than by individual scientists. Turbo is better than a standard rainbow (such as Jet) in terms of perceptual evenness, but it is still not on par with e.g., batlow or YlOrBr, and definitely not perceptually uniform (see e.g., the author's clarification that "[Turbo] is not a perceptually linear" and "[Turbo is intended] for day-to-day tasks where perceptual uniformity is not critical" on <https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://research.google/blog/turbo-an-improved-rainbow&ved=2ahUKEwjE4snyxbuKAXUjgPOHHU1jOBQQFnoECBoQAQ&usg=AOvVaw3ZCRKST1BPJ1AX72-lwrl4>).

This is visible in Figure 1, where the neighbouring colours in the blueish parts of the color bar clearly differ more strongly than e.g., in its greenish parts.

I appreciate the additional clarification and the solid points raised here. Per the major issue raised early on in the review, I have removed "Turbo" from use in the suggested colourmaps and now show "YlOrRd", "Batlow", and "Managua".

Line 54: The Ware et al., 2023 paper is trying to make a case for the use of non-perceptually-uniform and inaccessible colour maps, so it does not fit in here, I think.

Agreed, this reference has been removed here.

Lines 57–59: Not sure that is a helpful statement. It is unclear what "situation-specific adjustments to colormaps" means. If it means distorting the uniformity of color gradient of the scale, than this is a bad suggestion, as it would distort the actual data, and for the reader impossible to reproduce (or judge for its validity). In particular in plots showing the spread of fire, it seems key to properly display where the fire spread slowly, and how much more rapidly it spread elsewhere. Distorting the colour scale would suppress this information and misrepresent it.

This is a solid and thoughtful critique, which I appreciate and agree with. As such, I have removed this sentence from the revised manuscript.

Lines 61–63: Along similar lines, I disagree with this statement, as either a colour map is perceptually uniform or it is not. What "used appropriately" and "better design" mean here is unclear. Moreover, the paper referenced argues with very limited cases, and provides suggestions that are implementable only by visualisation experts and rather confusing to everyone who is not. And let's remember, hardly any scientist has received even the basic education in scientific visualisation. The paper's argument can be mentioned here, but I don't think it is fair nor clear to the reader to present it equally to other, more broadly applicable studies and more broadly based arguments.

These are extremely valid points and I appreciate your critical take on the use of my unclear language. I agree, and as such I removed the final argument and moved the previous sentence noting the use of rainbow/Turbo in fire progression mapping and scientific literature more broadly to the conclusion. To your point about lacking basic education in scientific visualization, I could not agree more and I wish this aspect was integrated more deeply into data analysis courses as well as made part of our general curriculum in scientific critique at undergraduate and graduate levels (to say the least).

Figure 1: Given that many people tend to look at figures mostly, these days, the figure caption could be a bit more descriptive to be more helpful: for example, explain that these are recommended colour maps, and what techniques are used in (b,d,f) to increase accessibility.

Agreed, I have added additional description pursuant to the reviewer's suggestion to improve the value of the caption text. Please see the revised captions associated with the revised Figure 1 and new Appendix Figure 2.

I enjoyed reading this nice piece and would like to thank the author for their effort!

I appreciate this statement, and again, thank you for your review!

And finally, for transparency, I am the author of the Scientific colour maps (some of which are shown here).