Making Better Scientific Graphics

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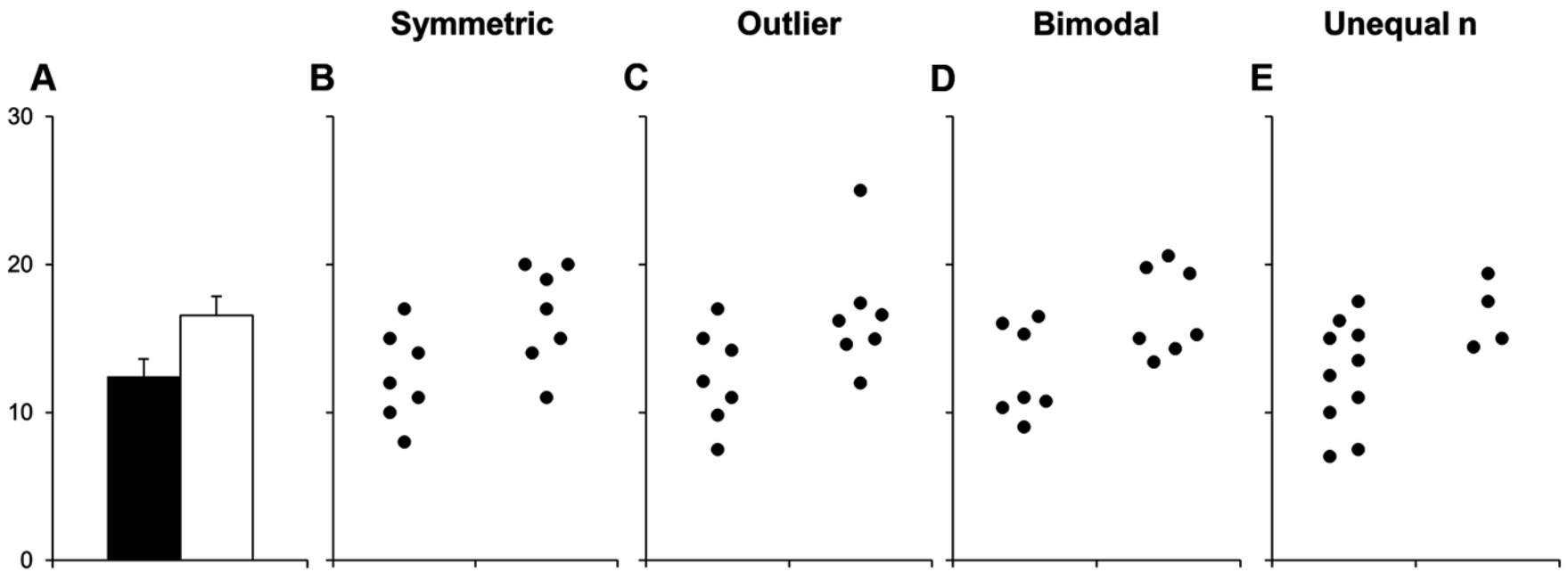
Some principles & recommendations

"Science is not finished until it is communicated"

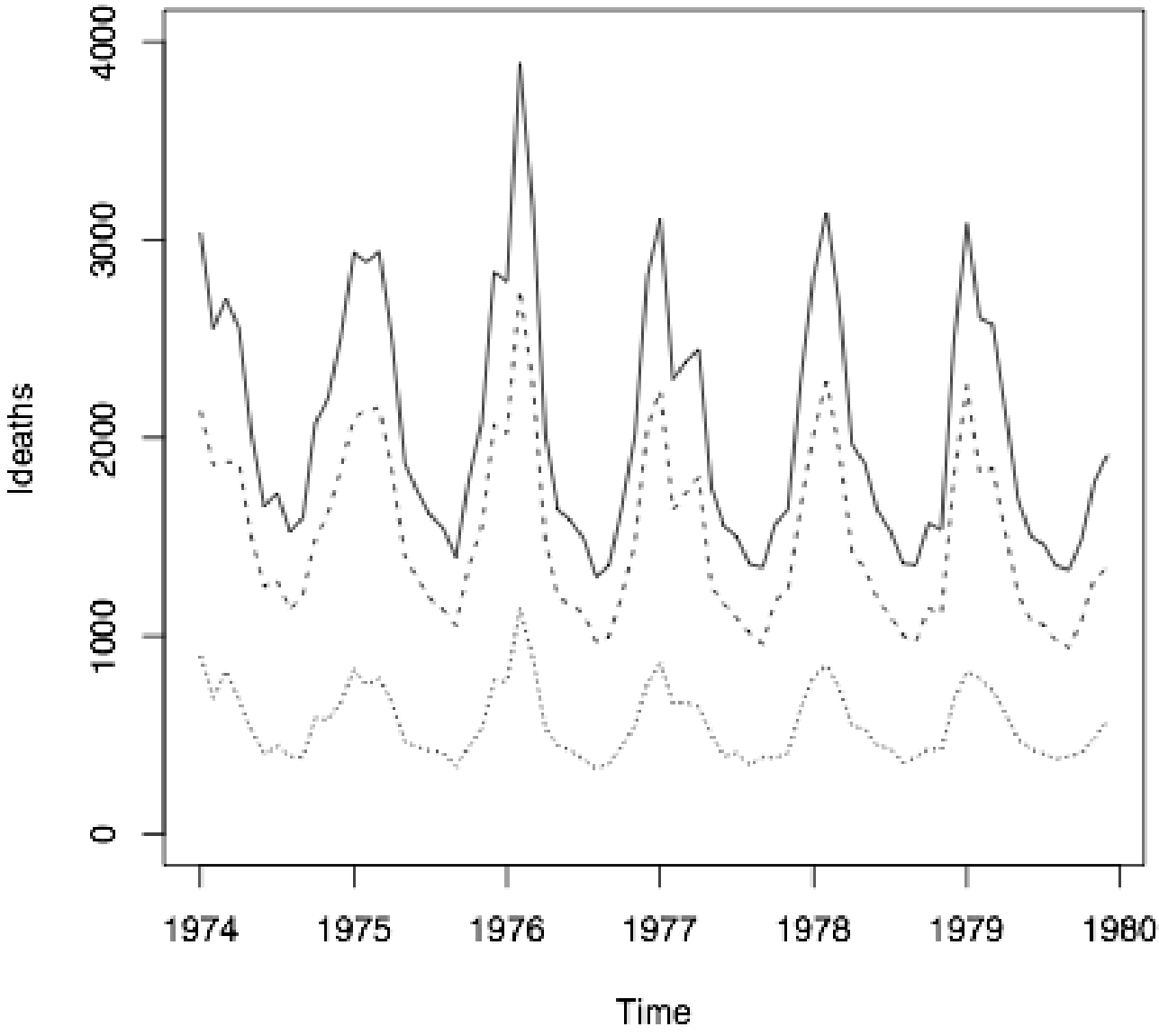
– Mark Walport, UK Chief Scientific Advisor

- show the data, avoiding distortion
- encourage comparisons
- simplify where possible
- maximise data-to-ink ratio, i.e. avoid 'chart junk'
- don't trust defaults in plotting software
- ensure legibility of text and lines

Show the data

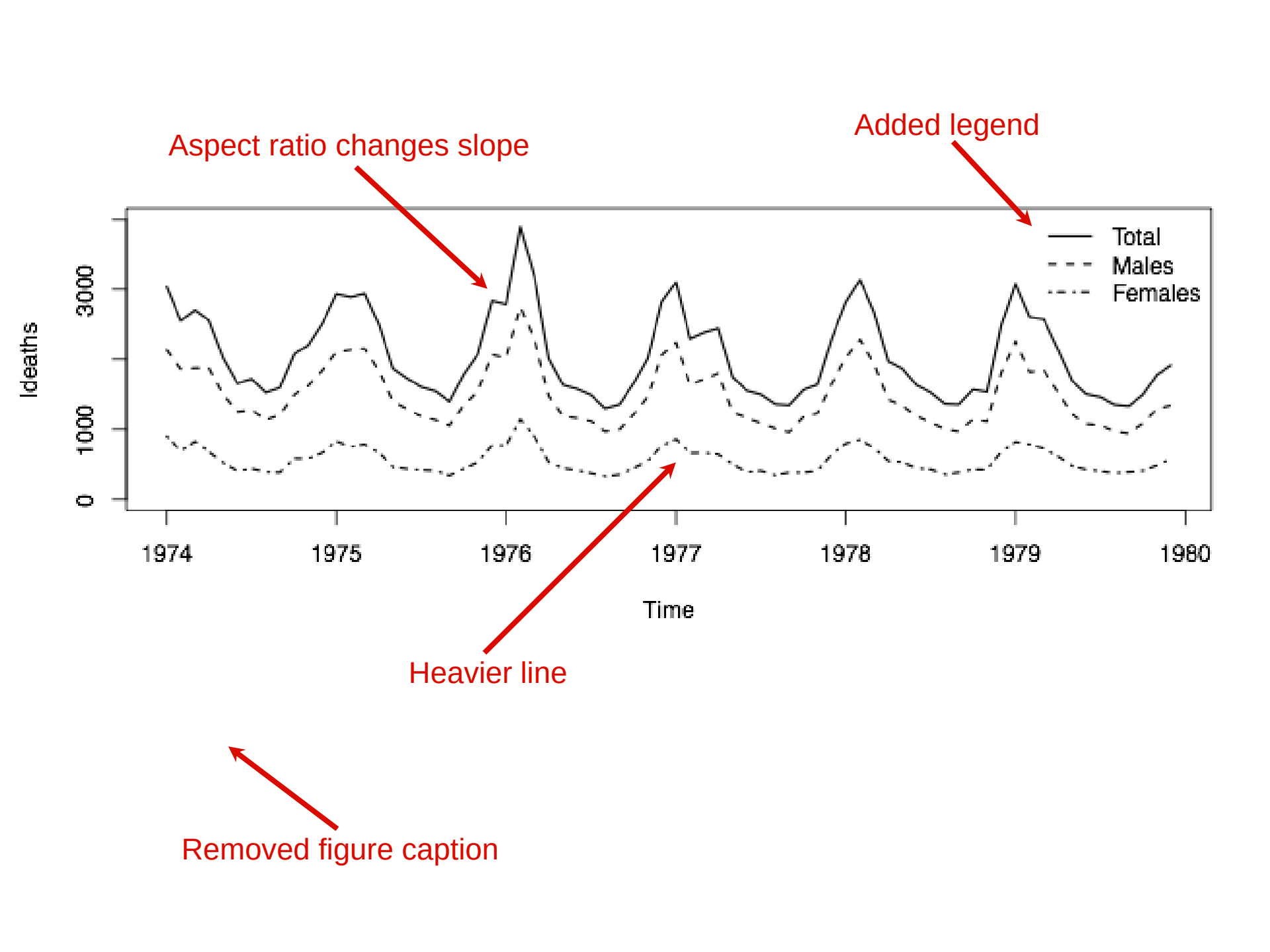


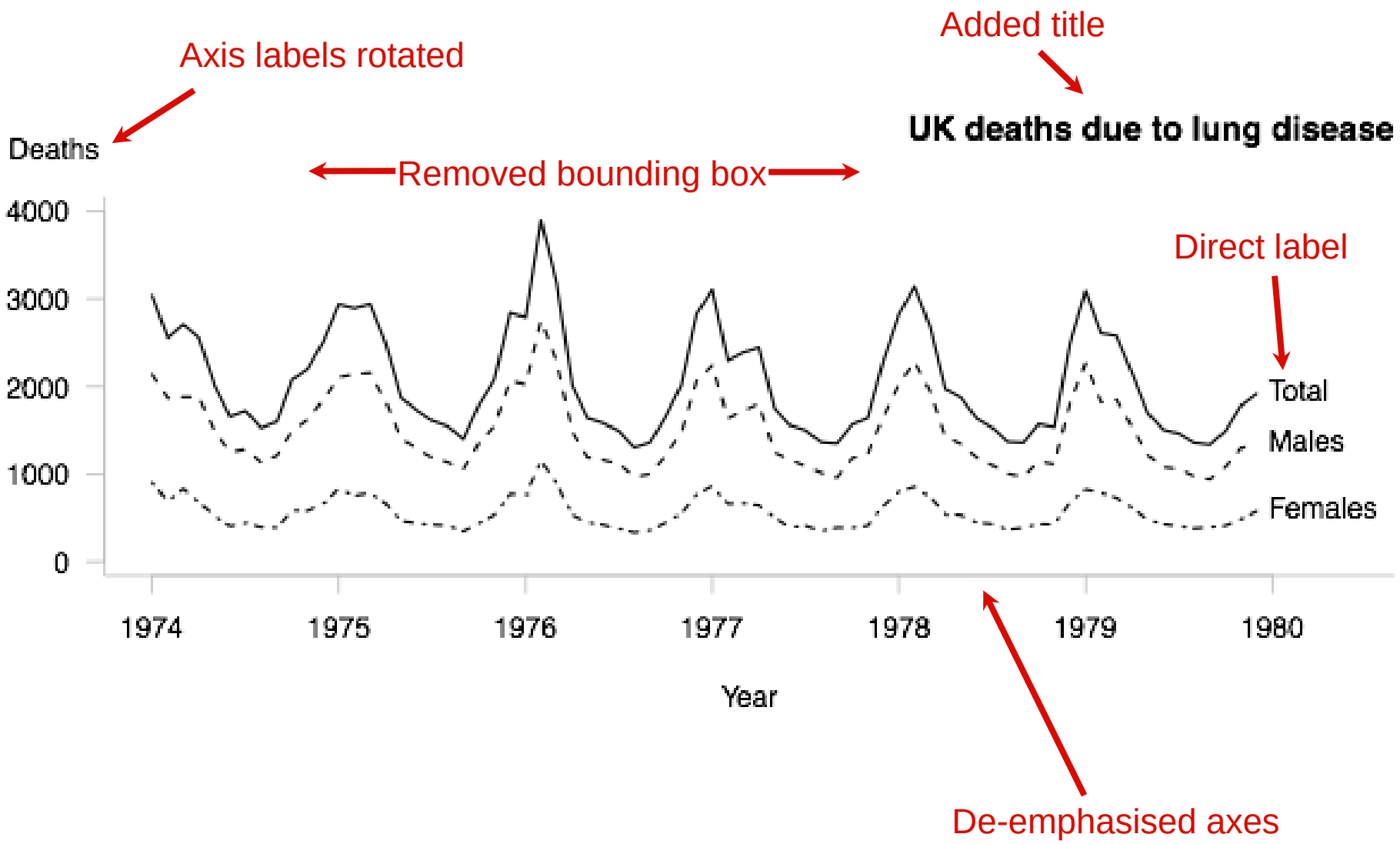
Weissgerber et al. 2015

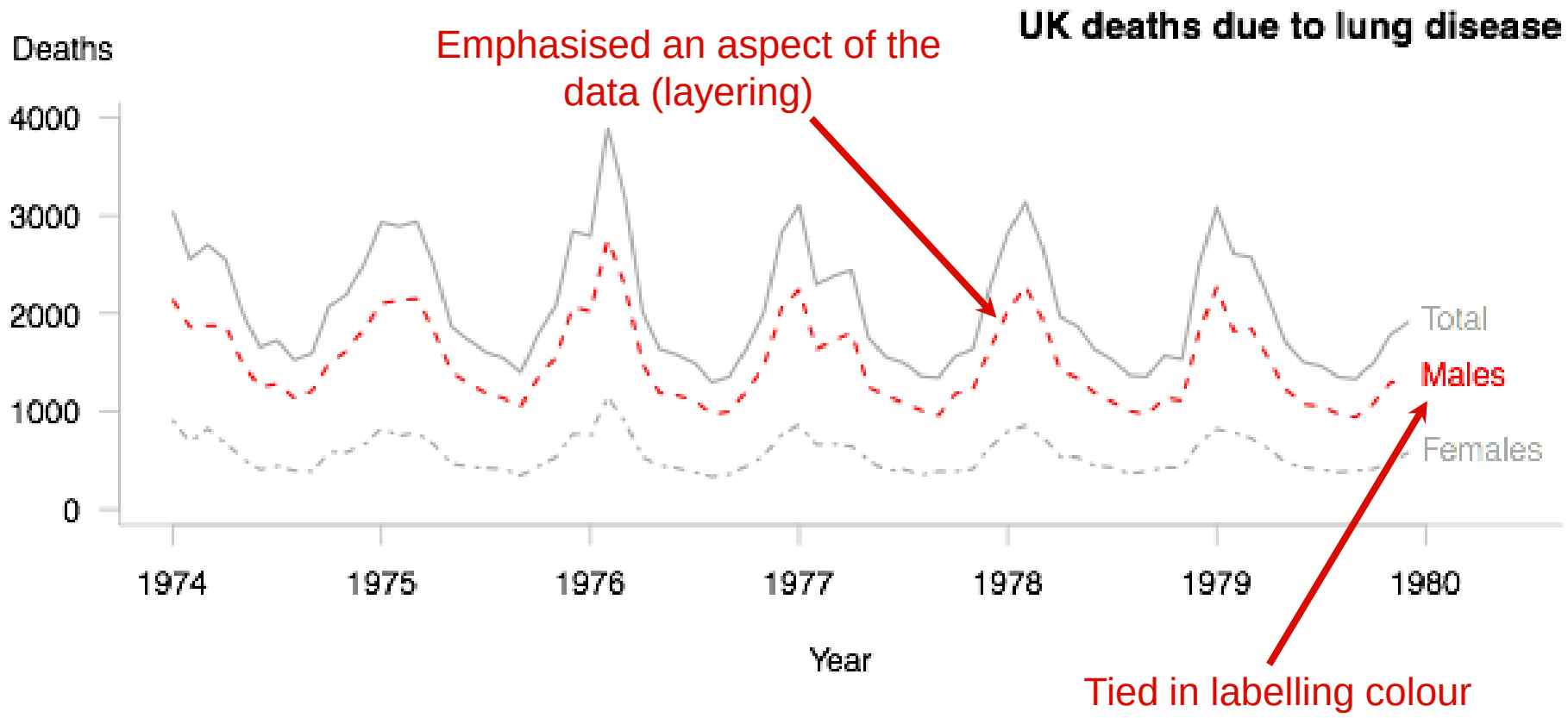


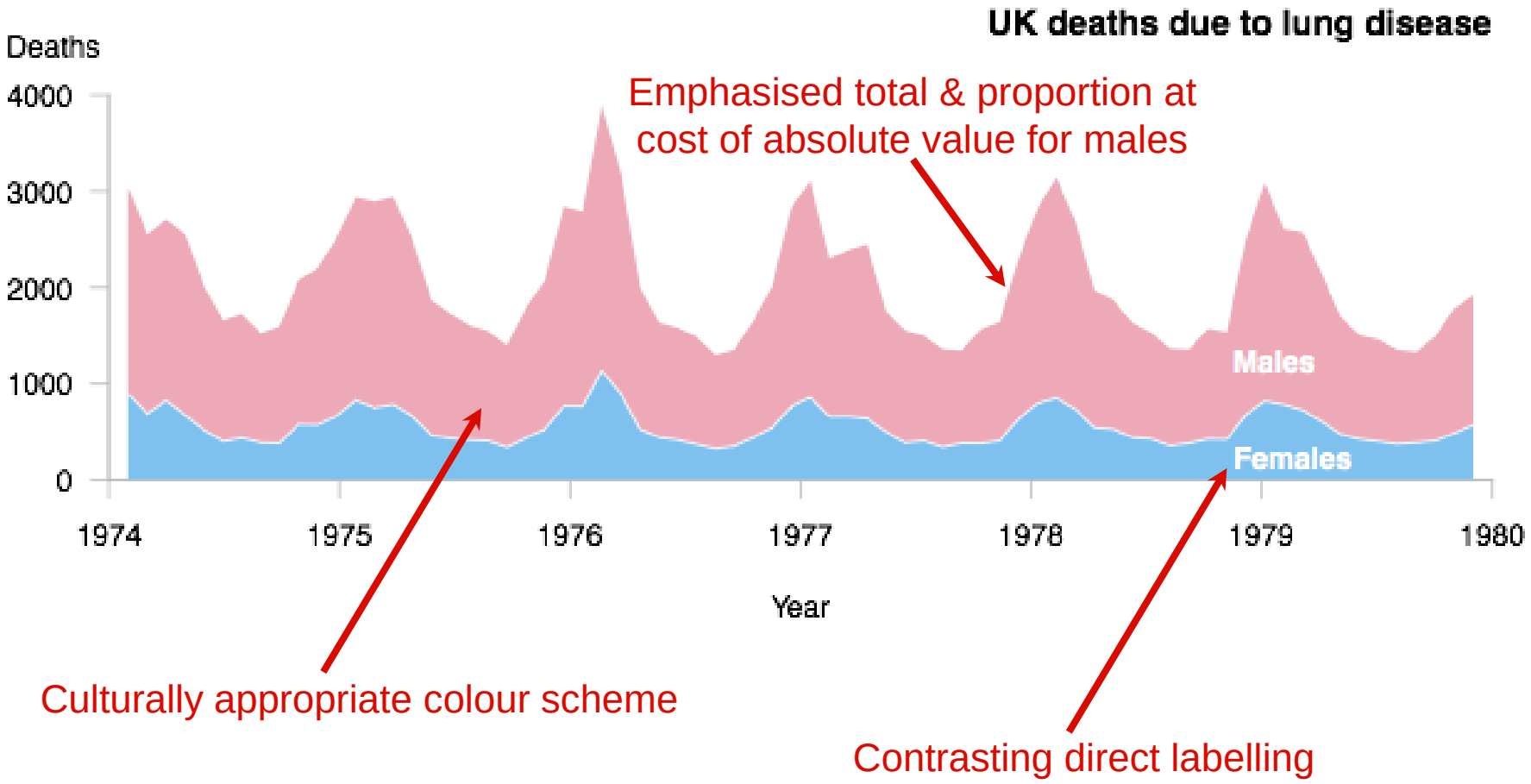
In R:
> plot(ldeaths)

Fig 1. Monthly deaths due to lung disease in the UK. The dotted line shows number of female deaths, the dashed line shows male deaths, with the total shown by the solid line.


Aspect ratio changes slope
Added legend
Heavier line
Removed figure caption
ldeaths
0
1000
3000
1974
1975
1976
1977
1978
1979
1980
Time
Total
Males
Females

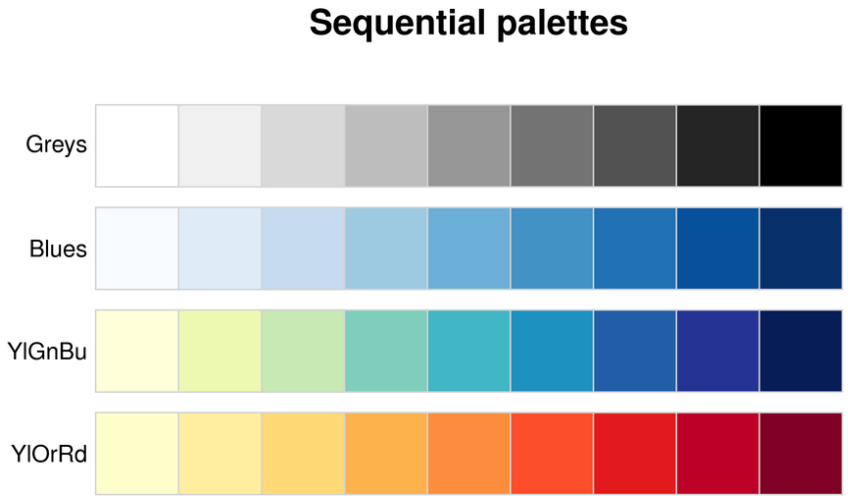

Axis labels rotated
Added title
UK deaths due to lung disease
Deaths
Removed bounding box
4000
3000
2000
1000
0
Direct label
Total
Males
Females
1974
1975
1976
1977
1978
1979
1980
Year
De-emphasised axes


UK deaths due to lung disease
Deaths
4000
3000
2000
1000
0
1974
1975
1976
1977
1978
1979
1980
Year
Total
Males
Females
Emphasised an aspect of the data (layering)
Tied in labelling colour

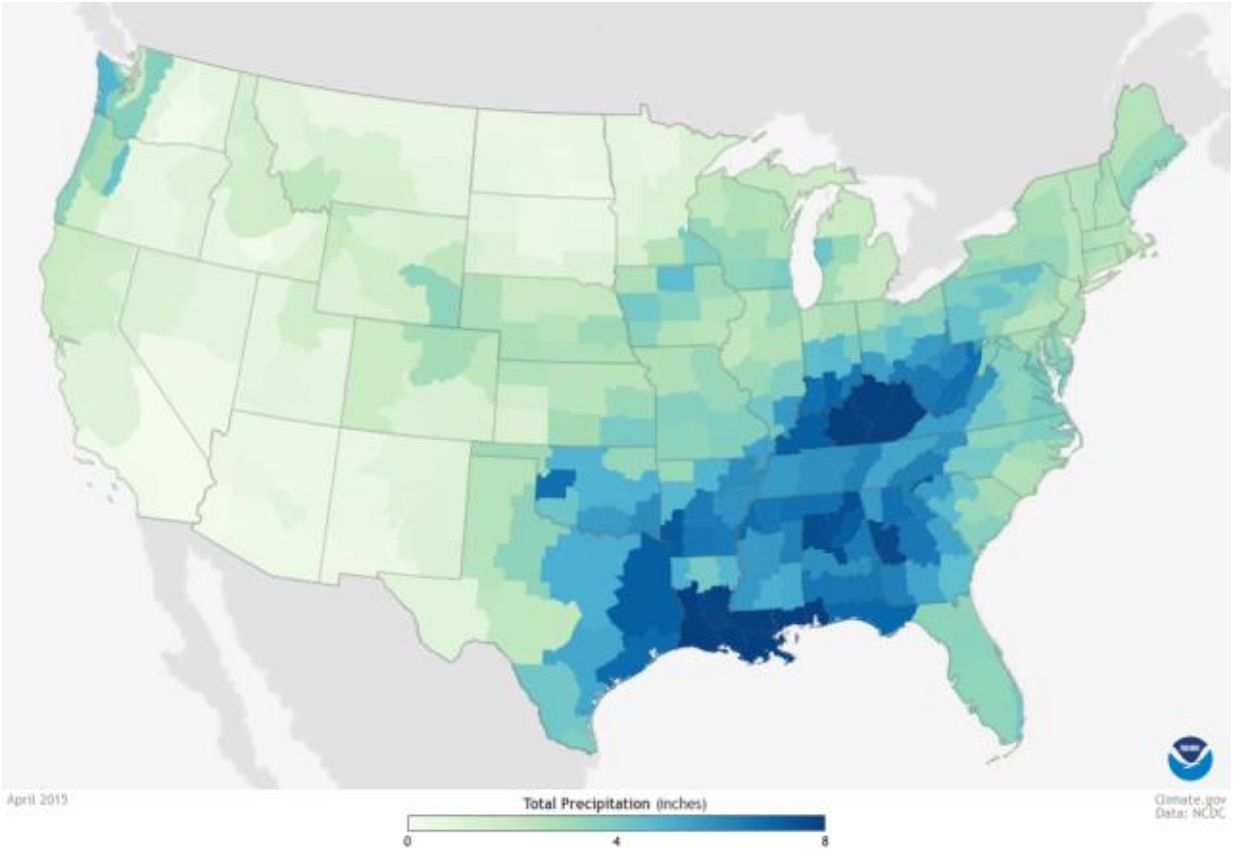

UK deaths due to lung disease
Deaths
4000
3000
2000
1000
0
Males
Females
1974
1975
1976
1977
1978
1979
1980
Year
Emphasised total & proportion at cost of absolute value for males
Culturally appropriate colour scheme
Contrasting direct labelling

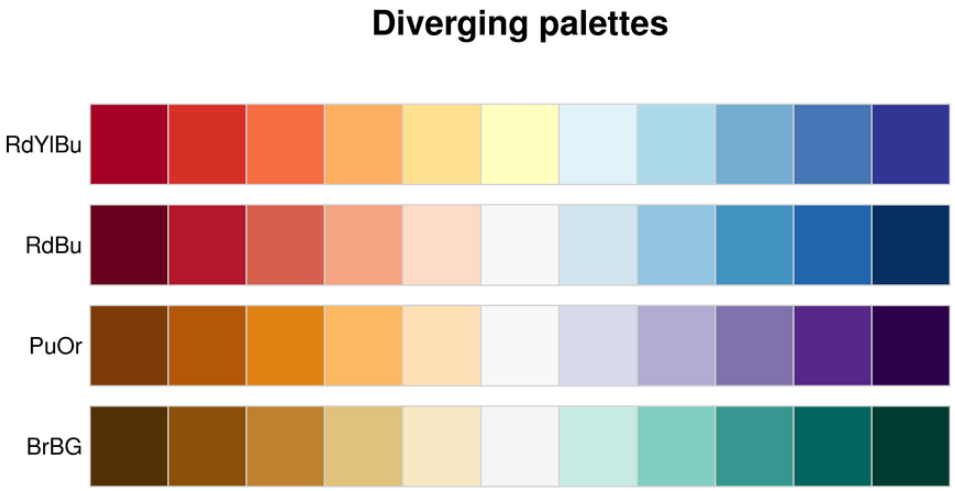
How to choose a colour palette?

- Ensure a perceptual relationship between the colour scale and the data (e.g. darker = more)
- Understand audience cultural expectations (e.g. blue = wet)
- Ensure it doesn’t distort the data
- Make it accessible
- Don’t use too many colours!



colorbrewer2.org





colorbrewer2.org

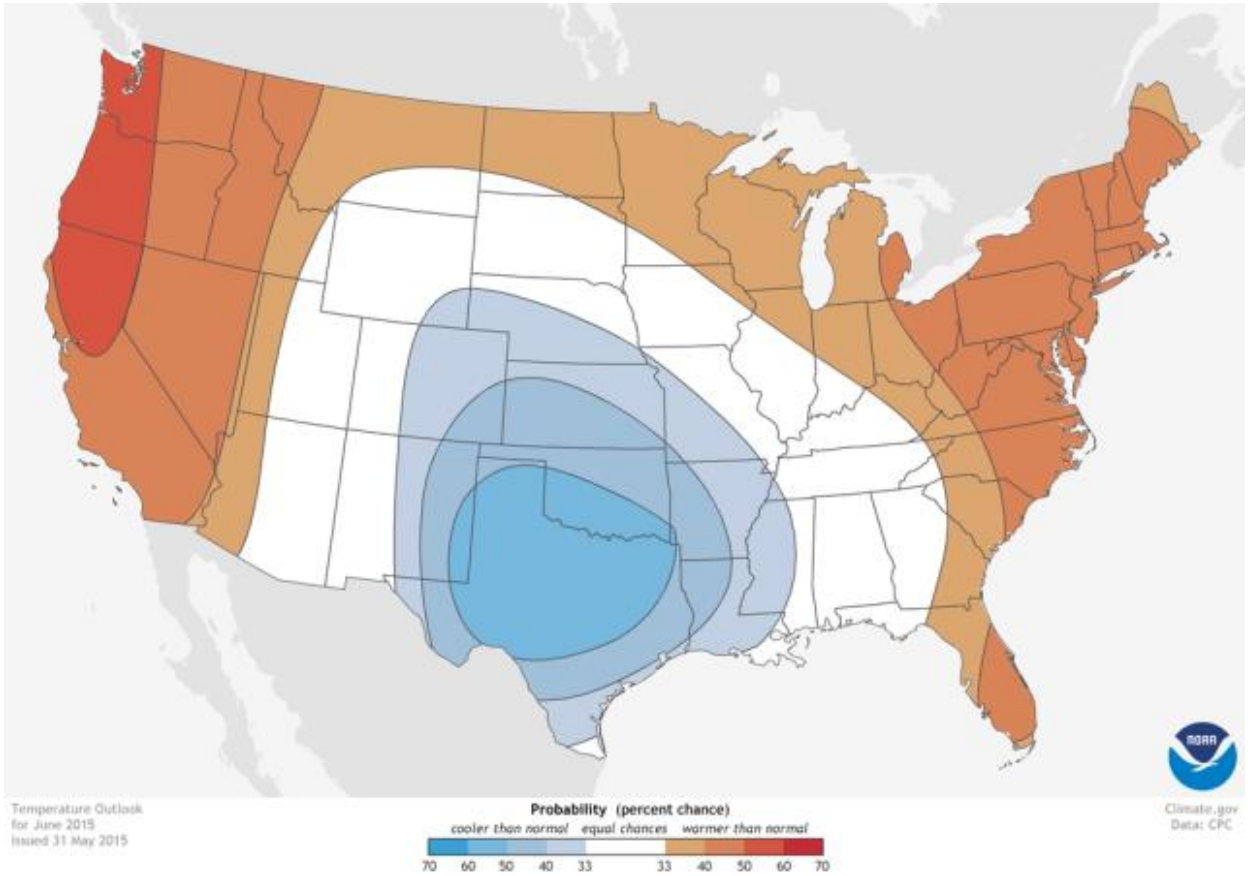


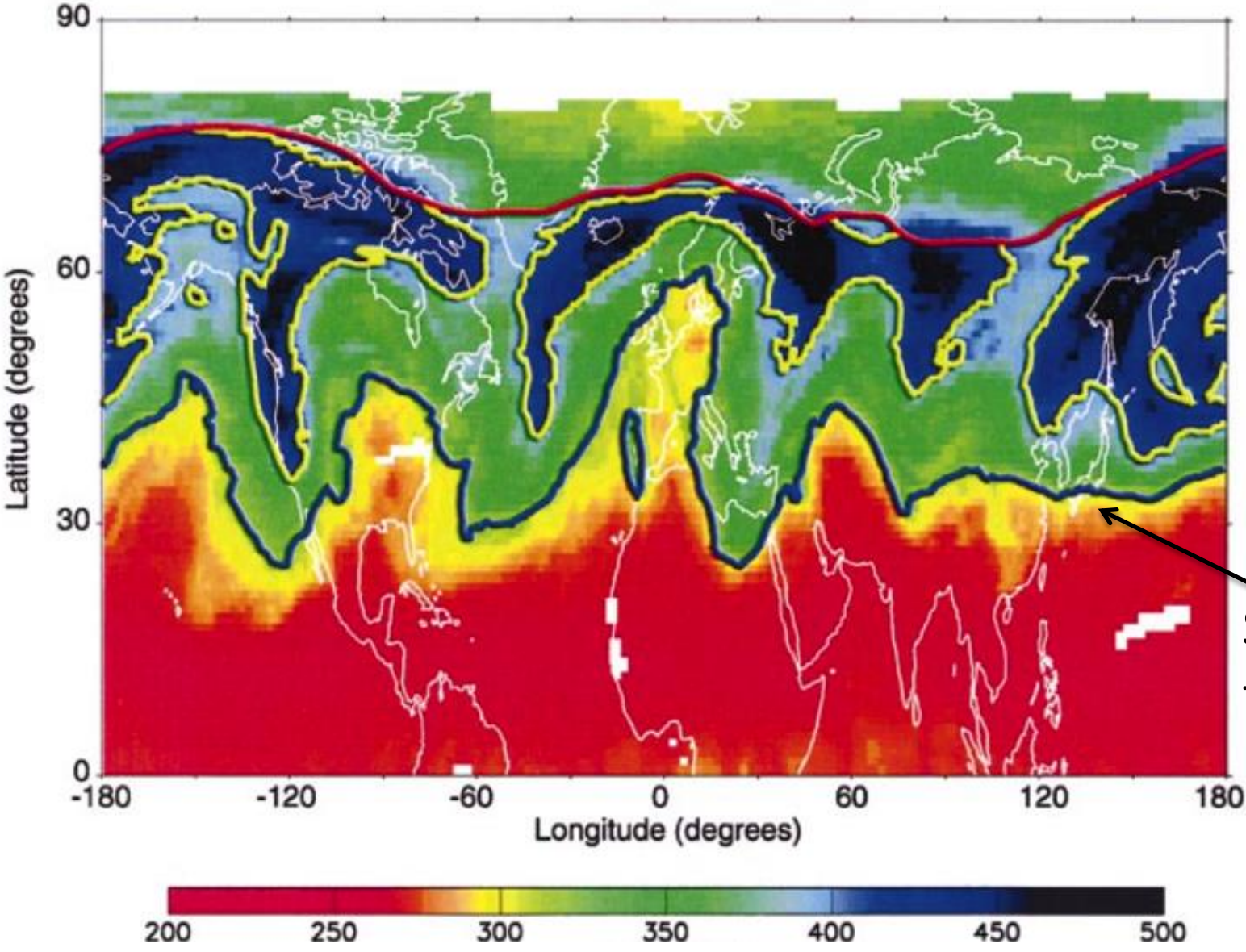
Fig. 1. The rainbow color map. Know thy enemy.

tiny.cc/endrainbow

#endrainbow

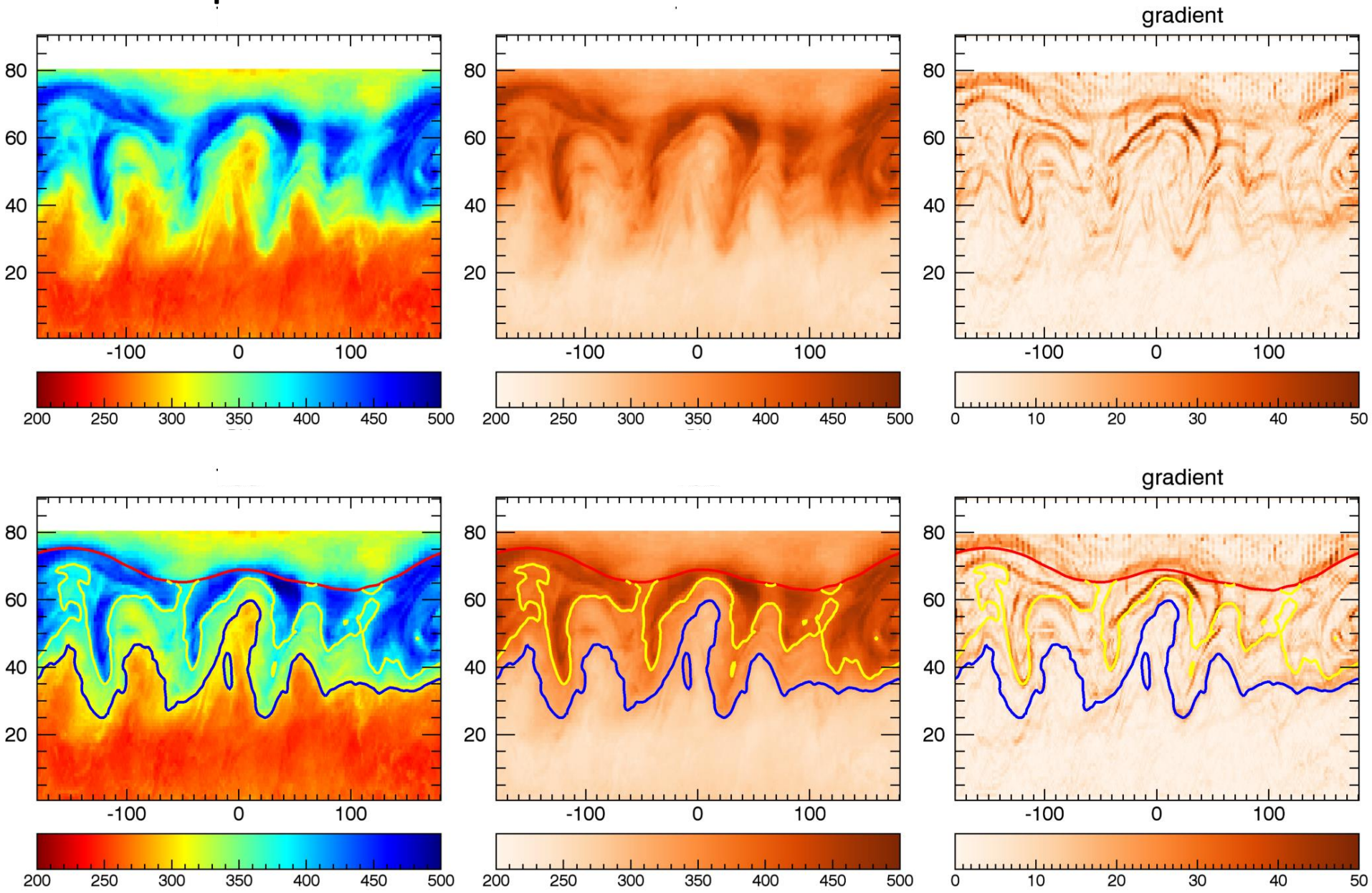
Image from K. Moreland

Dangers of rainbow colour scales



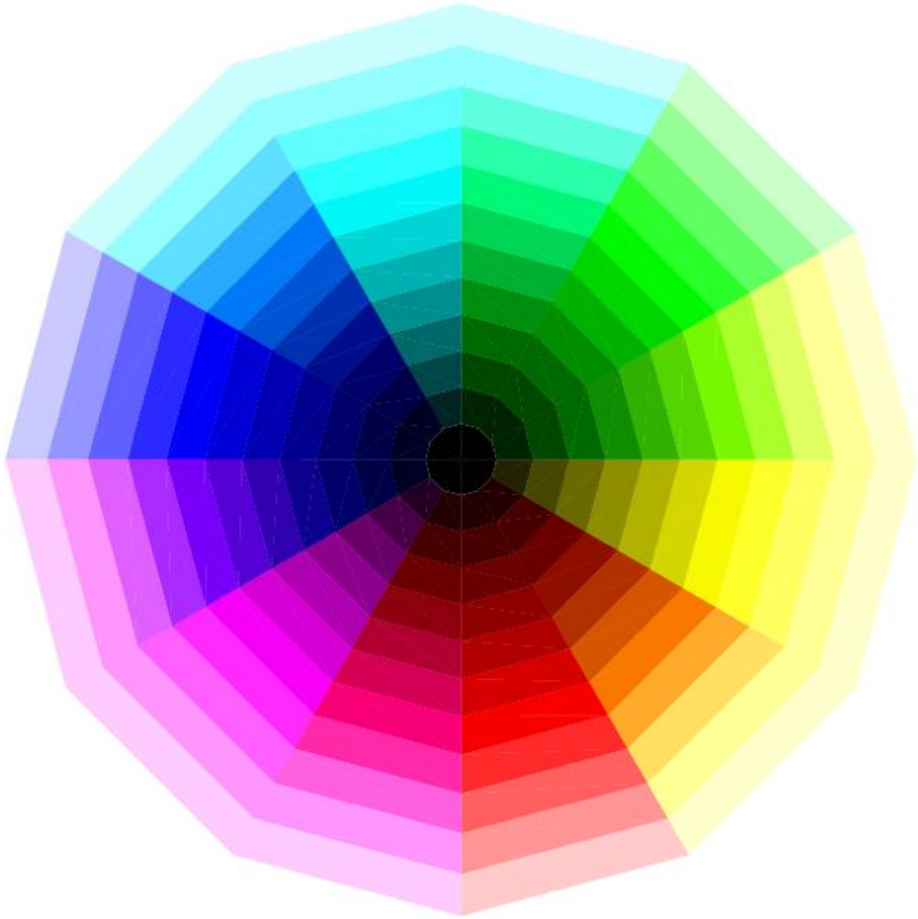
Subtropical front

‘Sub-tropical’ front is an artefact of the colour scale

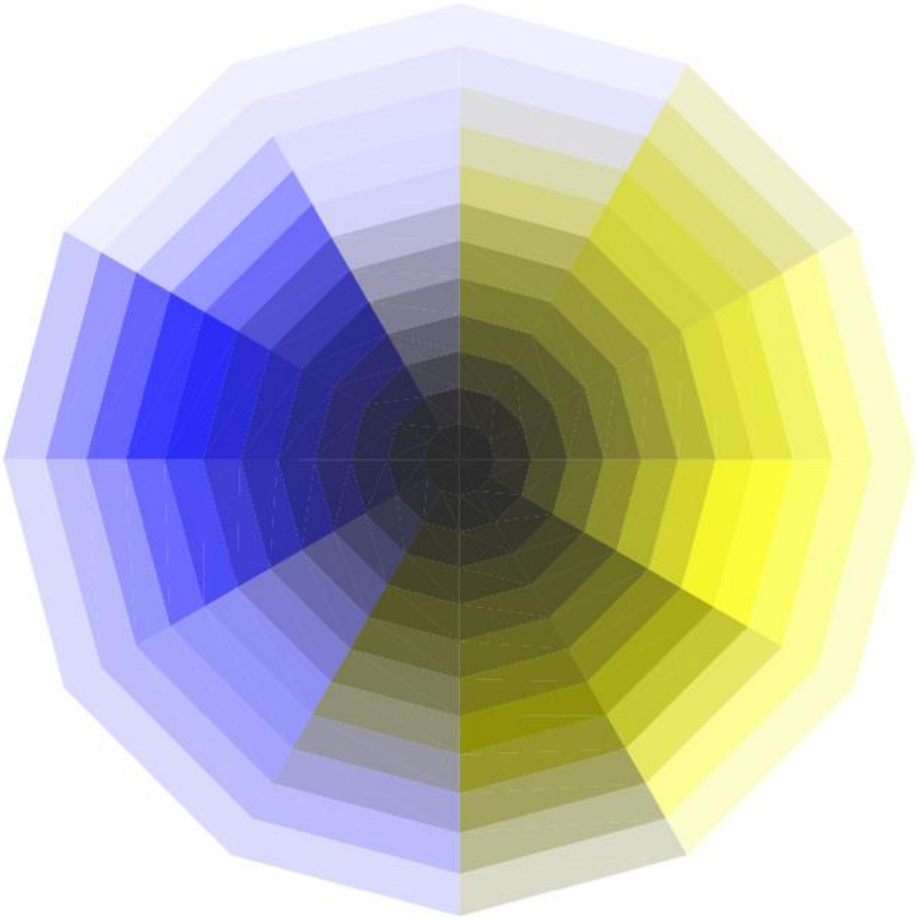


Figures from Sean Davis

Colour Wheel

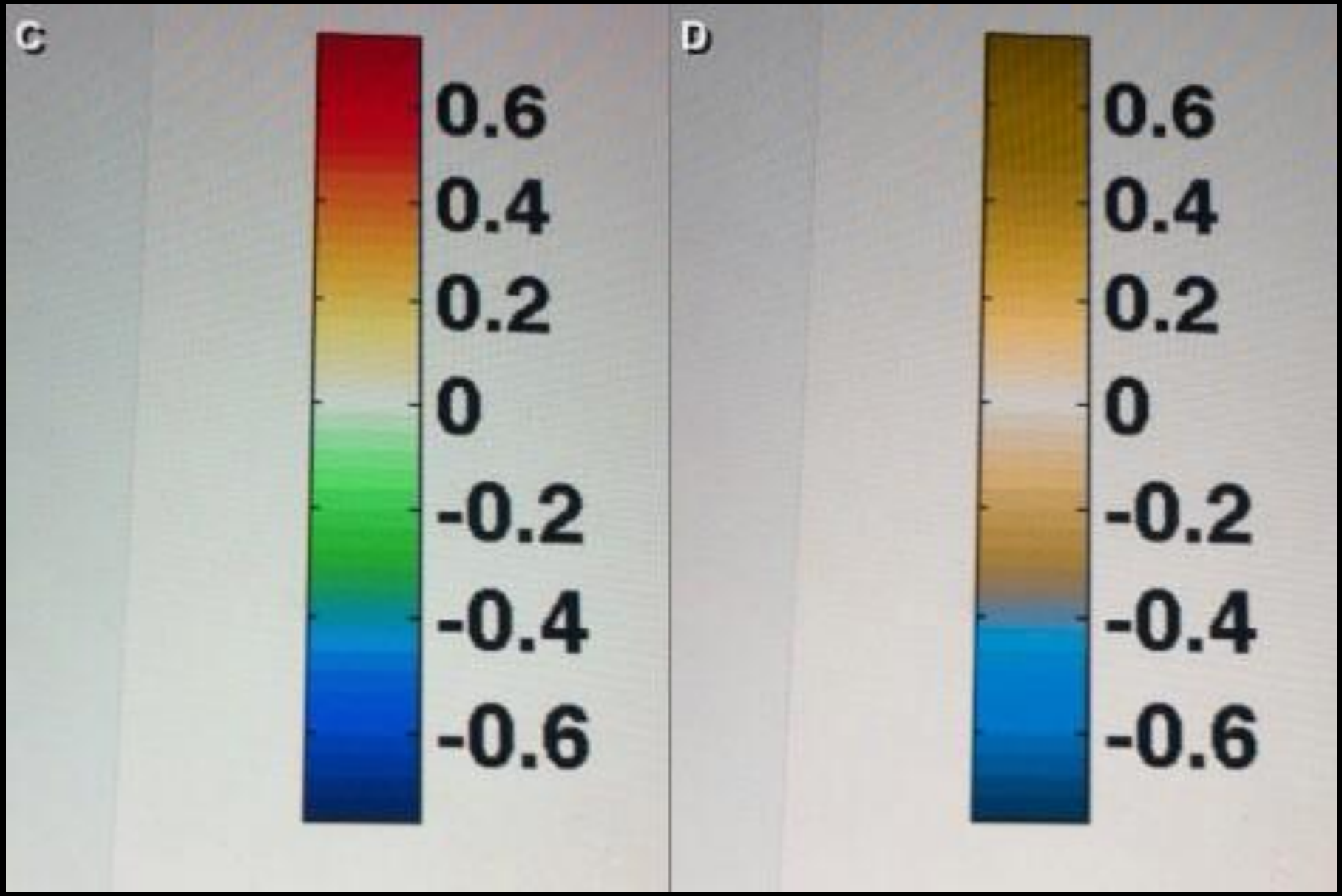


Normal colour vision

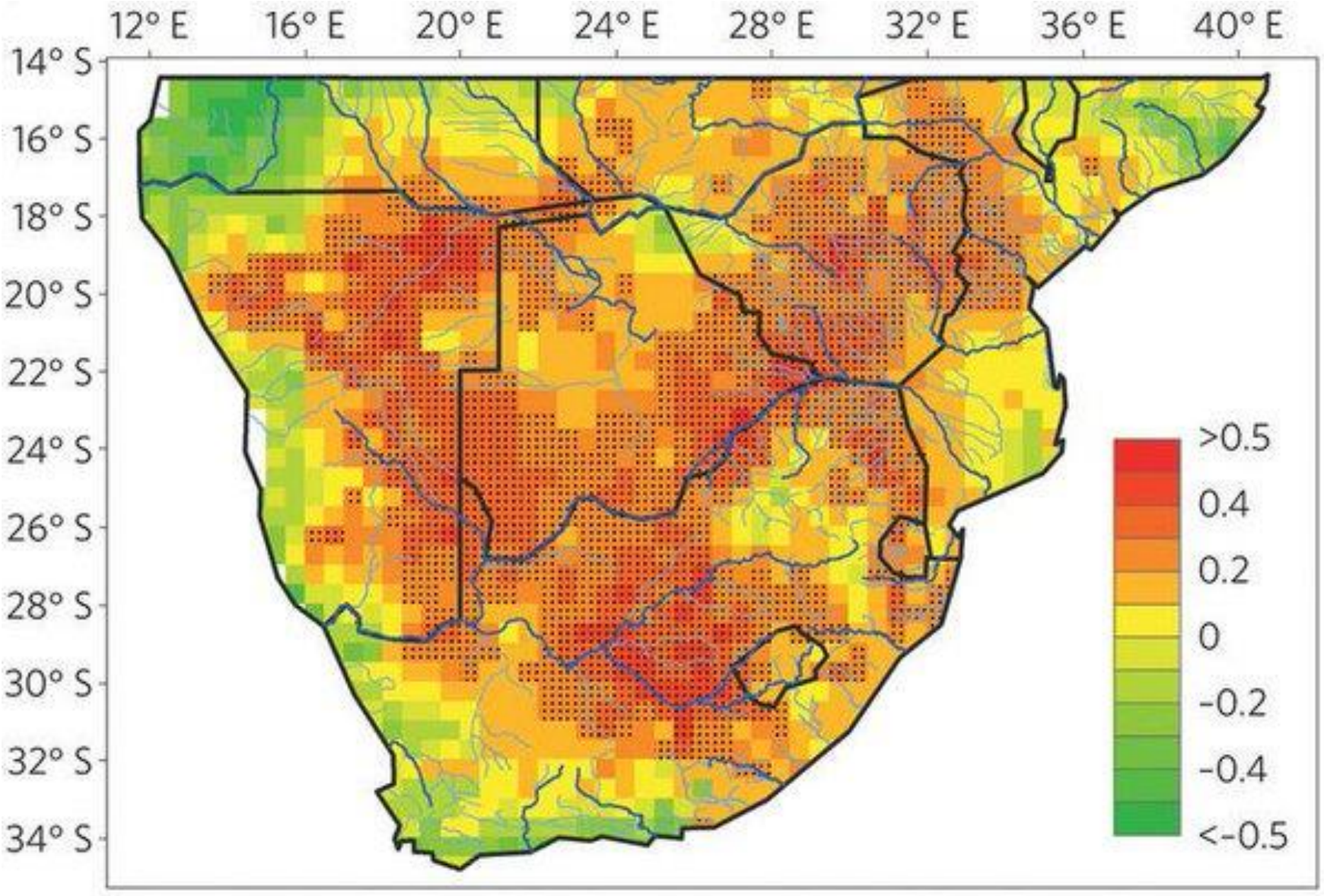


Simulation of severe deuteranopia

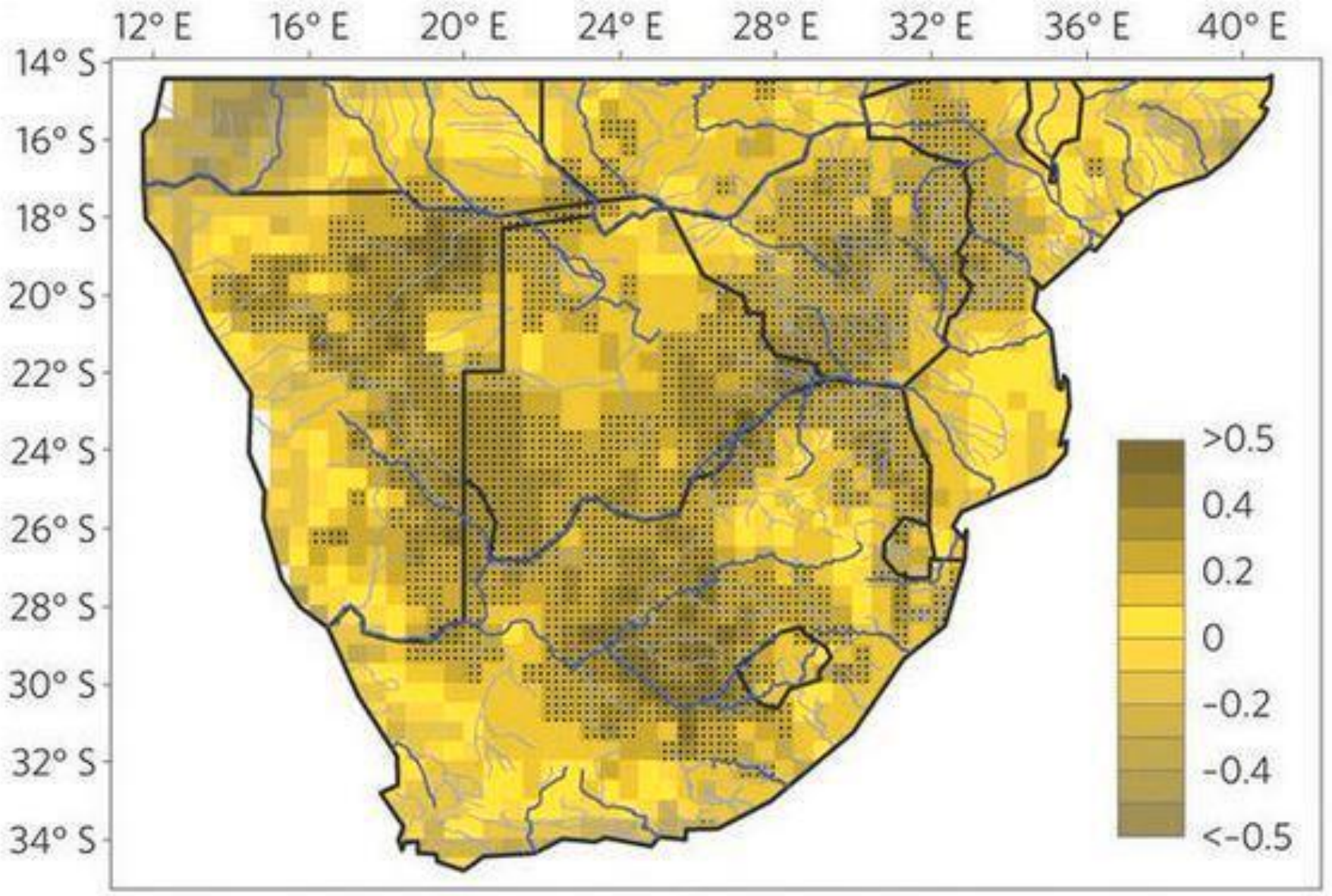
http://www.climate-lab-book.ac.uk/2015/reinventing-colour-wheel/



CVSimulator mobile phone app

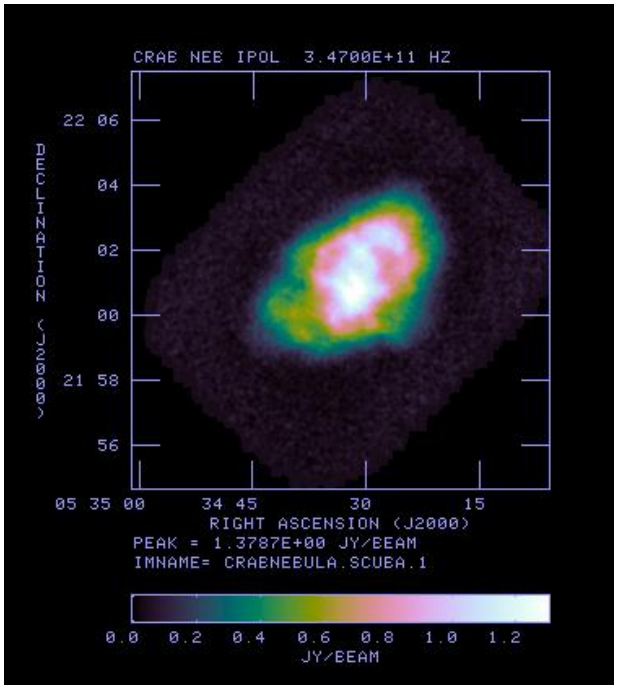


Normal vision



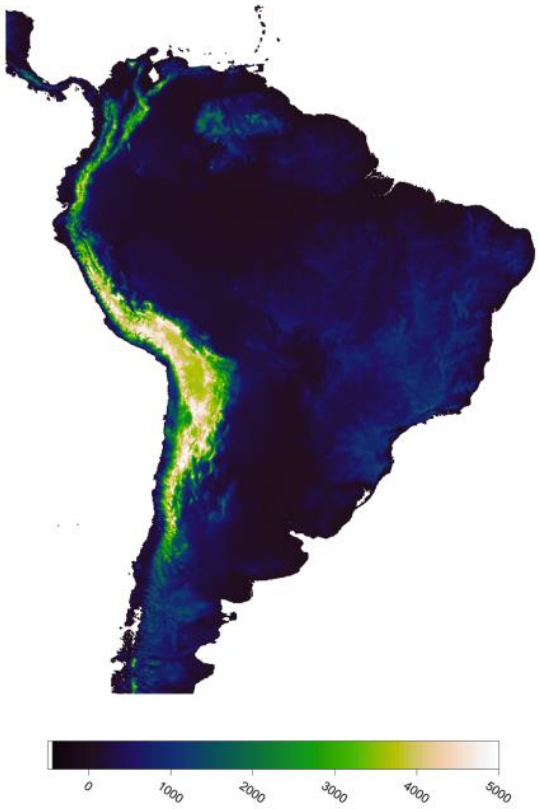
Colour blind simulated vision

Alternatives?

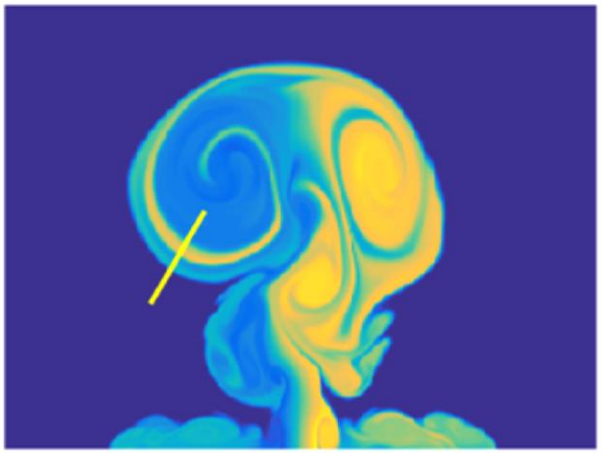


cubehelix

viridis



CIE Lab Linear L



parula

Summary

"Science is not finished until it is communicated"

– Mark Walport, UK Chief Scientific Advisor

- It has never been easier to make amazing (and amazingly awful) scientific graphics
- As a community, we need to encourage a 'grammar of graphics' on a day-to-day basis
- Reviewers should criticise poor graphics, in the same way as poor statistics or grammar
- Editors and journals need to promote good practice more actively and strictly enforce more comprehensive guidelines
- #endrainbow tiny.cc/endrainbow