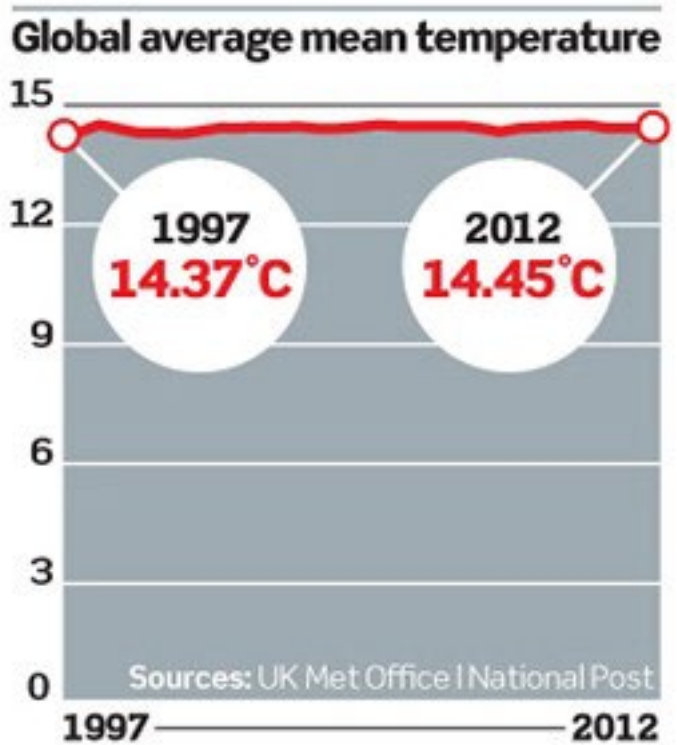
Plotting

What makes a good plot?

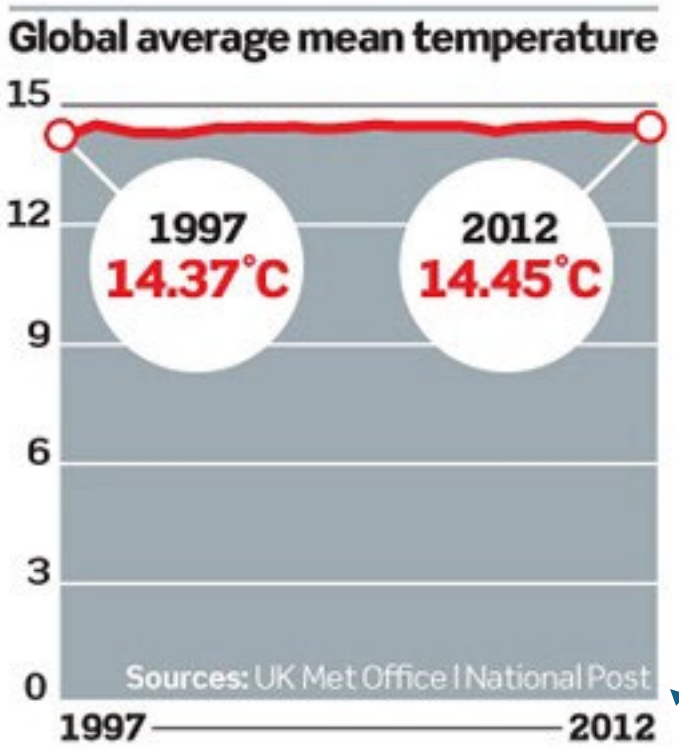


Christopher Booker @ The Telegraph

Meaningful Figure?

Sensible y-axis scale?

Labels?



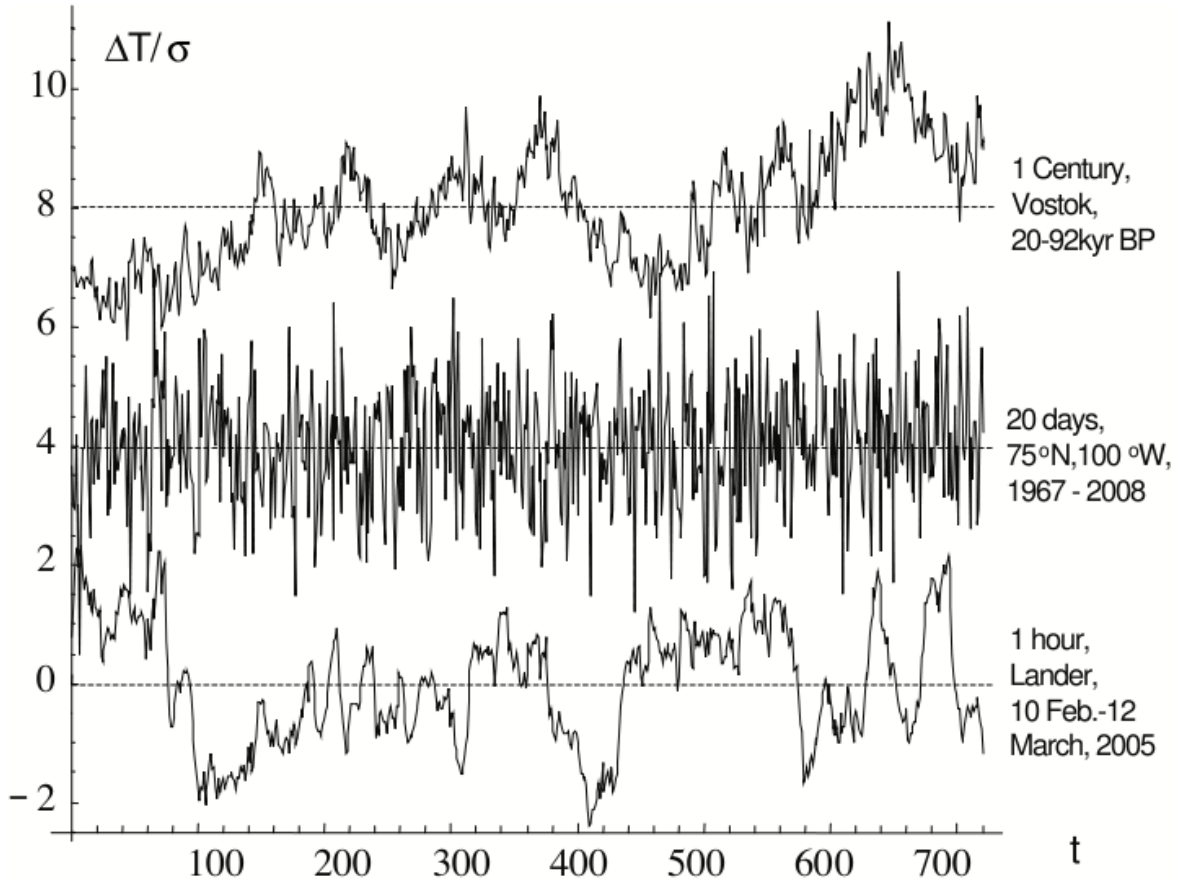
Information Content vs. Figure space?

Is a short-term temperature record graph really useful?

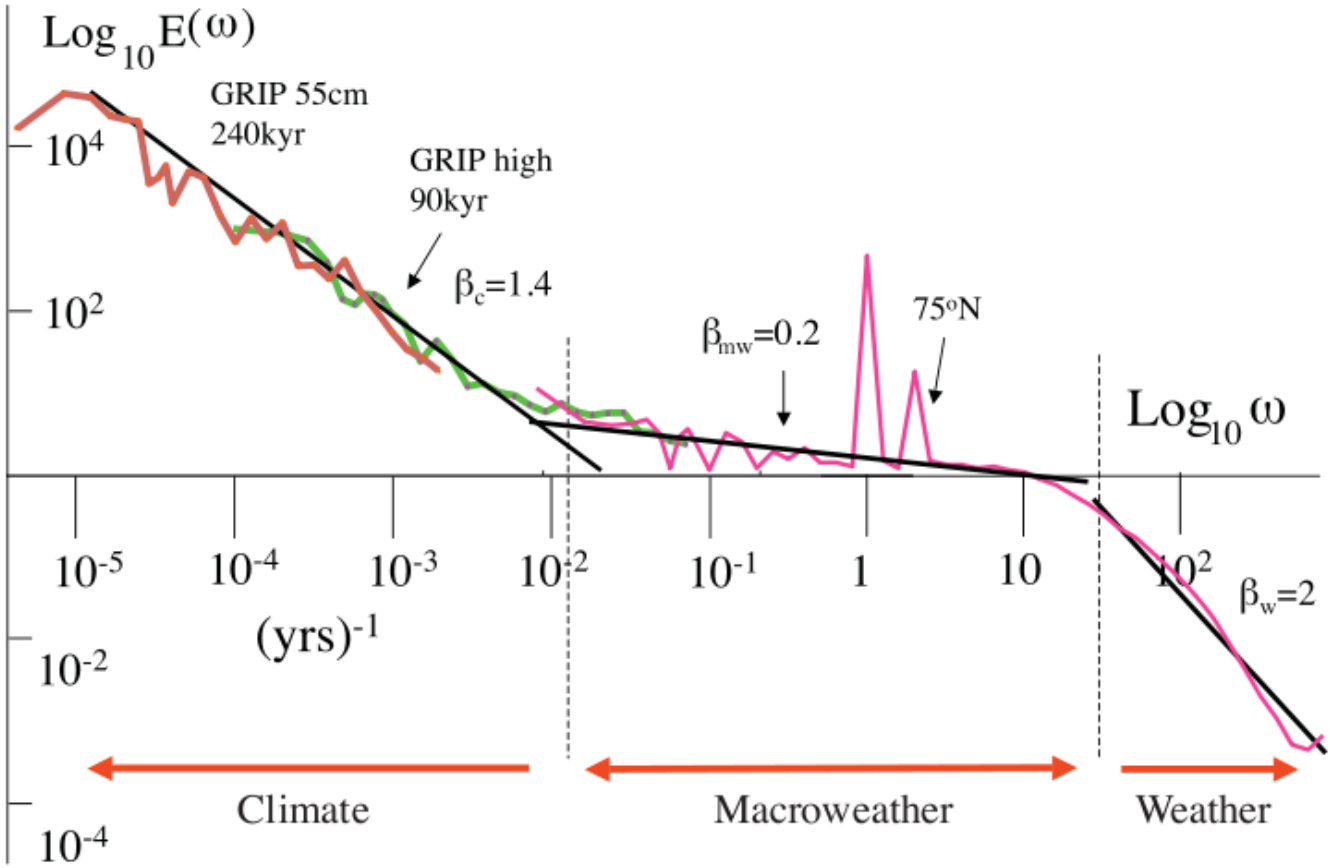
What's that doing here?

Christopher Booker @ The Telegraph

Lovejoy et al. Figure 1

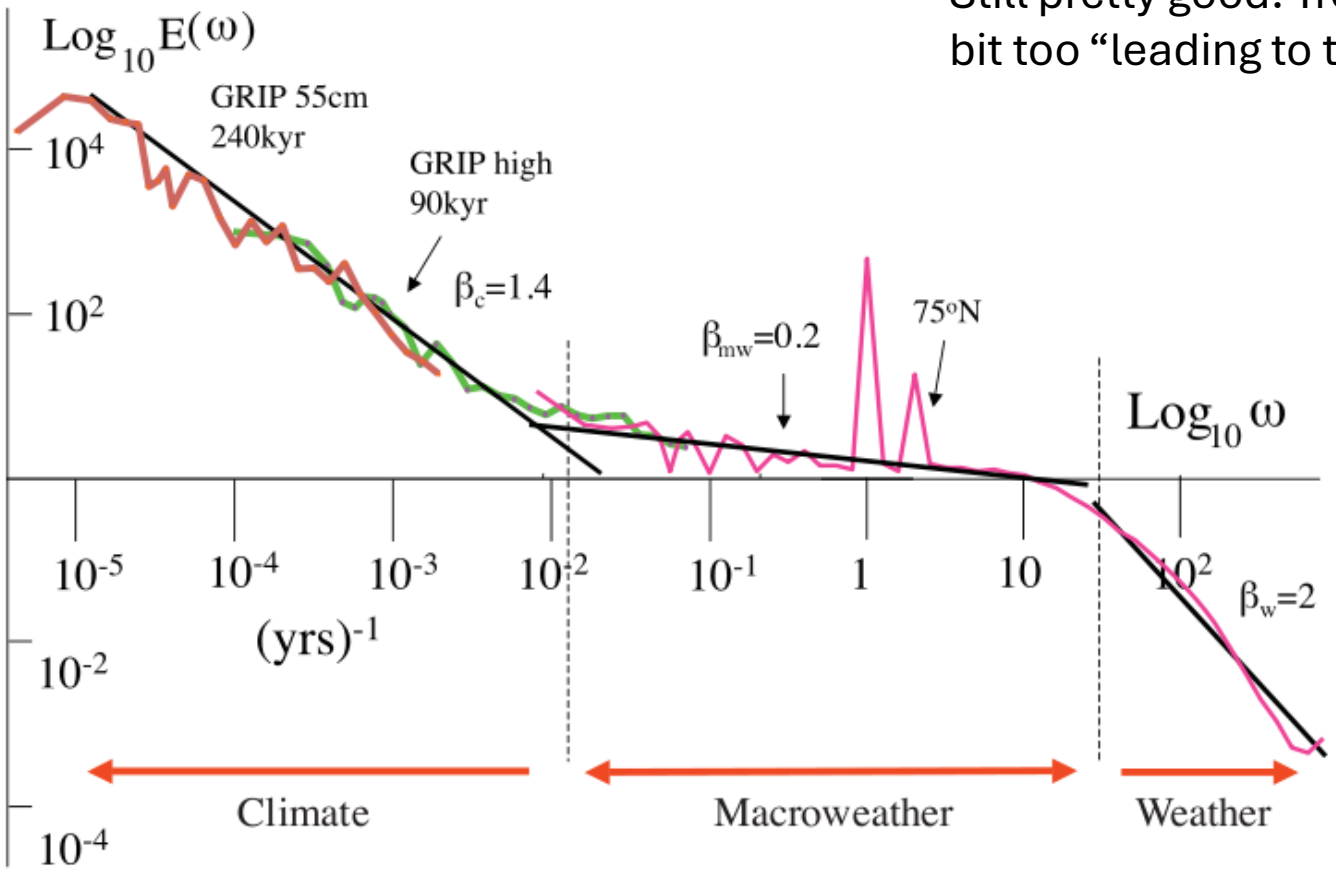


Lovejoy et al. Figure 2

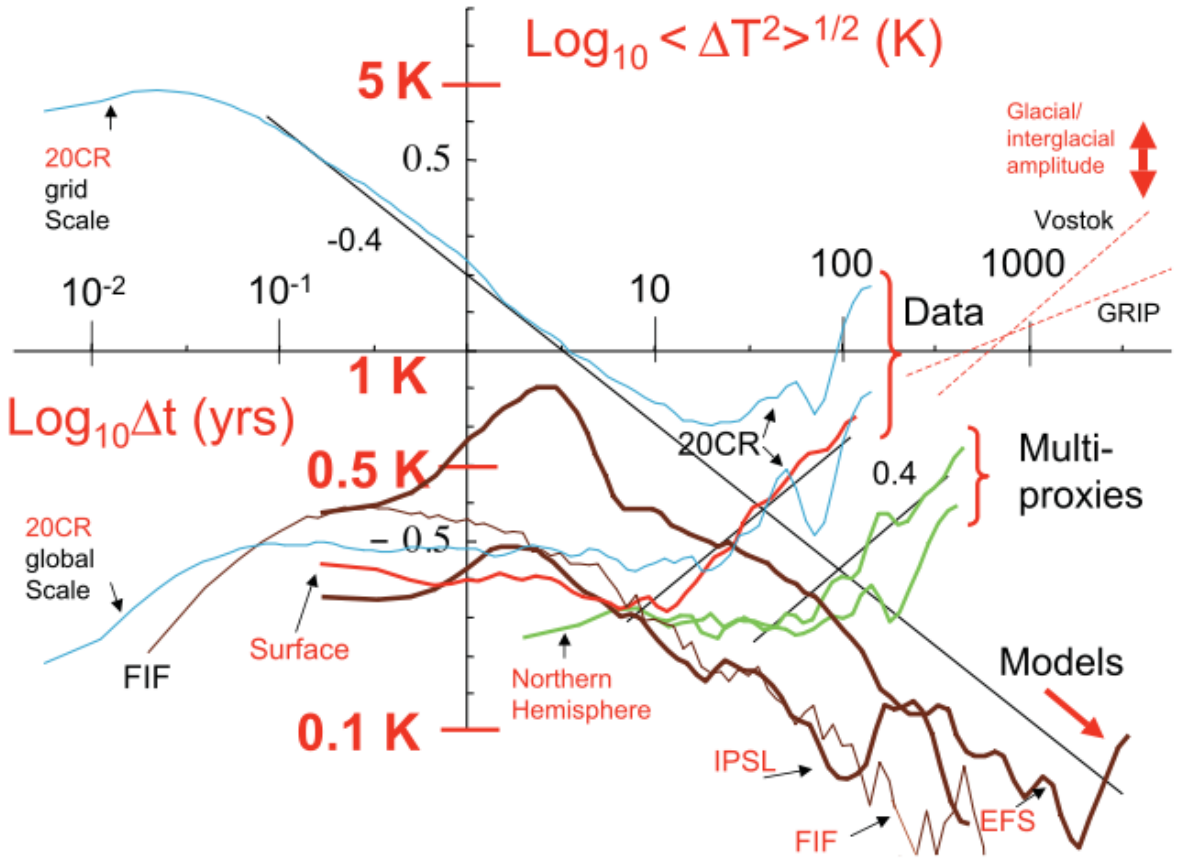


Lovejoy et al. Figure 2

Still pretty good. Trendlines may be a bit too “leading to the eye”.

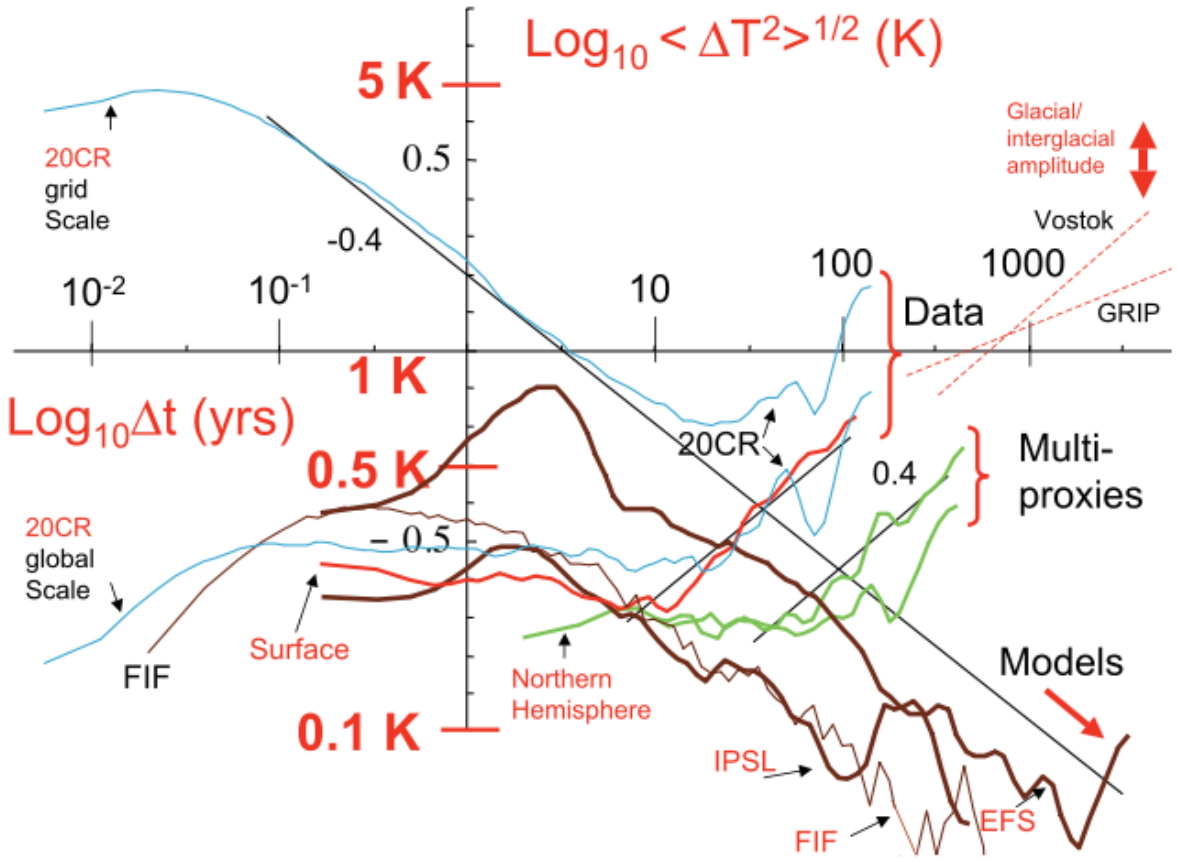


Lovejoy et al. Figure 4



Lovejoy et al. Figure 4: Information Content?

Too much Information!



Preprint (doi:10.5194/esdd-3-1259-2012) Final version is improved!

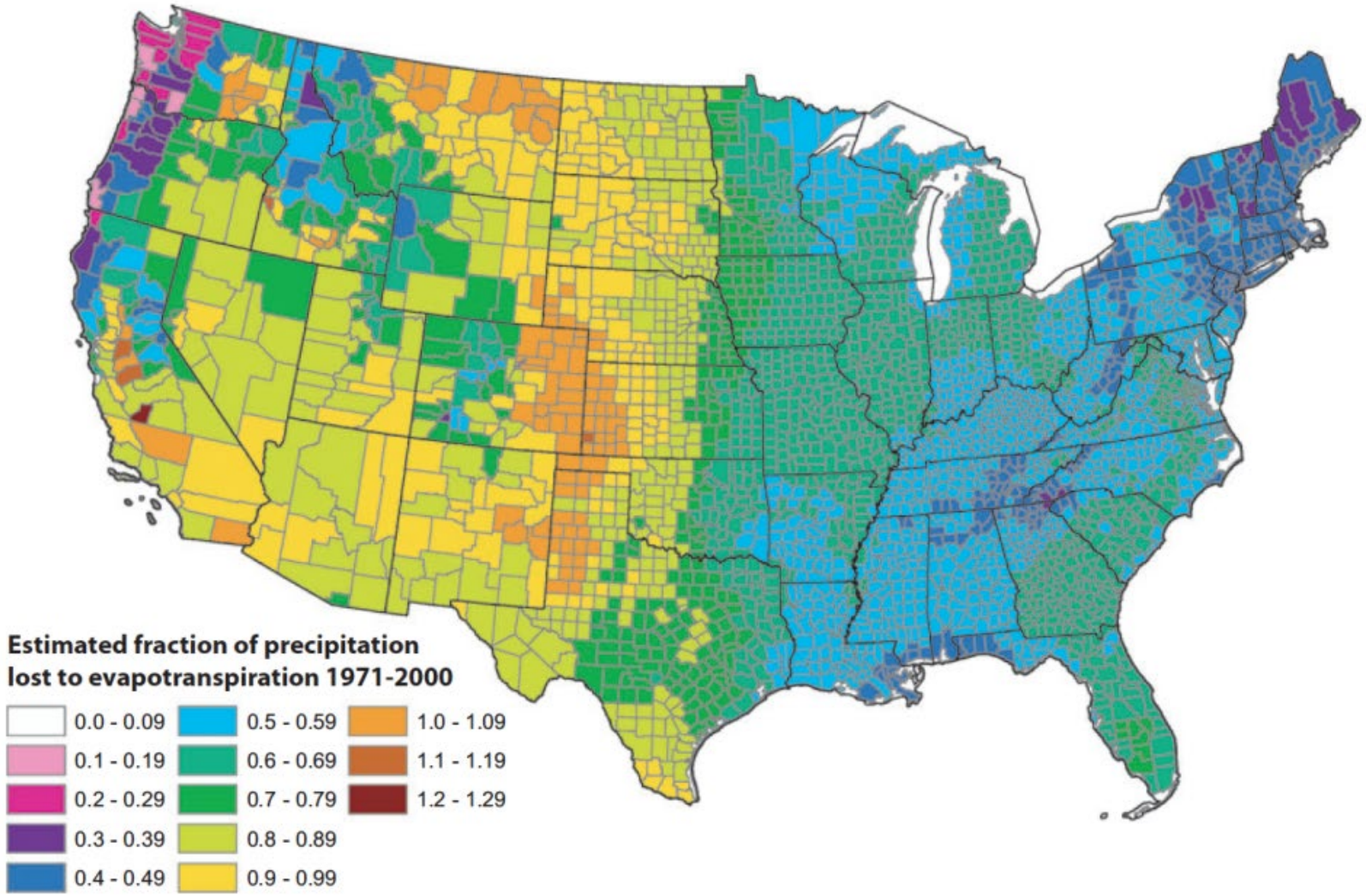
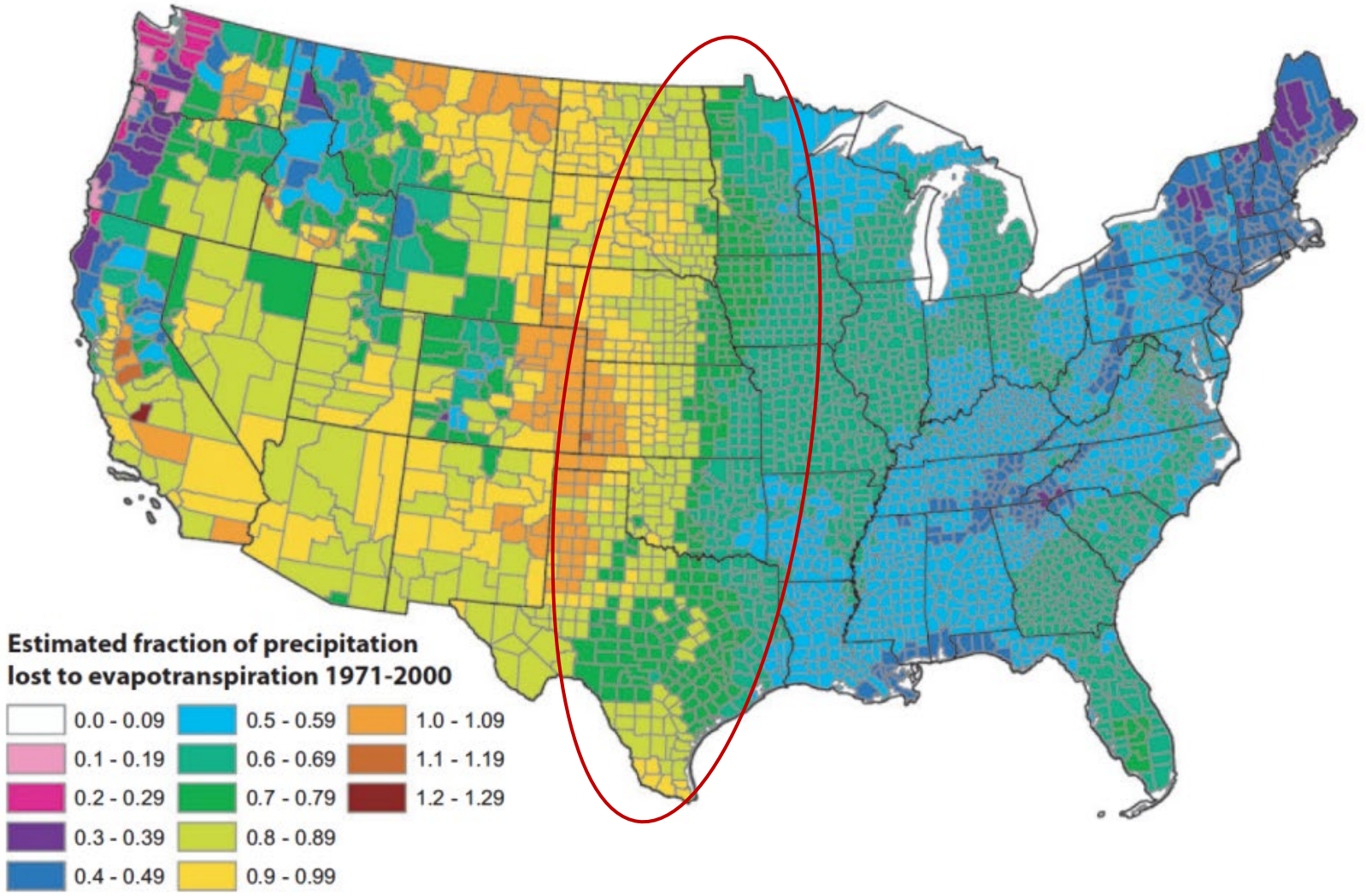


FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM climate data. The mean values for the counties (shown) were then calculated by averaging the 800-m values within each county. Areas with fractions >1 are agricultural counties that either import surface water or mine deep groundwater.

Colorbar Choice?



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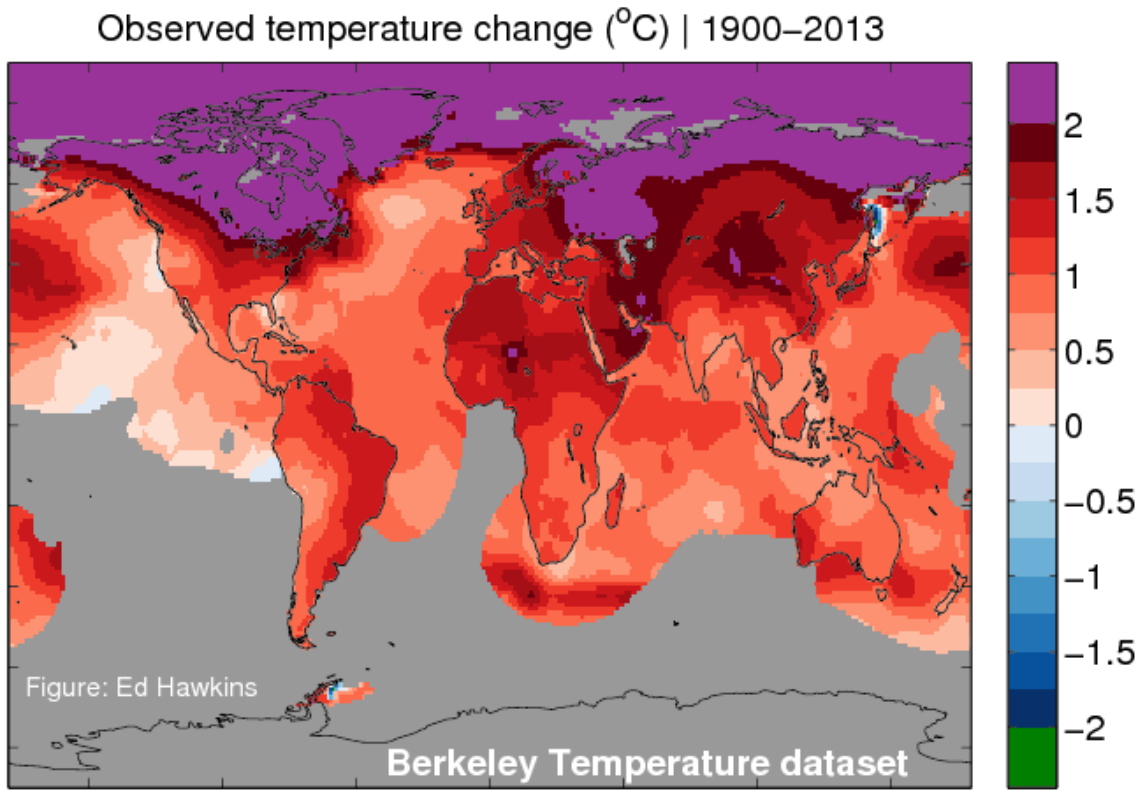
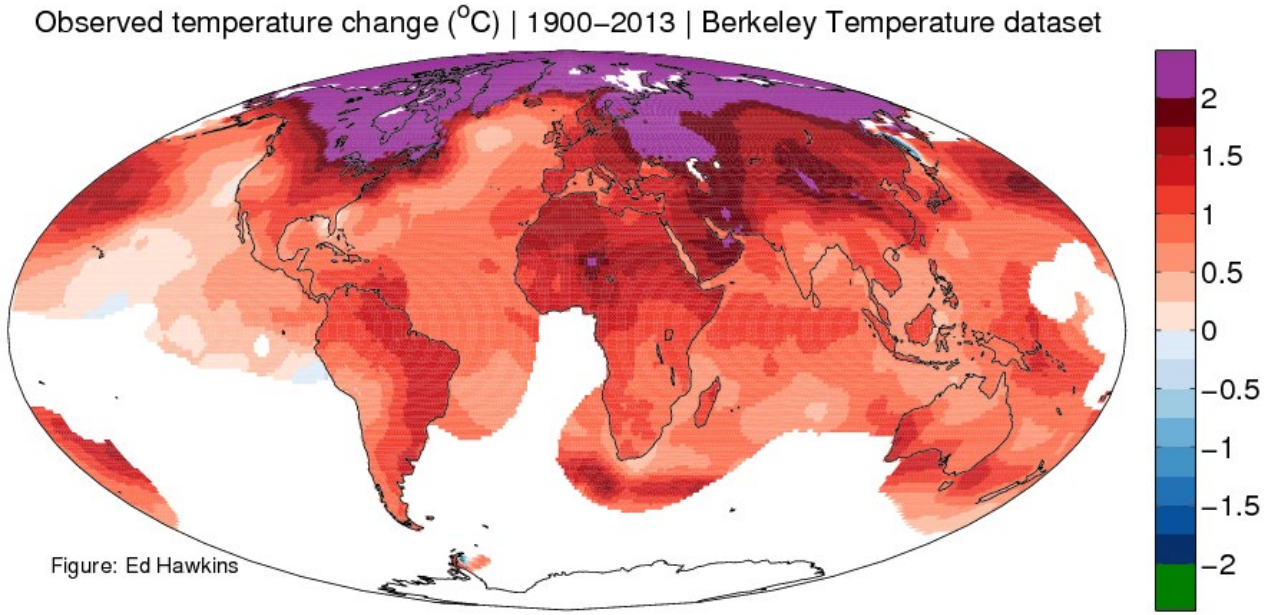
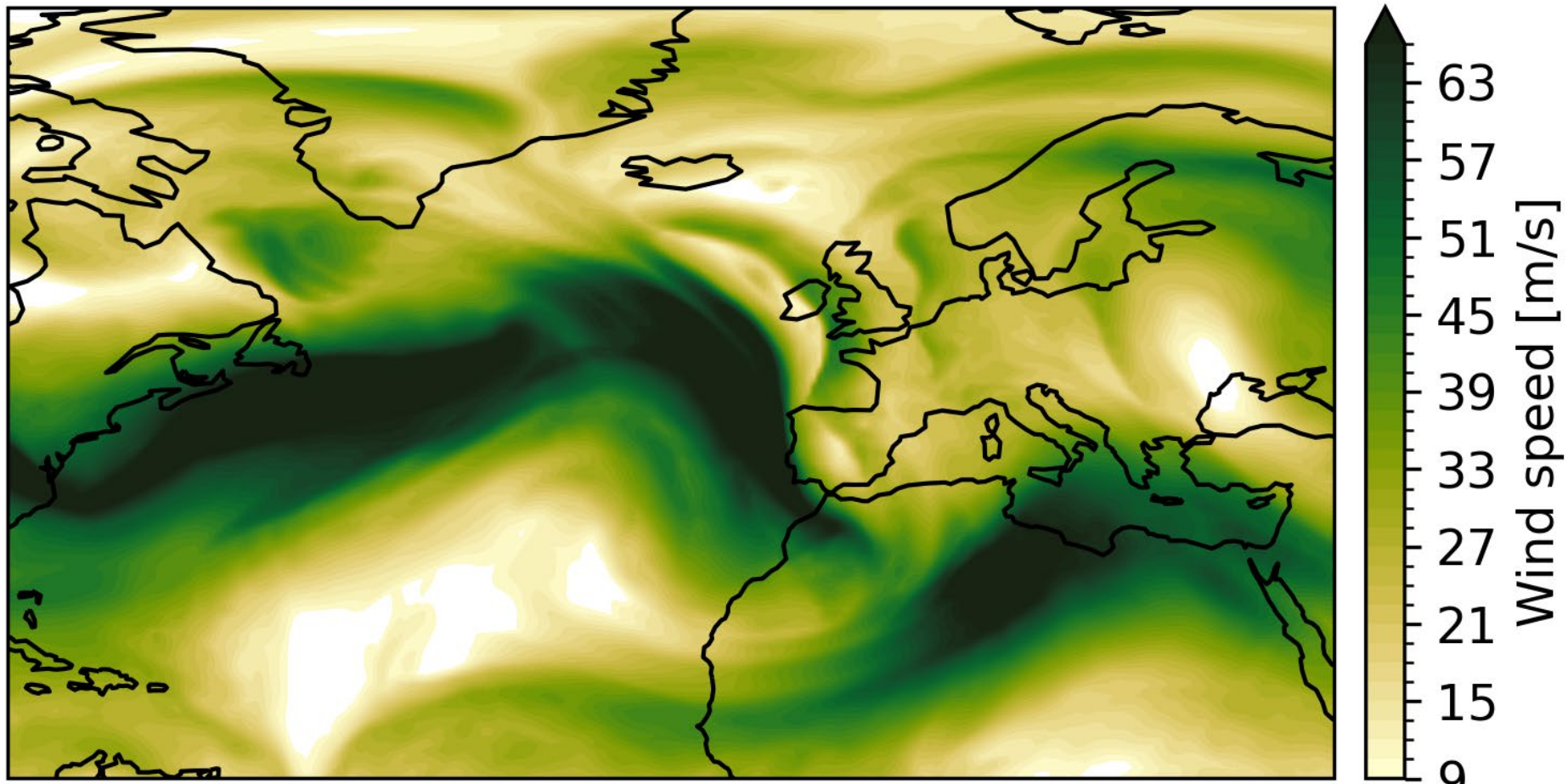
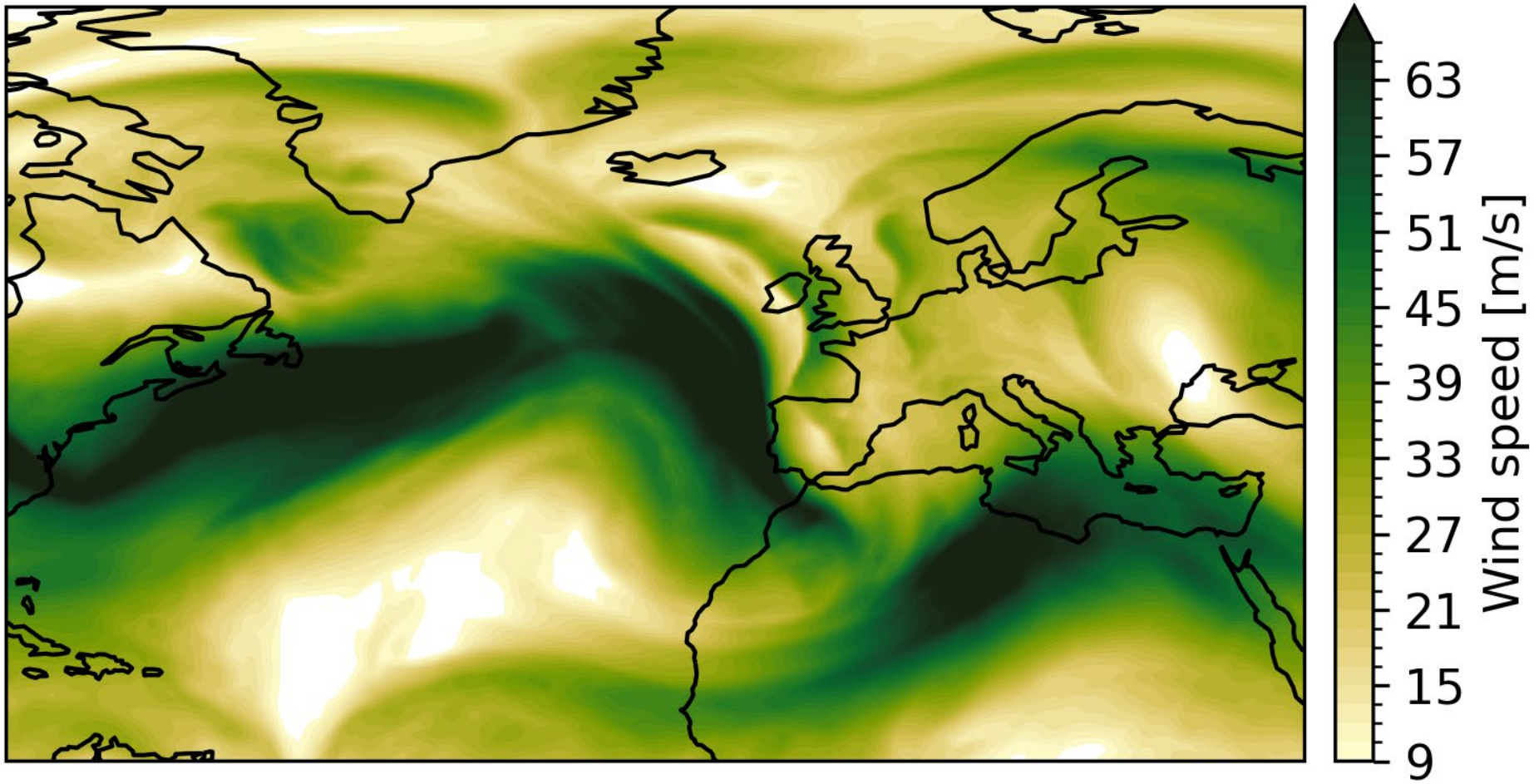
Projection

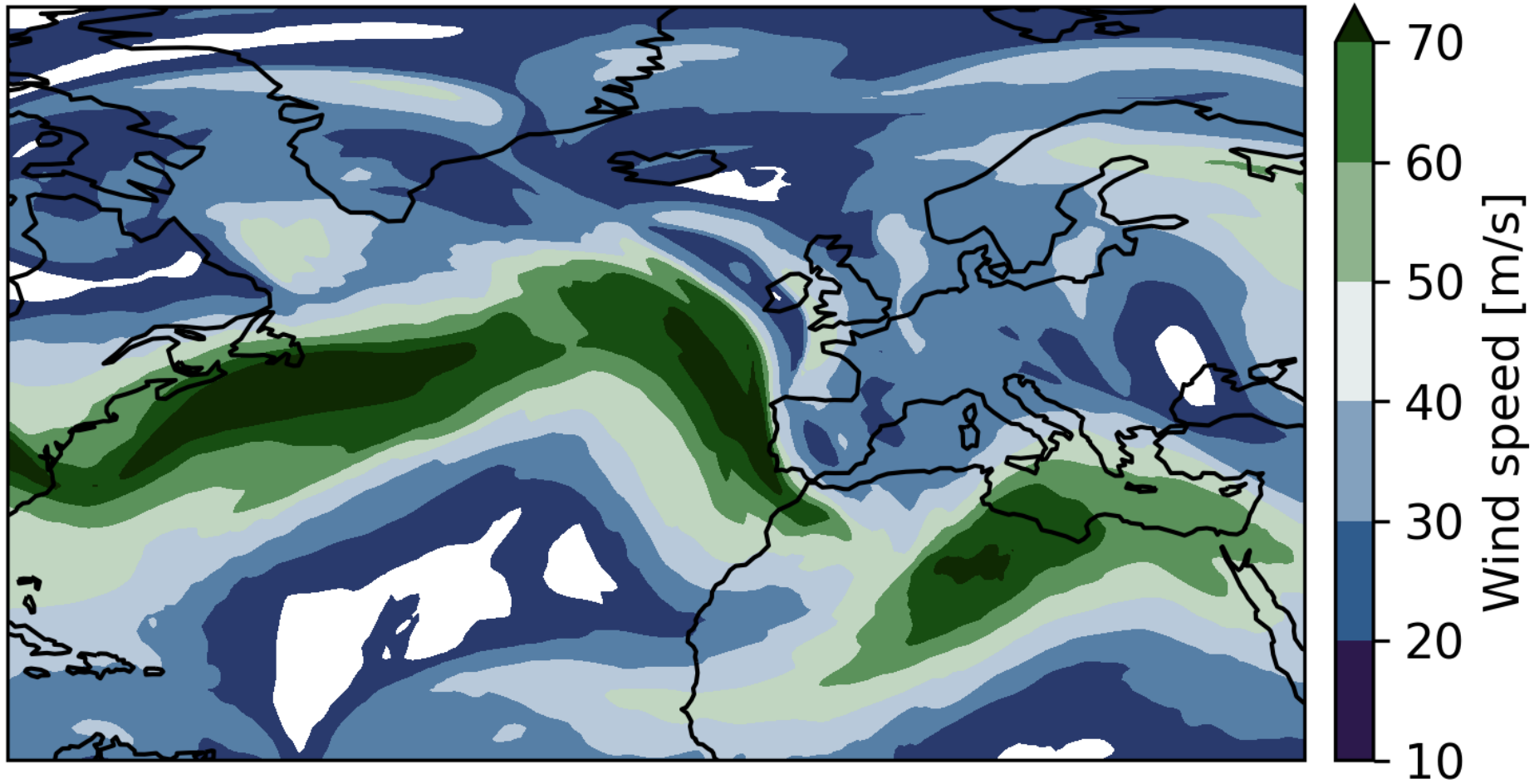

Observed temperature change (°C) | 1900–2013
Figure: Ed Hawkins
Berkeley Temperature dataset
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2


Observed temperature change (°C) | 1900–2013 | Berkeley Temperature dataset
Figure: Ed Hawkins
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2

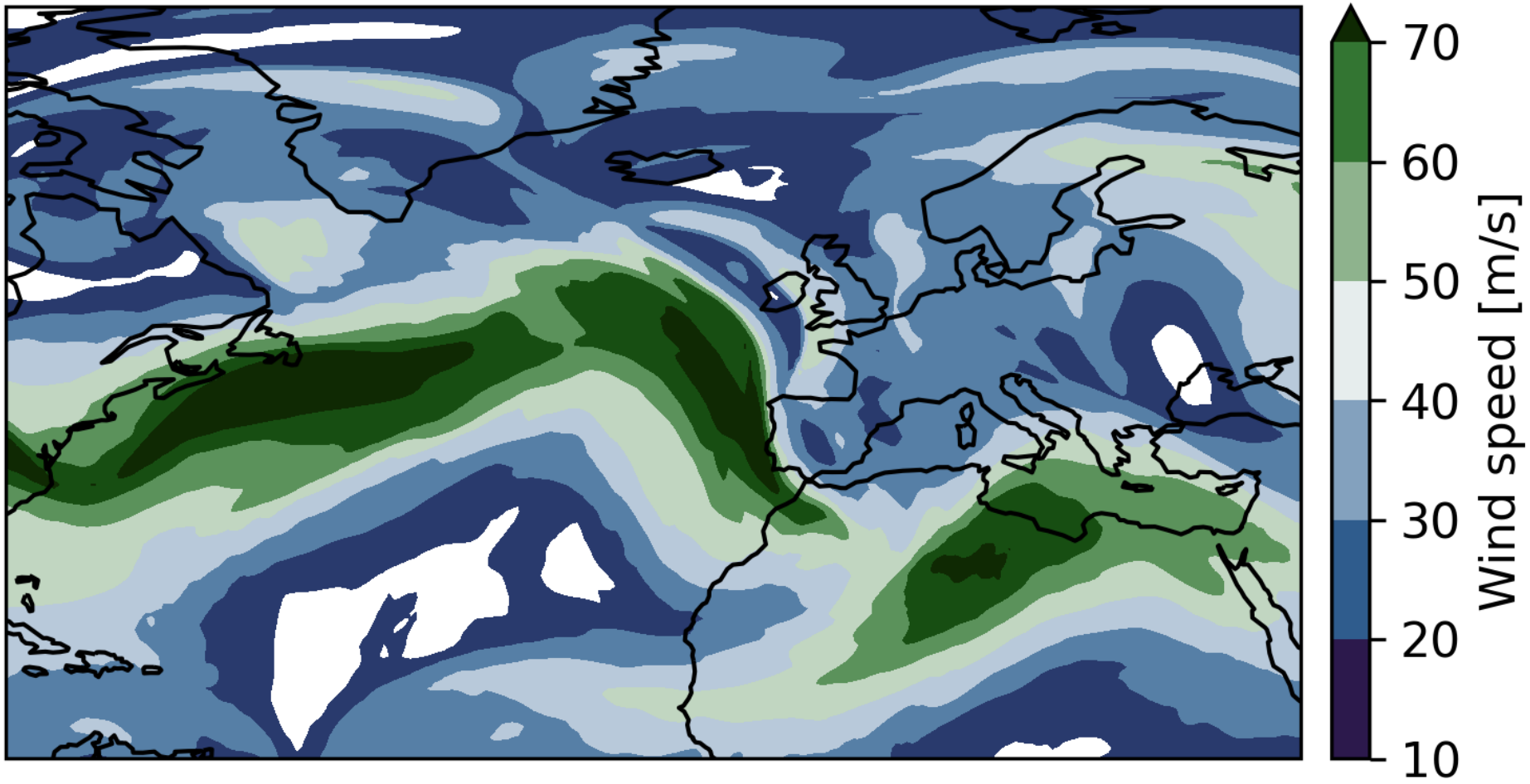

63
57
51
45
39
33
27
21
15
9
Wind speed [m/s]

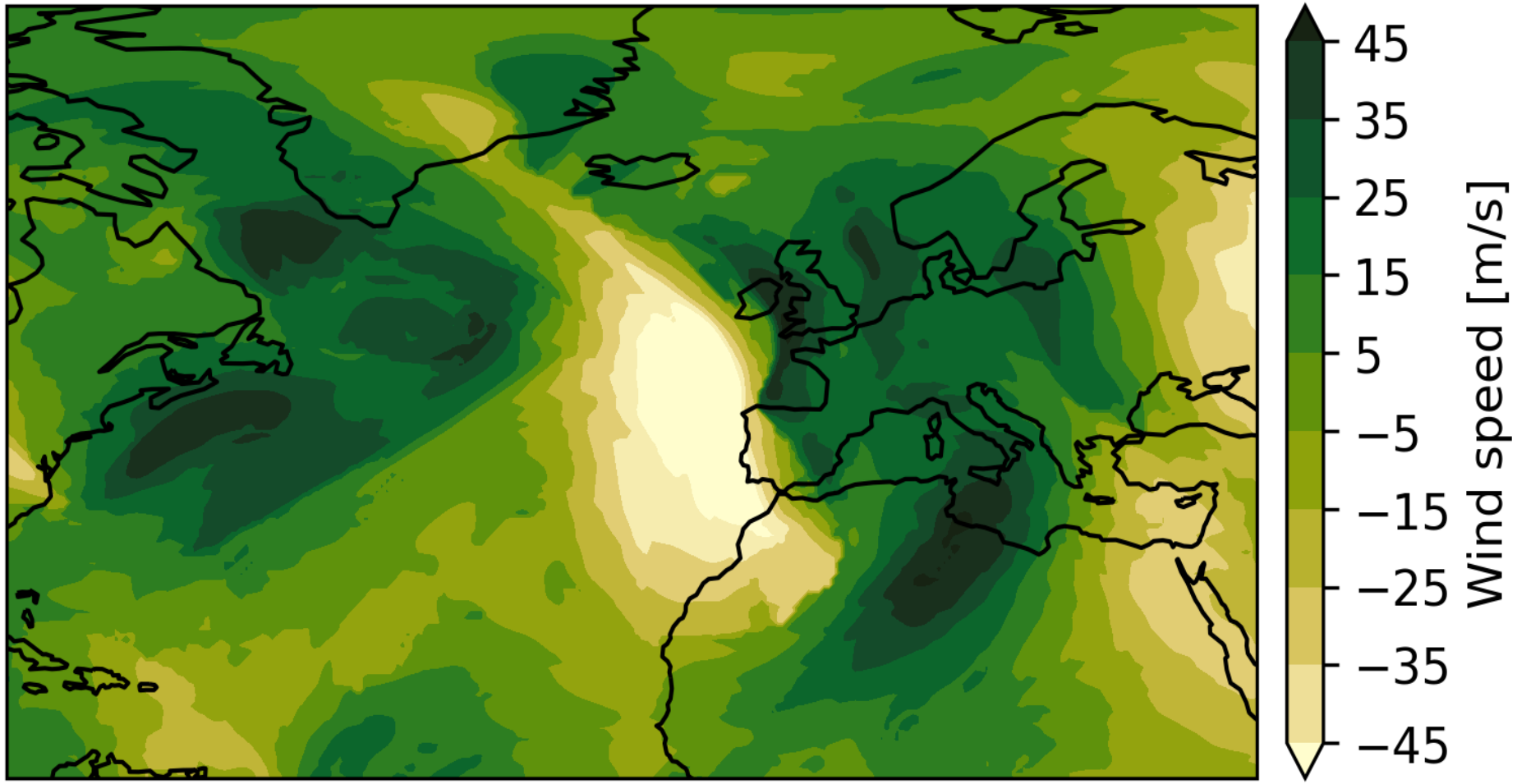
Things to avoid: too many levels



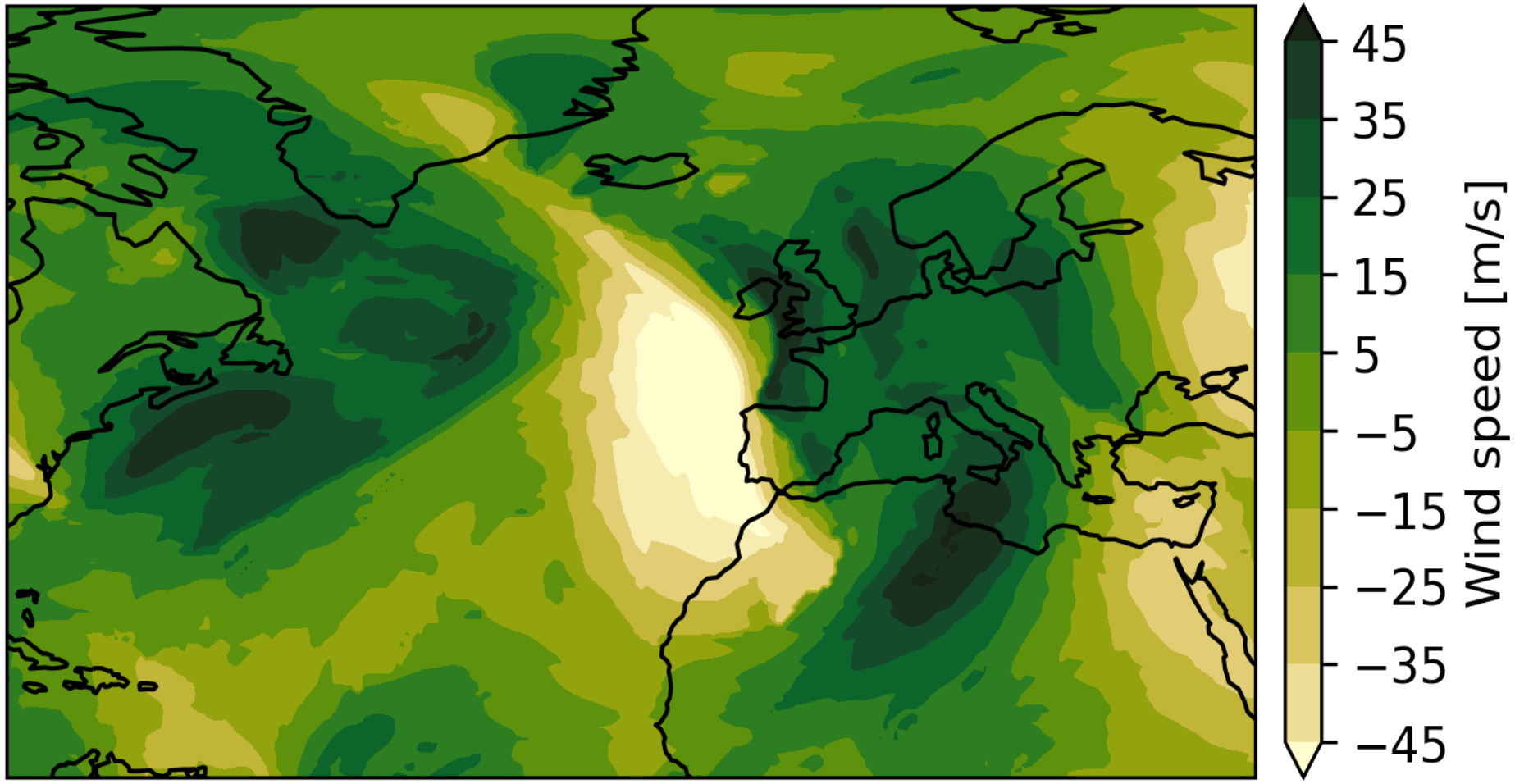

70
60
50
40
30
20
10
Wind speed [m/s]

Things to avoid: symmetric color for nonsymmetric data

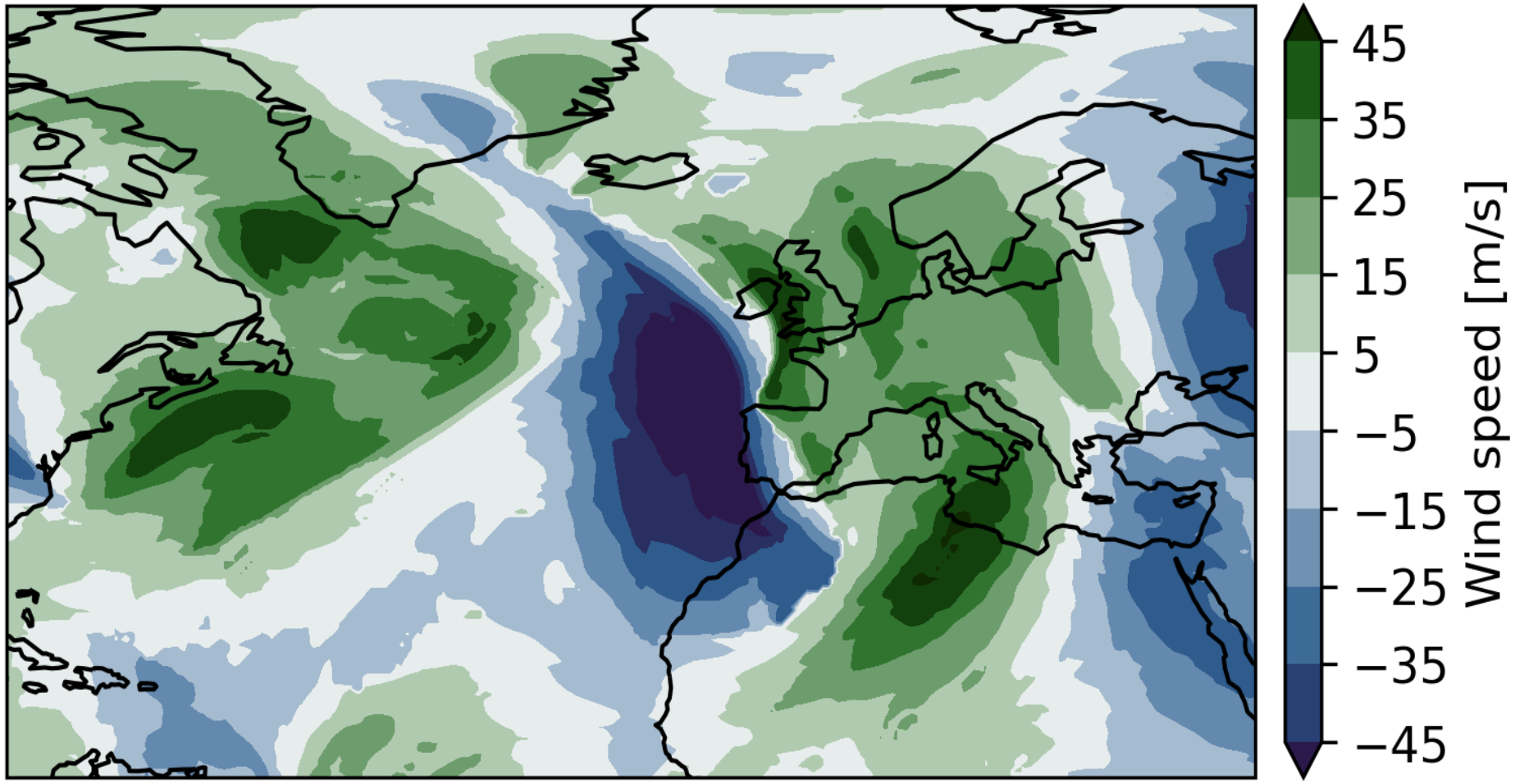


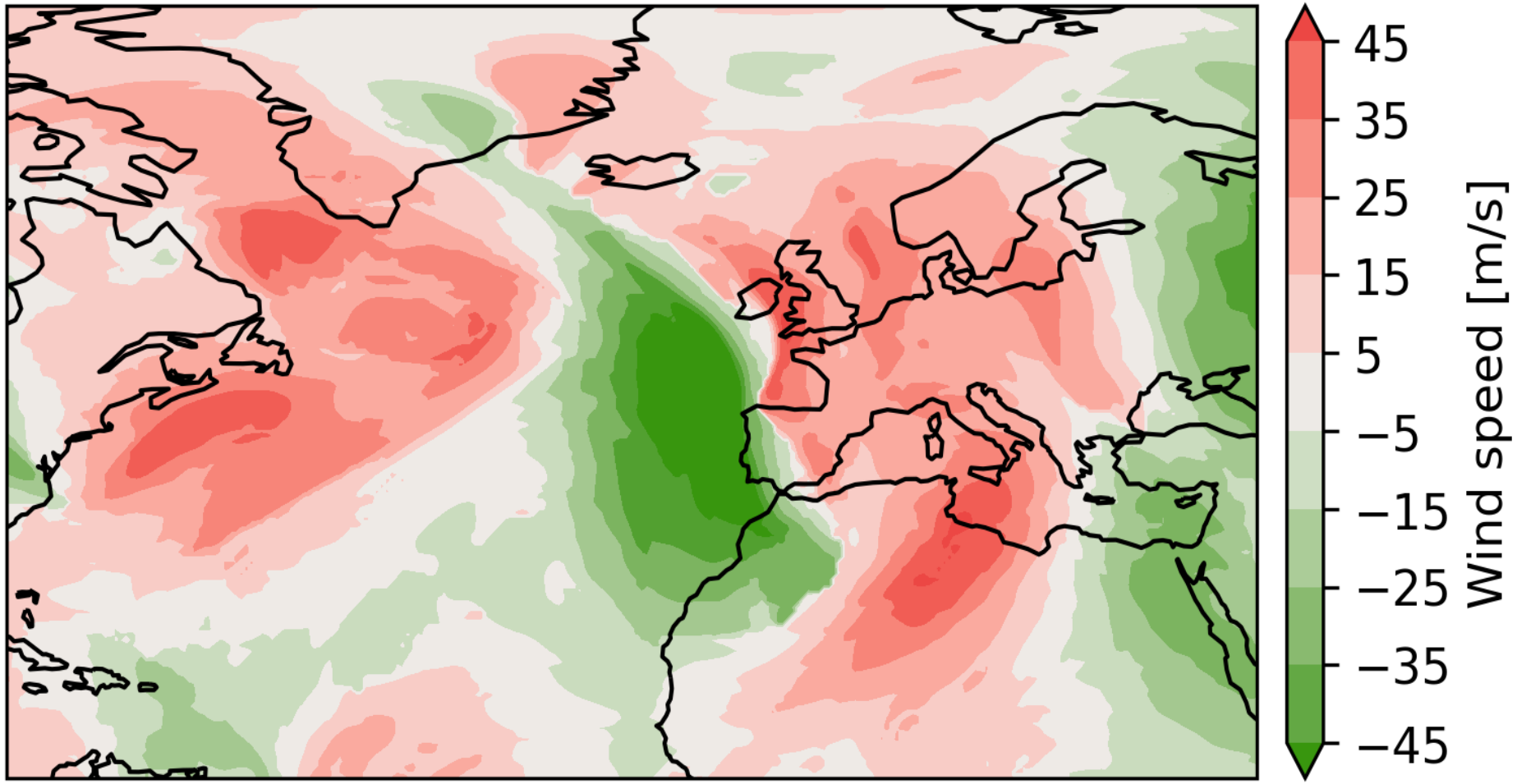

45
35
25
15
5
−5
−15
−25
−35
−45
Wind speed [m/s]

Things to avoid: nonsymmetric color for symmetric data

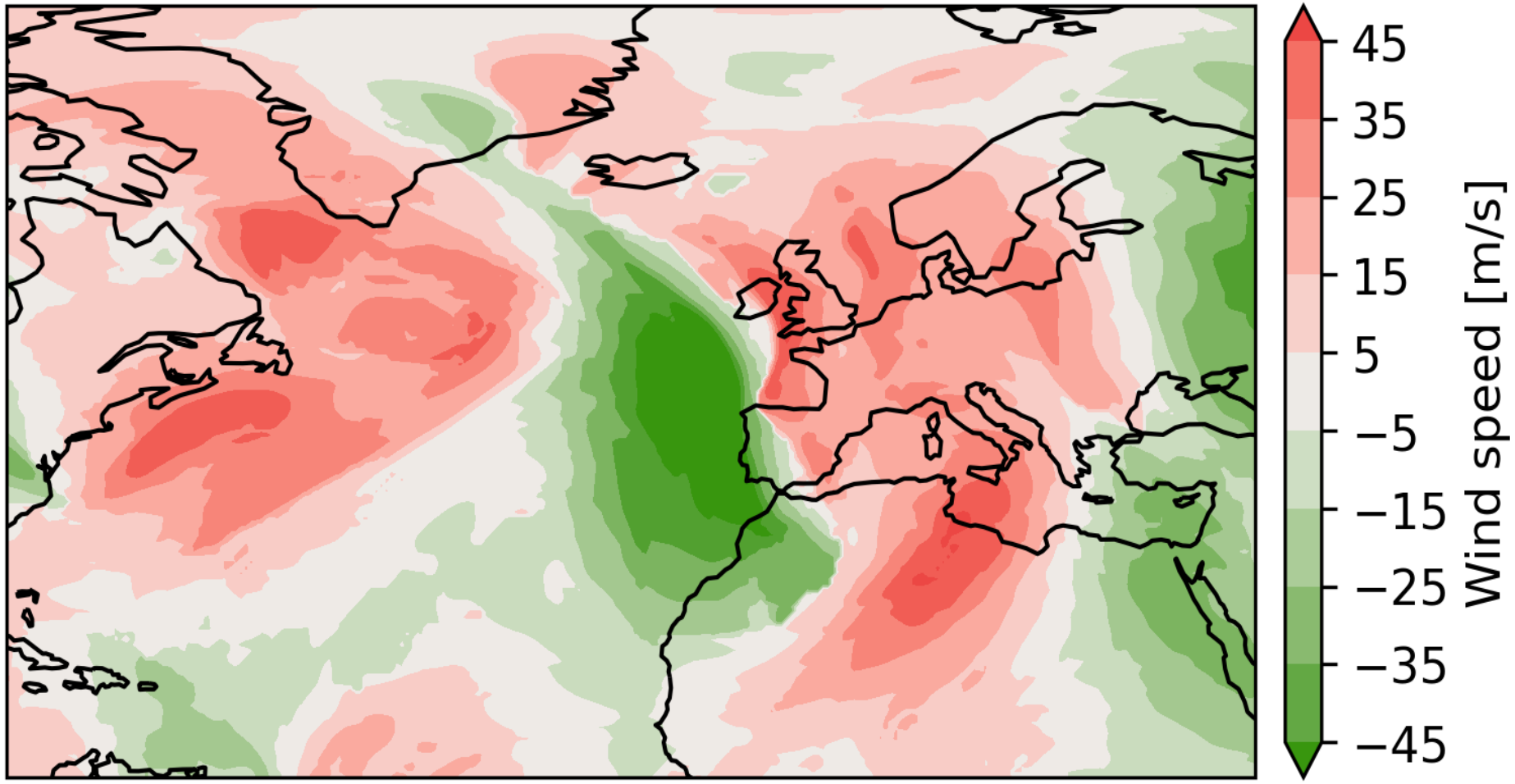


Should be instead

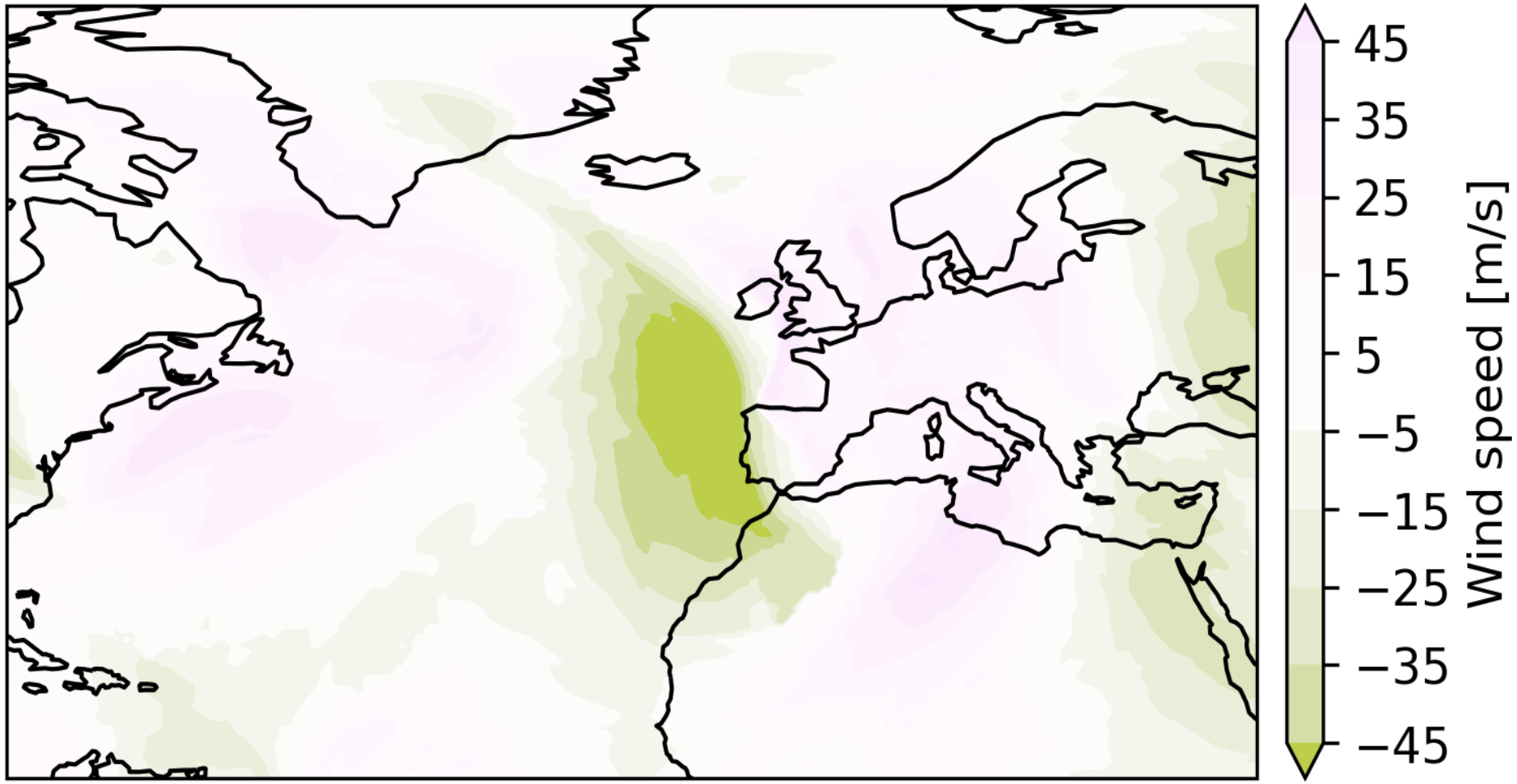



45
35
25
15
5
−5
−15
−25
−35
−45
Wind speed [m/s]

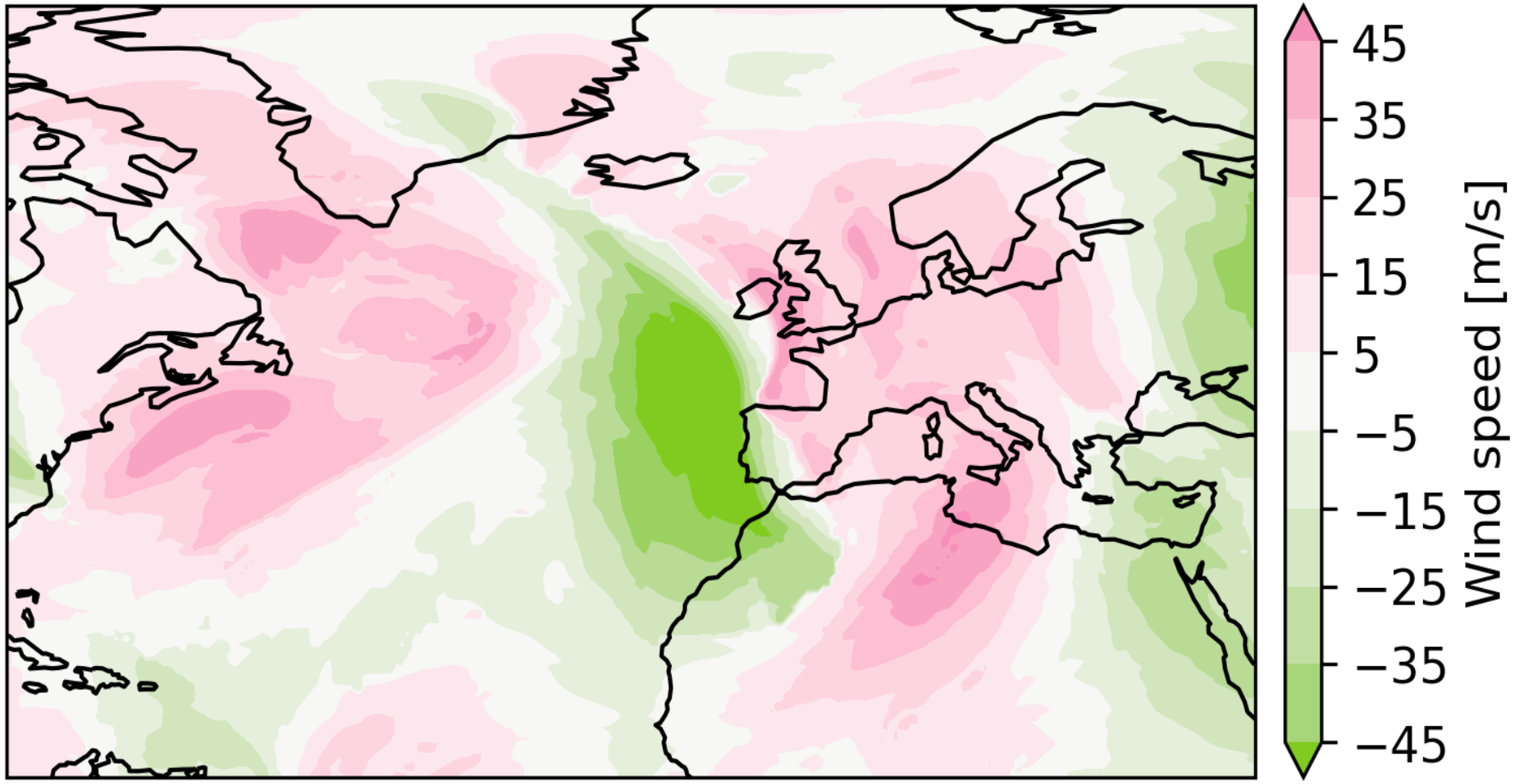
Be nice to colorblind people! This plot



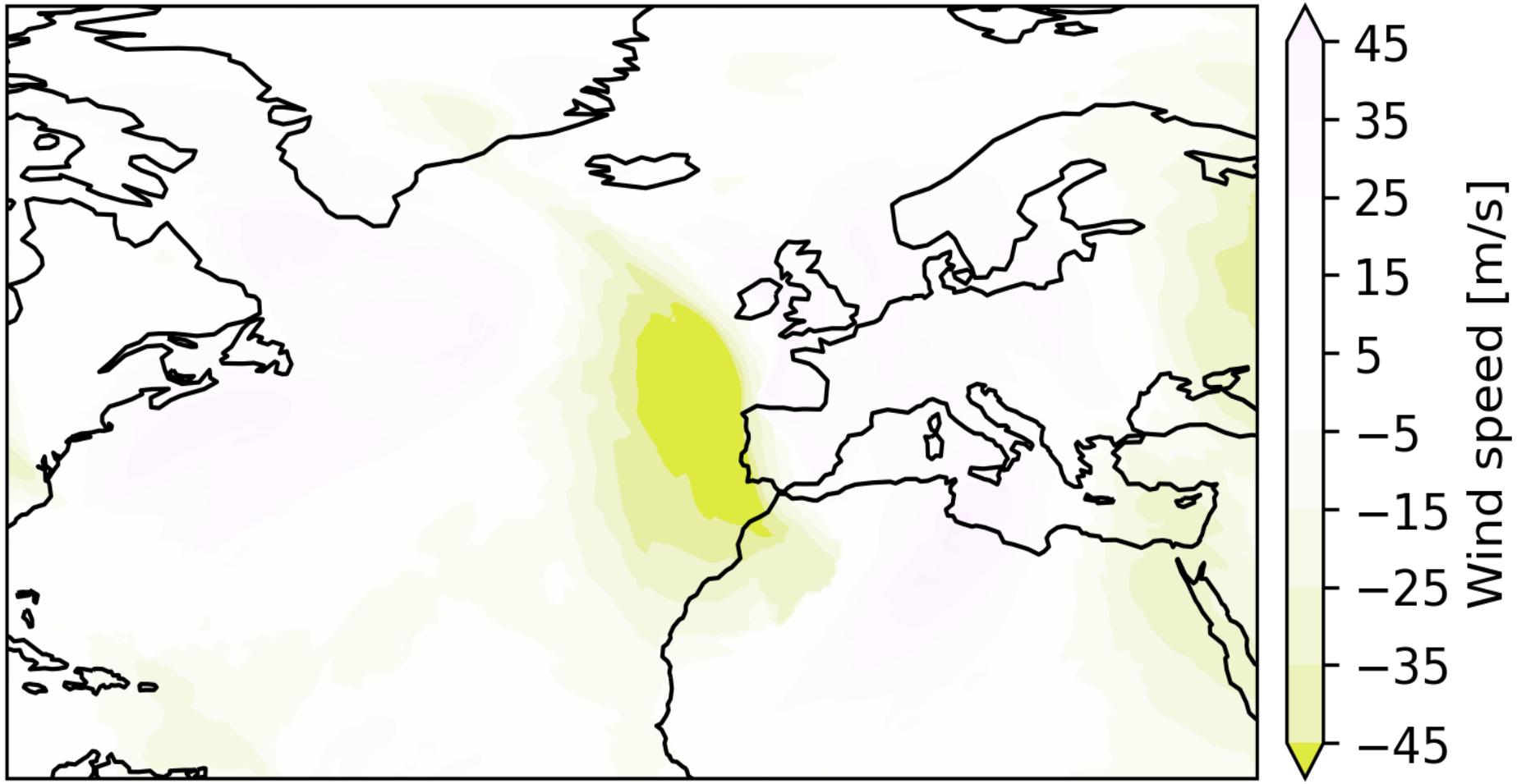
Will look like this for people with protanopia

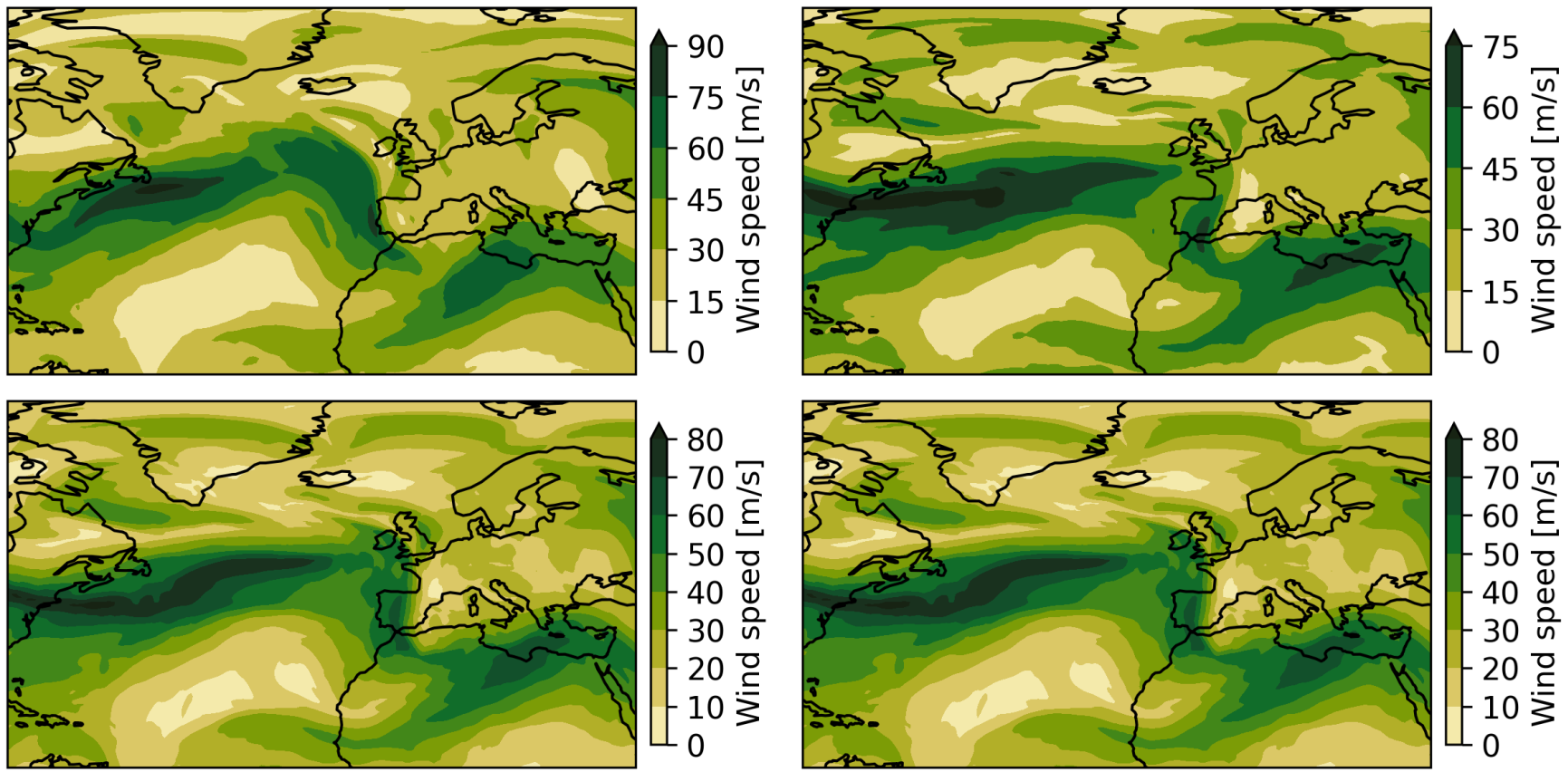


Will look like this for people with deuteranopia

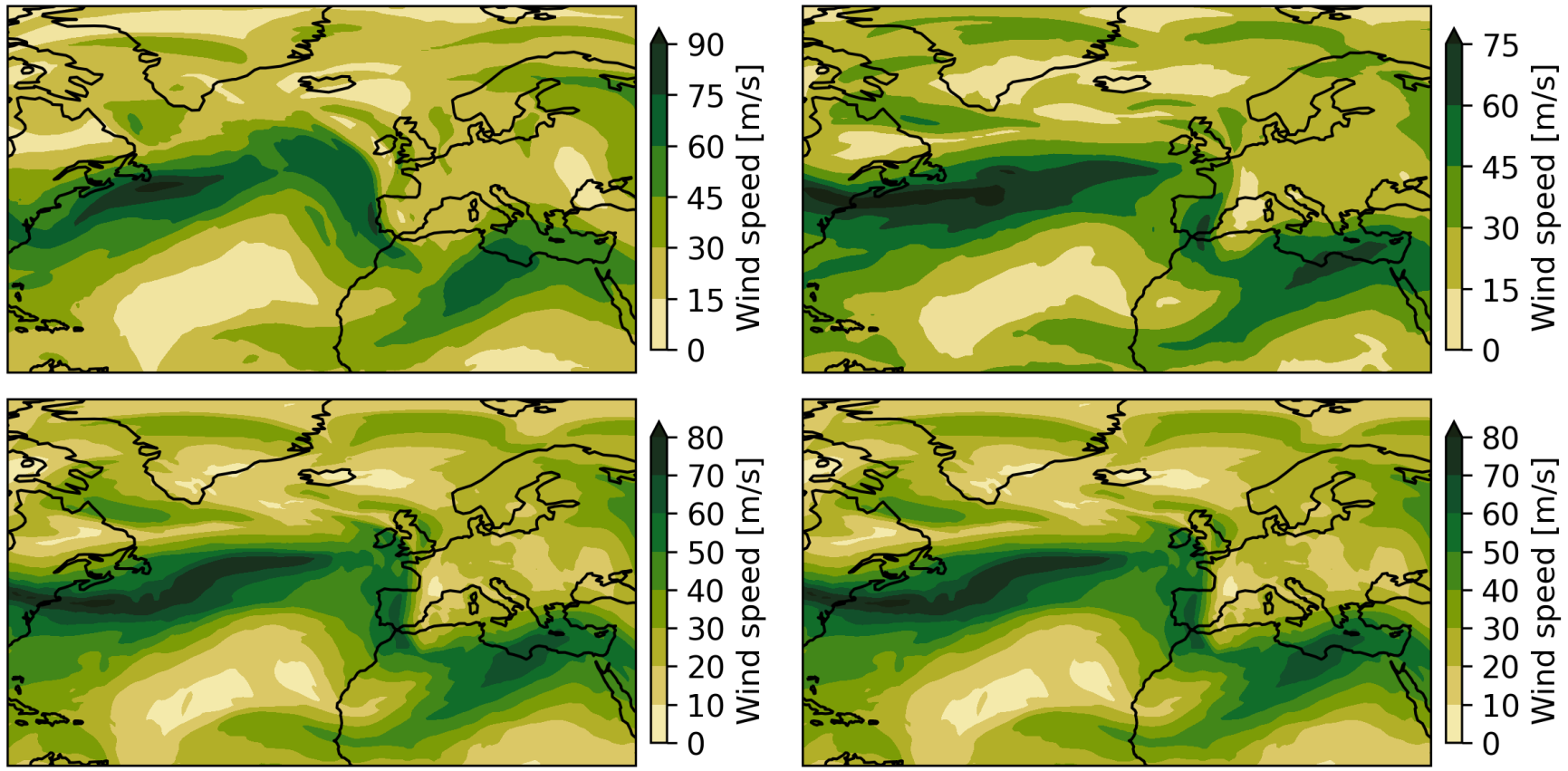


Will look like this for people with tritanopia

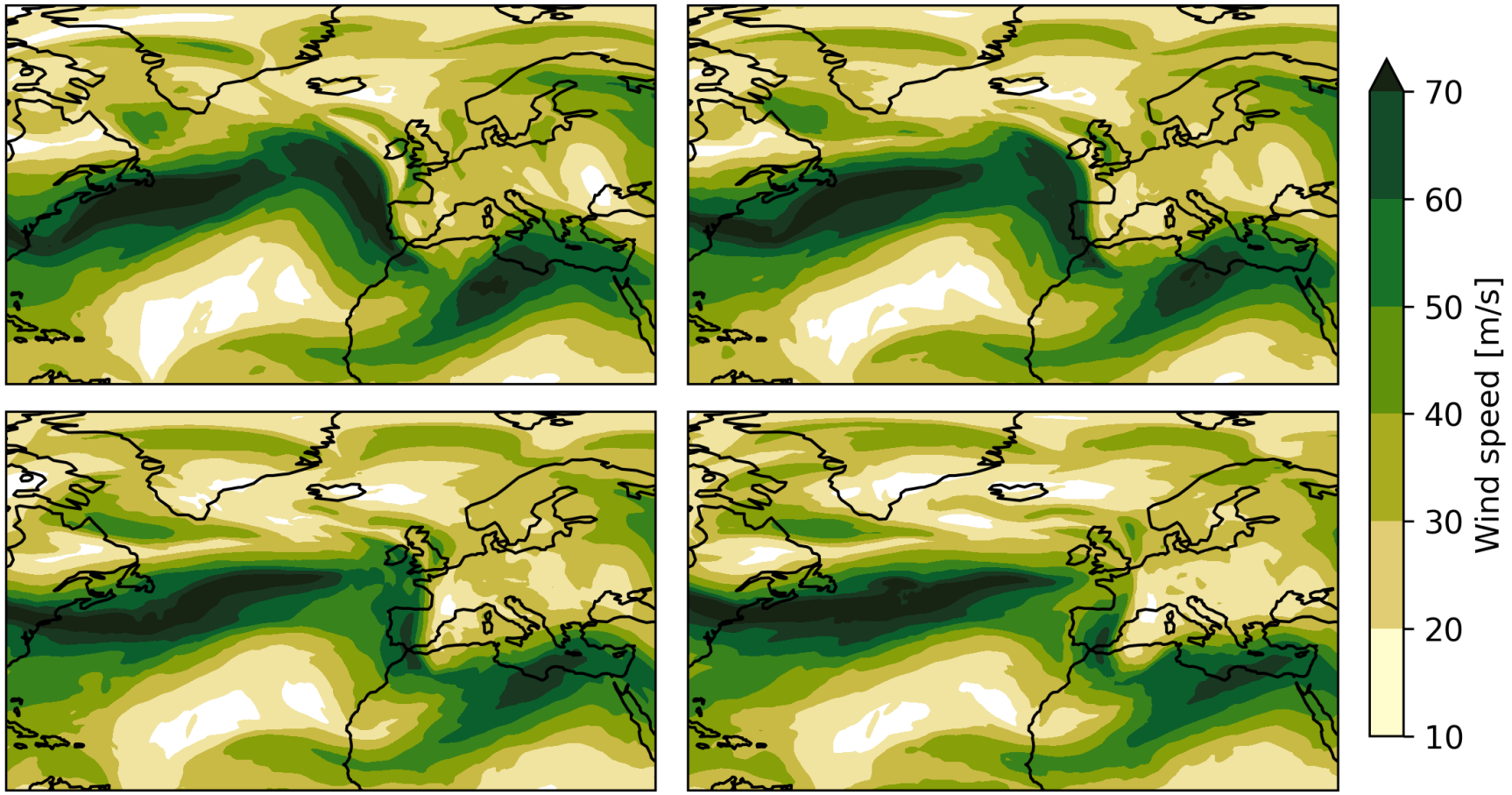



90
75
60
45
30
15
0
Wind speed [m/s]
75
60
45
30
15
0
Wind speed [m/s]
80
70
60
50
40
30
20
10
0
Wind speed [m/s]
80
70
60
50
40
30
20
10
0
Wind speed [m/s]

Things to avoid: Mixed Colorbars



For clarity, when showing many plots at once, use the same colorbar for all!*



*Exceptions exist, use your best judgement

Figure Checklist

1. Purpose:
   - What do I want to show?
   - Does a figure make sense? If yes what type?
2. Composition:
   - What elements do I need on my figure?
   - How do I arrange them?
3. Color:
   - Which colors to use?
   - Do they convey the correct information?
4. Clarity:
   - How easily can my figure be understood?

- Readability:
  - Number of subplots ok?
  - Fontsize ok?
  - Content density ok?
  - Axis choice ok? (i.e. should it be logarithmic?)
  - Projection ok?
- Colors:
  - Color choice ok?
    - Misleading?
    - Colorblind friendly? Also, think about that in your figure descriptions (“The red line shows…”)
  - Colorbar levels?
- Style:
  - Font consistent throughout the figure?
  - Figures consistent throughout the paper?
  - Aesthetically pleasing?
  - Everything aligned?

Choose the right color for what you want to show! In doubt, follow IPCC style sheet

Variable	Type	Colour gradient	Continuous	Discrete	Reference[14,15]
Temperature (atmosphere, ocean, etc)	divergent		temp_div.txt	temp_div_disc.txt	Color Brewer
	sequential		temp_seq.txt	temp_seq_disc.txt	Lajolla by Fabio Crameri
Precipitation (inc. rainfall, P-E, etc)	divergent		prec_div.txt	prec_div_disc.txt	Color Brewer
	sequential		prec_seq.txt	prec_seq_disc.txt	custom
Wind (Curl, speed, etc)	divergent		wind_div.txt	wind_div_disc.txt	Cork by Fabio Crameri
	sequential		wind_seq.txt	wind_seq_disc.txt	Speed from Matplotlib cmocean
Cryosphere (Ice/ snow/glacier area/ cover/ extent/ mass, etc)	divergent		cryo_div.txt	cryo_div_disc.txt	Broc by Fabio Crameri
	sequential		cryo_seq.txt	cryo_seq_disc.txt	Oslo by Fabio Crameri

(contd)

CO_2/CH_4/aerosols (emissions,concentrations budget, flux, etc)	divergent		chem_div.txt	chem_div_disc.txt	Color Brewer
	sequential		chem_seq.txt	chem_seq_disc.txt	Tokyo by Fabio Crameri
Sea level (sea surface height, sea level rise, etc)	divergent		slev_div.txt	slev_div_disc.txt	Custom
	sequential		slev_seq.txt	slev_seq_disc.txt	Davos (reversed) by Fabio Crameri
Other variables	divergent		misc_div.txt	misc_div_disc.txt	Custom
Other variables (e.g. salinity, pH, %, etc)	sequential		misc_seq_1.txt	misc_seq_1_disc.txt	Imola by Fabio Crameri
Other variables (e.g. mixed layer depth, density, sea level pressure)	sequential		misc_seq_2.txt	misc_seq_2_disc.txt	Dense from Matplotlib cmocean
To replace rainbow colour map	sequential		misc_seq_3.txt	misc_seq_3_disc.txt	Batlow from Fabio Crameri

Helpful links

- https://colorbrewer2.org/#type=sequential&scheme=BuGn&n=3
- https://davidmathlogic.com/colorblind/#%23648FFF-%23785EF0-%23DC267F-%23FE6100-%23FFB000
- https://earthobservatory.nasa.gov/blogs/elegantfigures/2013/08/05/subtleties-of-color-part-1-of-6/
- https://b.nanes.org/figures/
- https://www.simplifiedsciencepublishing.com/resources/how-to-make-good-figures-for-scientific-papers
- https://pmc.ncbi.nlm.nih.gov/articles/PMC6151470/