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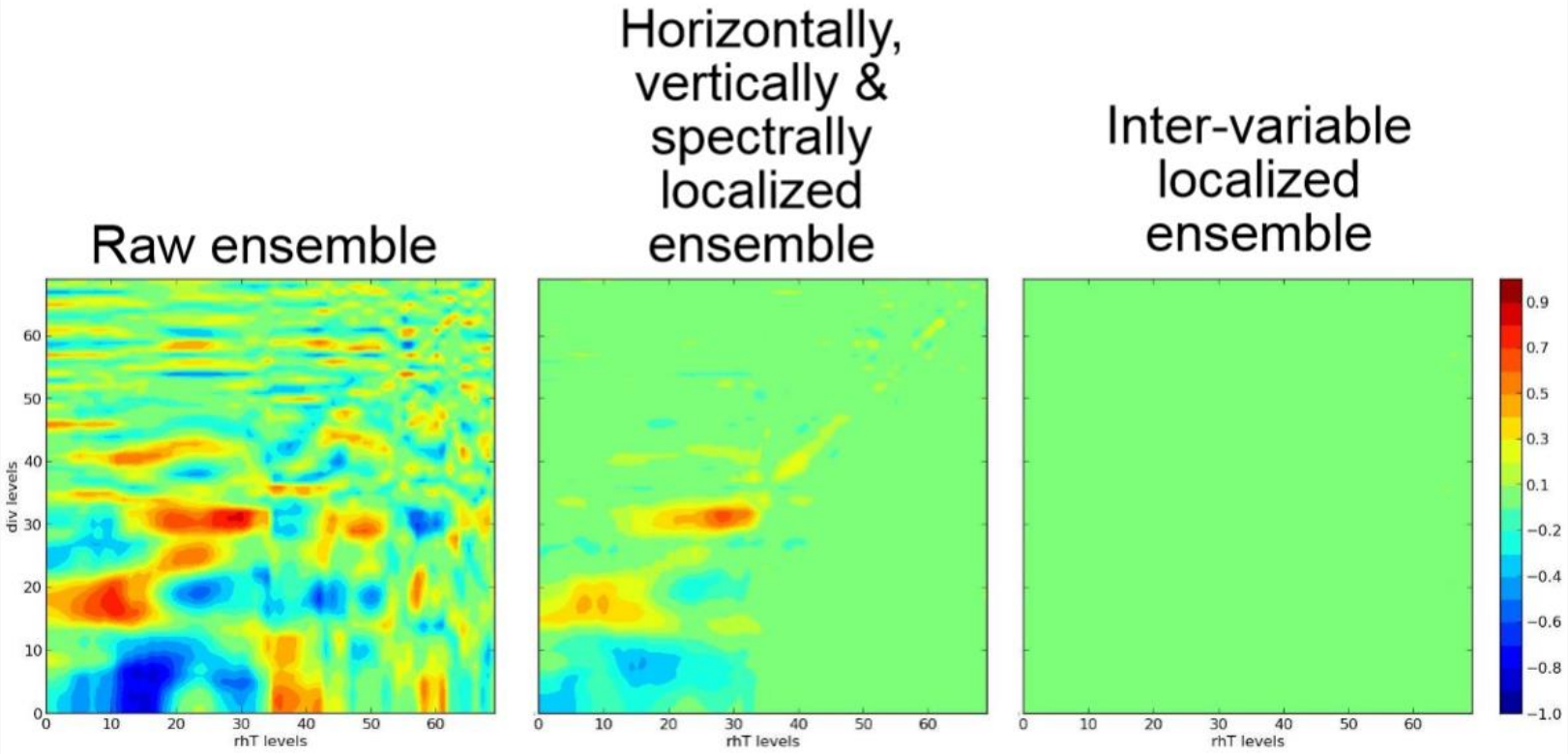
Using colour

© University of Reading 2008

Column cross-correlations between: divergence (up) & relative humidity (across).



© Crown copyright Met Office Andrew Lorenc 13

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Rainbow colour scales are popular. They're pretty.

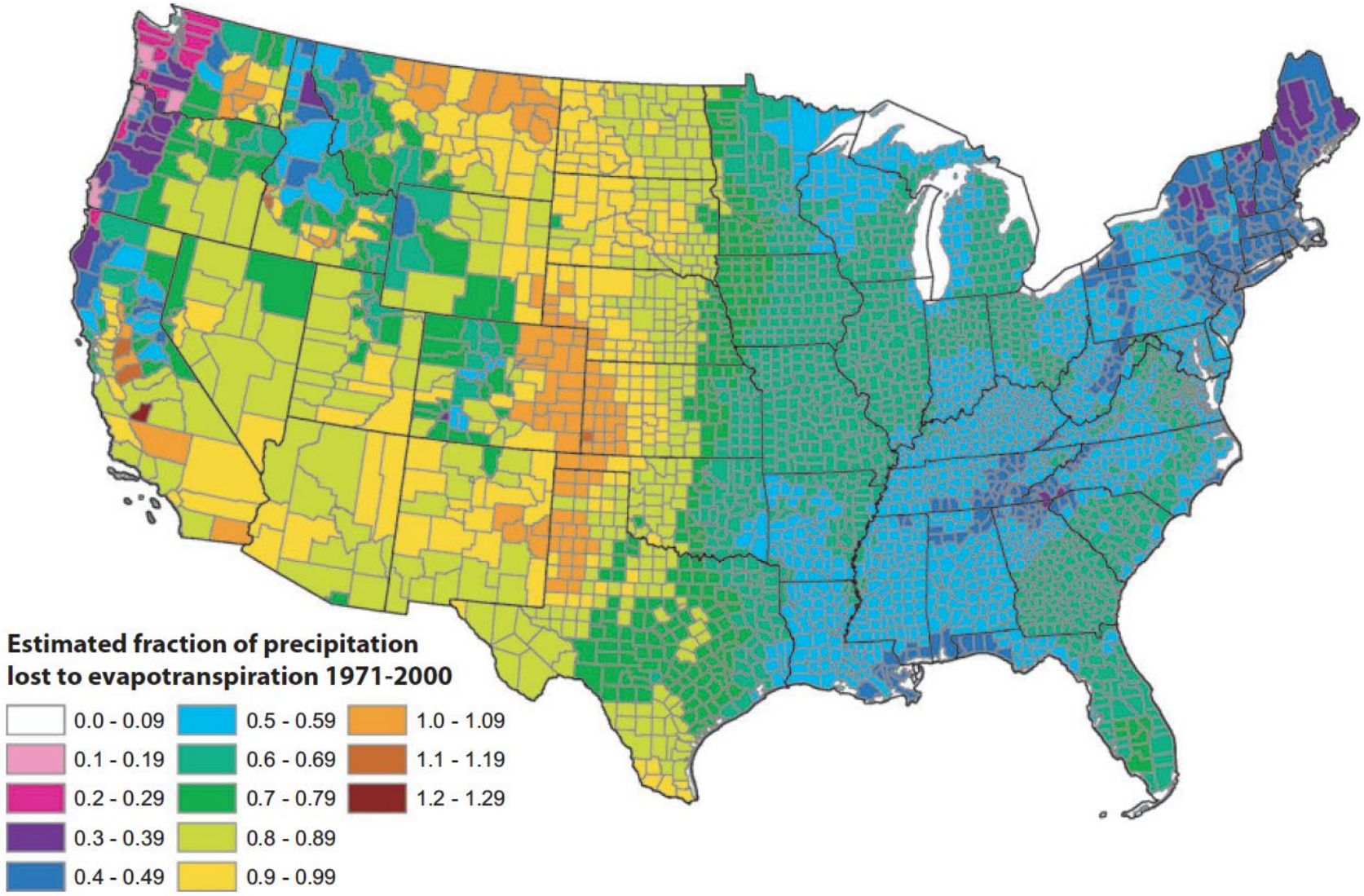

FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM 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.

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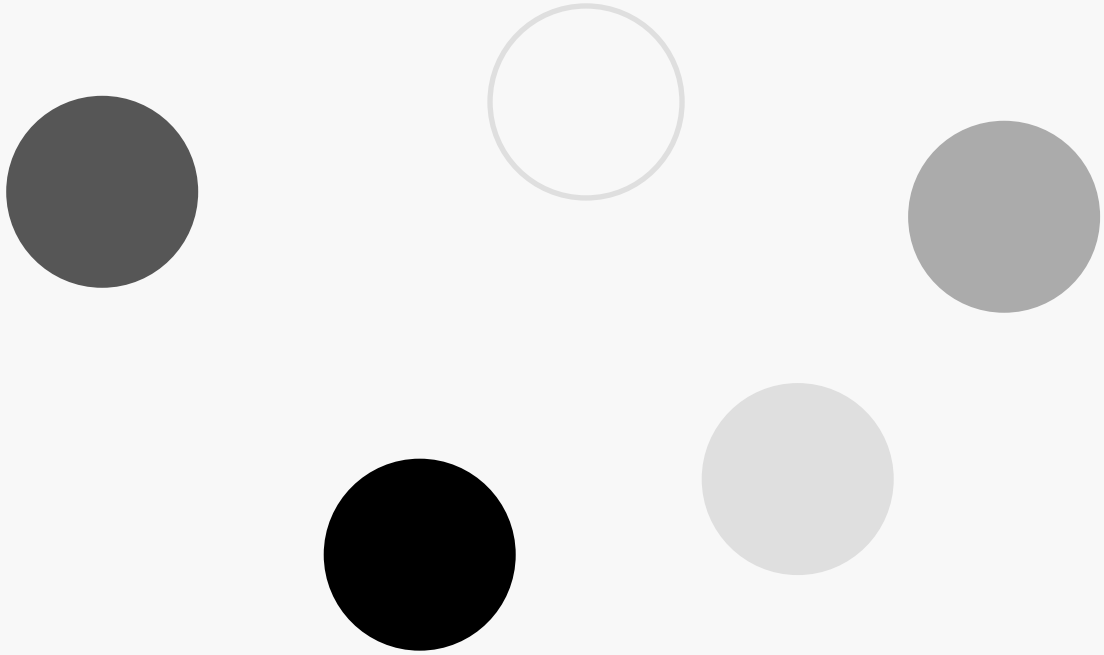
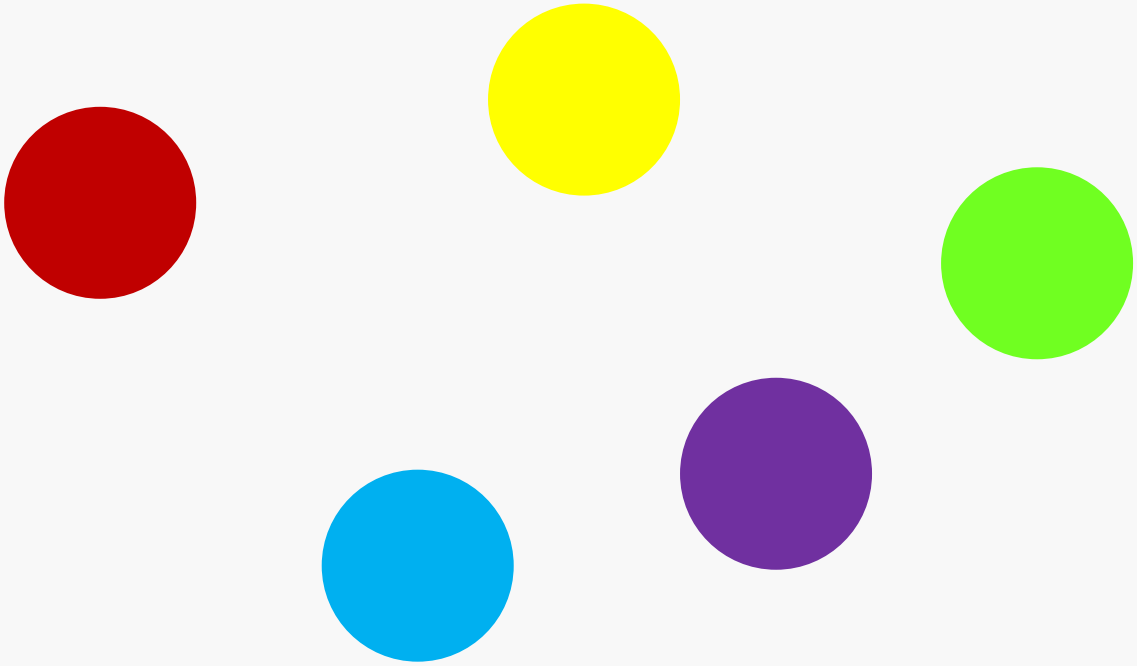
Can you put these circles in order?





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Let's look at the colour scale from the map again.
By looking at just luminance values, we can see the problem.

0.0 - 0.09	0.5 - 0.59	1.0 - 1.09
0.1 - 0.19	0.6 - 0.69	1.1 - 1.19
0.2 - 0.29	0.7 - 0.79	1.2 - 1.29
0.3 - 0.39	0.8 - 0.89	
0.4 - 0.49	0.9 - 0.99	

0.0 - 0.09	0.5 - 0.59	1.0 - 1.09
0.1 - 0.19	0.6 - 0.69	1.1 - 1.19
0.2 - 0.29	0.7 - 0.79	1.2 - 1.29
0.3 - 0.39	0.8 - 0.89	
0.4 - 0.49	0.9 - 0.99	

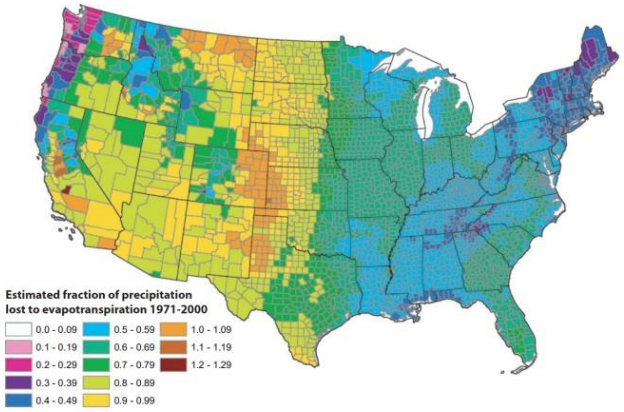

FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (*P*) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/*P* were made first at the 800-m resolution of the 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.

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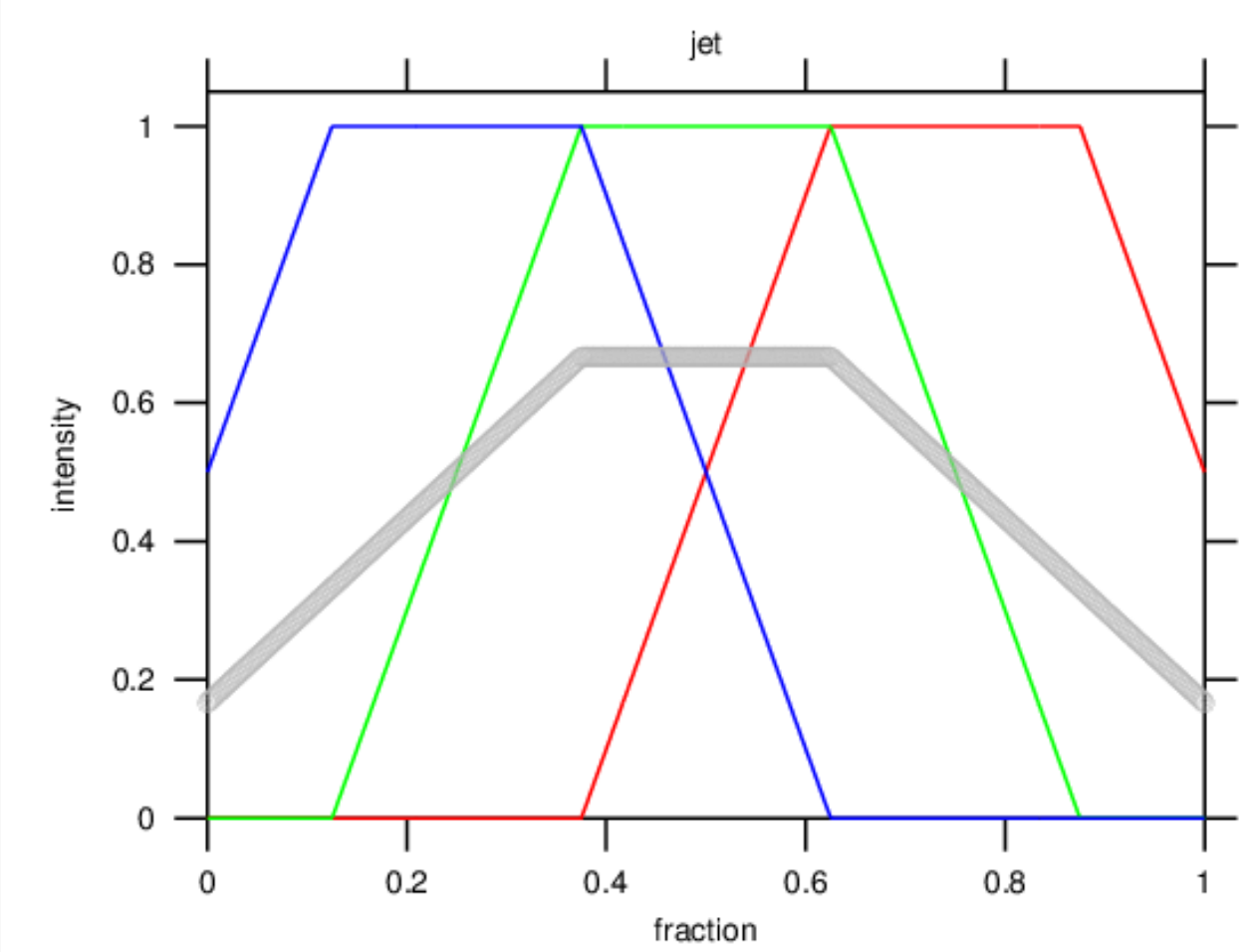
This is the luminance plot for ‘jet’.


jet
intensity
fraction
0
0.2
0.4
0.6
0.8
1

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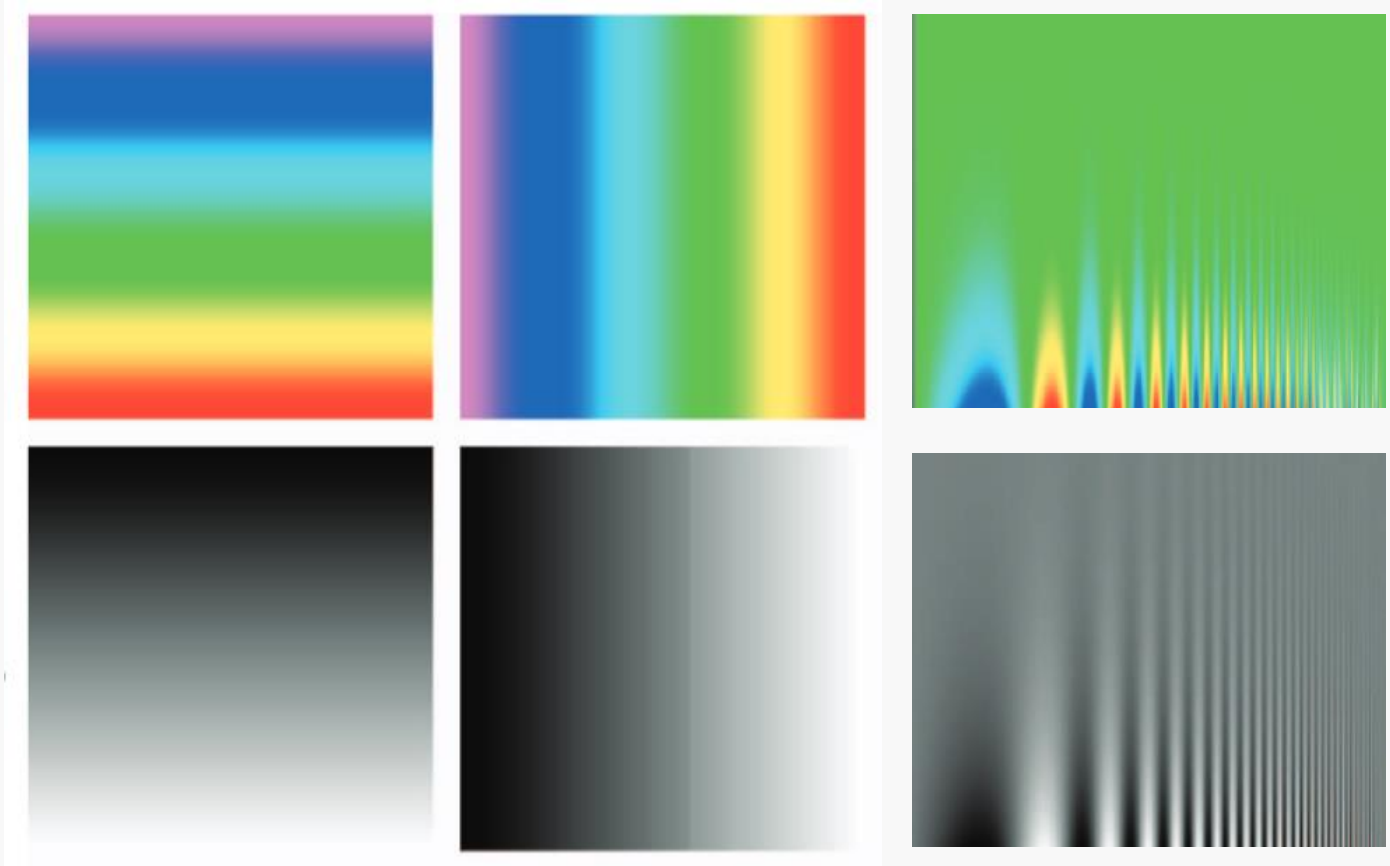
Here are some examples of rainbow vs grayscale



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cresspahl

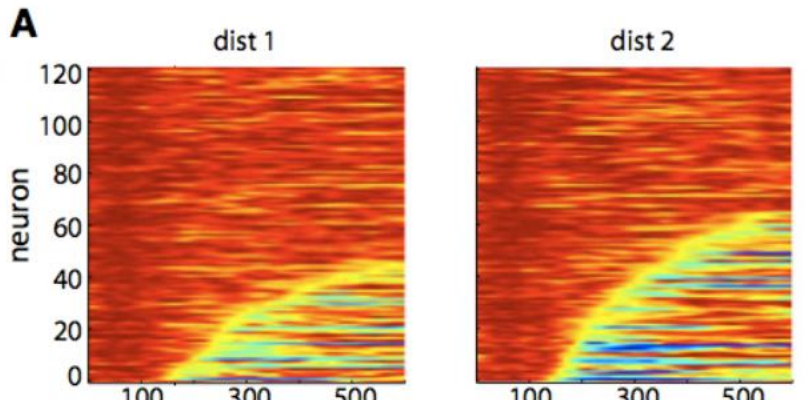
science, computing and nice little unicorns

March 7, 2012

The 'jet' colormap must die! Or: how to in
plots and create your own nice colormap

Let's talk colormaps.

May 7, 2011 at 2:04 pm (powerfully stupid graphics)



Visualization Viewpoints

Editor:
Theresa-Marie Rhyne

Rainbow Color Map (Still) Considered Harmful

David Borland and Russell M. Taylor II
University of North Carolina at Chapel Hill

Research has shown that the rainbow color map is rarely the optimal choice when displaying data with a pseudocolor map. The rainbow color map confuses viewers through its lack of perceptual ordering, obscures data through its uncontrolled luminance variation, and actively misleads interpretation through the introduction of non-data-dependent gradients.

Despite much published research on its deficiencies, the rainbow color map is prevalent in the visualization

mercials, weather forecasts, and even the IEEE Visualization Conference 2006 call for papers, just to name a few. The problem with this wide use of the rainbow color map is that research shows that it is rarely, if ever, the optimal color map for a given visualization.[1-6] Here we will discuss the rainbow color map's characteristics of confusing the viewer, obscuring data, and actively misleading interpretation.

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he noisy
urse!"

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Choosing the right colour scale depends on the type of data you are plotting.

Some well-behaved palettes:

BuGn
BuPu
GnBu
Greens
Greys
Oranges
OrRd
PuBu
PuBuGn
PuRd
Purples
RdPu
Reds
YlGn
YlGnBu
YlOrBr

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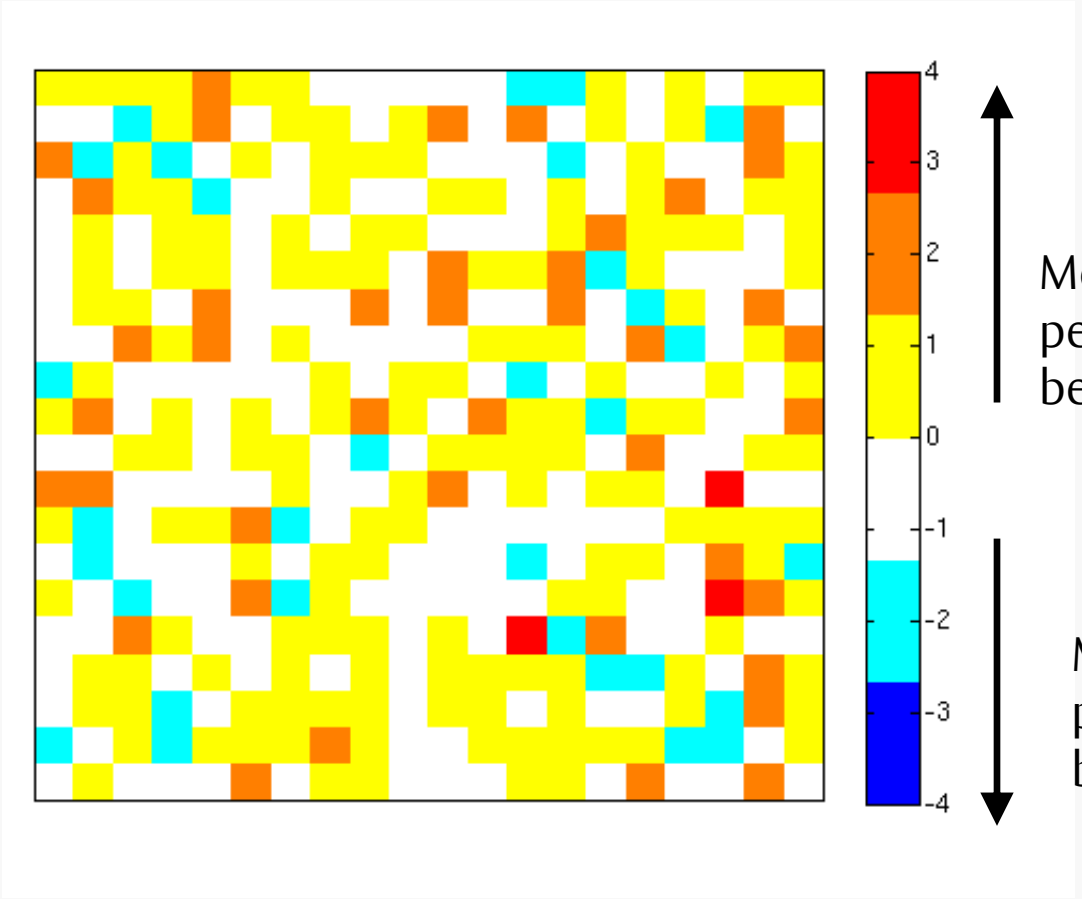
An example.
Which model performs better?

RMS error for model 2 - RMS error for model 1



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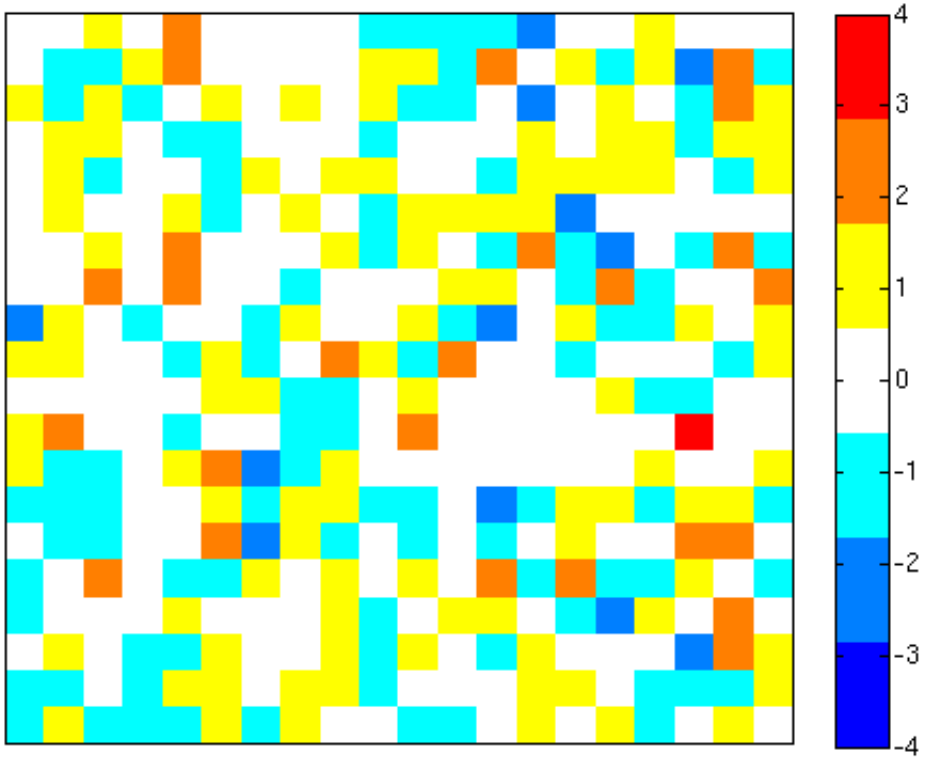
How about now?

RMS error for model 3 - RMS error for model 1



Model 1 performs better

Model 3 performs better

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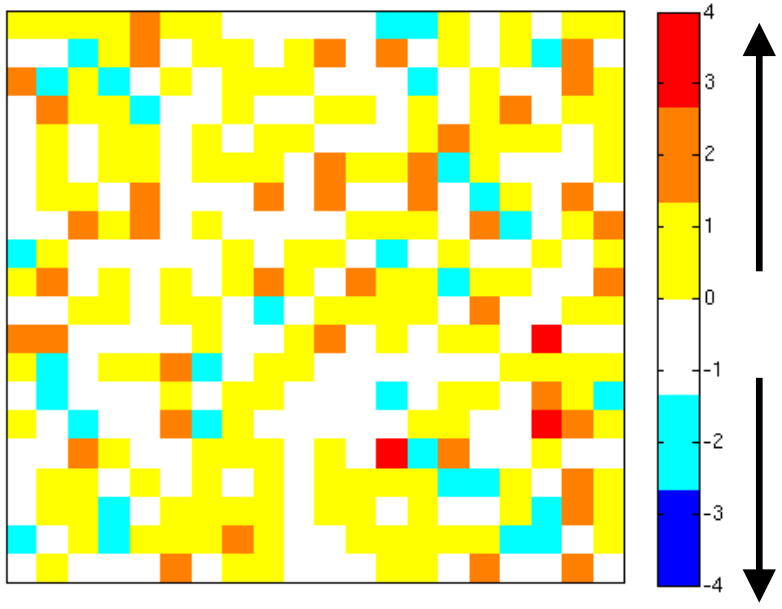
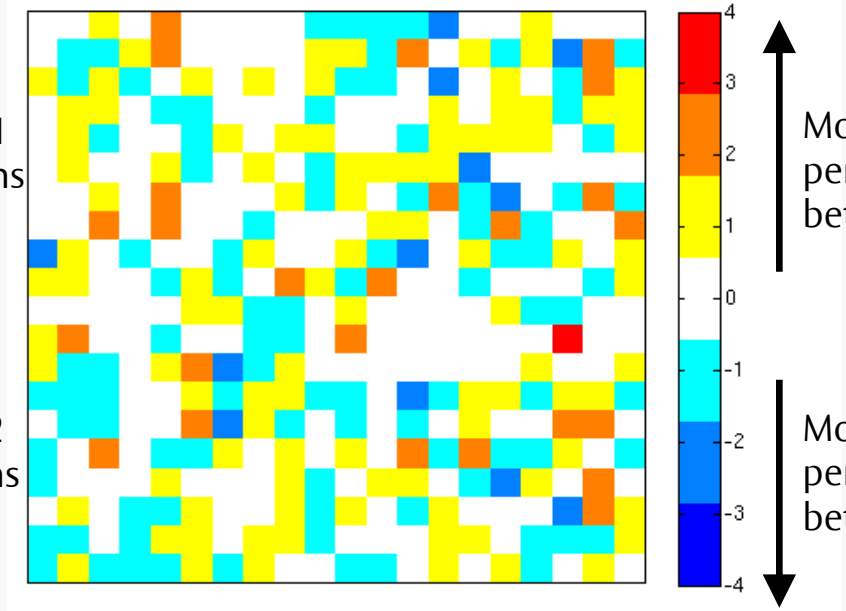
Same data. Different colour scale. Same answer?

RMS error for model 2 - RMS error for model 1



RMS error for model 3 - RMS error for model 1



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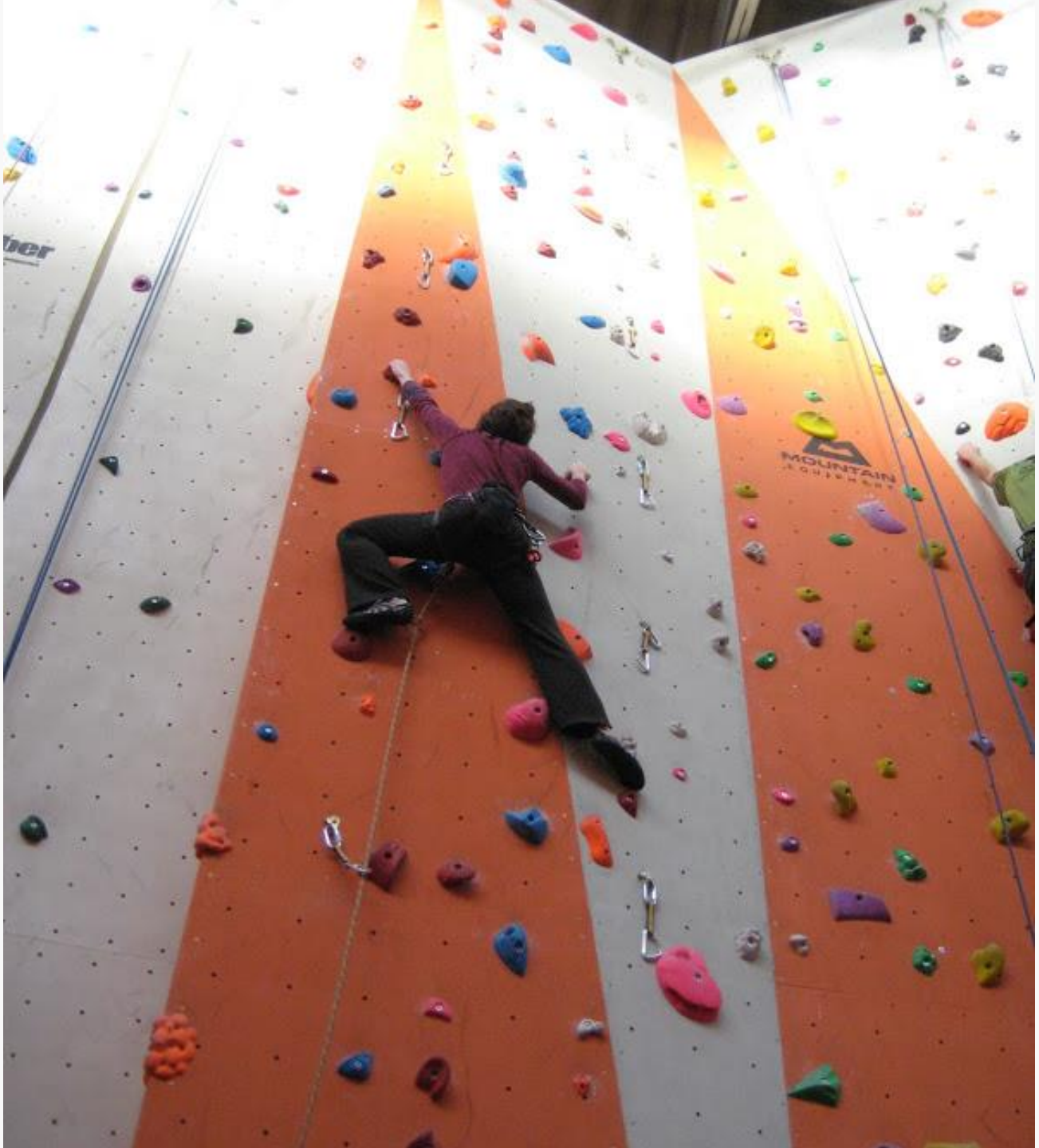
Another example: Let me introduce you to my friend Nick.


MOUNTAIN
EQUIPMENT

Let's assume I'm showing him this recent article in nature.

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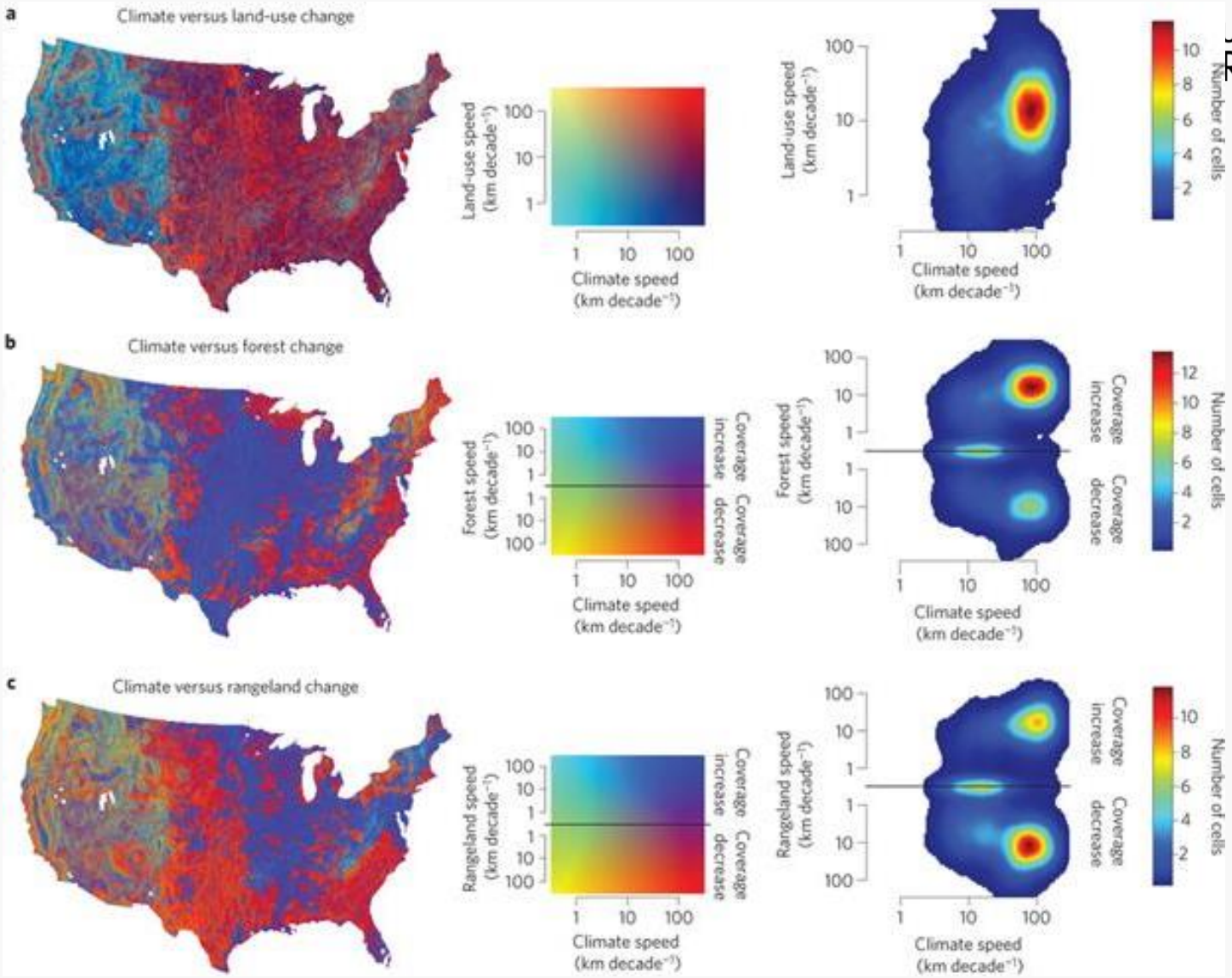
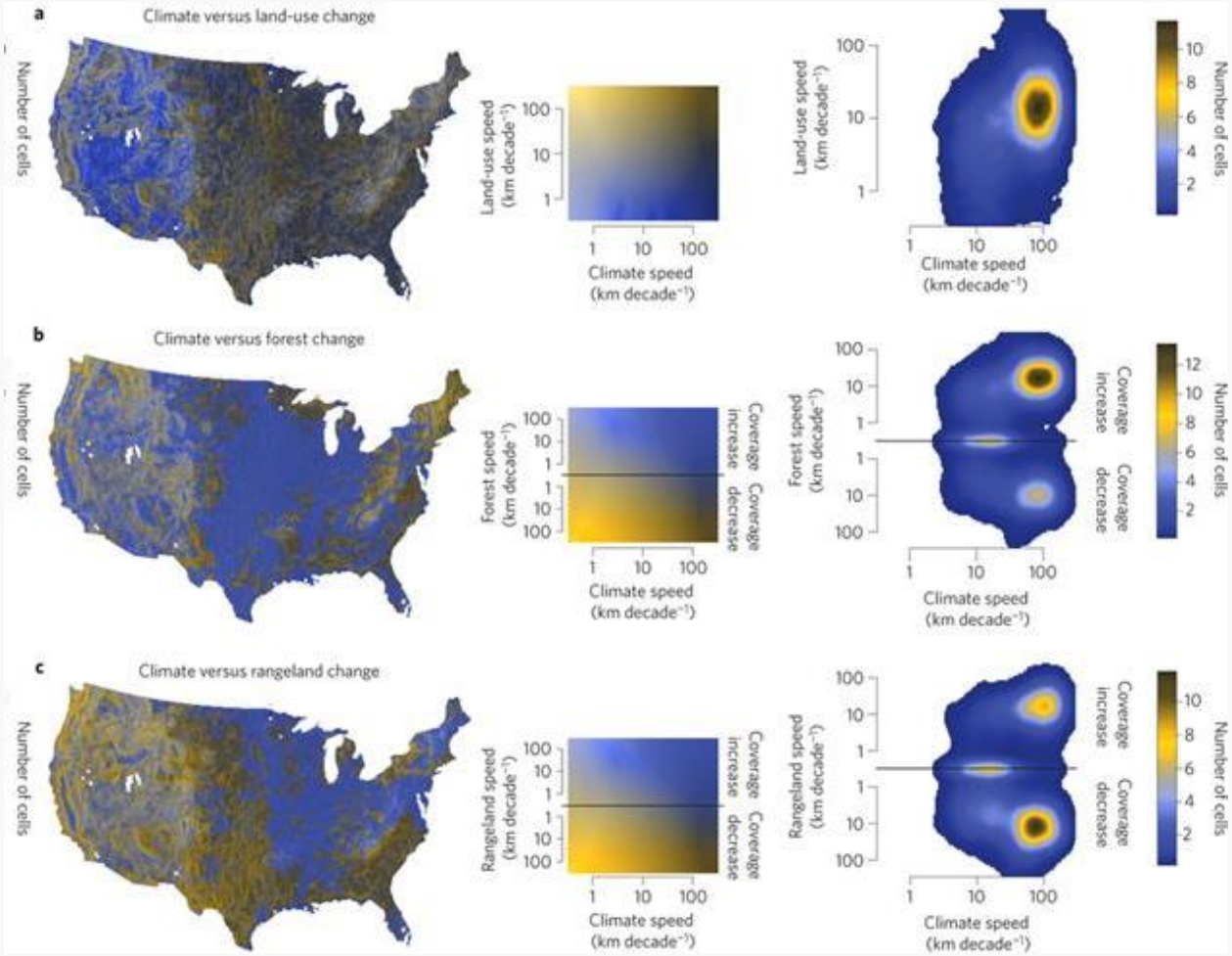


He sees the plot like this.



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Do you need colour at all?

OPINION

Obama's Divided Nation

ama presides over
ica more divided
any time in 50
ry that was riven
g racial lines gath-
2008 to elect its
ident. That presi-
four years dividing
the basis of eco-
The campaign re-
vealed no evi-
dence that Mr.
Obama will close
the chasm he has
created between
his voters and
those he attacked
and vilified.

It may be true
that Mitt Romney
failed to respond

drawn attention to what hap-

Obama spokestotum replied:

problem with pols, e
verbally facile as Mr.
that in crunch time,
reverts to No. 1. Exi
that 9% of the electo
who to vote for jus
Tuesday; and amo
42% said Mr. Oban
Sandy response—t
tie photo-op—was
factor. Of those,
voted for Mr. Ob
Mr. Christie is o
politico who is

Yes, Republic
across two pres
that there are
how crudely
issue like ille
Blowing up th
if you thoug
day's results

To recap. Some guidance…

- Don’t just use default settings – choose your colour scale with care.
  - Be especially of rainbow/multi-hue colour scales!
- Check whether changing your colour scale changes your interpretation of the data.
- Be aware of colourblindness.
- Consider using greyscale!

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There are resources to help you!

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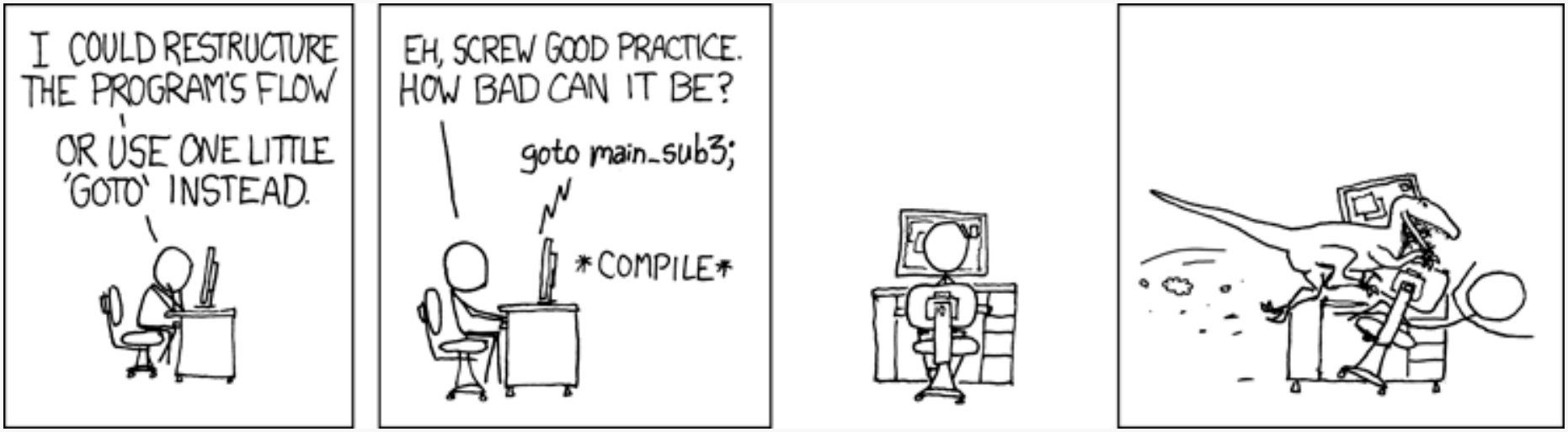
Resources

- ColorBrewer – lots of lovely colour scales that can be loaded into your favourite plotting program
- CubeHelix – an interesting way of constructing a perceptual colour scale
- Colour blindness test:
  - http://aspnetresources.com/tools/colorBlindness
    [there are lots more online]
  - Firefox add-on:
    https://addons.mozilla.org/en-us/firefox/addon/colorblind-simulator/
- Blog posts and articles:
  - http://cresspahl.blogspot.co.uk/2012/03/expanded-control-of-octaves-colormap.html
  - http://abandonmatlab.wordpress.com/2011/05/07/lets-talk-colormaps/
  - http://eagereyes.org/basics/rainbow-color-map
  - http://www.research.ibm.com/people/l/lloydt/color/color.HTM
  - http://www.perceptualedge.com/articles/visual_business_intelligence/rules_for_using_color.pdf
- Borland and Taylor paper in IEEE Computer Graphics and Applications

"We as a visualization community must do better, making the rainbow color map as rare in visualization as the goto statement is in programming."

Borland and Taylor, IEEE Computer Graphics and Applications, 2007



xkcd.com