Color imaging

- Plotting grid files with grdimage
- Usually involves preparing an intensity grid
  - Create from data grid with grdgradient
  - Supply separate intensity grid from another source

Option	Effect
–Ccptfile	Color table to be used
–Edpi	Set image resolution [data]
–Iintensity	Give intensity grid [none]
–M	Force "television" grayscales

Exercise: Colour Image of the US

- Go to tutorial directory and look for us.grd
- Find range of topography (z-column min/max to nearest km (grdinfo))
- Use makecpt with the relief color scheme to generate a cpt with continuous color changes every 500 meters

```
grdinfo us.grd
```

```
makecpt -C$cpt -T$min/$max/$interval -Z > $cptfile
```

Exercise: Colour Image of the US

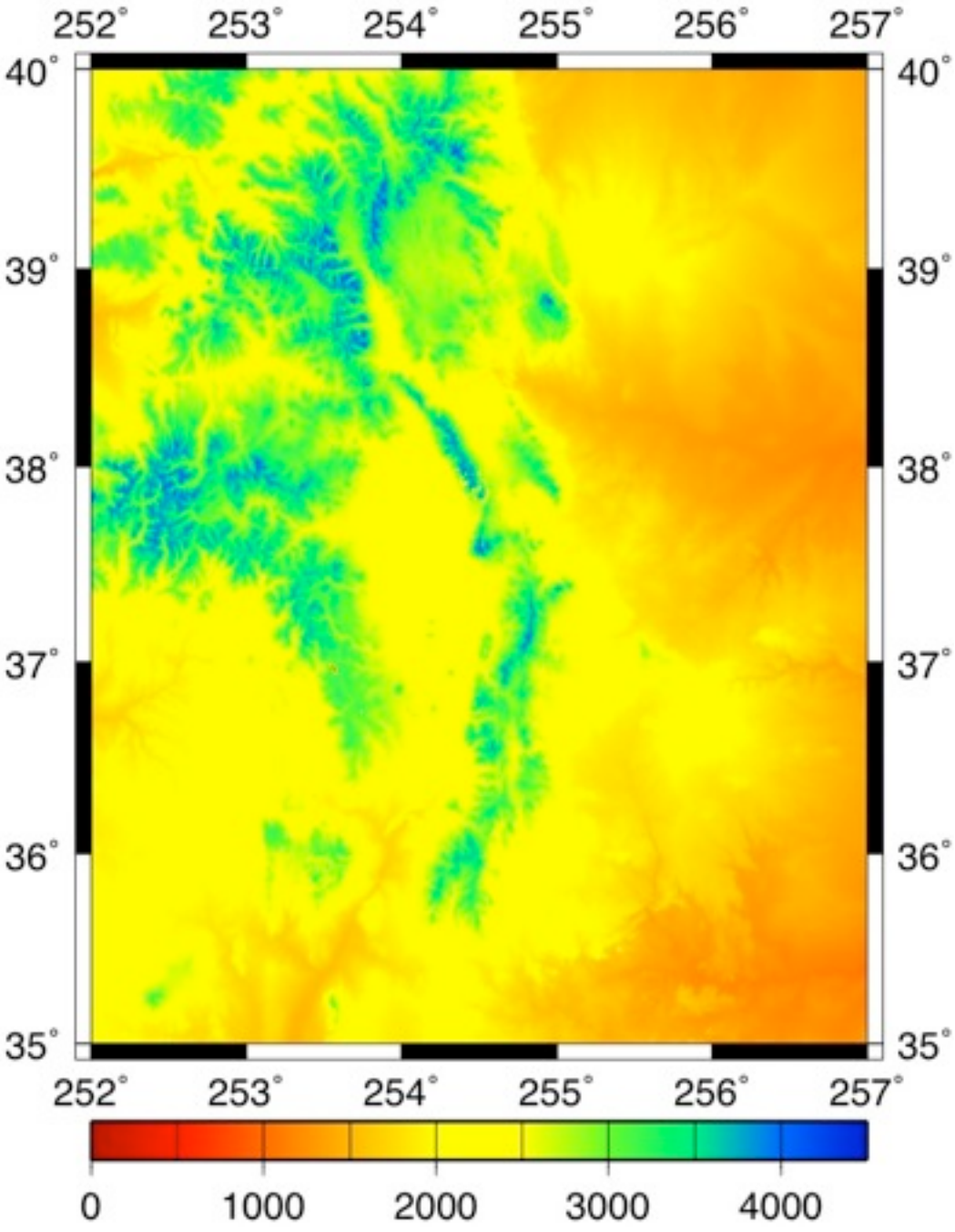
- Make a plain color map with grdimage
  - Use Mercator projection and default dpi

```
grdimage us.grd -R$region -J$projection
$width -B1 -C$cptfile -P -I$gradfile >
$psfile
```

- Make a scalebar with psscale

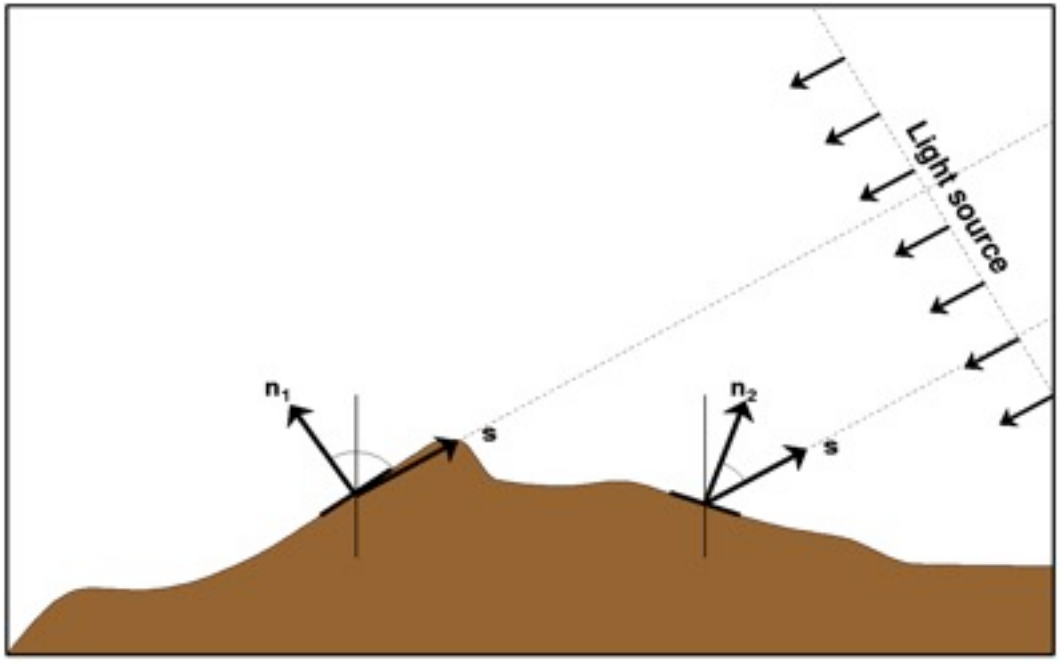
```
psscale -C$cptfile -D$xpos/$ypos/$length/
$width > $psfile
```

- Don't forget to amend your –K and –O options as you build your script as well as your redirections!


252°
253°
254°
255°
256°
257°
40°
39°
38°
37°
36°
35°
0
1000
2000
3000
4000

Artificial Illumination

- Simulates light from a source placed at infinity at a given azimuth and elevation
- Slopes facing light source should lighten while slopes facing away should darken

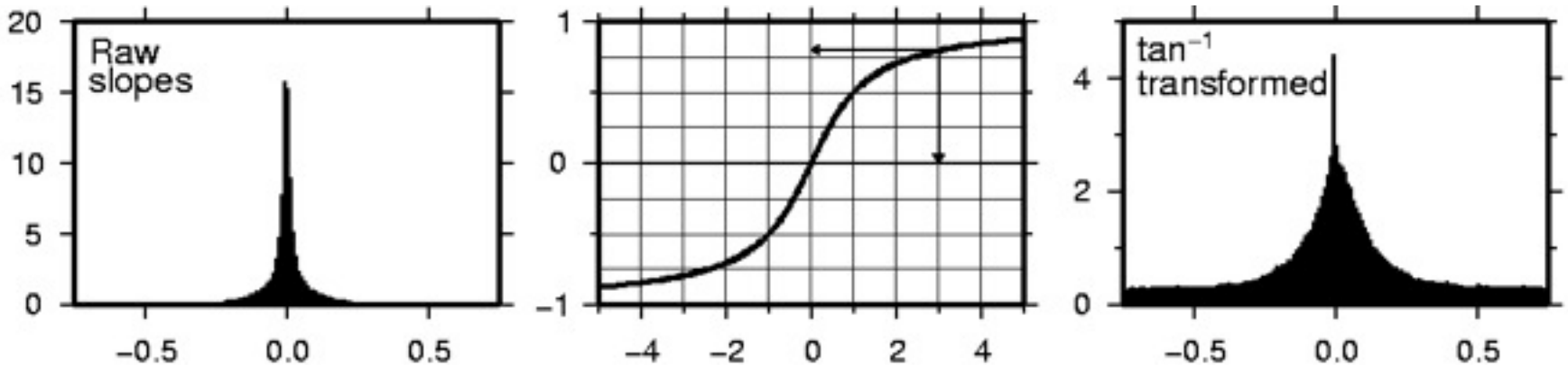


Artificial Illumination, cont.

- Shadows cast by topography are not used
- Since angles of normal vectors are only meaningful for topography, we generalise by using data gradient dz/dn instead, where n is the direction to the light source
- The resulting gradients are normalised to the [-1,+1] range and then transformed to give smoothly varying intensities

Intensity transformations

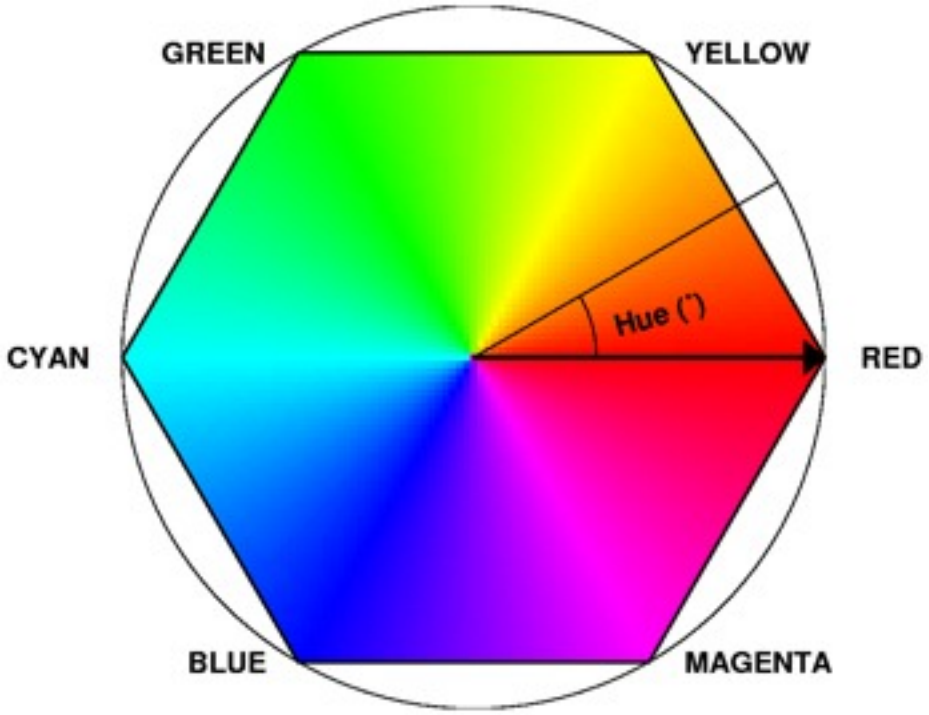
- Raw slopes tend to be too noisy
- Must normalize to [-1,+1] range
- Both tan-1 (below) and cumulative Laplace transformations exist to provide close to normally distributed intensities



How to illuminate a surface?

- If we use an intensity and try to modify RGB we find the hue is changing as well
- Turns out RGB is OK for some purposes but difficult to work with for shading
- We must transform our RGB values to another colour coordinate system in which illumination can be handled more naturally

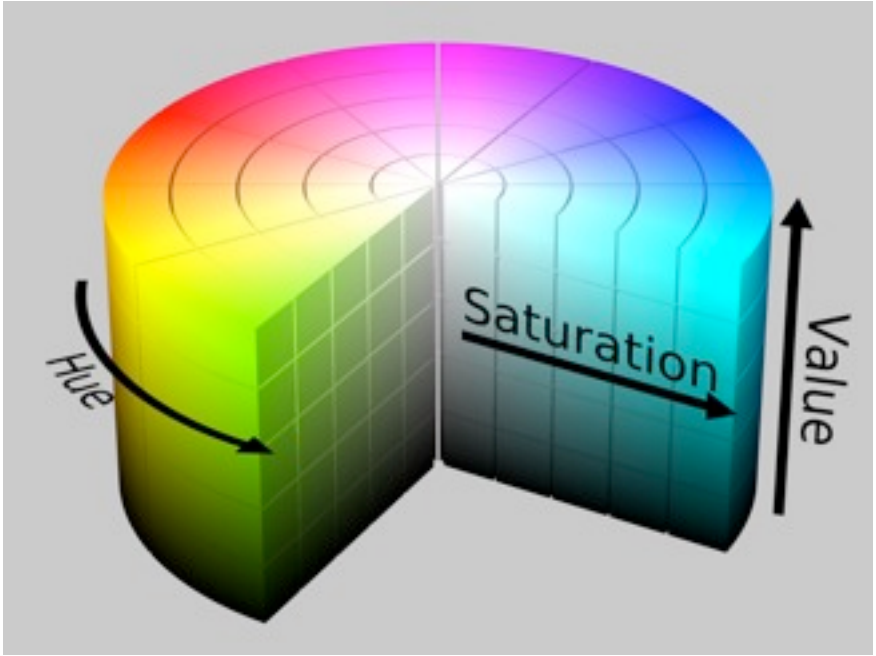
The HSV Color System



- Hue H is angle from 0° to 360 °
- Saturation S is a measure of purity or vividness of color
- Value V is a measure of the strength of the hue
- H, S, V do not form an orthogonal coordinate system

Face RGB are pure color + b/w

- Pure colors exist along the RYGCBM path
- Lighten by moving toward **W** (decrease S)
- Darken by moving toward **K** (decrease V)
- Hue H stays the same



Conclusions on Illumination

- Pure colour tables (i.e., the rainbow) are best because they have a greater range when adding white or black
- Slopes (data gradients) must often be smoothed to yield good shading
- While often derived from data gradients, intensities can also come from other sources, such as back-scatter

Artificial illumination

- Flat image fails to show details
- We will use surface slopes to give illusion of illumination from the east
- Use grdgradient to get normalized slopes

Option	Effect
–Aazimuth	Azimuth to light source
–M	Geographic grid
–N[**t**|**e**][norm[/offset]]	Normalization settings

Artificial Illumination, cont.

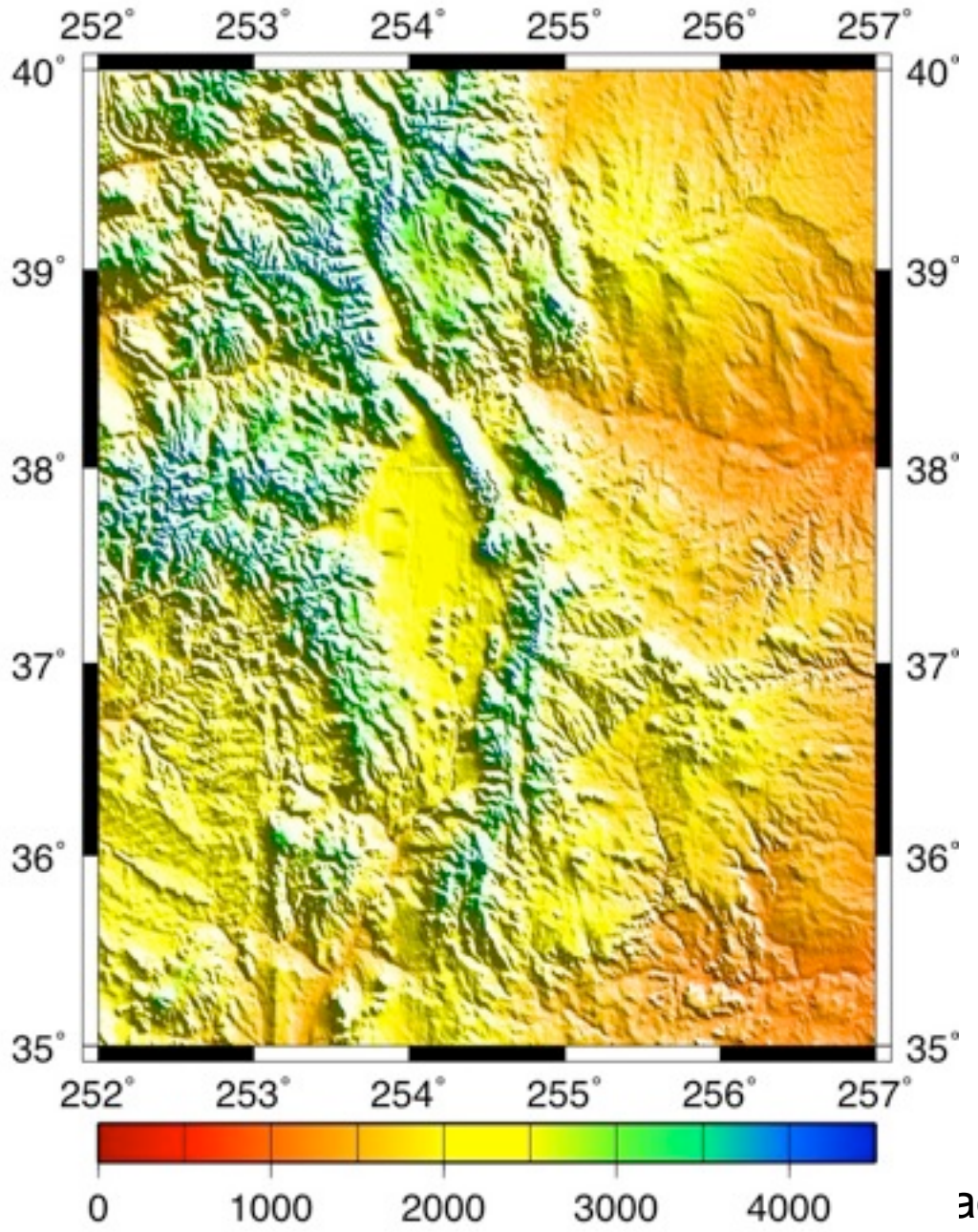
- Both **–Ne** and **–Nt** yield smooth slopes
- Default are norm = 1 and offset = 0
- Experiment with norm in the 0.5–10 range for different effects.
- norm < 1 will exaggerate illumination yet all intensities will be clipped to ±1
- Different azimuths will highlight different features in your data

Map exercise 19, continued

- Enhance your map script by adding artificial illumination.
  - Use -Ne1.5
  - Choose a few different azimuths to see how your map changes

```
grdgradient us.grd -A$azimuth -Ne1.5 -G
$gradientfile


grdimage us.grd -R$region -J$projection
$width -B1 -C$cptfile -P -I
$gradientfile > $psfile
```

```
#!/bin/ksh
# Project: Global (
# Date:
# Author:

# Input Files
grd=us.grd

# Output Files
cptfile=us.cpt
gradientfile=us.gr
psfile=us.ps

# Parameters
colour=seis
region=252/257/3
azimuth=45

# Build Map
makecpt -C$colou
grdgradient $grd -

grdimage $grd -JI                                    adientfile > $psfile

psscale -C$cptfile -D5/-1/10/0.5h -O -Ba1000g500 >> $psfile
```



Perspective (3-D) views

- Views are from infinity
- 3rd dimension (z) scaled separately
- Tool to use is grdview

grdview can make two types of plots:

- Mesh (or "chicken-wire") plots
  - Optionally draw contours on top
- Color-coded surface
  - Optionally apply illumination, draw contours, or drape another grid

grdview usage

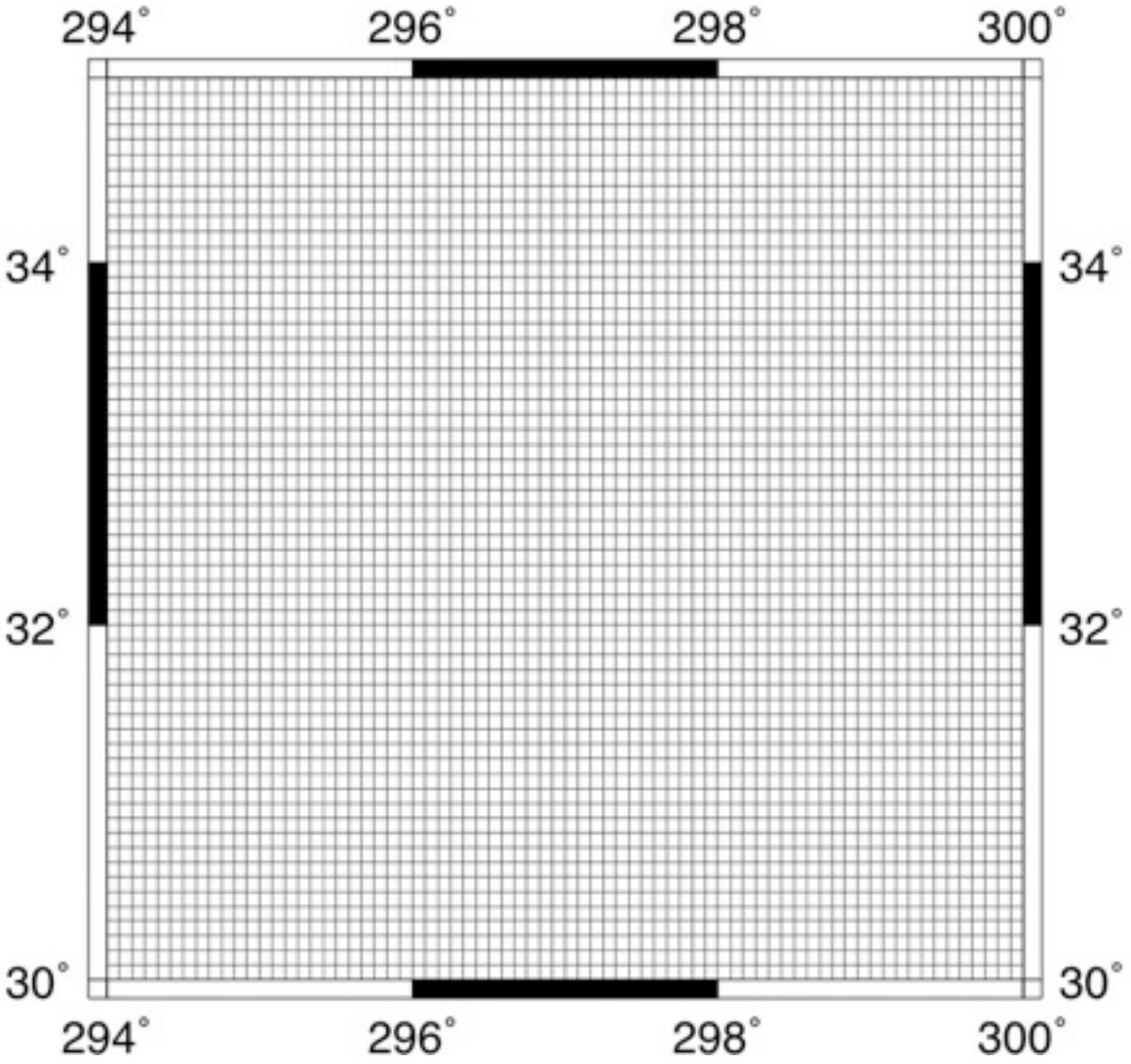
Option	**Effect**
–Ccptfile	Color table (or contours) to use
–Gdrapegrd	Assign colors from this grid
–Iintensgrd	Illumination intensity grid
–Qm[fill]	Draw mesh surface plot [white]
–Qs[**m**]	Draw surface (polygons)
–Qidpi[**g**]	Draw image (scan-line conversion)
–Qcdpi[**g**]	Same, but use NaN masking (PS3)
–Wcpen	Overlay contours on surface (see **–C**)
–Wmpen	Specify mesh pen [0.25p/0]

Grdview Exercise

- Use your old bermuda_bath.grd file
- Create a mesh plot [**–Qm** is default]

```
grdview $grd -JM10 -Qm -B2 -
  R-66/-60/30/35 > $psfile
```

- Does the plot look like you expected?


294°
296°
298°
300°
34°
32°
30°
294°
296°
298°
300°
34°
32°
30°

Perspective view

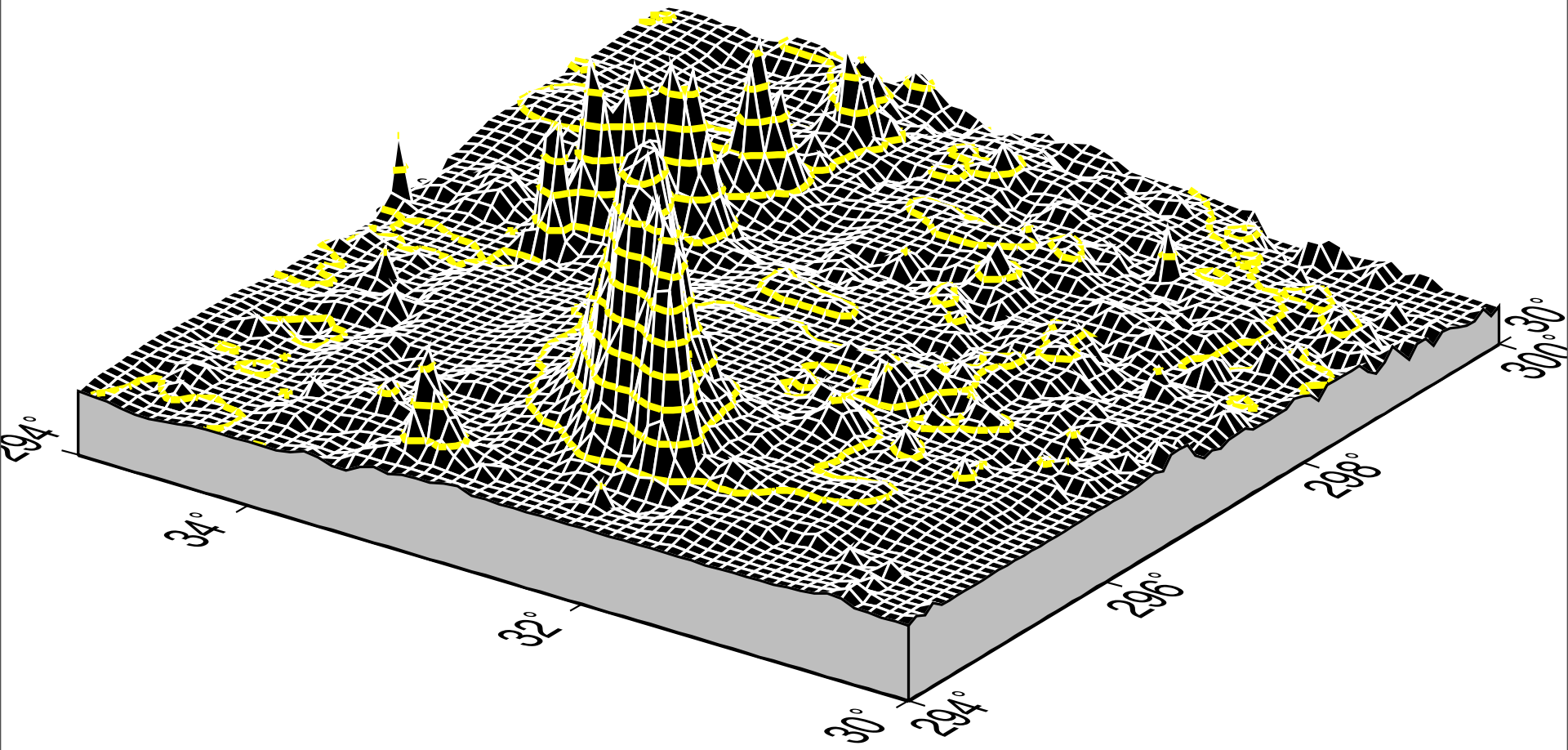
- Will need two additional options
  - **–JZ**height or **–Jz**scale for z scaling
  - **–E**azimuth/elevation for the view point

- Note that while the grid given to grdview provides both the z values for vertical scaling and color look-up, the latter may instead come from an optional drape grid file.

Map exercise 21

- Make a 3-D mesh plot of Bermuda with a view from the south-east, contouring every 500 m.
  - First create a colour palette file for the Bermuda bathymetry data
  - Then plot the data

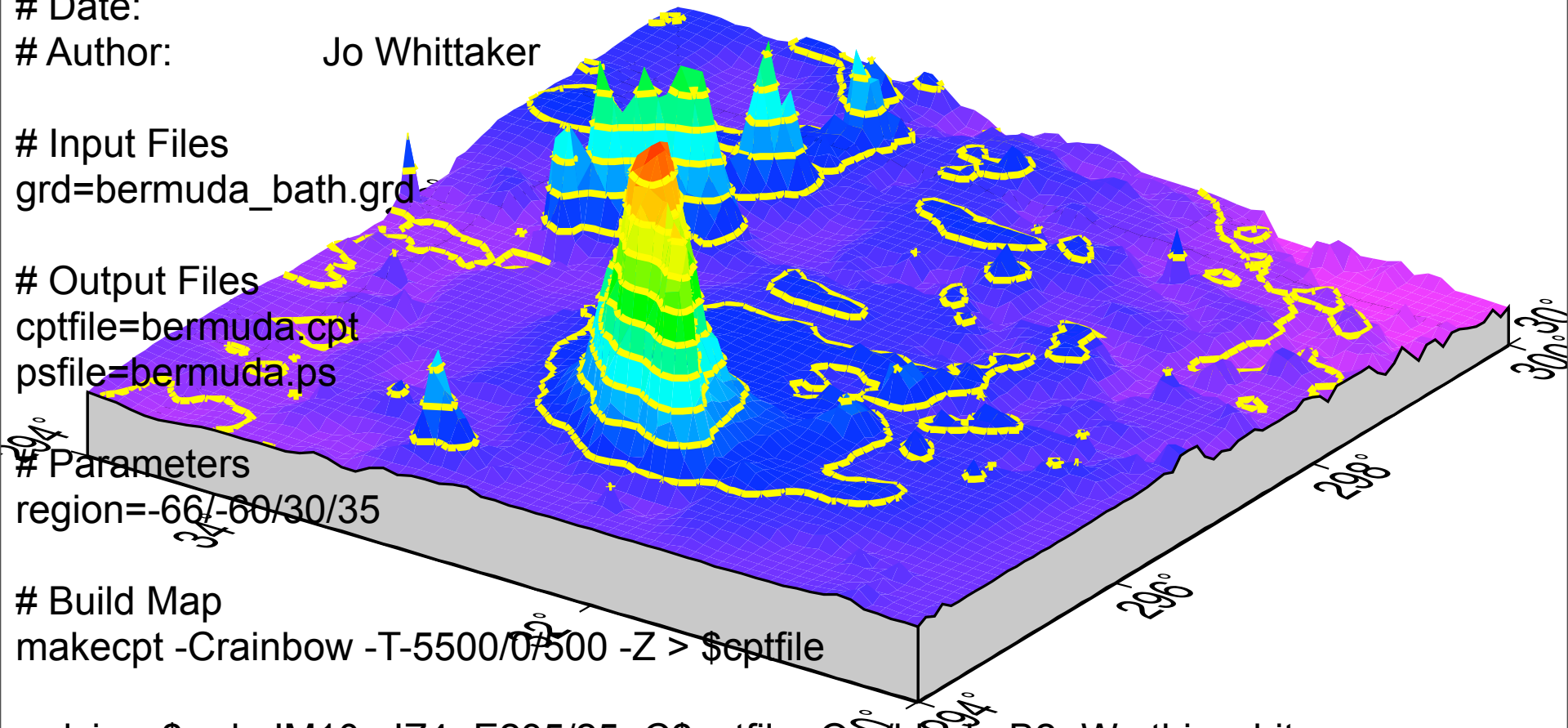
```
grdview bermuda_bath.grd -J$projection
$width -JZ$height -E$azimuth/$elevation
-C$cptfile -Wc2/yellow -Wmthin,white -
Qm/black > $psfile
```


294°
34°
32°
30°
294°
296°
298°
300°30°

Map exercise 21 cont …

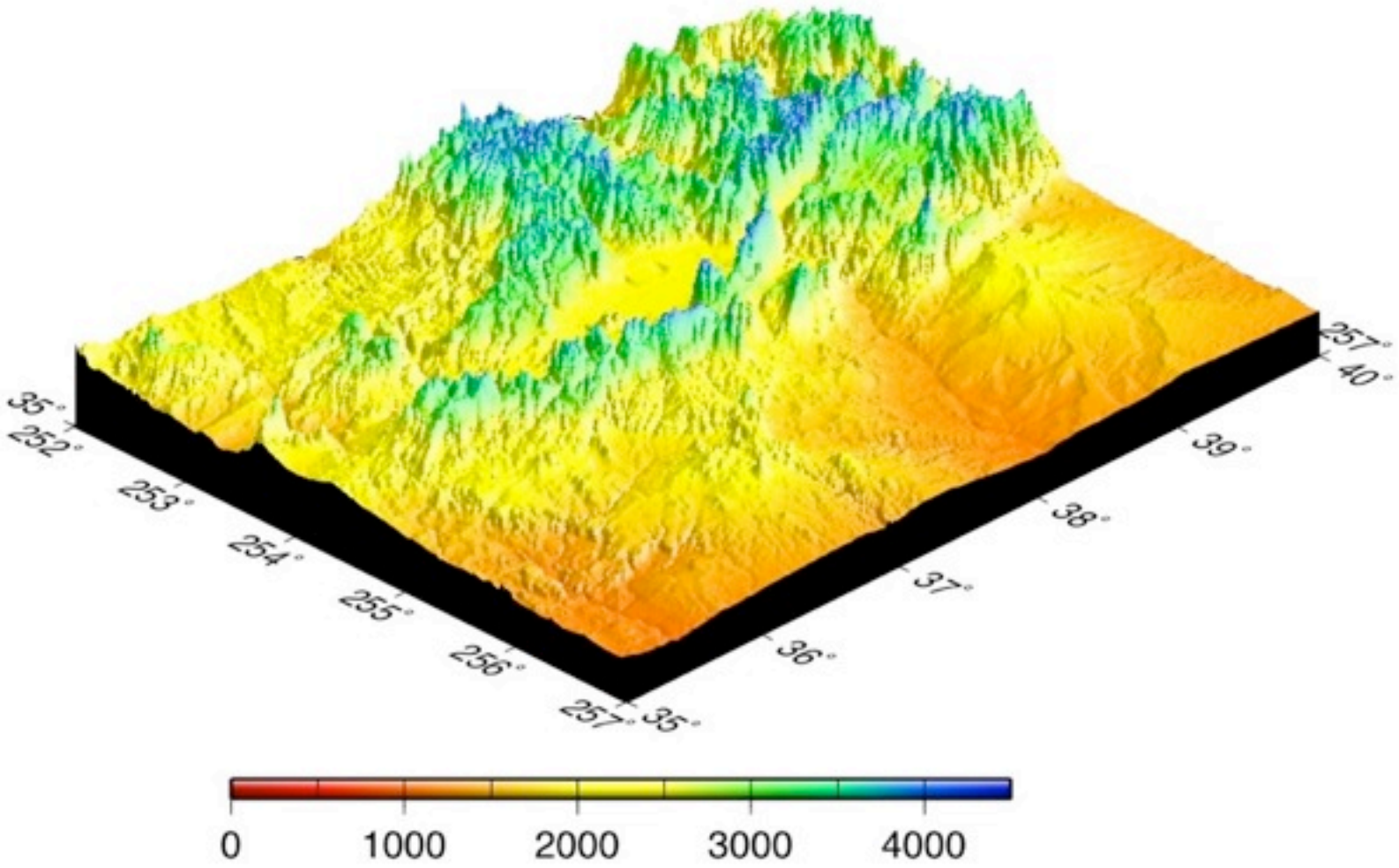
- Variations on the theme:
  - Select other view points and vertical scales
- Make a 3-D surface plot of Bermuda with a view from the south-east, contouring every 500 m.
  - Use -Qs for a surface plot

```
#!/bin/ksh
# Project: Global Cities Exercise
# Date:
# Author:               Jo Whittaker

# Input Files
grd=bermuda_bath.grd

# Output Files
cptfile=bermuda.cpt
psfile=bermuda.ps

# Parameters
region=-66/-60/30/35

# Build Map
makecpt -Crainbow -T-5500/0/500 -Z > $cptfile

grdview $grd -JM10 -JZ4 -E235/25 -C$cptfile -Qm/black -B2 -Wmthin,white -
Wc2p,yellow -N-6000/gray  -P > $psfile

open $psfile
```



Rockies Exercise

- Create a 3-D image view of the US Rockies using the Colorado (us.grd) data set:
  - Make a colour palette (not rainbow – choose something else)
  - Select your favorite viewpoint and vertical scale
  - Use scanline conversion at 50 dpi (-Qi50)
  - When happy, up the dpi to 100.
  - Plot your scalebar


35°
252°
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254°
255°
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257°
35°
36°
37°
38°
39°
40°
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1000
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Agegrid Exercise

- Make a global plot of the age of the ocean floor using the file age.3.6.xyz.bz2
- Use bunzip2 age.3.6.xyz.bz2 to get age.3.6.xyz
- You will need to
  - Convert the xyz data to grid (xyz2grd)
  - Plot the grid (makecpt, grdgradient)
  - Plot coastlines
  - Plot a scalebar