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
–**C**cptfile	Color table to be used
–**E**dpi	Set image resolution [data]
–**I**intensity	Give intensity grid [none]
–**M**	Force "television" grayscales

Exercise 27: 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 27: Colour Image of the US

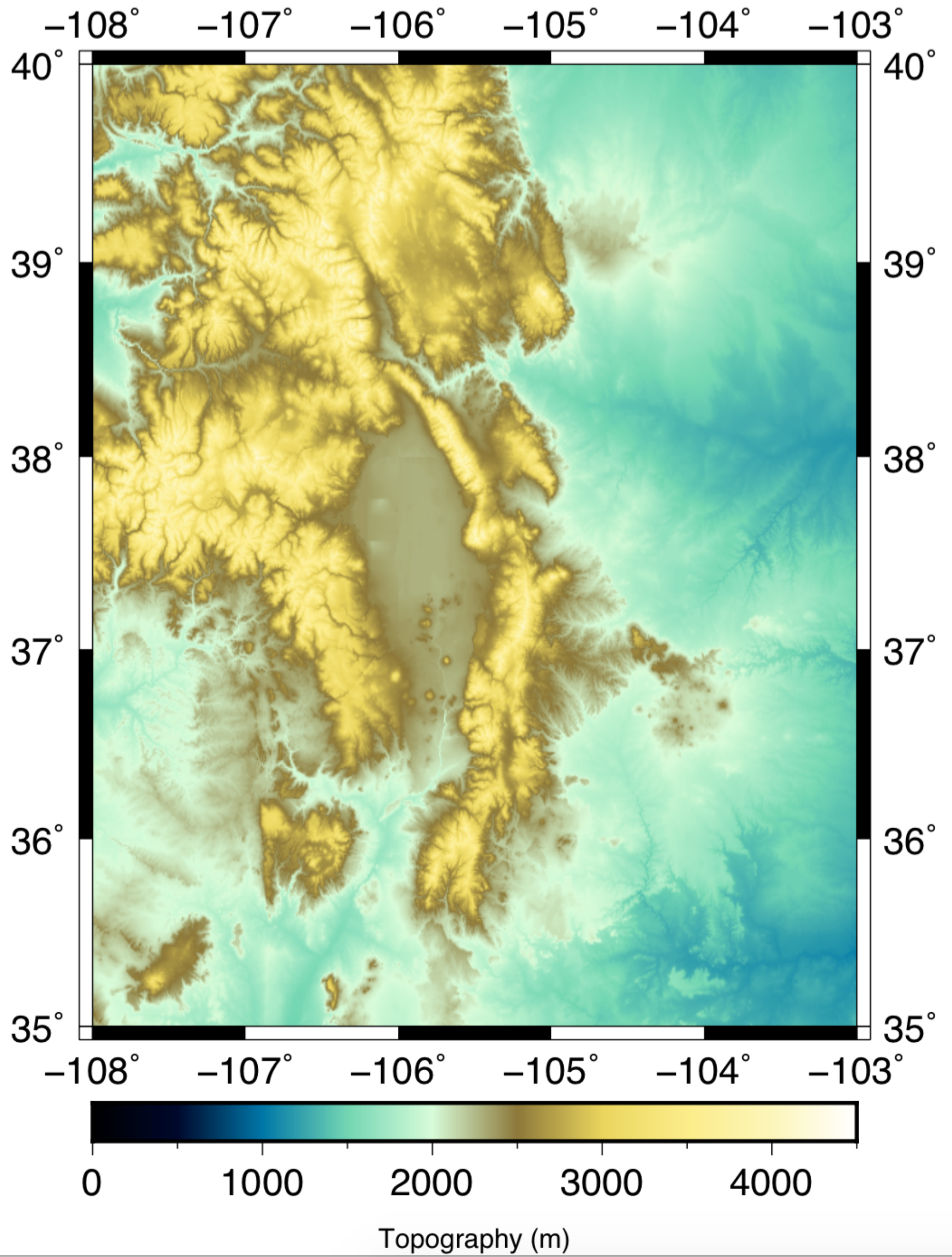
- Make a plain color map with grdimage
  - Use Mercator projection

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

- Make a scalebar with psscale

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

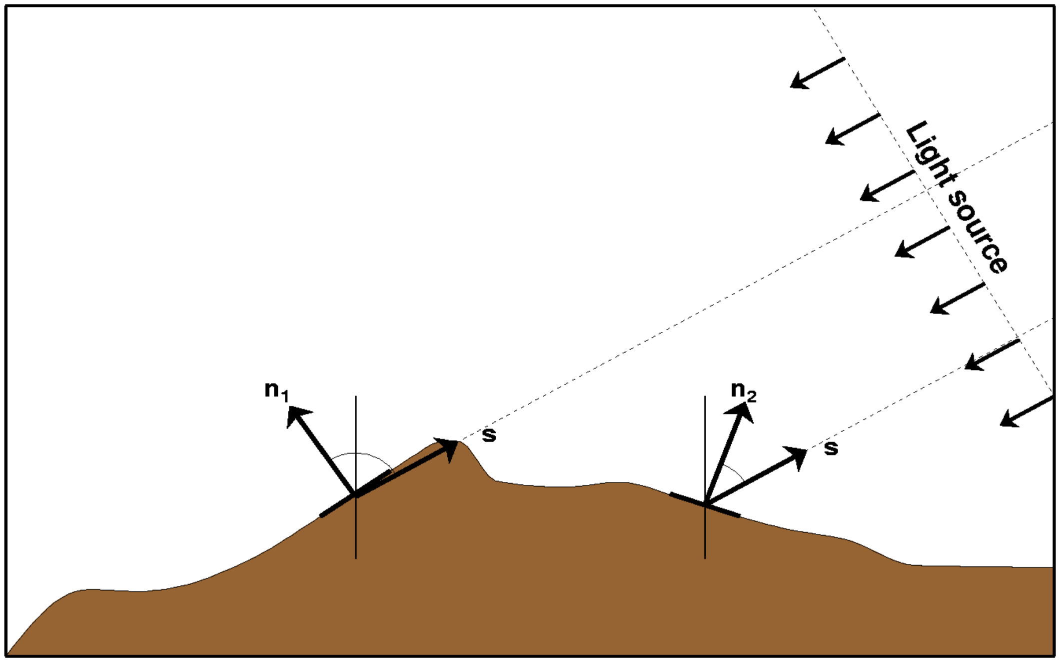
- Don't forget to amend your –K and –O options as you build your script as well as your redirections!



−108°
−107°
−106°
−105°
−104°
−103°
40°
39°
38°
37°
36°
35°
0
1000
2000
3000
4000
Topography (m)

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

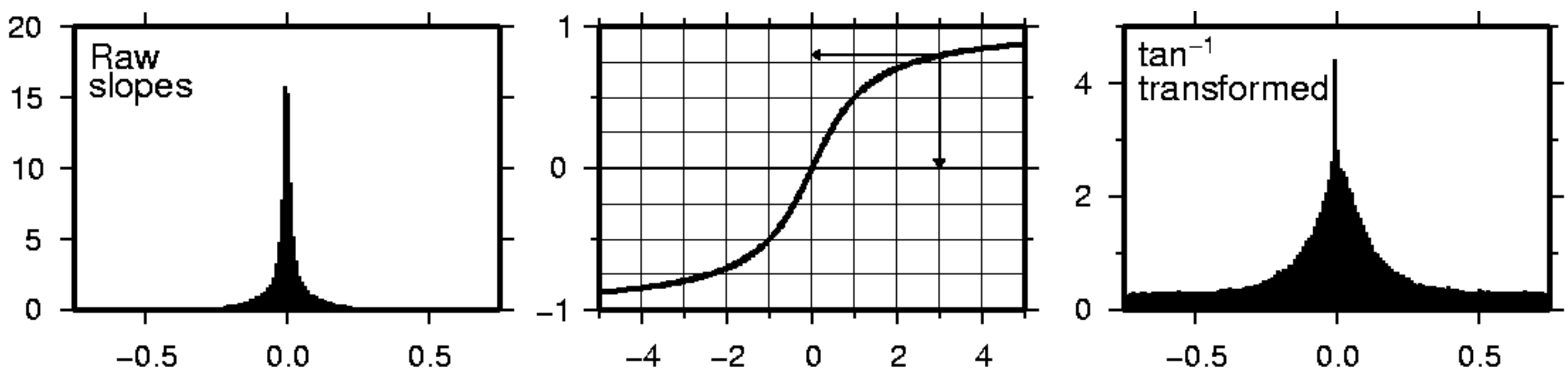


Artificial Illumination, cont.

- 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

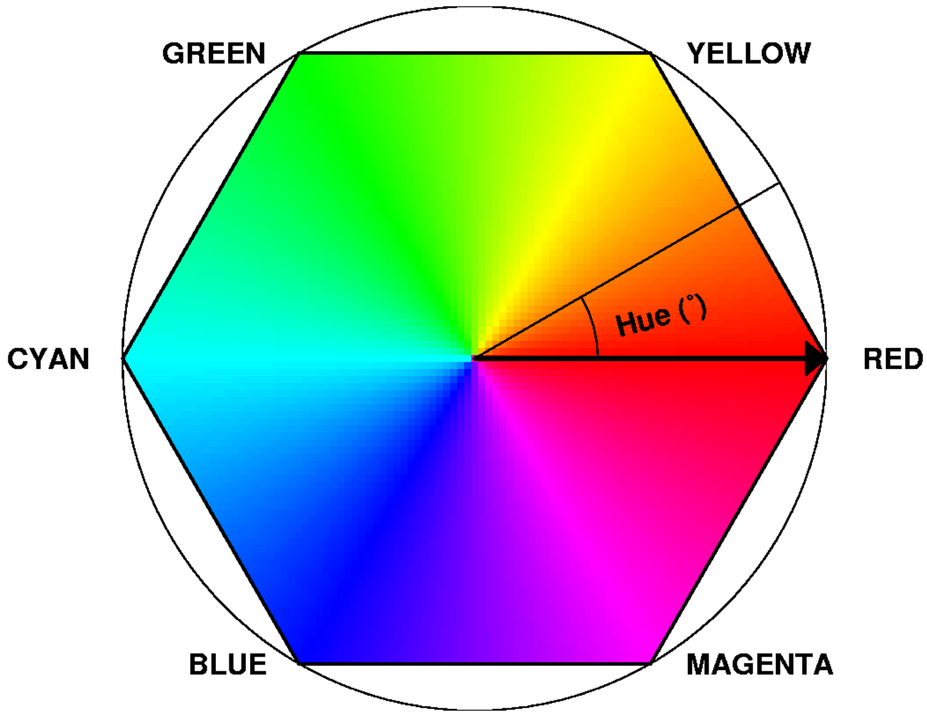
- Raw slopes tend to be too noisy
- Must normalize to [−1,+1] range
- Both tan−1 (below) and cumulative Laplace transformations exist to provide close to normally distributed intensities



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

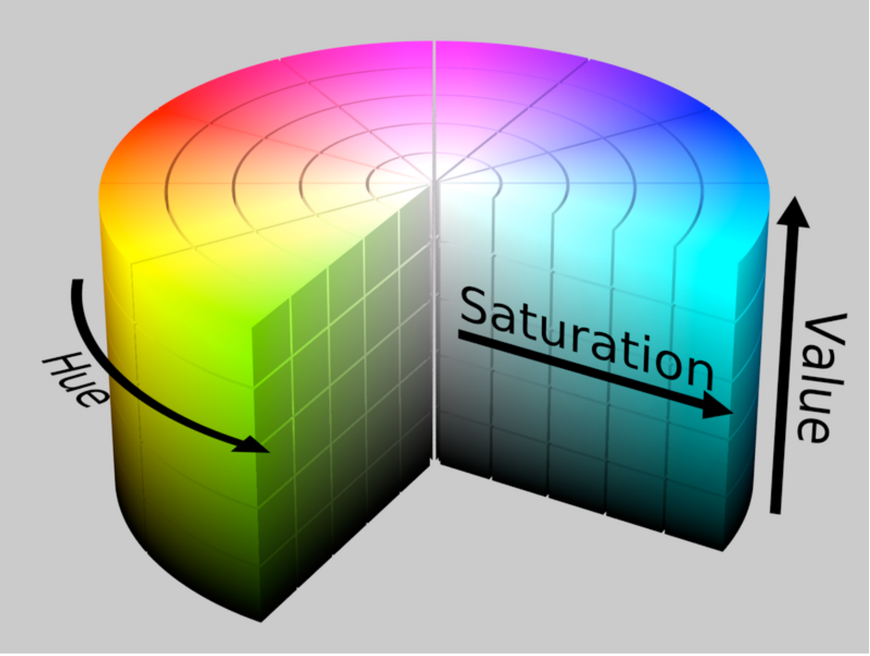
The HSV Color System



- <u>Hue</u> H is angle from 0° to 360 °
- <u>Saturation</u> S is a measure of purity or vividness of color
- <u>Value</u> V is a measure of the strength of the hue
- H, S, V do not form an orthogonal coor-dinate 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
–**A**azimuth	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 28

- Enhance your map from Ex 27 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:

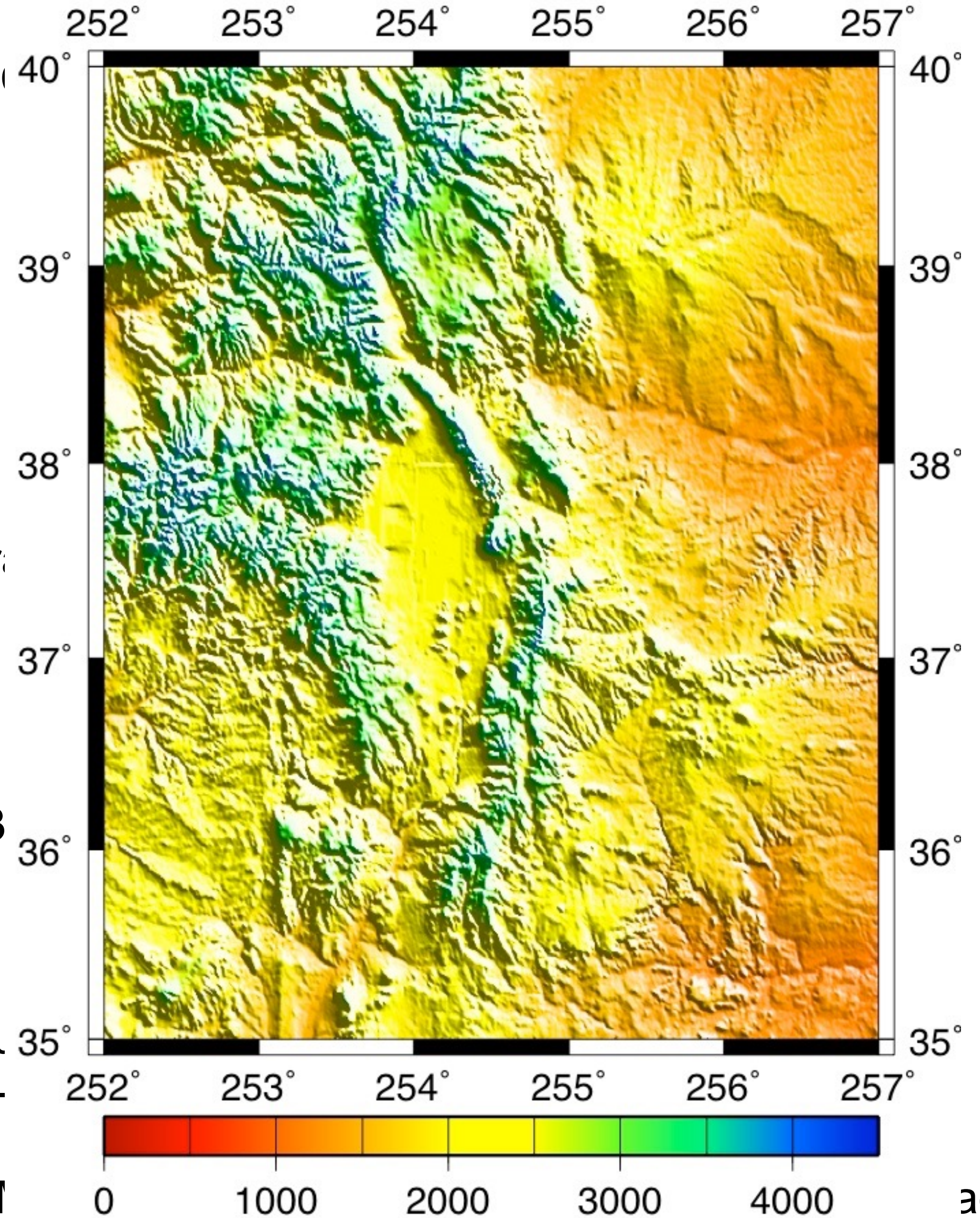
# Input Files
grd=us.grd

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

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

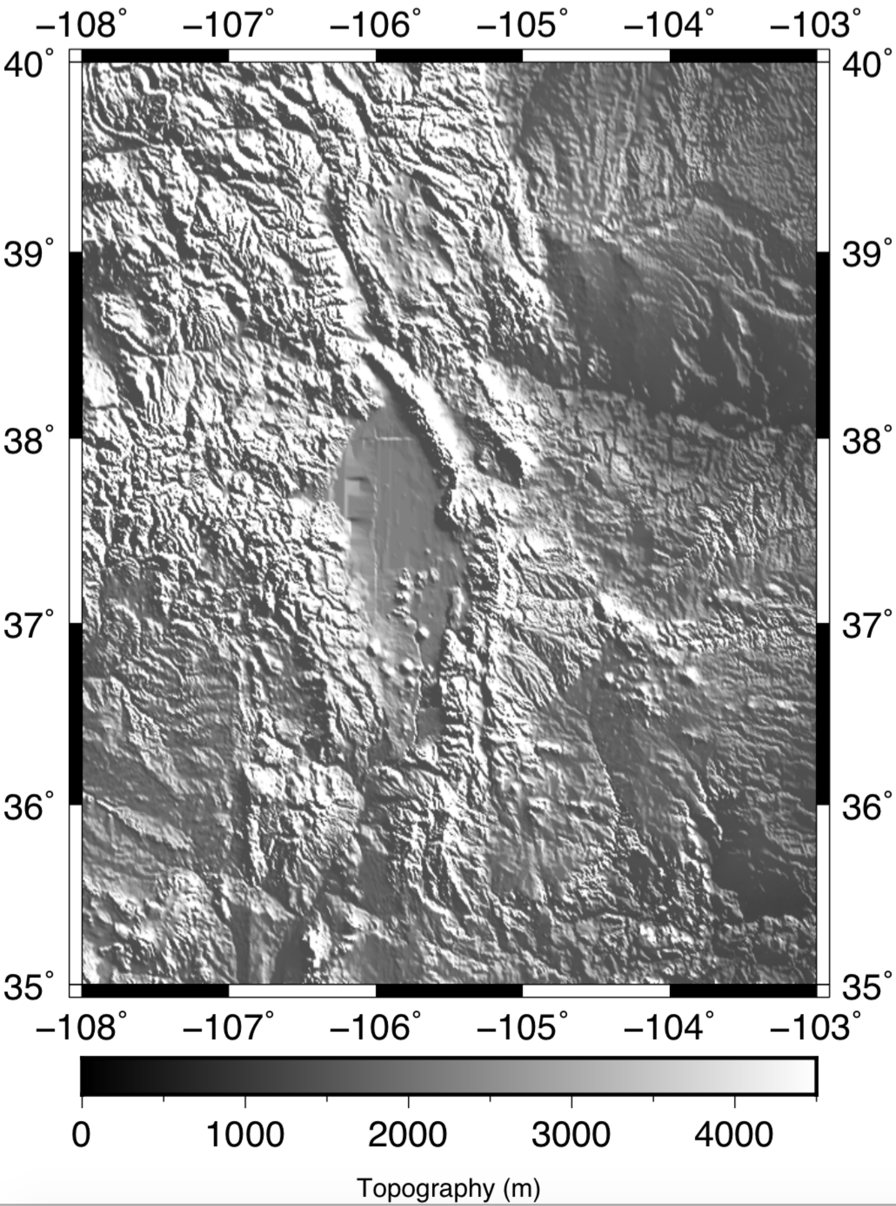
Build Map
makecpt -C$colou
grdgradient $grd -

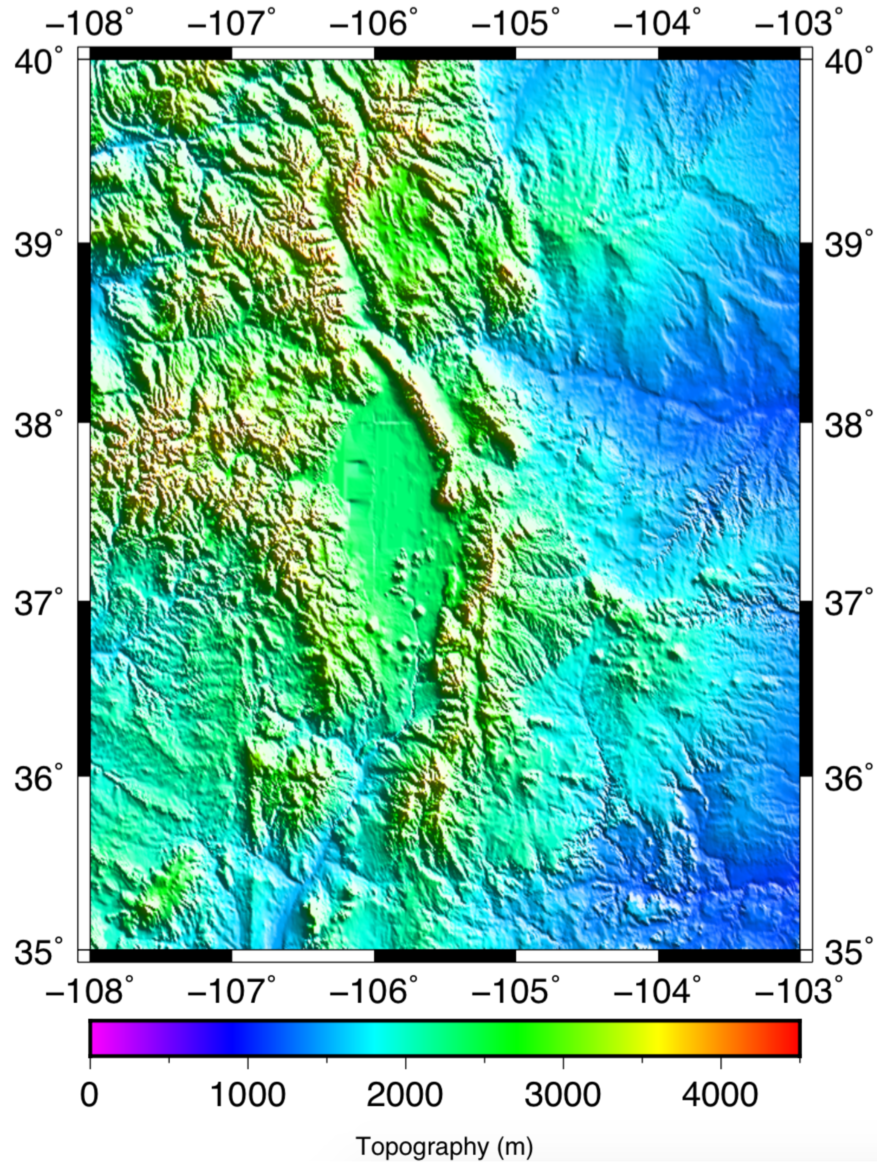
grdimage $grd -J



adientfile > $psfile

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


−108° −107° −106° −105° −104° −103°
40° 39° 38° 37° 36° 35°
0 1000 2000 3000 4000
Topography (m)


−108° −107° −106° −105° −104° −103°
40° 39° 38° 37° 36° 35°
0 1000 2000 3000 4000
Topography (m)

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

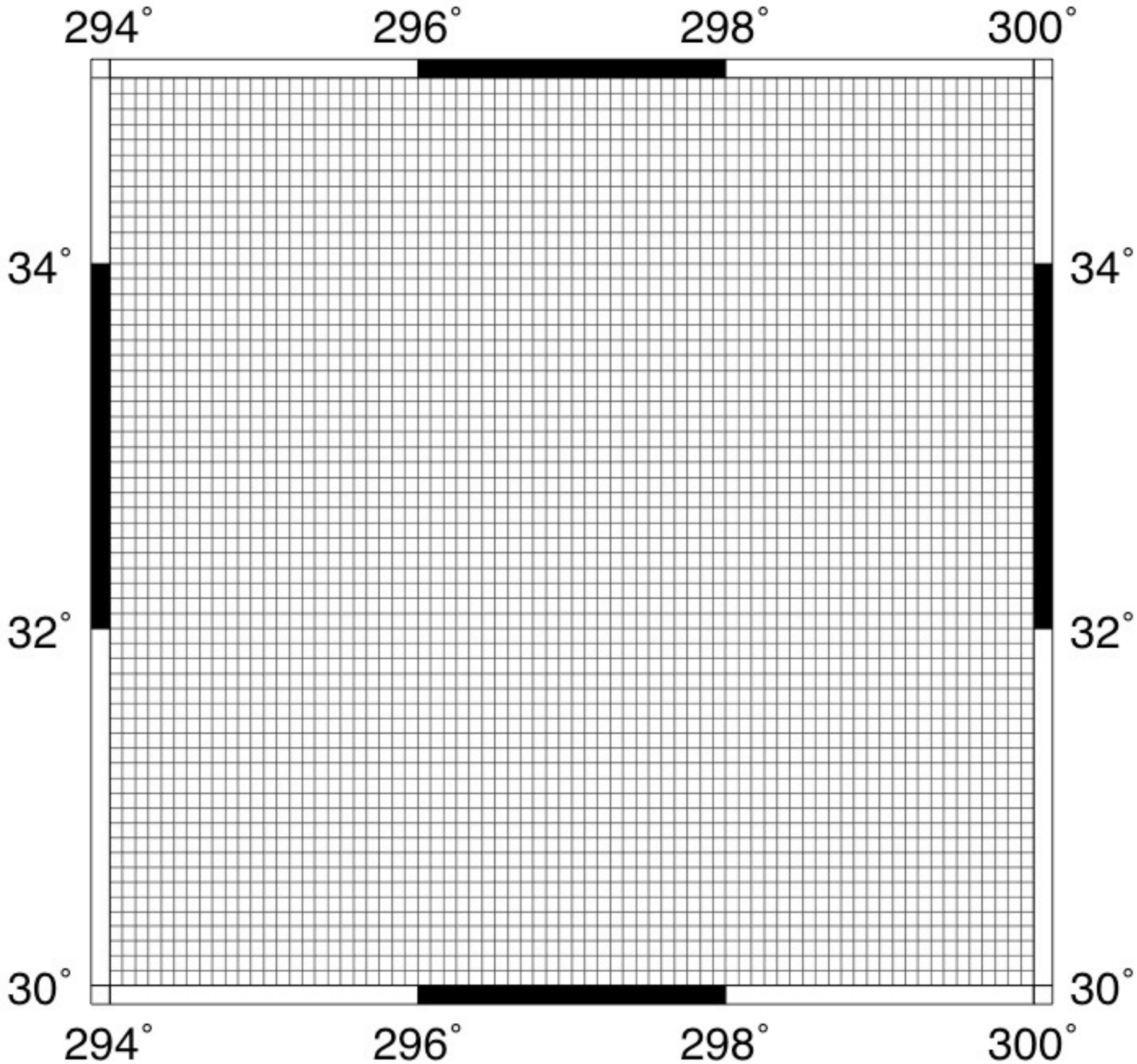
Option	**Effect**
–Ccptfile	Color table (or contours) to use
–Gdrapegrd	Assign colors from this grid
–Iintensgrd	Illumination intensity grid
–Qm[fill]	Draw mesh surface plot [white]
–Qs[**m**]	Draw surface (polygons)
–Qidpi[**g**]	Draw image (scan-line conversion)
–Qcdpi[**g**]	Same, but use NaN masking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

Grdview Exercise 29

- 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°

Perspective view

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

    !!! -E = -p in GMT5

- 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.

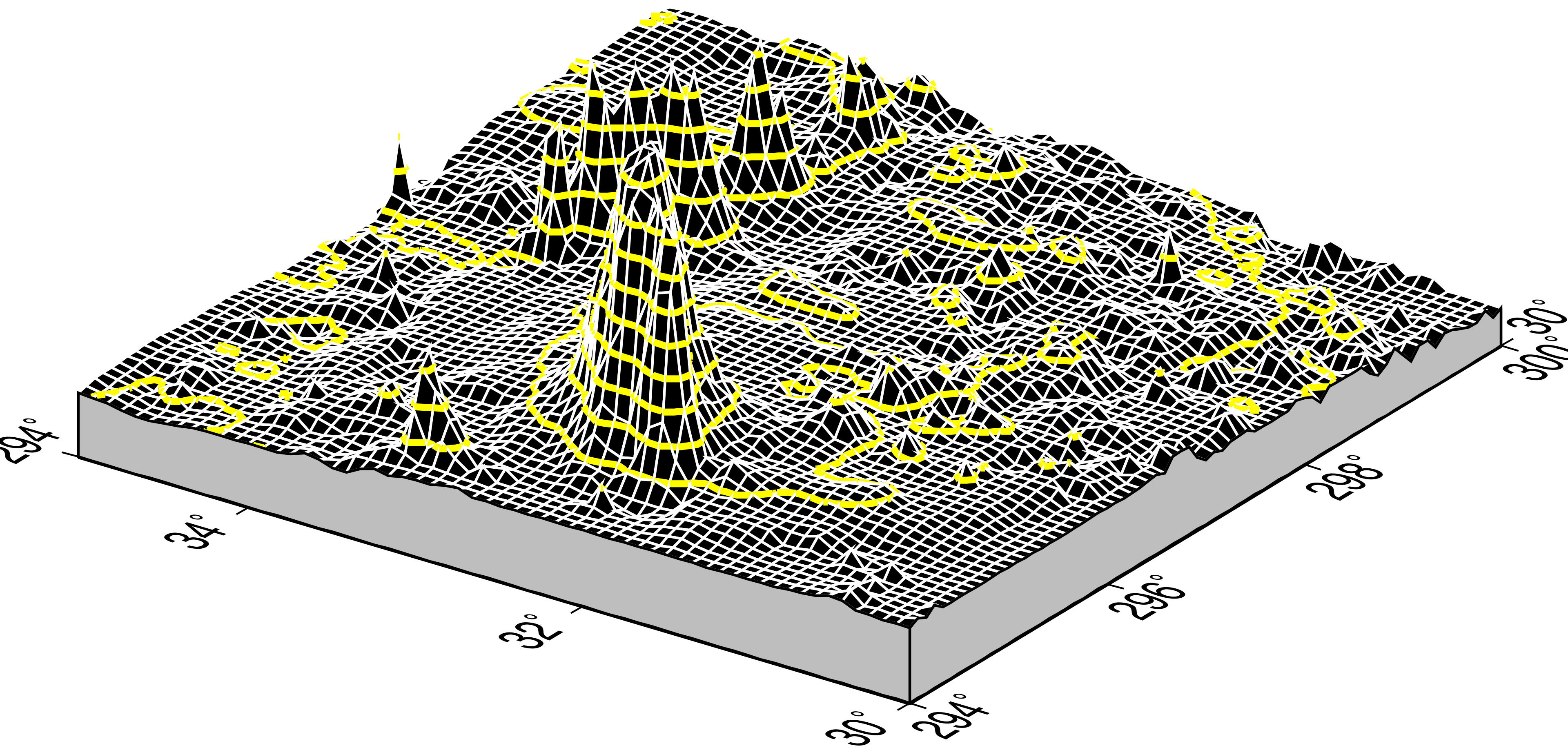
Map exercise 29

- 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

!!! -E = -p in GMT5

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

, not /

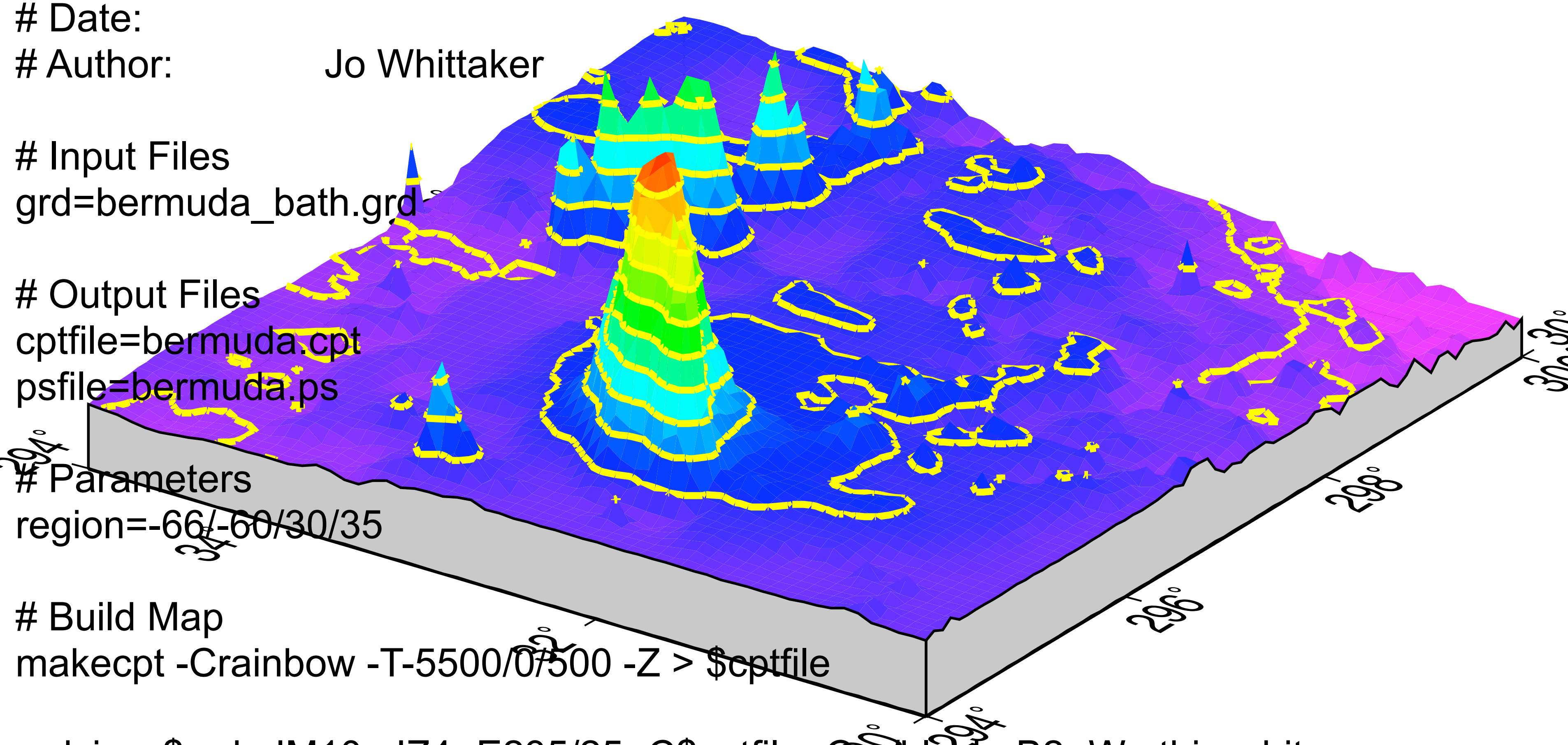


294°
34°
32°
30°
294°
296°
298°
300°
30°

Map exercise 29 cont …

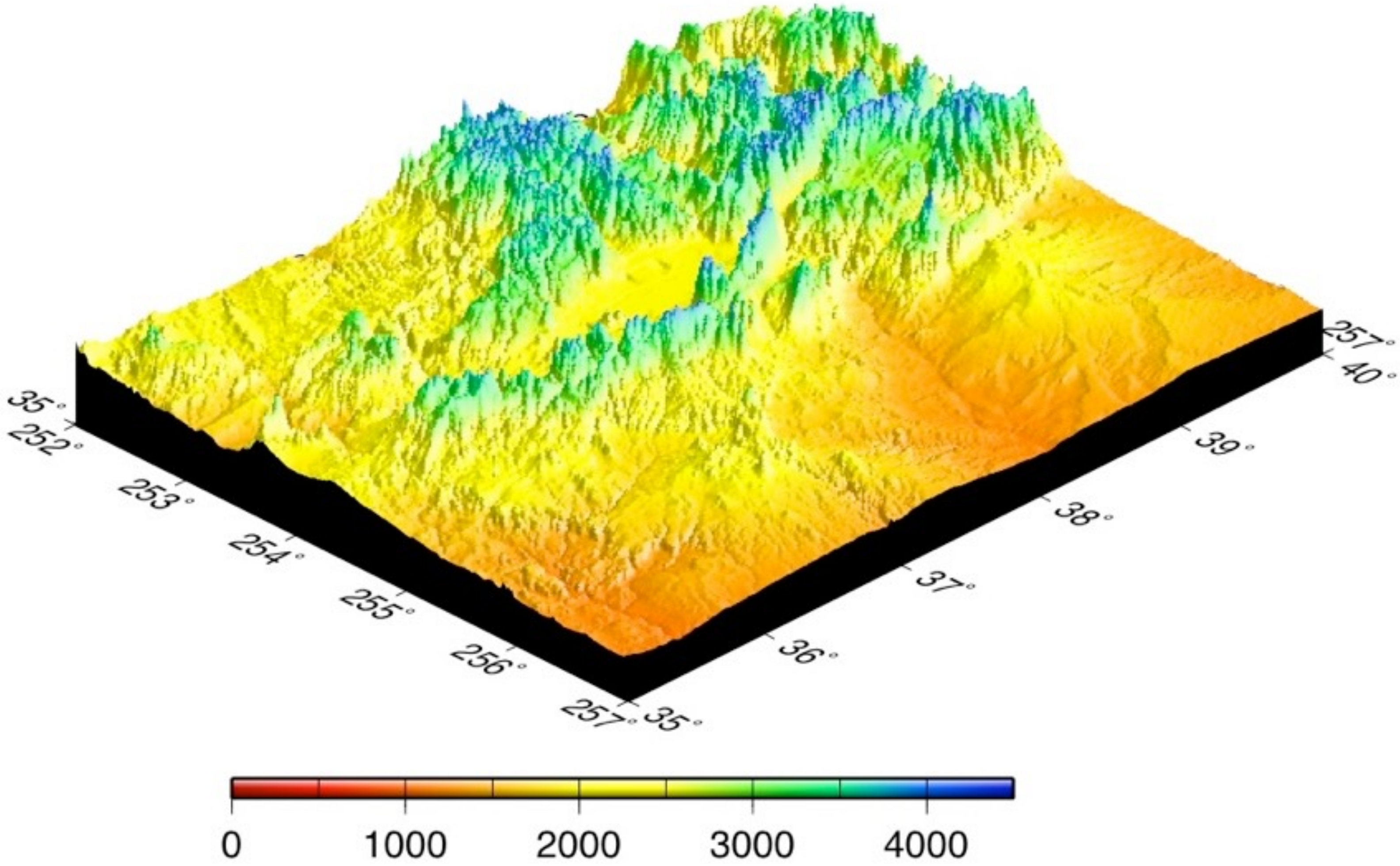
- Variations on the theme:
  - Select other view points and vertical scales
- Make a 3-D surface plot of Bermuda with a view from the south-east, contouring every 500 m.
  - Use -Qs for a surface plot

```
#!/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 <u>scanline conversion</u> at 50 dpi (-Qi50)
  - When happy, up the dpi to 100.
  - Plot your scalebar



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

Agegrid Exercise

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