GMT

Generic Mapping Tools or
Gravity, Magnetics and Topography

Lecture # 2

Gridding, Data Analysis, and Processing

Data Processing

- sample1d Resampling of 1-D data
- filter1d Filter 1-D data (time series)

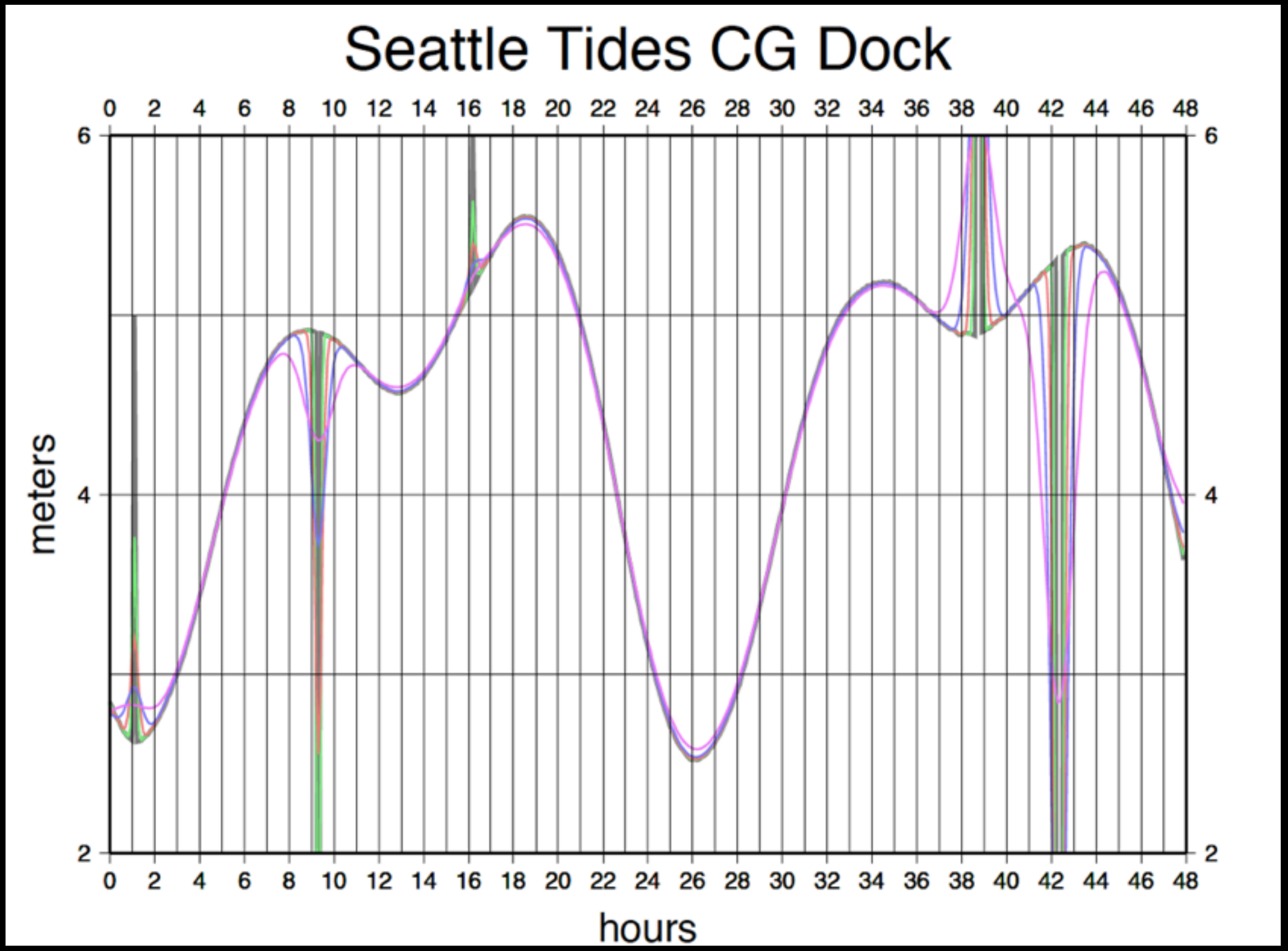
- fitcircle Finds best-fitting great or small circles
- grdtrend Fits polynomial trends to grdfiles (z = f(x,y))
- trend1d Fits polynomial or Fourier trends to y = f(x) series
- trend2d Fits polynomial trends to z = f(x,y) series

Filtering

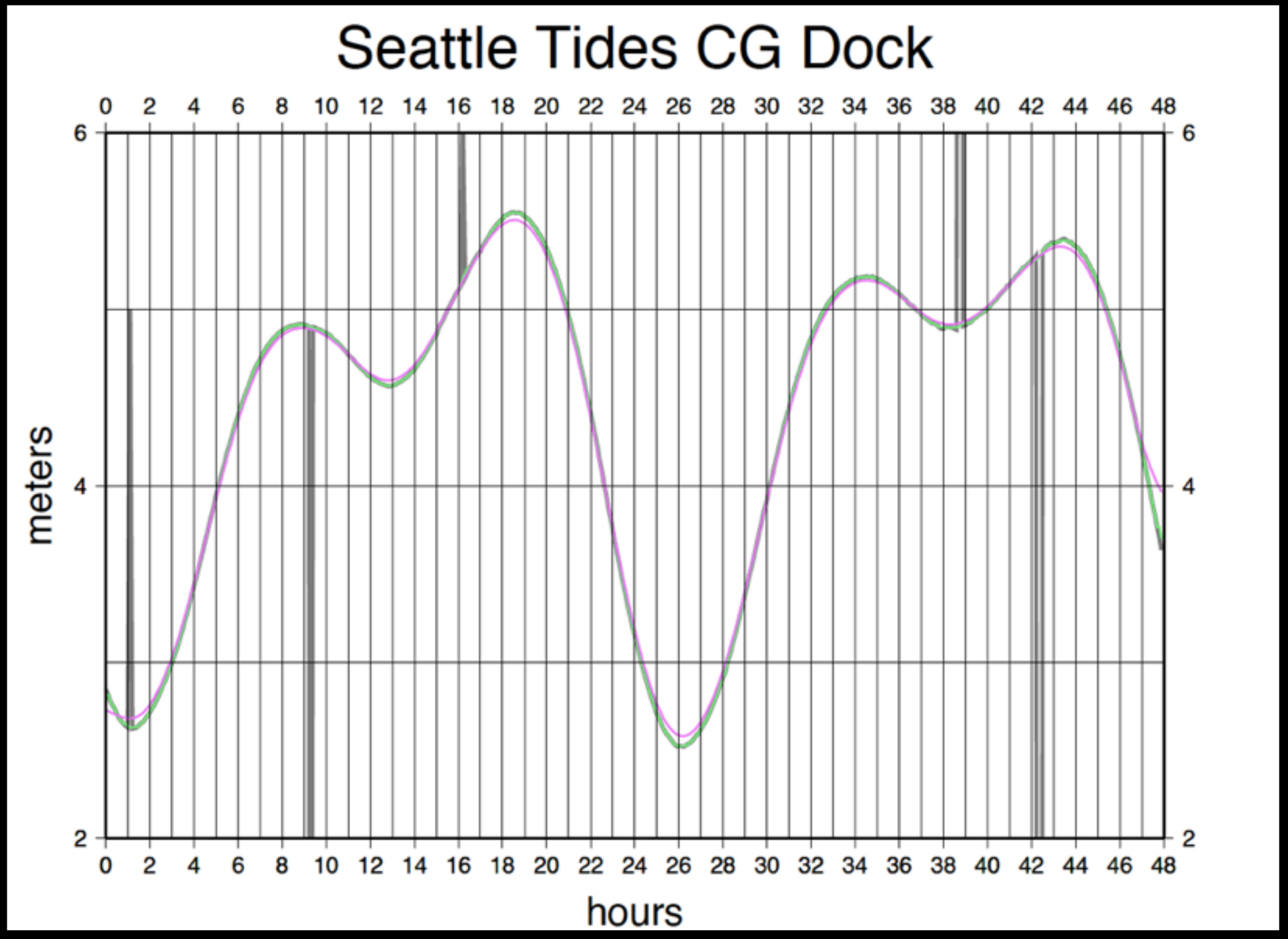
–F Sets the filter type. Choose among convolution and non-convolution filters. Append the filter code followed by the full filter *width* in same units as time column. Available convolution filters are:

(**b**) Boxcar: All weights are equal.
(**c**) Cosine Arch: Weights follow a cosine arch curve.
(**g**) Gaussian: Weights are given by the Gaussian function.
(**f**) Custom: Instead of *width* give name of a one-column file with your own weight coefficients.
Non-convolution filters are:
(**m**) Median: Returns median value.
(**p**) Maximum likelihood probability (a mode estimator): Return modal value. If more than one mode is found we return their average value. Append - or + to the filter width if you rather want to

Gaussian Filter



Median Filter

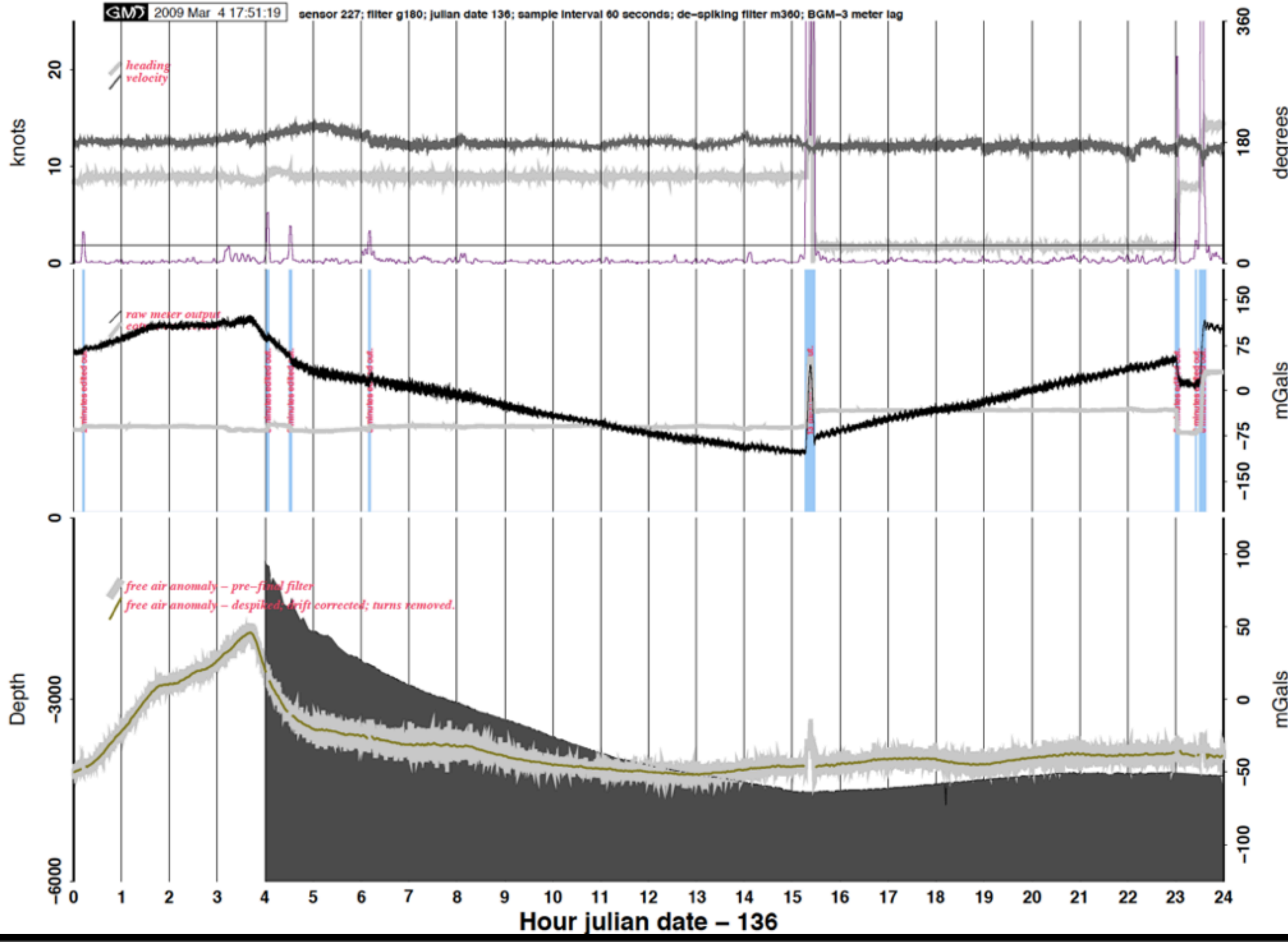


```
#!/bin/csh

# set plotting parameters

set databox = -R0/48/2/6
set scale = -JX9.0i/6.0i

# scale data from timetags to time (hours)
# input format
# 09+019:00:00:00.0000 2.844
# 09+019:00:06:00.0000 2.815
# 09+019:00:12:00.0000 2.780

cat tide.d* | awk '{hour = substr($1,8,2);  minute = substr($1,11,2); second = substr($1,13,2); time = hour+(minute + second/60)/60; if (NR > 1 && time < old_time+0)
{addhour += 24;} printf"%.2f %.3f\n",time+addhour,$2; old_time=time;}' > hold.data

# plot unfiltered data

cat hold.data | psxy $databox $scale -W10/125 -Bg1a4:hours:/g1a2:meters::."Seattle Tides CG Dock":WeSn -K > filtered1.ps

# plot median (30 minute or half hour) filtered data

cat hold.data | filter1d -Fm0.5 -E | psxy $databox $scale -W5/125/250/125 -Bg1a2 -K -O >> filtered1.ps

# plot median then Gaussian (30 minute or half hour) filtered data

cat hold.data | filter1d -Fm0.5 -E | filter1d -Fg4 -E | psxy $databox $scale -W5/250/125/250 -Bg1a2 -O >> filtered1.ps

# new plot; plot raw data

cat hold.data | psxy $databox $scale -W10/125 -Bg1a4:hours:/g1a2:meters::."Seattle Tides CG Dock":WeSn -K > filtered2.ps

# plot gaussian (0.5, 1, 2, 4 hour filter lengths).

cat hold.data | filter1d -Fg0.5 -E | psxy $databox $scale -W5/125/250/125 -Bg1a2 -K -O >> filtered2.ps

cat hold.data | filter1d -Fg1 -E | psxy $databox $scale -W5/250/125/125 -Bg1a2 -K -O >> filtered2.ps

cat hold.data | filter1d -Fg2 -E | psxy $databox $scale -W5/125/125/250 -Bg1a2 -K -O >> filtered2.ps

cat hold.data | filter1d -Fg4 -E | psxy $databox $scale -W5/250/125/250 -Bg1a2 -O >> filtered2.ps
```

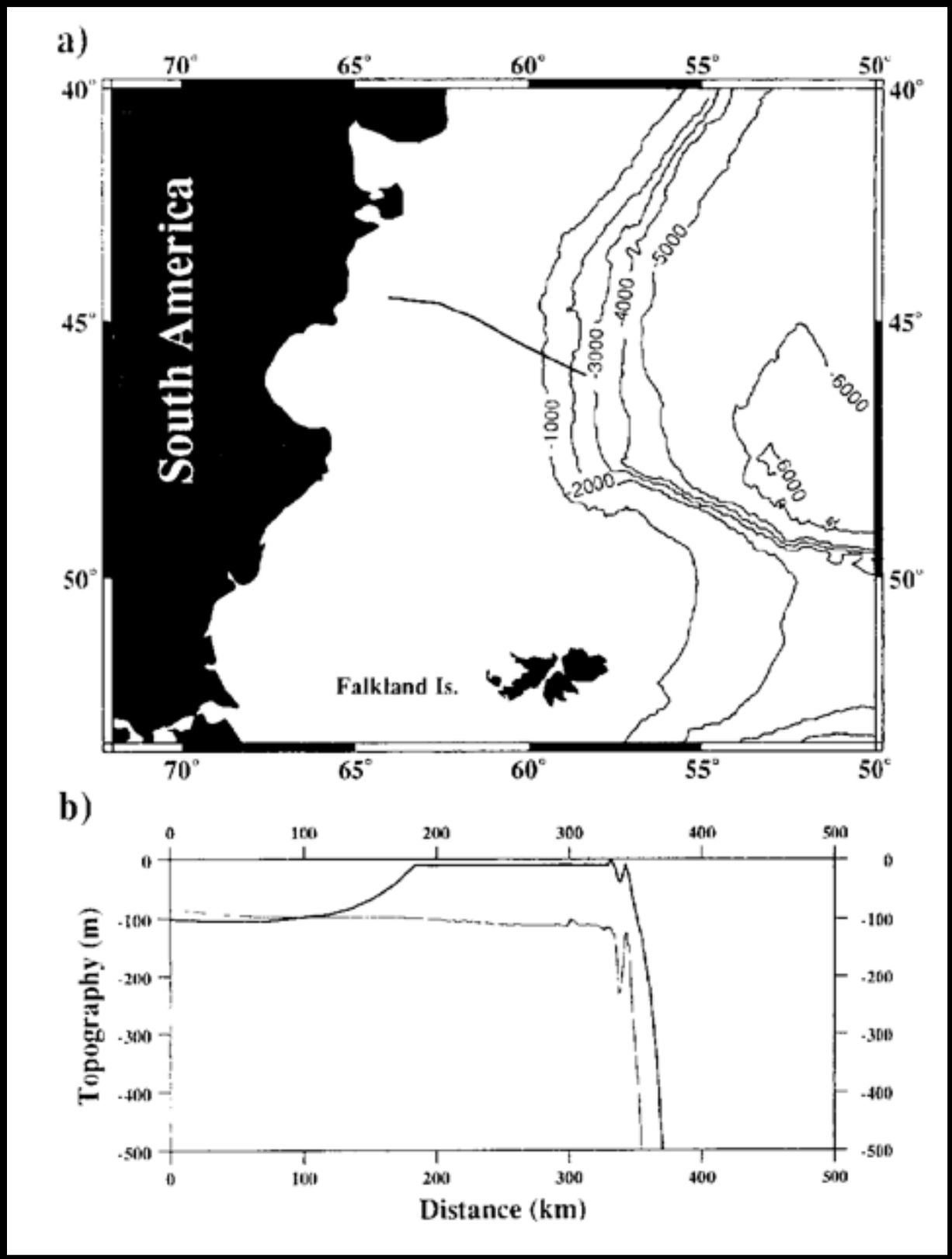
Data Processing

Gravity Example

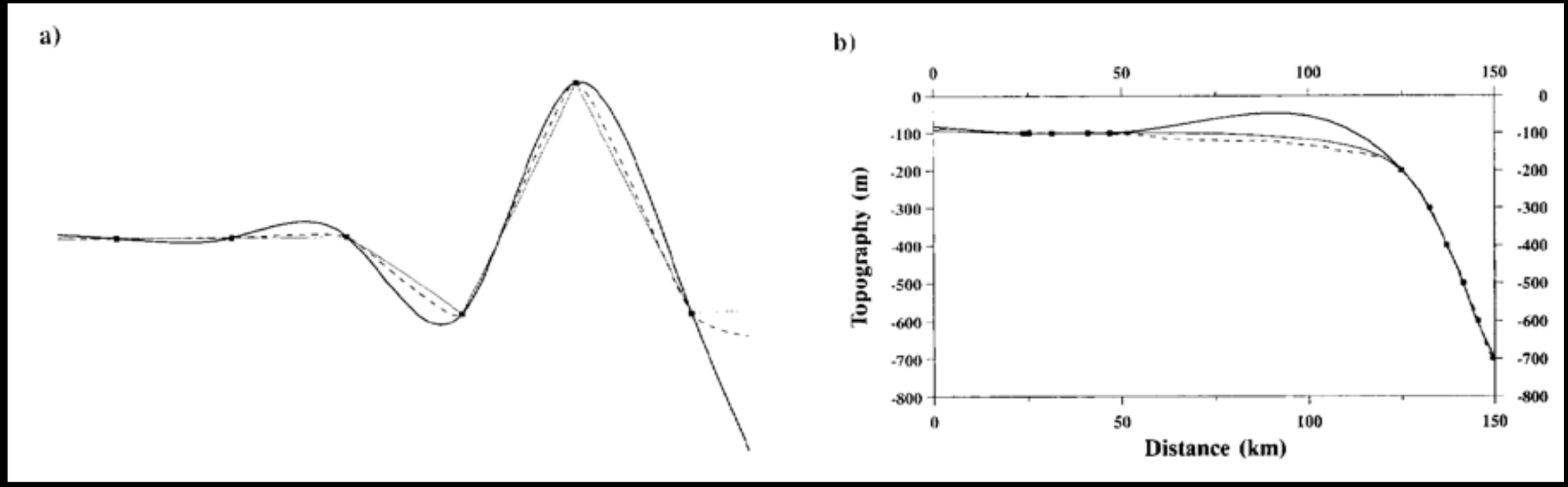
The basic problem is to join a number of data files, containing bathymetry, raw gravity and navigation data, to reduce the gravity values and estimate anomalies along track.


GMT 2009 Mar 4 17:51:19
sensor 227; filter g180; julian date 136; sample interval 60 seconds; dc-spiking filter m360; BGM-3 meter lag
heading
velocity
knots
degrees
raw meter output
mGals
free air anomaly – pre-final filter
free air anomaly – despiked, drift corrected; turns removed.
Depth
mGals
Hour julian date – 136

Minimum Curvature vs New Data

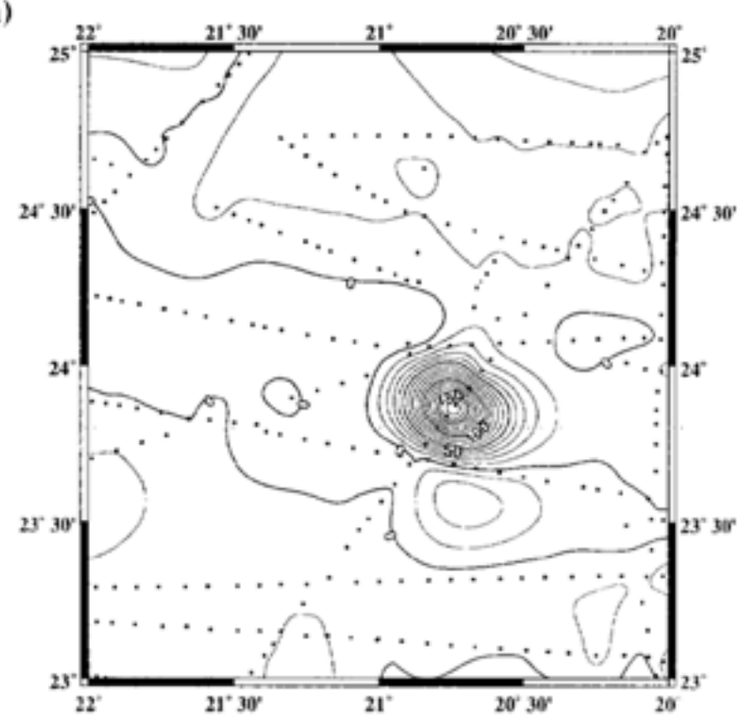


1-D Interpolation

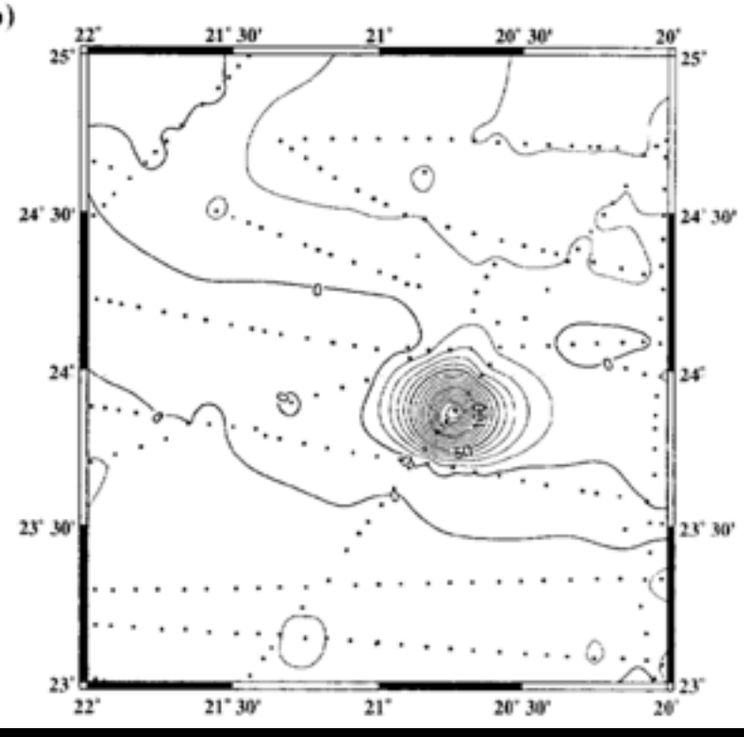


Splines in Tension

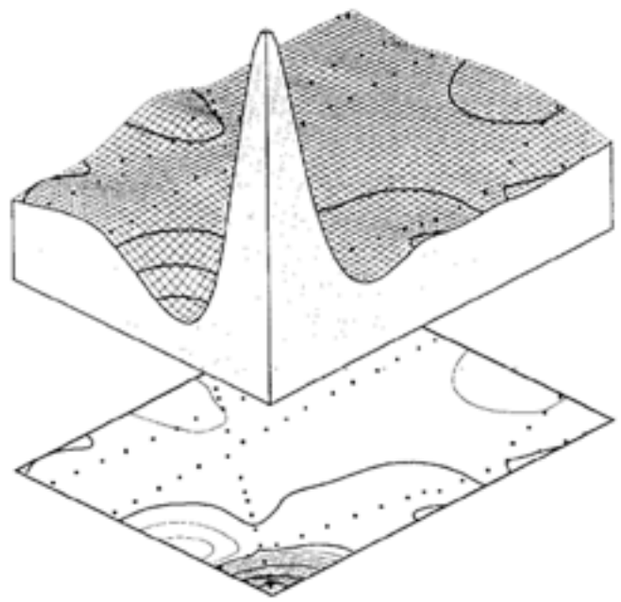
a)


22°
21° 30'
21°
20° 30'
20°
25°
24° 30'
24°
23° 30'
23°
0
50

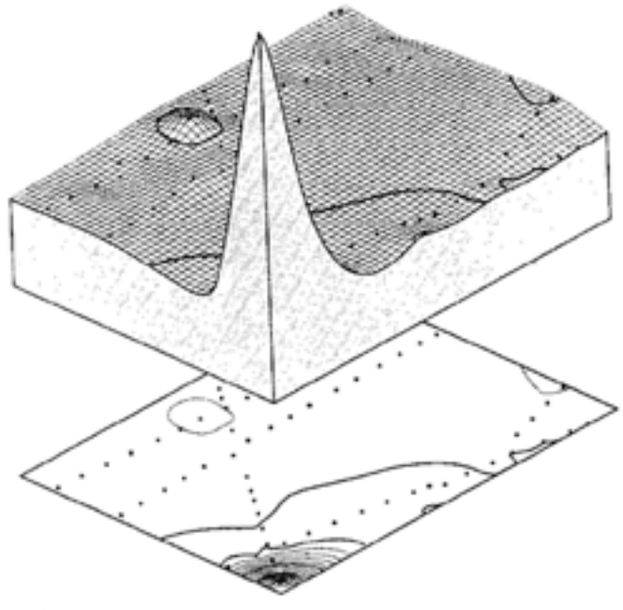
b)


22°
21° 30'
21°
20° 30'
20°
25°
24° 30'
24°
23° 30'
23°
0
50

c)

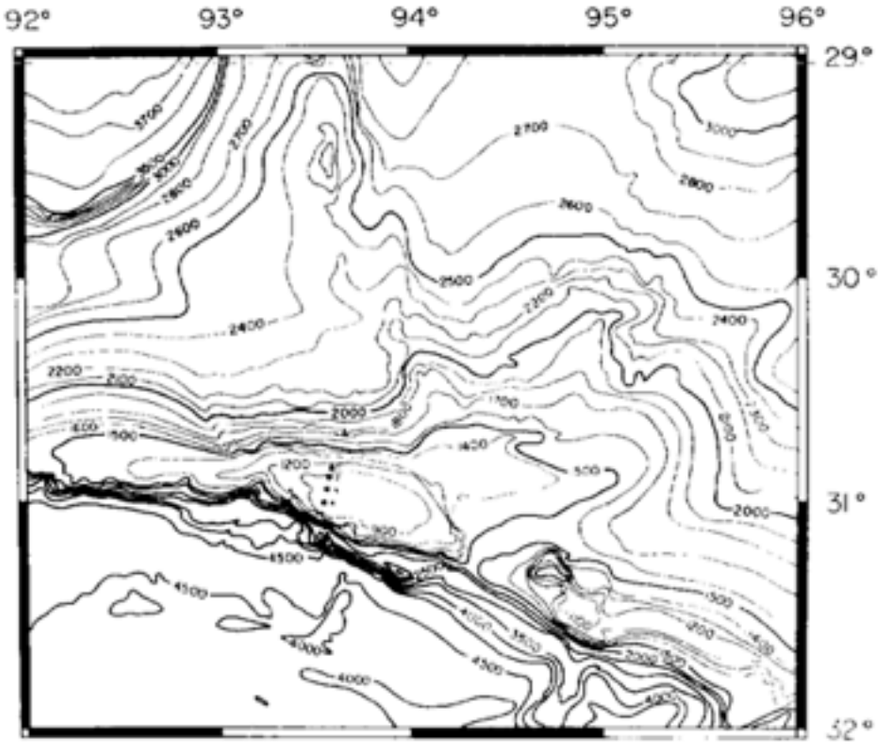


d)

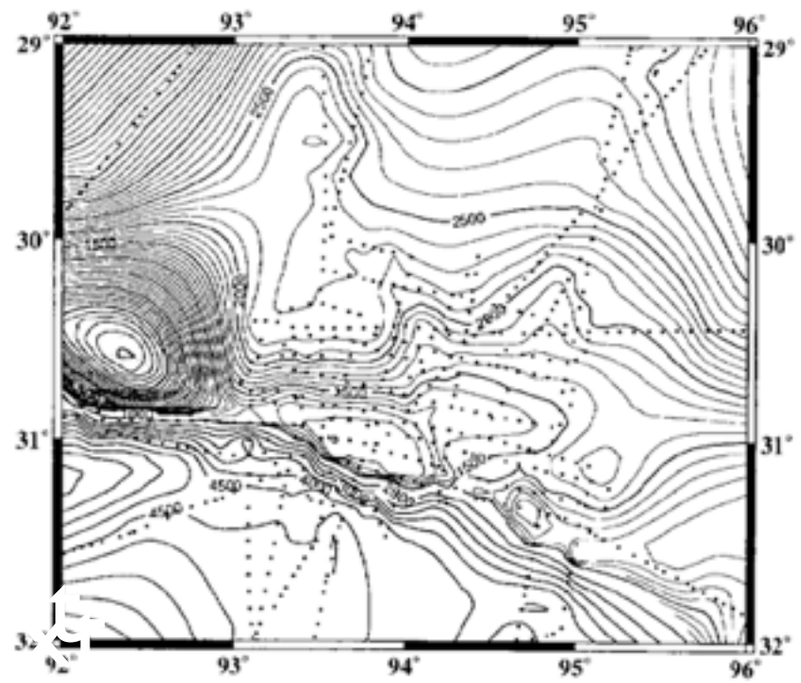


Broken Ridge

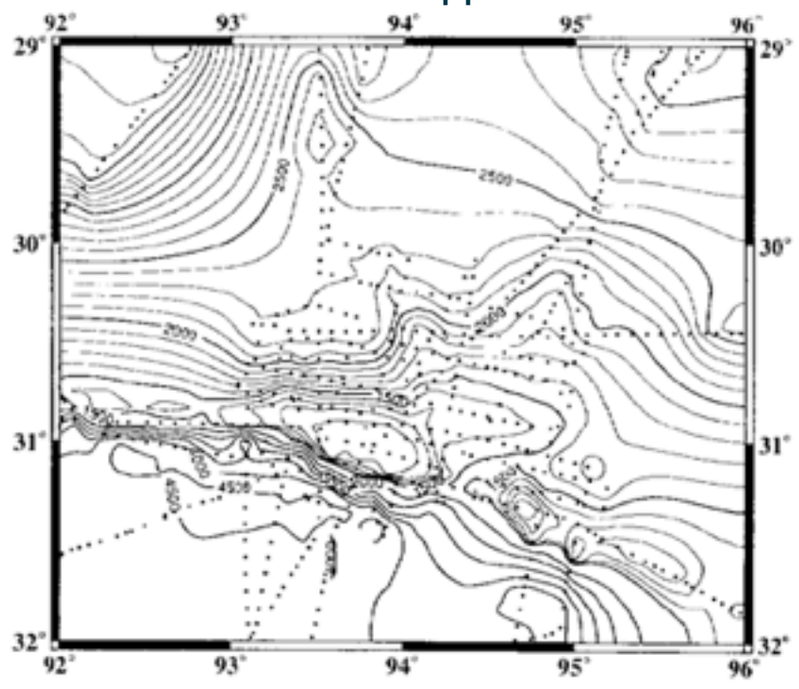
a) Hand Countoured



b) Minimum Curvature



c) Tension Applied



Gridding Programs

- blockmean L2 (x,y,z) data filter/decimator
- blockmedian L1 (x,y,z) data filter/decimator
- blockmode Mode-estimating (x,y,z) data filter/decimator

- greenspline Gridding using Green's function splines
- nearneighbor Nearest-neighbor gridding scheme
- surface Continuous curvature gridding algorithm
- triangulate Perform optimal Delauney triangulation on xyz data

Grid Manipulations

- grd2cpt Make color palette table from grdfile
- grdfilter Filter 2-D data in space domain
- grdsample Resample a 2-D gridded data onto new grid
- grdtrack Sampling of 2-D data along 1-D track

- grdblend Blend several gridded data sets into one
- grdclip Limit the z-range in gridded data sets
- grdedit Modify grd header information
- grdfft Operate on grdfiles in frequency domain
- grdgradient Compute directional gradient from grdfiles
- grdhisteq Histogram equalization for grdfiles
- grdlandmask Creates mask grdfile from coastline database
- grdmask Set nodes outside a clip path to a constant
- grdmath Reverse Polish calculator for grdfiles

NETCDF Grids

(**Network Common Data Form**)

a set of software libraries and self-describing, machine-independent data formats

supports the creation, access, and sharing of array-oriented scientific data.

Characteristics

- Data should be self-describing, without external tables needed for interpretation.
- Conventions should be developed only as needed, rather than anticipating possible needs.
- Conventions should not be onerous to use for either data-writers or data-readers.
- Metadata should be readable by humans as well as interpretable by programs.
- Redundancy should be avoided to prevent inconsistencies when writing data
- Data provenance: title, institution, contact, source (e.g. model), history (audit trail of operations), references, comment
- Description of associated activity: project, experiment
- Description of data: units, standard_name, long_name, auxiliary_variables, missing_value, valid_range, flag_values, flag_meanings
- Description of coordinates: coordinates, bounds, grid_mapping (with formula_terms); time specified with reference_time ("time since T0") and calendar attributes.
- Meaning of grid cells: cell_methods, cell_measures, and climatological statistics.

Other grid functions

- gmt2rgb Convert Sun raster or grdfile to red, green, blue component grids
- gmtconvert Convert table data from one format to another
- gmtmath Reverse Polish calculator for table data
- gmtselect Select table subsets based on multiple spatial criteria
- grd2xyz Convert 2-D gridded data to table
- grdcut Cut a sub-region from a grd file
- grdpaste Paste together grdfiles along common edge
- grdreformat Convert from one grdformat to another
- splitxyz Split xyz files into several segments
- xyz2grd Convert table to 2-D grd file