Plotting Altimeter Data: GMT and Google Earth

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Manipulate altimeter data in GMT
- High-quality PostScript, ready for publication
- GMT tools are used by many geoscientists
- Data analysis tools
- Now able to read Jason-2 data directly
- Always willing to expand capabilities

Showing altimeter data on Google Earth
- Increase *visibility* and *coolness-factor*
- Google Earth used by many people (and by some geoscientists)
- Tracks or grids
- Standard KML format
NetCDF made easy with GMT

- GMT to list or plot Jason-2 IGDR SSHA product

\$ gmtconvert -bic time/lat/lon/ssha
\$ gmtselect -bic lon/lat/ssha/time -f3T -R -180/180/43/43.5 --D_FORMAT=%.4f JA2_IPR_PcP034_171_*
\$ psxy -bic lat/ssha -R -10/50/-0.1/0.4 -JX 15c/10c -W 2p,red -B 10f1/0.05f0.01 JA2_IPR_2PcP034_171* > plot.ps
Jason-2 tracks in Google Earth

- Use **gmt2kml** to create symbols or lines (or both)
  - Use any number of JA2 files combined in one KML file
  - Use globally or regionally
  - Plot any variable (or just location)
  - Optionally, add labels to points
  - Plot (colored) symbols, lines (at altitude), optionally “extruded”

- **Example**
  - Create symbols colored by SSH anomaly
  - Create “walls” of SSH anomaly scaled by factor 200000

```
$ gmt2kml -biclon/lat/ssha c034/JA2* -Aa0 -Fs
-Cmy_rainbow.cpt -N -R-160/-100/30/70 -K > c034.kml
$ gmt2kml -biclon/lat/ssha c034/JA2* -Aax2e5 -E -Fl -R
-O >> c034.kml
```
Jason-2 tracks in Google Earth
Plotting GMT maps for Google Earth

- GMT’s **ps2raster** creates images and KML
  - Wrap global or regional image around globe

- **Step 1: Create your map**
  - **Without** map boundary or annotations
  - Make sure no white space is left (otherwise it may be cropped)

- **Step 2: Run ps2raster**
  - This creates a PNG image file and a minimalist KML file to be viewed with Google Earth
  - Optionally, make land and invalid data transparent

```
$ grdimage gslr.nc -Cpolar.cpt -JQ0 > gslr.eps
$ ps2raster -TG -A -P -W+k
$ open gslr.kml
```
Plotting GMT maps for Google Earth
Sea level rise

Sea level rise
One of the most significant potential impacts of climate change is sea level rise that may cause inundation of coastal areas and islands, shoreline erosion, and destruction of important ecosystems such as wetlands and mangroves. As global temperatures increase, sea level rises due to a thermal expansion of upper layers of the ocean and melting of glaciers and ice sheets.

The measurement of long-term changes in global mean sea level can provide an important corroboration of predictions by climate models of global warming. Satellite altimeter measurements can be combined with precisely known spacecraft orbits to provide an improved measurement of global sea level change.

Since August 1992 satellite radar altimeters have been measuring sea level on a global basis with unprecedented accuracy. TOPEX/Poseidon (T/P) satellite mission estimates of global mean sea level every 10 days and its successor Jason-1 provide estimates of global mean sea level every 10 days with an uncertainty of 3–4 mm. This record has continued with Jason-2/OSTM beginning in mid-2008.

The latest mean sea level time series and maps of regional sea level change can be found on this site.