EPS 108 DATA ANALYSIS PROJECT

SUMMARY

You are given synthetic data from globally distributed tide gauges recording local changes in sea level over the 20th century. We have provided sea level change results from a code that computes the sea level fingerprints on an elastic (which is suitable for this timescale) Earth due to the melting of the Greenland and Antarctic ice sheets. With this information, use a least squares approach to estimate the melt contributions to global sea level rise from the two major ice sheets, Greenland and Antarctica.

Hand in a report outlining your methods, results and conclusions with all relevant figures. In addition, a copy of your (well-commented) computer code must be attached as an appendix or emailed to Mrinal or me.

DATA

There are 4 files:

- `tidedata.dat`: stores local sea level where each row is the time series for a given tide gauge
- `time.dat`: is the time in years CE.
- `lons.dat`: the associated longitude of each tide gauge
- `lats.dat`: the associated latitude of each tide gauge

SEA LEVEL FINGERPRINTS

The following files provide the global sea level change due to the melting of the Greenland ice sheet and the Antarctic ice sheet over an elastic timescale. These global patterns are known as *sea level fingerprints*. Each fingerprint shows the equivalent eustatic (or globally averaged) sea level rise of 1 m. Note, this does not translate to 1 m of ice sheet melt. This calculation is linear and so if you want to calculate the fingerprints for a eustatic sea level change of 2 m, you multiply the fields by 2. The files are as follows:

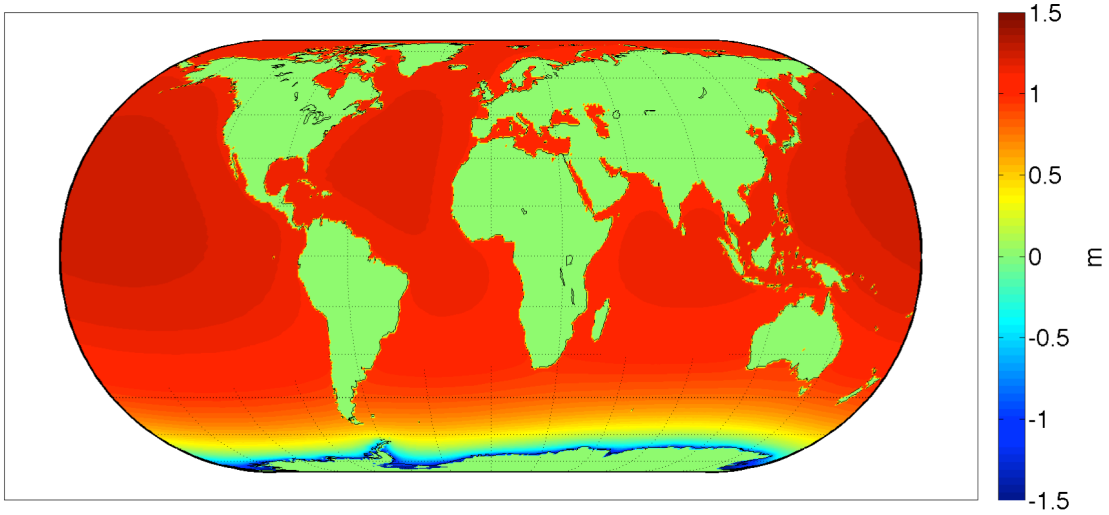
- `<Ice sheet>_fingerprint.dat`: a 2D map of the fingerprint
- `<Ice sheet>_fingerprint_colat.dat`: the associated colatitudes for each row of the 2D map
- `<Ice sheet>_fingerprint_lon.dat`: the associated longitudes for each column of the 2D map.

How are these calculated?

The sea level theory from which these fields were calculated describes how Earth's global sea level will change if you change the mass distribution, including deformations of the solid Earth, which in turn perturb the gravitational potential of the Earth---this dictates where the ocean's static surface will lie. The fingerprints provided are particular solutions of the relevant equations for the melting of specific ice sheets (i.e., Greenland or the Antarctic).

The sea level equation is an implicit (and integral) equation; the solution to the equation depends upon the solution itself. To overcome this, the solution is determined iteratively. Physically, sea level depends on the gravitational potential of the loaded Earth. Once you calculate the shifted sea level, this re-loads the Earth changing the gravitational potential and so the solution must be updated.

Antarctic Fingerprint



Greenland Fingerprint