Marine Geodäsie

Mid-Term Exam Summer 2021

Q1. Although many different techniques have been developed and tested for making geodetic measurements on the seafloor, the most well developed and commonly used are based on measuring changes in seafloor pressure or on making repeat measurements of acoustic ranges.

1.1. Describe what are the sensors actually measuring, and how are they doing it for each of these two basics techniques.

Pressure Sensor measures water pressure changes with a high signal/noise ratio, since the pressure depends on the water depth.

Acoustic range measures two-way Time
Baseline length d = v * t /2

1.2. What (other) physical parameters do we need to either measure, model, or estimate in order to convert the raw observations into parameters we can then interpret for each of these two techniques?

For Acoustic ranges: sound speed, which depends on salinity, depth(pressure) and temperature.

Pressure: temperature, because it influences the density of water.

1.3. Choose one of the two techniques and explain what environmental processes contribute to the observed signal, the source of these processes, their relative importance/amplitude, the typical temporal and spatial scales, and how you might model, estimate, and/or remove their contributions in order to resolve any geodetic motions in your data.

Seafloor pressure:

Tides: from sun and Moon gravity, inertial.
Semidiurnal twice daily, equal highs and lows,
Diurnal one high one low
Mixed twice daily
Up to more than 10 meters

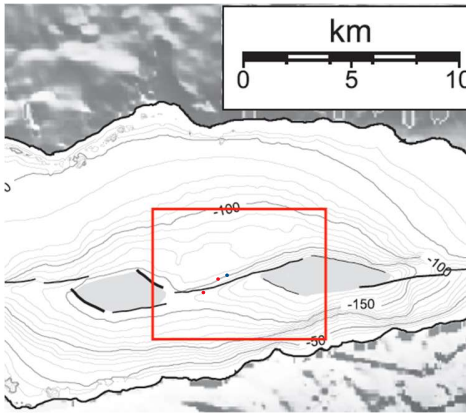
Tides are predictable because the positions of bodies in the Earth-Moon-Sun system are predictable and can be easily modeled.

Small waves: internal waves from atmospheric forcing and barotropic tidal flow over topography
Usually short wavelength and period

Mesoscale: heat transport, biological activity
horizontal 50~500 km; time scale 10~100 days

Atmospheric change like temperature can be in the same time measured and documented.

Q2. Land-based observations suggest that there are tectonic processes occurring under the nearby seafloor. Seafloor bathymetric surveys have identified a several kilometer long fault trace that might be accommodating vertical and/or strike-slip (horizontal) displacements. You are able to deploy 6 seafloor geodetic sensors. Explain what sensors would you deploy and how would you arrange them. (Sketch the layout). Explain your choices. What signal(s) might you expect to see, how would you interpret them? What sources of noise might you experience, and how might you address them? What other (non geodetic) observations might be most useful to help guide your interpretations?



Bathymetry (gray contours) and interpreted fault traces (black lines) for the area of interest (red box).

Instrument chosen:
4 transponders (red points), 2 each side (baseline length shorter than 2km)

2 pressure gauges (blue points). One each side.

In this case we have 2 baselines on each side of the fault and 4 baselines across the fault so the possible relative movement can be easily observed. And same for the 2 pressure gauges.

To be expected: the length of those baselines cross the fault will be changed and one pressure gauge will have a pressure change detected if there is a flank movement.

Noise: instruments errors.
Pressure gauge drift: self-calibrating

Other observations: if there is in this area during this time any earthquake detected.