Earth free oscillation measurements with LCR-ET 26 spring gravimeter

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Introduction

- Józefosław Observatory is located in central Poland, 25 km south from the center of Warsaw in the suburb area.
- LC&R Earth Tide no. 26 spring gravimeter with electrostatic feedback, additional pressure measurements.

Data

- Raw data hereafter means 1 min sampled data from gravimeter
- Filtered data means moving average with 400 s length

Noise

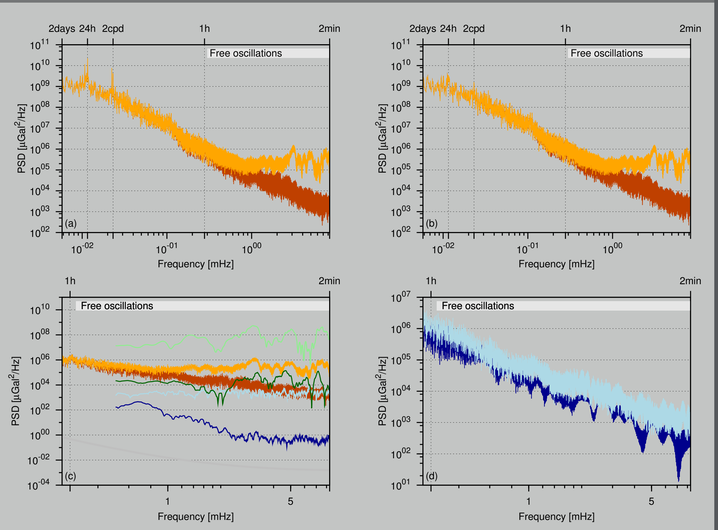

Figure: (a) shows raw (orange) and filtered (red-orange) records. (b) detided and de-pressured series. (c) comparison of different days. Green is very noisy day and green is one of the quiets days. Dark green and blue are filtered while light colors are raw records. (d) is comparison of noise during day (7-15 UTC, light blue) and night (21-5 UTC, dark blue).

Anthropogenic noise

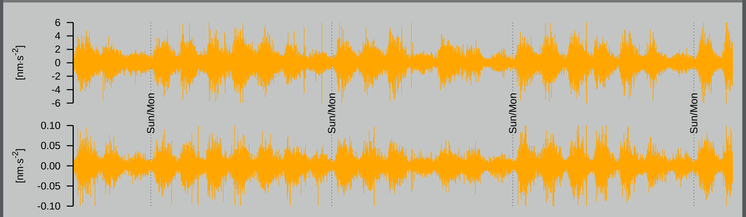

Figure: Time derivative of raw (top figure) and filtered (bottom figure) gravity residuals (tides, ocean loading and pressure effects removed)

Earthquakes

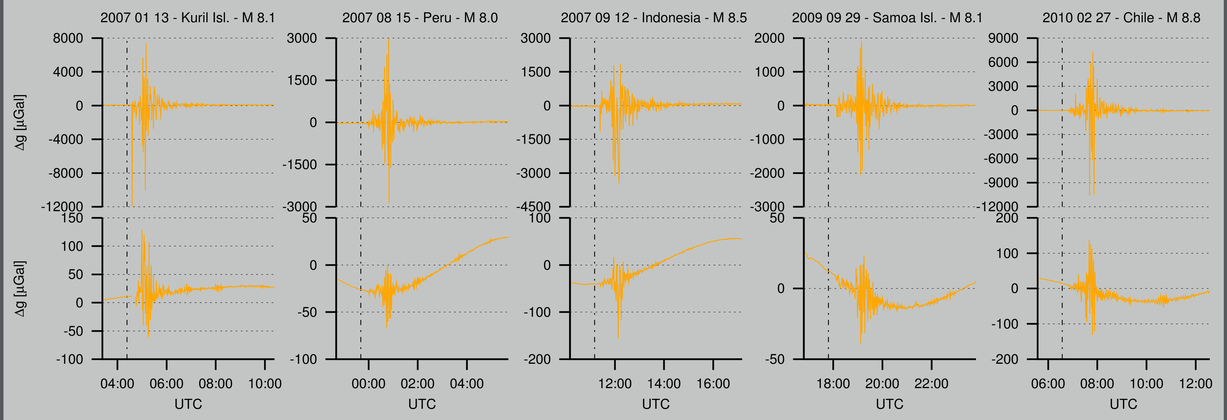

Figure: Raw (top) and filtered (bottom) records of LCR ET26 gravimeter from great earthquakes. Vertical bars indicate start of the event. Note different scale on vertical axis.

Spectrogram

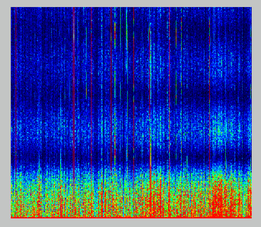

Figure: Multi-year spectrogram of filtered 1min sampled data. Vertical axis range is from 0 to 8 mHz.

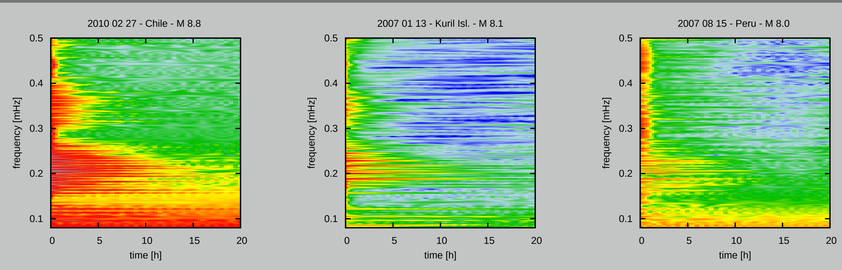

Figure: Spectrograms for selected great earthquakes. Note different color scale on each figure.

Spectra

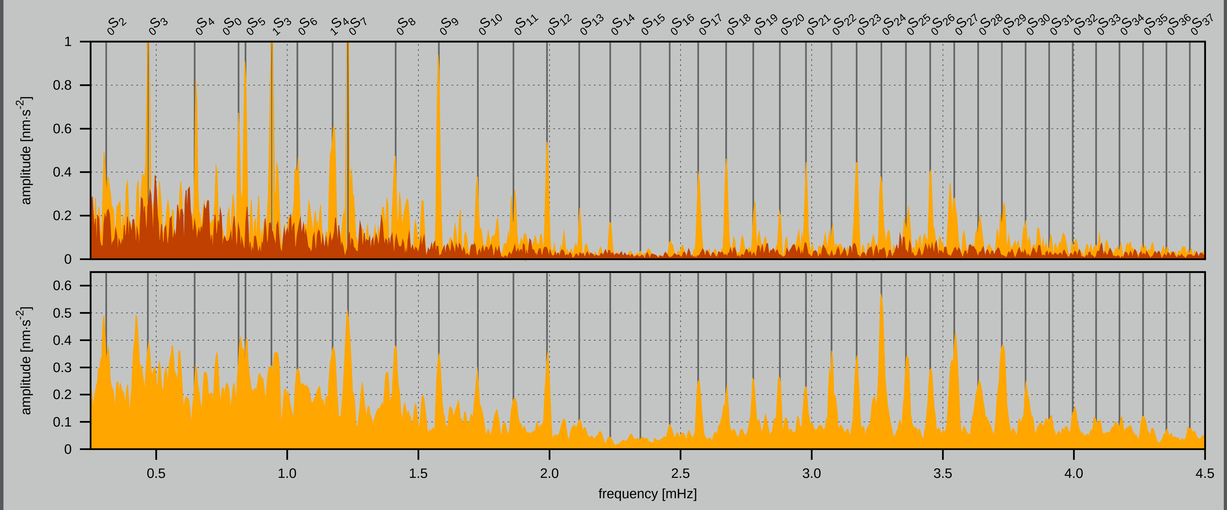

Figure: Amplitude spectra from about 5h to 43h after Chilean (2010) earthquake (top) and product spectra of four great earthquakes (bottom). For comparison there is shown a spectra from window of 48 length before earthquake (top, red-orange).

Spec

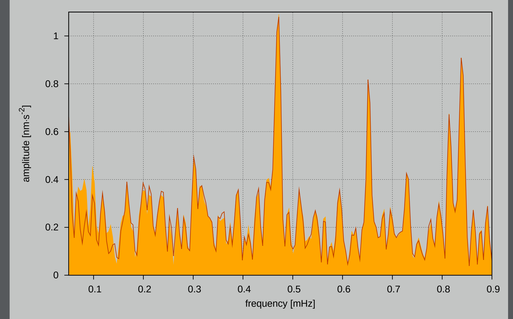

Figure: Amplitude spectra from Chilean earthquake in low frequency normal mode band. The solid colors show results without pressure correction and the dark line shows results for records where atmospheric correction was applied. We used the factor of $-3.5\,\mathrm{nm}\cdot\mathrm{s}^{-2}$, the result from least square tidal analysis.

Q factors

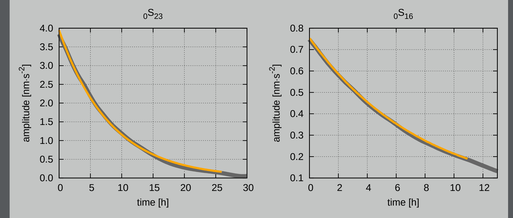

Figure: Fitted exponential regression function for two modes. The estimated Q value for ${}_0S_{23}$ is 293 comparing to theoretical value of 259. For ${}_0S_{16}$ we found 284 when the expected from Earth model is 325 respectively. Applying standard pressure correction do not affect results significantly.

Conclusion

- Despite of high background noise we confirmed the usefulness of LCR ET spring gravimeters in normal mode studies
- Quality factors are in agreement with previous studies and Earth models predictions
- Atmospheric correction do not improve results in our study due to poor noise condition
- Other localization need to be consider

References

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