

Deformations and global forces: Seismic and hydrostatic leveling records in the « Mont Terri » rock laboratory (Switzerland)

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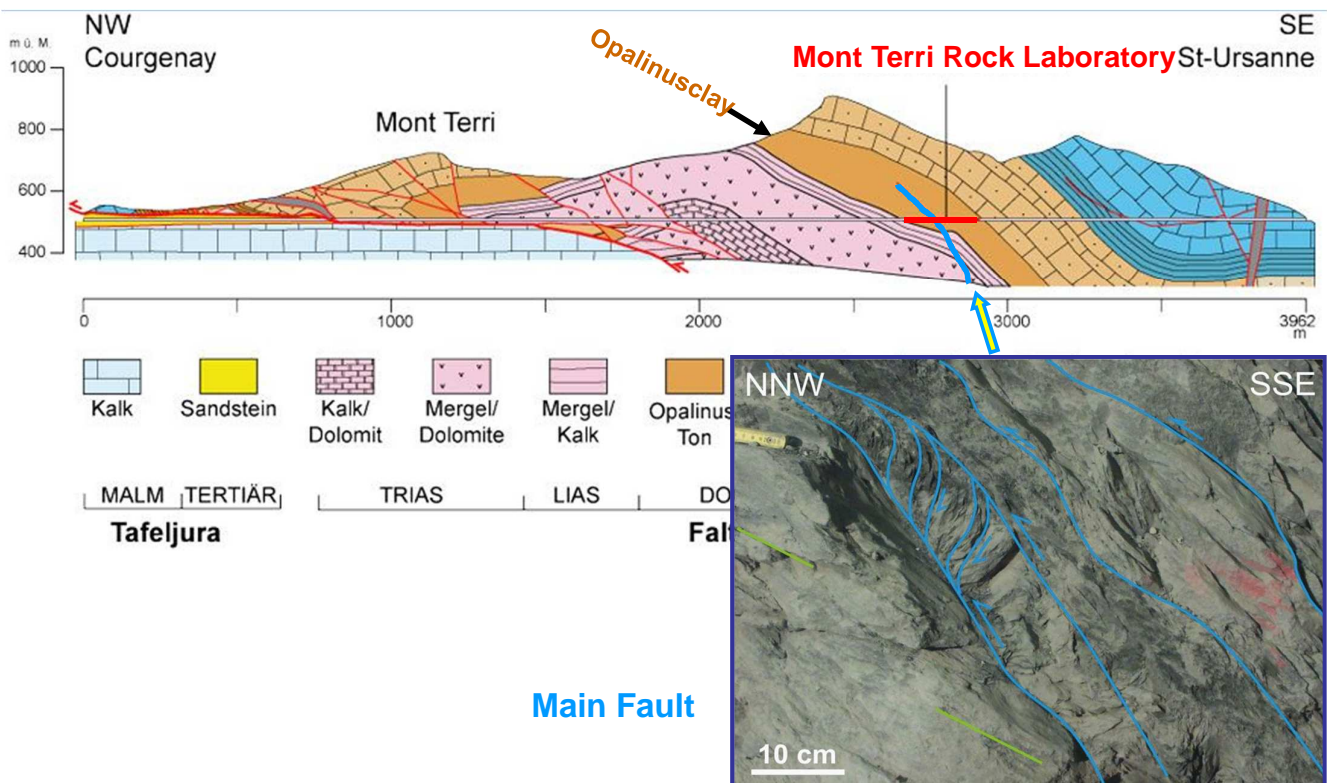


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1

Opalinucly: rock for nuclear waste disposal



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2

Broadband Seismometer
STS-2.5
Streckeisen, Switzerland

~ 23 cm



Outputsignal is proportional to ground velocity (1x integration = way)

Seismic
Datarecorder
Quanterra, USA



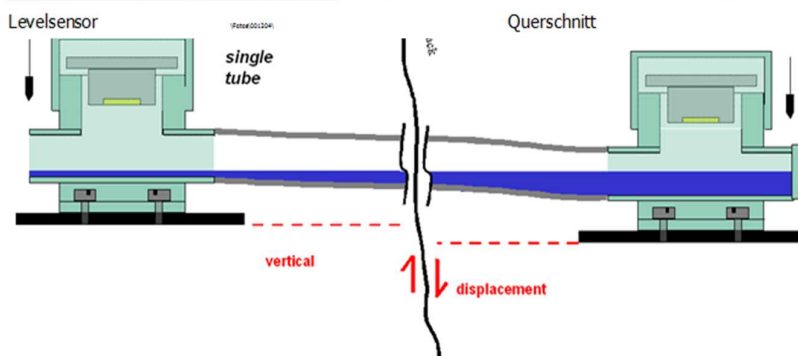
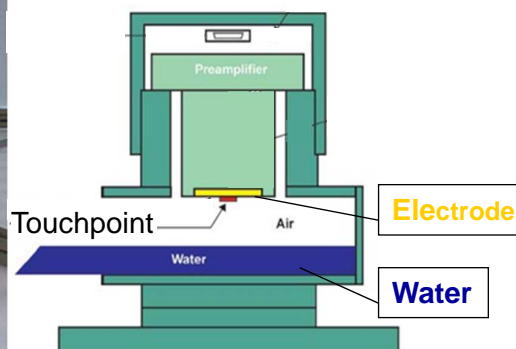
HLS 1
HLS 2
Barometer

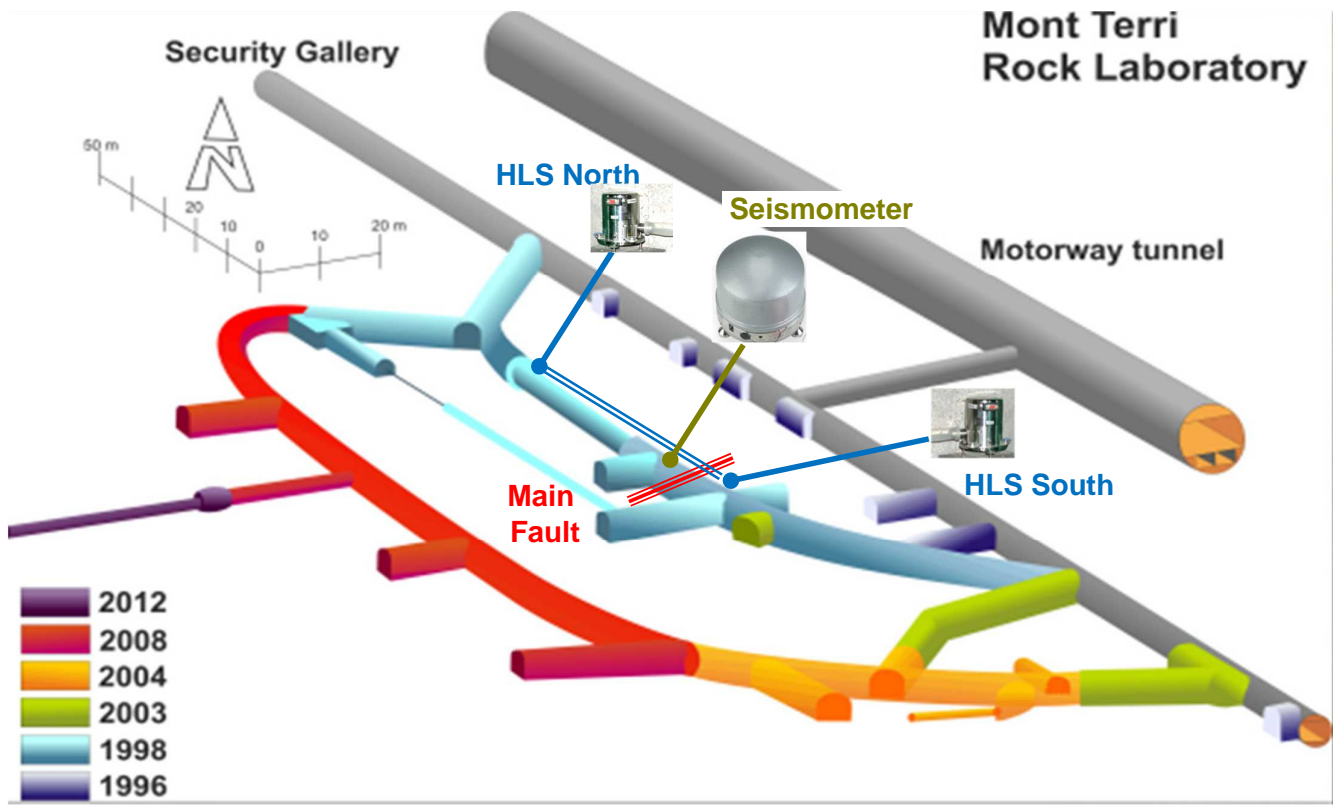
Very high resolution (~20⁶ counts)

HLS: Hydrostatic Levelling System Typ PSI

Levensensor:

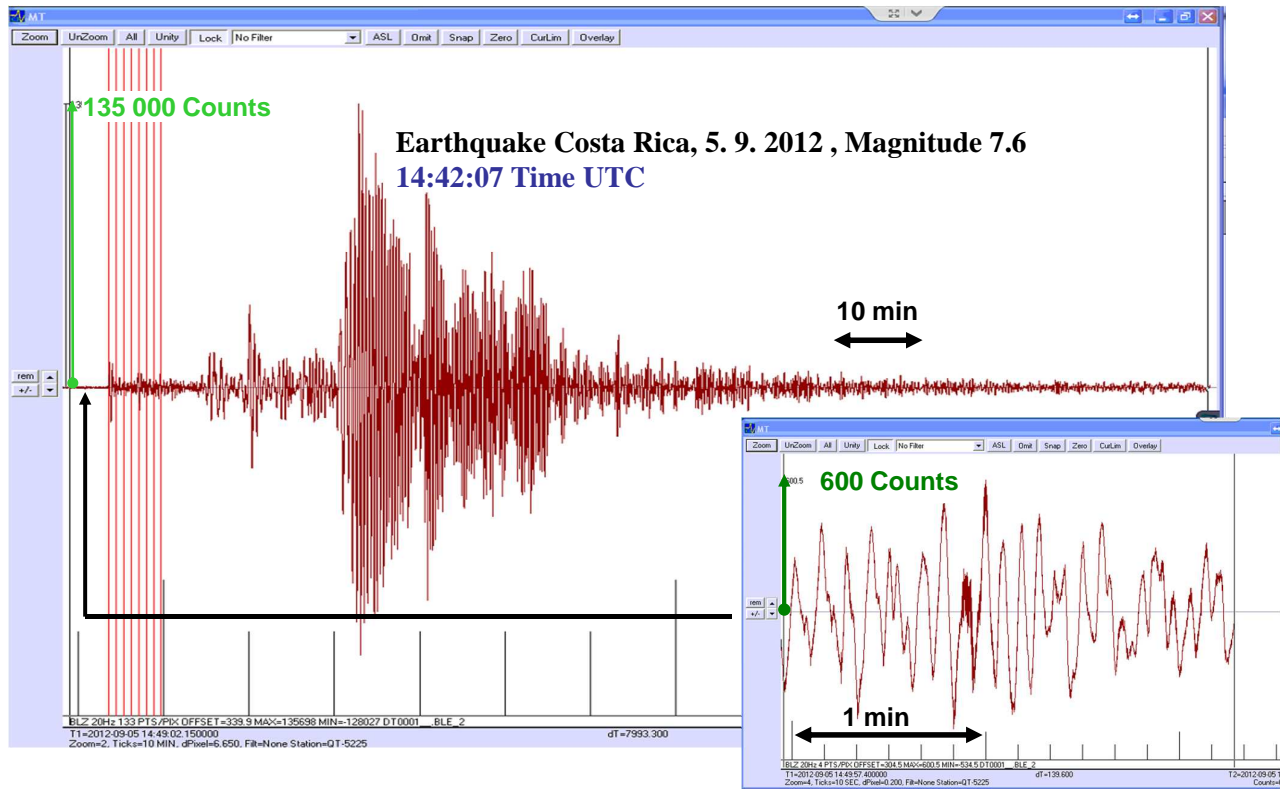
for precise
waterlevel
detection





Installation: 50m long HLS-System





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Online Monitor Alaska Earthquake M 7.5

90 minutes after the event
2 minutes timewindow

Alaska Earthquake: Magnitude 7.5 (automatic)
 05.01.2013 08:58:19h UTC

90 Min later at Montterri:

M	Location	Time	Lat
7.5	94km W of Craig, Alaska	2013-01-05 08:58:19 UTC	55.368°N
5.7	274km SE of Vostok, Russia	2013-01-01 07:35:50	46.904°N
5.6	41km SSW of 'Alaqahdari-ye Kiran wa Munjan, Afghanistan	2012-12-29 17:50:52	35.684°N

Seismometer STS 2.5

- Vertical
- Horizontal - perpendicular
- Horizontal - parallel
- Hydrostatic Levelling
- Levensensor North
- Levensensor South

Seismometer Horizontal component

HLS Nord, synchron

HLS Süd, opposite phase

5225 QuickView

Channels to Display: CH1, CH2, CH3, CH4, CH5, CH6

Channel 1: RMS=12.0209, AVG=0.6, V/N=1837, MIN=1003, MAX=11267

Channel 2: RMS=11.2541, AVG=-0.8, V/N=1837, MIN=1003, MAX=11267

Channel 3: RMS=10.64156, AVG=0.8, V/N=1837, MIN=1003, MAX=11267

Channel 4: RMS=10.27003, AVG=0.7225.6, V/N=1837, MIN=1003, MAX=11267

Channel 5: RMS=10.15242, AVG=0.256.9, V/N=1837, MIN=1003, MAX=11267

Duration: 120 Seconds of data

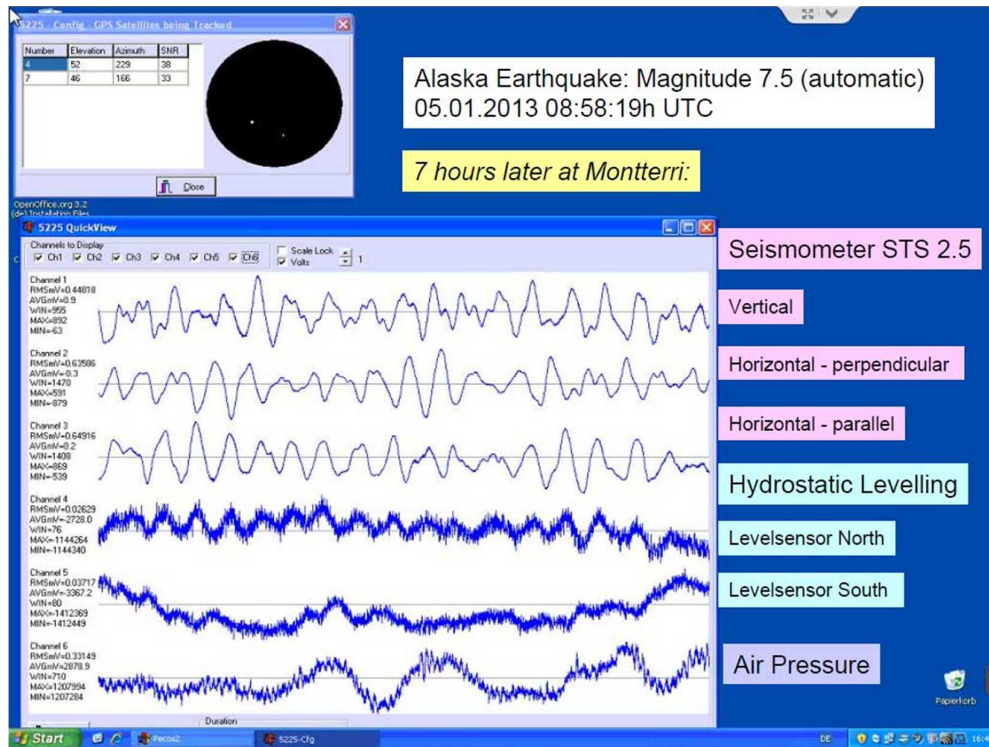


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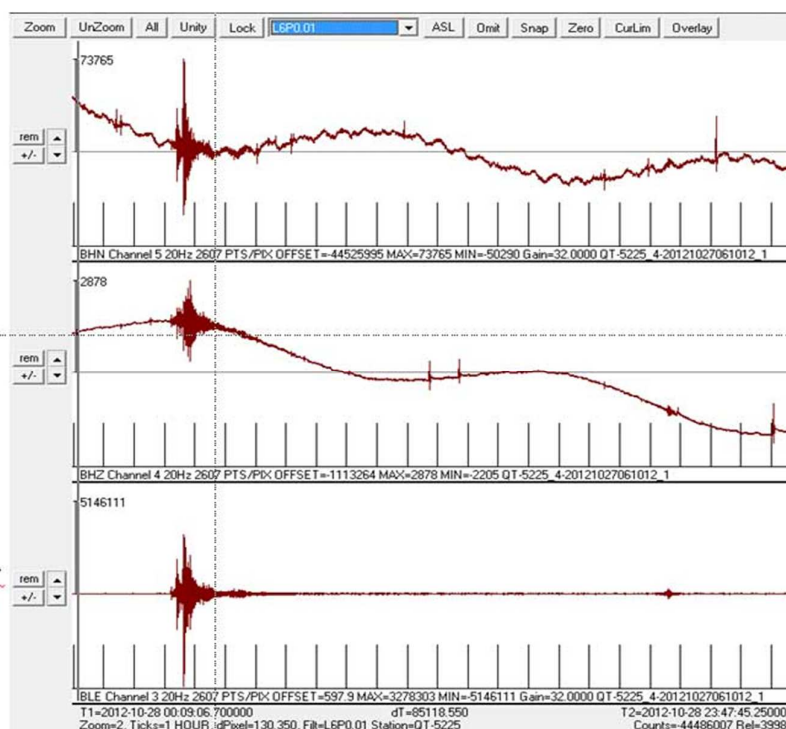


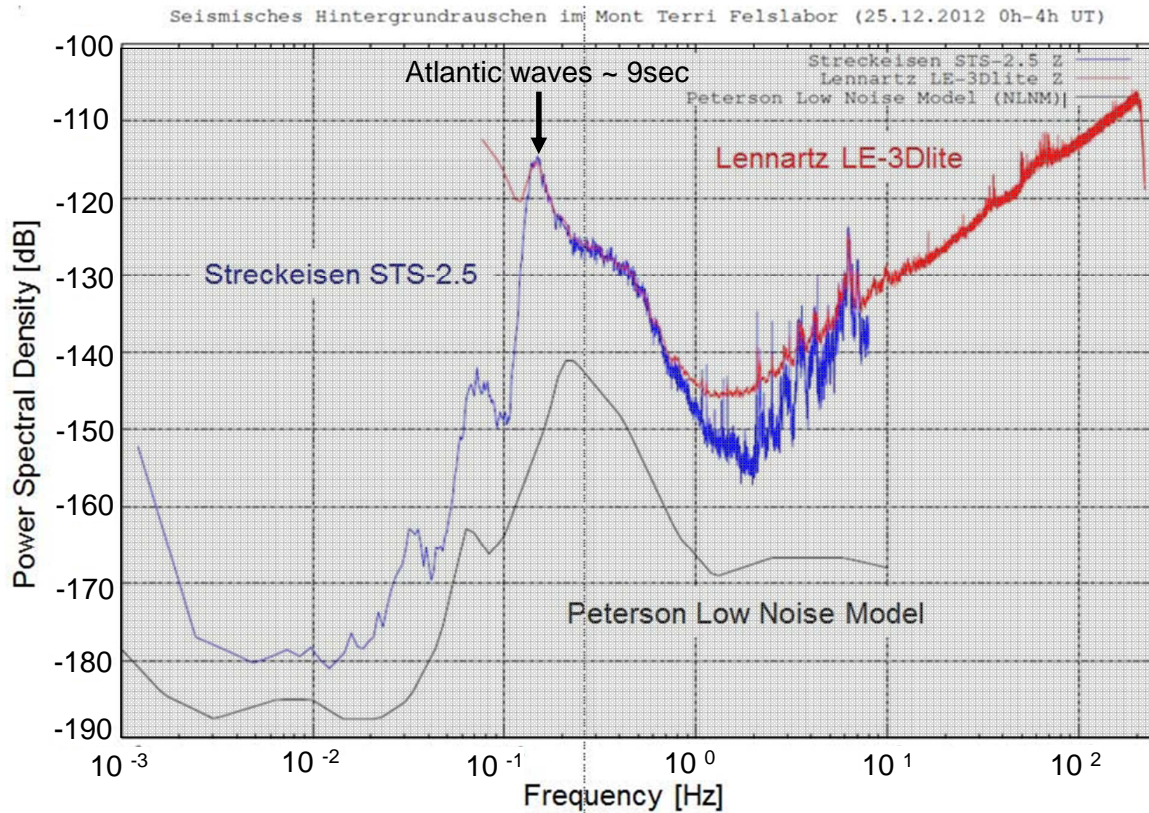
Earthquake in Canada – visible with HLS

HLS South
(CH4: BHN)

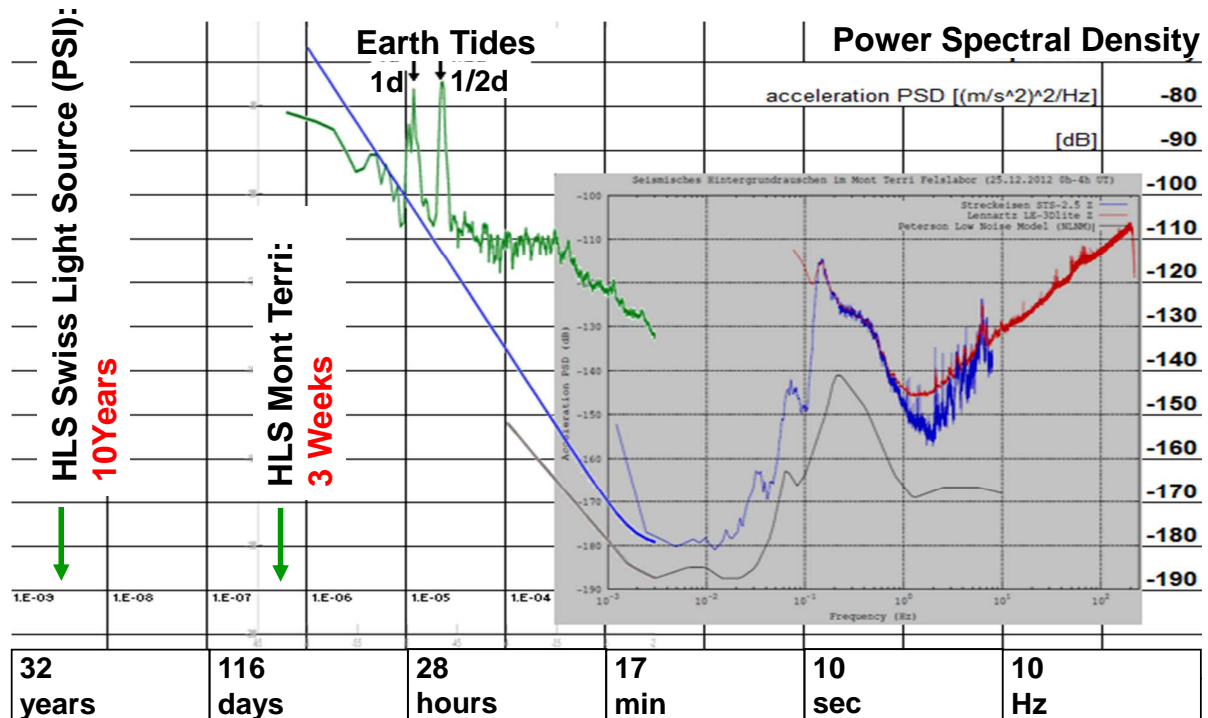
HLS North
(CH5: BHZ)

Seismometer
parallel zu Galerie (CH3: BLE)



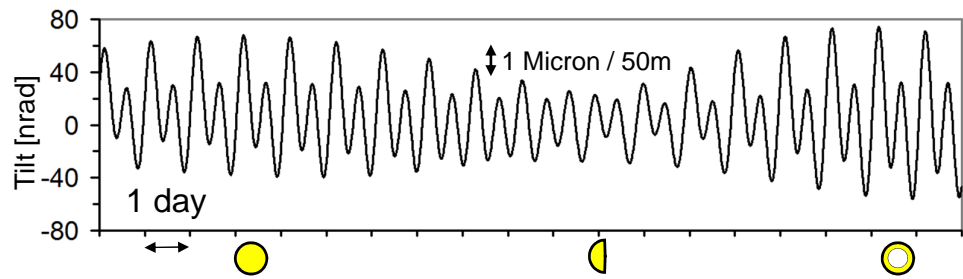


Expanded with HLS Signal

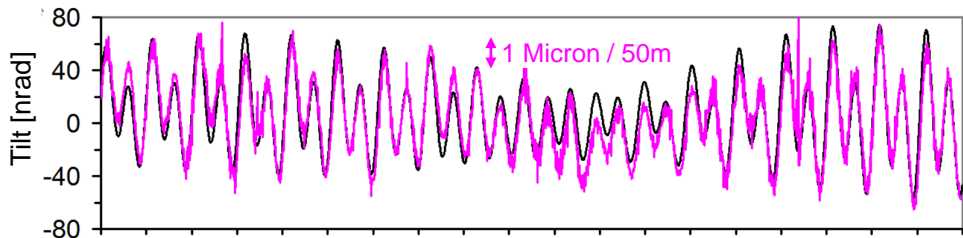


Calculation:

synthetic tide tilt
at the rock lab due
to gravity forces
of Moon and Sun

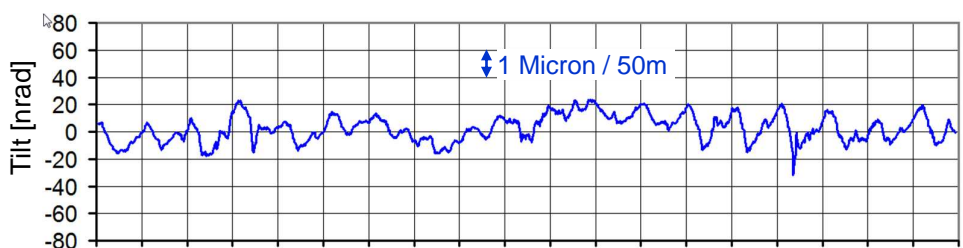


synthetic
and
measured



Residue:

synthetic
minus measured



Summary and Outlook

- The HLS Typ PSI-SLS can also measure under harsh tunnel conditions.
- Earth Tides and surface waves of remote earthquakes are perfect calibration signals for time synchronisation.
- HLS records fill the gap between dynamic groundmotion (seismometer) and steady state conditions.
- The high accuracy allows to improve dangerous settlements within a few months.

**Thank you for listening
and good-bye!**