Plate Boundary Observatory Borehole Strainmeters:
A New Way to Record “Slow Earthquakes” in Cascadia

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Plate Boundary Observatory (PBO)

- A component of the Earthscope initiative
- Funded by NSF
- Instrument types:
  - Continuous GPS
  - Borehole strainmeters
  - Laser strainmeters (not in Cascadia)
Cascadia: A Major PBO Target

- 45 planned BSM’s
- 16 now operating
- 5 drilled
- 2-4 additional stations may be added

Gladwin Tensor Strainmeter

- Measures elongation along 4 horizontal azimuths
- Resolution 1 nanostrain (1 part per billion)
- Sampling rate 20 samples/s
Features of PBO Strain Data

- Publicly available through UNAVCO, IRIS, and NCEDC
- Most online data updated daily
- 1 sample-per-second data updated several times per day
- Real-time capability:
  - Not a mandate of PBO
  - Could be an option if separately funded

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PBO Borehole Installation

- Strainmeters must be permanently grouted into borehole
- Seismometers (3-comp, 1-Hz) are also cemented in
- Boreholes 500-800 ft deep
B004 1 day

- 1 sample per second
- Available within about 5 hours from IRIS
- M6.0 earthquake in Gulf of California

Figure by Wendy McCausland
B004 - entire data record

- Long-term trends dominated by grout curing and borehole deformation
- Ideally long-term trend is contractional

From UNAVCO PBO website

B004 Jan-Feb 2007

- Data have been edited, linearized and detrended
Goal: “Modelable” Strains

- Local strains differ from instrument strains in:
  - Overall amplitude
  - Ratio of shear strain to areal strain
How Borehole Strainmeters Complement GPS

- Borehole strainmeters have much better time resolution than GPS
- Net strain is harder to infer from strainmeter data, due to increasing noise level with lengthening time period
- Absolute calibrations of strainmeters have some uncertainty