What We Know From Deformation Data

**Linear Elasticity Holds**

Surface measurements DO tell us about deep deformation. Before earthquakes the largest changes are:

- Tides
- Teleseisms
- **Steady** tectonic accumulation

Postseismic **much larger** than preseismic (e.g., El Mayor)

Very small preseismic leads to **small** nucleation zones.
Current Deformation Data

• 1. GPS (about 1990 on) -- 10-100 km spacing
• 2. InSAR (1992 on) - 100 m spacing (roughly)
• 3. Longbase strainmeters and tiltmeters - 100’s of m
• 4. Shortbase strainmeters and tiltmeters - 1 m and less

Evidence that the Earth Behaves as a [Layered] Elastic Medium

• Tides (including loading): 1 and 3 consistent over space and with each other. $10^{-9} - 10^{-8}$ (Japan, Italy, California)

• Seismic waves: 1, 3, and 4 consistent over space and with each other (and seismometers) $10^{-10} - 10^{-6}$ (everywhere)

• Coseismic strains: 1, 2, 3, 4, consistent with dislocation models. $10^{-9} - 10^{-5}$ (California, China, Iran, South America,.....)

Annual strain changes are less than $10^{-7} \text{yr}^{-1}$
An Example: Northridge

Longbase Strain: Northridge Earthquake at PFO

Gray is raw 1-Hz data
Red is lowpassed

Mag 6.7 203 km away

Time (min from 1994:017:12)
Another Example: Hector Mine
Older Data

Measurements got **much better** around 1990; data look **much smoother**

**EITHER:**

- Earth changed in 1990
- Older data had systematic errors

Almost any paper published **before about 1985** about deformation, (other than coseismic changes) should be viewed as we now view papers about canals on Mars.
Forecasts and Predictions

This word "Forecast" seems to have been used for the reason that it expressed a less degree of precision and certainty than the more usual words "Predict" or "Foretell".

Whether the reason is a sound one may be doubted. The use of vague phraseology has a tendency to make those who use it satisfied with uncertain conclusions.

Francis Galton (1866), commenting on the weather forecasts of Robert FitzRoy.