Seismology in CIG
Viewpoints from LDEO

Jim Gaherty

"Simple" Problems

- Event detection and association
- Travel-time picking
- Earthquake Location
- Moment-tensor analyses
- 1D waveform modeling

"Cutting Edge" Problems

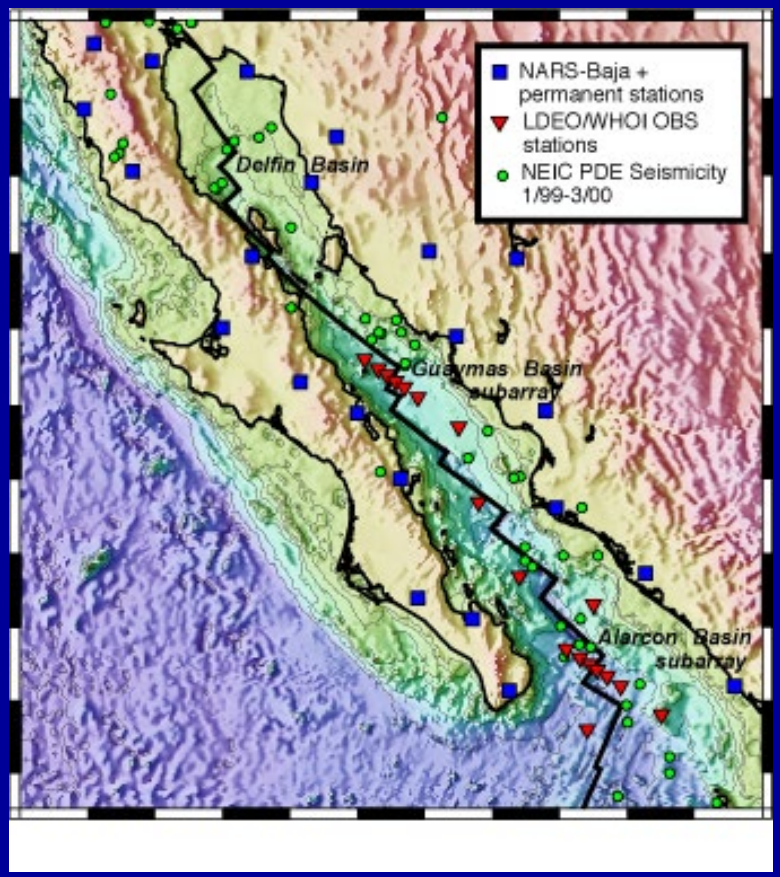
- Massive event relocation
- Teleseismic wavefield migration
- Integrating active- and passive-source datasets
- 3D waveform modeling

Simple Problems -- Tools that an Undergraduate can use

Open-source software that has:

1. User manual with minimal “lingo”
2. Point-and-click front end
3. Platform independent
4. Modest CPU and memory needs
5. Code well documented and modifiable

Example -- Typical PASSCAL or OBSIP deployment -- Earthquake Detection and Location



Basic Steps:

1) Provide station info
2) Input velocity model (including bathymetry)
3) Stream waveform data
4) Press “go”

Currently at LDEO:

Sequence of Solaris code and C shellscripts designed for LCSN. Extensive training and difficult to modify

Cutting-Edge Problems -- Development and maintainance of the most sophisticated research tools

Open-source software that is:

1. Modifiable to adjust to improvements in
2. Well documented code, expert-level user manual
3. Nearly platform independent
4. Moderately scalable
5. Take advantage of distributed CPU resources

Example -- Massive Wavefield Cross-Correlation and Event Relocation

Cross-correlation of entire N. Cal. event catalog, 1984-2003, on a 32-node cluster

15 million seismograms from 225,000 local earthquakes

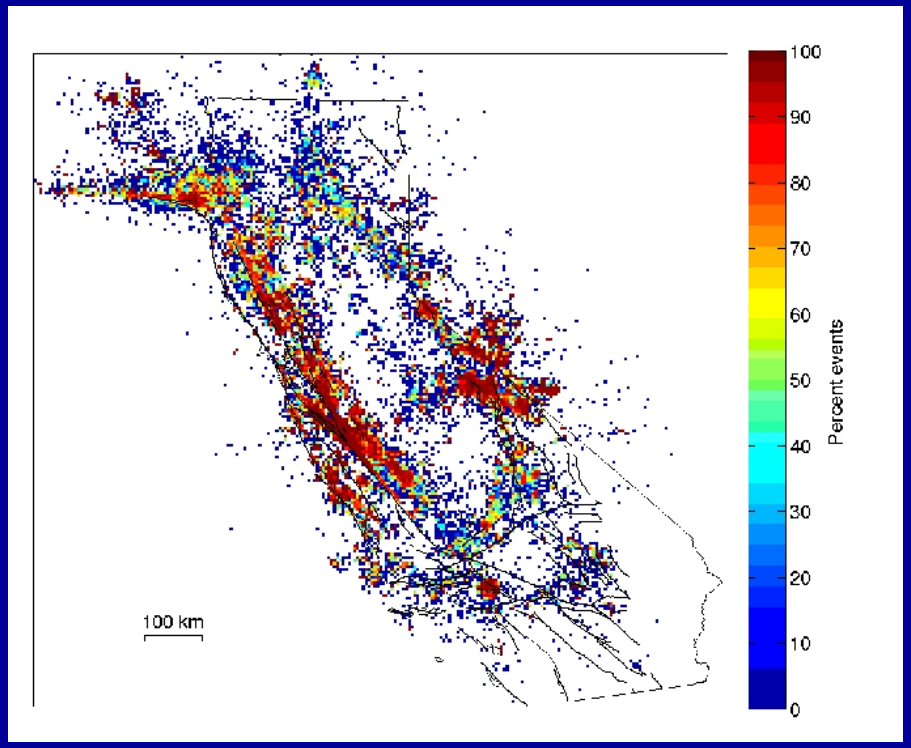
A total of 26 billion cross correlations

A total of about1.7 billion P-wave and 1.2 billion S-wave differential times

Psuedo-parallel -- moving spatial window

Issues to consider:

- Constantly evolving process -- more events, and ultimately real-time
- Requires regular soft ware development
- Increasing problems data flow and RAM



Courtesy F. Waldhauser

- Both processing and inversion require parallelization
- Move CPU to data source?

Open Questions

- Software only? Facilitate access to hardware? Move CPU's to the data?
- Relationship to IRIS? Tools integrated into the DMC?
- What is the correct "Framework" for data flow?
- Passive-source only? MCS, active-source refraction?
- How to build on existing resources, e.g. Stanford Exploration Project?