CIG and Marine Seismology*

- **Brief overview of current and future efforts**
- **A (brief) wish list**
- **Some illustrative examples**
- **What we could contribute**

(*a small part of it)

Overview of Current and Future Efforts

- Crustal Imaging:
  - Imaging strongly heterogeneous, 3-D, anisotropic structures (with crude travel time methods).
  - Using seismic waveform data to constrain physical properties, e.g., Moho transition zone thickness, melt sills at crustal and mantle depths.
  - Waveform Inversion (others are doing this)
- Mantle Imaging
  - Imaging weakly heterogeneous, anisotropic structures (with crude travel time methods).
  - Geodynamic tomography: Testing seismic data (P and S delay times, shear wave splits) and other data (bathymetry, gravity) against predictions of geodynamic models. In the future, integration with predictions of composition from melting models.

Brief Wish List

- ## Your data!
  - In an agreed upon structure with agreed upon metrics (e.g., what exactly is an S delay time?)
- ## Ability to forward/inverse model:
  - 3-D, anisotropic ray tracing for first and secondary arrivals, including realistic relief and internal interfaces.
  - Synthetic seismograms, including effects of seafloor bathymetry and 3-D structures (e.g., melt sills, interfaces)
  - An efficient means of calculating sensitivity kernels for use in crustal and mantle scale delay time tomography
- ## Quantitative integration of geodynamics and seismology
 - Ability to efficiently map from flow to anisotropy and heterogeneity.

S_{fast} and S_{slow} delay times
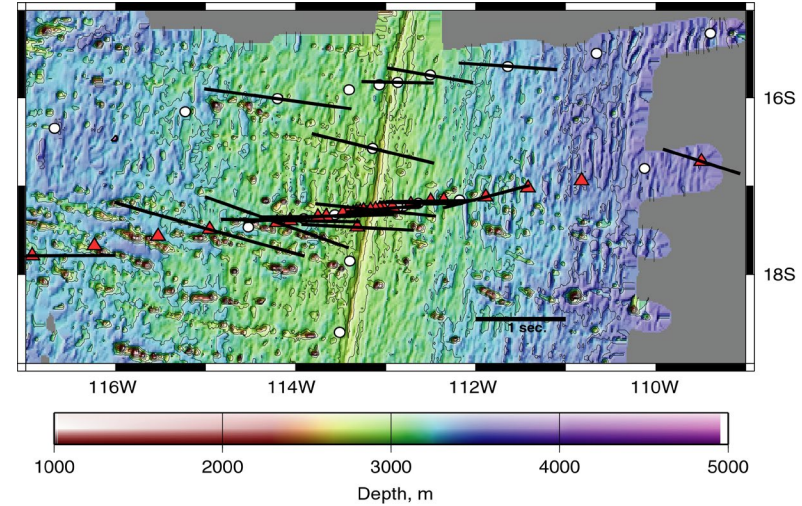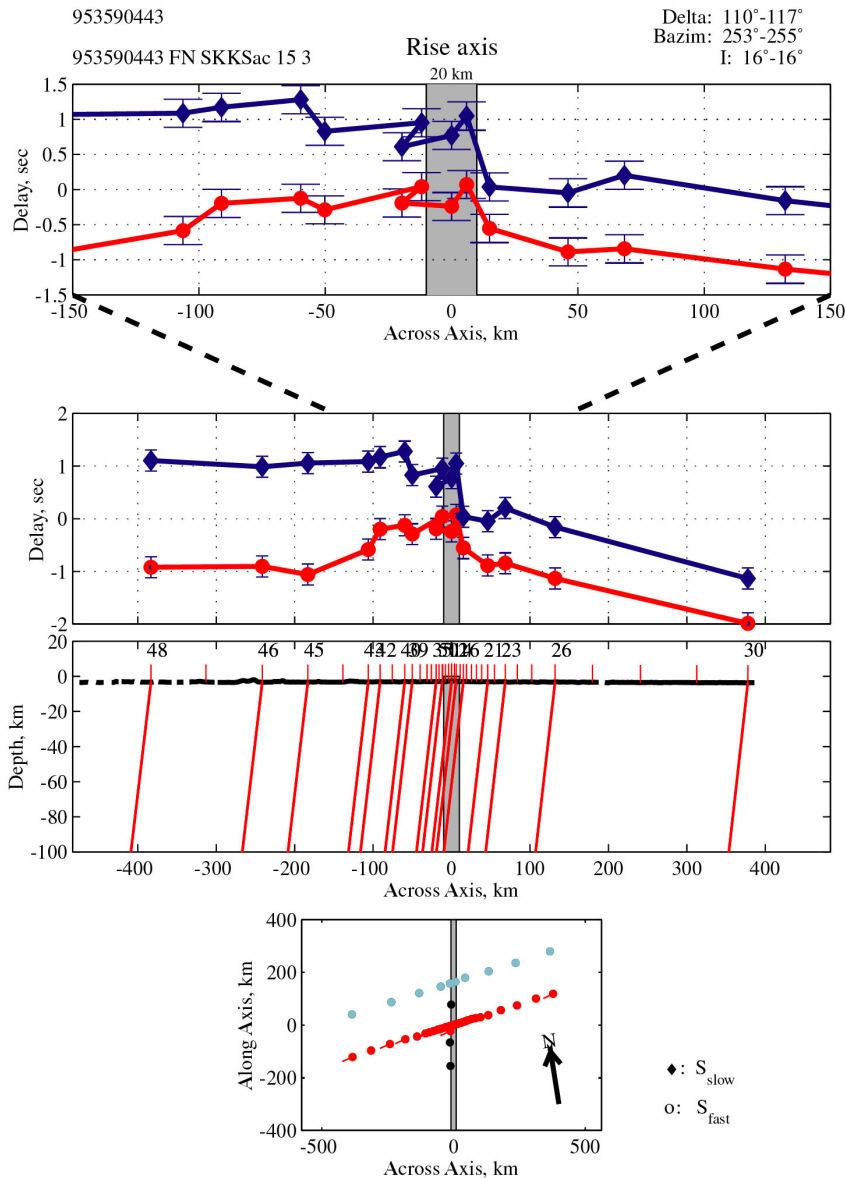
- There is a difference between splitting delay times and polarized delays measured by an array!

- Should be considered when measuring and reporting delay times.

- Also should report frequency for sensitiviy kernels.
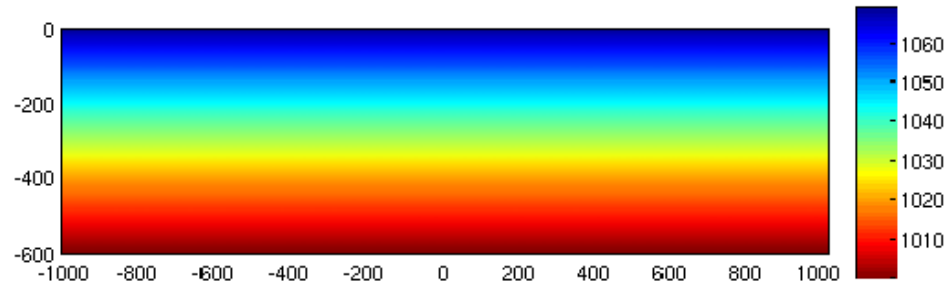
Wanted: An efficient/easy estimate of travel time sensitivity kernels for 3-D structures (mantle and crustal phases)
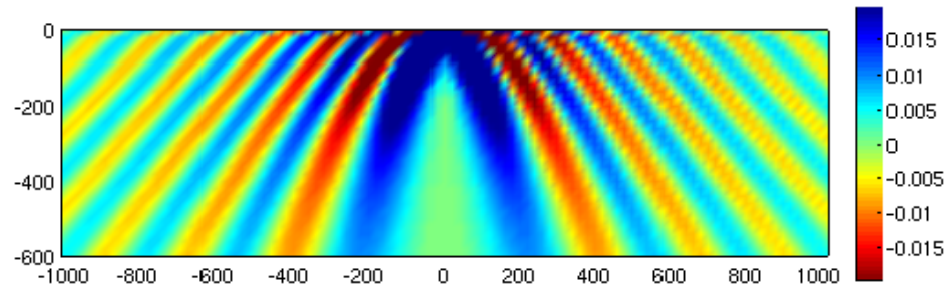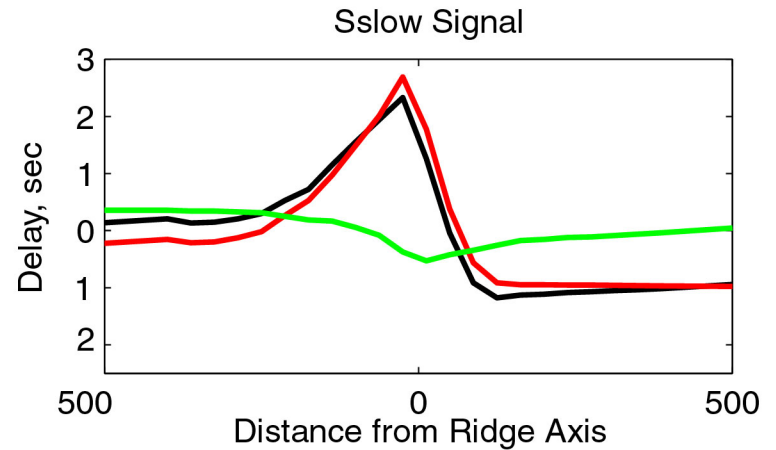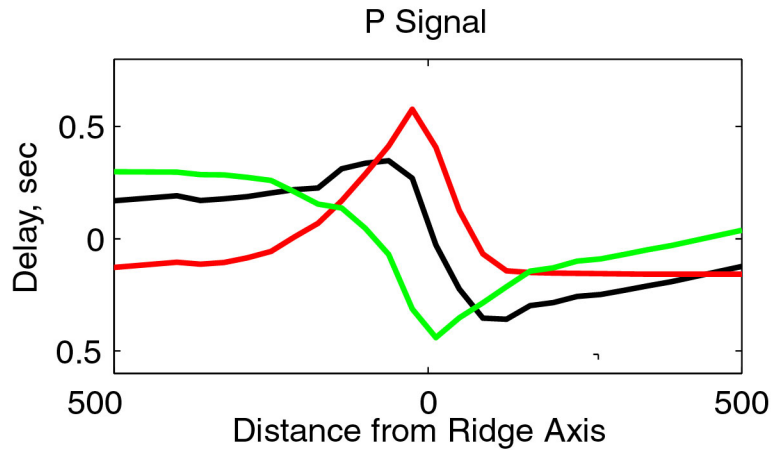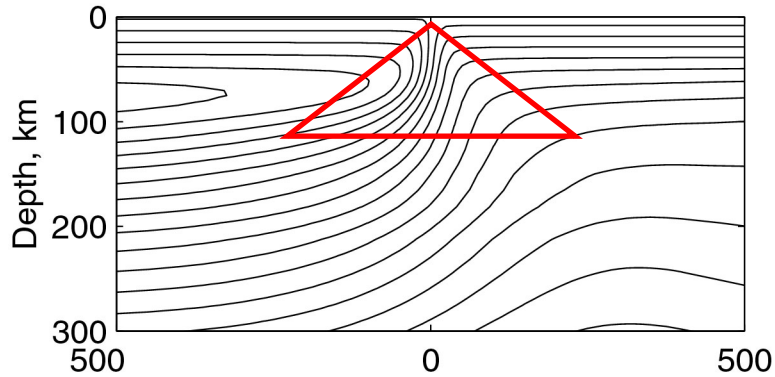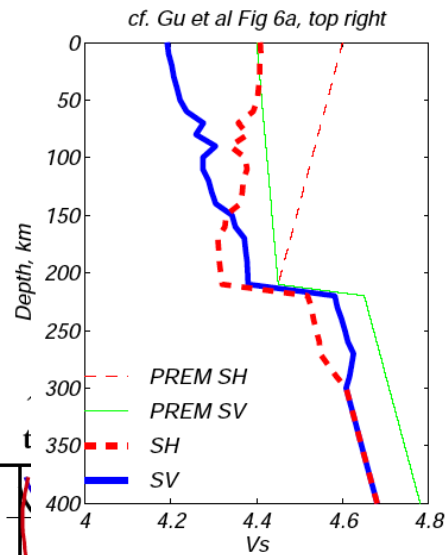
Graph rays 3-D, anisotropy

+
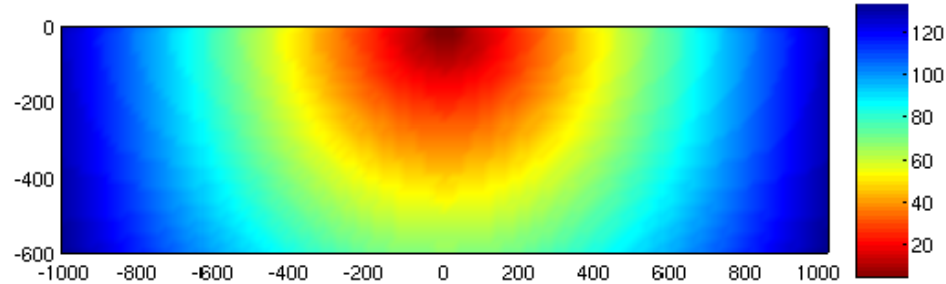
Incoming plane wave

=

Sensitivity kernel

Geodynamic Tomography

a)

Direction of maximum finite strain

P Signal

Sslow Signal
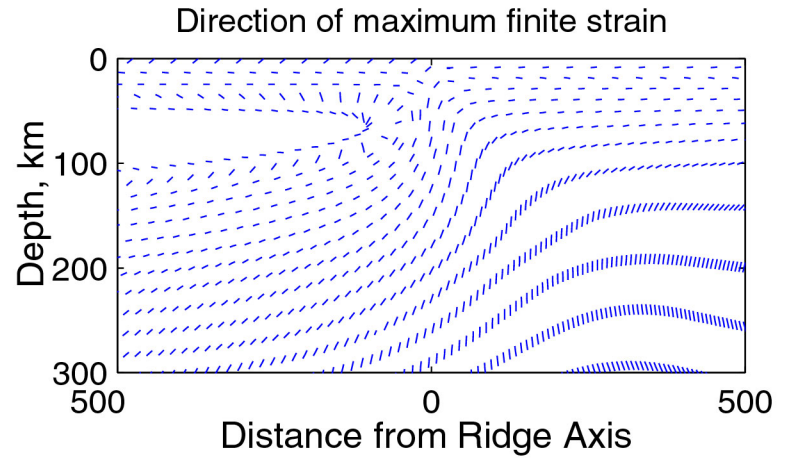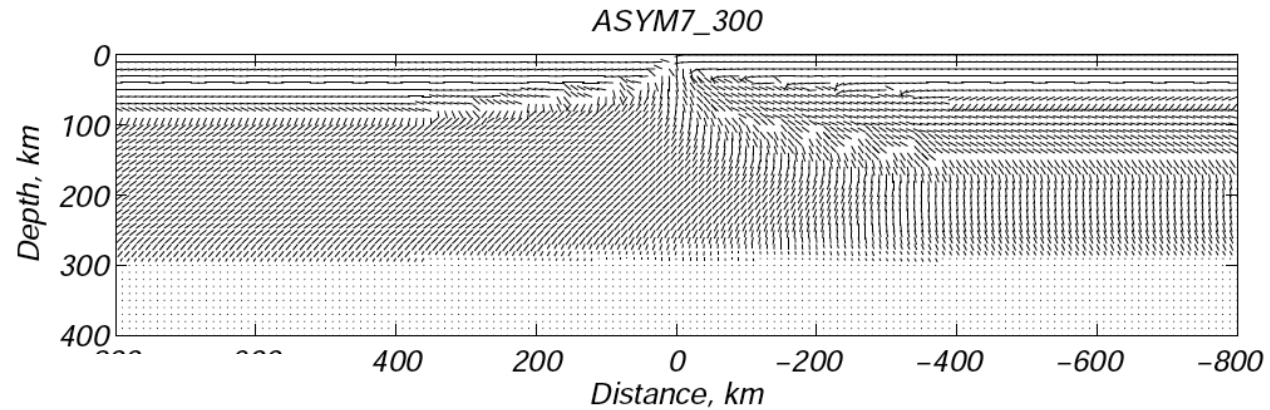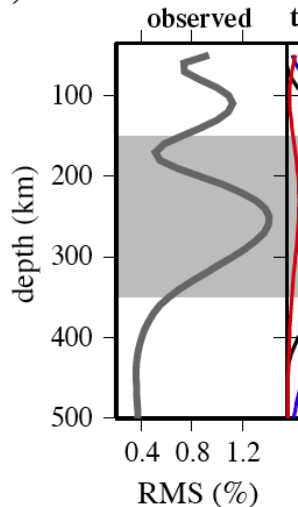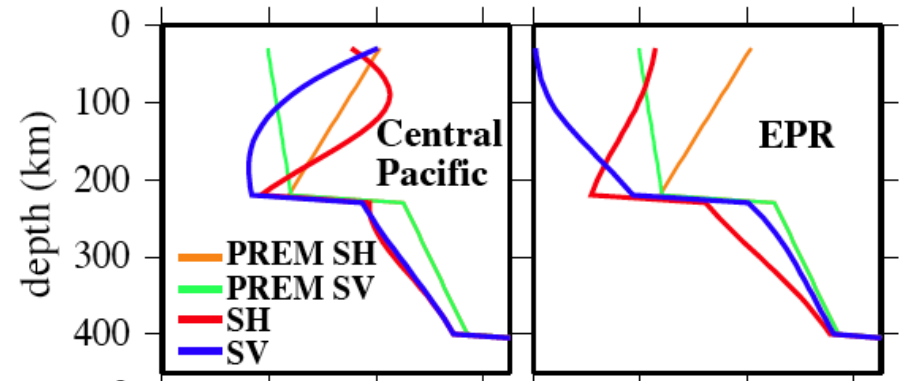
Total delay ≈ heterogeneity + anisotropy

Prediction of anisotropy used as starting model for tomographic inversion

ASYM7_300

cf. Gu et al Fig 6b, left

cf. Gu et al Fig 6a, top right

PREM SH
PREM SV
SH
SV

(a)

Central Pacific

EPR

PREM SH
PREM SV
SH
SV

observed

RMS (%)
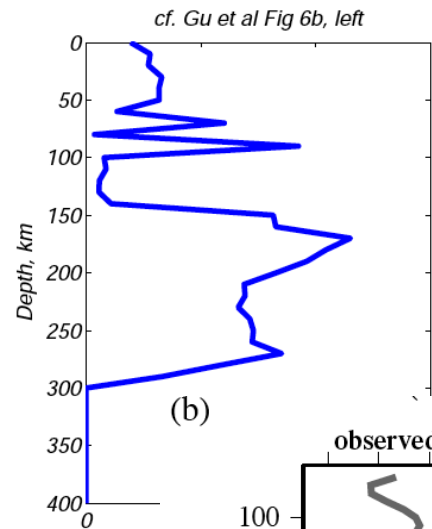
Comparison of geodynamic model predictions with global scale imaging of Bsh Bsv anomaly beneath the EPR. Geodynamic models provide linkage between multi-scale imaging

Example of Current Generation Experiments:
64 OBSs, 5000-10,000 source positions