

# Seismology: Multiple-Scale Imaging

Long range goal is multiple-scale high resolution  
broadband waveform tomography: Imaging Science

Range of applications is enormous:

- Energy,
- CO<sub>2</sub> sequestration, and other waste exploration and monitoring,
- solid earth structure,
- eq source inversion.

See the Long Range Science Plan for Seismology for specifics.

# Overall: Focus on Imaging

- Support imaging science developments in cooperation with the European Quest project, with IRIS, SCEC and anyone else willing (AFGL, National Labs)
- Add focus on regional seismology (USArray, CD, Margins, PASSCAL, OBSIP): How do you do that? Get a few codes that are high profile
- Conversion of geodynamic outputs to seismological inputs for models at all scales
  - Make an effort at the regional scale
- Provide engineering support for code optimization and meshing, distribution of binaries for different platforms
- Promote a community benchmark for evaluating imaging codes (? If you build it will they come?)

# Imaging Science Research themes

1. Waveform inversion of high frequency data including anisotropy and attenuation
2. Embedded scale inversion of disparate seismic datasets : global, regional, local, (i.e., BB and various high frequency datasets)
3. Joint inversion of seismic and other geophysical datasets
4. Quantification of uncertainty in inversions: Assess challenges resulting from ill-posed inverse problems with multiple minima

# Regional Geodynamics

Regional geodynamic models should be final scientific results of a large fraction of structural seismic investigations, e.g., USArray, CD projects, PASSCAL & OBSIP experiments

1. Translation of outputs of regional scale geodynamics model (GALE or magma or similar code) outputs to seismic properties for regional scale synthetic seismogram calculations.
2. Adapt CUBIT or equivalent for meshing regional seismic models
3. Adapt SPECFM for regional seismology problems (include body wave inputs)

# Specifics

- Continue the CIG Seismology Portal experiment: add regional seismology capabilities
- Continue and refine conversion of outputs from convection codes for input to seismic codes
- Take opportunity to make more forward and imaging codes available through CIG
  - Requires code champions or money
- Provide engineering support to keep up with hardware developments
  - Identify codes for optimization
  - Maintain binaries of mature codes for different machines to facilitate adoption by community
    - *Someone has to pay for this*

# Broader Community Involvement

- Close interaction with QUEST
- Hold research workshops with QUEST and participate in CIDER and other research workshop venues
- Hold user workshops for students/post-docs coupled to IRIS, EarthScope and similar meetings
- Develop 2D and 3D community synthetic datasets for testing imaging algorithms with different levels of complexity: basic structures, anisotropy, Q structure, etc
  - *Someone will have to pay for this development*