Taiwan Moho Discontinuity Reference Model

Receiver Function Studies

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H. L. Wang, L. Zhu, John Y.H. Duan and K. J. Shyu
RF Based TMDRM Studies

Related WPGM Presentations

Paper Published/In Press:


Two Poster Presentations:

- Duan, Y. H., H. W. Chen, H. Wang, S33B Poster I-B, Wen. 14:00 PM

Invited Presentation in WPGM, 2010
Spatiotemporal Balanced System?

Ref.: Chang et al., 2000 and Angelier et al., 1997
Motivations

Needs

Different Crust-to-Upper Mantle Tectonic Process Models were Proposed and Debated

Taiwan Orogeny and Tectonic Evolution

Limitations in Tomography and Surface Waves Studies

Moho Discon. Provide a Important Boundary Cond. on Rheological Behavior and Structure/Geology Evolution

Accessible via Deep Seismic Profiling

Strong Motion and Nonlinear Wave Propagation Responses

Upper-Crust Scale “Near-Surface Effects” Cannot be Ignored

Seeking Alternative Approaches …
Systematic Receiver Function Studies

- Thickness (H) versus Vp/Vs ratio (k) analysis – HsiaoLan Wang
- S-wave 1D Velocity Inversion – John Y.H. Duan
- Depth Imaging by Common Conversion Point (CCP) Stacking – HsiaoLan Wang
- Investigation on Critical Issues: – Gary K. J. Syu and ...
  - Stacking Strategies, Adaptive Beamforming and Frequency Selection
  - Azimuth Change of RF Waveforms
  - Effects
    - Available Taiwan Reference Velocity Models
    - Reverberations Related to Near-surface and Moho Transition Zone
    - Spatial Variation of Structure Boundaries
  - Anisotropy, Image Affected by Scattering from Crust and/or Mantle, ...
- On Going Efforts ...
Broadband Data Resources

- **Broadband Array in Taiwan for Seismology (BATS)**
- **Central Weather Bureau Broad-Band Network (CWBBB)**
- **Taiwan Integrated GEodynamics Research (TAIGER)**

Spatiotemporal Coverage

- **BATS**: 1998.01–2003.03; **15** stations, 1436 Records, 220 Events
- **BATS + CWBBB**: 1998 – 2004, **~46** Stations, 200 Events
- **BATS + CWBB + TAIGER**: 2006 – 2008, **104** Stations (23+36+45 respectively), 500 Events
Spatial Coverage of BB Stations

1998.1 – 2003.3
15 Stations

46 Stations
Spatial Coverage of BB Stations

2006.01 – 2008.04

BATS + CWBBB + TAIGER-BB

104 Stations

TAIGER WARR EXPERIMENT

2008 Onshore Explosions

2009 Offshore Airgun Shots
Broadband Data Pre-conditioning

Teleseismic Data QC:
- EQ Magnitude, S/N Ratio, and Azimuthal Coverage
  - \( Mb \geq 5.5; \ 30^\circ < \Delta < 95^\circ \)
- Data Pre-conditioning: Noisy Traces Edit, Picking First break, Seismic Waveform Interferometry via Cross-correlation
- Resolvable bandwidth: 0.1 to 3.0 Hz and 10 SPS
  - First Fresnel Zone Considerations on Station Spacing, Depth Resolution, and Suppressing Short-period Scattering Signals
- Comparing Results from Various Stacking Strategies: H-K stacking, Direct Stacking and Adaptive Beamform

Spatiotemporal Coverage and Frequency-Depth Resolution Issues – First Order Fresnel Zone
Teleseismic Data From DMC-IES

1998.01~2003.03 EQ Events

1998-2004 EQ Events

2006.01~2008.04 EQ Events

Figure 2
RF Beamform/Stacking Strategies

Original δp Stack Ad. Beam Stack

Azimuth

Baz: 290-310 Ev ent: 14 Ps: 3.5 s
Baz: 180-270 Ev ent: 5 Ps: 3.6 s
Baz: 120-140 Ev ent: 80 Ps: 4.0 s
Baz: 30-50 Ev ent: 9 Ps: 3.9 s

T-X Stacked Sections

Figure 10a
RF Data QC and Direct Stack

Stacked Radial Receiver Functions

BATS

BATS + CWBBB + TAIGER-BB
From T-X To P-T and H-K
(Crust Thickness and Vp/Vs Ratio)
Robustness in H-K Analysis
H and K Constrains on TMDRM, BATS Stations

Better Constrained along Lat., 11 out of 15 BATS Grade-A and B
H and κ Constraints on TMDRM, BATS + CWBBB Stations

27 out of 40 BATS+CWBBB, Grade-A and B

Figure 4
**Bouguer Gravity Anomaly and Moho**

**Collision Involves Whole Crust, Not Simply Upper Crust Only!**

**Predicted $\delta G$ by Moho Undulation**

Assume $\delta \rho = 500 \text{ kg/m}^3$

**Positive GA – Manifestation of High Density Slab in the Mantle**
Acknowledgements and Concerns

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TAIGER Project Team Efforts
  Taiwan-USA Team Leaders and Participants
  Chief Scientists (C.Y. Wang and Francis Wu)

Effort is Hampered by Prohibited Access of IES Internal Dataset Supported by “Tax Payer”

Ironically Speaking There are “TWO Policies” Exist Between TEC Data Center and IES – Such Case Shouldn’t be Happened !!
The “Rule” on TAIGER Data Policy

Objective: To avoid the conflict ... under collaboration, ... to be obeyed for mutual understanding.

Regulation: To make project a success ... and to avoid unnecessary duplication of efforts in the TAIGER community

Duplication of Efforts is not Appreciated in TAIGER Community!!
That's All Folks

Questions & Suggestions