Swiss Seismological Service

Seismology at ETHZ

ETH Zurich

SEG – Seismology and Geodynamics

- Tomography
- Geodynamics
- Planetary geophysics
- Earthquake physics

SED – Swiss Seismological Service

- Seismic Networks
- Earthquake Statistics
- Seismotectonics
- Seismic Risk
- Verification of Nuclear Explosions

AUG – Engineering and Environmental Geophysics

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Who actually does the work ?

ETH Zurich

- D. Faeh, I. Oprsal, C. Cornu, D. Roten
- N. Deichman, S. Husen
- M. Mai, J.-P. Ampuero, J. Ripperger
- S. vanderLee, F. Marone, M. vanderMeijde, C. Schmid
- L. Boschi, B. Fry
- M. Baer, U. Kradolfer, S. Maraini
- J. Braunmiller, F. Bernardi,
- S. Miller, A. Körner, G. Hillers
- S. Johnsson, (B. Delouis), J. Salichon
- H. R. Maurer, K. Holliger

Global Scale

Europe-Mediterranean (vanderLee, Boschi)

Current projects

- MIDSEA: S-waves, receiver functions, crustal model
- DOE
- Alpine region: combined P+S tomography, high-frequency surface waves

SPICE interests

- Euro-Med Reference Model: surface waves, P+S, body waves
- Reference 3D synthetics
- MT inversion using calibrated 3D synthetics
- Automatic data mining
- Shake-maps

Global Scale

Global seismology (L. Boschi)

Current projects: Global and regional tomography

SPICE interests

- Finite-frequency theory. to bring resolution of seismic tomography to a new level - or at least to establish whether seismic resolution can at all be brought to a new level. The Born approximation (banana doughnut theory), like ray theory, is an approximation, and needs further testing. Theoretical/validation study, applied to the 2D propagation of surface waves, both numerically (Tanimoto; Tape and Woodhouse) and analytically (Snieder, Trampert, Spetzler), accounting for finite frequency effects. Analytical implementations in 2d are naturally more economic than their 3d counterparts.
- Finite-frequency effects; specific topics could include: the role of azimuthal anisotropy; derivation of banana-doughnut, equations through normal-mode theory (early work of Woodhouse and Girnius, 1982; recent work of Tanimoto on GRL, 2003).

Local Scale

SED Source dynamics (M. Mai, J. P. Ampuero)

Current projects

- EU RELIEF
- TH Source dynamics
- PEGASOS

SPICE interests

- Realistic source modelling
- Kinematic and dynamic source inversion
- Near-field radiation
- Maximum ground motion
- Non-linear effects

Local Scale

SED Seismic Risk (D. Faeh, I. Opprsal, C. Cornu)

Current projects

- EU SAFE, SESAME, SISMOVAL
- SNF Augusta Raurica, SHAKEVAL
- PEGASOS

SPICE interests

- Visualization and statistics of the highly variable GM in complex structures
- Uncertainties in structural parameters compared to variability of ground motion due to different complex sources and source-receiver geometries.
- Possible a bechmark test for the Basel model. Collection of validated 3D velocity models.
- Standardization of input/output, platform independent codes
- Develop FD forward-modeling 2D and 3D methods possible in all-in-one hybrid formulation. Hybrid 3D FD combine ray method, discrete wavenumber, analytical, and FD method (source and path effects) with FD used for the site-effects. Applied for Basle, Ano-Liosia (Ahtens), 1995 Kobe EQ. First steps with full dynamical modeling have been done.

Small scale

AUG (K. Holliger)

Current projects

Finite-difference modelling using multiple simultaneous sources; computational savings scale directly with number of sources; particularly interesting for waveform inversion (3D waveform inversion will probably not be possible in our time without something like this).

Accurate modelling of slanting or irregular interfaces with strong material property contrasts based on combination of rotated grid approach combined with Schönberg-Muir anisotropic equivalent media theory; in seismology particularly relevant to model e.g. topography of the air-soil as well as bedrock interfaces.

Full-waveform inversion of crosshole georadar data; technology can be readily transferred to seismic applications.

Small scale

Borehole seismology (N. Deichmann)

Current projects

- Boreholes Basel: SP 2.8 km, BB 0.6 km
- Borehole Geneva: BB 1 km

SPICE interests

- Source scaling
- High-frequency, near-distance wavefield

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3D velocity model

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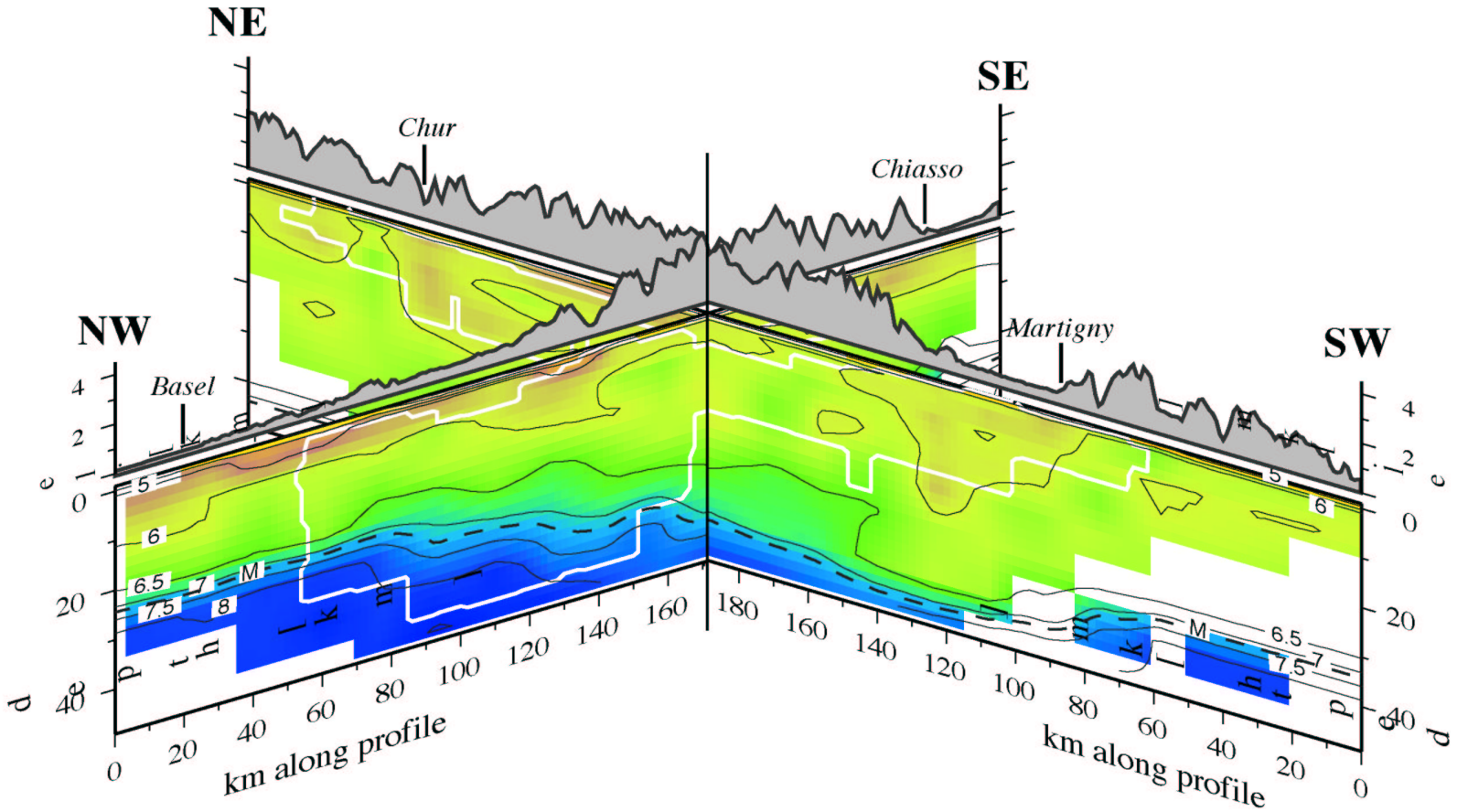

FIG 14

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Strong-ground motion attenuation

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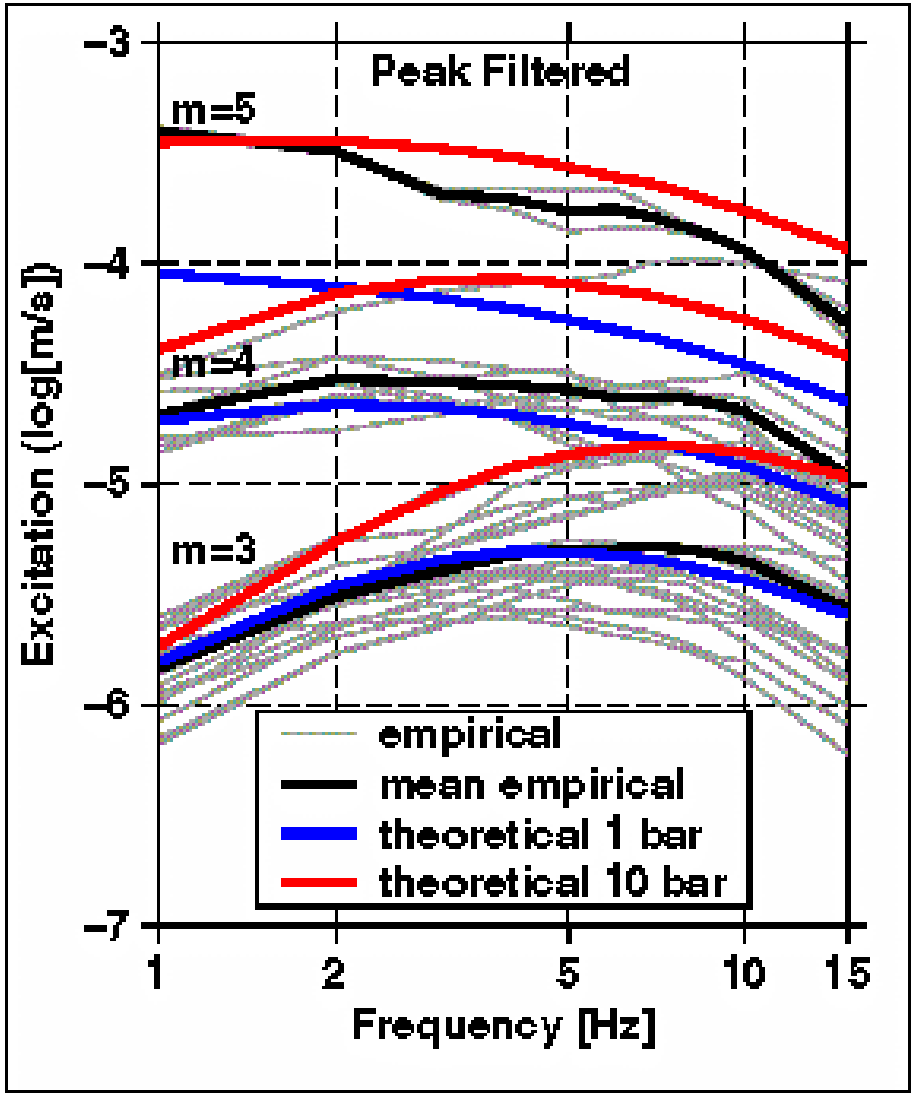

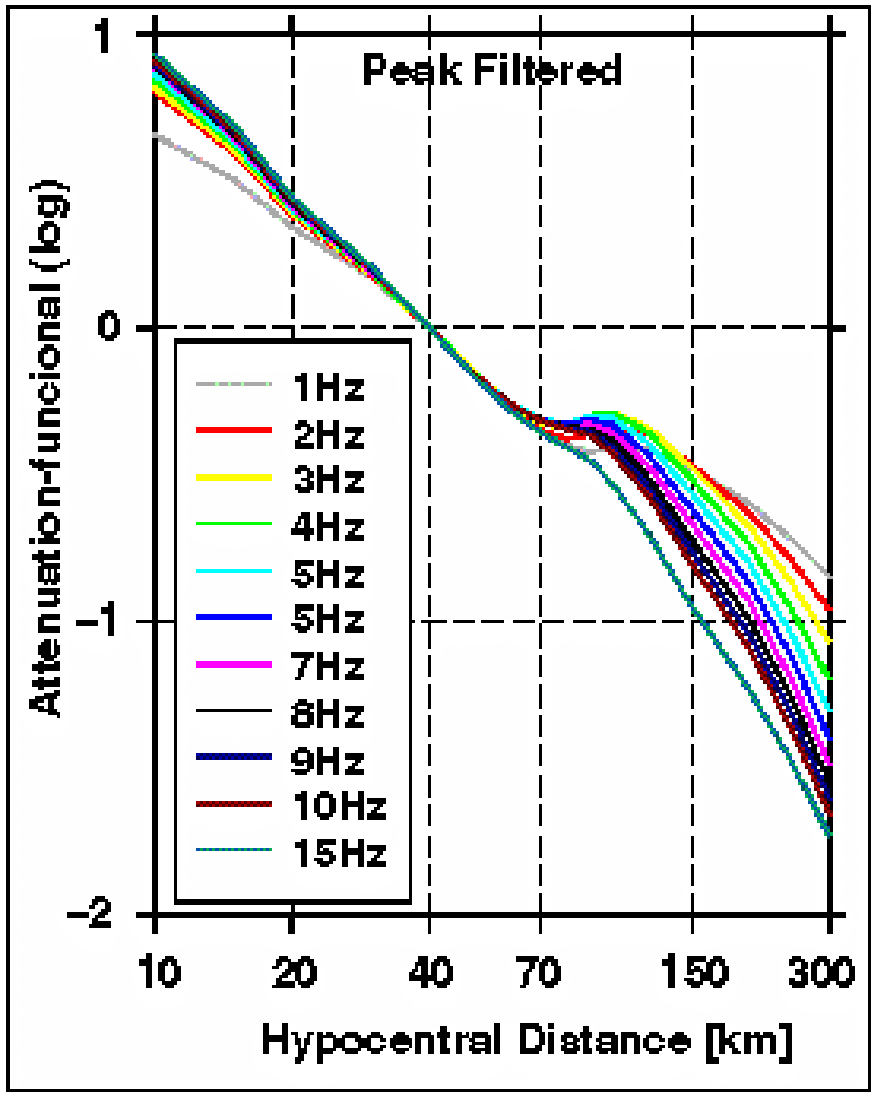

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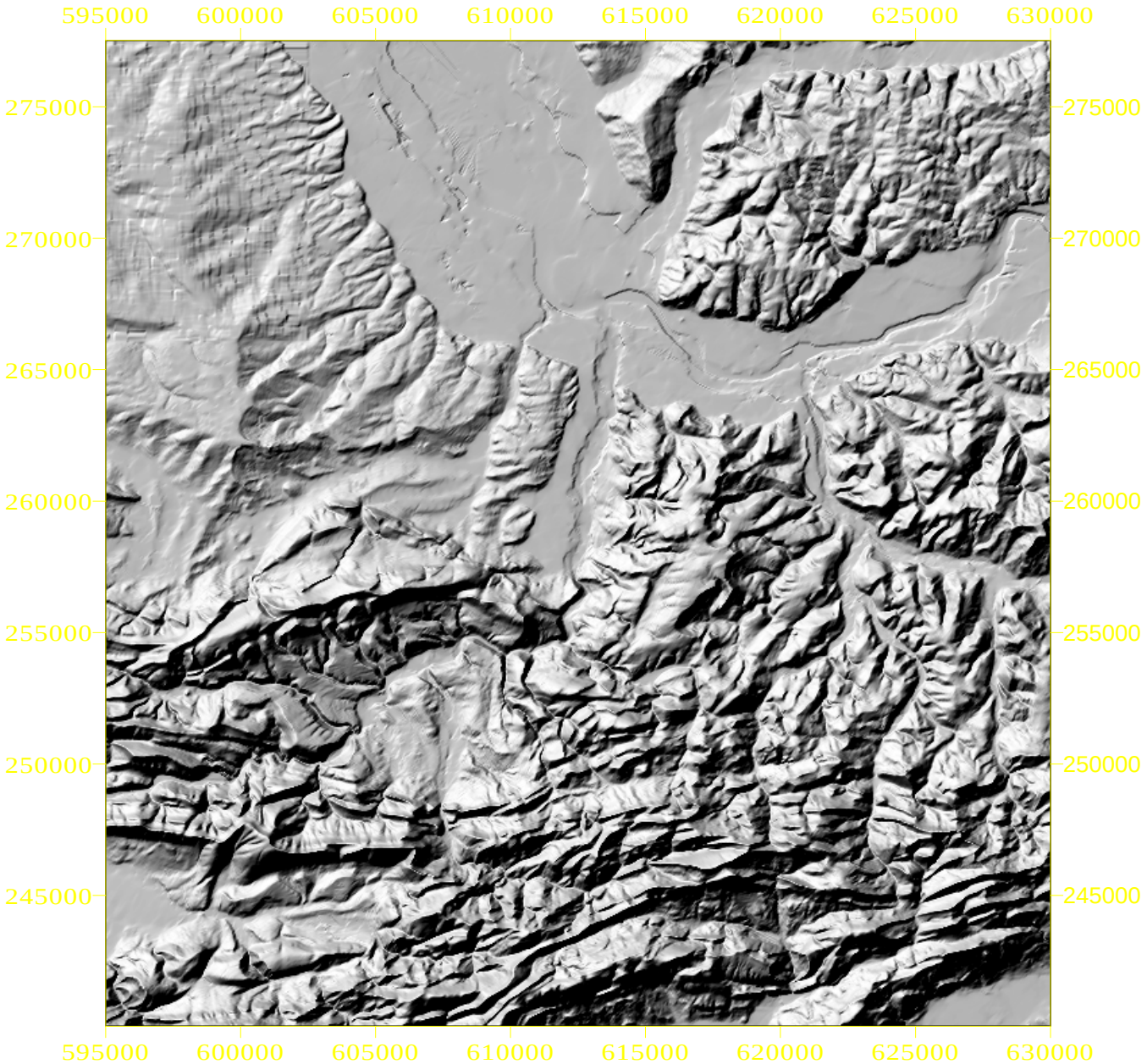
Basel sedimentary basin

ETH Zurich



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Basel microzonation: profile amplifications

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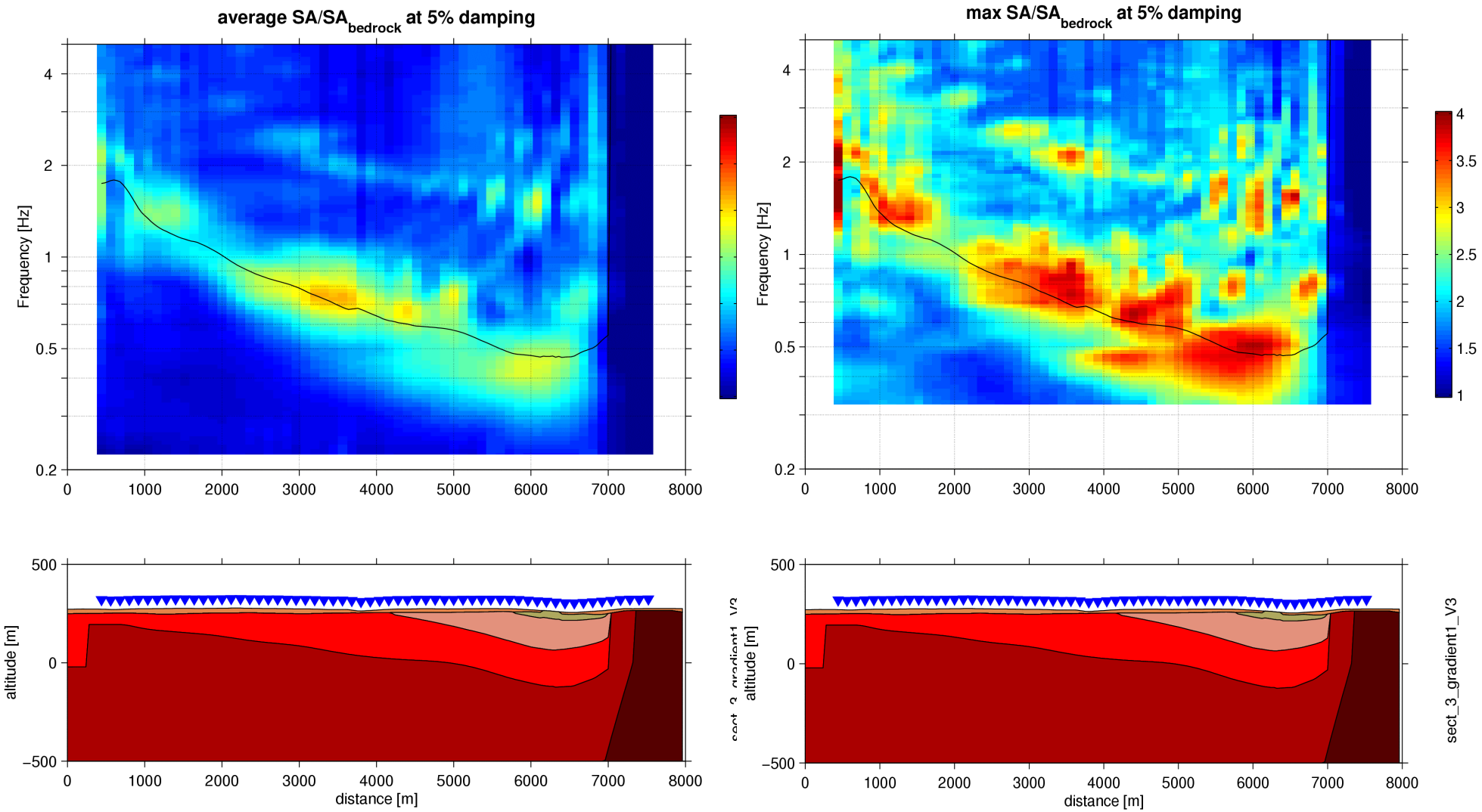

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Basel microzonation scheme

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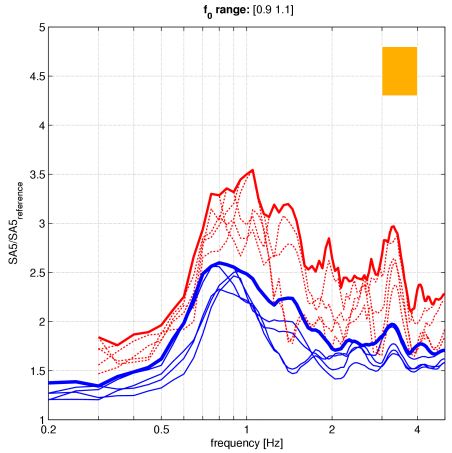

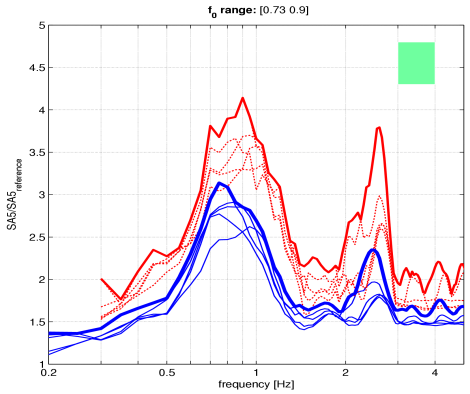

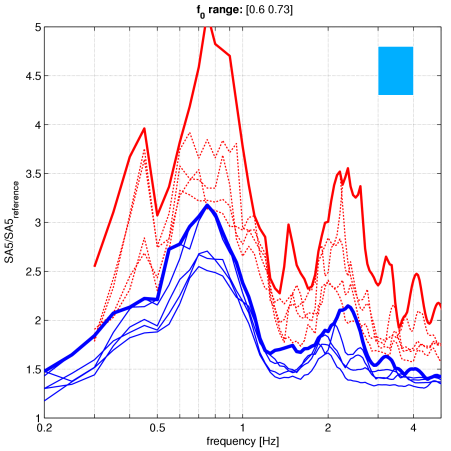

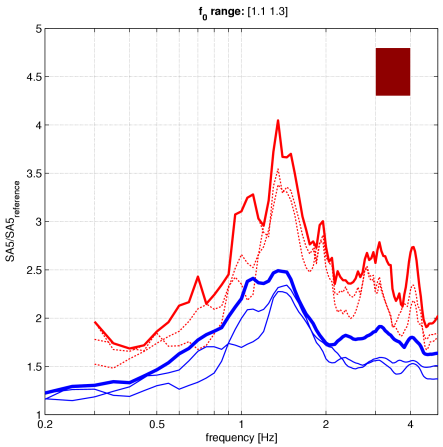

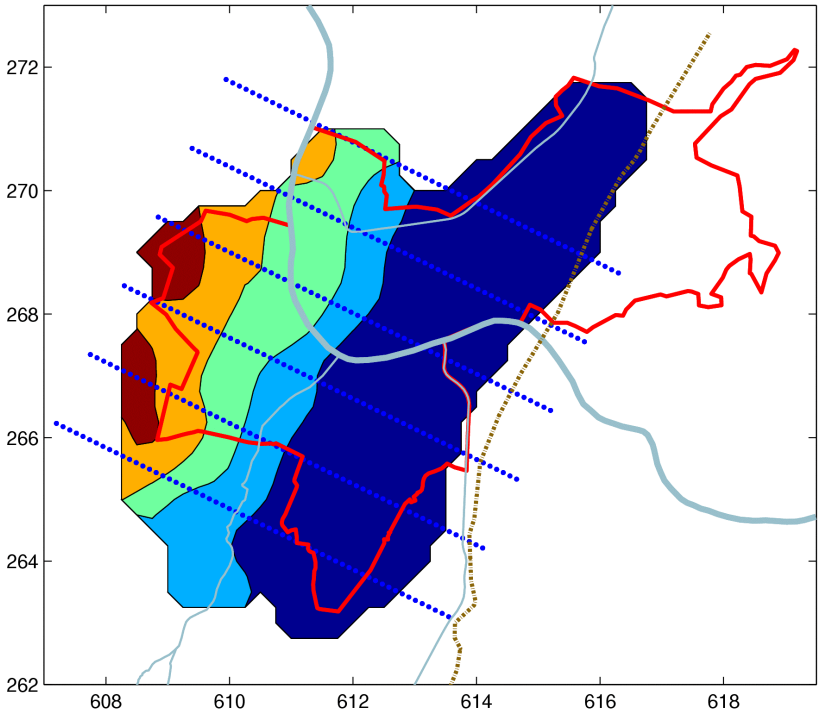

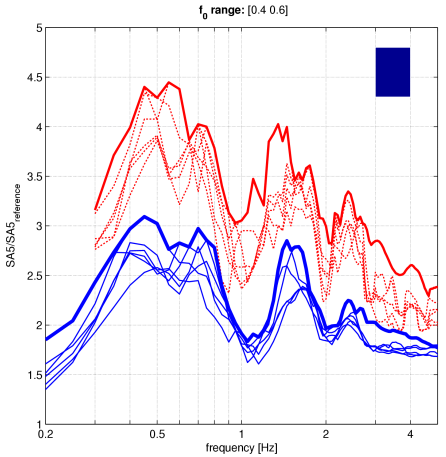

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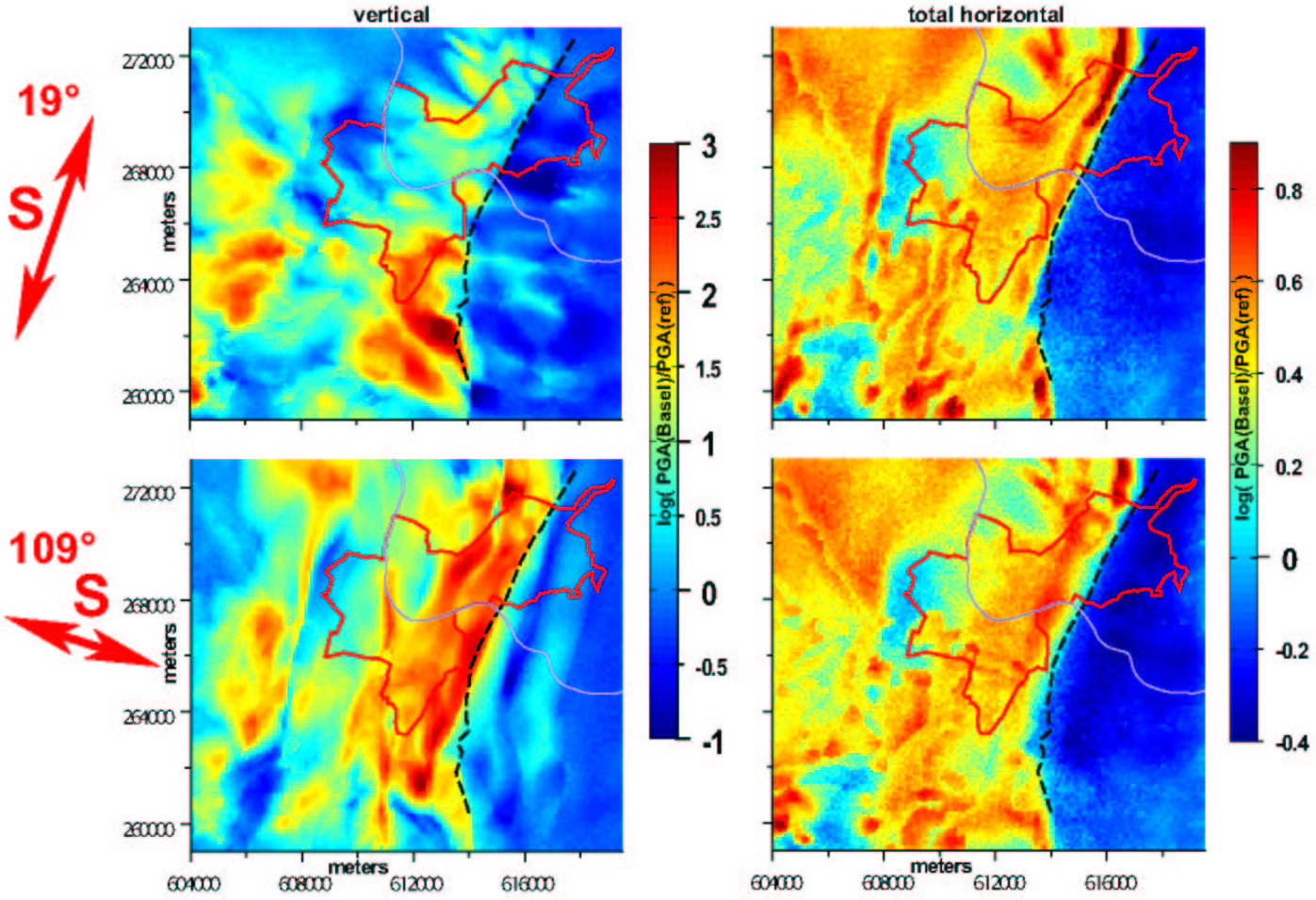
3D modeling, point source FD synthetics

I - log($PGA_{Basel}/PGA_{reference}$) amplification for vertically incident S-wave of 2 polarizations



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3D modeling, synthetic amplifications

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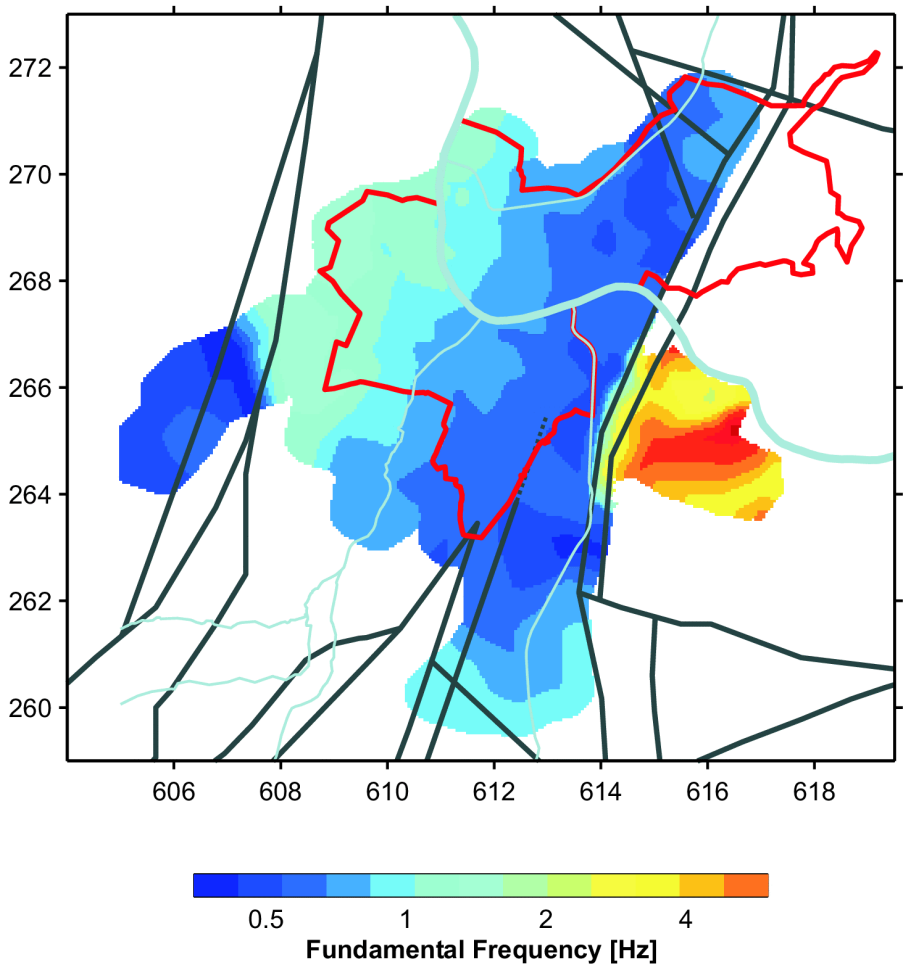
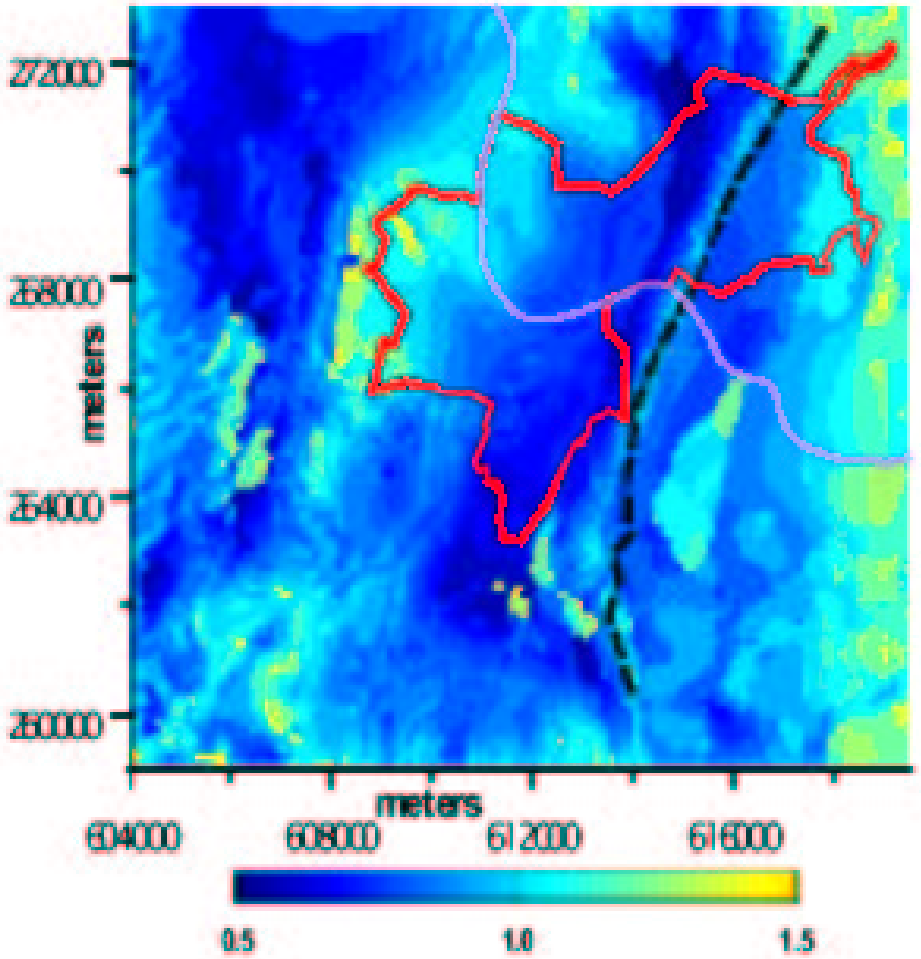


Measured fundamental frequencies



Averaged pseudo-acceleration response spectra (Hz), total horizontal component

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Basel synthetic source

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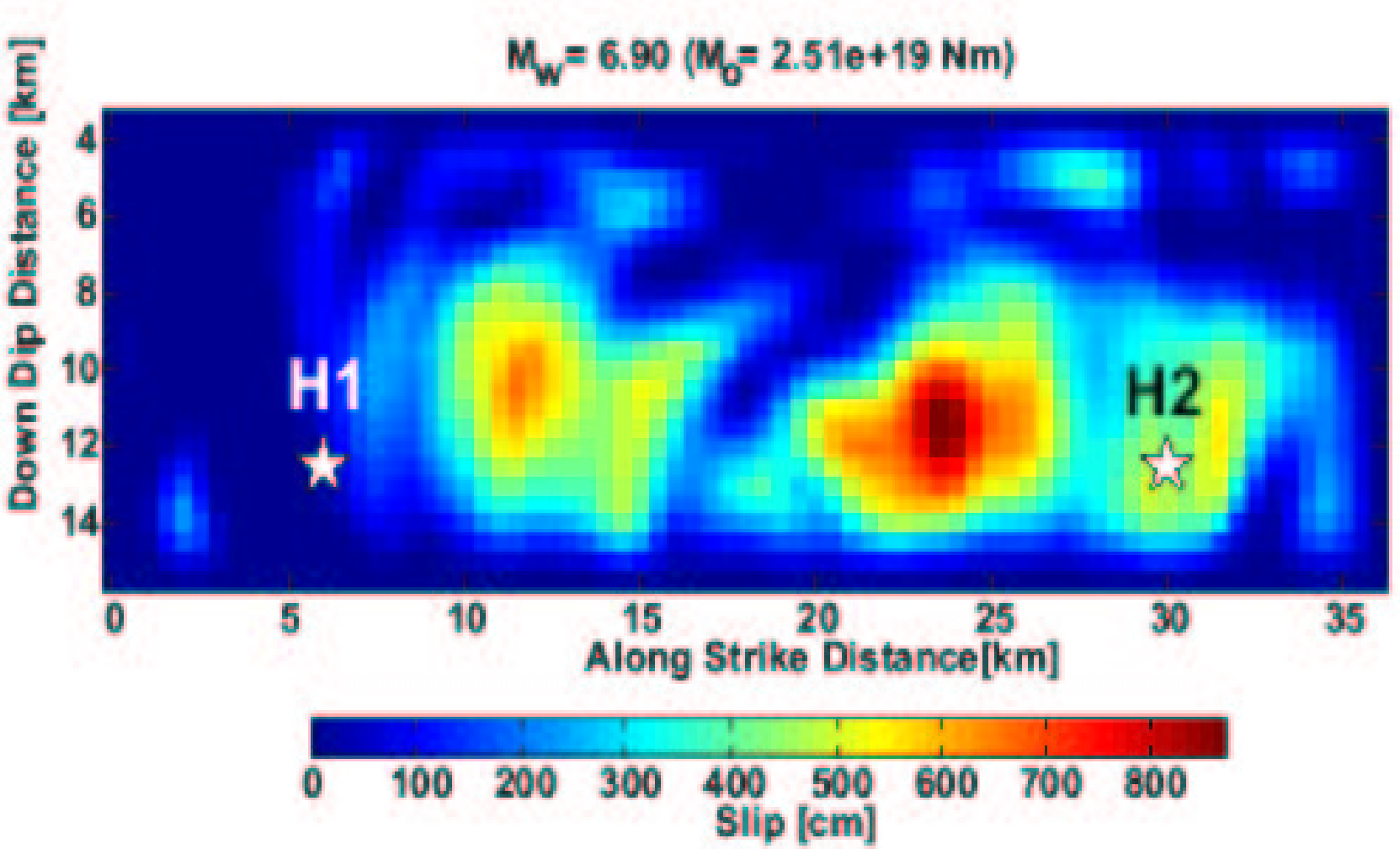

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Basel synthetic rupture model

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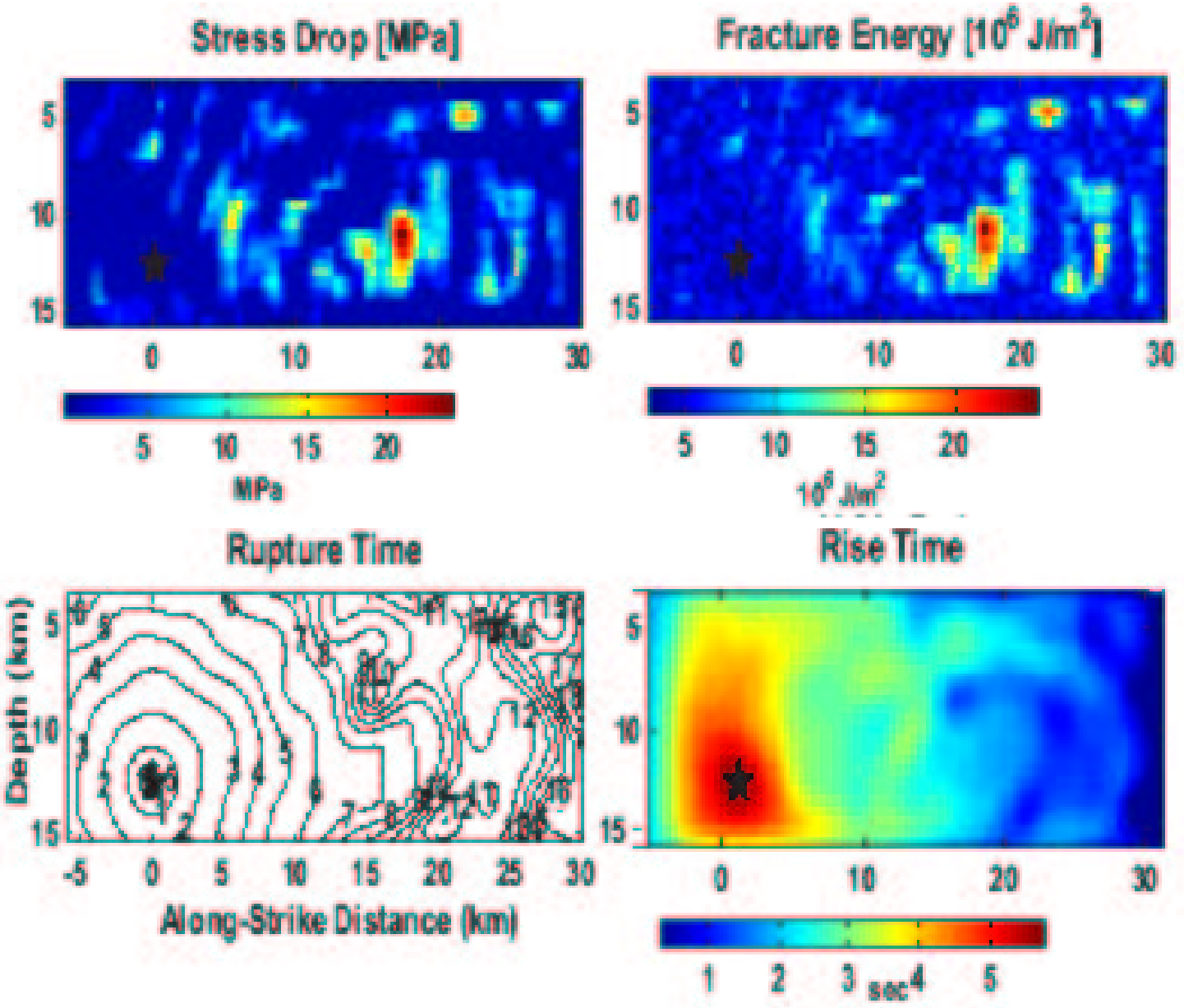

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Pseudo acceleration response spectra

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