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Title: Seismic Modeling Workshop - Joint inversion

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Seismic Modeling Workshop – Joint Inversion National Laboratory Overview/Discussion

Review of Monitoring Research - Workshop

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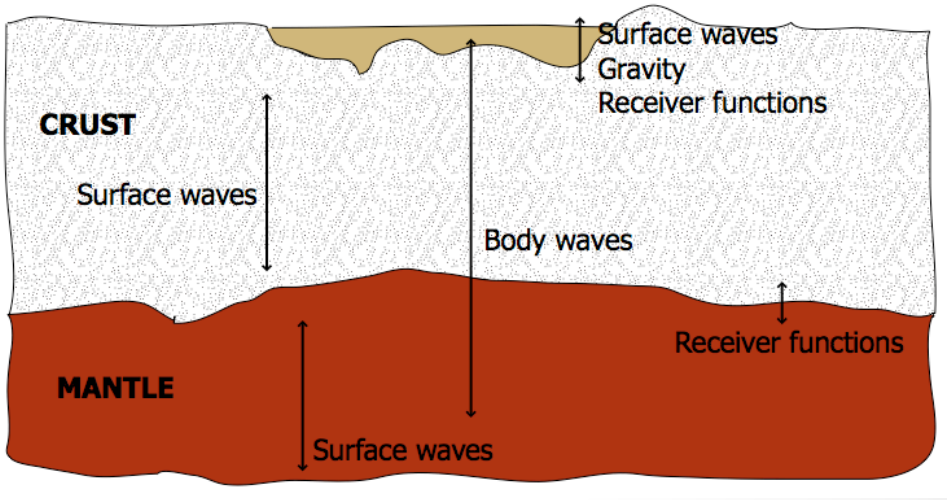
Why joint inversion? It enables spanning spatial and data scales!

Multiple benefits

- Different data sets have different spatial coverage and resolution.
- "Standard" geophysical models are developed only to fit one type of data.
- Different data types have different strengths.

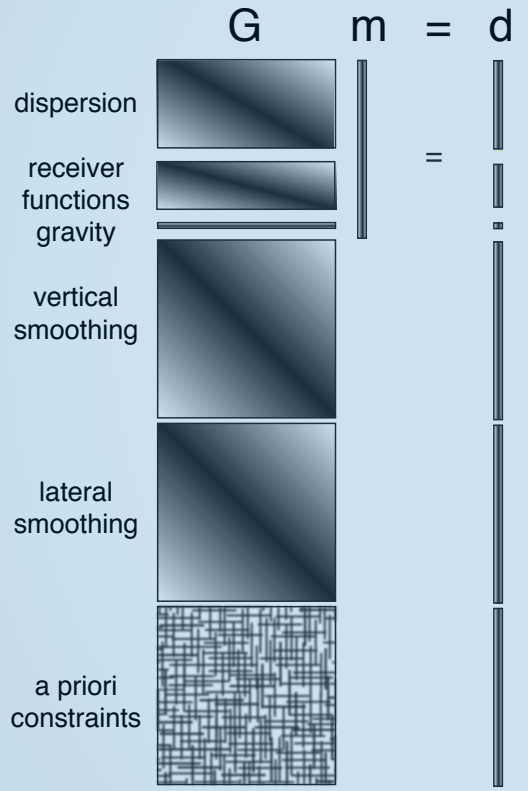


Multiple challenges

- Deal with different data bandwidths.
- Design responsive misfit norms; relative weighting of data sets.
- Make assumptions to model the different data; relationships between independent data sets.

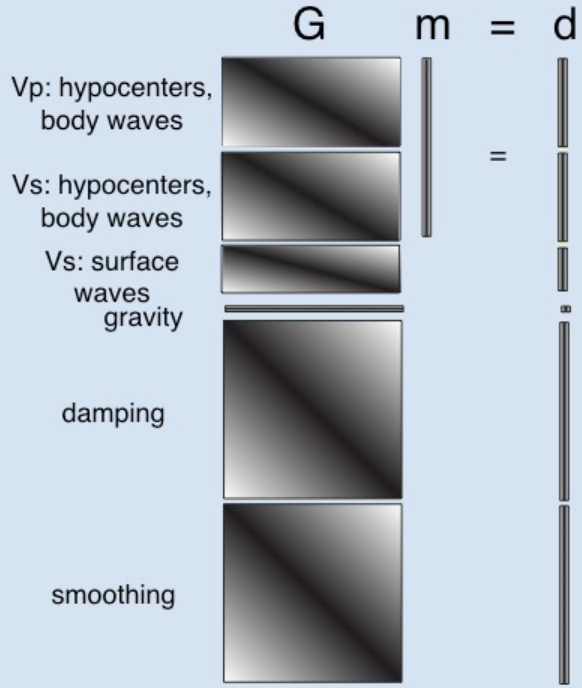
LANL codes

LANL-PSU



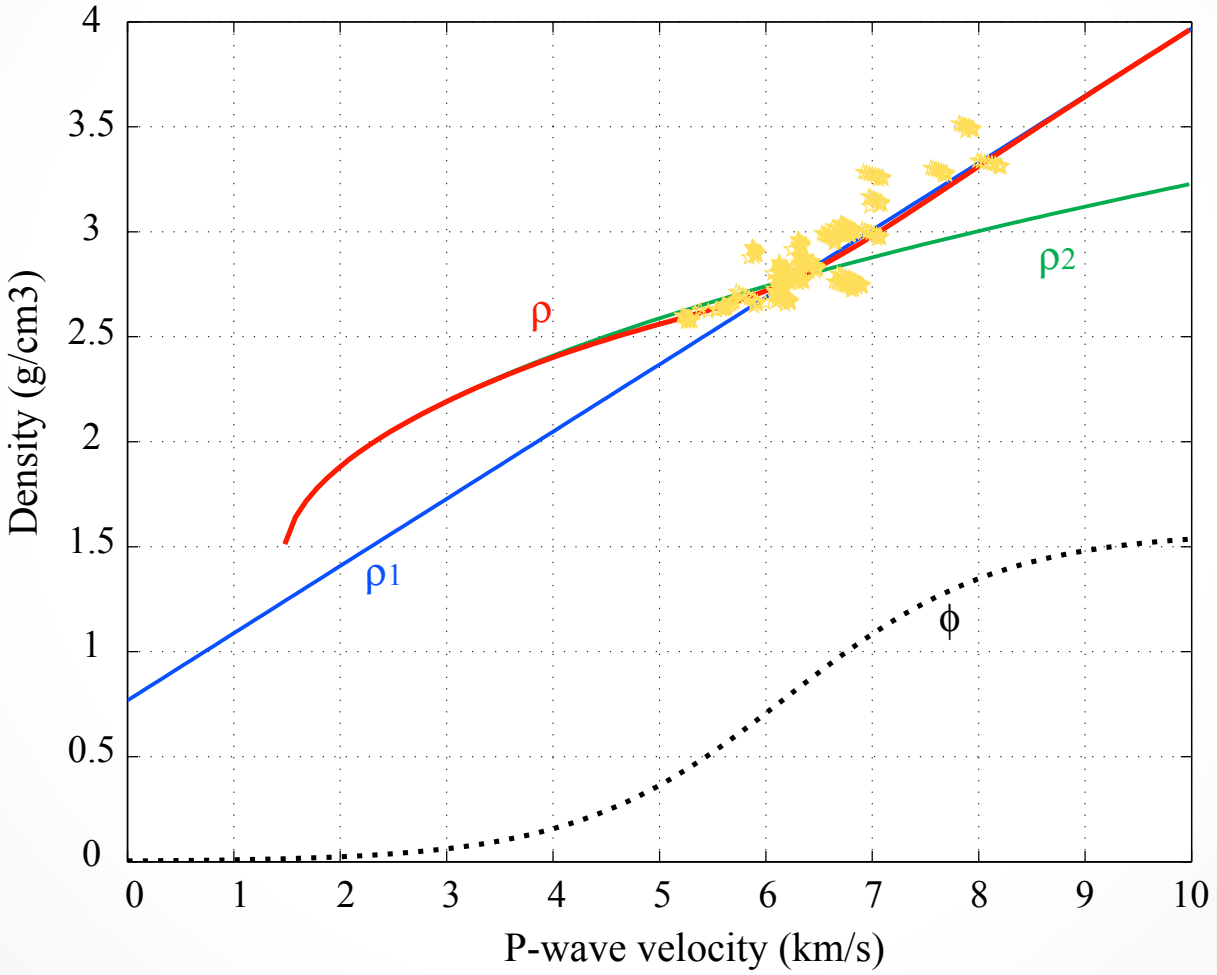
Schematic of data types and regularization used in this inversion.

LANL-MIT

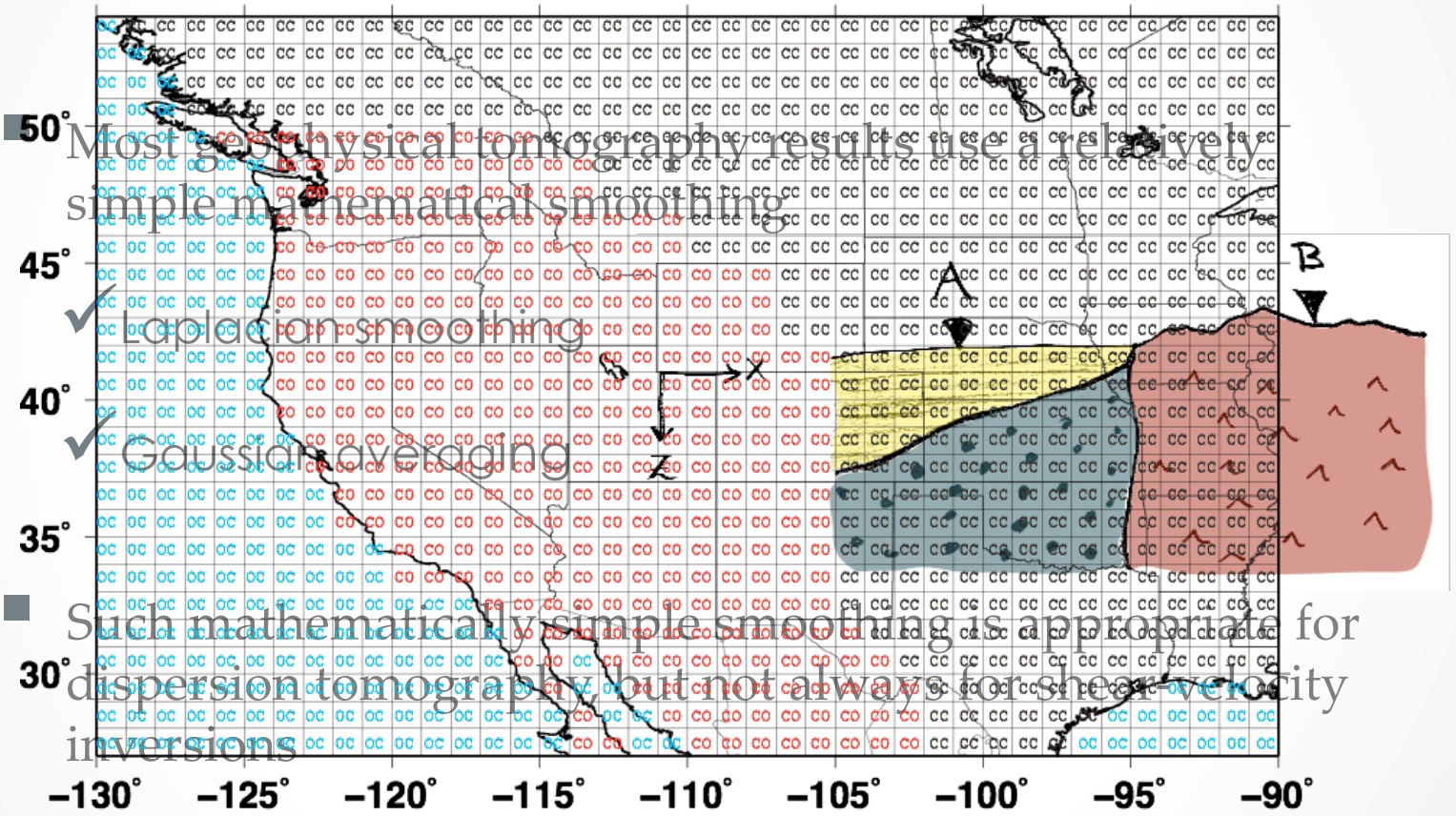


Schematic of data types and regularization used in this inversion.

Relationship between independent variables



Creative and better use of geologic information



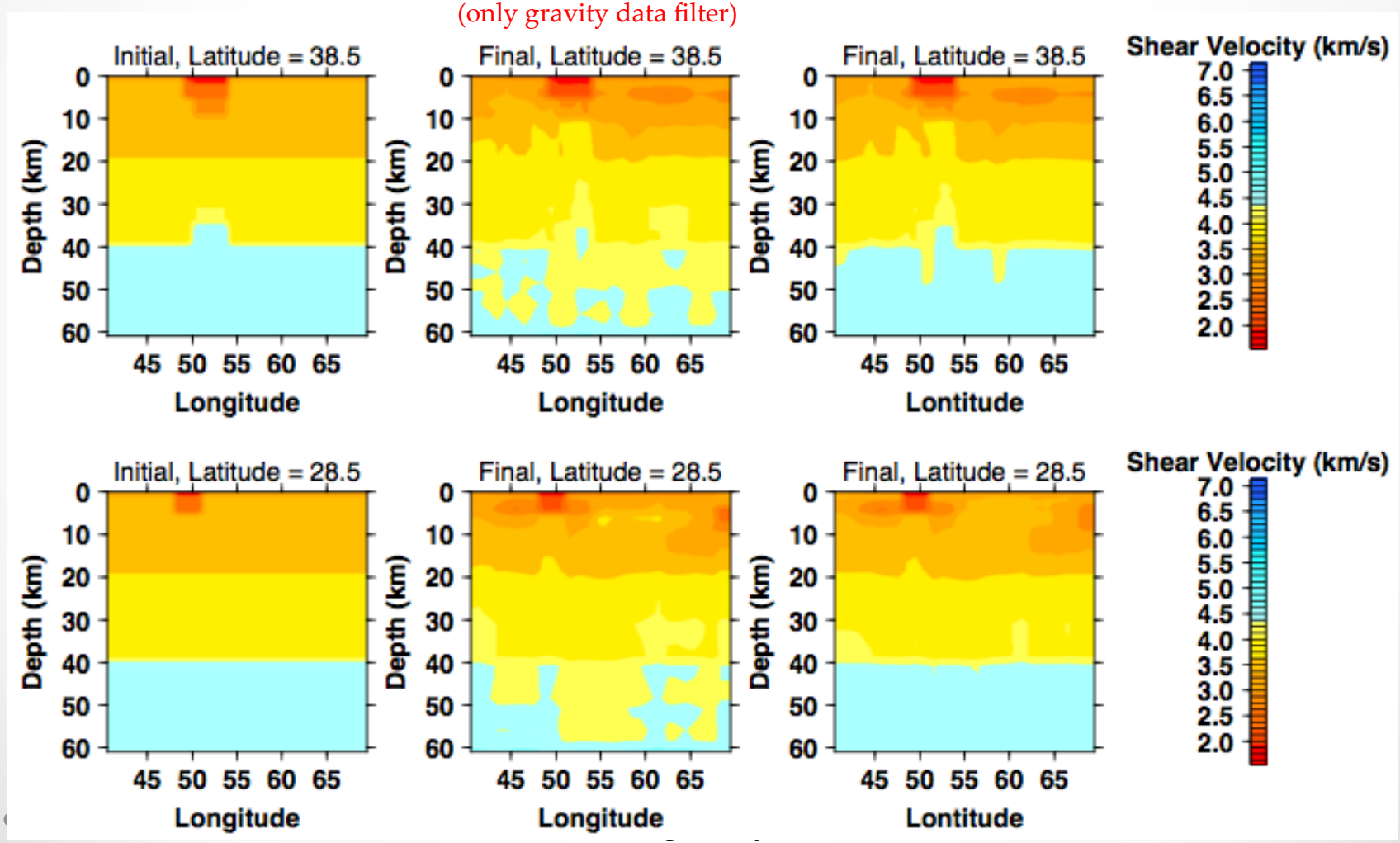
- Most geophysical tomography results use a relatively simple mathematical smoothing
  - ✓ Laplacian smoothing
  - ✓ Gaussian averaging
- Such mathematically simple smoothing is appropriate for dispersion tomography but not always for shear velocity inversions

Smoothing allowed inside the same geological/tectonic unit to preserve known boundaries

Gravity filtering

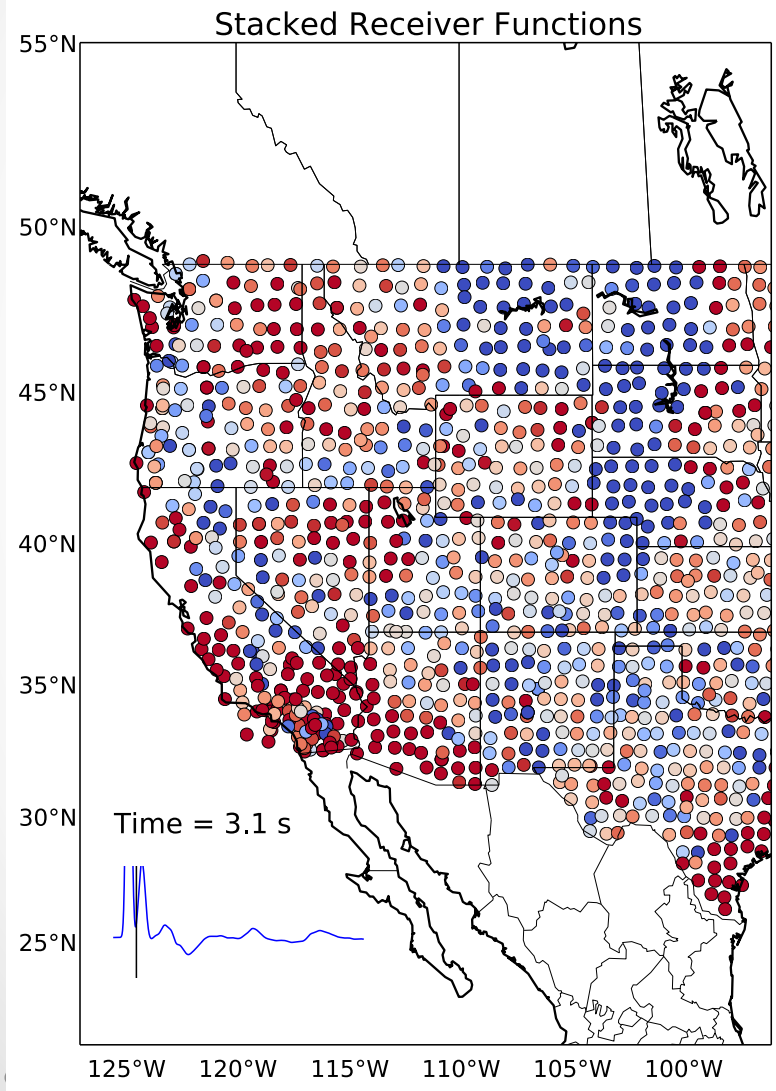
TRADITIONAL approach
(only gravity data filter)

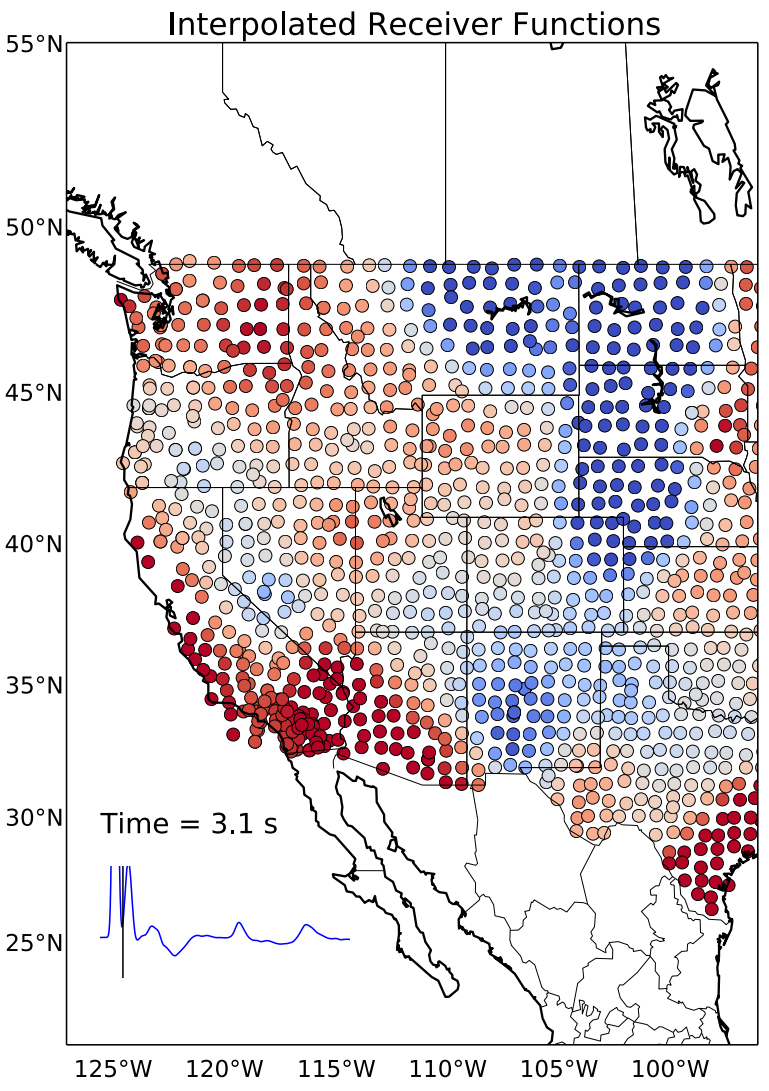
LANL approach
(equalizing Ax=b)



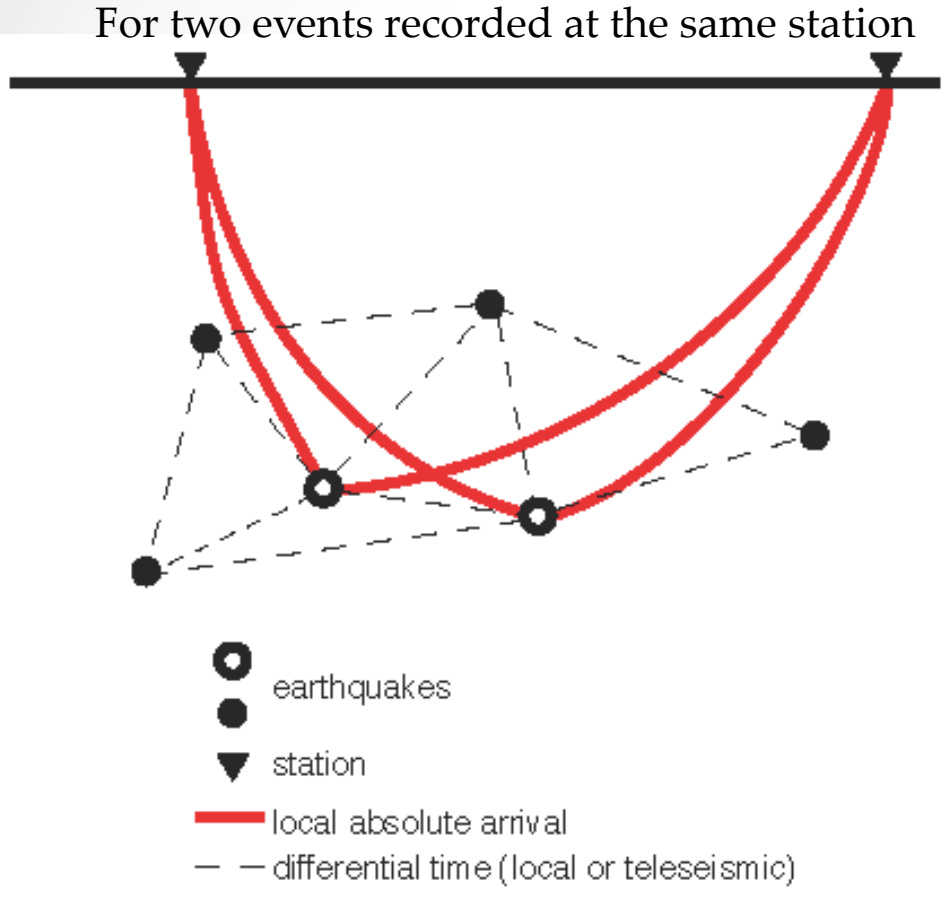
Smooth models

Receiver functions interpolation





Adding body waves travel times



we can define the "double difference"
(Zhang and Thurber, 2003)

Absolute and differential times

- structure near source region is resolved at finer scale by differential data
- structure beyond source region is resolved by absolute data

Regional scale version tomoFDD

- considers sphericity of the earth
- finite-difference ray tracing method is used to deal with major velocity discontinuities