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Seismic Modeling Workshop – Joint Inversion National Laboratory Overview/Discussion

Review of Monitoring Research - Workshop

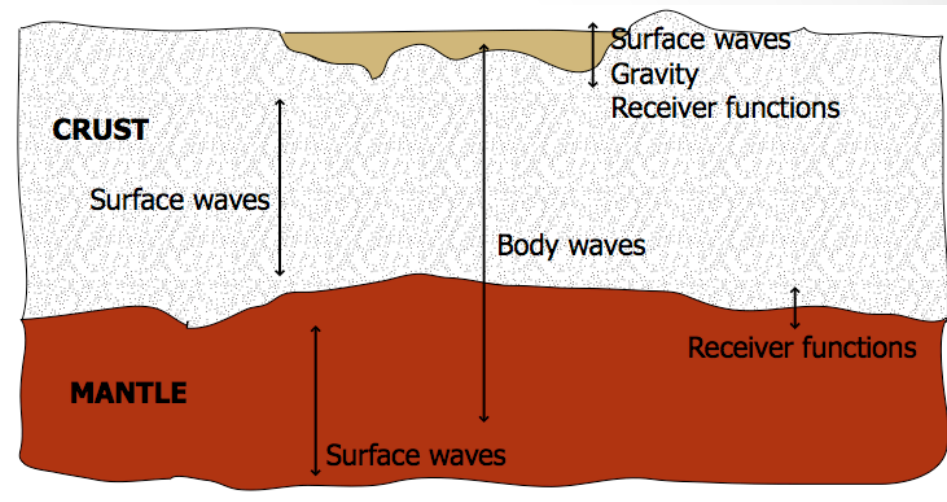
June 19, 2014

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Nathan Simmons, Lawrence Livermore National Laboratory

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.

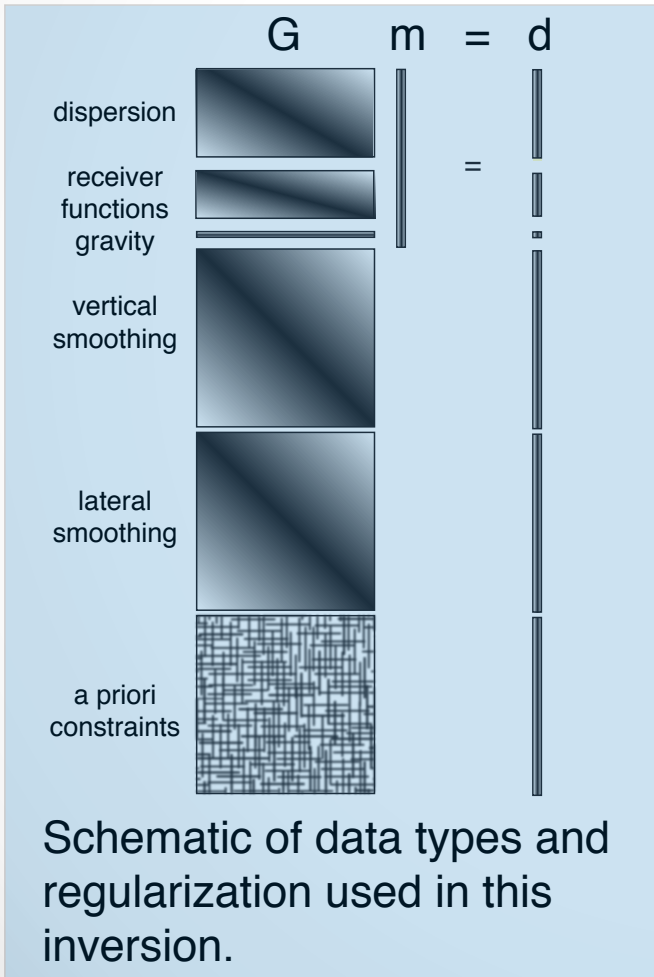


Multiple challenges

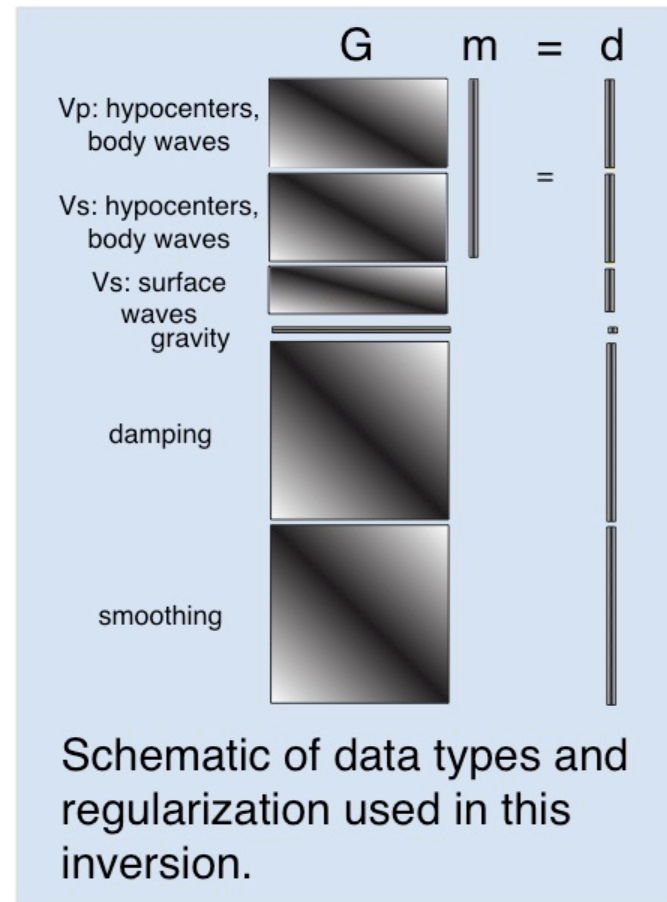
- Deal with different data bandwidths.
- Design responsive misfit norms; relative weighting of data sets.
- Make assumptions to model the different data; relationships between independent data sets.

LANL codes

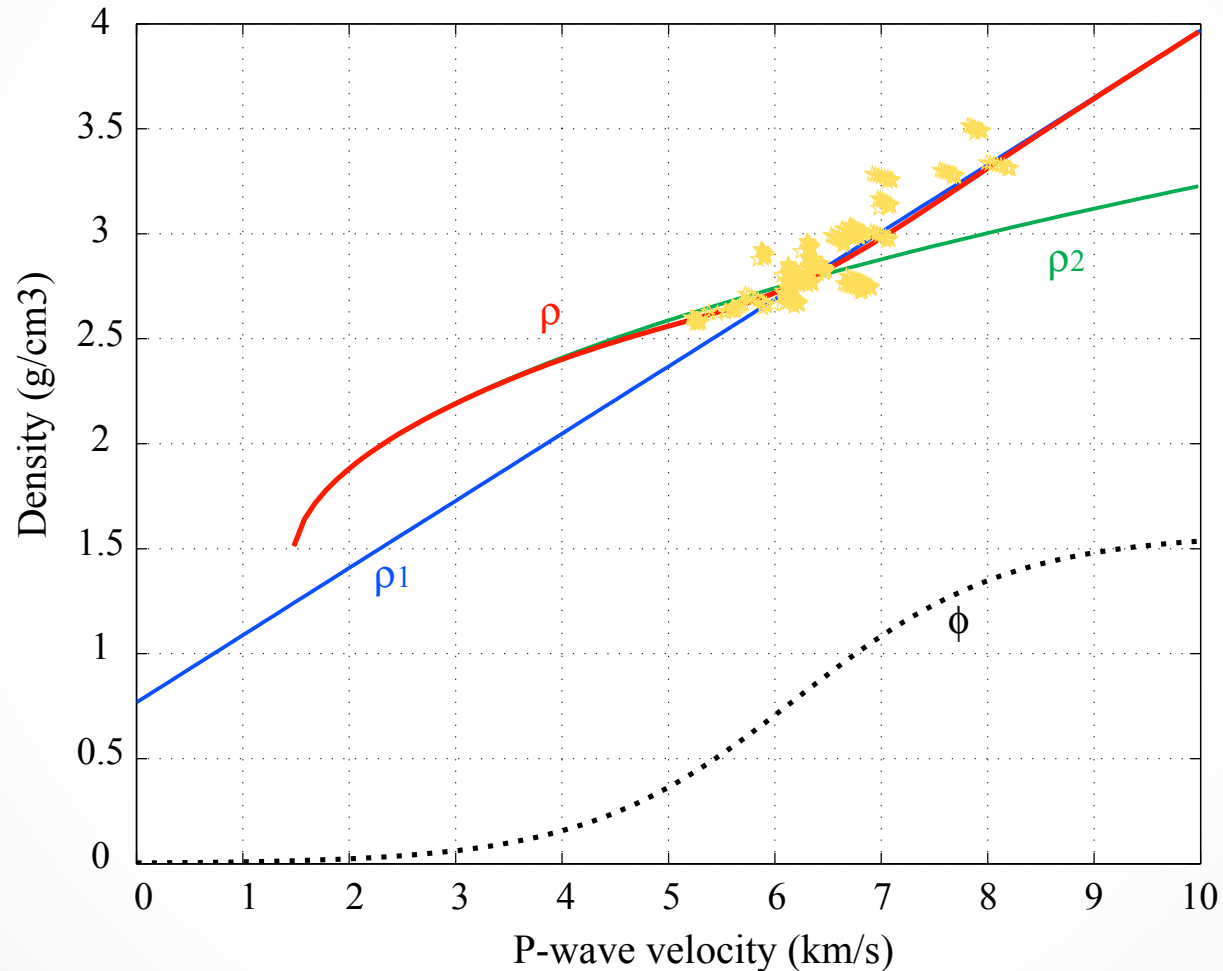
LANL-PSU



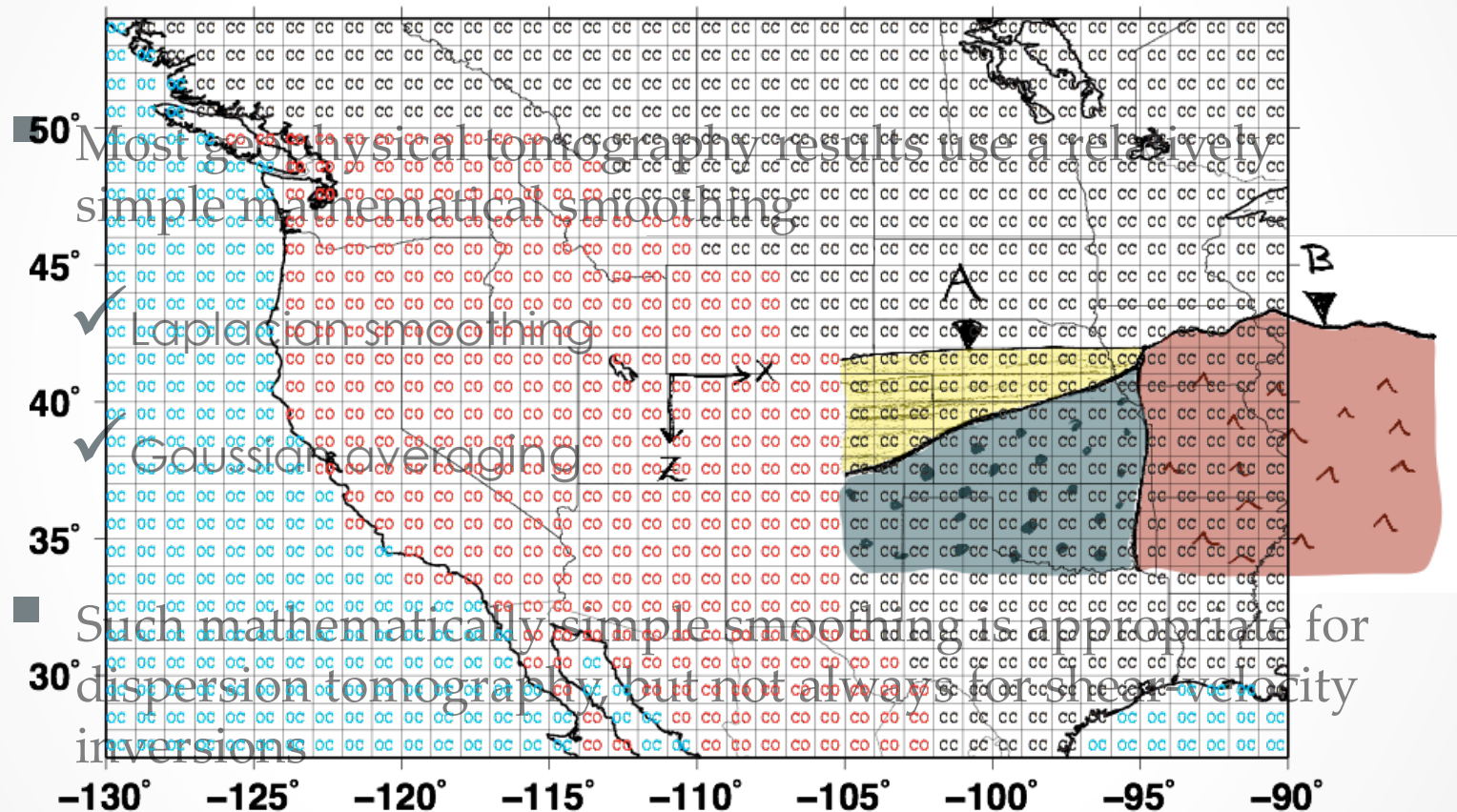
LANL-MIT



Relationship between independent variables



Creative and better use of geologic information

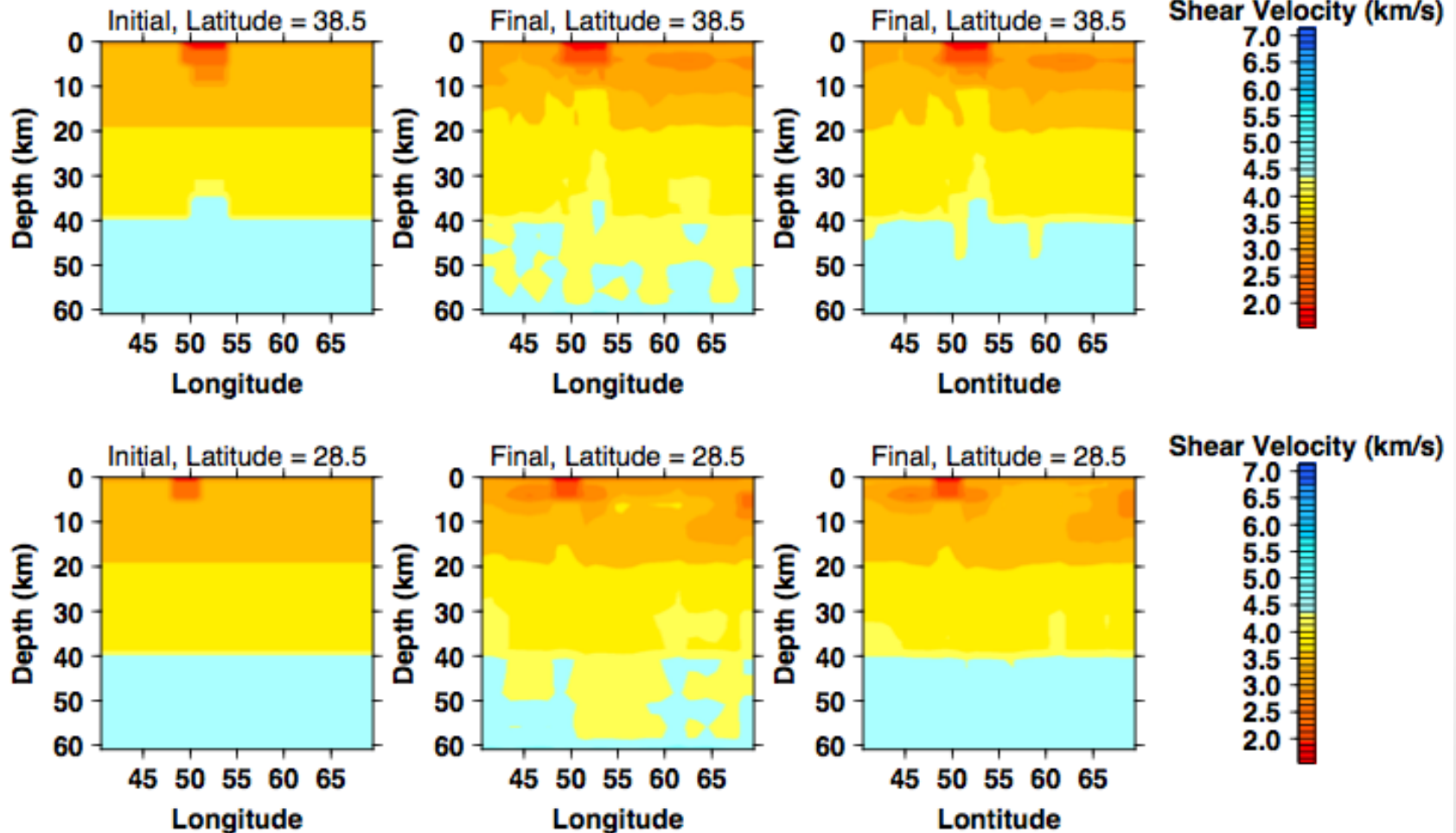


Smoothing allowed inside the same geological/tectonic unit to preserve known boundaries

Gravity filtering

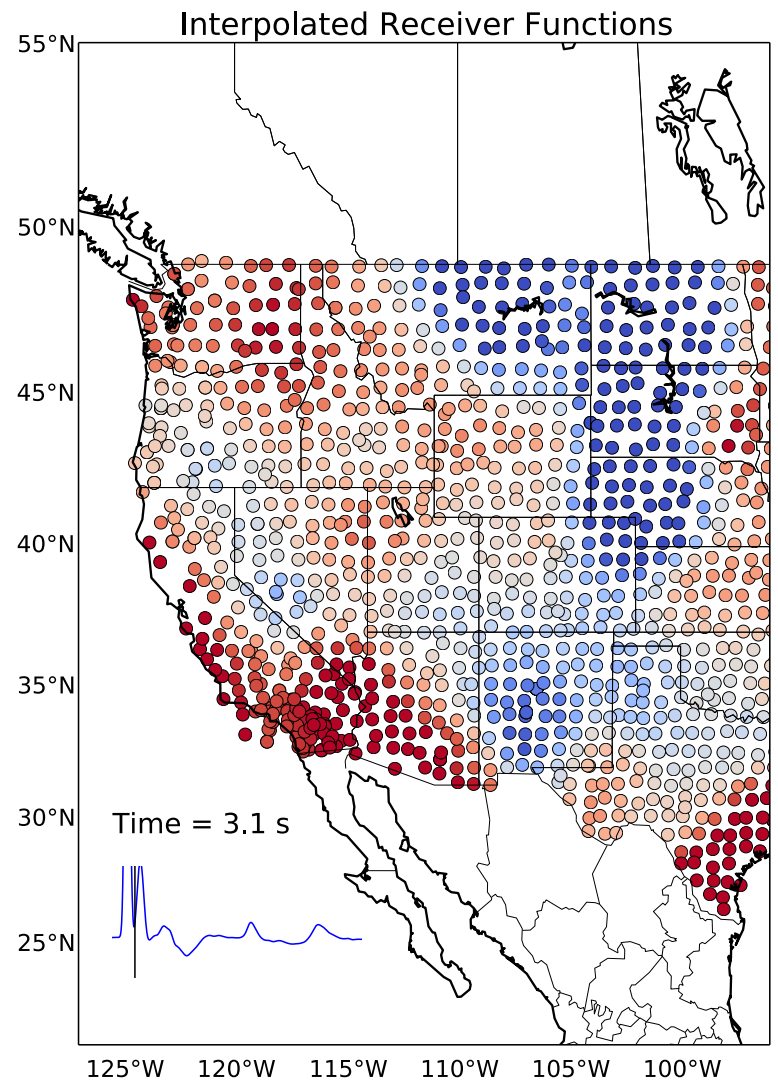
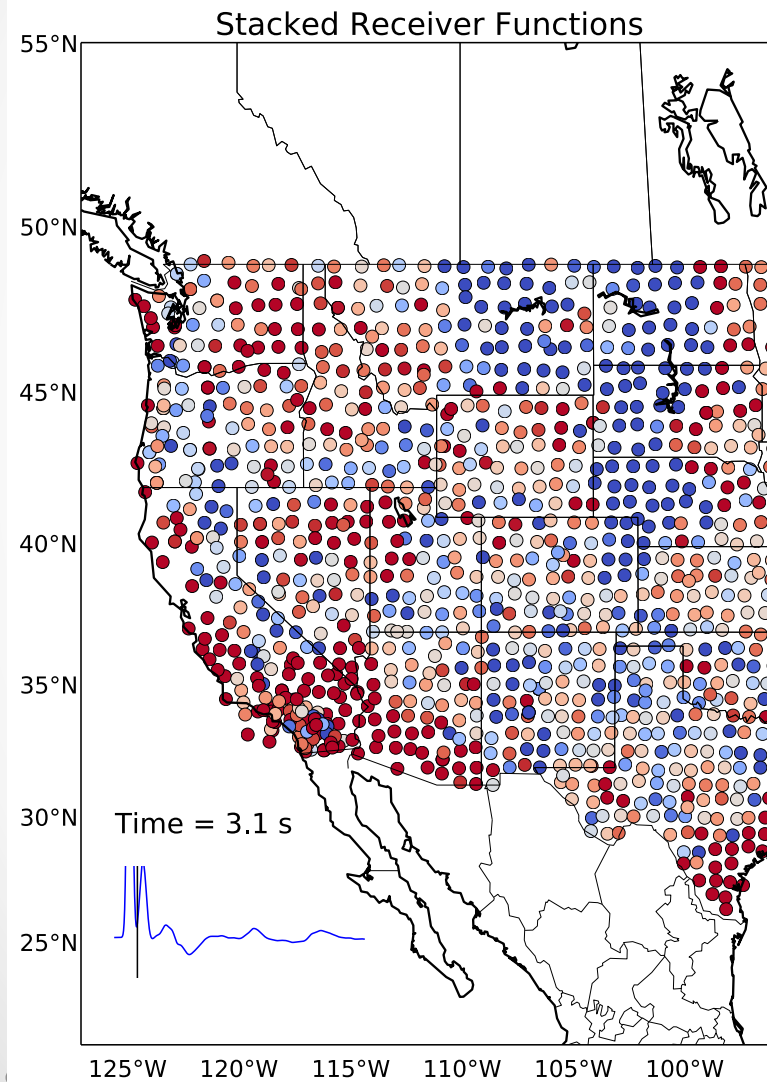
TRADITIONAL approach
(only gravity data filter)

LANL approach
(equalizing $Ax=b$)



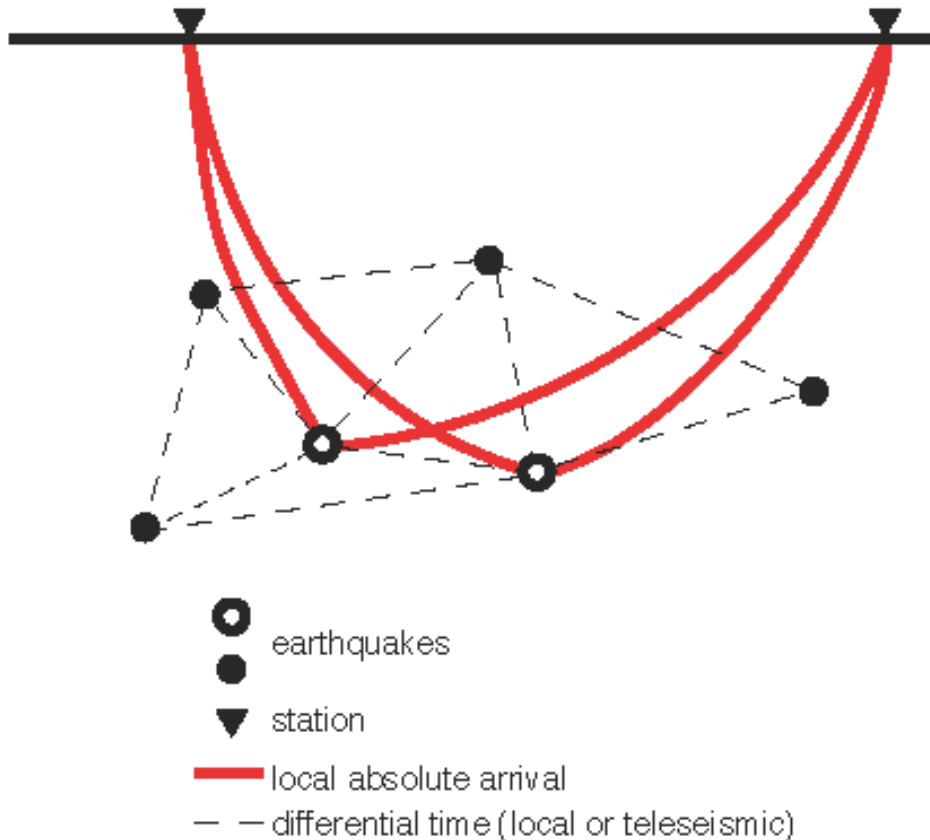
Smooth models

Receiver functions interpolation



Adding body waves travel times

For two events recorded at the same station



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

we can define the “double difference”

(Zhang and Thurber, 2003)