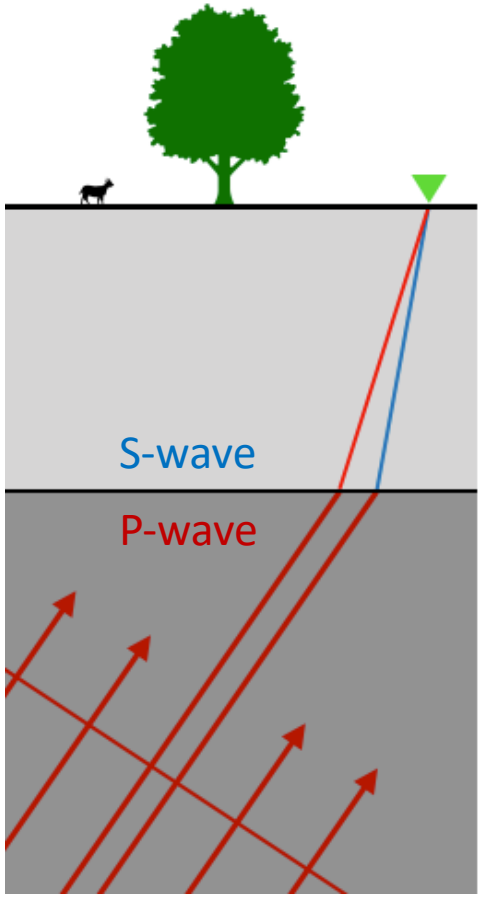
# Boundary and elastic parameter sensitivity for a receiver function waveform misfit in a global earth

Janneke de Jong
Hanneke Paulssen
Jeannot Trampert

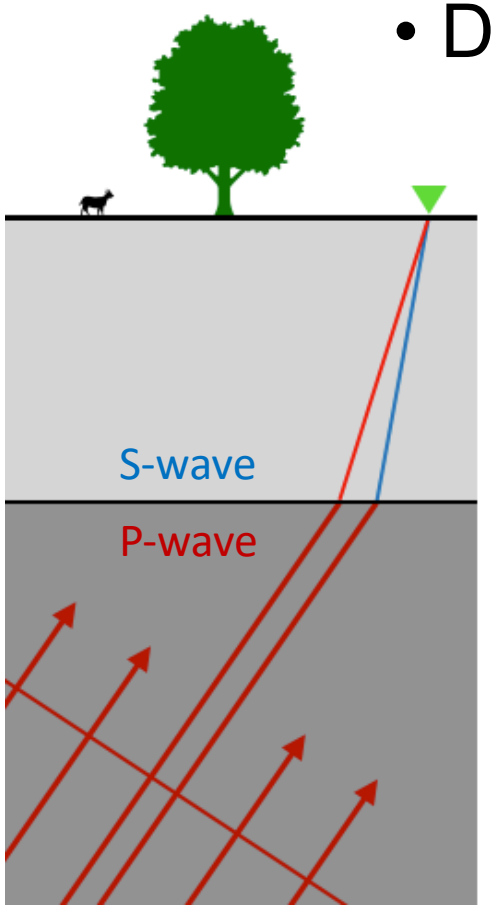

Utrecht University

# Receiver Functions



# Receiver Functions

- Seismic signal: $u_i(\mathbf{x}_r, t) = S(\mathbf{x}_s, t) * P_i(\mathbf{x}_s, \mathbf{x}_r, t) * E_i^n(\mathbf{x}_r, t)$
- Deconvolution: $RF(\mathbf{x}_r, t) = F^{-1}\left[\frac{u_R(\mathbf{x}_r, \omega)}{u_V(\mathbf{x}_r, \omega)}\right]$




$$= F^{-1}\left[\frac{S(\mathbf{x}_s, \omega)P_R(\mathbf{x}_s, \mathbf{x}_r, \omega)E_R^n(\mathbf{x}_r, \omega)}{S(\mathbf{x}_s, \omega)P_V(\mathbf{x}_s, \mathbf{x}_r, \omega)E_V^n(\mathbf{x}_r, \omega)}\right]$$

$$P_V(\mathbf{x}_s, \mathbf{x}_r, \omega) \approx P_R(\mathbf{x}_s, \mathbf{x}_r, \omega)$$

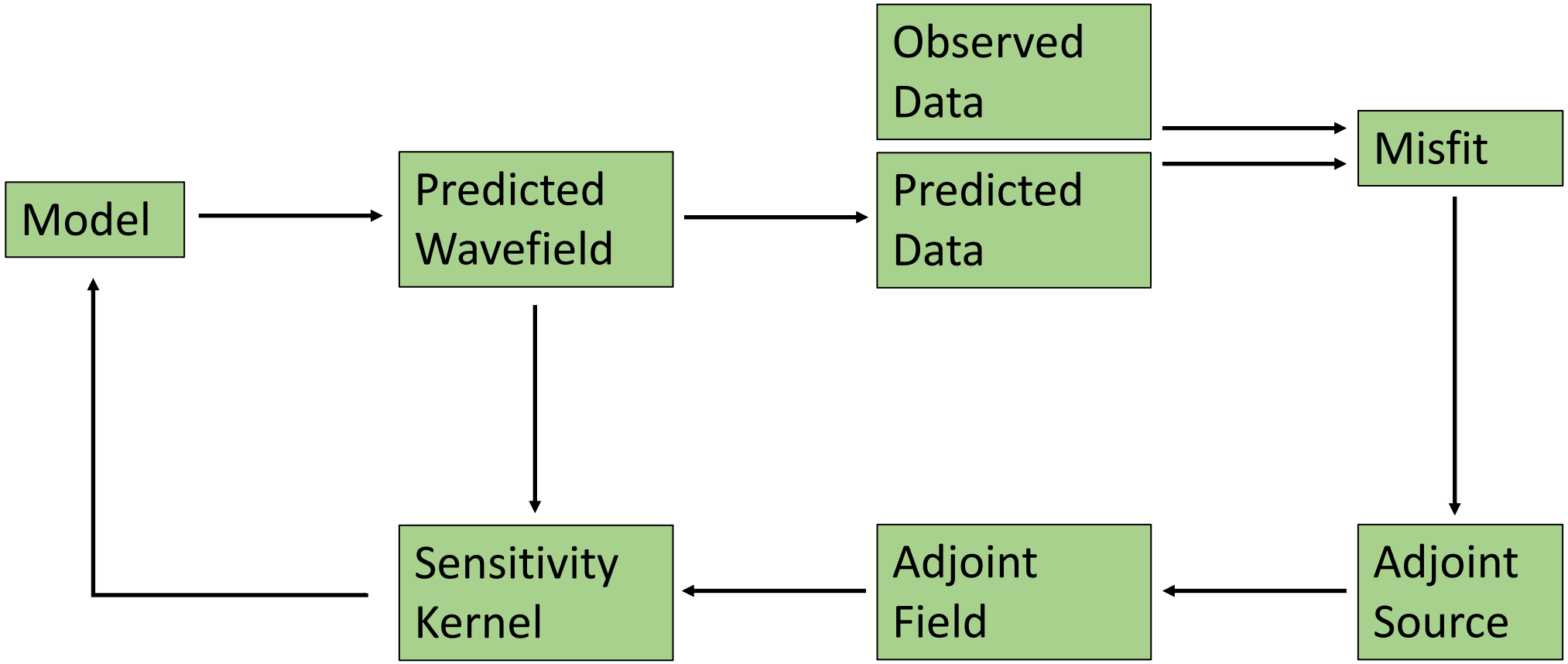
$$= F^{-1}\left[\frac{E_R^n(\mathbf{x}_r, \omega)}{E_V^n(\mathbf{x}_r, \omega)}\right]$$

# **Receiver Functions:** challenges

- Challenges of receiver functions:
  - Weak signal
  - Coda scatterers
  - Assumptions

- We use Full Waveform Inversion
  - All information in waveform
  - Less assumptions

# **Full Waveform Inversion:** Adjoint Method

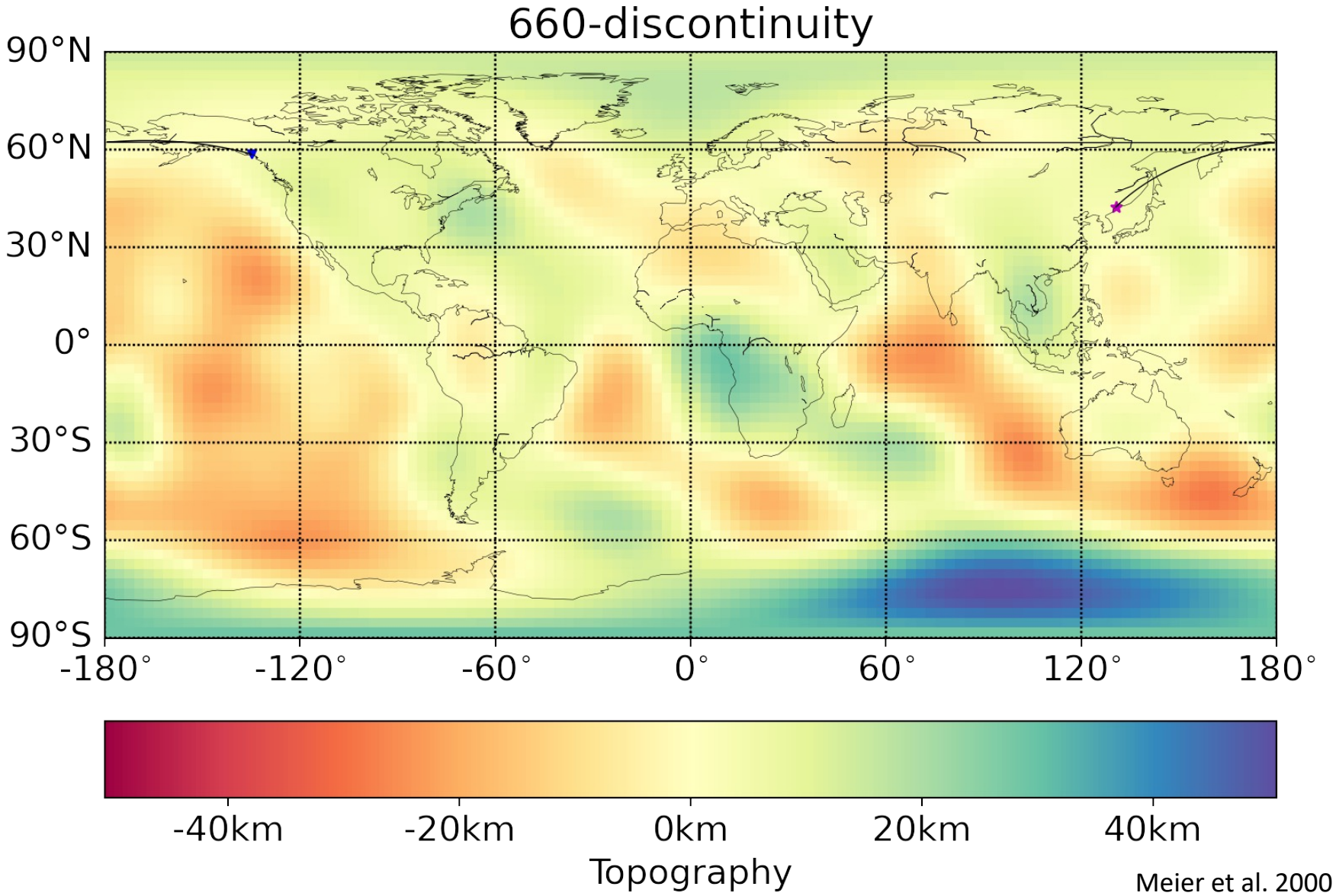



(De Jong et al. 2022)

# **Example:** Topography model, event, station

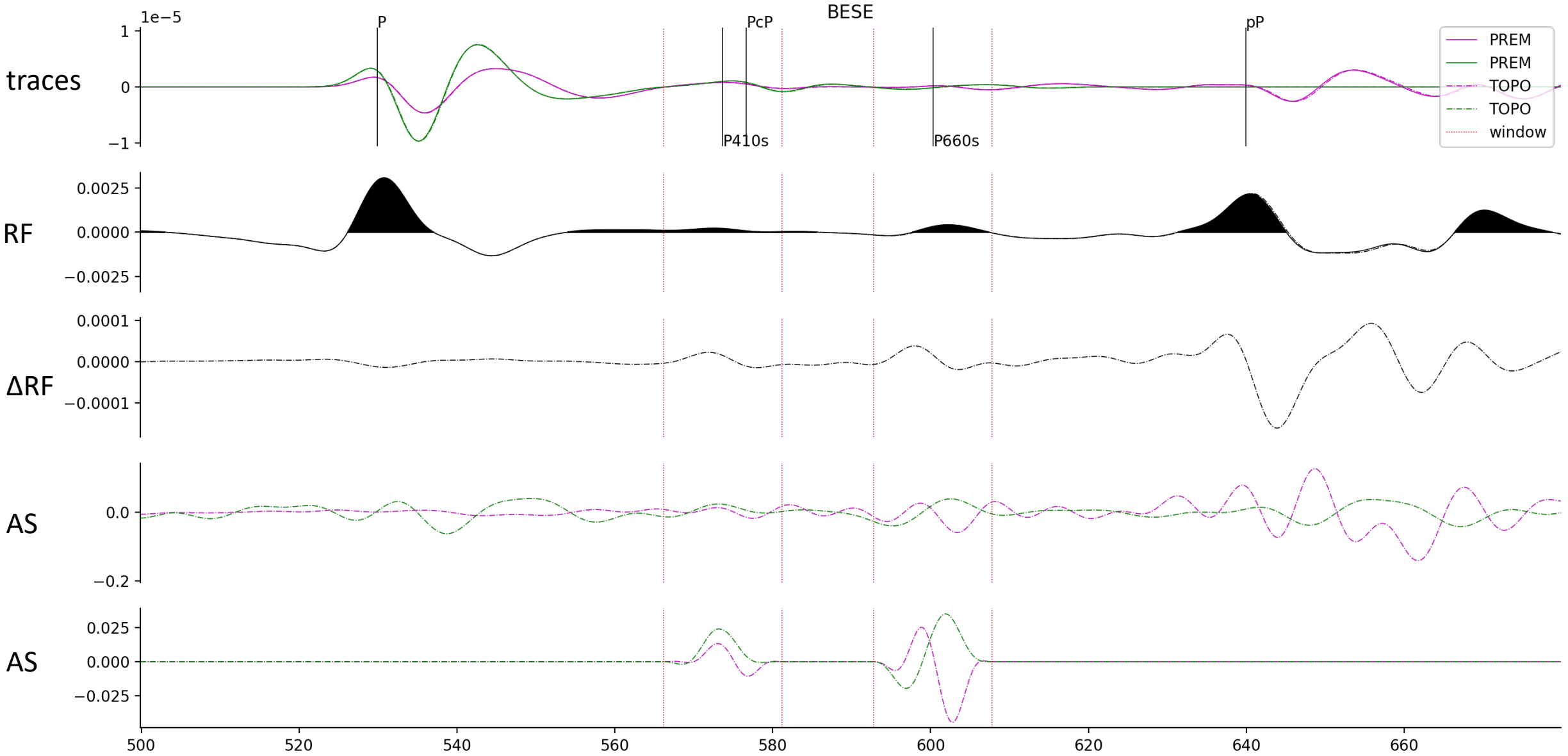
Event: Russia-China
Depth: 578.7 km
Mag: 6.9

BESE (57°) Station

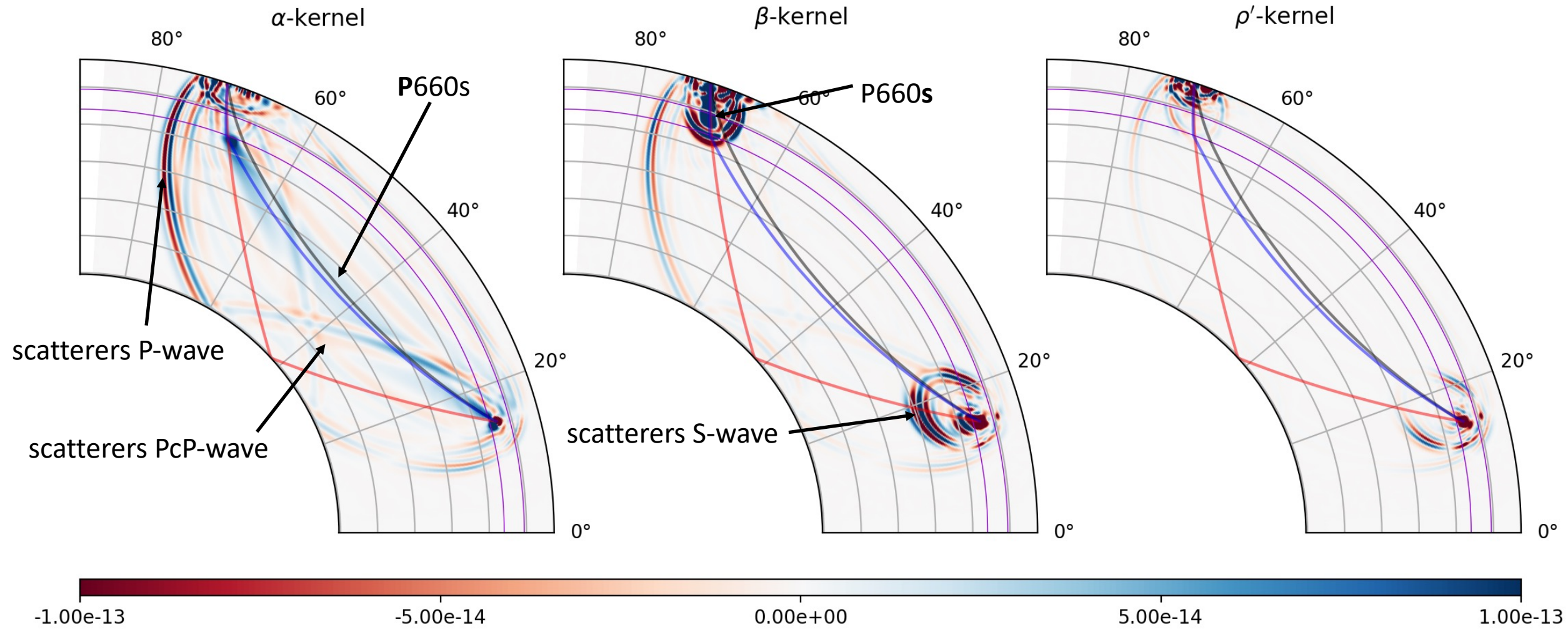



Meier et al. 2000

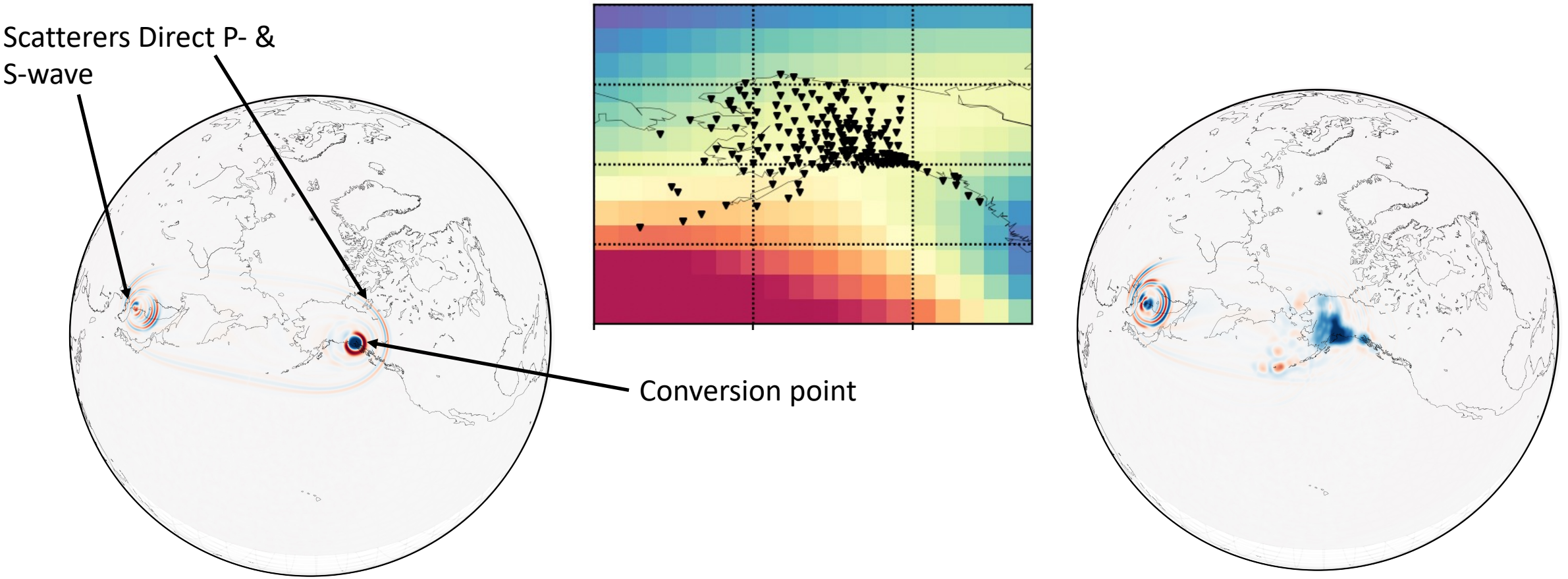
# **Example:** Waveforms and adjoint sources



# Mantle Kernels: P660s



# **Boundary Kernels:** 660-discontinuity



# **Sensitivity kernels:** Observations

## Mantle Kernels

- Sensitivity to PS-ray path
- Senstivity to large portion of the mantle
  - ~~$P_V(\mathbf{x}_s, \mathbf{x}_r, \omega) \approx P_R(\mathbf{x}_s, \mathbf{x}_r, \omega)$~~
- Sensitivity to other phases
  - P-wave, S-wave, PcP

## Boundary Kernels

- Sensitivity to conversion point
- Source area
- P-wave scatterers
- S-wave scatterers

# Take-away message

- Strong sensitivity to conversion point and P660s fresnel zone
- Direct P, direct S and other phases contribute significantly
- Receiver function's waveform depend on large portion of the mantle
- Sensitivity kernels can be used to determine which phases and areas contribute to a receiver functions waveform

# Literature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