# Global body waves from seismic noise correlation: A new datset to probe the Earth's interior

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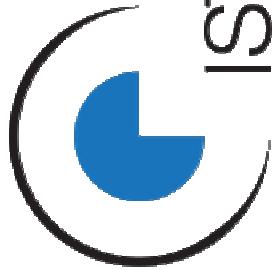
QUANTITATIVE ESTIMATION OF EARTH'S SEISMIC SOURCES AND STRUCTURE

European Research Council
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# GOAL:

## Extract deep traveling global body waves by correlation of ambient seismic noise
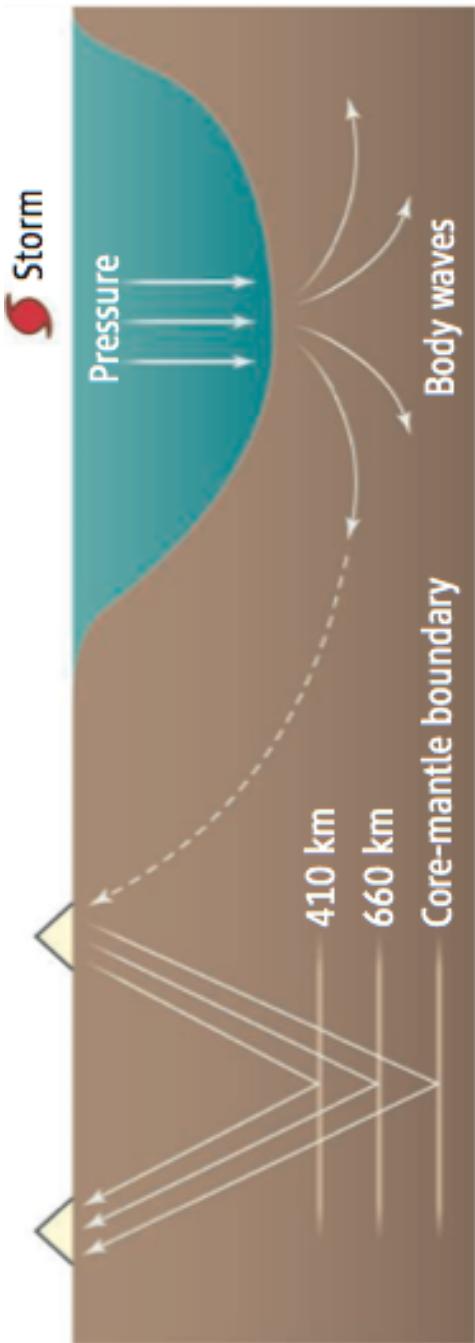


(Prieto, Science, 2012)
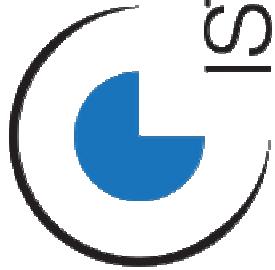
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# GOAL:

## Extract deep traveling global body waves by correlation of ambient seismic noise

$$C_{AB}(\omega) = \sum_{S_x} G(x_A, x_s) G^*(x_B, x_s) \, |S(\omega)|$$
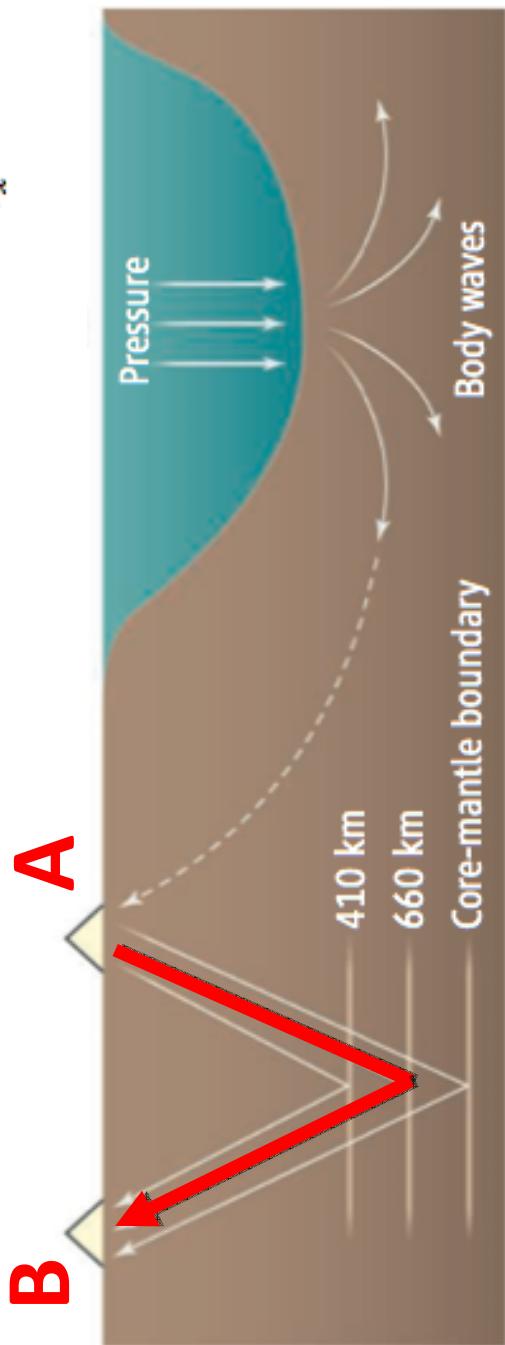
(Prieto, Science, 2012)

QUEST — QUANTITATIVE ESTIMATION OF EARTH'S SEISMIC SOURCES AND STRUCTURE

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# Regional Mantle Body Waves

## ZZ component



43 Broadband stations
900 correlations FB 0.1-0.5 Hz

(Poli et al. Science, 2012)

# Regional Mantle Body Waves



STACKING:
- Surface wave muting
- align on P410P
- Vespagram

Station 1    Station 2

Crust

Upper Mantle

P660P

P410P

P

PP

PKP

number of traces

A

C

Data

Model

time[s]

slow[s/km]

43 Broadband stations
900 correlations FB 0.1-0.5 Hz

(Poli et al. Science, 2012)

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Latitude (deg)

Lon

# Regional Mantle Body Waves



STACKING:
- Surface wave muting
- align on P410P
- Vespagram

Zero slowness Trace

Station 1    Station 2

Crust

Upper Mantle

number of traces

A
A
A

P

PP

PKP

Data

Model

time[s]

slow[s/km]

C

43 Broadband stations
900 correlations FB 0.1-0.5 Hz

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QUEST
QUANTITATIVE ESTIMATION OF EARTH'S STRUCTURE
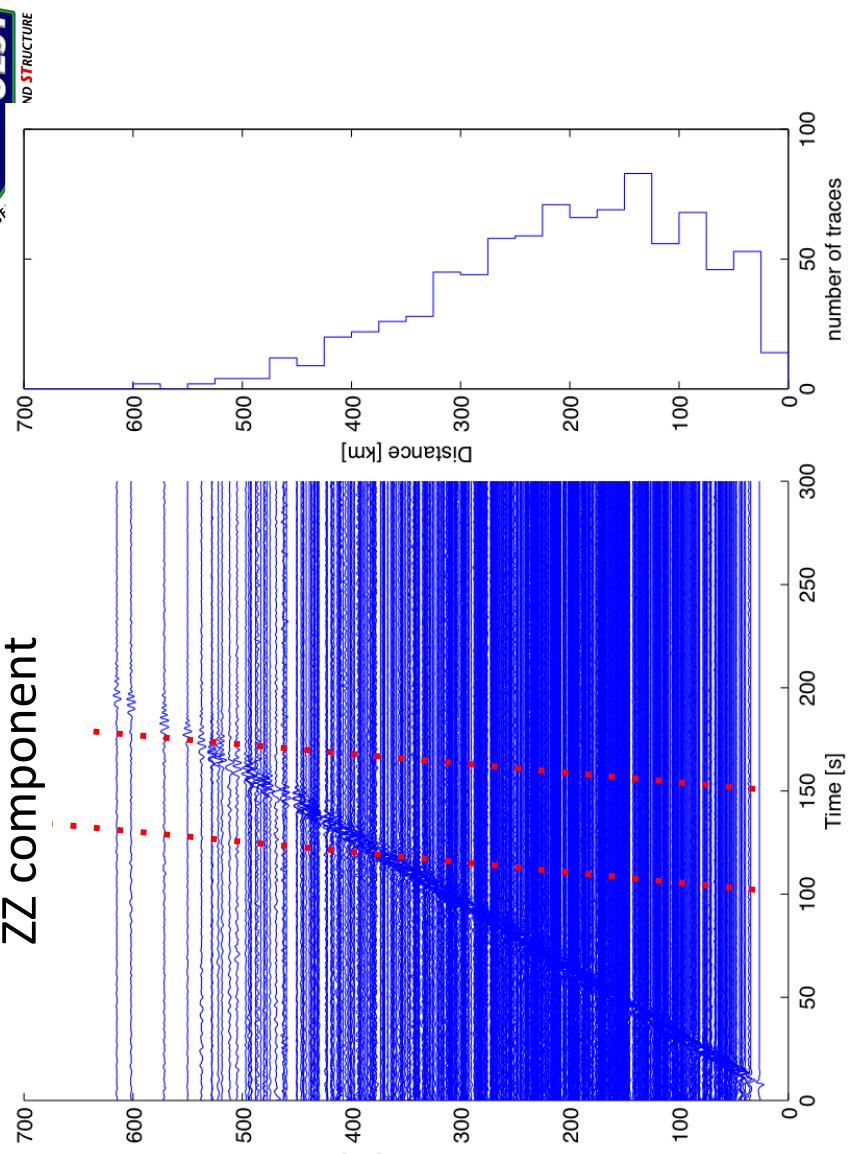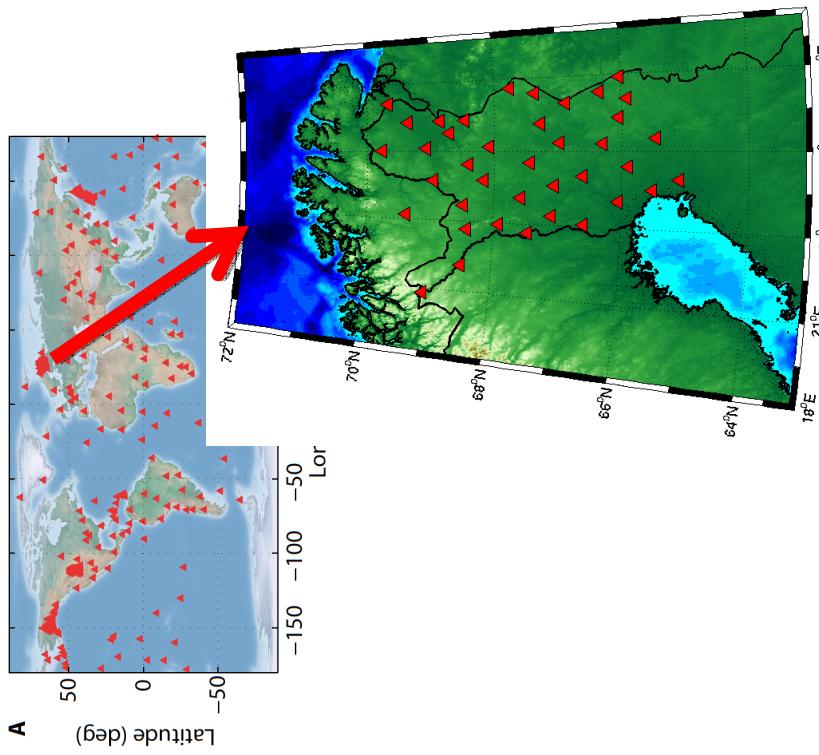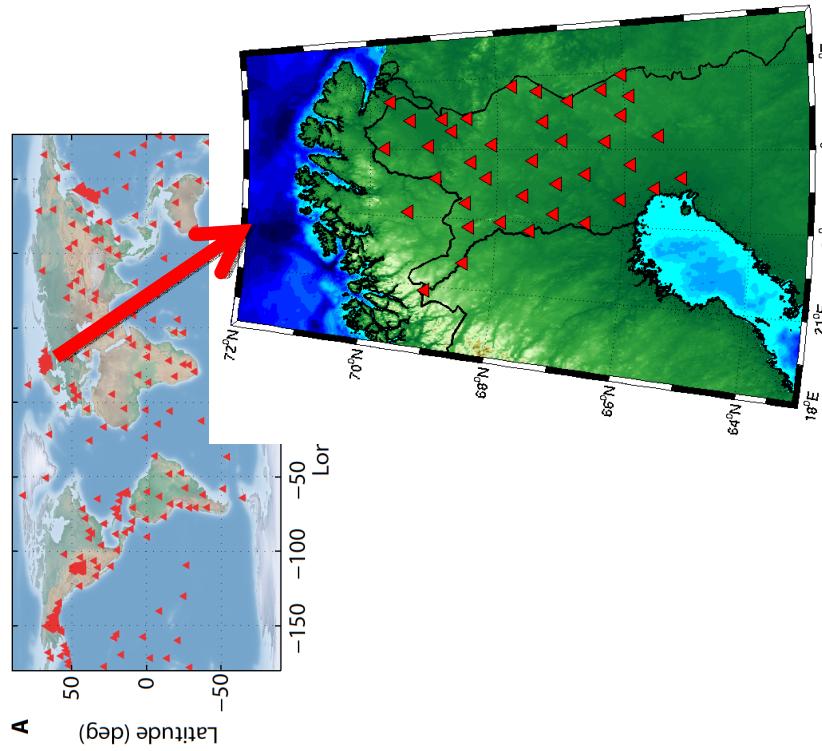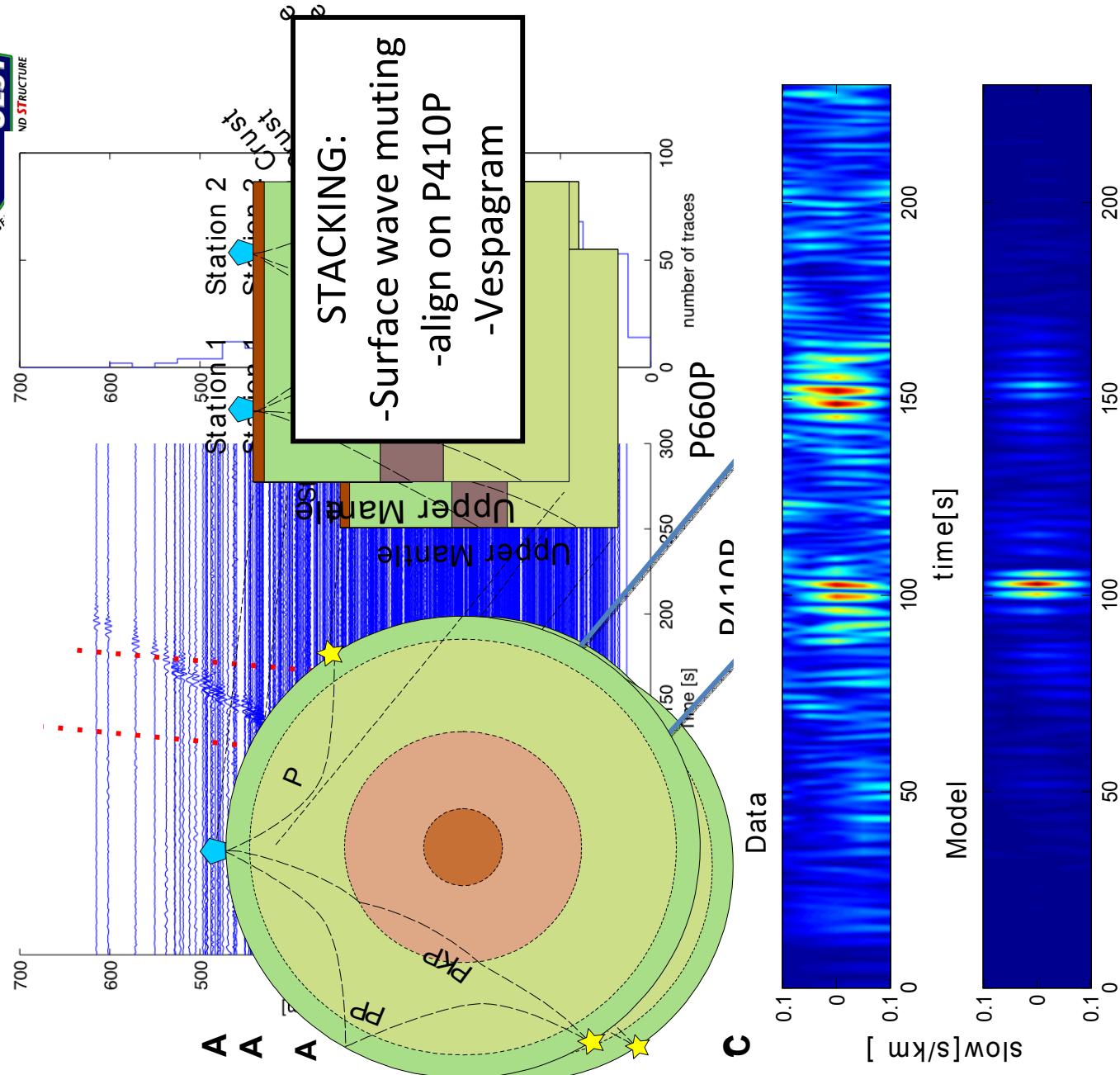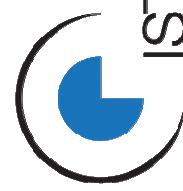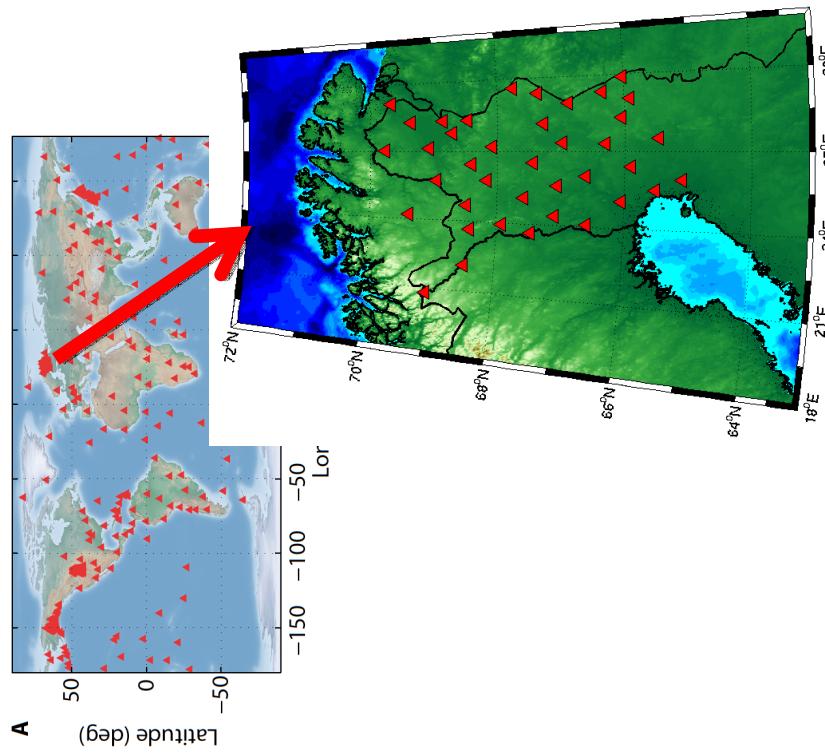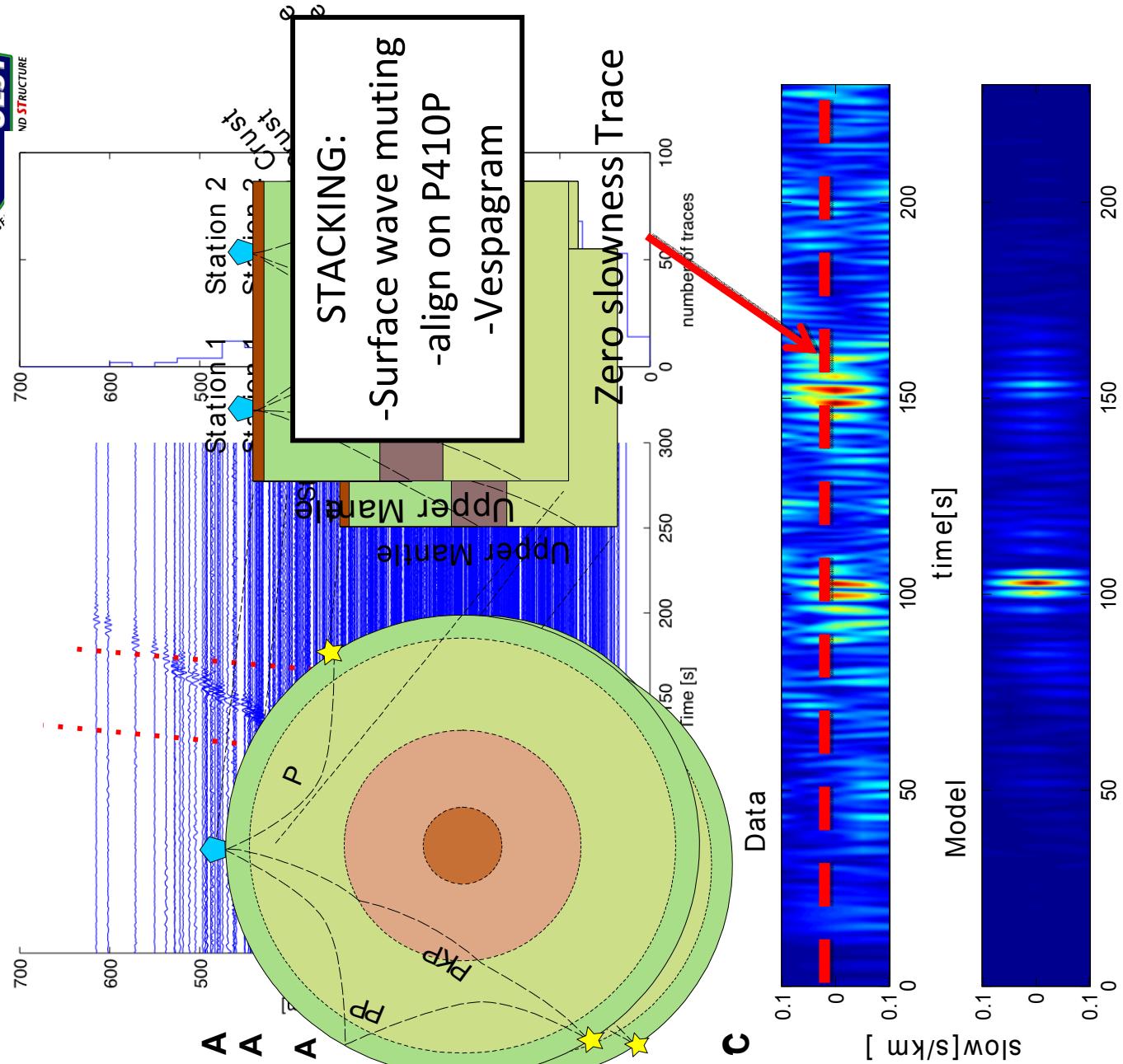
# Imaging Deep Earth with Noise:
# The Mantle Transition Zone



## Zero-offset Traces



**FORWARD MODELLING:**
Models of the mantle transition zone, with different velocity gradients and depth of discontinuities
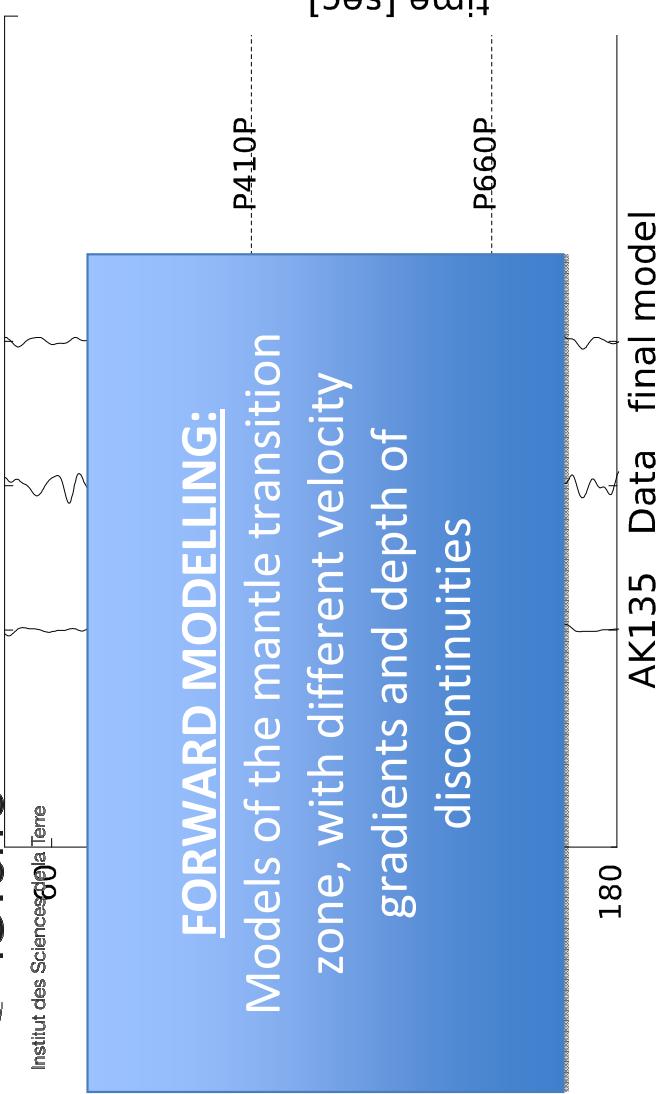
## Best Fitting Model

| MTZ model | Slope | Depth |
|---|---|---|
| TOP | 15 km | 405 km |
| BOTTOM | 4 km | 654 km |
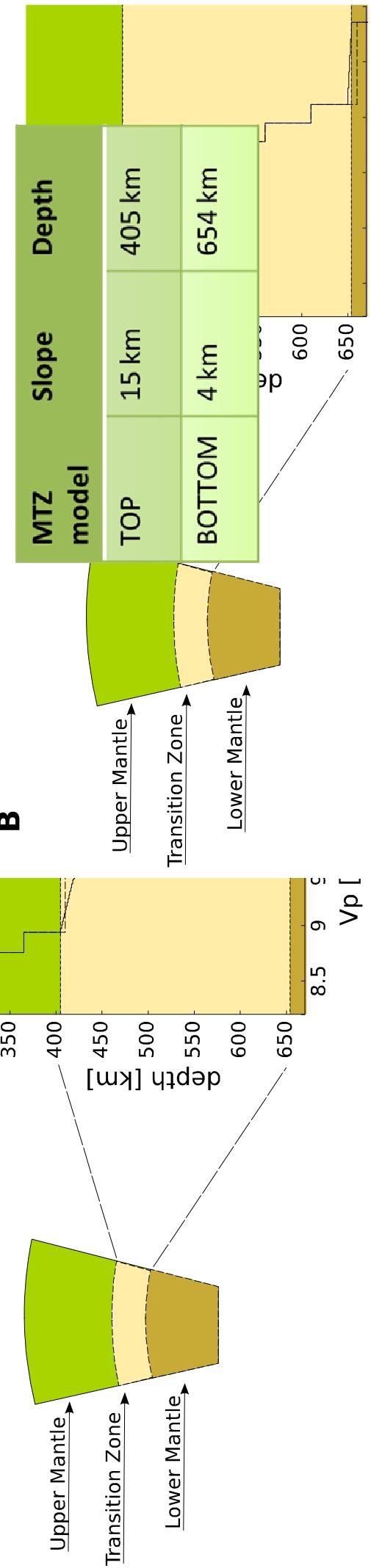
# GLOBAL NOISE CORRELATION
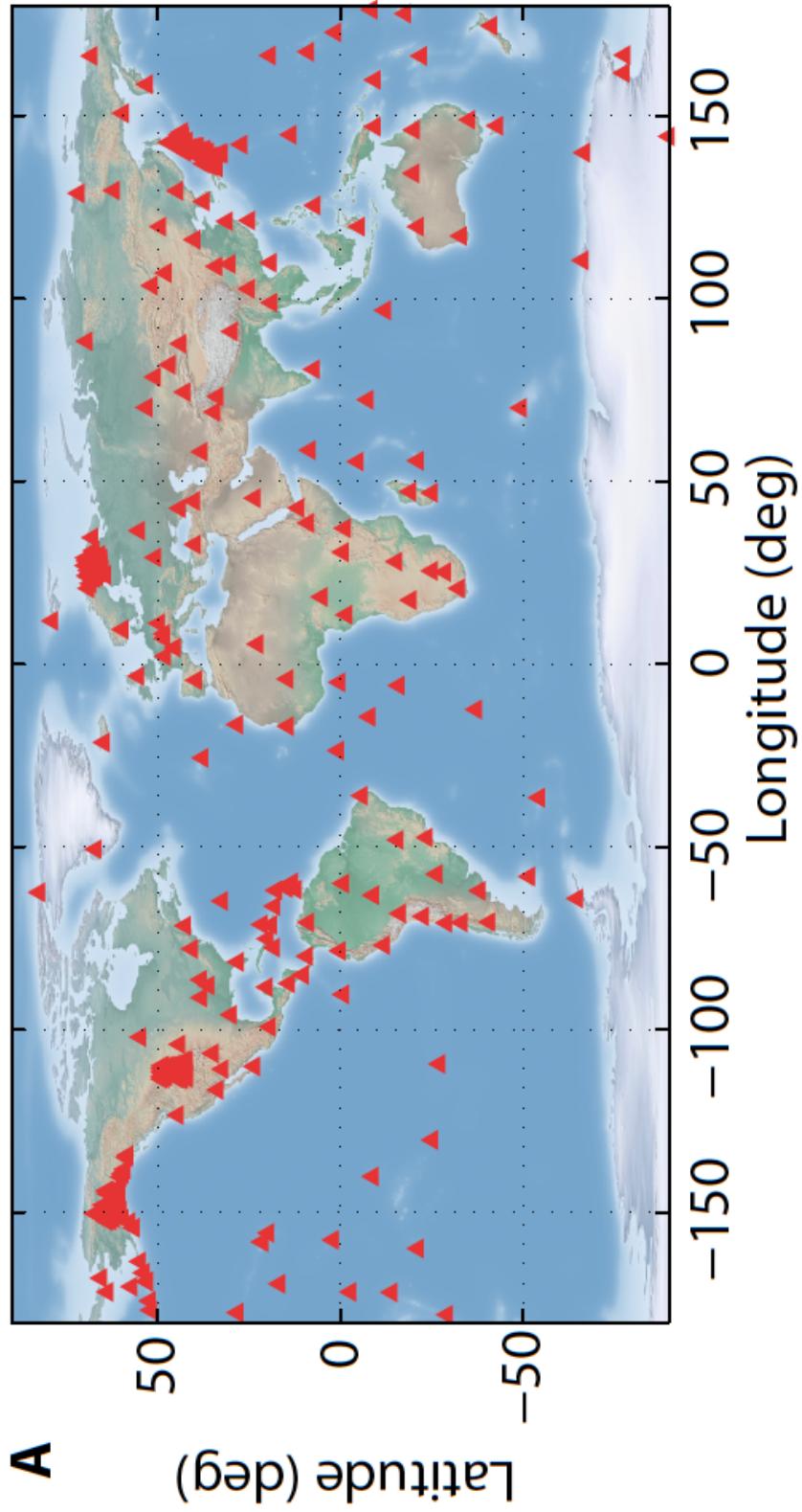


**339 STATIONS 1 YEAR OF DATA (2008)**
**57000 CORRELATIONS FB 0.01-0.5 Hz**

**Network:**
**GSN, K-NET, LAPNET, USARRAY, ALASKA SEIS. NET.**

# GLOBAL NOISE CORRELATION

## CORRELATIONS

## SYNTHETICS
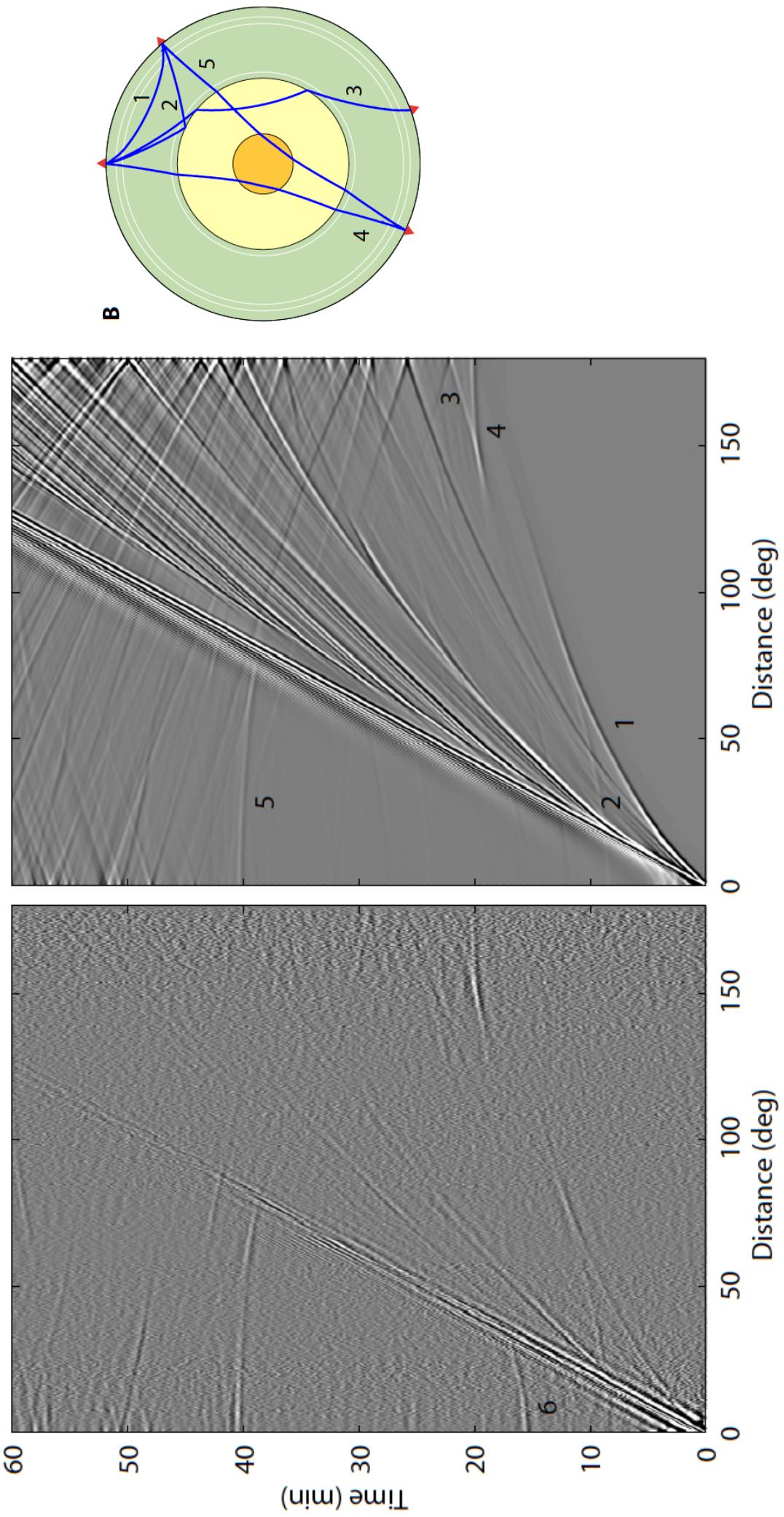


(Boue et al., GJI, 2013)

**BIN SIZE 0.01°**

# IMAGING DEEP EARTH WITH NOISE (I)

## Teleseismic P Waves Noise Tomography
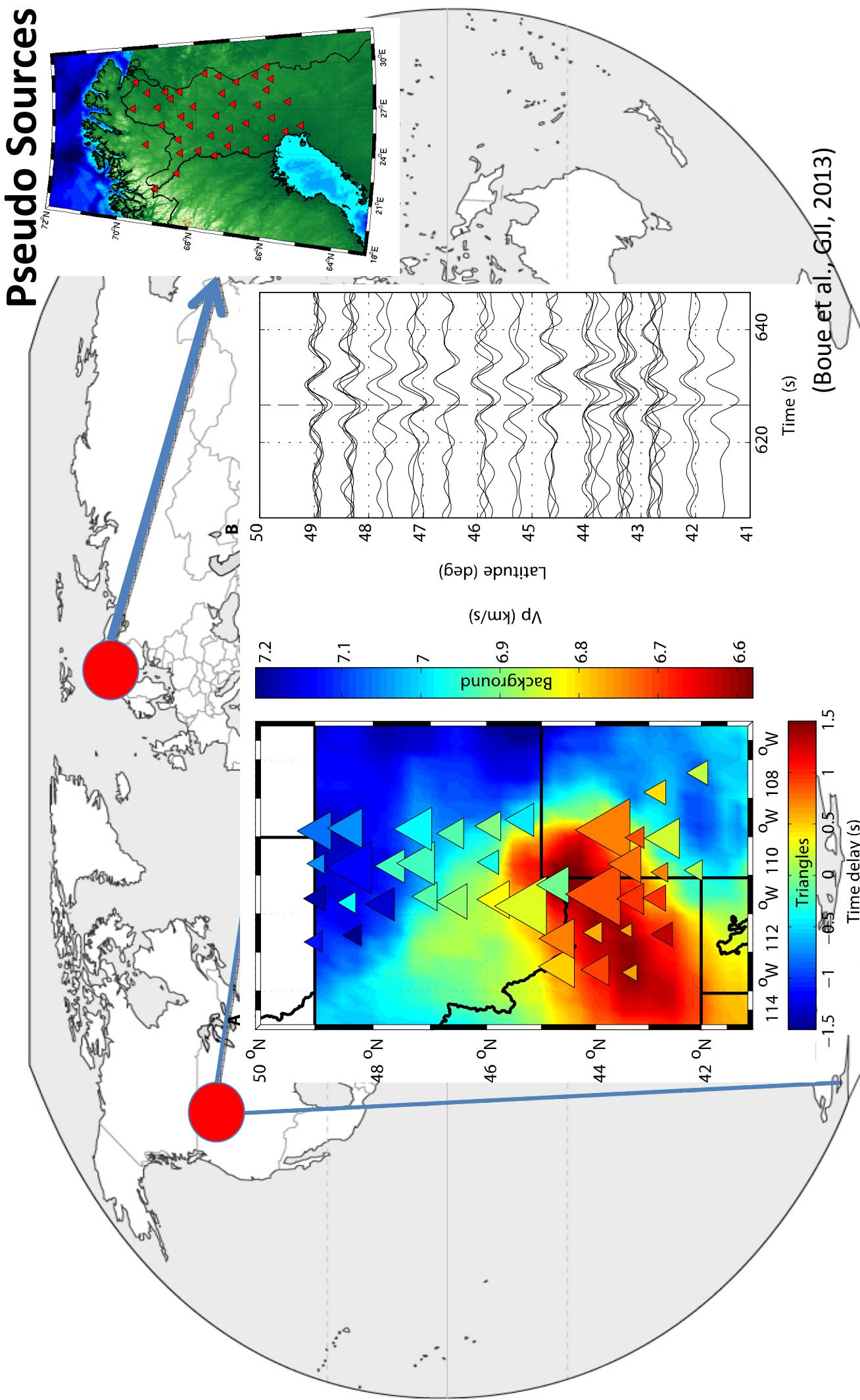
### Pseudo Sources



(Boue et al., GJI, 2013)

# IMAGING DEEP EARTH WITH NOISE (II)

## Short Period (7s) Noise Imgaging of th CMB



Japan–Alaska

Time from PcP (s)

Finland–Japan

Time from PcP (s)

USA–Alaska

Time from PcP (s)
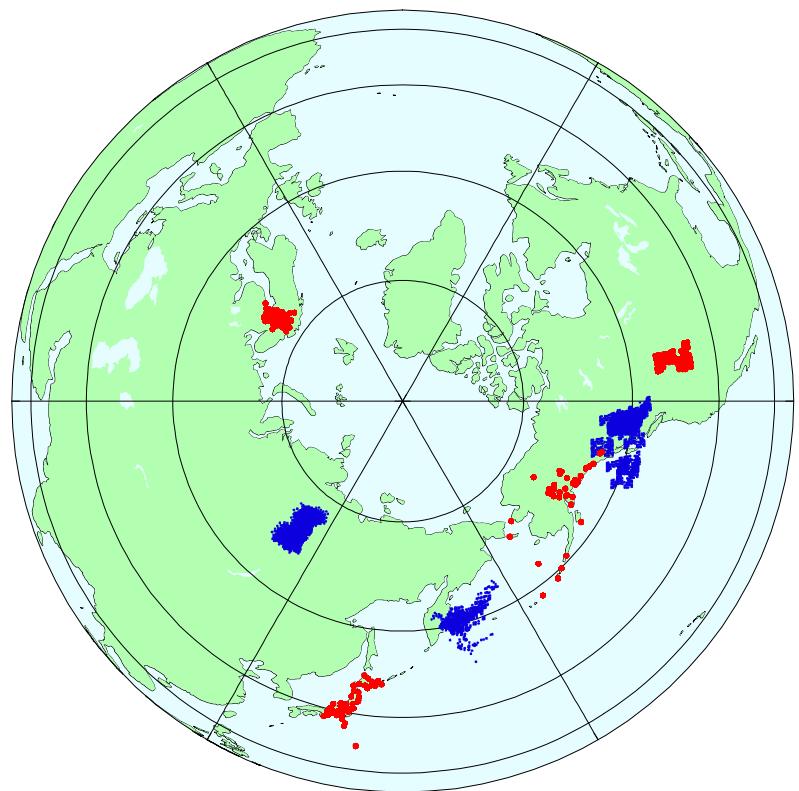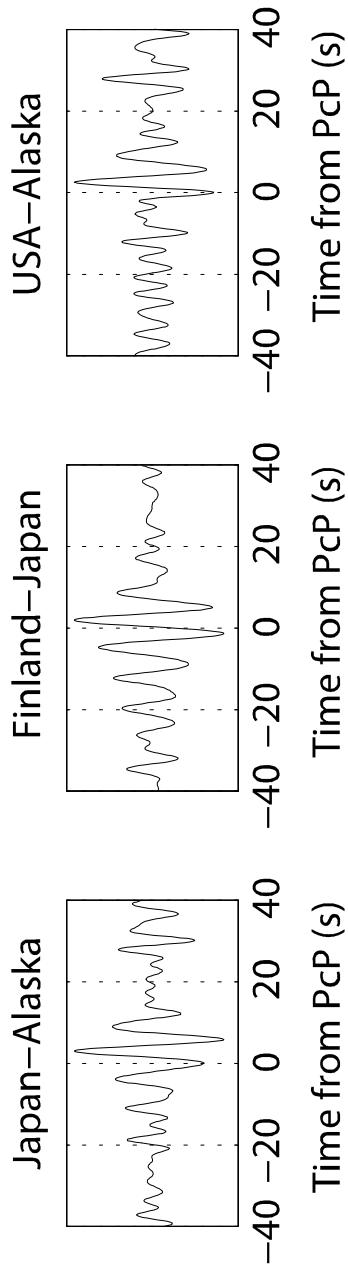
(Boue et al., GJI, 2013)

# IMAGING DEEP EARTH WITH NOISE (III)

## Anisotropy of the inner core (P'P'df)



(Boue et al., GJI, 2013)

# EARTHQUAKES OR NOISE?
## Work in progress...
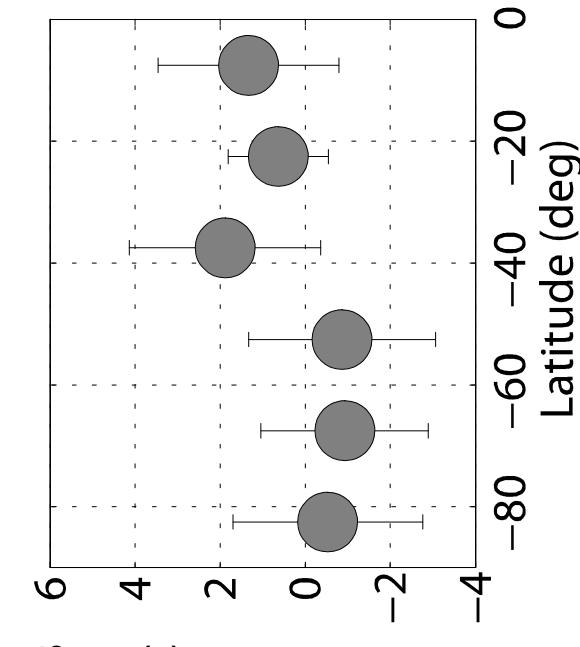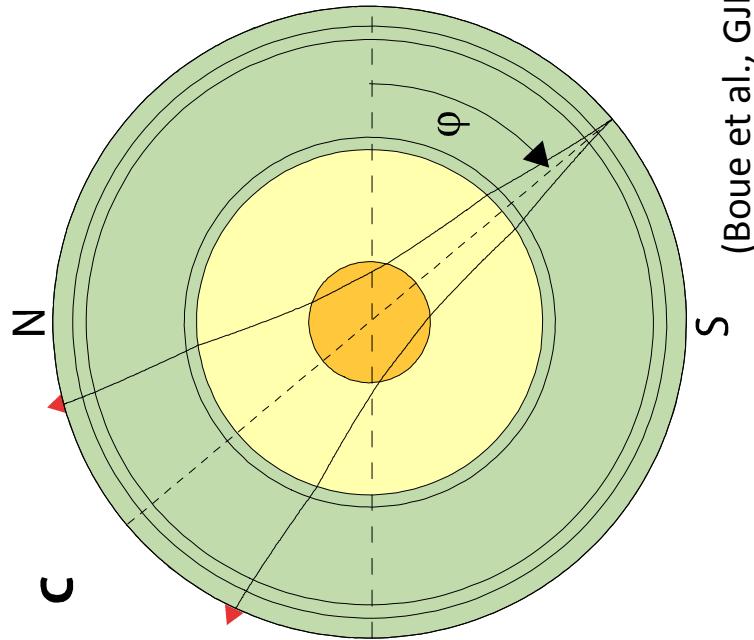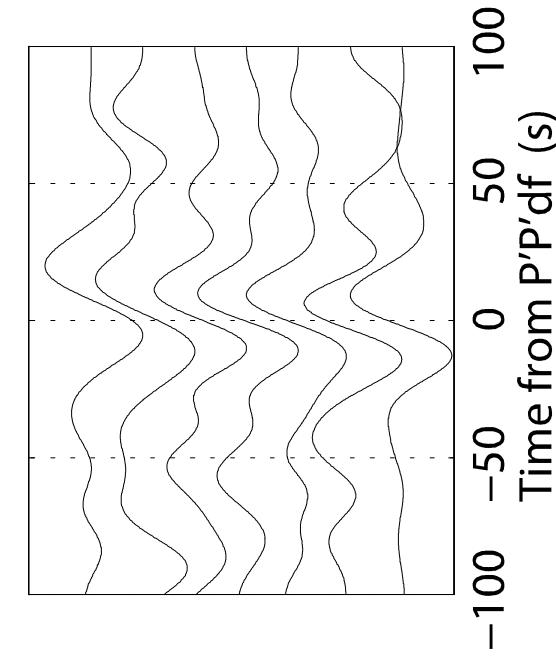
Only Large EQs

No Large EQs

# EARTHQUAKES OR NOISE?
## Work in progress...
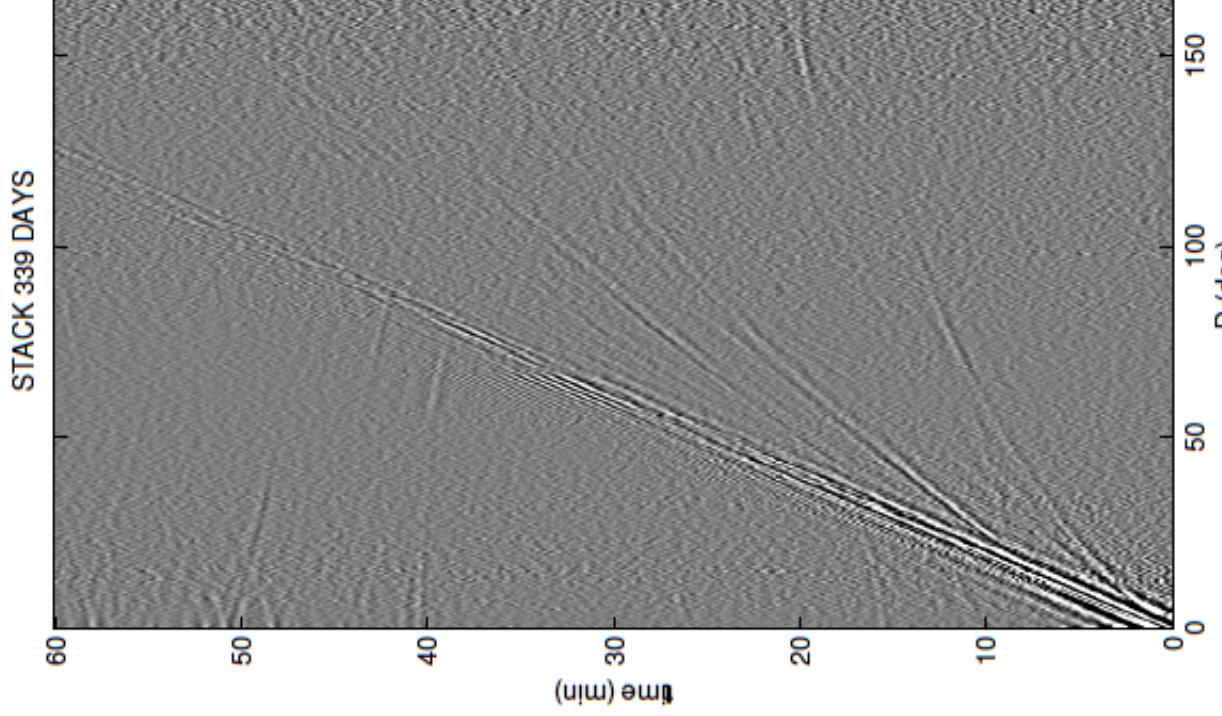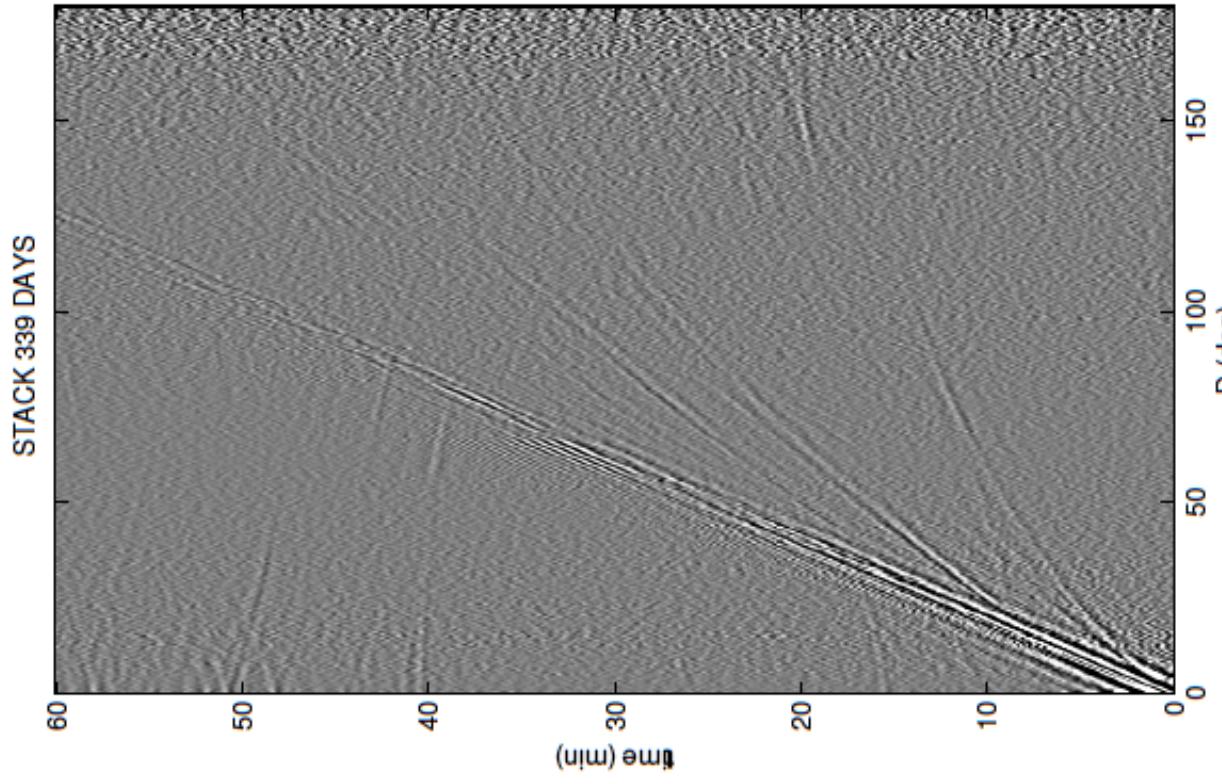
No Large EQs       Only Large EQs
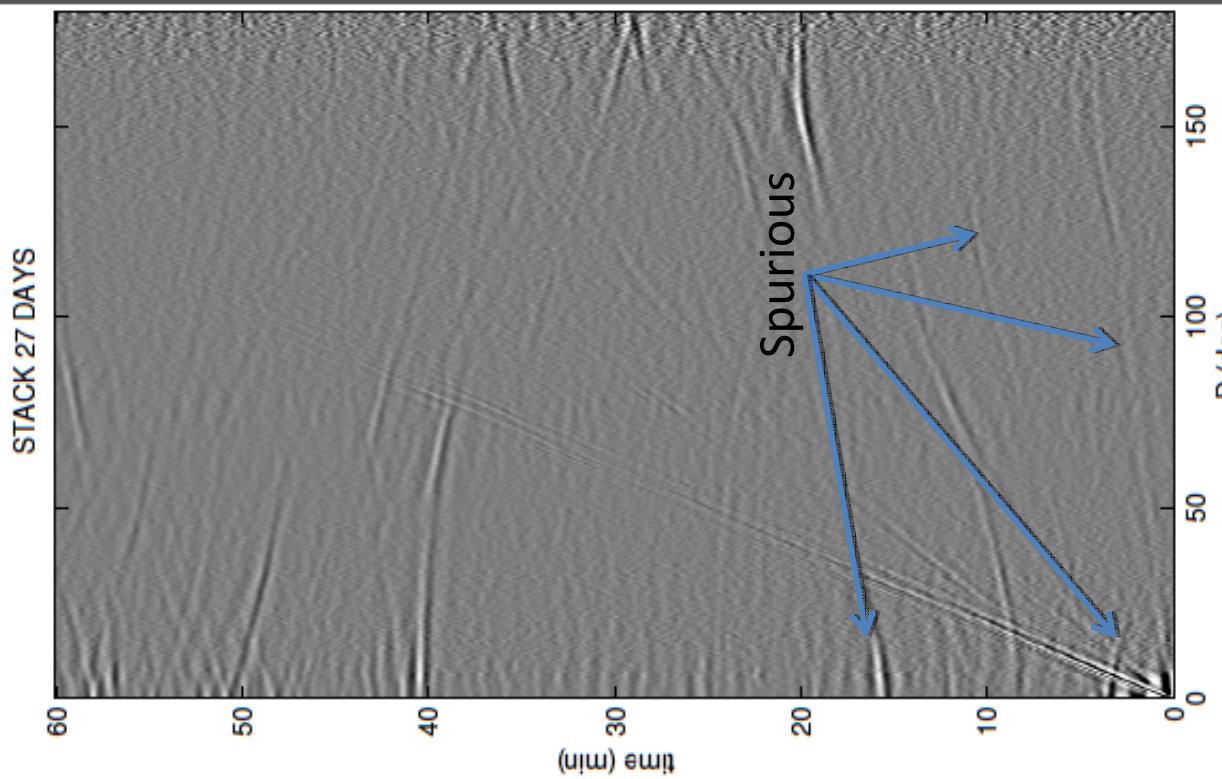


(Boue et al.,SSA 2013)

# SUMMARY

- It is possible to identify broadband teleseismic body waves using seismic noise correlation.

- The extracted body waves all contain information about the Earth structure, as the lithosphere, the mantle transition zone, the CMB and the inner core anisotropy

- Such body waves provide a new original dataset that can be used to improve the actual knowledge of the deep Earth interior

- Source of body waves? Relative contribution/effect of Eq/Noise/Coda must be deeply analyzed...

# THANKS

We thank all of the dedicated seismologists and technical staff who run the seismic networks for making their seismic data available.