New constraints on shear properties of the Earth's inner core from the global correlation wavefield

T. Costa de Lima, T-S. Phạm, X. Ma, H. Tkalčić

Research School of Earth Sciences, Australian National University.

Acknowledgments to Sheng Wang

Australian National University

EGU23-16057 | GD8.1

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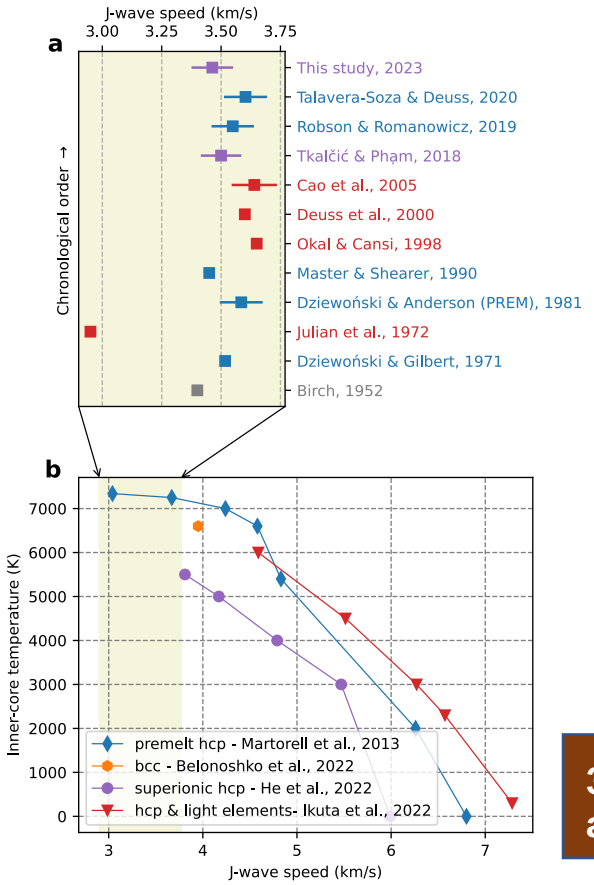
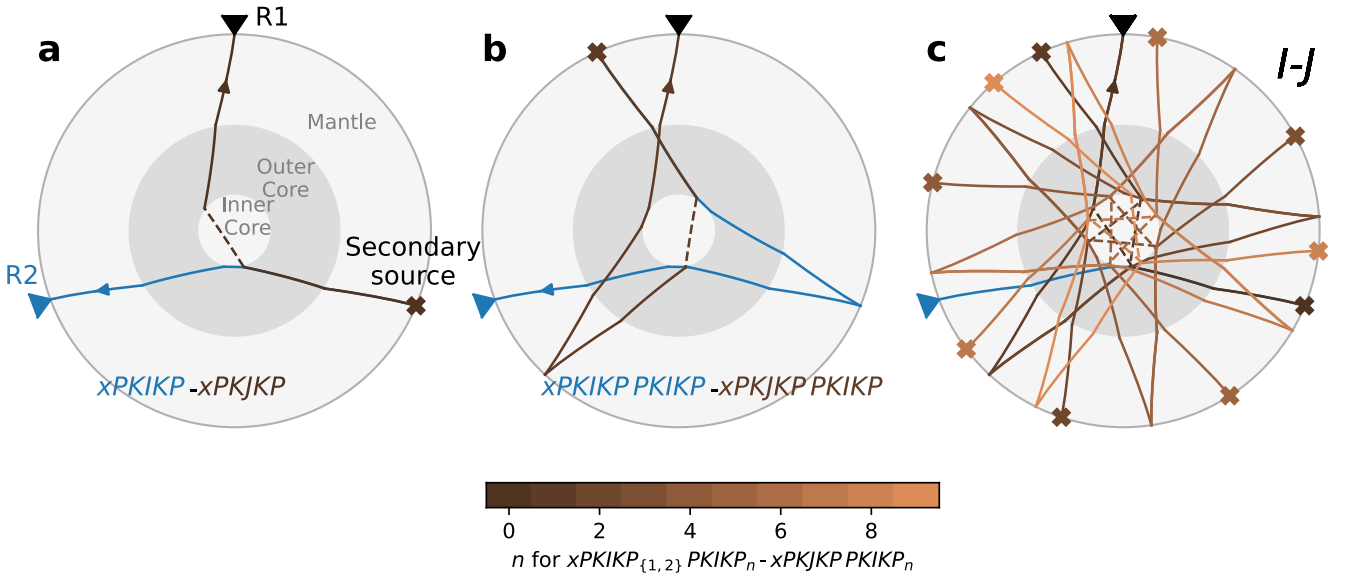
Photography not allowed

A new absolute value of shear-wave velocity in the IC …





Schematic formation of I-J correlation feature. This feature is highly sensitive to IC J-waves and we show its timings are also independent from the reference background velocity model. Thus, it provides an absolute new estimate of J-wave speed.

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3.39 ± 0.02 km/s near the top and 3.54 ± 0.02 km/s in the center

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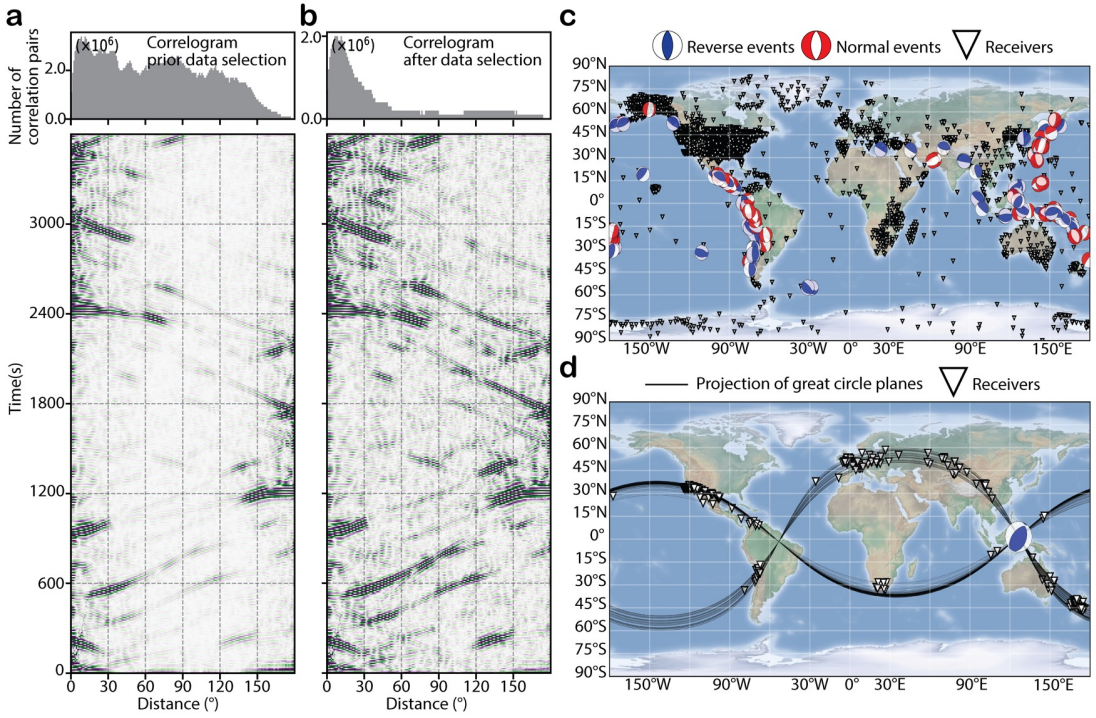
Data and method

A careful selection of source mechanism and source-receiver pair geometry is crucial for **improving the quality of observations**. Only normal and thrust events are considered and receiver-pairs near the same great circle plane.



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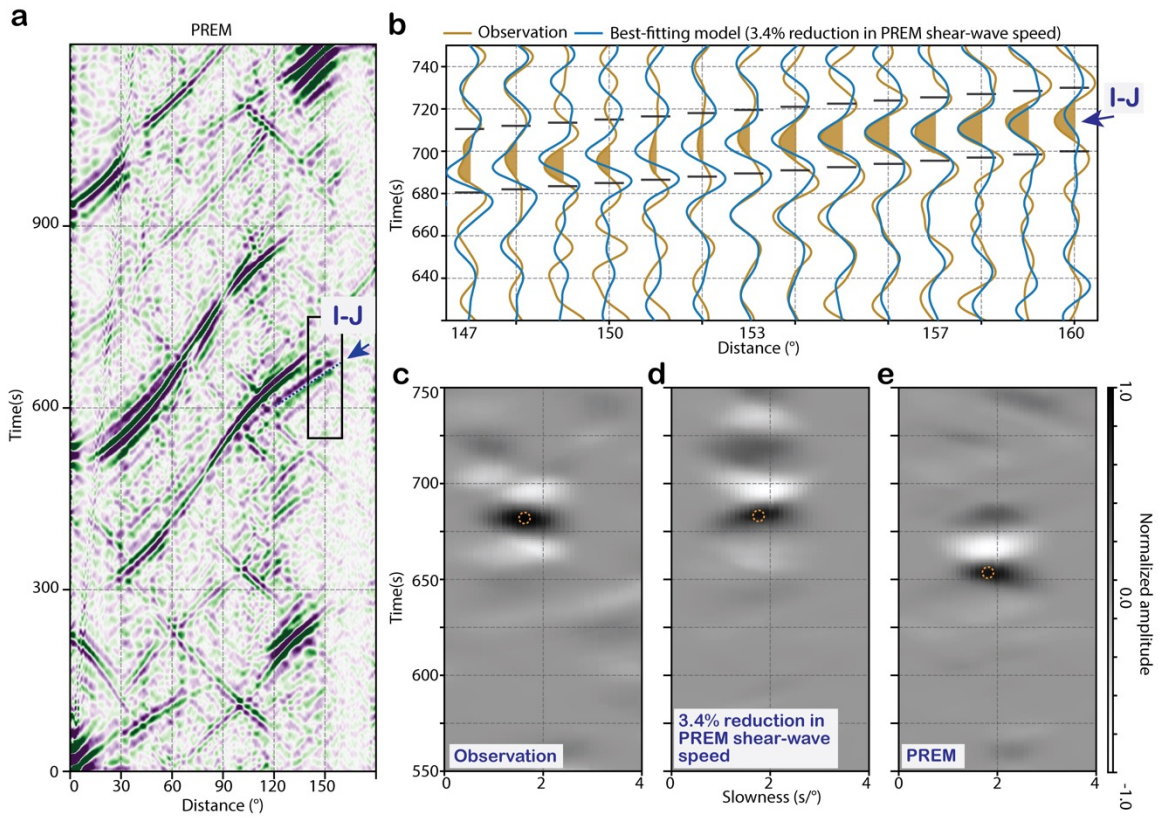
Modelling of I-J



I-J modelling is **independent of the background Earth velocity model**, and equivalent to a **3.4% reduction in J-wave speed relative to PREM**… Please come to chat to know more ☺

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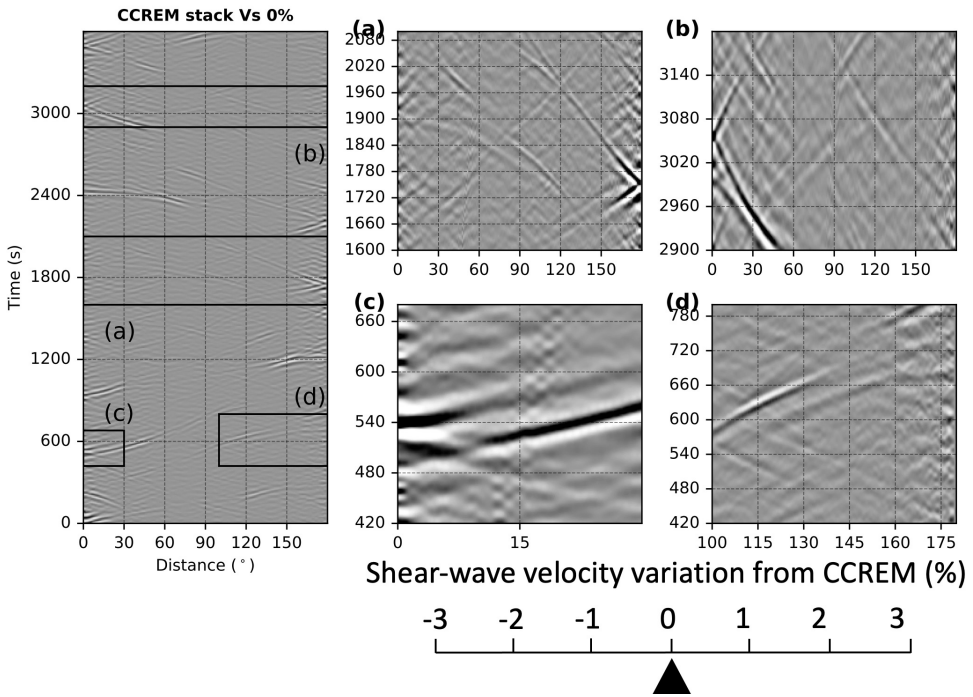
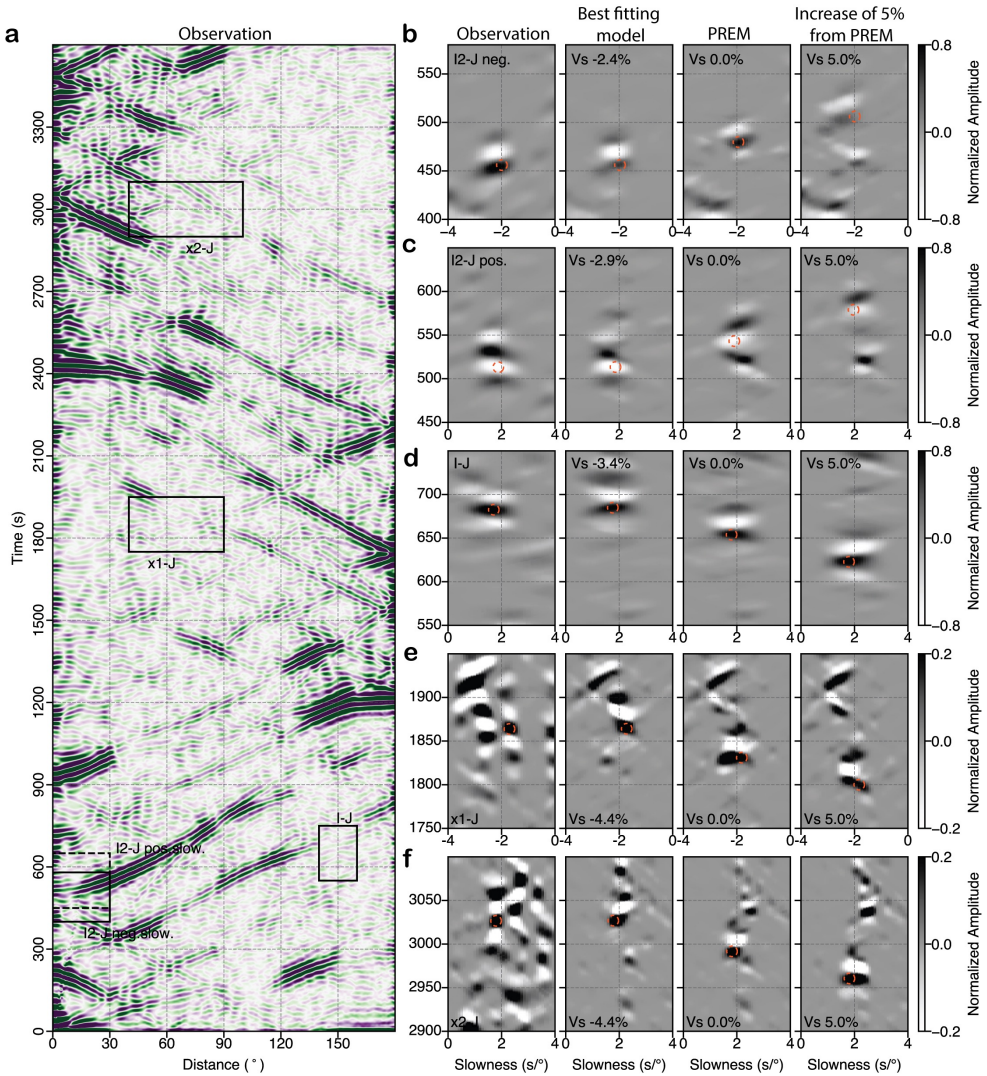
Detection of multiple J-wave sensitive correction features

We do a systematic search for correlation features sensitive to the IC shear-wave speed. We make relative perturbations in J-wave speed and keep the rest of the Earth's velocity model unchanged. Then, we calculate the correlograms and look for features showing strong variations in timing (vertical axis of correlograms).



We identify **4 correlation features sensitive to J-waves.**

Comparison of slant stacks of observation and synthetic counterpart of all features.



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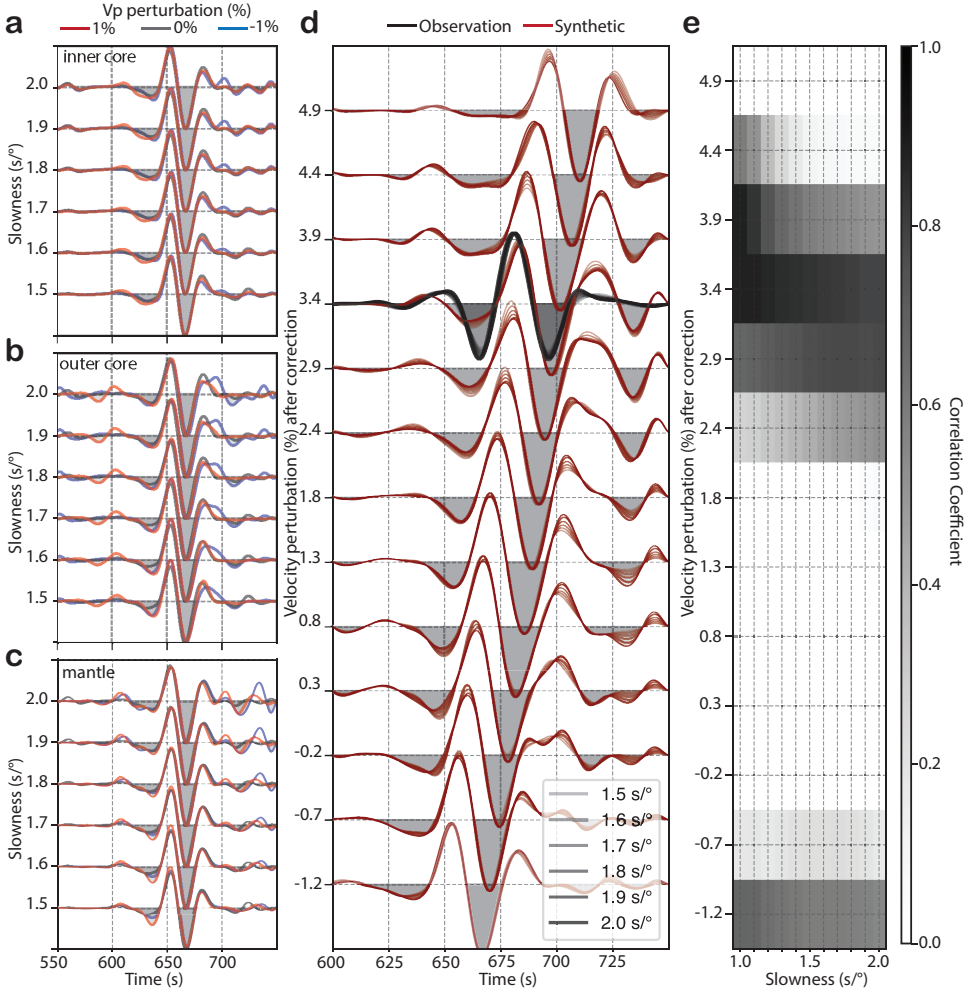
Sensitivity of I-J correlation feature on the background velocity model and modeling of J-wave speed



An absolute estimation of shear-wave speed in the IC.

(a-c) Slant stacks of synthetic I-J estimated with perturbation in compressional velocity in (**a**) the inner core, (b) outer core, (c) and mantle, of +1%, 0%, and -1% relative to PREM, shown in blue, grey, and red, respectively.

Note that the arrival times of I-J correlation feature are minimally influenced by variations in the Earth reference model.

(**d**) Waveform modeling of I-J. The waveforms are phase-weighted stacks at the slowness of 1.5, 1.6, 1.7, 1.8, 1.9, and 2.0 s/° calculated using PREM with IC Vs perturbations.

(**e**) Correlation coefficient matrix between observed and synthetic slant stacks. Note the consistency of the best-fitting model for the range of slowness from 1 s/° to 2 s/°.

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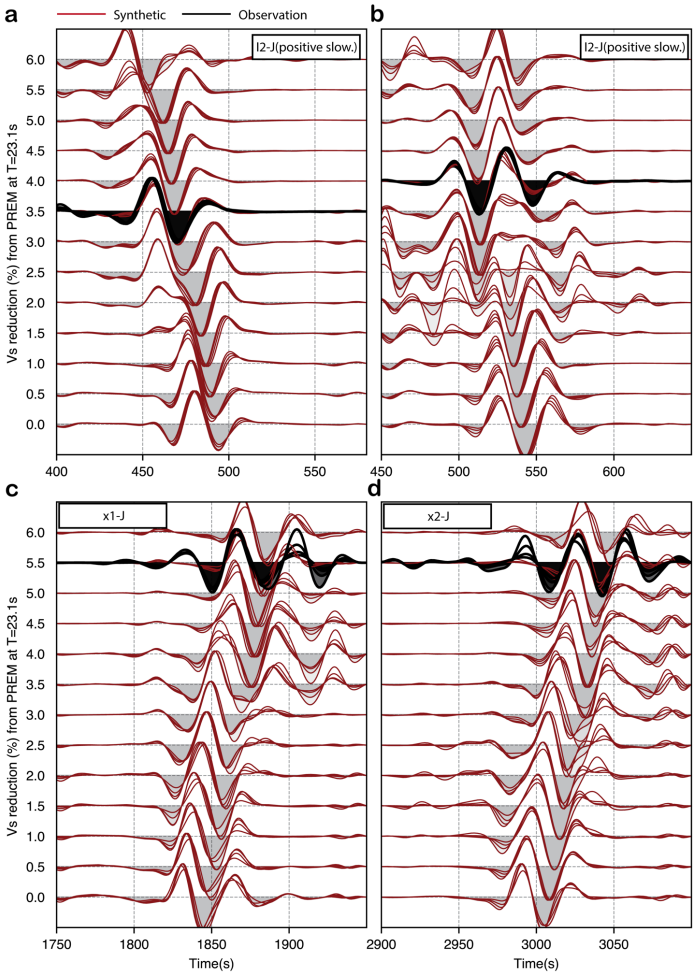
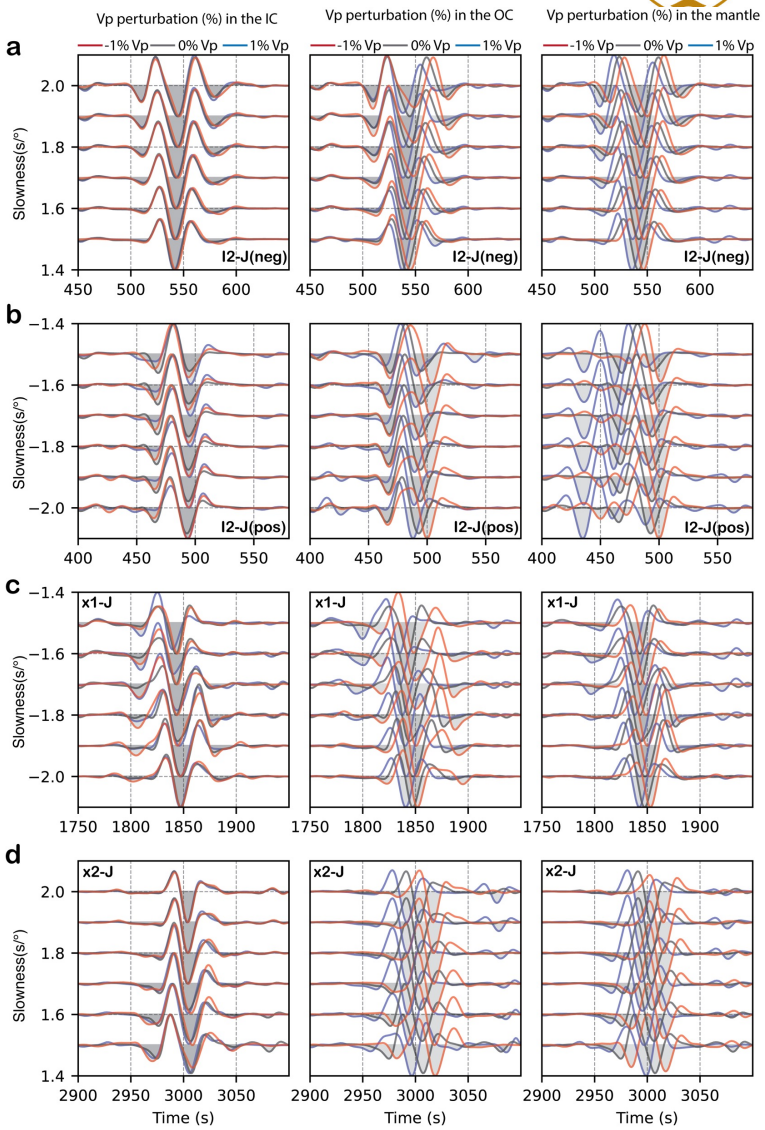
Other features are contaminated by uncertainties in the Earth velocity model… thus, they provide only relative measures of J-wave speed.



Modeling of several J-waves correlation features. (a) Slant stacks of the I2-J negative slowness leg at the slowness of -1.5, -1.6, -1.7, -1.8, and -1.9 s/° estimated for IC velocities perturbed from PREM (values in percentage are indicated in the vertical axis). The observed waveforms are in black, and the synthetic waveforms are in red. (b) to (d) similar to (a) but for the I2-J positive slowness leg, x1-J, and x2-J, respectively.

The reductions in the inner core shear speed to fit both upper and lower branches of I2-J (2.34%, and 2.85% reduction in Vs from PREM at T=1s, respectively) are consistent with the observation of Tkalčić and Pham (2018) of 2.5 ± 0.5%.



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