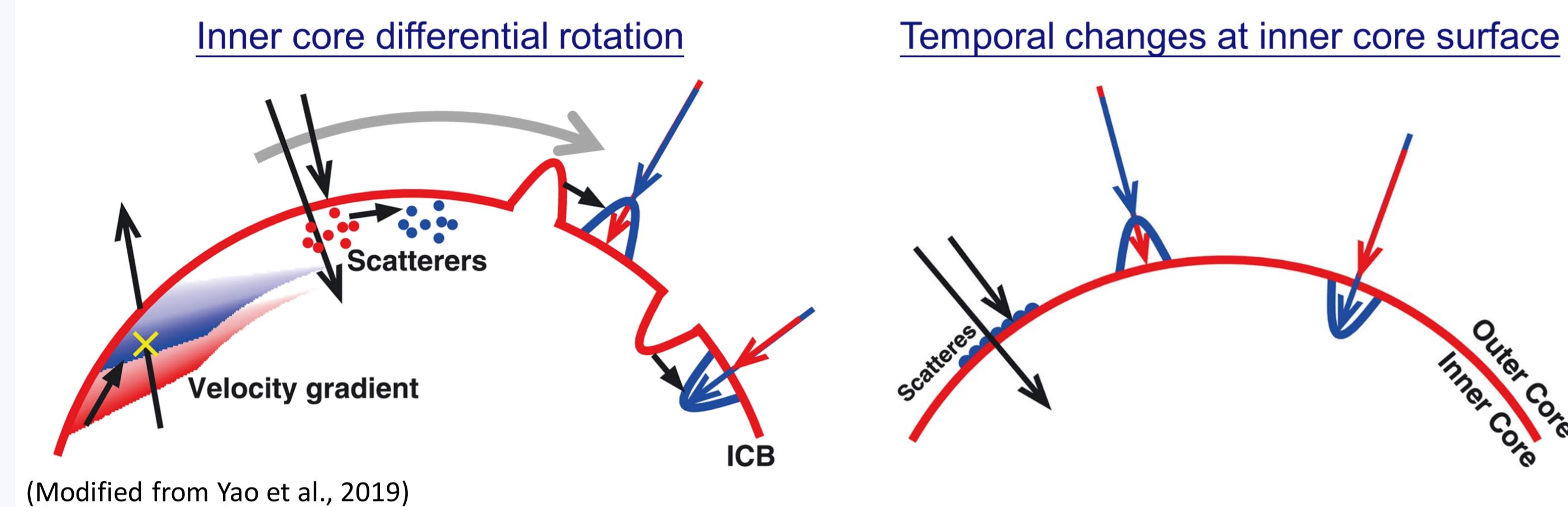


Background

The great debate of inner core temporal change

Two mechanisms have been proposed to explain the temporal changes of the inner core seismic phases between repeating earthquakes.



Seismic evidence contradicting the inner-core rotation hypothesis

Three lines of contradictory seismic evidence to the hypothesis of the Earth's inner core differential rotation have been documented in the literature (Yao *et al.*, 2019):

- 1) Rapidly disappeared scatterers at inner core surface inferred from doublet signal coda;
- 2) Contradictory estimates of differential rotation rate inferred from seismic observations recorded by close seismic stations;
- 3) Unreasonable rotation rate inferred from doublet observations based on the hypothesis.

Two new reports of the hypothesis of inner core differential rotation

Based on a large collection of doublet data, Wang *et al.* (2024) and Yang & Song (2023) reported two different patterns of inner core differential rotation.

nature geoscience 2023

Article
Multidecadal variation of the Earth's inner-core rotation
Yi Yang & Xiaodong Song

"Here we analyse repeated seismic waves from the early 1990s and show that all of the paths that previously showed significant temporal changes have exhibited **little change** over the past decade. This globally consistent pattern suggests that differential inner-core rotation has recently **paused**."

nature 2024

Article
Inner core backtracking by seismic waveform change reversals
Wei Wang, John E. Vidale, Guanning Pang, Keith D. Koper & Ruoyan Wang

"... many multiplets exhibit waveforms that **change and then revert** at later times to match earlier events. ... demonstrates that the inner core gradually **super-rotated** from 2003 to 2008, and then from 2008 to 2023 **sub-rotated** two to three times more slowly back through the same path."

Take-home Message

- The hypothesis of inner core differential rotation **cannot consistently explain** the seismic observations; **neither is it needed** for the explanation of the seismic observations;
- Temporal change of inner core surface is **required** by the seismic observations; so does it **fully explain** the seismic observations.

Supplement

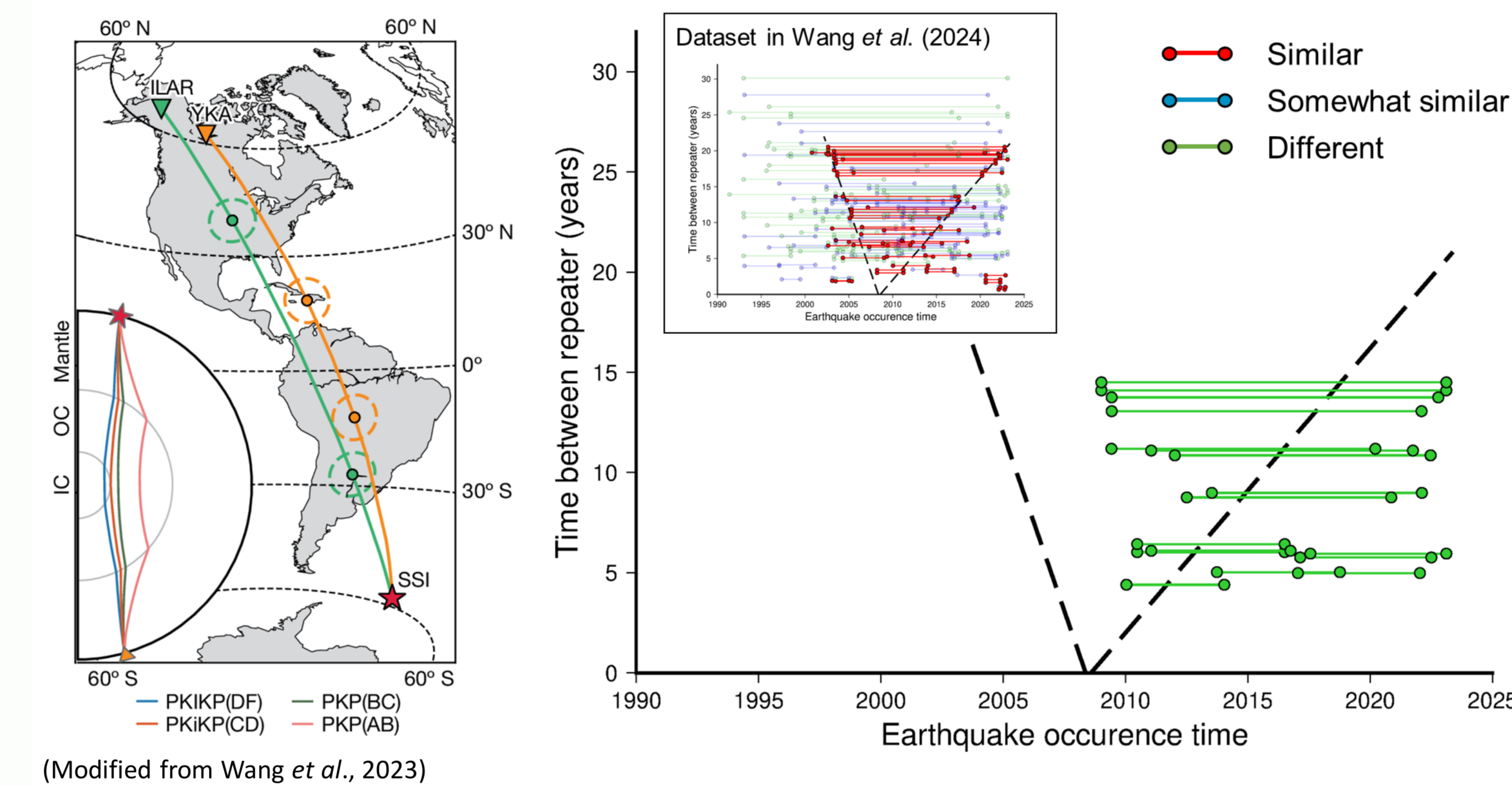
References to the great debate of inner core temporal change

Another poster of the authors on *Thur.*: DI41A-3056

Four new lines of seismic evidence contradicting the inner core differential rotation hypothesis

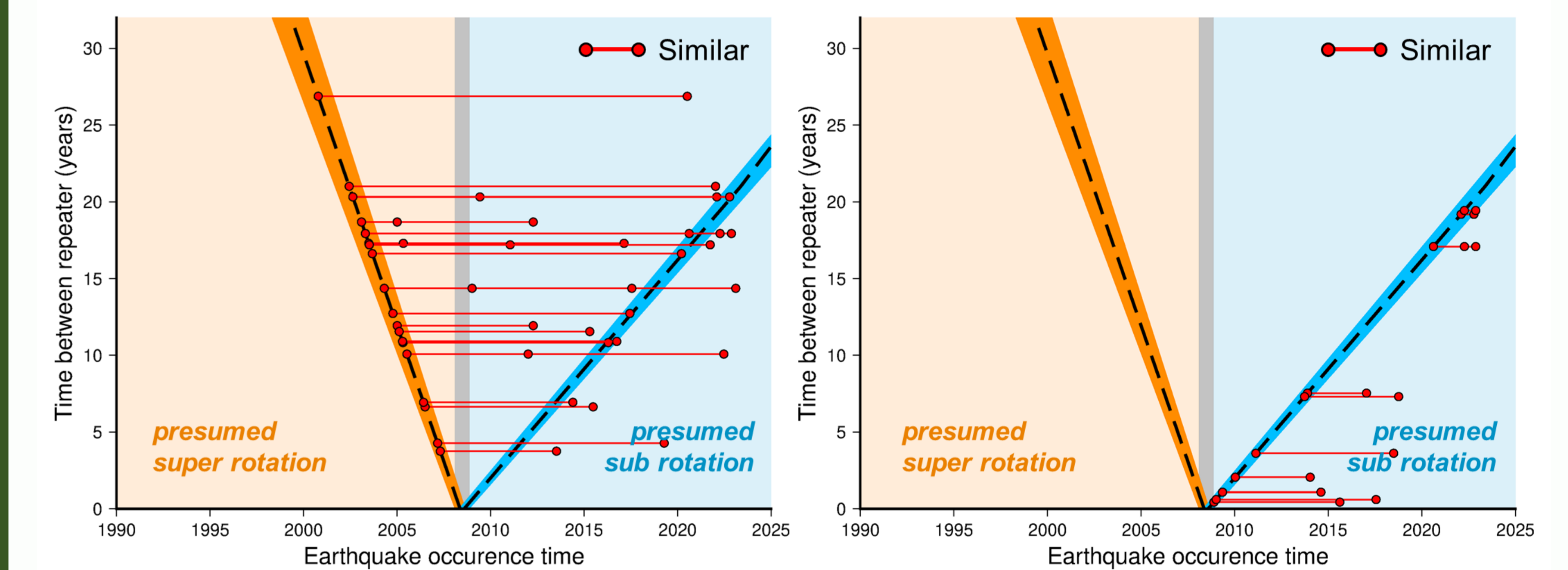
1 Observed changes after 2009 vs. "paused changes"

The inner core phases show evident waveform changes at the two arrays after 2009 in Wang *et al.* (2024), contradicting the report of "the differential inner-core rotation has recently paused" in Yang & Song (2023).



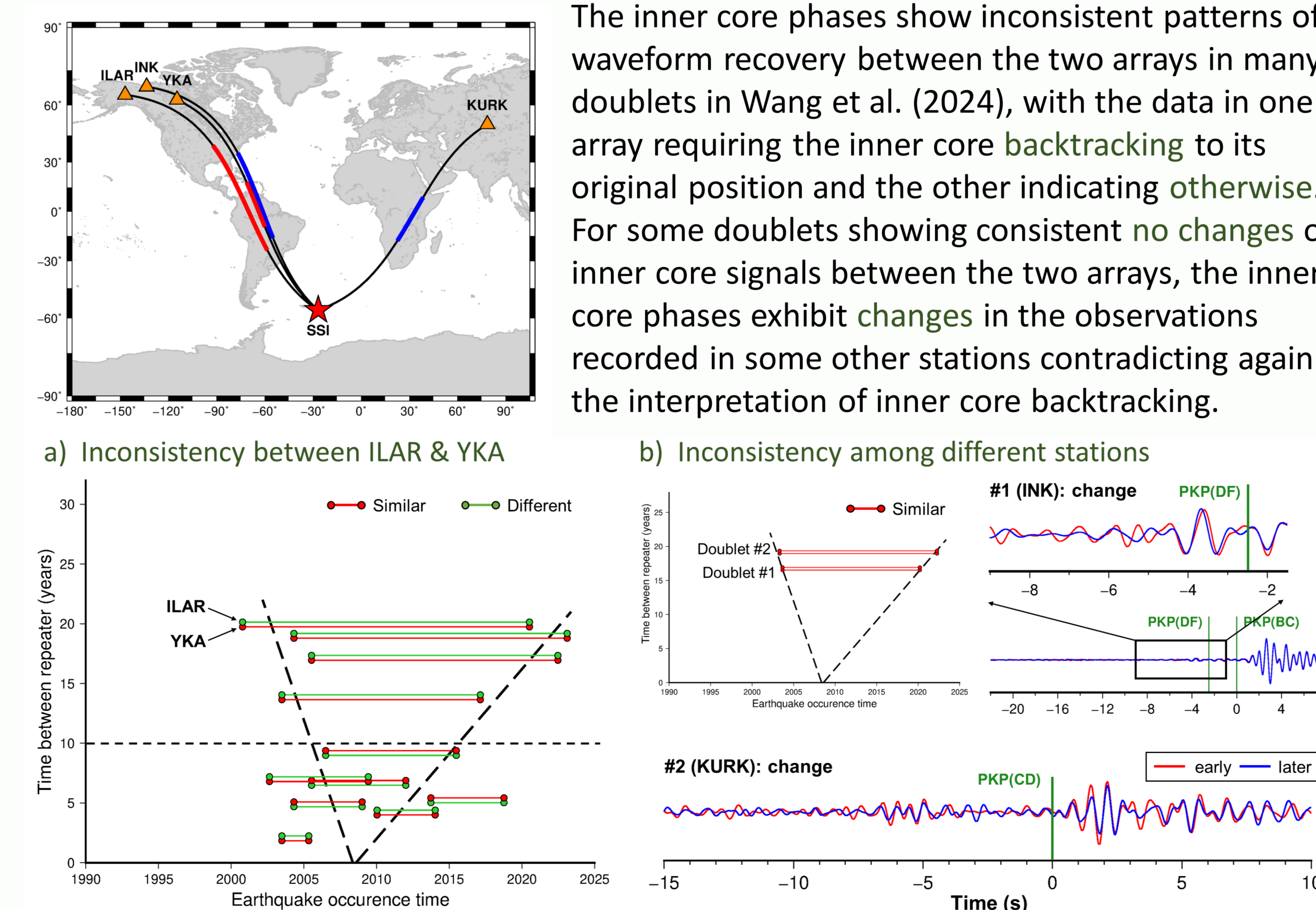
2 Random recovery time inconsistent with IC backtracking

Based on the proposed inner core differential rotation model (the two gradient dashed lines and the shaded regions), one could predict the waveform recovery time of doublets. However, the observed recovery times of doublets are random and persist after the presumed backtracking has recovered the inner core to its original positions, inconsistent with the proposed backtracking model and any possible models of backtracking.



3 Contradictory observations for differential rotation

The inner core phases show inconsistent patterns of waveform recovery between the two arrays in many doublets in Wang *et al.* (2024), with the data in one array requiring the inner core backtracking to its original position and the other indicating otherwise. For some doublets showing consistent no changes of inner core signals between the two arrays, the inner core phases exhibit changes in the observations recorded in some other stations contradicting again the interpretation of inner core backtracking.



4 Opposite differential rotations based on different datasets

The inferred direction of inner core differential rotation in 1999 and 2007 would be contradictorily both westward and eastward (Tian & Wen, 2023), following a twin-station analysis and the hypothesis of inner core differential rotation (Yang & Song, 2022), contradicting any models of inner core differential rotation.

