



## Spatio-temporal distribution of outer-rise seismic sequences

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### ► To cite this version:

Anthony Sladen, Jenny Trevisan. Spatio-temporal distribution of outer-rise seismic sequences. International Joint Workshop on Slow Earthquakes, Sep 2018, Fukuoka, Japan. 2018, International Joint Workshop on Slow Earthquakes. hal-02401181

HAL Id: hal-02401181

<https://hal.science/hal-02401181>

Submitted on 16 Nov 2020

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## Summary

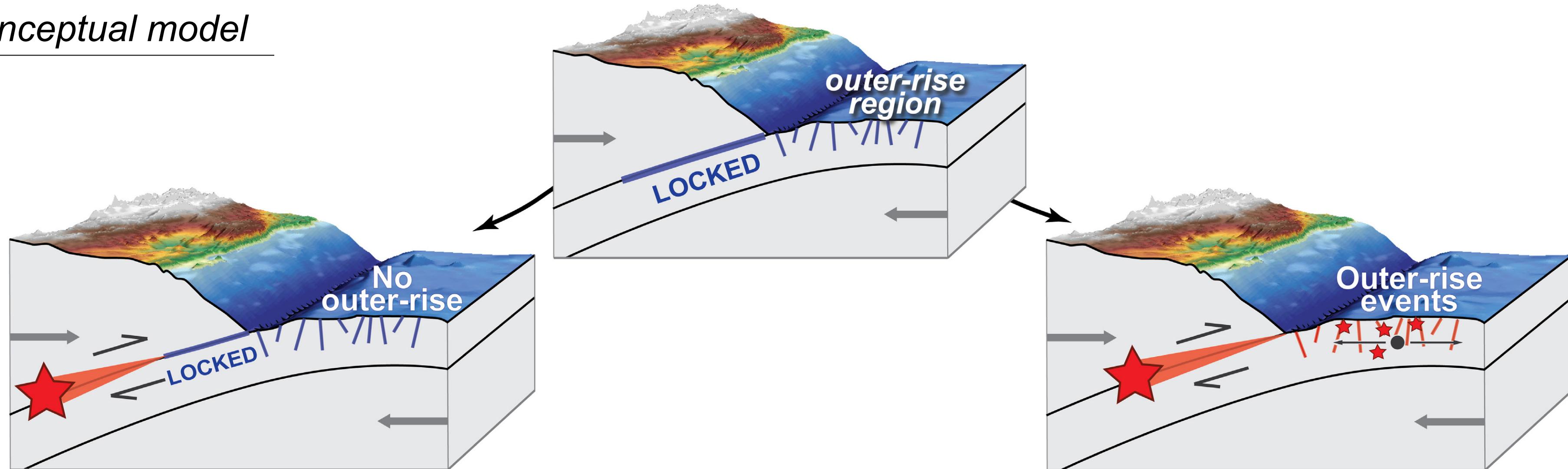
As they enter the subduction zone, oceanic plates are bent by tectonic forces. This bending creates the outer-rise region, a zone of extension just seaward of the trench dominated by normal fault activity. Over the long term, tectonic forces are expected to create an homogeneous distribution of outer-rise seismic activity. However, over time scales shorter than the seismic cycle, the seismic response of the outer-rise region can exhibit spatial and temporal variability. One example are the large bursts of outer-rise seismicity triggered following some large megathrust earthquakes and probably due to static stress transfer (see Bloc A below).

To investigate this variability, we analyze 24 years (1990-2013) of global outer-rise seismicity using the International Seismological Centre Bulletin. In most subduction zones, we find that one to two thirds of the outer-rise seismicity occurs in sequences (see Bloc B). And about half of these outer-rise sequences can be related to the unloading of the adjacent megathrust fault (see Bloc C). Our results suggest that shallow slow slip on the megathrust faults, if a relatively common behavior, could also have a control on the outer-rise seismic activity.

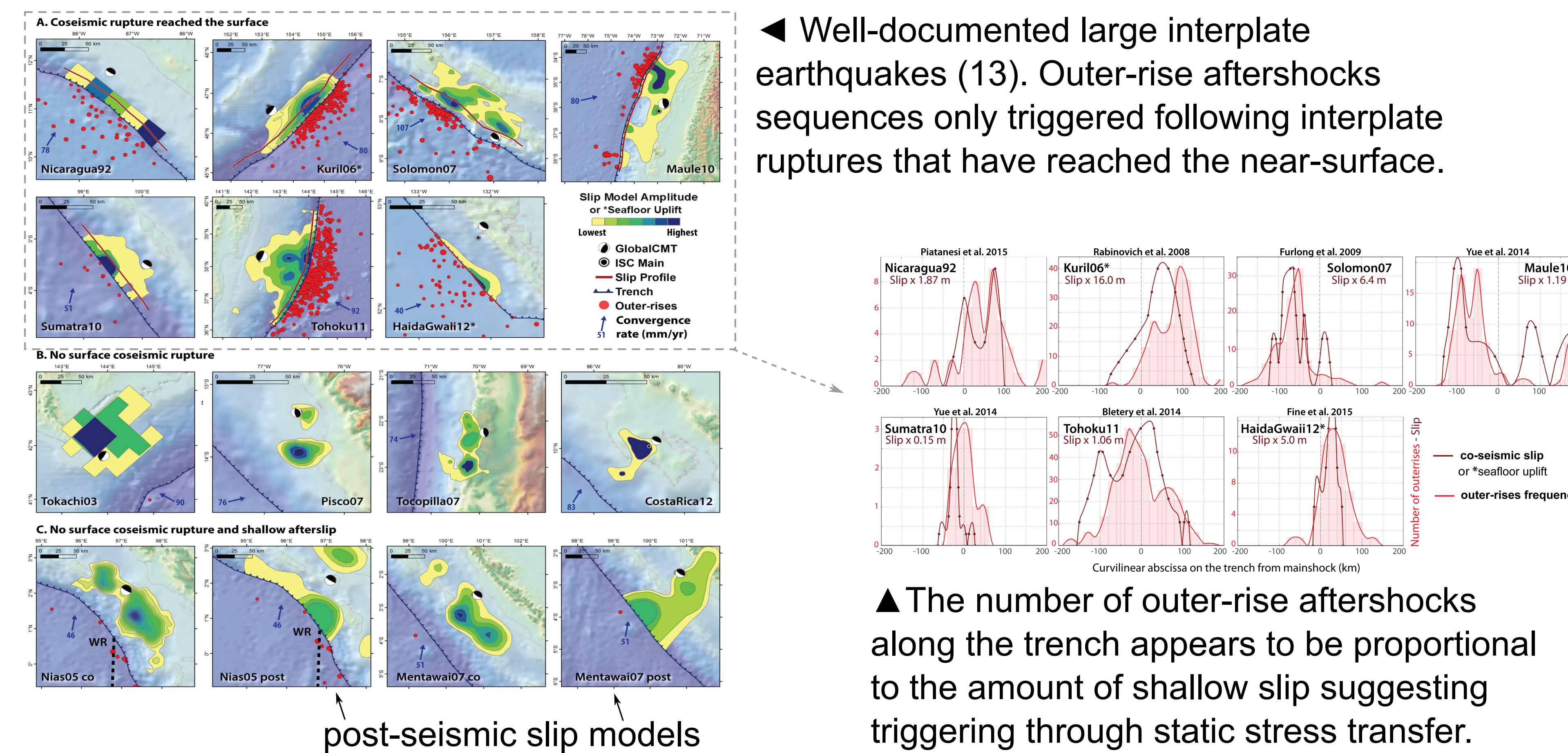
## A Outer-rise aftershocks are controlled by near-surface rupture of the megathrust fault

Sladen and Trévisan, EPSL, 2018

### Conceptual model



### Observations



### References

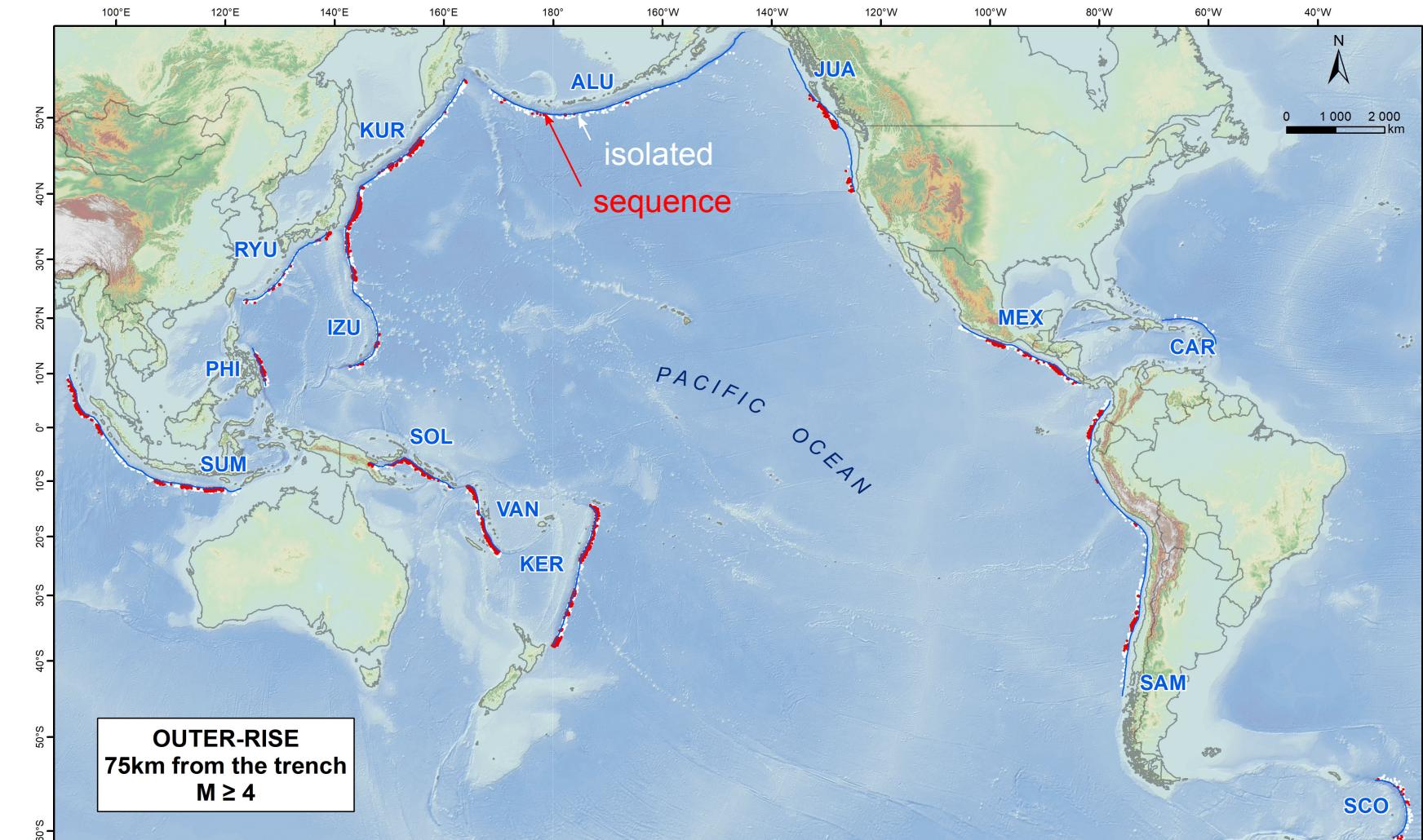
Sladen, A., and J. Trévisan (2018), Shallow megathrust earthquake ruptures betrayed by their outer-trench aftershocks signature, *Earth and Planetary Science Letters*.

Bulletin of the International Seismological Centre (ISC), <http://www.isc.ac.uk/iscbulletin/>

B

## Global distribution of Outer-rise seismicity ( $M \geq 4$ )

Strong variability in the global rate of outer-rise earthquakes (ORE). For instance, the outer-rise of the Vanuatu arc is 10x more seismically active than the Aleutian



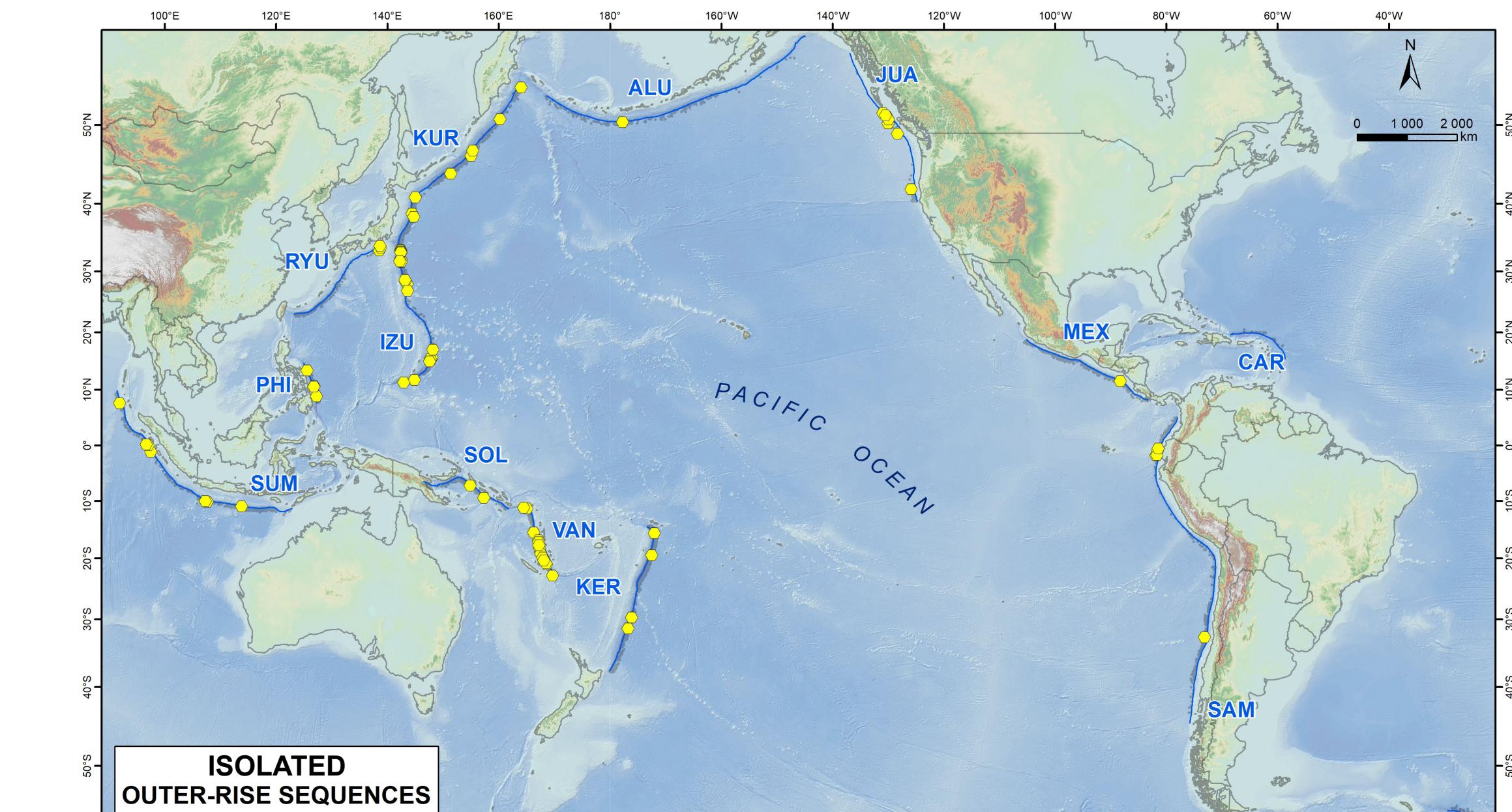
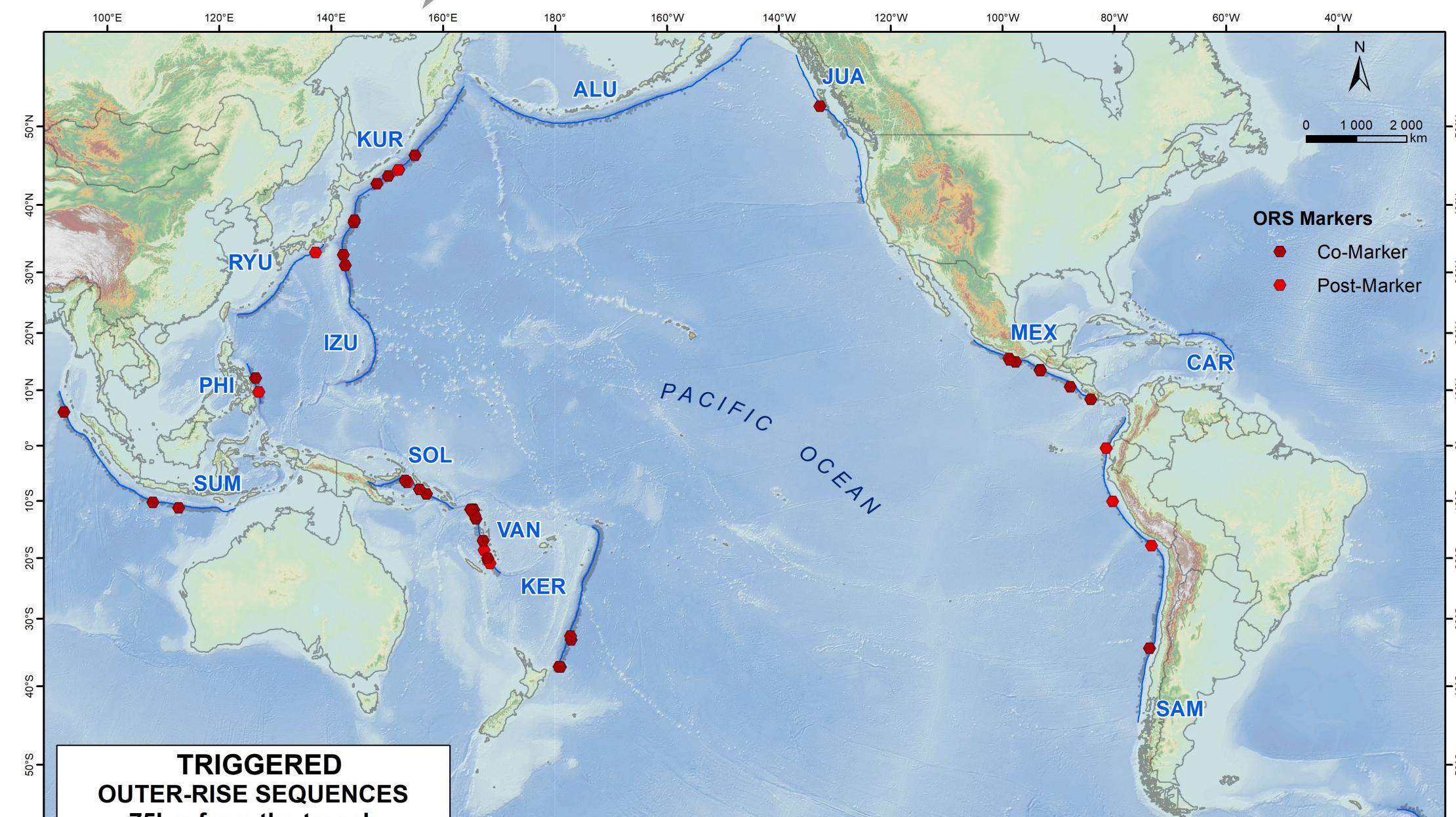
In most subductions, we observe that a large fraction of outer-rise seismicity is occurring in sequences

C

## Global distribution and types of Outer-Rise Sequences (ORS)

### Two types of outer-rise sequences (ORS)

- Isolated and triggered ORS have about the same global distribution,
- No clear systematic link between tectonic features and the location of ORS

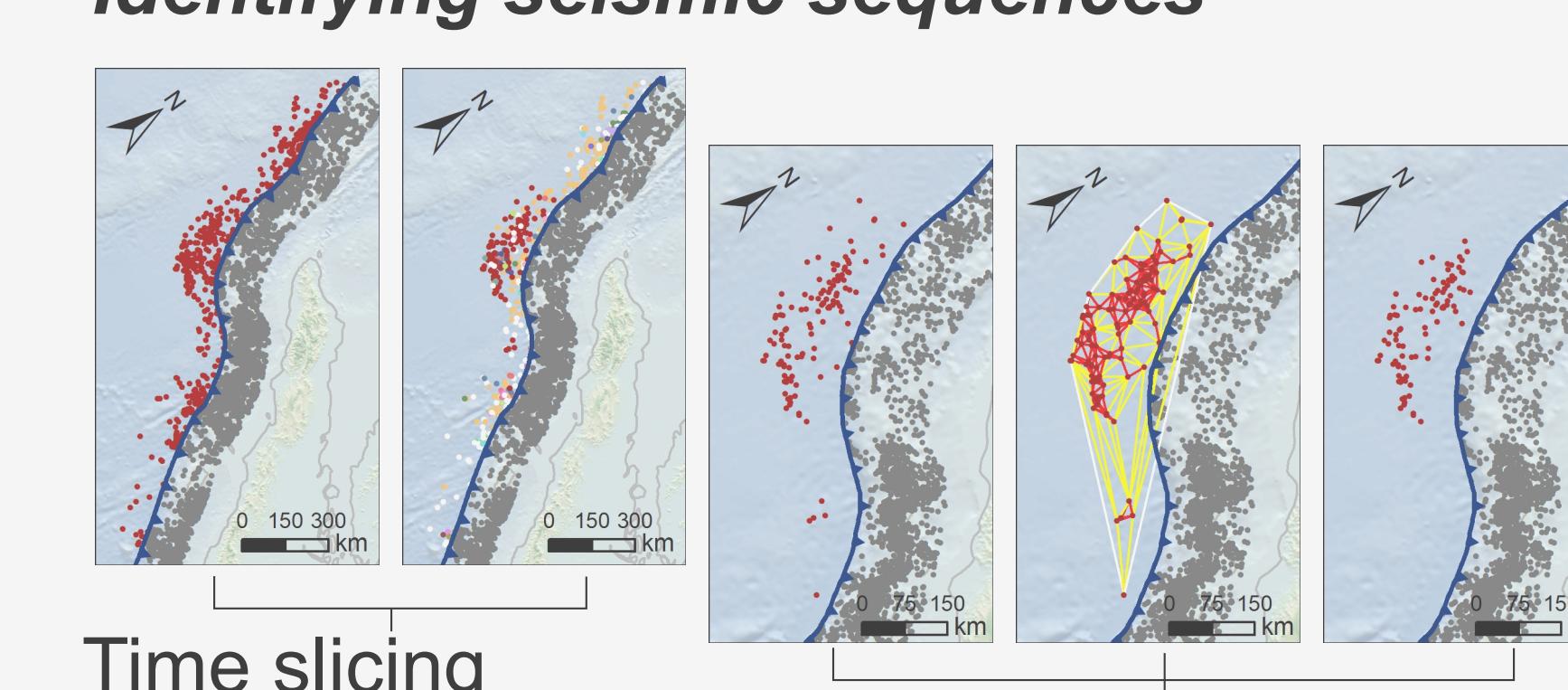


### Methodology

#### Earthquake Catalog

- ISC Bulletin seismicity  $M \geq 4$  from 1990-2013,
- each subduction system treated independently.
- only events with at least two detections from distant stations ( $>1000\text{km}$ ) to limit influence of local networks

#### Identifying seismic sequences



Time slicing  
Spatial slicing within each time interval based on mean length of Delaunay branches

