



HAL
open science

Spatio-temporal distribution of outer-rise seismic sequences

Anthony Sladen, Jenny Trevisan

► **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

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Summary

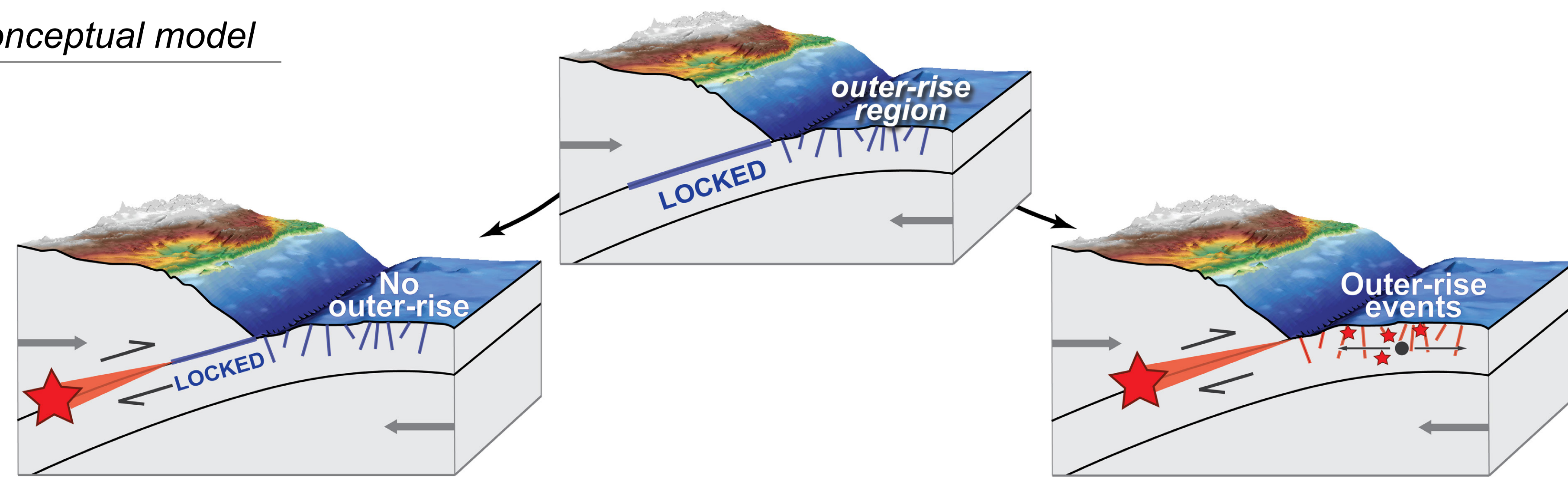
As they enter the subduction zone, oceanic plates are bent by tectonic forces. This bending creates the outer-rise region, a zone of extension just seaward of the trench dominated by normal fault activity. Over the long term, tectonic forces are expected to create an homogeneous distribution of outer-rise 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.

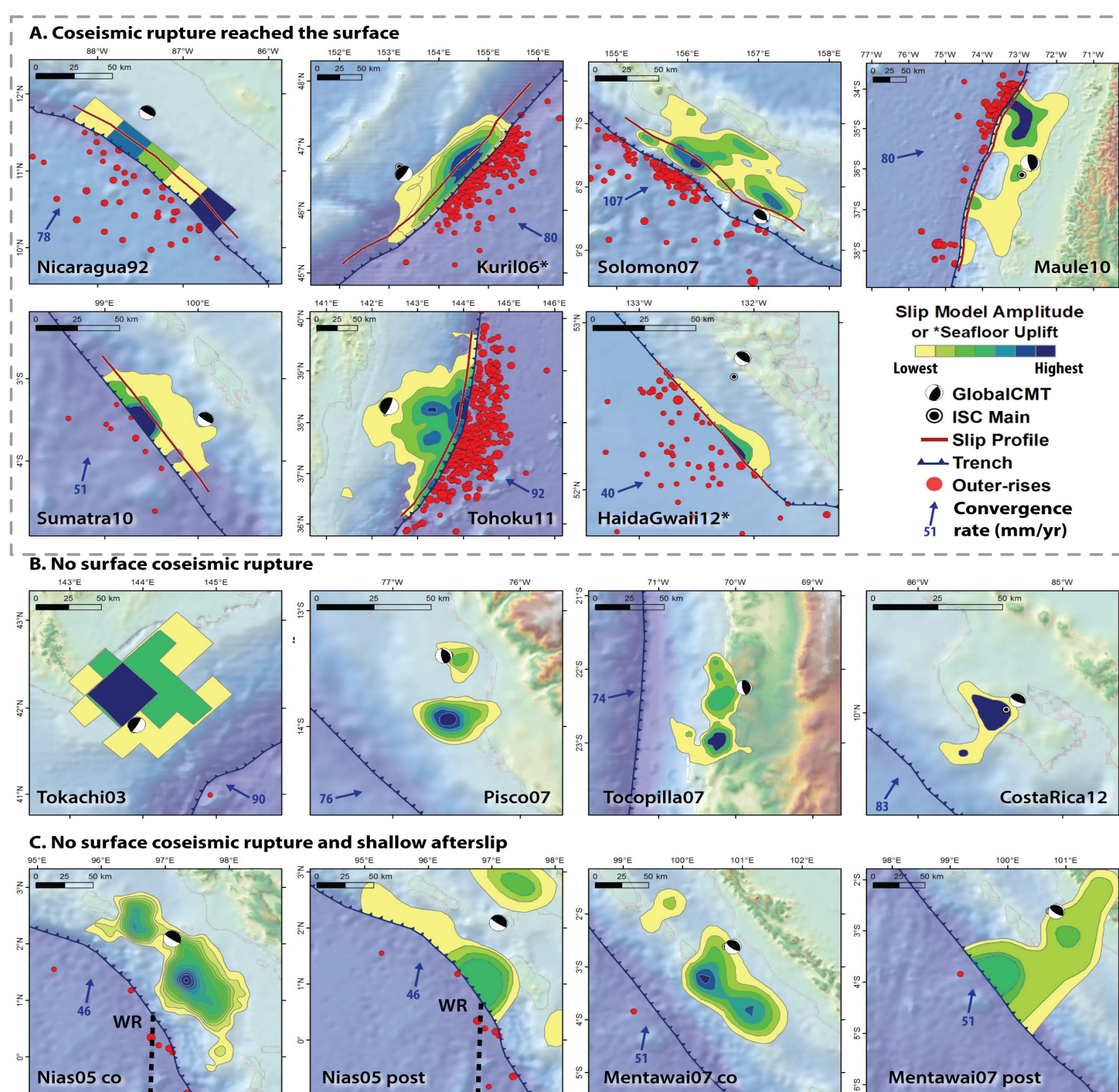
A Outer-rise aftershocks are controlled by near-surface rupture of the megathrust fault

Sladen and Trévisan, EPSL, 2018

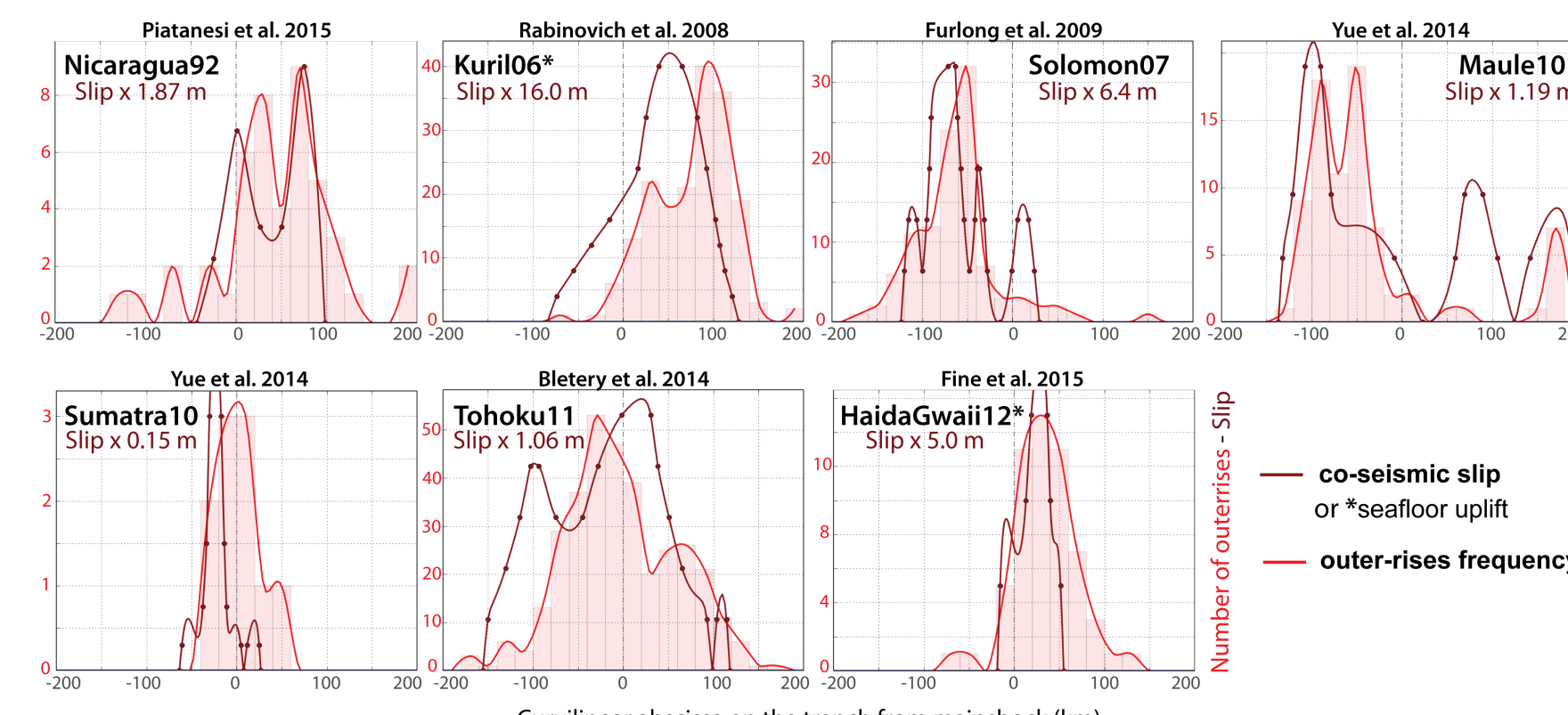
Conceptual model



Observations



Well-documented large interplate earthquakes (13). Outer-rise aftershocks sequences only triggered following interplate ruptures that have reached the near-surface.



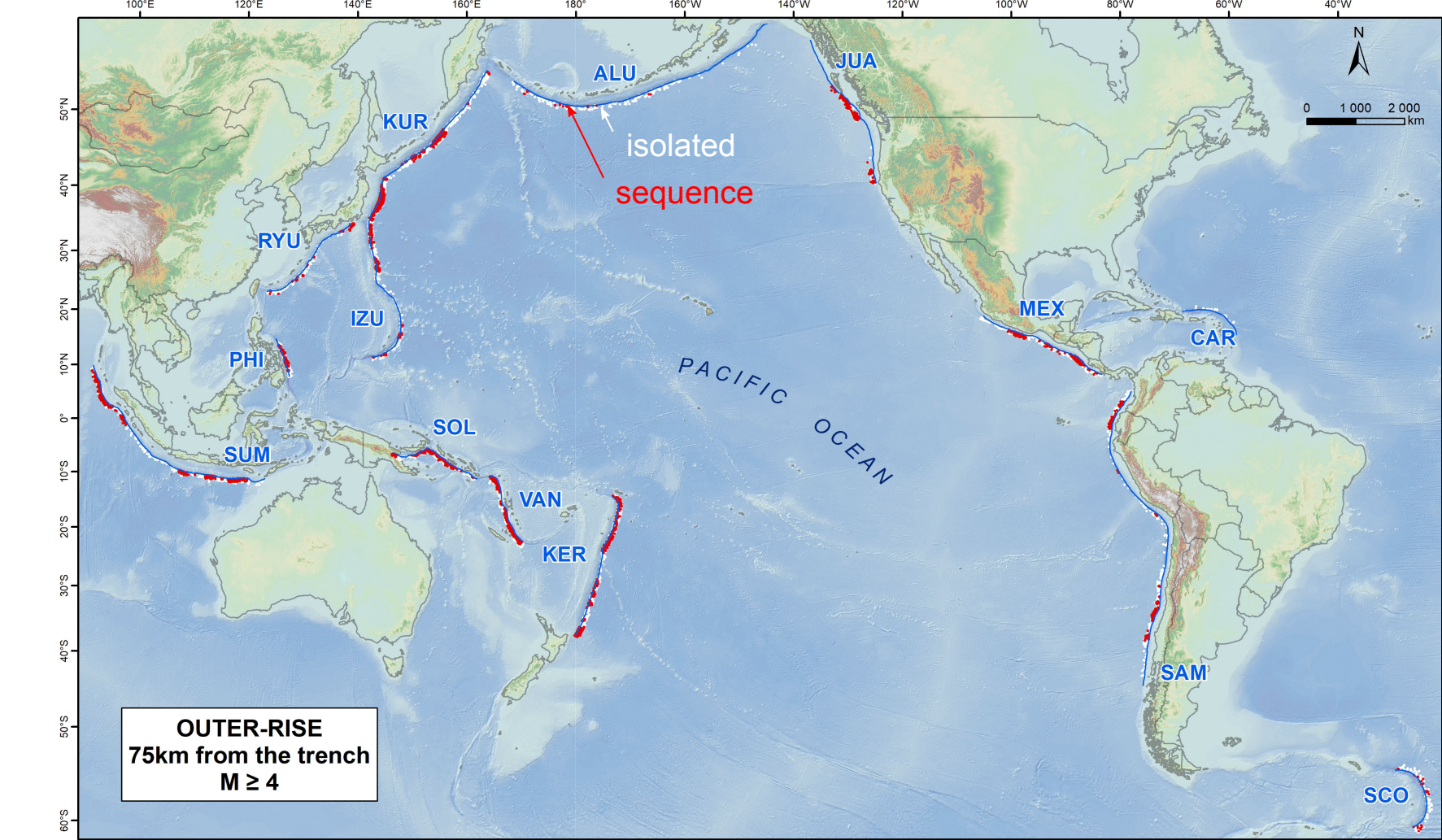
The number of outer-rise aftershocks along the trench appears to be proportional to the amount of shallow slip suggesting triggering through static stress transfer.

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≥4)

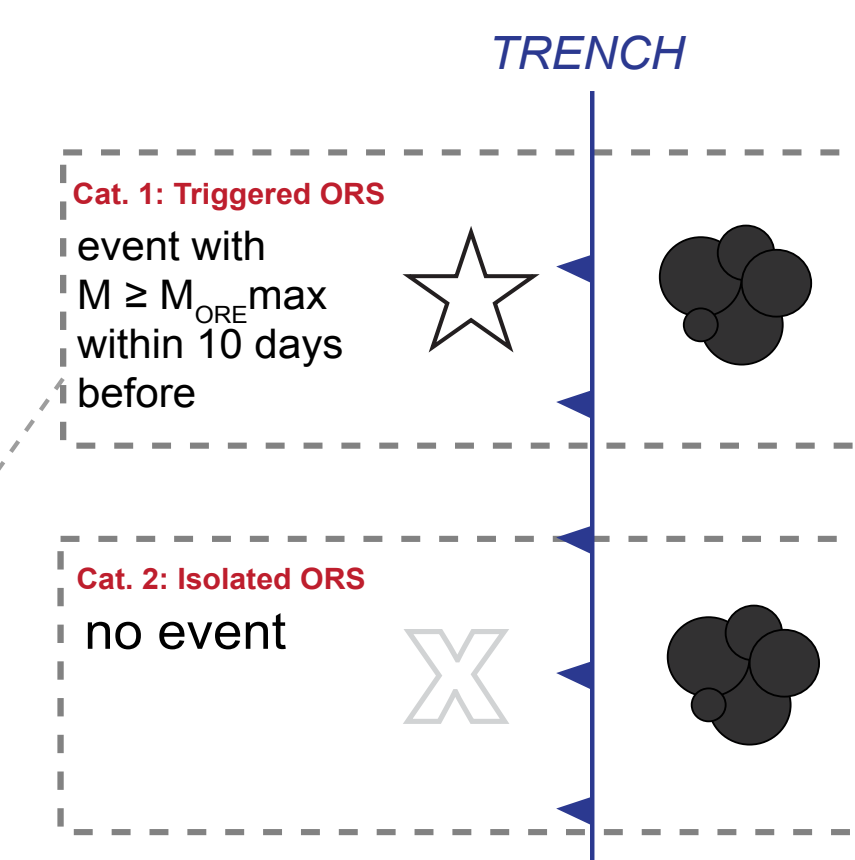
Strong variability in the global rate of outer-rise earthquakes (ORE). For instance, the outer-rise of the Vanuatu arc is 10x more seismically active than the Aleutian



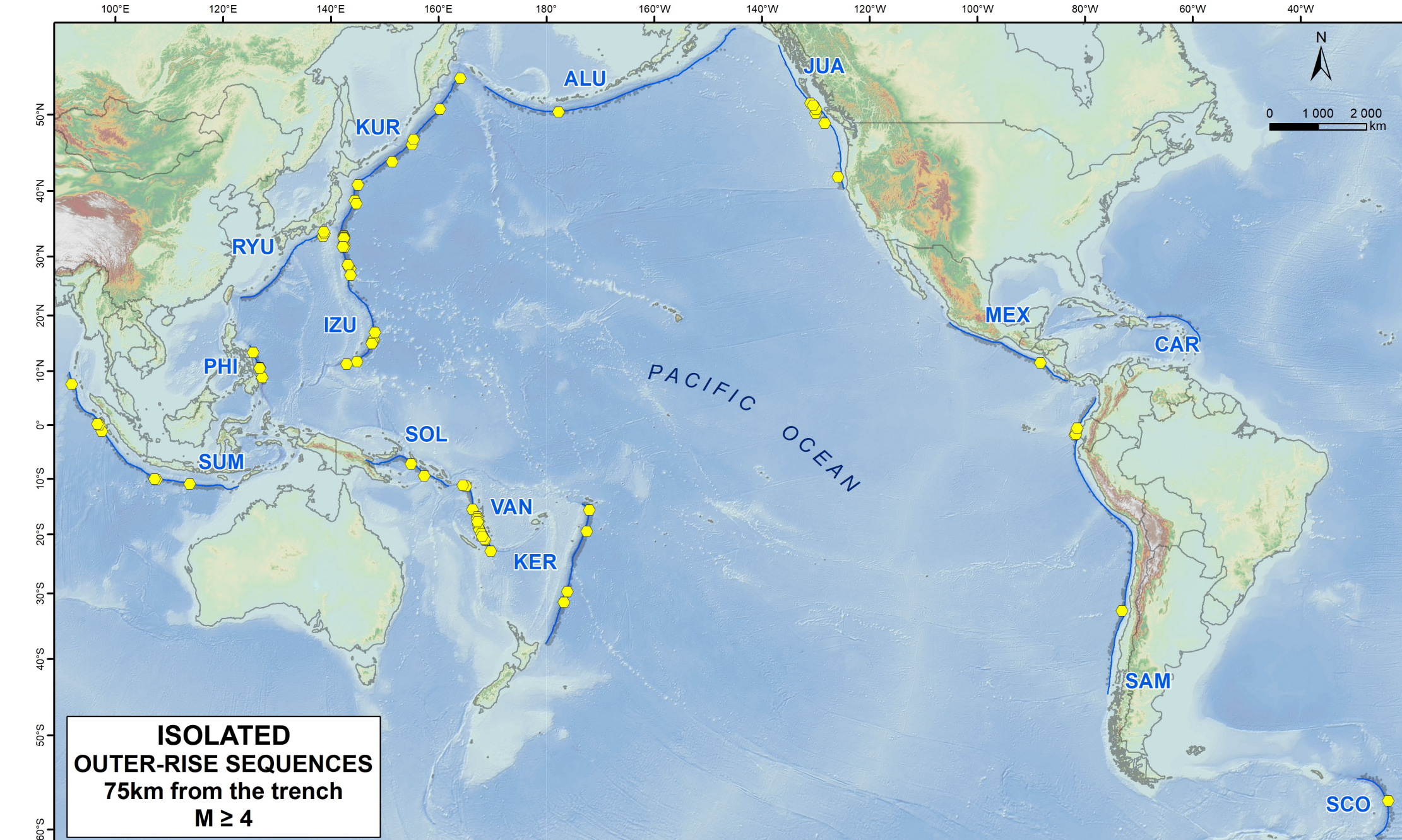
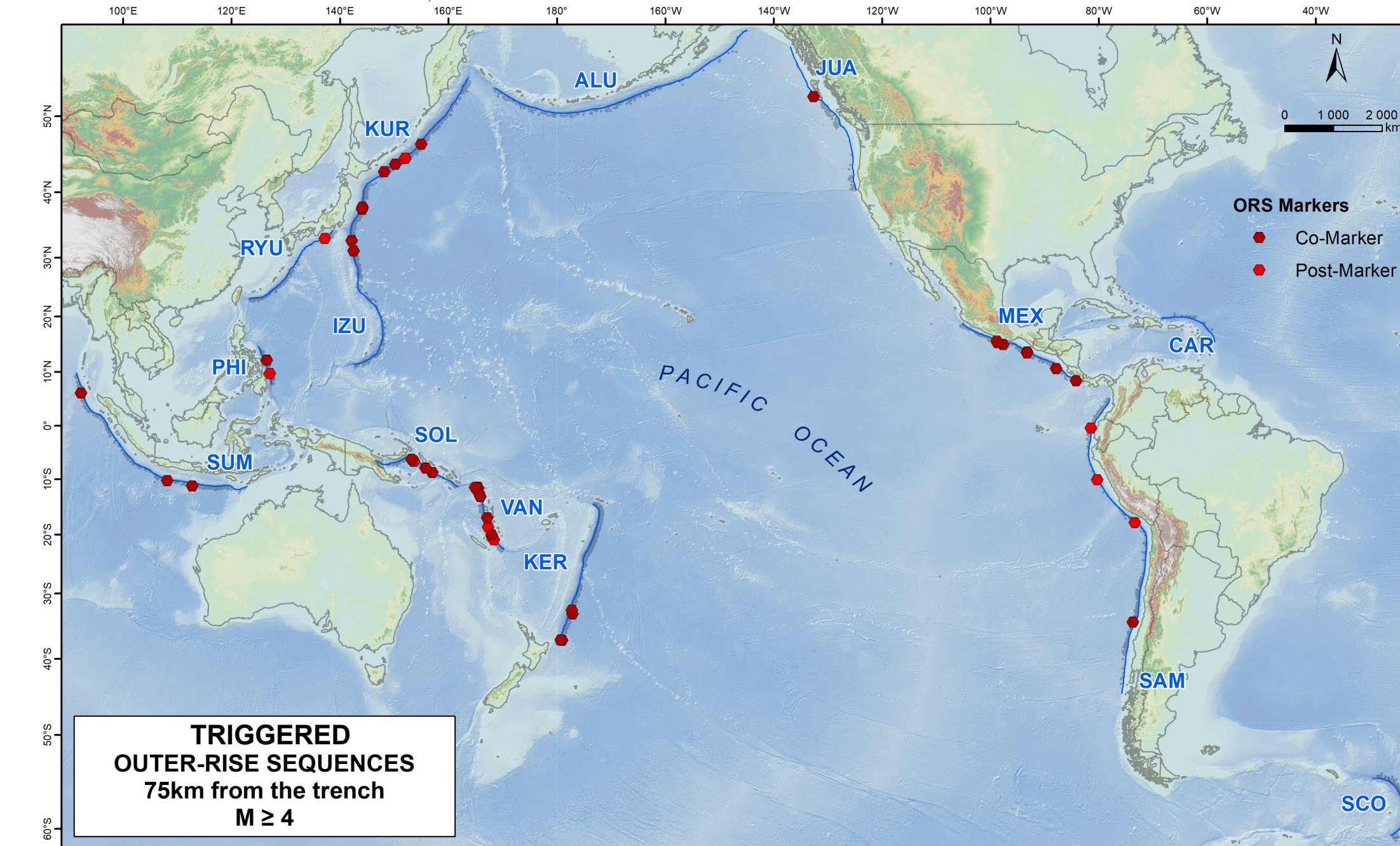
In most subductions, we observe that a large fraction of outer-rise seismicity is occurring in sequences

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

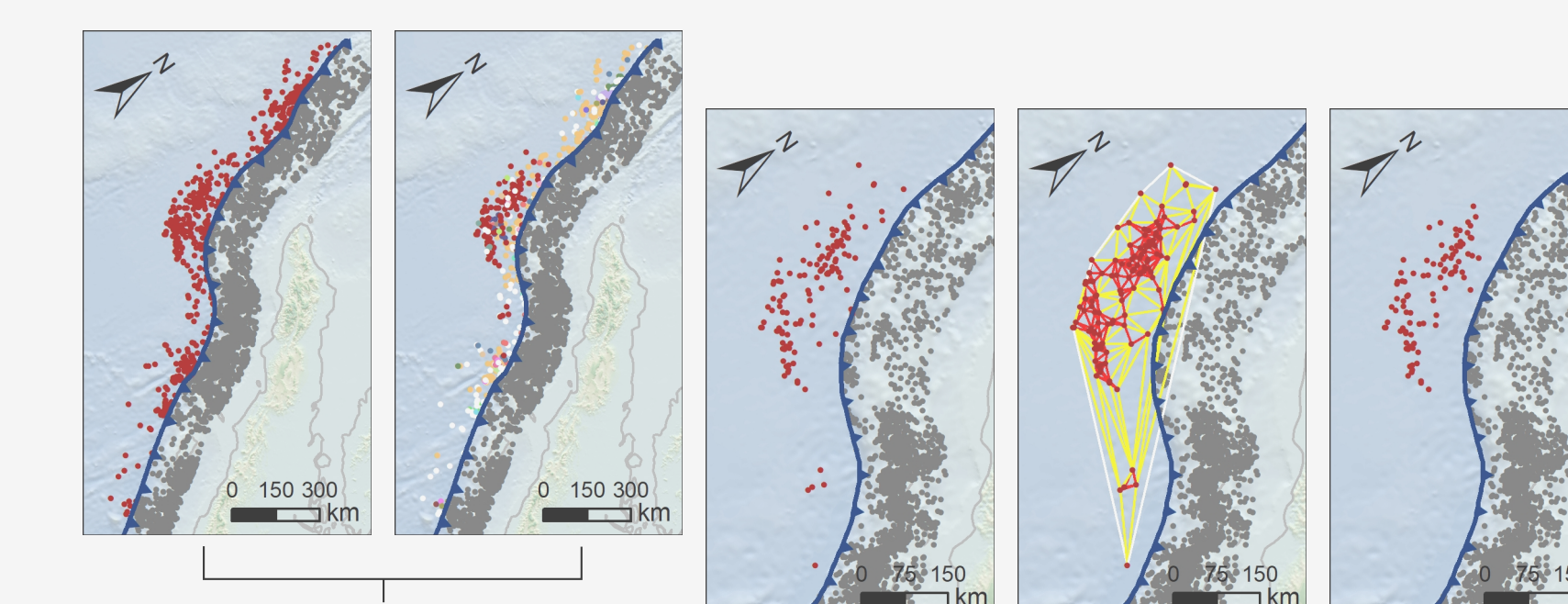


Methodology

Earthquake Catalog

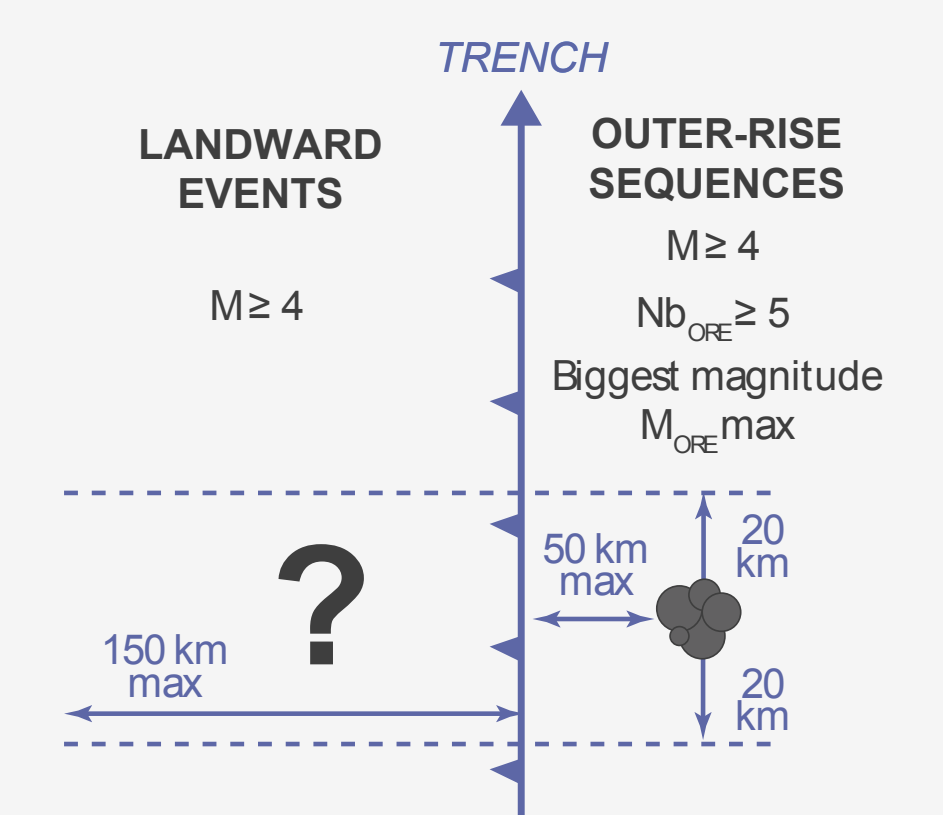
- ISC Bulletin seismicity M≥4 from 1990-2013,
- each subduction system treated independently.
- only events with at least two detections from distant stations (>1000km) to limit influence of local networks

Identifying seismic sequences



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

Isolated or triggered ORS?



Looking 10 days before ORS