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Outstanding Student & PhD candidate Presentation contest

Aseismic slip and cascade triggering process of foreshocks leading to the 2021 Mw 6.1 Yangbi Earthquake

Xiaoge Liu, Wenbin Xu*, Zilong He, Lihua Fang, Zhidan Chen

School of Geosciences and Info-Physics, Central South University, China

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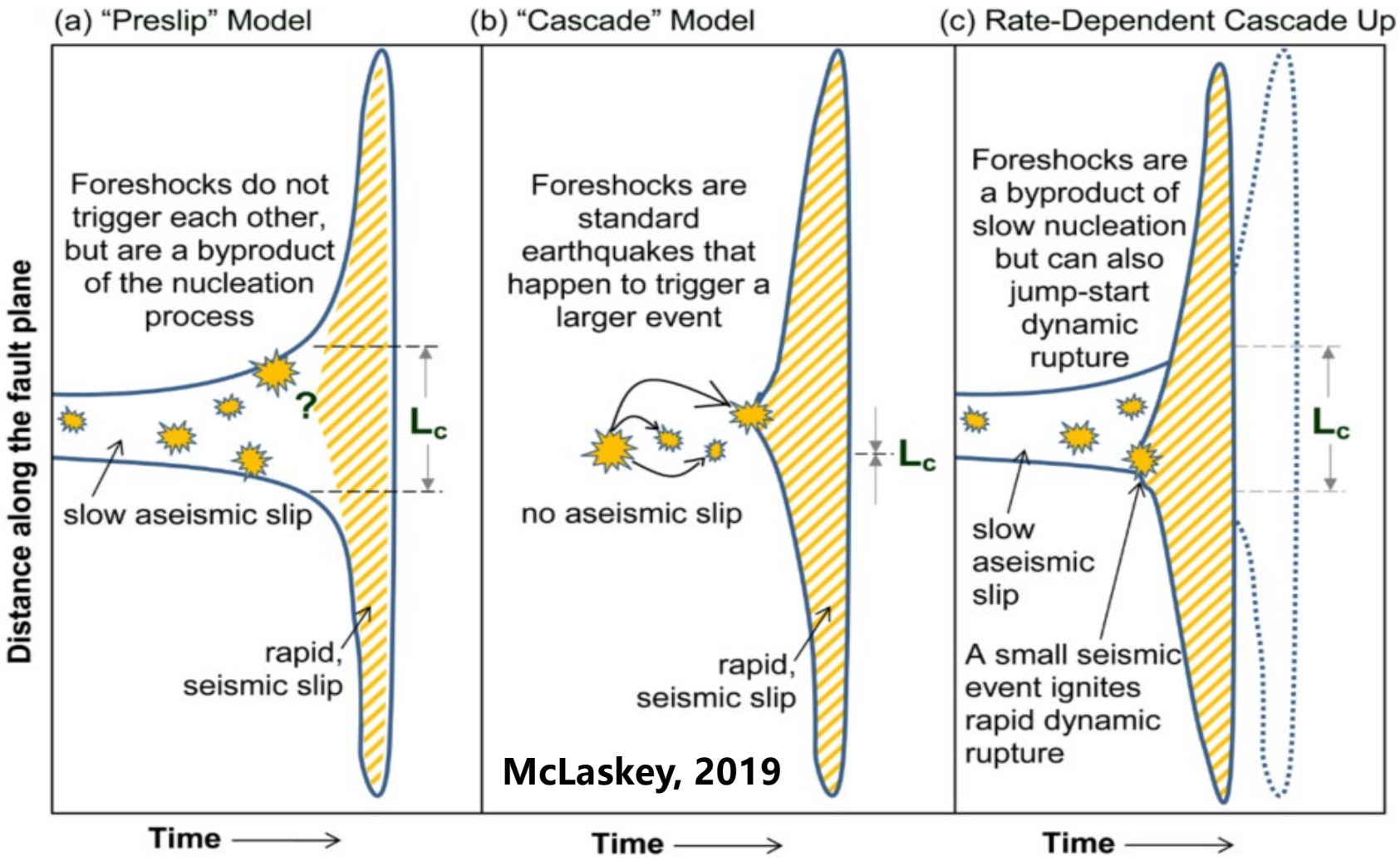
Endmembers of foreshocks initiation



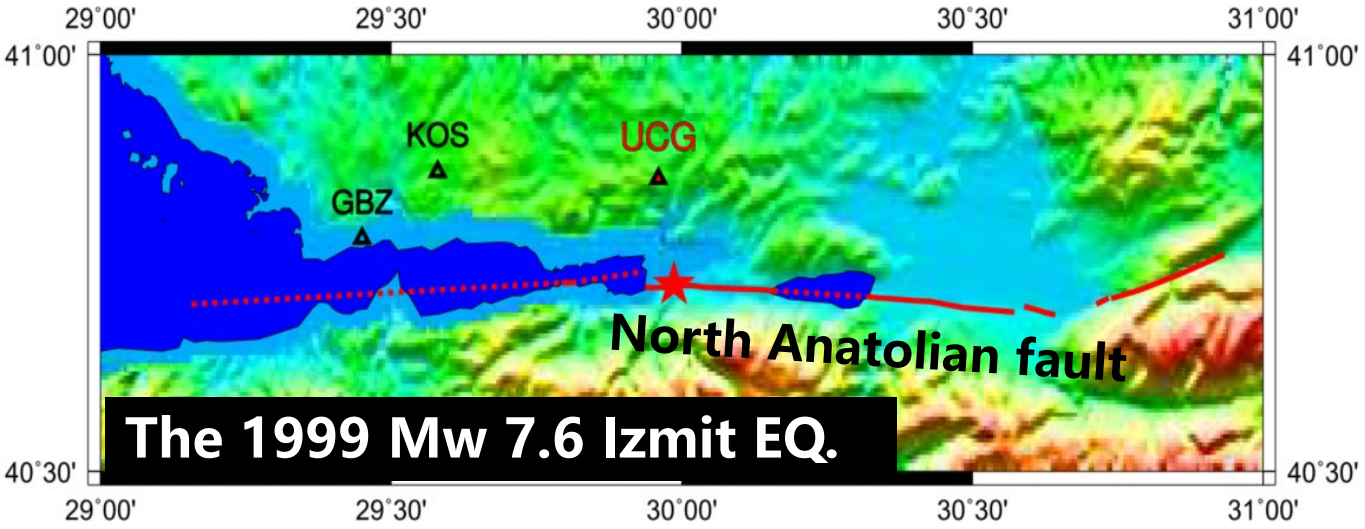
McLaskey, 2019

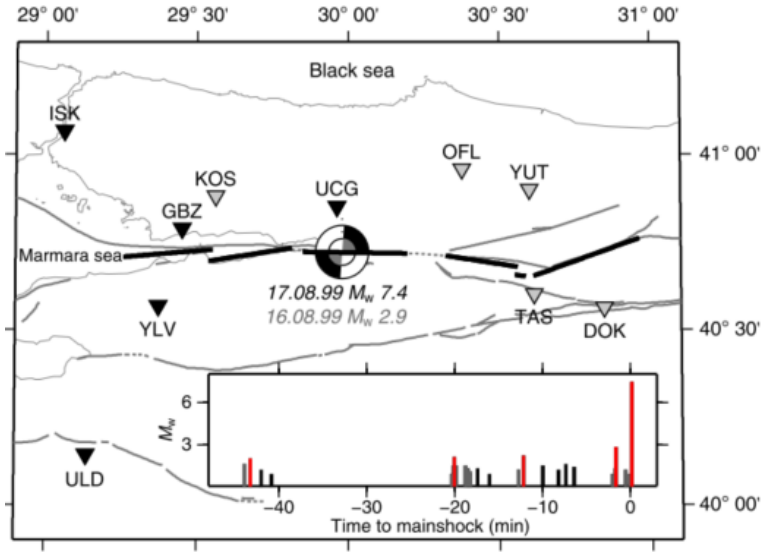
(I) Aseismic slip triggering foresohcks

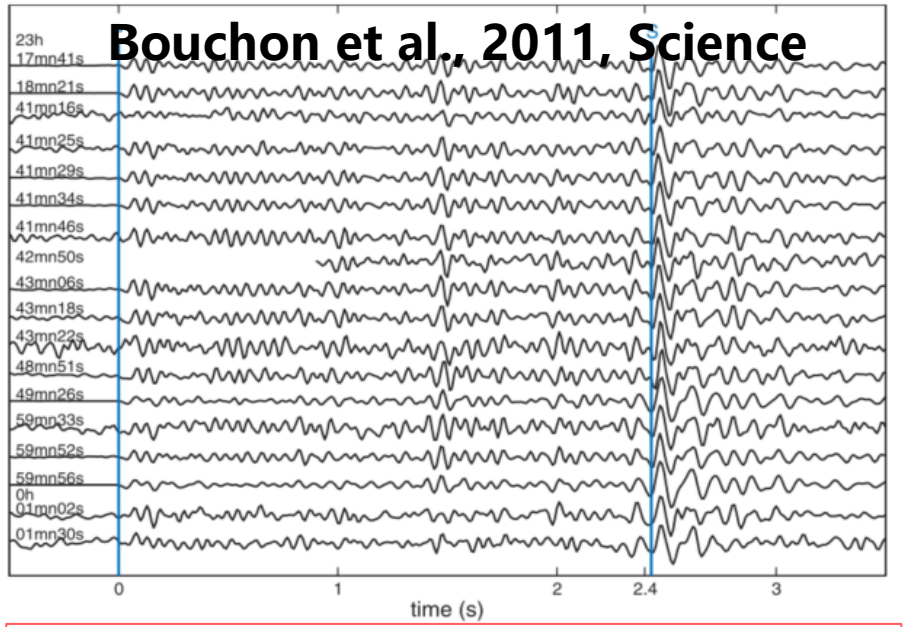
(II) Foreshocks triggering the later one by stress transfer with random chance

(III) Both endmembers are involved

The 1999 Mw 7.6 Izmit foreshocks



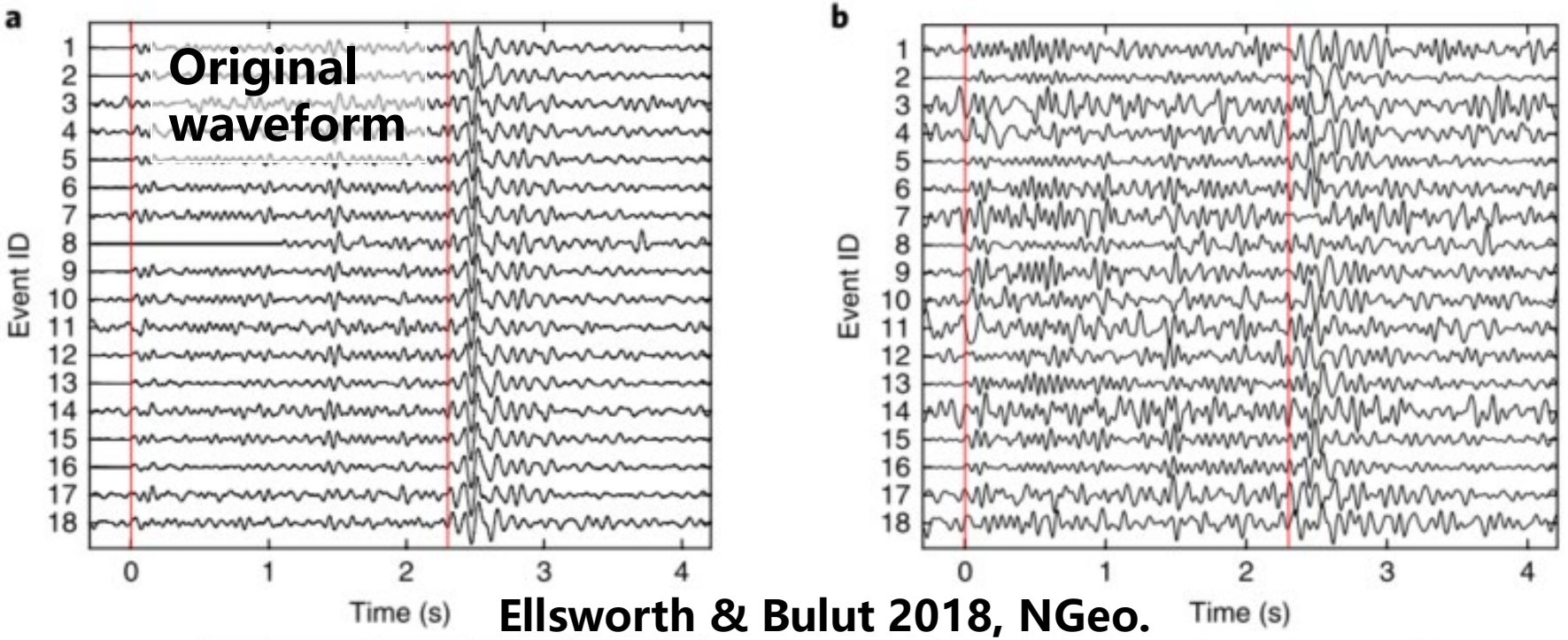




(a) Repeating earthquakes
&
(b) Interval between foreshocks becomes smaller (acceleration)

Preslip or aseismic slip model

The 1999 Mw 7.6 Izmit foreshocks

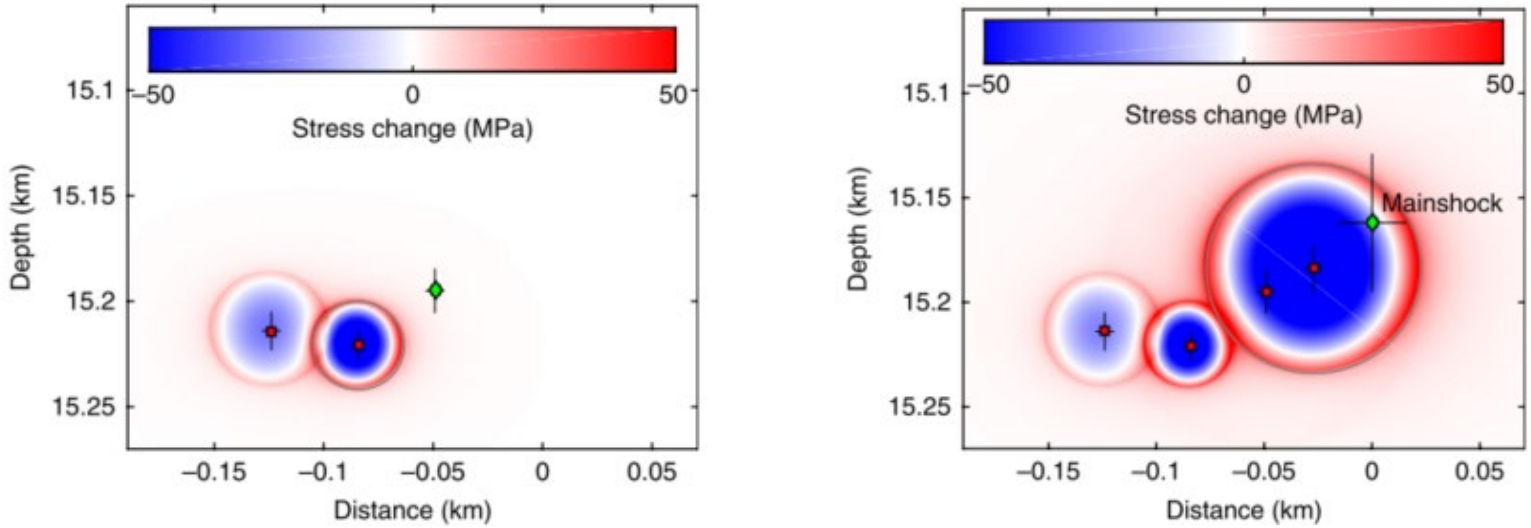


Residual waveforms after removing common mode.

Very different residual waveforms.

Not repeating EQs

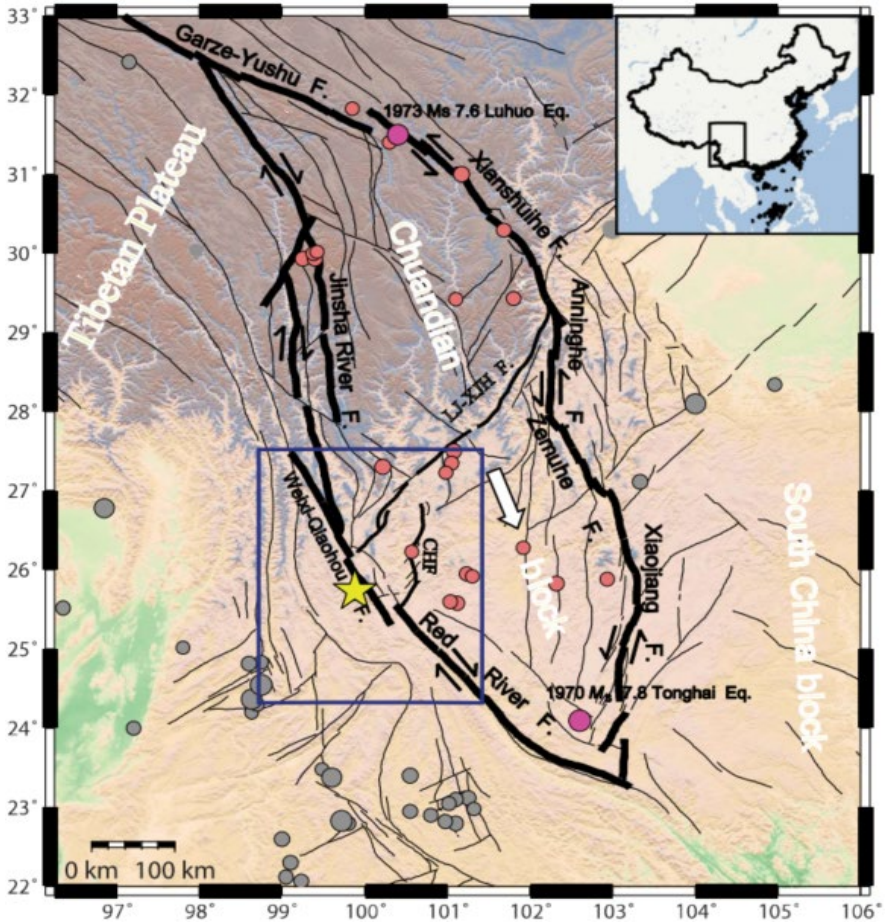
Ellsworth & Bulut 2018, NGeo.



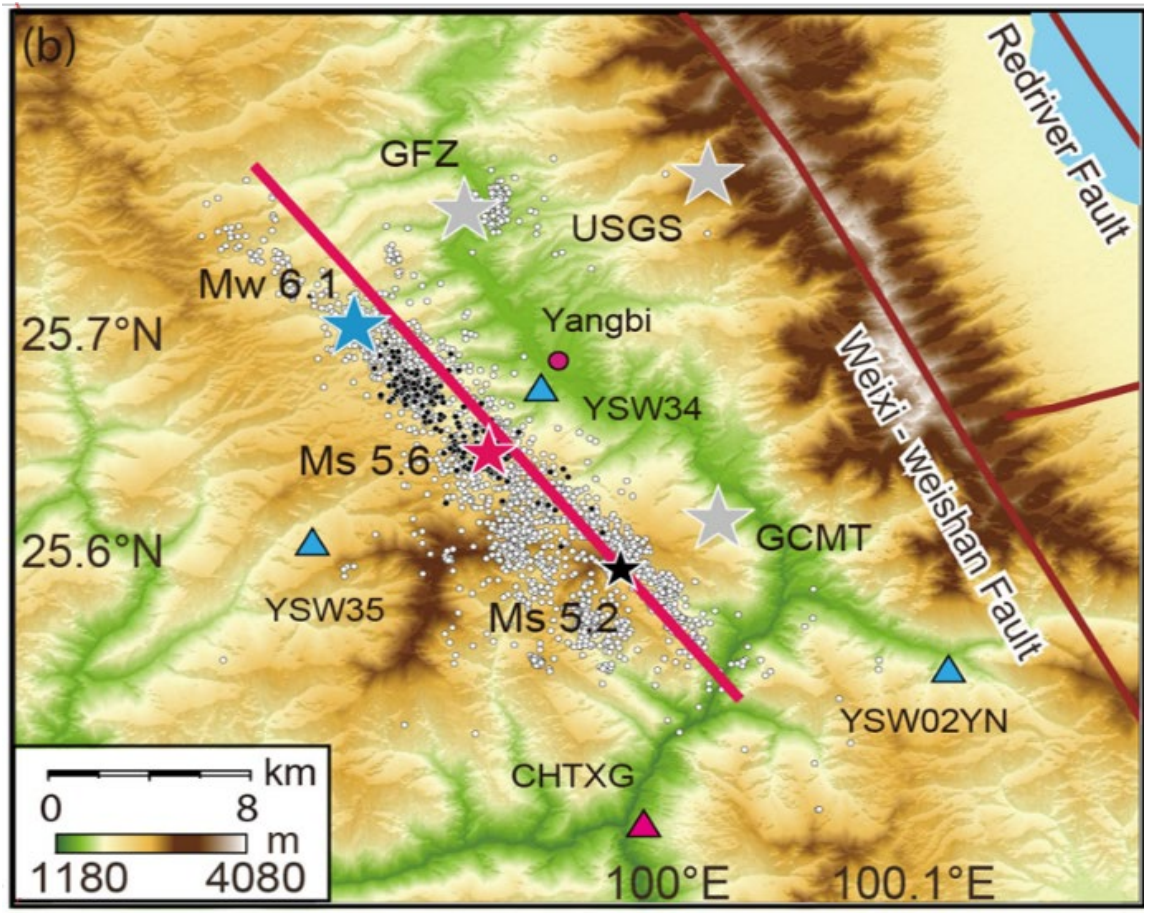
Cascade model

The 2021 Mw 6.1 Yangbi Earthquake

On May 21, 2021, the Yangbi earthquake (Mw 6.1) occurred at the Sichuan-Yunnan block in the southeastern Tibetan Plateau.

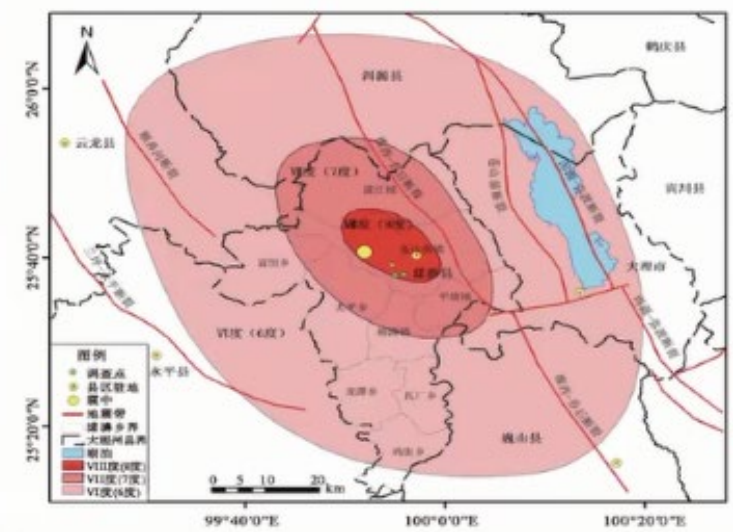


Zhang et al., 2021



Liu et al., 2022

Serious damage



He et al., 2021; Dai et al., 2021

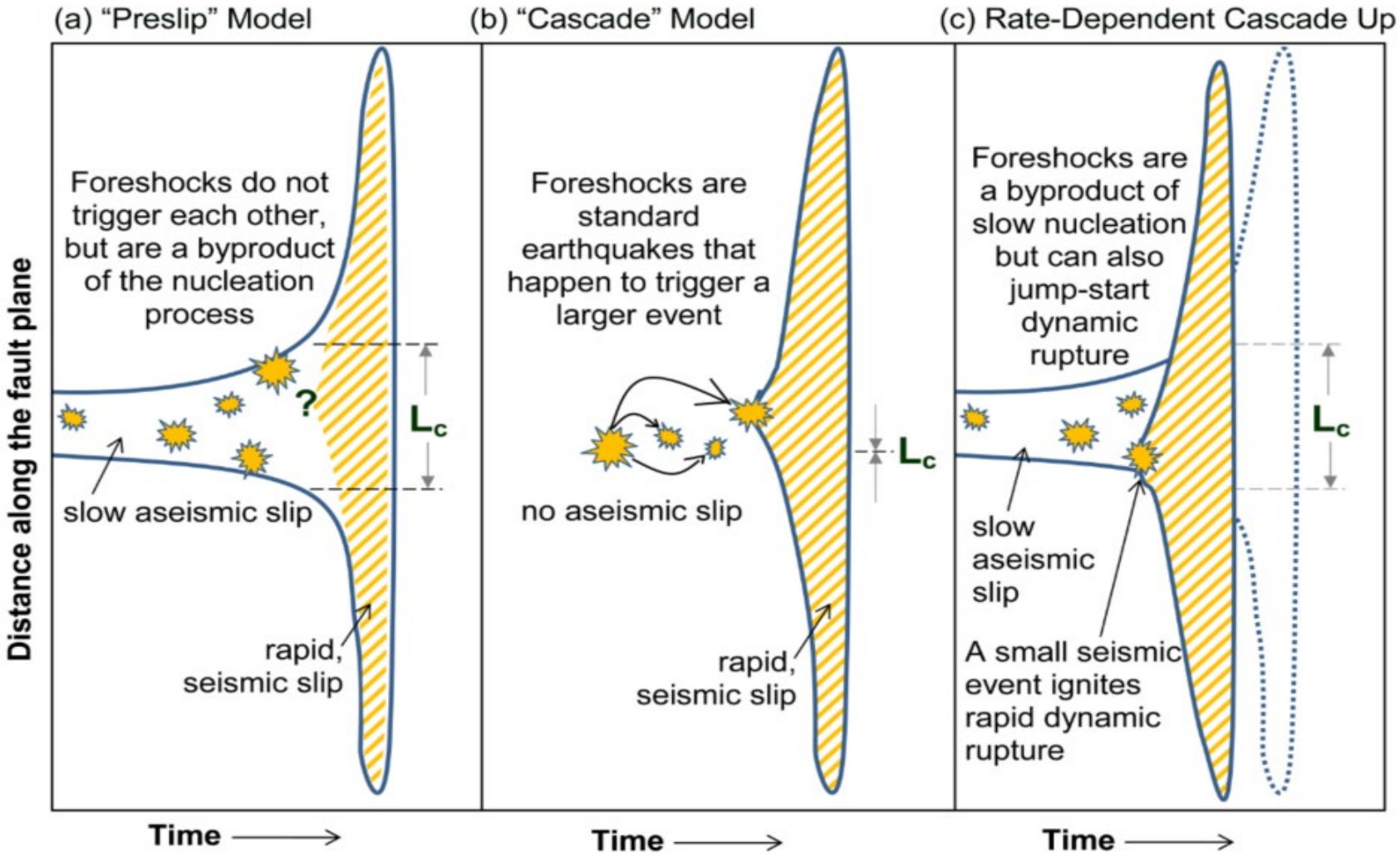
3 deaths, 27 injuries.

Highest intensity: 8

~100 km in regions with intensity: 6

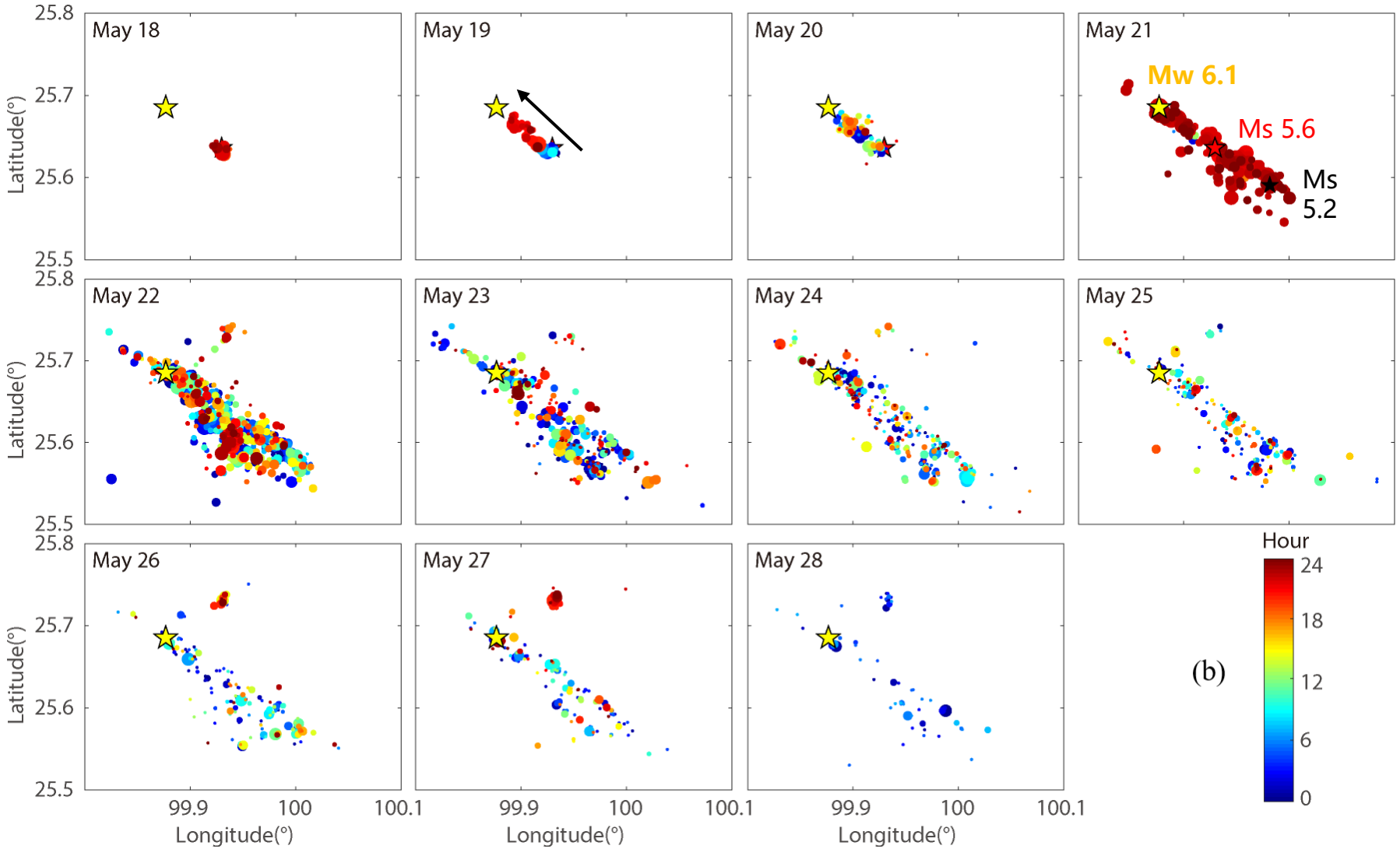
Motivations

What nucleation processes behind the 2021 Yangbi earthquake sequence?



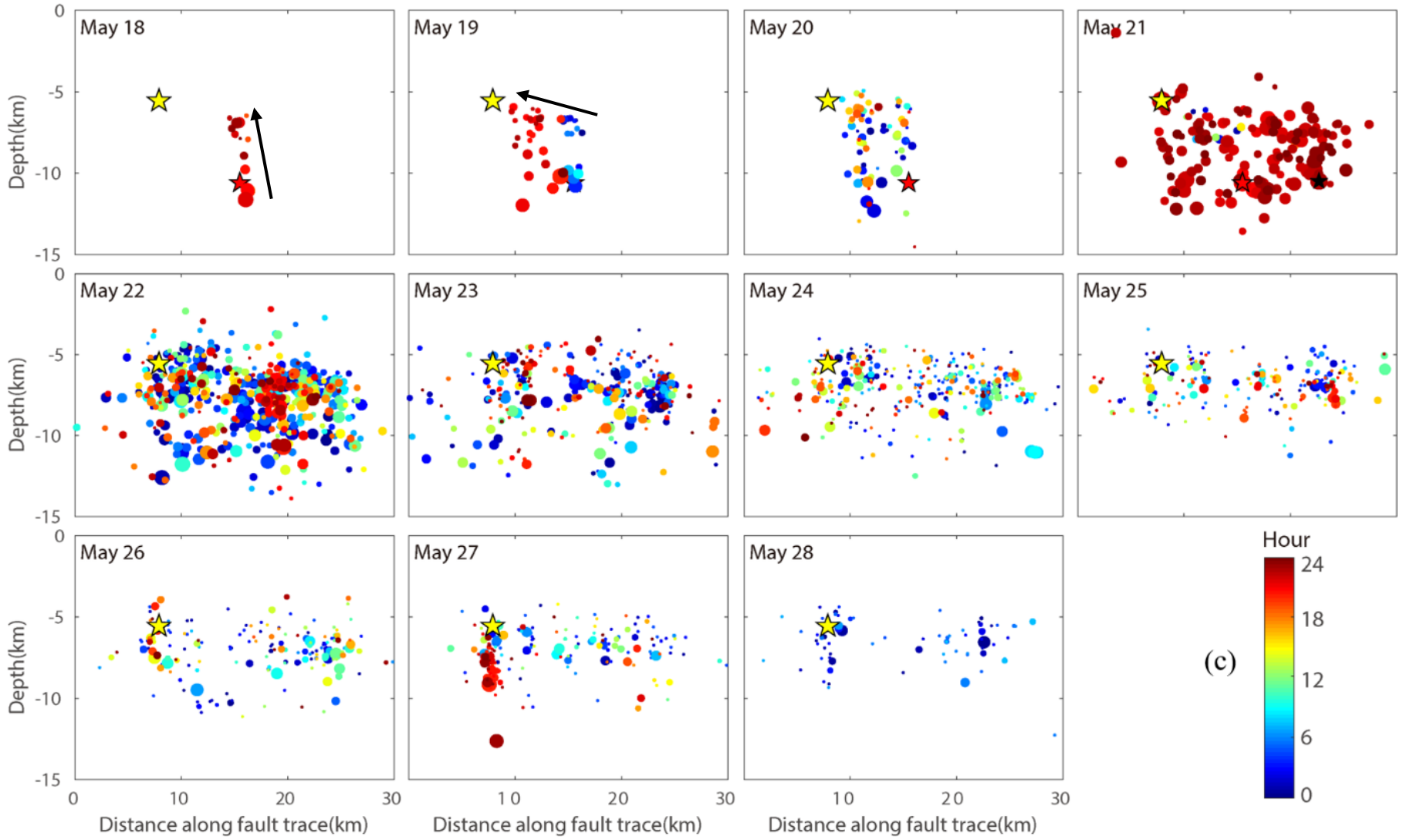
McLaskey, 2019

Spatio-temporal EQs distributions



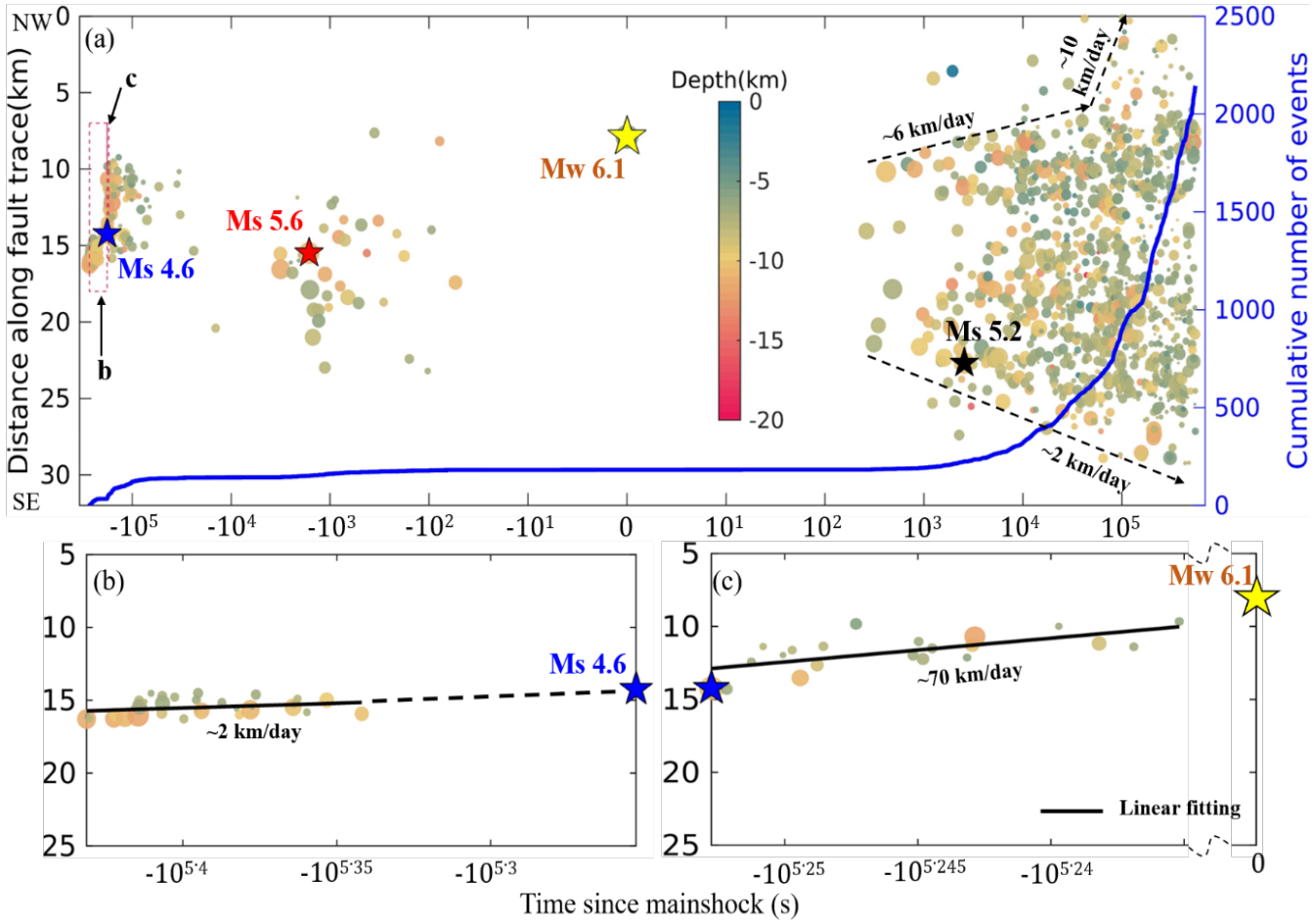
Foreshocks migration toward to the mainshock in the strike direction.

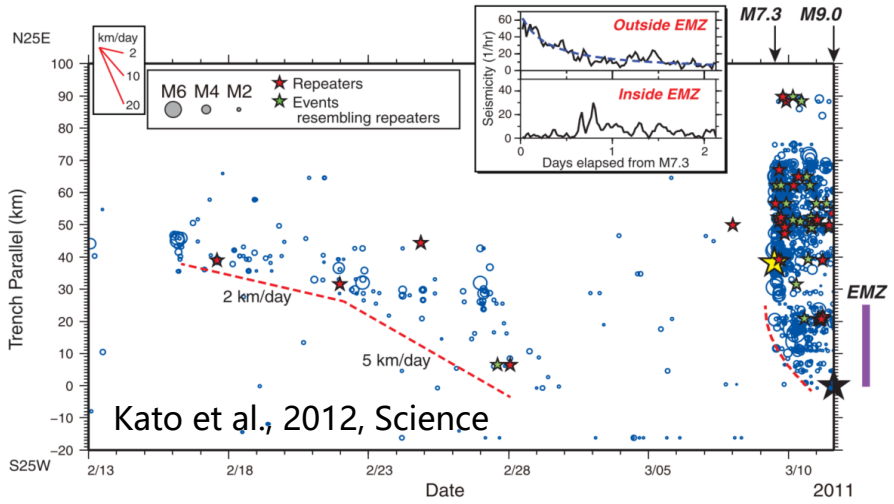
Spatio-temporal EQs distributions

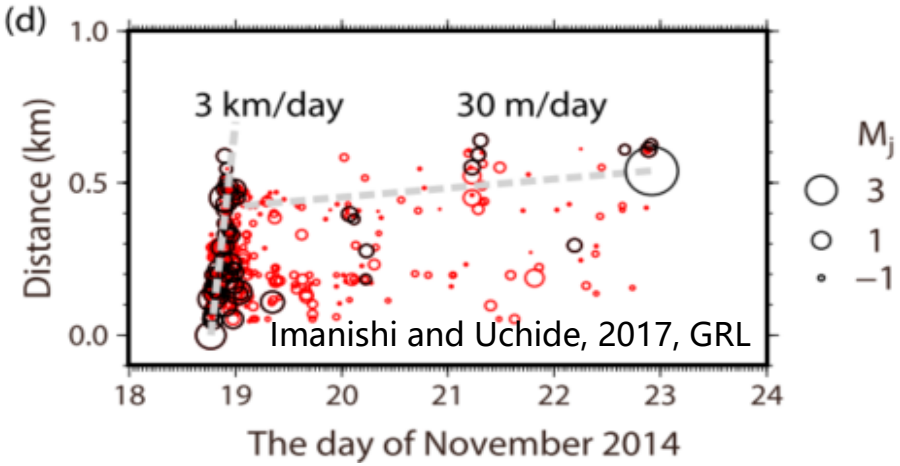


Foreshocks migration toward to the mainshock in the dip direction.

Nucleation Processes

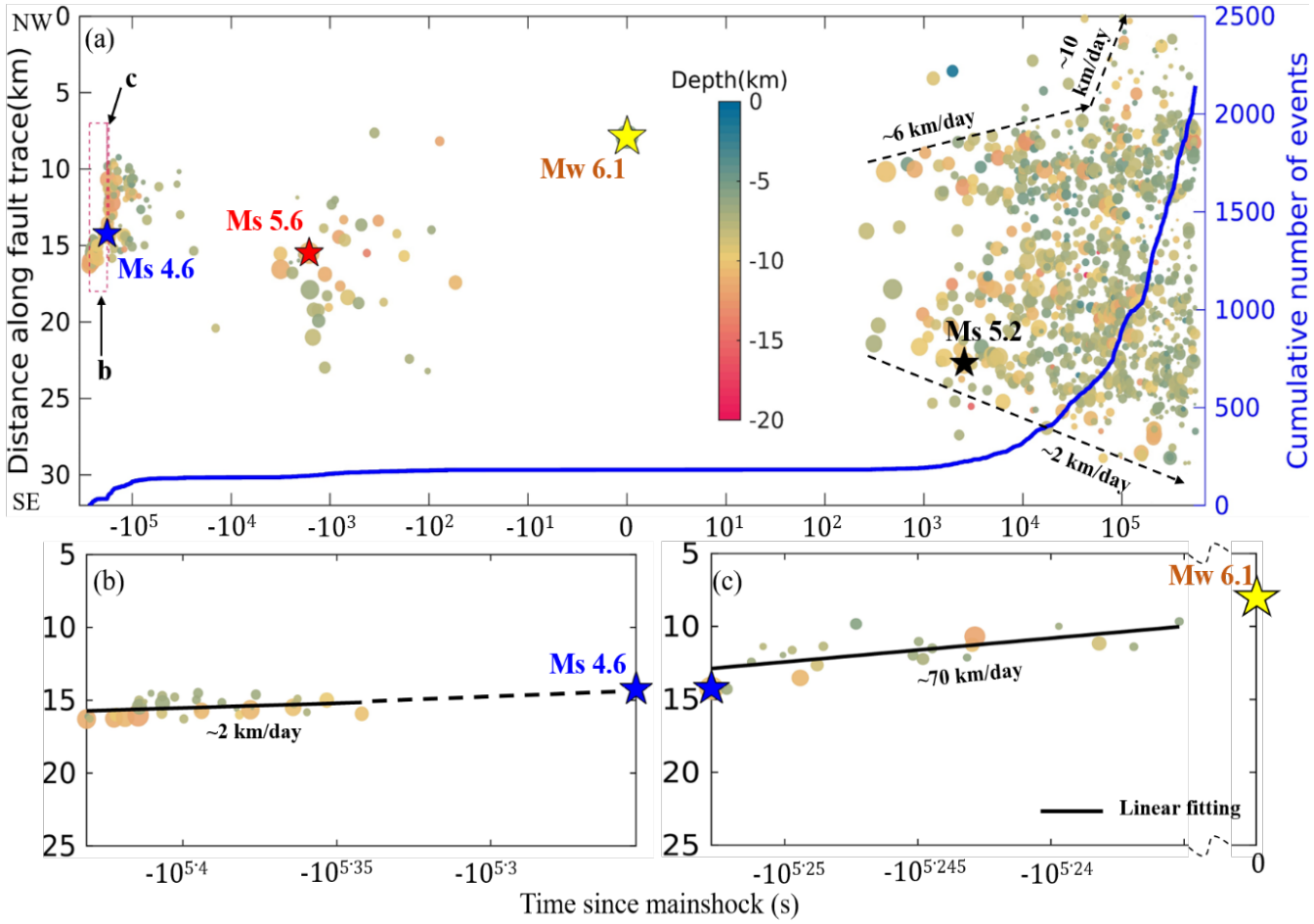


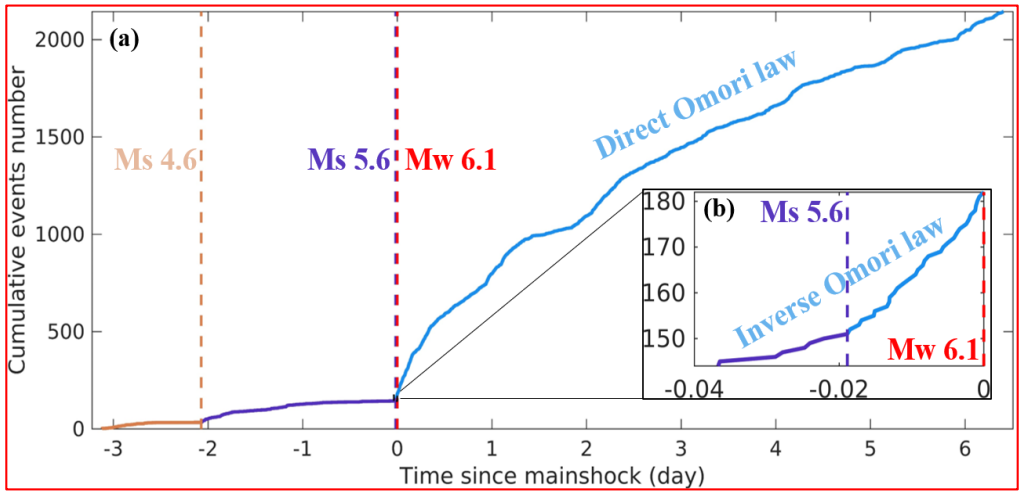


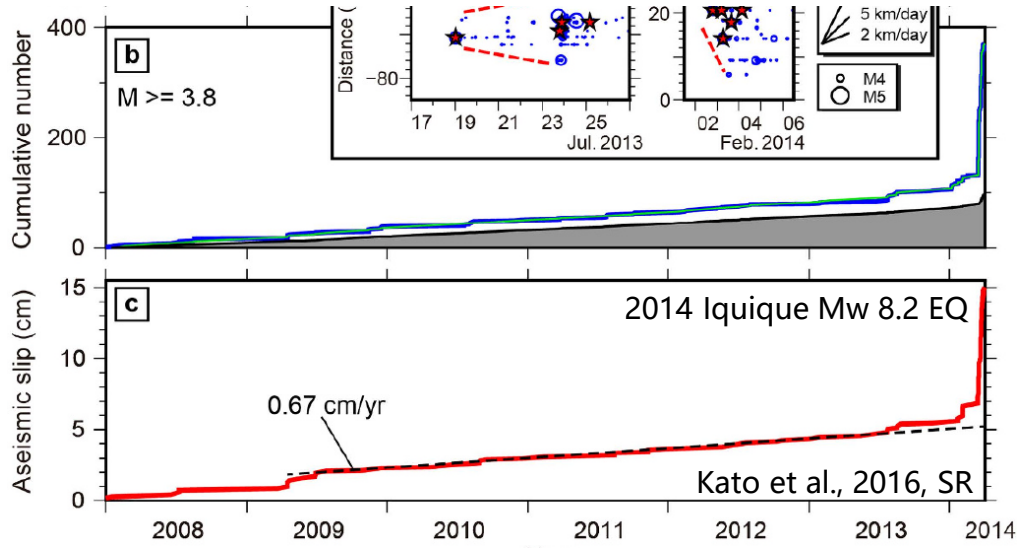


These seismicity migrations with logarithmic time suggest preslip before the mainshock

Nucleation Processes

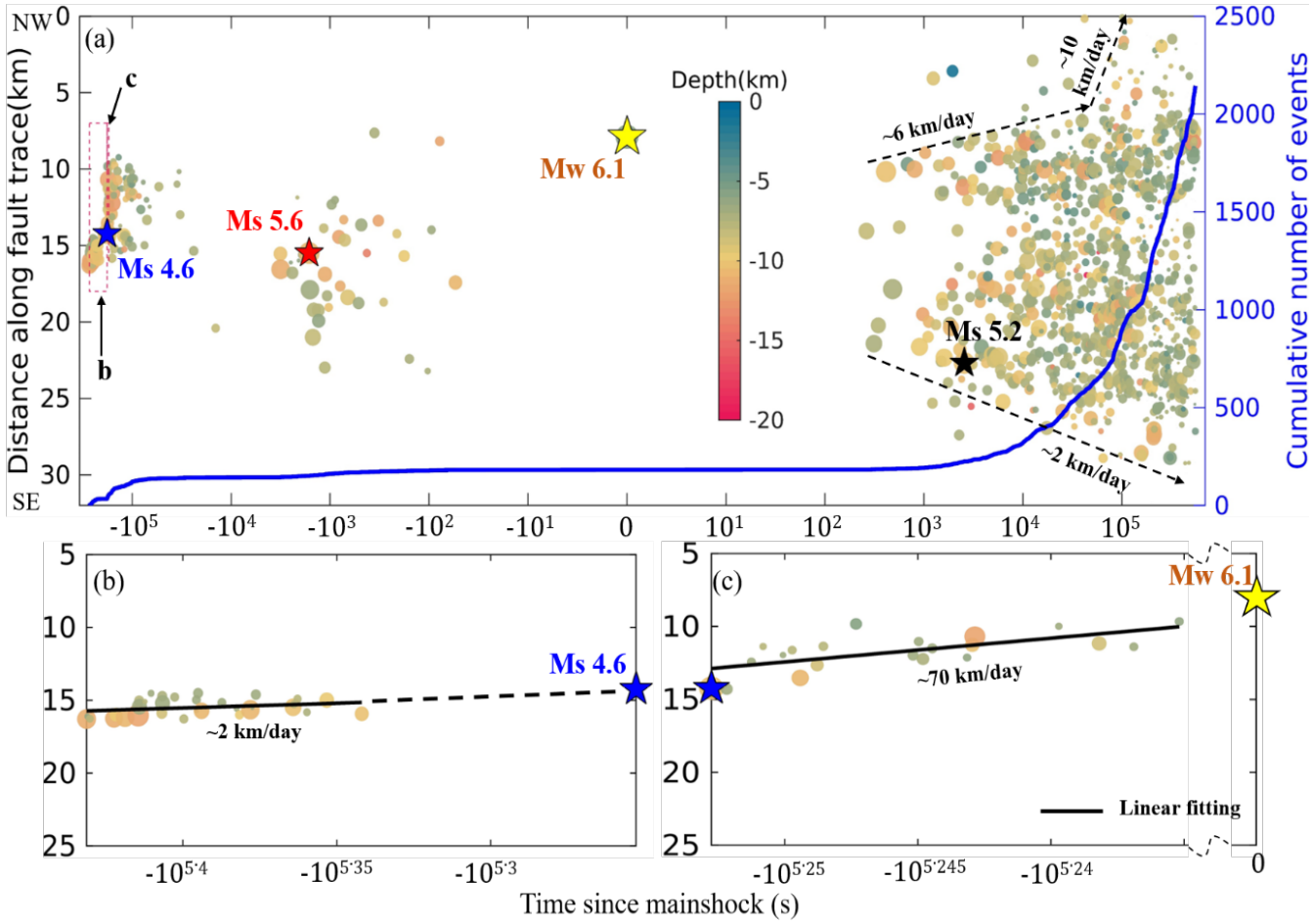


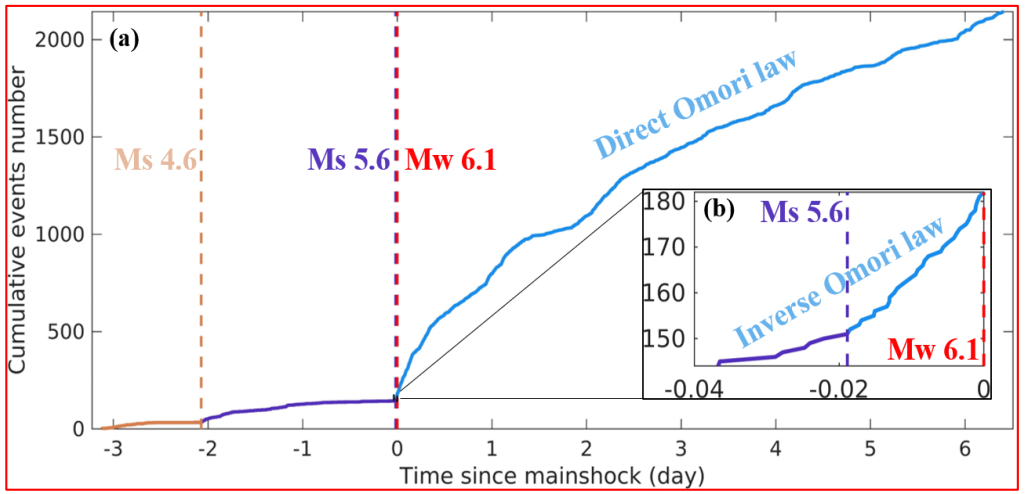


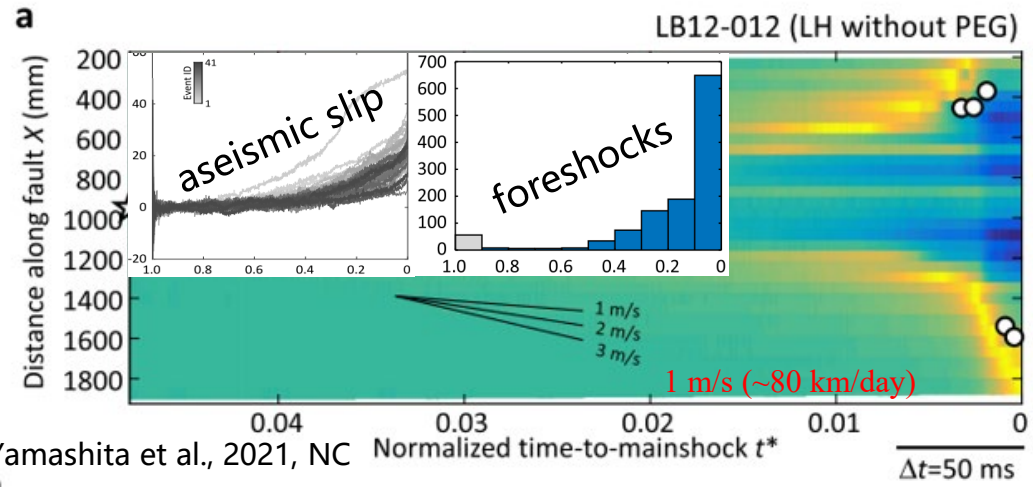


Inverse Omori foreshock increase may suggest preslip acceleration before the mainshock

Nucleation Processes



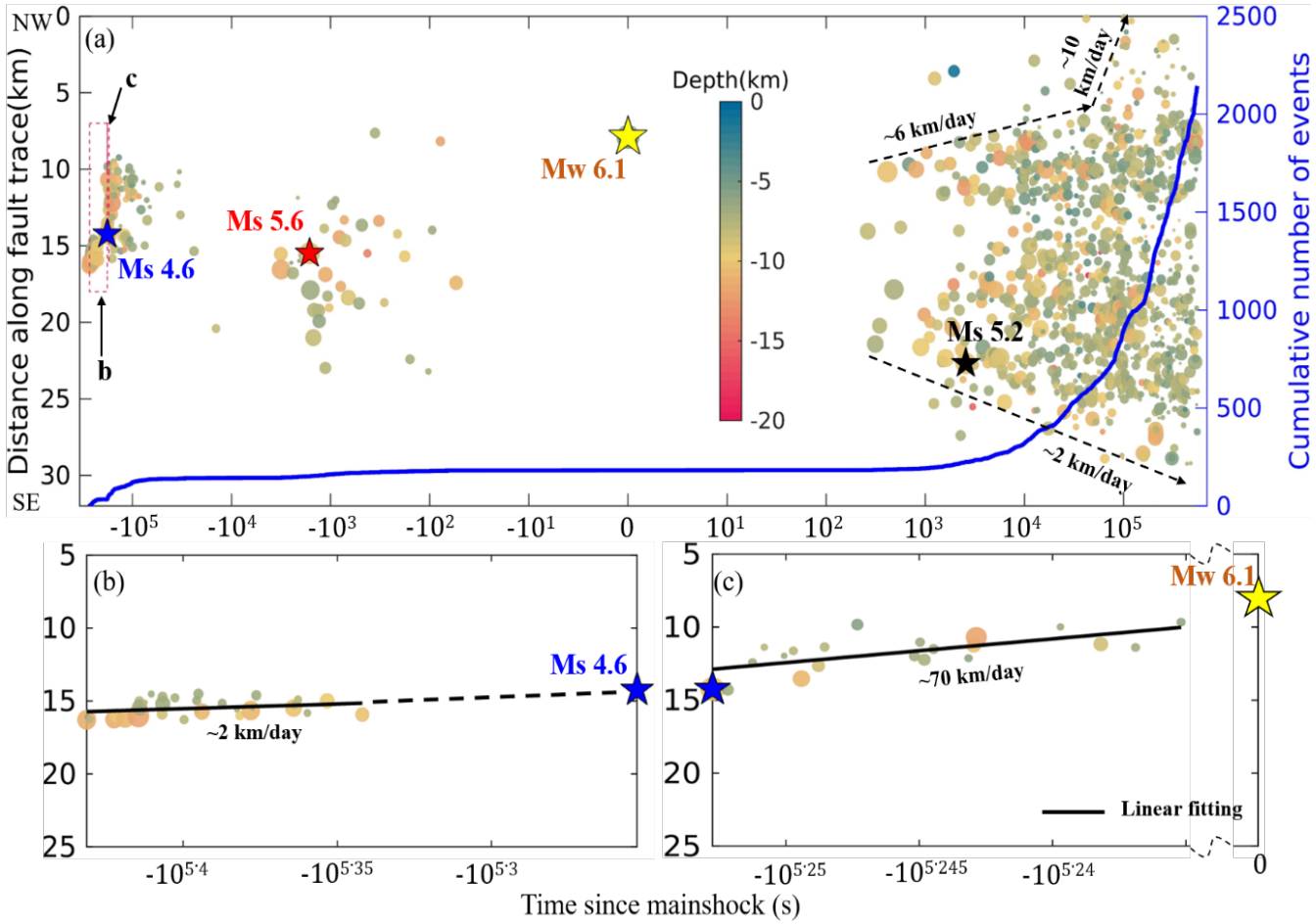




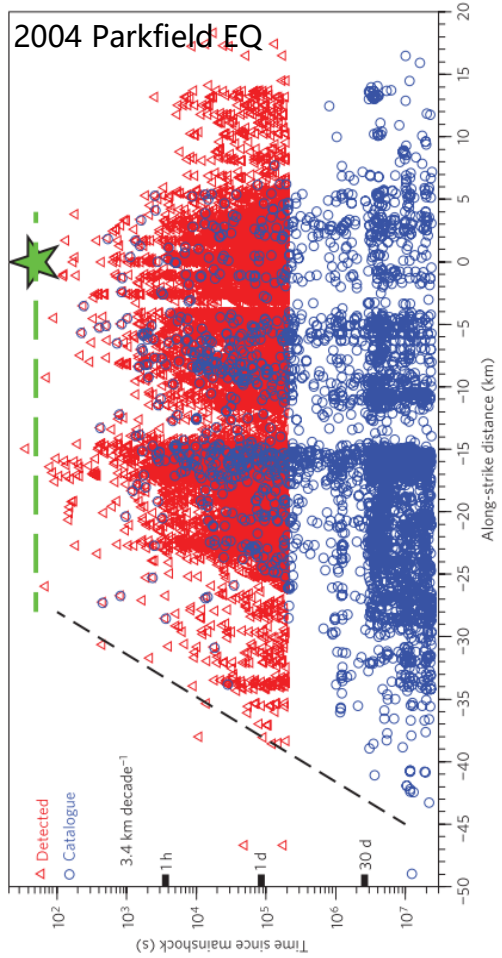
Yamashita et al., 2021, NC

Inverse Omori foreshock increase may suggest preslip acceleration before the mainshock

Nucleation Processes

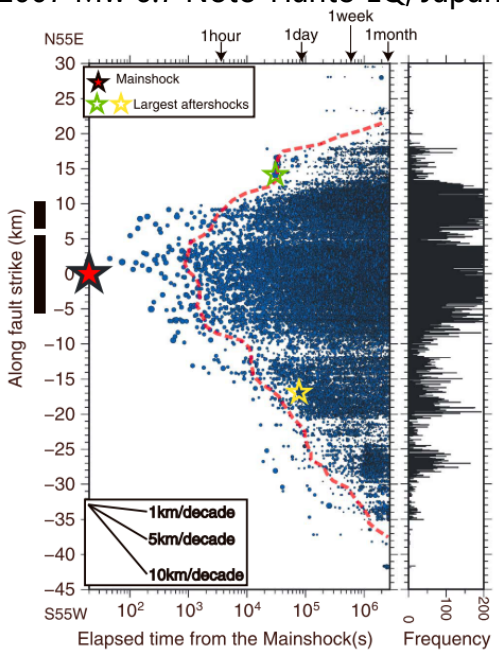


2004 Parkfield EQ

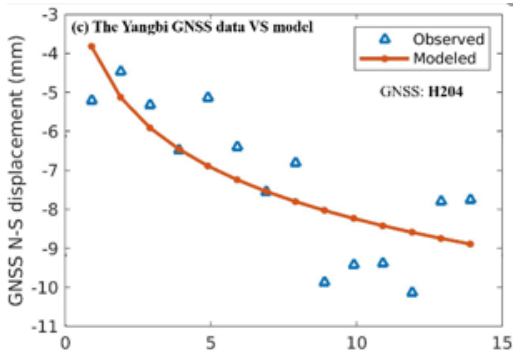


Peng and Zhao 2009, NG

2007 Mw 6.7 Noto-Hanto EQ, Japan

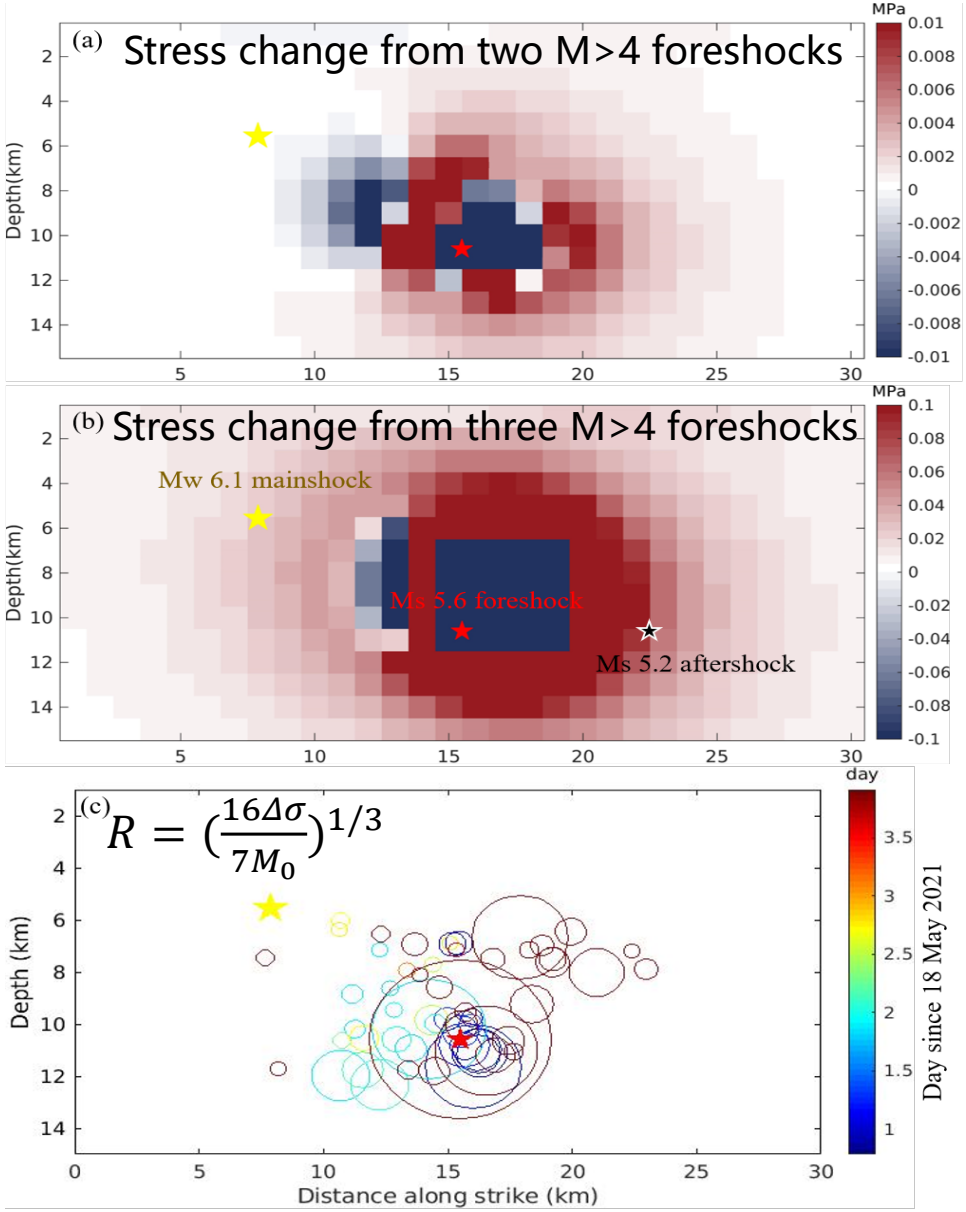


Kato et al., 2014, GRL



These seismicity migrations with logarithmic time suggest afterslip after the mainshock

Aseismic slip & stress transfer



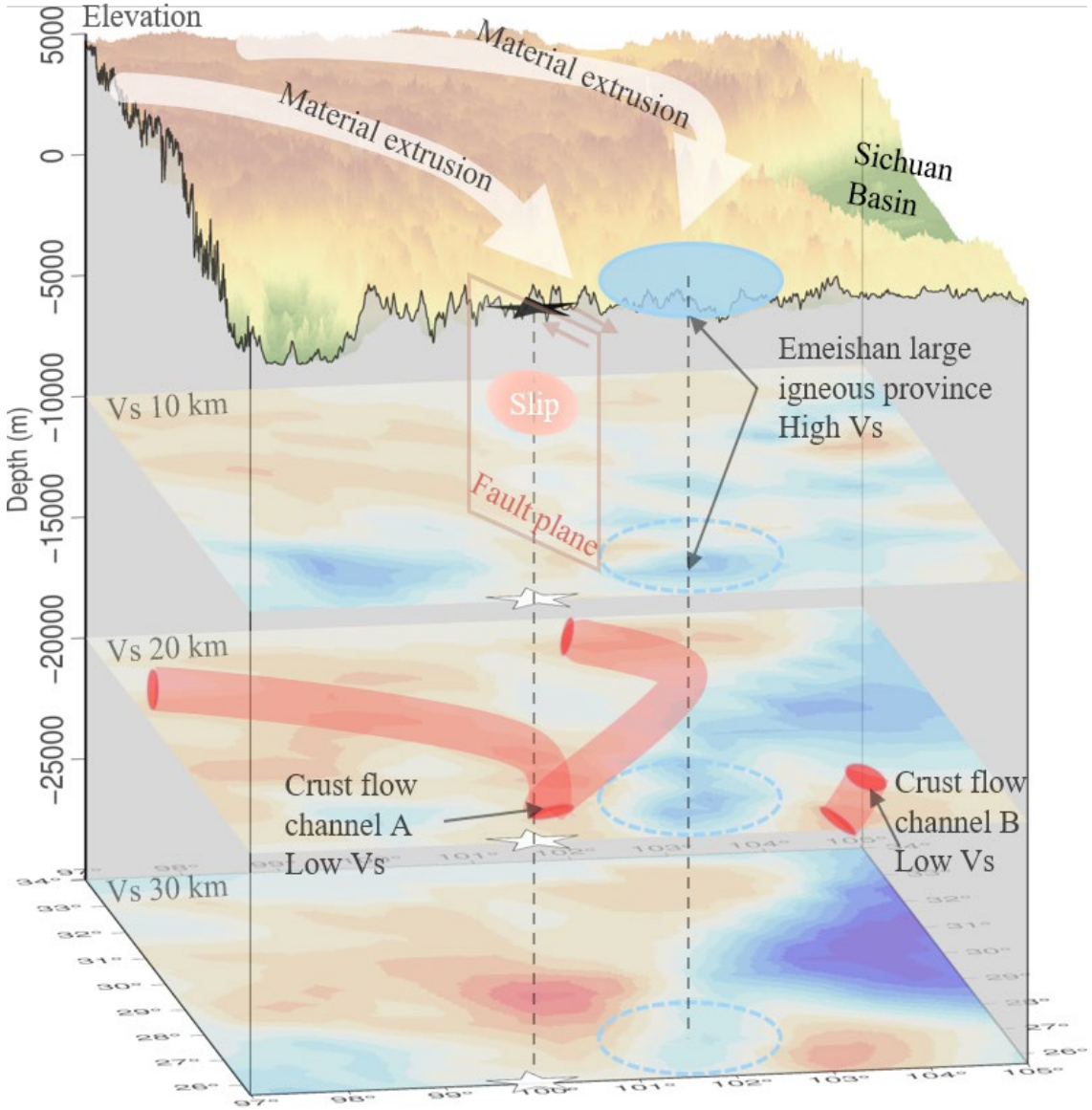
Stress releasing & overlapped rupture in the largest foreshock & directional migration

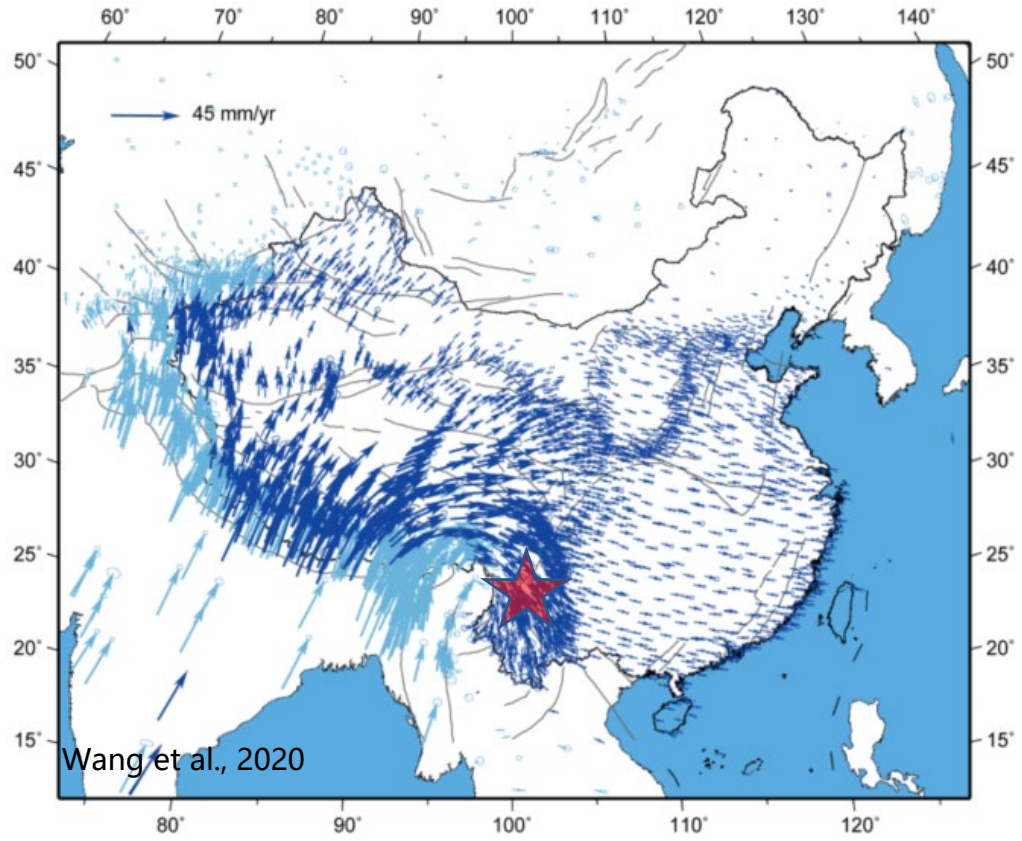
Aseismic slip likely dominates the nucleation of Ms 5.6 foreshock

Stress loading & no overlapped rupture in the mainshock hypocenter & directional migration

Both aseismic slip and stress transfer leading to the 2021 Yangbi mainshock.

Basic driving mechanisms





lateral upper crustal extrusion and lower crust flow are possible basically driving mechanisms for the Yangbi earthquake.

Summary

- **Combining the stress triggers from foreshocks on the mainshock, the apparent migrations of relocated foreshocks to the large foreshock and the mainshock hypocenters support the combined effects of aseismic slip and cascading failure that led to the mainshock.**

- **By combining low velocity, high conductivity, and high Lg-wave attenuation beneath the Yangbi region, we infer that the lateral upper crustal extrusion and lower crust flow are possible driving mechanisms for the Yangbi earthquake.**

Thank You

Question:
xiaogeliu@csu.edu.cn