

Analysis of the foreshock sequences preceding two moderate (Mw4.7 and Mw5.8) earthquakes in the Sea of Marmara offshore Istanbul, Turkey:

Highlighting a two-scale preparation phase

V. Durand¹, S. Bentz¹, G. Kwiatak^{1,2}, G. Dresen^{1,3}, C. Wollin¹, O. Heidbach¹, P. Martínez-Garzòn¹, F. Cotton^{1,3}, M. Nurlu⁴ and M. Bohnhoff^{1,2}

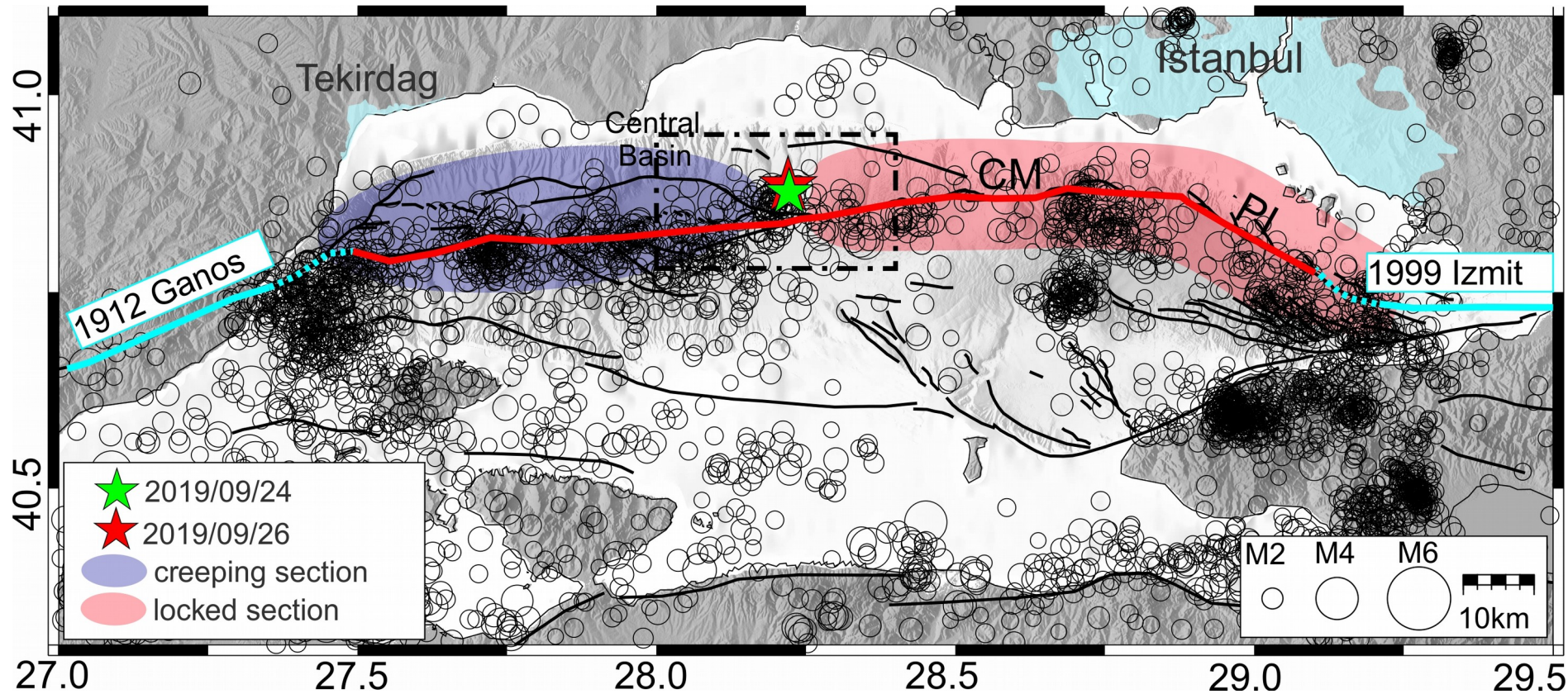


¹Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Potsdam, Germany.

²Institute of Geological Sciences, Free University of Berlin, Berlin, Germany.

³University of Potsdam, Institute of Geosciences, Potsdam, Germany.

⁴AFAD, Disaster and Emergency Management Presidency, Ankara, Turkey



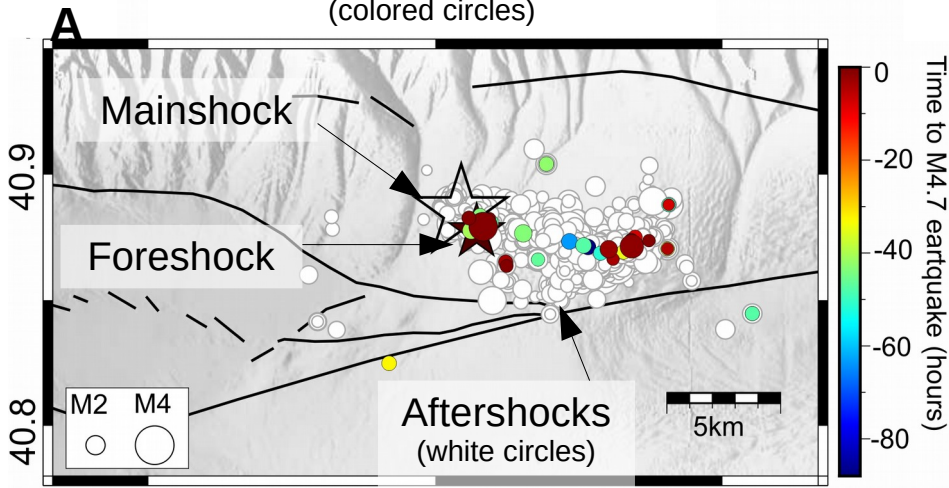
September 26th 2019: a M_w 5.8 occurred in the Marmara Sea, SW of Istanbul

➡ at the **transition between a creeping and a locked segment** of the North anatolian Fault (NAF)

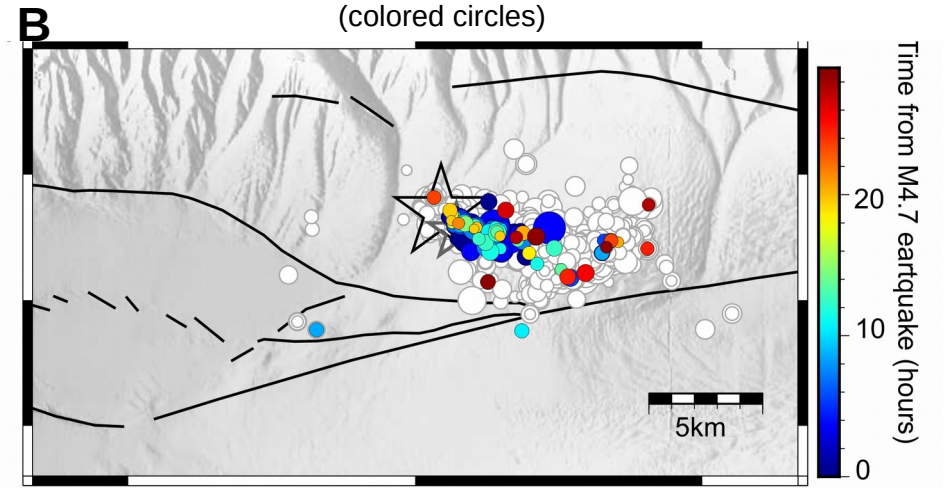
➡ this earthquake has been preceded by a M_w 4.7 foreshock

We apply a template matching and a relocation methods to generate a more precise catalog

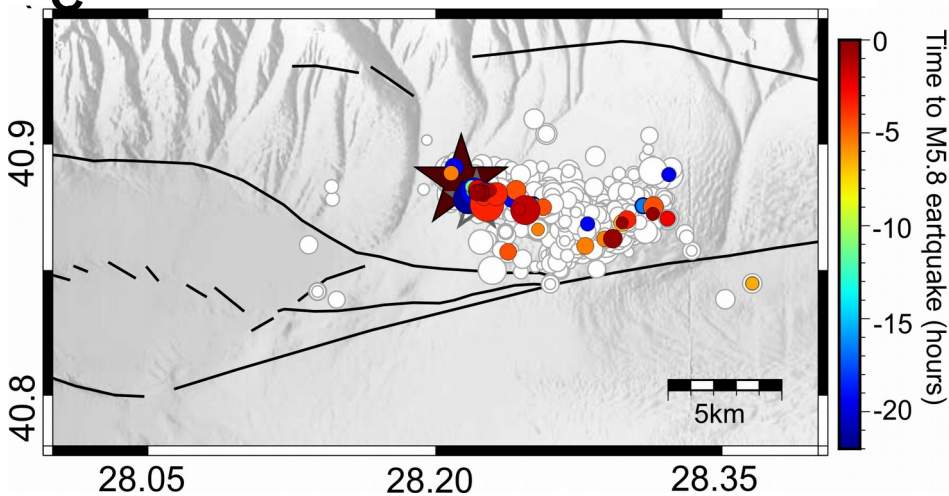
9 days before the foreshock
(colored circles)



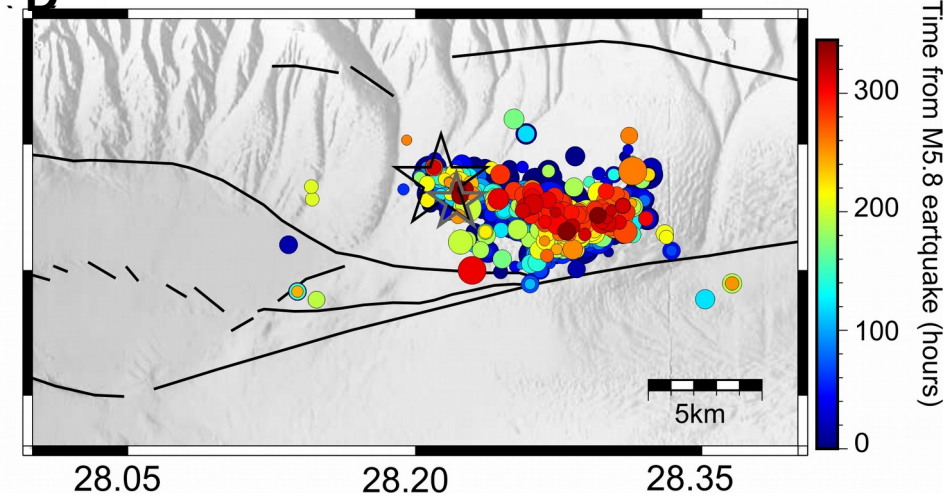
Between the foreshock and 2h before the mainshock
(colored circles)



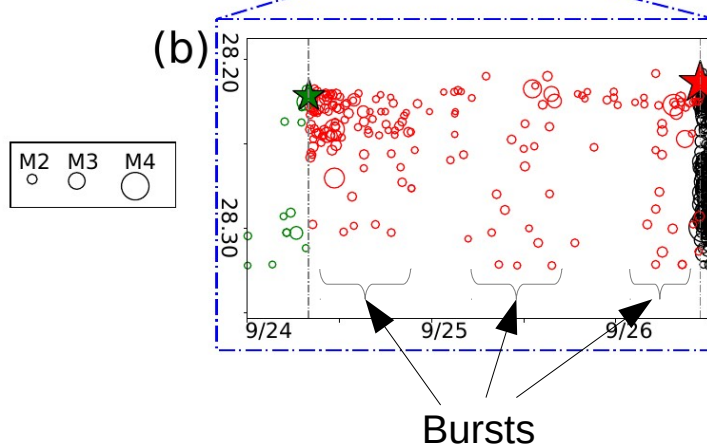
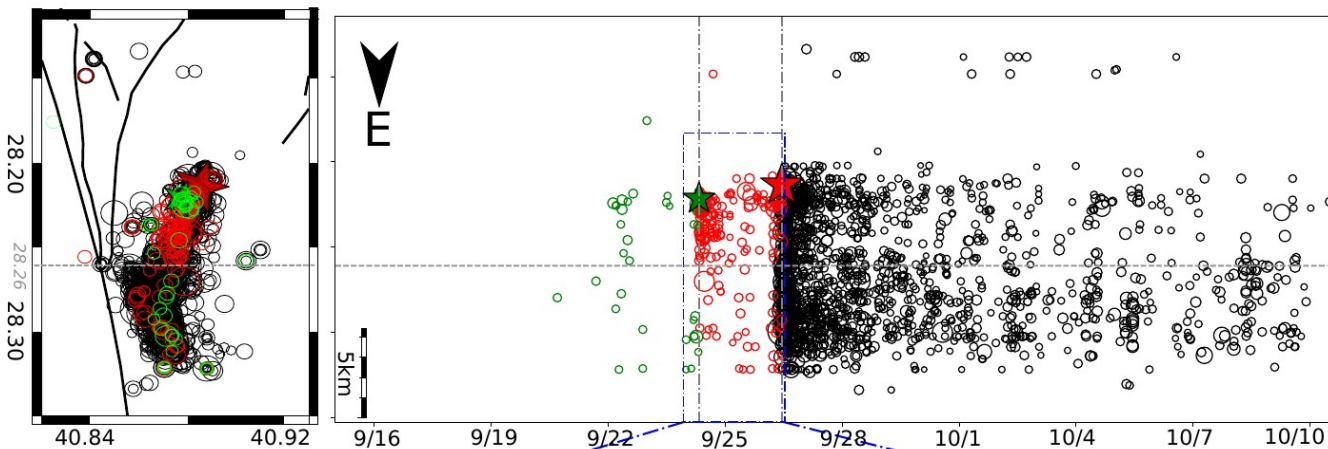
2 hours before the mainshock (colored circles)



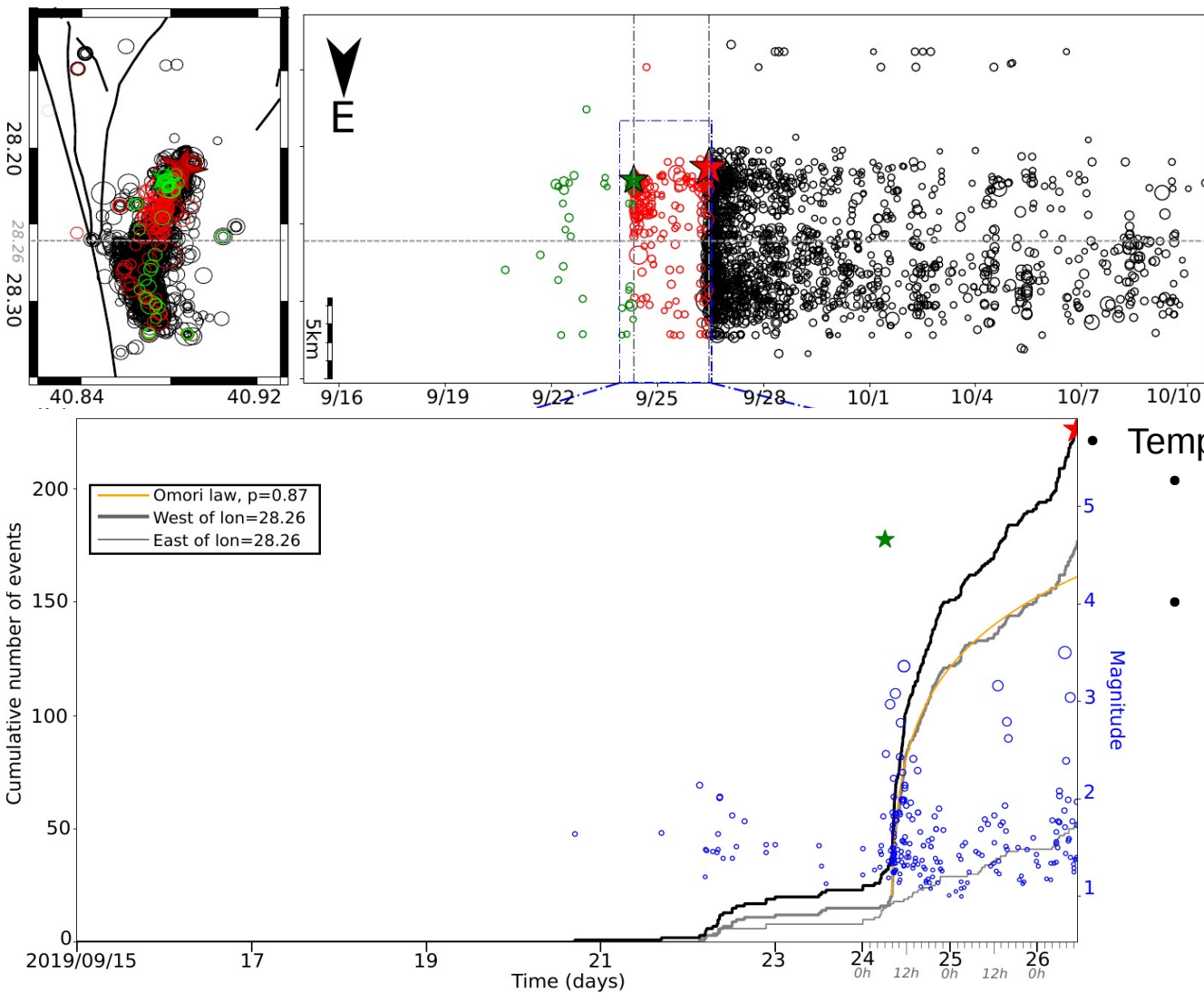
Aftershocks (colored circles)



We note that already before the foreshock (Fig.A), the whole length of the final rupture is seismically active



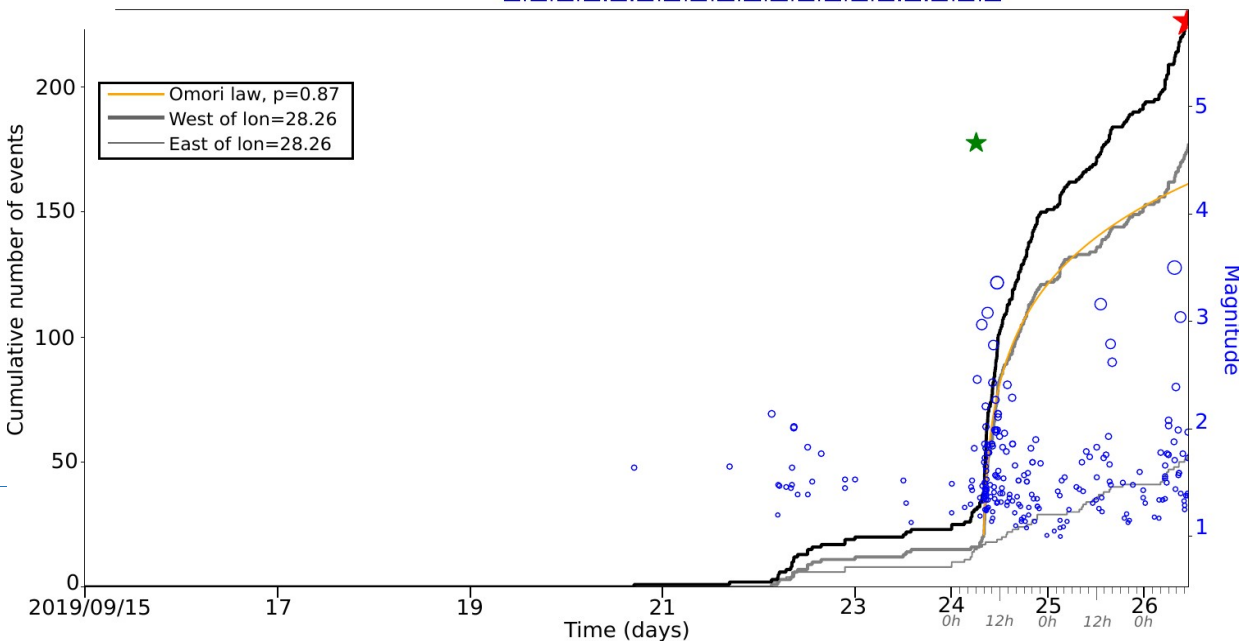
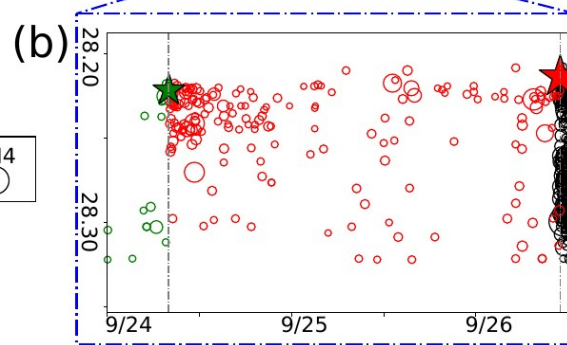
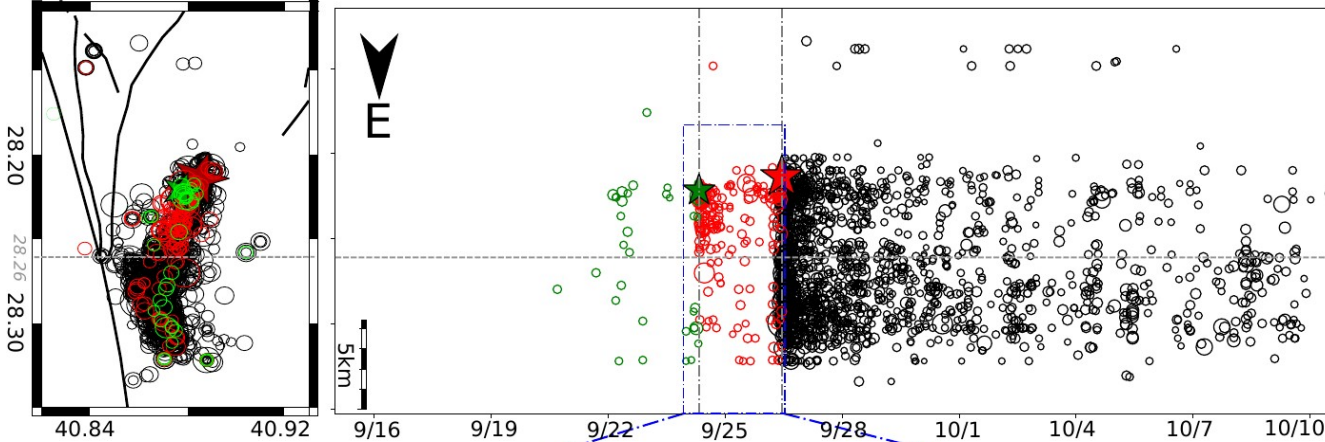
- The whole rupture is activated by bursts during the period between the foreshock and the mainshock
- Then, ~1day before the mainshock, we observe a concentration of the seismicity around the mainshock epicenter



• Temporal evolution:

- The foreshock is followed by an Omori law decay of the seismicity
- 8 hours before the mainshock, increase of the seismic activity: deviation from the Omori law

The thick gray line shows the evolution of the seismicity on the foreshock rupture length (west of the gray dashed line on the upper figure), the thin gray line the evolution on the eastern part of the final rupture area.



Conclusions:

A 2-scale preparation phase

- LT activation of the seismicity along the entire fault segment (bursts)



Aseismic slip preparing the mainshock final rupture

- ST concentration around the epicenter



Cascade mechanism as the triggering impulse