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SM5.2 - Improving seismic networks performances: from site selection to data integration
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The Namche Barwa Temporary Seismic Network (NBTSN) and its performance in monitoring the 18 November 2017 M 6.9 Mainling, Tibet, China, earthquake

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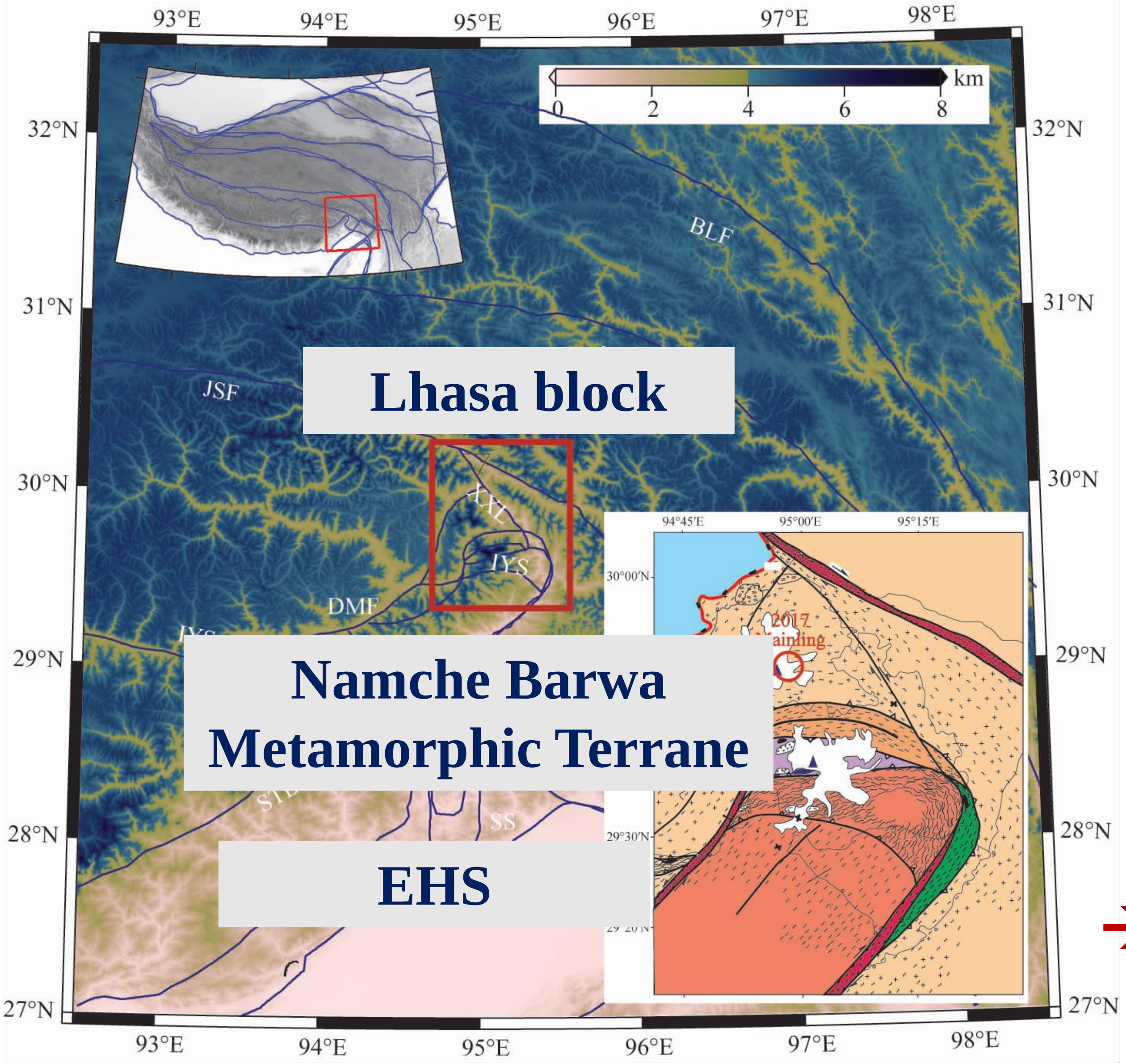
Outline

- Background
- Performance of the NBTSN
- Application to the 2017 Mainling earthquake
- Conclusions

Himalayas (EHS)



Tapponnier et al., 2001; Yin and Harrison, 2003; Ding et al., 2001, 2005; Reddy et al., 2008, 2009; Zeitler et al., 2001, 2014; Xu et al., 2008; Chang et al., 2015; Wang et al., 2014; Bai et al., 2017

→ **Research Hotspot**

Uncertainty in earthquake catalogs

Chen and Yang, 2004; Jackson *et al.*, 2008

For the Himalayan region:

uncertainty in locating the focal depth of earthquakes has resulted in **controversy** about whether they originate in the lower-crustal or upper-mantle regions.

We need more accurate data!!!

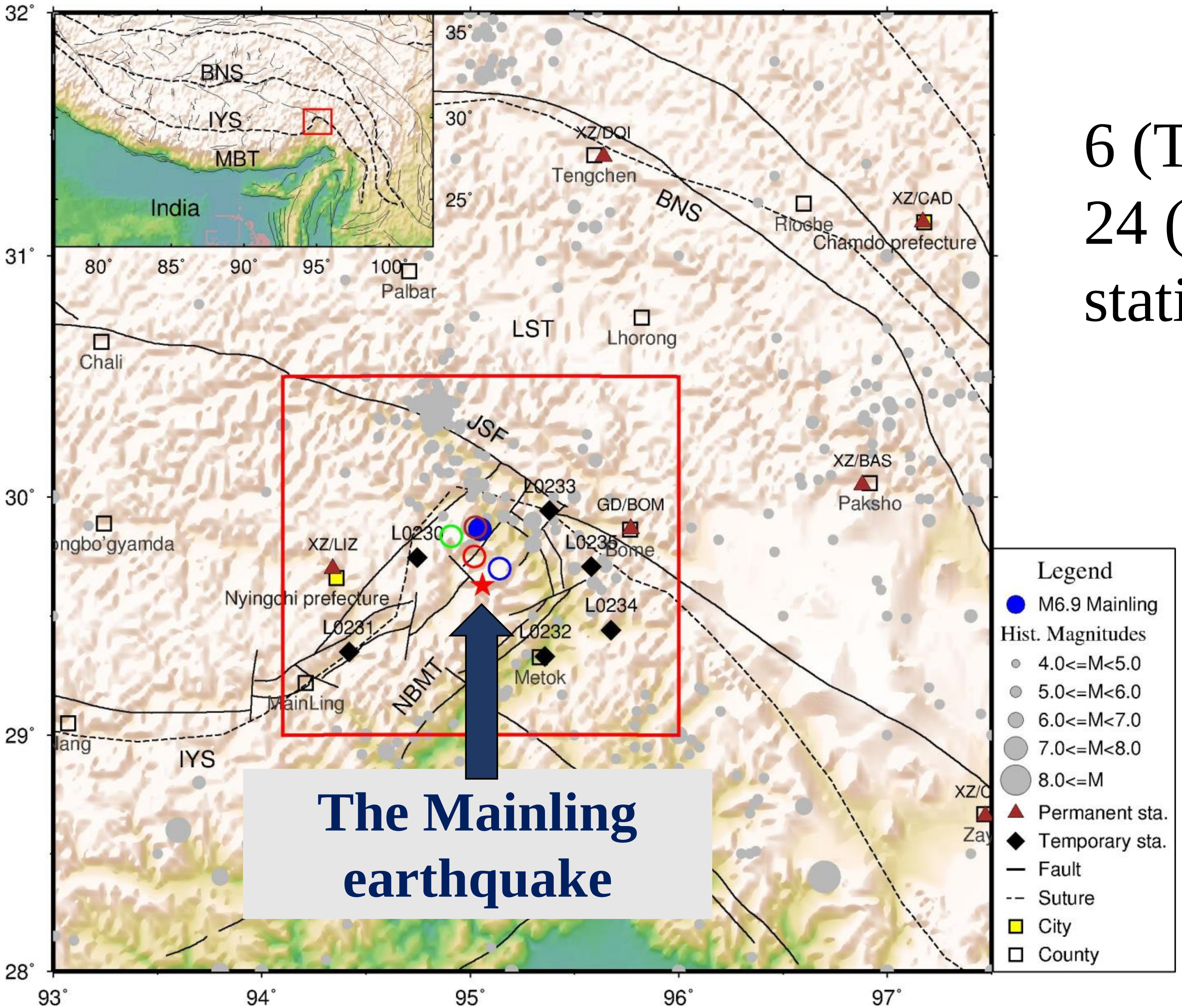
Sparse seismic network in EHS

Average distance between seismic stations in the EHS > **100** km

large biases in determining earthquake location, focal depths, and focal mechanism solutions

We need to improve the density of seismic stations in the EHS region!!!

The Namche Barwa Temporary Seismic Network (NBTSN)

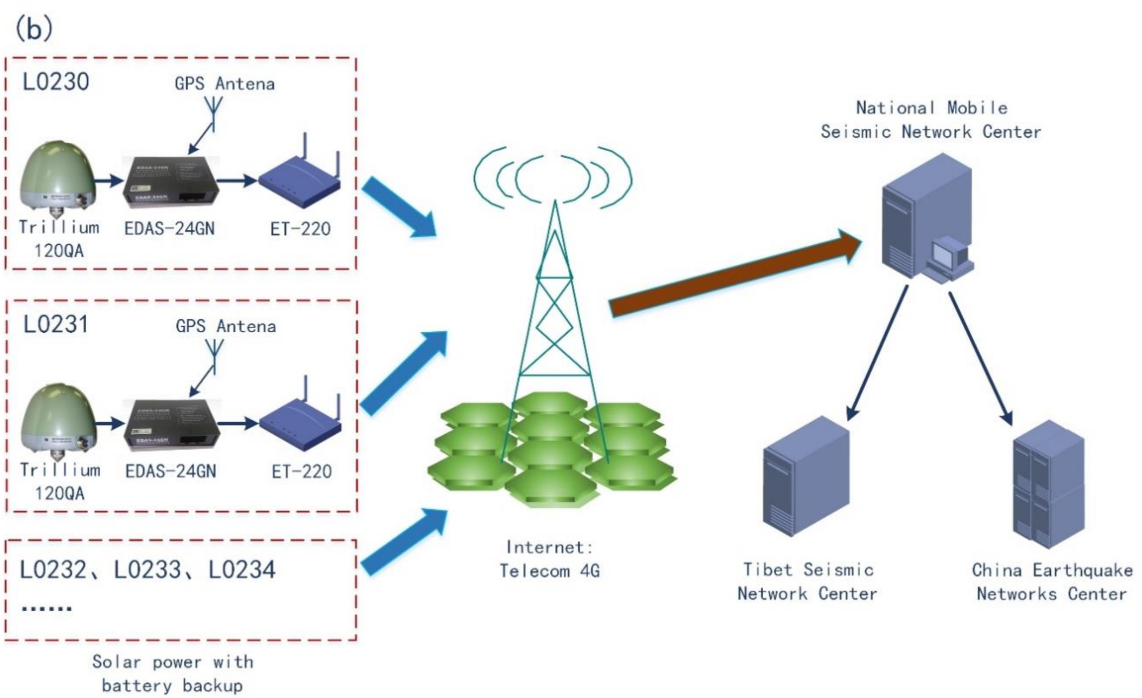


The Mainling earthquake

6 (Temporary) + 24 (Permanent) stations

NBTSN

Seismic network deployment



Trillium 120QA + EDAS-24GN

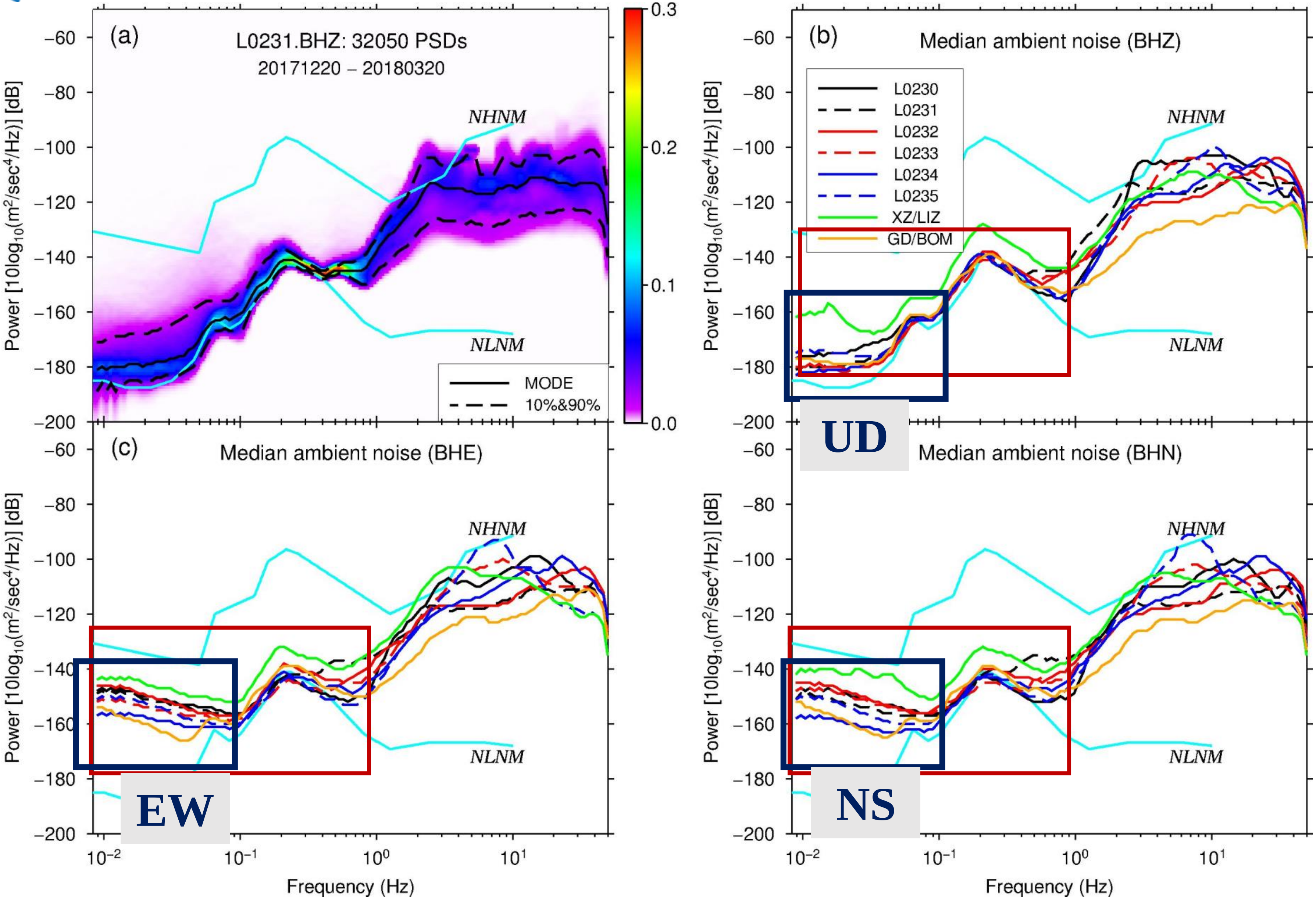
Sampling rate: 100 Hz

5 stas: real-time trans
1 sta: local CF storage

1-m-deep vault
Foam + rubber buckets

120W Solar panel + 100Ah backup Battery

Station noise levels



Earthquake-monitoring capability

Local earthquake magnitude formula:

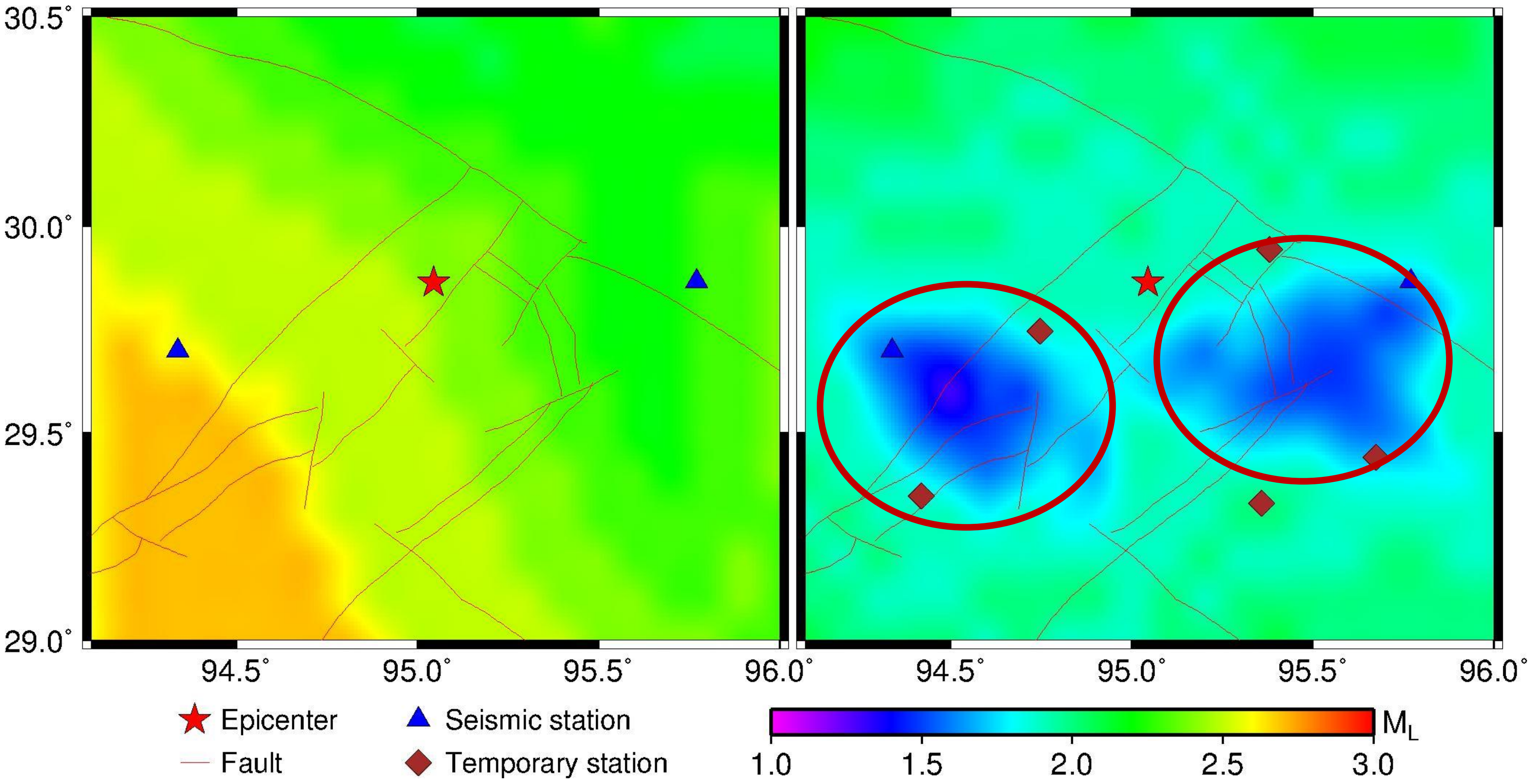
$$\boxed{M_L = lg(4 * E_N) + R(\Delta)}$$

Sta.	Lon. (ºE)	Lat. (ºN)	Alt. (m)	Seismometer	Digitizer	RMS (m/s) (1-20 Hz)
L0230	94.75	29.75	3374	Trillium 120QA (120s – 100 Hz)	EDAS-24GN	1.0549E-07
L0231	94.42	29.35	2951	Trillium 120QA (120s – 100 Hz)	EDAS-24GN	7.7884E-08
L0232	95.36	29.33	1652	Trillium 120QA (120s – 100 Hz)	EDAS-24GN	8.1633E-08
L0233	95.38	29.94	2581	Trillium 120QA (120s – 100 Hz)	EDAS-24GN	32124E-07
L0234	95.68	29.44	2011	Trillium 120QA (120s – 100 Hz)	EDAS-24GN	1.8043E-07
L0235	95.58	29.71	2789	Trillium 120QA (120s – 100 Hz)	EDAS-24GN	6.7453E-07
XZ/LIZ	94.34	29.70	2995	CTS-1EF (120 s – 50 Hz)	EDAS-24IP	3.1458E-07
GD/BOM	95.77	31.41	2763	CMG-3ESPC (60 s – 50 Hz)	TDE-324CI	8.2813E-08

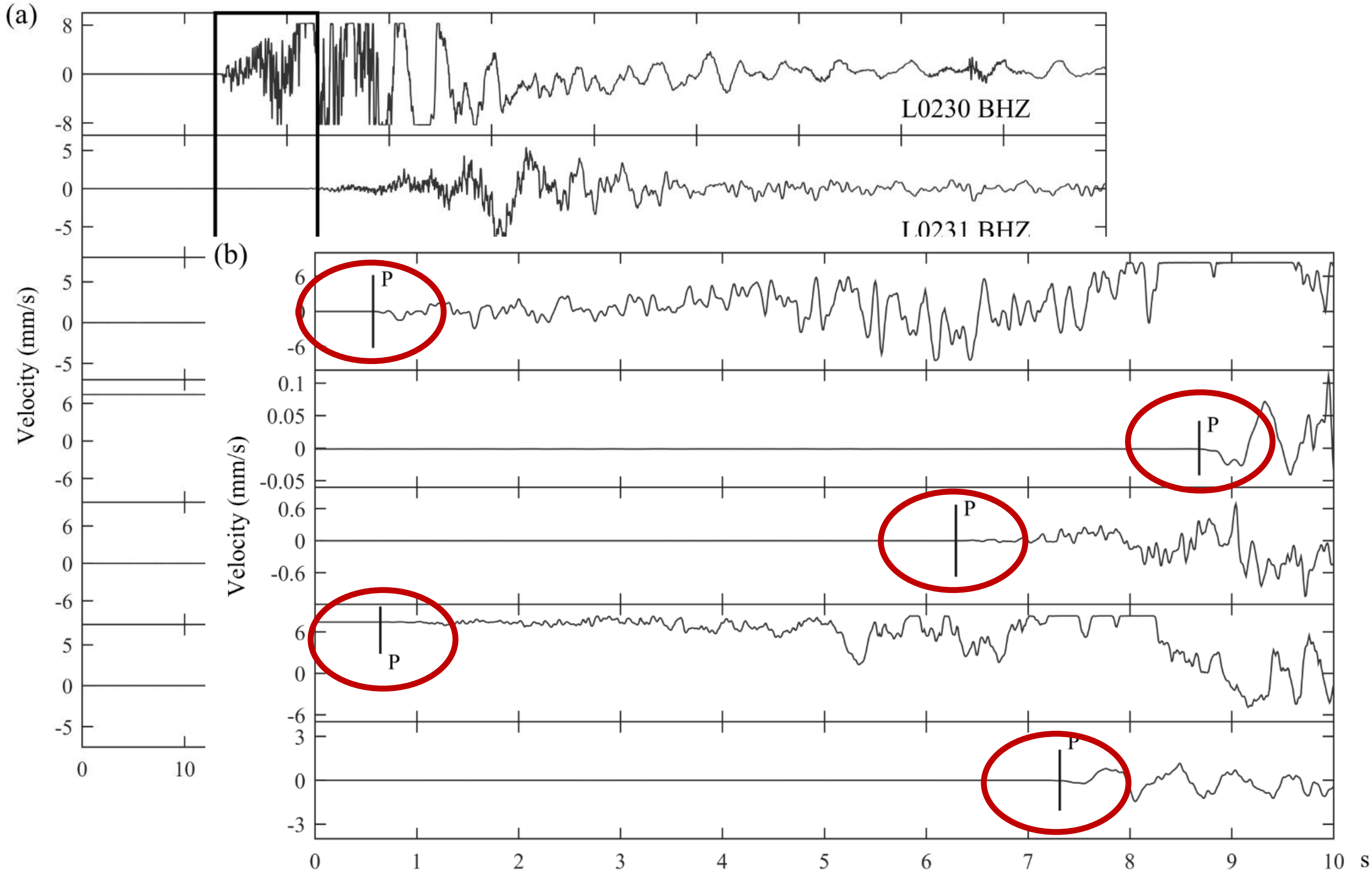
Earthquake-monitoring capability

The monitoring capability in the region improved by ~0.5-1.0

Most part of the study area with the monitoring capability of ~M_L2.0



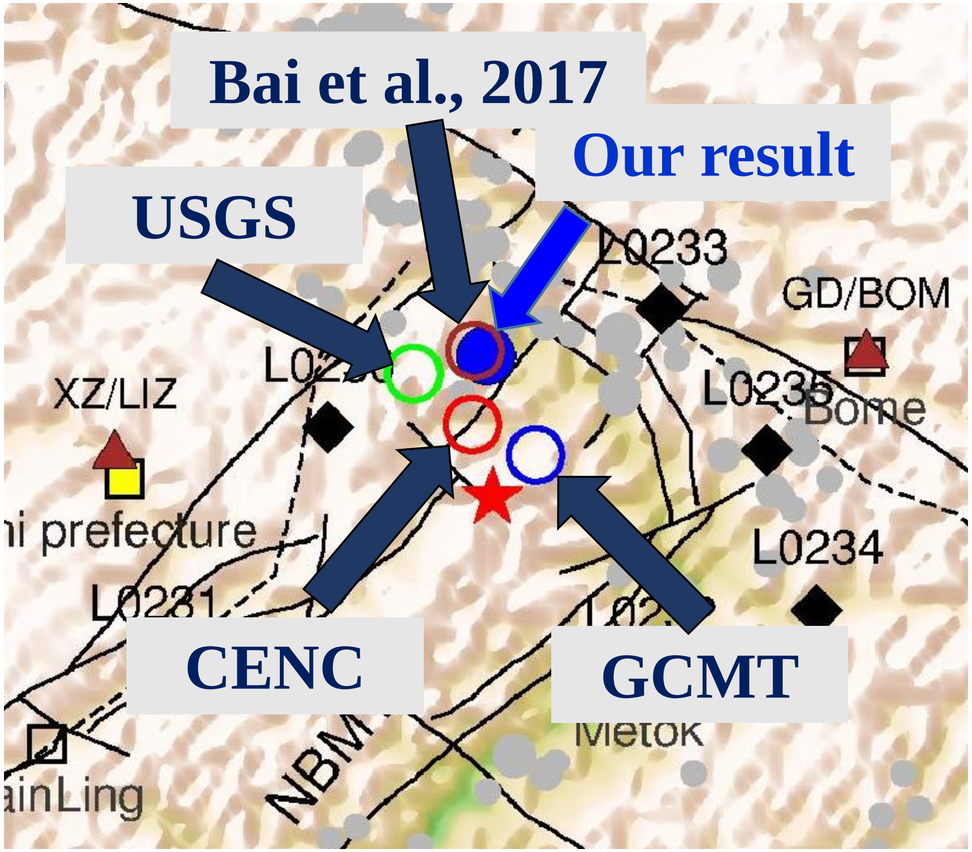
Application to the Mainling earthquake



The mainshock relocation

The used 1D *P*- and *S*-wave velocity model for this region (Crust 1.0; Laske et al., 2013)

P-wave (km/s)	S-wave (km/s)	depth (km)
5.8	3.3	10
6.0	3.5	30
6.5	3.6	64
6.8	3.9	



Result:

longitude: 95.05º±0.01ºE

latitude: 29.86º±0.01ºN

depth: 11±3 km or

8±3 km (below sea level)

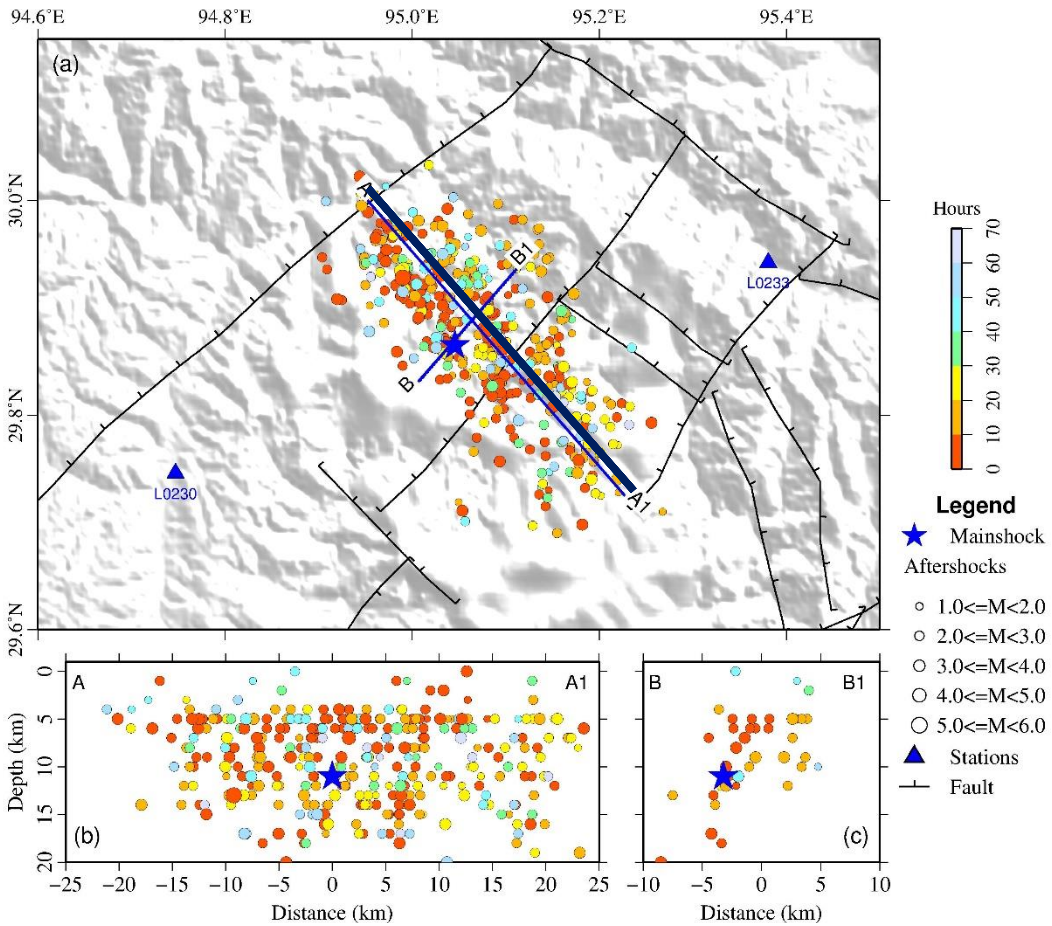
Aftershock distribution

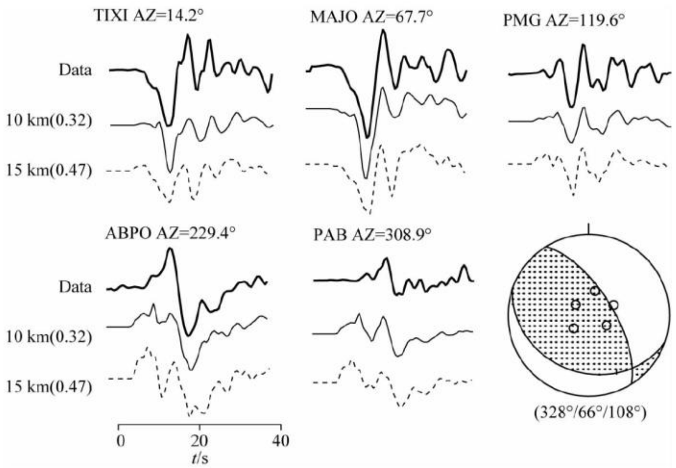
(1) more than 60 aftershocks in the first 2 hours, with the largest aftershock of M 5.0

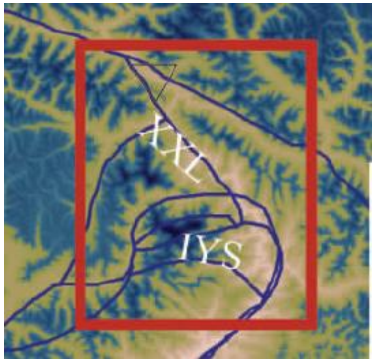
(2) 184 aftershocks until 18:00 (Beijing time) on the same day

(3) 604 aftershocks up to the end of 20 November 2017 (midnight, Beijing time), including 3 M_L4-4.9, 73 M_L3-3.9

Bai *et al.*, 2017

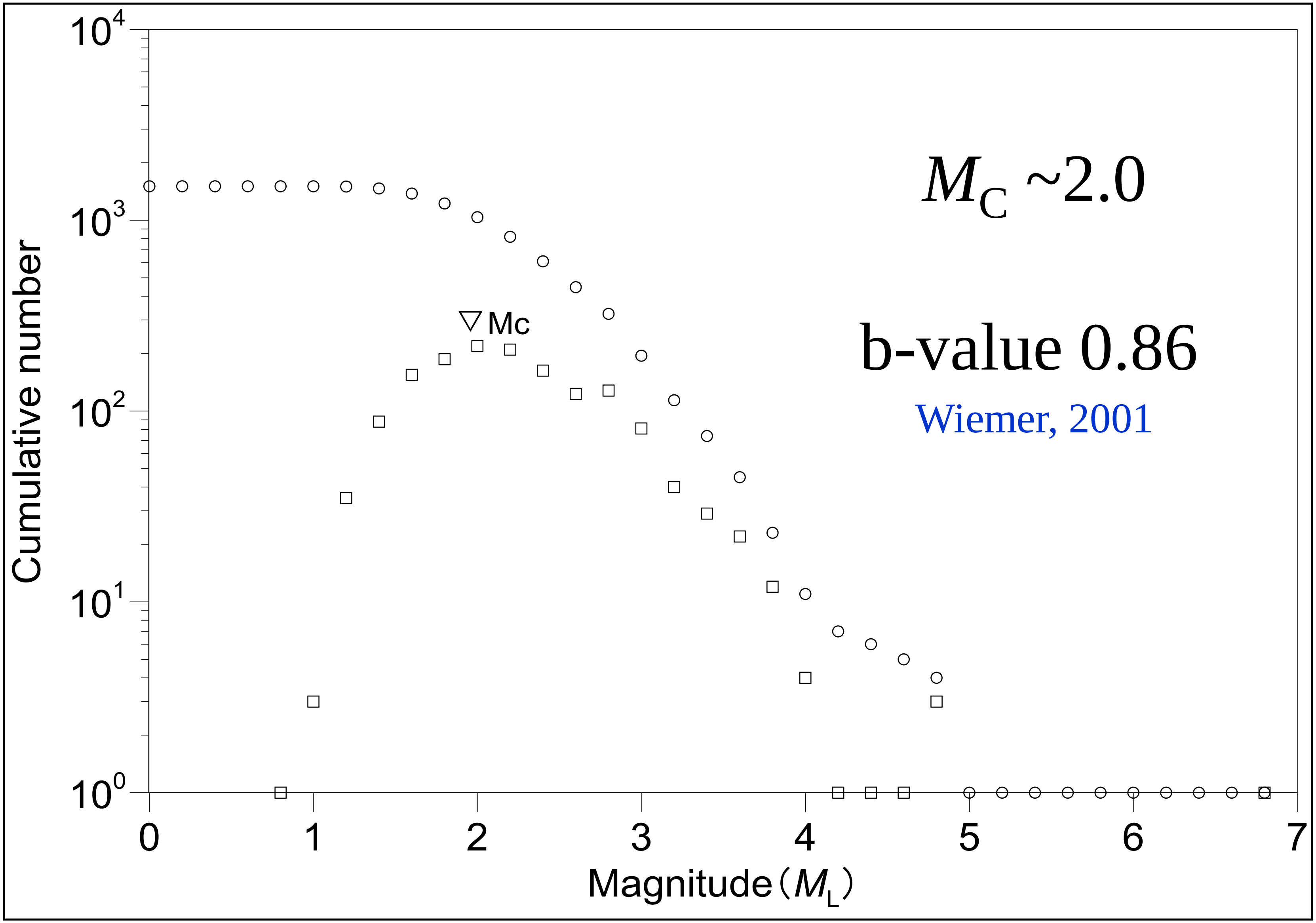






Magnitude of completeness estimation

Gutenberg and Richter, 1944

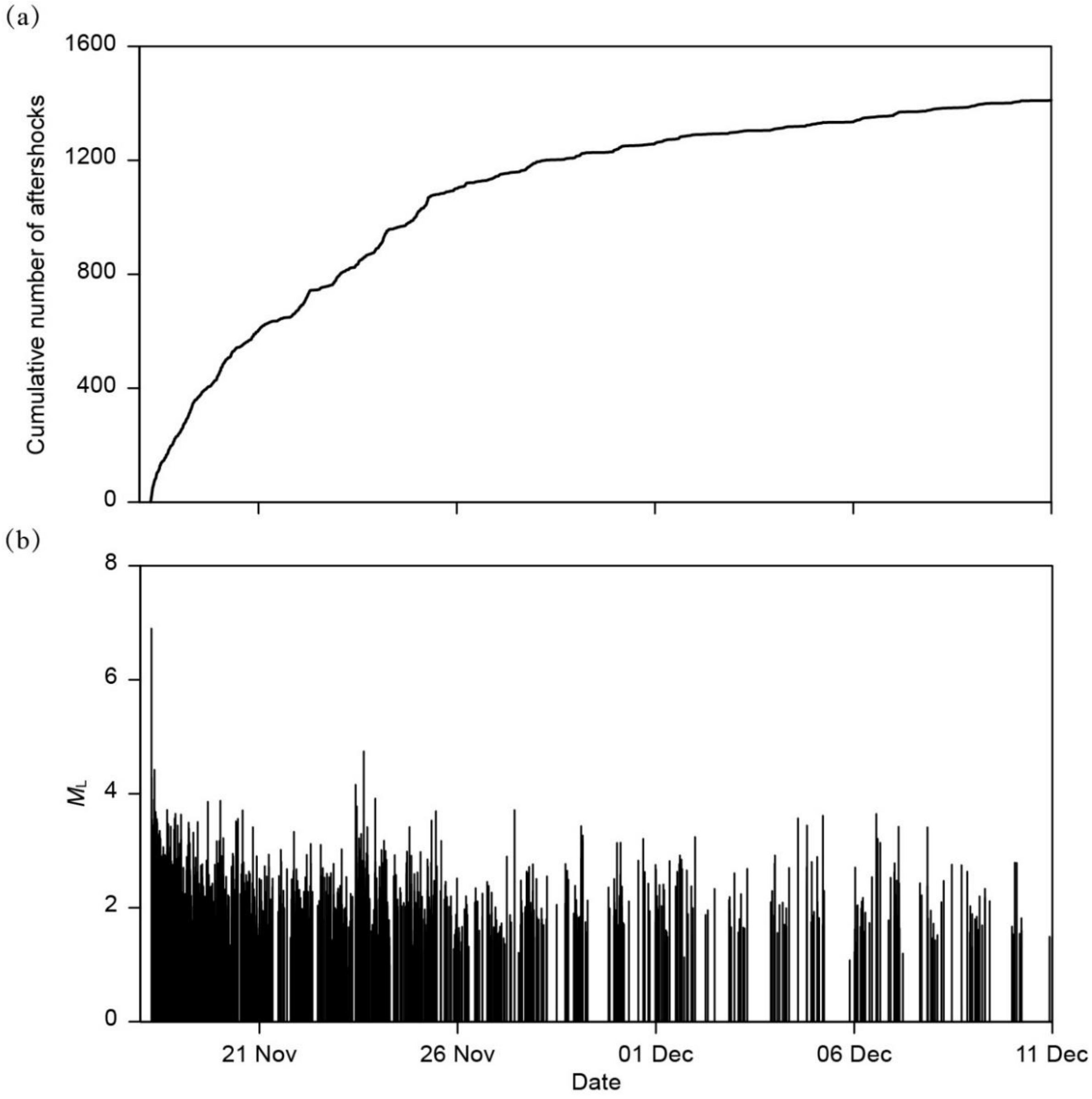


M_C ~2.0

b-value 0.86

Wiemer, 2001

Seismicity temporal distribution



> 1400 aftershocks (M_L0.6-4.7) until the midnight of 10 Dec. 2017

More than 100 events per day during the first three days of the sequence

Conclusions

♀ The introduction of temporary monitoring stations throughout a study area can potentially increase the density of a seismic network, thus improving the earthquake location accuracy.

♀ Without the presence of the NBTSN, many of the aftershocks caused by the Mainling earthquake would have remained undetected, resulting an incomplete knowledge of the nature and timing of the aftershock sequence.

♀ The seismic data recorded by the NBTSN provided a valuable resource for further exploration of the mechanism of large block boundary earthquakes and related geological disasters.

Thanks for your attention!

Detailed information can be found in Peng et al., 2018, SRL

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