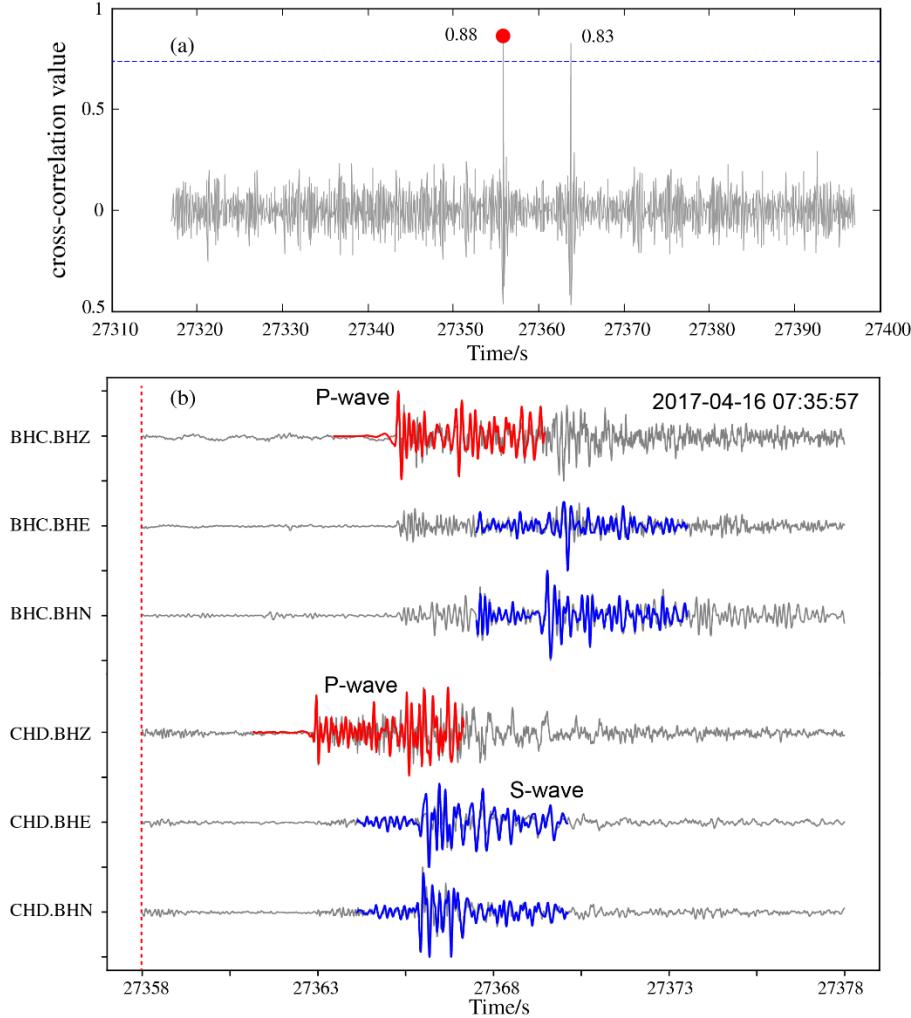
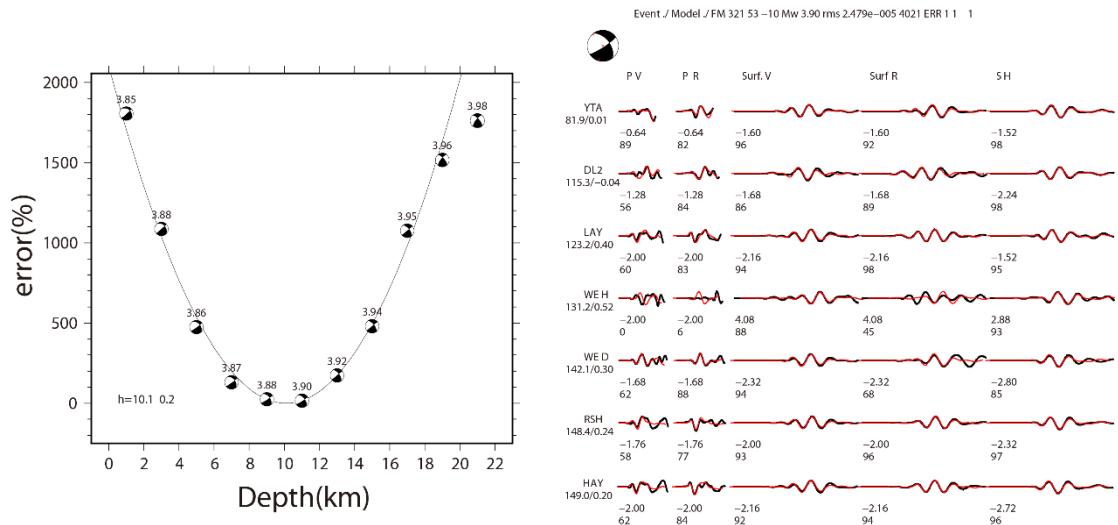


1    **Supplementary Material**



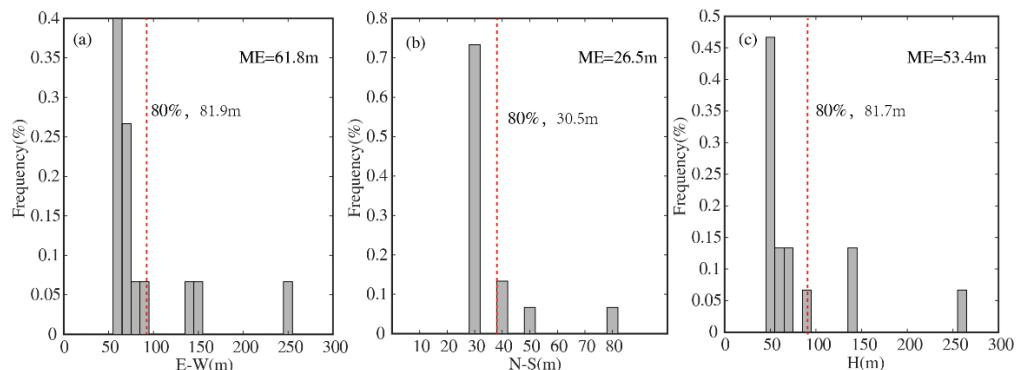
2

3    **Figure S1.** (a) Mean CC after migration of time (blue dotted line represents the threshold; red  
4    dot represents detected events). The horizontal axis is sampling point corresponding to time,  
5    sampling rate is 100. (b) Example of a detected  $M_L$ 2.6 event at 07:35:57 on 16 April 2017 (gray  
6    waveform). It is detected by the template from  $M_L$ 3.0 event at 09:40:46 on 15 April 2017, its P-  
7    wave is the red line and S-wave is the blue line. Red dotted line is the origin time of earthquake  
8    corresponding to the horizontal ordinate of red dot in Figure 2a.



9

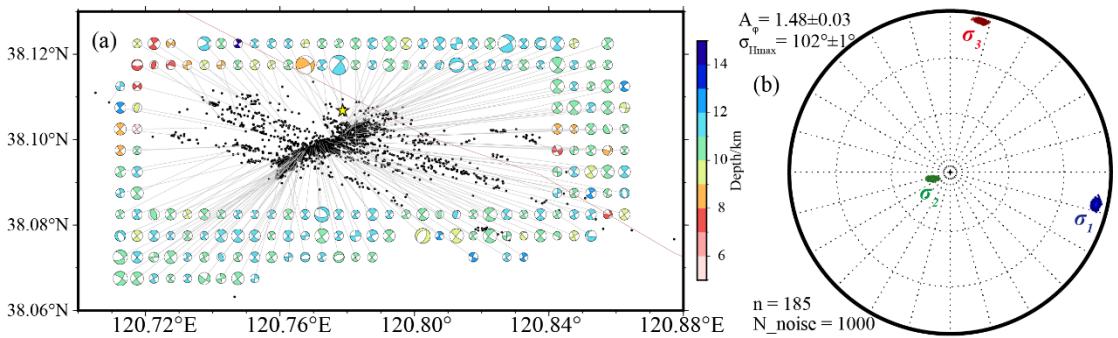
10 **Figure S2.** Example of calculating focal mechanism using CAP method. The earthquake was  
 11 2017-03-21 00:54:40  $M_{L}4.1$ , the corresponding focal mechanism solution was strike-slip with  
 12 positive fault component; the right figure was the fitting diagram of body wave and surface wave  
 13 of each station, which shows that the fitting was good.

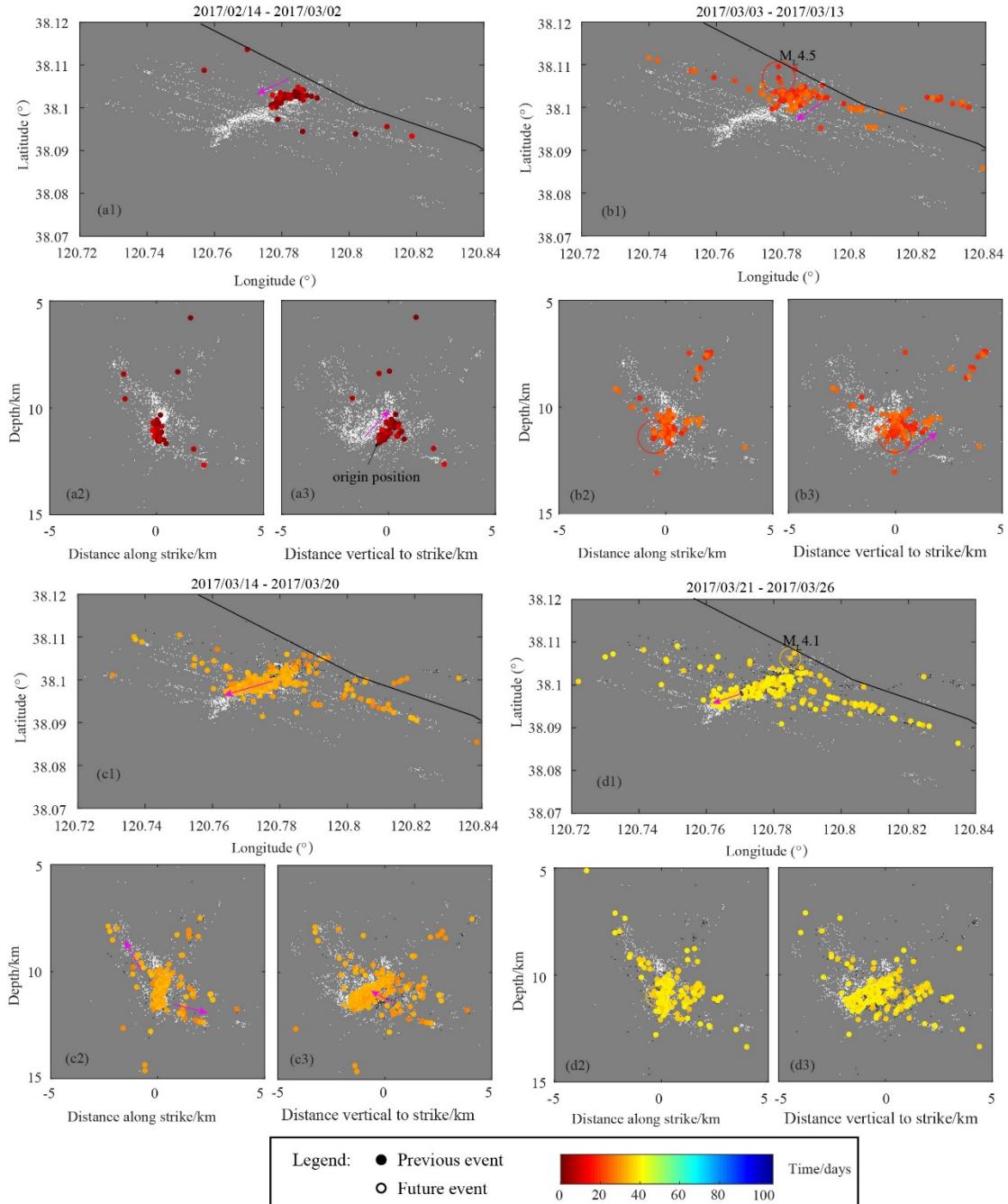


14

15 **Figure S3.** The errors of all earthquakes in the horizontal and vertical directions. ME indicated  
 16 the median value of earthquakes in the direction. The red line mark 80% errors. We selected 90  
 17 events on February 14, 2017 (with magnitude range of 0.5-2.8) based on singular-value  
 18 decomposition (SVD) option in the hypoDD. The median location errors and 80% errors of  
 19 horizontal and vertical directions were also less than 100 m in the horizontal and depth directions.  
 20 These values suggested that the horizontal separation of ~0.5 km for parallel sections were likely  
 21 not due to location uncertainties.

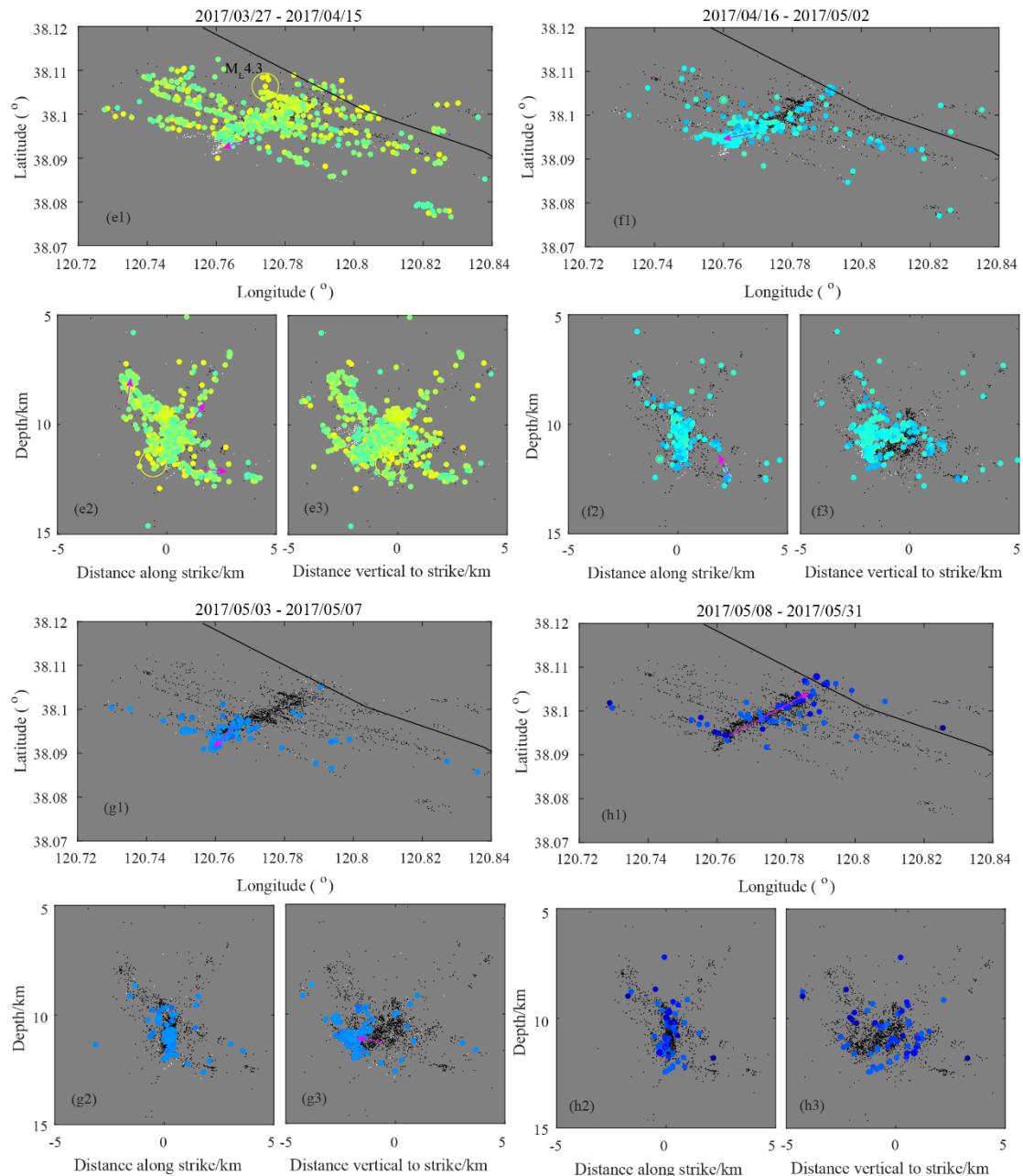
24 **Figure S4.** Focal mechanisms of the earthquakes with magnitude larger than 2 and the stress  
 25 inversion result. The color in (a) indicated the depth. The stress tensor was inverted using the  
 26 iterative stress inversion [Vavryčuk, 2014; Levandowski et al., 2018].  $A_\varphi$  was the stress ratio and  
 27  $\sigma_{Hmax}$  was the horizontal principal stress orientations, n was the counts of the earthquakes and  
 28 repeated 1000 times jackknife Stress inversion.





29

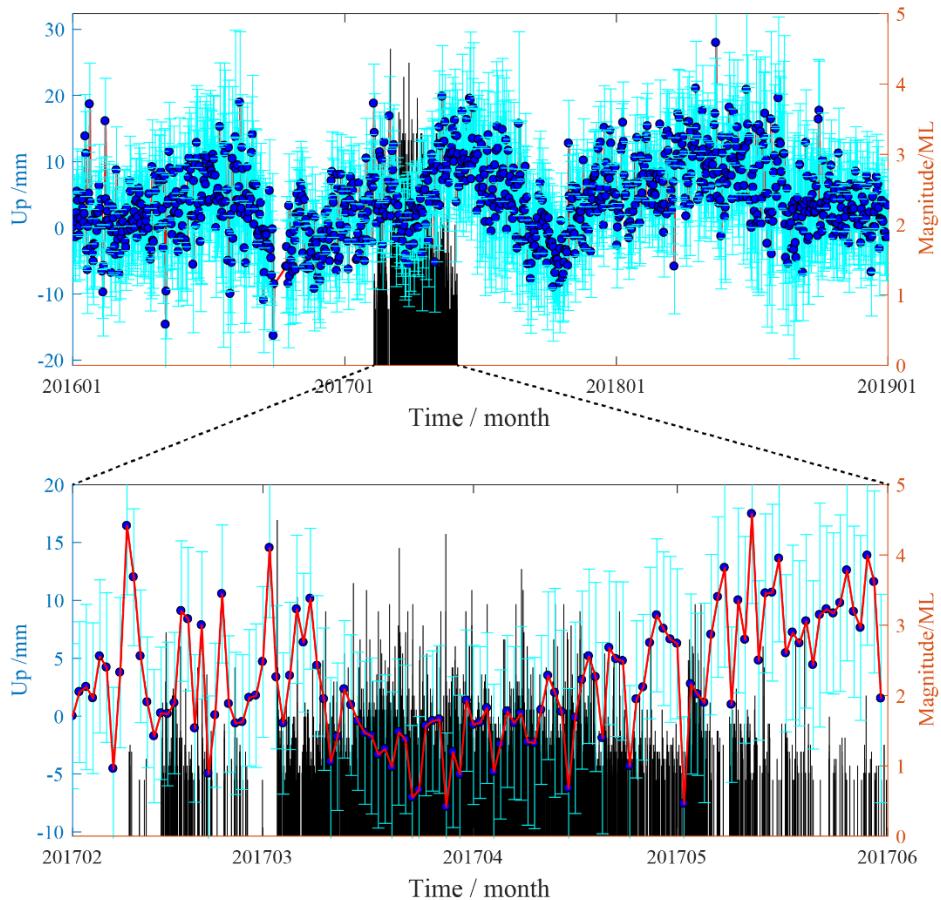
30 **Figure S5.** Space-time progression of swarm earthquakes. Each frame shows a map view on  
 31 top and two cross-sectional views on the bottom. The color indicates the occurrence time, as shown  
 32 in Figure 3. The hollow circles indicate the rupture areas of earthquake greater than 3 based on an  
 33 assumption of 3 MPa stress drop. Black points showed events occurring before the frame, while  
 34 those occurring afterward were white. The purple arrows indicated the expand direction.



35

36

**Figure S6.** Space-time progression of swarm earthquakes(continue).



37

38 **Figure S7.** Joint observations of the GPS data and earthquakes. The black lines mark the 2017  
 39 Changdao earthquake swarm. The blue dots indicate the vertical component of GPS data and the  
 40 cyan vertical lines indicate the error, the red lines show the change over time.

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42

**Table S1.** One-dimensional velocity model

Depth (km)	0	1.2	2.7	3.9	6.5	9.1	13.3	20.0	28.6	35.0
<i>P</i> wave velocity (km/s)	2.0	3.3	3.8	5.88	6.1	6.14	6.38	6.6	7.0	8.0
Vp/Vs	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72

43