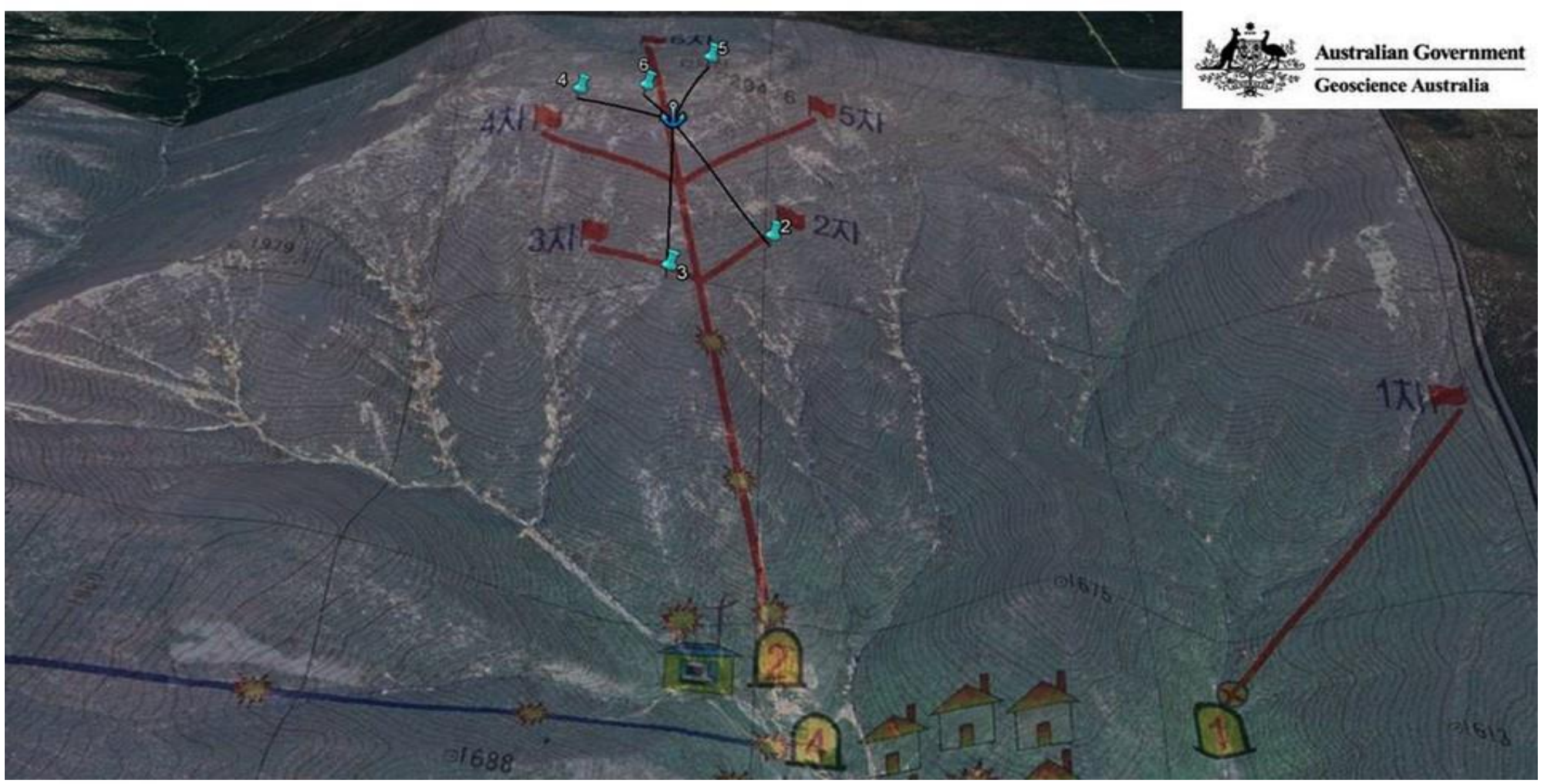




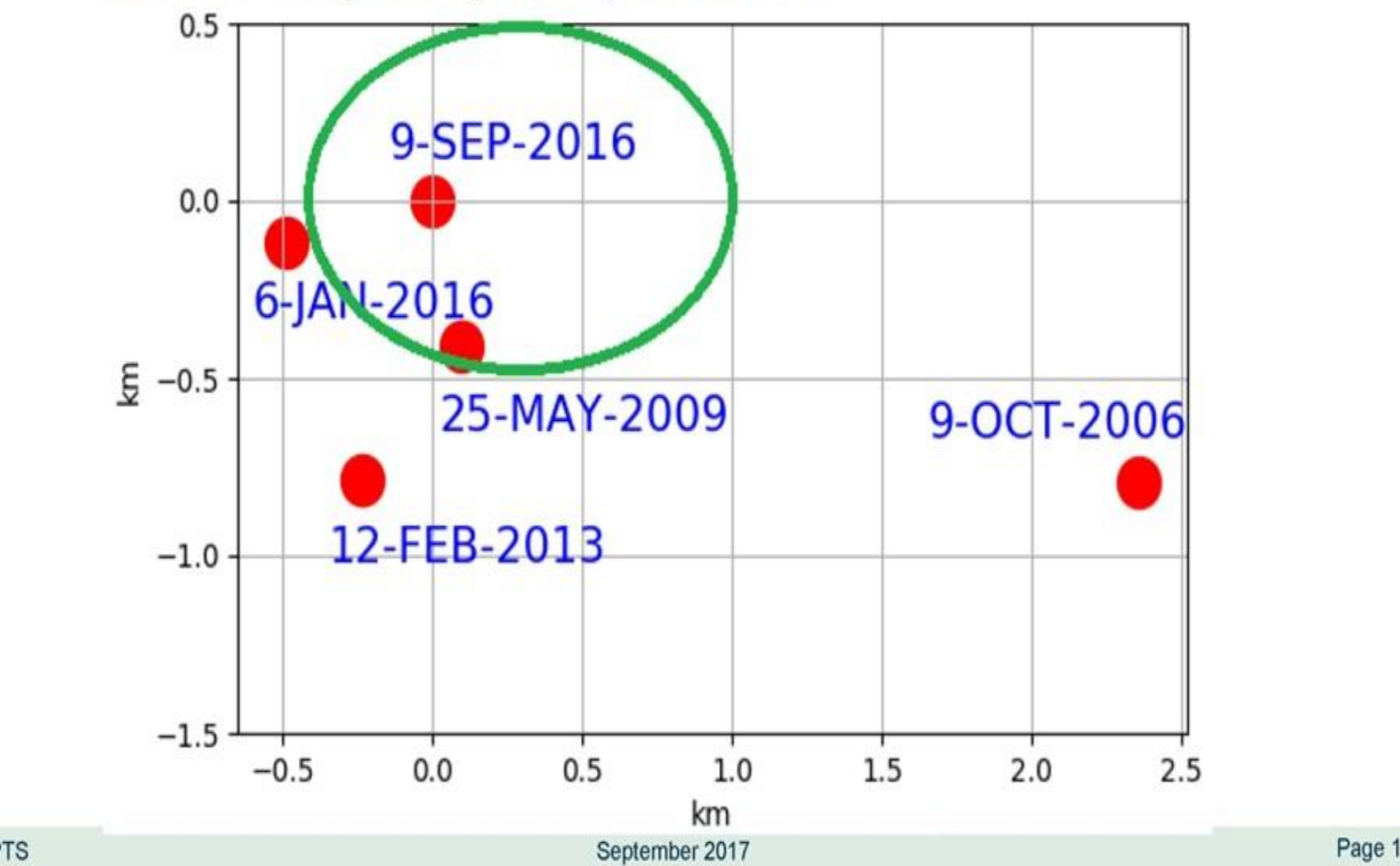
Ten NDCs and the IDC exchanged their seismic analyses on six North Korea-declared tests at the sixth East Asia Regional NDC workshop (EARNW) held September 17-21, 2018, in Ulaanbaatar, Mongolia. The cross correlation technique is clearly becoming popular among the participants for a variety of utilities, including detection, location, and even for size estimation. Relative location results presented at the workshop exhibit geometric patterns of five epicenters matching closely with a poster displayed at the so-called "Punggye dismantlement ceremony". The latest (and the largest so far) event of September 3, 2017, prompted a couple of NDCs to re-investigate the procedure of seismic magnitude scaling relationships between teleseismic and regional phases. Two NDCs provided extensive lists of aftershocks that followed the 6th test, demonstrating the robustness of the cross-correlation technique. As designed, the EARNWs have successfully facilitated data sharing discussions on specific events among the participating NDCs.

Relative Location by Australian NDC (GA) Seems to Partially Corroborate DPEK Briefing Well



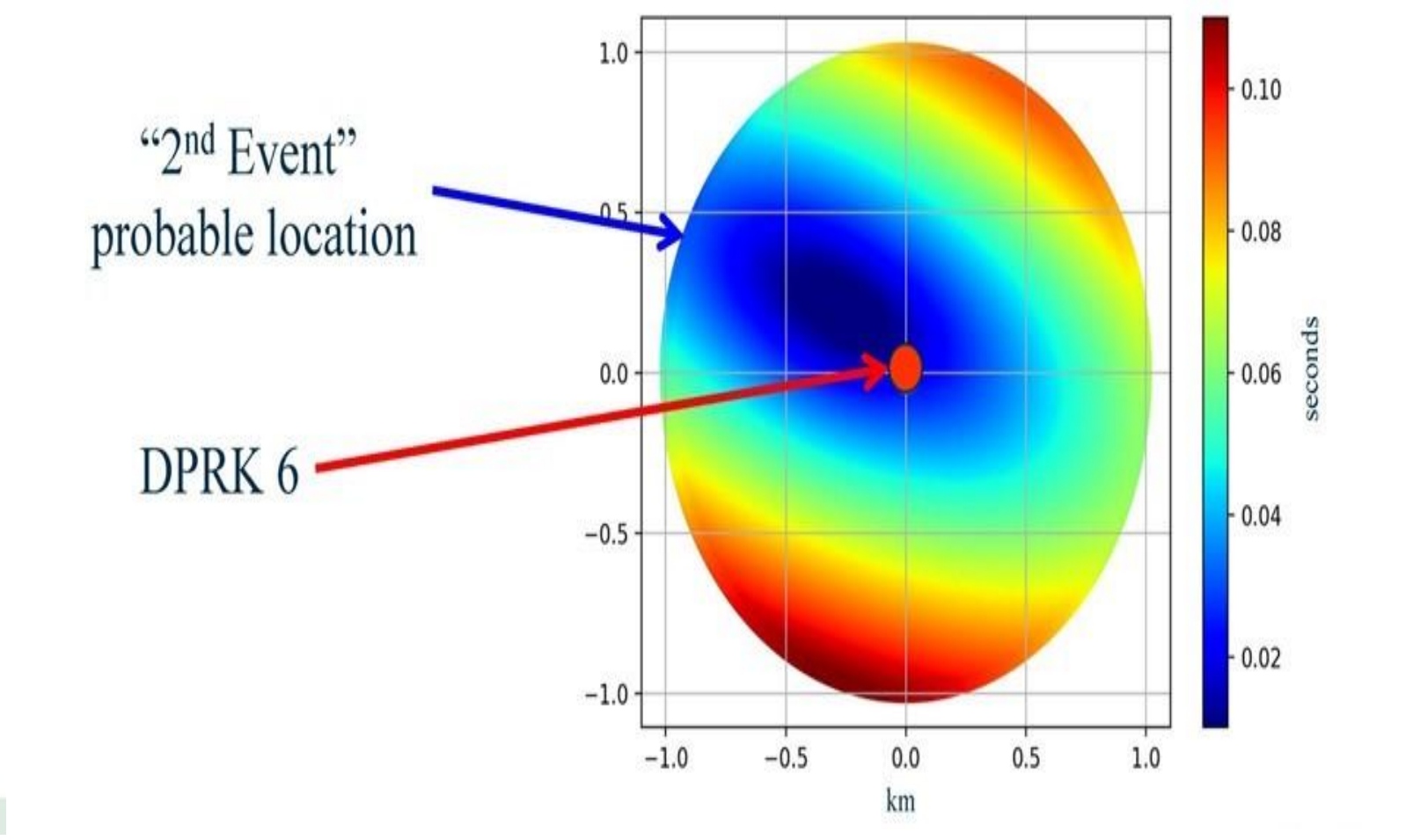
Cross correlation analysis of DPRK6 event

Cross correlation of seismic signals from DPRK 6 event with signals from the prior declared tests provides useful relative location and magnitude estimates. Green ellipse (~1.5x1.0 km) is probable location of DPRK 6 obtained using the RMS travel time residuals for cross correlation detections at four IMS regional stations USRK, KSRS, MJAR, and SONM

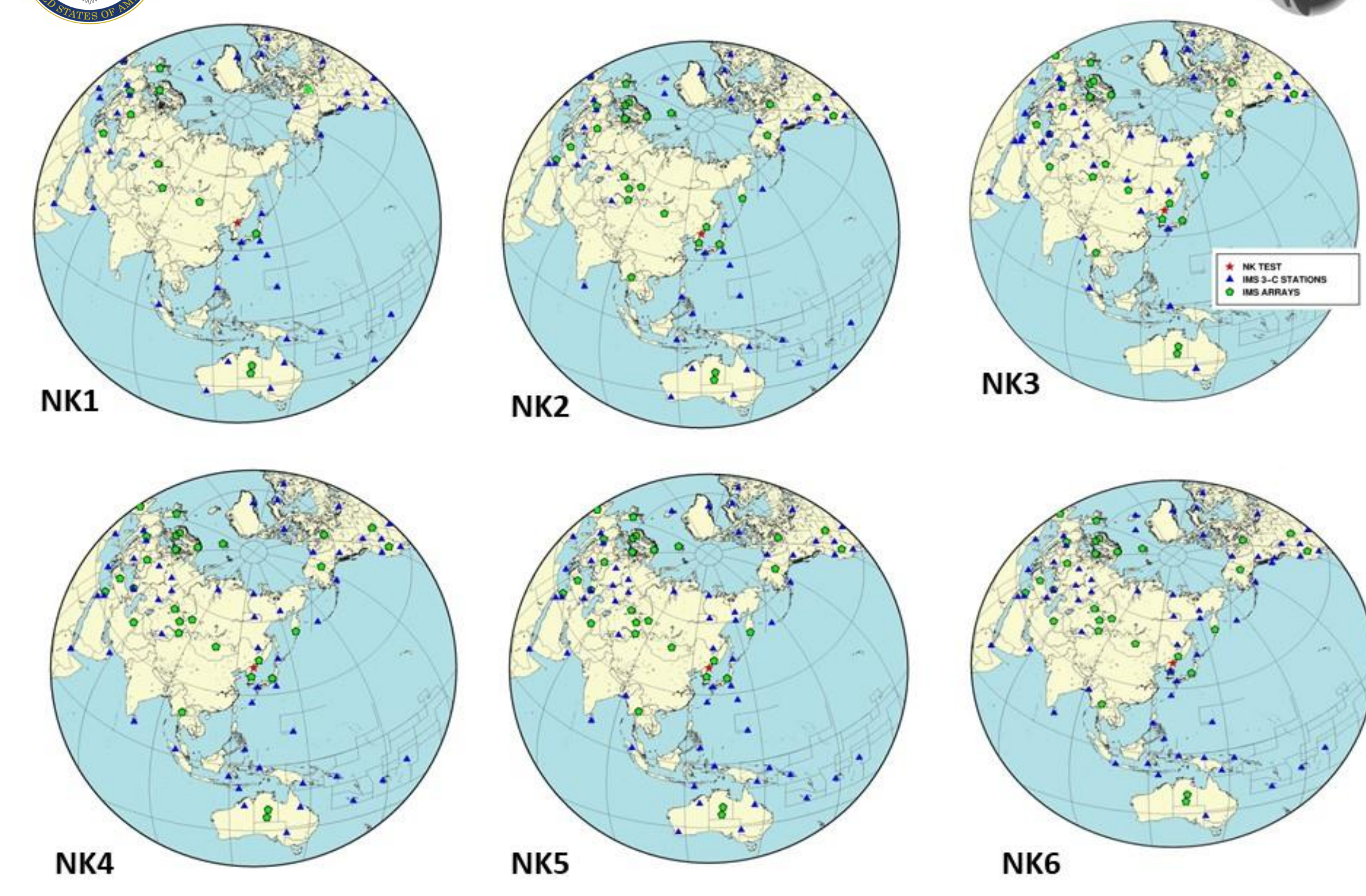


Cross Correlation of DPRK 6 and "2nd Event"

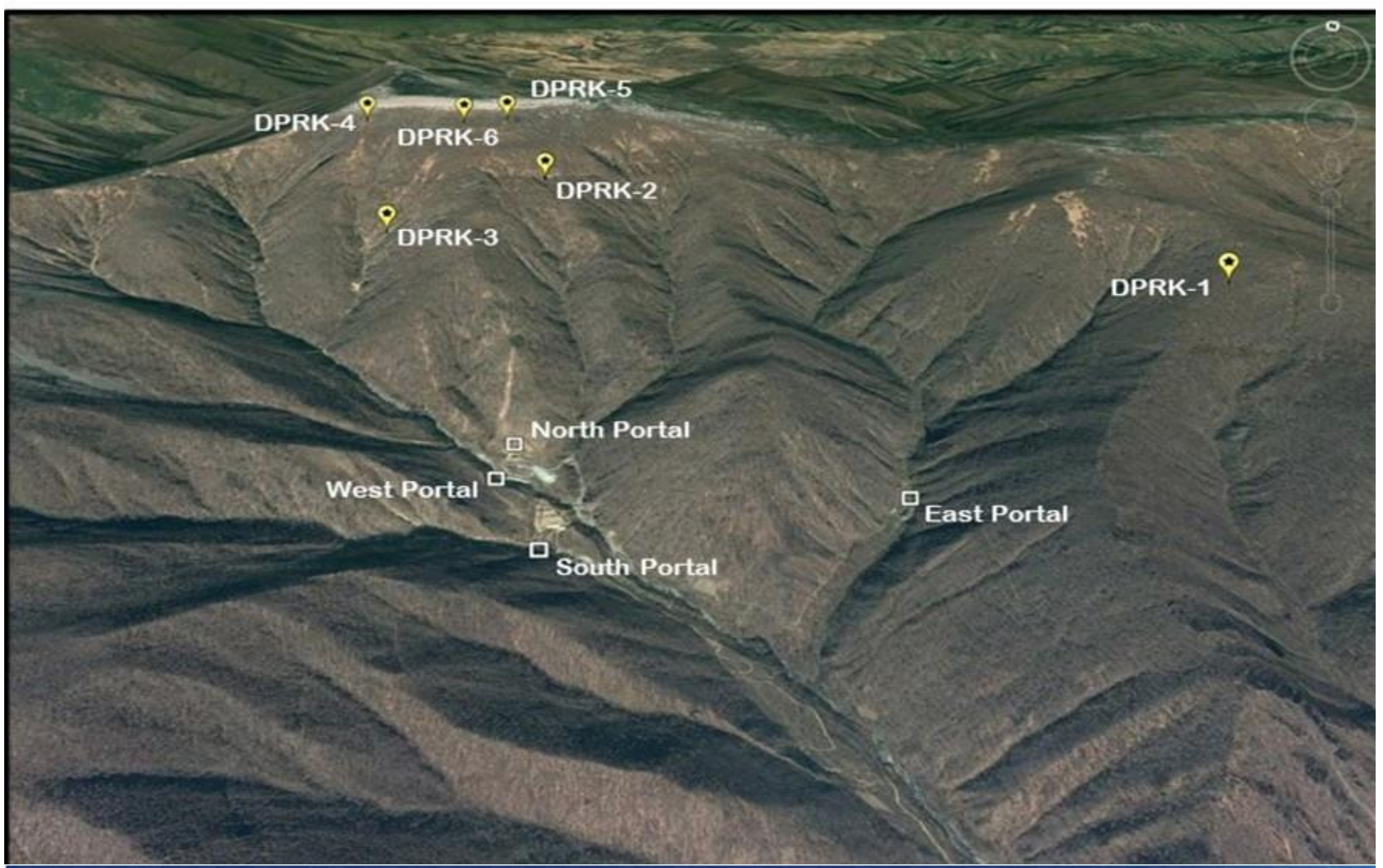
Cross correlation of seismic signals from DPRK 6 event with signals from the "2nd Event" provides useful relative location and magnitude. Using three regional stations USRK, KSRS and MJAR. Figure below shows that the aftershock overlaps or is in close proximity to the main shock, perhaps slightly offset to the north-west, and has body wave magnitude 2.3 units of magnitude lower than the main shock.



IMS Stations That Saw NK1 Through NK6



US NDC Relative Locations



JWA List of Induced Earthquakes in Punggye Area

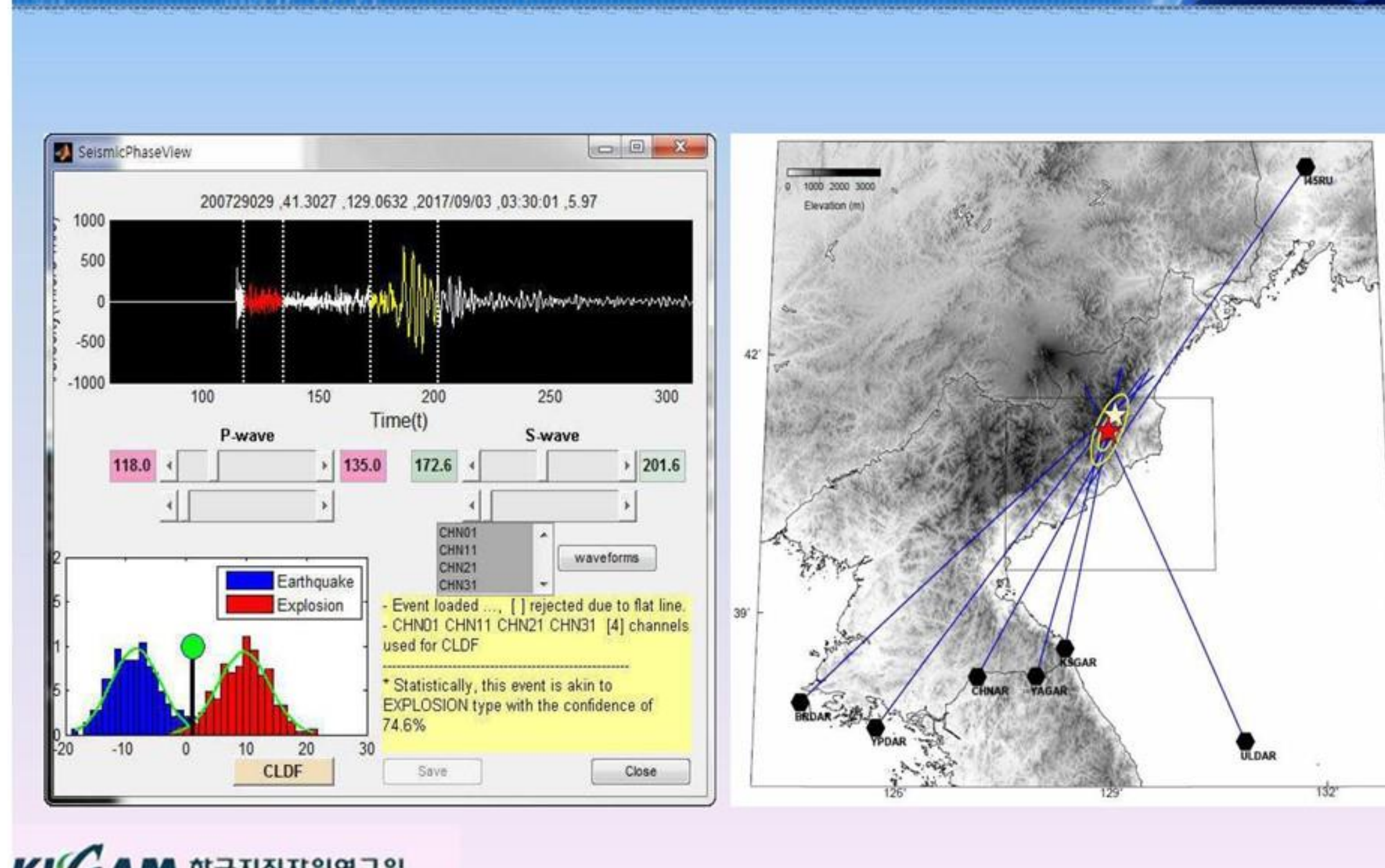
List of induced earthquakes from DPRK 2017NT (As of 2018-09-03)

No.	Occurrence time (UTC)	Number of detected IMS stations	Remarks
1	2017-09-03 03:38	9	mb 4.1 (REB), largest magnitude
2	2017-09-23 04:43	2	M 2.6 (KMA)
3	2017-09-23 08:29	4	mb 3.4
4	2017-10-12 16:41	2	M 2.7 (KMA)
5	2017-12-01 22:45	3	M 2.5 (KMA)
6	2017-12-05 14:40	2	M 2.8 (KMA)
7	2017-12-09 06:13	2	M 3.0 (KMA)
8	2017-12-09 06:40	2	M 2.8 (KMA)
9	2018-02-06 10:53	2	M 2.6 (KMA)
10	2018-02-07 21:46	3	M 2.7 (KMA)
11	2018-02-07 21:46	3	Occurred 23seconds later from No.10 event
12	2018-04-22 19:31	2	M 2.3 (KMA)

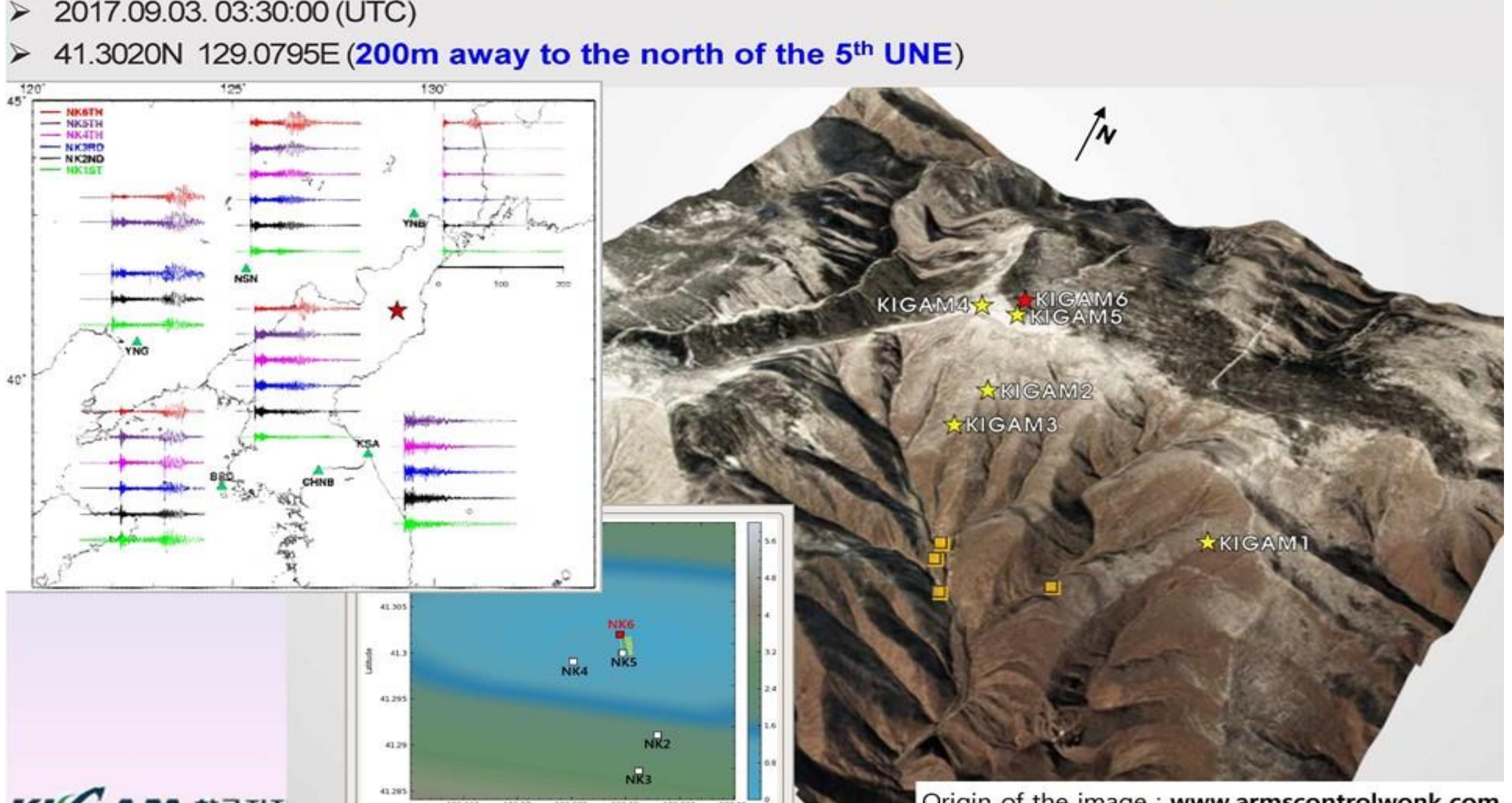
List of aftershocks following the 6th DPRK-declared test

- 2017/09/03-03:39:28.95 mb <4.04> USRK Station @ DPRK 2016 January
- 2017/09/23-04:43:57.75 mb <2.77> USRK Station @ DPRK 2016 September
- 2017/09/23-08:30:12.825 mb <3.061> USRK Station @ DPRK 2017
- 2017/10/12-16:42:05.95 mb <3.007> USRK Station @ DPRK 2013
- 2017/12/01-22:47:48.8 mb <2.924> USRK Station @ DPRK 23092017 aftershock Lg
- 2017/12/05-14:42:45.75 mb <2.89> USRK Station @ DPRK 23092017 aftershock Lg
- 2017/12/05-23:32:04.225 mb <2.478> USRK Station @ DPRK 23092017 aftershock Lg
- 2017/12/06-16:21:59.525 mb <2.43> USRK Station @ DPRK 23092017 aftershock Lg
- 2017/12/09-06:41:54.475 mb <2.675> USRK Station @ DPRK 23092017 aftershock Lg
- 2017/12/09-06:15:25.475 mb <3.148> USRK Station @ DPRK 23092017 aftershock Lg
- 2018/02/05-10:34:25.352 mb <2.593> USRK Station @ DPRK 23092017 aftershock Lg
- 2018/02/06-10:55:47.5 mb <2.81> USRK Station @ DPRK 23092017 aftershock Lg
- 2018/02/07-21:47:22.475 mb <2.915> USRK Station @ DPRK 23092017 aftershock P
- 2018/02/08-17:41:12.05 mb <2.43> USRK Station @ DPRK 23092017 aftershock Lg
- 2018/04/22-19:33:13.2 mb <2.808> USRK Station @ DPRK 23092017 aftershock Lg

Event Discrimination (Spectral Ratio, Infrasound)



Location of the 6th UNE : Relative Location



	NK1	NK2	NK3	NK4	NK5	NK6
M (CTBTO, REB)	4.08	4.51	4.92	4.82	5.09	6.07
m _b (CTBTO, Relative)	3.93	4.54	4.96	4.85	5.09	6.01
m _b (US NDC @ PAFB)	3.81	4.50	4.90	4.82	5.05	6.04
m _b (RF NDC @ SMS)			4.93	4.84	5.07	
m _b (CN NDC @ Beijing)				4.89, 3.4-7.2KT		
m _b (USGS/NEIC)	4.3	4.7	5.1	5.1	5.3	6.3
m _b , W (NORSAR)	4.2, ~1KT	4.7, ~5KT	5.0, ~10KT	4.9, <10KT	5.2, ~20KT	5.8-6.1, 200-300KT
m _b (UK NDC)	3.94	4.63	5.01	4.93	5.17	
M _s (UK NDC)	2.83	3.63	3.92	3.99	4.21	
m _b (ROK NDC)	3.9	4.5	4.9	4.8	5.04	6.1
DOB, W (KIGAM)		480m, 3KT	330m, 6-7KT	770m, 4-6KT	700m, 10KT	126-147KT
m _b , DOB, W (KMA)	1KT	480m, 3-4KT	330m, 6-7KT	4.8, 800m, 6KT	5.0, 800m, 10KT	5.7, 900m, 100KT
W (JPN MoD, m _b (REB))	~0.5-1KT	~2-3KT	~6-7KT	~6-7KT	~11-12KT	
m _b (Mongolia NDC)	4.1	4.4	5.1	4.9	5.0	5.7
M _s (CN CAS/IGG)	2.92	3.65	3.95	4.05	4.23	
m _b (Lg) (CN CAS/IGG)	3.93	4.53	4.91	4.67	4.82	5.56
DOB & W (CN CAS/IGG)	360-400m, 1-1.2KT	580-620m, 6-7KT	580-620m, 15-16KT	780-1200m, 11-16KT	780-1200m, 16-22KT	56±26KT
W (CN USTC)	0.5KT	7±2KT	12±4KT	11±4KT	18±6KT	108±48KT
m _b (P _{max}) (IMS + GGG)	3.95	4.73	5.02	5.08	5.26	6.26
m _b (Lg) (GGG)	3.98	4.68	5.12	5.02	5.28	6.18