Detecting events in the urban seismic wavefield using a novel nodal array in Singapore: earthquakes, blasts and thunder quakes

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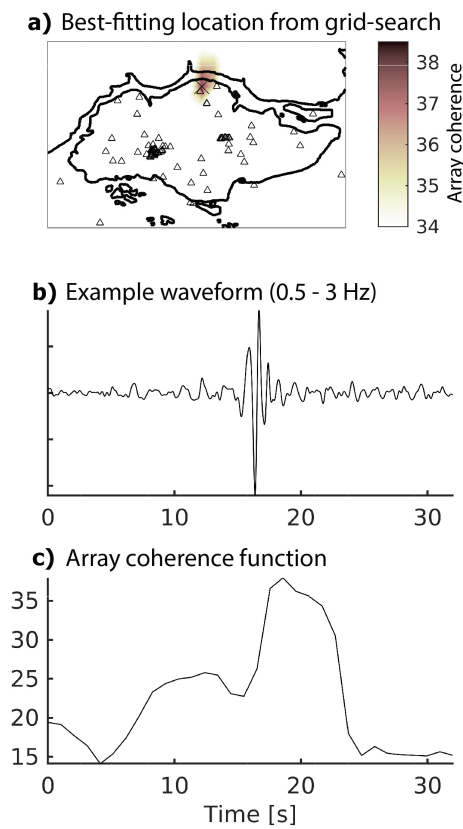
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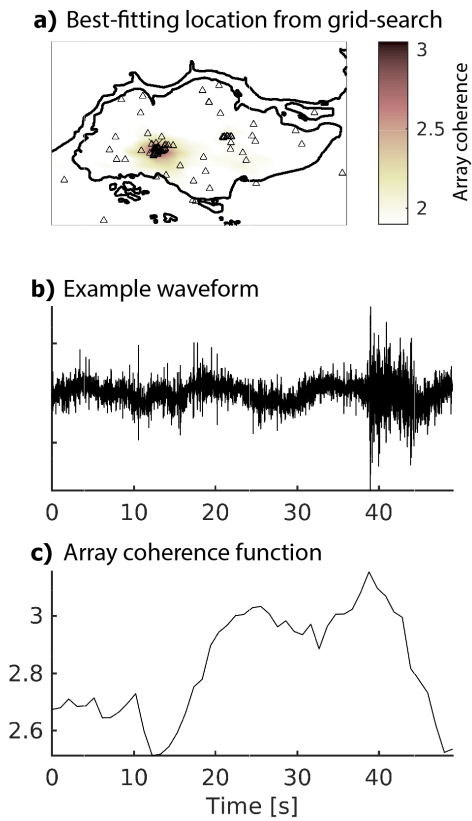
Additional Supporting Information (Files uploaded separately)

Caption for Movie S1. Long period seismic waves passing through Singapore. Colours on map correspond to ground velocity. Waveforms are from three stations located across Singapore (triangles 1, 2 and 3).

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May 4, 2020, 7:56am

a) Best-fitting location from grid-search

b) Example waveform (0.5 - 3 Hz)
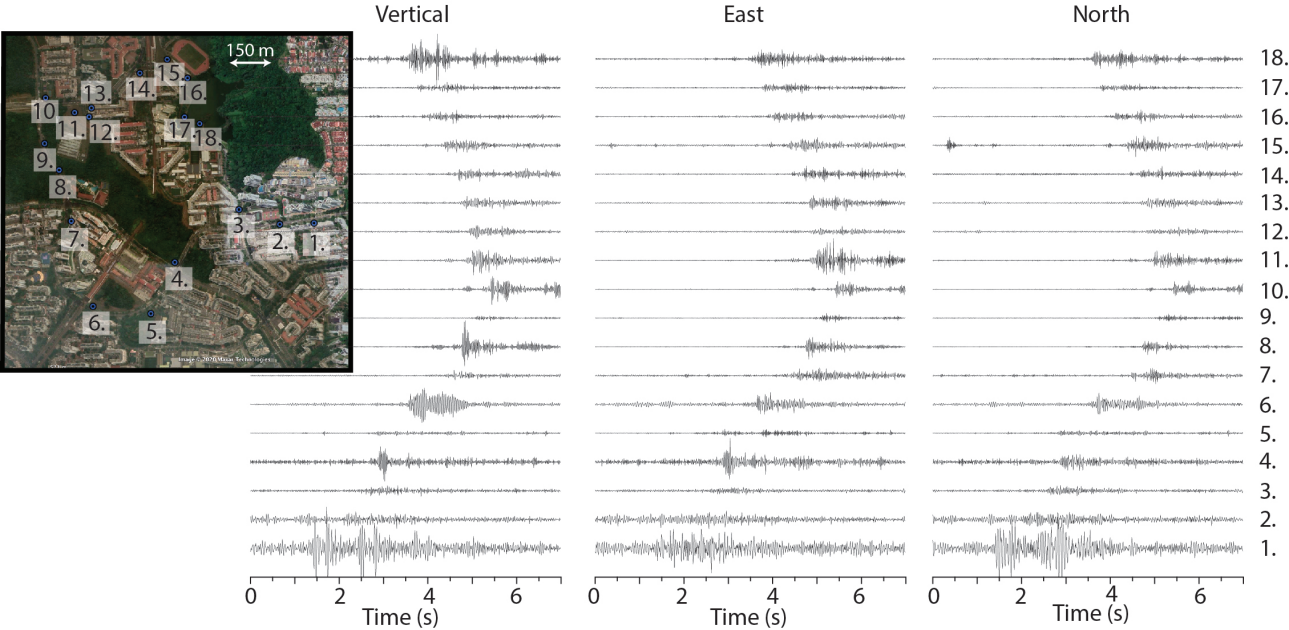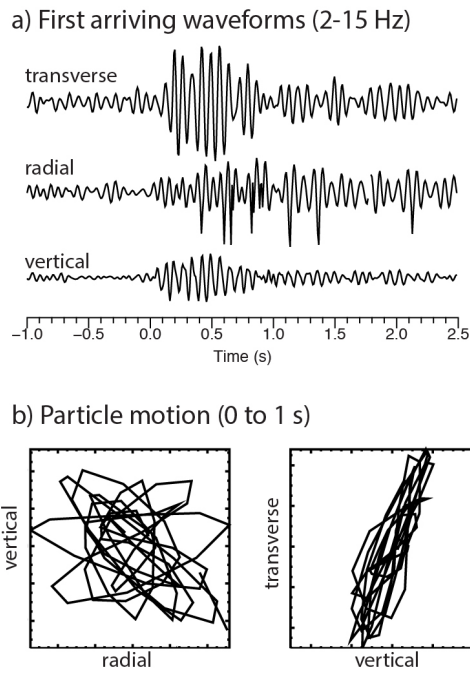
c) Array coherence function

Time [s]

Figure S1.   Local event at 17:57 on 3rd March 2019. a) Location obtained by grid search, with the best-fitting location defined as the point that maximises the array coherence. b) Example waveform filtered 0.5 - 3 Hz. c) Array coherence function (in 0.5 - 3 Hz frequency band).

a) Best-fitting location from grid-search

b) Example waveform

c) Array coherence function

Figure S2. Thunder quake at around 2 am on 1st April 2019. a) Location obtained by grid search, with the best-fitting location defined as the point that maximises the array coherence. b) Example waveform (raw) c) Array coherence function.

Figure S3. Waveforms induced by thunder at 18 stations within a 1 km x 1 km area. Waveforms are highly variable across the area likely affected by nearby buildings and near-surface structures.

May 4, 2020, 7:56am

a) First arriving waveforms (2-15 Hz)

transverse

radial

vertical

Time (s)

b) Particle motion (0 to 1 s)

vertical

radial

transverse

vertical

Figure S4.   a) First arriving waveforms induced by a thunder source at red coloured station in Figure 10 (same as station number 6 in Figure S3). Horizontal components have been rotated to radial and transverse directions for the best-fitting event location. b) Particle motion for the first 1 second is consistent with a Rayleigh wave.

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Table S1. Approximate origin time of detected local events

Probable blasting events

UTC Day	UTC	Local Day	Local Time
01/03/2019	09:10	01/03/2019	17:10
03/03/2019	09:56	03/03/2019	17:56
03/03/2019	09:56	03/03/2019	17:56
05/03/2019	03:56	05/03/2019	11:56
05/03/2019	08:38	05/03/2019	16:38
07/03/2019	09:54	07/03/2019	17:54
08/03/2019	04:05	08/03/2019	12:05
11/03/2019	05:00	11/03/2019	13:00
13/03/2019	05:39	13/03/2019	13:39
13/03/2019	11:48	13/03/2019	19:48
15/03/2019	05:23	15/03/2019	13:23
17/03/2019	09:34	17/03/2019	17:34
18/03/2019	05:00	18/03/2019	13:00
18/03/2019	09:15	18/03/2019	17:15
19/03/2019	05:12	19/03/2019	13:12
20/03/2019	10:00	20/03/2019	18:00
20/03/2019	09:32	20/03/2019	17:32
21/03/2019	04:32	21/03/2019	12:32
22/03/2019	04:15	22/03/2019	12:15
25/03/2019	05:20	25/03/2019	13:20
27/03/2019	04:20	27/03/2019	12:20
28/03/2019	05:15	28/03/2019	13:15

Unknown origin events

UTC Day	UTC	Local Day	Local Time
01/03/2019	20:02	02/03/2019	04:02
08/03/2019	11:20	08/03/2019	19:20
11/03/2019	17:07	12/03/2019	01:07
11/03/2019	19:13	12/03/2019	03:13
12/03/2019	04:02	12/03/2019	12:02
15/03/2019	15:46	15/03/2019	23:46
17/03/2019	23:31	18/03/2019	07:31
18/03/2019	18:36	19/03/2019	02:36
18/03/2019	19:00	19/03/2019	03:00
21/03/2019	20:17	22/03/2019	04:17
23/03/2019	19:43	24/03/2019	03:43
27/03/2019	05:30	27/03/2019	13:30
28/03/2019	04:06	28/03/2019	12:06