Infrasound Detection and Location of Sources in and around the Korean Peninsula

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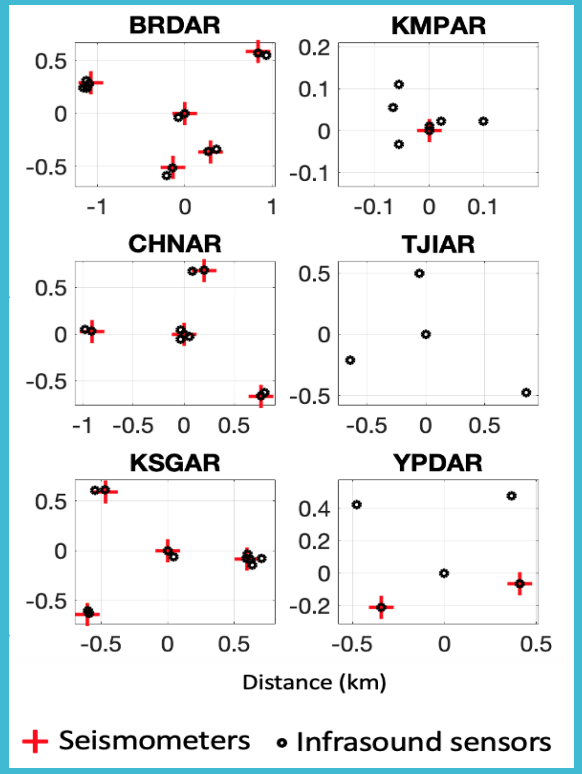
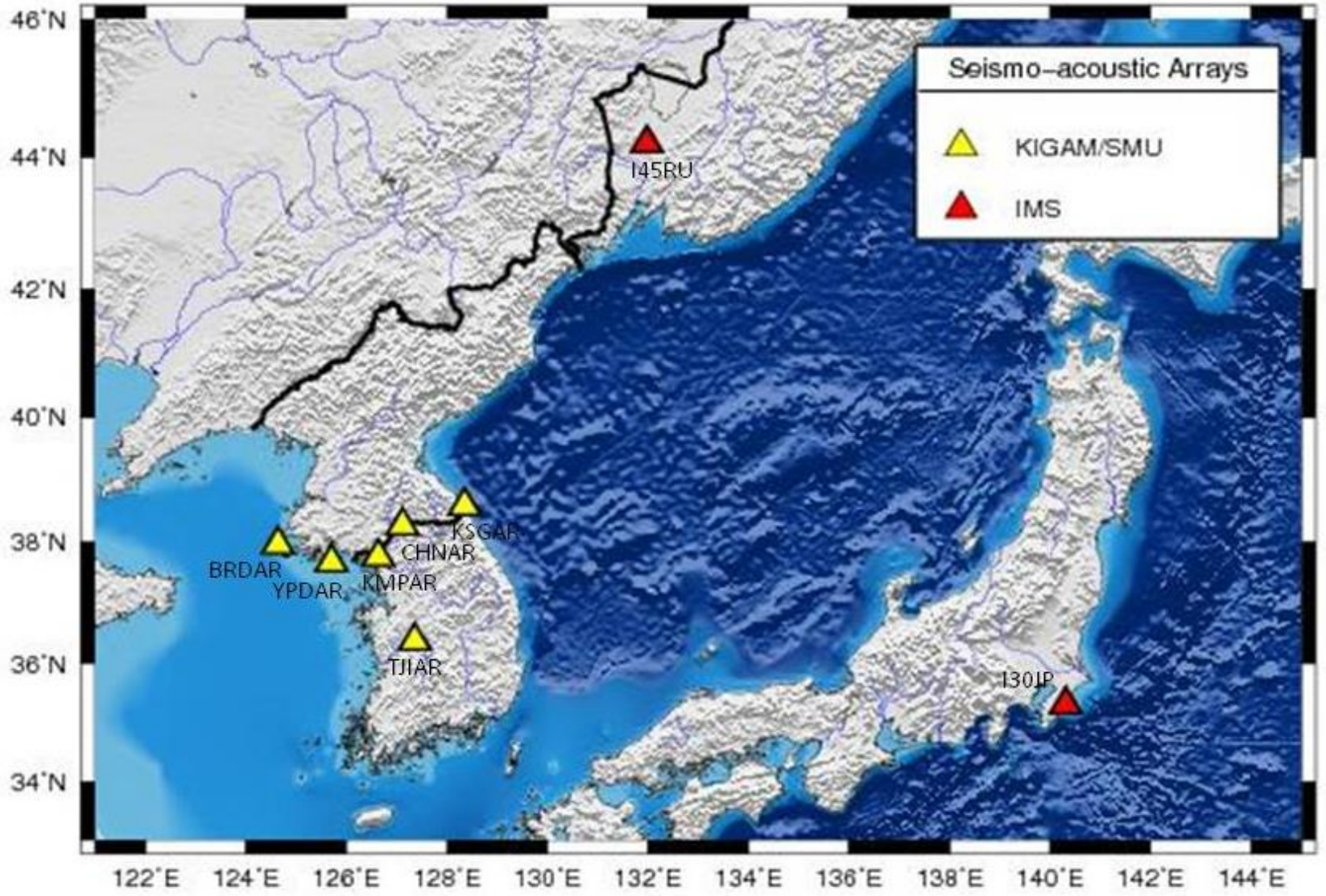
AS1.6 – Infrasound, acoustic-gravity waves, and atmospheric dynamics, 25 May 2022

Locations of Infrasound Arrays



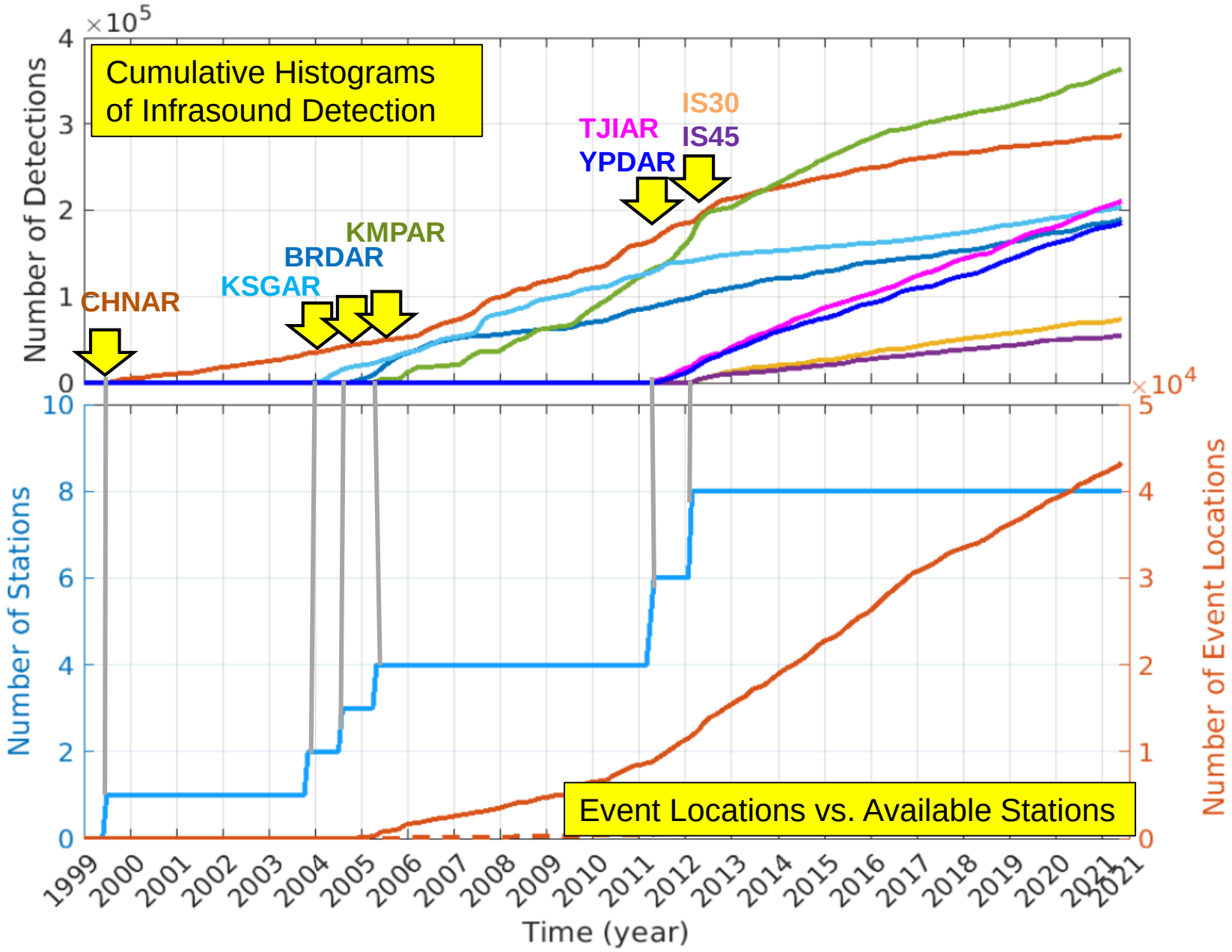


Stump et al. (SRL Data Mine 2022)

Infrasound Detections and Locations for 22 years

Signal detection (1-5 Hz) using Adaptive F-Detector (Arrowsmith et al., 2008)

Increased numbers of detections and event locations with addition of array data in time.

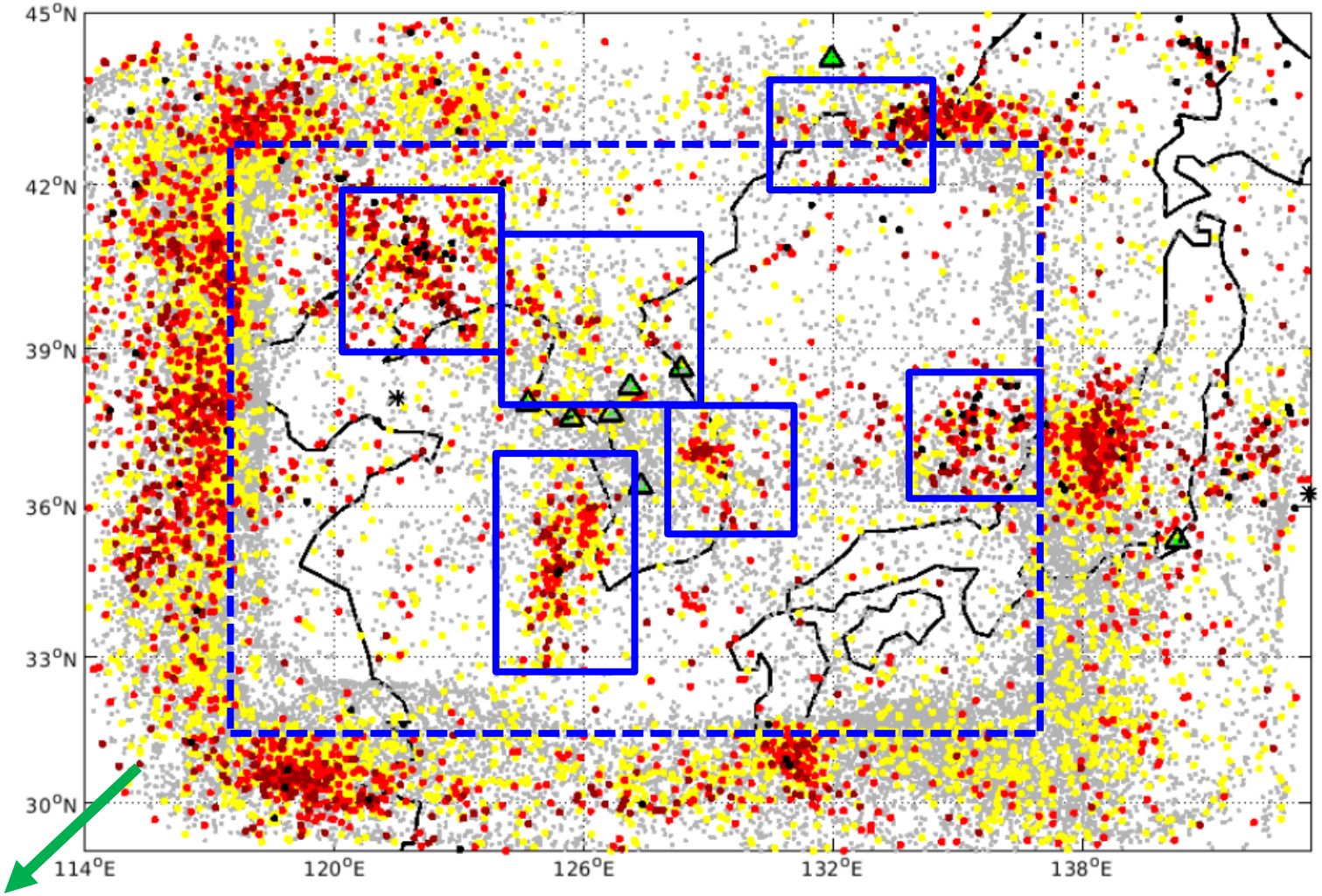


Event Locations

in and around the Korean Peninsula

Association and location procedure based on Bayesian Infrasonic Source Location (BISL, Modrak et al., 2010).

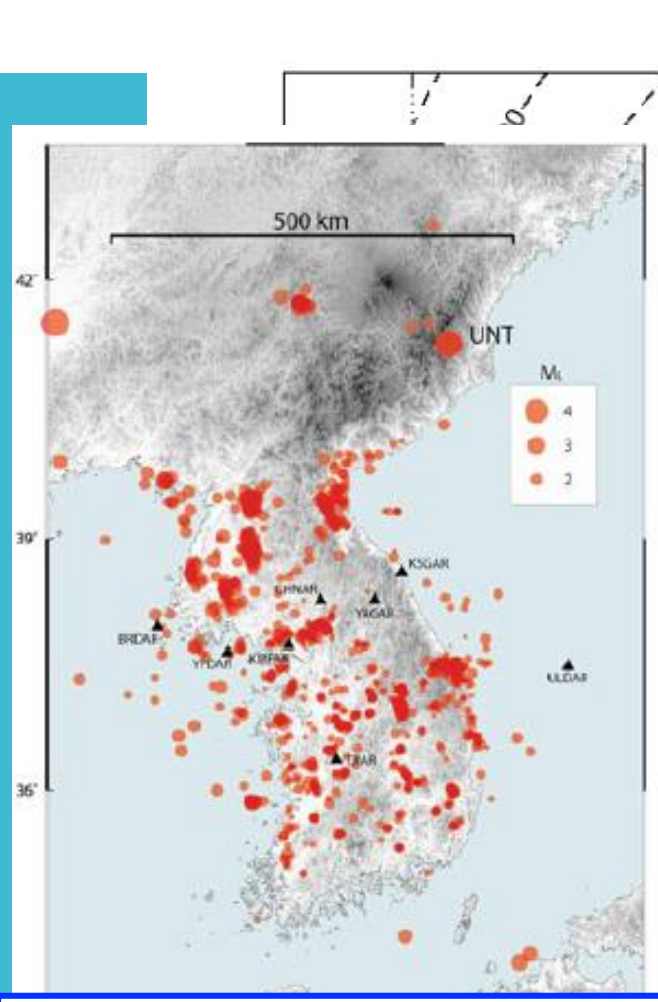
A total of 44,126 infrasound event locations.
Repeated sources with large numbers of associated arrays.



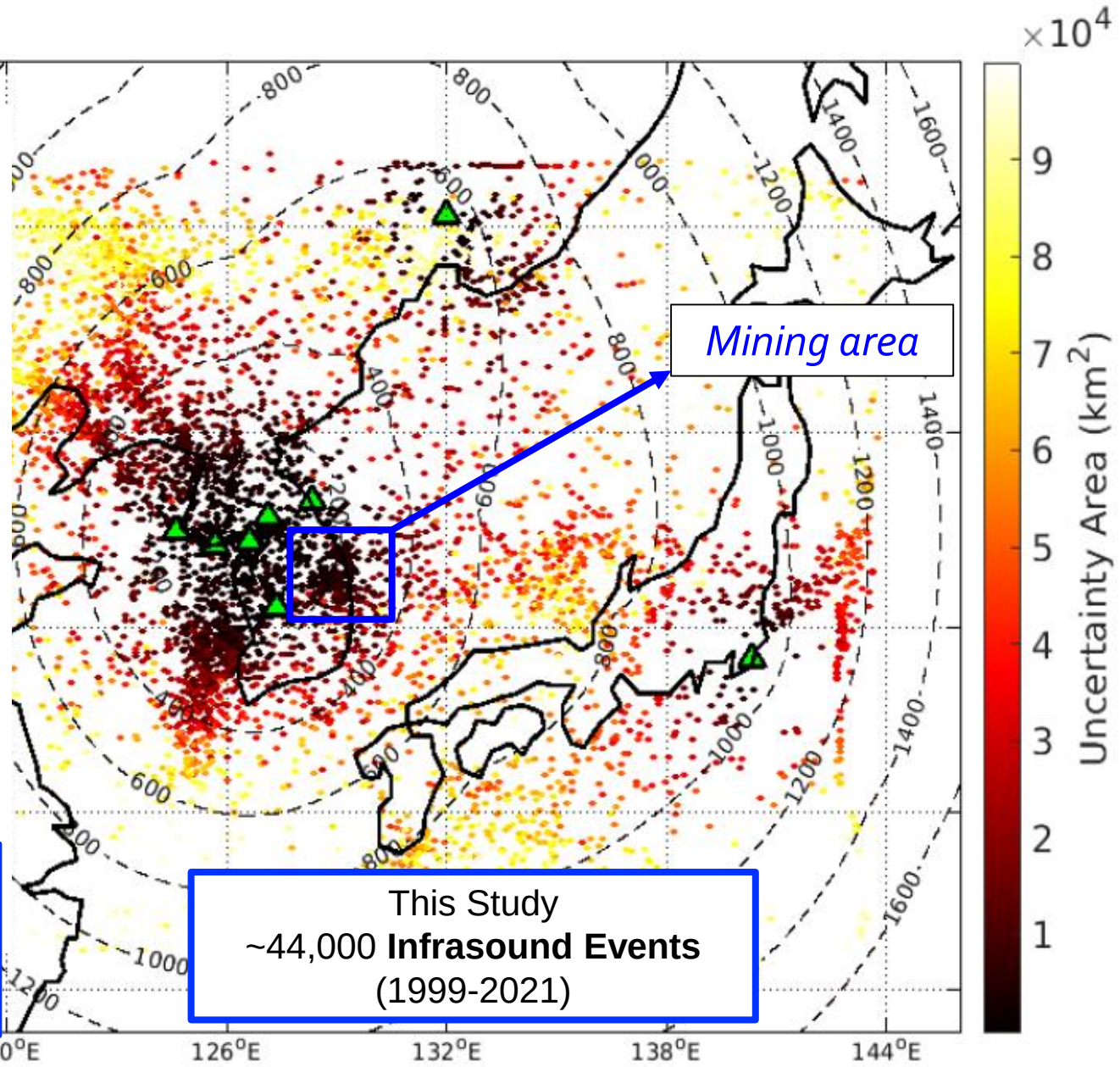
Events outside dashed box are mostly from false association based on the perturbed time simulation.

Korean Peninsula Infrasound Hotspots

1. Infrasound event locations are mostly generated by human activities.
2. Location uncertainty can be improved with good station coverage.

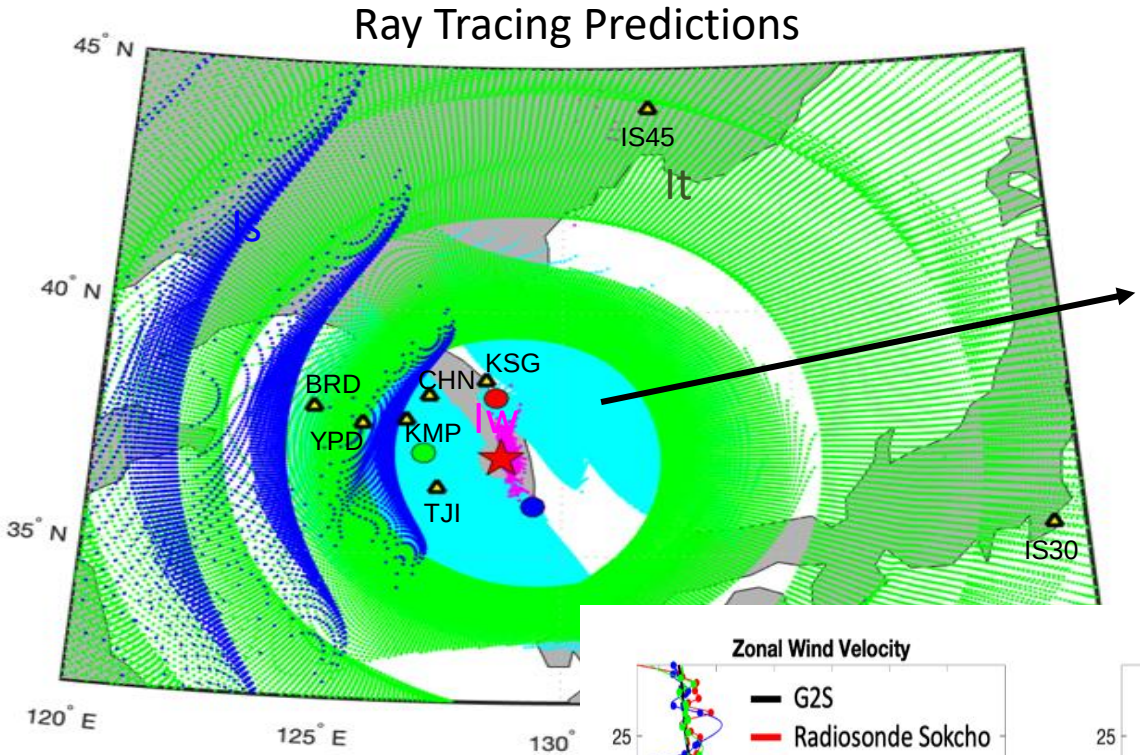


Che et al. (2019)
~2,000 **Seismic Events**
Associated with Multiple (>1)
Infrasound Signals (1999-2008)

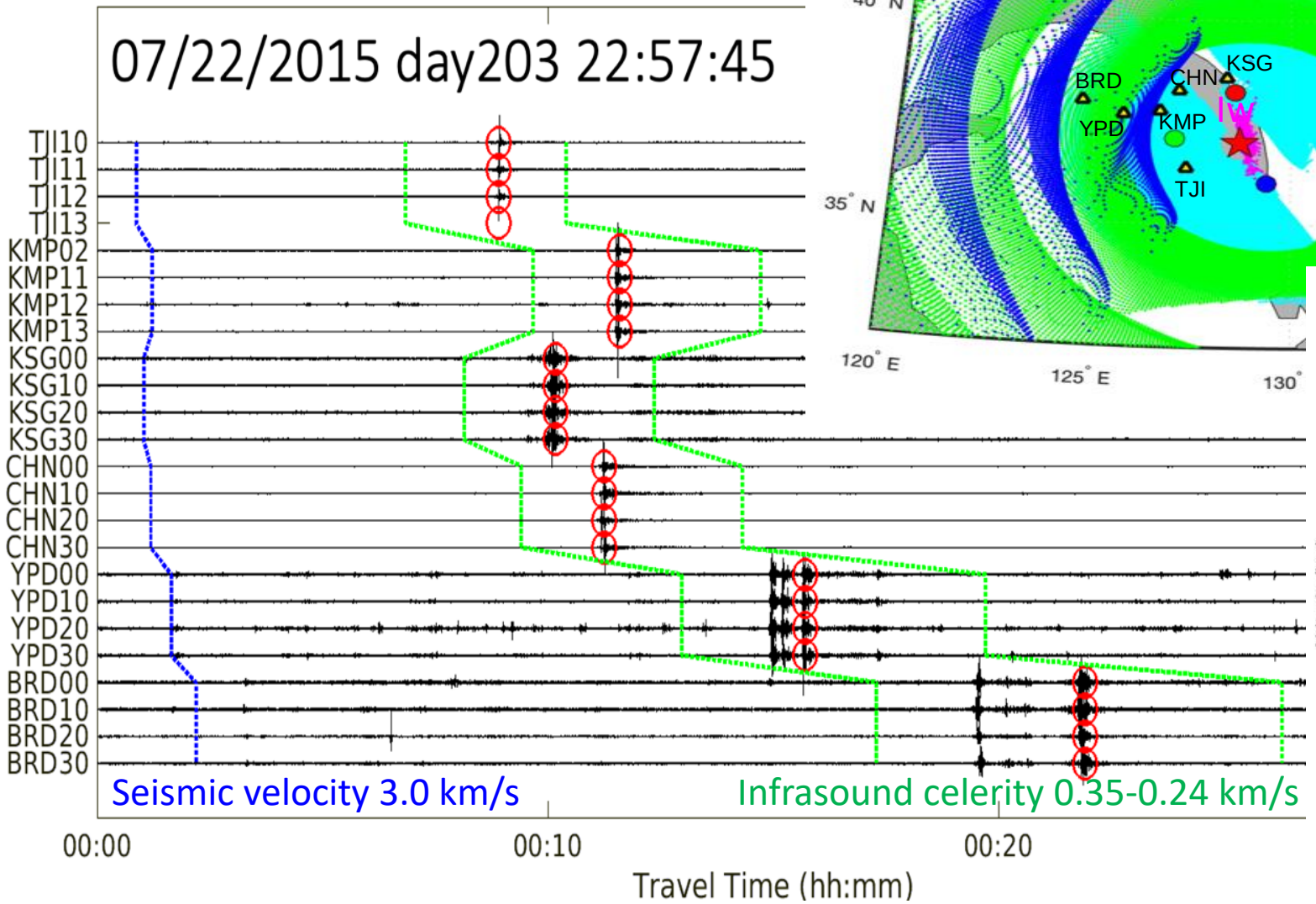


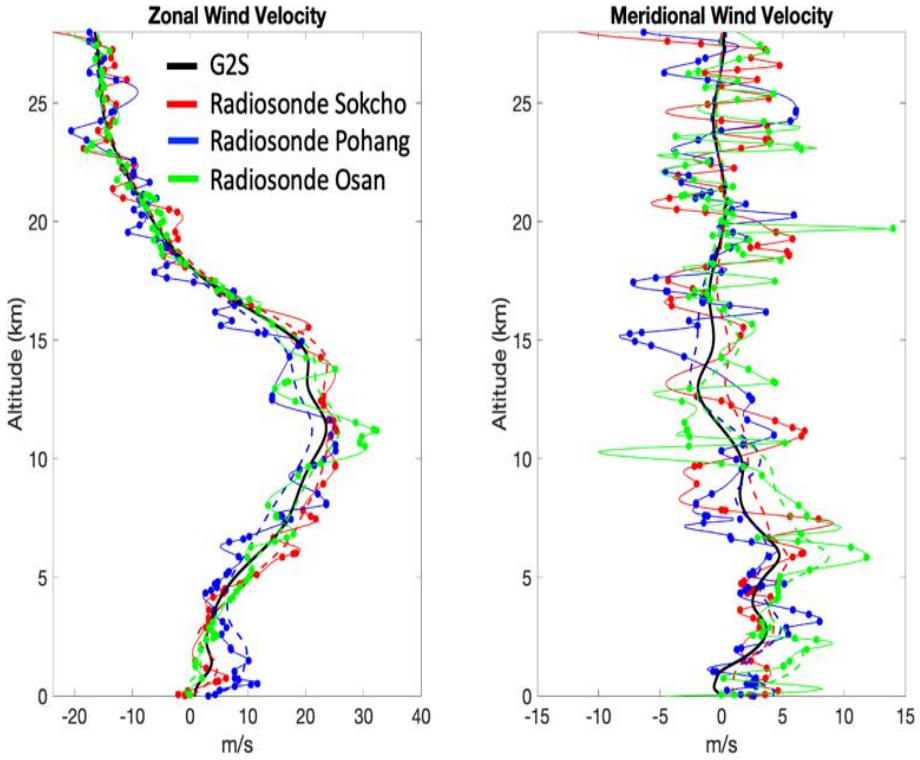
This Study
~44,000 **Infrasound Events**
(1999-2021)

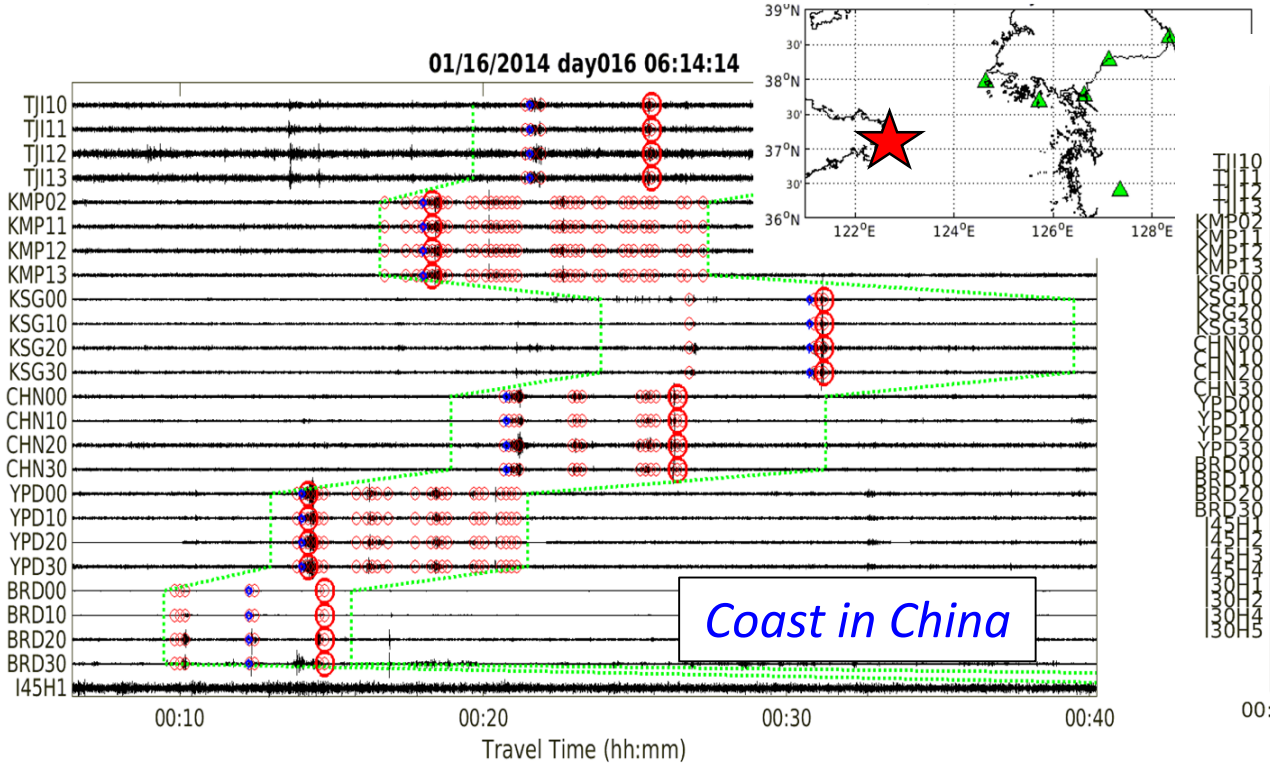
Mining Explosions

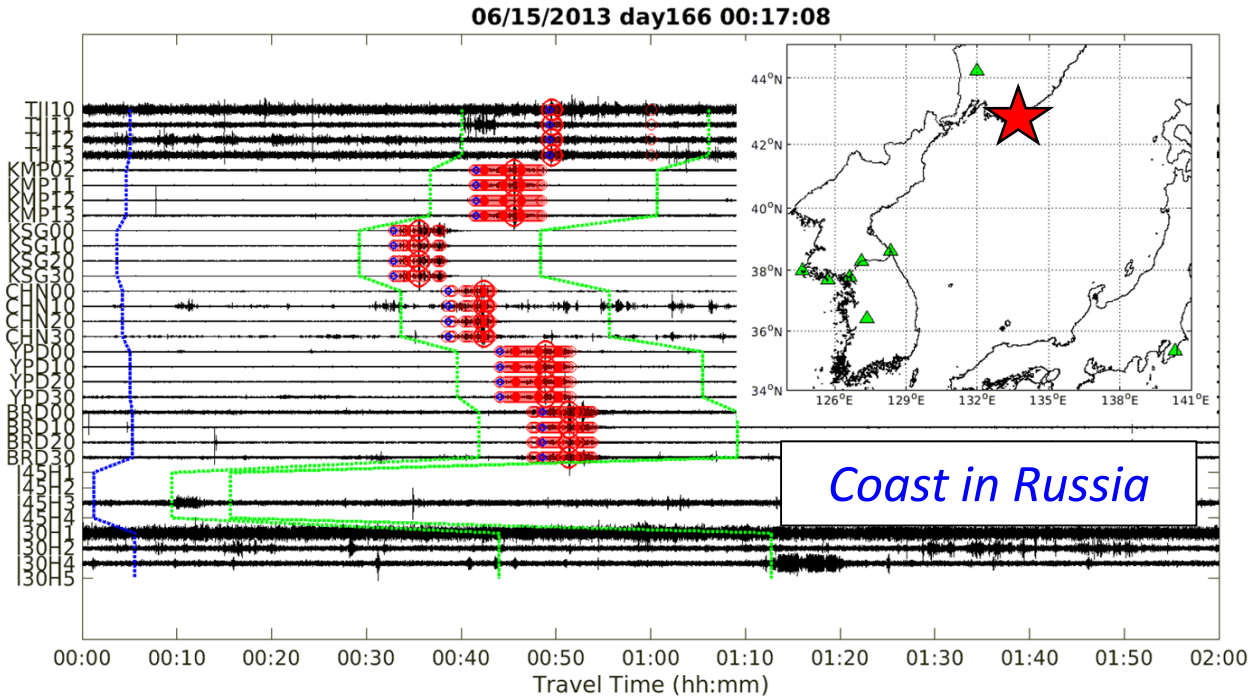


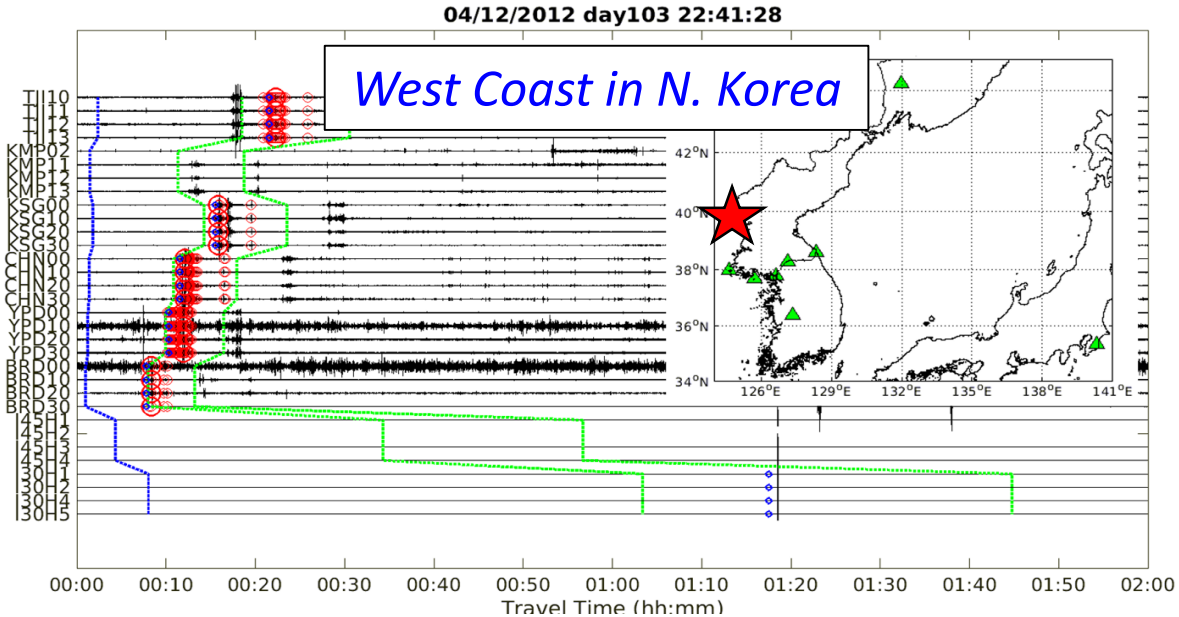
Is & Iw using Radiosonde

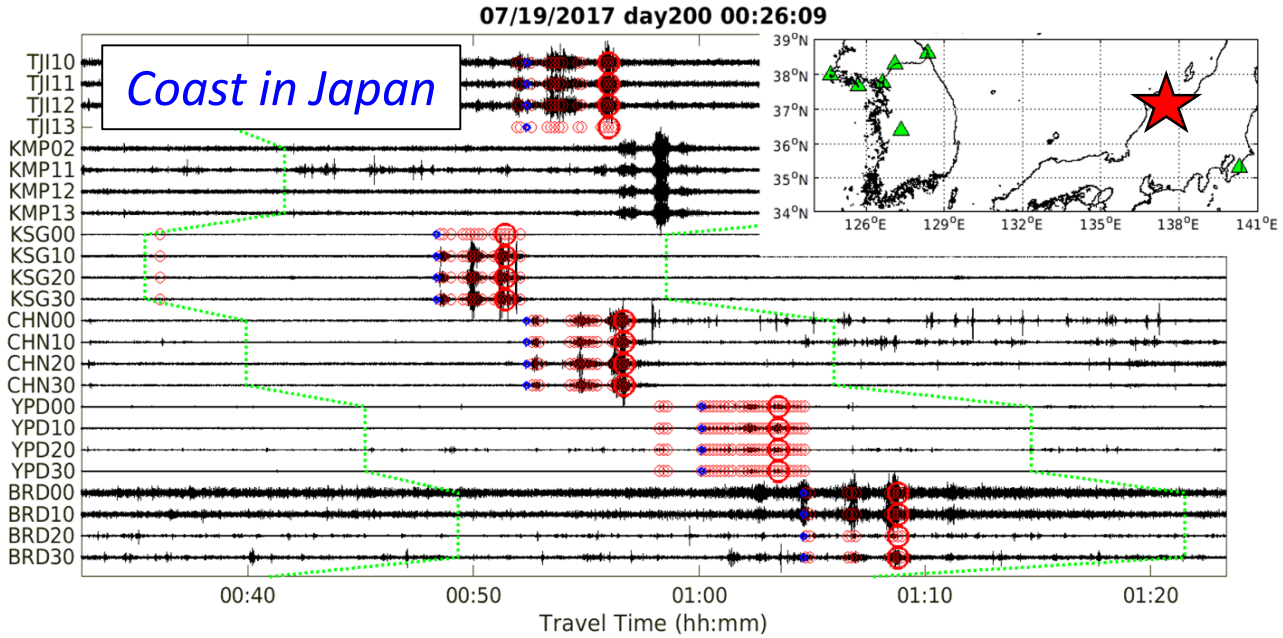





01/16/2014 day016 06:14:14
TJI10
TJI11
TJI12
TJI13
KMP02
KMP11
KMP12
KMP13
KSG00
KSG10
KSG20
KSG30
CHN00
CHN10
CHN20
CHN30
YPD00
YPD10
YPD20
YPD30
BRD00
BRD10
BRD20
BRD30
I45H1
Coast in China
00:10
00:20
00:30
00:40
Travel Time (hh:mm)
39°N
38°N
37°N
36°N
122°E
124°E
126°E
128°E


06/15/2013 day166 00:17:08
TJI10
KMP02
KSG00
KSG10
KSG20
KSG30
CHN00
CHN10
CHN20
CHN30
YPD00
YPD10
YPD20
YPD30
BRD00
BRD10
BRD20
BRD30
I45H1
I45H2
I45H3
I45H4
I30H1
I30H2
I30H4
I30H5
Coast in Russia
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
Travel Time (hh:mm)
44°N
42°N
40°N
38°N
36°N
34°N
126°E
129°E
132°E
135°E
138°E
141°E


04/12/2012 day103 22:41:28
West Coast in N. Korea
00:00
00:10
00:20
00:30
00:40
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
42°N
40°N
38°N
36°N
34°N
126°E
129°E
132°E
135°E
138°E
141°E

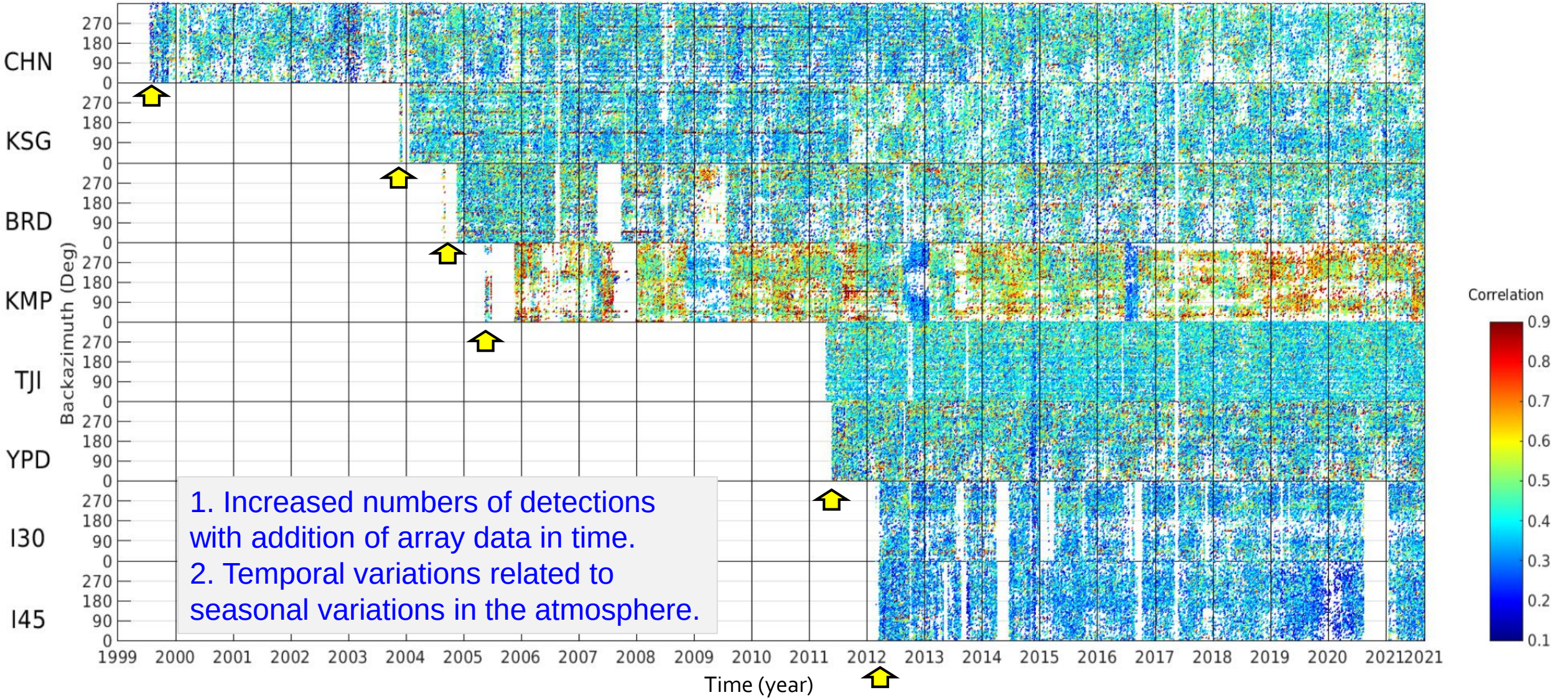

07/19/2017 day200 00:26:09
Coast in Japan
TJI10
TJI11
TJI12
TJI13
KMP02
KMP11
KMP12
KMP13
KSG00
KSG10
KSG20
KSG30
CHN00
CHN10
CHN20
CHN30
YPD00
YPD10
YPD20
YPD30
BRD00
BRD10
BRD20
BRD30
00:40
00:50
01:00
01:10
01:20
Travel Time (hh:mm)
39°N
38°N
37°N
36°N
35°N
34°N
126°E
129°E
132°E
135°E
138°E
141°E

Summary

- We documented the infrasound detections and event locations for 22 years (1999-2021) in and around the Korean peninsula.
- Events that have large numbers of associated arrays are mostly related with human activities, and most events on the edges are false association.
- Ongoing work focuses on estimating source size with infrasound amplitude accounting for propagation effects.

Automatic Infrasound Detections for 22 years

ignal detection (1-5 Hz) using Adaptive F-Detector (Arrowsmith et al., 2008)

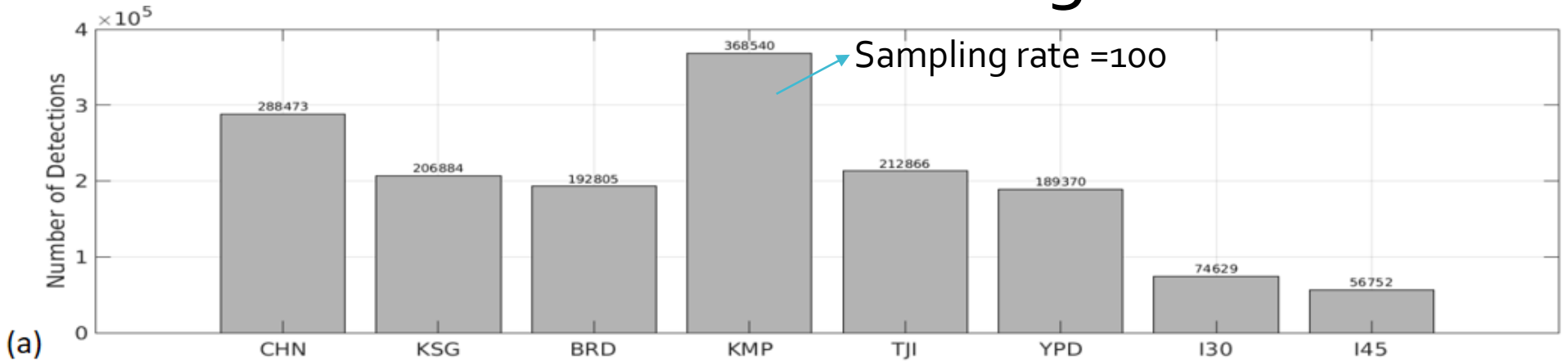


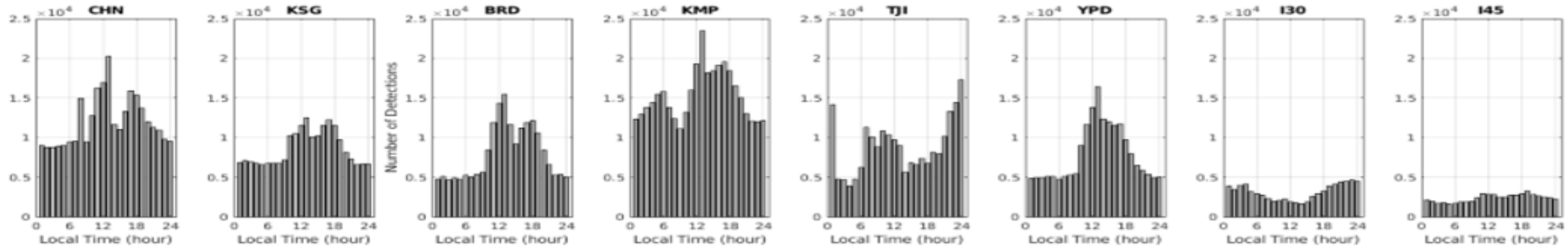
1. Increased numbers of detections with addition of array data in time.
2. Temporal variations related to seasonal variations in the atmosphere.

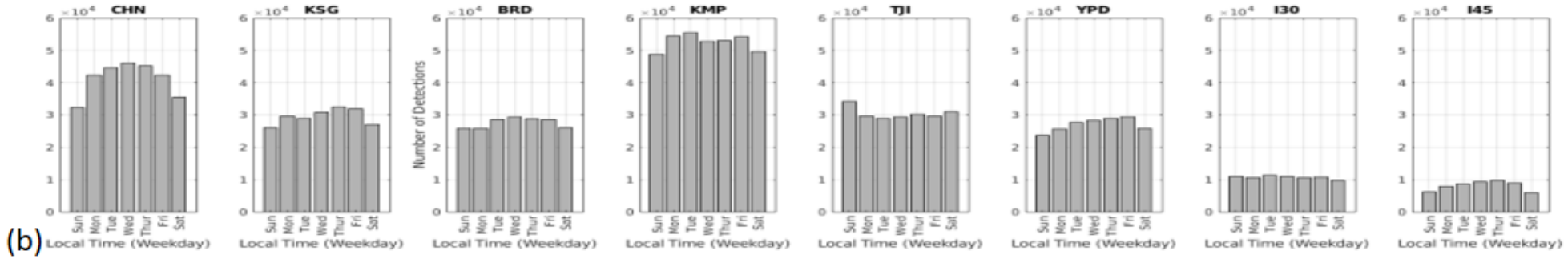
Infrasound Detection Histogram

Hour

Weekday

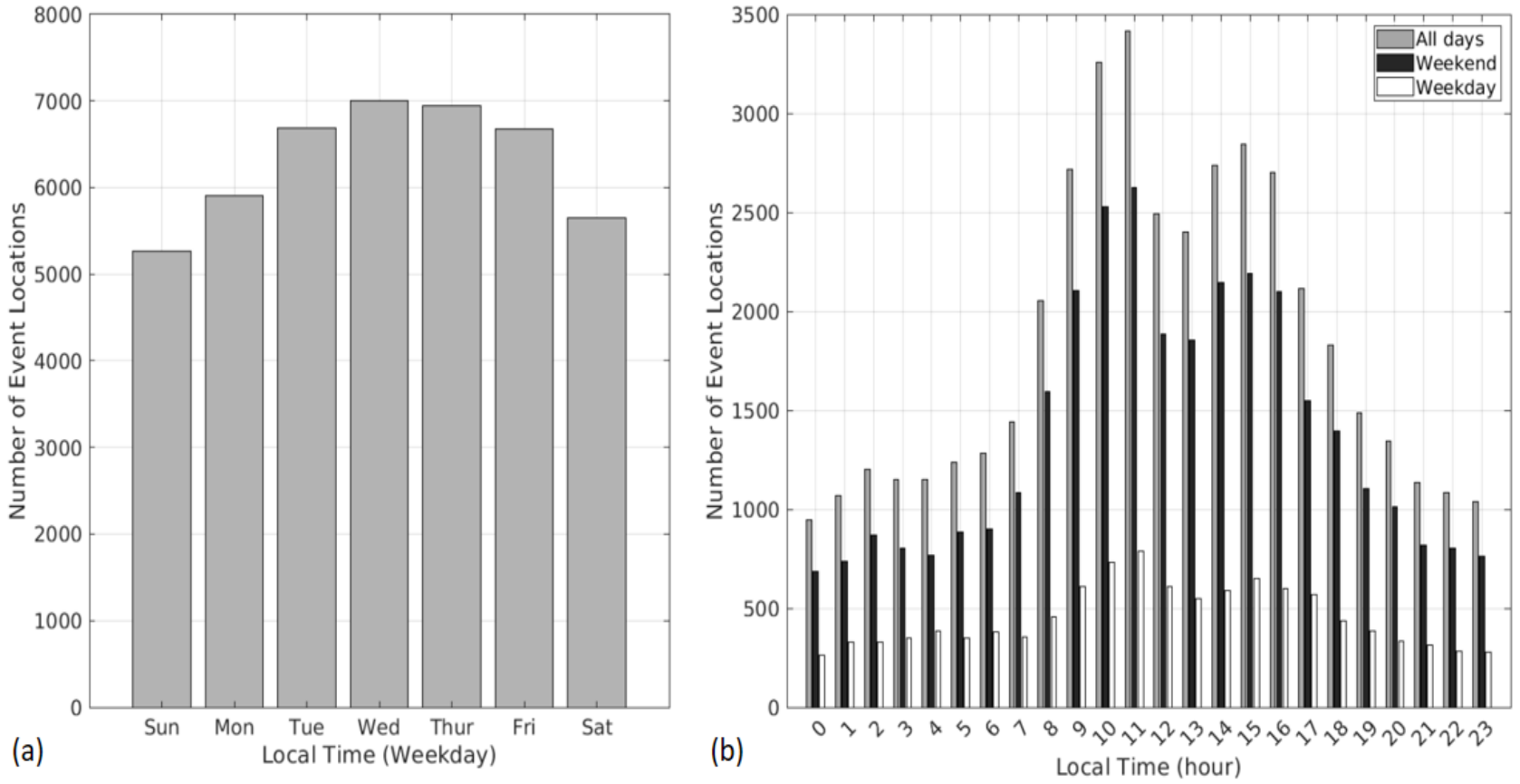






Infrasound detections are associated with human activities.

Histograms of Infrasound Event Locations

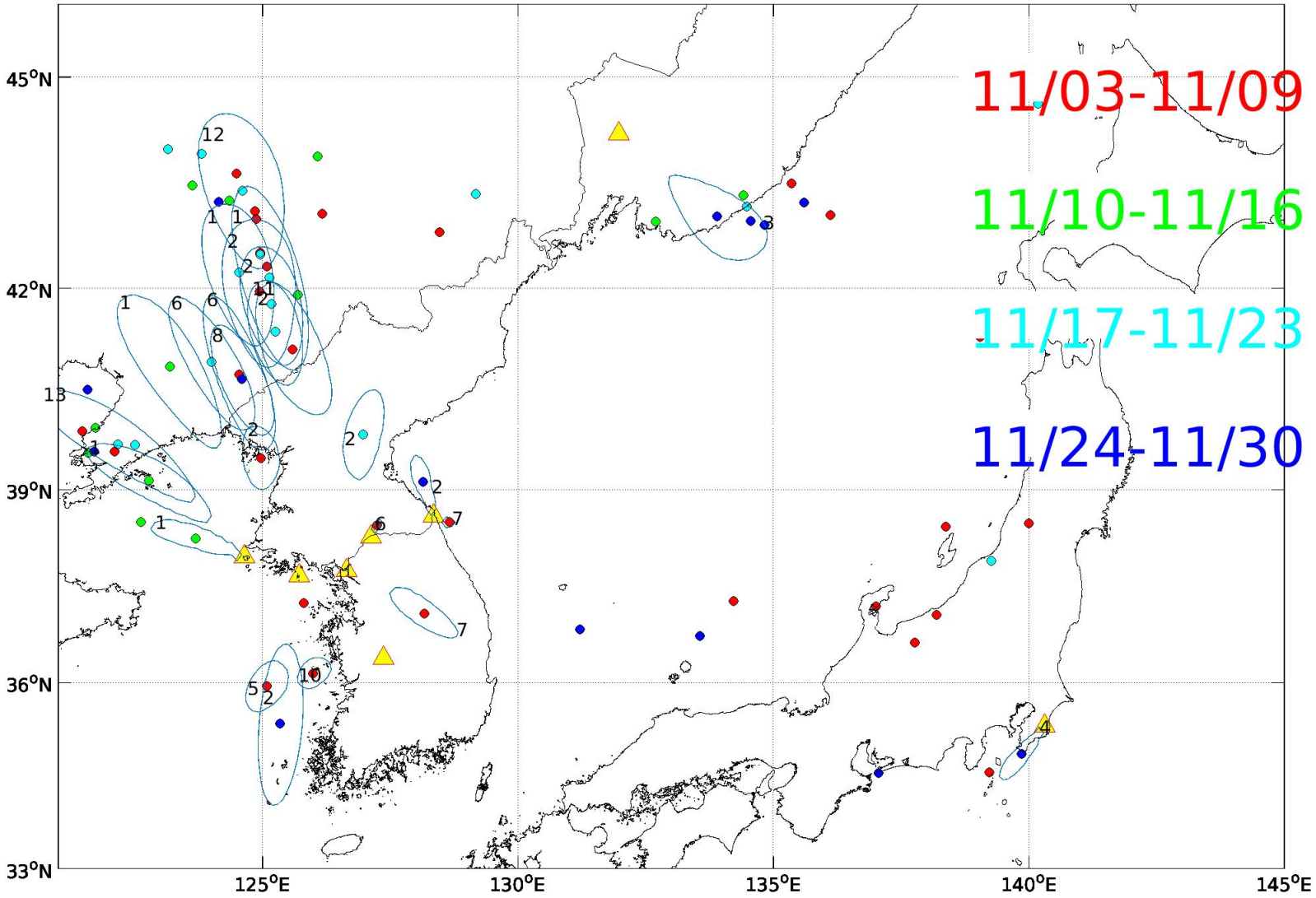


Histogram of source times for event locations suggests that many of the events may be related to human activities.

The number of events versus weekday and hour of the day.

Example of Event Locations with 95% uncertainty area less than 25,000 km²

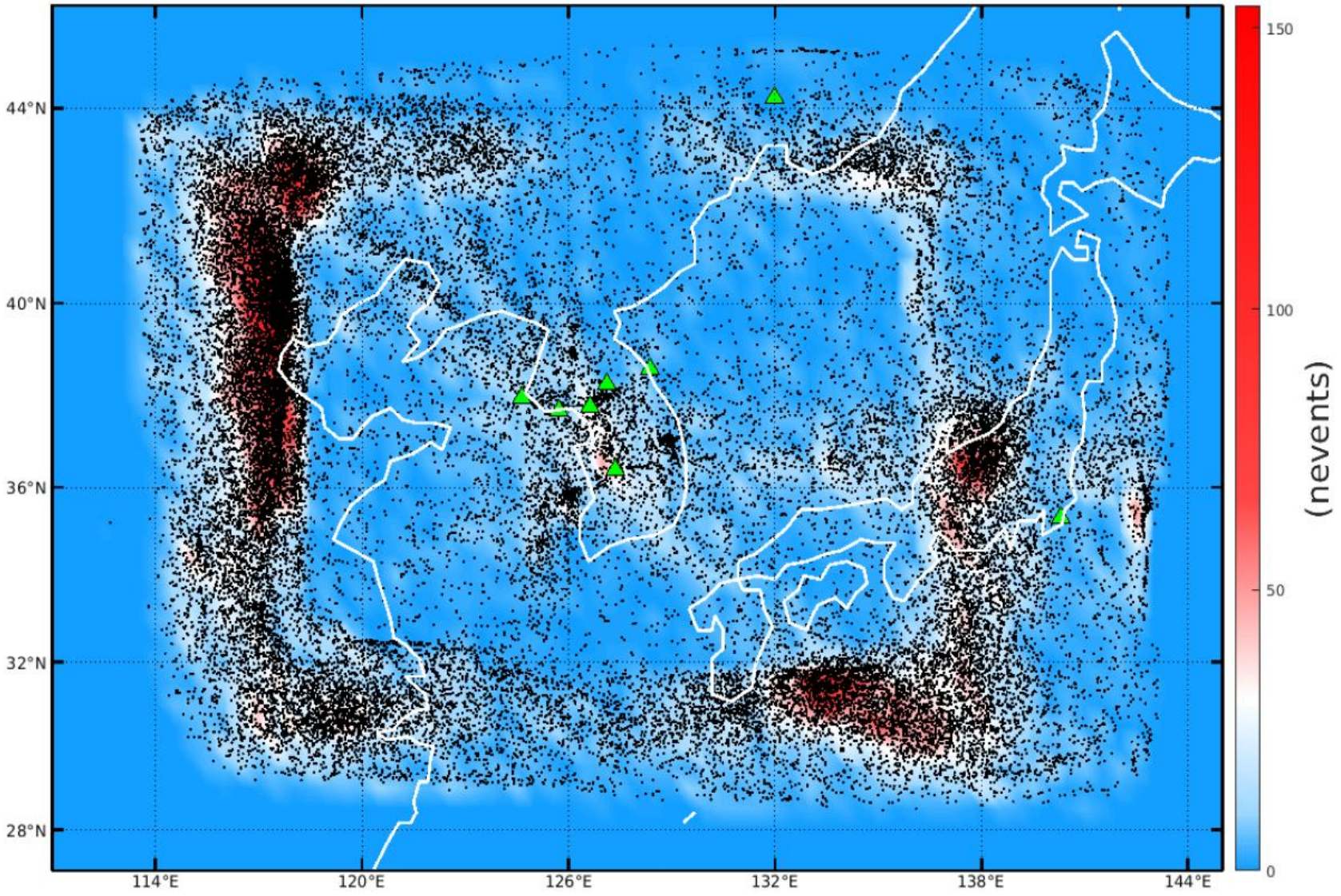
From the November 2021 monthly processing



False Event Association

Simulation using perturbed detection time information (Arrowsmith et al., 2018)

Most events in the edge areas are possible continuous sources.

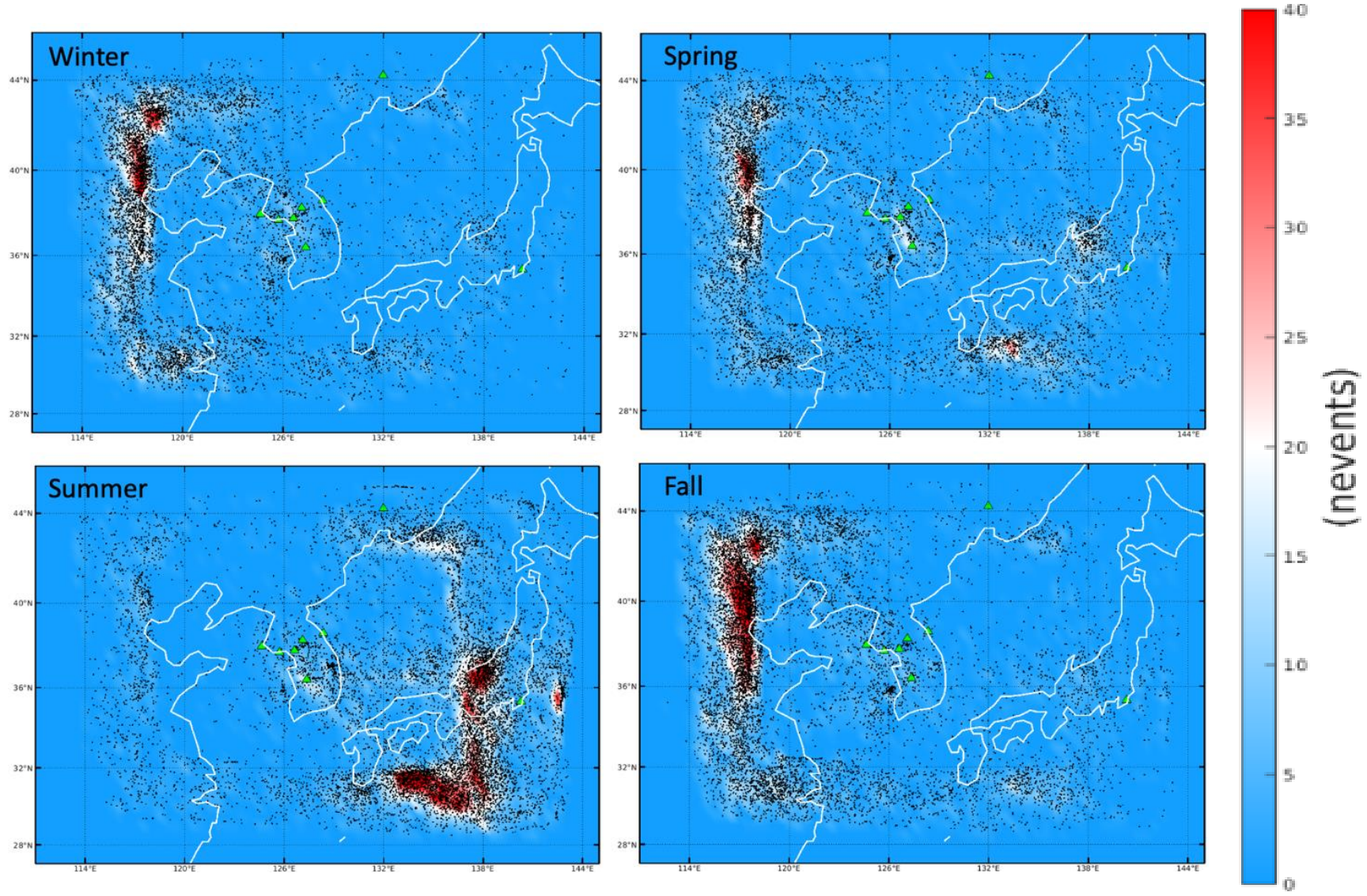


Event from bulletin (black dots) False event (color-coded)

False Event Association

Simulation using perturbed detection time information (Arrowsmith et al., 2018)

Seasonal effect in the false event association.



Ongoing work

Relation between average infrasound amplitudes of event and range from the event bulletin (1/1/20-2/4/20).