

## **Reviewer Comments**

Title: Infrasound and seismoacoustic signatures of the September 28th 2018 Sulawesi super shear earthquake

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MS No.: nhess-2019-179

### **General Comments:**

The manuscript entitled “Infrasound and seismoacoustic signatures of the September 28th 2018 Sulawesi super shear earthquake” by Pilger et al explores observations and modeling of both infrasound and seismic signals recorded on select IMS arrays. They incorporate a variety of techniques including array processing, atmospheric propagation modeling, and back projection as a means to understand each of the observations seen on the arrays.

Although they conclude that the observations are not dependent on the fact that the earthquake was super shear, the observations complement the growing field of research on infrasound generated by earthquakes and its contents are of interest to the infrasound community. Therefore, I recommend the paper for publication after moderate revisions and look forward to reading the revised manuscript.

Thank you.

### **Specific Comments:**

Line 28:

Do you use time-dependent attenuation and/or propagation modeling in this paper? Or are you referring to using atmospheric conditions close to the earthquake origin time since atmospheric conditions can change over short time scales? If not, please omit this phrase. If so, please add text to the manuscript describing your time-dependent propagation modeling.

Lines 49-51:

Can you provide a reference for this statement?

Line 52:

It may be beneficial to add an inset to Figure 1 with a zoom in on the source region that shows the city and rupture zone in more detail that can be pointed to in the introduction.

Line 79 (and in general):

There seems to be a variety of terms to describe different sources of infrasound (e.g. epicentral, seismoacoustic waves, secondary, etc). I suggest either condensing your definitions to distinguish between epicentral infrasound and secondary infrasound, or explicitly stating how the terms differ in the manuscript.

Lines 100-101:

This is more of a personal preference that you don't have to follow, but it may help highlight your results if instead of starting sentences off with "Figure XX shows", sentences start by stating what the figure shows as the subject of the sentence. For example,

"Figure 1 shows the earthquake epicenter as well as the nearest stations around the event."

Could be changed to

"The earthquake epicenter, as well as the nearest infrasound stations around the event, is shown in Figure 1"

Line 101:

It could be beneficial to give a quick mention of the ranges here, as done in Line 23.

Line 102:

You can mention that the detection/no detection you describe in this paragraph will be shown in the analysis of section 3.

Lines 105-106:

Did you check other IMS arrays? If not, it may be best to refrain from making this assertion.

Line 107:

I know SING is only a single sensor and therefore array processing cannot be performed, but I would suggest adding a figure of the waveform somewhere since it is mentioned it a few times. This can be done as part of figure 2, on its own in the main text, or in supplemental material.

Line 119:

This may be a good place to define apparent velocity and state why it is useful (indicates arrival inclination which can be used to infer propagation path, i.e. higher trace velocity likely indicates arrivals from higher altitude ducts).

122-123:

It could be good to reference Matoza et al (2017) here.

Matoza, R. S., D. N. Green, A. Le Pichon, P. M. Shearer, D. Fee, P. Mialle, and L. Ceranna (2017), Automated detection and cataloging of global explosive volcanism using the International Monitoring System infrasound network, *J. Geophys. Res. Solid Earth*, 122, 2946–2971, doi:10.1002/2016JB013356.

Line 124:

I suggest being more specific and stating propagation path. Also, "identified" might be a strong word especially at such long distances with uncertainties in the windfiles, possibly "inferred" or "plausible" would be better words? It may also be useful to describe celerity here, as I would argue it is usually a much more decisive propagation path indicator than trace velocity or frequency content (when the origin time of the event is known).

Line 128:

I suggest qualifying this sentence to station that the attenuation map is that of the surface (where the arrays are). This is important because you map stratospheric wind vectors on the same plot and not all readers may infer this.

Lines 144-147:

For merging the lower atmospheric ECMWF files with upper atmospheric climatologies, did you use Doug Drob's G2S model? If so, this should be explicitly stated and Drob et al (2003) should be cited.

Lines 148-158:

I believe this methodology does not account for atmospheric variability (which caused location biases in the Shani-Kadmiel et al (2017) paper). Please specify either way in the manuscript here or in the discussion section.

Lines 161 – 165:

Please state your filter bands used in the manuscript text (it is only stated in the figure caption)

Line 165:

It may be good to mention back-azimuth here as that is the term that is used in the rest of the paper  
 “direction of origin (back-azimuth)”

Lines 166:

I assume you mean 4 infrasound arrays that made detections?

Line 168:

Celerity should be defined earlier (see comment for line124). Also, a more precise definition of celerity would be “the horizontal distance between source and receiver divided by the total traveltime”.

Table 1:

The expected arrival time row may not be necessary, as it requires the assumption of a stratospheric celerity (0.3 km/s), which is not always the correct propagation path. Also, please state in the text how is signal duration defined.

Figure 2:

Adding subplot labels (a, b, c) that can be referred to in the results section may help support your claims and help the reader follow along.

The font sizes might be slightly small in this figure.

Line 188:

The list format of your results section is a bit odd. I suggest removing this line and making the bullets into paragraphs.

Line 202:

It might be nice to add a plot of the winds as supplemental material (even if it is just one sonde above the source) and discuss if the back azimuth deviations are consistent with the cross winds of the specified propagation duct.

Line 241:

This sentence is unnecessary and could be removed.

Line 243:

Please clarify the phrase “acoustic velocities”. Do you mean apparent velocity?

Line 244:

It should be qualified that celerities outside these bounds exclude purely acoustic waves from the origin at the time of rupture.

Lines 260-265:

Please be more clear on your definitions of both attenuation and propagation modeling. You calculate them using different methods, but they both show results of transmission loss with your attenuation shown in map view and the propagation modeling shown as a cross section.

Line 268:

What is the spatial resolution of the range dependent atmospheric profiles? 0.5 x 0.5 degree as stated in Figure 3 caption? Please state this in the manuscript text.

Line 270:

Please elaborate on what INFERNO is and how you use it.

Lines 266-295:

The transmission losses, associated uncertainties for each array, and source frequency in this paragraph could all be put into a table to more concise and easily get your point across to the reader.

Figure 4:

Why did you choose 1Hz modeling? That seems a bit high for propagation of such large distances.

Figure 5:

Lines 384-395 refer to Sulawesi Island, North Maluku, etc. It might be helpful to label these areas in the figure so the reader can more easily follow along. Or, if you chose to add an inset to Figure 1 you can refer to the locations there.

Line 425:

Tiny semantic issue, but I don't believe the earthquake is named after the mountain. The earthquake ruptured the Denali fault as well as the Toschunda fault and is located in/near Denali National Park.

Line 449:

Do you have a reference for this?

Line 463:

I would argue that both topography and conducive propagation conditions are necessary for detection.

### **Technical Corrections:**

Line 25

“is supposed to” sounds a bit awkward

Perhaps “The seismic-to-acoustic coupling at nearby terrain features *is shown to* generate distinct infrasonic signatures clearly recordable at remote infrasound arrays.

Line 27:

Suggest adding the word “infrasound” for clarity.

Event-related *infrasound* observations

Lines 30, 95, 148, 358:

In these lines, “back tracking” is used. Please choose one term (I think “back projection” is the most widely used) and use throughout the manuscript.

Line 41:

Do you mean “a very high *rate of* natural seismicity”?

Line 63:

“in the course of” may better be stated as “surrounding this event”

Line 65:

Would it be more appropriate to say “both” instead of “either”?

Line 179:

I don’t think “from above” is necessary.

Line 196:

There should be a better way to cite this. Please check the NHSS citation guidelines.

Figure 3:

The stratospheric wind vectors pretty hard to see. Can you make them slightly larger?