Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-371-RC1, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "A low-cost mobile multidisciplinary measurement platform for monitoring geophysical parameters" *by* Olivier F. C. den Ouden et al.

Anonymous Referee #2

Received and published: 28 December 2020

The authors describe a new geophysical sensor package that focuses on infrasound. The unit is remarkably small, lightweight, low power, and ideal for temporary or remote deployments. The authors suggest it could be used in mobile platforms as well - balloons and perhaps oceangoing vessels are implied. The work describes a set of detailed tests on each sensor in the package, as well as theoretical calculations describing the expected response. The authors conclude with a discussion of the strengths and weaknesses of the package compared to other extant solutions.

This is good work and worthy of publication after some further background work and motivation. The technical content appears sound, and the device is well character-

ized. It joins a bevy of low cost infrasound sensor/logger combinations, such as the Gem (cited, but not specifically mentioned), the Raspberry Boom (not mentioned), and the one discussed in Grangeon & Lesage (DOI: 10.1016/j.jvolgeores.2019.106668, not mentioned). Some discussion on how this particular device differs from them is warranted; see comments below.

MAJOR COMMENTS

1. This paper is similar in scope and intent to Anderson et al, 2018: "The Gem infrasound logger and custom-built instrumentation" and Grangeon and Lesage, 2019: "A robust, low-cost and well-calibrated infrasound sensor for volcano monitoring". The present work includes several other sensors, including accelerometers and anemometers, that the above units lack. This should be highlighted. The authors should also read both of the above papers carefully and specifically address how their unit is different. The Raspberry Boom (Raspberry Pi based infrasound monitor) should also be mentioned.

2. The use cases of the device are not well defined. The Gem unit and the one Grangeon and Lesage developed were originally meant for volcanoes. Is that (one of) the use case(s) envisioned here? The connection between ground motion and infrasound sensor interference is important, but will only be a problem when ground shaking is especially strong. That is, for infrasound studies involving local earthquakes or other strong motion sources (see Johnson et al (2020) "Mapping the sources of proximal infrasound" or Bowman, 2019 "Yield and emplacement depth effects on acoustic signals from buried explosions in hard rock".). Maritime environments are mentioned and might make a very good fit, I suggest the authors look up the chapter by Grimmett et al. in the second volume of Infrasound Monitoring for Atmospheric Studies. Balloons are also mentioned – the recent article by Poler and others is cited. The sensor noise level of 0.05 Pa is generally too high for ambient infrasound studies on stratospheric balloons, although focused efforts against loud targets (ground explosions, the microbarom) might be possible. The inclusion of the accelerometer reminds me of the

recent paper "An active source seismo-acoustic experiment using tethered balloons to validate instrument concepts and modelling tools for atmospheric seismology", which might suggest a better use case.

3. I am very skeptical about the utility of the anemometer. The tests were performed under constant temperature and humidity conditions, but it seems to me that different ambient temperatures would really affect its performance. While knowing the wind speed is indeed useful for assessing the source of infrasound background noise, it is generally very clear when interference is due to wind or other sources. Finally, I am not clear why the wind direction is relevant.

4. My general complaint with this type of paper is that the sensor availability is not described. How can the scientific audience get their hands on one of these devices? Will they be ever available for sale, or perhaps part of an equipment pool? This is very important information for groups that may be weighing the option of developing their own units vs. purchasing those already made by others.

MINOR COMMENTS:

Line 13: I suggest a less generic name. Infrasound loggers already exist. Something clever and memorable would be nice here. Lines 51-58: I don't think the discussion of citizen weather stations is particularly relevant. Lines 59-60: Be specific here – e. g. on buoys in the open ocean (cite Grimmett) and on stratospheric balloons (cite Poler). 75: its, not it's 76-77: Here is where a paragraph comparing the unit with others such as the Gem, Raspberry Boom, etc., would be very useful 91: Integrating with existing sensor infrastructures is repeated throughout the paper but no examples of how this would be done are given 94: It is not "novel", there are similar sensor packages already available (e. g. the Gem). 105: How many days can it run on one battery charge? 115: mb or gb? 133: List horizontal and vertical accuracy, and whether it can function above 60,000 ft. This is important if the unit is deployed on a balloon. 147: Sensor self noise is seldom a problem on surface instruments, but it is a major problem on balloon-borne

microbarometers. 149 A comma missing here? 161-166 Particle velocity sensors are pretty rare and probably not worth mentioning, especially since the present unit doesn't use them. 167-169: But this is not true on balloons, see spectra in Bowman and Albert (2018) "Acoustic Event Location and Background Noise Characterization on a Free Flying Infrasound Sensor Network in the Stratosphere" 188: Isn't this the same sensor, or at least very similar, to the one used by Gems, InfraBSUs, and the Raspberry Boom? 282: How were these resistivity values determined? From the manufacturer? 373-375: In general wind noise is pretty obvious from the infrasound time series itself, and the added effort of an anemometer may not be strictly necessary in many cases. Also, how will the anemometer work in extreme environments, such as maritime or high altitude applications? 397: What is ANSYS? 402-406: Can wind speed and direction be accurately determined across the whole range of temperature and humidity conditions the sensor is expected to encounter? This is a very specific and relatively benign set of conditions for the test! 431-434: Has the acceleration response of the MEMS microbarometer been investigated? Some MEMS-based infrasound sensors, like the InfraBSU, are remarkably insensitive to acceleration. 489: I would not characterize the anemometer as "robust" since I am not convinced it has been sufficiently tested under the variety of environments it may encounter in the field. 528: A "weather balloon" is a specific term for a continuously ascending latex balloon carrying a radiosonde. If a long duration drifting balloon like the one described by Poler is intended, please use the term "scientific balloon". Figure 4: If the IMS curves are being used for reference, please make that clear and cite Brown et. al (2014) Figure 7: Please also cite the source of these noise models.

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