LISTENING FOR FIREBALLS: A TRIAL OF SEISMO-ACOUSTIC AND OPTICAL OBSERVATIONS OF METEORS OVER PERTH, AUSTRALIA. Islam Hamama[1], Eleanor K. Sansom[2], Denis Vida[3], Hadrien Devillepoix[2], Masa-Yuki Yamamoto[1], Martin C. Towner[2], Colin Armstrong[4,] Matthew Woods[4], David Rollinson[4]; [1]Kochi University of Technology, Japan, [2]Space Science and Technology Centre, Curtin University, Perth, Australia, [3] Department of Physics and Astronomy, University of Western Ontario, [4]Perth Observatory, Western Australia

Introduction: Infrasound are the sound waves with a frequency range between 3 mHz and 20 Hz, which is the lowest band for human ear detection. These waves are characterized by low frequency content which can be propagated thousands of kilometers in the atmosphere. Infrasound sources can include earthquakes [1], volcanic eruptions [2] as well as fireball events and the reentry of spacecraft [3, 4, 5] The progressive multichannel cross correlation (PMCC) method can be applied on the infrasound array sensors to identify the apparent velocity and the direction of infrasound waves from meteors. In addition, the non-linear numerical modeling can be applied to better understand the generation of shockwaves.

In September 2022, four infrasound sensors developed by Kochi University of Technology, Japan (KUT), were deployed near Perth, Australia. The Global Fireball Observatory, Global Meteor Network and Fireball Recovery and InterPlanetary Observation Network operate cameras in the area to detect and triangulate the path of meteoroids through our atmosphere. Coordinating GFO/GMN/FRIPON fireball observations with the infrasound array will improve and validate the shock-wave propagation models. Linear numerical modeling such as ray-tracing and parabolic equation methods can be carried out to estimate the infrasound ray trajectory and their attenuation where there has been an observed and well characterized fireball event.

Instrument Setup: Infrasound sensors developed by KUT in collaboration with SAYA Inc, Japan (INF04), use multicapacitance microphones to record infrasound (range from 0.05 Hz to audible). They have low power requirements and data are recoded using a Raspberry Pi data logger. These were trialed successfully during the Hayabusa2 capsule re-entry in 2020 [4, 5]. Four sites were deployed to the east of Perth, Western Australia (Fig. 1). Site 1 is situated at the Perth Observatory, and will promote science outreach at the site, along with the school at site 2. Sites 3 and 4 are located at water pump stations on agricultural land. Sites were chosen for their low background noise during night operations, 4G connectivity and mains power access.

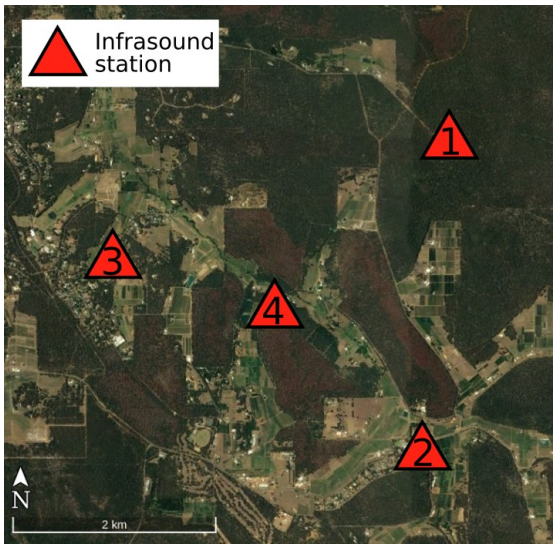

Figure 1: Geometry of infrasound array near Perth, Western Australia

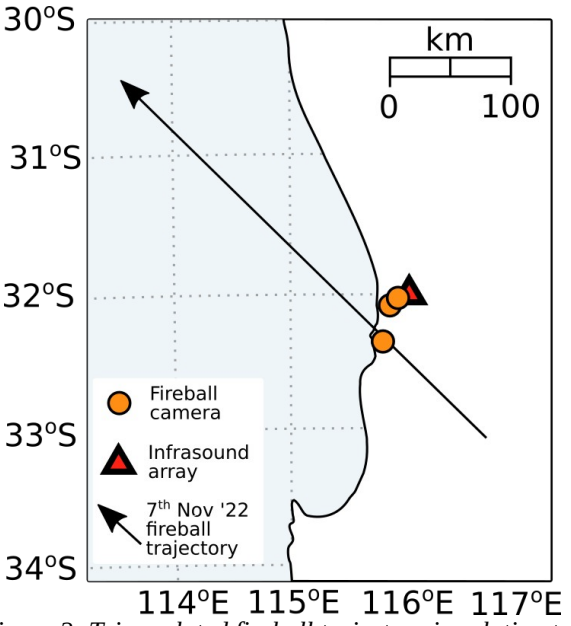

Figure 2: Triangulated fireball trajectory in relation to dedicated fireball observatories and infrasound array (Fig. 1).

First results: On 7th November 2022 a fireball was observed over the region, and was captured by six GMN and one FRIPON camera (Fig. 2 and Fig. 3). This >14 second long event entered at 106 km altitude at 29 km/s, and was around 86 km altitude at its closest point to the infrasound array. It was recorded by three of the sensors (Sites 2, 3, 4; Fig. 4). We will present the first results from this dedicated fireball infrasound array, aimed at correlating near-field infrasound detections of fireballs with triangulated fireball events from optical observations.

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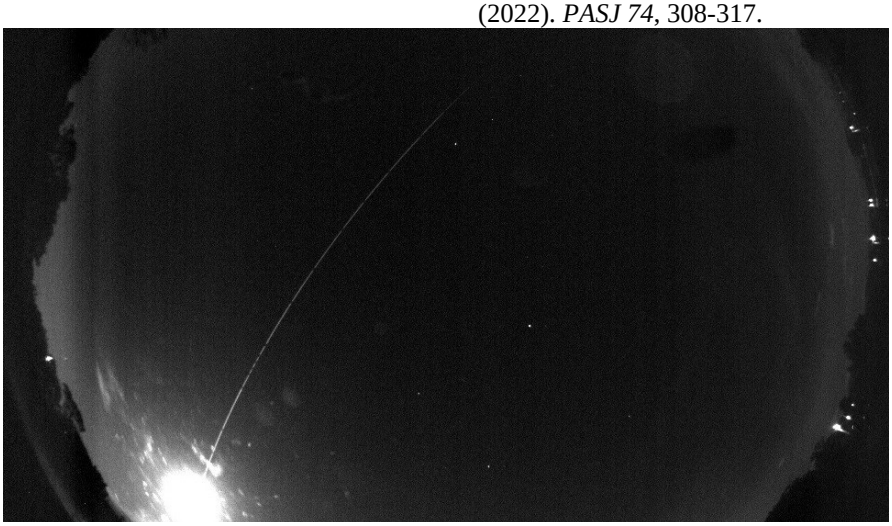

Figure 3: Fireball captured on the 7th Nov '22 from FRIPON camera in Perth, Australia

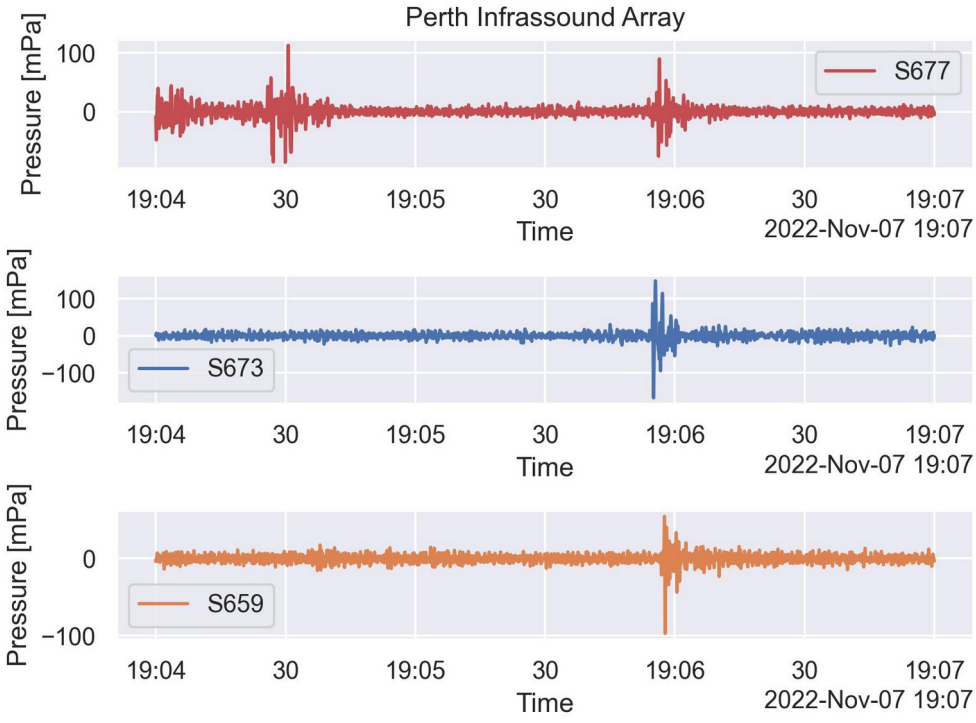

Figure 4: Signals from Perth infrasound array for the 7th Nov '22 event from Sites 2, 3 and 4.