SnT 2025
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
8 SEPTEMBER ONLINE DAY
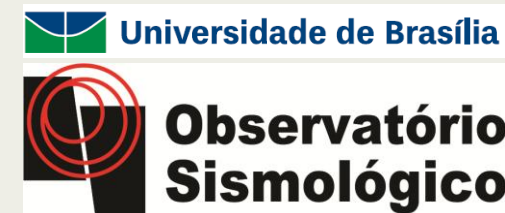9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE

P5.1-830

Analysis of infrasound generated by the meteoroid explosion over Japan on November 29, 2020

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INTRODUCTION AND MAIN RESULTS

We located the meteoroid explosion near Shingu, in Wakayama Prefecture, Japan (latitude: 33.6284º, longitude: 136.451º). The location is consistent with sightings and similar to the estimated by Center for Near Earth Object Studies (CNEOS). The bolide had a yield of less than 1 kt TNT estimated by CNEOS, showing that IMS network is sensitive enough to detect small-yield events.

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Introduction

The explosive fragmentation of large meteoroids is a major source of infrasonic waves. Since the last atmospheric nuclear explosion occurred in 1980, bolide explosions have become the most significant infrasound sources available for calibrating and testing the sensitivity of International Monitoring System (IMS) infrasound instruments.

The main objective of this study is to analyze the infrasonic waves generated by the meteoroid explosion over Japan on November 29, 2020 (local time), to extract wave attributes that can be used to locate and evaluate the sensitivity of the IMS infrasound network.

We used the Progressive Multi-Channel Correlation (PMCC) method, which is the preferred underground and atmospheric detection technique for the IMS monitoring community.

PMCC is a correlation detector used to estimate wavefront parameters of coherent plane waves for a given time window by analyzing time delays in correlations between successive array element triplets.

The algorithm computes wave attributes such as azimuth, trace velocity, frequency, and root-mean-square amplitude (Mialle et al., 2019).

Pixel families, infrasound records, and polar plot.

Locations of the meteoroid explosion estimated by this work and by the Center for Near Earth Object Studies (CNEOS) along with infrasound stations.

Data and methods

We used data from 4 infrasound stations, two are in Russia (I44RU and I45RU), one in Japan (I30JP), and another in the United States territory of Wake Island (I60US).
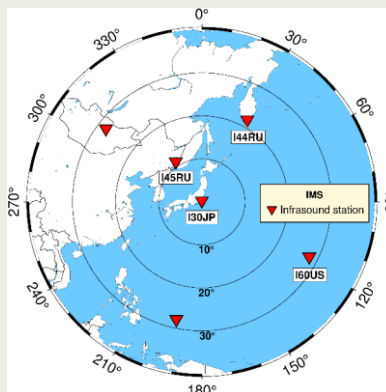
Location of IMS infrasound stations used in this study.

Results

The estimates of mean azimuth, wave speed, and mean frequency, computed by DTK-GPMCC, are presented the following table.

Station	DateTime (UTC)	Mean azimuth (º)	Mean speed (km/s)
I30JP	2020-11-28T16:59:40	243.297 ± 1.272	0.368 ± 0.012
I45RU	2020-11-28T17:45:12	160.882 ± 0.974	0.322 ± 0.002

The following figures show the pixel families indicating the azimuth and the speed variation of the infrasonic waves recorded by the I30JP and I45RU arrays, respectively.
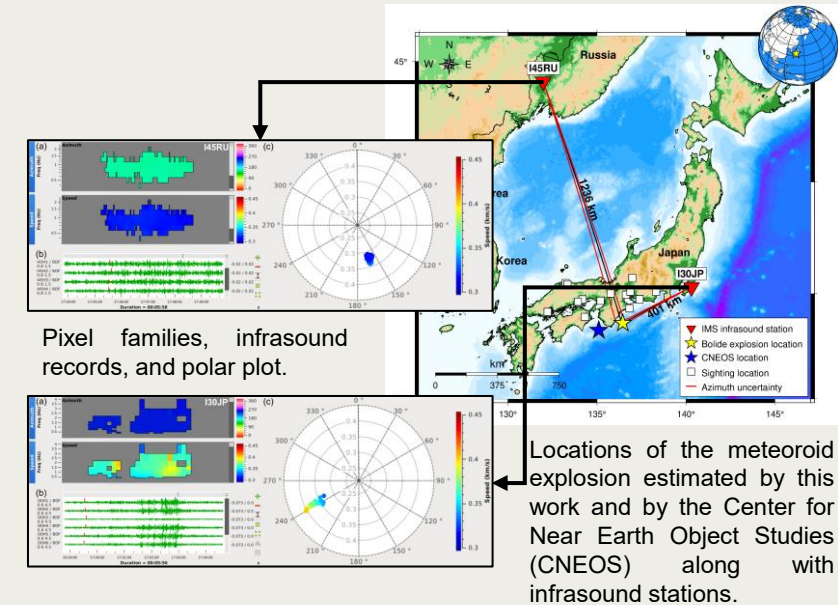
Conclusions

We located the meteoroid explosion near Shingu, in Wakayama Prefecture, Japan (latitude: 33.6284º, longitude: 136.451º). The location is consistent with sightings and similar to the estimated by CNEOS. The bolide had a yield of less than 1 kt TNT estimated by CNEOS, showing that IMS network is sensitive enough to detect small-yield events.

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