Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MTT40-P01 Room:Convention Hall Time:May 24 16:15-17:30

The Infrasound signals produced by a bolide on 20th January, 2013

Makiko Iwakuni[1*], Nobuo Arai[1], Yoshihiro Hiramatsu[2], Yoshiaki Ishihara[3], Masa-yuki Yamamoto[4], Yoshihiro Kakinami[4], Takahiko Murayama[1], Mami Nogami[1]

[1]Japan Weather Association, [2]School of Natural System, College of Science and Engineering, Kanazawa University, [3]Geoinformatics Research Group, Information Technology Research Institute, AIST, [4]Department of systems engineering, Kochi University of Technology

The infrasound observation system has been installed in Isumi, Chiba-prefecture (approximately 60 km SE of Tokyo) as a component of the International Monitoring System for the CTBT's verification regime. It is an array observation site and is comprised of six elements with an aperture of about 2km. It had been deployed on November 2004. Some interesting infrasound signals are observed, which was generated by the volcanic explosions, large earthquakes, artificial explosions and so on.

A bolide was flying over Kanto region around 02:42 on 20th of January 2013 (JST). Optical observation data gave the information that the explosion area of this bolide was over Mt. Tsukuba. Distance between Mt. Tsukuba and Isumi is about 100km, back azimuth of Mt. Tsukuba is 350 degrees. The infrasound sensors detected some pulsed waves around 02:48. A back azimuth of signals was estimated 356 degrees from north. It is consistent with the area of its explosion. From observed apparent velocity of signals, the elevation angle of these signals was estimated 20 degrees. According to both this elevation angle and the distance, the altitude which the bolide explosion happened is estimated approximately 30km and travel time of atmospheric wave is calculated about 5 minutes. Arrival time of signals at Isumi is around 02:48, it is also consistent with evaluation results.

In this presentaion, some remarkable optical observation, seismic records and TEC are introduced and discussed.

Keywords: infrasound, bolide, explosion, perssure wave, microbarometer

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MTT40-P02 Room:Convention Hall Time:May 24 16:15-17:30

Intercomparison Observation of the Infrasound at Sakurajima Volcano

Toshiki Shimbori[1*], Kazuya Kokubo[1], Akimichi Takagi[1], Shin'ya Onizawa[1], Tetsuya Yamamoto[1], Keiichi Fukui[2], Shinobu Ando[3], Yoshiaki Fujiwara[4], Takayuki Sakai[4], Hitoshi Yamasato[4], Yoshihiro Ueda[5], Koji Kato[6], Masaki Nakahashi[7], Shinichi Matsusue[7]

[1]Meteorological Research Institute, [2]Kakioka Magnetic Observatory, [3]MEXT, [4]Japan Meteorological Agency, [5]Osaka DMO, [6]Fukuoka DMO, [7]Kagoshima LMO

For the purpose of detecting volcanic eruptions, the Japan Meteorological Agency (JMA) has been continuously monitoring the air shock with infrasound microphones which are installed near volcanoes. In the Meteorological Research Institute (MRI), for the purpose of investigating the characteristics of various infrasound sensors, intercomparison observation of the infrasound generated by the eruptions at Sakurajima volcano has been done with the cooperation of the Kagoshima Local Meteorological Observatory (KLMO) since 2009. The instruments for infrasonic observation are set up at Seto, Kurokami station which is about 4.7 km east-southeast of the Minami-dake summit crater. From comparison of the simultaneous observation data between the infrasonic piezoelectric microphone which is operationally used for volcano monitoring in KLMO of JMA and the infrasonic condenser microphone of MRI, it is found that the peak-to-peak value or the rms value of both infrasound wave forms are the same with each phase correction. In the presentation, the characteristics of amplitude, phase and wind noises of these infrasound sensors, including digital quartz barometer, will be reported.

Acknowledgements
We would like to thank Dr. A. Yokoo, Kyoto University, for his observation data.

Keywords: air shock, infrasound, infrasound microphone, pressure wave, barometer, volcano monitoring

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MTT40-P03 Room:Convention Hall Time:May 24 16:15-17:30

In-situ measurement of acoustic wave propagation characteristics in middle and upper atmosphere by PDI on-board S-310-41

Daiki Kihara[1*], Masa-yuki Yamamoto[1], Takatoshi Morinaga[2], Jun-ichi Furumoto[3]

[1]Kochi University of Technology, [2]Hokkaido University, [3]Kyoto University

Acoustic wave propagation in the middle and upper atmosphere is mainly characterized by atmospheric temperature and wind. Although they can be derived with empirical atmospheric models like MSIS, the detail propagation process is still unknown (Sutherland et al., 2004). In-situ measurements of acoustic wave propagation are comparatively difficult and previous measurements were extremely limited. In 1960's, the sound propagation between upper atmosphere and multiple ground sites were measured using multiple explosions of grenade on-board a sounding rocket in order to obtain temperature and wind profiles in the middle and upper atmosphere (e.g. Stroud et al.,1960). In 1990's, a measurement method by using MU-Rader with RASS (Radio Acoustic Sounding System) was developed (Tsuda et al., 1994). In order to detect acoustically modulated atmosphere, the RASS transmits low-frequency sound pulses at around 100 Hz from the ground, while in-situ measurement of acoustic waves in the middle and upper atmosphere by using sounding rockets has not been conducted.

The S-310-41 sounding rocket of JAXA was launched from Uchinoura Space Center, Japan, on 7 Aug. 2012. PDI (Propagation Diagnostics in upper atmosphere by Infrasonic/Acoustic waves) was equipped on the rocket as one of 3 sub payloads to measure frequency distribution of sound propagation in the middle and upper atmosphere. The PDI consists of a speaker for generating sound source, one main and two sub microphones as sound detectors, an electric circuit for sound generator, and an absolute pressure sensor. These devices were successfully operated with transmitting 7 fixed-frequency infrasonic/acoustic waves between 10 Hz and 1 kHz at each output power of 1 W for every 0.2 s along with silent period for another 0.2 s, repeating every 1.6 s. Acoustic wave propagation between the speaker and microphones was measured in the payload section. Massive audible sound emitted by the rocket motor burning and impulsive sound signals of nose-cone and payload separations was also detected. Acoustic waves with 50 Hz and 100 Hz were transmitted by the RASS system from the ground to the rocket.

Impulsive sound signal of the rocket motor burning was recorded until about 34 s after the launch (at about 35 km altitude). In a silence situation after the rocket burn-out, the sequential signals generated by the on-board speaker were continuously measured. Faint sound signal was recorded even at the apex of 150 km. Our analyses of measured sound signals showed that the signal strength was attenuated with decreasing of ambient atmospheric pressure (rising in altitude), which was similar tendency of theoretical value by Sutherland et al. (2004). We successfully measured the sound signals of the nose-cone open and the payload separation. Using these pulses, we calculated the sound speed and the temperature of the atmosphere. However, discrepancies between the measured sound speed and the model calculations were found. Transmitted acoustic waves from the ground were not able to be confirmed from measurement by the PDI. In this paper, we will compare the obtained in-situ data with simulated data of laboratory experiments in vacuum chambers before the flight, composing with model calculations by the MSIS.

Keywords: Sounding rocket, S-310-41, Acoustic wave propagation, Middle and Upper atmosphere

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MTT40-P04 Room:Convention Hall Time:May 24 16:15-17:30

Development and downsizing of a PSD type infrasound sensor

Yudai Manabe[1], Masa-yuki Yamamoto[1*]

[1]Kochi University of Technology

Infrasound is one of the open fields for remote-sensing methods of geophysical phenomena in the atmosphere. There have been developed and used many types of infrasound sensors, however, typically used infrasound sensors are almost manufactured by foreign countries, resulting high cost situation in Japan. If we can develop low cost infrasound sensors, multiple-site arrayed observation will be realized in near future. Recently, infrasound signal generated by tsunami was clearly detected by many CTBTO infrasound stations (Arai et al., 2011), suggesting a new era for establishing a dense infrasound sensor network in every part of Japan for preventing or reducing catastrophic disasters. Because the nature of pressure waves with large wavelength, amplitude of infrasound generated by tsunami might be proportional to the size of the disasters. Combination with sensor networks of seismometers on ground and ocean floor, GPS-buoy type wave recorders, and water manometers on ocean floor, establishing a dense network of infrasound sensors with arrayed configuration is desired.

Since 2006, we have been developing new sensing method of infrasound by using piezo film and PSD (Position Sensitive Detectors), achieving frequency range between 0.001 Hz and 10 Hz as well as minimum pressure level of 0.01 Pa (Yamamoto and Ishihara, 2009). Here, we tried downsizing the PSD type infrasound sensor developed in 2008 into a size of 0.15 m x 0.15 m x 0.25 m height with calibrating it by using space chamber (0.8 m length x 0.58 m diameter) as an accurate volume pressure reservoir. By pushing and pulling a small amount of air by a small syringe, calibrating pressure waves with extremely weak amplitude (10 Pa to 0.01 Pa) can be generated in the chamber, precise measurement of artificially generated infrasonic signals could be realized. The waves were measured not only by the developed PSD sensor, but also by Chaparral Model-2.5 infrasound sensor at the same time. Comparison with output signals by two types of sensors, the downsized PSD type infrasound sensor was carefully studied. In this poster, we will show the new design and obtained calibrating datasets.

Keywords: infrasound, sensor development, PSD, downsizing, low-cost, calibration

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MTT40-P05 Room:Convention Hall Time:May 24 16:15-17:30

Preparation of the metadata for infra-sound in IUGONET project

Yukinobu Koyama[1*], Toshihiko Iyemori[1], Tomoaki Hori[2], Yoshimasa Tanaka[3], Shuji Abe[4], Atsuki Shinbori[5], Norio UMEMURA[2], Satoru UeNo[6], Yuka Sato[3], Akiyo Yatagai[5], Manabu Yagi[7]

[1]Graduate School of Science, Kyoto University, [2]Solar-Terrestrial Environment Laboratory, Nagoya University, [3]National Institute of Polar Research, [4]International Center for Space Weather Science and Education, Japan, [5]Research Institute for Sustainable Humanosphere (RISH), Kyoto University, [6]Kwasan & Hida Observatories, School of Science, Kyoto University, [7]Planetary Plasma and Atmospheric Research Center, Graduate School of Science, Tohoku University

The KARIYA infra-sound data (1984-2004) observed by Dr. TAHIRA have released to the public on the web site of the WDC for Geomag., Kyoto. On the other hand, the IUGONET project have developed the metadata database for upper atmosphere and the data analysis software. As a part of this project activity, we created some metadata about the infra-sound data and a procedure to load and plot the data. In this presentation, we tell about our database activity related to the infra-sound data. Furthermore, we propose cooperation with other field.

Keywords: upper atmosphere, metadata, database, data analysis software, infra-sound