MTT41-P01 Room:Convention Hall Time:May 26 18:15-19:30

Numerical modeling of acoustic radiation from oceanic swell using CIP-CUP scheme

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Oceanic surface gravity waves called as swells with period of several seconds radiate atmospheric acoustic waves called as microbaroms with half the period. The radiated microbaroms are continuously observed with microbarometers on the ground near the coast. From the observed microbaroms we could estimate the amplitude of oceanic swells and the temperature and wind of atmosphere because the amplitude of microbaroms depends on that of swells, and the propagation velocity of microbaroms depends on the temperature and wind. For the estimation we develop a coupled ocean-atmosphere model. General coupling models consist of independent parts of ocean and atmosphere coupled by complicated boundary conditions. Instead we model ocean and atmosphere as a unified fluid to exclude the boundary condition, using CIP-CUP (Constrained Interpolation Profile - Combined and Unified Procedure) method. This method make it possible to precisely compute the advection part and to stably compute the ocean-atmosphere boundary, which has a considerable density gap of three order of magnitude. In this presentation, we compare the computed microbaroms radiation with an analytical model to discuss the validity of our model.

Keywords: microbarom, infrasound, atmospheric acoustic wave, swell, oceanic surface gravity wave, CIP-CUP method

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High resolution barometer array and broadband seismic observation in Palau

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We are operating high resolution barometer array in Palau and reported atmospheric gravity wave and performance of array analysis in this project (Ishihara et. al., JpGU, 2014). Palau locates in tropical zone and weather condition almost stable every day. This array has good condition to detect event-like signal in stable ambient condition. And broadband seismic stations, weather radar station and NOAA station are operated in Palau. For interpretation of event-like signal, we can use integrated data with some observation data in convenient research field. We are operating two seismic stations. However vertical component of STS-1 sensor had severe problem in its measurement. Last we repaired the component. We started full spec observation as original plan and they are under operation smoothly now.

Over 100 sec in period, atmospheric gravity waves recorded frequently in barometer array. Theoretically signal intensity of gravity wave is decreased in some ten seconds in period. In recent measurement, remarkable some ten seconds pressure variation is detected and propagated in this barometer array. Apparent velocity is also similar with gravity wave and accompany with longer period signal. It is interpreted as one of gravity wave.

In seismic signal, horizontal components detect similar signal and initiate just same time with pressure data. Vertical component doesn't show remarkable signal, so that ground tilt is occurred by pressure variation. Rail fall is also one of sources of ground tilting. However NOAA weather station that is close to a seismic and barometer station does not report heavy rainfall and small shower in each region. Both phases of seismic and barometer is quite synchronized. Filtered barometer signal shows many high-frequency event-like signals covering all stations. Most cases associate with ground tilting recorded in seismic data. It means that horizontal components include ground tilting as noise until some ten seconds. We will evaluate coefficient of conversion from pressure variation to ground tilting and possibility of reduction of the component. And we will report the characteristics of wide frequency range propagating barometer signal.

Keywords: atmospheric gravity wave, broad band sesimic record, ground tilting

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Detection of microbaroms on icebreaker SHIRASE

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Microbaroms with about 0.2 Hz caused by oceanic wave are often observed as infrasound wave. We installed infrasound sensor and have observed small pressure variation since 2008 at the Showa station in Antarctica. The results show continues wave with about 0.2 Hz arrives from ocean area. Therefore, the wave is concluded with microbaroms excited at the Antarctic Ocean. However, the excitation mechanism of microbaroms has been still unknown enough because of lack of observation. To understand it, the infrasound sensor was installed on icebreaker SHIRASE and infrasound was observed from Fremantle, Australia during JARE-54 (54th Japan Antarctic Research Expedition) in 2012 and JARE-55 in 2013, and Harumi, Japan during JARE-56 in 2015 to offshore of the Syowa station. Although waves with similar frequency band of microbaroms was observed on the ship, pitch angle variation of the ship also had similar frequency. The pitch angle motion of the ship results vertical motion of the sensor, namely, pressure change. Rough estimation of vertical motion indicates that more than 50% of pressure change in microbaroms-band arises from vertical motion of the ship. In order to eliminate pressure change coming from microbaroms, accurate estimation of vertical motion of the ship is key issue. In this paper, we show attempt to detect microbaroms on the ship and preliminary results.

Keywords: infrasound, microbaroms, ocean wave, the Antarctic Ocean

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Recent progress of infrasound studies and sensor developing activities

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Infrasound is one of the most important open fields to study the missing link from troposphere to upper atmosphere. In this decade, observation of the infrasound has been gradually improved with the progress of constructing the sensor network in all over the world for watching the nuclear explosions. On the other hand, many kinds of remote-sensing observing methods have been developed by many scientists for ionspheric plasma observation like the GPS-TEC mapping method to clarify the wide field disturbances like TID (Traveling Ionospheric Disturbance), indicating the importance of vertically propagating large wavelength waves to be projected and seen on the mapping results. Seismic, volcanic, atmospheric and oceanic observation regions are also deeply concerning with the infrasound studies.

Hence, not only the electromagnetic coupling processes but also neutral atmospheric pressure waves like the audible sound and infrasound should be studied. However, the observation of infrasound is currently less sufficient rather than the seismic and GPS sensor networks. As for the event studies, it has been reported that huge earthquakes like Smatra (2004) or Tohoku-oki (2011) as well as their induced tsunami waves became clear wave sources of these kinds of pressure waves, suggesting the infrasound whose propagating velocity is faster than that of tsunami waves on the sea is important for the disaster prevention. Even the relatively small scale geophysical phenomena like volcanic eruptions, meteorite entries, land or snow slides, or thunders also creates clear N type infrasound signal at a time of arrival of the shock waves generated at the source region, possibly depending on its size and moving distance.

In order to measure such pressure waves in a few to several 100 km scale, arrayed sensors network is required, thus the cost of each pressure sensor is important to built. We recently developed a new infrasound sensor that include some weather monitoring sensors and seismometers, enables us to integrate several parameters information to create an independent emergency alert system by one sensor complex for any geophysical events just after the arrival of the sonic waves. In this paper, we will show the most recent progress of the infrasound studies as well as the development of infrasound sensors. Collaboration of science and engineering researches, manufacturing companies with their engineers and infrastructure management officers in regional governments are very important to open the new era of the infrasound applications useful into the society.

Keywords: Infrasound, Multsites observation, Sensor development, Hazard prevention, Polar region observation, Collaboration of science and engineering