

民間会社が運用する観測ロケット Momo シリーズを用いた高層大気中音波伝搬の計測

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Measurement of sound wave propagation in middle atmosphere by using Momo series sounding rockets operated by a private company

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Sound propagation in middle and upper atmosphere has been investigated experimentally since 1950-1960's when the early stage of sounding rocket development in the world. After recognizing characteristics of altitude profile of the sound speed, namely, temperature profile in middle and upper atmosphere in more basic sense, atmospheric model studies have been carried out into the present era. More recently, importance of sound propagation from the ground to the thermosphere, or vice versa, has gradually been focused on among many topics of the Earth's atmospheric studies, especially some studies on physics of atmospheric gravity waves (AGW) or infrasound to be propagated upward/downward in these atmospheric spheres. However, experimental studies are extremely limited in these areas because we need high altitude balloons or sounding rockets for in-situ observation in these altitude ranges.

In 2012, we conducted an experiment with using S-310-41 sounding rocket of ISAS/JAXA and altitude profile of sound attenuation process was investigated. After the early dates of sounding rocket development in Japan, it was the first experiment of investigating sound propagation process in middle and upper atmosphere mainly because the affinity between sound and vacuum space is poor, especially in case of higher altitude in thermosphere to be reached with high altitude rockets of ISAS/JAXA S-310/S-520 series.

In 2017, Momo series sounding rockets opened a new page of Japanese space exploration as the first sounding rocket developed totally by a private company, Interstellar Technologies Co. (IST). In 2018, we installed two infrasound sensors with a buzzer for sound source aboard Momo-2 sounding rocket and tried the similar experiment for sound attenuation and propagation, but the rocket was exploded just after the launch. At that time, we measured the shock wave of rocket explosion with the onboard sensors as well as high accuracy pressure sensors deployed on ground.

In 2019, we also installed the same instruments onboard Momo-3 sounding rocket. In the experiment we operated 10 fireworks on ground, before and after the rocket launch, making loud pressure wave impulses to be propagated from the troposphere to stratosphere, mesosphere, and lower thermosphere. The launch of the Momo-3 was successful and it became the first private company's rocket reached 100 km altitude border. The apex was 113.4 km and we successfully recorded the sound/infrasound signals until 282.5 s from the launch. Moreover, in July 2019, Momo-4 flight is on-going situation within 3 months after the Momo-3 experiment. Such rapid repetition as well as low-cost launch is considered as significant advantage of the private company's rockets.

In this presentation, we will introduce the most recent activities with using the Momo series sounding rockets operated by IST and its first result of interesting sound propagation characteristics found in the datasets with showing situation of Momo series operation process as well as current environment of a new rocket launch pad in Taiki town, Hokkaido.