Preliminary Report of Rocket Observations of the Auroral Hiss

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ロケットによるオーロラ・ヒスの観測

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要旨: S-210JA ロケット 2 機による VLF hiss の観測が行われ，1 機はオーロラ・アークの出現時，もう 1 機は，オーロラは出現していないが，地上観測で 12kHz 帯 VLF hiss が観測されている時期に打ち上げられた．両機とも，高度 95～110km の領域で，VLF 帯の電磁波現象が強くなるのが観測された．

***Abstract*:** Two rockets with VLF receivers were launched from Syowa Station in Antarctica to study the electro-magnetic properties of auroral arcs. This paper is a preliminary report on the rocket observations. One payload was launched during relatively quiet auroral arc conditions. The other payload was launched while a 12 kHz VLF hiss recorder at a ground station showed fairly strong hiss, but no auroral arc was observed.

In both cases, the electric field intensity in the VLF range was observed to increase at an altitude from 95 to 110 km.

A series of rocket experiments have been planned by the Japanese Antarctic Research Expedition Group for the study of aurora. The purposes of the experiments are to study the electro-magnetic properties of aurora, the dynamics and energy balance in aurora and its ion chemical properties. The auroral hiss observations in auroral arcs described in this preliminary report have carried out a part of the aim of the first goal.

(1) Observational results of the S-210JA-2 rocket

At 22h40m LT on September 25, 1971, a quiet auroral arc was observed at Syowa Station. Accompanying this event, changes were observed in the ground records of the geomagnetic field meter, the hiss recorder at 8 kHz, the ULF recorder, the riometer and the UV photometer at 5577 Å and 6300Å (see Fig. 3.). Accordingly, the S-210JA-2 rocket was launched at 00h08m LT. The observation was carried out successfully, with the performance of the rockets and the equipment being satisfactory.

The payload consisted of a VLF hiss receiver, an optical pumping type magnetometer and a UV photometer. The VLF hiss system consisted of two receivers,

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one a loop antenna and the other a whip antenna, which detected the magnetic and the electric field strengths, respectively. Each antenna axis was normal to the rocket spin axis. Both receivers had the same receiving frequency bandwidth of 6 to 10 kHz (the center frequency was 8 kHz) and were calibrated by a 8 kHz oscillator every 20 seconds.

The altitude variations observed for the electric and the magnetic field intensities are shown in Figs. 1 and 2, respectively.

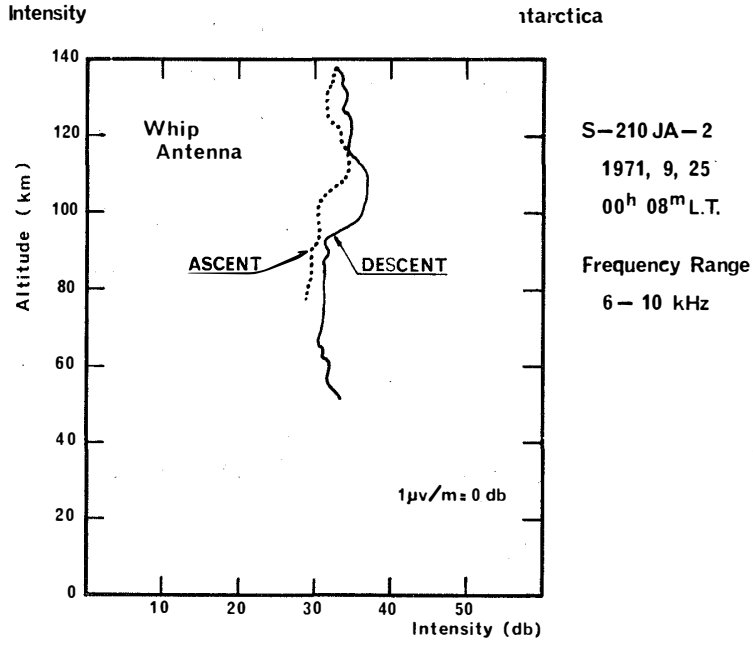

Fig. 1. The altitude variation of the electric field intensity of the auroral hiss at 8 kHz observed by the S-210JA-2 rocket.

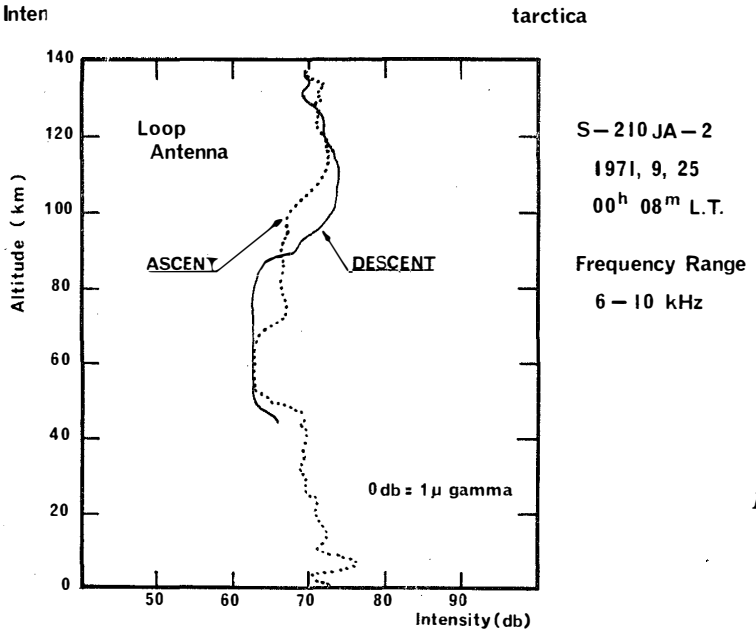

Fig. 2. The altitude variation of the magnetic field intensity of the auroral hiss at 8 kHz observed by the S-210JA-2 rocket.

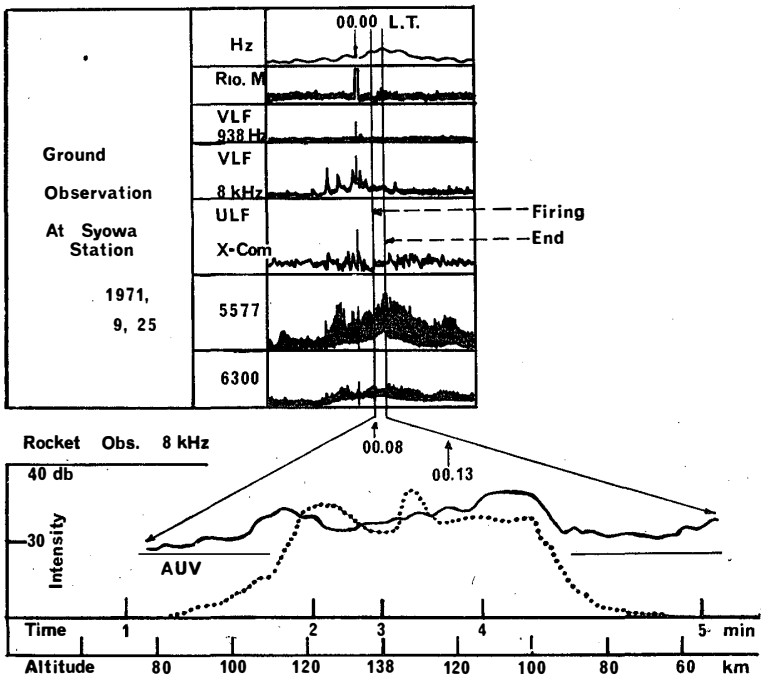

Fig. 3. A comparative figure between the ground observations and the rocket observations at Syowa Station on September 25, 1971.

From these results, we can see the enhancement of the electric field intensity in a range from about 100 to 120 km during the ascent and from about 95 to 115 km in the descent. The same enhancements are also seen for the magnetic field intensity from 100 to 130 km in the ascending stage and from 90 to 130 km in the descending stage. For a comparison between the rocket observation results and the ground observation results, see Fig. 3.

From Fig. 3, we can see that the rocket was launched in a situation for which the hiss event observed at the ground was in its last phase, on the other hand, the UV photometer at the ground station was detecting a fairly strong ray emission at 5577 Å. Accordingly, the enhancement of the field intensity observed on the rocket is believed more to be caused by an auroral hiss than by a hiss penetrating from the magnetosphere. Actually, it may be inferred from the results shown in Fig. 3 that the electric field variation vs. altitude showed a trend similar to that of the auroral UV observed on the rocket. This result provide an important clue to the study of the auroral hiss.

(2) Observational results of the S-210JA-19 rocket

To investigate the auroral hiss in greater details, rocket S-210JA-19 was exclusively devoted to studying the electro-magnetic wave phenomena emitted from aurora arcs. To measure both the frequency spectrum pattern and the field intensity of the auroral hiss, and the electron density profile in the ionosphere, the

payload is made up of two wideband receivers with loop and whip antennas, including a tuned receiver with a whip antenna, an antenna impedance meter and a Langmuir probe.

The S-210JA-19 rocket was launched at 22h09m LT on July 15, 1973. Fairly

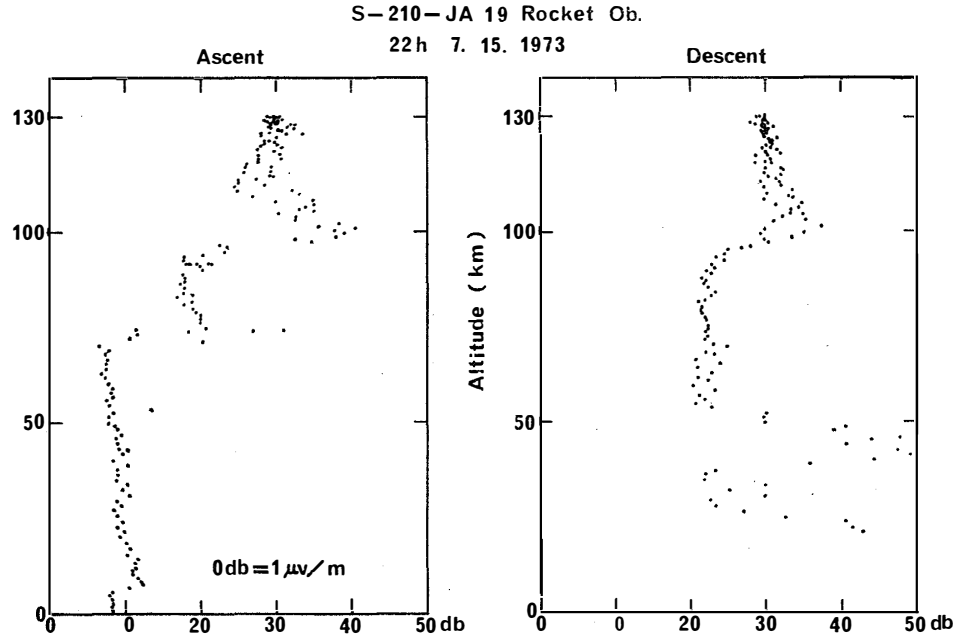

Fig. 4. The altitude variation of the electric field intensity of the hiss at 30 kHz observed by the S-210JA-19 rocket.

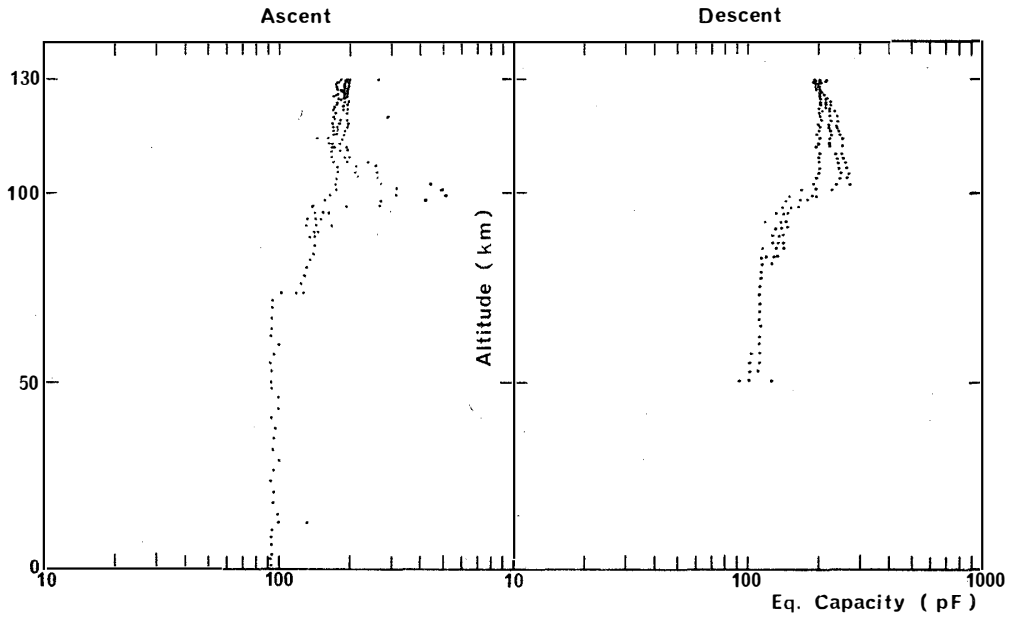

Fig. 5. The altitude variation of the equivalent antenna capacitance at 17.4 kHz observed by the S-210JA-19 rocket.

strong hiss on the 12 kHz hiss recorder at the ground station was observed on this day, but no auroral arcs were observed.

All observations were carried out successfully. In a present stage of analysis, we can only report on the altitude variation of the electric field intensity at 30 kHz and on the equivalent antenna capacitance at 17.4 kHz. The results are shown in Figs. 4 and 5, respectively.

The electric field measurement started when the whip antenna was unfolded at 73 km. From Fig. 4, we can see a relatively sharp enhancement of the electric field intensity at 30 kHz at about 100 km. Corresponding to the field variation, the equivalent antenna capacitance also increased sharply at about 100 km as shown in Fig. 5. These results suggest that some region of enhancement of the electron densities exists at an altitude of about 100 km.

However, since no auroral arcs were observed on this day, for further interpretation of the results in terms of this phenomenon, we shall try to extend the analysis after all results obtained from the rocket observations and the ground records are completely processed.