THE LONG-LASTING QP EMISSIONS OBSERVED ON ARASE SATELLITE AND LOVOZERO STATION

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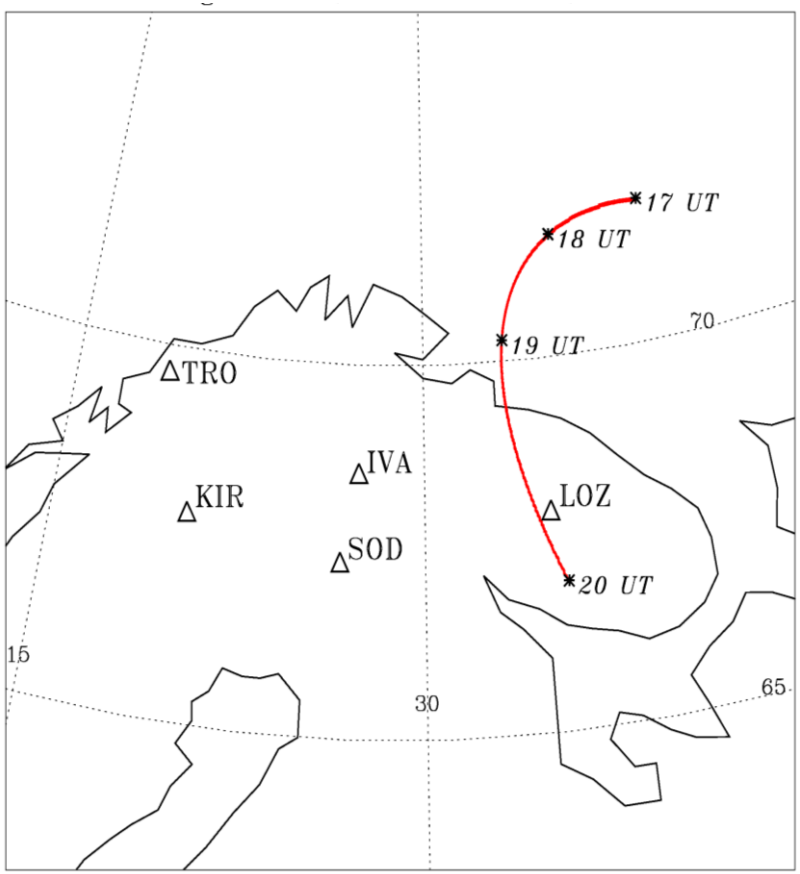
Introduction

Quasi-periodic (QP) VLF emissions are wideband emissions at frequencies between about 0.5 and 4 kHz which are observed inside or near the plasmapause. They are characterized by a periodic modulation of the wave intensity with typical periods from several seconds up to a few minutes.

There are two types of QP emissions: the type1 of QP emissions is accompanied by the simultaneous ground geomagnetic pulsations with the same frequency, the type2 of QP emissions is not accompanied.

It was generally believed that QP emissions type 1 and QP emissions type 2 have different spectral properties and generation mechanisms. Periods of QP2 emissions are usually explained in terms of relaxation oscillations of the cyclotron instability or the auto-oscillation regime. However, the generation mechanism of QP2 emissions has not yet been fully understood.

The aim of this research is to study the unique event with long-lasting QP emission when the new Japan Arase satellite was geomagnetically conjugate to the Russian Lovozero station.



Data used

- The Arase satellite, formerly known as Exploration of energization and Radiation in Geospace (ERG) satellite was developed by the JAXA (Japan Aerospace Exploration Agency)

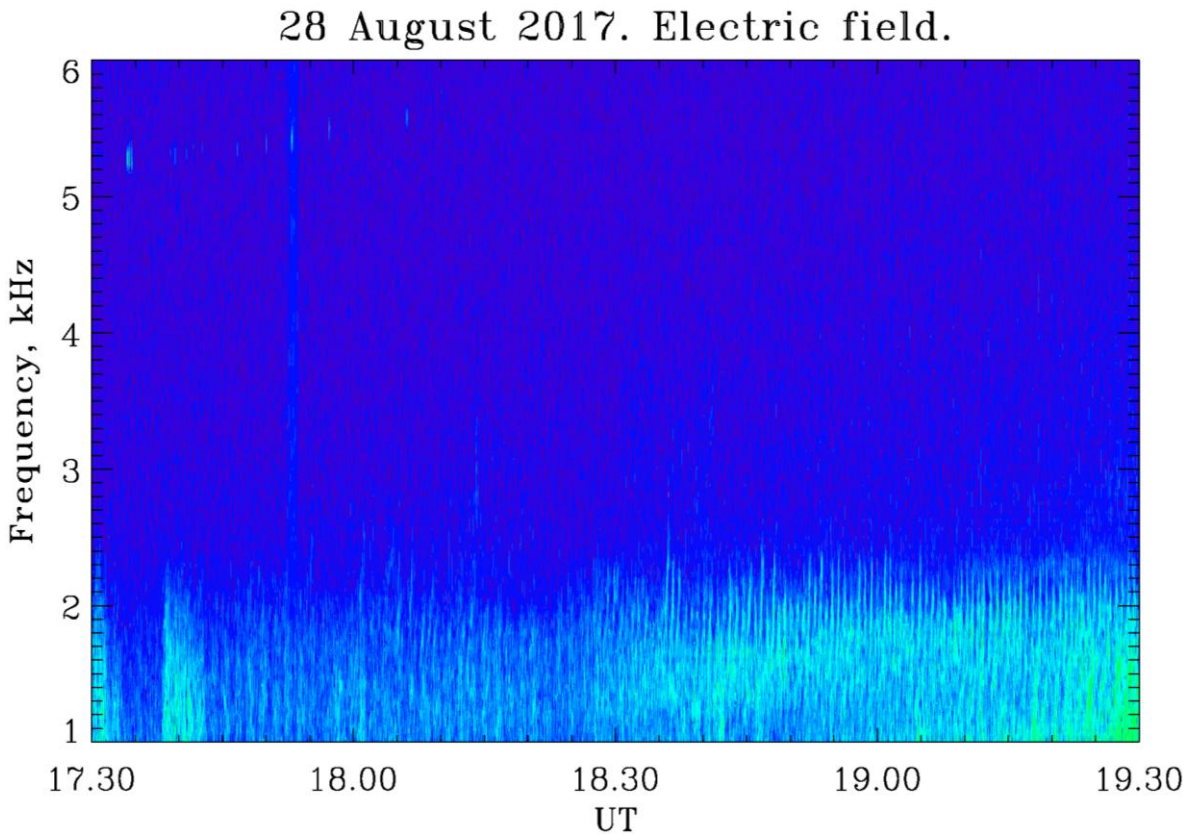
- The Lovozero station (64.22N, 114.6E, LOZ) data of the Polar Geophysical Institute. We used the VLF Lovozero data, fluxgate magnetometer data.

- For the analyses we will choose the time intervals when the Arase satellite was geomagnetically conjugate to the Kola Peninsula (Figure 1).

- The IMAGE magnetometer data

- The riometer data in Scandinavia and Kola Peninsula was used for the detection of the level of electron precipitation into the atmosphere during our event.

Arase data

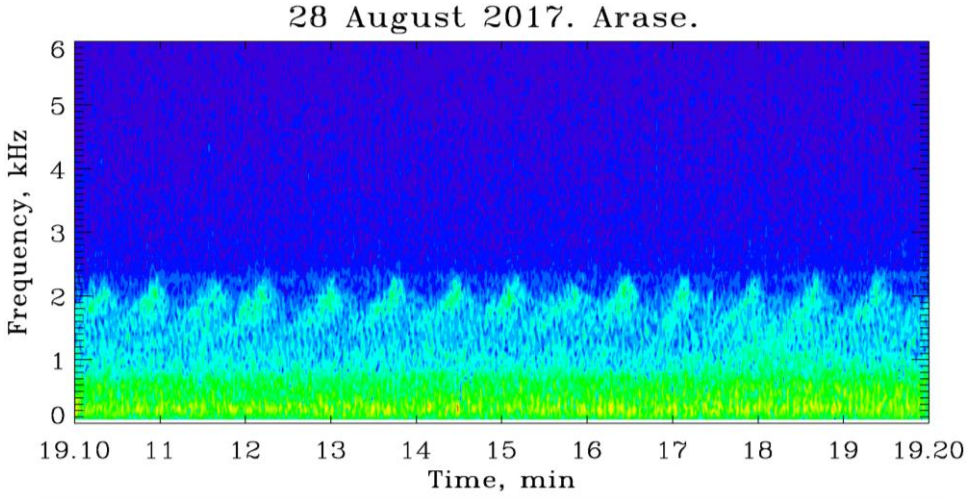


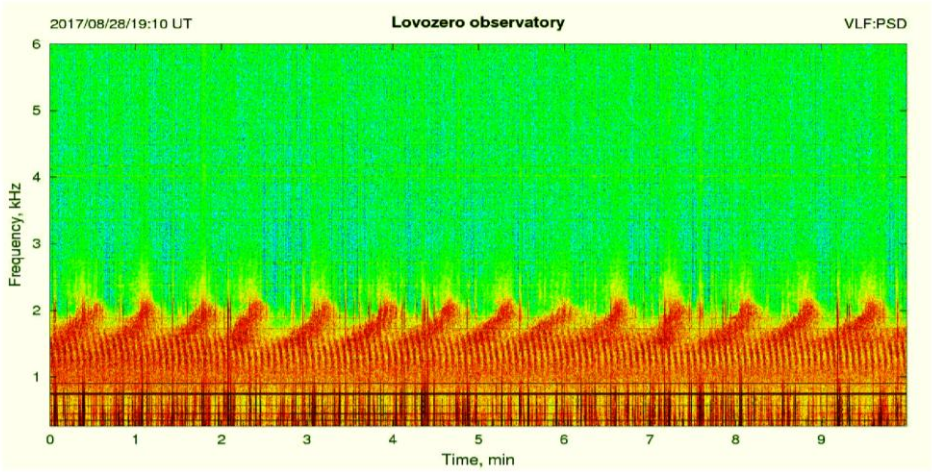
During the period of the QP emissions appearance ***the geomagnetic conditions was quite*** (SYM-H = -20 nT, AE = 100-200 nT). According to the OMNI database solar wind speed was about 300 km/s, Bz-component of the interplanetary magnetic field was positive.

The clear QP emissions was observed in electric field on Arase satellite

It is interesting that QP emission was not observed in magnetic field variations. Possibly its caused different sensitivity of the instruments which measure electric and magnetic field.

Arase and Lovozero observations



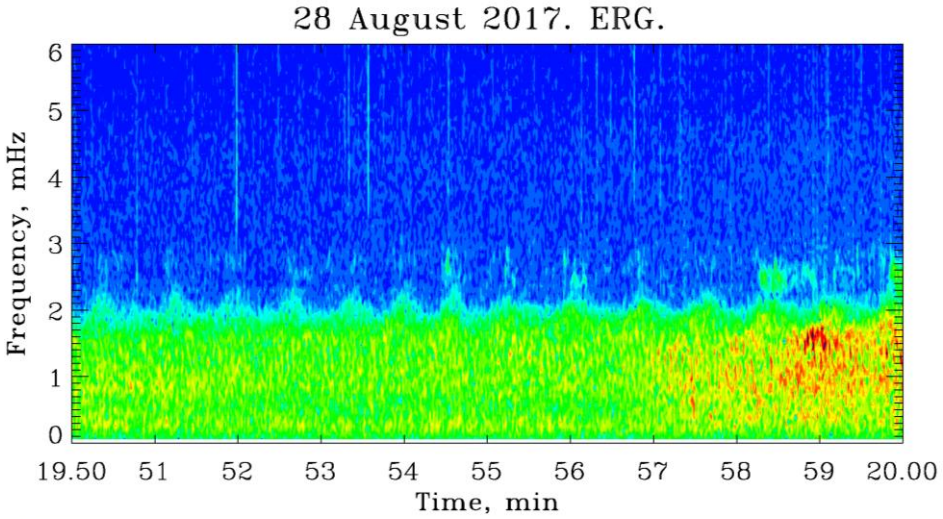


The simultaneous very clear QP emission on the ground and in space was observed during about 90 minutes in the evening sector of MLT from 18.30 to 20.00 UT.

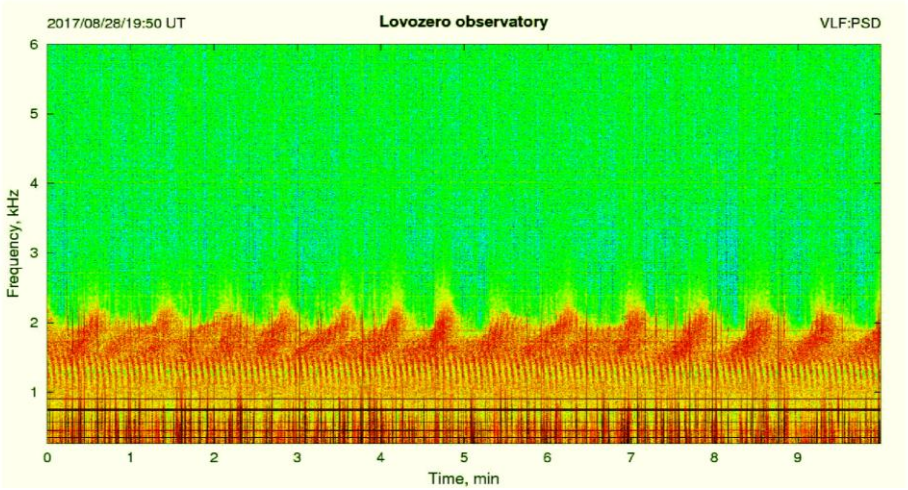
The Arase satellite at this moment was located on the nightside magnetosphere, near midnight (X = -3.5 Re, Y = 2 Re, Z = -4 Re in GSE coordinate system).

- It is shown the 10-minutes time interval when QP emission was registered on Arase satellite and LOZ station.

- There is very high correlation between QP elements on the ground and in space.



The period of these QP emissions increase with time



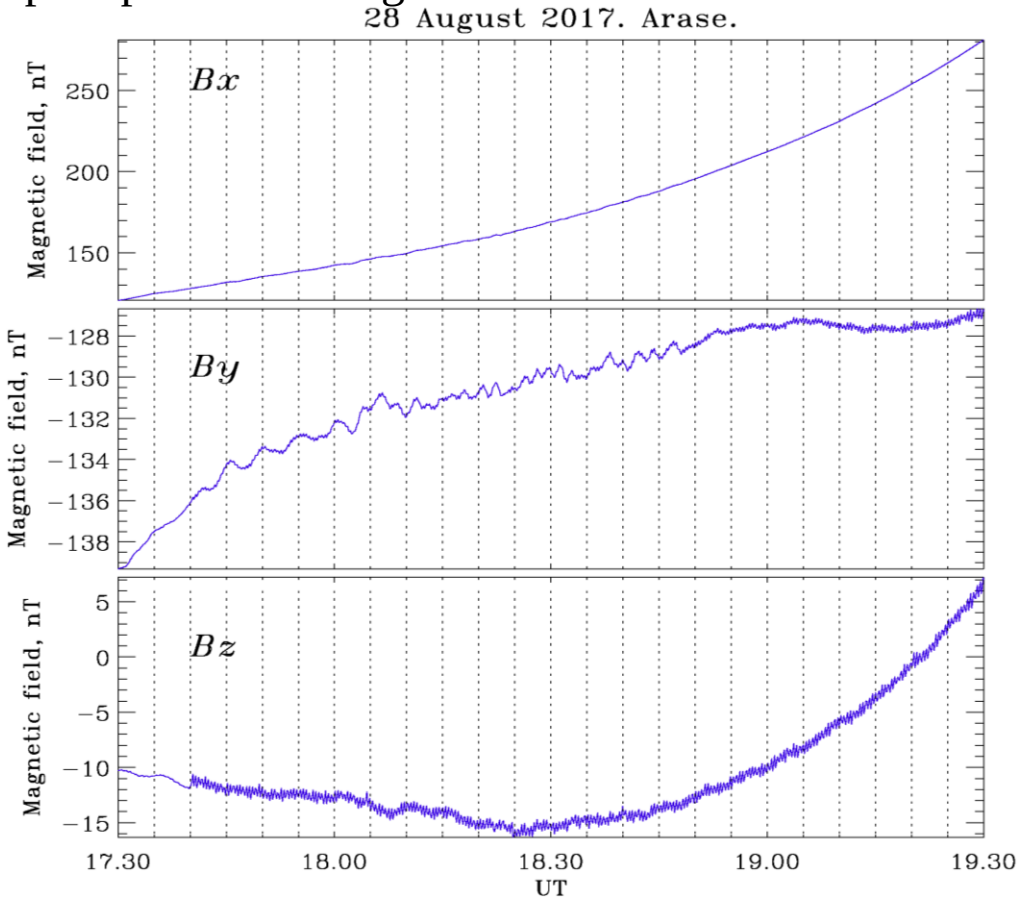
-The QP emissions was registered in a frequency range 1-2 kHz
- the period of QP emissions was approximately 40 seconds.

- Inside the QP emissions the higher frequency fine structures were observed, the physical nature of this fine structure is not well understood.

Magnetic field variations

The analysis of the IMAGE magnetometer data (LOZ, IVA stations) shows that QP emissions are not accompanied by the geomagnetic pulsations with the same period on the ground-based magnetometers.

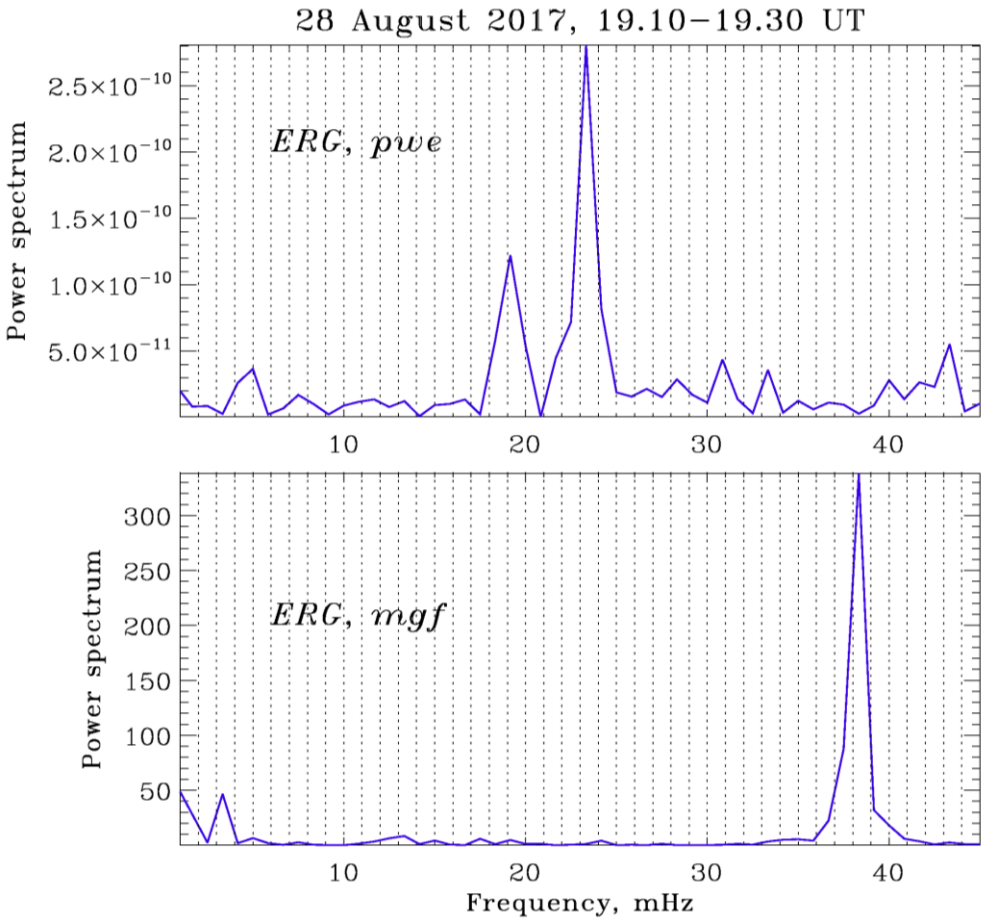
According the Scandinavian riometers data there is no strong cosmic noise absorption (about 0.2-03.dB) increase during this event which testify about the absence of strong electron precipitation during.



- But according to the magnetometer data of Arase satellite (MGF instrument) it is found ***Pc3 geomagnetic pulsations*** in Bz, By components

- Amplitude of the pulsations is 0.5-0.7 nT.

The analysis of the particle data on Arase satellite shows the absence of the pulsations with the same period in the fluxes of charge particles



The spectral analysis shows that the frequency of these pulsations is about 38 mHz while for the envelope of QP emissions has two spectrum (19 mHz, 22 mHz) peaks was observed.

So the frequencies of the ULF Pc3 waves in space and the frequencies of QP emissions does not coincide (it differs almost twice).

The appearance of these QP emissions can be associated with the small-scale Pc3 pulsations which seen in space and does not seen on the ground due to its damping in the ionosphere. So these QP emissions should not be attributed to the QP1 and QP2 classes. Thus even if we don’t see geomagnetic pulsations on the ground it does not necessarily indicate that this is QP2 class of QP emissions.

Conclusions

So it is found very clear and long-lasting (1.5 hour) QP emissions which was long-lasting (1.5 hour) QP emissions which were simultaneously observed on Arase satellite and Lovozero station located on Kola Peninsula. It was registered on the evening-night side during low geomagnetic activity. These QP emissions are not accompanied by the geomagnetic pulsations with the same period on the ground-based magnetometers. But according to the magnetometer data of Arase satellite it is registered the Pc3 geomagnetic pulsations with higher frequency.

When QP envelope and ULF periodicities are different, it can correspond to different harmonics of a same fundamental oscillation of the field line. The small-scale Pc3 pulsations do not seen on the ground due to its damping in the ionosphere. So investigated QP emissions can be attributed neither to QP1to QP1 class no QP2 class.

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