Abstract
During the last 10 years, infrasonic chirps in the frequency range 0.5 – 8 Hz have been essentially observed by arrays belonging to the Swedish infrasound Network (SIN). These chirps have been attributed to certain types of discharges associated with the sprite formation. However, the characteristics of several chirps from the FIN: Southern and northern coasts of the Gulf of Bosnia were primarily different from the rest. The temporal and directional distribution of the phenomena is demonstrated. Also, long-term variably possible relation to the solar cycle is studied.

1. Introduction
Infrasonic chirps from sprites

- Hobara, 2004: Observed chirps in Sweden are from high altitude according to Ray-tracing calculation.
- Farges et al., 2005: Confirmation of infrasound chirps from red sprites from simultaneous observation of infrasound with the optical images (Euro sprites).

2. Possible generation mechanism of chirps from sprites

- Wave generation by drag due to charged particles.
- Expansion of the rapidly heated lightning channel.
- The drag due to the motions of the charged particles.

3. Search for chirps from sprites

- Scanning Market survey for simultaneous data record.
- Generating scalograms with 200 samples window (e.g. Fig. 3(a)).
- The source position is applied to analyze the data.

Chirp parameters calculated:
- Highest frequency (lowest dilation) - Minimum source altitude
- Lowest frequency (highest dilation) - Maximum source altitude
- Duration and slope
- Frequency of the chirp

For Jamton, the chirp may be formed at the upper branch due to increase of source altitude with decreasing the arrival angle from the north.
For Lycksele, the chirp was not observed because there is only the lower branch on the curve (Fig. 4(d)).

4. Case study on May 13, 2003

4.1. Infrasonic observation

- Observation results (Fig. 5(a)).
- The source position of the infrasound emission was determined (64.42 N 23.53 E, over the Gulf of Bosnia) by using the triangulation technique from signals from two different stations (Fig. 4(b)).
- The sharp front of cloud system is clearly identified near the infrasound source location (northern part of Gulf of Bosnia) according to the NOAA data around the observation time (Fig. 4(d) and 4(e)).

4.2. Results of the ray tracing

- The angle of incidence of the rays at the station.

5. Statistical study between 1994 and 2004

5.1. Search results

- Large number of events observed in Jamton
- Small number of events in Lycksele due to the higher background noise level.

5.2. Occurrence of chirps at Jamton

- Occurrence frequency of infrasound chirps may be anti-correlated with the degree of solar activity (indicated by the sunspot numbers).
- Occurrence frequency of chirps at a very low and the sunspot numbers high in 1999.

5.3. Arrival angles of chirps at Jamton

- Arrival angle decreases with increasing frequency.
- At the maximum cross-correlation, the source position of the chirp (number of samples) - Maximum source altitude

5.4. Chirp parameters

- Chirp phenomenon is sensitive to the infrasound propagation across the complicated wind system.

5.5. Summary

- Ray tracing results indicate that the formation of the infrasound chirp depends on the propagation from high altitude source to the observer against the background wind direction.
- The sharp front of cloud system over the Gulf of Bosnia being capable of generating parent lightning discharge for the red sprite.

References