Discrimination of precursory seismo-electric fields from lightning's fields

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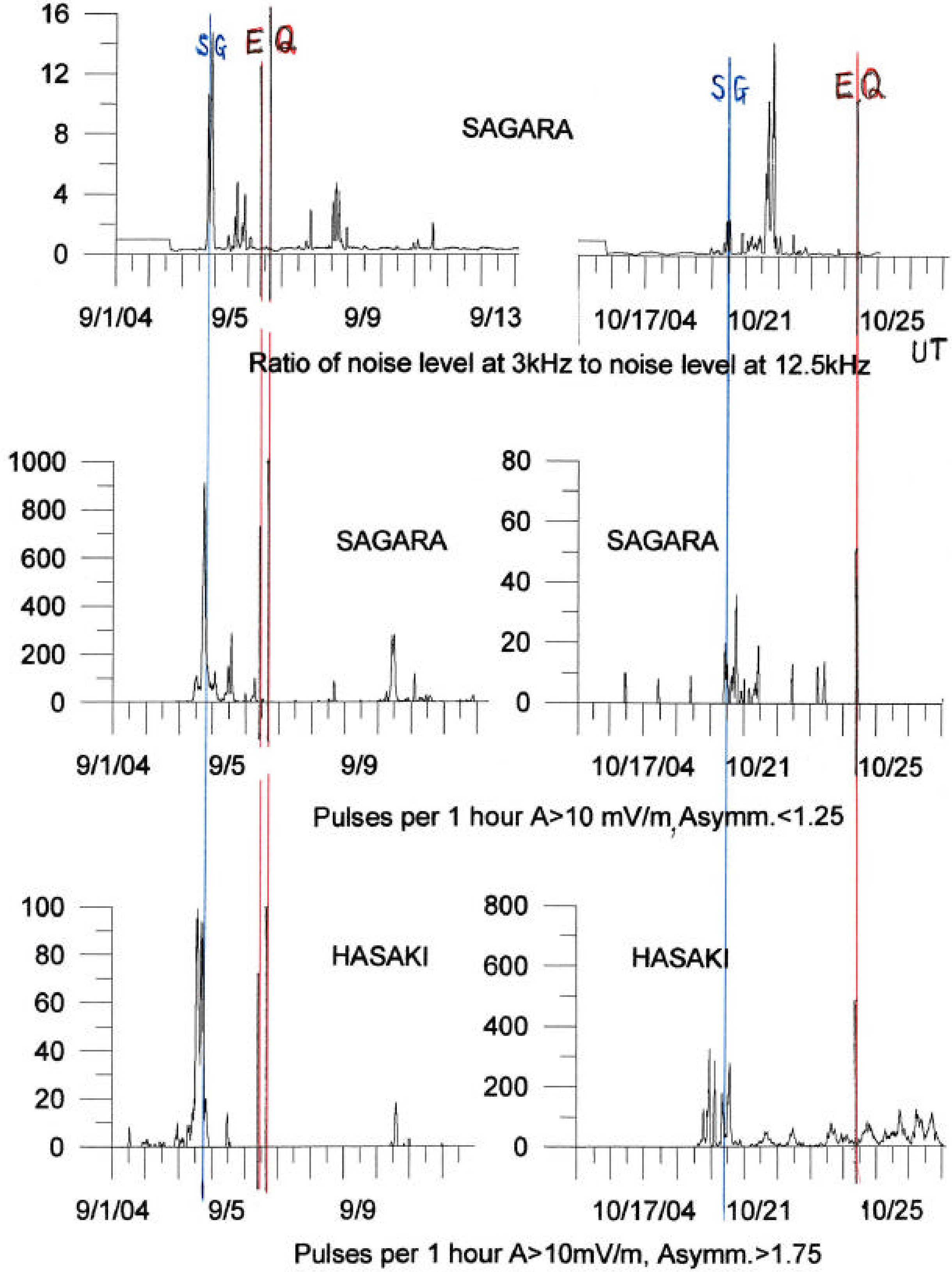
Introduction: Since more than fifty years ago, it has been well-know that radio noise is observed before earthquakes near the source regions. So, observing precursory electric fields will be the best method for predicting the earthquake, but the prediction was difficult, because of no method for discriminating the precursory fields (signal) from lightning's fields (noise), which are main natural noise. Recently we invented the method of discrimination.

Principle and method: Lightning's fields usually have the maximum intensity in the band from 3 to 10 kHz, and are relatively strong in the band from 100 Hz to 1 MHz. Within this band, the frequency from 1 to 3 kHz absorbs heavy attenuation loss where the wave is propagated through the ionosphere over long distance. The spectrum of lightning's fields and propagation loss make the fields of distant lightning maximum at around 12.5 kHz.

The spectrum of precursory seismic fields is thought to be inversely proportional to frequency, and to find the fields usually the earth potential has been observed, which is easily to observe but affected by rainfall, under water and electrodes. In the atmosphere, the observation has little such defects but is affected by power, i.e. by 50/60 Hz and the harmonics. Considering that eliminate many harmonics is difficult and that distant lightning's fields are attenuated at the frequencies from 1 to 3 kHz, these frequencies will be optimum to observe the precursory fields near source region. When we divide the fields of 1 - 3 kHz by those of 12.5 kHz, the quotient will least be affected by distant lightning, and will discriminate the precursory fields, which are generated at a near site, from the fields of distant lightning. Namely, when we receive the fields of 1 - 3 kHz, and the quotient is larger than 1, then the source of the fields is not distant lightning but is probably within 500 km from the observation site. Although the quotient of distant lightning approaches to zero, the quotient of near lightning does not approach to zero, though is usually smaller than 1. When the fields of 1 - 3 kHz are extremely large, and the quotient is smaller than 1, then the fields are probably generated by near lightning. Namely, we can discriminate the precursory fields from lightning fields. When we observe the fields of 1 - 3 kHz, which are within some bounded values, and of 12.5 kHz, and when the quotient is larger than 1, the fields are probably precursory ones, where the artificial noise is negligible.

Observations: Attached figures show the results observed at the sites of Sagara (34.41 deg. N, 138.11 deg. E) and of Hasaki (35.83 deg. N, 140.73 deg. E), when the earthquakes occurred, which are SE Off Kii Peninsula Eq. (04/09/05 14:57 UT, M:7.3, Depth:43.5km) and Mid Niigata Pref Eq. (04/10/23 08:56 UT, M:6.8, Depth:13.1km). At Sagara the signal occurred at 1.8 days before SE Off Kii Eq., and the record at Hasaki also shows the signal with which the signal at Sagara is synchronized. The distances from Sagara and Hasaki to the source region are 196 km and 446 km, and Sagara is nearly on the line joining the source and Hasaki. Namely, 1.8 days before SE Off Kii Eq., the synchronized signals were observed at two sites at the distance of 250 km. At 4 days before Mid Niigata Pref Eq., the signal also occurred at Sagara, which is synchronized with the signal at Hasaki. The source distances are 296 km and 232 km.

Concluding Remarks: Though at the observation sites, the seismic intensity (SI: according to the Japanese scale of zero to seven) were 3 or less, the discrimination method could detect and eliminate the lightning's fields. So, the method will be effective for predicting earthquakes.


SG
EQ
SAGARA
9/1/04
9/5
9/9
9/13
10/17/04
10/21
10/25
UT
Ratio of noise level at 3kHz to noise level at 12.5kHz
SAGARA
SAGARA
Pulses per 1 hour A>10 mV/m, Asymm.<1.25
HASAKI
HASAKI
Pulses per 1 hour A>10mV/m, Asymm.>1.75