Seismo-atmospheric effects

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ABSTRACT

The perturbation in the atmosphere in association with earthquakes have been reviewed. First, we present some experimental evidence on seismo-atmospheric perturbations on the basis of the reception of over-horizon VHF signals, and then we discuss the change in lighting characteristics due to the atmospheric conductivity change associated with earthquakes.

SEISMO-ATMOSPHERIC EFFECTS

This report is concerned with the review of the atmospheric effect associated with seismic activity (so-called seismo-atmospheric effect in this paper). There have been reported a few possible seismo-atmospheric effects; (1) Seismo-atmospheric effect as revealed from the over-horizon VHF radio reception, (2) modification of lightning activity due to the atmospheric conductivity change in association with earthquakes and (3) ULF/ELF emissions observed in Japan, possibly associated with the Taiwan Chi-chi earthquake. Each of these will be reviewed in the talk.

The possible reception of over-horizon VHF radio signals from a FM transmitter is observed on abnormal situations (probably in close association with earthquakes). The anomalous signal reception seems to be associated with earthquakes, and such reception takes place about 7 to 0 days before an earthquake. The direction finding measurements have indicated that such signals are due to favorable tropospheric (but not ionospheric) conditions attributed to the effects of earthquakes.

Next we discuss a mechanism of possible influence of pre-seismic activity on the rate of natural ELF-VLF pulses. The main idea is as follows. Distribution of the electric field around a thundercloud depends on the conductivity profile of the atmosphere. Quasi-static fields decrease in the regions with enhanced air conductivity, because air conductivity may grow due to pre-seismic gas and water releases into atmosphere. Then, the electric field becomes reduced in the lower section of troposphere, and the probability decreases of the cloud-to-ground stroke in such ‘contaminated’ area. Simultaneously, the field grows inside and above the thunderclouds, and hence the number of horizontal and tilted inter-cloud (or intra-cloud) strokes will grow. Spatial redistribution of lightning strokes reduces their individual amplitudes, while the rate (median number strokes per a unit time) of discharges grows. We demonstrate that transformation of strokes modifies the spectral content of ELF-VLF radio noise and changes the rate of detected pulses.

Finally, we discuss the ULF/ELF emissions observed in Japan, possibly associated with the Taiwan Chi-chi earthquake. A careful comparison with the nearby lightning as detected in VLF enables us to confirm that the abnormal ELF noise level (a few hours before the Chi-chi earthquake) is not due to the nearby lightning. The phase difference of those ELF/ULF emissions (Bx, By) was measured, which indicates that those emissions are linearly polarized, suggesting that they have propagated in the subionospheric waveguide over long distances. The direction finding confirms this.

REFERENCES

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