Seismo-atmospheric and – ionospheric perturbations as detected by radio probing

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This review is mainly concerned with the seismo-atmospheric and -ionospheric perturbations as detected by radio probing. It is recently known that the atmosphere and ionosphere are perturbed in possible association with earthquakes, and we present our latest results on these subjects. Two problems are dealt with in this review; (1) Anomalous Schumann resonance effect observed in Japan, in association with earthquakes in Taiwan, and (2) subionospheric VLF/LF probing of the seismo-ionospheric perturbations (event studies and a statistical study).

The Schumann resonance phenomenon has been monitored at Nakatsugawa (near Nagoya), Japan since the beginning of 1999, and we have found a very anomalous effect our Schumann resonance data possibly associated with two large land earthquakes in Taiwan (Chi-chi and Chia-yi earthquakes). The anomaly is characterized mainly by the unusual increase in amplitude of the fourth Schumann resonance mode and a significant frequency shift of its peak frequency. The data over five years have been further examined, which has yielded that all of the land earthquakes in Taiwan resulted in the similar anomaly in Nakatsugawa. The mechanism will be discussed in details in terms of the wave interference effect.

Next we discuss the seismo-ionospheric perturbations. First of all, two large earthquakes (2004 Niigata earthquake and Sumatra earthquake) are examined to study the corresponding seismo-ionospheric perturbations. Clear pre-seismic ionospheric perturbations have been found on the basis of fluctuation method. In addition to these event studies, we have also performed a statistical analysis on the correlation between the ionospheric perturbation and earthquakes. We have found significant correlation of ionospheric perturbations (amplitude and dispersion) with large earthquakes with magnitude greater than 5.5 on the basis of the LF data between the JJY (40kHz) transmitter and an observing station, Kochi. Both of these case studies and the statistical study have yielded further convincing evidence on the presence of seismo-ionospheric perturbations.