

Lower ionospheric perturbations associated with earthquakes, as detected by subionospheric VLF/LF radio signals

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It is recently recognized that the ionosphere is very sensitive to seismic effects, and the detection of ionospheric perturbations associated with earthquakes (EQs), seems to be very promising for short-term EQ prediction. We have proposed a possible use of VLF/LF (very low frequency (3-30 kHz) /low frequency (30-300 kHz)) radio sounding of seismo-ionospheric perturbations. We first provide a brief history (mainly Russian results) of the use of subionospheric VLF/LF propagation for the study of ionospheric perturbations associated with EQs. Then, a convincing evidence on the ionospheric perturbation for the disastrous Kobe EQ in 1995, has been obtained by means of a new analysis method based on the terminator times in the VLF/LF diurnal variation. Next, we present our latest results on seismo-ionospheric perturbations. As the first results, we present a few statistical studies on the correlation between VLF/LF propagation anomaly and EQs on the basis of long-term data. As the second step, we present case studies for a few recent large EQs (including Niigata-Chuetsu EQ, 2004 Sumatra EQ etc.). Finally, we describe some experimental facts closely related with the mechanism of lithosphere-atmosphere-ionosphere coupling (or how the ionosphere is perturbed due to the lithospheric activity).