



The presence and structures of ionospheric perturbations associated with the 2004 Sumatra earthquake, as seen from ground- and satellite-based VLF transmitter signals.

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The presence of ionospheric perturbations associated with the 2004 Sumatra earthquake (December 26, 2004, M=9.0) has been studied on the basis of ground-based observation of an Australian VLF transmitter (frequency= 19.8 kHz) at a few Japanese receiving stations and also the in-situ observation of the same VLF transmitter whistler-mode signals on the satellite, Demeter. VLF ground observations at a few stations (Kochi, Chofu and Chiba) have indicated the VLF anomalies (in the sense of enhanced nighttime fluctuations) on December 8 and on several days after December 21. Especially, the latter one has a much more global character, which is believed to be a precursor to the earthquake. The statistical study on the Demeter has also indicated the precursory evidence on the presence of ionospheric perturbations in the form of whistler-mode signal depletion in the ionosphere before the earthquake. The spatial scale of the ionospheric perturbation from both studies is found to be a radius of ~ 2.5 Mm. Then, we have found wave-like structures in the ground-based VLF data. The detailed analyses by using the wavelet, time delay or so of such wave-like structures have enabled us to estimate the propagation velocity, and we finally conclude that this

observation would be the 1st convincing evidence on the important role of atmospheric gravity waves in the lithosphere-ionosphere coupling.