

## VLF radio signal propagation anomaly associated with strong earthquakes from joint observations from the ground and space based observations

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The VLF radio signals recorded both from the ground based VLF radio wave monitoring network and the DEMETER is investigated during the 2010 Ms 7.1 Yushu earthquake. The ground-based observations show that the disturbance intensity of VLF wave's amplitude relative to the background gets an enhancement over 22% at 11.9 kHz, 27% at 12.6 kHz and 62% at 14.9 kHz VLF radio wave along the path from Novosibirsk - TH one day before the main shock, as compared to the maximum 20% observed during non-earthquake events. The space based observations indicate that there is a decrease of the signal to noise ratio (SNR) for the power spectral density data of 14.9 kHz VLF radio signal at electric field four days before the main shock, with disturbance intensity exceeding the background by over 5% as compared to the maximum 3% observed during non-earthquake events. The geoelectric field observations in the epicenter region also show that a sharp enhancement from ~ 340 to 430 mV/km simultaneously appeared at two monitors 14 days before main shock. The comparative analysis from the ground and space based observations during the earthquake and non-earthquake time provides us convincing evidences that there are seismic anomalies from the VLF radio wave propagation before the 2010 Ms 7.1 Yushu earthquake. The possible mechanism for VLF radio signal propagation anomaly during 2010 Yushu earthquake maybe related to the change of the geoelectric field nearby the earthquake zone.

Keywords: VLF radio signal, ground based observation, space based observation, earthquake