

The novel MVP-LAI system and nighttime TEC perturbation amplifications before earthquakes

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Abstract

A novel system of Monitoring Vibrations and Perturbations in the Lithosphere, Atmosphere, and Ionosphere (MVP-LAI) was established in Leshan, Sichuan, China in 2021. The system comprises 14 distinct instruments with 22 devices continuously monitoring changes in 14 geophysical parameters ranged between a few meter underground to ~ 350 km in altitude to examine and/or expose causal mechanisms of the LAI couplings. Note that the ground-based GNSS receivers of the system receive the electromagnetic signals from the geostationary BeiDou satellites that retrieve the total electron content over certain locations 24×7 without montage. Significant amplifications of TEC perturbations appear during the night since mid-May 2021. The M6.4 Yunnan and M7.4 Qinghai earthquakes occurred in Mainland China on 21-22 May 2021. The amplifications are related with the two earthquakes due to that the associated TEC perturbations reside over the epicenters. The resident TEC perturbations and ground vibrations close to the epicenters share a frequency of ~ 0.005 Hz, which can be attributed to the resonant coupling between the lithosphere and ionosphere.



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The novel **MVP-LAI** system and nighttime TEC perturbations amplifications before earthquakes

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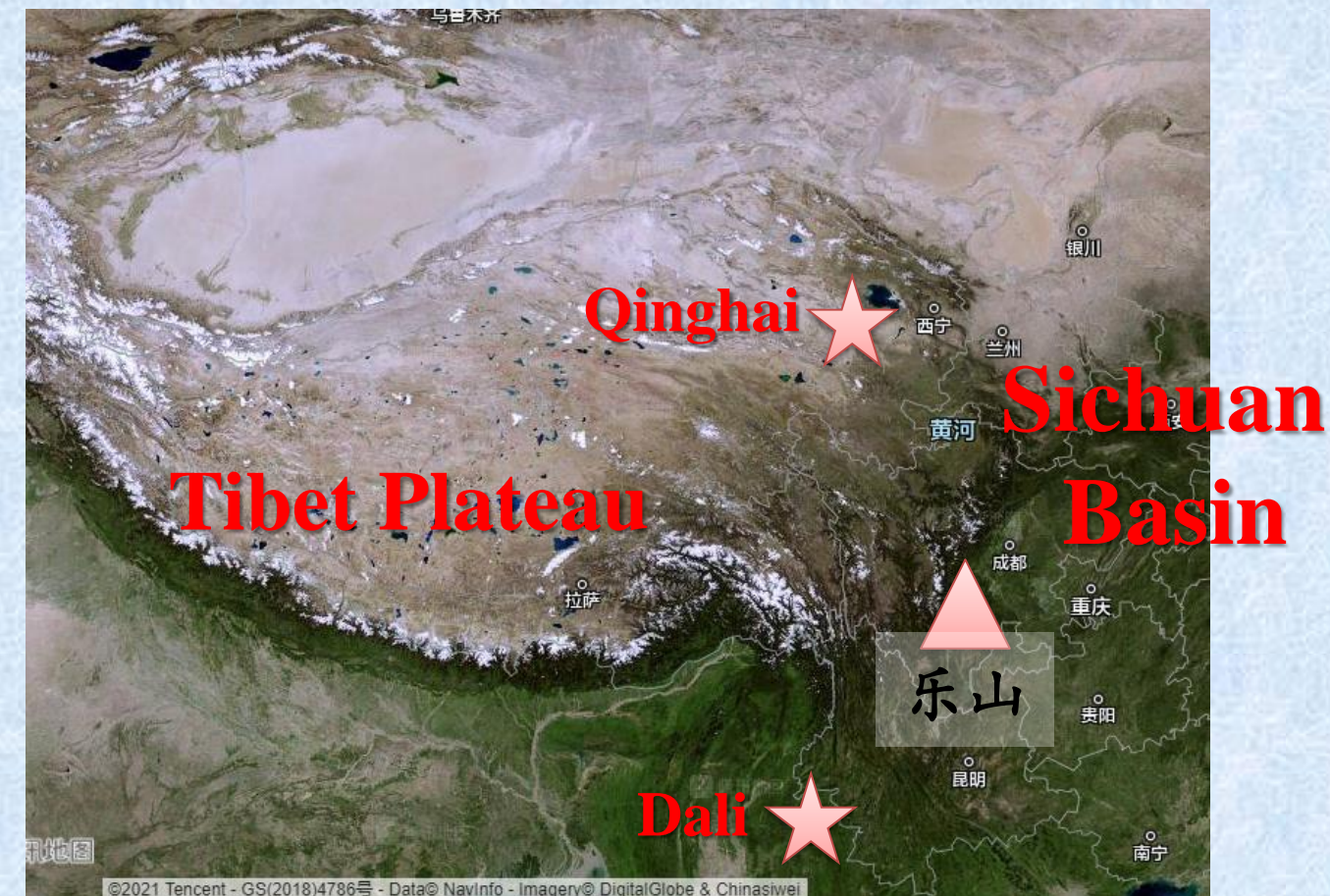
³China Earthquake Administration, China



Abstract

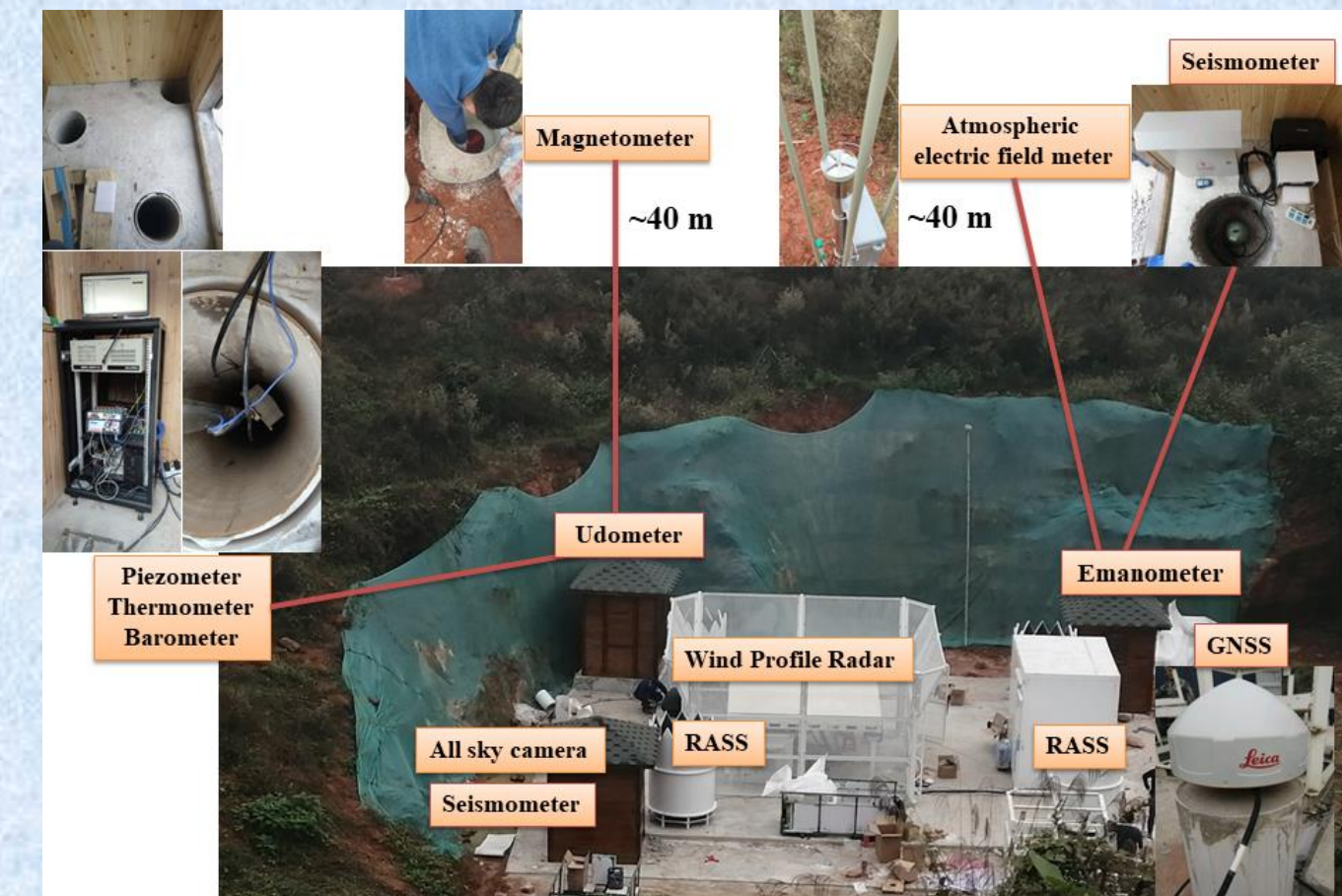
A novel system of **Monitoring Vibrations and Perturbations in the Lithosphere, Atmosphere, and Ionosphere (MVP-LAI)** was established in Leshan, Sichuan, China in 2021. The system comprises 14 distinct instruments with 22 devices continually monitoring changes in 14 geophysical parameters ranged between a few meter underground to ~350 km in altitude to examine and/or expose causal mechanisms of the LAI couplings. Note that the ground-based GNSS receivers of the system receive the electromagnetic signals from the geostationary BeiDou satellites that retrieve the total electron content over certain locations 24×7 without montage. Significant amplifications of TEC perturbations appear during the night since mid-May 2021. The M6.4 Yunnan and M7.4 Qinghai earthquakes occurred in Mainland China on 21-22 May 2021. The amplification is related with the two earthquakes due to that the TEC perturbations reside over the epicenters. The resident TEC perturbations and ground vibrations close to the epicenters share a frequency of ~0.005 Hz, which can be attributed to the resonant coupling between the lithosphere and ionosphere.

Why Leshan (乐山)



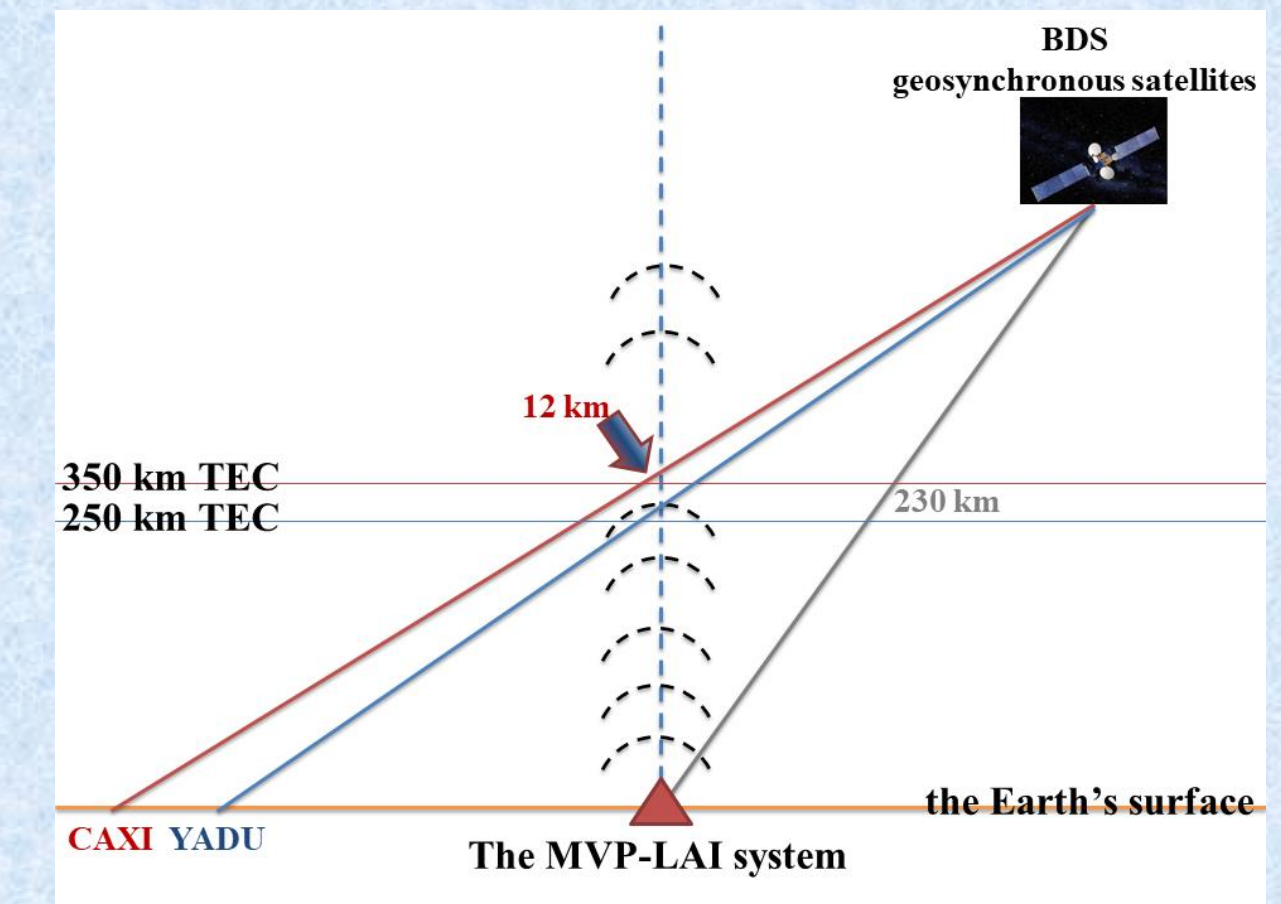
Obvious difference of **3000 m** in altitude between the Sichuan Basin and the Tibet Plateau

How many distinct instruments



We have more than **14** distinct instruments for monitoring > 20 geophysical parameters

What's new for TEC observations



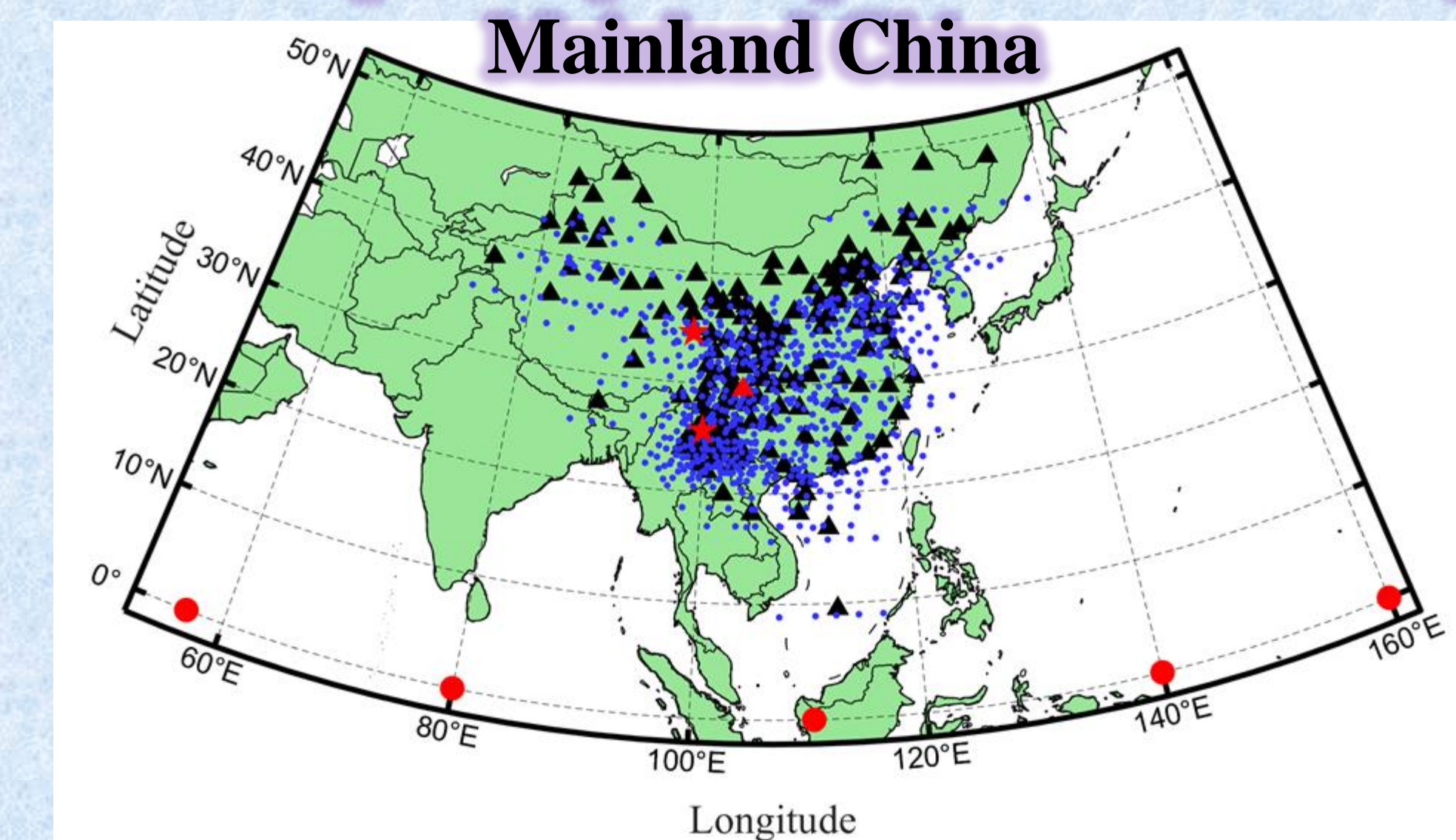
The BeiDou geostationary satellites are utilized for the monitoring TEC over certain locations **24-7 without interruption**

Chen, C.-H., Sun, Y.-Y., Lin, K., Zhou, C., Xu, R., Qing, H., Gao, Y., Chen, T., Wang, F., Yu, H., Han, P., Tang, C.-C., Su, X., Zhang, X., Yuan, L., Xu, Y., Liu, J.-Y., 2021. A new instrumental array in Sichuan, China, to monitor vibrations and perturbations of the lithosphere, atmosphere and ionosphere. *Surveys in Geophysics*. doi: 10.1007/s10712-021-09665-1.

Find data at <http://geostation.top>

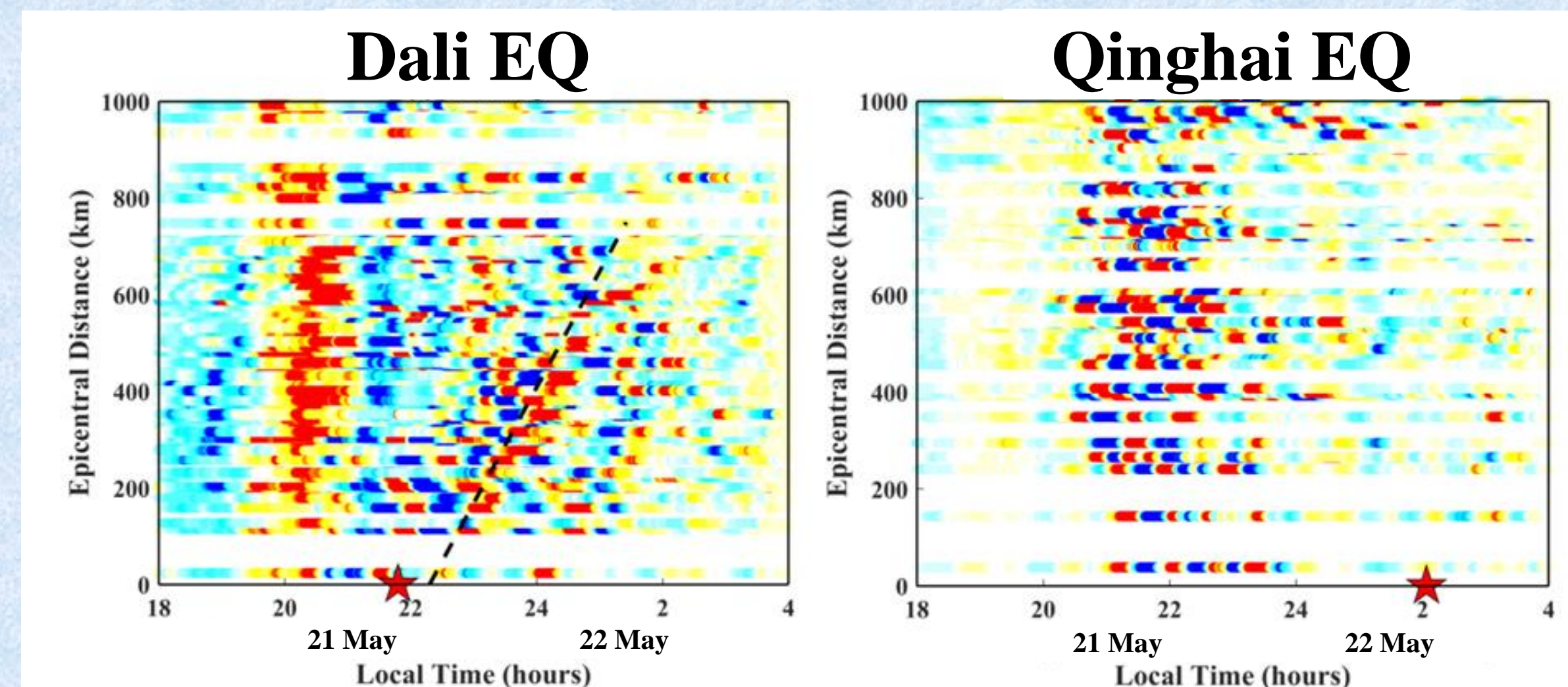
Novel anomalous phenomena before the two major earthquakes

170 ground-based GNSS receivers monitor 850 ionospheric pierce points well covering Mainland China



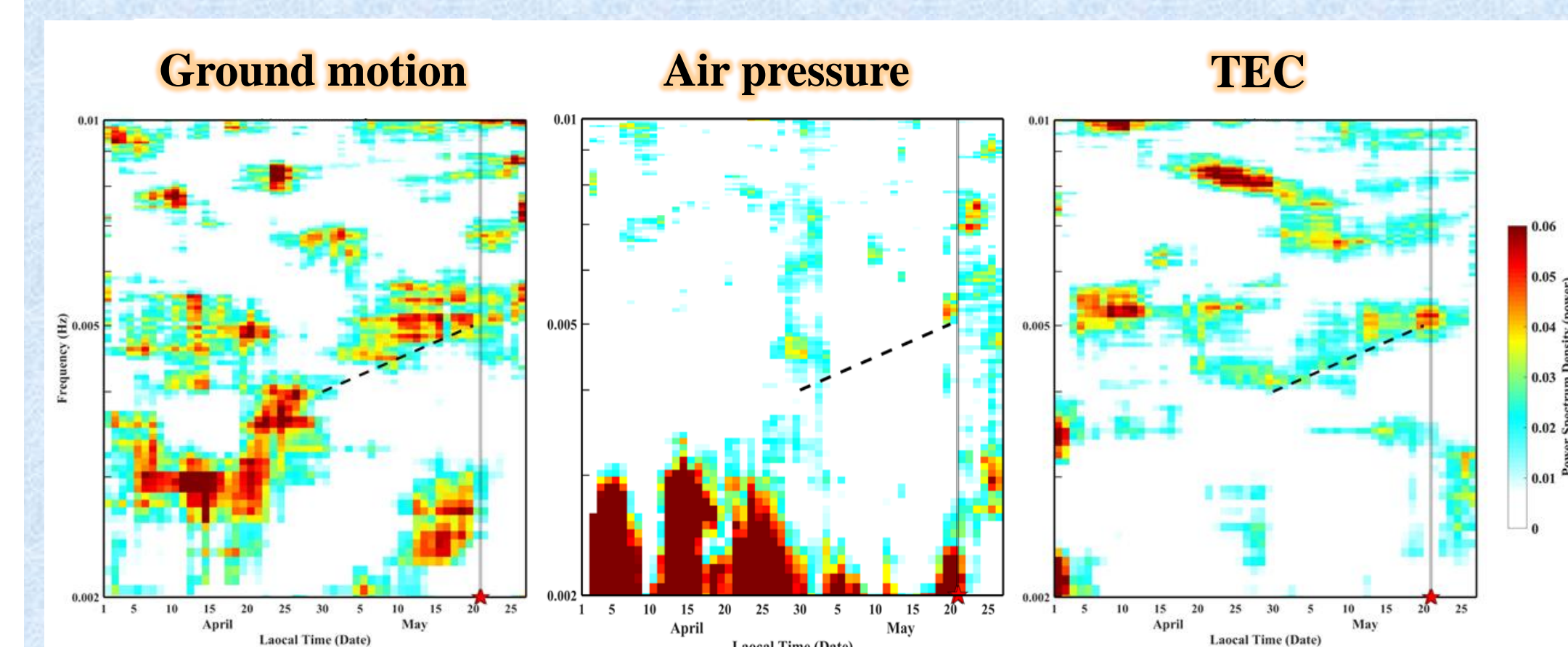
The locations of ground-based GNSS receivers. **▲**: the ground-based receivers. **●**: the ionospheric pierce points. **●**: the five geostationary satellites (C01-C05). **★**: the epicenters of the M6.1 Dali and M7.3 Qinghai earthquakes. **▲**: the location of the **MVP-LAI system**

TEC perturbations reside over the epicenters of the two earthquakes



The TEC perturbations within 1000 km from the epicentres of the Dali and Qinghai earthquakes, between 18:00 local time on 21 May and 04:00 local time on 22 May, respectively.

Ground motion, TEC perturbations and air pressure share a frequency of ~5 mHz



The frequency of ~5 mHz simultaneously observed in the lithosphere, atmosphere and ionosphere suggests that the resonance dominates the seismo-anomalies during M6.1 Dali and the M7.3 Qinghai earthquakes.