Coseismic-Ionosphere Disturbances and Seismo-Ionospheric Precursors

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Ground-based observations of the GNSS (global navigation satellite system) TEC (total electron content) and satellite sounding of GNSS radio occultation (RO) as well as in situ satellite plasma probing are employed to study the co-seismic ionospheric disturbances (CIDs) and seismo-ionospheric precursors (SIPs). The horizontal propagation of CIDs induced by tsunami and seismic waves can be detected by the TEC of ground-based GNSS receivers, while the associated vertical propagation can be sensed by satellite RO sounding. A complementary system for tsunami early warning using ground-based GNSS receivers is proposed. On the other hand, the GIM (global ionosphere map) of ground-based GNSS TEC is applied to search temporal and spatial SIPs of earthquakes. A spatial analysis can be applied to detect SIPs and locate forthcoming large earthquakes. In situ satellite plasma measurements are further employed to three-dimensionally observe SIP structures/dynamics and find possible causal mechanisms. Here, the first results in ionospheric space weathers of plasma depletion bays and non-migrating tides as well as plasma disturbances of SIPs and an intense magnetic storm probed by CSES (China seismo-electromagnetic satellite) are briefed.