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Effect of magnetic storm on the state of pre-seismic ionosphere

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The analysis of the ionospheric total electron content (TEC) variations obtained by using the GPS measurements before Hokkaido earthquake of September 25, 2003 (M8.3) is presented. It are used both the observation of Japanese GPS stations and global TEC maps created at the IONEX format to estimate the spatial scale of ionospheric irregularities associated with this earthquake and possible geomagnetic storm influence on the pre-seismic plasma anomaly. The pre-seismic behavior of TEC was detected within several days before the main event. Anomaly appeared as the local TEC enhancement (plasma cloud) located in the vicinity of the forthcoming earthquake epicenter. These structures are generated in ionosphere at the similar local time during 5 days prior to the main shock. During the process of the earthquake approach the amplitude of plasma modification was increased, and it has reached the 85-90% of non-disturbed level at around 18 hours before the Hokkaido earthquake. The ionosphere region of strong positive disturbance has extended larger than 1500 km in latitudes and 4000 km in longitudes. It is shown that according to its main parameters (locality, affinity with the epicenter, dome-shaped zone of manifestation and time of existence) the detected ionospheric plasma anomaly may be associated to the future seismic activity. It is necessary to mention that geomagnetic storm took place one day prior to the main shock and usually it is appeared at ionosphere as global disturbance (or ionosphere storm). In our case the formation of local positive ionosphere modification become manifest during the period of 5 days preceding the earthquake, i.e. we can observe the storm influence on the TEC variations only for the day of earthquake

and one day before to it. It is shown that the general pattern of spatial-temporal TEC variations can be presented as superposition of ionospheric storm effects and the ionosphere anomaly of seismogenic origin. As result, the intensification of the pre-seismic plasma anomaly due to magnetic storm action became visible at ionosphere 18 hours before Hokkaido earthquake.