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Recent studies have reported unusual behaviors of geomagnetic diurnal variation (GDV) in the vertical component prior to the 2011 off the Pacific coast of Tohoku earthquake (Mw 9.0). To make a better understanding of this phenomenon, time-spatial analysis of GDV has been applied in this study. Geomagnetic data of long term observations at 17 stations in Japan have been analyzed using the same method in Han et al. 2015. Ratios of diurnal variation range between the target station and the reference station KAK have been computed. After removing seasonal variations revealed by wavelet transform analysis, the 15-day mean values of the ratios in the vertical component shows a clear anomaly exceeding the statistical threshold about 2 months before the mega event in both ESA and MIZ stations in the Tohoku Region. Similar results could not be found in other regions of Japan. Spatial distributions of the ratios show a good agreement between the location of the anomalies and the epicenter of Mw 9.0 earthquake. These time-spatial results seem to be consistent with independent results obtained from other observations such as radon density, seismicity, and GPS displacements, which suggest the geomagnetic data might be useful in earthquake monitoring and disaster mitigation.

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