



Possible correlations between the pre-seismic anomalous behaviour of the electromagnetic parameters and the extreme seismic events; Case study: M9 Great Tohoku earthquake on March 11, 2011

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The geomagnetic data collected at the Memambetsu and Kakioka observatories, on the interval 01 August 2010-31May 2011, have been retrospectively analyzed to confirm the relationship between the pre-seismic anomalous behavior of the electromagnetic parameters (normalized function B_{zn} and R_n) and M9 Great Tohoku earthquake on March 11, 2011. The daily mean distributions of the both $B_{zn} = B_z/B_{perp}$ (where: B_z is vertical component of the geomagnetic field; B_{perp} is geomagnetic component perpendicular to the strike orientation) and $R_n = R_{par}/R_z$ (where: R_{par} is resistivity parallel to strike; R_z is vertical resistivity), together with their standard deviation (SD) are performed in the frequency range (0.001Hz to 0.016Hz) by the use of the FFT band-pass filter analysis. In pre-seismic conditions, the B_{zn} has a significant enhancement due to the crustal resistivity changes, possibly associated with the earthquake-induced rupture-processes and fluid flow through the faulting system developed inside the foci and its neighboring area. After analyzing the both B_{zn} and R_n anomalous values obtained at Memambetsu and Kakioka observatories, the second one taken as reference, by using a standardized random variable equation, a pre-seismic peak greater than $2.5SD$ related to the M9 Tohoku earthquake was identified on 5-6 February 2011. The lead time is 32 days before the M9 Tohoku earthquake occurrence. The final conclusion is that the proposed electromagnetic methodology might provide some suitable information for extreme earthquake hazard assessment.