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Wavelet-Based Approach to Study Coherence of the ULF Vector Fields

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The work is devoted to numerical analysis specially adapted for multi-point detection of geomagnetic events, which precede or accompany the earthquakes. Both numerical simulated data and geomagnetic perturbations during real earthquakes were investigated. The objective of this paper is to provide a detail application of the correlation properties of the ULF fields on small distances in seismoactive zone of Japan. By applying a combination of Fourier, Hilbert and wavelet transforms to single components and their combinations we developed five correlation techniques and analyzed the geomagnetic variations at 5 observation points for two-year permanent observations. Two main problems: correlation properties of the field before an earthquake and a coherency of geomagnetic pulsations launched by the earthquake already taken place are considered for two-year permanent observations. Five different coherency criteria have been examined: 1. the cross correlation function; 2. semblance; 3. in-phase; 4. s; and 5. frequency stability criterion. We found that the time of detection of a signal by using cross correlation, semblance and in-phase criteria are much more stable compared to the signal kernel interval but the determination of the time shift is relatively unstable. This algorithm allows detecting even a weak signal when the ratio signal/noise ~ 3. The carried study revealed anomaly signals in the period range from 15 min to 1.5 hour independently at all observatories. The signature of the anomaly signal is a wave train usually consisting of 2-3 of pulses which appears 3-4 hours and 8h prior to the earthquake time if we study correlations within 90km radius. Intensity of the signals is around 0.5 - 1 nT .