

Application of wavelet transform to EQ-echo records and its effect

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We have been documenting anomalous VHF-band radio-wave propagation beyond the line of sight prior to earthquake since 2002 in Hokkaido area. These records have been documented as electric field intensity variations, and they include not only EQ-echoes which are shown as upward rapid drifts associated with impending earthquake but also other transient form records and high frequency noise. It is not appropriate to apply the Fourier transform to data including such variation because transient local changes in time domain data are transformed into overall feature in frequency domain. In contrast, the wavelet transform enable us to curb this influence to expansion and contraction of a mother wavelet. In this study, we applied band-pass filtering using the wavelet transform to the documented electric field intensity variation. As the results, we distinguished between high frequency noise components and intensity variation relating to EQ-echoes. It contributed clear detection of the EQ-echo especially to improve edge recognition to estimate duration time. Furthermore, we conducted frequency analysis for EQ-echoes associated with large earthquakes that occurred in Hokkaido and found that high frequency components of waveform were attenuating in the EQ-echo associated with the southern Rumoi sub-prefecture earthquake (M6.1) of 2004. This feature appeared in this record only and may characterize as long-distance propagation. We also analyzed frequency characteristic EQ-echos observed at Erimo and Fuyushima observation points simultaneously as a precursor of Hidaka earthquake (M4.7) of 5 April. It is rare and important case that EQ-echos associated with same earthquake are observed at multiple sites simultaneously. The frequency characteristics of these records probably reflect characteristics of transmission pass and scattering material.