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A Multiple Algorithm Approach to the Analysis of GNSS Coordinate Time Series for Detecting Geohazards and Anomalies

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In this research, a multiple algorithm approach to the analysis of GNSS coordinate time series for detecting geohazards and anomalies was developed. This multiple algorithm approach includes the novel use of spatial, temporal and a combined (temporal and spatial) analysis. In the spatial analysis algorithm, the spatial autoregressive model was used, assuming that the GNSS coordinate time series from a network of stations are spatially dependent, while in the temporal analysis algorithm, it is assumed that the GNSS coordinate time series of a single station is temporally dependent and an Artificial Neural Network is used to extract this dependency. Then, in the combined analysis algorithm, a combination of the spatial analysis and temporal analysis algorithms was used. This multiple approach was examined using: (i) the GEONET network of GNSS stations in Japan in relation to the Tohoku-Oki 2011 Mw9.0 earthquake; (ii) the BIGF network of GNSS stations in the British Isles. It can be concluded from these case studies that this multiple algorithm approach can be used to detect the effect of a geohazard (e.g. earthquake) on the GNSS coordinate time series of a network as well as anomalies in the GNSS coordinate time series of a network. The spatial analysis algorithm showed more suitability for detecting coordinate offsets in the low-frequency component and trend problems (e.g. velocity changes) in the GNSS coordinate time series. However, it is vulnerable regarding sudden large coordinate offsets (e.g. earthquakes) as the effects at one station propagate to nearby stations. In contrast, the temporal and combined analysis algorithms detect coordinate offsets in the high-frequency component which makes them effective in detecting sudden large coordinate offsets in the GNSS coordinate time series.