A Network Strain Filter- A new tool for detection and monitoring of transient crustal deformation from GPS array data -

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We developed a new tool for automated detection and monitoring of transient signals from large-scale continuous geodetic arrays, which is referred to as a Network Strain Filter. The Network Strain Filter models geodetic time series as a sum of contributions from tectonic deformations (which have correlation among stations), site-specific local benchmark motion and white noise (which do not have correlation among stations), and reference frame errors. The underlying principle is to exploit the spatially coherent signals from a whole network, which can be done by expanding the spatial variation of tectonic deformation with a wavelet basis, and estimate the time-varying coefficients using Kalman filtering techniques along with other contributions.

With this formulation, it enables us to process data from whole networks simultaneously and leads to detect spatially coherent transient signals automatically, which may be due to aseismic slip on faults and/or magmatic intrusion. We applied the Network Strain Filter to data from GEONET (GPS Earth Observation NETwork) for the case where a slow event was observed at stations around the Boso Peninsula in 1996. The Network Strain Filter successfully depicts the strain rate changes in time and space associated with the event, which can be automatically and visually accomplished. The feature provides a useful method for automated, routine-based monitoring of crustal deformation for large-scale GPS arrays, where visual inspection of individual time-series is too much burden to detect transient signals.