Development of a new method for monitoring and detecting transient deformation signals in dense geodetic arrays

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Data from large-scale continuous GPS arrays have revealed transient signals caused by aseismic fault slip and magmatic intrusion. It is almost certain that more subtle signals due to smaller magnitude events exist. But the huge amount of data from large GPS arrays makes it difficult to search for time varying processes by eye. Hence, automated methods to detect transients are urgently required.

We developed a time-domain based filtering method to detect crustal deformation-related signals in data from large geodetic arrays, which we refer to as a Network Strain Filter (NSF). In NSF, we use Kalman filtering techniques and wavelet functions to search for spatially and temporally coherent signals in data from dense arrays to find transients.

We carried out simulations to test the performance. Results show that the recovered displacement field agrees well with the input transient. We also applied the method to the data observed by GEONET during the 1996 Boso off slow earthquake event and found that NSF could detect the transient as deviation from steady state deformation. These results demonstrate the capability of the NSF to detect and monitor transient deformation.