Geophysical Research Abstracts
Vol. 16, EGU2014-5540, 2014
EGU General Assembly 2014

Jumps in GNSS coordinates time series, a simple and fast methodology to clean the data sets

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GNSS coordinate time series often suffer from the presence of undesired offsets of different nature which may impair the reliable estimation of the long-period trend and that should be corrected in the original data sets. Examples of such discontinuities are those originated by earthquakes, monumentation problems, replacement/maintenance of the station equipment, change of the reference system and by a number of unforeseen events. We have developed an automated and fast data inspection procedure for estimating the time of occurrence and the magnitude of the jumps and for correcting the time series accordingly. These processing characteristics are important because many time series are now spanning almost two decades, and dense GNSS networks are becoming a reality. The procedure has been developed and tailored to GNSS data sets starting from the Sequential T-test Analysis of Regime Shifts (STARS) originally conceived by Rodionov (Geophys. Res. Lett., 31, L09204, 2004) in the context of climatic studies.

This technique does not make any a priori assumption on the time of occurrence and on the magnitude of the discontinuities. A jump is detected and its magnitude estimated when, over two consecutive time windows of the same length, the mean value exhibits a statistically significant change. Three user-defined parameters are required: the cut-off length, L, representing the minimum time interval between two consecutive discontinuities, the significance level, p, of the exploited two-tailed Student t-test, and the Huber parameter, H, used to compute a weighted mean over the L-day intervals.

The method has been tested on GPS coordinates time series of stations located in the southeastern Po Plain, in Italy. The series span more than 15 years and are affected by offsets of different nature. The methodology has proven to be effective, as confirmed by the comparison between the corrected GPS time series and those obtained by other co-located observation techniques such as VLBI and terrestrial measurements.