Step Discontinuity Detection in GPS time series

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We routinely use GPS station coordinate time series to measure tectonic strain accumulation and other geophysical processes in the Sierra Nevada and Great Basin (SNGB) of the western United States. While tectonic strain accumulation is ostensibly slow and steady, the GPS time series are punctuated by step discontinuities as well as other periodic and aperiodic transient signals of both known and unknown origin. To estimate the parameters of geophysical motion most accurately, all known non-geophysical effects must be identified and removed from the time series. The occasional abrupt discontinuities that appear in the time series are attributable to a number of equipment or system-related causes. We have developed an algorithm to automatically detect step discontinuities and to separate discontinuities due to equipment and software changes from those having geophysical causes. In order to identify those steps which are due to equipment changes, the algorithm retrieves metadata in International GNSS Service (IGS) log files available on the internet and correlates this information with automated step detection results. Examples of events listed in the log files are antenna and receiver changes. We have applied this algorithm to generate statistics on step distribution in several hundred time series across the SNGB. We examined several representative time series and found that there is great variability in the character of these individual series. After correcting for the effect of equipment-related changes, many unmodeled non-linear transients remain. Examples of these include rate changes (ramps) which cause the automated algorithm to detect spurious steps. We suggest modifications to the method which might alleviate these problems.