Geophysical Research Abstracts
Vol. 15, EGU2013-3200, 2013
EGU General Assembly 2013

A Bayesian approach to offset detection in GPS coordinate time series

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The accuracy of Global Positioning System (GPS) time series is degraded by the presence of offsets. Offsets may be caused by different phenomena (antenna swap, seismic event, ...) but some of them can not be explained and remain unpredictable. DOGEx (Detection of Offsets in GPS Experiment) results show that, at present, manual detection methods (where offsets are hand picked) almost always give better velocity estimates than automated or semi-automated methods. For instance, the 5th percentile range (5% to 95%) in velocity bias for automated approaches is equal to 4.2mm/year (most commonly $\pm$0.4mm/yr from the truth), whereas it is equal to 1.8mm/yr for the manual solutions (most commonly $\pm$0.2mm/yr from the truth). Moreover, the magnitude of offsets detectable by manual solutions is smaller than for automated solutions, with the smallest detectable offset for the two best manual and automatic solutions equal to 5mm and 7mm and to 8mm and 10mm, respectively.

Assuming the time series noise levels simulated for DOGEx are representative of real GPS time series, robust geophysical interpretation of individual site velocities lower than 0.2-0.4mm/yr is therefore certainly not robust although a limit of nearer 1mm/yr would be a more conservative choice.

In this work, the results of DOGEx are briefly discussed in order to motivate the introduction of an automatic detection procedure to estimate offset epochs and velocities from GPS time series. The detection algorithm based on a Bayesian approach handles the overall known properties of GPS time series, such as flicker noise, velocities, periodic signals and randomly occurring offsets. It not only provides an objective estimation of GPS velocities, but at the same time it allows for the consideration of a-priori information such as epochs of events which could cause offsets, or a-priori knowledge on the velocity of each sites. The flexibility, robustness and limitations of the approach are discussed by applying the method to simulated time series and to the Monte-Carlo method to test the accuracy of the procedure.