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Detecting multiple breaks in geodetic time series using indicator saturation.

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Identifying the timing and magnitude of breaks in geodetic time series has been the source of much discussion. Instruments recording different geophysical phenomena may record long term trends, quasi-periodic signals at a variety of time scales from days to decades, and sudden breaks due to natural or anthropogenic causes, ranging from instrument replacement to earthquakes. Records can not always be relied upon to be continuous in time, yet one may desire to accurately bridge gaps without performing interpolation. We apply the novel Indicator Saturation (IS) method to identify breaks in a synthetic GPS time series used for the Detection of Offsets in GPS Experiments (DOGEX).

The IS approach differs from alternative break detection methods by considering every point in the time series as a break, until it is demonstrated statistically that it is not. Saturating a model with a full set of break functions and removing all but significant ones, formulates the detection of breaks as a problem of model selection. This allows multiple breaks of different forms (from impulses, to shifts in the mean, and changing trends) without requiring a minimum break-length to be detected, while simultaneously modelling any underlying variation driven by additional covariates. To address selection bias in the coefficients, we demonstrate the bias-corrected estimates of break coefficients when using step-shifts in the mean of the modelled time-series. The regimes of the time-varying mean of the time-series (the 'coefficient path' of the intercept determined by the detected breaks) can be used to conduct hypothesis tests on whether subsequent shifts offset each other - for example whether a measurement change induces a temporary bias rather than a permanent one.

We explore this non-classical analysis method to see if it can bring about the sub millimetre errors in long term rates of land motion currently required by the GPS community.