Chameleonic noise in GPS position series: what is the true color of the GPS error spectra?

Alvaro Santamaría-Gómez¹ and Jim Ray²

¹GET, Université de Toulouse, CNES, CNRS, IRD, UPS, Toulouse, France (alvaro.santamaria@get.omp.eu)
²National Geodetic Survey (retired), Silver Spring, MD 20910, USA

Chameleonic: readily changing color or other attributes.

Chameleon: a lizard that changes skin color to match what surrounds it so that it cannot be seen.

The error spectrum of decadal long GPS position time series is typically represented by a combination of flicker (pink) noise at long periods and white noise at short periods. It is known that when fitting a linear trend to the series, part of the flicker noise at the longest observed period will be absorbed by the trend. Here, using real and synthetic GPS position series, we show how the error spectrum is even more altered by the position discontinuities that populate the series. The fitted position offsets at the discontinuity epochs absorb a significant portion of the power spectrum at periods longer than the separation between the discontinuity epochs. The resulting error spectrum is flattened at long periods and this implies that:

- the estimated content of colored noise is biased low and can even apparently change its color towards whiter noise, i.e. the true noise color is not observable due to the discontinuities,
- the red (random walk) noise, most probably present in the series in small quantity, becomes undetectable even if long series are used,
- the pink (flicker) noise is not the best color noise to represent the error spectrum in long series containing discontinuities,
- the colored noise content cannot be compared between series with different sets of discontinuities.

These findings need to be considered when comparing the noise levels between series from different solutions, networks or monuments. In particular, and contrary to a recently published recommendation, station operators should make every effort to avoid adding new discontinuities into their station time series if reliable velocity estimates are expected.