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Uncertainty estimation of the velocity model for the TrigNet GPS network

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Satellite based geodetic techniques – above all GPS – provide an outstanding tool to measure crustal motions. They are widely used to derive geodetic velocity models that are applied in geodynamics to determine rotations of tectonic blocks, to localize active geological features, and to estimate rheological properties of the crust and the underlying asthenosphere.
However, it is not a trivial task to derive GPS velocities and their uncertainties from positioning time series. In general time series are assumed to be represented by linear models (sometimes offsets, annual, and semi-annual signals are included) and noise. It has been shown that models accounting only for white noise tend to underestimate the uncertainties of rates derived from long time series and that different colored noise components (flicker noise, random walk, etc.) need to be considered. However, a thorough error analysis including power spectra analyses and maximum likelihood estimates is quite demanding and are usually not carried out for every site, but the uncertainties are scaled by latitude dependent factors.
Analyses of the South Africa continuous GPS network TrigNet indicate that the scaled uncertainties overestimate the velocity errors. So we applied a method similar to the Allan Variance that is commonly used in the estimation of clock uncertainties and is able to account for time dependent probability density functions (colored noise) to the TrigNet time series. Finally, we compared these estimates to the results obtained by spectral analyses using CATS. Comparisons with synthetic data show that the noise can be represented quite well by a power law model in combination with a seasonal signal in agreement with previous studies.