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Extracting seasonal signals from continuous GPS time series with modern statistical methods

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It is well known that continuous GPS position time series show seasonal variations. Previous investigations have revealed the importance and potential contributions of seasonal mass loading signals in continuous GPS time series. For instance, some researchers have made comparisons of annual vertical crustal displacements from GPS and GRACE. Seasonal signals from GPS time series were usually obtained by weighted least squares fitting, assuming the data are temporally uncorrelated. However, several studies demonstrated that not only white noise is included in GPS time series but also colored noise, like random walk and flicker noise. The mismodelled noise would definitely alias into the seasonal signals.

In our work, GPS data from stations around the Danube river basin are used. Based on previous studies, we utilize a combination of PCA (Principle Component Analysis) and MLE (Maximum Likelihood Estimation) techniques to extract the annual and semi-annual signals buried in GPS time series. Within the work, the PCA method is firstly applied to remove the so called Common Mode Errors (CME). After an iterative removal of CME, the resulting time series are fit to a commonly used model that contains a linear term and seasonal terms to form residuals. The MLE algorithm is thereafter deployed to test noise models that describe the time series. Finally, the periodic terms are extracted by weighted least squares using the best noise models. These seasonal signals will ultimately be used for inversion and comparison purposes.