Geophysical Research Abstracts
Vol. 16, EGU2014-1596, 2014
EGU General Assembly 2014

Long-term dependencies on selected GPS-SLR co-located sites

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We have used XYZ coordinates in ITRF2008 obtained by GPS data processing in Bernese 5.0 and SLR in GEODYN-II from 20 globally distributed co-located sites. 10 of them are placed in Europe (10 GPS and 12 SLR at the same time), 2 in Australia (2 GPS and 3 SLR), 3 in Asia (3 GPS and 3 SLR), 1 in Africa (1 GPS and 1 SLR), 1 in South America (1 GPS and 1 SLR), and 3 in United States (3 GPS and 3 SLR). The threshold of 5 years of continuous observations was implemented. The longest time series are even 18 years long. At the pre-processing stage for removing outliers median absolute deviation (MAD) was applied as well as the sequential t-test algorithm for analysing regime shifts (STARS). Afterwards we have examined the annual signals in North-East-Up components by least squares estimation (LSE) and compared the obtained amplitudes and phase shifts (number of months between maximum of best-fitted annual sinusoid and the beginning of the year) for both types of observations. The amplitudes change from 1 to even 21 mm, while phase shifts are unevenly distributed over the seasons. No consistency (by means of region-dependencies as well as observation-dependencies) in the obtained results was obtained. It is very well recognised that annual signal in GPS-driven time series could be an artefact of several factors (e.g. draconitic year or mismodelling in short-periods). From the other side if correlated noise is present in the data, artificial oscillations can be generated in the low frequency band and can be taken by a mistake as true signals probably in both types of observations. Therefore we have applied wavelet decomposition (WD), which can be used to determine and model time series components with the modulated amplitude, but constant in phase signals. The frequency-determined components of time series at various decomposition levels enable selection of those that we are interested in, and we can remove them from further analysis. Each time series S(t) is divided into low-frequency signal approximations A and high-frequency details D, and this is done in such a way that the sum of all details and the last approximation produces the analysed data. In our research regular, symmetric and orthogonal Meyer wavelet was applied. After that the cross-correlations between two corresponding details for each type of observations to investigate long-term dependencies were calculated. Finally the horizontal and vertical velocities from both types of observations after removing of seasonal effects with uncertainties determined using coloured noise assumption and First Order Gauss-Markov (FOGM) model were compared.