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Noise in GPS position time series from Taiwan

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Position time series of 393 continuous GPS (CGPS) stations with durations of 5-10 years are generated and analyzed for the noise model and seasonal motions in Taiwan. The noise parameters obtained are also used to evaluate the reliability of GPS velocity uncertainties. GPS data are processed by GAMIT/GLOBK to obtain the position time series. To obtain the seasonal properties in the CGPS time series, we modeled each GPS position time series to derive the secular velocity, seasonal variations in annual and semi-annual periods, offsets due to the antenna changing and co-seismic deformations using the weighted least square method. Uncertainties of the residual position time series after removing the modeling motions for each CGPS station are evaluated by the weighted root mean square (WRMS). The average WRMS of position time series for all CGPS stations are 1.8-2.5 mm and 3.9-7.7 mm in the horizontal and vertical components, respectively. GPS daily position time series are considered to be the signal pattern of the white plus flicker noise. The overall seasonal amplitudes for all the GPS stations are 1.8-3.3 mm in horizontal and 3.2-8.8 mm in the vertical component. Areas of strongest annual amplitudes in both horizontal and vertical components are concentrated in the west and southwest coastal plain in Taiwan which suffers severe ground subsidence from water over-pumping. The motions shown here appear to be elastic and are most likely induced by the effective stress in the regional aquifer changing between expansion and contraction. Stations located just east of the Longitudinal Valley in eastern Taiwan show high correlation between the horizontal seasonal motions and rainfall and groundwater levels. This may be resulted from the periodic contraction and extension motions of the Longitudinal Valley fault due to variations in hydrological loadings. Uncertainty of CGPS velocities estimated by the noise patterns of the Power Law noise series indicated that the uncertainty are 5-12 times larger than those obtained by the noise setting of the white noise pattern.