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Denoising of stations coordinates time series of space geodesy : Application to DORIS stations time series

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When a great number of data is available on complex systems, like stations coordinates time series of space geodesy, adapted methods of analysis are necessary to determine the searched physical effects. The aim of the present paper is to elaborate a methodology of denoising of stations coordinates time series of space geodesy which allowed, in one hand, to recuperate the original signal from the noised data in order to collect the maximum of exploitable information on the signals and their noises, and in other hand, to apprehend the stability of the DORIS stations.

The denoising technique, presented in this work, is based on the shrinkage wavelet transform coefficients obtained by a decimated discrete decomposition of the signal. We use VisuShrink method when the series is affected by a white noise and level-dependent thresholding method in the case of coloured noise.

The analysis methodology adopted is based on the study of the stationarity of the series by tracing their autocorrelation function, followed by the determination of the series noise type by Allan variance, and finally the denoising of the series by the wavelet transform, according to the type of noise affecting each series.

The methodology developed was applied to weekly series of residual coordinates sets (dN: North component, dE: East component and dH: Vertical component) of two DORIS stations Noumea (NOUA) and Syowa (SYPB) expressed in the local geodetic reference frame after removal of ITRF2000 model of positions and velocities.

The results obtained show that majority of the studied series are affected by a white

noise and the optimal denoising method is the soft thresholding one. In fact, the standard deviation of denoised series (dE) of the station NOUA is about 17mm with the soft thresholding and 20mm with the hard one compared to the 36mm of the original series, and consequently the reduction of the noise is thus rather considerable. The signal-to-noise ratio (SNR) of the three components (dN, dE and dH) of the station NOUA is weak, which explains why these three components are much disturbed than the components of station SYPB.

Key words: Time series, Wavelet, Allan variance, Autocorrelation function, DORIS.