NOISE CHARACTERISTICS IN DORIS STATION POSITIONS TIME SERIES DERIVED FROM IGN-JPL, INASAN AND CNES-CLS ANALYSIS CENTRES

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ABSTRACT. Using wavelet transform and Allan variance, we have analysed the solutions of weekly position residuals of 09 high latitude DORIS stations in STCD (STation Coordinate Difference) format provided from the three Analysis Centres : IGN-JPL (solution ign11wd01), INASAN (solution ina10wd01) and CNES-CLS (solution lca11wd02), in order to compare the spectral characteristics of their residual noise. The temporal correlations between the three solutions, two by two and station by station, for each component (North, East and Vertical) reveal a high correlation in the horizontal components (North and East). For the North component, the correlation average is about 0.88, 0.81 and 0.79 between, respectively, IGN-INA, IGN-LCA and INA-LCA solutions, then for the East component it is about 0.84, 0.82 and 0.76, respectively. However, the correlations for the Vertical component are moderate with an average of 0.64, 0.57 and 0.58 in, respectively, IGN-INA, IGN-LCA and INA-LCA solutions. After removing the trends and seasonal components from the analysed time series, the Allan variance analysis shows that the three solutions are dominated by a white noise in the all three components (North, East and Vertical). The wavelet transform analysis, using the VisuShrink method with soft thresholding, reveals that the noise level in the LCA solution is less important compared to IGN and INA solutions. Indeed, the standard deviation of the noise for the three components is in the range of 5-11, 5-12 and 4-9mm in the IGN, INA, and LCA solutions, respectively.

RESULTS AND DISCUSSION

After having removed the trend, the annual and semi annual signals from the original time series of North, East and Vertical components, the slopes of the Allan variance (Allan, 1966) graphs (see figure 1) show that the noise type which characterises the positions time series of DORIS stations in all three solutions is a dominant white noise. However, the white noise signature in the position residuals would comfort the basic linear motion model (Feissel-Vernier et al., 2007). As the analysed time series are affected by a dominant white noise, then we have employed the VisuShrink method (Donoho and Johnstone, 1994) which is better suited to de-noise a time series affected by a white noise. The chosen wavelet is the Meyer wavelet as in (Khelifa et al., 2012) and the wavelet coefficients are calculated from a decomposition of the time series at level 4 with a soft thresholding. The results shown in the table 1 reveal that the noise level is the smallest in the LCA solution compared to IGN and INA solutions.

Station	Site	STD (mm) - IGN			STD (mm) - INA			STD (mm) - LGA		
		North	East	Vertical	North	East	Vertical	North	East	Vertical
ADFB	Terre Adelie	6.5	8.3	7.1	6.9	7.0	5.6	5.6	5.2	4.1
BEMB	Belgrano	6.8	6.8	7.2	7.0	5.7	5.8	5.9	5.8	4.5
METB	Metsahovi	6.8	9.1	7.9	7.4	9.6	8.1	5.9	7.8	6.3
REZB	Reykjavik	7.7	10.1	10.1	8.3	10.2	8.4	6.3	8.8	6.4
ROUB	Rothera	7.8	9.0	9.0	7.5	9.8	7.4	5.8	7.0	5.9
SPJB	Ny-lesund	7.2	5.4	6.3	7.3	5.4	5.2	6.0	5.0	4.9
SYPB	Syowa	9.6	9.5	10.0	9.9	10.1	9.2	6.5	7.7	6.9
THUB	Thule	6.5	6.3	8.5	6.6	6.1	6.1	4.8	4.7	5.2
YEMB	Yellowknife	8.2	10.3	10.5	8.5	11.8	10.1	5.8	9.1	6.7

Table 1: Standard deviation (STD) of the noise determined by wavelet in the components North, East and Vertical for the three solutions IGN, INA and LCA.

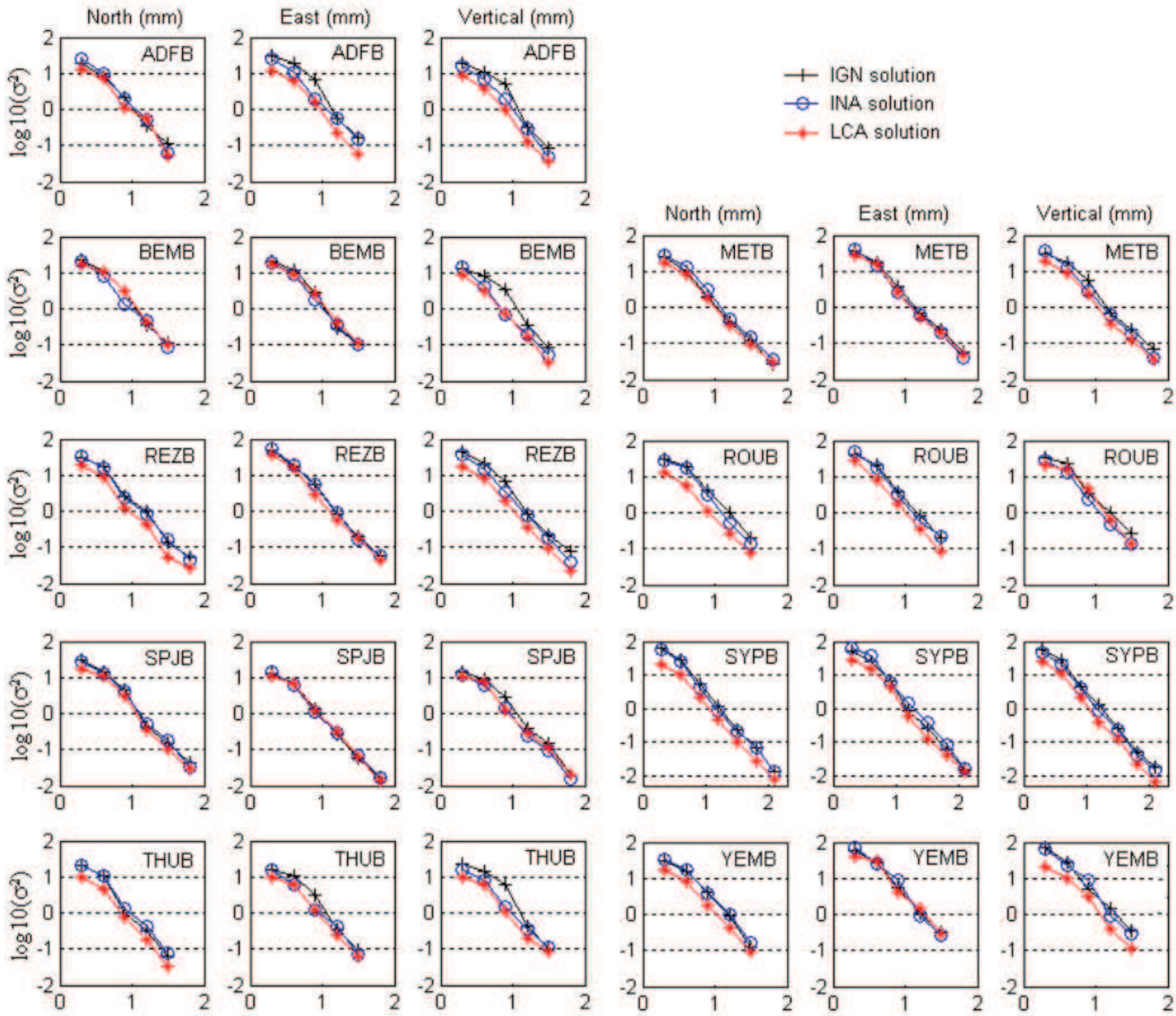

Figure 1: Allan variance (noise types) in the North, East and Vertical components for the three solutions IGN, INA and LCA

REFERENCES

Allan, D.W., 1966, "Statistics of atomic frequency standards", IEEE Trans., 54, 221-231.

Feissel-Vernier, M., de Viron, O., Le Bail, K., 2007, "Stability of VLBI, SLR, DORIS, and GPS positioning". Earth Planets Space, 59, 475-497.

Donoho, D., Johnstone, I., 1994, "Ideal spatial adaptation via wavelet shrinkage", Biometrika, 81, 425-455.

Khelifa, S., Kahlouche, S., Belbachir, M.F., 2012, "Signal and noise separation in time series of DORIS station coordinates using wavelet and singular spectrum analysis", C. R. Geosci., 344(6-7), 334-348.