



Noise analysis in the DORIS station position time series with a view to assessing the monument stability

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- The monument stability of the DORIS ground stations network becomes increasingly crucial to meet current objectives for the terrestrial reference frame determination:
 - 1 mm in accuracy
 - 0.1mm/year in stability
- The purpose of this study is to look at the stations positions time series to possibly obtain information about the monuments stability.
- Following the “Assessment of the DORIS network monumentation” (Saunier, 2016), sites identified as dubious in terms of stability should be investigated.

DORIS Network Monumentation

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- **3 standard monuments**



Type I (29%): steel tower on load-bearing wall of a small building



Type II (22%): custom-made tripod on concrete pillar



Type III (27%): very rigid steel tower on concrete block

- **3 elements of stability:**

- Metallic structure
- Foundation (concrete base)
- Soil structure



- **Dubious stability:**

- Substandard monuments (22%)
- High buildings
- Soft soil

1st study topic: antennas on buildings



17 DORIS stations over 60 sites are mounted on building roof terrace



DORIS antenna mounted on buildings

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Long-term stability

- Gradual subsidence
- Defects in construction: progressive tilt

Short-term stability (occurring diurnally, seasonally or occasionally)

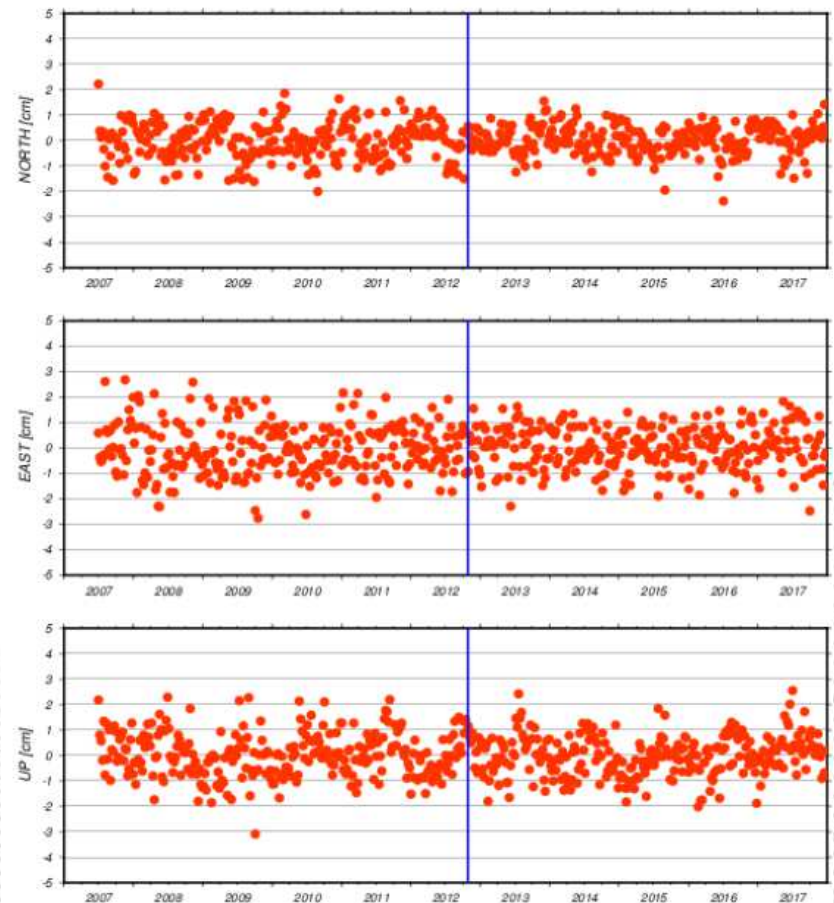
- thermal expansion of the monument (due to external weather conditions)
- elastic distortion effects (prevailing winds, storms...)
- floods; heavy amount of rainfall
- thawing of the permafrost in polar regions

⇒ **Can these phenomena be observed from the position time series?**

Residual Coordinate Time Series

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1. Stacking of the operational IDS combined series (ids 12) from 1993.0 to 2018.0.
 2. Estimation of the differences between the weekly coordinates and the mean linear model as output of the stacking.
 3. Selection of weekly residuals from 2014.0 to 2018.0 (time period with no major event on the DORIS network).
- Estimation of the Weighted Allan Variance.
- Spectral Analysis.



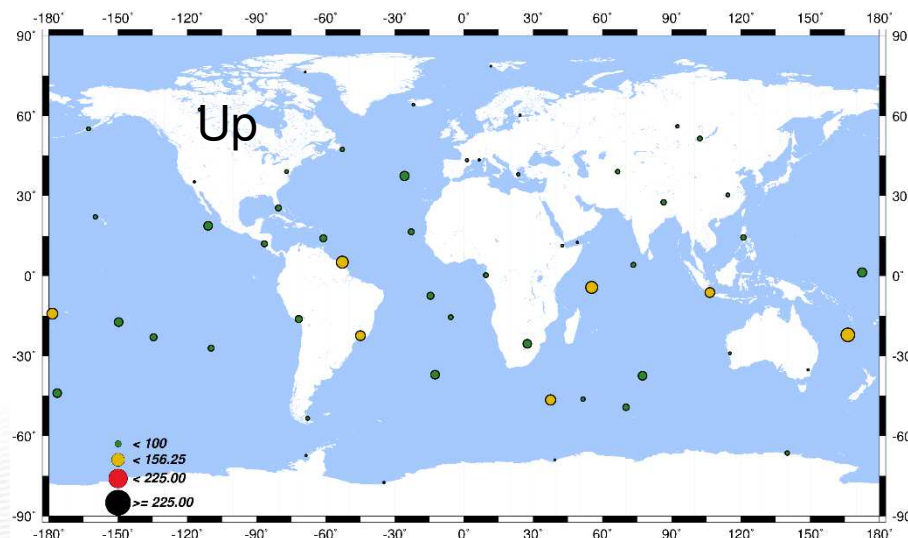
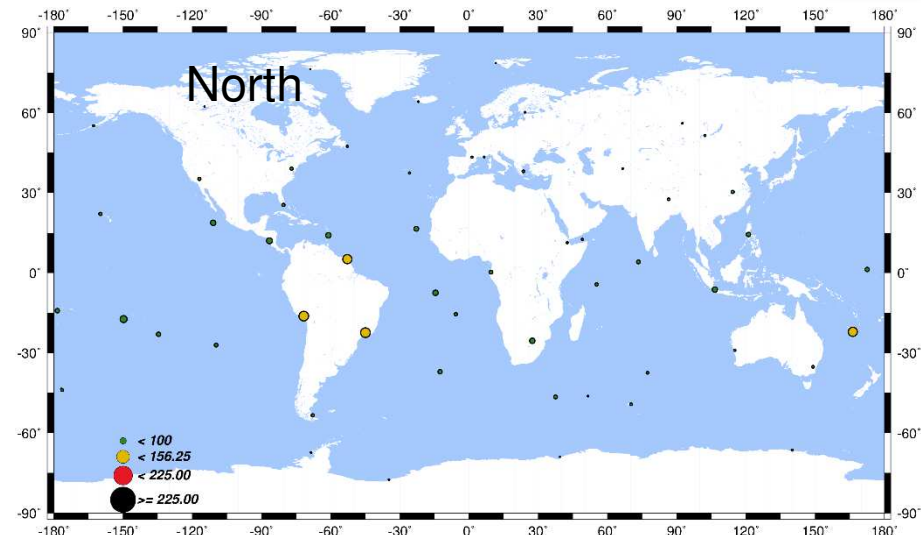
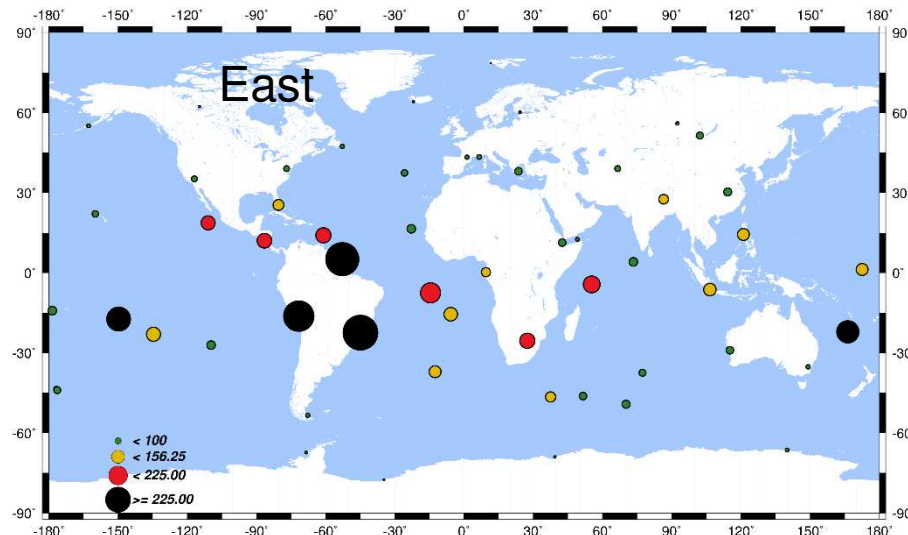
Residuals of TLSB



<http://ids-doris.org>

Weighted Allan Variance (WAVAR)

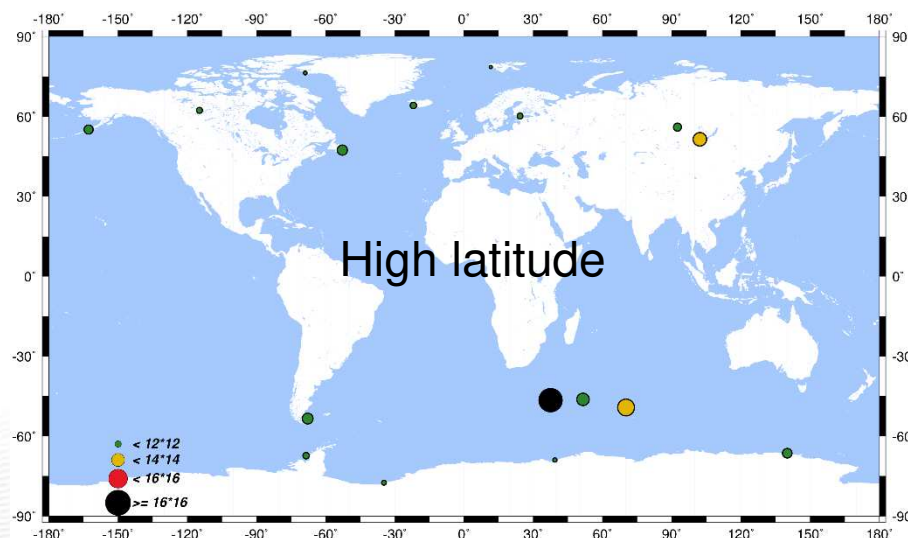
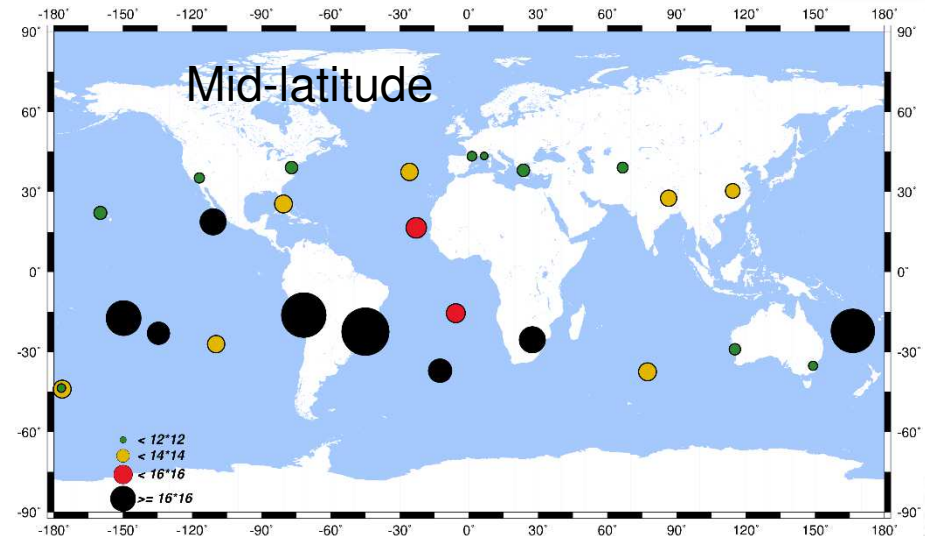
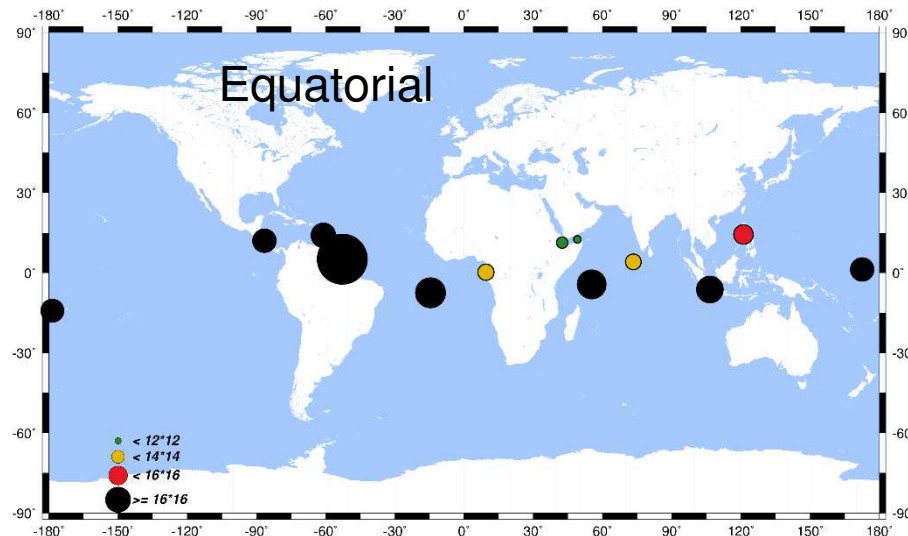
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- **Higher WAVAR for the East – Crosstrack direction.**
- **Top 3 of the highest WAVAR are for 3 sites (Kourou, Cachoeira and Arequipa) in the SAA region.**
- **Latitude pattern – more observations at higher latitude.**

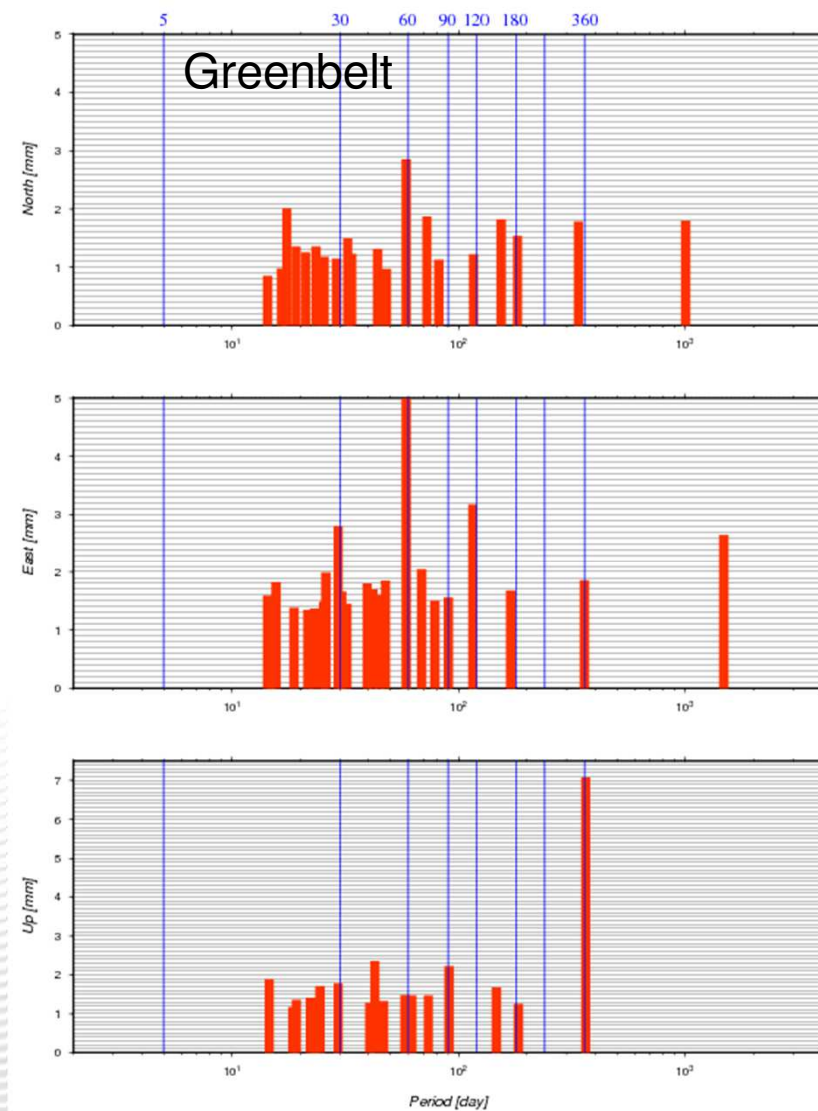
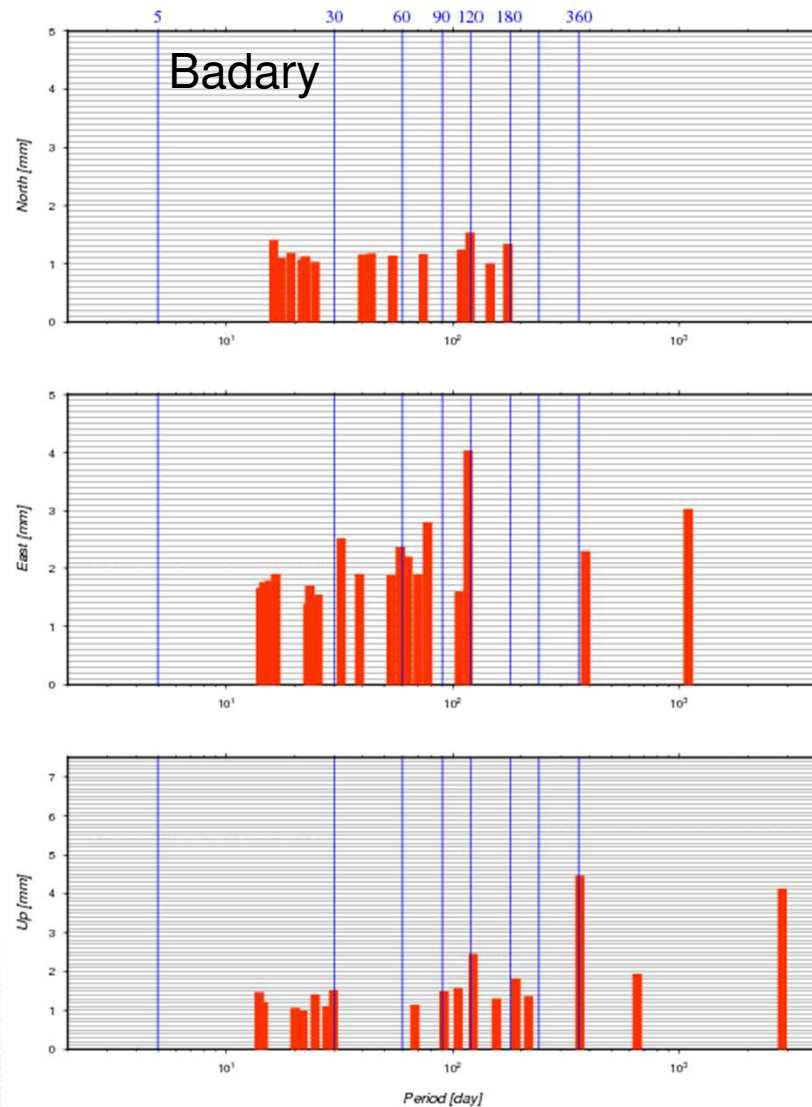
3D Weighted Allan Variance (3DWAVar)

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- No real evidence of special pattern of the site with antennas on building.

Spectral Analysis

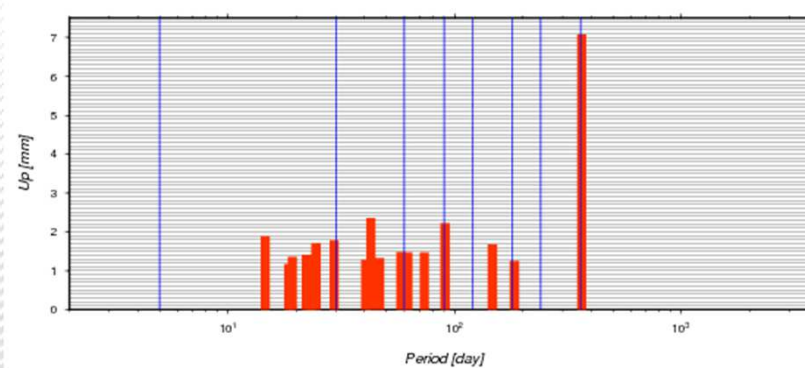
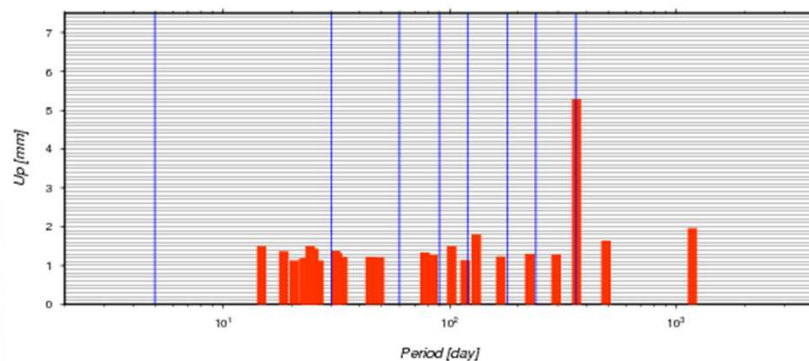
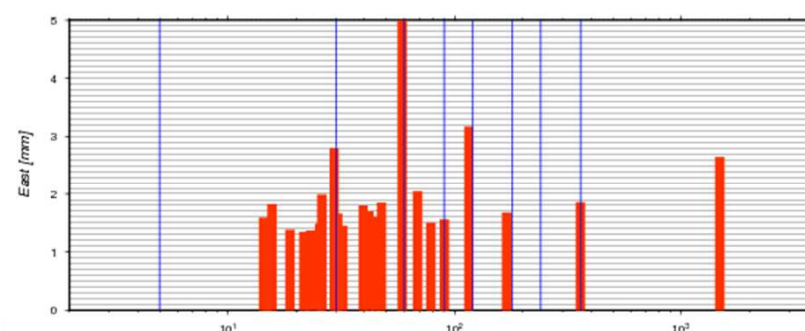
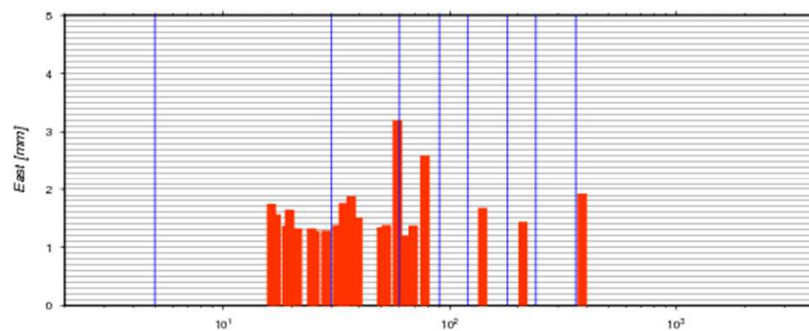
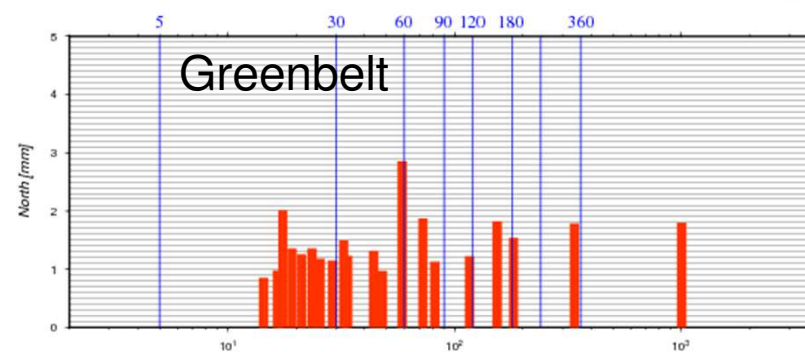
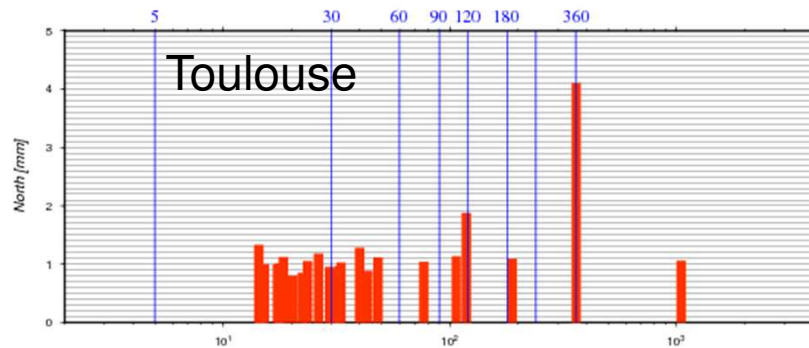




<http://ids-doris.org>

Spectral Analysis

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Preliminary Conclusions

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- **So far, no evidence of the impact of being mounted on building roof terrace on the station position performance.**
- **Next:**
 - Extension of the spectral analysis to all the sites with antenna on building or substandard monuments.
 - Comparison of spectral analysis on winter and summer time periods.
 - Time evolution of the DORIS-to-GNSS geodetic tie vectors.