Introduction

- Ionospheric scintillations impact GPS ionosphere-free linear observations from SWARM satellites and subsequently the derived orbits and gravity field solution.
- Different patterns of noise exist when flying above the equator or pole.

Filtered with Matérn covariance matrix

- An adequate covariance matrix $W$ (Kermarrec and Schön 2017) is built based on the knowledge of the ionospheric spectral density: $W(\nu) = (\alpha^2) \Delta \nu W(\nu)$. Smoothness $\alpha$ depends on the ionospheric strength (weak: 0.1-0.5, moderate: 0.5-1.2, strong: 1.2-1.7).
- The noise corresponding to ionospheric scintillations is extracted from the identified time series $y' = y - \hat{y}$, with $\hat{y} = W^{-1} y$, $\gamma = \frac{\alpha^2}{W}$ with $\nu_0, \alpha \in 3$mm.

Summary of applied methodology

- Preprocessing step
- Subtraction of the mean and polynomial fitting of the observations
- Noise detection in the preprocessed observations
- Rate of change with $\text{deg} \cdot \text{day}^{-1}$ ionosphere-free linear combination of carrier phase observations
- Empirical threshold $\text{30} \text{ ms}^{-1}$
- Extraction of the iono-T5: minimal length $\text{250} \text{s}$
- Filtering with adequate VCM
- Reconstruction of the observations

Summary of the methodology used to detect, filter and reconstruct the contaminated time series of observations.

Improved kinematic orbit determination

- The position residuals contain less high frequency noise.

Conclusions

- Matérn covariance matrices with $\nu = 1.5$ and $\nu = 1$ are used to mitigate the impact of noise increase due to ionospheric scintillations and these homogenize the observation noise.
- The spectral decomposition -slope of the psd at high frequency-= of the filtered OMC is similar to the one that would be obtained without noisy observations.
- The noise caused by ionospheric scintillation is strongly eliminated using Matérn covariance matrix, with 6%, 10% and 20% in the along, cross-track and radial direction, respectively.

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