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GNSS-based displacement detection using Bayesian inference for deformation monitoring

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The paper is about an interesting topic of applying a methodology based on Bayesian inference to detect displacement using GNSS measurements. The Bayesian approach is a relatively new approach on GNSS data, which has been though tested in different forms. There is some novelty in the study of this paper, however, the quality of some parts of the paper is relatively low.

First of all, the bibliography related to previous research of GNSS in deformation monitoring is not based on high quality previous studies. More specifically, there are experimental studies of Psimoulis (Psimoulis et al. 2008, Journal of Sound and Vibration, Psimoulis and Stiros, Computer-Aided and Civil Infrastructure Engineering, Psimoulis et al., 2018, Geophysical Journal International), Haberling (Haberling et al., 2016, Journal of Geodesy) and Moschas (Moschas et al., 2014 Earthquake Engineering and Structural Dynamics, Moschas and Stiros, 2015 GPS Solutions) related to the assessment of the accuracy of GNSS measurements for structural/dynamic motion monitoring, which should be cited. Also, studies of Xiaolin Meng and others (Gethin Roberts) related to bridge monitoring (Meng et al., 2018 Sensors, Meng et al, 2019 Remote Sensing, etc.). Regarding the application of low-cost GNSS receivers, apart from the studies of Gili et al., there is the study of Xue et al., 2021 (Journal of Applied Geomatics), which analyse more extensively the accuracy of low-cost GNSS receivers.

There is a very thorough explanation about the Bayesian Inference method, the MCMC method and EKF method, which is very useful for readers who are not familiar who these methods. However, the EKF is presented for the explanation of how the GNSS data are processed. Since, the paper is not focused on that, but on the analysis of the GNSS time-series, and the GNSS data are processed with RTK-Lib, there is no need to present EKF method.

The experiments are explained clearly and the application of the methodology is demonstrated. The GNSS time-series are known to be sensitive in long-period noise, mainly due to troposphere, ionosphere and multipath effects. The authors mention that the short-baseline will limit the ionosphere/troposphere effect (but potentially not eliminate), while the multipath effect will remain. To my view, the GNSS time-series can be more noisy, which could make even more challenging the identification of the displacement. The results seem realistic. However, the experiments could be more controllable in order to avoid potential vibration of the plank, which was not part of the experiment. The authors should check, whether these fluctuations of the GNSS time-series, which do not coincide with the applied displacement, are not the result of changes in the satellites constellation/geometry, cycle slips, etc. These are sources of errors of the GNSS data with similar characteristics (see Msaewe et al., 2018, Roberts et al., 2018, etc.).

Furthermore, the authors only assess the proposed methodology on the vertical component, which generally is the least accurate of all the component of the GNSS data. It

would be good to have a couple of tests for horizontal displacement, which can be potentially easier to control.
The manuscript needs improvement mainly in the justification of the results and the introduction. The topic is interesting, but further improvement is required, in order to be the material publishable.