

Reply to the comments on preprint npg-2023-23 entitled ‘Extraction of periodic signals in GNSS vertical coordinate time series using adaptive Ensemble Empirical Modal Decomposition method’

We would like to express our appreciation to you for your valuable suggestion. We have responded to the comments as below. (C and R indicate comment and response, respectively)

C1: As minor comments, we would like the authors to present their thoughts regarding the processing of not only vertical GPS data, but also horizontal components. As is known, horizontal components almost always contain strong trends reflecting slow movements of tectonic plates. It would be interesting to read about how the authors would highlight harmonic components against the background of strong trends. With the exception of simple preliminary elimination of the general trend with subsequent analysis of the remainder.

R1: The absolute sea level is related with the vertical movement of the tide gauges. That is why we focus on the vertical component of GNSS stations which distributed nearby these tide gauges. Yes, the strong trends exist in horizontal components of GNSS stations. If we don't eliminate them beforehand, the decomposition of EEMD seems failure. Especially the last IMF with long term period cannot be distinguished with the reminder. We have tried data processing such as standardization. It cannot still weaken the trend effect in the data. Only by weakening the trend effect, can the accuracy of the harmonic components be guaranteed. Because the crucial step in EEMD is the formation of upper and lower envelope lines which is based on data. However, when the trend is strong, the spacing between the signal's maxima and minima becomes small or unclear, potentially causing EMD to overly focus on the trend component and overlook other inherent harmonic features. Given an extreme example, it cannot be decomposed for the data only linear signal included. Up to now, we think although the elimination of the general trend is simple, it is regarded as the effective way in weakening its effect. We are sorry that we have not any idea of the weakening trend effect except this. Besides, we conducted an extensive literature survey, which studies on the horizontal components. Some directly utilize detrended time series (Klos et al., 2020; Dong et al., 2022), while others incorporate a step to remove trend components before extracting periodic signals (Xu and Yue, 2015; Klos et al., 2018). Thanks for your comment. We will consider more on this topic.

References

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