RE: NHESS-2021-35

We thank Deodato Tapete and two anonymous reviewers for their invaluable comments that have helped improve our manuscript. Our responses to the comments are highlighted in bold. Please refer to the tracked-change version for the line numbers addressed in this letter.

CC1 (Deodato Tapete)

The present manuscript focuses on the spatial and temporal distribution of land subsidence hotspots across the expanding and developing urban footprint of Wuhan in China.

At the moment there is a growing InSAR literature investigating land subsidence and karst collapse hazard in Wuhan. Therefore, the authors should contextualise their results and compare with published InSAR results achieved by processing either (nearly) the same Sentinel-1 dataset used in this paper or other SAR datasets.

It is with regard to this important aspect that my comment is made.

The authors seem not to have accounted for the following study:

Han, Y.; Zou, J.; Lu, Z.; Qu, F.; Kang, Y.; Li, J. Ground Deformation of Wuhan, China, Revealed by Multi-Temporal InSAR Analysis. Remote Sens. 2020, 12, 3788. https://doi.org/10.3390/rs12223788

Han et al. (2020) have processed and analysed basically the same Sentinel-1 dataset i.e. April 2015 to June 2019, with SBAS-InSAR technique. So, there is a straightforward opportunity for the authors of the present manuscript to make a comparative discussion of their results with those published by Han et al. (2020).

Another very recent paper that the authors should also consider is:

Jiang, H.; Balz, T.; Cigna, F.; Tapete, D. Land Subsidence in Wuhan Revealed Using a Non-Linear PSInSAR Approach with Long Time Series of COSMO-SkyMed SAR Data. Remote Sens. 2021, 13, 1256. https://doi.org/10.3390/rs13071256

In this paper, my collaborators and I have processed and analysed the longest time series of COSMO-SkyMed data that has been published so far over the city of Wuhan.

Because our paper and the present manuscript share the common interest on correlating the observed land subsidence with soft soil consolidation, it would be interesting if the authors would enrich the discussion of their results vs. those published

in our paper.

Thanks for pointing this out. Both papers are important studies in the literature. Han et al. (2020) used Envisat ASAR (2008-2010), ALOS PALSAR (2007-2010) and Sentinel-1 (2015-2019) data to study the spatial displacement characters of Wuhan. They identified the displacement trend significantly decreased in 2017. Jiang et al. (2021) used long-term and consistent high resolution CSK dataset acquired from 2012 and 2019 to study the displacement of Wuhan using the non-linear PS-InSAR approach. They found accelerations of ground displacement correlated with construction activities. They also identified the 2016 heavy rainfall events caused accelerations. Both research found the displacement correlated with soft soil consolidation. Our results agreed with both of the studies. The findings of these two papers are properly cited in the introduction and results section of our manuscript.

Further line-by-line comments are appended here below:

- Lines 34 - 44: these sentences are very common knowledge for the journal readership and can be removed, alongside the cited references. This should help the authors to shorten the manuscript and save space for the discussion later on.
We remove these sentences and references in the manuscript accordingly.

- Lines 52-54: with regard to the mention of COSMO-SkyMed, the whole archive of COSMO-SkyMed 2012-2019 has been analysed and very recently published by Jiang et al. (2021) - see comment above. This should be acknowledged to keep the state-of-the-art section updated with the very recent literature
We add the recent works by Jiang et al. (2021) and Han et al. (2020) in the state-of-the-art section (Line 56 and 59-60).

- Figure 1: karst collapses and levelling points are barely visible. The authors should consider the addition of a zoomed view.
We updated Figure 1 by adding a zoomed view in Figure 1(c).

- Line 74: The authors should specify what "The Rise of Central China" is.
"The Rise of Central China" is a policy to accelerate the development of central China including Shanxi, Henan, Anhui, Hubei, Hunan, and Jiangxi. We add this information in Line 80.

- Lines 112-116: these sentences are very common knowledge for the journal readership and can be removed, alongside the cited references. This should help the authors to shorten the manuscript and save space for the discussion later on.
We remove these sentences and references in the manuscript accordingly.

- Line 124: why did the authors choose 500 m as the upper limit of bperp, given that Sentinel-1 ref. tube deviation is +/- 100 m (https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/satellite-description/orbit)?
Thanks for pointing this out. With the good orbit control ability of Sentinel-1, a 500 m limit of perpendicular baseline is meaning less in this study. Thus, we remove this statement. Only temporal baseline less than 60 days are used (Line 133).

- Line 125: The section lacks of information about the software that has been used to process Sentinel-1 data or, instead, if a proprietary code has been used.
We processed the Sentinel-1 interferometric data using software published in the journal Computer & Geosciences and list as an reference, which is illustrated in Line 128-129.

Reference:
Yu, Y., Balz, T., Luo, H., Liao, M., and Zhang, L.: GPU accelerated interferometric SAR processing for Sentinel-1 TOPS data, Computers & Geosciences, 129, 12-25.

- Line 148: this spatial intersection should be better displayed by combining the InSAR subsidence rates and geological datasets in the same figure.
The readability might be reduced if we superpose the displacement rates on colored geological map. Thus, we superpose the boundary of the first terrace EGZ and second terrace EGZ on the displacement map to roughly illustrate the correlation between EGZ and displacement and updated Figure 4.

- Section 4.4. Houhu area: how do the present results and time series compare with those published in Han et al. (2020) at equal SAR data processed?

How with Jiang et al. (2021) who processed X-band high resolution data with non-linear PSInSAR technique?
Our study agreed with results from Han et al. (2020) and Jiang et al. (2021). The long term displacement from Jiang et al. (2021) indicated widely distributed

subsidence occurred during 2012-2019 which might corresponds to different nonlinear subsidence phase. At the meantime, the localized subsidence center identified in our study coincide with Han et al. (2020) with same order of displacement rate. The results in our study enable us to identify short-term (2015-2019) localized subsidence centers. (Line 211-213 and 218-219)

- Section 5.2, Relationship between karst subsidence and river water level/rainfall: how do the present results compare with those published in Han et al. (2020)?

Han et al. (2020) found that the changes of land subsidence near the bank of the Yangtze River are generally consistent with the variations in the river water level over most of the monitoring period. However, they also noted a time delay with respect to the time of water level changes, suggesting the complexity of and variation in the hydrogeological condition along the Yangtze river in Wuhan. What is the authors' opinion in this regard based on their data?

The groundwater level in the first terrace might correlate with river level (Li et al. 2013, Chen 2016). Han et al. (2020) and (Bai et al. 2016) identified water level correlated displacement in the first terrace covered by soft soils. In our opinion, the water level related displacement should exist along bank of rivers.

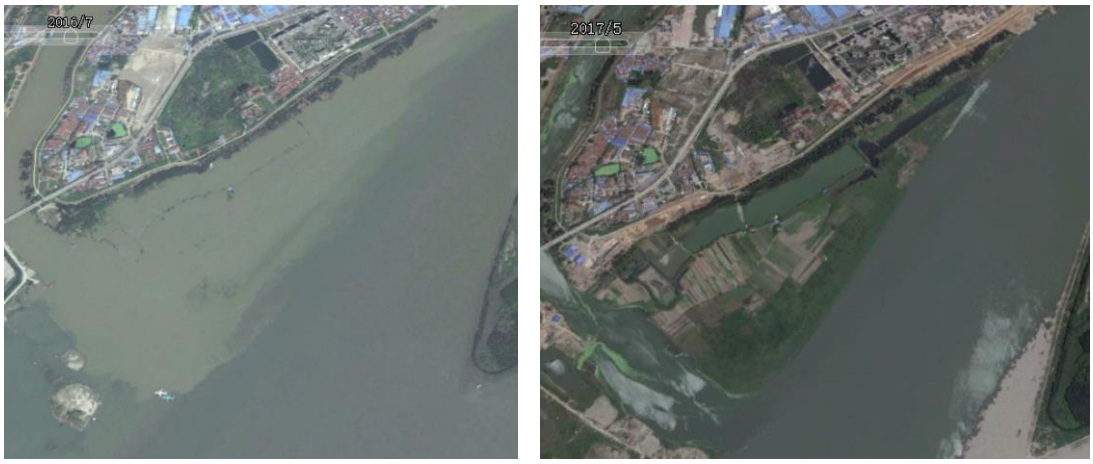

Figure C1. Typical land cover along the bank of Yangtze River from @Google earth™ image.

In our opinion, PS pixels located on natural ground should be selected to analyze the interaction between subsidence and river water level. The bank area was flooded in July 2016 as shown in the Fig. C1. Although a SBAS workflow which can make use of distributed scatterers was employed in our study, the pixels we selected in this study were mainly manmade structures. Very sparse pixels are detected on the natural ground as we can see from in Figure 8(a) and

10(a).

The pixels we selected on manmade stuctures at the bank of Yangtze River shows obvious seasonal signal as Han et al. (2020) did in their study which might correlated with river level. However, we cannot exclude the thermal impact caused by temperatures which is very common in manmade structures. Therefore, we skipped this part in our manuscript.

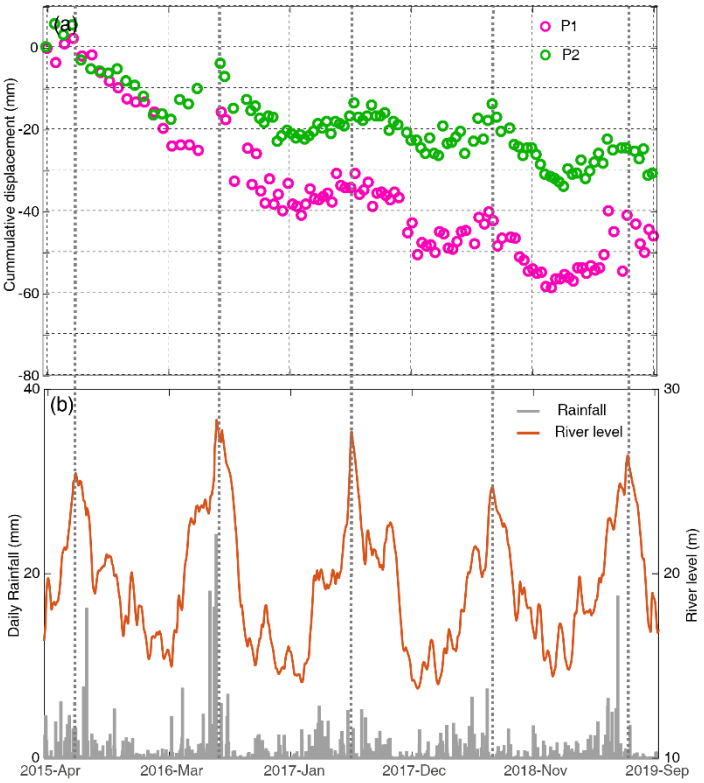

Fig.C2 (a) Cumulative subsidence of selected points P1 (lon=114.2749, lat = 30.5100) and P2 (lon0 = 114.2369; lat0 = 30.4634), (b) Water level of Yangtze River and rainfall.

The displacement of QL1 in karst areas did not observe the thermal impact and construction intensities are low as we can infer from Fig. 14. As pointed out by reviewer 2, the displacement of QL1 is more correlated with rainfall rather than river level. We updated section 5.2.

- Lines 292-295: please revise this last sentence in the context of the future direction of the present research.

Agreed and revised.