*Reviewer's original comments are in black italic text*

Manuscript Author's responses are below the relevant comment in blue text.

*General evaluation*

*By analyzing the differences between two InSAR velocity fields in the north-central Gulf of Mexico, this manuscript highlights the reproducibility challenges arising from methodological choices in data processing, including filtering and instrumental, environmental and geophysical corrections. Such discrepancies have been noted in previous studies. The authors advocate for the development of a harmonized processing framework and for cross-validation exercises within the InSAR community, similar to existing initiatives in other Earth sciences areas such as climate science (e.g., CMIP for climate models) or geodesy (e.g., IGS for the GNSS), where such efforts have led to the definition of minimum agreed-upon modelling standards. An open question, however, is whether the InSAR community is currently sufficiently mature and organized to mobilize the resources required to establish such a framework.*

*In the absence of such coordinated international efforts, meaningful inter-comparisons will remain challenging, given the inherent complexity of InSAR processing the multitude of possible methodological differences. The authors make a commendable effort to identify which discrepancies can be considered negligible in order to enable a meaningful comparison. While I am not fully convinced that all such differences are adequately accounted for, their attempt is valuable and their experience worth sharing.*

We thank the reviewer for this thoughtful and constructive assessment. We appreciate the recognition of the reproducibility challenges highlighted in our comparison of two InSAR velocity fields in the north-central Gulf of Mexico.

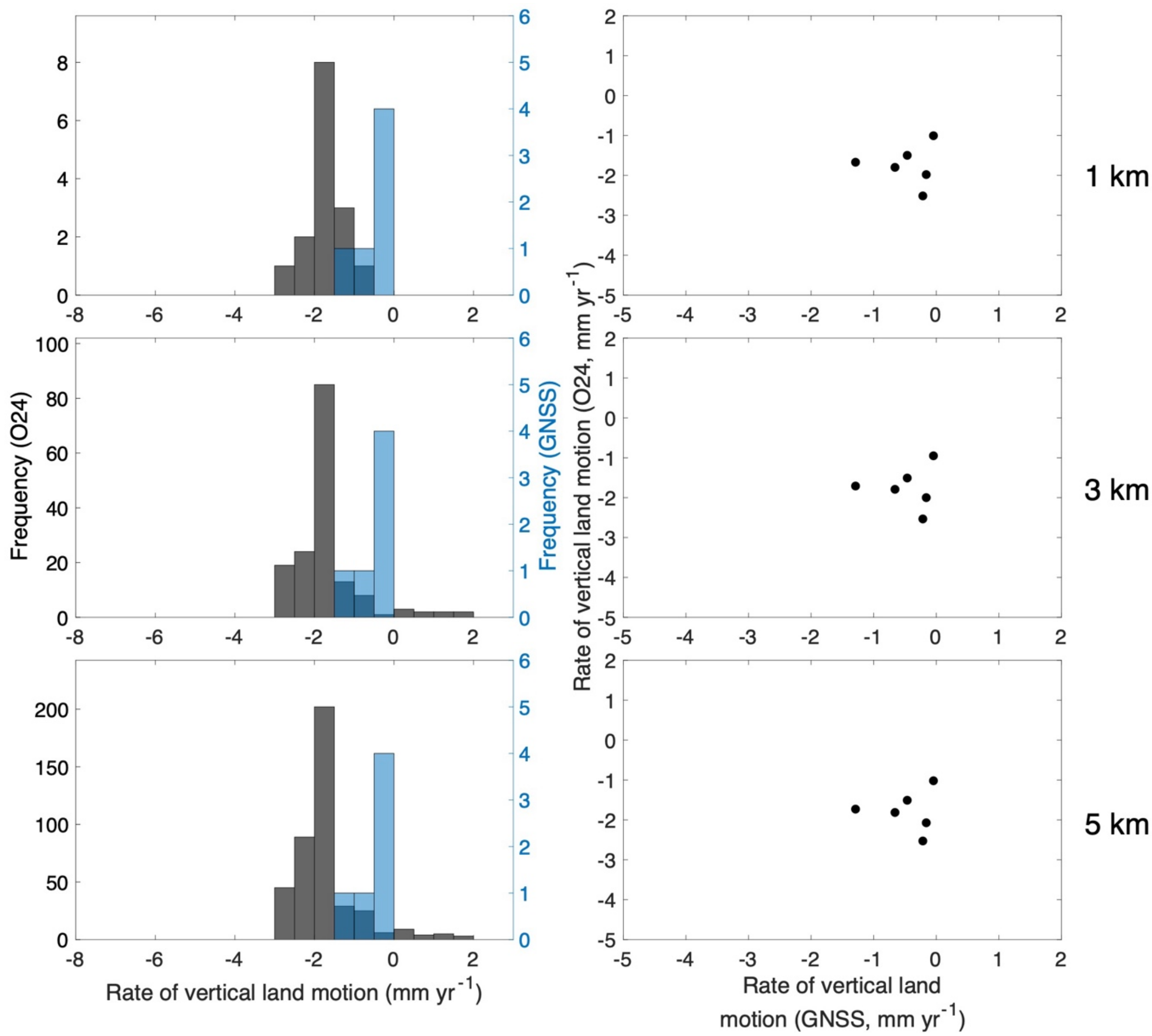
We agree that InSAR processing involves a wide range of methodological choices, and that fully reconciling all possible sources of discrepancy is challenging. In this study, our goal is not to exhaustively attribute or resolve all differences between products, but rather to document and illustrate the magnitude of differences between two independently generated InSAR velocity fields, and to identify cases where discrepancies may be considered relatively small for the purposes of intercomparison.

In response to the reviewer's suggestion, we have expanded the discussion to include examples of established community-driven frameworks in other Earth science domains, including CMIP and radiocarbon dating, as illustrative analogues of how coordinated benchmarking and standardized protocols can improve comparability and reduce structural uncertainty. We fully recognize that the development of a similarly coordinated framework in the InSAR community will require further community organization and engagement.

*In this context, I have several concerns regarding the GNSS data used to assess the two InSAR velocity fields. First, it is unclear whether the GNSS observations used for validation are fully* *independent from those used to calibrate the respective InSAR products. More specifically, are the 41 GNSS stations used in the comparison distinct from those employed to align the InSAR products to their reference frames?*

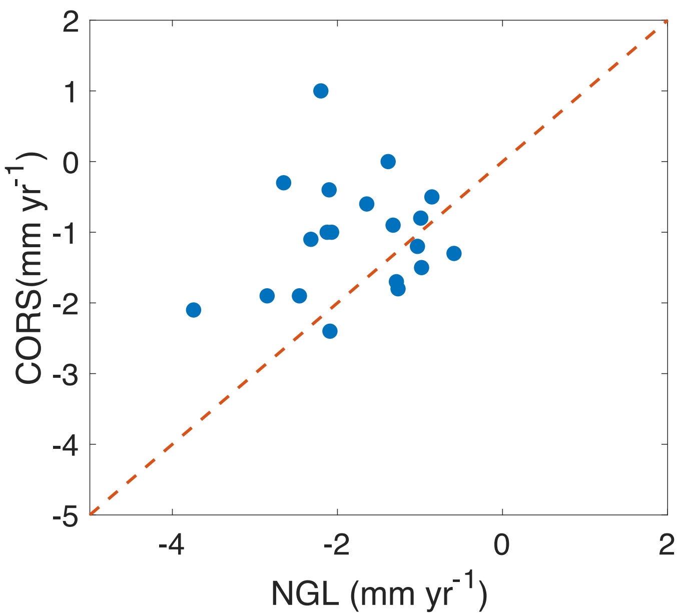
For W24, four GNSS sites were used as reference sites, all of which were excluded from our analysis. Therefore, there are no dependency issues in the comparison between W24 and the GNSS-derived vertical velocities.

For O24, a larger set of GNSS sites was used to establish the reference framework. Of the 41 GNSS sites in our study, 20 were also used in the O24 reference framework. Among the remaining 21 independent GNSS sites, only six occur within our InSAR cover study area. For these six sites, we compare GNSS velocities with nearby InSAR-derived rates using different search radii and find that similar discrepancies persist across all tested radii (see figure). While the sample size is small, the results are similar to those presented in Fig. 4a.



*Second, regarding the use of NGL GNSS velocities, it would be useful to assess how these compare with independent solutions, particularly those produced by groups using different processing strategies, software, or orbit and clock products (e.g., not relying on JPL products).*

To address the reviewer's comment, we examined additional publicly available GNSS velocity solutions from independent providers, including NOAA CORS, NASA MEASUREs, and the NSF GAGE Plate Boundary Observatory (PBO). These products are derived using different processing strategies and thus provide an opportunity to assess the sensitivity of GNSS velocity estimates to processing choices. Among these, the NOAA CORS solution provides the most consistent spatial and temporal overlap with our study region and is therefore used for a quantitative comparison with the NGL velocities. A direct comparison between CORS- and NGL-derived vertical velocities is presented below. The root mean square error is ~1.0 mm $yr^{-1}$. The CORS solution, referenced to IGS14, is available only up to GPS week 1993 (early 2017), resulting in a shorter time span than the NGL product. This difference in temporal coverage may contribute in part to the observed discrepancies between the two velocity estimates.




*Another point concerns temporal variability and the use of two different time spans (2007- 2020 and 2017-2020). The authors conclude that the impact of this difference can be neglected. However, Figure S7 appears to show a systematic bias, with the shorter time span exhibiting larger subsidence rates than the longer one. Unlike the more localized (individual) discrepancies, this overall shift seems significant. It could even be more pronounced if time periods of equal duration were compared (e.g., 2007-2010 versus 2017 to 2020) if the underlying geological process is accelerating. I encourage the authors to further investigate and discuss this aspect.*

We recognize that a slight shift between the two velocity estimates is visible in Figure S7, with the shorter time span tending to yield slightly less negative (i.e., lower magnitude subsidence) rates. However, this difference is small and not statistically significant across all sites. As shown in the manuscript, z-test results indicate $|z| < 1$ for all 19 GNSS stations, suggesting that the differences between the two periods are within the uncertainty of the velocity estimates. In addition, the root-mean-square difference between the two periods is only 0.7 mm $yr^{-1}$. We therefore interpret the observed shift as being within the expected variability of the velocity estimates rather than evidence of a systematic change or acceleration over the different time windows.

*Recommendations for improvement (specific points)*

*To strengthen the manuscript and improve readability, I suggest addressing the following points (minor).*

*Table 1 appears both in the main manuscript and in the Supplemental Material.*

We have removed the table from the Supplemental Material.

*Figure S1: please consider adding GNSS station identifiers to the map (see data file in Supp.). Given the relatively limited number of stations (41), the map should remain readable while providing useful detail for reproducibility. A similar comment applies to Figure 5, which includes even fewer stations.*

We have added the GNSS station identifiers to Figures 3a & S2.

*Figures S3: confusing, please revisit panels and captions*.

We have revised the caption as follows:

"Relationship between GNSS-derived vertical velocity and nearby anthropogenic activity. Filled circles represent the 41 GNSS sites shown in Figure 3a; triangles represent the 30 GNSS sites in Texas shown in Figure S2; GNSS sites eliminated between Figures 3b and 3c are labeled in orange. (a) Relationship between vertical velocity and the total groundwater withdrawal within a 5 km radius of each GNSS site from 2000 to 2017 (Houston et al., 2021); (b) Relationship between vertical velocity and the number of active oil and gas wells within a 5 km radius of each GNSS site. Oil and gas well data are from the Railroad Commission of Texas (https://www.arcgis.com/home/item.html?id=6304a76feaa24d98b8eaecdcc0f9e4bc; last updated June 14, 2021), the Louisiana Department of Energy and Natural Resources (https://www.sonris.com/), the Mississippi State Oil & Gas Board (https://www.ogb.state.ms.us/downloads.php), and the State Oil and Gas Board of Alabama (https://gsa.alabama.gov/ogb/gisdata)."

*Please verify the reference frame of the daily GNSS data from NGL. I found indications that they may be aligned to IGS20 rather than IGS14. While differences between these frames are likely negligible compared to other sources of uncertainty, this should be clarified.*

We note that the reference frame is specified in lines 93-94 of the original manuscript: "Daily GNSS data and the overall vertical velocities referenced to IGS14 were downloaded from the Nevada Geodetic Laboratory (Blewitt et al., 2018, https://geodesy.unr.edu/)."

For clarification, we have added the following sentence in lines 94-95:

"At the time of data acquisition, NGL products were aligned to IGS14, although more recent releases are aligned to IGS20."

*Section 3.2: the mean record length is reported, but the median record length would be a more robust and informative statistic.*

We have now reported the median record length as the reviewer suggested.

*Concluding remark*

*Overall, the manuscript is well written, clear, and logically structured, making it easy to follow. The topic and the material are stimulating, and the authors draw on extensive experience and expertise in assessing the respective strengths and limitations of InSAR and GNSS. Their effort to compare products that are inherently difficult to reconcile, due to the complexity of InSAR processing, is commendable. The manuscript provides interesting insights, particularly regarding land coverage distinction and the specific GIA context, both of which merit further investigation. The statistical analyses are applied rigorously and appeared sound overall. I believe the manuscript can be further strengthened by addressing the points raised above, as well as the more detailed comments provided.*

Again, we appreciate the constructive feedback and feel that the manuscript has improved with the revisions detailed above.