

# ***Interactive comment on “Satellite signal shows storage-unloading subsidence in North China” by J. P. Moiwo and F. Tao***

## **Anonymous Referee #3**

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### 1. General comments

This paper focuses on the water storage change and subsidence in North China region, which are caused by excessive groundwater exploitation. Although the topic of the study is suitable to the scope of this journal, there are following problems in the paper.

(1) The comparison between groundwater storage anomalies derived from field observation and from GRACE and GLDAS has already studied in detail with similar approach by Feng et al. (2013). Although the Shandong region was not included in Feng et al. (2013), the water decrease in the region does not remarkable.

(2) It is interesting to connect land subsidence observations with groundwater withdrawal and loss of aquifer volume. However, the authors use only one station (Beijing)

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data. It is too rough to estimate the average value of the study area using the one station data. The subsidence in Beijing is extremely large compared to other area, and does not represent the value of the whole study area.

I suggest cutting most part of the topic of (1), and discussing more critically the topic of (2). One way for the revision is that the authors focus on the small area (but large enough to GRACE resolution) of Beijing and the surrounding area. Another way is to use multiple (at least several) GPS station data sets, which distribute uniformly over the large study area.

## 2. Specific comments

### (1) Introduction

1) pp. 6046, l. 2 . “There are several other reports . . .” The authors should review previous studies in more detail. Especially, they should state what has already done as well as what is the new discovery in this paper.

2) pp. 6046, l. 16. “field measured groundwater and soil water storage . . .” It is unclear whether the soil water storage data shown in Figure 2 to 6 field measured data or GRACE/GLDAS-derived data.

### (2) Materials and method

1) pp. 6048, l. 21 – pp. 6049, l. 20. This part is not required for the discussion in this paper and should be removed.

2) Figure 2 to 6 and Table 1. Storage anomaly and storage change are shown in the figures and the table. However, storage changes are just shown, but are not discussed. Therefore they should be removed. Furthermore, it is not required to show all the figures (i.e., monthly, seasonally, yearly, . . .) because the scope of this paper is long-term storage variation only.

3) pp.60051, l.8-16. The description of this part is not a standard style of GRACE anal-

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ysis and should be rewritten. It is strange to apply Wahl's Gaussian filter after applying Swenson's filter. The authors should also mention which version of the GRACE data used in this study (e.g., release 4, release 5, ...).

4) pp. 6053, l.20-21. What is the difference of "average random error" and "average error"?

5) The authors should state the method of GPS data analysis in more detail.

### (3) Results and analyses

1) pp.6055, l. 25-27. Is the phase difference really due to the problem of GRACE sensitivity in short-term?

2) pp. 6057, l.17-20. The authors state "land surface deformation could only be caused by abstractions of groundwater, hydrocarbons or coal. Thus GPS data product of relative LSC is used to analyze for land subsidence due to loss of water storage in the region". Is the effect of abstractions of coal and hydrocarbons negligible in the GPS data?

3) pp. 6058, l.1-12. The authors stated that it must be treated with caution to the averaged land subsidence value derived from the only one GPS station data. In spite of this, they used this value for a critical discussion in the next section. I think it is quite over discussion.

4) pp. 6058, l.13-23. This part should be moved to the discussion section.

### (4) Discussion

1) pp. 6060, l. 11. "SWS" Is that obtained by field observation or GLDAS-derived value?

2) pp.6060, l. 23-28. The authors have already stated the same thing in pp.6059.

### 3. Technical corrections

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- (1) pp.6051, l.16: “the bottom right” → “the bottom left”.
- (2) Figure 1, caption of the bottom left figure: What is the meaning of “GRACE averaged monthly total water storage anomaly”? Is that the linear decrease trend throughout the observation period? It is very difficult to read the spatial variation from the figure because of the color problem. Full color should be used instead of black and white.
- (3) Table1: There are no columns corresponding to the description “the column highlighted grey” in the footnote of the table.
- (4) pp.6054, l.21: p and alpha are not defined.
- (5) Figure 2, Figure 3, Figure 7: Please use a common horizontal scale in each figure.
- (6) pp.6059, l.20: “number pf” → “number of” .
- (7) pp.6059, l.18 and l.19: “km<sup>3</sup>” → “km<sup>3</sup>/yr”.
- (8) pp.6059, l.27-29: “mm” → “mm/yr”, “km<sup>3</sup>” → “km<sup>3</sup>/yr”.
- (9) pp.6060, l.18: (Probably) Eq.(2) → Eq. (3)?

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 6043, 2015.

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