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Interactive comment on "Time-lapse gravity and levelling surveys reveal mass loss and ongoing subsidence in the urban subrosion prone area of Bad Frankenhausen/Germany" *by* Martin Kobe et al.

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Dear Prof. Eppelbaum,

We thank for your comments and the positive assessment of our work. We appreciate that you approve of our time-lapse gravity approach and recognize the temporal gravity changes could be subrosion-induced. After shortly summarizing the manuscript, the review recognizes the great effort carried out by the authors to identify underground mass transport by using frequently-repeated gravity measurement campaigns and an

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extensive data analysis including hydrological correction of soil water variations. The low standard deviation of the results was acknowledged.

In the following, we want to answer to your suggestion about multilevel gravity surveys: Lev Eppelbaum wrote: As a wish, I must note that two level (or multilevel) precise gravity survey (Eppelbaum et al., 2010) may be especially effective for the time-lapse gravity studies. Such a survey will be more sensitive to appearing of even small irregularities in the studied near-surface section.

First of all, thank you for this very interesting comment and basis for discussion. We have thought about the determination of vertical gravity gradients as well. On the one hand, if time-lapse gravity surveys were conducted in subsidence areas, a more precise determination of the vertical gravity gradient would provide an improvement of the correction of height changes of the gravity points. On the other hand, the vertical gravity gradient could be considered as a separate parameter to be monitored, especially regarding underground modelling both in space and time. Indeed, the second or even third derivative of the gravity potential would be more sensitive to near-surface density variations, e.g. subrosion-induced mass changes, then the first derivative (e.g., Eppelbaum, 2009). However, especially in Bad Frankenhausen, the determination of vertical gravity gradients would require a great effort and it is a question of time and costs as well as the constraints in accuracy in urban areas. Furthermore, it would be of course also sensitive to near-surface hydrological mass variations in a strongly-disturbed and heterogeneous subsurface.

We keep this interesting point of discussion in mind and we will include it in the conclusion of our manuscript.

Eppelbaum, L: Application of Microgravity at Archaeological Sites in Israel: Some Estimation Derived from 3D Modeling and Quantitative Analysis of Gravity Field, 22nd Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP), 434-446, 2009.

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