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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Railway deformation detected by DInSAR over active sinkholes in the Ebro Valley evaporite karst, Spain" *by* J. P. Galve et al.

Anonymous Referee #2

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The paper describes an experiment regarding the monitoring of a part of a railway line in Spain, affected by subsidence phenomena, through multitemporal synthetic aperture radar interferometry (MTInSAR, or MTI) techniques. The monitoring uses both C-band ENVISAT ASAR, and L-band ALOS PALSAR data. Although the monitoring of subsidence through MTI techniques is nowadays in practice an operational type of application, the specific field of terrain instabilities due to sinkholes or other karst or evaporite-type terrain poses specific challenges due to the temporally elusive nature of the phenomena in the general cases. Also, monitoring of railways and other linear infrastructures poses other types of problems to MTI techniques, due to their 1-D nature.

These limitation require specific, often ad-hoc measures to render MTI results useful. In this respect, reports of successful applications of MTI to these monitoring problems appear particularly interesting and worth publishing. The specific problem of detection of precursory movements connected with sinkhole failure remains still unsolved, despite some evidence of the possibility of detecting precursor compaction of certain types of sinkholes characterized by the presence of overlying depositional material. This seems to be definitely the case in the test sites studied in this paper, however the general problem could be at least mentioned in the introduction to provide a more objective view of the problem.

The paper is generally well-written, with a few places where language could be improved for better understanding.

From what can be inferred from the manuscript, the data used in this paper seem in part the same data used in Galve et al. (2015), i.e. ENVISAT ASAR and ALOS PALSAR time series. However, the present paper concentrates on the PS and SBAS pixels detected specifically on railways, whereas the investigations in Galve et al. (2015) were generally devoted to other sinkholes spread in the same area.

Data analysis appears convincing, as all reported evidences of moving PS or stable SBAS pixels can be related to the presence of cavities. The discussion, just hinted in the conclusions, about the efficiency of DInSAR techniques in detecting subsidence areas, is indeed interesting and still open. It is also considered in the conclusions in Galve et al. (2015). So, devoting some more space to this issue would be interesting in my opinion. In particular, it would be interesting to know how much of the railway network present within the investigated area presented useful PS or SBAS-stable pixels to be analyzed for subsidence. Reasons for the low efficiency generally reported in literature (critical role of orbital angles, resolution, etc.) are correctly cited in the discussion, so it would be interesting to compare the figures found here. A closely related aspect is the occurrence of false alarms: did the data analysis evidence points with apparent subsidence, but which revealed no movement to a more accurate (in situ)

survey? For example, the few points showing subsidence rates beyond the thresholds in the profiles in Fig. 3, and not spatially related to the known sinkholes (say, the points at about 2900 m and 3600 m in profile 2). Can they be ruled out as false alarms?

Other points which could deserve a better explanation:

- how were the two profiles in Figs. 1 ad 3 obtained? In Galve et al. (2015) profiles are shown as hollow rectangles, rather than 1-D lines, so it can be inferred that all points falling within the rectangles were considered. Is the same methodology used here? If this is the case, how wide were the rectangles?

- it is not sufficiently clear, in my opinion, why only ALOS data were available over profile 1, while only ENVISAT data were available on profile 2. From the data description, both sensor time series are acquired in ascending geometry, so orbital configuration seem comparable in the two cases. Is it a matter of spatial coverage? Or, could it be related to different incident angle in the two time series? (By the way, incident angles are not mentioned in the text). Or wavelength?

Specific comments:

Page 3973, line 20: "For ENVISAT data, despite the strong backscattering of the railway, motion may not be recorded using PS method due to the multiple scattering of the different surfaces."... the meaning of this sentence is not clear, can you rephrase?

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 3967, 2015.