

Dear Reviewer

We would like to thank you for your valuable comments that helped us to improve our paper. Please find below our detailed reply to your comments presented in bold font.

Best regards,
Samsonov et al.

SPECIFIC COMMENTS

1. In the abstract you wrote that the smallest residual was achieved in case of sill model using both, ascending and descending data, but it is not true. I agree on the more robustness of the joint inversion models (indeed no outliers were produced) but you obtained the smallest residual in the case of sill sources and ascending orbit data (as shown in table 2).

Reply: We clarified the abstract as follows: “The sill source model produced the smallest residual of 0.7 cm/year applied to ascending interferograms and 0.9 cm/year applied to descending interferograms. A residual of 1.0 cm/year was achieved with the sill model when both, ascending and descending, interferograms were used.”

2. Introduction: I did not well understand when you write that the “typical spatial resolution of InSAR measurements is 1-10 m”. The spatial resolution depends on the used data (for example ENVISAT and ERS provide an about 4x20 m spatial resolution) and on the chosen multilook factors. Please could you explain better?

Reply: We modified the text accordingly. Our intention is to describe the typical resolution of current SAR sensors. We now expanded the range to include modern sensors: 1-20 m resolution for 10x10 km to 300x300 km coverage. Of course, resolution of the output products can be reduced by multilooking but we intend to report the best possible resolution (as a range for different sensors).

3. Data processing: Did you fixed also a maximum temporal baseline in the interferogram generation?

Reply: We did not intentionally limit the temporal baseline but it happened naturally because images with longer temporal baselines were incoherent and were not used in this study. All interferograms except one had less than a 12-14 month time span.

4. Data processing: Why did you choose these multilook factors? I know that the GAMMA software works well with squared pixels. Maybe it would have been better to use different multilook factors, for example for the MF3F data you could have used 7x5 in order to have a pixel spatial resolution of about 20x20m. I never work with RADARSAT-2 data so I would like to know if there is some reasons to work with no squared pixels.

Reply: Our intention was to achieve, after multilooking, a square image of about 2000x2000 pixels. We could select slightly different multilooking, which probably would produce similar results, since we do not exploit high resolution details due to the simple models and deep location. Since coherence is inversely proportional to the square root of multilooking, we tried to select as coarse a resolution as possible, sufficient for describing our signal and achieving high coherence.

5. Results: Why do not you use the cumulative displacement as input for the modeling? Could you exploit a single interferogram converted to ground displacement and scaled to annual rates because the trend is quite linear? Please comment on this.

Reply: We intentionally demonstrated in Figs 2-3 that the interferograms used for modelling accurately describe the observed phenomena, in both the temporal and spatial domains. The quality of these interferograms is superior to the quality of all other interferograms put together. On average, the coherence of individual interferograms was very poor. Half of the year this area is covered by snow and also is affected by seasonal changes due to agricultural field development, foliage, flooding and shallow groundwater. It was quite an effort to produce the MSBAS time series presented in Fig 3, using advanced filtering, phase unwrapping, filling gaps by interpolation etc. Still most interferograms were partially incoherent. By analyzing individual interferograms and producing the MSBAS time series, we concluded that modelling based on two highly coherent interferograms is more accurate and more reliable than modelling MSBAS cumulative deformation or rates.

We performed the analysis exactly as reviewer recommends in the second part of this question, we exploit a single interferogram (one ascending and one descending) and scaled it to annual rates because the trend is quite linear. Also, the MSBAS results presented here show only vertical motion. The east-west motion was calculated and not shown here, and the north-south component is not estimated at all. Therefore MSBAS results are inherently of lower precision than original InSAR data for the purpose of modelling deformation.

6. In table 1 could you explain the way to estimate the angle alpha?

Reply: We used satellite azimuth (angle alpha) in the metadata provided by the satellite operator. We now improved the precision of both angles in Table 1, before they were rounded up.

7. In figure 8 you show two different plots for the simulated deformation rate based on joint inverted best-fitting parameters. I think this is due to different source location in the case of ascending and descending data. Can you confirm it? please say something about this in the caption. Obviously the same is for figure 9.

Reply: Simulated interferograms correspond to the same two sources; however, images (b) and (e) appear different because of the conversion of 3d displacements to the line-of-sight geometries, ascending (b) and descending (e). These images are different because the total motion consists of horizontal and vertical components.

8. Is the sill source a good source model to justify a deformation occurred due to mining deposits? Could you add something on this?

Reply: We wrote the following to address the suitability of the sill model to mining operations (in the last paragraph of results section): “Although the actual shape of underground mine is unknown, it seems logical to assume that its vertical dimension (height) is smaller than the horizontal dimension (radius or width and length), resembling a sill-shaped model.”

TECHNICAL CORRECTIONS

Abstract, line 11: I suggest to write “...April 2010 thanks to particularly...”

Reply: Corrected as suggested.

Introduction, 5883, line 9: I would write in the following different way: “Subsidence produced by earthquakes, mining collapses and sinkholes generated by karst processes is usually spatially and temporally localized...”

Reply: Corrected as suggested.

Results, 5890, line 9: “than in the ascending one”

Reply: Corrected as suggested.

Figure 2: Please add a spatial scale

Reply: Spatial reference was added as suggested.

| Figure 4d, 5d, 6d, 7d, 8g, 8h, 9g, 9h: Please add LOS deformation rate on the vertical axis name

Reply: We added a new label to these figures as suggested.