

Deformation Studies in Warsaw Using Persistent Scatterer Interferometry based on COSMO-SkyMed and ENVISAT Data



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The poster presents selected results of the project “The integrated system of surface deformation monitoring based on Persistent Scatterer Interferometry, measurements from permanent GNSS stations and precise levelling”. The main aim of the project is to create integrated system for monitoring ground deformations caused by man-made factors, based on radar satellite interferometry (PSI), permanent GNSS stations and precise levelling.

Study area and data

Warsaw agglomeration is characterized by complex geological structures and by various ground deformations. Some of them are geological-based large-area deformations. Additionally there are many places of local man-made subsidence caused by the construction of new apartments and office buildings, metro lines and other underground works. Many of local deformations are located close to the natural or artificial escarpments.

The presented work was based on the two sets of radar data. History of movements of earth surface in Warsaw agglomeration in the period 2002 – 2010 was re-created on the basis of analysis of archival radar images collected by ENVISAT satellites derived from various ascending and descending orbits. High-resolution COSMO-SkyMed stripmap images registered in the period 2011 – 2016 were used both for analysis of large area and local deformation in the study area.

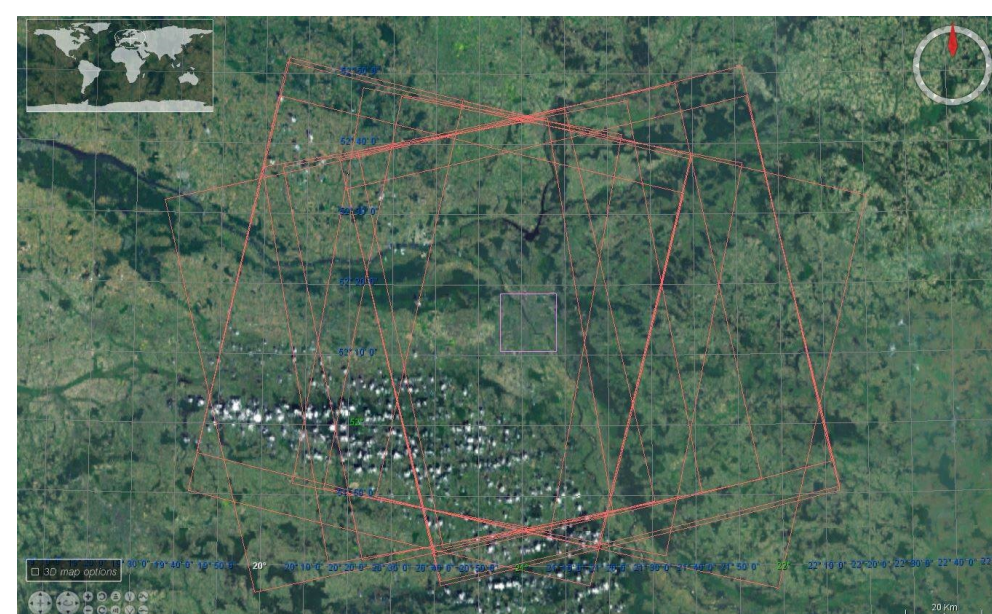
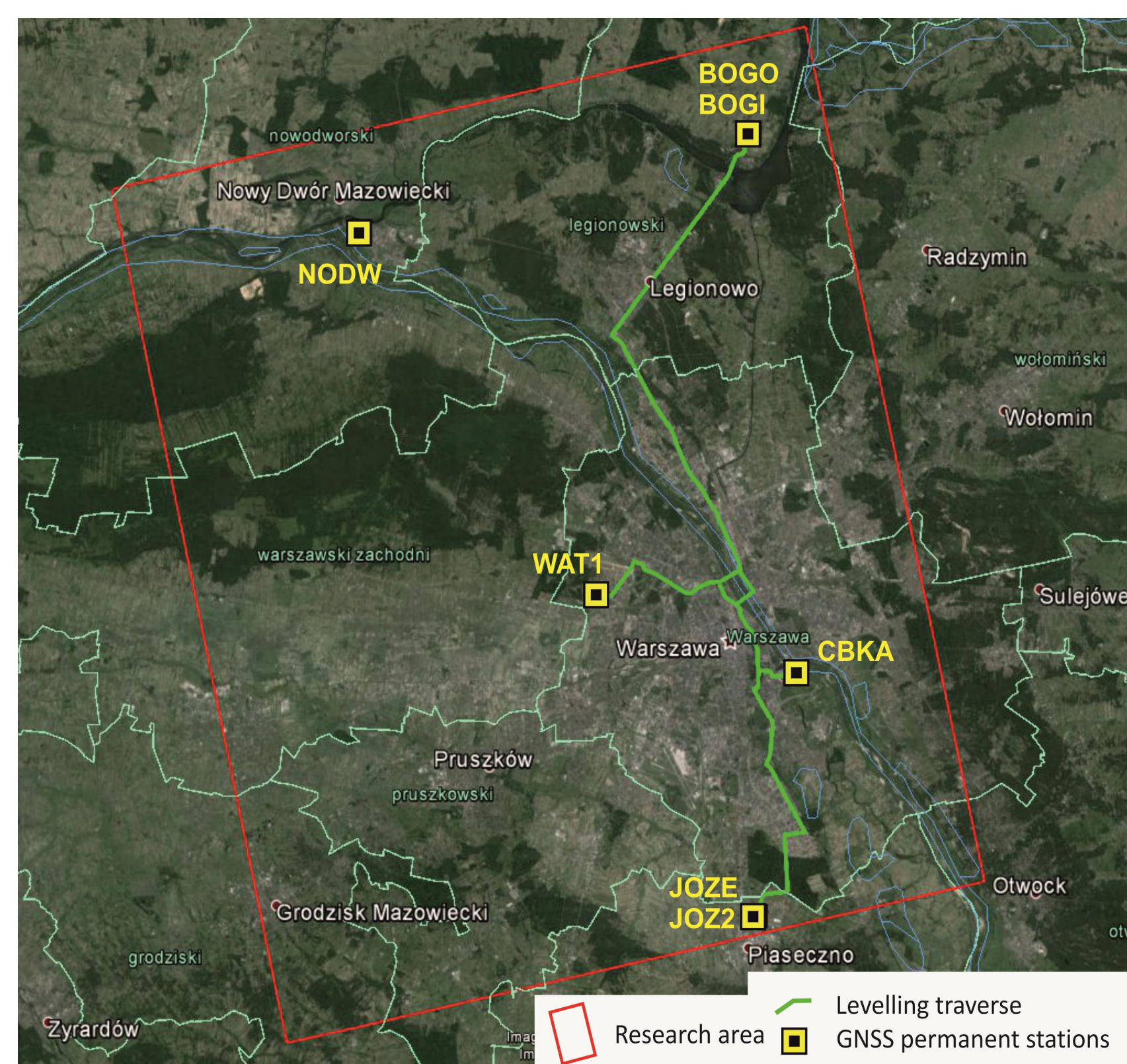


Fig. 1 Study area. Footprints of ENVISAT images registered from various orbits.

Fig. 2 Study area. Footprint of Cosmo-SkyMed images.



Validation

Results of interferometric analyses are validated using measurements from permanent GNSS stations located within the study area and with the use of large archival database of precise levelling measurements and present measurements (including long levelling traverses between permanent GNSS stations). Results gathered from three techniques are analysed jointly, referring to complex geological structure and man-made movements.

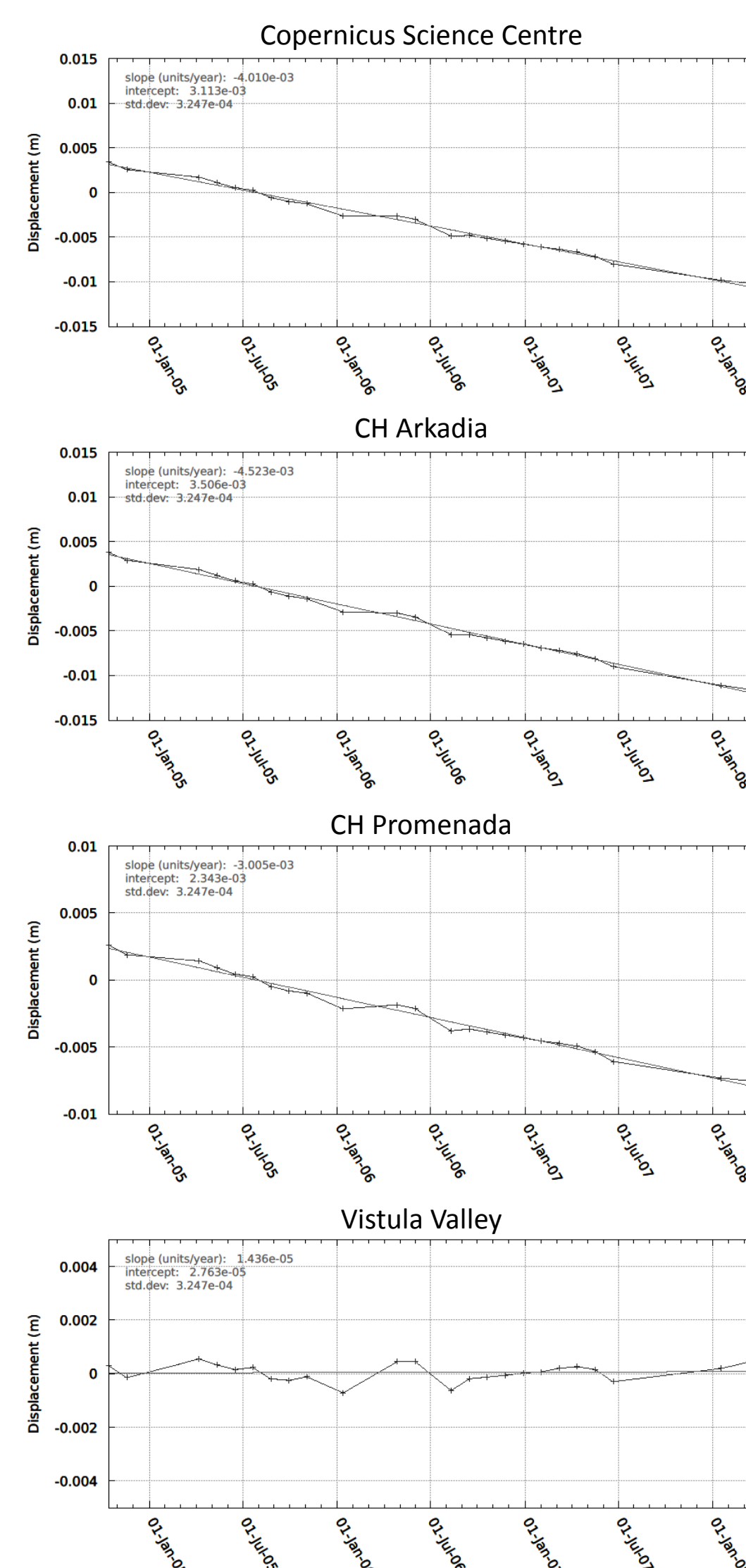


Fig. 3 Locations of precise levelling measurements from the period 1992–2015.

Results and analysis

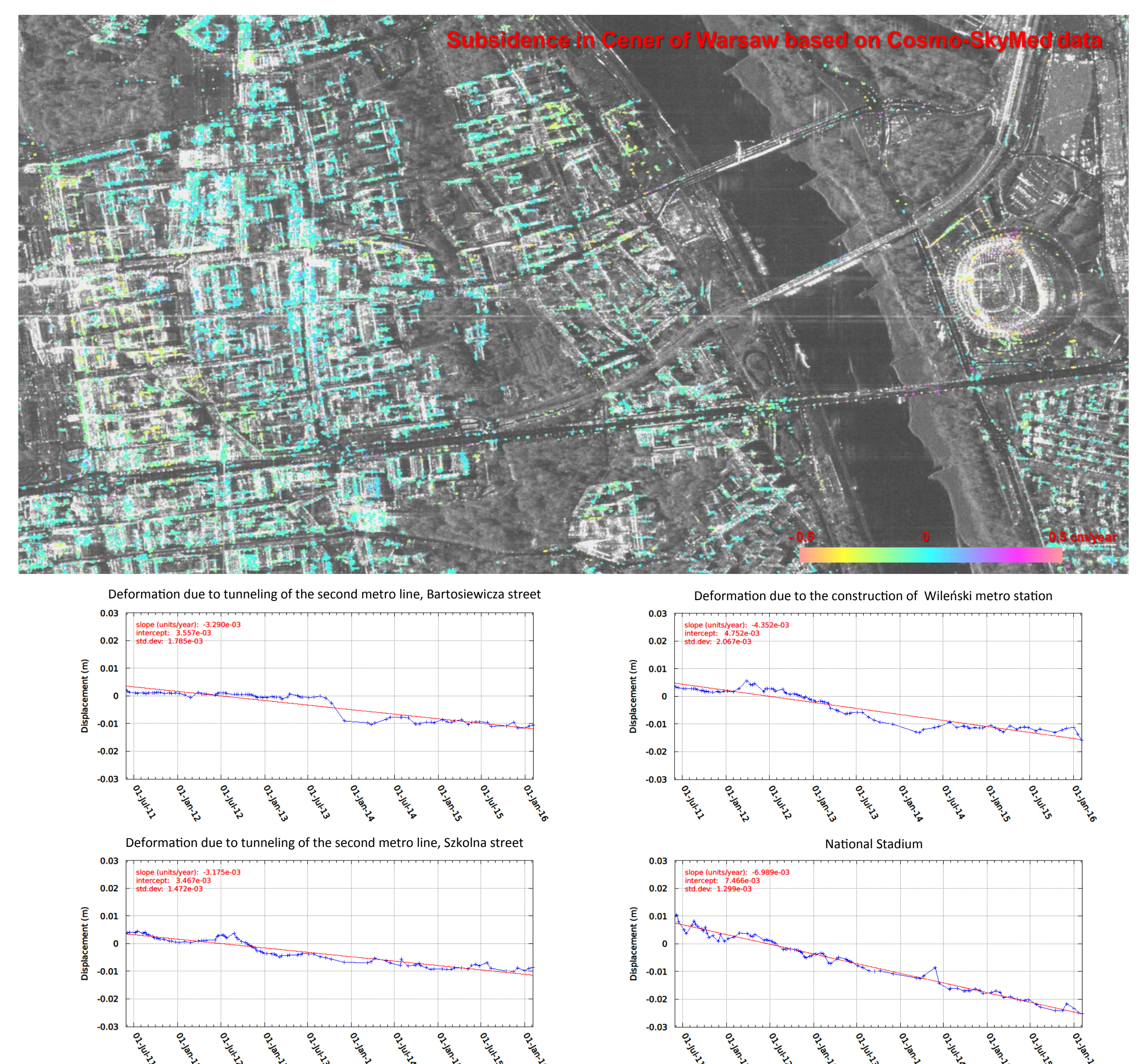
ENVISAT

The conducted research indicates a limited possibility to use ENVISAT data for subsidence studies in Warsaw agglomeration. The radial shape of the agglomeration outside of the main part of the city and a large amount of vegetation within the city was the main obstacle. As a consequence of this situation there were problems with correct phase unwrapping especially in the external districts of the agglomeration, low density of persistent scatterers and problems of applicability of some methods of selection of candidates for persistent scatterers. Small set of data from the certain orbits was the other obstacle. As a consequence many local deformations which existed within the study area were omitted and there were difficulties to obtain the correct results for the whole study area. Despite of this some places of local subsidence were correctly identified and measured.



COSMO-SkyMed

The results obtained using COSMO-SkyMed data show many local man-made deformations existing within the study area, related to construction of first and second metro lines, new buildings and with location of some constructions very close to the natural and artificial escarpments. Some of deformations were not known before of this study. Identified subsidence was up to 1 cm/year. There was also a possibility to identify some large-area deformations within the study area. The reasons of their existence are under investigation.



Acknowledgements

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