DInSAR applications for deformation monitoring

Delia **Teleaga**[1] , Valentin **Poncos**[1], Juerg **Lichtenegger**[2]

[1]Advanced Studies and Research Center (ASRC), Bucharest, Romania

[2] ESA EDUSPACE, Zurich, Switzerland

www.asrc.ro

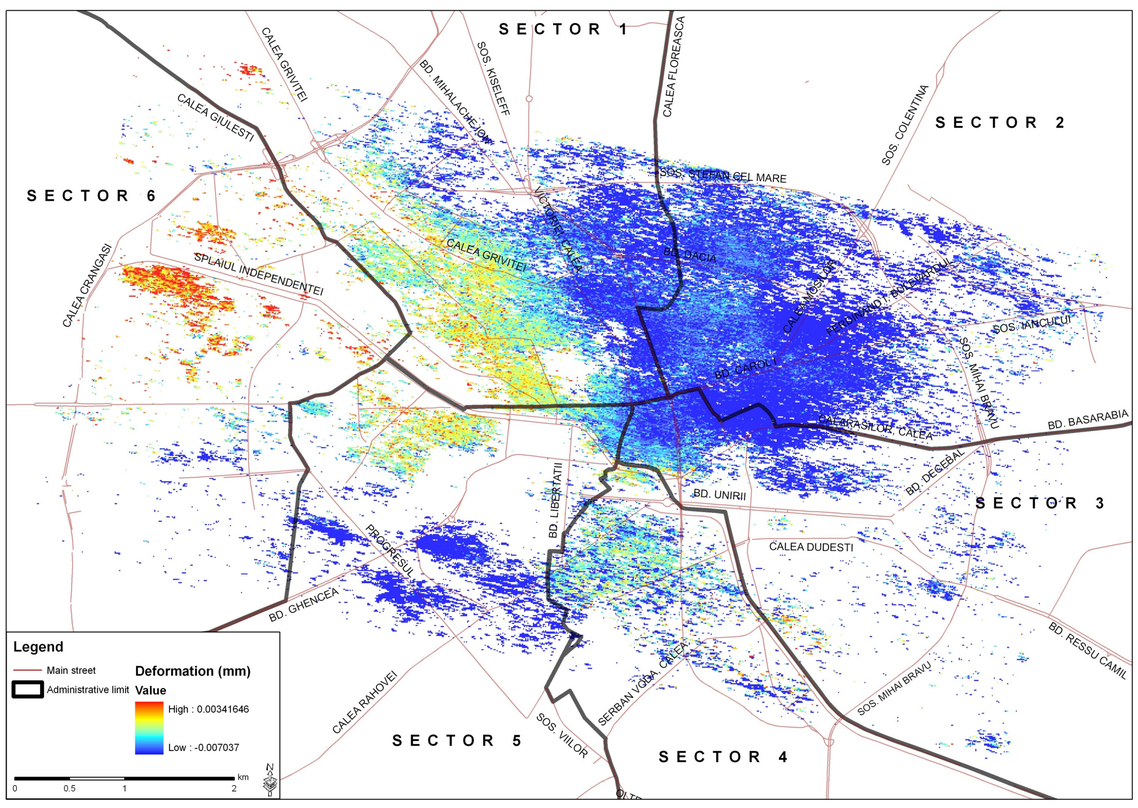
delia.teleaga@asrc.ro
valentin.poncos@asrc.ro

Introduction

Differential Synthetic Aperture Radar Interferometry (DInSAR) is a remote sensing technique used to detect ground displacements up to millimeters accuracy. The advantage of DInSAR over other methods is the continuous coverage of the measurements area. This particularity of the technique is useful to detect ground motion without apriori knowledge of a site, thus it also serves as an indication for the optimum installation of conventional monitoring tools (GPS, leveling) if needed.
Here, DInSAR was applied to monitor various sites like urban, glaciers and landslides.

Urban site: Bucharest, Romania

- 43 ERS 1/2 images from a descending pass between 1992 and 1999 (ESA Cat-1 project).
- high density urban area, for which traditional measurements of subsidence are missing.
- small baselines stacking approach: select only combinations of interferograms with perpendicular baseline < 10 m.

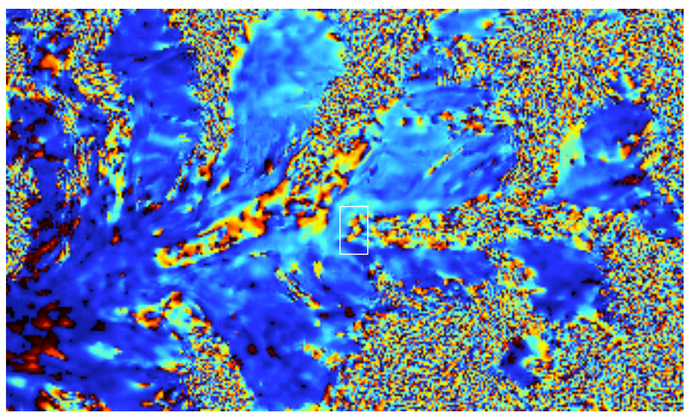


Deformation map of Bucharest obtained from interferograms with perpendicular baselines smaller than 10 m

Glacial site: Imja Lake, Himalaya

- two ENVISAT images acquired at 10th of January 2009 and at 14th of February 2009 (ESA Cat-1 project).
- compute a differential interferogram, using a 30 m resolution DEM supplied by ICIMOD, Kathmandu/Nepal.
- the 2km long glacial lake of Imja at 5000 m altitude is a potential danger for people, animals and infrastructure down-valley, as the lake could produce a catastrophic flash flood. The steep side moraines are unstable and with an earthquake may collapse and provoke a tsunami.

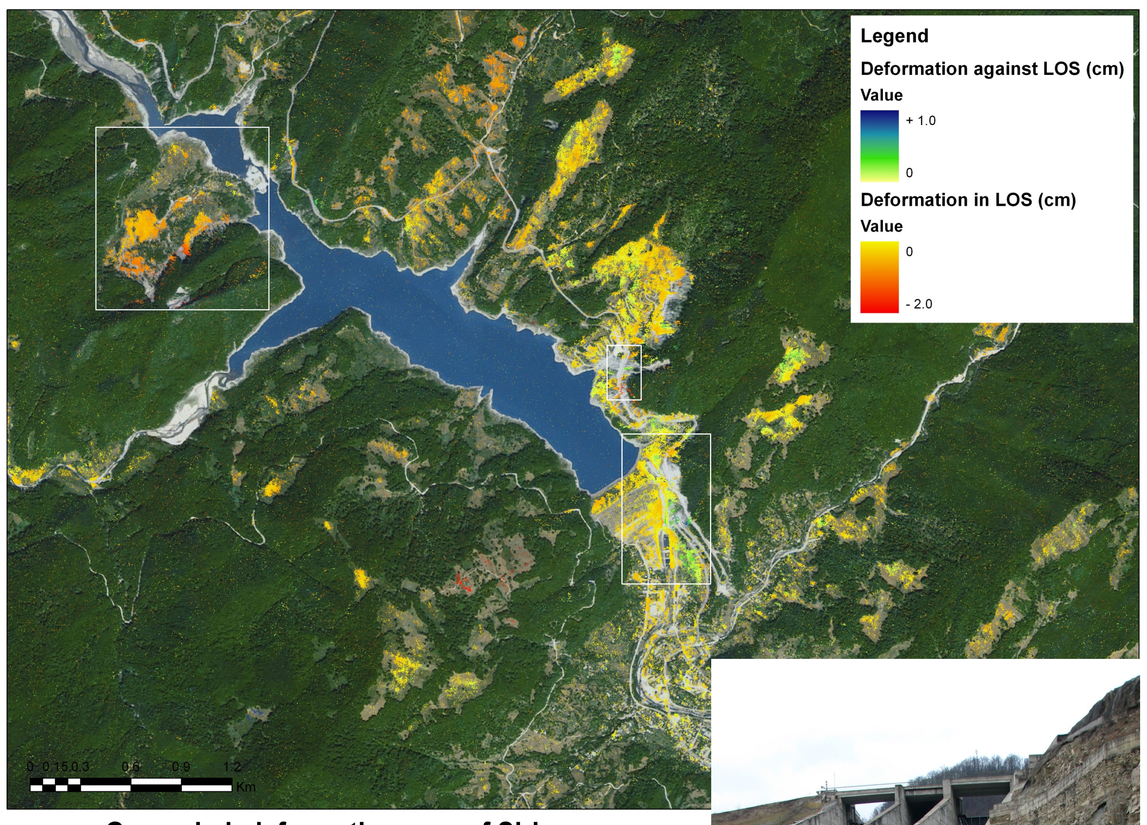
Differential interferogram over the Himalayan glaciers around the Imja lake, showing deformation rates up to 2 cm in 35 days.



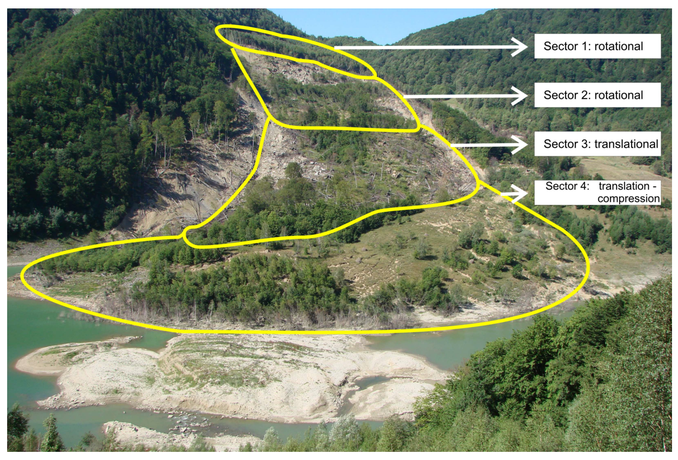
Ice covered by ground moraines at the western end of the lake. This part also shows a movement in the interferogram probably due to the melting process. It could result in a lowering of the terrain and hence a rapid lowering of the lake level.

Waterdam site: Siriu, Romania

- the waterdam construction triggered slopes instability that led to one major landslide blocking the lake and other landslides affecting the main roads and the waterdam infrastructure.
- two TerraSAR-X High Resolution Spotlight images at 11 days temporal distance from September – October 2009 supplied by Infoterra GmbH, Germany were used.
- with DInSAR a number of instable sites were detected. It was shown that the major landslide is still active, the road is moving in two main regions due to the slopes activities and the waterdam infrastructure is also affected by yet another slope movement.



Geocoded deformation map of Siriu area displayed over an optical image



Morphodynamical sectors of the landslide

Deformation of the waterdam infrastructure due to the slopes instability

Road affected by a landslide. It can be seen as coherent on the deformation map, except the two new landslides (gray) that occurred in between the acquisition dates. According with the InSAR measurements, the left side of the landslide is stable, the middle part (between the new flows) is moving slightly, while the right side is very instable, moving with 2 cm in 11 days.

Acknowledgements

- the interferometric processes were performed with the DORIS software developed at the Delft University of Technology.
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