Space based monitoring and analysis of the backscattering mechanisms and related displacement observed in the Danube Delta

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Introduction

Alos PalSAR imagery from 2007 – 2009 is used with different purposes in the Danube Delta geosystem, e.g. detection of areas with flooded vegetation and measurements of the water level changes in these areas, detection of areas with ground level humidity variation (in porous or uncompacted rocks) and estimation of depth changes of the dry/moist surface, ground subsidence/uplift, indirect measurements of crustal motion in areas with compacted rocks, and beach erosion levels.

Single backscattering mechanisms and ground displacement related to tectonics

From the average deformation map over 2007-2009, the areas which remained coherent over 2 years may be extracted and their motion analyzed (Fig. 1). It seems to be a correlation between the DInSAR displacements and the tectonic faults overlapping Danube Delta (Fig. 2).

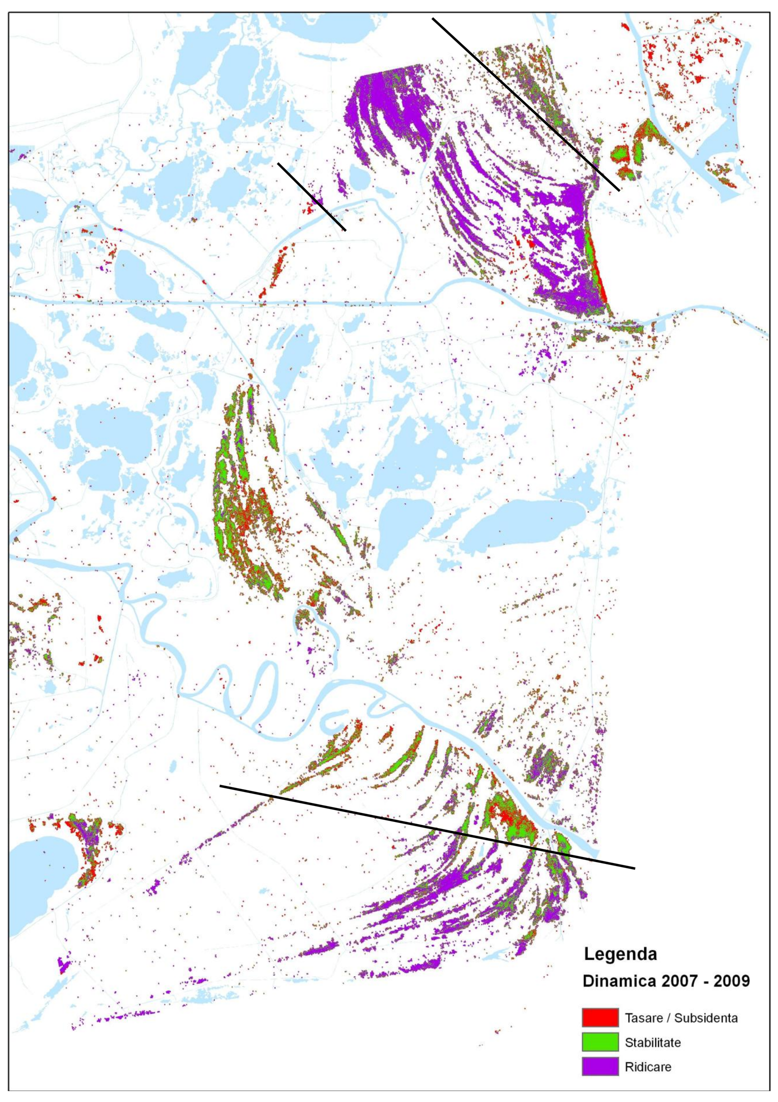

Fig. 1 Radar map showing the trend of the ground motion in the Danube Delta between 2007-2009. With black there are drawn 3 discontinuity lines, which may indicate effects of a tectonic motion. These lines does not match perfectly, but there is a good similarity with the tectonic faults present in this region (Fig. 2).

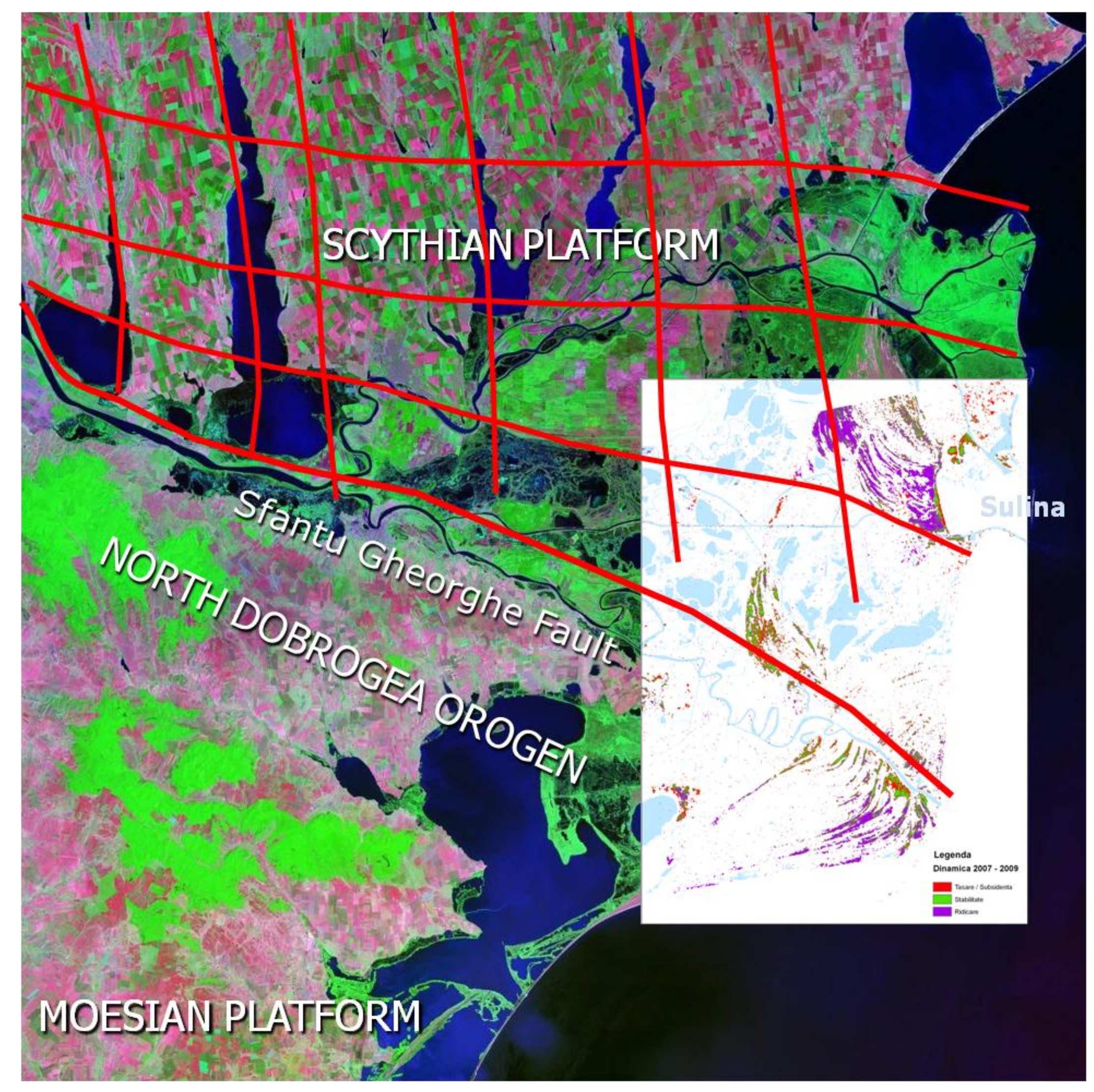

Fig. 2 The deep structure of the Pre-Dobrogea Depression is defined by the intersection of two major fault systems: a system of WNW - ESE trending, parallel faults and a N-S trending system.
The radar map from Fig. 1 is superimposed on this tectonic map.

Double bounce backscattering mechanisms and water levels variations, indicators of a water flow gradient

Most of the regions in Danube Delta are flooded areas covered by vegetation. Due to the double bounce mechanism [1], which is working very nice with PalSAR data in such kind of areas [2], water levels variations and water flow directions may be studied (Fig. 4, 5).

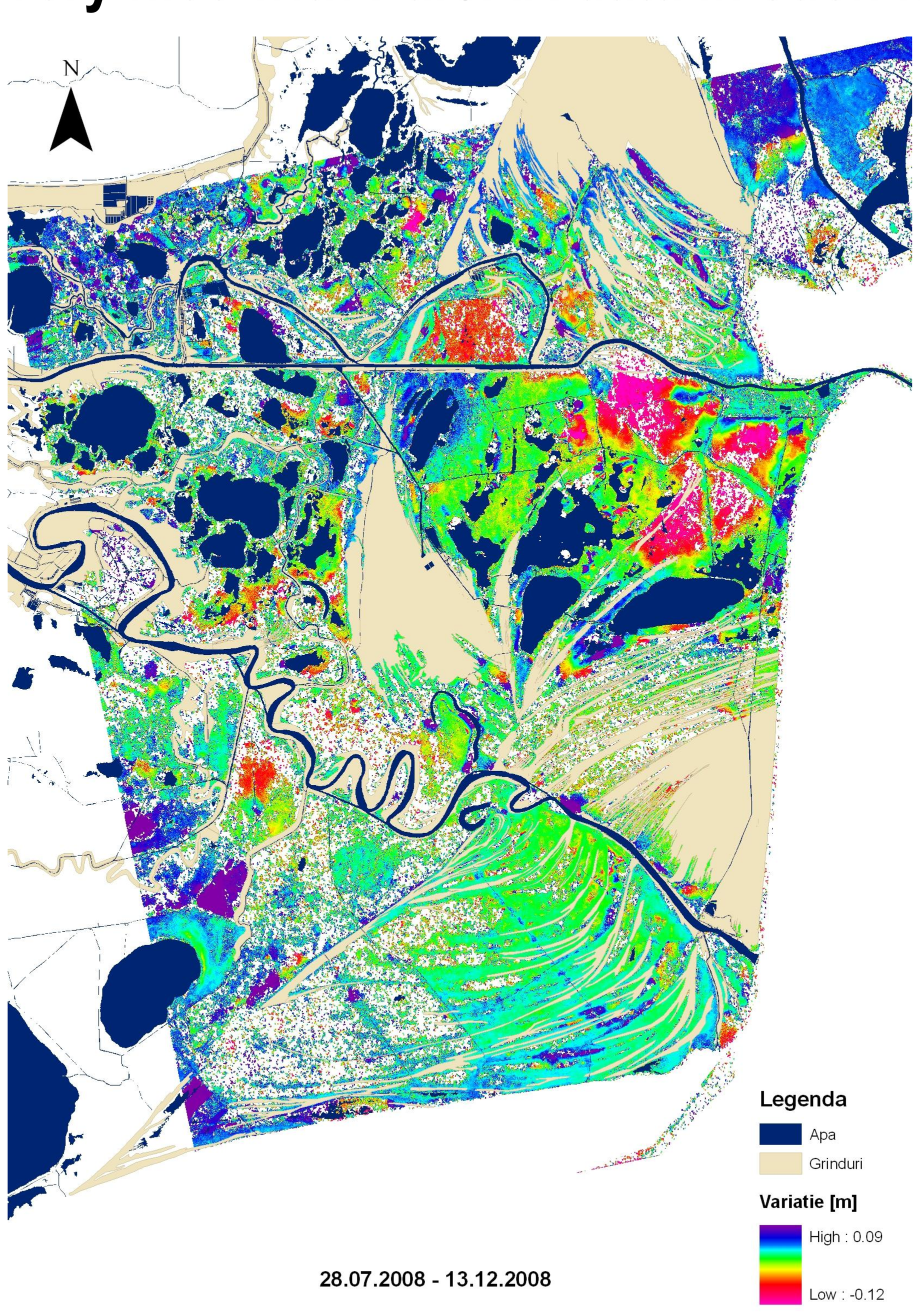

Fig. 4 PalSAR deformation map over Danube Delta, interpreted as water level variation map between 28.07.2008-13.12.2008

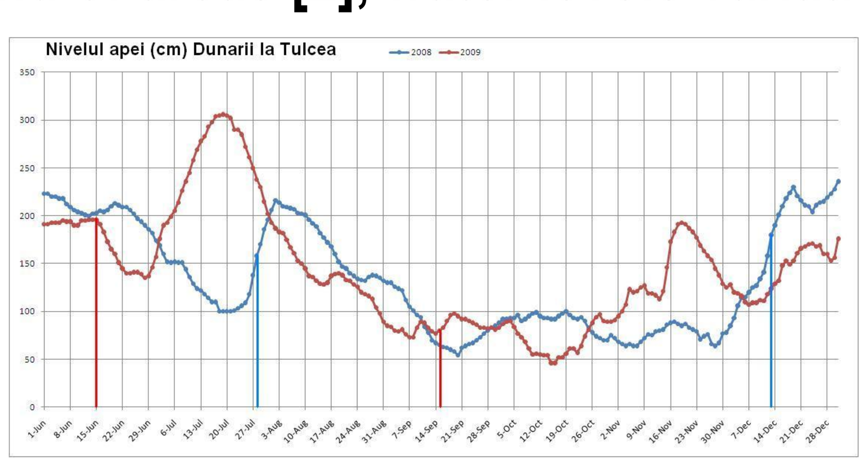

Fig. 3 Daily water levels of the Danube river measured at Tulcea, closed to our region of interest

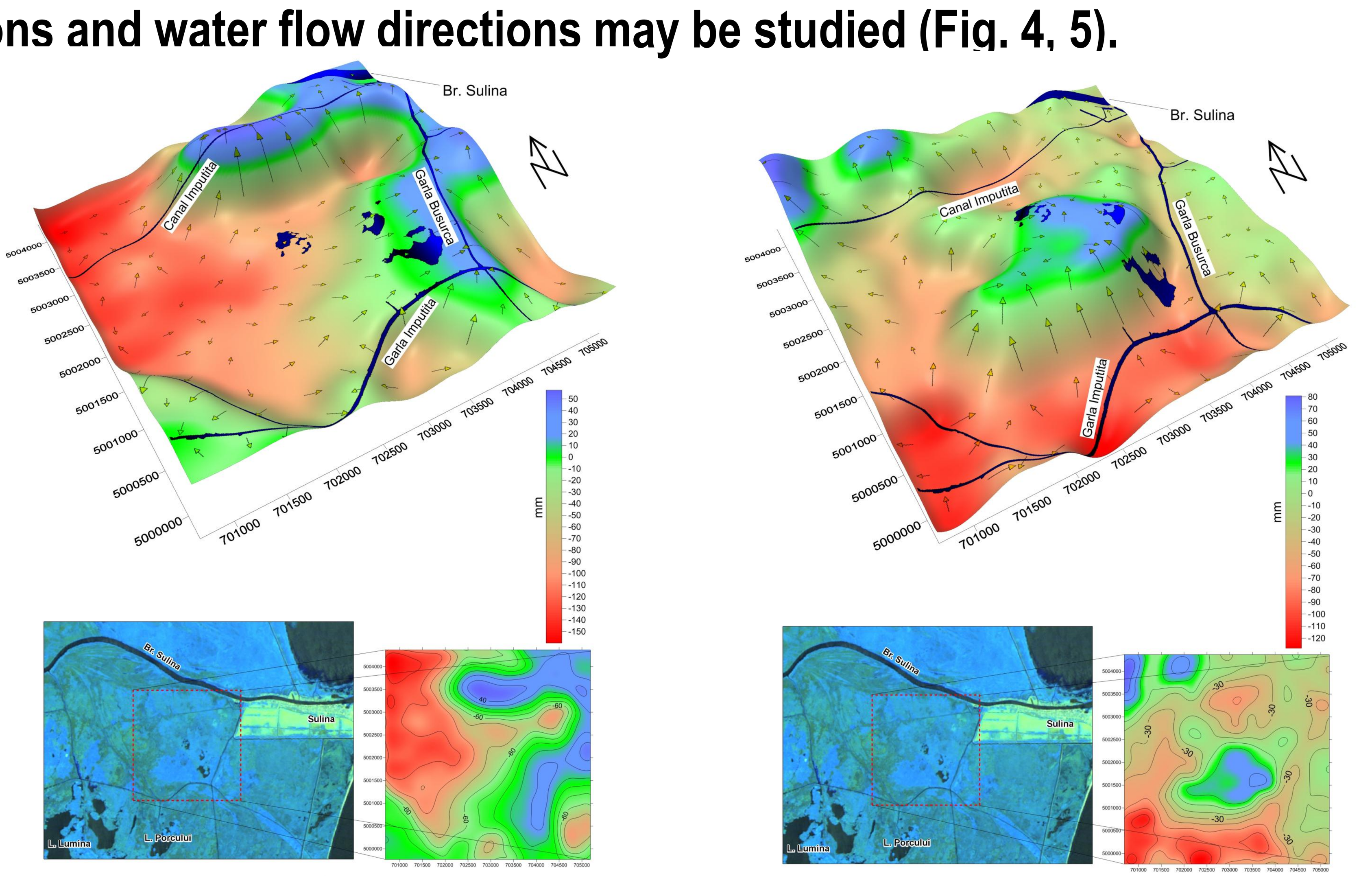

Fig. 5 Modeling of the water level variation in a test region, located West of Sulina, for 2 periods: (left) in 2008, when the water level of the Danube river increased from 158 cm (in Juli) to 180 cm (in December); (right) in 2009, when the water level of the Danube river decreased from 196 cm (in Juni) to 80 cm (in September)

Conclusions and Further Work

Danube Delta is dominated by water and sand bars with a relatively high dynamic and humidity variation. It was shown that PalSAR penetrates the sand levels and can measure displacements that seem to be correlated to tectonic activity. Also, on most of the flooded areas, the double bounce mechanism offers a way to measure water levels variation. This makes possible the calculation of water gradients and water flow direction. Presently, the sparsity of the measurements makes difficult to correlate them with a single flooding event and water dynamics. Periodic measurements with a short repetition interval are necessary to characterize individual flooding events and elaborate models.

Acknowledgements

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References

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