Spa**C**eborne SAR **I**nterferometry as a **N**oninvasive tool to assess the vulnerability over **C**ultural h**E**ritage sites

Athanasia-Maria Tompolidi[1], Issaak Parcharidis[1] , Constantinos Loupasakis[2], Michalis Fragiadakis[3], Pantelis Soupios[4],Eleni Grigorakou[2], Zeinep Achmet[3], Georgia Kalousi[5], Vasiliki Eleftheriou[6],Rozalia Christodoulopoulou[6],Dionysia Michalopoulou[6], Vassiliki Sythiakaki[7],Eleni Kanaki[7],Dionysia Mavromati[7], Panagiotis Elias[8],Theodoros Gatsios[9]

[1]Department of Geography,School of Environment, Geography and Applied Economics, Harokopio University of Athens, Greece
[2]Department of Geological Sciences, School of Mining & Metallurgical Engineering, National Technical University of Athens, Greece
[3]Department of Structural Engineering, School of Civil Engineering, National Technical University of Athens, Greece
[4]Geosciences Department, College of Petroleum Engineering and Geosciences, King Fahd University of Petroleum and Minerals, Saudi Arabia
[5]Terra Spatium S.A.,Athens,Greece
[6]Acropolis Restoration Service,Ministry of Culture and Sports, Athens, Greece
[7]Ephorate of Antiquities of Heraklion,Ministry of Culture and Sports,Heraklion,Greece
[8]Institute for Astronomy, Astrophysics,Space Applications and Remote Sensing, National Observatory of Athens,Greece
[9]Department of Geophysics-Geothermics, Faculty of Geology, National Kapodistrian University of Athens, Greece

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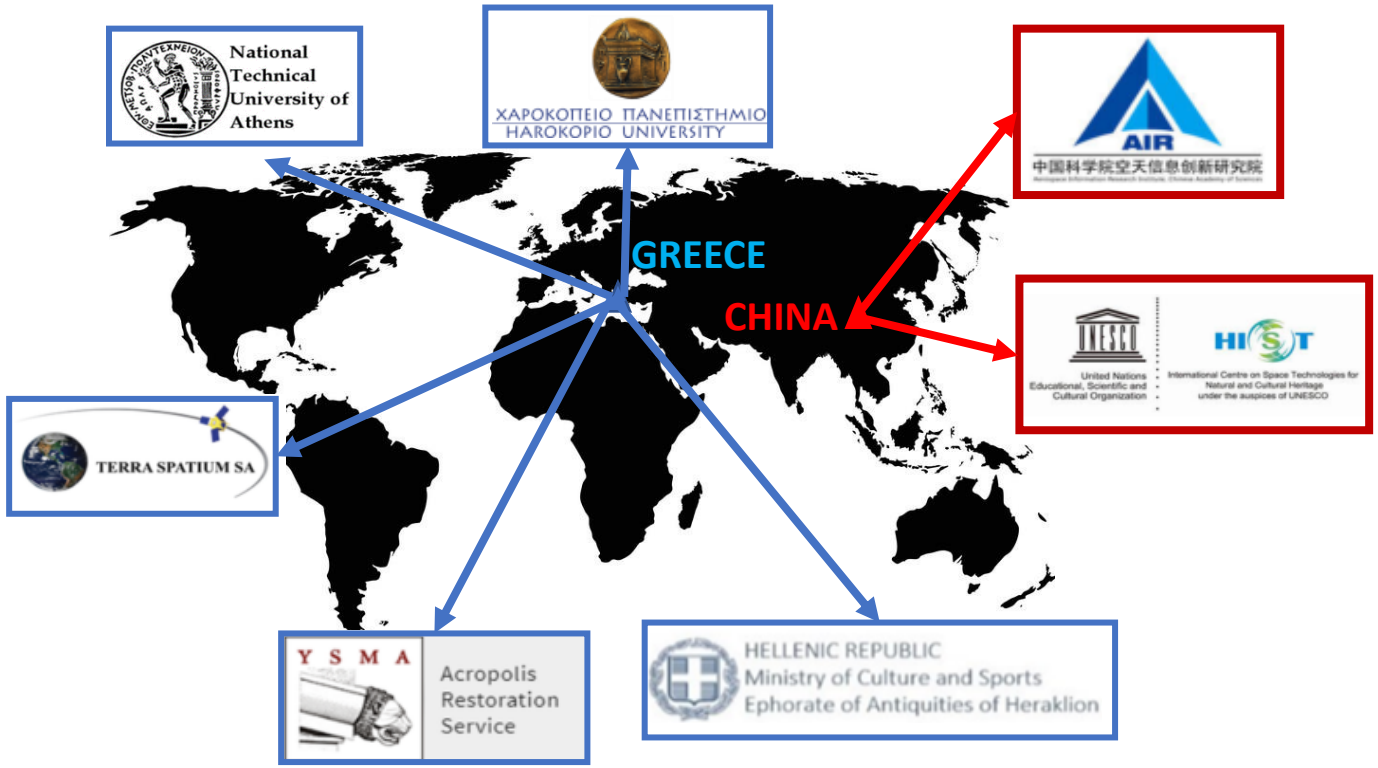
The Project

• The Consortium



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• Case Studies

GREECE

The Acropolis of Athens

''In UNESCO's World Heritage Sites List since 1987''

The Heraklion City Walls

''Among the best-preserved Venetian fortifications in Europe''

CHINA

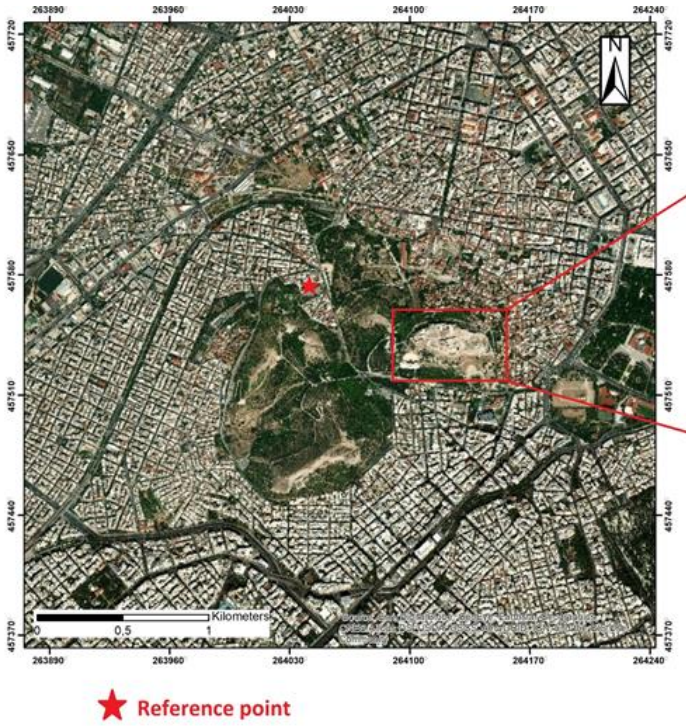
The Great Wall in Zhangjiakou

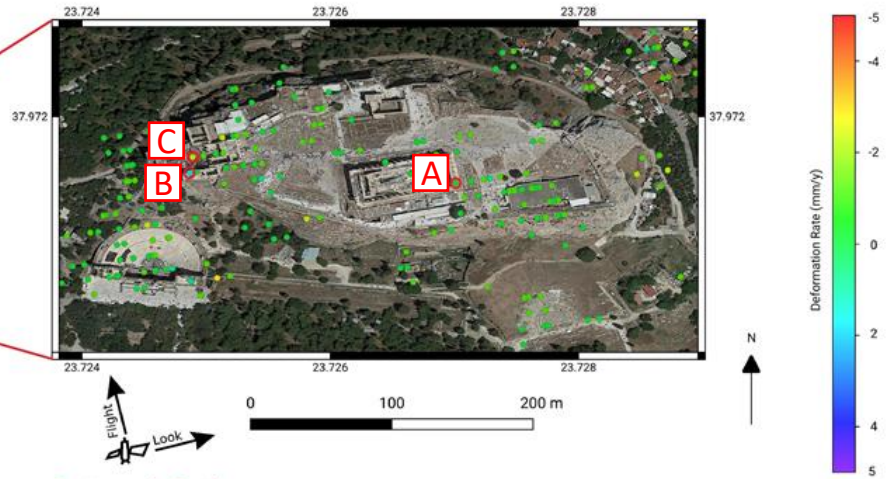
''Constructed in the period of the Ming Dynasty (1403-1487 A.D.)''

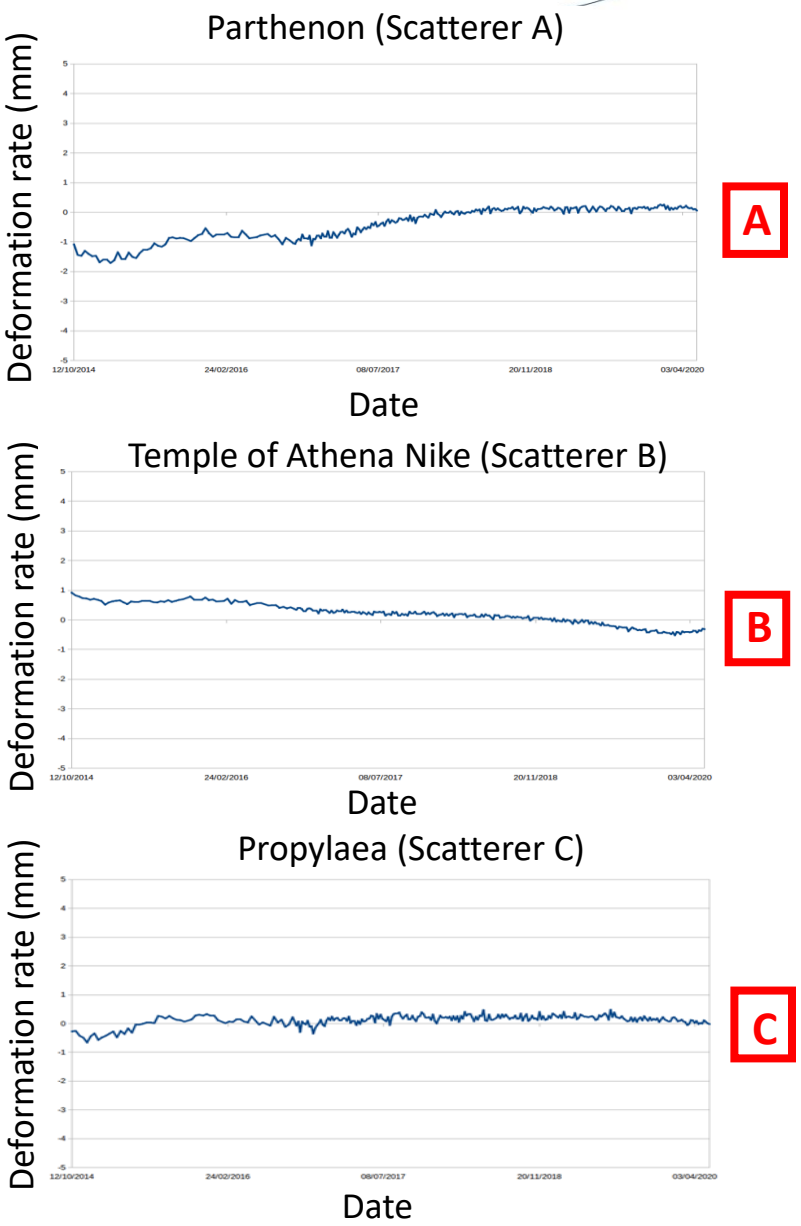
The Ming Dynasty City Walls in Nanjing

''Is considered as the longest surviving city walls in China''

Acropolis Case Study – Persistent Scatterers Interferometry(PSI)



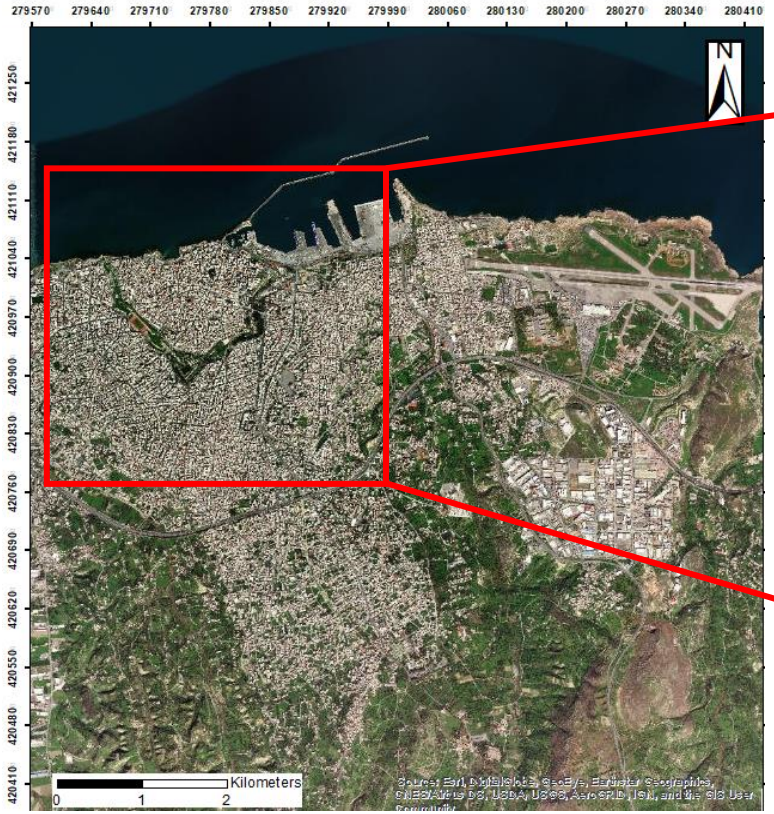


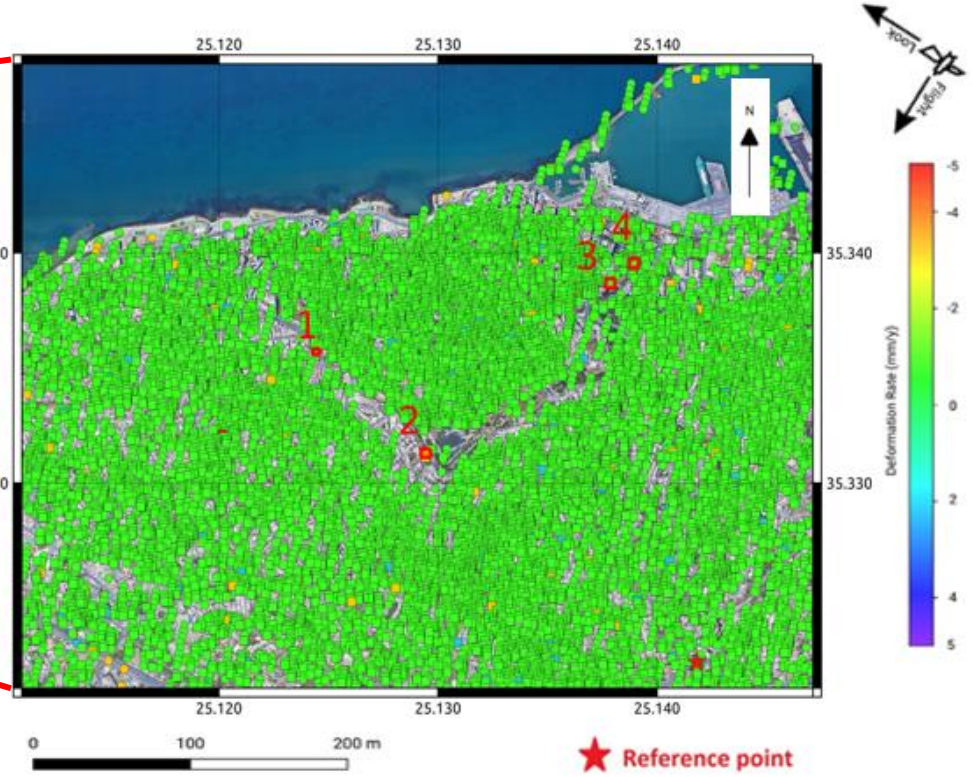


Location: The Acropolis Complex is located in the center of the city of Athens, Greece.
Geological background: lies upon two lithostratigraphic units of the Athens schist (upper Cretaceous) and the overlying Acropolis limestone (upper Jurassic).
Data: 274 Sentinel-1 SLC images (Ascending acquisition geometry).
Description of multitemporal deformation timeseries from October 2014-May 2020:

A) moves **towards** the Line-Of-Site (LOS)
B) moves **away** from the LOS
C) shows **stability** compared to Scatterer A and B

Heraklion City Walls Case Study – Persistent Scatterers & Distributed Scatterers Interferometry (PS/DS)



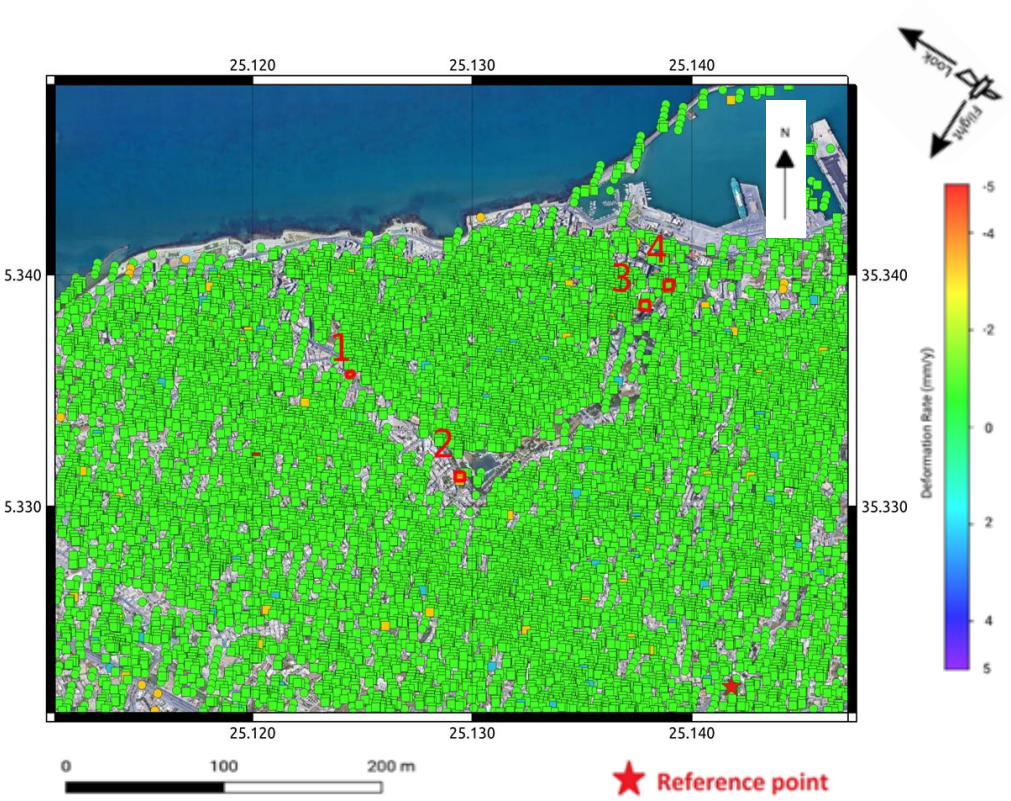


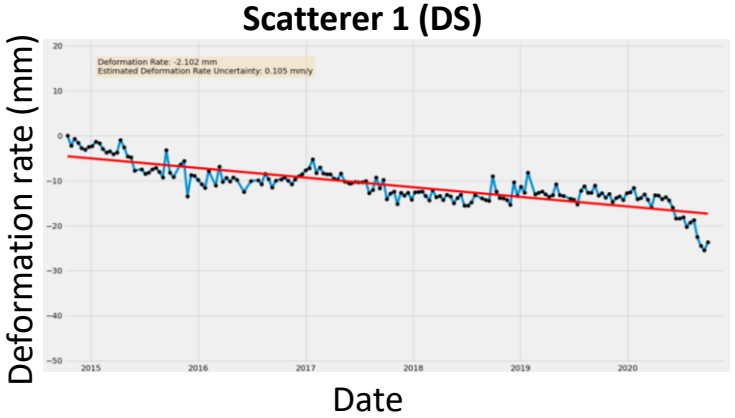
Location: The Heraklion City Walls is located in the center of the city of Heraklion of Crete, Greece.

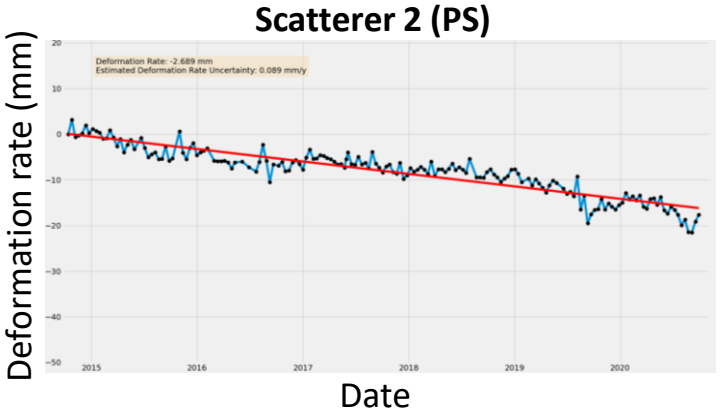
Geological background: lies upon pre-Neogene rocks form the alpine basement over which the basin's sediments have been deposited. Basement rocks comprise bodies of the upper nappes of Crete(Ophiolite, Pindos and Tripolitza nappes). Mesozoic to Eocene limestones occur in the margins of the basin and as isolated bodies within the basin. Eocene flysch sediments occur at its northeastern margins.

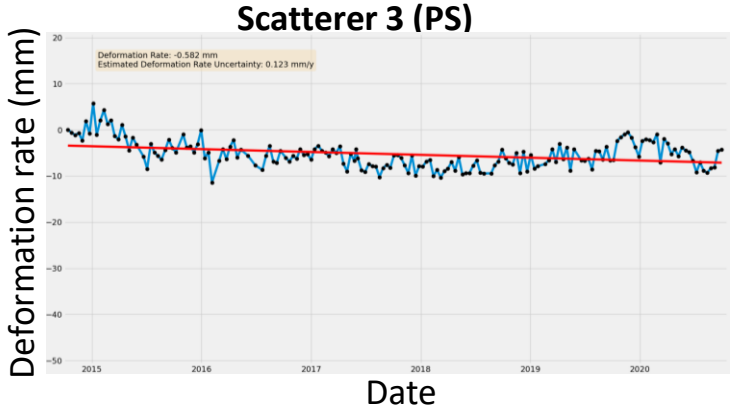
Data: 175 Sentinel-1 SLC images (Descending acquisition geometry).

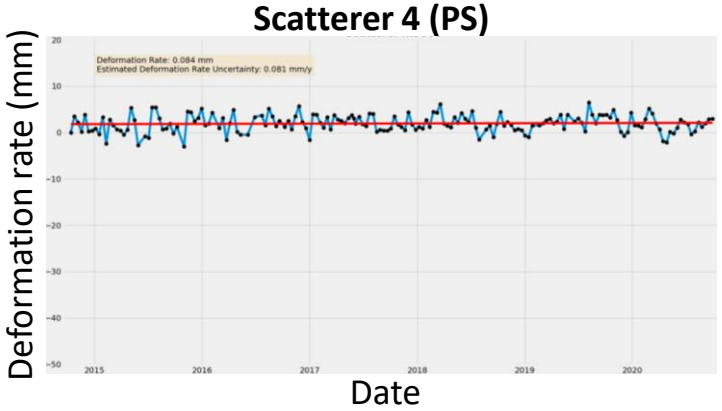
Heraklion City Walls Case Study – Persistent Scatterers & Distributed Scatterers Interferometry (PS/DS)











Description of multitemporal deformation timeseries from October 2014-September 2020:

1) + 2) move **away** the Line-Of-Site (LOS)

3) + 4) show **stability** compared to Scatterers 1 and 2

References

Chen F., Zhou W., Xu H., Parcharidis I., Lin H., Fang C., (2020) Space technology facilitates the preventive monitoring and preservation of the Great Wall of the Ming Dynasty: a comparative study of the Qingtongxia and Zhangjiakou sections in China, in **IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing**, doi: 10.1109/ JSTARS.2020. 3023297 (IF = 3.8).

Xu H., Chen F., Zhou W., Zheng W., Deng Y., Parcharidis I., (2020). Three-Dimensional Deformation Monitoring and Simulations for the Preventive Conservation of Architectural Heritage: A Case Study of the Angkor Wat Temple, Cambodia. ***GIScience & Remote Sensing***, (accepted in press), doi: 10.1080/15481603.2020.1871188 (IF = 5.9).

Tompolidi A., Fylaktos A., Gatsios Th., Parcharidis I., (2020). SCIENCE PROJECT: SpaCeborne SAR Interferometry as a Non-invasive tool to assess the vulnerability over Cultural hEritage sites. In Proc. **Safe Greece2020** - 7th International Conference of "New Technologies and Civil Protection.14-16 October 2020.

Fassoulas, C. (2001). The tectonic development of a Neogene basin at the leading edge of the active European margin: the Heraklion basin, Crete, Greece. ***Journal of Geodynamics***, 31(1), 49-70.

Zhang, B., Wang, R., Deng, Y., Ma, P., Lin, H., & Wang, J. (2019). Mapping the Yellow River Delta land subsidence with multitemporal SAR interferometry by exploiting both persistent and distributed scatterers. ***ISPRS Journal of Photogrammetry and Remote Sensing***, 148, 157-173.

Regueiro, M., Stamatakis, M., & Laskaridis, K. (2014). The geology of the Acropolis (Athens, Greece). ***European Geologist***, 38, 45-52.

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