



## RADARSAT-2 Multi-Incidence Angle Polarimetric Analysis Over The UNESCO Site Of Samarra (Iraq)

Nicole Dore (1,2), Jolanda Patruno (1,2), Eric Pottier (1), and Mattia Crespi (2)

(1) University of Rennes 1, Rennes, France (nicole.dore00@gmail.com), (2) University of Rome "La Sapienza", Rome, Italy

This work has as goal to study the microwaves behaviour over the archaeological structures still visible in the ancient properties of Samarra. This capital of the ancient Abbasid Caliphate is located in Iraq, in the Salah al-Din Governorate and has an extension of about 15,058 ha (buffer zone of 35,414 ha). Because of the big extension of the site, only three areas were taken into account for this research. These are (a) the Octagon of Huṣn al-Qadisiyya and other structures in the surroundings; (b) the reserve of al-Hayr, the racecourses area and Dār al-Khilāfa; (c) the city of al-Mutawakkiliyya.

Bigness of the structures, unstable political situation and agricultural expansion threats, that let the city of Samarra be inscribed in the UNESO list of sites in danger since 2007, gave a reason more to investigate this area.

The study was carried out by means of fine quad-pol images of the Canadian satellite RADARSAT-2, launched in December 2007. Despite C-band lower capability of penetration compared to ALOS PALSAR L-band, the choice of this satellite is due to its higher spatial resolution compared to the PALSAR one. Thanks to the higher spatial resolution and the location of the site in a semi desert area, we succeeded in identifying some archaeological structures already known from optical sensors and ancient aerial photographs.

The analysis focused on eight polarimetric images, four with a  $23^\circ$  incidence angle acquisition mode and four with a  $45^\circ$  incidence angle antenna configuration, acquired in a period spanning from April 2012 to July 2013. The difference between the angles was motivated, respectively, by the possibility of a higher penetration of the microwaves in the ground and by the higher possibility of double bounce response in the case of presence of buried structures. The time spacing, on the other hand, allowed a temporal analysis over different seasonal periods accompanied by meteorological conditions available on the web for the zone and of help in the discrimination among images with the same incidence angle configuration.

The potentiality of this SAR research for archaeology is well known, in particular for those areas of the World where surveys in situ are not allowed because of political instability (as in the case of Samarra), or for those zones in which a cloud cover is always present and where optical satellites cannot acquire as radar does in any kind of illumination and in any sky coverage.