

# *Use of space technologies for cultural heritage: the challenges and benefits for archaeology*

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## **Abstract**

We used here the term ‘space technologies’ as a user friendly term better understood by the non-specialists. In reality we are referring to the scientific and technological theme known by specialists as ‘geomatics’. Reason to use the term ‘space technologies’ is to facilitate the contact with archaeologists, who do not necessarily have a strong background in science, technology, engineering’s and mathematics.

Archaeological features can only be studied and documented in great detail working closely on these objects in the ground. However, the understanding of the cultural landscape on which the archaeological site was constructed, and the different natural and human made elements that constitute the archeological site, are better understood with a global view from above. This is one of the contributions of earth observation from space. Under certain conditions, radar satellite images, allow the identification of new archaeological features not clearly visible in the terrain by the human eye. Airborne LIDAR sensors that can, under optimal conditions, penetrate certain type of forests, are being used to detect archaeological features that are not possible to identify otherwise.

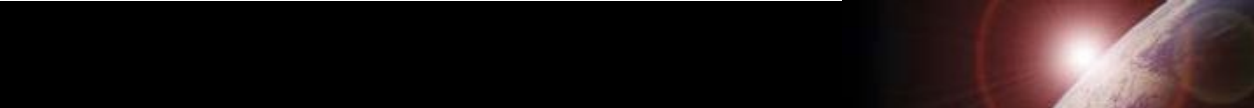
A complete documentation, interpretation and visualization of an archaeological site require an interdisciplinary group of experts working jointly. Earth observation from space (e.g. satellite images), in particular the recent high-resolution images, has

become a valuable support tool in archaeology. Satellite data, when combined with aerial data as well as with local data acquisition of the archaeological structures (e.g. laser scanning) constitute today the optimal set of data (digital data) for the documentation of archaeological sites and its associated cultural landscape. However, the technical and scientific skills to manage all this digital data are not within the archaeologist community.

The management of all the digital data produced by satellite images, airborne, remote control helicopters and/or laser scanners is complex to manipulate. It requires heavy computing processing and large human effort involvement. Although there is commercial software available that allows certain operations to be done automatically, there is still the need to develop large amount of in-house software in order to improve the registration of all data, the overall accuracy, the associated modeling and visualization. Worldwide recognized institutions with expertise in remote sensing and photogrammetry are obtaining excellent results in the documentation and visualization of archaeological structures and sites.

In developing countries site managers responsible for archaeological sites have reduced resources for the management of these sites. Most frequently their specialization is in archaeology and as a consequence they are not familiar with science and technology mainly on techniques dealing with digital data acquisition and associated processing, manipulation and visualization. The challenge is therefore is to 'bridge the gap' between high-level scientists in remote sensing and photogrammetry, and those local site managers.

The author has large experience developing and implementing a network of space partners working on the provision of technical assistance to World Heritage sites authorities in developing countries. He will share in this paper the benefits and challenges of bringing together archaeologists, remote sensing experts and photogrameters jointly with local site managers. These interdisciplinary group works then with the common objective of improving the documentation, visualization and understanding of archaeological sites. The ultimate goal is for local site managers to have additional tools and information for the improvement of their daily conservation activities.



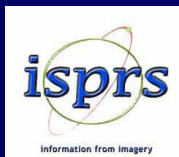
# **Use of space technologies for cultural heritage: Advantages and Challenges For archaeology**

Mario Hernandez

International Society for Photogrammetry and Remote Sensing (ISPRS), Regional Representative for Latin America

European Association of Remote Sensing Laboratories (EARSeL), Bureau Member for International relations

Friendship hotel  
Beijing, China 24<sup>th</sup> October 2012



International remote sensing course, November 2012, Chile

International Society Photogrammetry  
and Remote Sensing



Each two years: Intl symposium on remote sensing for  
cultural and natural heritage

European Association of Remote Sensing Laboratories

## Open Initiative on the use of space technologies for heritage

(Space 4 Heritage)



Over 60 space partners located in 33 countries

## Motivating the young generation

Two young women archeologists

Nicole Dore and Jolanda Patruno



UNESCO



## SAMARRA



## SAMARRA



UNESCO sites in danger since 2007

80% of the city is still unexcavated

Big structures for satellites detection



**Coordinates:** 43°45'50"- 43°51'70"N  
(WGS 84) 34°25'34"- 34°05'12"E  
**Site width:** 45.472 ha



Semi desert area characterized by fluvial terraces, never flooded

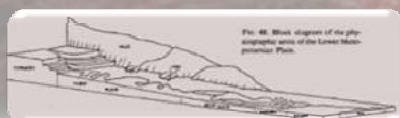


Fig. 48. Block diagram of the physiographic area of the Upper Mesopotamian Plain.

### SAR DATA SET



ALOS  
PALSAR

INCIDENCE  
ANGLE

✓ 15<sup>th</sup> November 2008  
*polarimetric*

23.10°



RADARSAT - 2

INCIDENCE  
ANGLE

✓ 16<sup>th</sup> April 2012

43.43°

✓ 07<sup>th</sup> May 2012  
*polarimetric*

26.63°



### ARCHAEOLOGICAL PLANS

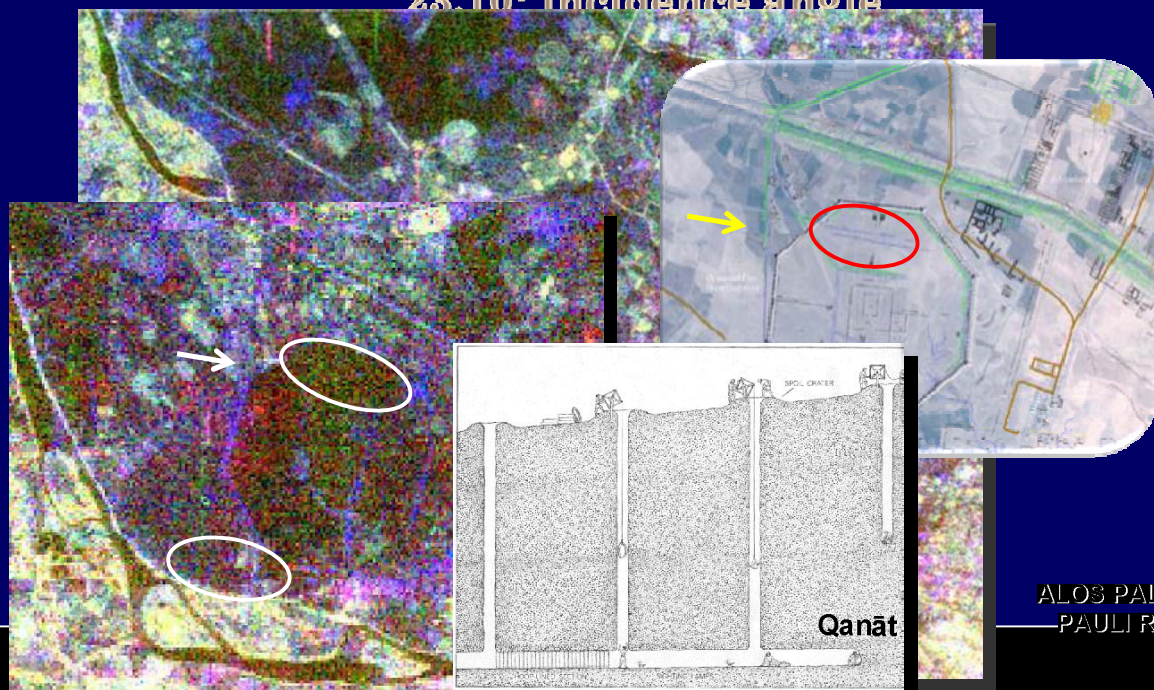
High quantity of UNESCO archaeological documentation for results validation



al-Mubarak  
(Husn al-Qadisiyya)  
Octagonal city  
abandoned unfinished  
in 796 A.D.



### 23.10° incidence angle



ALOS PALSAR  
PAULI RGB

## Remote sensing assistance to Egypt

Decision - World Heritage Committee of June 2007



### Abu Mena- Egypt (Decision of the World Heritage Committee)

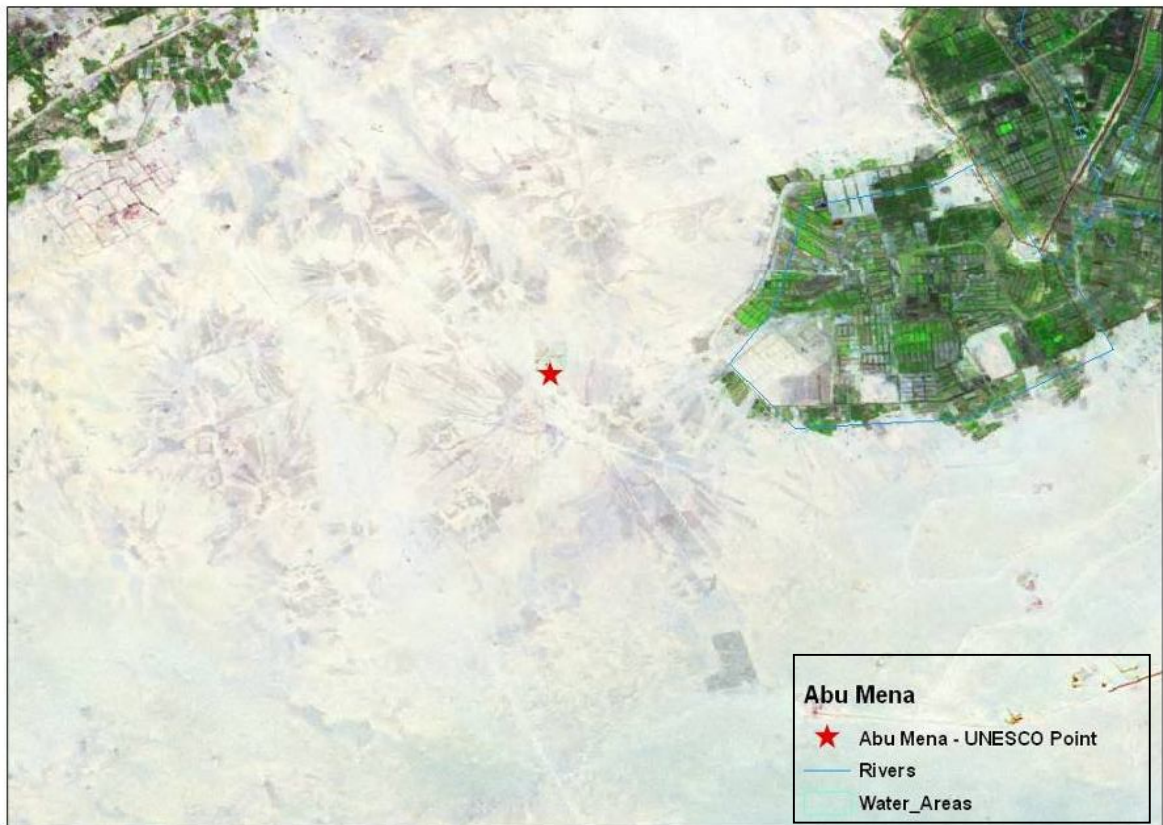


#### Main issues:

- Raising ground water level
- Affecting the heritage site
- Abu Mena authorities to solve the hydrological problem

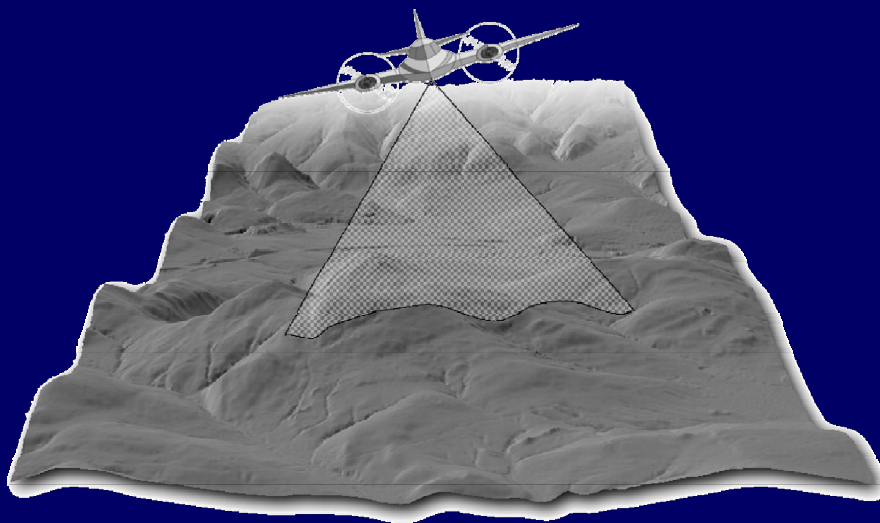


ABU MENA, EGYPT  
1990 LANDSAT MOSAIC



Airborne Laser Scanning

LiDAR (Light Detection and Ranging)









Identification and Nomination for World Heritage Site  
**Andean Main Road**  
 (Camino del Inca/Qhapac Ñan)

UNESCO, ESA, CONAE, Argentina, Bolivia, Chile, Colombia, Ecuador y Perú



### Locations of Interest in Argentina

- Provincia de Jujuy: Santa Ana
- Provincia de Salta: Quebrada del Toro - Valle Calchaquí. Volcán Llullaillaco (potencialmente binacional)
- Provincia de Tucumán: Cuidacita - Punta Balasto
- Provincia de Catamarca: Punta Balasto
- Provincia de La Rioja: Las Pircas - Chitanca
- Provincia de San Juan: Tocontá - Tórtolas (potencialmente binacional)
- Provincia de Mendoza: Uspallata - frontera con Chile (tramo binacional)
- Binacional
- Uspallata - Los Andes

#### GENERAL OBJECTIVE

CONAE assists the Argentinean Government:

- Identification, promotion, documentation
- To bring an additional benefit to the local communities





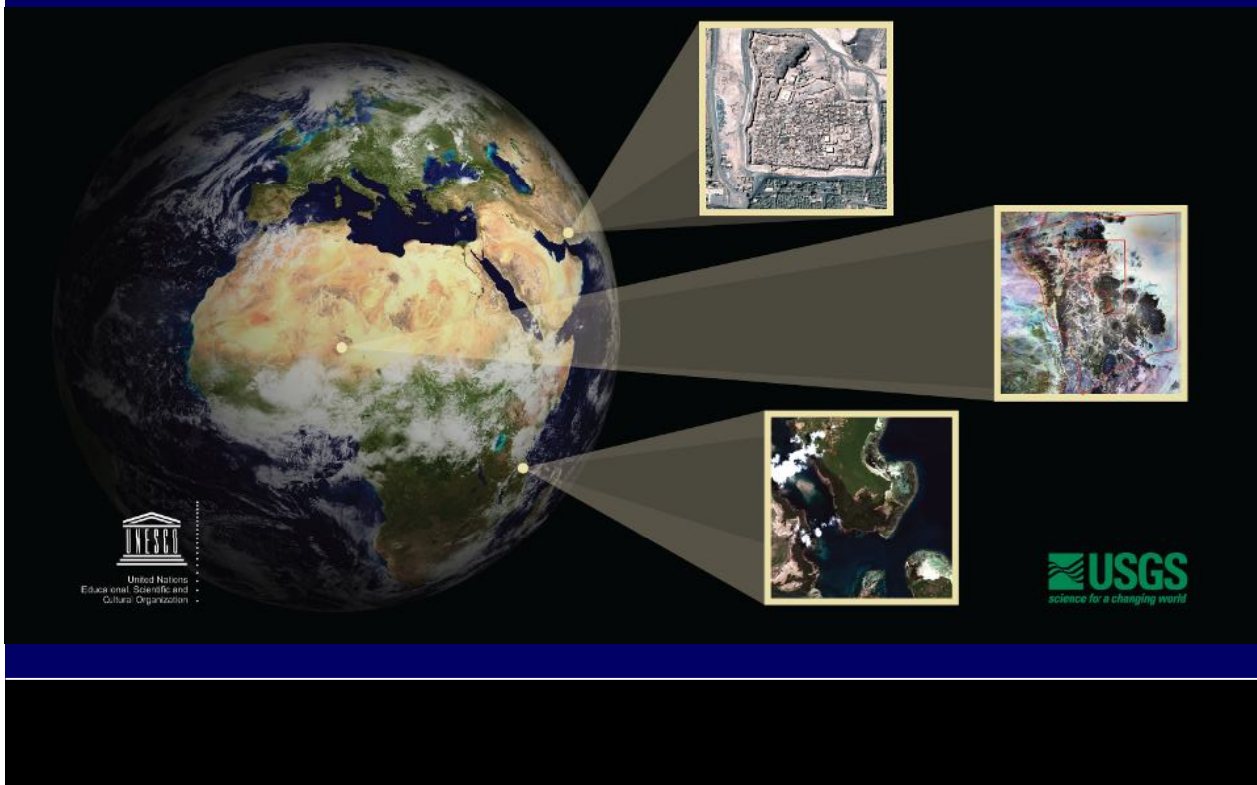
# From Space to Place



# From Space to Place

**An image atlas of world heritage sites on the 'in danger' list**

## The Atlas



A new era: Digital Archaeology

Preserving our 'Digital Heritage'





### **At the Museum entrance**

A big heavy stone with the instructions of the Governor ordering to construct the Temple of Bells





From Space to Place:      Back to Place



Chartres-France cathedral a World Heritage site

