Using satellite imagery to record endangered archaeology

Louise Rayne and Robert Bewley, EAMENA
ler14@leicester.ac.uk and Robert.bewley@arch.ox.ac.uk

The Endangered Archaeology of the Middle East and North Africa (EAMENA) project

EAMENA is a joint project between the Universities of Leicester and Oxford, funded by the Arcadia Fund, with the aim of documenting archaeological sites to protect those under the greatest threat of destruction and damage throughout the Middle East and North Africa. Using a remote sensing methodology to identify sites and the Arches software platform for recording them we are building and updating a detailed database of sites that are threatened, damaged or already destroyed (Figure 1). These data are being provided to people and organisations with the responsibility to protect cultural heritage in the Middle East and North Africa. We are working in close collaboration with all the relevant authorities.

Remote sensing methodology

We are undertaking image interpretation to identify archaeological sites using Google Earth, some recent high-resolution satellite imagery and some historical aerial photographs and decommissioned spy satellite images in conjunction with survey and excavation data, where available. Sites are initially examined using Google Earth by specialists in the archaeology of the Middle East and North Africa. The morphology, form, interpretation and state of preservation of the sites are recorded in the EAMENA database, using standardised terminology. This allows inexpensive and rapid recording of sites which are at risk, often allowing recent changes to be measured and allowing archaeologists to target their fieldwork and cultural protection efforts.

Case studies

For specific areas, for example the Al-Jufra oases in Libya, a more in-depth analysis has been undertaken using high-resolution satellite imagery, historic aerial photographs, decommissioned spy satellite images and multispectral imagery. Located in the Sahara, the oases consist of three central towns (Hun, Waddan and Sukna) with irrigated gardens. The expansion of agriculture in
al-Jufra was measured using Landsat images in order to assess its impact on archaeology. The SAVI (Soil Adjusted Vegetation Index) images (Figure 2) show that agriculture has expanded rapidly since the 1970s, from around 617 ha in 1975 to 10130 ha in 2016. It has directly impacted on the preservation of archaeological sites, especially many ancient water management systems.

Modern urban expansion is one of the major causes of damage to archaeological sites in the region. This is particularly noticeable around the Roman site of Cyrene in Libya. Aerial photographs dating to 1949 and a declassified spy satellite image (KH7) from 1966 were orthorectified and compared to a WorldView-3 image from 2015. The comparison shows that the town of Shahat has expanded with the construction of new roads and buildings. This construction work has caused features including rock-cut tombs (marked 4 on Figure 3) to be demolished, some of which can now only be recorded from the older images.

The data so far

In 2015 and 2016, the first two years of the EAMENA project, significant progress was made (see www.eamena.org). A database structure was designed which allowed recording of archaeological sites and an assessment of the causes of damage. Records for over 90,000 sites have been created so far in Egypt, Iraq, Iran, Jordan, Libya, Morocco, Saudi Arabia, Syria, and Yemen, representing a wide range of sites (from prehistoric burials to twentieth century military installations). The causes of damage include looting and the impact of conflict but also agriculture, dam building, road construction and modern development.

Fieldwork was also undertaken by Leicester members of the project in several locations including in the Wadi Draa, Morocco in November 2015. Here, an ancient city in the region was under severe threat of destruction, but the project was able to aid and support the local archaeologists in halting the ongoing damage. We are now working with the Ministry of Culture and the local community to help secure more lasting protection and recognition of the remains.

We are now developing a strategy for the incorporation of archived historic imagery into our database, with the recent addition of the work of Sir Aurel Stein in Transjordan in the 1930s (see www.apaame.org). We have been involved in training, outreach and dissemination activities. These included a successful training course for Libyan archaeologists held in Leicester in March 2016 (Figure 4). Since the start of the project other highlights have included the Protecting the Past conference in Jordan, in September 2015, a day seminar at St John’s College, Oxford, and meetings with key partners in Geneva, Atlanta and Washington DC. Reports to Departments of Antiquities
on specific sites and the impacts of known threats have been prepared for areas in Jordan, Libya and Morocco. We are also continuing to establish contacts and partnerships with many organisations in order to facilitate data acquisition and sharing, including satellite companies and universities.

Our ongoing work includes further recording using satellite imagery and fieldwork, as well as planning for future training courses and partnerships, and translation of the website and database into Arabic. As we develop our database, we will be able to undertake more extensive analyses on the extent and nature of the threats to the archaeology of the region as a whole. Access to the database is available online, through a registration process on the website (www.eamena.org).

Archaeologists cannot expect to save every archaeological site from either damage or even destruction but we do have a duty to record as much of the remains of past human activity as possible. The Endangered Archaeology project is making a rapid documentation and assessment of what exists in highly sensitive locations where the archaeological resource is very significant and there is a good preservation. It is a race against time but with the availability of good quality satellite imagery and other associated data we are able to make good progress.

Figure 1: EAMENA database so far.
Figure 2: Landsat 2 SAVI from 1975 and Landsat 8 SAVI from 2016 showing increase in cultivated area.
Figure 3: Archaeological sites immediately outside the acropolis of Cyrene have been damaged, and are at risk of further damage, by construction activities.
Figure 4: EAMENA training course held in Leicester in March 2016.