Challenging mountainous landscapes: The stratified cultural heritage of Crete from the Air

Gianluca Cantoro
Laboratory for geophysical Satellite Remote Sensing and ArchaeoEnvironment
Foundation for Research and Technology Hellas - Institute for Mediterranean Studies (Crete, Greece)
gianluca.cantoro@ims.forth.gr

Abstract
The island of Crete, the center of the Minoan civilization, prosperous Bronze Age culture that constitutes an essential marking point in Cretan (pre)history, is more and more object of heavy large-scale changes and landscape modifications. The exponential expansion of green-houses practice in the South-Eastern coast, and some tourist driven expansions (for hotels or infrastructures for safari or hiking) are often putting at risk some normally inaccessible areas.

The landscape
Crete, the largest of the Greek islands and among the largest in the Mediterranean Sea, has been described as a “mountain emerging out of the sea”. More than half of its territory is mountainous, with groups of peaks between 1500 and 2500 meters high. Despite the apparent inhospitality of this place, it is still one of the most populated islands in the Mediterranean and definitely one of the most attractive tourist destinations. Back in time it became the center of the Minoan civilization, the prosperous Bronze Age culture that constitutes an essential marking point in Cretan (pre)history. Heavy large-scale changes and landscape modifications are more often appearing in the rare hilly/flat areas (see the exponential expansion of green-houses practice in the South-Eastern coast, Fig.1) and some tourist driven expansions (for hotels or infrastructures for safari or hiking) are often putting at risk some normally inaccessible areas. In such conditions, the mapping of cultural heritage with ground survey may be time consuming, sometimes unsuccessful or unfortunately too slow compared to the modern landscape modifications.

The Aerial Archaeological Survey
In such a situation (and not only), undeniably beneficial is the approach from the air, where professional cameras can be pointed at specific contexts during airborne systematic or targeted survey flights. In addition, historical imagery can provide unique and precious information for the understanding of past landscapes. A series of systematic flights over Crete have been conducted in 2012, with the main goal to monitoring natural conditions of known archaeological sites and their surroundings. The main aim was to assess their condition and classify the level of danger in which they were for natural or anthropic factors. Immediately after the first flight, it became clear how much “unknown” heritage was still up on the mountains of this greek island. The documentation of main sites and newly discovered areas of interest produced a large dataset of images (around 3000 in 5 flights of about 1.5 hours each) which needed archiving and processing. Indeed, in order for all this data to be exploited for the comprehension and mapping of the historical palimpsest, all the photographs (obliques and verticals) need to be orthographically projected or -in a way- converted into a map, with consistent scale and accuracy. The footprint of each photograph –enriched with photogrammetrically derived information (such as the camera pitch and yaw at the moment of photograph)– is being integrated and implemented in a WEB accessible geodatabase built at the hosting institution. This web-GIS (still under constant improvement), allows to access previews of images starting from a modern place-name search, an area identification by polygon or by archaeological site name. This last search, is possible thanks to the integration of this web-GIS with the extensive survey of Crete conducted in the framework of Digital Crete Project (http://digitalcrete.ims.forth.gr/), where the largest number of sites of all periods have been ground-surveyed and mapped with GPS devices. An advanced search engine allows users to filter the selected photographs with further parameters, such as date (including photographs of one specific month over different years for phenomenological cycle analysis), image typology (aerial oblique, low altitude drone aided, RGB or Near Infrared and so on), camera parameters (photographs looking in one specific direction –thanks to the yaw record-, or looking almost vertically -thanks to the pitch parameter-) or simple flightID.

Few examples

Despite the complexity of the landscape and the limited presence of flat (and easily cultivable) areas, its wealth of standing or buried artefact is still surprising. It is indeed not rare the case where the construction of common infrastructures (national, regional or local roads) have to deal with traces of the past (Fig.2). For such a reach context, rescue archaeological excavation are not sufficient and often do not provide the wider picture that most human-landscape interactions need to be properly understood.

In such conditions, the mapping of cultural heritage with ground survey may be time consuming, sometimes unsuccessful or unfortunately too slow compared to the modern landscape modifications. Thousands of photographs have been collected over Crete in the first extensive aerial archaeological survey, allowing the identification of numerous new sites and the photogrammetric documentation of known ones with great accuracy. The footprint of each photograph –enriched with photogrammetrically derived information (such as the camera pitch and yaw at the moment of photograph)– is being integrated and implemented in a WEB accessible geodatabase built at the hosting institution. This web-GIS (still under constant improvement), allows to access previews of images starting from a modern place-name search, an area identification by polygon or by archaeological site name. This last search, is possible thanks to the integration of this web-GIS with the extensive survey of Crete conducted in the framework of Digital Crete Project (http://digitalcrete.ims.forth.gr/), where the largest number of sites of all periods have been ground-surveyed and mapped with GPS devices. An advanced search engine allows users to filter the selected photographs with further parameters, such as date (including photographs of one specific month over different years for phenomenological cycle analysis), image typology (aerial oblique, low altitude drone aided, RGB or Near Infrared and so on), camera parameters (photographs looking in one specific direction –thanks to the yaw record-, or looking almost vertically -thanks to the pitch parameter-) or simple flightID.