Remote Sensing and Virtual Archaeological Landscapes

Use of Space Technologies for the
Conservation of Natural and Cultural Heritage
Campeche, Mexico

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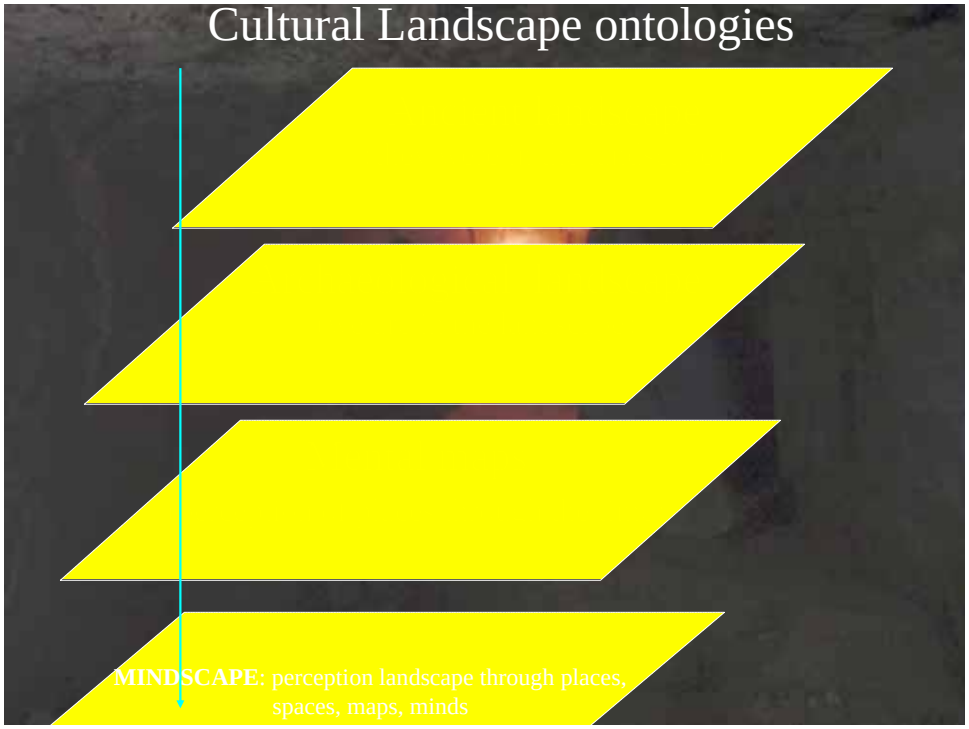
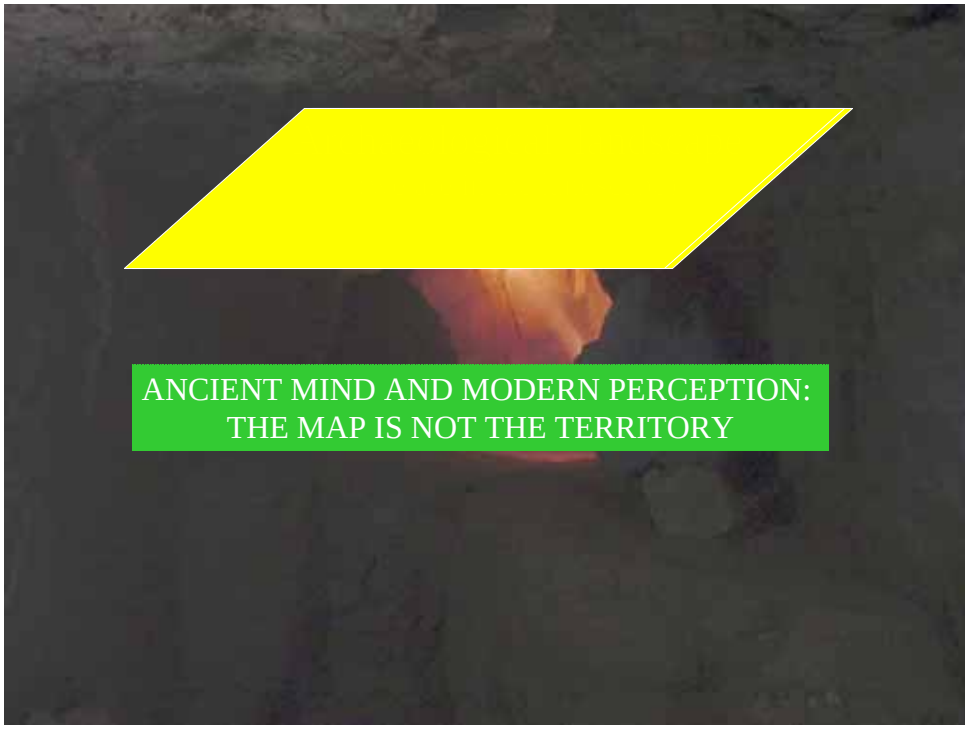
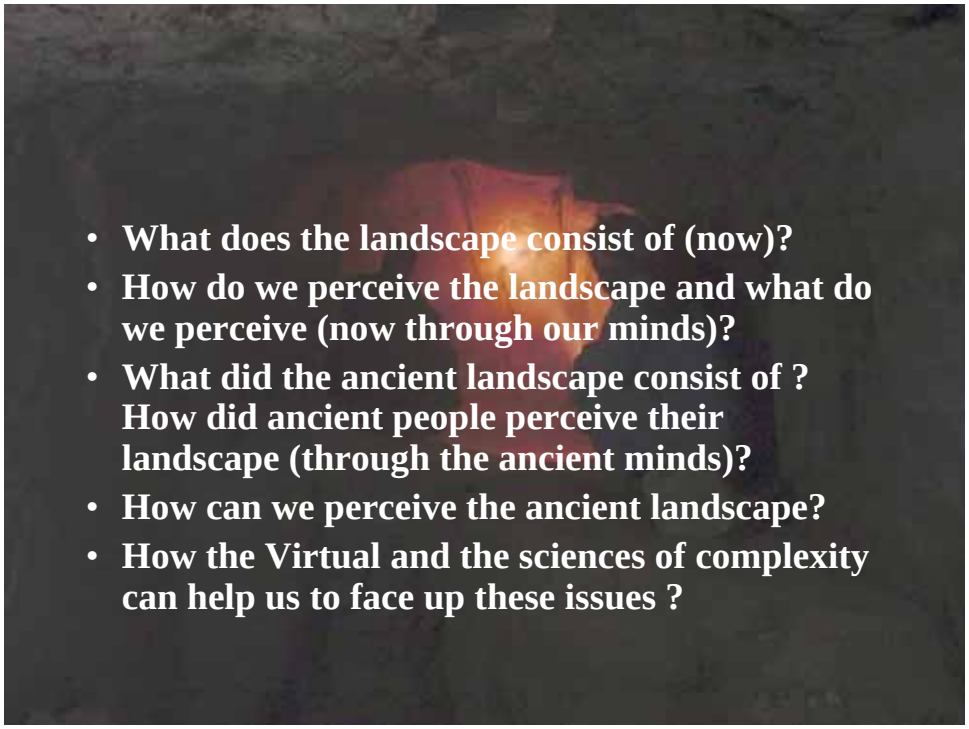
http://www.virtualheritage.org

- *"The landscape itself is a reticulate maze of criss-crossing lines of ancestral travel, with the most significant localities at its nodal points. Localities identified by particular landscape features – hills, rocks, gullies, waterholes, an so on- embody the ancestors' powers of creativity and movement in a congealed form."* (Ingold, 2000, 141)


Cultural Landscape ontologies
MINDSCAPE: perception landscape through places, spaces, maps, minds

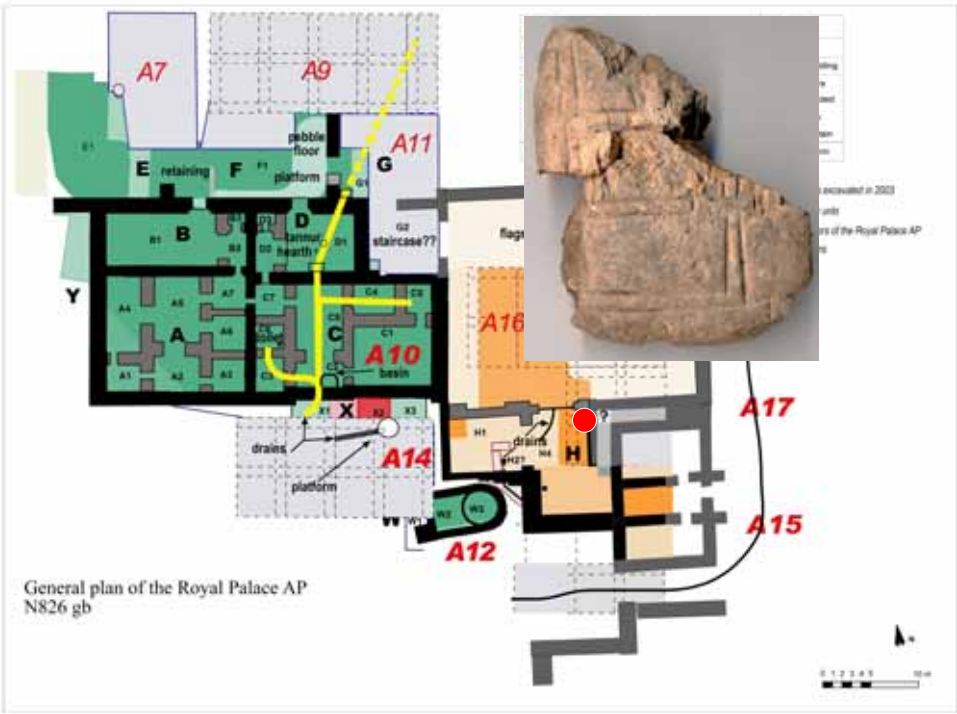

ANCIENT MIND AND MODERN PERCEPTION:
THE MAP IS NOT THE TERRITORY


Landscape Matrix
• Texture
• Color
• Shape
• Pattern
• Affordance
• Relation
• Places


• What does the landscape consist of (now)?
• How do we perceive the landscape and what do we perceive (now through our minds)?
• What did the ancient landscape consist of ? How did ancient people perceive their landscape (through the ancient minds)?
• How can we perceive the ancient landscape?
• How the Virtual and the sciences of complexity can help us to face up these issues ?

One of the first needs in ancient times is to draw and to identify the space

A floor plan on a clay tablet from about 2300 B.C.



Mindscape

- The mindscape regards all the ecosystem's relations needed for constructing the "map" in ancient and modern minds; mindscape is the way with which it is possible to perceive the landscape.
- We aware that only cultural and anthropological background can help us to imagine and to construct a mindscape in diachronic and territorial terms.

Mindscape

- **What does the landscape consist of (now)?**
- **How do we perceive the ancient landscape and what do we perceive (through ancient mental maps)?**
- **How do we perceive the archaeological landscape (through actual mental maps)**
- **What did the ancient landscape consist of ?**
- **How did ancient people perceive their landscape (through the ancient minds)?**
- **How can we perceive the ancient landscape?**
- **How the Virtual and the sciences of complexity can help us to face up these issues ?**

Mapscape

- Mapscape represents the act of studying cartographic relations and spatial overlay (analogic, raster and vector) in order to produce a theoretical model of the landscape starting from the contemporary viewpoint and in comparison with the ancient dwelling.
- Cartographic data and drawings of the modern landscape are mapscapes, a GIS overlay of raster and vector data is a mapscape; we could say that every metaphoric action for representing the “observed landscape” is a mapscape.

Mapping and Mapmaking

- According to Denis Wood “mapping and mapmaking “do not mean the same thing” (1992, 32)[…] Mapping is a capacity universal to humans, established along with other capacity of the human mind-brain through a process of evolution under natural selection. […]
- Whereas mapping, like speaking, might be regarded as a “universal expression of individual existence, mapmaking, like writing, has to be seen as an unusual function of specifiable social circumstances arising only within certain social structures

Taskscape

- The definition of taskscape is interesting because Ingold doesn’t intend the landscape in aesthetic sense, but as context of human and not human activities. “The landscape as a whole must likewise be understood as the taskscape in its embodied form: a pattern of activities collapsed into an array of features”. […]
- “The activities that comprise the taskscape are unending, the landscape is never complete. Neither built nor unbuilt, it is perpetually under construction. […] The landscape seems to be what we see around us, whereas the taskscape is what we hear. In other words, the taskscape exists not just as activity but as interactivity.

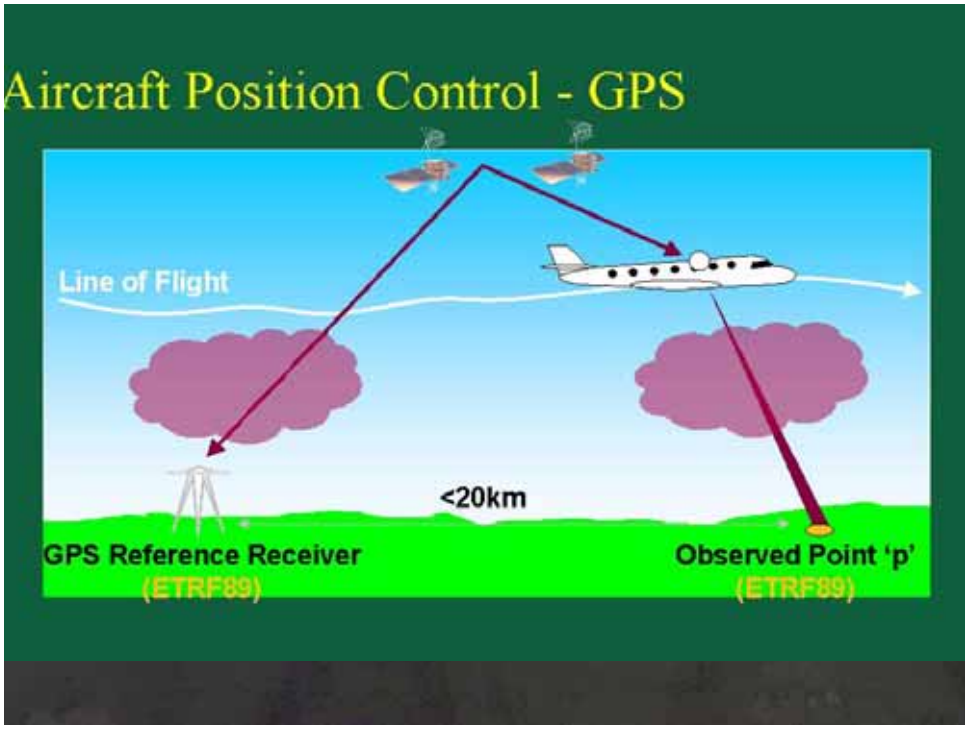
Aksum, 2001: taskscape

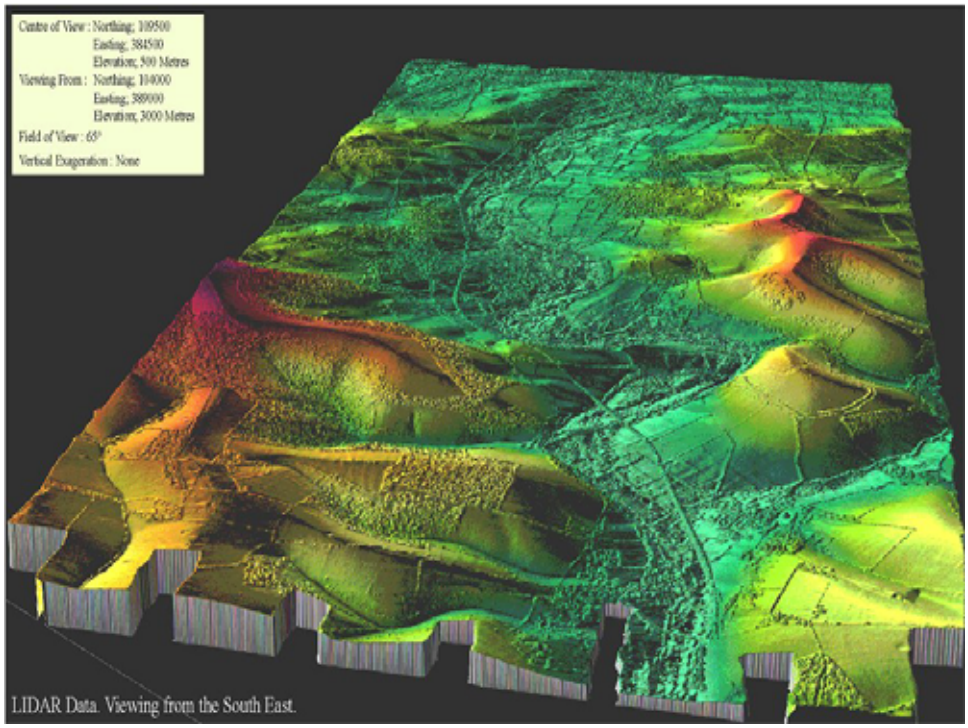
Domestic activities

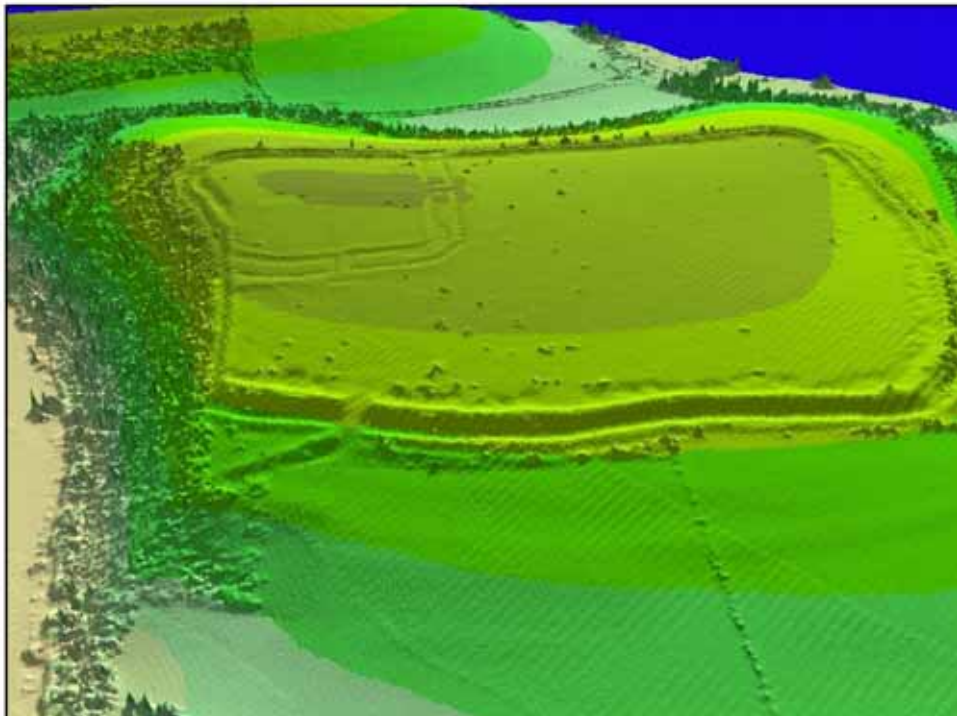
Ceremonial activities

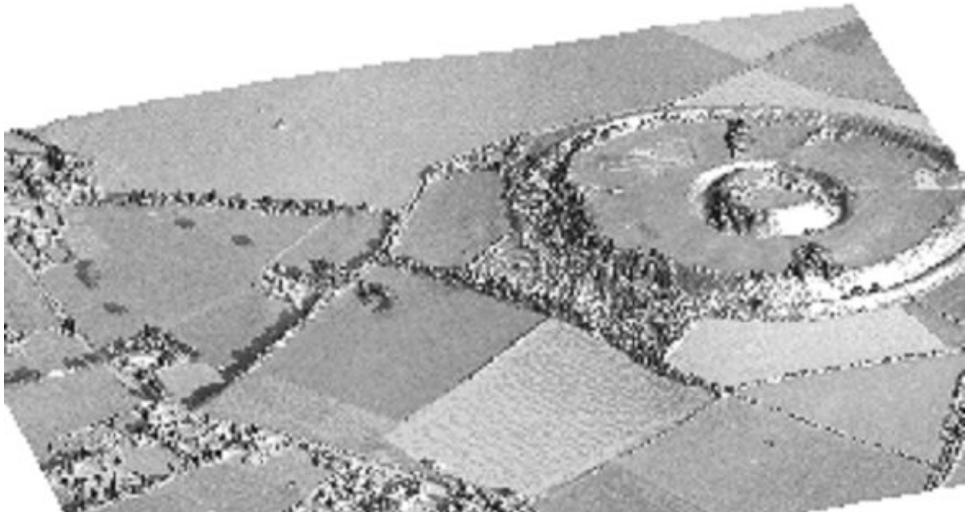
Space and place (map vs territory)

- Territory ⟶ Space (reality)
- Map ⟶ place
- Map ⟶ virtual


Aircraft Position Control - GPS
Line of Flight
<20km
GPS Reference Receiver
(ETRF89)
Observed Point 'p'
(ETRF89)


Centre of View : Northing; 109500
Easting; 384500
Elevation; 500 Metres
Viewing From : Northing; 104000
Easting; 389000
Elevation; 3000 Metres
Field of View : 65°
Vertical Exageration : None
LIDAR Data. Viewing from the South East.

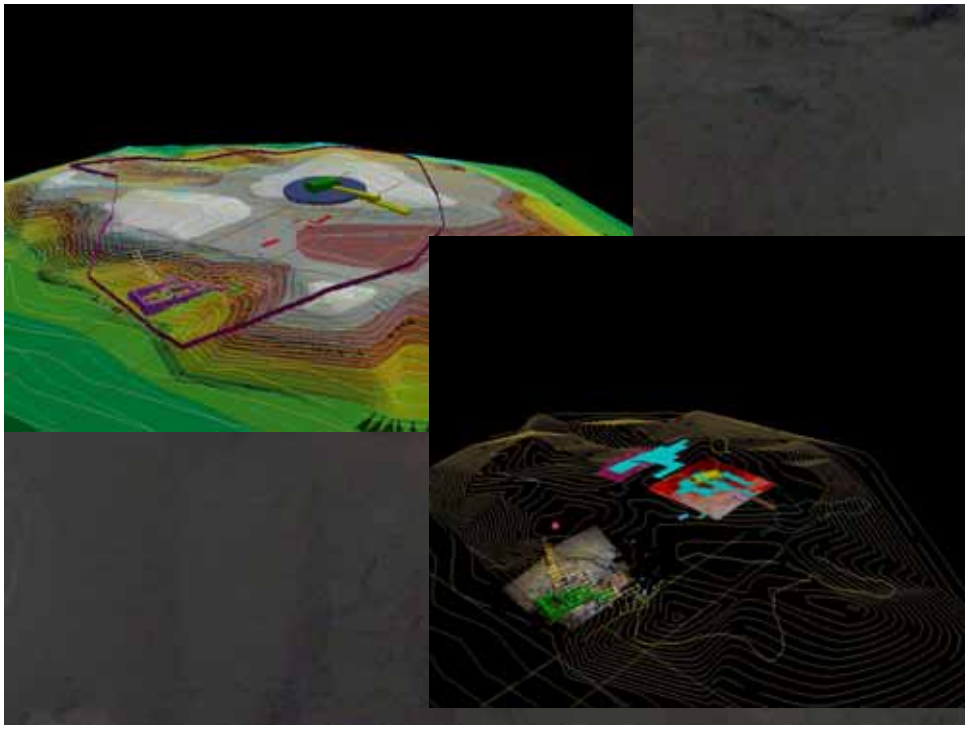




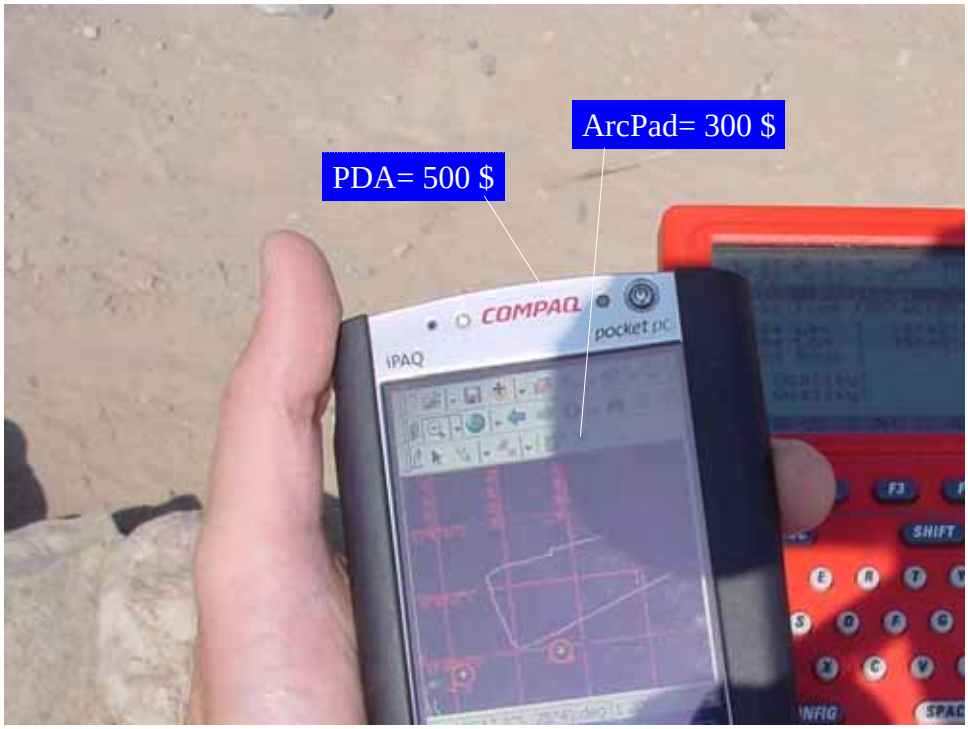
Data acquisition

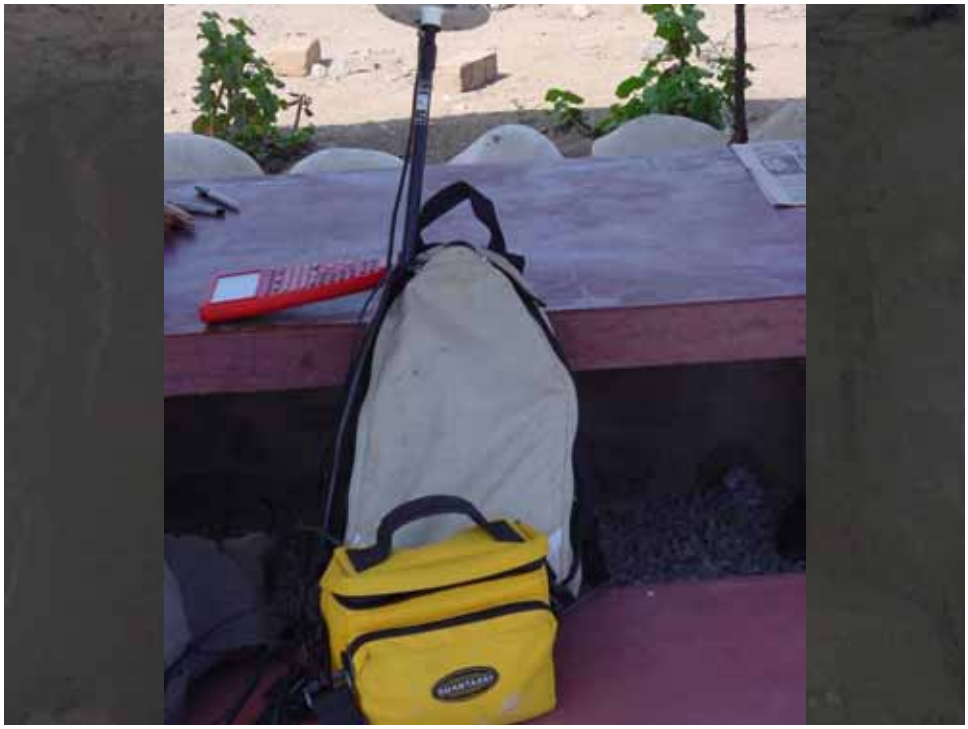
GPS

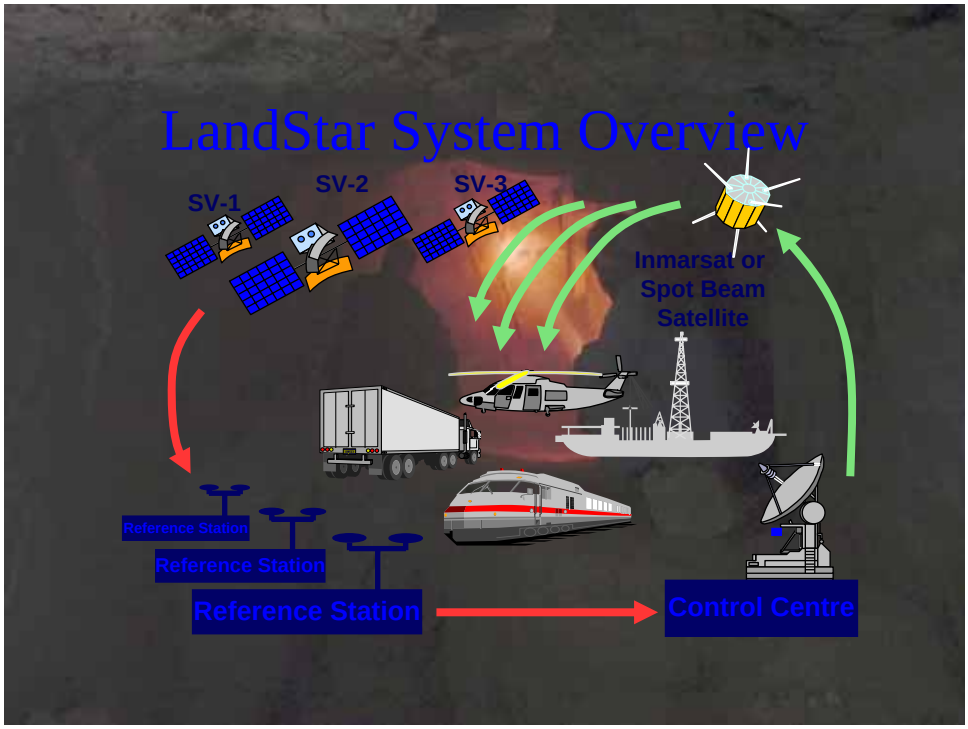
3D digitizer




cyra


ArcPad= 300 $
PDA= 500 $
COMPAQ
iPAQ
pocket pc
SHIFT




LandStar System Overview
SV-1
SV-2
SV-3
Inmarsat or
Spot Beam
Satellite
Reference Station
Reference Station
Reference Station
Control Centre

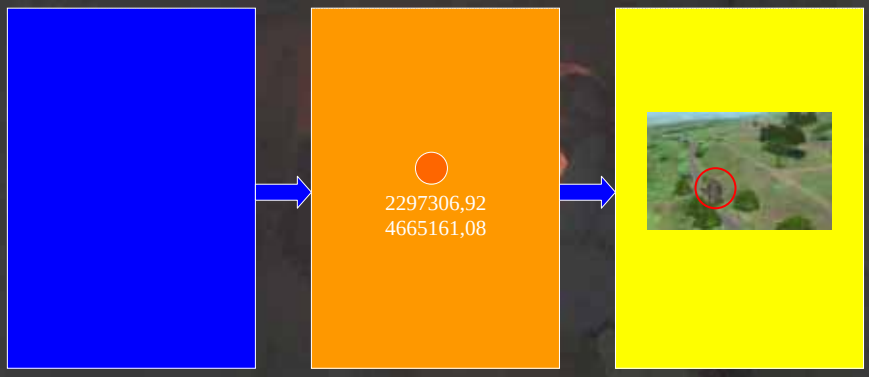
Geographical/spatial accuracy

- Satellites Ikonos, Quickbird < 1mt
- DGPS with Racal Systems (satellite correction) < 25 cm
- DGPS dual frequency (ground station) < 1cm
- 3D Photomodelling >= 1 cm
- 3D Laser scanners < 7 mm

Key issues

- Integrated technologies
- Accuracy
- Scale
- Georeferenced data
- Representation
- Communication
- Costs/time

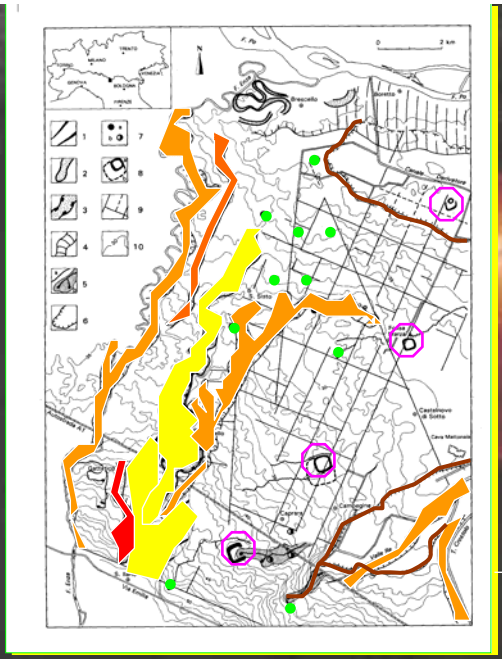
From space to place



The map is not the territory

(Gregory Bateson, 1972, *Steps to an ecology of mind*)

The Terramare Project: reconstruction of an invisible archaeological landscape



S. Ilario Alluvial fan (Late Pleistocene);

Praticello paleochannel deeply cut down, active during the Bronze Age;

fluvial ridge;

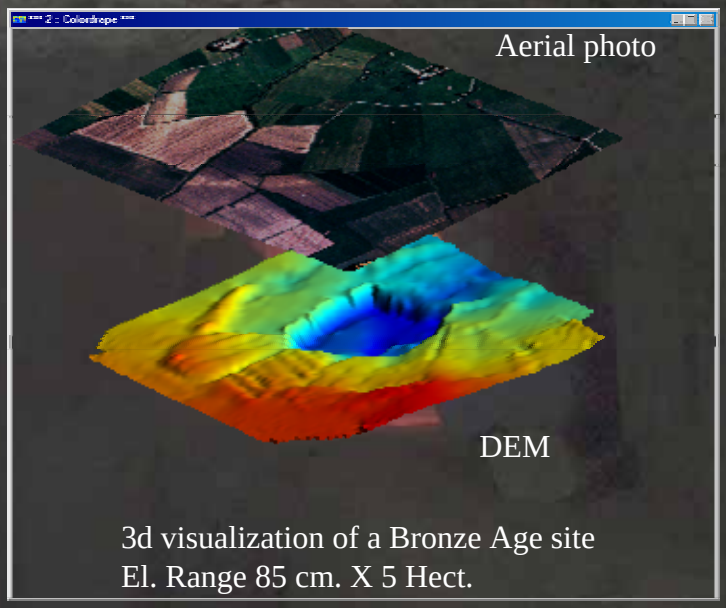
small meandering water courses;

low lying flood basins;

unstructured Bronze Age sites (a: on surface; b: buried);

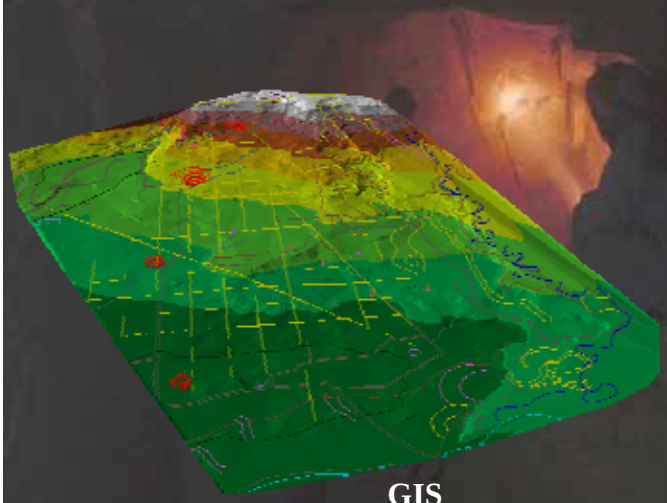
terramare (structured sites);

main axes of the Roman centuriation;

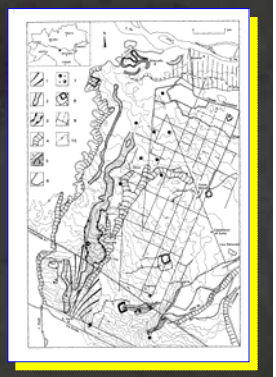


3d visualization of a Bronze Age site
El. Range 85 cm. X 5 Hect.

Landscape and microtopography

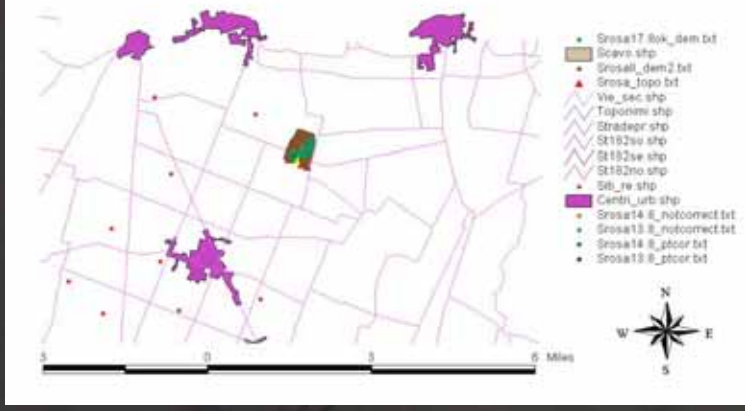


GIS

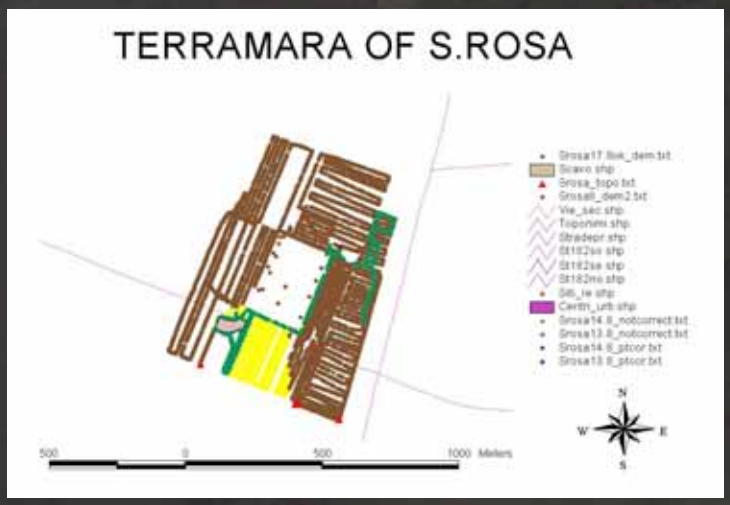


Cartography

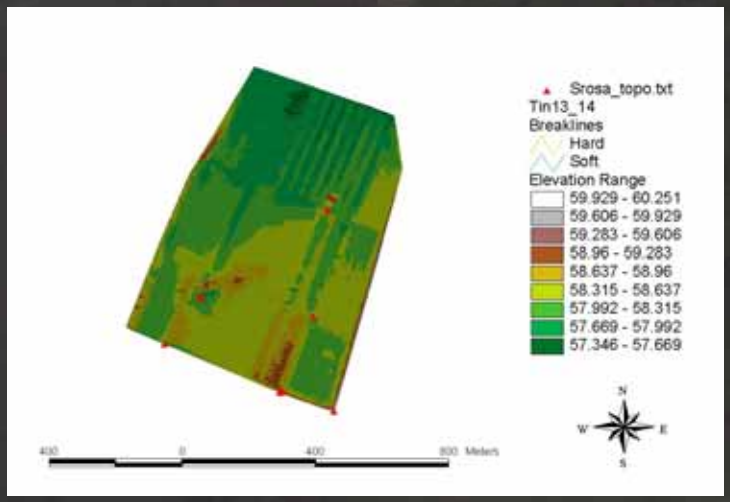
TERRAMARA OF S.ROSA



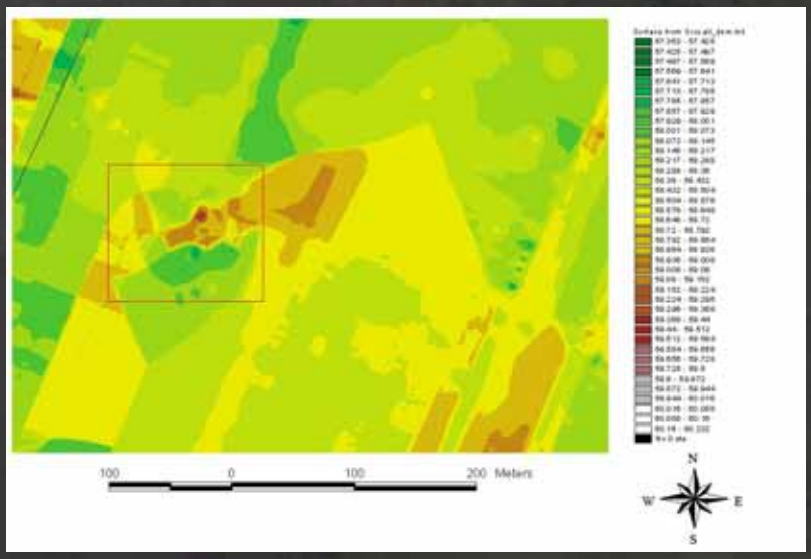
DGPS SURVEY: 60.000 POINTS



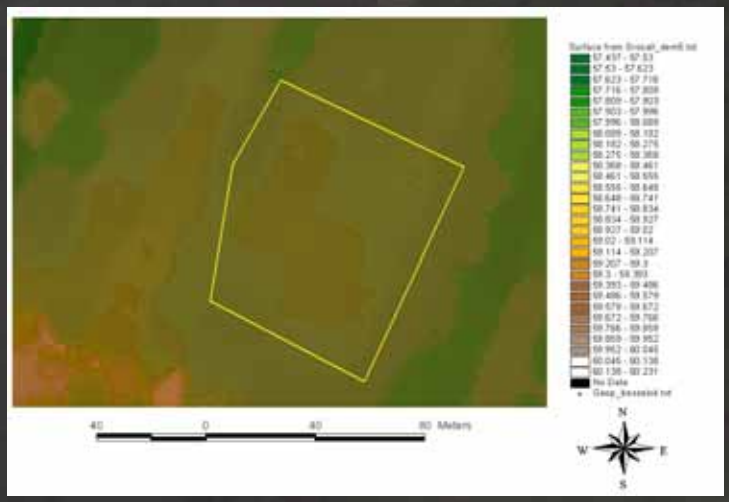
DGPS SURVEY: 60.000 POINTS



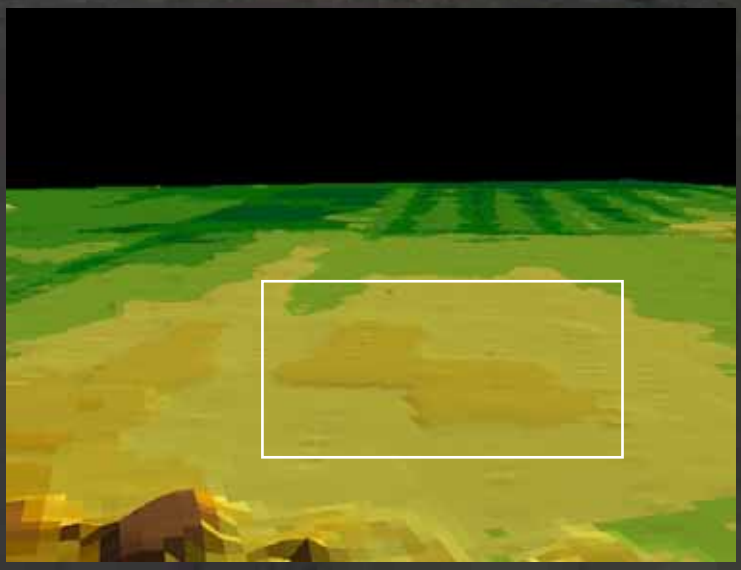
DGPS: DEM of the Bronze Age site of S. Rosa



DGPS: identification of a Roman villa



DGPS survey: 3D visualization of the DEM concerning a Roman villa



DGPS survey: 3D visualization of the DEM concerning a Roman villa

DGPS Leica 510
Racal system: 3-500 $ per month (fee)

Single freq.: 8-10.000 $

DGPS single frequency
Accuracy: < 30cm
Racal system

(Backpack, antenna, Receiver, display: 4.5 kg


Chavin Project
Stanford University
University of Berkeley
CNR-ITABC
-3000
-2000
-1000
0
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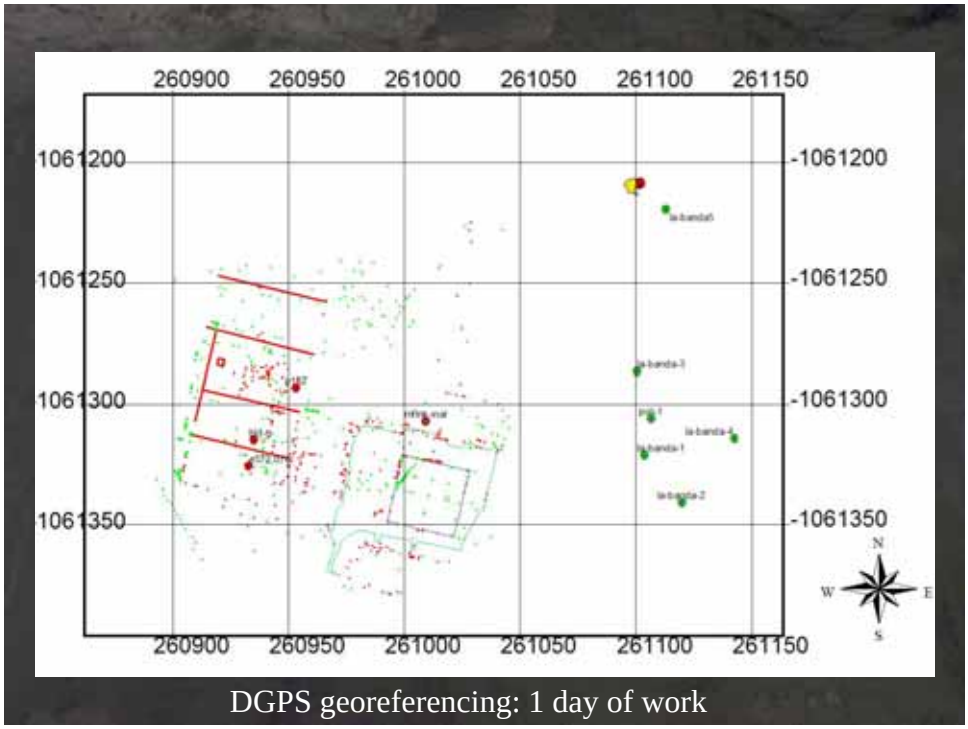
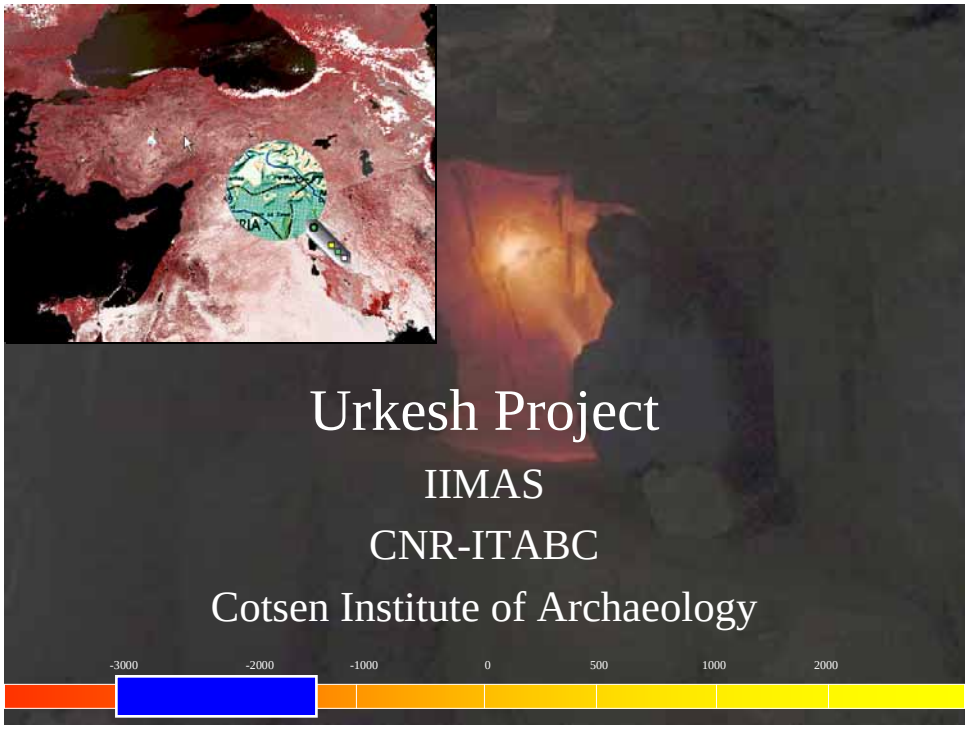
2000



DGPS georeferencing: 1 day of work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IIMAS
CNR-ITABC
Cotsen Institute of Archaeology
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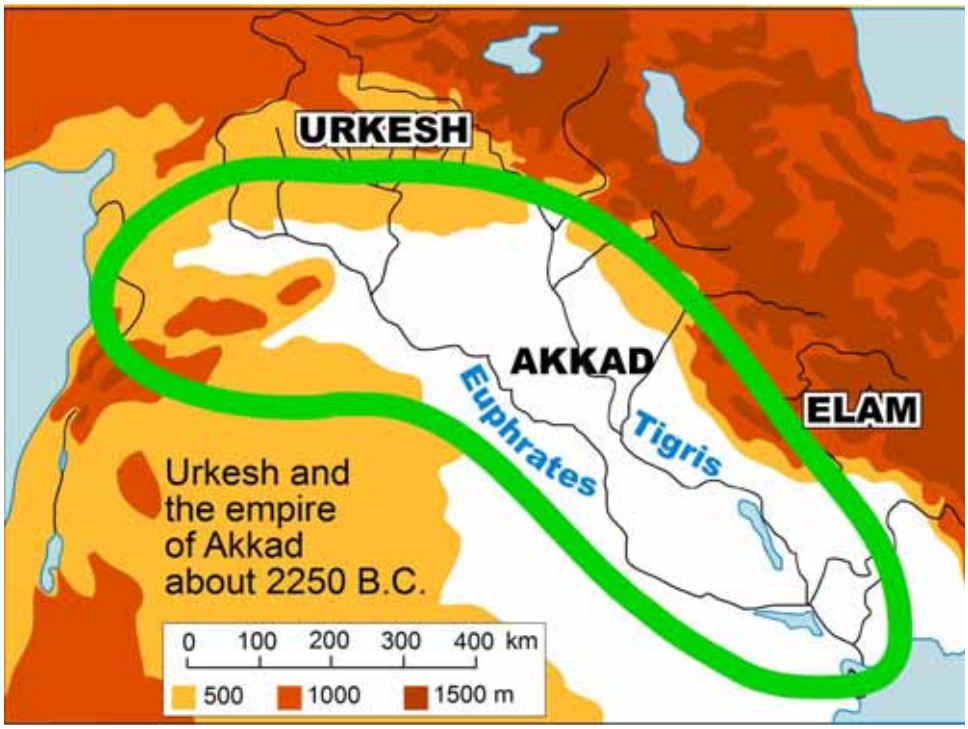
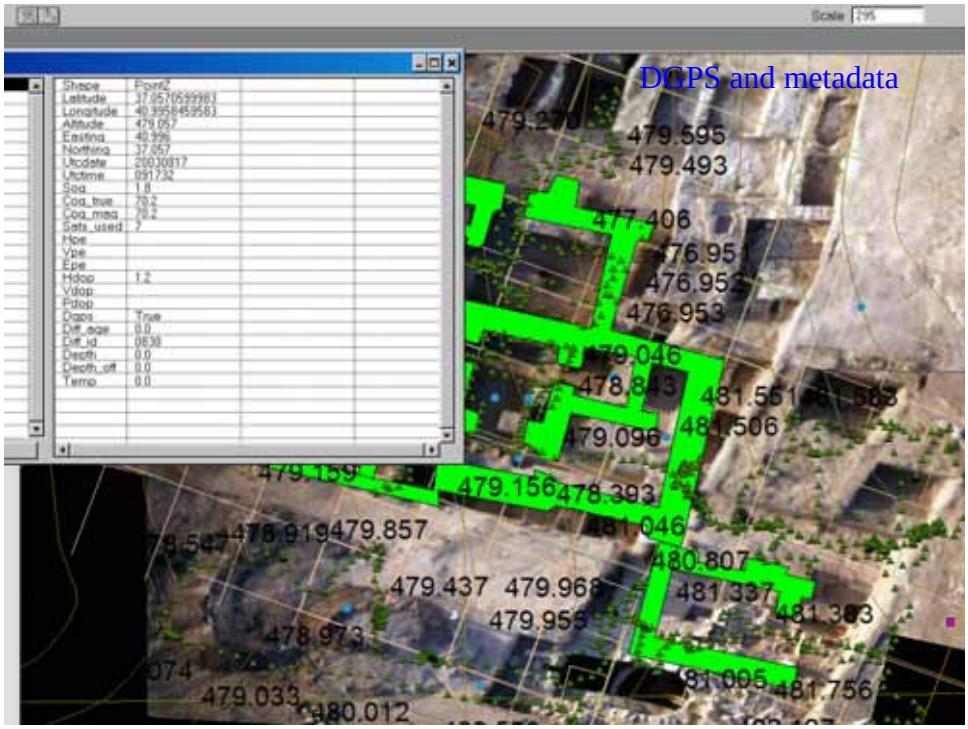

URKESH
AKKAD
ELAM
Euphrates
Tigris
Urkesh and
the empire
of Akkad
about 2250 B.C.
0 100 200 300 400 km
500
1000
1500 m


Tell Mozan, Siria


DGPS and metadata
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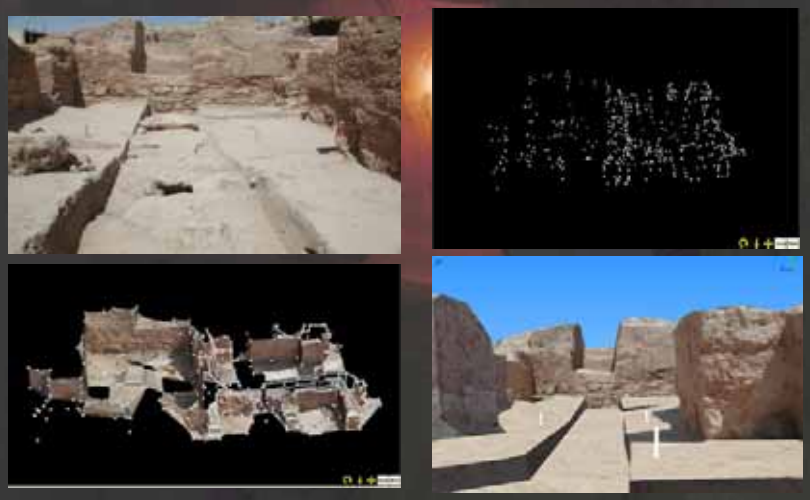
479.033
480.012

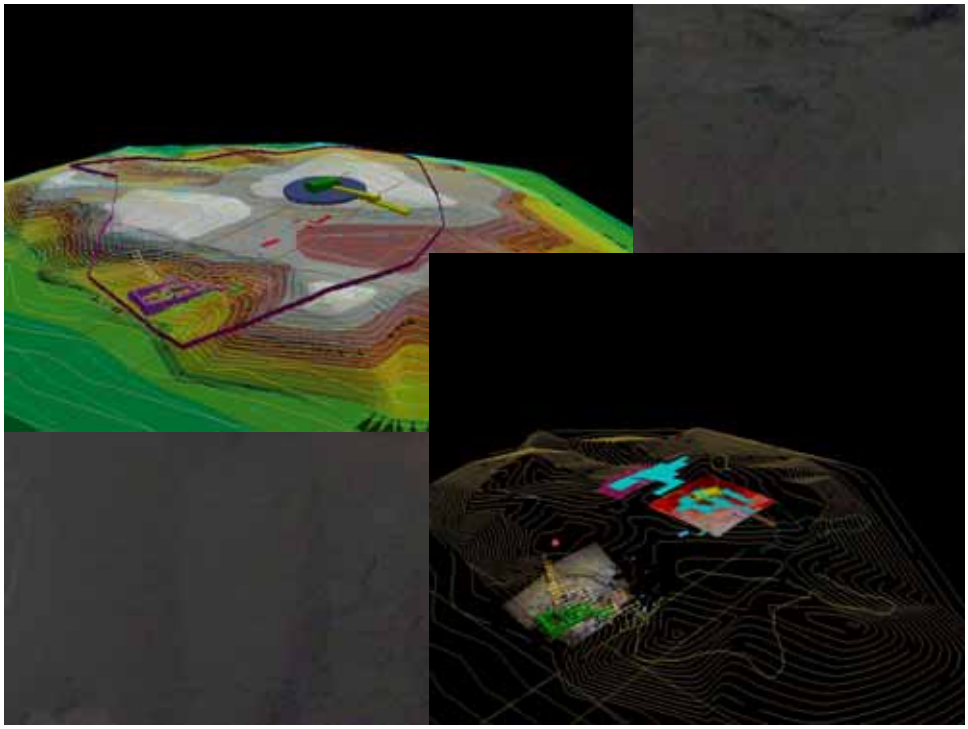
Tell Mozan, Siria

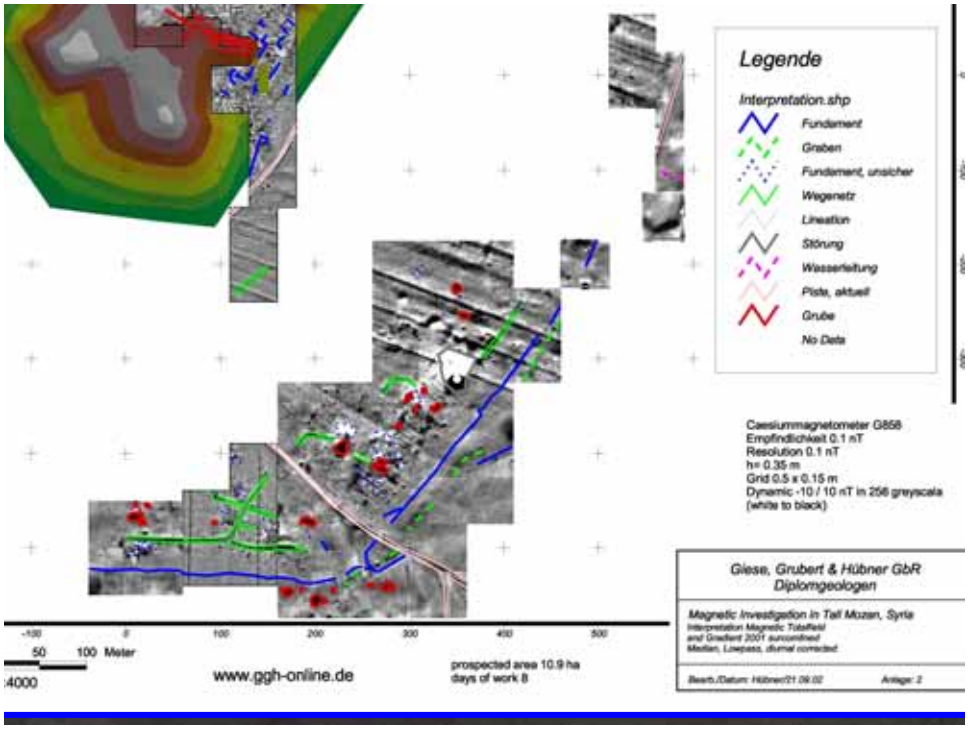
Tell Mozan, Siria

Photomodelling techniques



Tell Mozan, Siria




Legende
Interpretation.shp
Fundament
Graben
Fundament, unsicher
Wegenetz
Lineation
Störung
Wasserleitung
Piste, aktuell
Grube
No Data
Caesiummagnetometer G858
Empfindlichkeit 0.1 nT
Resolution 0.1 nT
h= 0.35 m
Grid 0.5 x 0.15 m
Dynamic -10 / 10 nT in 256 greyscala
(white to black)
Giese, Grubert & Hübner GbR
Diplomgeologen
Magnetic Investigation in Tell Mozan, Syria
Interpretation Magnetic TotalField
and Gradient 2001 succombined
Median, Lowpass, diurnal corrected
Bearb./Datum: Hübner/21.09.02
Anlage: 2
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www.ggh-online.de
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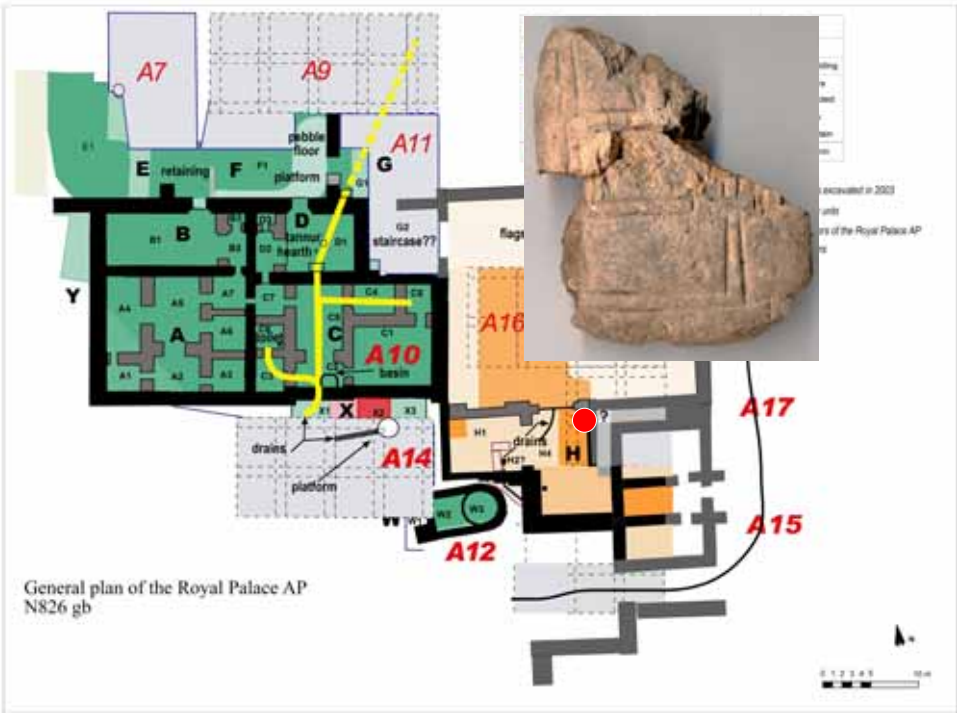
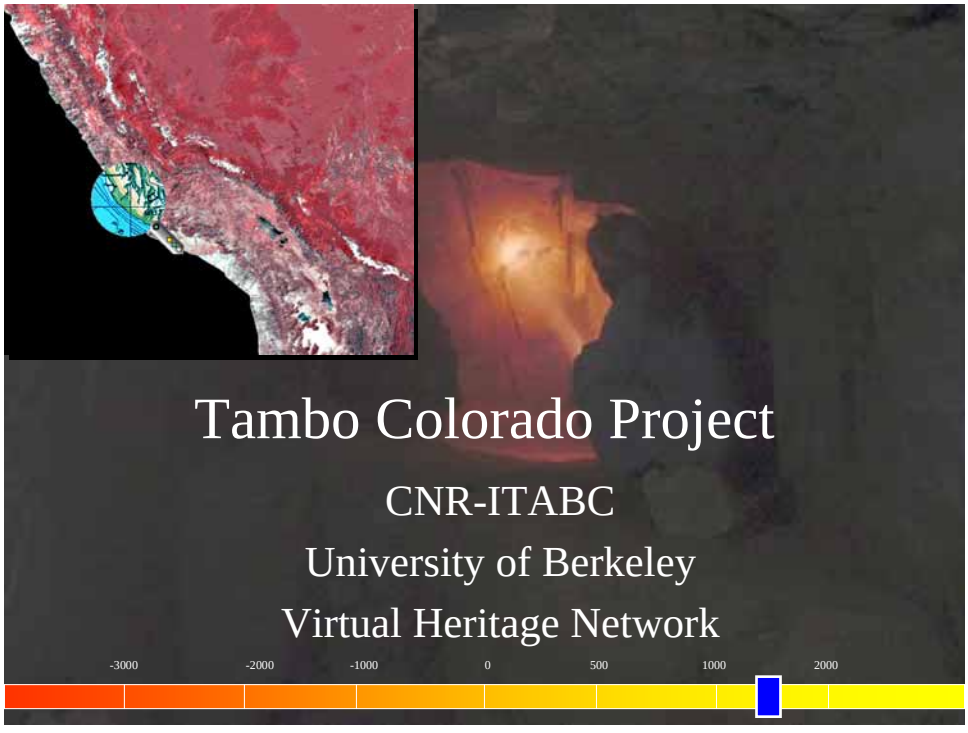
days of work 8


A7
A9
A11
E
retaining
F
platform
G
B
D
hearth
staircase??
Y
A
C
A10
basin
A16
A17
X
drains
A14
platform
H
drains
A15
A12
General plan of the Royal Palace AP
N826 gb


Tambo Colorado Project
CNR-ITABC
University of Berkeley
Virtual Heritage Network
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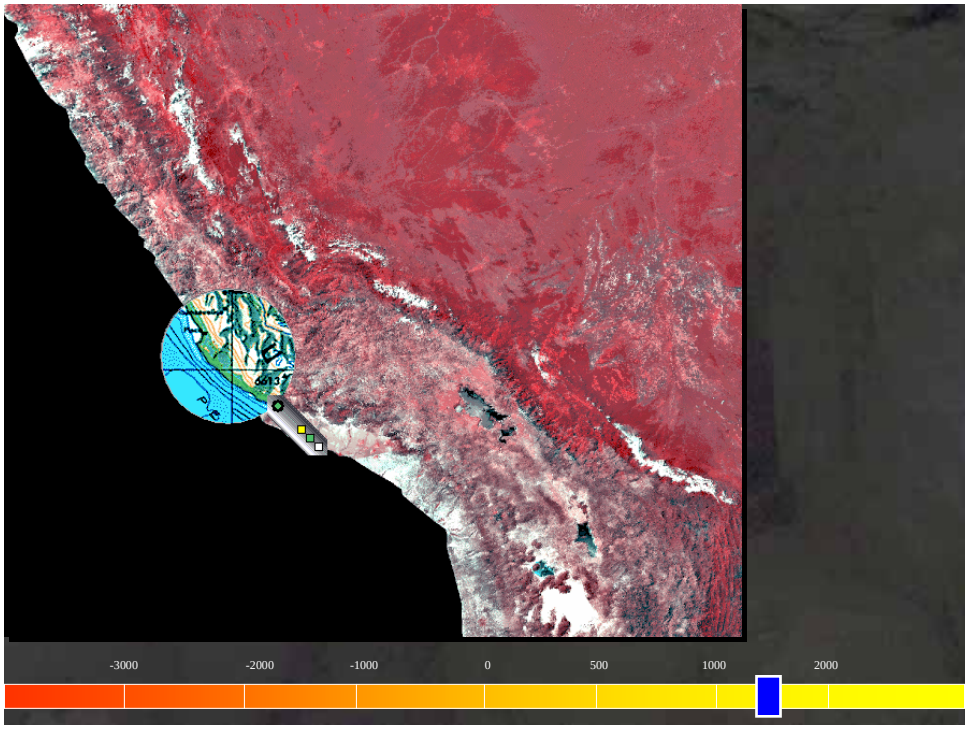


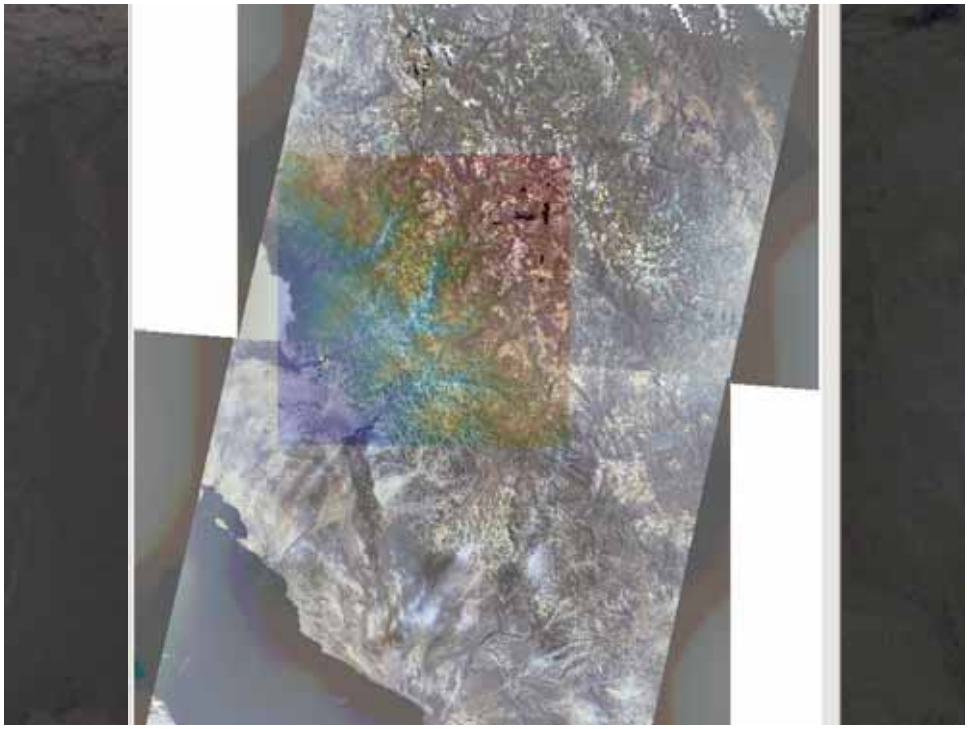
Tambo Colorado

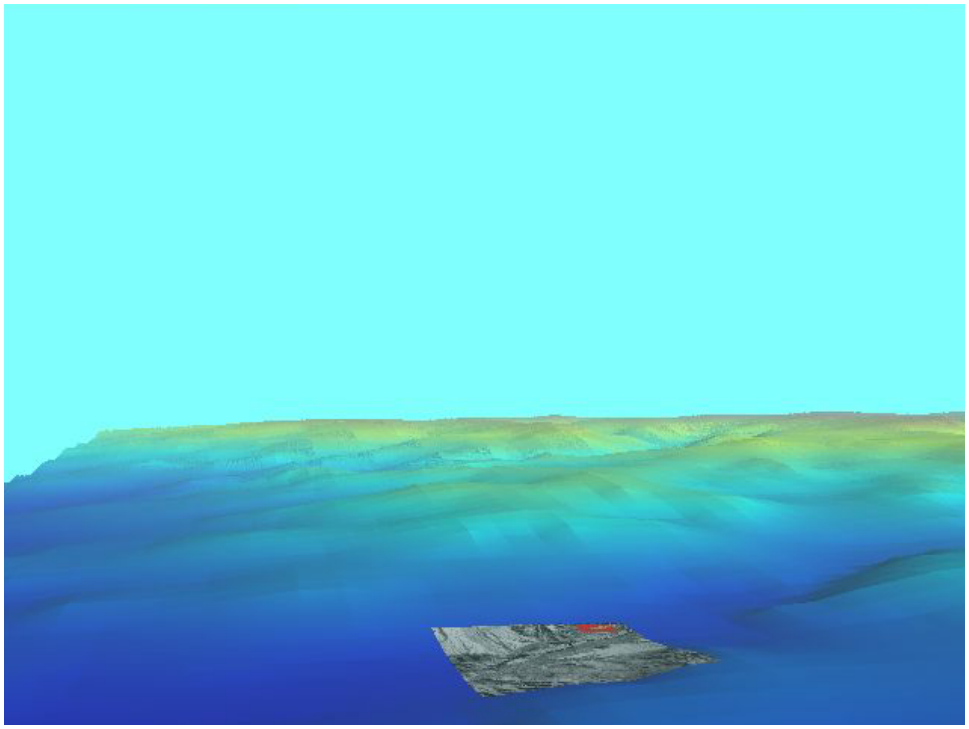
- Tambo Colorado was one of several sites built by the Incas in the manifestation of their power and in an effort to integrate the conquered peoples of Chincha and Ica into their empire.
- The site contains extensive standing adobe architecture from the Inca period as well as both post and pre-Incan surface structures that are found extensively throughout the surrounding terrain
- This project has focused on the development of an integrated digital documentation strategy, utilizing state-of-the-art digital documentation techniques ranging from high resolution photography and satellite imagery to high definition survey methods such as laser scanning.
- This has facilitated the recording of the site in a variety of scales from the macro-scale of the region to the micro-scale of surface structures and construction details of the architecture.
- The methodology is designed to provide an accurate three dimensional record of the existing architectural elements and surrounding landscape in order to assist with archaeological analysis of the built environment and to provide a record of a site that is rapidly deteriorating.

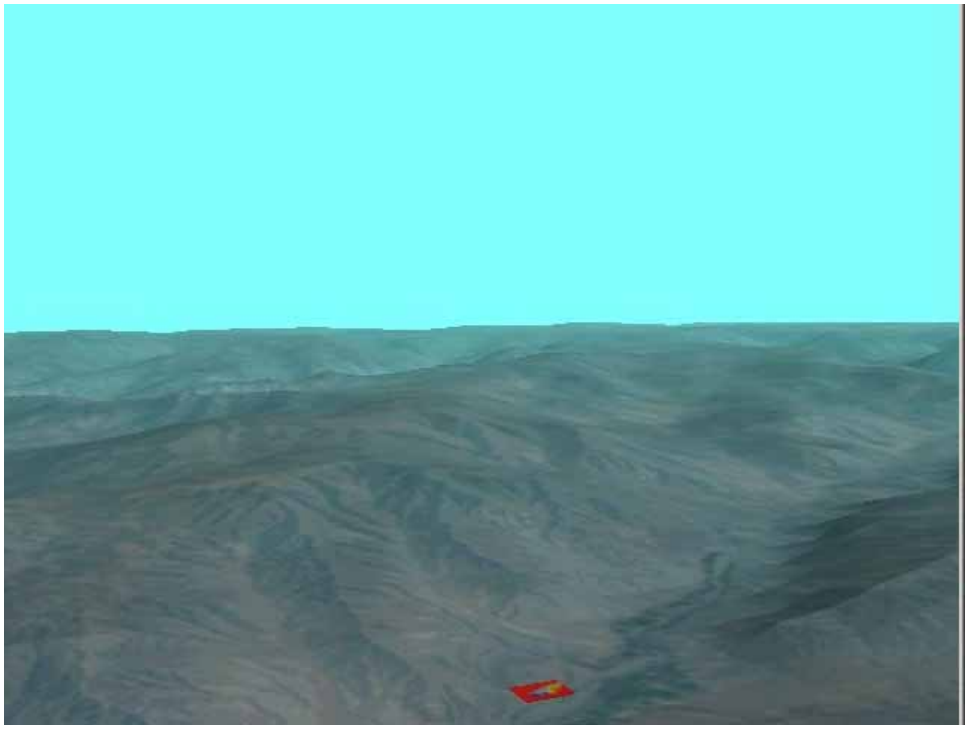
Integrated technologies

- Close range laser scanners
- Long range laser scanners
- Kite photography
- QTVR
- Digital video/multimedia
- DGPS

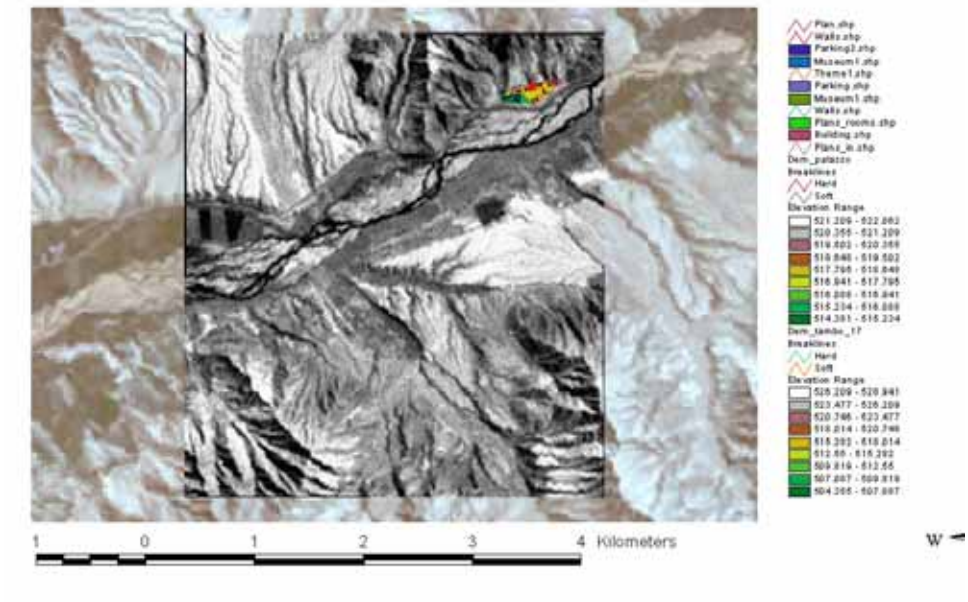
Tambo Colorado, Peru







Tambo Colorado: DGPS map and Landsat 7 bands



DGPS single frequency
Accuracy: < 30cm
Racal system

Mapping in real time, PDA- bluetooth, Arcpad, DGPS RTK