Instituto Nacional de Antropología e Historia

PEMEX

PLAN DE MANEJO INTEGRAL DE LA ZONA DE MONUMENTOS RQUEOLOGICOS EL TAJIN

Geokinetics

PROSPECCIÓN ARQUEOLÓGICA A TRAVÉS DE LIDAR Y ORTOFOTOGRAMETRIA EN EL TAJÍN, VERACRUZ

Archaeological Survey through LiDAR and Orthophotogrammetry In Archaeological Zone of El Tajín, Veracruz; México

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Geospatial Latinamerican Forum

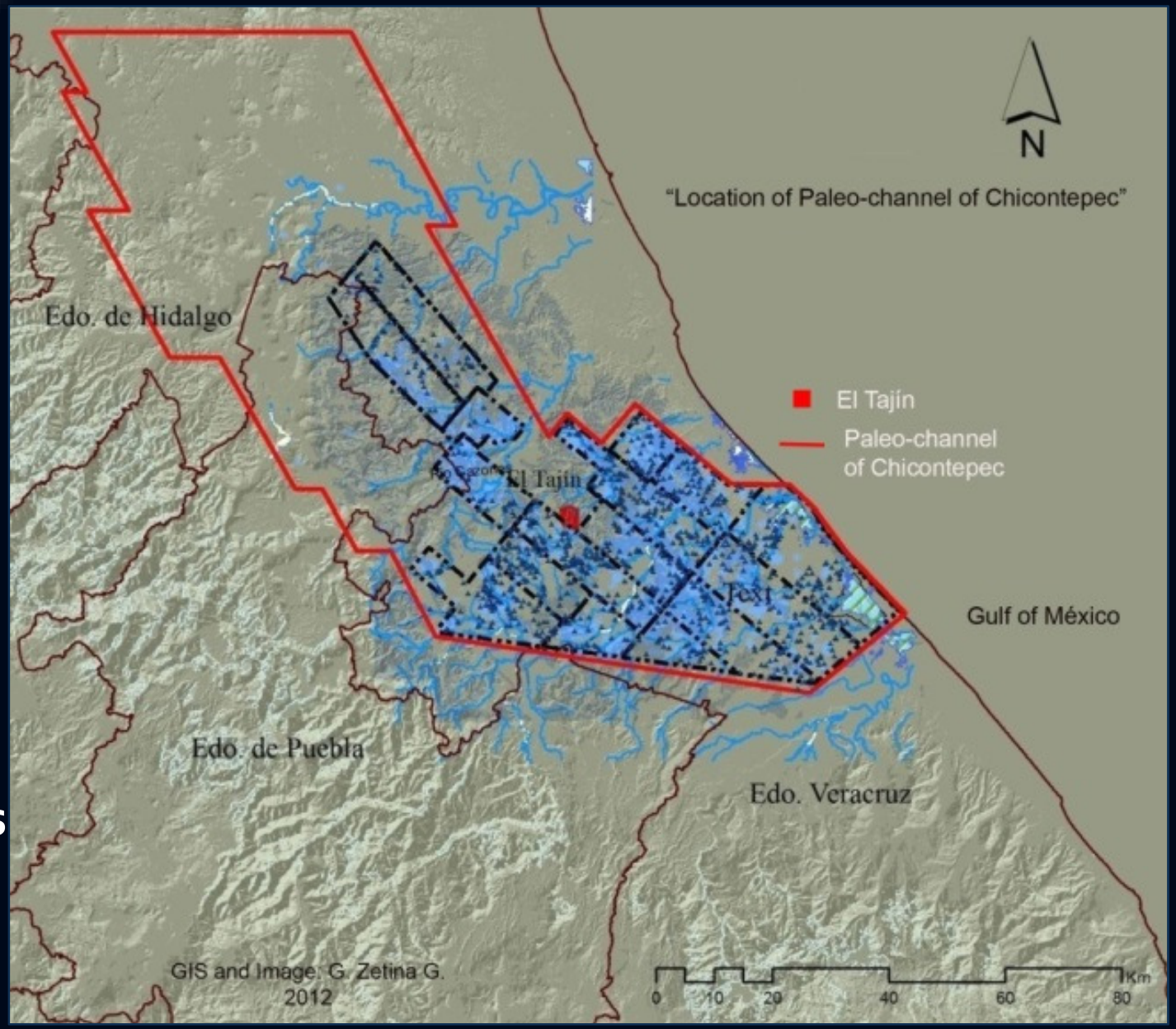
Cd. de México 24 de Septiembre de 2014

BACKGROUND

- *Part of Research based of Remote Sensing directed by Dr. Patricia Castillo*
- *Part of Plan of Management of this Archaeological Zone*

Location of El Tajín, Northern Veracruz; México

One of the most important zone of exploration and exploitation of hydrocarbons



- Oil/urbanization threatening sites on the Gulf Coast of Mexico

Looting

Vulnerability by location

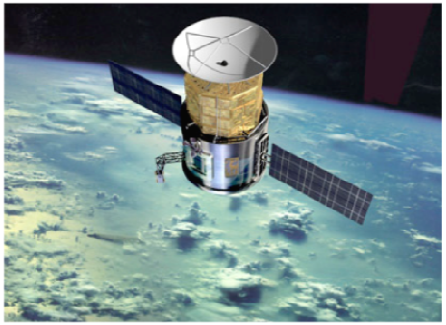
TRADITIONAL METHODOLOGIES ARE INSUFFICIENTLY FAST TO RECORD AND PROTECT

REMOTE SENSING

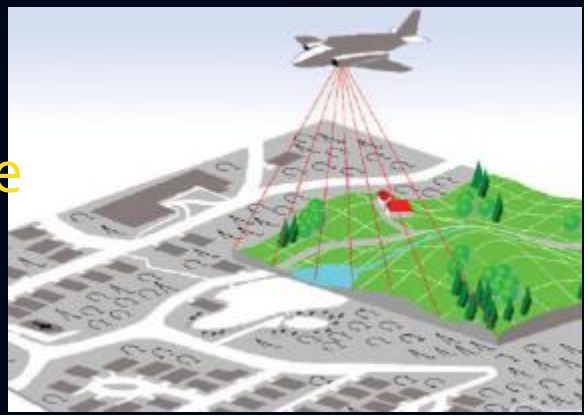
Photogrammetry

Satelite Imagery

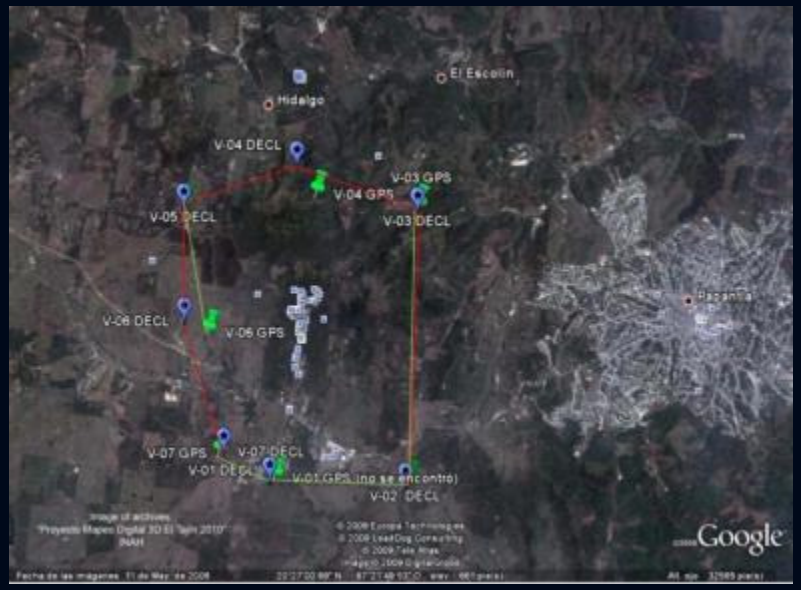
Laser Scann

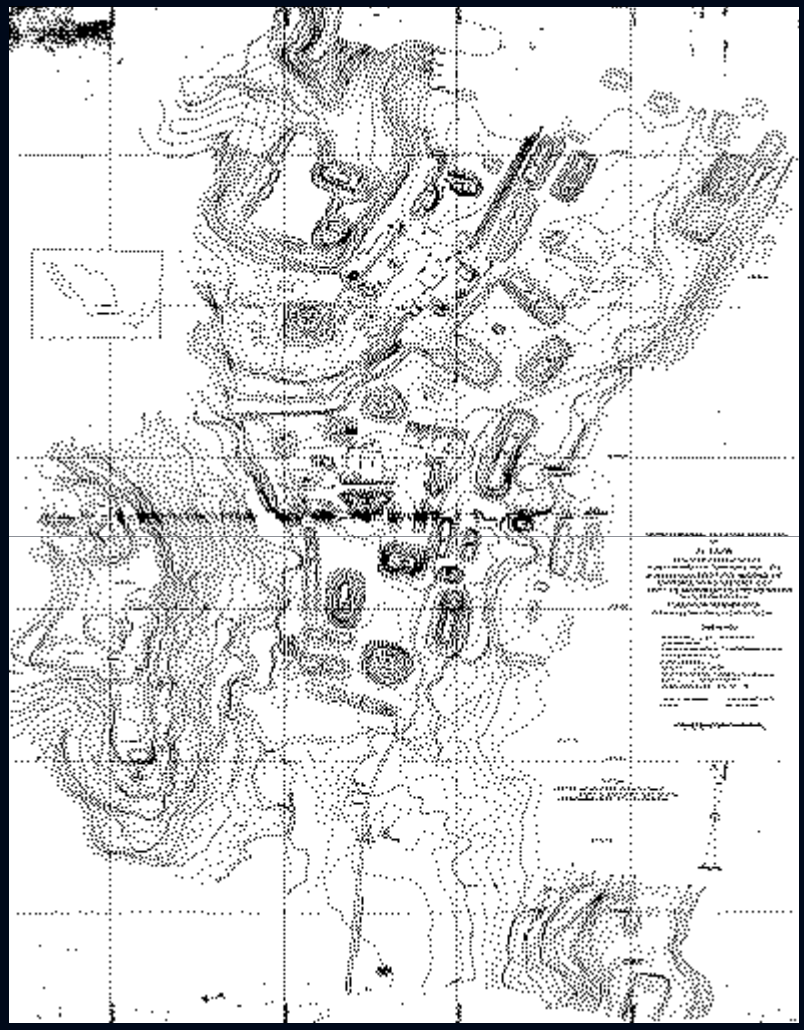


Remote sensing transforming the way cultural patrimony is being recorded



Location of El Tajín´s protected polygon of 12.21 km²





Last topographic map (1969-70) of Archaeological Zone of El Tajín, before of LiDAR

THE RESEARCH'S PROJECT

Prospección Arqueológica Tradicional

1. Los Recursos Económicos y Humanos Disponibles

2. El Diseño de la Prospección (muestreo)

3. Definición de variables que afectan la prospección (accesos, condiciones sociales, ecológicas, etc.)

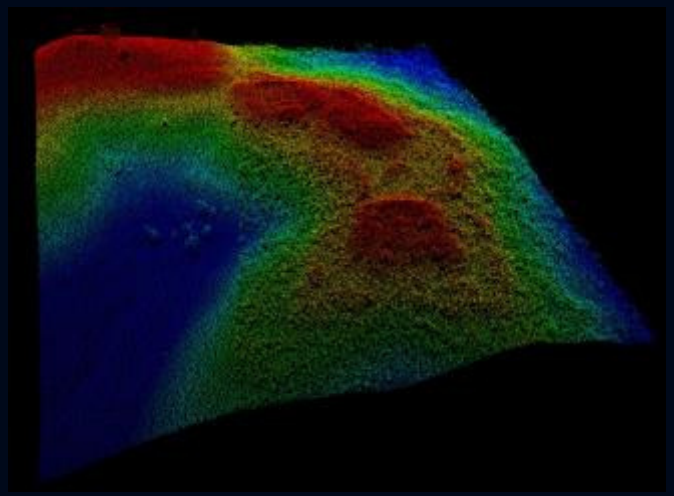
Remote Sensing in El Tajín

(Castillo Peña, 2011)

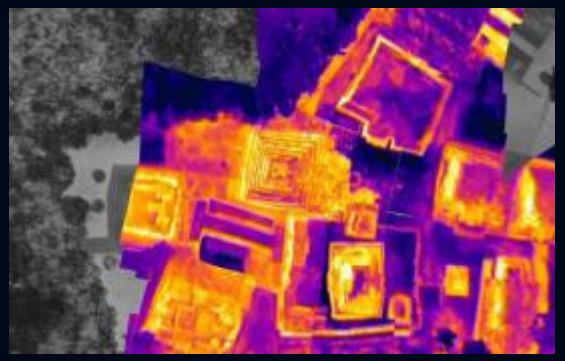
Photogrametry

Cover a wide area quickly and identify, record , preserve and study all buildings inside protected area to better comprenhension of inner dynamics

LiDAR



Termography



Determine if there are structural damage to main buildings due oil exploration and natural disasters like flooding and earthquakes

Objetives of Research

1. Identify and record all archaeological remains inside of polygon of protection of archaeological zone

2. Know parts and characteristics of ancient settlement of El Tajín

3. Design Long-term preservation and research strategies and study of Monuments within the Zone

4. Develop better oficial regulations to preserve and manage cultural proprieties in collaboration with municipalities and the government and people.

TAKING OF DATA

Table 1. Comparative general of taking of LiDAR's data

Comparative of set of data's LiDAR		
	2011	2014
Area	12.22 km²	12.22 km²
Beggining of labors	07-may-11	21 de enero 2014
End of labors	29-jul-11	
Total of control points (GNSS)	8	-----
Point density (m2)	20-30	40-60

(a)

Equipment to previous terrestrial activities a) GNSS Leica GS09 receiver, b) GPS Leica ATX900 antenna, and c) Total Station Leica TS02

Aerial laser scanner airborne (a) detail of LiDAR and (b) LiDAR and camera photogrammetric inside of helicopter

(a) (b)

LiDAR Scanner and parameters

Parameters of Data Acquisition of LiDAR with OPTECH equipment

Parameter	*Value*
Height	80-3500 m Altitude above ground level (AGL)
Horizontal accuracy	1/5,500 (x altitud AGL en m); 1 sigma
Vertical accuracy	5 cm; 1 sigma
Returns láser recording	4 pulses: 1ro, 2do, 3ro and last
Laser intensity recording	For each return
Frequency of láser	100 kHz (100,000 pulses per second)
Clasification of laser	Clase IV (US FDA21 CFR)
Voltage of operation	28-35V
Points by m2	20-40
Total points recorded	1´200,413,710

in ortho-rectified

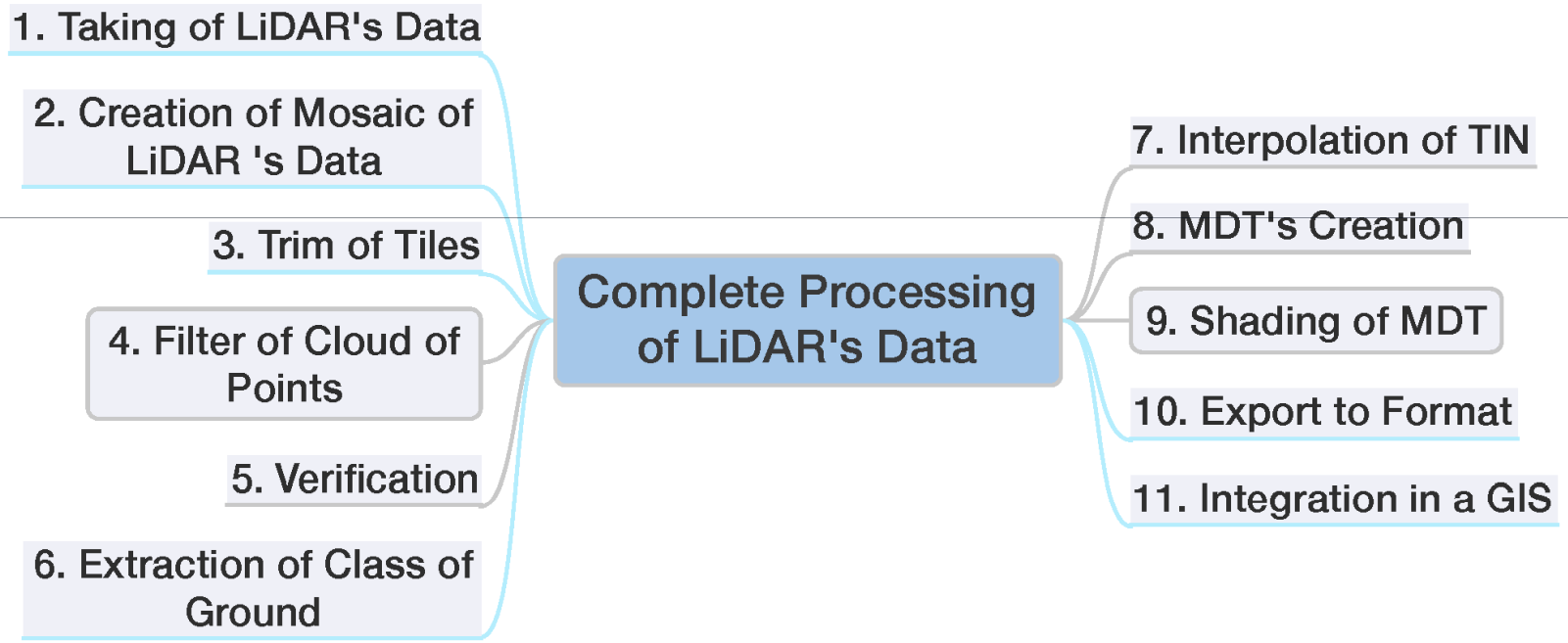
Photogrammetric Camera and parameters

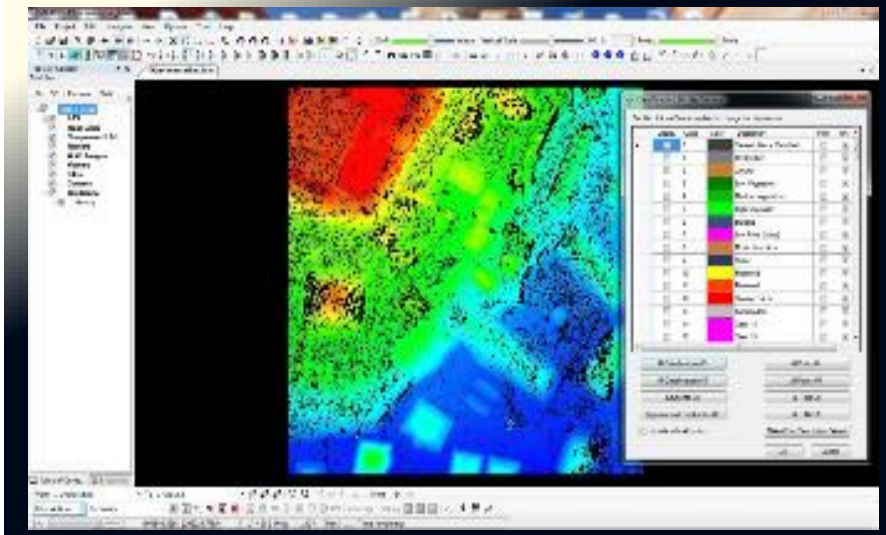
Parameters of taking of orthophotos

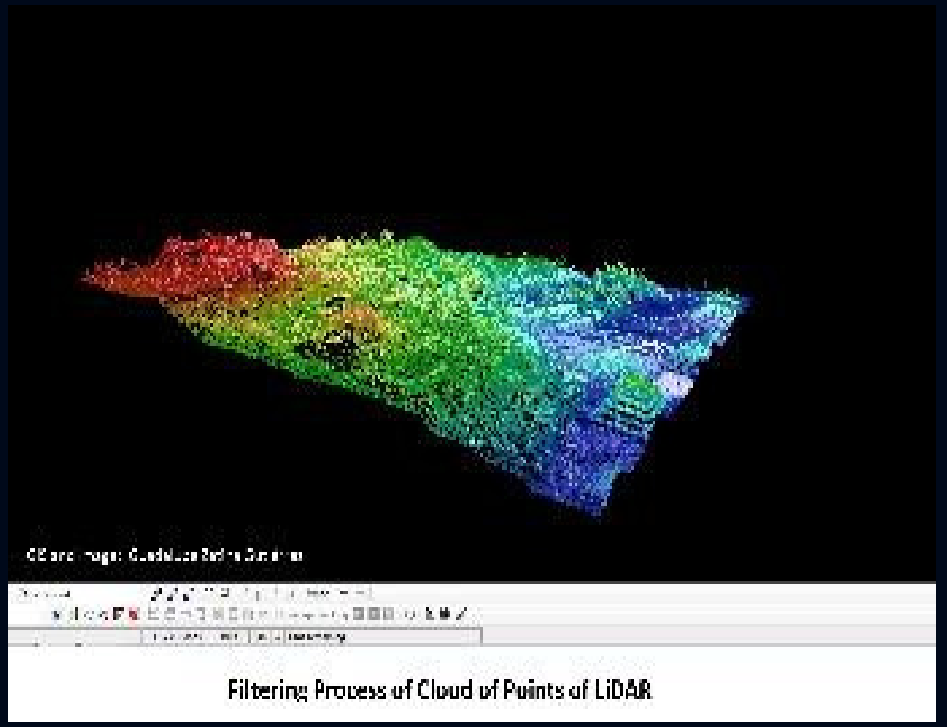
Parameters	*Value*
Size of array	4,092 (longitudinal) x 4,079 (transversal)
Size of pixel	0.009 mm
Lens	ZEISS Distagon 55.0mm, 36° field of vision
Control of exposure	Automatic with priority to opening or shutter
Shutter	Focal plane arrays automatically
Velocity of shutter mechanism	1/125 - 1/4,000 per second
Compensation of exposure	± 2 EV interval of 1/3 EV
Dimension and wight of camera	16x18x41 cm; 5 kg
Voltage of operation	28V - 4 AMPS
Total number of photos	1600

PROCESSING OF DATA OF LiDAR AND PHOTOGRAMMETRY

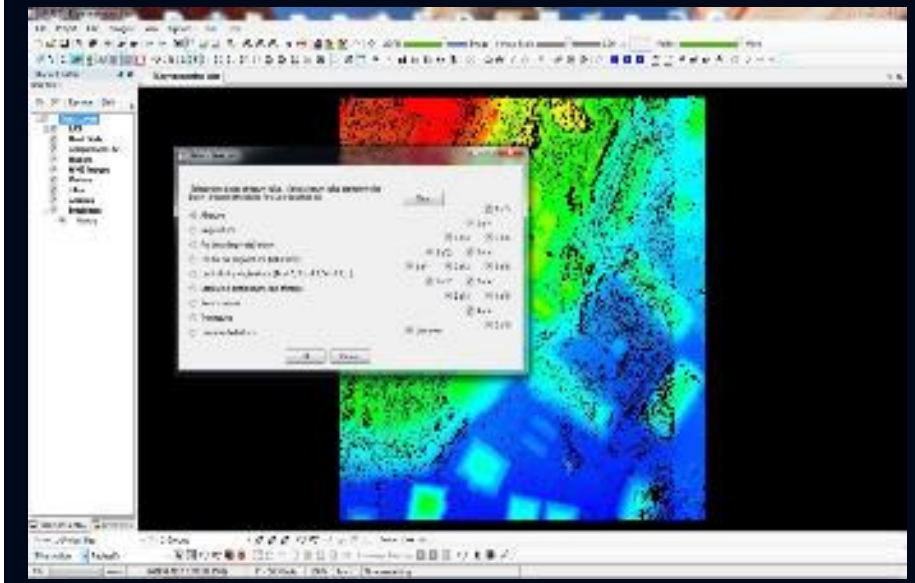
Processing of LiDAR





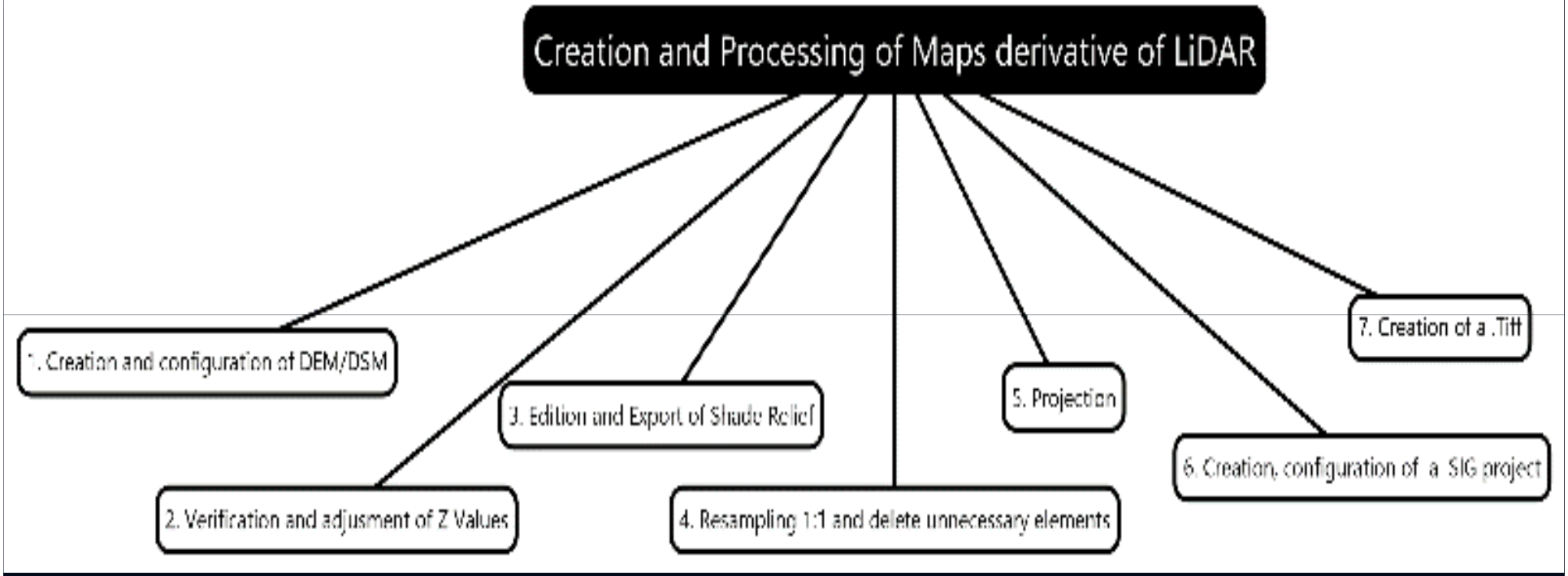


Filtering Process of Cloud of Points of LiDAR



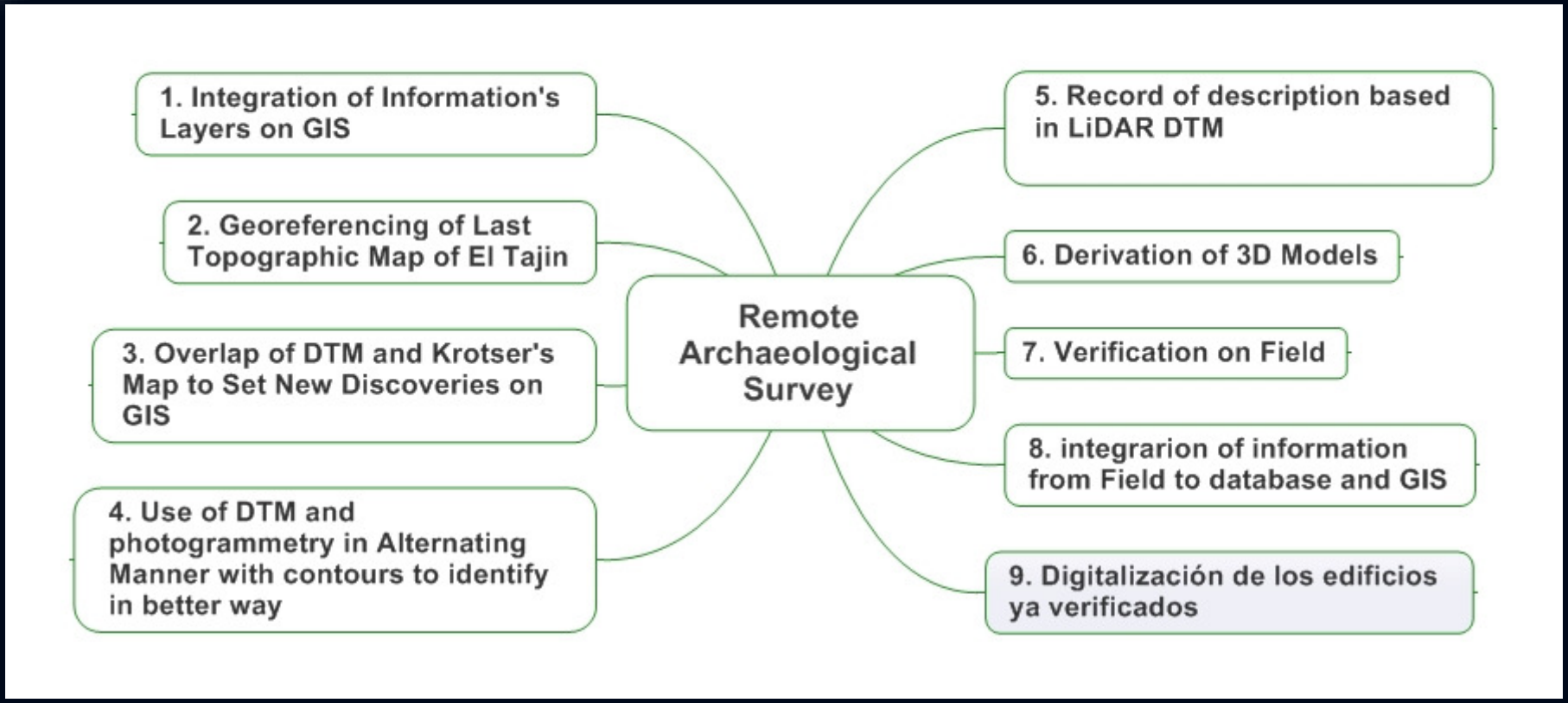
Filtering of cloud of points by heights, returns, and types in Mars Software

Processing of composition of Maps

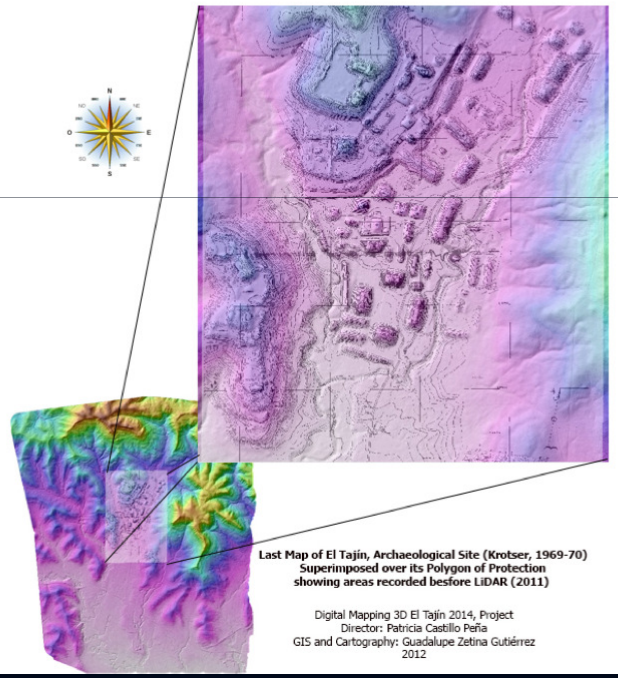


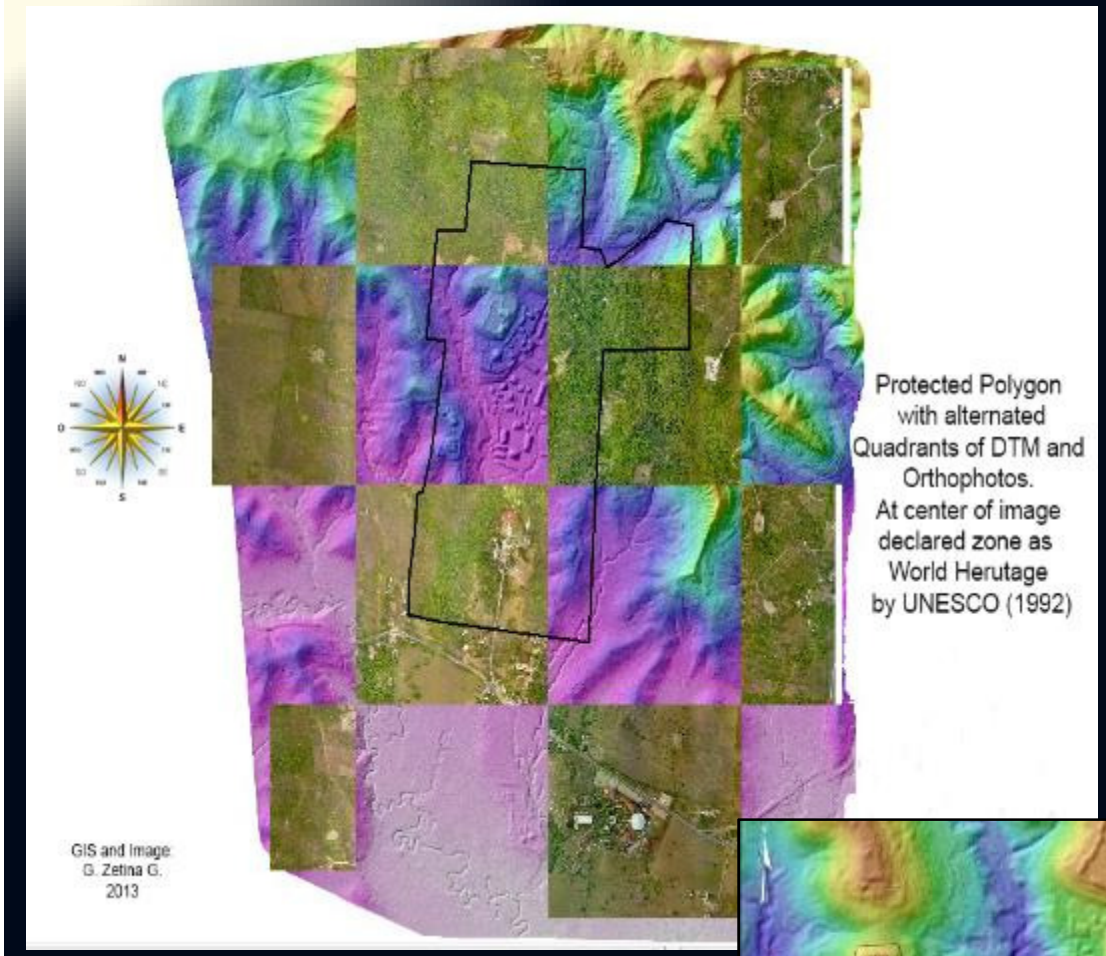
REMOTE ARCHAEOLOGICAL SURVEY

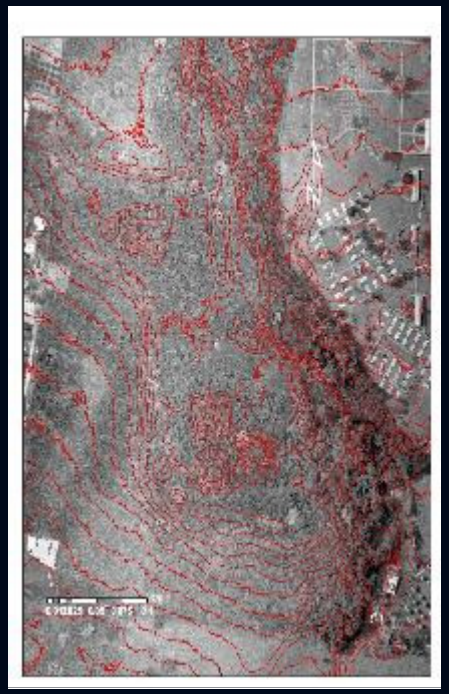
Process of Remote Archaeological Survey

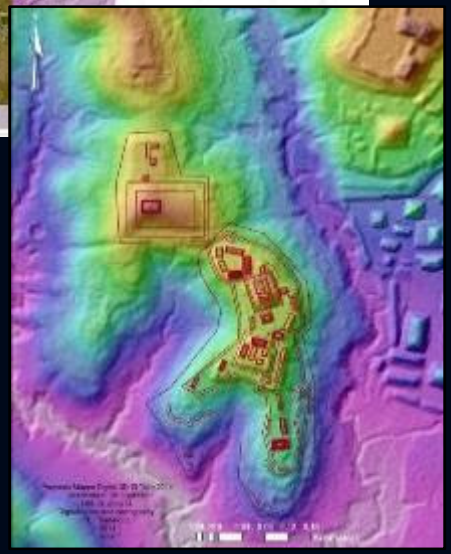


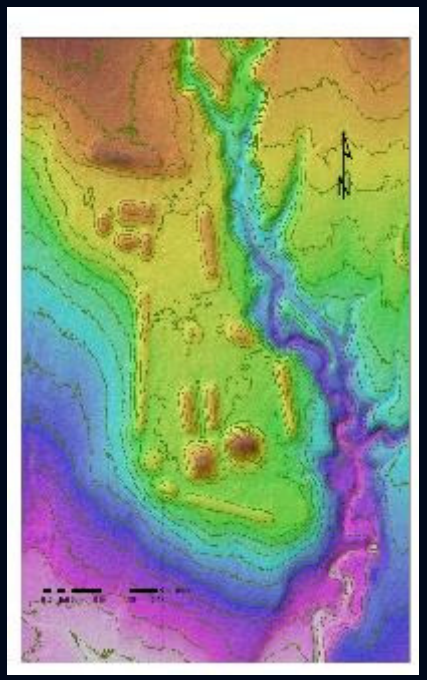
Krotser archaeological survey map from 1970-72 overlain over a LiDAR derived DTM within the UNESCO protected area for El Tajín.

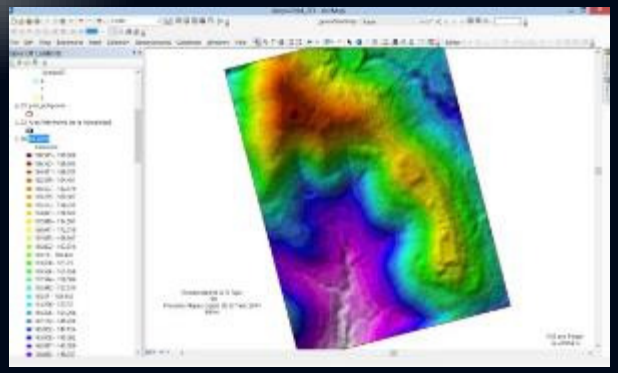



Protected Polygon
with alternated
Quadrants of DTM and
Orthophotos.
At center of image
declared zone as
World Herutage
by UNESCO (1992)
GIS and Image
G. Zetina G.
2013









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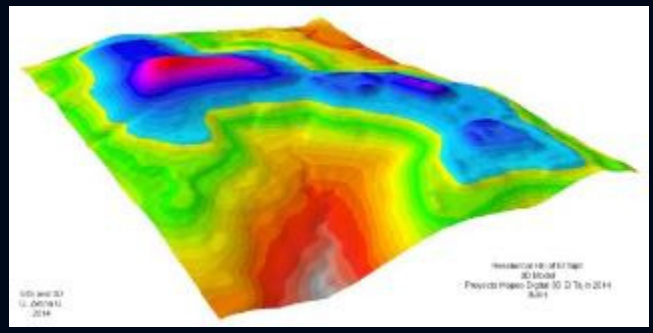
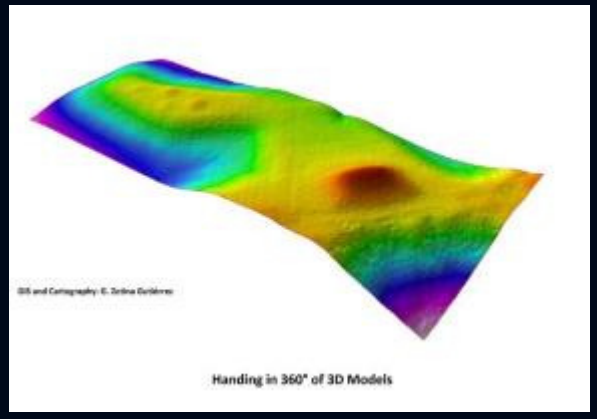
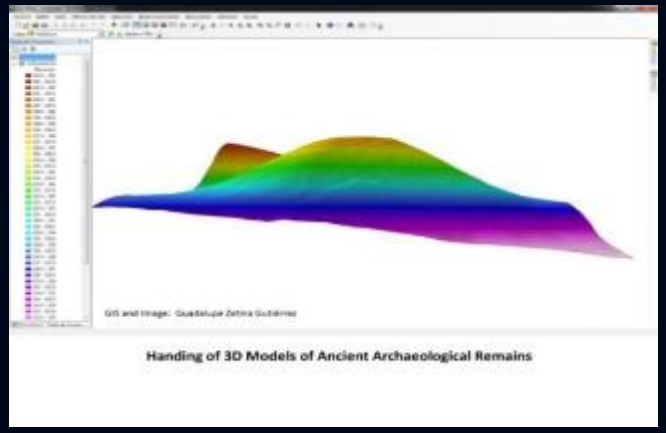


3D Model





3D Models

RESULTS AND CONCLUSIONS

Advantages of use in our research inside this ancient settlement are:

1. Represents a nondestructive technique and a precise, faster and efficient way to identify, record, research and preserve archaeological remains.

2. The velocity of identification and recording is at least ten times faster

3. Focus not on isolated sites or isolated architectural remains but instead entire landscapes

4. we can describe and understand better the distributions and parts of archaeological settlements

5. Allowed us to build an inventory so that we could monitor archaeological sites to facilitate public policies regarding archaeological conservation

6. We have better criteria to designate excavation areas in better way than the traditional methods.

7. Allow us create more effective strategies to protect sites with the data collected from digital mapping.

Zetina Gutiérrez, Fisher and Castillo, On Press
Remote Sensing Journal,
Special Issue New Perspectives, of Remote Sensing for Archaeology

Specific results

1. Development of methodology to remote archaeological survey

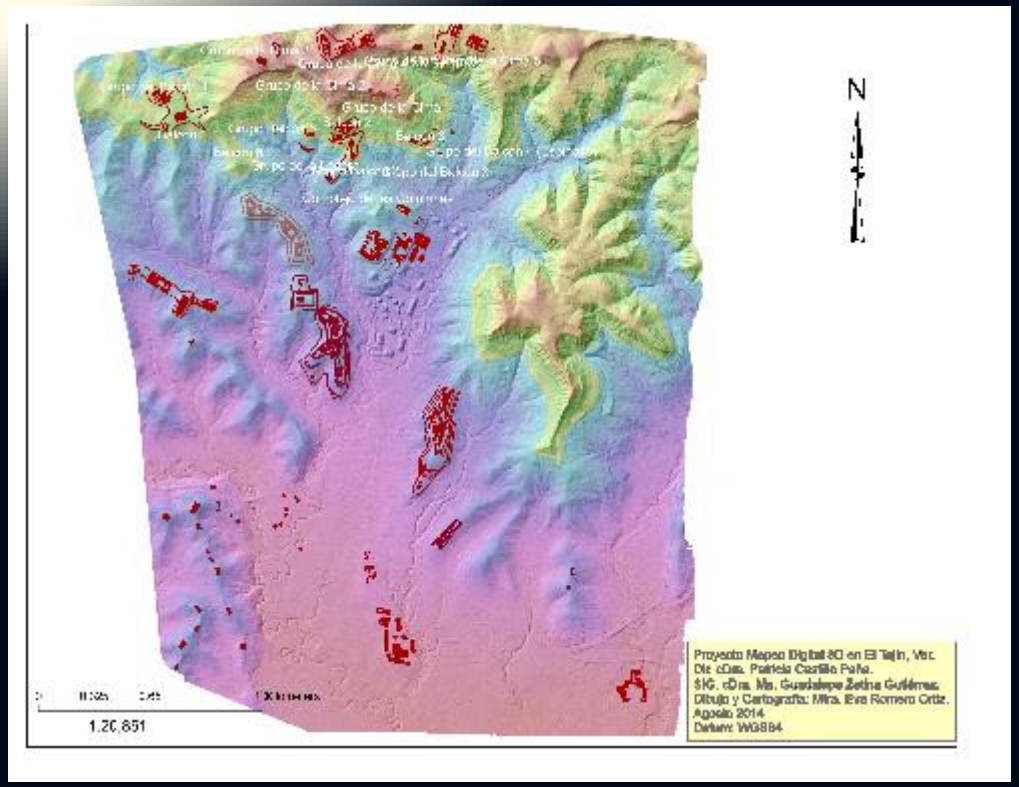
2. Recorder of more of documented 91 new archaeological structures.

3. Topography in detail.

4. Hydrological model derived from LiDAR

5. We **identify paths, roads and routes.**

Zetina Gutiérrez, Fisher and Castillo, On Press
Remote Sensing Journal,
Special Issue New Perspectives, of Remote Sensing for Archaeology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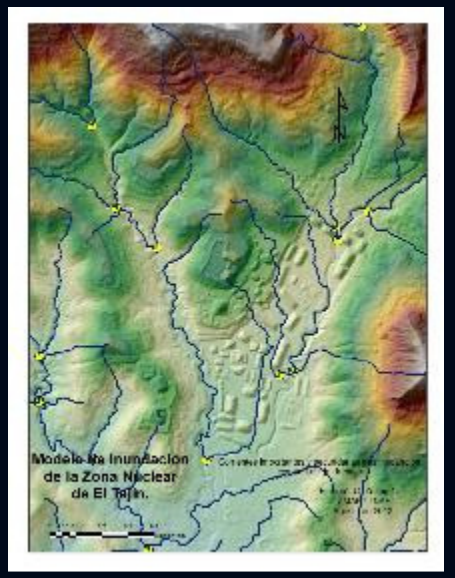
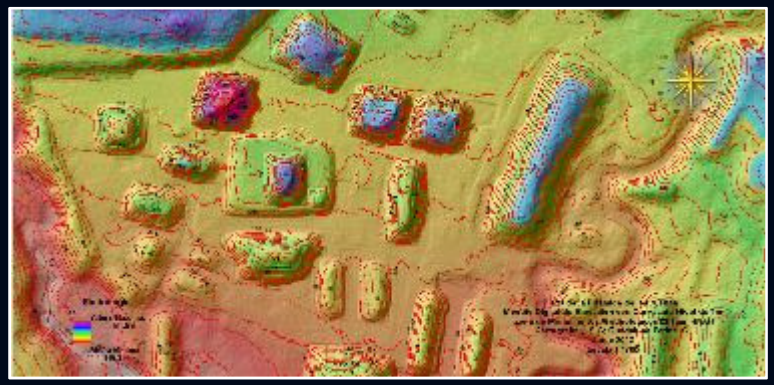
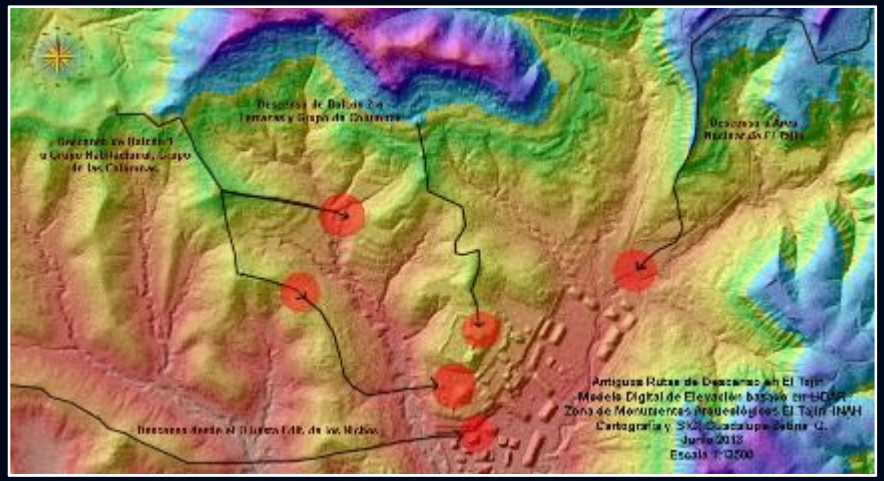
1:20,851


Modelo de Inundación
de la Zona Nuclear
de El Tajín.




Antiguas Rutas de Descanso en El Tajín
Modelo Digital de Elevación basado en LIDAR
Zona de Monumentos Arqueológicos El Tajín INAH
Cartografía y SIG Guadalupe Zetina G.
Junio 2013

¡GRACIAS!

THANK YOU!