

## Interpretation of Environmental Archaeology, Photogrammetry, and GIS for Exploring the Ancient Village Sites in China

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### ABSTRACT

It is more important problem for Chinese archaeology, that we could not take pictures from the sky. Then, we sometimes used satellite images, especially, high-resolution images. But high-resolution satellite images scale are too small for archaeological survey, we therefor use Radio-controlled Model Helicopter to take air pictures about the archaeological sites.

The combine use with satellite images and large-scale images will give to archaeologists real informations. In this paper, we will suggest about ancient village sites in China, for environmental archaeology using photogrammetry and GIS.

### 1, INTRODUCTION

The origin of rice cultivation in China is said from 12000 BC, that are older than Yellow River Civilization, and archaeologists said also the 5<sup>th</sup> civilization is found in the world.

Recent archaeological reports are also said, many fortress sites were found along the Yangtze River (長江), those have huge fortress wall (20-30 width, and 5-7m high) around the village sites. These fortress sites are suited along the rivers, the old people in China well utilized the river flow.

In 1997 and 1998, we surveyed 2 archaeological sites (smaller one is 龍馬古城, 1.1 km \* 0.6km, larger one is 三星堆, 2km \* 3km) near Chendzu City, in Sichuan Basin, upper Yangtze River.

### 2, SATELLITE AND CLOSE-RANGE IMAGE

#### 2-1, Satellite Images

In this time, we used the satellite images taken from Russian Cosmos-1951, and miscued by SPIN-2. Image size are 10km \* 10km (5000 \* 5000 pixels), resolutions are 2m (Fig.-1). This image is ortho-images, this image is not saw by stereo. Then, we need elevation data. These satellite images show us important informations that we could not look on the surface ground. These images are B/W images not only

color images. But, we can understand that the dark parts are river traces. And, we can understand the whole image of fortress site, especially 三星堆 site is too wide to take pictures from the radio-controlled model helicopter.

We could not get real maps about this area, therefor, we measured the elevation about each places to make the maps and computer graphics.

#### 2-2, Radio-controlled model helicopter

In the requests of large-scale images, we used radio-controlled model helicopter, that has 40 Hp gasoline engine, 2.5m rotor diameter, and can carry cameras and monitor CCD camera less than 10kg, within 10 min (Fig.-2). The capacity of the flight with 10kg lodge is about 300m high.

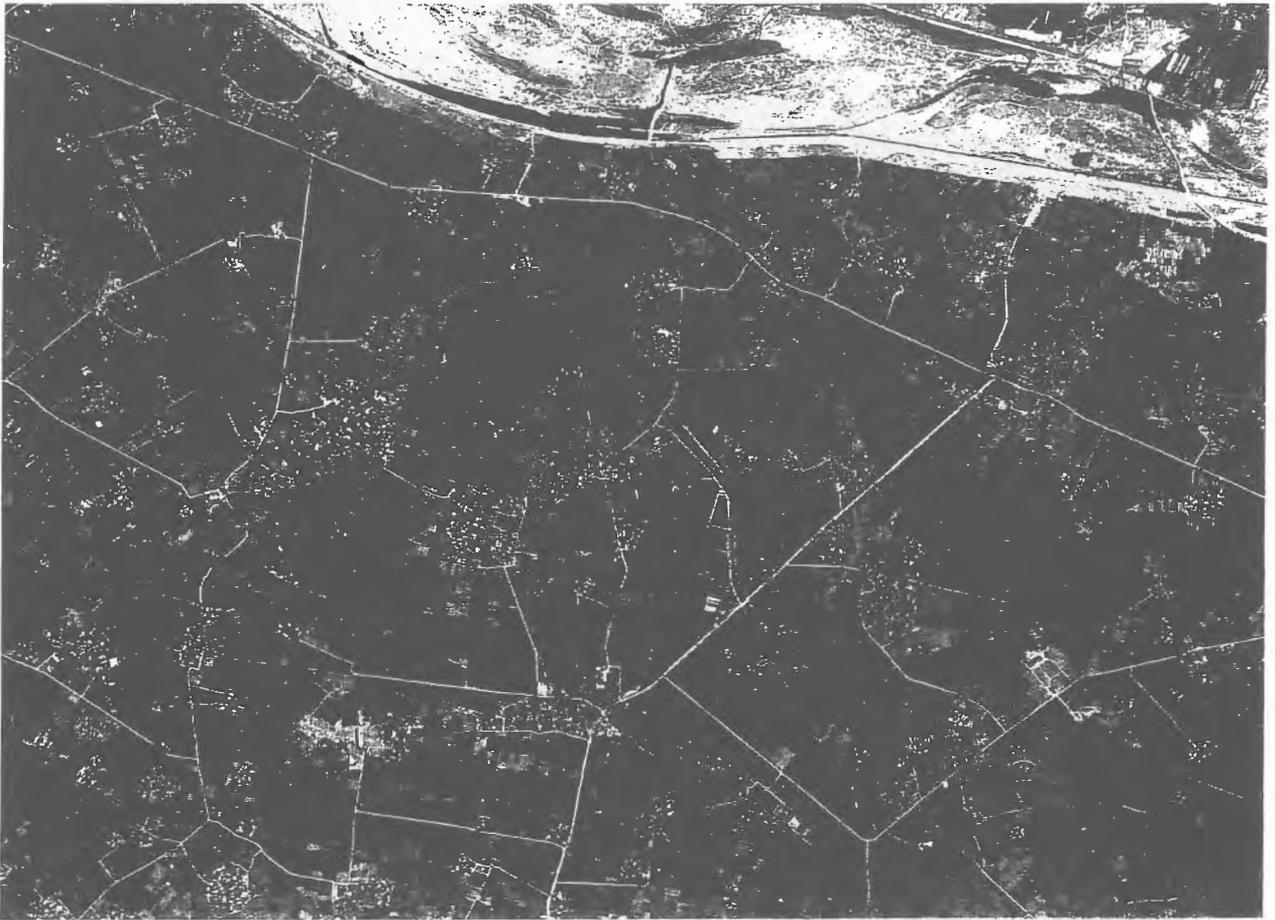
We used both of steel cameras (HasselBlad and 35mm small format camera) and digital still camera (Kodak DCS-460) hanged from radio-controlled model helicopter.

In the 龍馬古城 site, we needed 2 days and took 27 coorses, 250 pictures, to make maps for the scale 1:1000.

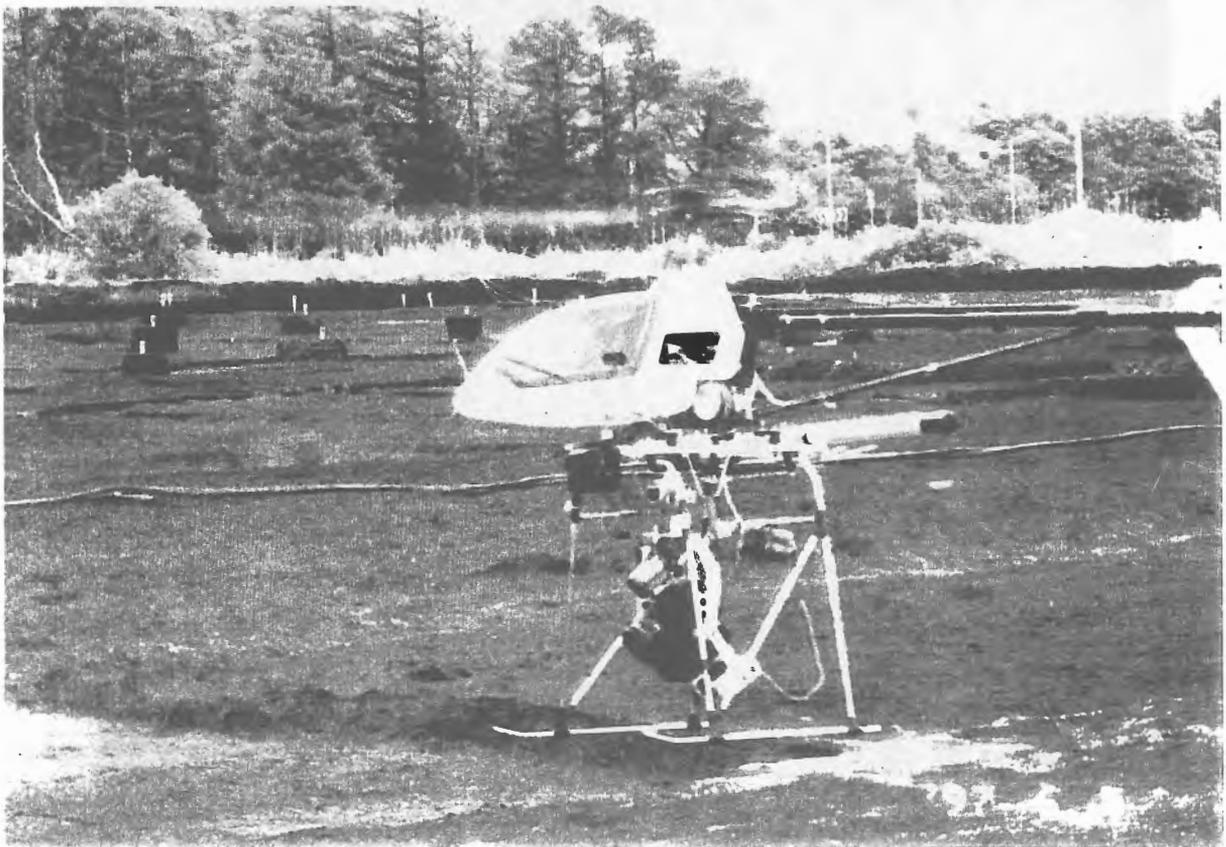
### 3, PHOTOGRAMMTRY AND 3D MODELING

#### 3-1, Photogrammetry and 3D modeling of the 龍馬古城 archaeological site

龍馬古城 site's topographical maps (scale 1:1000) were make by stereo photogrammetry, we needed 25 stereo models to



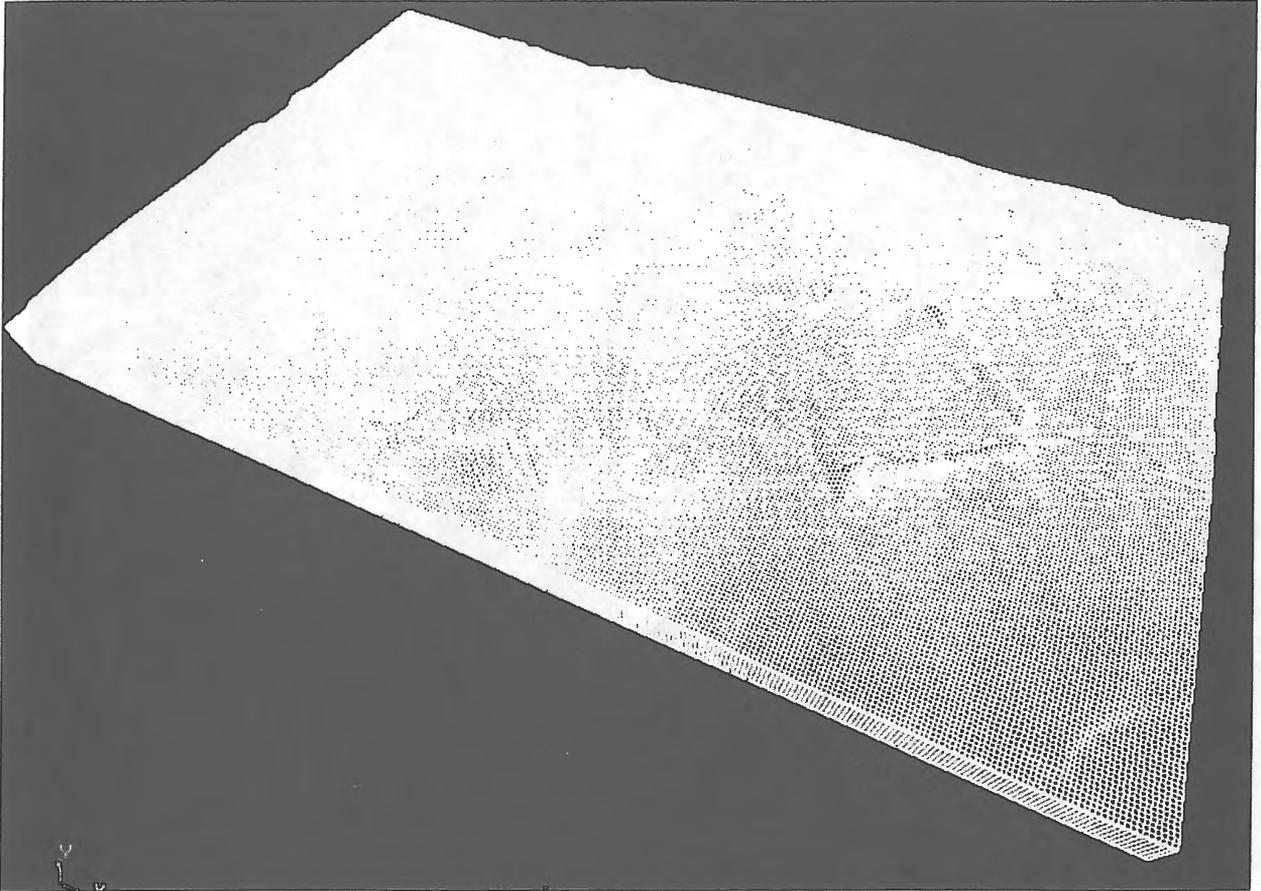
**Fig.-1 Satellite Image**



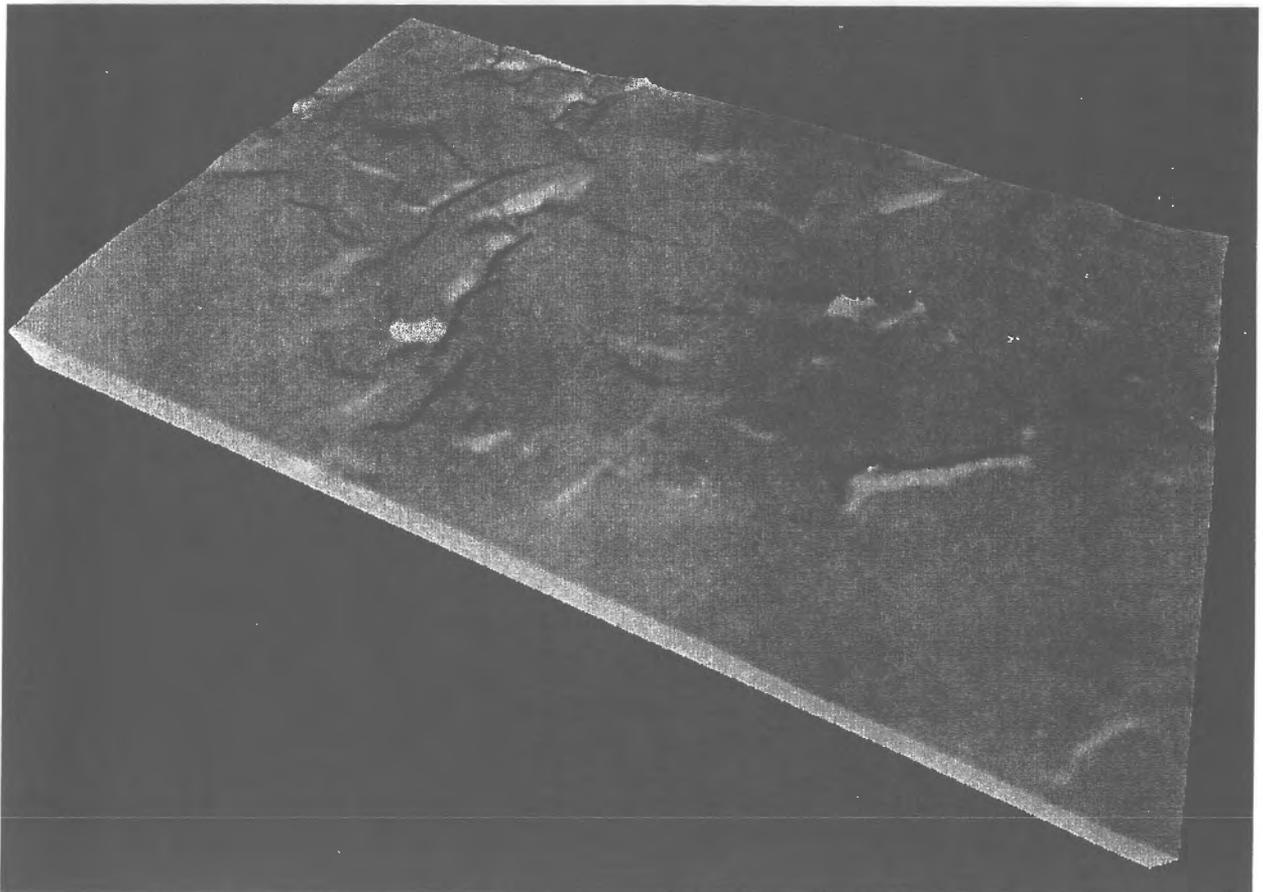
**Fig.-2 Radio-controlled Model Helicopter**



Fig.-3 龍馬古城 digital Mosaic Image



**Fig.-4 Digital Elevation Model**



**Fig.-5 Shading Model**

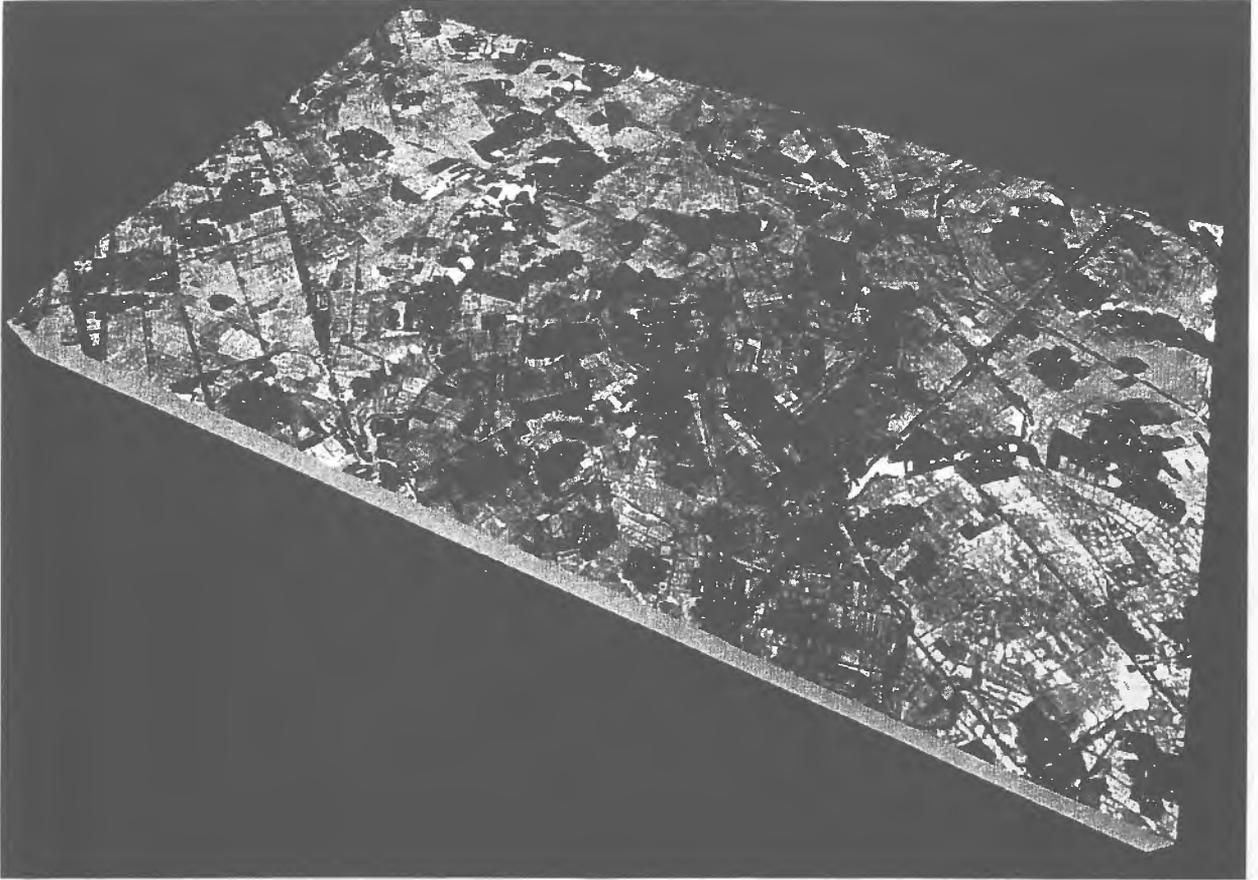


Fig.-6 CG of 龍馬古城



Fig.-8 Environmental Archaeology in 龍馬古城

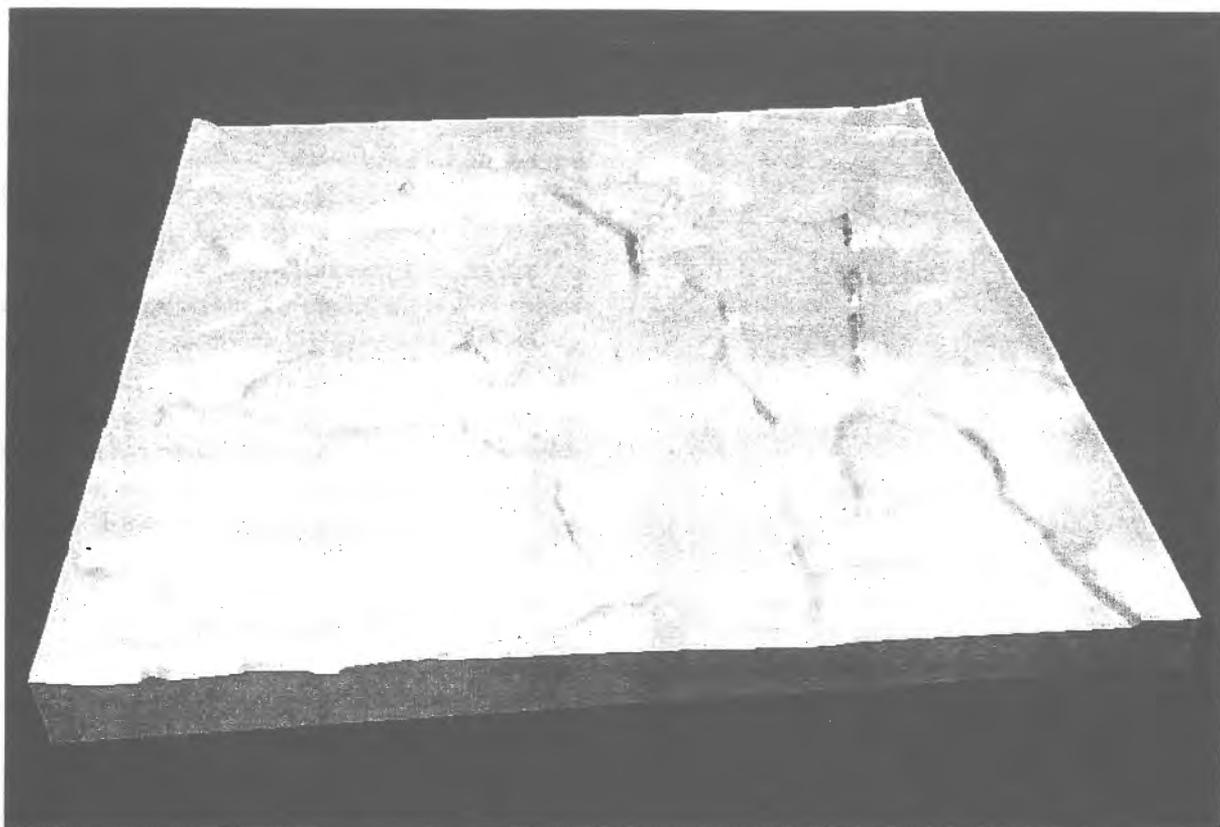


Fig.-7 Shading Image of 三星堆 Archaeological Site

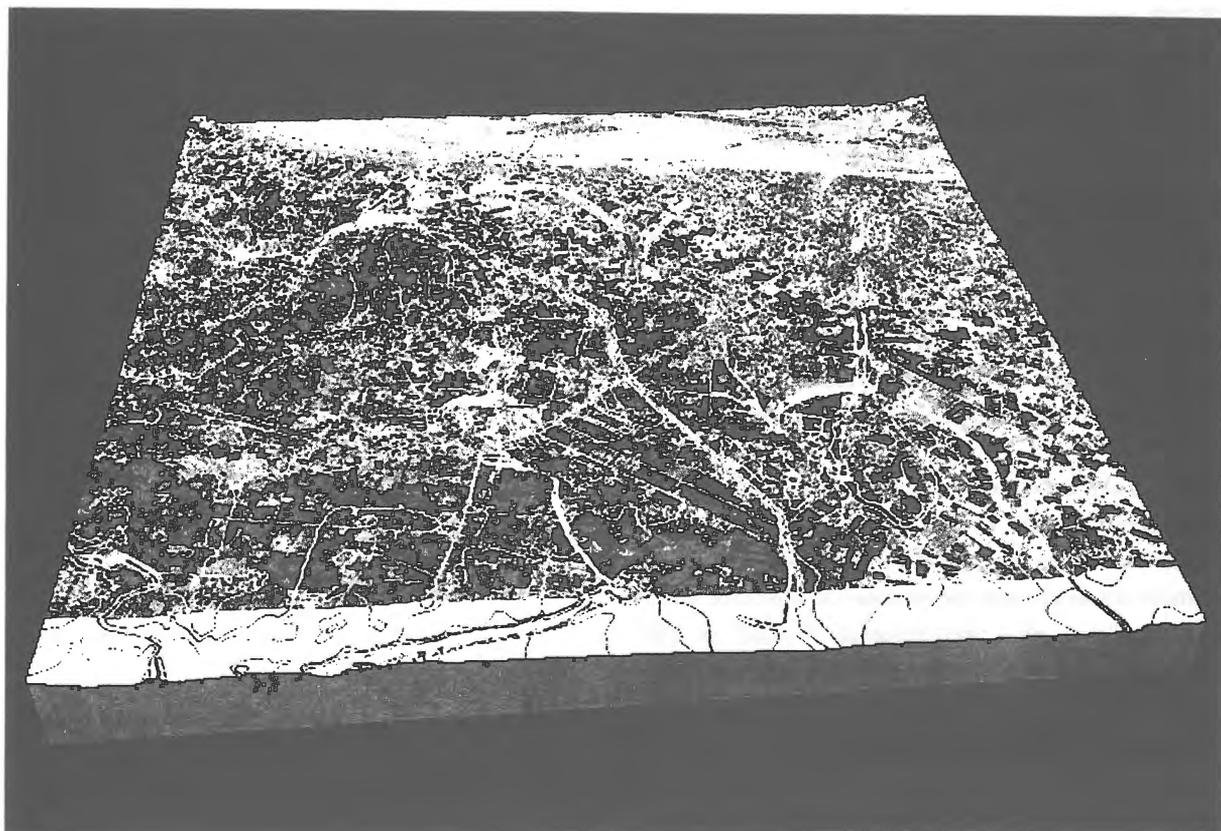
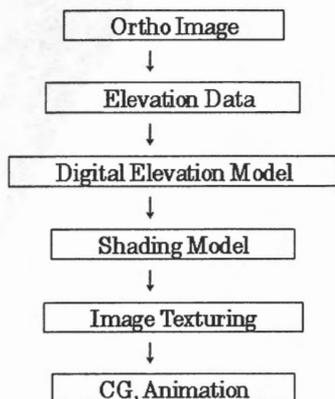


Fig.-9 Environmental Archaeology in 三星堆

make topographic maps and the central area (Fig.-3) were more detail air photographs, we needed. For this central area, we needed 10 stereo model photographs. 3D modeling of the 龍馬古城 archaeological site are following ...



Digital elevation models are making from elevation data that are mesh elevation data are make from irregularity data. In this time, we constructed 10m-mesh digital elevation model around the archeological site, and 2m-mesh digital elevation model around the central area (Fig.-4). These data are make to wire-flame model and to translate to CAD data.

Shading images are make from the CAD data (Fig-5).

龍馬古城 ortho images were taken from radio-controlled model helicopter are color images. We put these color images on the CAD data in computer, and made CG and Animation. Fig.-6 is one of the CG of 龍馬古城 archaeological site.

### 3-2, 3D Modeling of the 三星堆 archaeological site

The other hand 三星堆 site's maps were make from digital elevation model method. This method needs only ortho images and elevation data. We were able to get ortho images before the entry of China, but we did not have any elevation data before. Therefor, we got elevation data from the survey that used laser theodolite and geographical interpretation of surface.

三星堆 site are suited along the 岷江 river, there are 2-3 steps river terraces. The fortress walls are suited on the high terraces, not suited on low terraces or flood areas.

It is important where are river terraces and where are suited fortress wall or other archaeological remains, in the geographical interpretation (Fig.-7).

## 4, Environmental Archaeology

3D modeling show easy environmental informations to us. Dark brown parts of Fig.-6 (龍馬古城) are considerable river traces or pond, lakes. We remarked old river traces and

fortress walls on Fig.-6 (Fig.-8). This figure shows us that ancient people lived in 龍馬古城, how to use the land.

In side of 龍馬古城, there were some rivers or canals, and there are some soil marks that are considerable big buildings post holes on high river terraces.

三星堆 archaeological site is also made 3D modeling like 龍馬古城 archaeological site (Fig.-9). The north part of archaeological site were flood out, so, we could not catch the fortress wall. It was maybe not suited therefor 岷江 river was flood the same areas and it became to be a well enemy fences in stead of fortress walls. One more important matter, we are able to catch the informations about the river or canal of inside the fortress. The northwest corner of fortress, we are found the remains that to be considerable to the canal entry. But, this area were not excavated, we do not know exactly.

## 5, CONCLUSION

It is important that 3D informations will show us easy to understand for ancient land use.

In the area where we can not take air pictures, it is useful way that to use satellite images and radio-controlled model helicopter. Also that, 3D modeling give us easy information to understand about archaeological sites and land use.