

# ALOS FOR ARCHAEOLOGICAL INVESTIGATION IN WEST ASIA

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## 1. INTRODUCTION

< The making of the base map of the ancient sites of the Mesopotamian region and its utilization > is a project starts at 2007, aims at design a scientifically method in order to investigate the archaeological sites within the region of Mesopotamia of West Asia co-operate with JAXA. The method involves use and analysis the data were obtained through the satellite.

This report provides information, and results relating to the project, as well as future prospects.

The archaeological investigation and activates in the sites of Mesopotamian Civilization in West Asia started in 19<sup>th</sup> century by several European and American archaeologist and explores, followed after 1956 by many Japanese teams interred the field, while Kokushikan University-Tokyo-Japan starts its field work in Iraq at beginning of 1969 until last years due to unstable political situation resulted by conquered of the country. As a result of occupied the country and wars the field of cultural heritage becomes facing several challenges including illegal digging, and destruction of ancient sites that the whale situation of Iraqi cultural heritage was worsened as a result of the Gulf War in 1991, and Conquest of Iraq at 2003. Therefore, the protection is necessary need. To show the scope, condition and nature of destruction we conclude below Picture.1 was taken after the Saddam Hussein's regime collapse in 2003, the photo belongs to the conservation room of the Iraqi National Museum after the looting was taken place [1]. In addition, looting was carried out by this confusion in some well-known ancient sites as well as a museum [2].

Therefore we will start a project to protect Iraqi cultural heritage immediately. And to achieve this objective and others there is a need to developing database of archaeological sites and maps with high accuracy positional information. In consideration, the participation of Iraqi themselves consider one of the most important project's objective which make the project more useful, and fruitful as well.

Actually, before there were attempts are tried to document and design database for the archaeological sites based on listed sites scattered in different sources by using digitizing. However, the method does not enable show the present condition of the remains, and these which are unregistered. The suggestion is to do field work as much as possible in order to collect data suitable to list theme within the database, but, due to the security situation on the ground, it becoming difficult for Japanese team entry the field work area, therefore, and to solve this problematic using an advantage of the Satellite Remote Sensing could be produce data and observation from the sky which we believe it will be useful for our base map and database for the archaeological site based on GIS.



**Pic, 1 The Iraqi National Museum after the looting in May, 2003**

## 2. METHOD

### 2-1 Base Map for Archaeological Sites Database

In 2005 we began study distribution of archaeological sites based on the available sources by using other satellite data in time before cooperate with JAXA [3]. In addition,

from point of view of remains protection, we made a distribution map but hastily. During the work a problems were appeared or example, when we used some data from several sources relate to Iraqi map for very important remains data, we found that the case of these remains is not well represented showing in minimal precisely due to that a small reduced scale map was used {4}, it was based on scale of 1:100000 USSR topographical maps, because it was hard to obtain available topographical map for study distribution of the remains during Saddam Hussein reign.

Therefore, we made a base map by using satellite data in order to use it for make ancient site distribution map

The basic data were utilized throughout Satellite which we used it for base map was made based on the LANDSAT data of Global Land Cover Facility (GLCF). Because the project covering wide range area including whole of Mesopotamia in west Asia, it was necessary to get much of geographical information from whole area of the study. Due to the resolution ranging in scale from 15-30m that could not interpret the small scale remained site, only large- scale size, as well as another reason represents the fact that it was difficult to obtain data after the war. To solve this problematic issue we decided to use QuickBird and SPOT, FORMOSAT2, TERRA/ASTER were had higher resolution about notable remained sites outskirts. The QuickBird data have a benefit represents by its ability to supply us by even the holes were resulted by the illegal excavations, but it's difficult to get data throughout it due to its high cost.

Modern developed techniques such as Google earth service on Google could considers as a choice, but its resolution for the fixed areas still limited, and in minimal that it indicates only for the true colors at that time, therefore, it is remained useful only for preliminary uses such as the interpretation.

By an appearance of the ALOS which JAXA launched in 2006, the confirmation of remained sites became a possible solution and to improve the conditions for use the data which could investigate a wide area was set due to its low- cost.

Because the present purpose of the project was making of the latest base map for archaeological ancient sites based on database making, we decided to use AVNIR2 and PRISM of the optical sensor mainly.

## 2-2 The Method for Develop the Base Map

Making of the base map used technique of basic remote sensing [Fig. 1]. We use ALOS as the latest base map. It was panchromatic sharpening processing of AVNIR2 and PRISM. The data of the base map of the oldest times used CORONA. It is the photograph which American intelligence satellite took it in the 1960s. We used Landsat and TERRA/ASTER when it could not cover it by those data.

Because the reference data of the positional information could still less acquire GCP on the ground, we just used positional information of PRISM Sensor corresponding with supervised data of geographical information.

The information of the topography used DSM data from PRISM and SRTM.

When the base map complete and available, it will become as a source for Iraqi side that legend of the base map added information remains such as a road, and the place name.

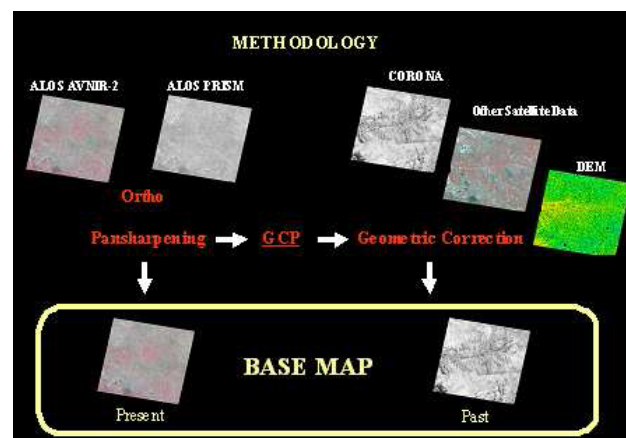


Fig. 1 Making of the Base Map

## 2-3 Applied Data

Lately applied data of geographical information shall be indicated as follows.

Satellite Image:

ALOS (main data source)  
CORONA  
Terra ASTER  
Landsat  
FORMASAT-2  
SPOT  
QuickBird

Elevation Data:

ALOS PRISM  
SRTM

Topographic Map:

Soviet Military Topographic Map with the scale of 1:100000 (completed during 1970's)

Place Name:

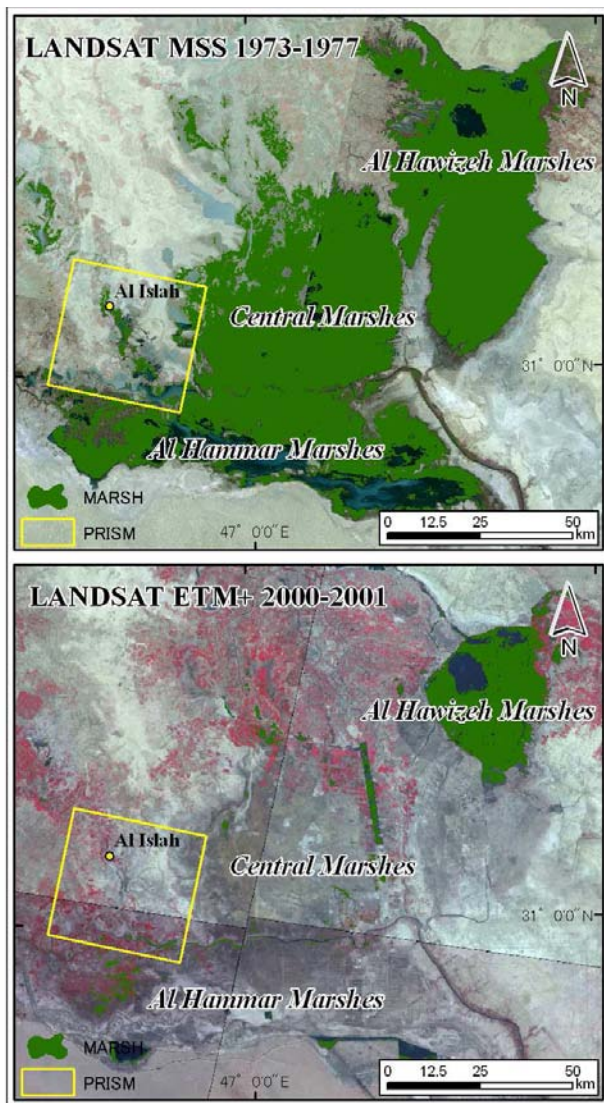
GEOnet Names Server data

The applied software for the analysis of data is ESRI ArcInfo, Leica Geosystems ERDAS IMAGINE.

### 3. CASE STUDY

#### 3-1 Base Map Making

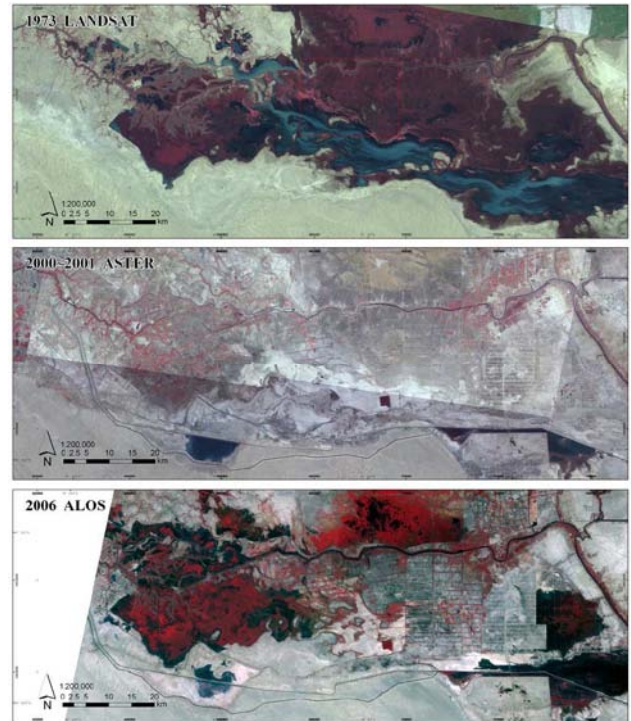
The war of 2003[5] put the whole cultural heritage of the country of Iraq under a critical confused situation which required starting makes a base map as a preliminary step. Because Iraq involves a wide space area, we received the required available information from Iraqi side in order to start the field work at an area that should take a priority. The area where the ancient sites are need a protection locates and scatter within the marsh area in southern part of Iraq, and called the Mesopotamian Marshland.



**Fig, 2 Land Cover Change of Mesopotamian Marshland**

Figure 2 showing the changed land due to marshland took by Landsat data. The green area of legend is represented the marshland, while the yellow square in the range of PRISM refers to base map which we used.

The Mesopotamian Marshland has Importance Central in the history of modern Iraq as Birth Place of Mesopotamian Civilization. It covers whole of southern Iraq area. Recently, and due to the modern developing of the marshland area planned by Iraqi government at 1990's in order to make farmland several ancient sites were found. When the Iraqi regime collapsed due to the 2003 war, the local inhabitants destroyed the river's bank caused water passing toward the marshland area. In addition, and due to that the gate opened, the area become in rescue due to re flooding activities were caused many ancient sites become under rescue of re buried again . [Fig.3]



**Fig, 3 Reflooding of the Mesopotamian Marshland**

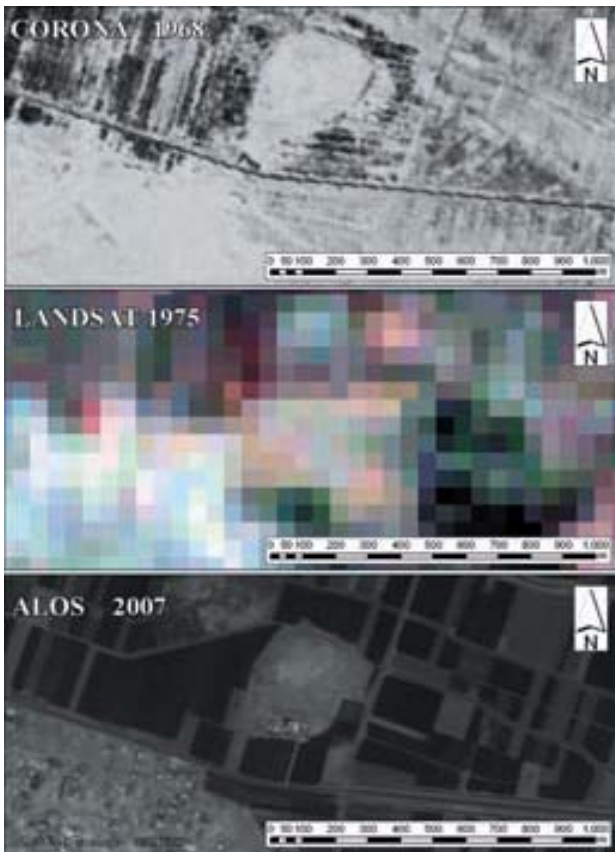
For all of the reason were mentioned above, it becoming necessary to make a map for ancient sites for purpose investigations before they completely covering by water and loose. Therefore, the base, and change maps of the damp of the ground around Dhi Qar governorate were supplied for Iraqi side in order to use them for their work. In fact, and objectively, these maps could show the situation of re flooding process in Mesopotamian marshland area, and might be help in the management of ancient site in Iraq. Problems are facing the base map including the identification place of existing sites was one of the difficulties, in addition, that the number of showed sites on the map was little. Meanwhile, the ancient sites were able to add to the base map got a positional information from the Iraqi side. Some results were utilized by Iraqis by using GPS receiver. Therefore, the establishment the technique to determine was demanded from satellite data in order to discover more ancient sites distribution.



### 3-2 Distribution Investigation into Ancient Sites

In 2007, we investigated the distribution of ancient sites in area of middle Euphrates River in Syria [6]. The ancient sites which we intended for are called "Tell" in Mesopotamia area. Tell is a trace of a house and the village built by mud brick.

The distribution map of recorded ancient sites in the area did not existing until now, therefore, we inspected whether an investigation was possible by using satellite data. However, we assumed that the Tell which was excavated by a team of Kokushikan University in this area and a data were investigated, and the investigation method made a list include Tel place estimated from the base map before fieldwork. These including, the topographical map made in Syria, a topographical map made in the Soviet, CORONA image, SPOT image, ALOS data, and a base map of multitemporal, all of these maps mentioned above were employed to estimate Tell [7].



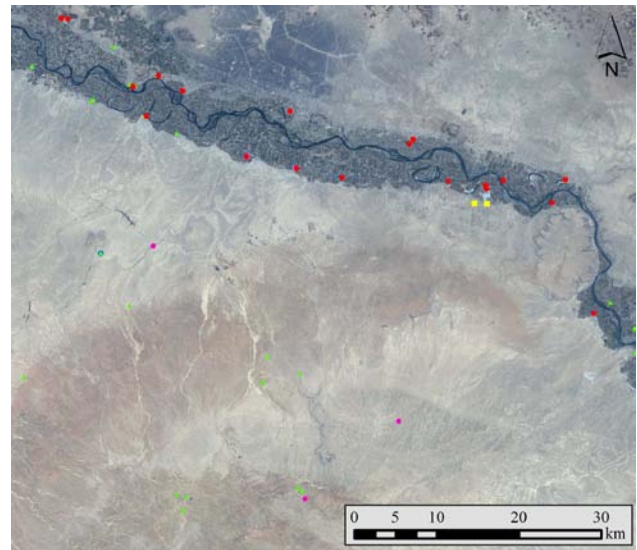
**Fig. 4 Shape of Tell from Multitemporal Base Map**

Figure 4 is an example of the Tell that it can make out from the base map.

Based on the list, we confirmed whether it was remains by a field work. And by the Tell's surface collection.

17 of 22 places expected that they are a Tells were able to confirm the already tested results.

It shows the Tell distribution map of 19 places that merged two places that we discovered by the information of local inhabitants on Fig 5.



**Fig. 5 Distribution of Tell**

The red symbol of legend on the map is a Tell. The Tell appeared as hill-shaped elliptic bare land of the farmland of the alluvial area. The problems are resulting from the image interpretation method make out that elliptic bare land having a flat surface mistakenly, if there was relative height more than 10m that by using method of DEM, Tell was able to confirm it. We thought that it was effective for an estimate Tell by DEM information, together with the image interpretation method.

Using an investigation method in Syria, we estimated Tell distribution for ancient site Kish area of reference at 25 square km of Babel prefecture of the central part of Iraq. There were 34 places of elliptic bare land that were extracted by the image interpretation method. The fact 20 places were able to confirm their height by using DEM method. Moreover, there is a possibility for the Tells in elliptic bare lands and have these points to include them with relative higher more than 10m. In the same time we don't know whether these points which based on the Tell expected are real under the present condition.

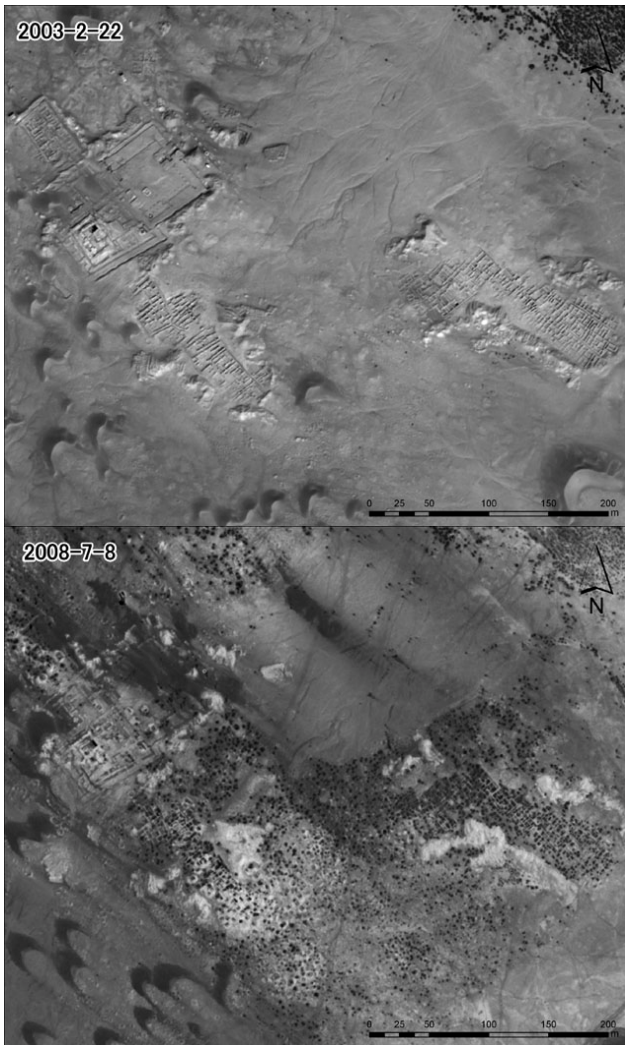
We supplied these data for Iraqi side in order to use them in distribution investigation of the Tell. The experiment can repeat and apply in Jordan too, but, in the case when we arrive to required precision for the Tell extraction. Because Jordan uses the GPS receiver which is accepted with database remains already, have been fully equipped with it.

### 3-3 Possibility to ancient sites monitoring using the ALOS data

Based on this project including a base map and distribution map, and to expansion of scope of data base

we tried monitoring the illegal excavations of ancient sites by using remote sensing in order to protect cultural heritage.

Figure 6 is QuickBird data of 2003 and 2008 in the remains of Umm al Akrab in southern Iraq. A shape of one side of around 5m was able to make it out in 2008. This was not seen with an image of 2003. Pic2 is the photograph of Umm al Akrab illegal dig situation of 2008. This photograph was sent from an Iraqi side. It is thought that the pattern of this surface which increased is a result of the illegal dig.



**Fig, 6 Changes of the Remains of Umm al Akrab**

The interpretation of the illegal dig is possible in the case when QuickBird uses of high-resolution data, However, area has small due to cost of this technique. The continued use of monitor to collect the ancient sites in wide area is not possible epically as a country of Iraq when the problem remains and not solve, that the difficulties are still remain, so, in the case if middle resolution satellite is possible to use, the issue of determine location of illegal excavation in ancient sites becoming available , and close to achieve the purpose . Therefore, we chose Umma site

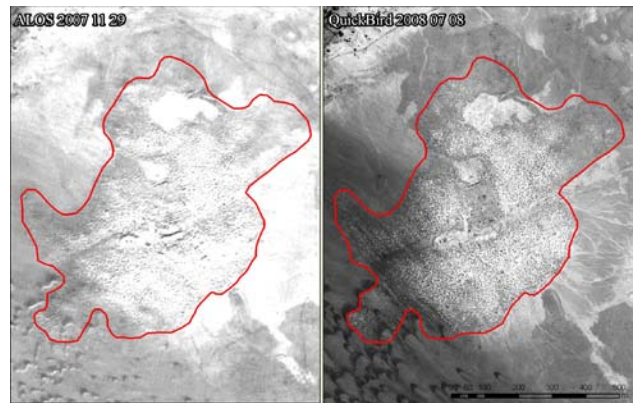
which could obtain data from both satellite levels, the high, and the middle as a test fieldwork.

Fig.4 showing Umma site which it was observed throughout both of ALOS and QuickBird the red lines in a figure is represented the illegal dig area that interpreted the Umm Al Akrab as supervised data from the QuickBird.



**Pic, 2 Illegal Dig Hole of Umm al Akrab, 2008**

Interpretation of individual illegal dig holes was difficult at space resolution 2.5m of the ALOS, but could interpret ate at the place that an illegal dig became close.



**Fig, 7 Area of Illegal Dig in Umm**

We use ALOS data for illegal excavation patterns, for the site of Shmet located approximately 10km northwest of Umma.Fig.8

Shmet is a site belongs to Sumerian era, Iraqis excavated the site at 2001 until 2003. Blue lines on the attached figure are represented the official excavation area location, while the red lines refer to the illegal excavation location area of Umma as utilized data. After the illegal excavations were determined, the data supplied for Iraqis side, it was marked as a real illegal excavation area.

When an illegal dig hole comes close, it was possible for the monitoring of the illegal dig by using a middle resolution satellite such as the ALOS.





**Fig. 8 Illegal Dig Area of Umma that Estimated by ALOS**

#### 4. SUMMARY AND FUTURE PLAN

It was useful to make a base map by remote sensing \, when to get a map is difficult. And it was proved to be able to use satellite remote sensing for monitoring of the ancient site destruction. In the case of use this technique continue to use in Iraq in order to protect the cultural heritage covering a widely area, it will be low-budget. Unfortunately, our ALOS was finished the observation, therefore, the continuation of illegal excavation in ancient site by monitoring is more difficult. However, the use of remained of archive data is useful to complete base map making.

And we strongly believe that the protection of cultural heritage from destruction and looting should build on cooperate with Iraqi, and based on our utilized data.

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