بسم الله الرحمن الرحيم

United Nations / India Workshop

The Use of Earth Observation Data in Disaster Management and Risk Reduction: Sharing the Asian Experience

Integration of Remote Sensing and GIS for Flood Modeling, Marabiee El-Shaarief, Khartoum, Sudan

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Introduction:

Flood is one of the major disastrous events that hit the world. Recently it becomes common and frequently over the whole world and that is attributed to climate change. This raise in flood events made scientist interested and aware in prevention studies utilizing flood modeling (Nanshan, et al 2007).

Sudan like many others countries, prone to the risk of disasters, and it have witnessed different catastrophic event such as floods, desertification, drought and pest infestation.

In term of flood, Sudan is characterized by two major flood types; riverine floods along the Nile and its tributaries, and flash flood that caused by heavy rainfall. In term of prediction and monitoring of floods, the riverine flood is considered to be manageable or can be predicted easily when it compared with a flash flood that caused by rainfall.

This research was carried out to highlight the role of the advanced space technologies in the field of flood disasters, how to contribute and support decision making in flood monitoring and management at different phases of prevention, mitigation and preparedness.

Hence it models the flood event depending on rainfall-runoff estimation to simulate and predict the behavior of flood taking in consideration the impact of construction (Road and Canal) on flood risk.

To achieve this goal the specific objectives are:

- To estimate Runoff and incorporate the result in flood modeling.
- To generate an inundation hazard map.
- To assess the role of the newly constructed road and agricultural canal on the flood risk in the study site.

The study was carried out in Marabiee El-Sharief area which is located in Sharq El-neel Locality in Khartoum State (Figure 1). And it have witness to a severe flash flood in 2013.

The site is located in a flood prone area according to the general topography, besides that it is situated in lowland area in the middle of a water course (Figure 2).

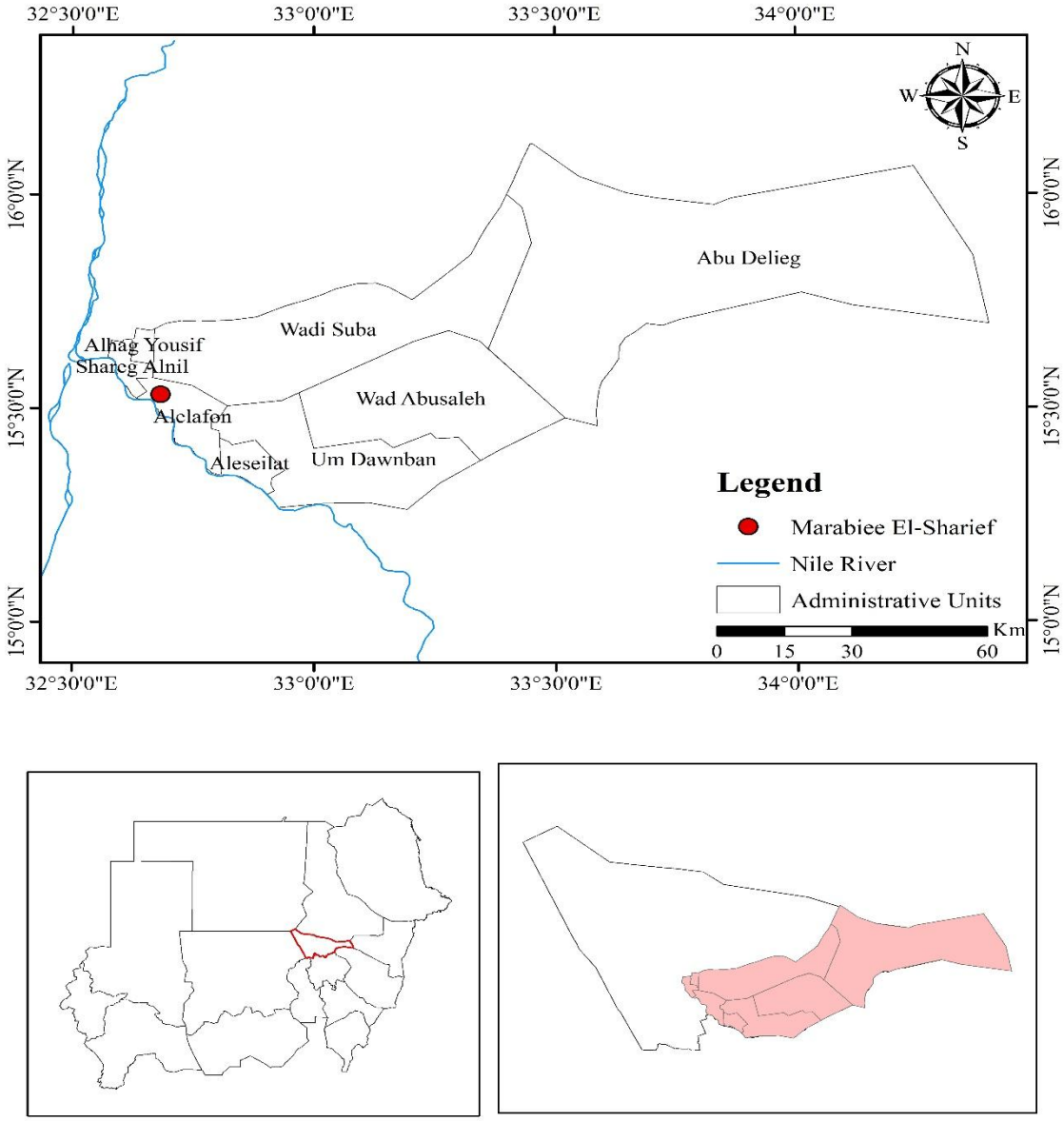


Figure 1: Location Map of Study Area

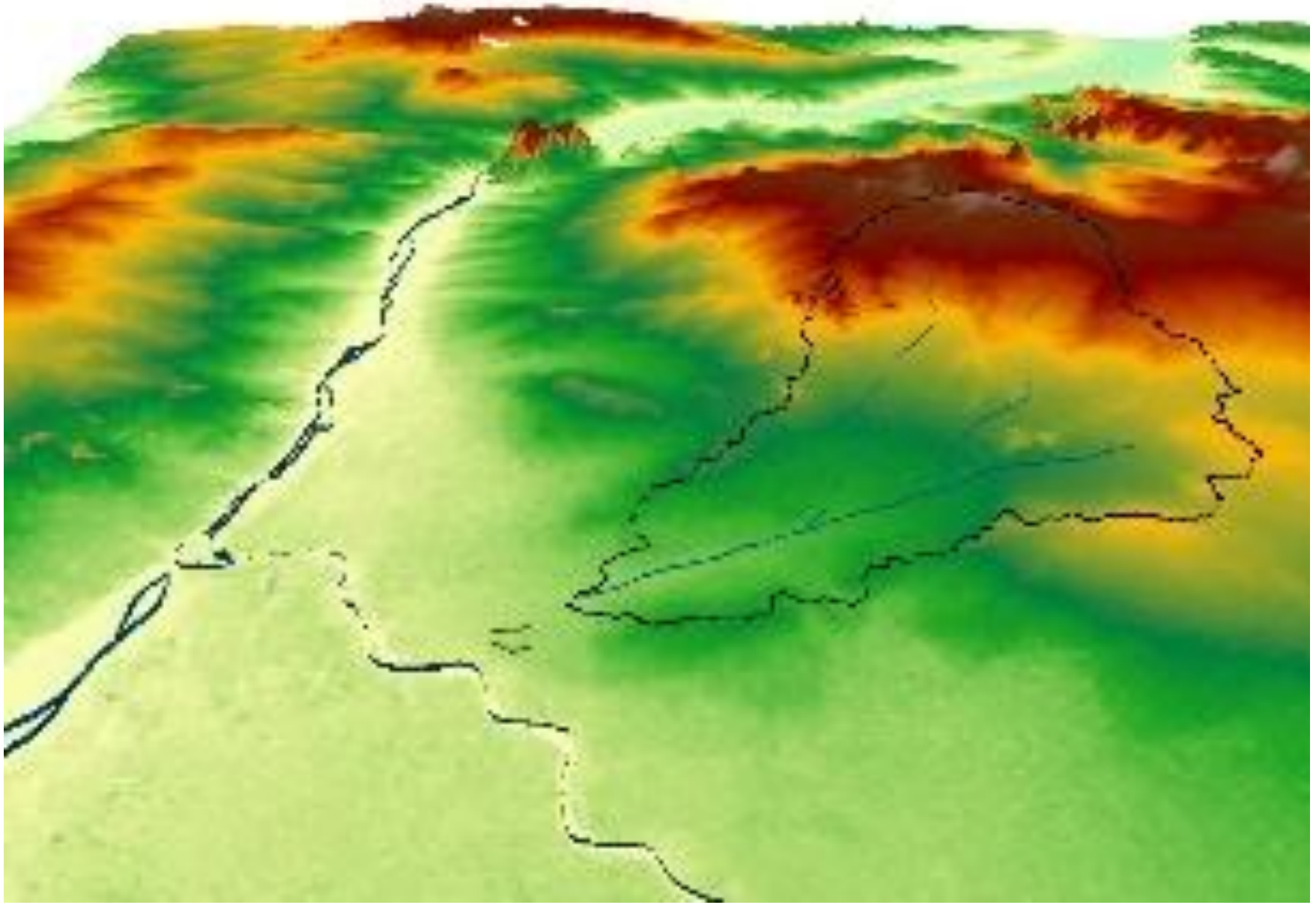


Figure 2: 3D Topography Map of Study Area

Data:

- Formosat Image.
- Digital Elevation Model (SRTM).
- Digital Elevation Point.
- Rainfall Data.
- In addition to others data like LC, Soil and Buildings maps.
- Field Survey. Morphometric measurement (Khor, Road and Canal).

Methodology:

The method is an integration of remote sensing data analysis, field survey, GIS and modeling.

The Last output of flood modeling is an inundation map; in order to make an inundation map the Runoff was estimated firstly according to SCS-CN method. Then with amount of runoff and topography (DEM and DTM) the water surface profile was created according to steady flow simulation in HEC-RAS environment.

Outputs was exported to Arc Map and two inundation maps was created with different criteria (Fig 2 & 3).

The study simulates two different scenarios to show the effect of constructions (canal and road) on flood risk in the study area. After that output maps were classified into 4 classes to determine the percentage inundated area out of the study area (Fig 4 & 5).

Data Collection and Preparation

Field Survey
- Cross Section.
- Bridge.
- Road.
- Canal.

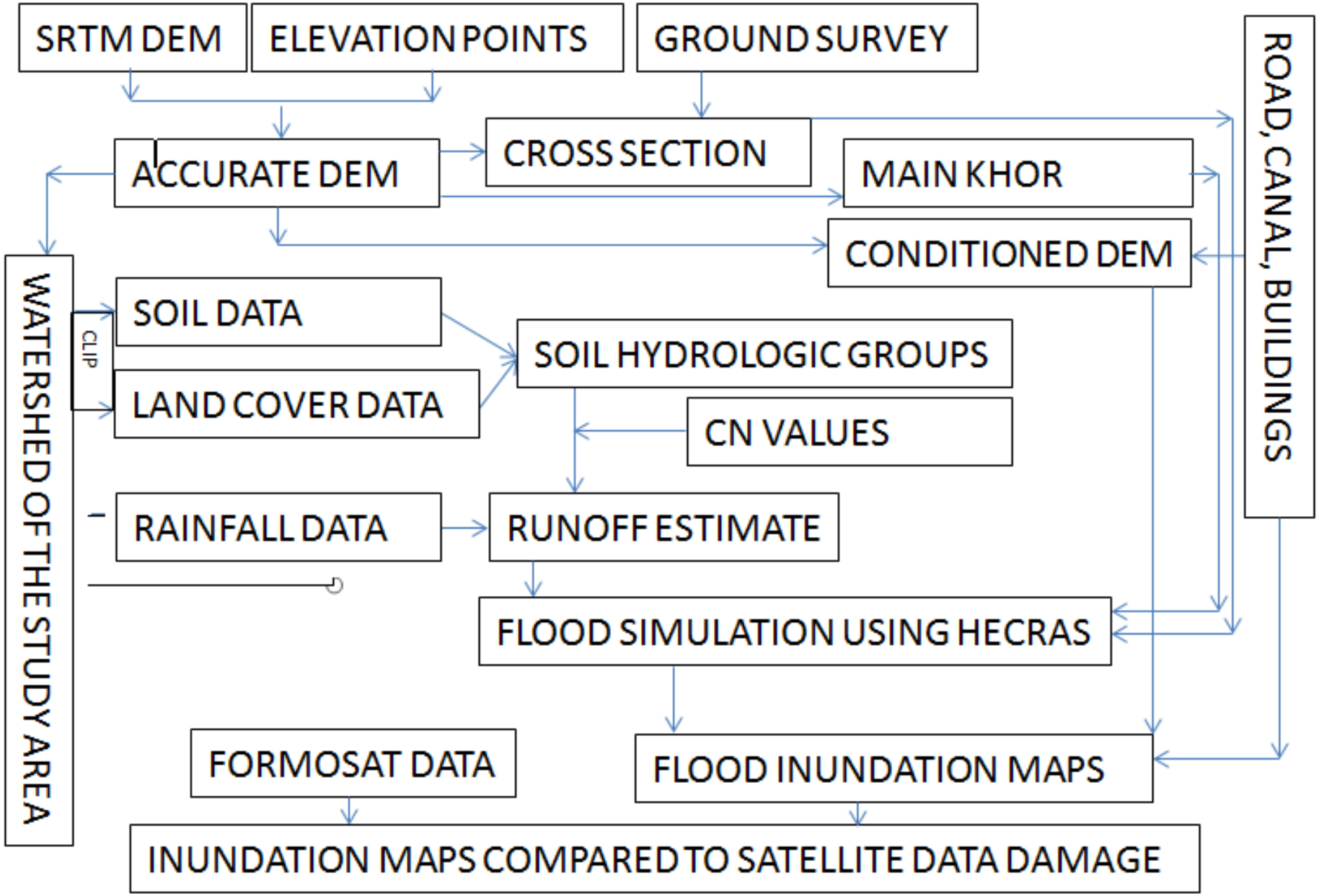
Office Work
Preparation of Maps and required layers for modeling.

Modeling: Integration of Data

Arc-GIS:
- Runoff Estimation (CN).
- Inundation Map.

HEC-RAS:
Water Surface Profile.

Assessment of Modeling Results:
Comparison between modeling result and Satellite Image.


SRTM DEM
ELEVATION POINTS
GROUND SURVEY
ROAD, CANAL, BUILDINGS
ACCURATE DEM
CROSS SECTION
MAIN KHOR
CONDITIONED DEM
WATERSHED OF THE STUDY AREA
CLIP
SOIL DATA
LAND COVER DATA
SOIL HYDROLOGIC GROUPS
CN VALUES
RAINFALL DATA
RUNOFF ESTIMATE
FLOOD SIMULATION USING HECRAS
FORMOSAT DATA
FLOOD INUNDATION MAPS
INUNDATION MAPS COMPARED TO SATELLITE DATA DAMAGE

Results and Discussion:

The study showed the effect of a road and an agricultural canal on flood distribution in the study area, where the water level increased as a result of the presence of the road and the canal which considered as barriers that prevents the natural flow of water toward the Nile (Figure 3), where 95.7% of the study area inundated due to their presence (Table 2).

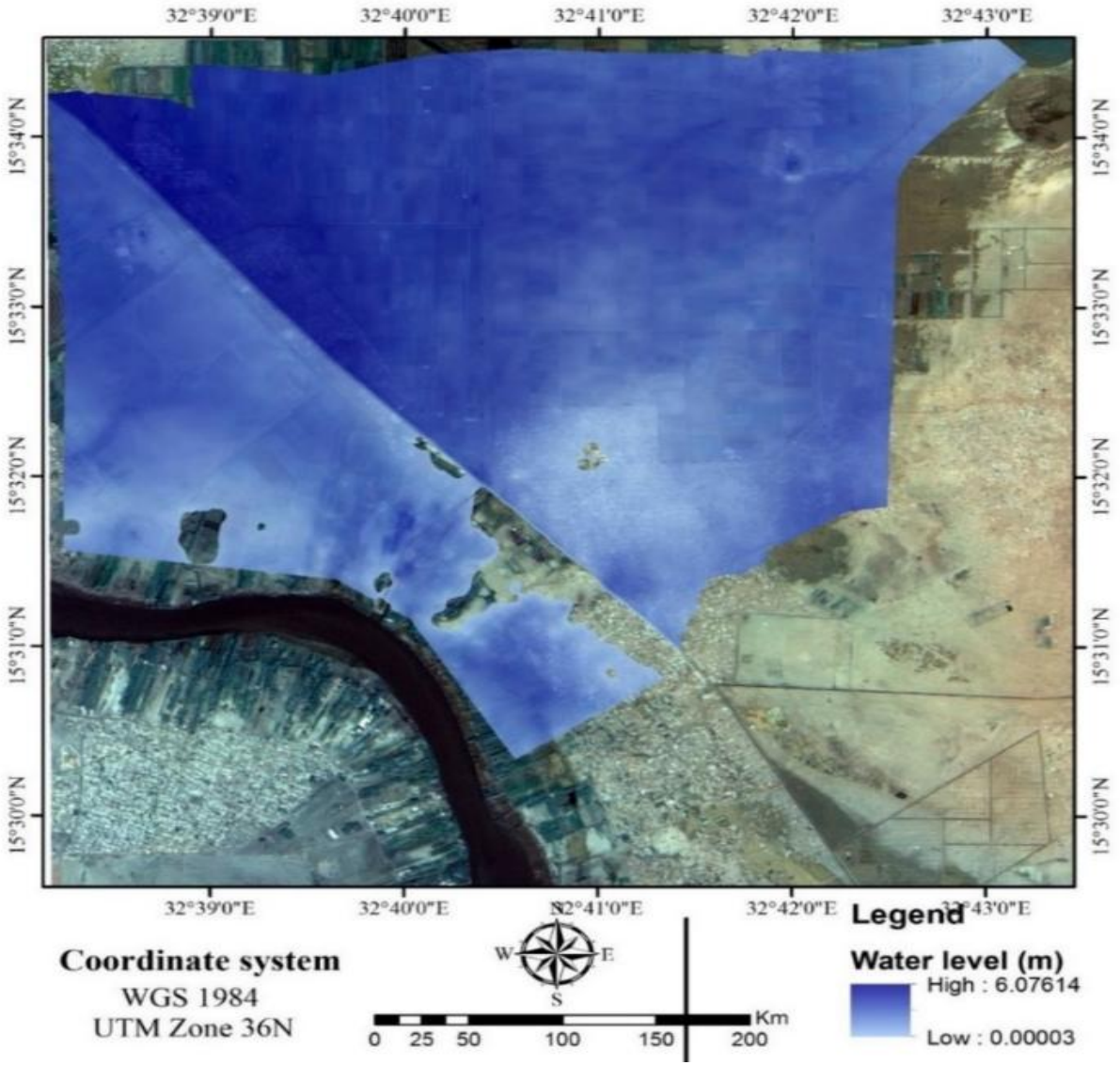


Figure 3: Scenario One (With Road and Canal)

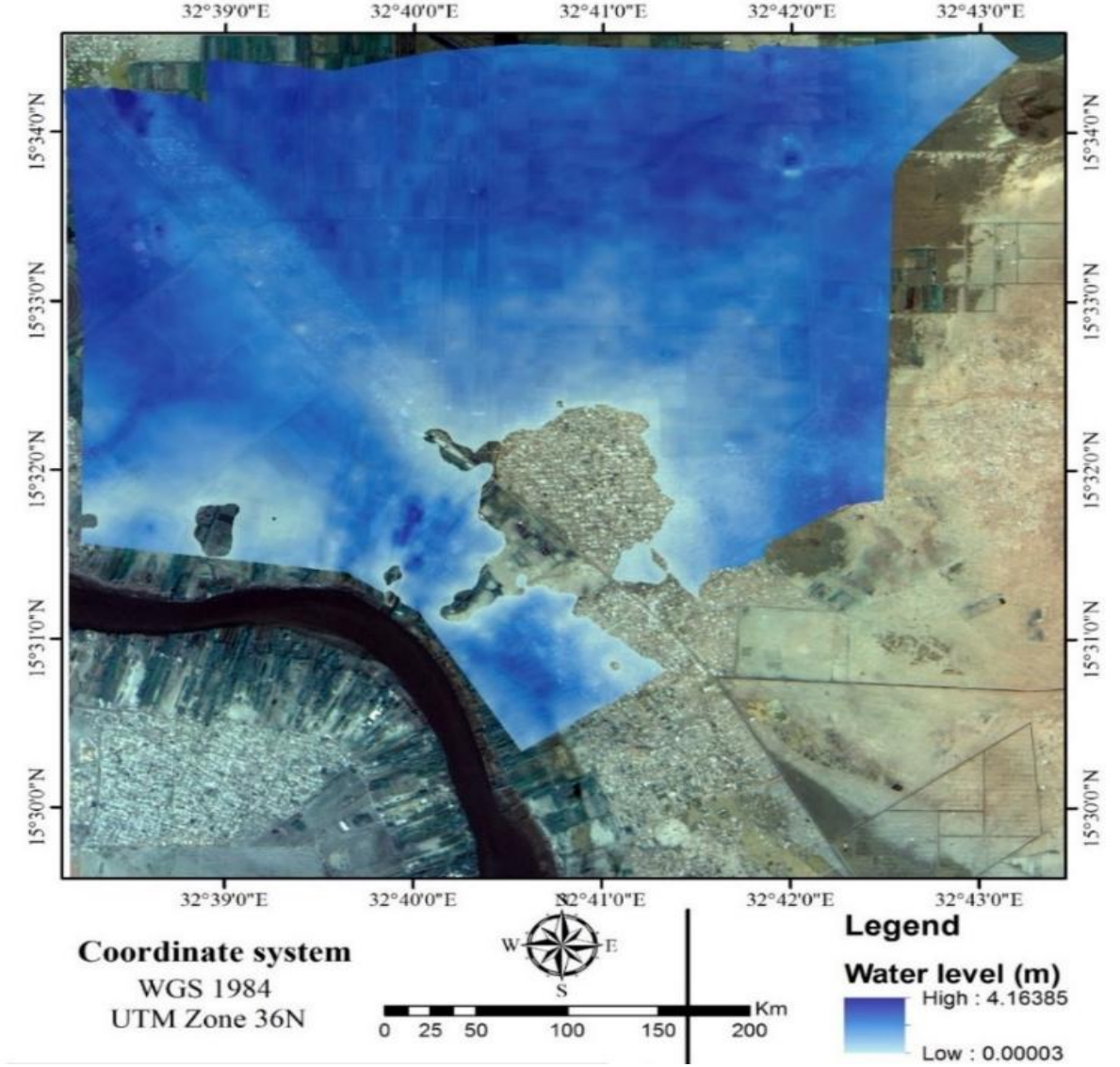


Figure 4: Scenario Two (Without Road and Canal)

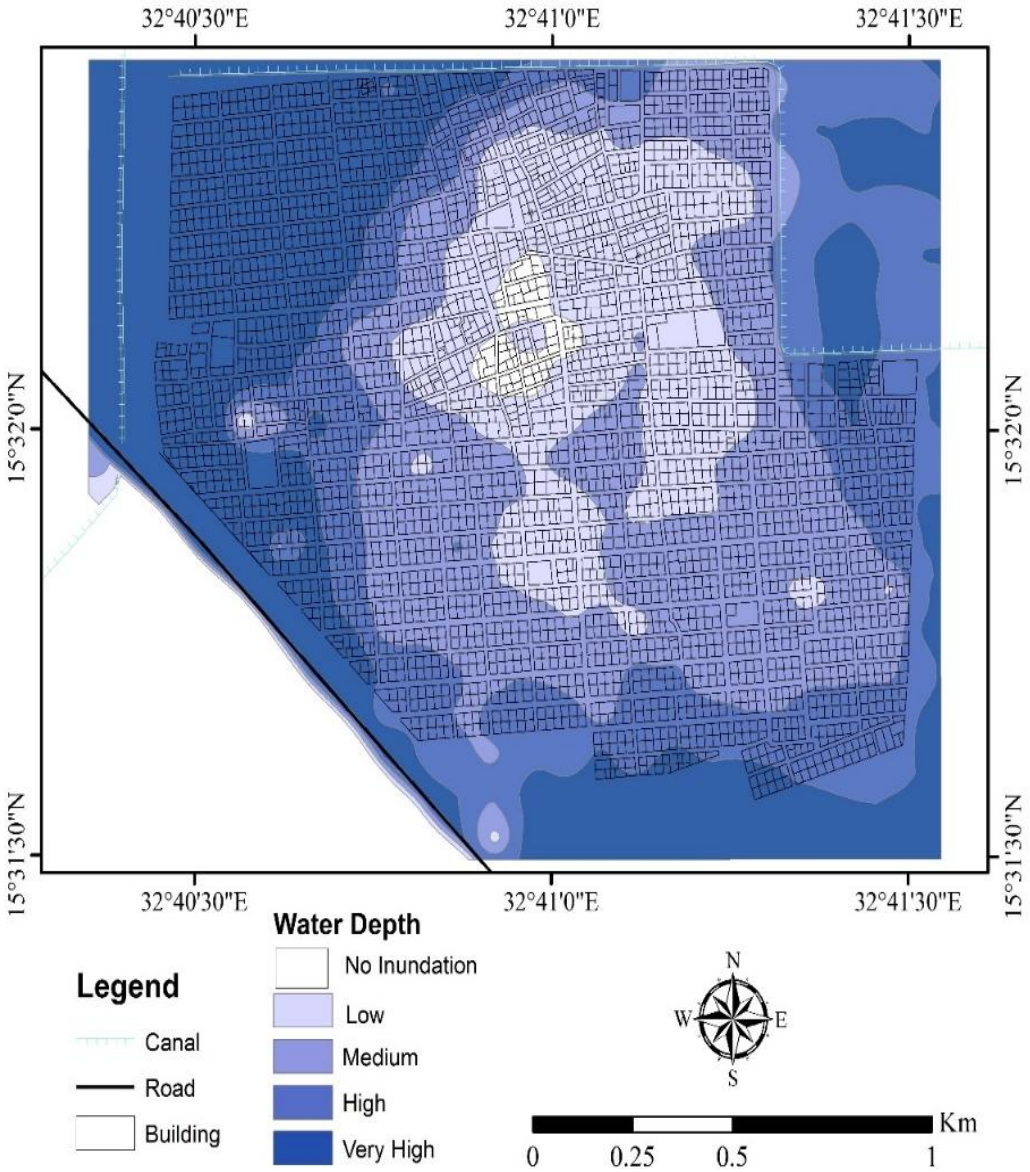


Figure 5: Classified Map of Scenario One.

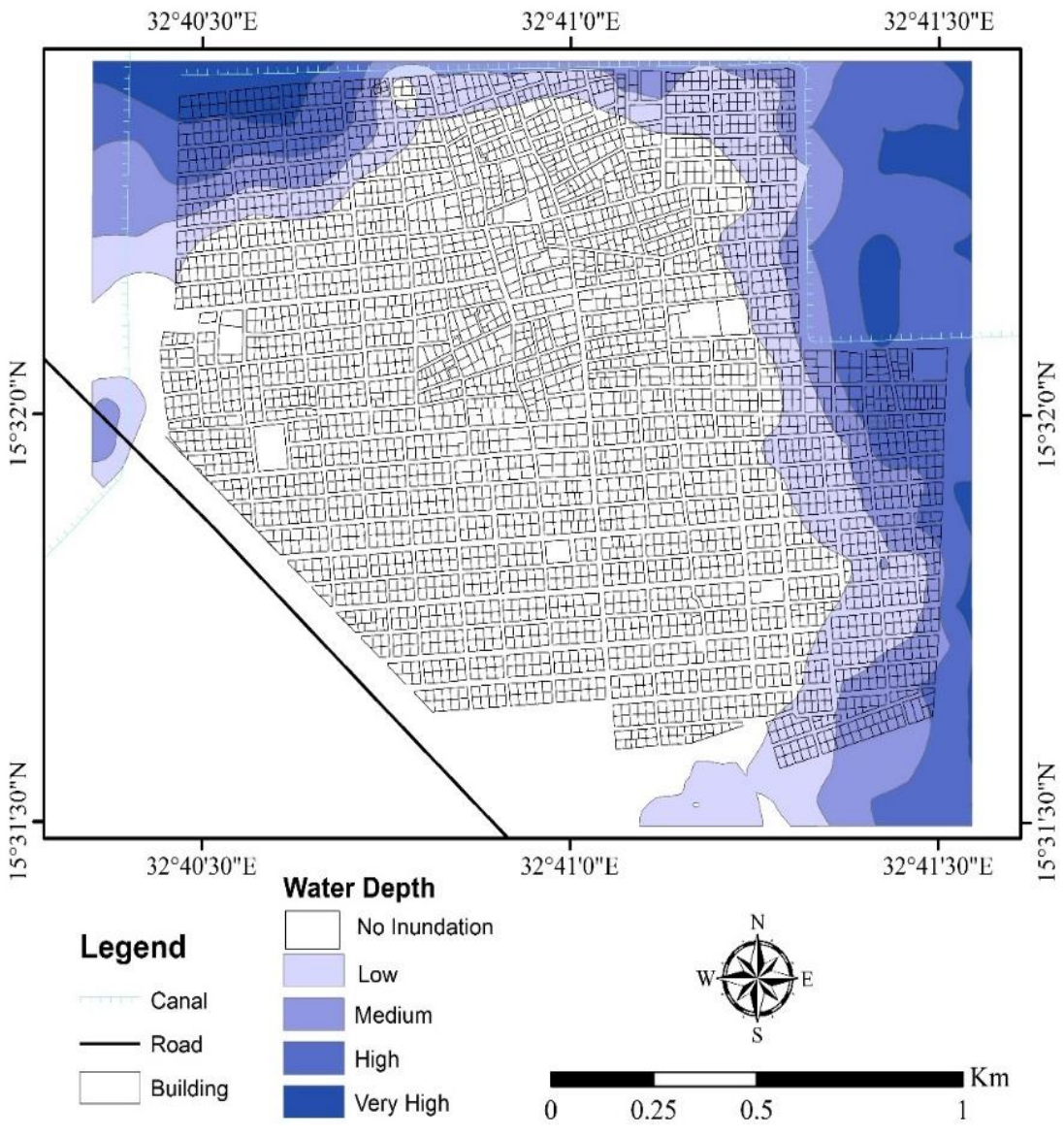


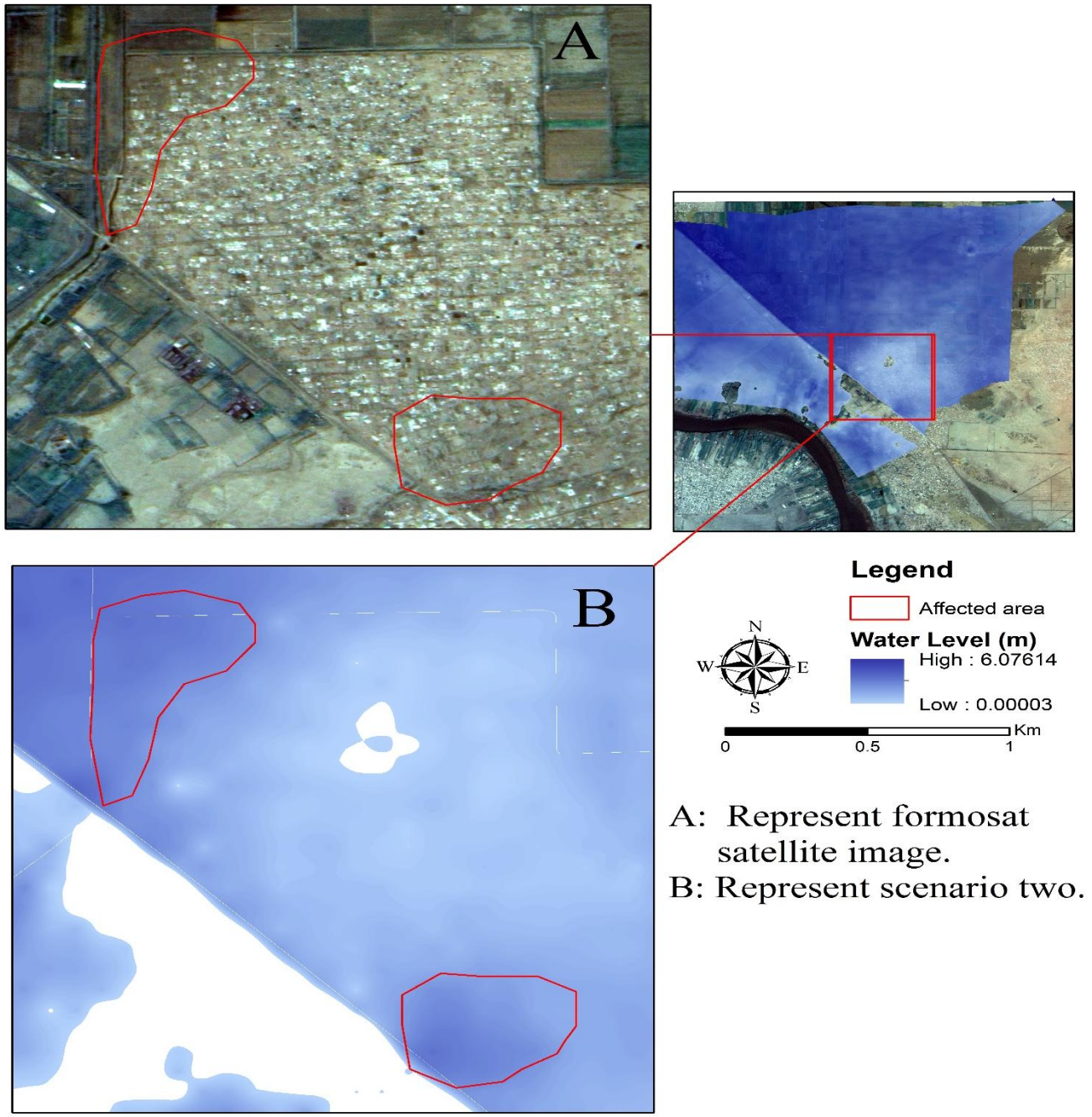
Figure 6: Classified Map of Scenario Two.

Table (1) Show the areas of Inundated and Dry land in the study area:

	Dry Area (m2)	Inundated Area (m2)	Total Area (m2)
Scenario 1	47773.7	3216818	3264591.7
Scenario 2	1893723.7	1370868	3264591.7

Table (2) Show percentage area of each class in the study area:

	Scenario (1) %	Scenario (2) %
Class 1 (Low)	16.2	13
Class 2 (Medium)	26.1	10.8
Class 3 (High)	23.4	13
Class 4 (Very High)	32.8	5.2
Dry Area	1.5	58



A: Represent formosat satellite image.
B: Represent scenario two.

Figure 7: Comparison map Between Model Result and Formosat Image

Conclusions and Recommendations

- The study proved the advantages of using the advanced space technologies in the field of flood disasters.

- Flood modeling give an advantage of supporting decision making.

- The study showed the effect of a road and an agricultural canal on flood distribution in the study area, where the water level increased as a result of the presence of the road and the canal.

- Flood extent is crucial in both the process of planning particularly in urban planning and flood damage assessment; hence flood mapping is highly recommended to be incorporated in any development plan.

- Researches and studies that focus on the applications of remote sensing, GIS, and modeling in similar environment is recommended.

Thank you for your attention,