Application of Remote Sensing and GIS to Flood Monitoring and Mitigation

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Abstract: In 2002 Thailand was faced with severe flooding in the North, Northeast and Central parts of the country caused by heavy rainfall of the monsoonal depression which brought about significant damages. According to the report by the Ministry of Interior and the Ministry of Agricultural and Co-operatives, the total damages were estimated to be about 6 billion bath. More than 850,000 farmers and 10 million livestock were effected. An area of 1,450,000 ha of farmland in 59 Provinces were put under water for a prolonged period. Satellite imageries were employed for mapping and monitoring the flood-inundated areas, flood damage assessment, flood hazard zoning and post-flood survey of river configuration and protection works. By integrating satellite data with other updated spatial and non-spatial data, likely flood zones can be predicted beforehand. Some examples of satellite data application to flood disaster mitigation in Thailand during 2002 using mostly Radarsat-1 data and Landsat-7 data were illustrated and discussed in the paper. The results showed that satellite data can clearly identify and give information on the status, flooding period, boundary and damage of flooding. For comprehensive flood mitigation planning, other geo-informatic data, such as the elevation of topography, hydrological data need to be integrated. Ground truth data of the watershed area, including the water level, velocity, drainage pattern and direction were also useful for flood forecasting in the future.

Keywords: Remote sensing, GIS, Flood.

1. Introduction

Remote sensing and GIS can provide spatial information, which can be effectively used for flood monitoring, forecasting and analysis. Flood modeling is also useful for flood management particularly to help solving flood inundation problem, which often occurs in the lower plain.

Monitoring of 2002 flood in Thailand was carried out by using data from RADARSAT 1, LANDSAT 7 ETM+, IRS 1C, 1D and higher resolution satellite imagery including IKONOS and QuickBird. Programming for RADARSAT 1 data acquisition was successfully done providing full other physical data to assess the damages due to flood disaster in terms of transportation network, agricultural and urban areas.

2.Data Analysis and Procedure

1) Data Acquisition Program

GISTDA initially set the program to acquire the data from RADARSAT on 26 August 2002 and Chiang Rai province was the first recorded data of this satellite. The data acquisition was programmed to receives data in the North and Northeast of Thailand from September to October and the Southern region in November.

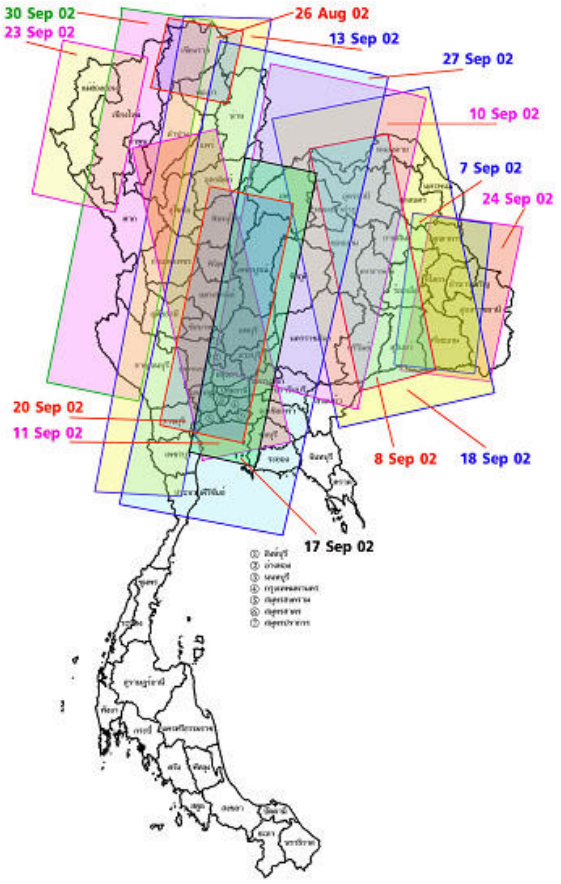

Fig. 1. RADARSAT acquisition programming

2) Data Preparation

The satellite data of RADARSAT 1 was recorded in 16 bit, it should be transformed to 8 bit in order to reduce the volume of data and to facilitate data processing. The geometric correction and image registration by the technique of image to image was also required. Filtering was employed to remove the speckle noise. The data fusion of RADARSAT 1 and LANDSAT 7 could be performed and represented in false-color. Flooding areas appeared in blue, while the forest was in red as shown in Fig. 2.

3) The Combination of Satellite Imagery and GIS Data

The prepared image was combined with GIS which consisted of spatial and attribute data. Such combination helped to study the damages caused by flood disaster such as the damages on transportation networks, agricultural and urban areas. The damages were examined and identified for each administrative unit such as subdistric, distric and province to facilitate proper allocation of relief funds.

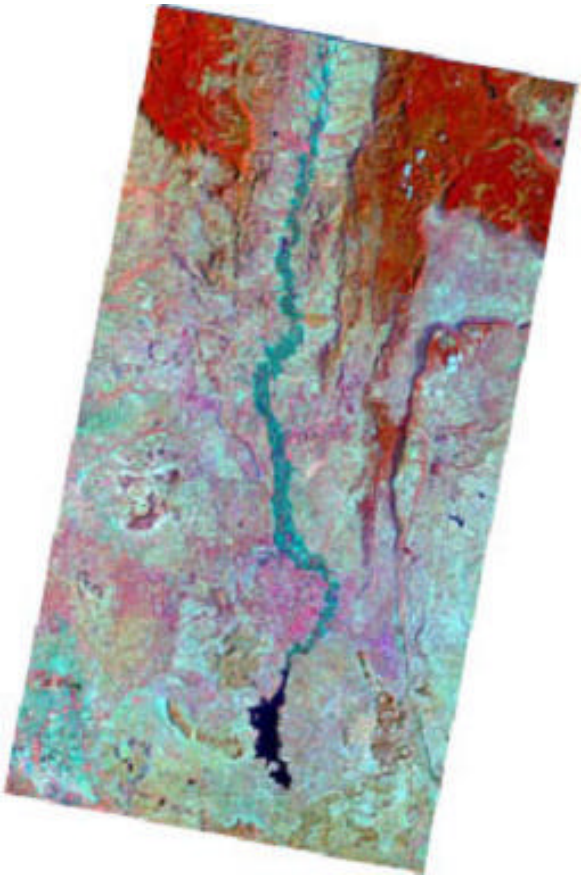

Fig. 2. Data fusion of RADASAT 1 SAR imagery, recorded on September 27, 2003 and LANDSAT 7 imagery of February 18, 2002 , showing flooded area in Pasak watershed.

4) The Prediction of Flood Disaster by Using Multi Temporal Satellite Image

Flood disaster appearing on the satellite data could be the submerged areas in flood plain or flooded areas caused by overflow from the river or tributaries. Since the damage of flood disaster depended upon the duration of inundation, GISTDA planned to receive the satellite data in the same area consistently especially the data from RADARSAT 1 which was able to record the data in 7 modes leading to the availability of multi-temporal image as shown in Fig. 3.

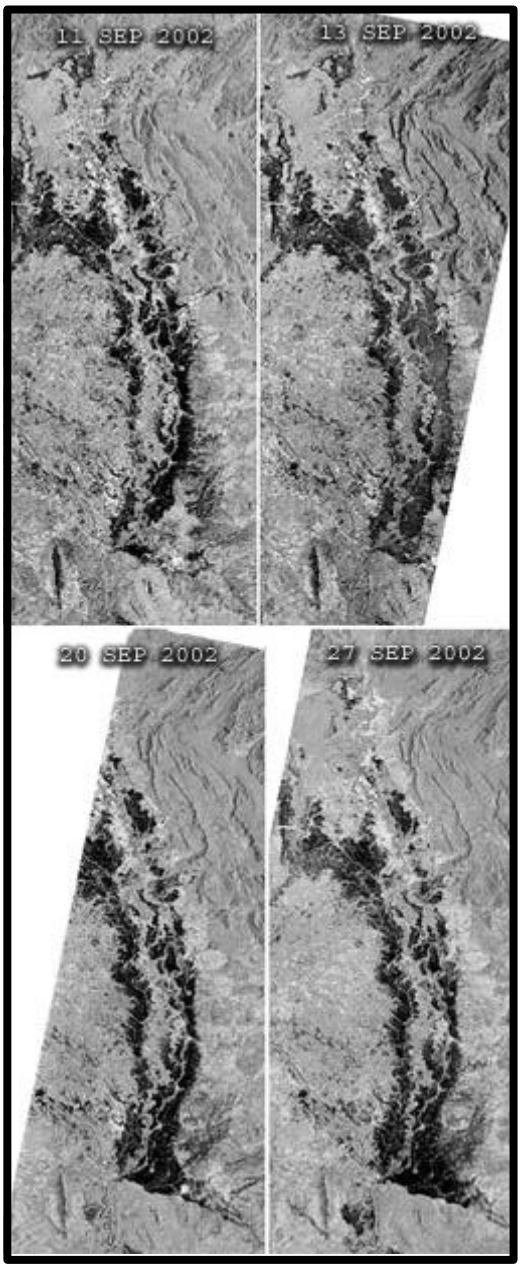

Fig. 3. RADARSAT 1 imageries showing flooding events along the Yom watershed during September 11 – 27, 2002

5) The Application of Satellite Imagery to Predict and Relieve the Damages Caused by Flood Disaster

Flood disaster in Thailand was mainly caused by high volume of runoff water during the rainy season especially in the watershed areas leading to overflow and then flooding along the riverbanks. The factors to slower or to obstacle the drainage system were consisted of the slope, shallow bed of the river and tributaries, and tide as well as man-made environment. According to Fig. 4, the satellite data recorded in 2002 showed the situation of flooding in various watersheds which was beneficial for co-analysis with hydrological and meteorological data and model leading to the prevention and mitigation strategies from flood disaster.

3.Conclusion

The technology of Remote Sensing and Geographic Information System can provide an efficient and timely information for disaster monitoring and complements the conventional methodes for damage assessment and mapping.The information derived from these technology could be applied in case of landuse planing and dis aster management. Then relevant organizations in public sectors can prepare strategic plans to protect and reduce the impact on life and the assets of government and local people in the downstream area.

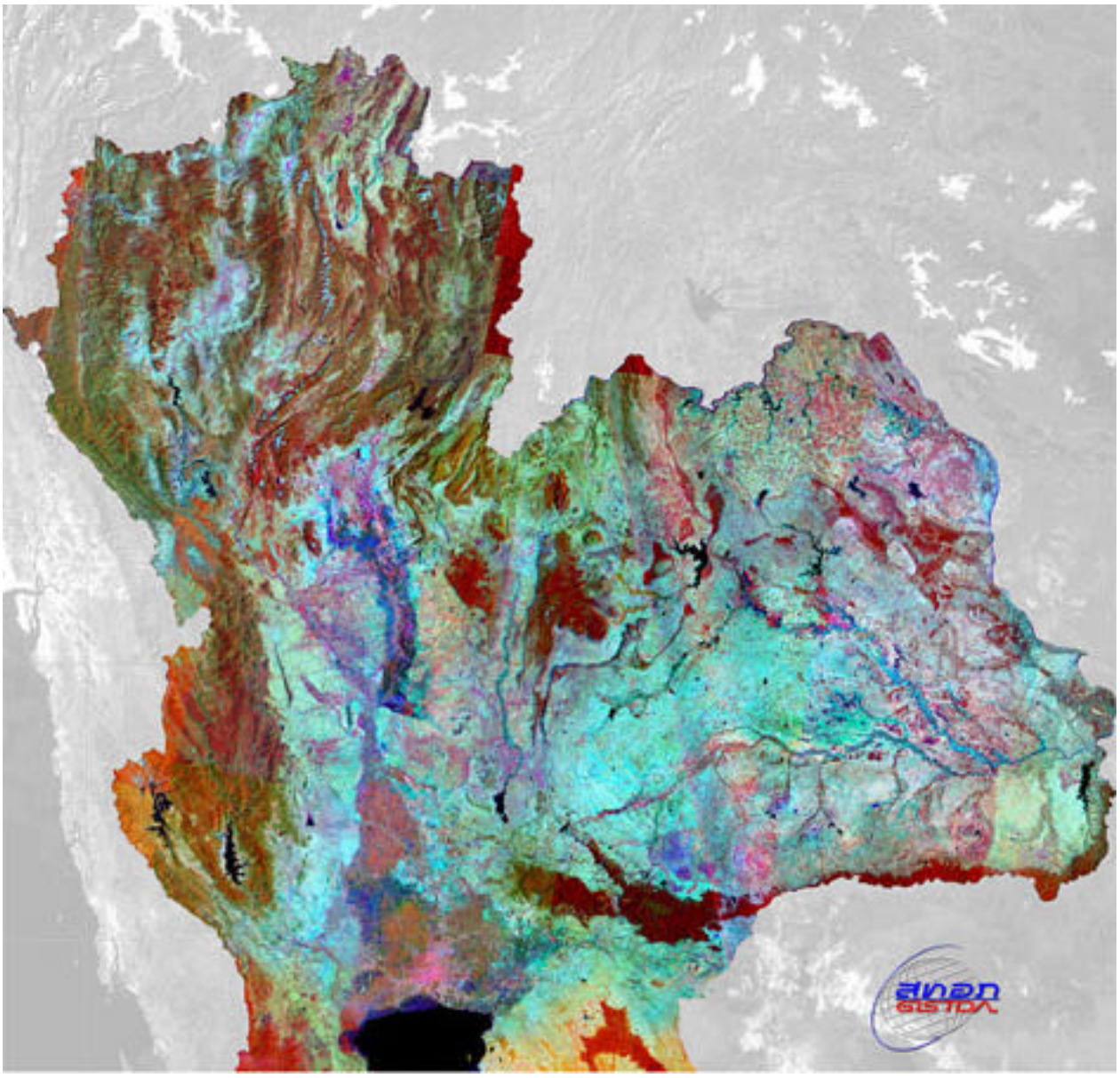

Fig. 3. Overall picture of 2002 flood