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Flood Mapping and Analysis using Sentinel Application Platform (SNAP) - A Case Study of Kerala

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***Abstract*: In August 2018, harsh flooding affected the Kerala state due to heavy rainfall during the Monsoon season. According to the media reports these were the worst floods since 1924 which have affected one sixth of population of Kerala. Flood inundation mapping and analysis was carried by using Sentinel-1 data. For the analysis of the temporal and spatial dynamics of the disaster we use Sentinel 1 Synthetic Aperture Radar (SAR) data due to its systematic frequent acquisition. A dataset of pre-event and post-event Sentinel -1 image within the two data set i.e. 29-5- 2018 and 27-8- 2018 are selected for the temporal analysis. In this study, pre-processing steps are performed using SNAP tool and s1tbx tools. Sentinel Application Platform (SNAP) software is used for these pre-processes that are Radiometric Calibration, Terrain Correction and Speckle filter. Three approaches were used to extract water bodies of Kerala flood.**

***Keywords*: SNAP (Sentinel Application Platform) tool, SAR (Synthetic Aperture Radar) calibrate and speckle filtering of data, flooded area, Google Earth.**

1. Introduction

From 8 August 2018, severe floods affected the south Indian state of Kerala, due to unusually high rainfall during the monsoon season. It was the worst flood in Kerala in nearly a century. About a million people were evacuated. All 14 districts of the state were placed on red alert. According to the Kerala government, one-sixth of the total population of Kerala had been directly affected by the floods and related incidents. The Indian government had declared it a level 3 calamity, or "calamity of a severe nature". It is the worst flood in Kerala after the great flood of 99 that took place in 1924.

Thirty-five out of the fifty-four dams within the state were opened, at the first time in history. All five overflow gates of the Idukki Dam were opened at the same time, and for the first time in 26 years 5 gates of the Malampuzha dam of Palakkad were opened. Heavy rains in Wayanad and Idukki have caused severe landslides and have left the hilly districts isolated. The situation was regularly monitored by the National Crisis Management Committee coordinated the rescue and relief operations.

Kerala received heavy monsoon rainfall, which was about 75% more than the usual rain fall in Kerala, on the mid-evening of August 8, resulting in dams filling to capacity; in the first 24 hours of rainfall the state received 310 mm (12 in) of rain. Almost all dams had been opened since the water level had risen close to overflow level due to heavy rainfall, flooding local low-lying areas. At the first time in the state's history, 35 out of its 54 dams had been opened. The deluge has been considered an impact of the global warming. The flooding has affected hundreds of villages, destroyed an estimated 10,000 km (6,200 mi) of roads and thousands of homes have been damaged or destroyed.

Remote sensing and particularly synthetic aperture radar (SAR) sensors are suitable for data acquisition under dense precipitation conditions and provide rapid assessment and long term monitoring of the flooded areas. SAR system is sensitive to water due to specular reflection and able to acquire image both day and night which give it a characteristic specification. This provides utilization of SAR data for surface water and changes such as flood mapping are more common and feasible than optical data. Change detection approaches using SAR data includes backscatter intensity, polarimetry and interferometric coherence information for input and apply classification algorithms. Flood mapping gives an idea about the change in existing scenario and possible future area likely to be affected by floods. The objective of the study is to extract and mapping of flooded regions using Synthetic Approach Radar (SAR) for change detection scenario of pre-disaster and during disaster.

A. Assumption and methods

Kerala is the state on southwestern of India. Kerala's climate is mainly wet and maritime tropical, The study areas lies between northern latitudes 8°18' and 12°48' and eastern longitudes 74°52' and 77°22' and with 5000 feet elevation above mean sea level. The total area of the Kerala is about 38,863 km2 (15,005 sq. meter). The capital of Kerala is Thiruvananthapuram. The total population in Kerala is about 33.39 million. Sentinel programme is launched by European Space Agency (ESA) and so far Sentinel-1, 2 and 3 are fully operational. In the present study, Sentinel-1A data is used for flood inundation mapping, SAR data is acquired from ESA Sentinel data hub. SAR images are used for mapping floods. A

dataset of pre-event and post-event Sentinel-1 image within the two data set i.e. 29-5- 2018 and 27-8- 2018 are selected for the temporal analysis. These two images are opened into the SNAP software and the pre-processing is carried out. In pre-processing, subset the images (select on the Menu panel Raster -> Subset). Figure 1 shows the before flood and after flood image. After sub setting the images, there was a new images formed. Open this two images and multilooking process was carried out by using no. of range looks=3 and no. of azimuth looks=3. Then calibration is done on the subset image. There are two bands are formed i.e. Sigma0_VV and Sigma0_VV_db. The pixel values in a SAR imagery be related to the radar backscatter. The figure 2 shows the calibrated images (Sigma0_VV and Sigma0_VV_db). After that geometric terrain correction was done by using range doppler terrain correction.). Positional accuracy and orientation is achieved by geometric correction. Figure 3 and figure 4 shows the terrain correction. Terrain correction image converted into RGB image. Selected the colour in month wise (green, blue, red). For month of May, the colour is blue and for month of August, the colour is green and red are used. The figure 5 shows the RGB image. The main purpose of the RGB image is for the sensing, representation and display of images in electronic systems. RGB image shows the amount of flood occurred in month wise or also year wise.

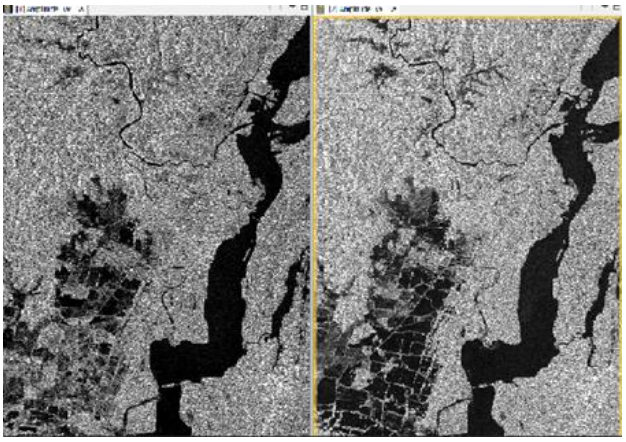

Fig. 1. Calibrated images (Sigma0_VV and Sigma0_VV_db)

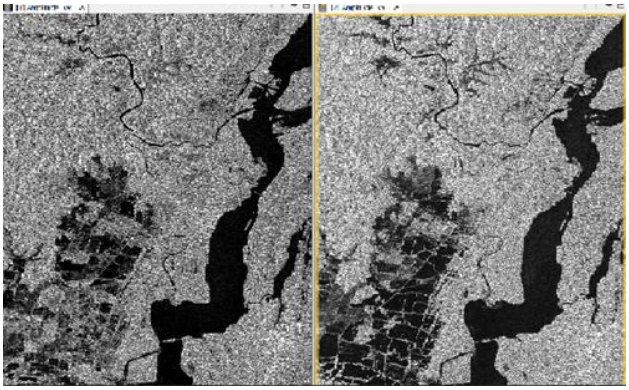

Fig. 2. Before flood and after flood of Kerala

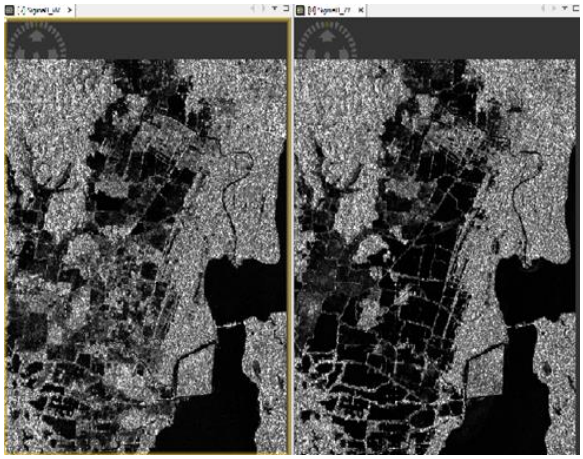

Fig. 3. Terrain correction

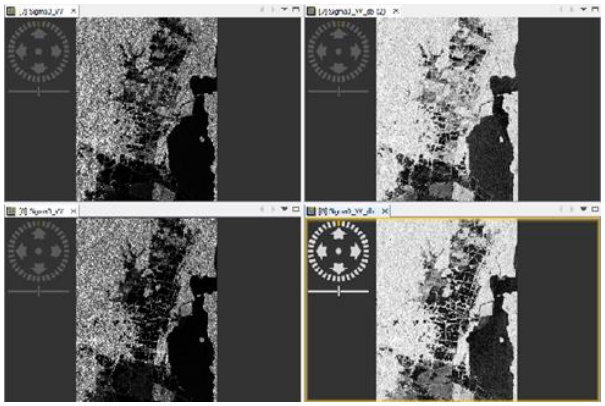

Fig. 4. Terrain correction

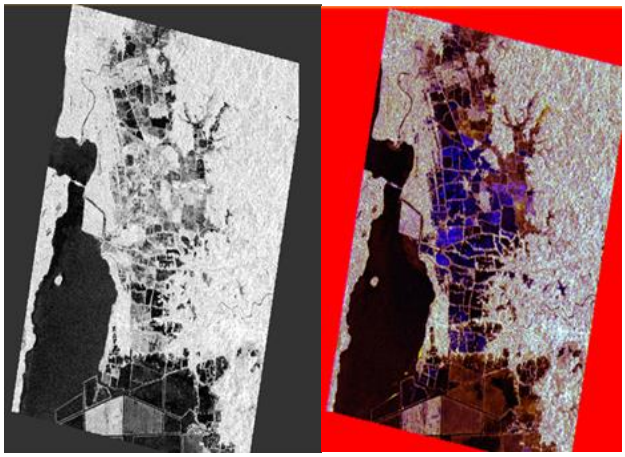

Fig. 5. RGB Image (Blue colour-May, Red and Green – August)

2. Methodology

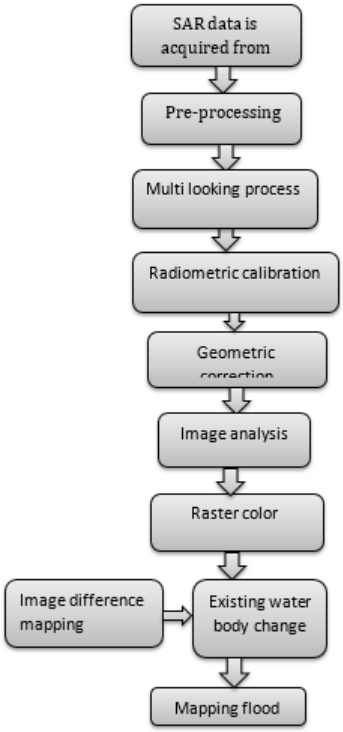

Fig. 6. Detailed methodology of flood inundation mapping and analysis

3. Result

The results showed accurate flooded regions during 2018 Kerala flood. The use of advanced satellite technology, SNAP software can be effectively used for mapping flood disasters and Risk zones. SNAP tool is useful to analysis flood prone zone of Kerala region for both pre-disaster and post-disaster scenario.

Figure 5, showed RGB image the analysis result of 29th May 2018 and 27th August 2018 SAR data respectively. Colour showed flooding at the month level. The blue colour indicated month of May, Red and Green colour indicated month of August.

Using SNAP software, the flood inundated regions and flood prone regions are mapped. Combination of different techniques such as image classification and analysis shows better results in flood inundation mapping on comparing with traditional methods.

4. Conclusion

This paper presented a case study of kerala, flood mapping and analysis using sentinel application platform.

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