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ORIGINAL ARTICLE **OPEN ACCESS**

Water spread area mapping in Erode and The Nilgiris district of Tamil Nadu using Sentinel 1A SAR satellite data

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ABSTRACT

A study conducted based on 'Water spread area mapping with the use of Sentinel 1A SAR satellite data in Erode and The Nilgiris districts' Water is one of the important factors in the world because all the ecological activities depend on water. Totally 3/4th of the world containing water, these classified into salt and non-salt water. This non-salt water containing very least amount. Water spread area in India is 252800000 ha, these areas derived majorly from 12 rivers. Every year water spread is changed/reduced due to lack of rainfall and adverse climatic condition. So that the mapping, area calculation and analysis of temporal variation in the water spread area accounts more. Water spread is clearly identified by microwave sensors. Sentinel 1A SAR C band data with VH polarization used for the area delineation in Erode and The Nilgiris districts of Tamil Nadu during April, June, July, and August month in the year of 2018. Least backscattering coefficient from the SAR data obtained from the water spread area. Totally 10900.6197 ha area of water spread is derived from the Erode and The Nilgiris districts.

Key words: Polarizations, water spread area, Sentinel 1A SAR, backscattering coefficient.

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INTRODUCTION

The water catchment area is the more productive and ecological very different ecosystem. Detection of surface water using SAR backscatter depends on the fact that areas of open, smooth (no or small waves relative to the wavelength of energy employed by the SAR) water bodies typically exhibit lower backscatter coefficients [1, 2]. Optical and synthetic Aperture radar type spatial resolution imagery suitable for monitoring the surface water dynamics. Remote sensing imagery observes the land surface in a timely and accurate way, and has been widely used to monitor the dynamics of surface water [2-6]. Water bodies are a specular reflector of the radar pulse, resulting in minimal signal returned to the satellite [8]. SAR data are high-resolution data than data have using fact is less. Such as Sentinel-1A, TerraSAR-X (X-band), COSMO-SkyMed (X-band), and RADARSAT-2 (C-band) [3, 6], are always expensive, which limits the use of the data at large scale. In this article focused on the surface water spreading a map on over the erode and Nilgiris district.

Study area

Here I chose The Nilgiris and Erode districts of Tamil Nadu, to assess the different time interval (monthly one data). The total geographic area of The Nilgiris is 2565 km2 and Erode 5722km2. Water spread area is to estimate the different time (April 23, May 16, June 22, July 17, August 21) of passing data is collected, most of the farmer is dependent to canal irrigation and well irrigation. The Nilgiris is majorly covered by western guards of Tamil Nadu and erode district are mostly plain region. During summer the temperature reaches a maximum of 25 °C and a minimum of 10 °C. The temperature in April averages 31.2 °C, December is the coldest month, with temperatures averaging 25.4 °C. Both southwest monsoons are 80 % of rainfall get and northeast monsoon minimum amount of rain only getting

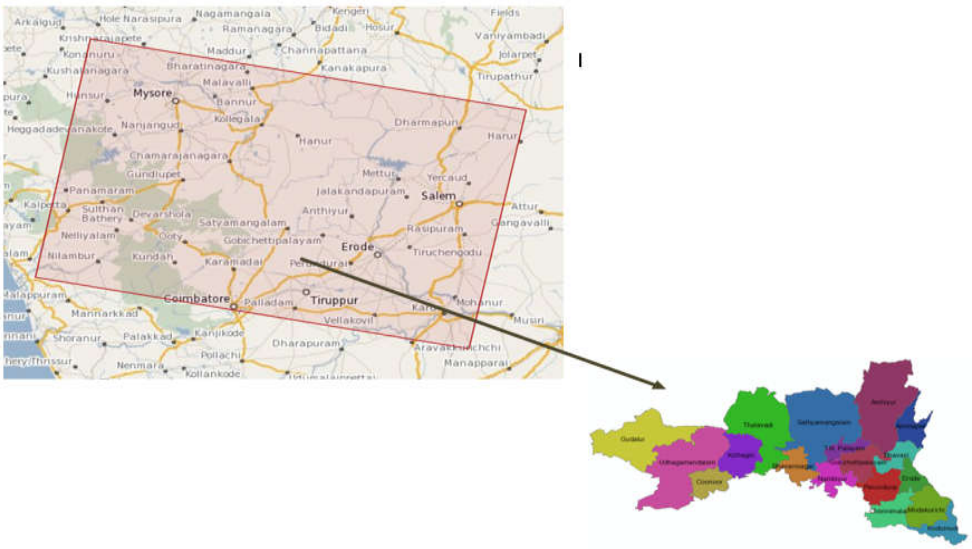


Fig.1.study area of Erode and The Nilgris Districts

MATERIALS AND METHODS

Sentinel -1A data

Europe's Copernicus program frames the first mission of Sentinel 1, this satellite caring the C – band Radar instrument. Sentinel-1A has only been operational since September 2014. Its own illumination, Sentinel-1A can provide continuous measurements independent of daylight or weather conditions, since C-band radar is not affected by cloud cover because of its active remote sensing technology..

Sentinel-1A Synthetic Aperture Radar data is sensitive to moisture, this satellite 12 days once revisit. Water spread area estimate to the different type of monsoon data are (summer and Karif season data) (April 23, May 16, June 22, July 17, August 21) using. VH polarization is sensitive to moisture and vegetation. Providing four imaging modes: interferometric wide swath (IW), extra wide swath (EW), strip map (SM), and wave (WV), with a 12-day repeat cycle. VH polarization swath width is the approximately 250km and spatial resolution is 5m by 20m

Parameters	GRD
Pixel value	Magnitude detected
Coordinate system	Ground Range
Polarizations	Single (VV), Cross (VH) and Dual (VV+VH)
Ground range coverage (km)	251.8
Radiometric resolution (dB)	1.7
Bits per Pixel	16
Resolution (range x azimuth) (m)	20.4 x 22.5
Pixel spacing (range x azimuth) (m)	10 x 10
Incident angle	32.9^{o}
Number of Looks	5 x 1
Range look bandwidth (MHz)	14.1
Azimuth look bandwidth (Hz)	315
Equivalent Number of Looks (ENL)	4.4
Absolute location accuracy (m) (NRT)	7

Source: esa.int Reference: S1-RS-MDA-52-7440

Methods

Sentinel-1A data contain errors due to fluctuations in the transmitted power, receiver gains, system noise, and the illumination pattern of the antenna, the radiometric calibration was performed to convert digital pixel values of VH amplitude into sigma naught (σ°) values that can be directly related to the radar backscatter of the scene.

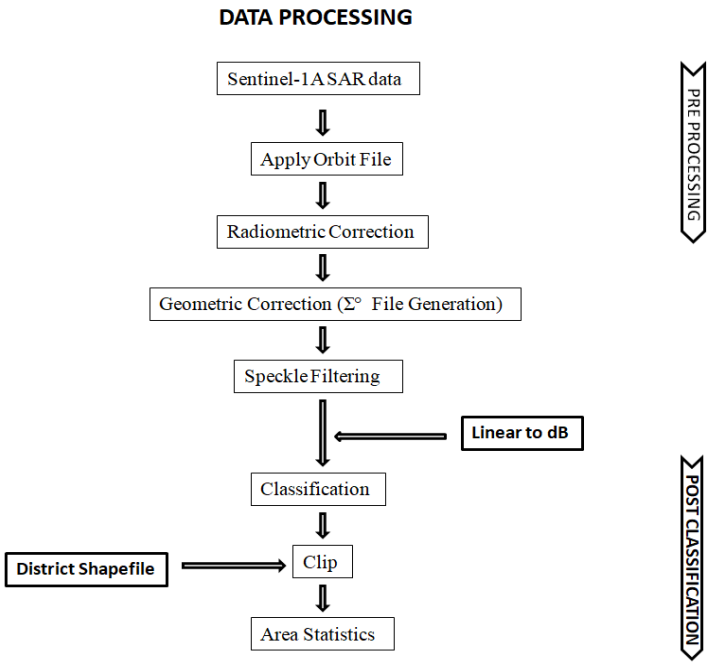


Fig.2. Data processing methodology

Pre processing

First sub steed on the Erode and The Nilgiris district of Tamil Nadu, when applying image pre processing of Sentinel-1A IW GRDH dataset in order to reduce orbital errors, radiometric distortion and geometric distortion, speckle noise.

Orbital correction

The CPOD (Copernicus Precise Orbit Determination) service is responsible for the precise orbit determination of Sentinel 1A. Orbital correction was done using precise orbit files that are available in https://qc.sentienl1.eo.esa.int/ which could be directly downloaded to SNAP toolbox for the orbital correction of the data.

Radiometric Correction

The most significant problem in the wide swath SAR images is the backscattering trend in the range direction, which results a progressive reduction in brightness over images from near to far range [7]. This out is further processing; these pixels are truly represented on the backscattering of surface.

An equation provided by Rosich and Meadows [7] is used to produce the sigma nought value.

$$\text{Value (i)} = |DN_i|^2 / A_i^2$$

When, depending on the selected Look Up Tables (LUT),

Value (i) = one σ^0_i

A_i = Sigma nought (i).

Geometric correction

SAR geometry effects such as foreshortening, shadow and layover will result in geometric distortions in the data that will be corrected by terrain geo-coding using DEM (Digital Elevation Model). Geo-coding converts an image from Ground Range or Slant Range geometry into a map coordinate system. In SNAP toolbox, the terrain correction will be carried out using SRTM 3sec DEM which is automatically downloaded from the servers.

Post – Processing of the Satellite data

Speckle filtering

Speckle filter exploits the space varying temporal correlation of speckle between images to significantly reduce the noise. Different speckle filters are available in the SNAP toolbox. Refined Lee filter averages the image while preserving the edges was used to reduce the noise in the data.

Intensity to dB conversion

After speckle filtering of the images, the intensity values are converted to dB values using the linear to dB conversion tool in SNAP and stored for further processing.

Water spread area estimation

Image classification approaches categorizes all pixels in an image into land cover category based on the pixel value. We using the automatic approaches of water bodies reflected pixels. The value of classification approach is less than 0.02. The (dB) backscattering coefficient value is in the range of -26.75 to -22.75.

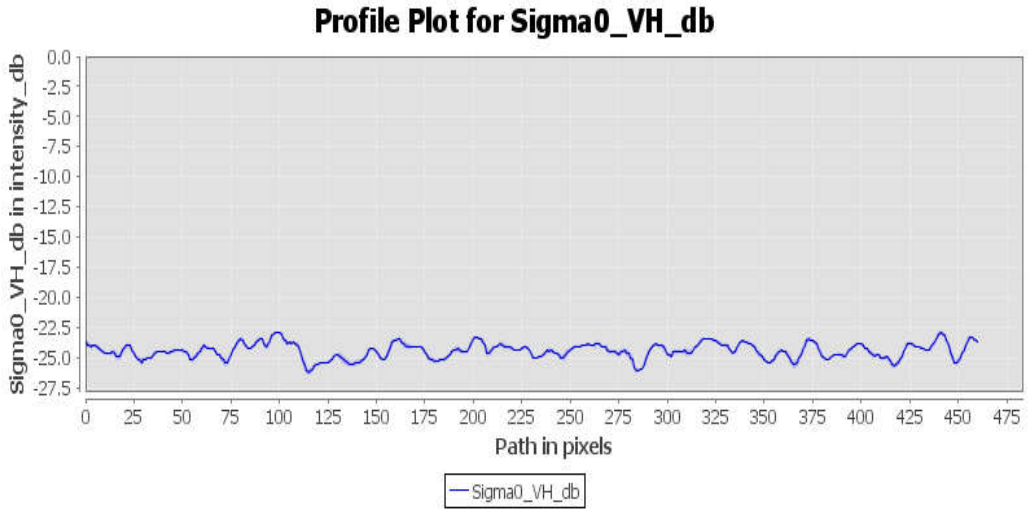


Fig.3. backscattering dB value of water bodies

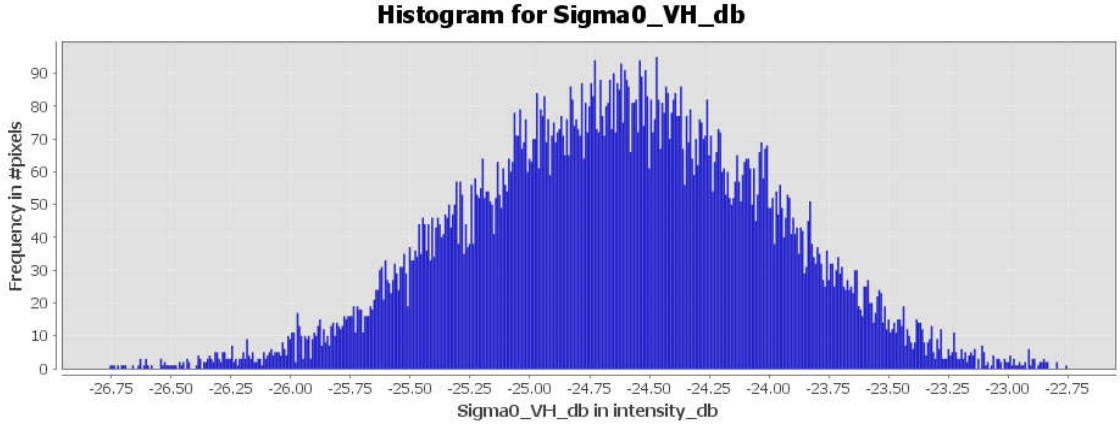
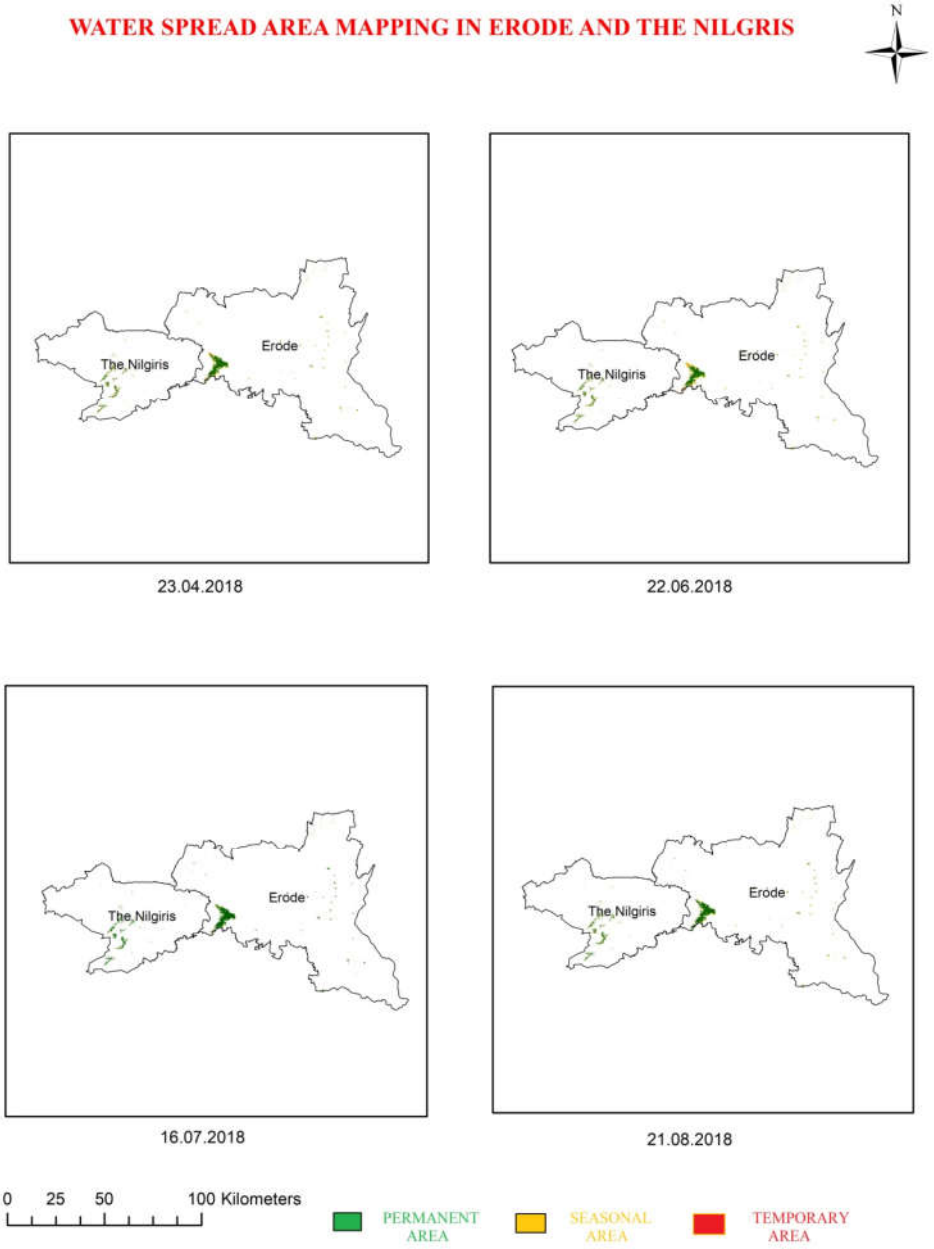


Fig.4. histogram of water bodies

Table.1. **Water Spread Area statistics in Erode and The Nilgiri Districts**

Water spreaded area					
Total district water spreading area	*April_ha*	*June_ha*	*july_ha*	*August_ha*	*Total_Area_ha*
Total	7944.9412	8023.9936	8288.0903	9257.3398	10900.6197
Different season water spreading area	*April_ha*	*June_ha*	*july_ha*	*August_ha*	*Total_Area_ha*
Waterbodies - Reservoirs/Tanks – Perennial	3680.0600	3869.7300	3896.0200	3950.7300	4227.5374
Waterbodies - Reservoirs/Tanks - Rabi extent	3209.3712	3254.5336	3238.6503	3815.1598	4624.1190
Waterbodies - Canal / Drain – Lined	3.7000	7.9100	7.1400	7.6100	137.4243
Waterbodies - Reservoirs/Tanks - Zaid extent	1051.8100	891.8200	1146.2800	1483.8400	1911.5390
Total	7944.9412	8023.9936	8288.0903	9257.3398	10900.6197



RESULT AND DISCUSSION

With the advent of SAR (Synthetic Aperture Radar) sensors has water spread mapping have resulted in higher accuracies. Sentinel 1A data at 12 days interval was acquired during the period for the study. The back-scattering co-efficient were extracted, analysed and used for water spread area mapping. By the use of VH polarization data to the water spread area is calculated, according to that August month having more (9257.34 ha) spread area when compared to the April month (7944.94 ha).

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