

Dynamic Approach to Extract Shorelines using Remotely Sensed Landsat Imageries: A Study in a Part of Honnavara Coastal Region, Karnataka, India

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ABSTRACT

Shoreline delineation is a complex task and it requires lot of man power required in terms of traditional method such as ground survey. But after 1973's the Remote Sensing Landsat satellite have evolved and monitoring the earth environment from 1973 to present. A series of satellite have launched Landsat MSS, Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI/TIRS. By using the Landsat imagery, different indices and mathematical transformation have developed by several researchers for different application. The present study describes about how the Landsat imageries are utilized for shoreline extraction. The method of integrating Tasseled Cap and NDVI have utilized and by performing Unsupervised classification the shoreline will be delineated in a dynamic way.

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Introduction:

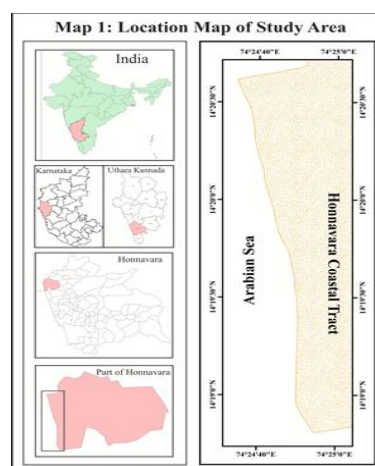
Shorelines are dynamic in nature. It is place where land and sea will meets together. It will keeps on changing day to day, year to year and decade to decade, due to increase in the sea level rise and also its natural process. The delineation of shorelines are very important in coastal management and erosion studies. The Shorelines can be obtained by traditional method through Ground survey. But the modern technologies of Geographical Information Systems and remote sensing have played a major role in coastal Studies.

There are several methods are there to delineate the shorelines such as Image Slicing, Grouping, Band Ratio method, Mathematical Transformation, Histogram Thresholding. The Several Researchers (Christ et al., 1984; Chenquan et al., 2002; Muhammed et al., 2014) found the tasseled cap transformation coefficient for different Landsat sensors. The present study will integrates the tasseled cap transformation and NDVI techniques to extract Shorelines in an efficient way.

Study Area:

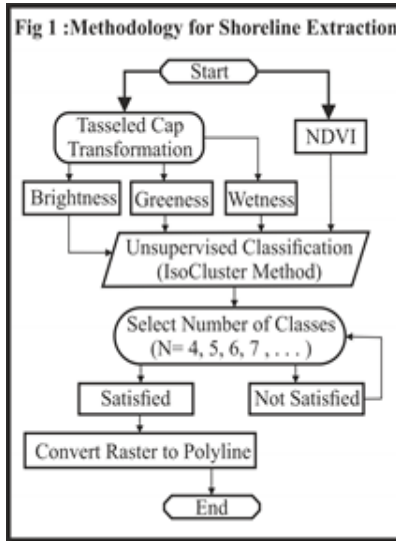
The Study area is coastal region in a west coast of Honnavara Taluk, Uthara Kannada District, Karnataka State, India as shown in Map1. Location of study area geographically extends from 14 Degree, 18 Minutes, 45 Seconds Latitude to 14 Degree 20 Minutes 37 Seconds Latitude and 74 Degree 24 Minutes 30 Seconds Longitude to 74 Degree 24 Minutes 54 Seconds

Longitude. The Coastal tract is nearby by to Karwar Harbor which act as a port town and District headquarters. The main occupation in this study area were fishery and tourism. The geological formation depicts that consists of alluvium and rich in minerals. The geomorphology of study area comprises the mud flats, sandy beach. The soil texture varies spatially in area, the major soil found in study area are Laterite gravelly clay soil, Alluvial loamy and stratified soil. The coastal area consists of mangroves vegetation in small amount of area. The shoreline study is important for these kind of areas due to global sea level rise and to understand the coastal inundation and other parameters.



Methodology:

Fig 1, depicts the methodology for the present study. Initially the Landsat imagery were downloaded through <http://earthexplorer.usgs.gov>, through three different Landsat sensor with three different date of acquisition were considered such as (29-12-1992) for Landsat 5 TM, (18-11-2003) for Landsat 7 ETM+ and (24-11-2014) for Landsat 8 OLI with path (146) and Row (050). The Tasseled cap transformation of Brightness, Wetness and Greenness along with that spectral indices of NDVI is used. Based on these four key factor, the unsupervised classification is performed and shoreline will be delineated.



Results:

1) **Tasseled Cap Transformation (TCT):** The Tasseled Cap transformation is a method of image band conversion to enhance spectral information. It primarily is used to detect vegetation using the derived brightness, greenness, and wetness bands (Yamamoto, 2012).

- a) **Brightness:** Based on the at sensor reflectance and coefficient values the Brightness of the image is obtained. The value ranges based on the memory bit of the imagery. Whereas Landsat 5 TM and Landsat ETM+ varies from 0 to 255 and Landsat 8 OLI varies from 0-65535 in output raster. For coefficient values see the Table 1.
- b) **Greenness:** Greenness indicates the richness in vegetation based on the tasseled cap transformation coefficient. The denser the vegetation then higher the values will be obtained and lower the vegetation then lower the values will be obtained. For coefficient values see the Table 1.
- c) **Wetness:** Wetness is an indicator of water body and moisture content in vegetation canopy. The transformation coefficient applied to the bands of Landsat imagery. Then output raster will be displayed based on richness in water or moisture content. For coefficient values see the Table 1.

2) **Normalized Difference Vegetation Index (NDVI):** These is a spectral indices, it is an indicator of healthy vegetation, and the output values varies between -1.0 and 1.0. Negative values of NDVI near to -1 correspond to deep water. Output values near to zero (-0.1 to 0.1) generally correspond to barren areas of rock, sand, or snow. Low, positive values represent shrub and grassland (approximately 0.2 to 0.4), while high values indicate temperate and tropical rainforests (values approaching 1).The typical range is between about -0.1 (for a not very green area) to 0.6 (for a very green area). To calculate NDVI see the table 1.

3) **Unsupervised Classification:** The unsupervised classification of IsoCluster method is performed based on four key factors such as Brightness, Greenness, Wetness and NDVI that obtained from Landsat imagery using Image Classification tool in ArcGIS Software. Initially the number of classes will be selected in this research the researchers used number of classes (n) equal to 8. The Classification will be performed based on the cell by cell classification by generalizing the highest values and lowest values in a set of Key factors.

4) **Shoreline Extraction:** The output result of unsupervised classification depicts the individual classes. By the field knowledge the classified raster will be converted to Polyline using Raster to Polyline tool in ArcGIS software. The Map 2, indicates the shorelines extracted from different Landsat Sensors.

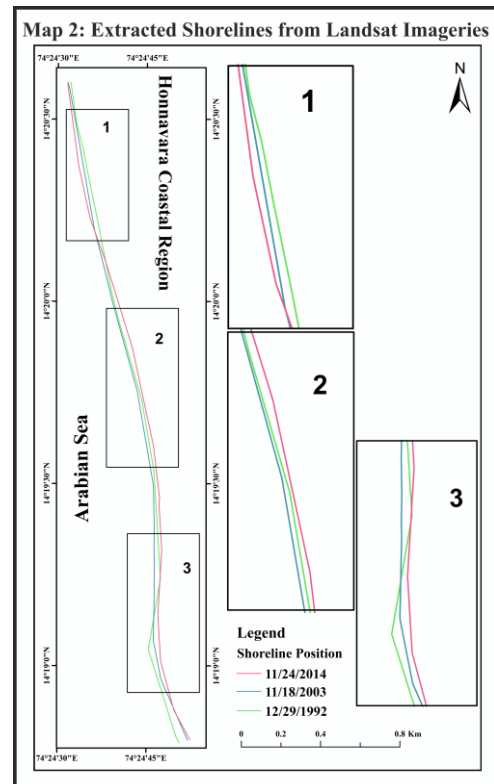


Table 1: Tasseled Cap Transformation(TCT) and Normalised Difference Vegetation Index(NDVI) Calculation		
Landsat 5 TM	Brightness	(Band 1 * 0.3037) + (Band 2 * 0.2793) + (Band 3 * 0.4743) + (Band 4 * 0.5585) + (Band 5 * 0.5082) + (Band 7 * 0.1863)
	Greenness	(Band 1 * -0.2848) + (Band 2 * -0.2435) + (Band 3 * -0.5436) + (Band 4 * 0.7243) + (Band 5 * 0.0840) + (Band 7 * -0.18)
	Wetness	(Band 1 * 0.1509) + (Band 2 * 0.1973) + (Band 3 * 0.3279) + (Band 4 * 0.3406) + (Band 5 * -0.7112) + (Band 7 * -0.4572)
	NDVI	(Band 4 - Band 3) / (Band 4 + Band 3)
Landsat 7 ETM+	Brightness	(Band 1 * 0.3561) + (Band 2 * 0.3972) + (Band 3 * 0.3904) + (Band 4 * 0.6966) + (Band 5 * 0.2286) + (Band 7 * 0.1596)
	Greenness	(Band 1 * -0.3344) + (Band 2 * -0.3544) + (Band 3 * -0.4556) + (Band 4 * 0.6966) + (Band 5 * -0.0242) + (Band 7 * -0.2630)
	Wetness	(Band 1 * 0.2626) + (Band 2 * 0.2141) + (Band 3 * 0.0926) + (Band 4 * 0.0656) + (Band 5 * -0.7629) + (Band 7 * -0.5388)
	NDVI	(Band 4 - Band 3) / (Band 4 + Band 3)
Landsat 8 OLI	Brightness	(Band 2 * 0.3029) + (Band 3 * 0.2786) + (Band 4 * 0.4733) + (Band 5 * 0.5599) + (Band 6 * 0.508) + (Band 7 * 0.1872)
	Greenness	(Band 2 * -0.2941) + (Band 3 * -0.243) + (Band 4 * -0.5424) + (Band 5 * 0.7276) + (Band 6 * 0.0713) + (Band 7 * -0.1608)
	Wetness	(Band 2 * 0.1511) + (Band 3 * 0.1973) + (Band 4 * 0.3283) + (Band 5 * 0.3407) + (Band 6 * -0.7117) + (Band 7 * -0.4559)
	NDVI	(Band 5 - Band 4) / (Band 5 + Band 4)

Source: Review of Literature

Conclusion:

This study concludes that the potential use of remote sensing technology in shoreline extraction using Landsat imagery. The Tasseled cap transformation and NDVI spectral indices have quite simple to use and the methodology adopted for the study reduces the time and man power. This study can be adopted for assessing a shoreline change, coastal management, to understand the coastal dynamics, decision makers and policy makers. Further research can be extended based on this study.

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