Impacts of Hydrodynamic Factors of Sea and Sea Level Rise on Coastal Zone of Trivandrum, India using Coastal Vulnerability Index Geospatial Model

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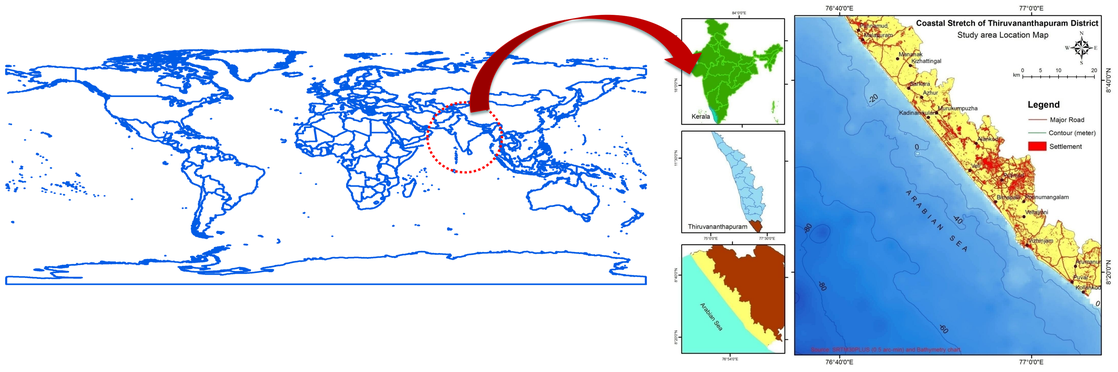
INTRODUCTION

The movement of suspended sediment along the coastal water is an indicator of erosion and deposition of the coastal landforms. The present study deals with the spatio-temporal movement of suspended sediments in the shallow along the coast of Trivandrum District, South India. The suspended sediment concentration along the coastal area has been estimated by analyzing spectral properties of clear and turbid water of Landsat 8 – OLI (Operational Land Imager, 30m). The spectral combination of various bands reflects the presence of organic and inorganic matters, which distinctly separated them from the clear water. In this study, the empirical algorithm has been developed for extraction of suspended sediments from multi-temporal images. The customized model is here systematically analysis the spectral properties of multiple bands to mapping the suspended sediments at various concentration and spatial distributions. The spectral reflectance curve obtained after atmospherically correction of multispectral bands reaches higher reflectance at the wave length of 0.63 – 0.84 µm (Red and NIR band) that shows presence of high concentration of sediments, whereas, the wave length at 0.4 – 0.5 (Blue band) is reflected poorly due to higher absorption of waves by the clear water. The empirical relationship of multispectral bands is attributed to estimate sediment in the coastal water, which can be used to understand the phenomenon in the formation of coastal landform. The algorithm is successfully retrieved SSC from coastal water and monitored the movement of sediments with ease along the coast during pre and post monsoon. Spatially, the sediment concentration is estimated with a range of 20 – 93 mg/l in a pixel within the depth of 10 m (Kaliraj and Chandrasekar, 2012).

The study has revealed that the sediment concentration starts to decrease as we move away from the shoreline towards the sea at the depth beyond 30meters. Thus, we have ended up that the suspended sediment is directly proportional to wave direction and littoral current at off-shore, whereas bathymetry and distance from the shoreline towards the sea is inversely related. The study on sediment drift and its impacts on the coast through conventional method are difficult; meanwhile, multi-temporal images may provide effective results for studying sediments concentration and their movement along the coastal water. It is observed that the suspended sediments drift produce depositional landforms at the low wave energy zone and erosional landforms at high wave energy zone. This study proves the efficacy of remote sensing to estimate sediment concentration and transportation in the shallow coastal water (Nechad *et al.*, 2010; Sinha *et al.*, 2004).

STUDY AREA

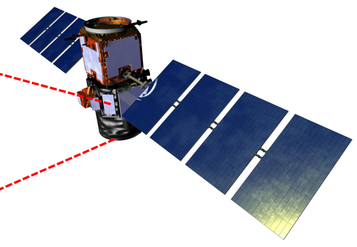
The coastal zone shown in Figure of the Thiruvananthapuram District covers a stretch of about 72 km extending seaward for 10 km from the coast bound. Thiruvananthapuram district is situated between north latitudes 8º 17' and 8º 54' and east longitudes 76º 41' and 77º 17'.Major locations of the coastal stretches are active in business, tourist attractions and are very densely populated with thick settlements. The present study has attempted to map the SSC along the coast using single band algorithm and monitored the movement during pre-monsoon and post-monsoon.

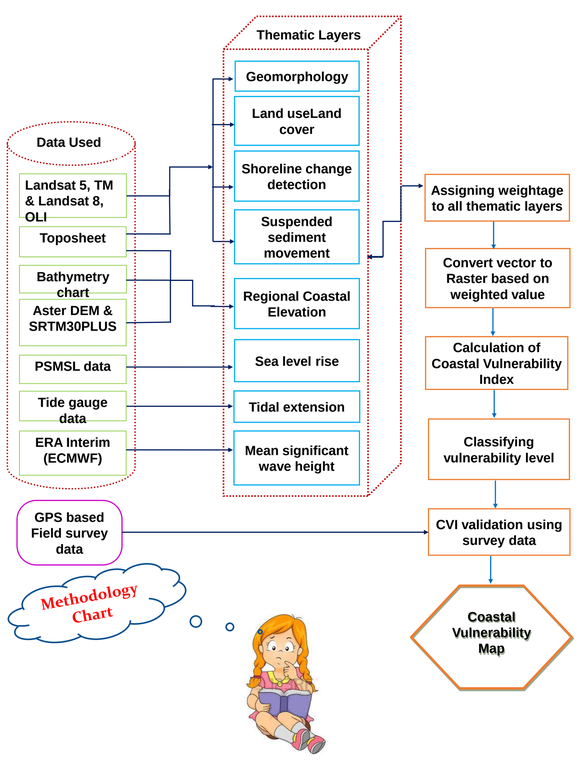


METHODOLOGY

The data used to carry out the work includes the satellite data and other spatial dataset. Landsat 8 scans the earth surface and measures different ranges electromagnetic spectrum. Operation Land Imager (OLI) gives the multispectral data for visible as well as infrared range. It covers the entire earth in 16 days.

Specification Particulars		
Satellite	LANDSAT 5	LANDSAT 8
Sensor	TM	OLI
Band combination	4,3,2	8, 4, 3
Temp Resolution/ Inclination	16 days	16 days

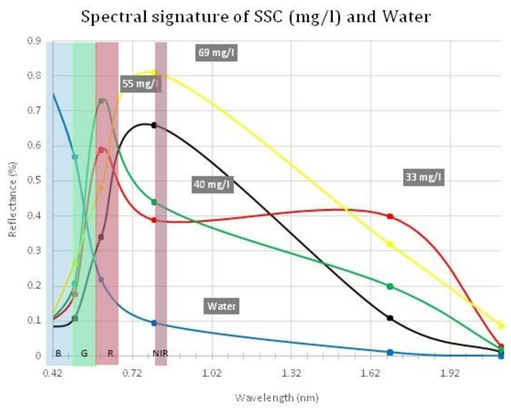




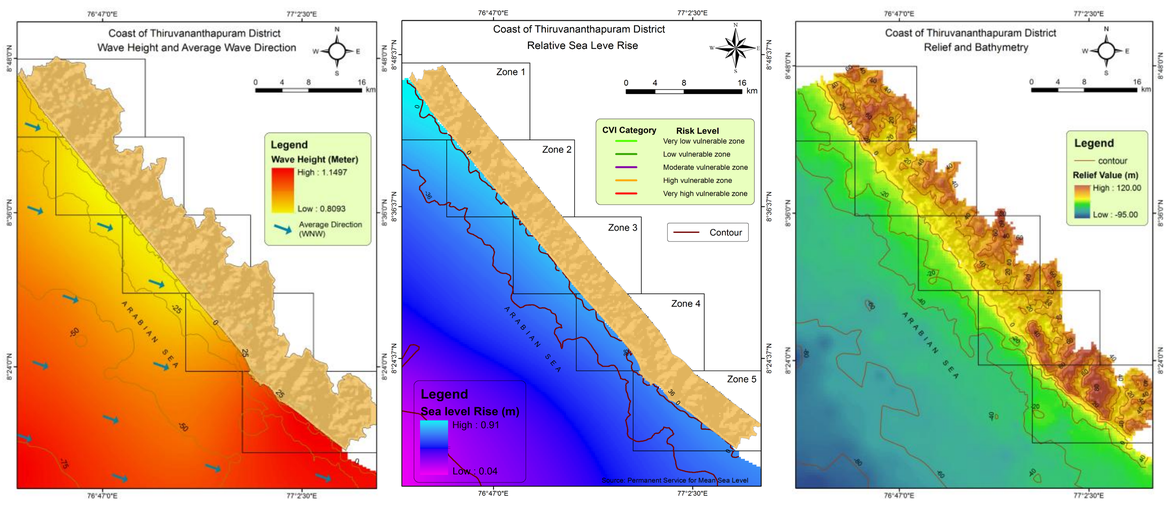
CVI Model

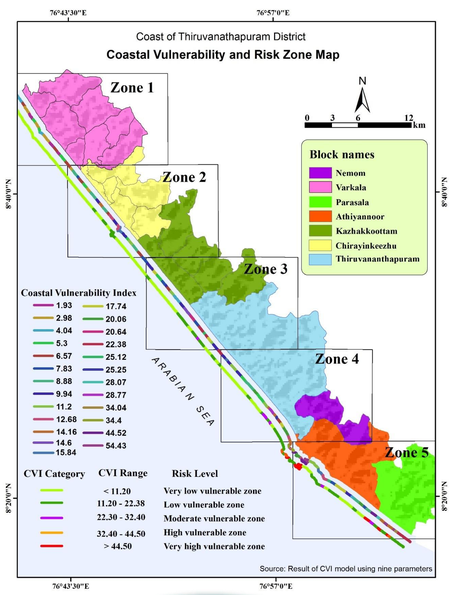
$$CVI = \frac{\sqrt{a*b*c*d*e*f*g*h*i}}{9}$$

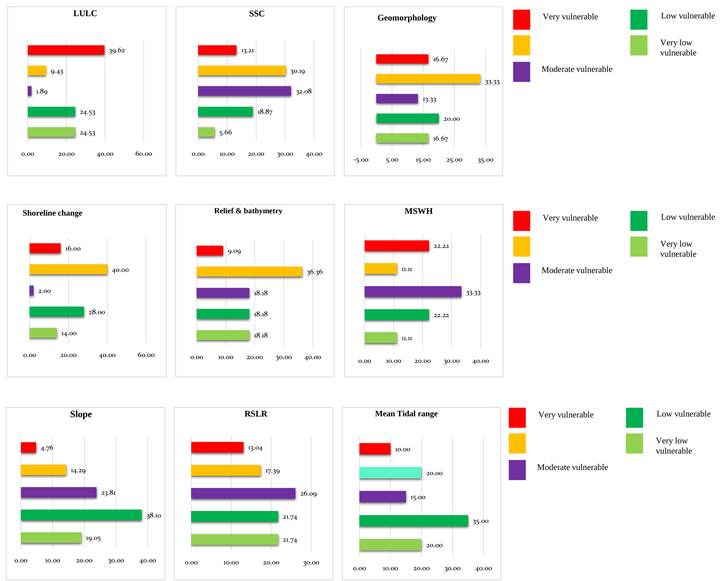
a = Geomorphology
b = Land use land cover
c = Shore line erosion and accretion
d = Regional elevation
e = Coastal slope
f = Relative sea level rise
g = Mean significant wave height
h = Tidal extent
i = Suspended sediment concentration



RESULT AND DISCUSSION







X – axis:- Risk Level
Y – axis:- Percentage of shore line
Where;
LULC= Land use land cover;
SSC= Suspended sediment concentration;
RSLR= Relative sea level rise;
MSWH = Mean significant wave height;

CONCLUSION

Sectors	CVI value	Rate of Vulnerability	Factors Influencing coastal vulnerability
Zone 1	1.93 - 6.57	Very low vulnerable zone	Swashing of sediments on gentle slope leading to formation of beaches, reducing vulnerability to erosion
Zone 2	2.98 - 15.8	Low vulnerable zone	The coastal configuration, gentle slope, seasonal sediment deposition and low wave height are favorable factors for coastal stability.
Zone 3	5.36 - 25.12	Moderate vulnerable zone	Seasonal changes of waves and littoral currents causes shoreline erosion & damaging even the landforms in the shallow coastal stretches
Zone 4	8.88 - 34.4	High vulnerable zone	Decrease in shoreline accretion rate and increase in mean wave height due to the seasonal change in sea level has been influenced the shore line.
Zone 5	12.68 - 54.43	Very high vulnerable zone	Increasing sea level, damages the landforms due to action of high energy waves approaching at steep slope, through the deeper nearshore

❖The maps and data presented here can be viewed in at least two ways:

1. as an example of where physical changes are most likely to occur as SLR
2. as a planning tool for Thiruvananthapuram shore.

❖Thiruvananthapuram shore preserves a dynamic natural environment, which must be understood in order to be managed properly, because More frequent and intense storms may increase potential damage and loss of life

❖Actions to minimize this damage and loss of life can be implemented at a municipal level. Managements should make policies and aim to develop;

- Plans for climate change
- Coastal inundation &
- Storm surge events etc.

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