

Coastal Vulnerability Mapping

R S Mahendra
Scientist-E, TWG
mahendra@incois.gov.in

**Presentation on INCOIS Operational Services Training to Indian
Navy Officers**

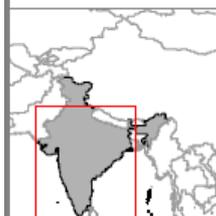
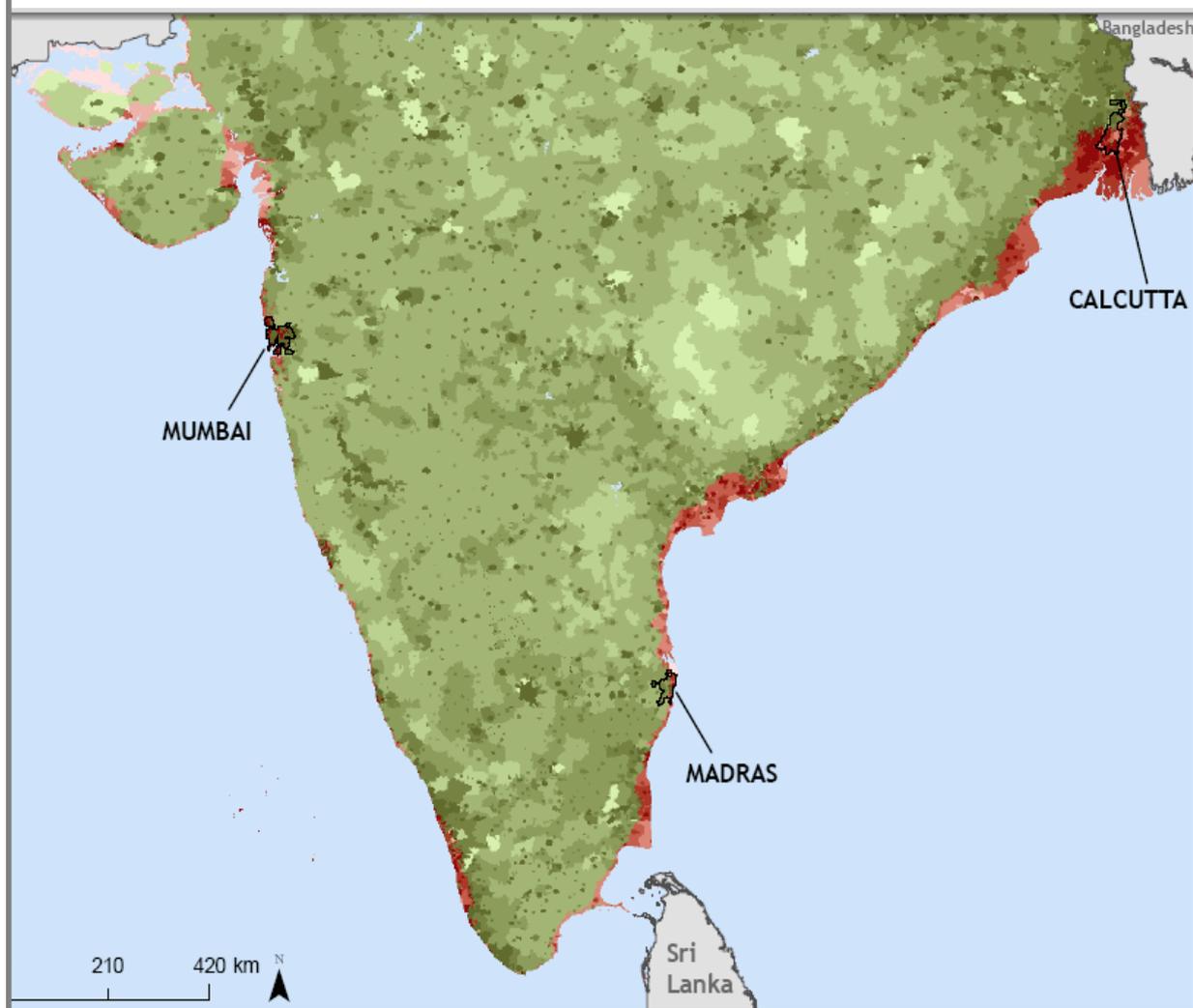
21 February 2019



ESSO-Indian National Centre for Ocean Information Services (ESSO-INCOIS)
Ministry of Earth Sciences, Hyderabad-90

Vulnerability of the Indian Coastline

- 26 % of Indian Population live within 100 Km from the shoreline
- Most of the coastal areas are low lying and vulnerable to oceanogenic disasters such as Tsunamis, Storm Surges, Sea-level rise
- Dec 26, 2004 Tsunami resulted in a loss of 18, 045 deaths and 6,47,599 persons displaced
- Increased frequency and intensity of the disasters (Uttarkhand flood-2013, Phailin Cyclone -2013 (helen , Lehar)



Population Density within and outside of a 10 meter low elevation coastal zone (LECZ), 2000

Persons per sq km	<25	25-100	100-250	250-500	500-1,000	>1,000
within LECZ						
outside LECZ						

Oceanogenic Disasters

Tsunami, Cyclones, Storm surge, Sea level rise, Coastal erosion, High Waves, etc.



- 13% of World's cyclones in the Seas around India
- Annual; Frequent phenomenon
- Inundation of Coastal areas



Coastal Inundation

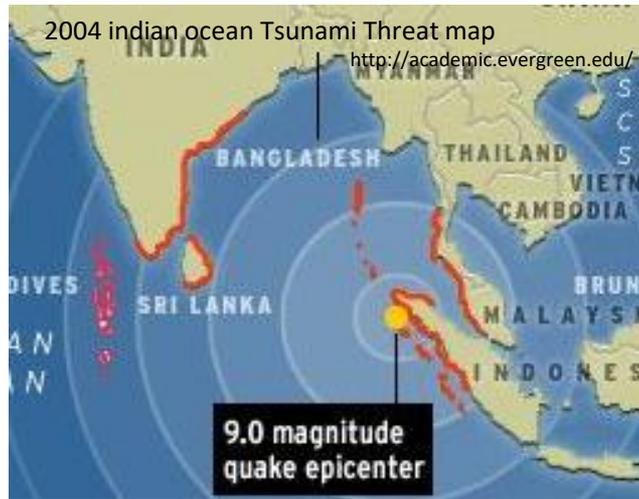
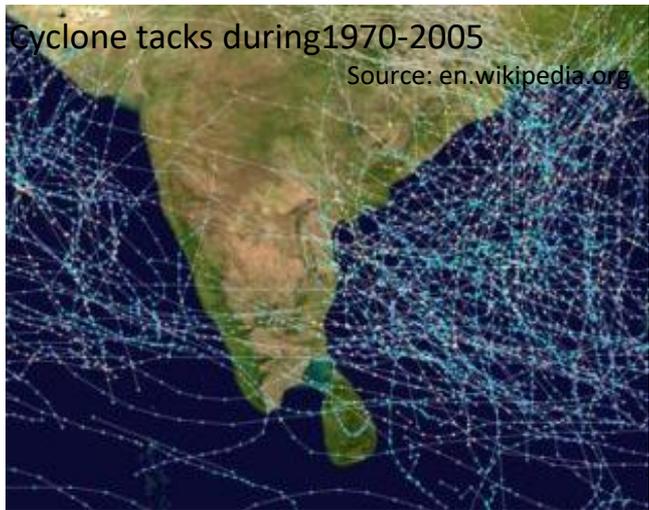
Damage



- Tsunami in Indian Ocean
- A few events in the past
- Inundation of Coastal areas (Large stretches)
- Highly devastating Tsunami on December 26, 2004

Oceanogenic Disasters

History



Cyclones

- 13% of World's cyclones in the Seas around India
- Annual; Frequent phenomenon
- Inundation of Coastal areas

Tsunamis

- A few events in the past
- Inundation of Coastal areas (Large stretches)
- Highly devastating Tsunami on Dec 26, 2004

Characteristics

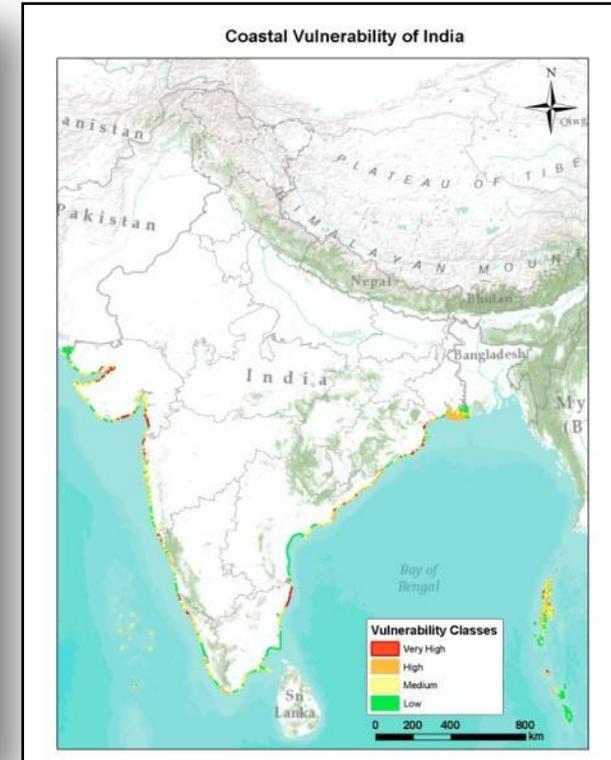
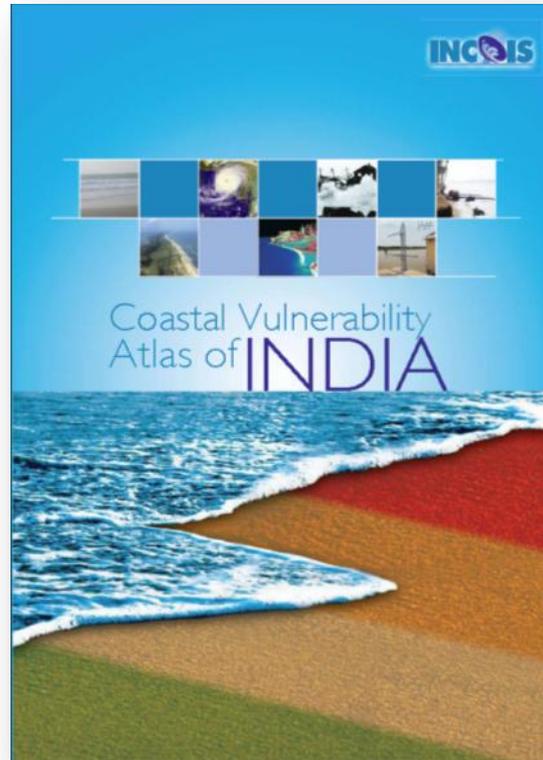
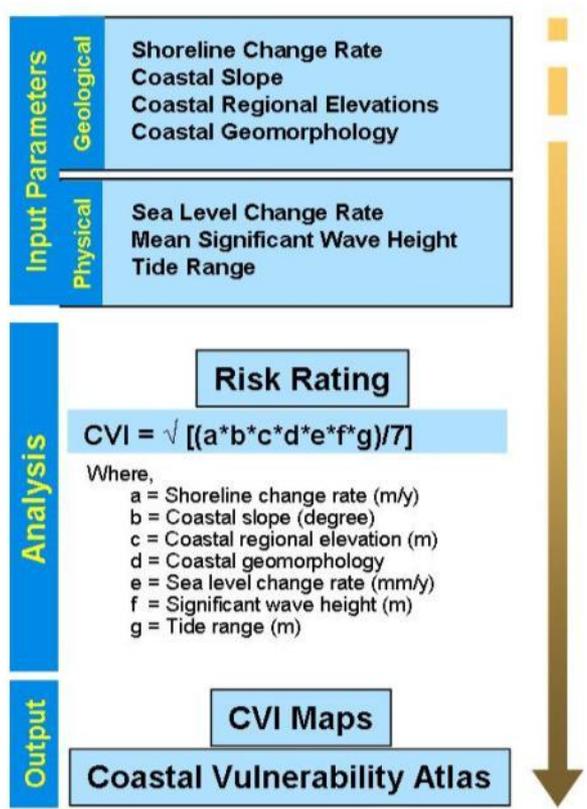
Marine Hazard	Tsunami*	Storm Surge*	Long-term Sea Level*	Coastal Erosion
Likely Frequency	Decade to Millennia depending on regional tectonic regime	Months to decade, depending on the regional climate regime	Ongoing, a consequence of global warming and local factors	Ongoing due to natural coastal processes and anthropogenic intervention
Limits are Likely to be affected	Local run-up limit for specified wave amplitude predicted by modelling	Flood limit for specified surge level predicted by terrain modelling	Mean high waterline mark predicted by terrain modelling with allowance of extreme events	Shoreline position marked based on the temporal satellite observations and coastal modelling

*Source: UNESCO/IOC Report on Coastal Vulnerability

Mapping of Coastal Vulnerability Indices

“Vulnerability is an internal risk factor of the subject or system that is exposed to a hazard and corresponds to its intrinsic predisposition to be affected, or to be susceptible to damage”

Methodology



Data Used

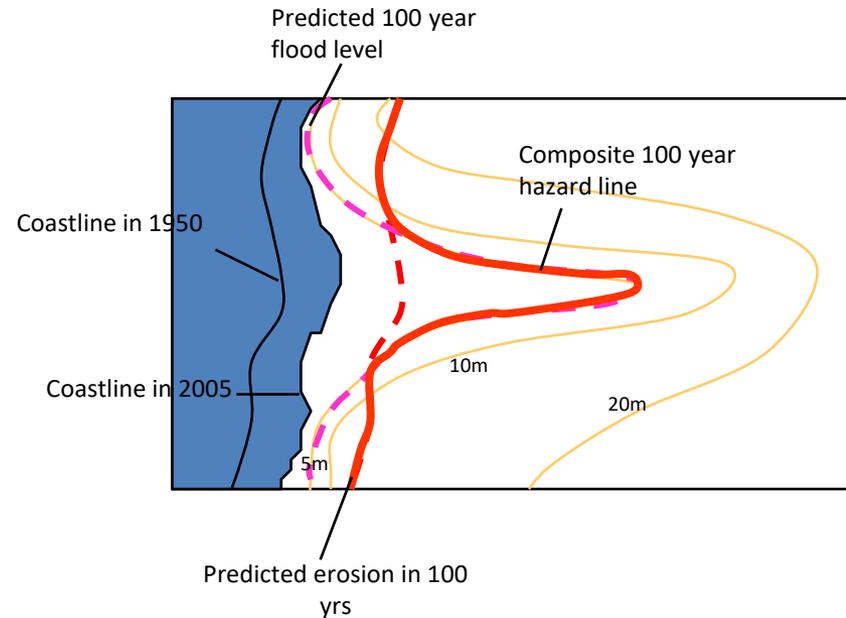
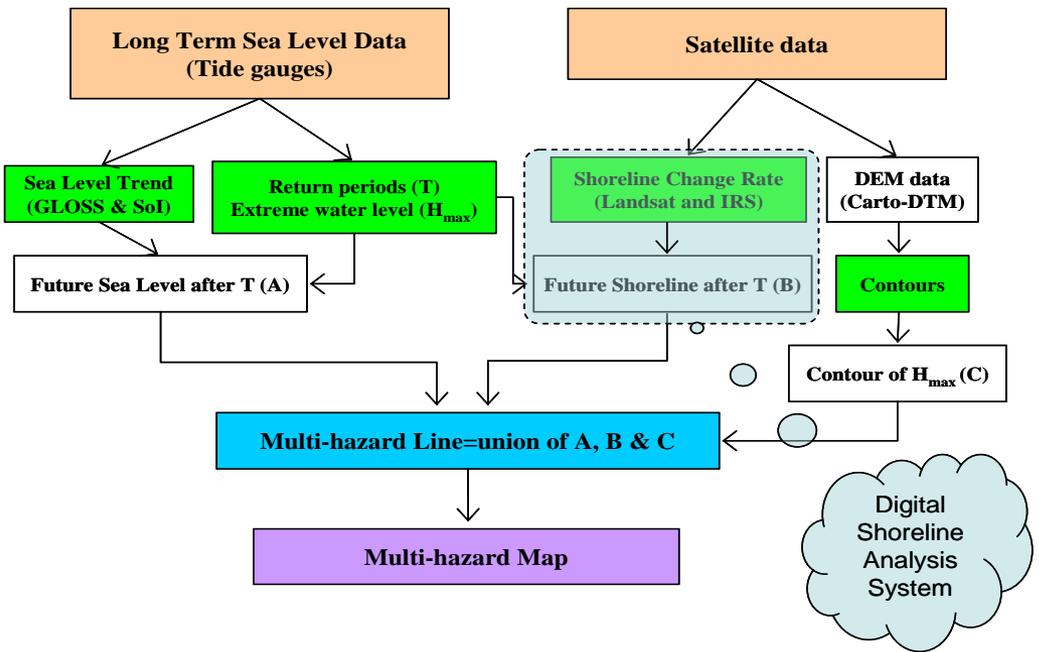
Parameter	Data
Geomorphology	IRS LISS-IV
Slope	GEBCO
Elevation	SRTM
Tidal Range	Astronomical tides
Shoreline Change Rate	Landsat data (1972-2000)
Historical Sea Level	PSMSL data from GLOSS
Significant Wave Height	Simulated data from Mike model



INCOIS, (2012). Coastal Vulnerability Atlas of India. INCOIS-ASG-CGAM-CV-2012-01, Pages 212, Maps 156, INCOIS, Hyderabad, India. ISBN 978-81-923474-0-0.

“The Multi-Hazard Map is a “composite, synthesized and overlay of multiple hazards”

MHVM Methodology



Data Used

Inputs	Source
Extreme Water level	Hourly Mean SOI Tide Data and events from published data sources
Sea-level Change	Monthly Mean from PSMSL
Shoreline Change	Landsat/IRS
Topography	ALTM/Carto DTM

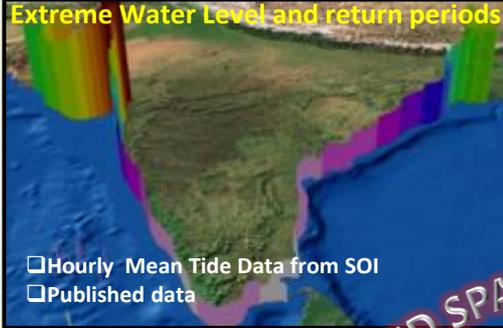
High Resolution Topographic data



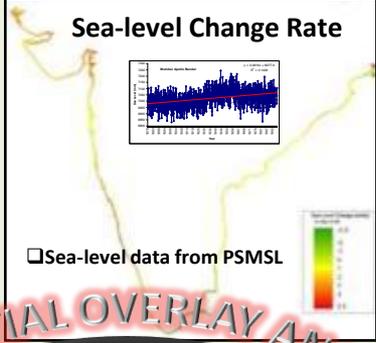
Coastal Multi-hazard Vulnerability Assessment

INPUTS

Extreme Water Level and return periods



Sea-level Change Rate



Shoreline Change Rate

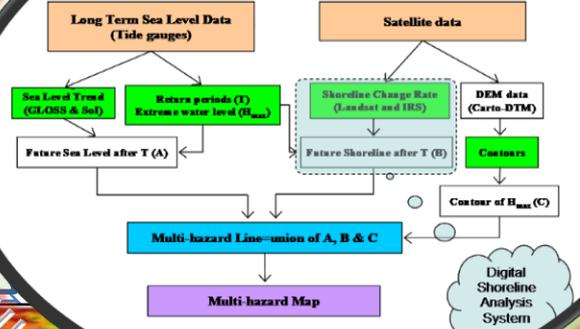


High-Resolution Topography

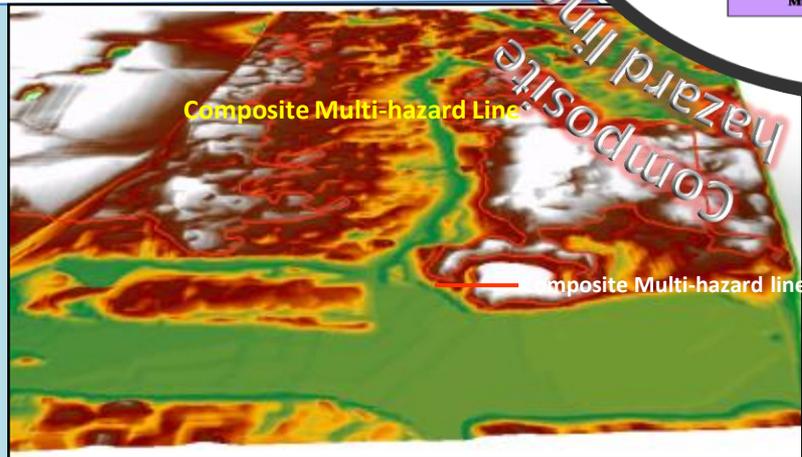


SYNTHESIZED SPATIAL OVERLAY ANALYSIS

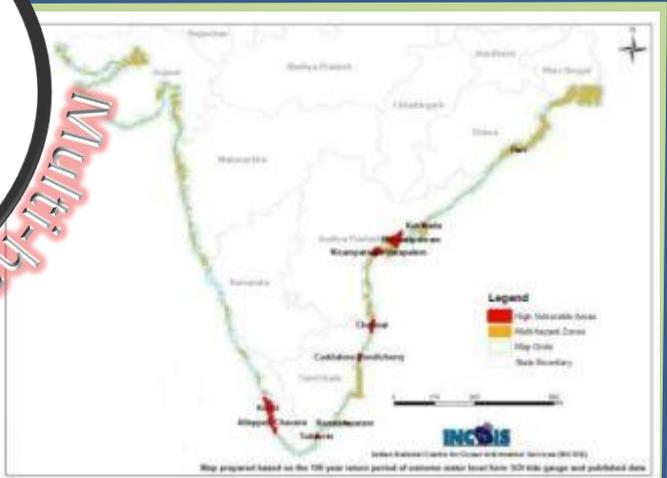
MHVM Methodology



Composite Multi-hazard Line



Multi-hazard Maps



3D GIS Mapping

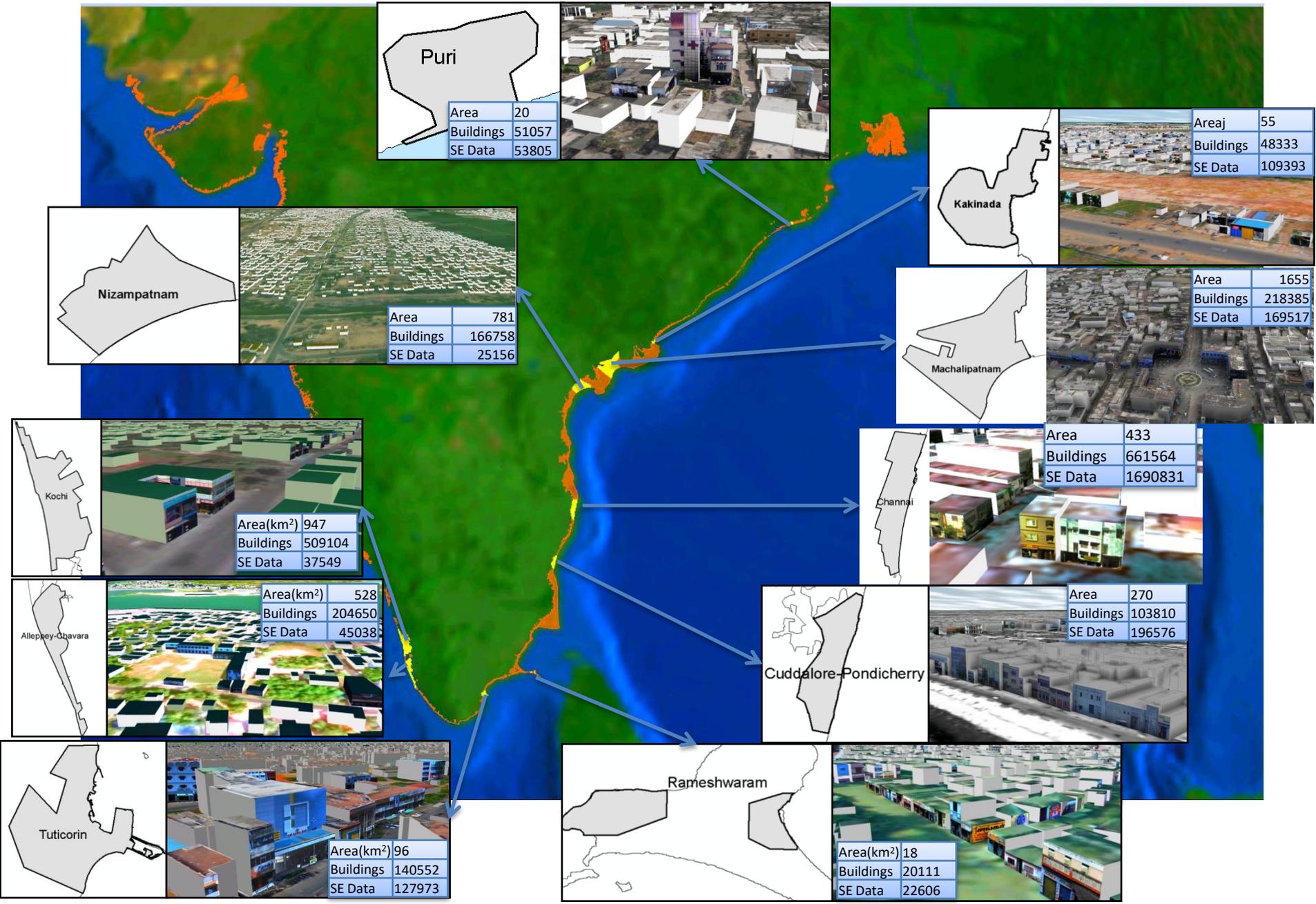
3D Buildings with Socio-economic data Of Machilipatnam

Image Label Properties

SLNO	36668
PROPERTYID	675G
GISID_1	111_675
STATE	Andhra Pradesh
DISTRICT	Krishna
TOWN_OR_VI	MACHILIPATNAM
WARDNO	13
STREET_COL	ENGLISH PALEM
OWNERNAME	NAZEEM BEGUM
TENANTNAME	
HOUSE_NO.	22-81
AADHAR_NO	
ELECTRICNO	622402030063
OCCUPATION	Business
INCOME	12,000 PM
PH_MOB_NO	8019717719
BUILD_USG	Residential
CONS_TYPE	Pykka
WALL_TYPE	Brick Plastered
ROOF_TYPE	Tile
FOUND_TYPE	Piler
CONST_YEAR	2000
NO_OF_FLOR	0
TOTAL_PERS	5
TOT_MALE	3
TOT_FEMALE	2
AGE_LE_12Y	0
AGE_GR_60Y	0
L6am_10am	5
L10am_6pm	1
L6pm_10pm	5
L10pm_6am	5

DateType = String
Character Length = 254

3D GIS Mapping Areas



Coastal Risk Assessment at Building level



Thank you