MANAGEMENT OF COASTAL EROSION ALONG PONDICHERRY COAST

SRIGANESH. J
Project Scientist - II
National Institute of Ocean Technology (NIOT)
Ministry of Earth Sciences (MoES)
Chennai - Tamil Nadu - India

06-10-2014

OUTLINE

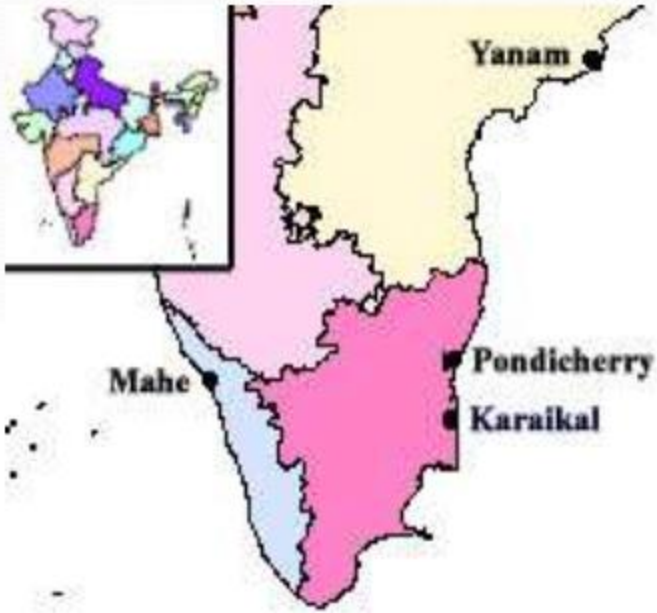
- Objective of Pondicherry Project
- Status of the Pondicherry Coast
- Pondicherry coast and various intervention of erosion protection
- Shoreline Change Analysis
- Nearshore observation along the coast
- Performance of Pilot Beach Nourishment
- Proposed Beach restoration Scheme
- Modelling and analysis
- Conclusion

OBJECTIVE

- Management of Coastal Erosion along Pondicherry coast using ecofriendly soft solutions.

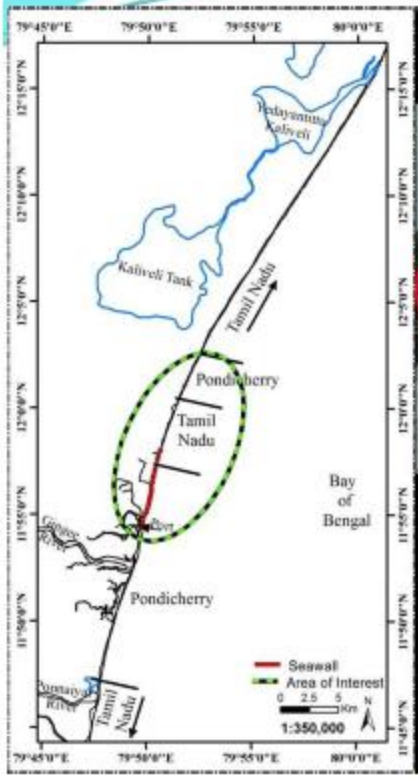
- The project also satisfy a number of critical success factors, which include:
  - Satisfying long term beach management objectives
  - No unacceptable down drift impact on Pondicherry Beach or other adjacent coastal compartments.
  - No detrimental impact on the ecological values of Pondicherry Beach.
  - Improve marine habitat where possible.
  - Improve Tourism

LOCATION OF PONDICHERRY IN PUDUCHERRY U.T



- Pondicherry - East Coast – 160 kms - south of Chennai – Tamil Nadu.
- Karaikal – East Coast - 160 kms south of Pondicherry - surrounded by Nagapattinam district - Tamil Nadu.
- Mahe – West Coast - same latitude to Pondicherry, 653 kms away - Kerala.
- Yanam – East Coast - 840 kms North East of Pondicherry - Andhra Pradesh.

PONDICHERRY ERODING COAST - STATUS



After construction of Pondicherry Port severe erosion on Northern coast
Accretion on the southern coast

INTRODUCTION - PONDICHERRY CITY COAST

Before harbour

Natural Beach

After harbour

Sea wall protection

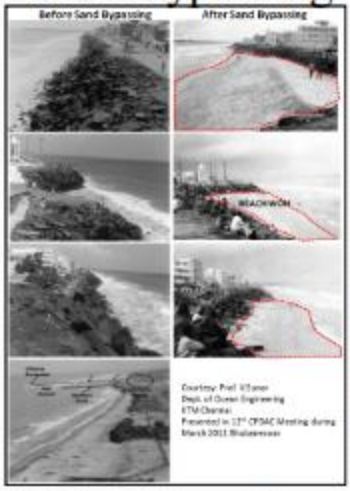
At Present

Strengthened sea wall

Coastal Structures along Pondicherry

SHORT TERM AND PERMANENT PROTECTION

Sand Bypassing



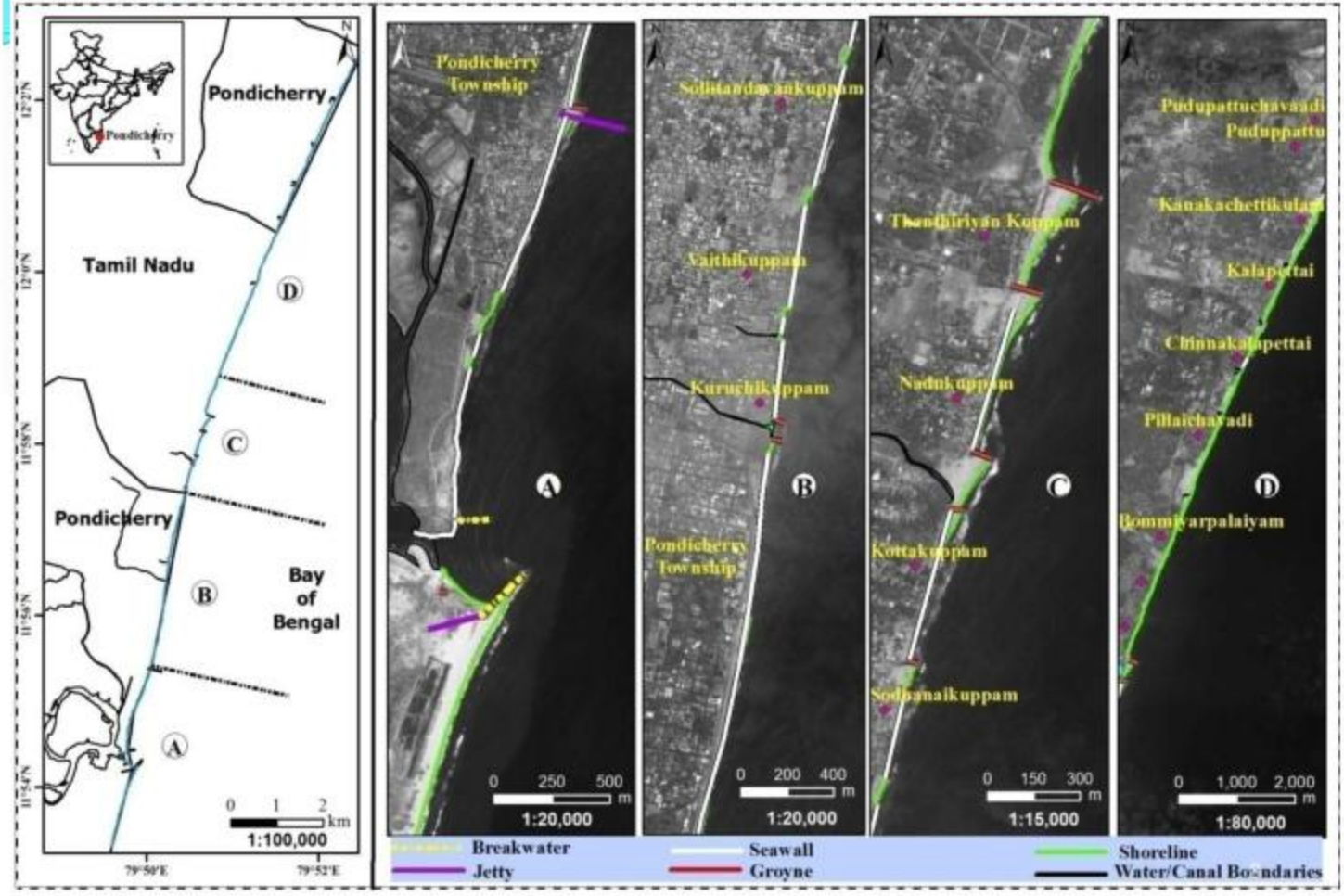
Seawall

Groins

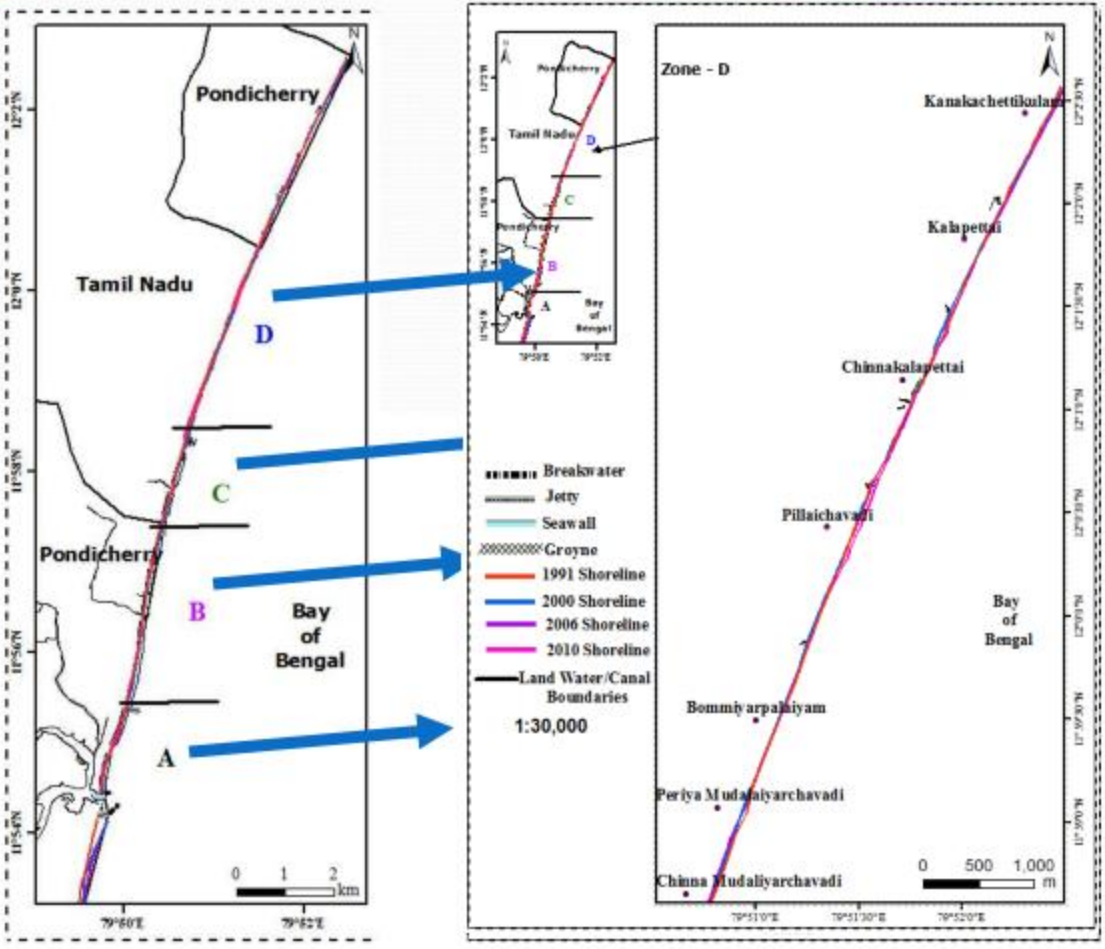
- First Sand bypassing carried out and discontinued due to various technical reasons, lead to erosion along Pondicherry city.

- Seawall of length 6 km was constructed, which steepened beach

SHORELINE CHANGE ANALYSIS



1991 – 2010 SATELLITE IMAGE ANALYSIS



ZONE A

PONDICHERRY PORT (ACCRETION & EROSION)

2005

- Beach – North & South
- September 2005 – Erosion on North & Accretion on South.
- Northern coast Protected with Seawall.

2010

- Accretion inside the Southern Breakwater.
- Northern coast erosion extended

2012

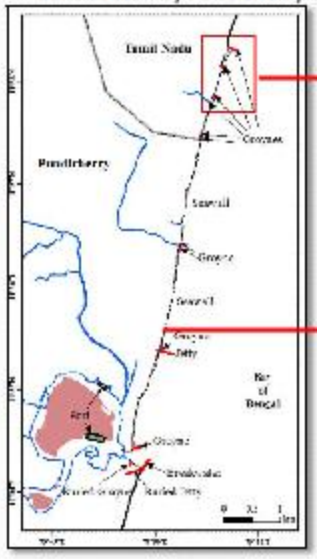
- Accretion inside the Southern Breakwater & South of the Southern Breakwater
- Erosion on the North of the Northern Breakwater.

ZONE B , C : SEAWALL & GROIN

6 km length of seawall was constructed by Pondicherry

2 km length of coast line protected by both seawall and groins by Tamil Nadu

The erosion problem shifted further north



Year 2000

+

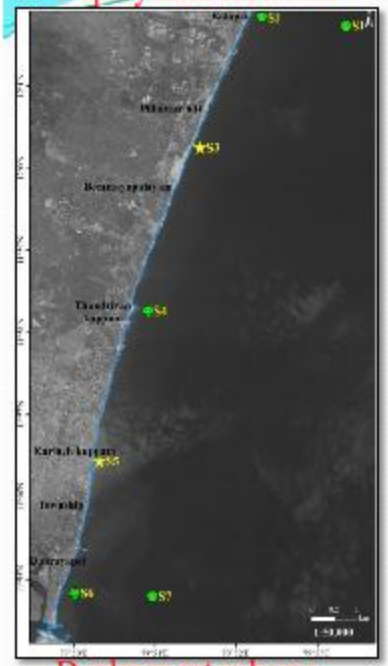
Year 2003

=

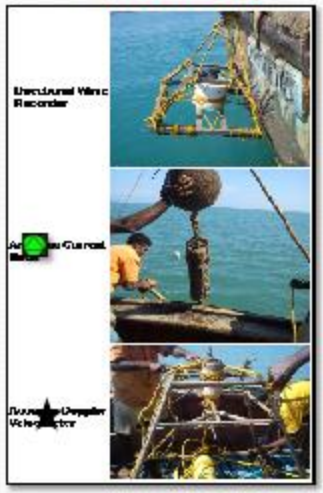
At present

HYDRODYNAMIC MEASUREMENTS

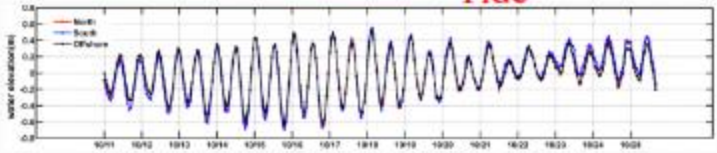
Deployment locations



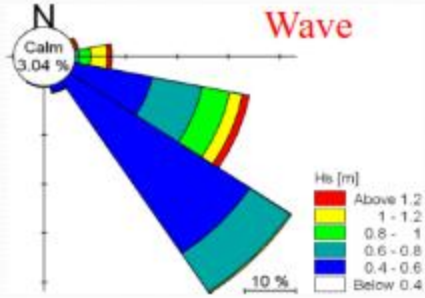
Instruments



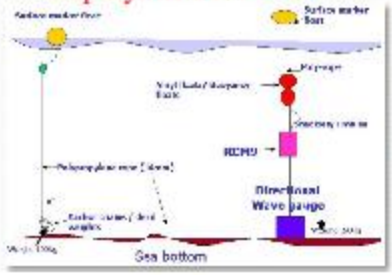
Tide



Wave



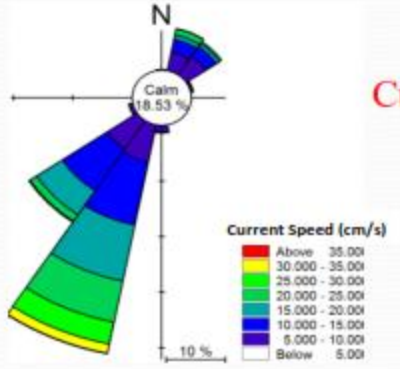
Deployment scheme



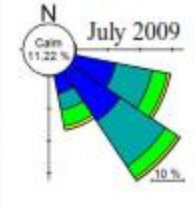
Observed parameters

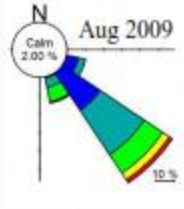
- Water Levels
- Waves
- Coastal currents
- Nearshore currents
- Sediment characteristics
- Shoreline changes

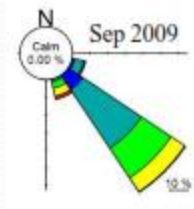
Current

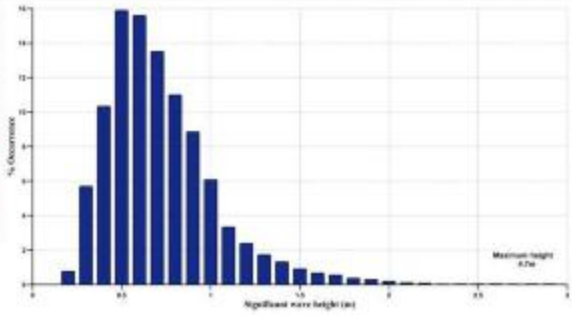


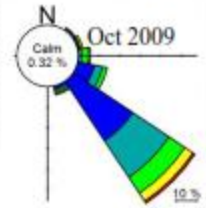
FIELD MEASUREMENTS - ANNUAL WAVE CLIMATE

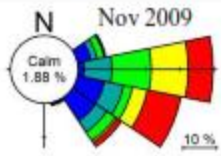


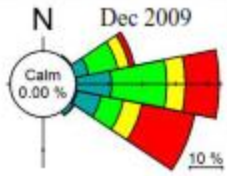


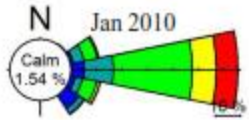


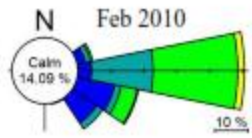


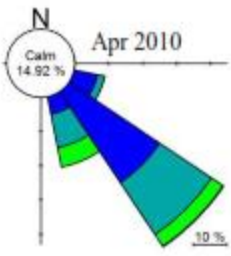


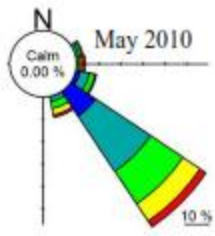


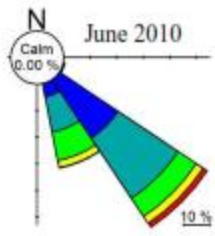


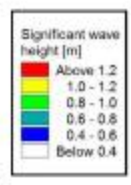




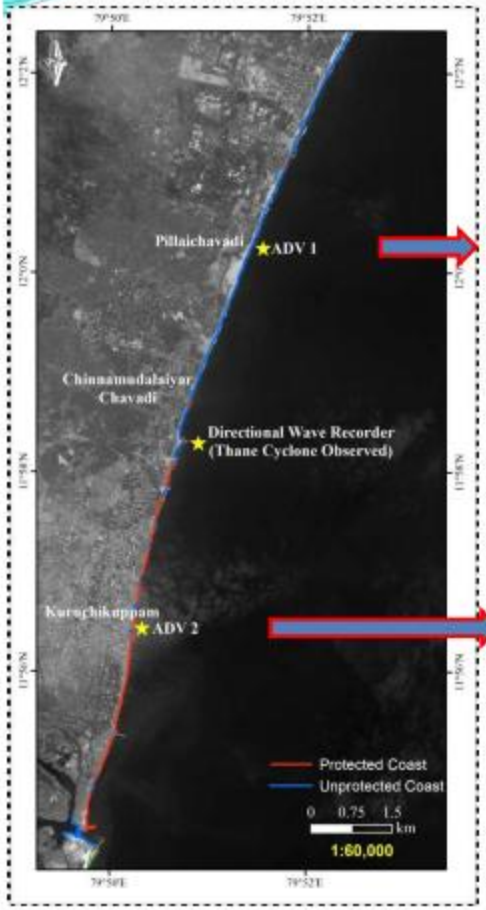


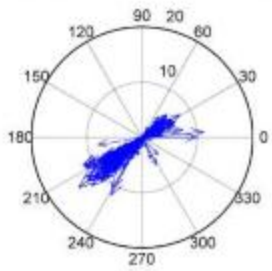


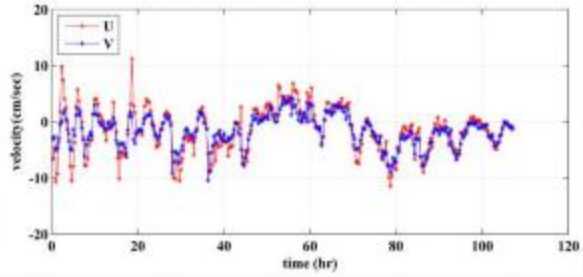


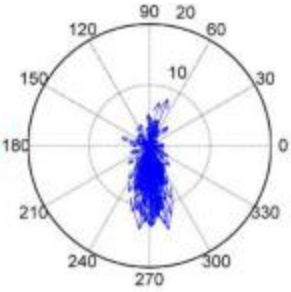


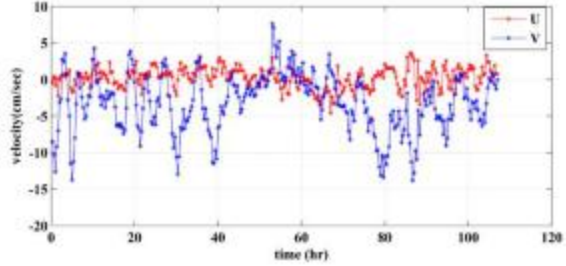
NEARSHORE CURRENTS: NE MONSOON



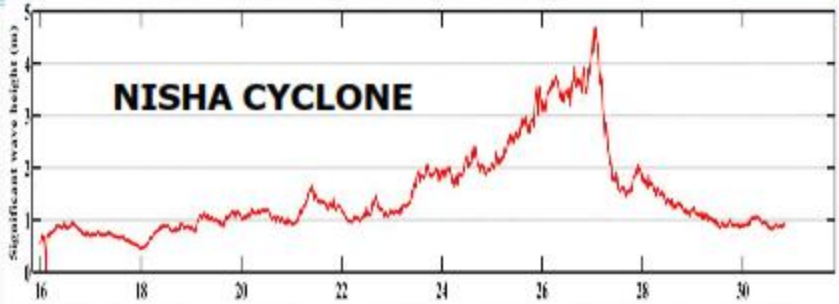


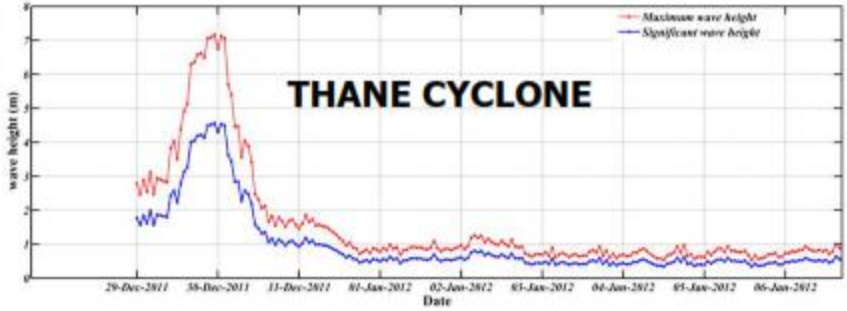


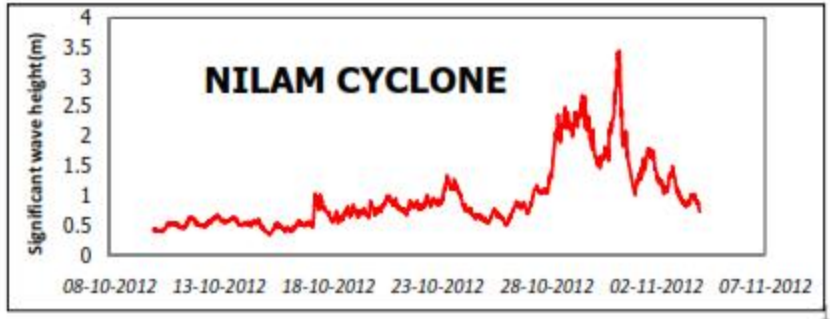




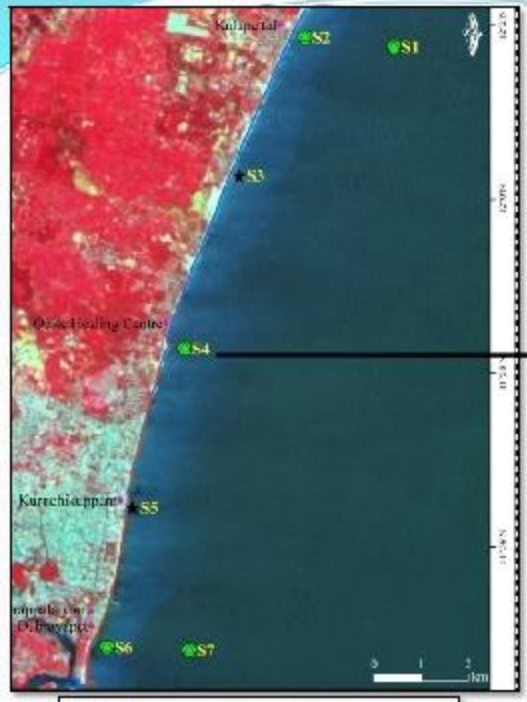
INCREASED COASTAL DISASTER

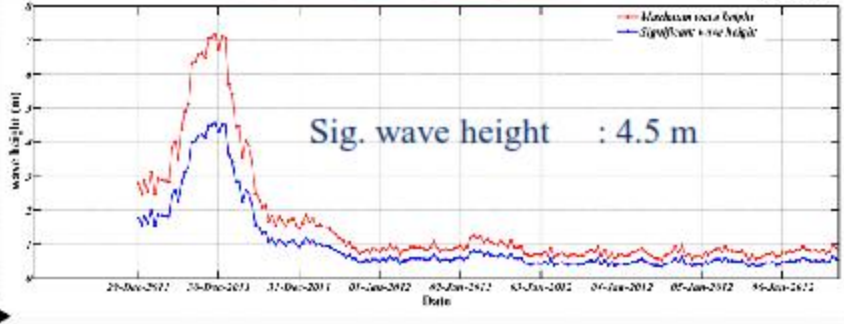


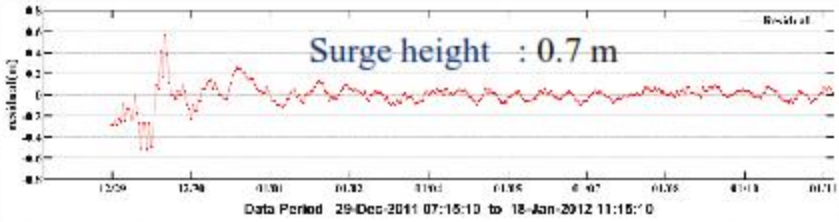


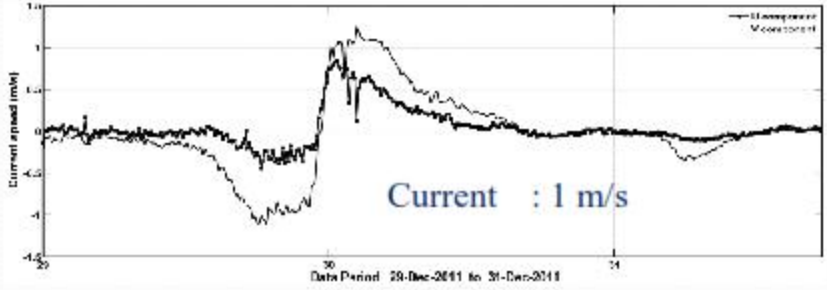


EXTREME EVENTS – THANE CYCLONE







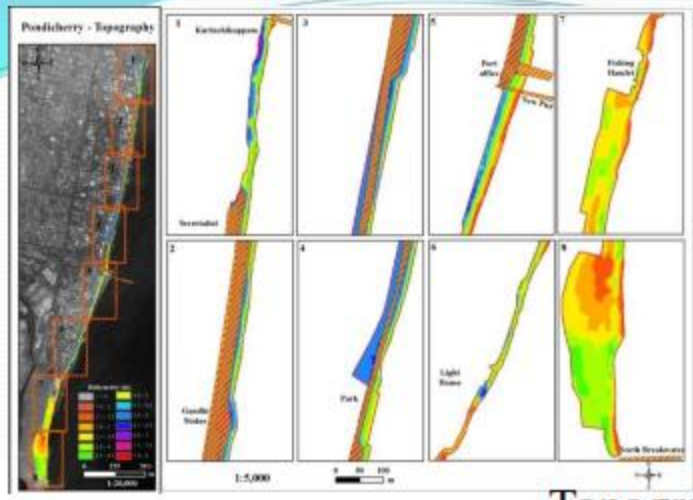


EXTREME EVENTS – NILAM CYCLONE

Pre-Cyclone

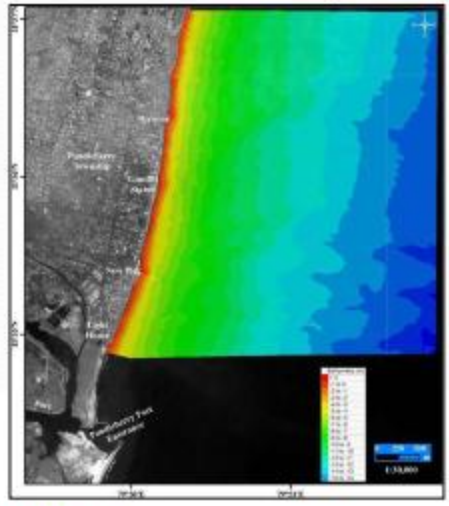
During Cyclone

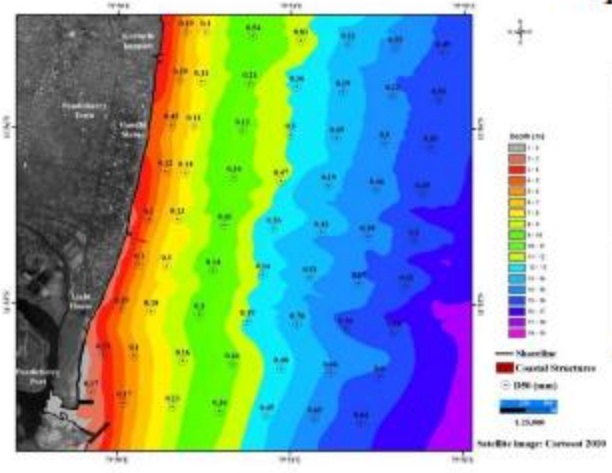
FIELD MEASUREMENTS

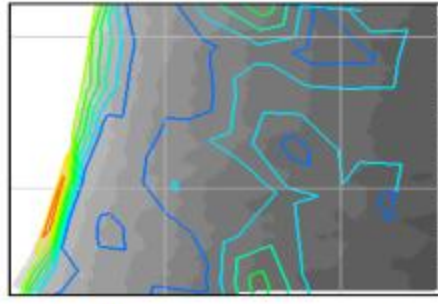


Topography

Bathymetry



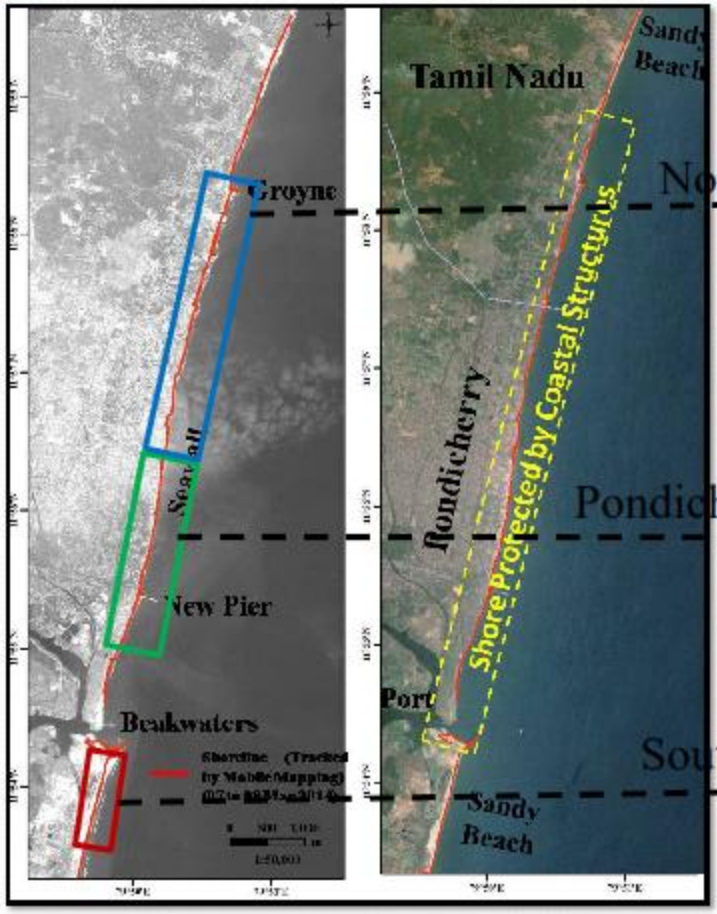




Bathymetry	D50
Above -1.5	Above 1.45
-3 to -1.5	1.3 to 1.45
-4.5 to -3	1.15 to 1.3
-6 to -4.5	1 to 1.15
-7.5 to -6	0.85 to 1
-9 to -7.5	0.7 to 0.85
-10.5 to -9	0.55 to 0.7
-12 to -10.5	0.4 to 0.55
-13.5 to -12	0.25 to 0.4
-15 to -13.5	Below 0.25
-16.5 to -15	
Below -16.5	

Seabed Sediment characteristics

SHORELINE MAPPING & BEACH PROFILE



Northern Pondicherry

Pondicherry ECR / Seawall

South of Harbour

RECOMMENDATIONS BASED ON INITIAL STUDY

- Study completed and report submitted to Pondicherry/Tamil Nadu governments with recommendations for the Coastal Management.

- Eco-friendly techniques and "soft engineering measures" to stabilize the coast could be implemented along with beach nourishment for retaining the sand and to restore the ecological functions and services that are provided by sandy beach ecosystems as well as enhance livelihood opportunities for the fishing communities.

- Initial estimates indicate that sand to the extent of 3.0 million m^3 needs to be placed north of the harbour near to Gandhi statue, which can help in gaining a natural beach and also controlling the erosion.

- The solutions recommended are considered for implementation by Pondicherry Government.

CONSULTATION MEETINGS

Meetings	Date	Coordinated	Conducted at	Remarks
1	19/06/2013	PWD, PORT, PIA	PWD Conference Hall	Beach Nourishment concluded
2	03/07/2013	PIA, PWD,	PIA Conference Hall	Proposed Beach Nourishment with Dredging
3	08/07/2013	Collector	Collector Chamber	Beach Nourishment along with near shore Current Measurements
4	17/07/2013	Field Measurements started (PORT, PIA and PWD)	Two ADV deployed –	To start the Beach Nourishment
5	19/07/2013 to 30/08/2013	Beach Nourishment – PIA	NIOT proposed site	Beach formed on north of the New Pier
6	05/09/2013	MoES secretary & NIOT Director, OSS Group Head, DST, PONDY CAN	New Pier – Pondicherry	Site visit confirmed the Beach Formation

As an initial step beach nourishment with a quantity of 50,000 m^3 Can be carried out to north of port break water during July – August 2013.

DIRECTION OF SEASONAL COASTAL CURRENTS

Coastal Structures (South to North)

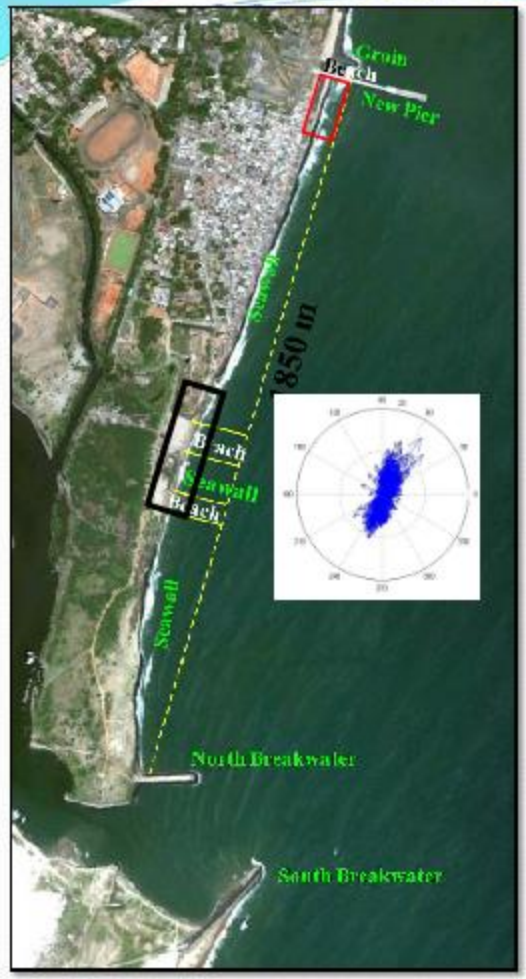
Sno	Coastal Morphology	Length (m)
1	North Breakwater	0
2	Seawall	575
3	Sandy Beach	130
4	Seawall	105
5	Sandy Beach	70
6	Seawall	70
7	Sandy Beach	65
8	Seawall	800
9	Jetty	5
10	Sandy Beach	30
11	Groin	25

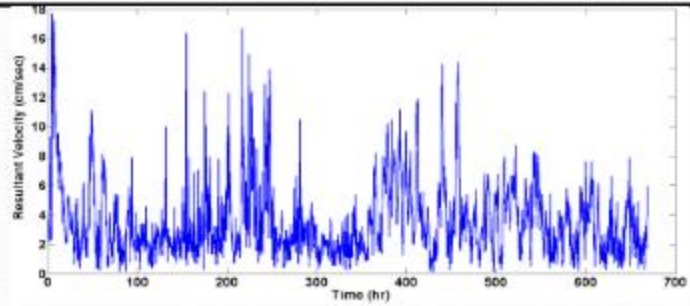
INITIAL BEACH NOURISHMENT

- NIOT proposed nourishment locations are 600m and 900m from the northern breakwater

- Government of Pondicherry proposed to measure the nearshore currents by NIOT, during the beach nourishment period

Outcome of Beach Nourishment

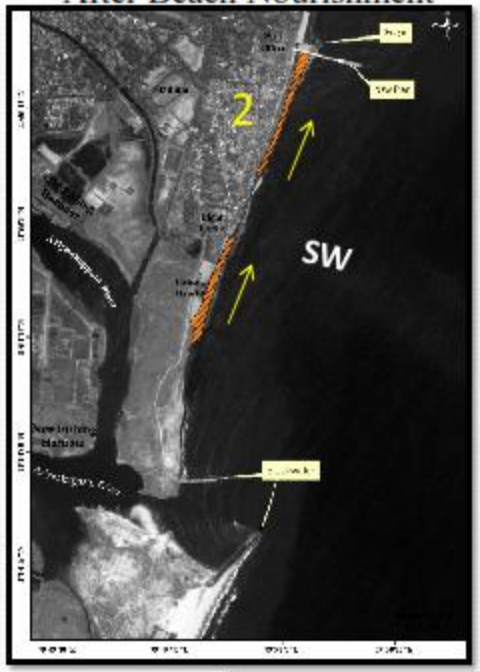




PERFORMANCE OF INITIAL BEACH NOURISHMENT

During Beach Nourishment

After Beach Nourishment

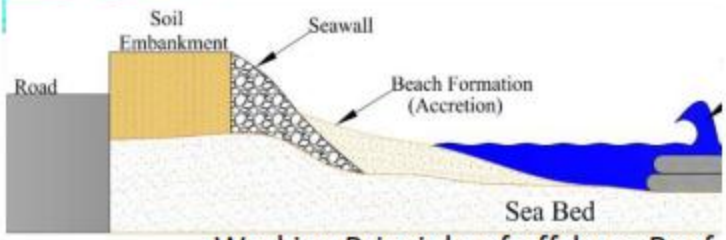


Present Beach Condition

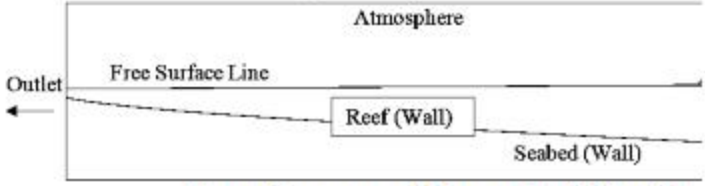
OPTION 1 - BEACH NOURISHMENT

- Nourishment between Groynes using dredged sand from harbour mouth.
- Advantages:
  - Soft solution
  - If erosion continues, it will leave hazards on the beach or in the surf zone.
  - Structures behind beach are protected
- Disadvantages:
  - Repetitive process.
  - Increase siltation at harbour mouth during NE Monsoon

Option 2 - Artificial Offshore Reef



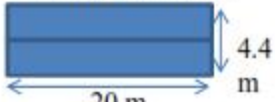
Working Principle of offshore Reef



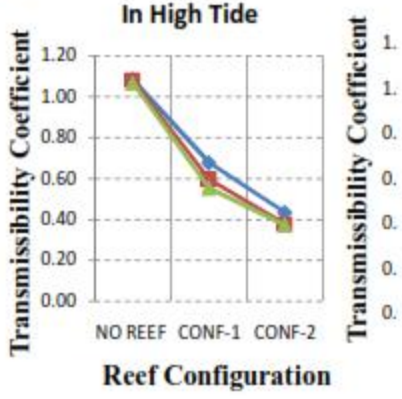
Line Diagram of Numerical Model

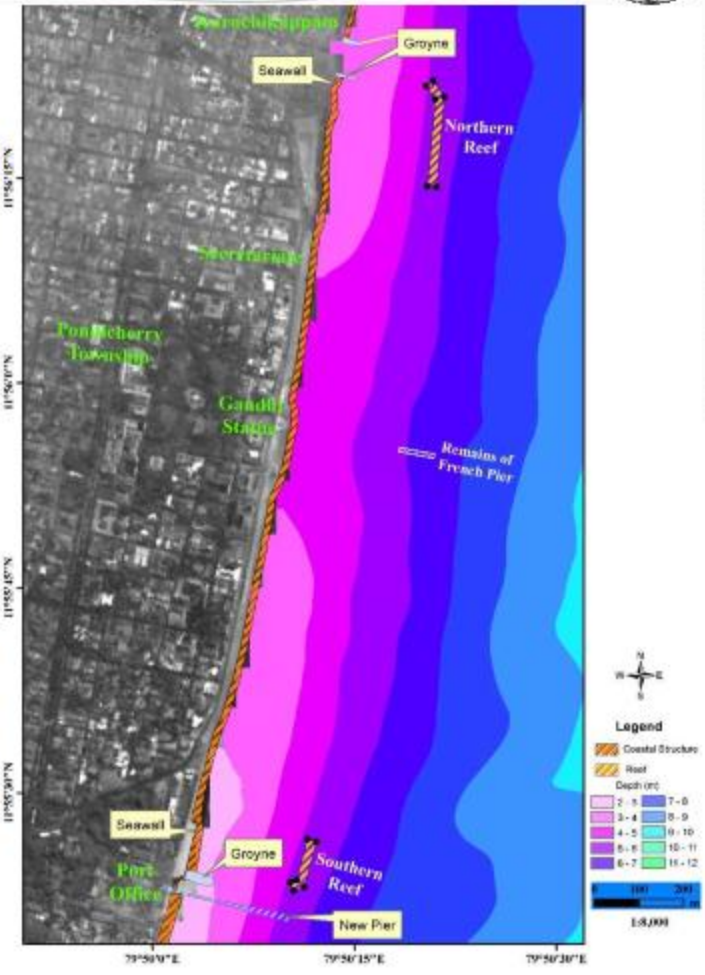
Configuration-1

Configuration-2

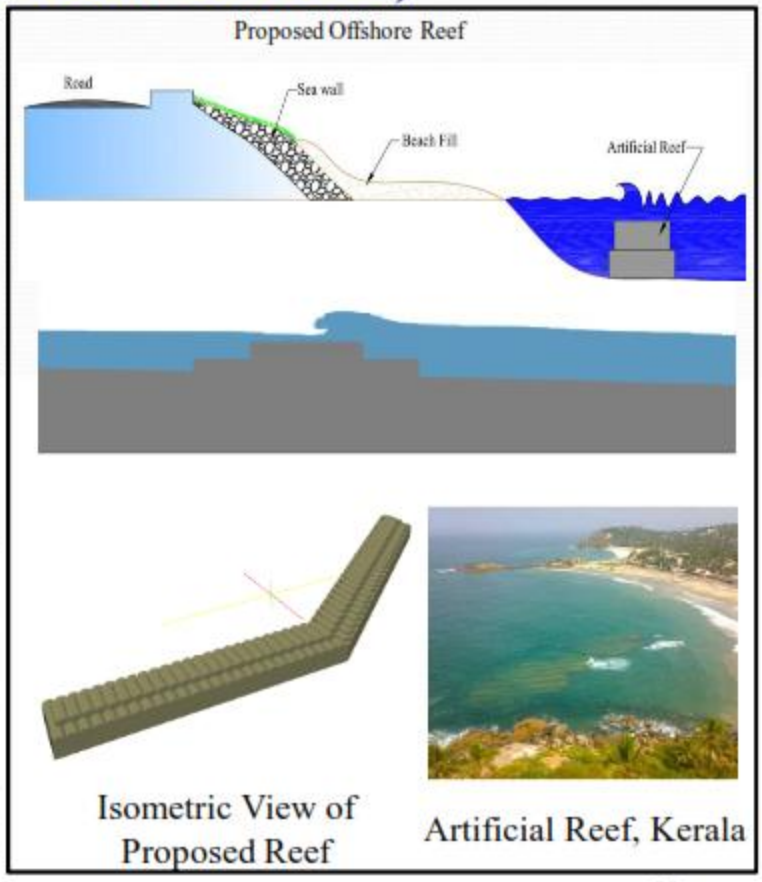


reef_animation.wmv





OPTION 3 - HYBRID SOLUTION
(REEF + BEACH NOURISHMENT)



Isometric View of Proposed Reef

Artificial Reef, Kerala

CONCLUSIONS

- Soft solution of offshore reef with Beach Nourishment proposed.
  - To restore natural beach
  - To allow free flow of sediment along the coast
  - To enhance the life of the nourishment project
  - To protect the coast from the storms

- The Dredge spoil was identified inside the harbour, which has minimum effect on the sediment budget

- Sediment size for nourishment was selected to match with the existing sediment size to increase longevity of the project

Thanks for kind attention