



In partnership with



Wave induced coastal flooding in the Indian coastal regions during Kallakadal events

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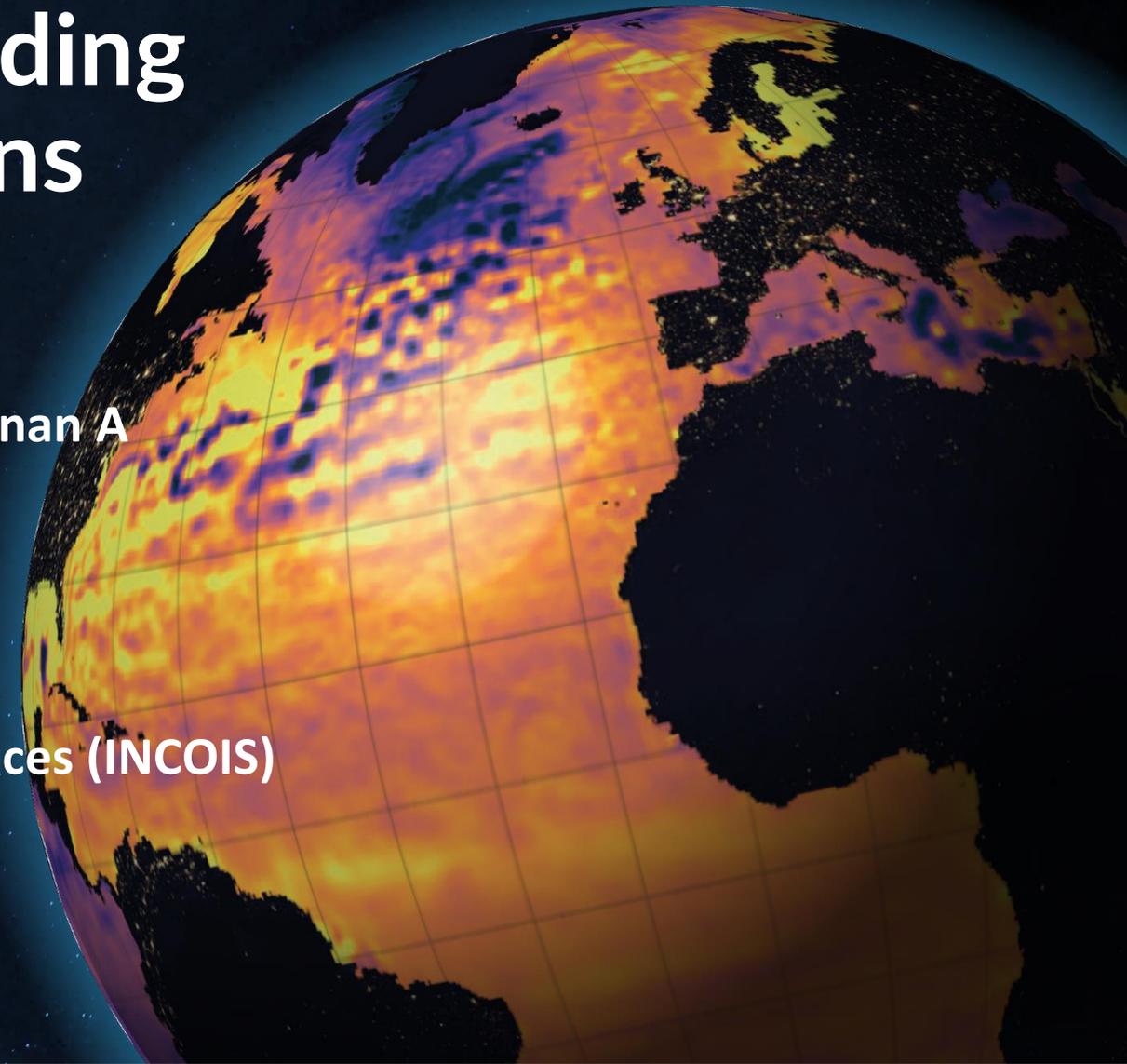
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Ministry of Earth Science, Govt. India

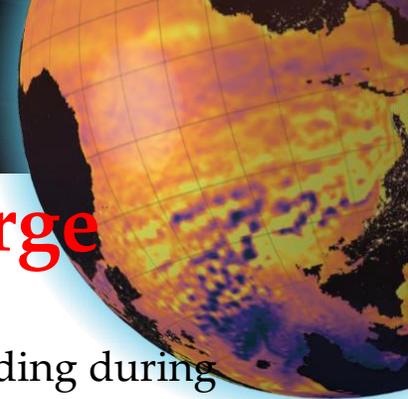
Hyderabad, India





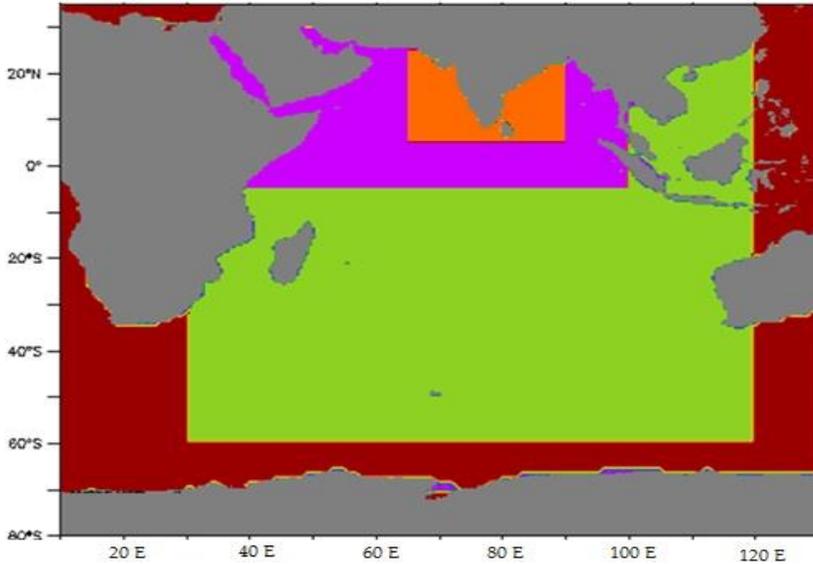
Outline of the Talk

- Introduction-Kallakadal/Swell surge Events
- Mechanisms of Long Period Swell Generation in the Southern Indian Ocean
- Causative mechanism of Coastal Flooding during Kallakadal Events
- Conclusions



Wave induced Flash flooding events - Kallakadal/Swell surge

WAVEWATCHIII Multi-Grid setup at INCOIS

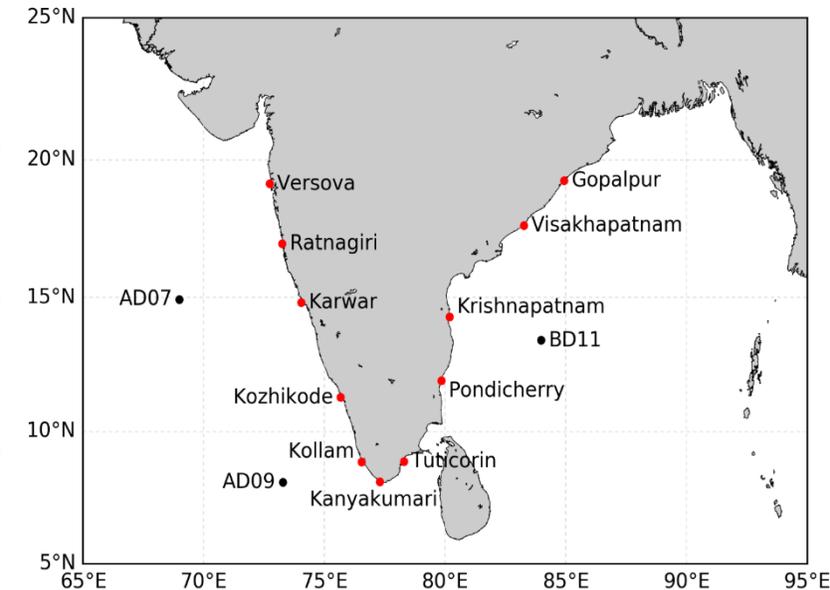
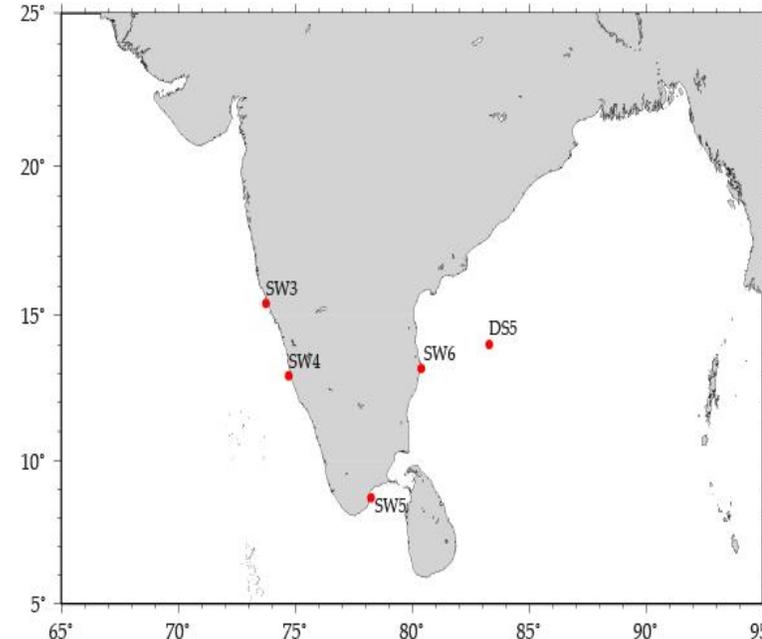


- Version-6.07
- Source term-ST4
- Etopo1
- Spatial resolution
 - 1 deg Southern Hemisphere grid
 - 0.5 deg Indian Ocean grid
 - 0.25 deg North Indian Ocean grid
 - 0.04 deg Coastal grid
- Spectral resolution
 - 29 frequencies and 36 directions

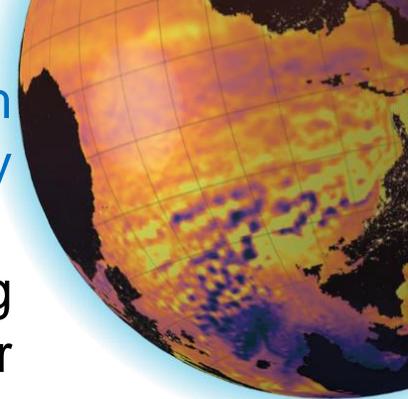
➤ Kurian et al., [2009] has reported a special case of coastal flooding during pre-monsoon (April-May) season by the long period (~15 s) swell waves on the southwest coast of India, named as *Kallakkadal (Sea Thief)*.

Kallan-Thief; Kadal-Sea (local language of Kerala, India – Malayalam)

➤ Kallakkadal is a flash flooding event without any precursors or any kind of local wind activity to give advance warning to the coastal population.



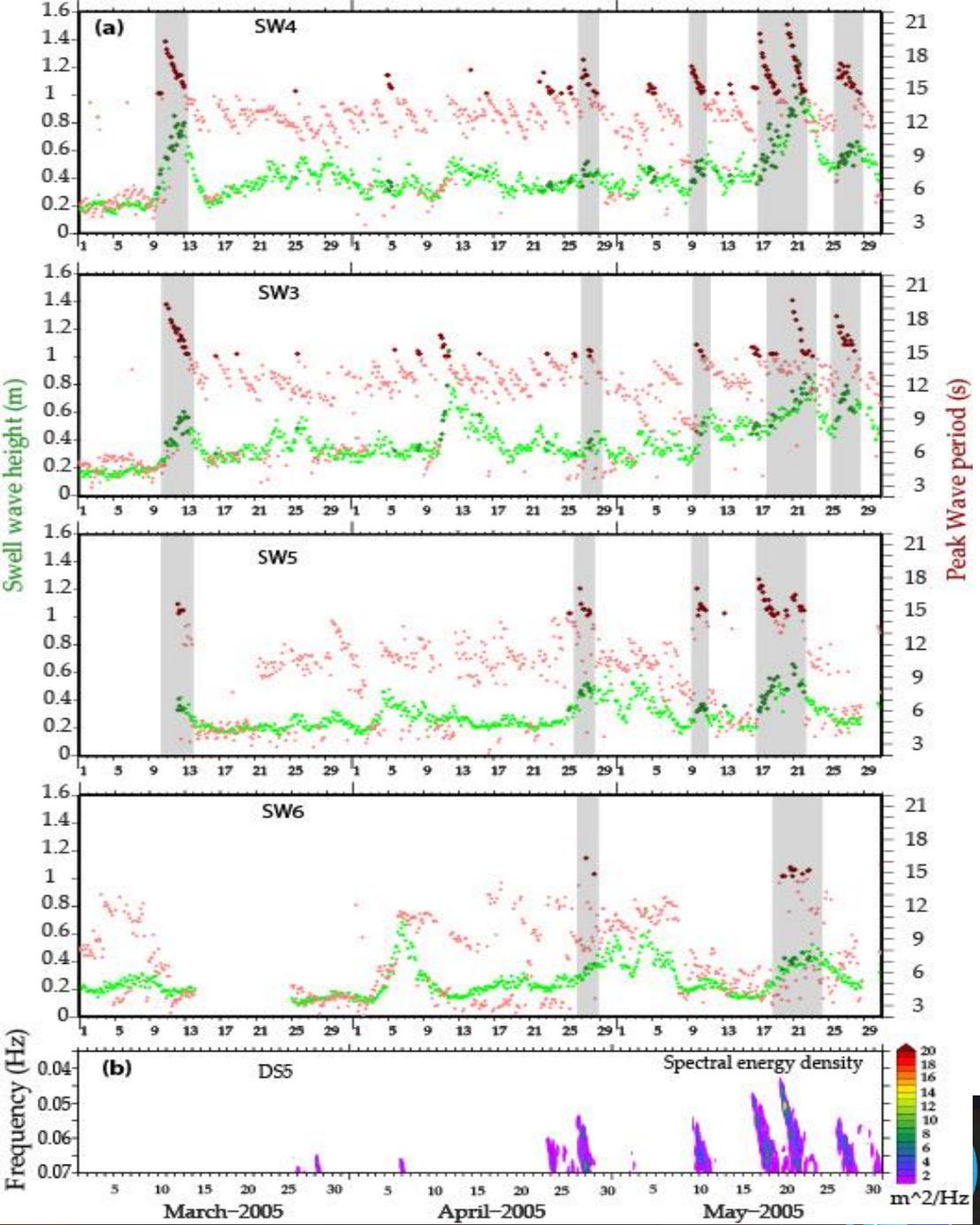
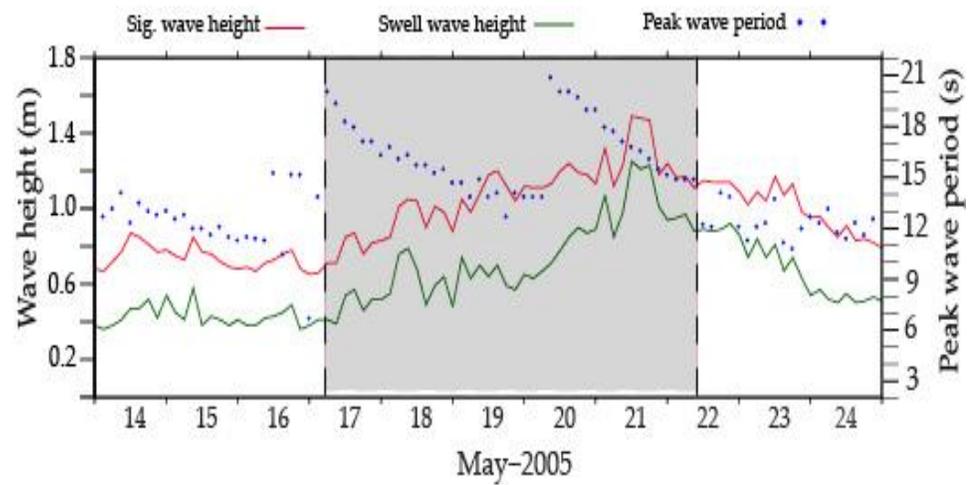
In-situ observations used for the study



The shaded portion shows major high period swell occurrence (March-May 2005)

Long period swells (>14s) that are having a moderate height (>0.4m) and lasting for at least a half day (>12 hours)

Wave parameters during the strong swell event (17-21 May), off Mangalore.



Analysis of meteorological condition in the southern Indian Ocean

Cut-off low systems during 12-14 May 2005

JGR Oceans

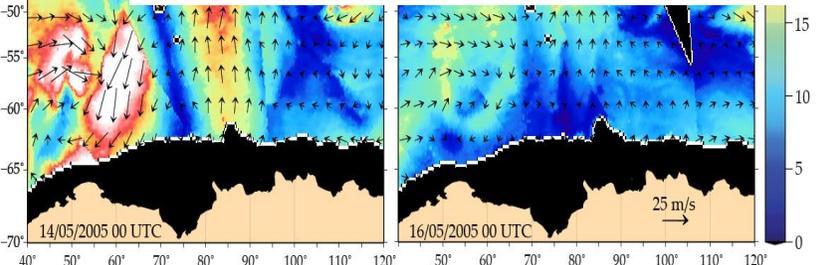
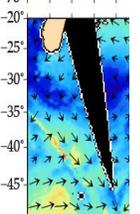
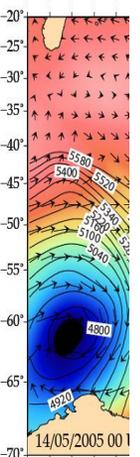
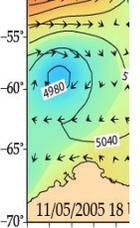
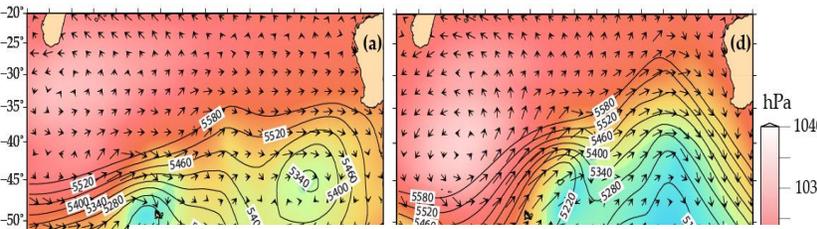
Research Article |  Free Access

Teleconnection between the North Indian Ocean high swell events and meteorological conditions over the Southern Indian Ocean

P. G. Remya , S. Vishnu, B. Praveen Kumar, T. M. Balakrishnan Nair, B. Rohith

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generation of waves, and they travel to NIO as swells.



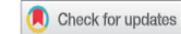
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Indian Ocean wave forecasting system for wind waves: development and its validation

P. G. Remya , T. Rabi Ranjan, P. Sirisha, R. Harikumar  and T. M. Balakrishnan Nair

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Implementation of altimeter data assimilation on a regional wave forecasting system and its impact on wave and swell surge forecast in the Indian Ocean

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T.M. Balakrishnan Nair ^d, Raj Kumar ^{e f}, Arun Chakraborty ^g



Causative mechanism of Coastal Flooding

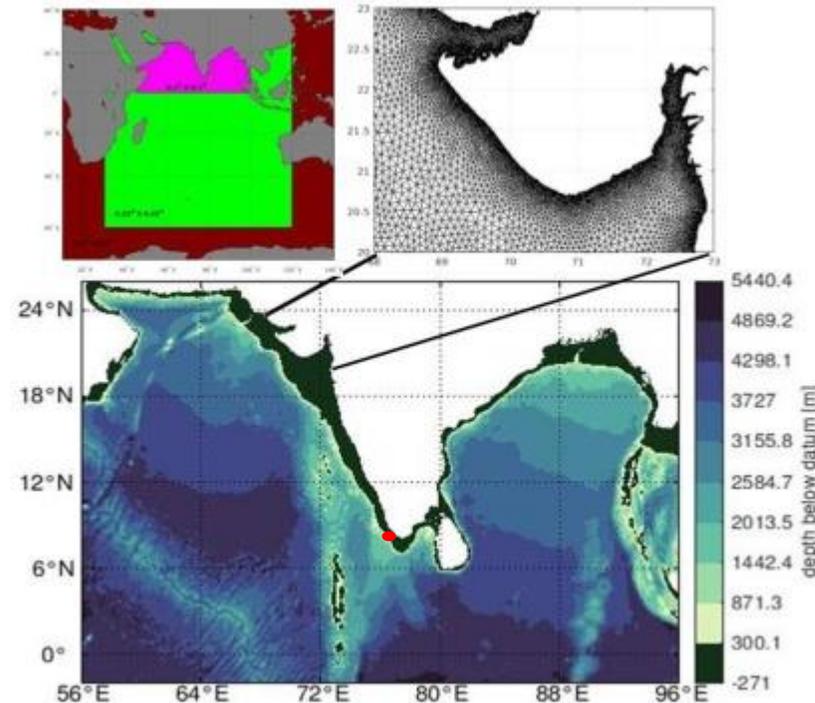
- A combination of WAVEWATCHIII and XBeach to study the coastal inundation during high waves.
- The bathymetry data is a blend of in-situ data (hydrographic charts, surveyed data from ships) for coastal regions and the General Bathymetric Chart of Ocean (GEBCO) data of 30 m spatial resolution towards the offshore.

➤ Case 1-April 21-24 ,2018

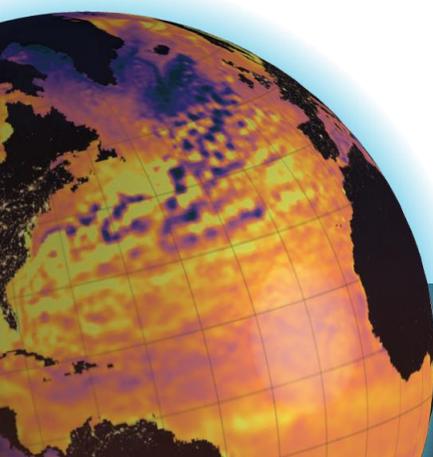
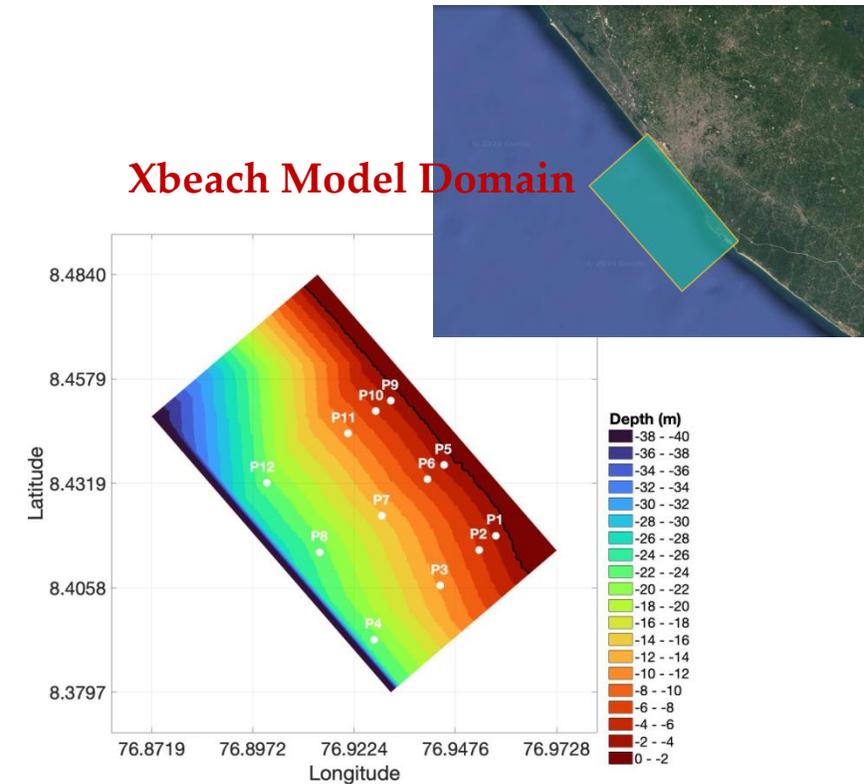
➤ Case 2-March 30-April 2,2024

➤ Case 3- May 3-May 7, 2024

WAVEWATCHIII Model Domain

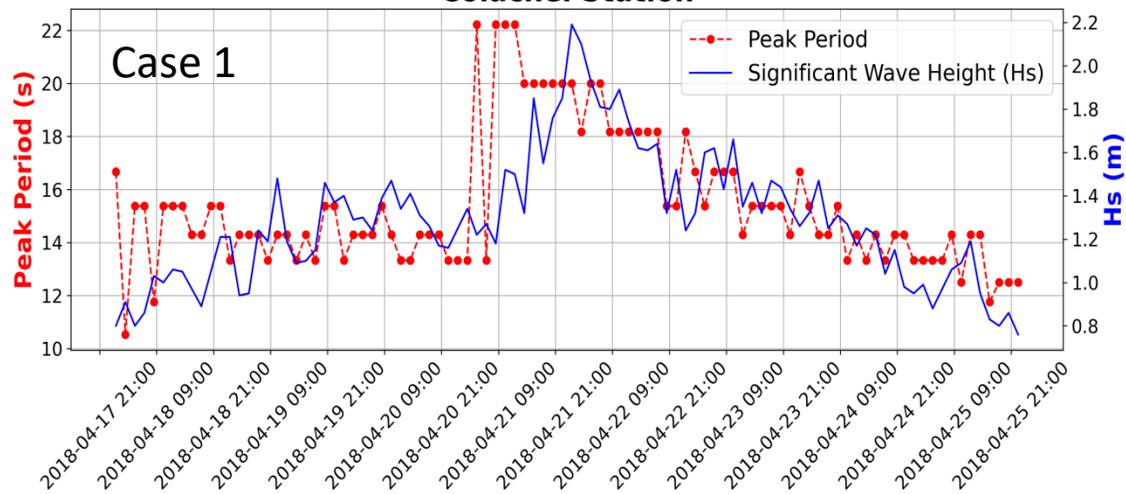


Xbeach Model Domain

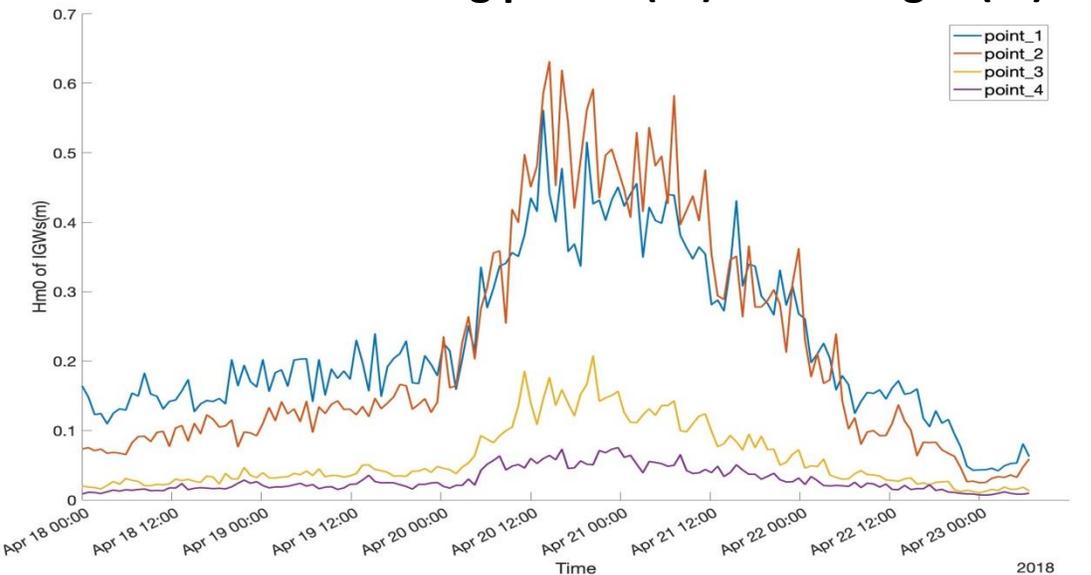


Observed short waves

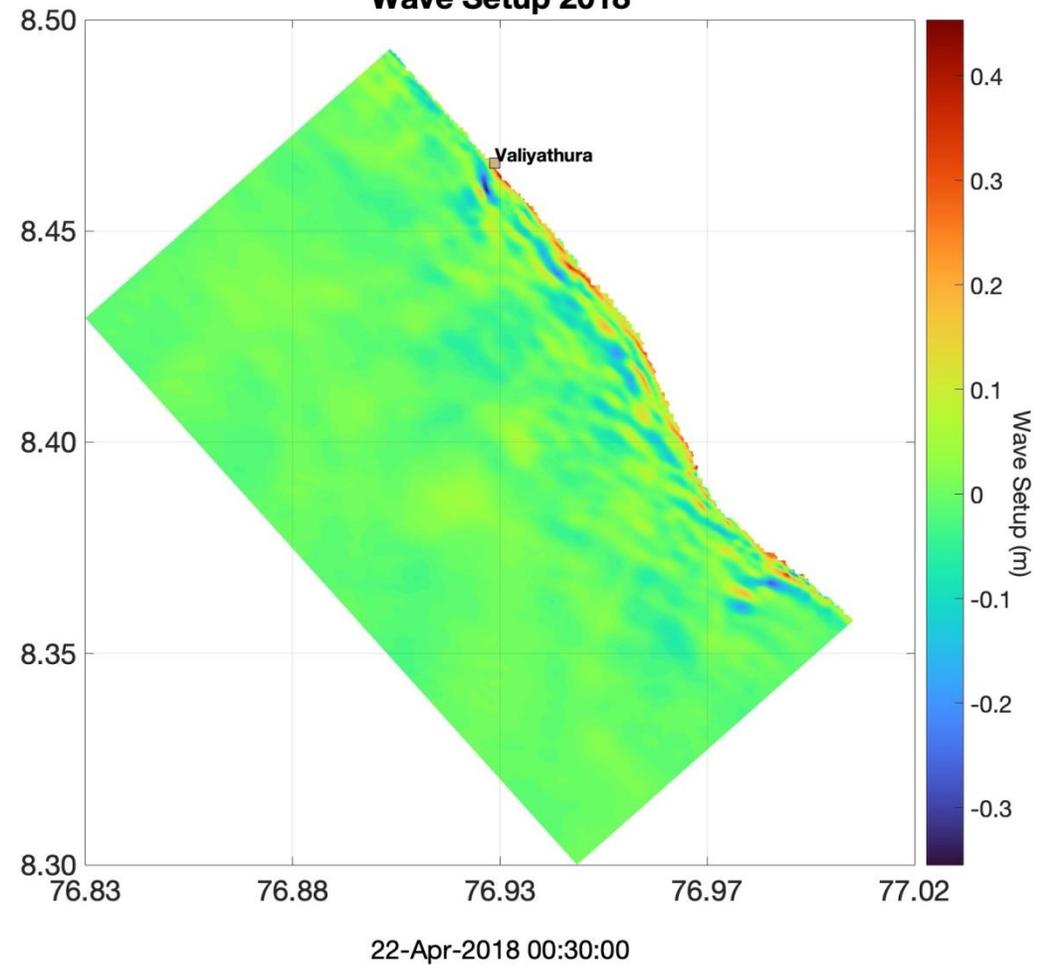
Colachel Station



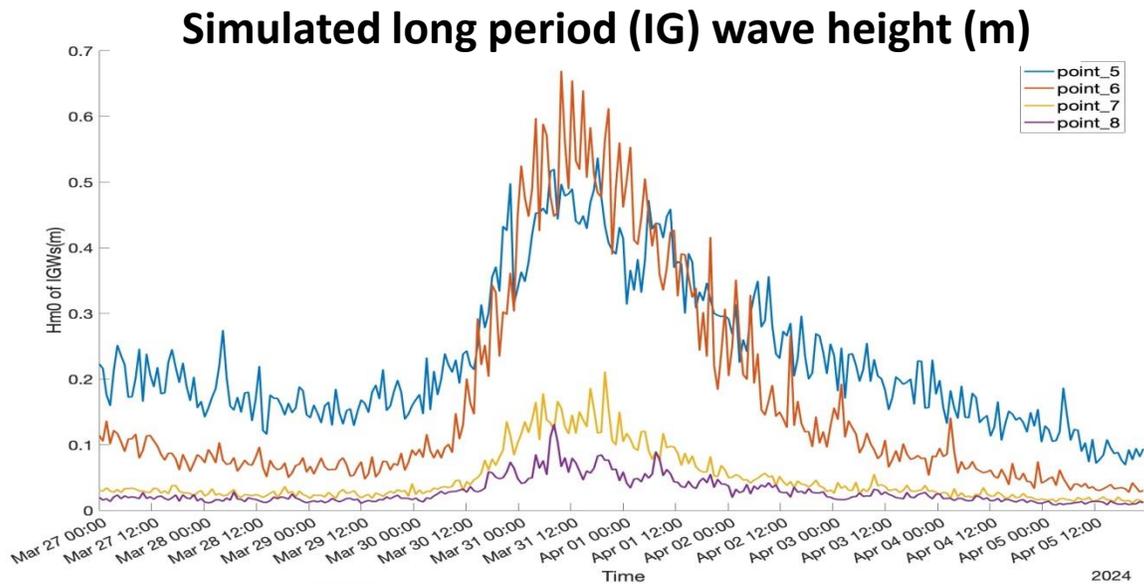
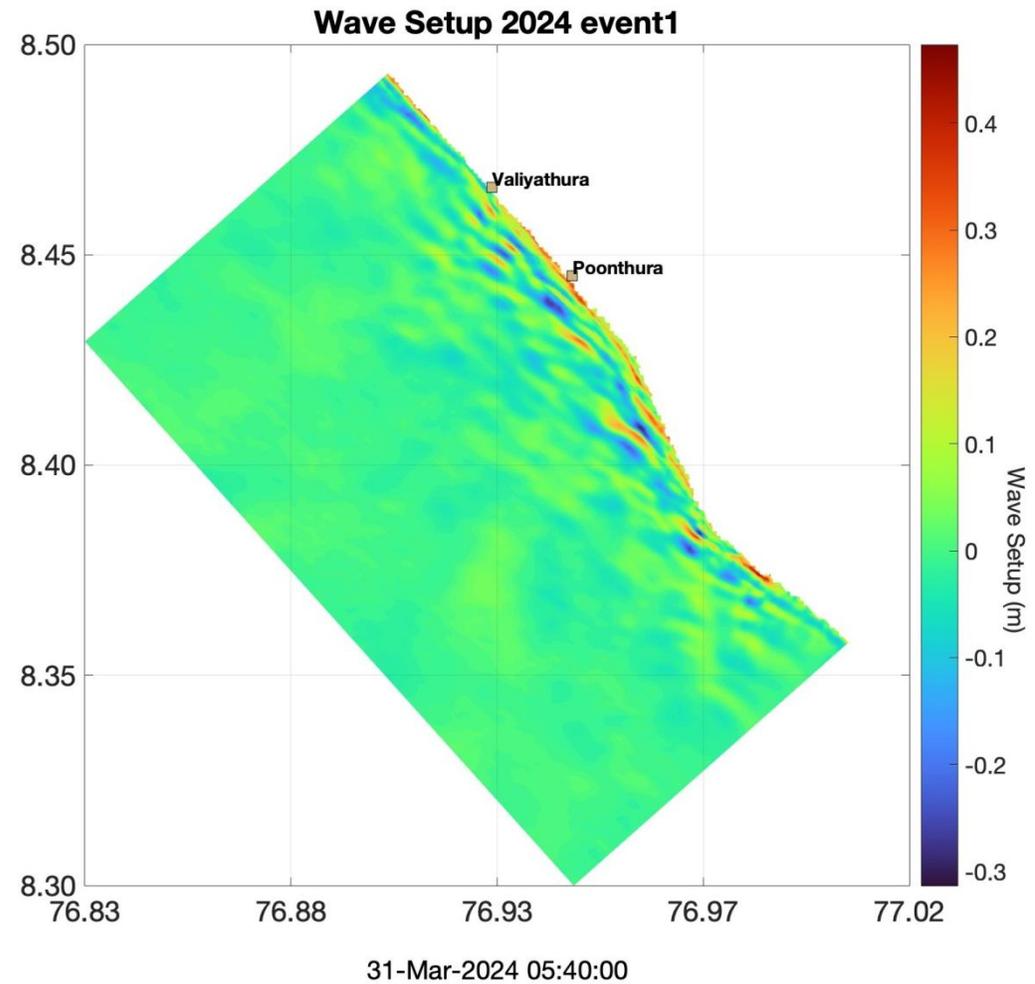
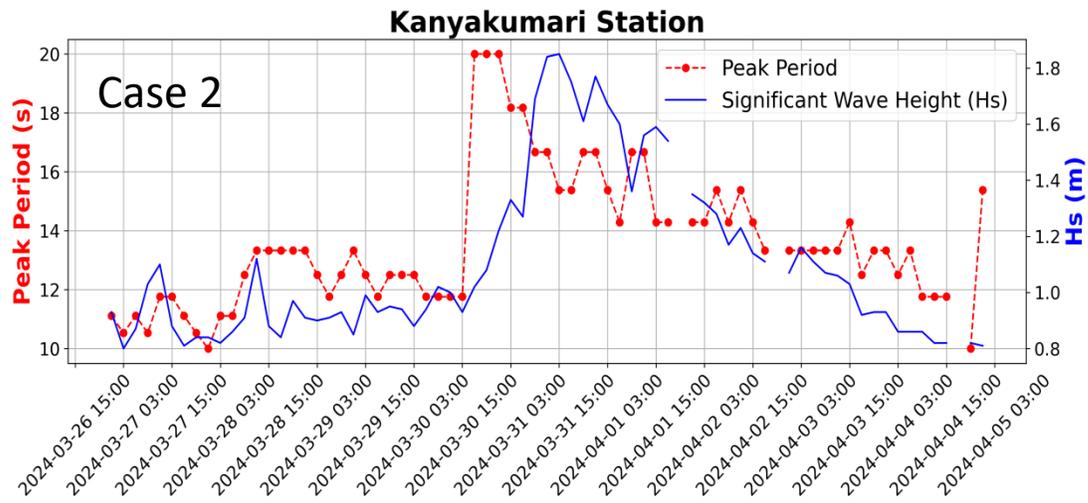
Simulated long period (IG) wave height (m)



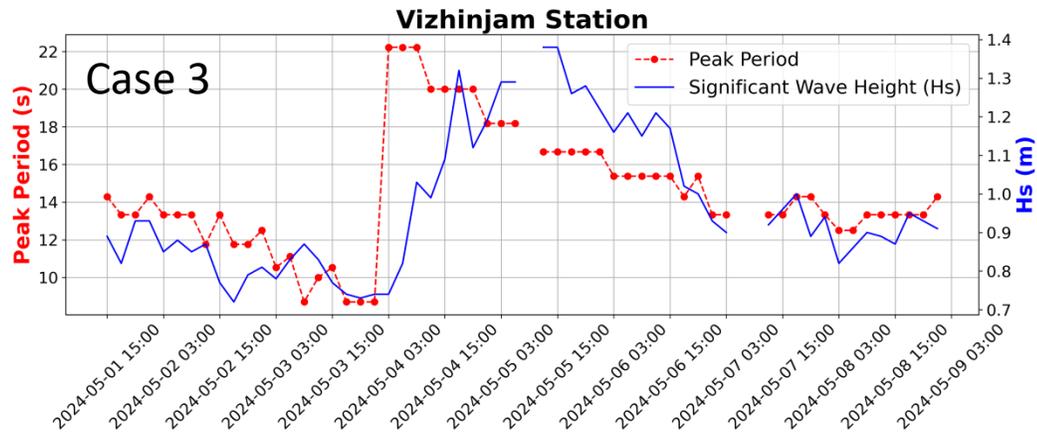
Wave Setup 2018



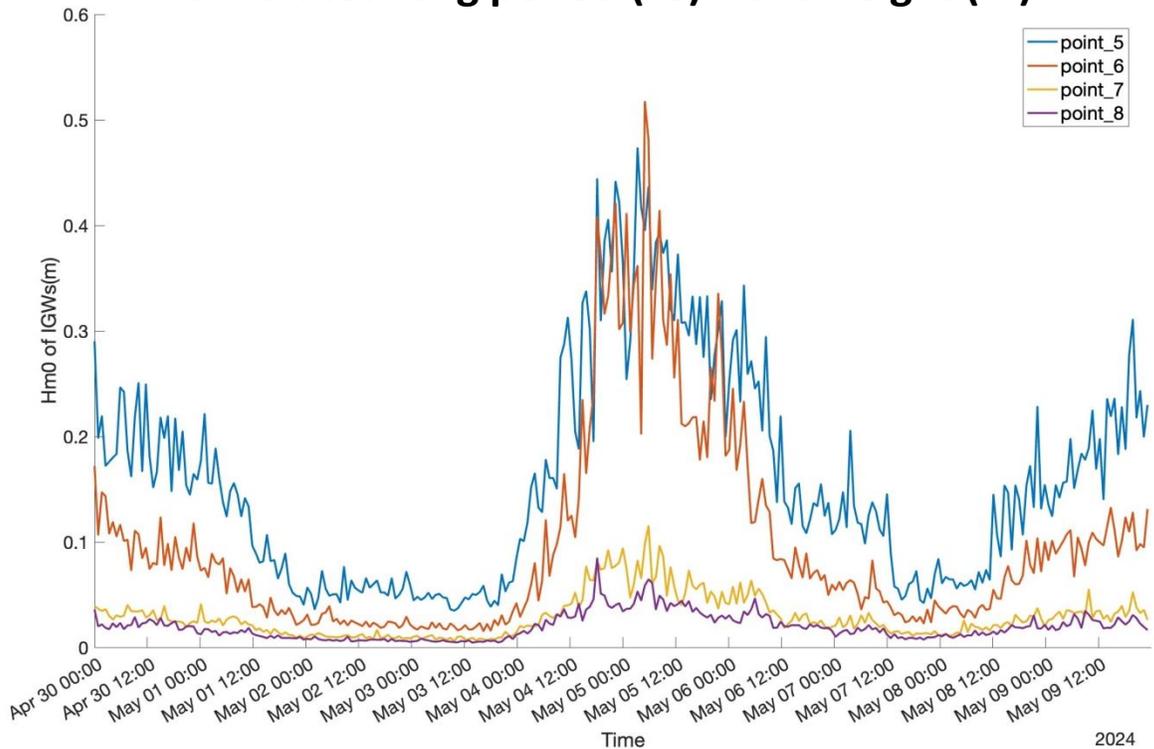
Observed short waves



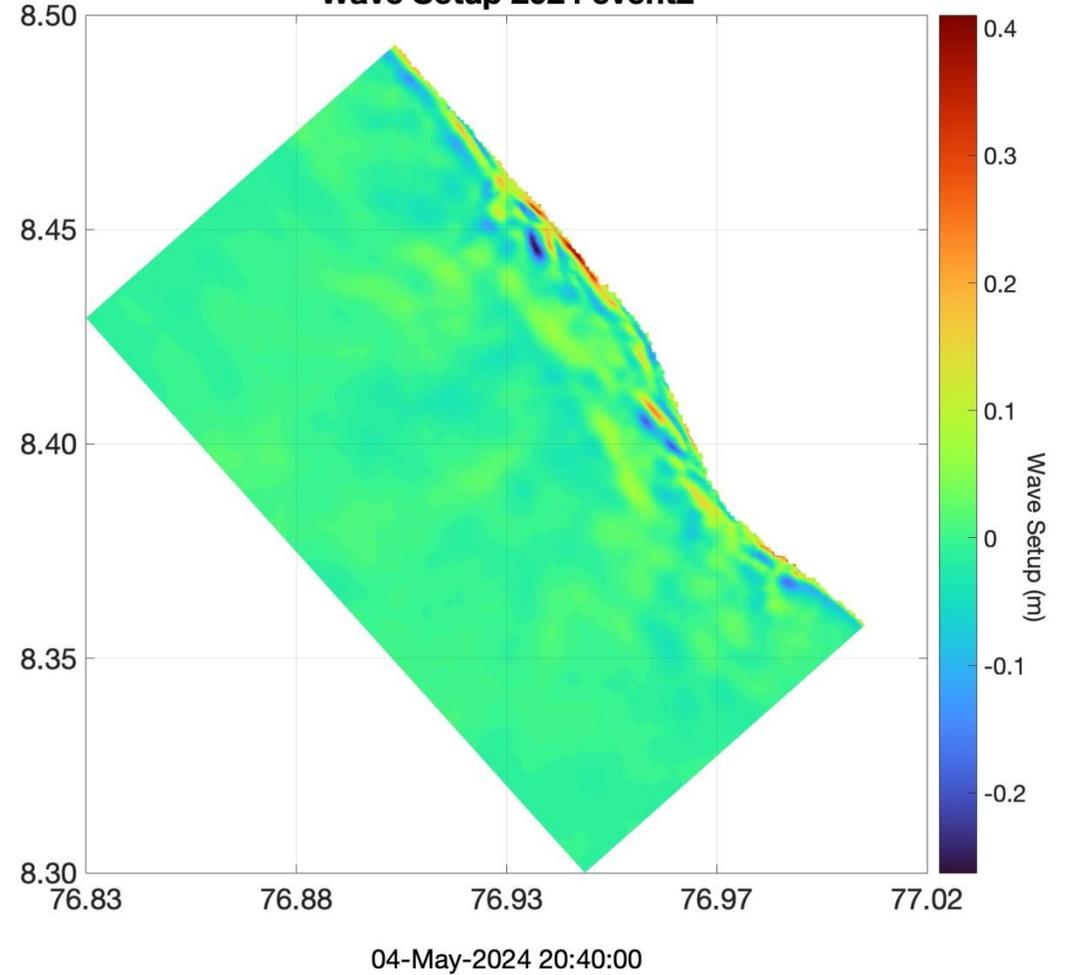
Observed short waves



Simulated long period (IG) wave height (m)

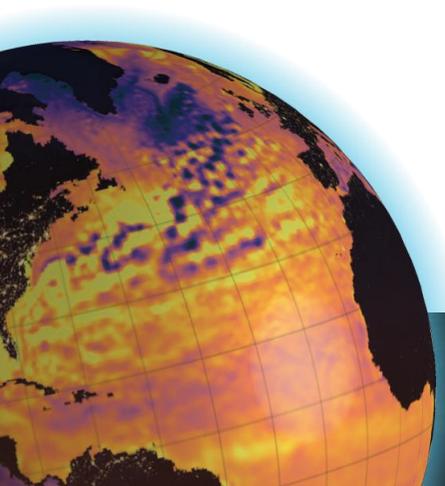


Wave Setup 2024 event2



Conclusions

- The COLs are quasi-stationary in nature, providing strong (~25 m/s) and long duration (~3 days) winds and a large fetch; essential conditions for the generation of swells.
- The intense winds associated with COLs in the Southern Ocean trigger the generation of waves, and they travel to NIO as swells
- The effect of low-frequency (IG) waves and rise in the coastal water level due to wave setup plays major roles in the inundation during Kallakadal events.





SYMPOSIUM OP'24

ADVANCING OCEAN PREDICTION
SCIENCE FOR SOCIETAL BENEFITS

Thank you!

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