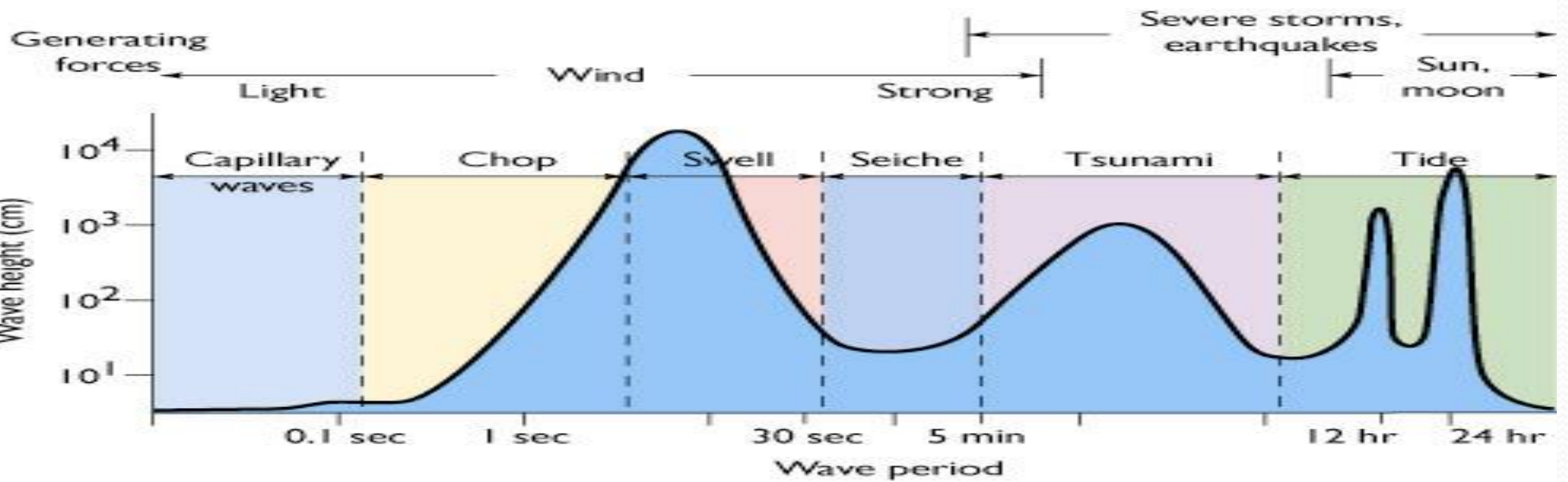
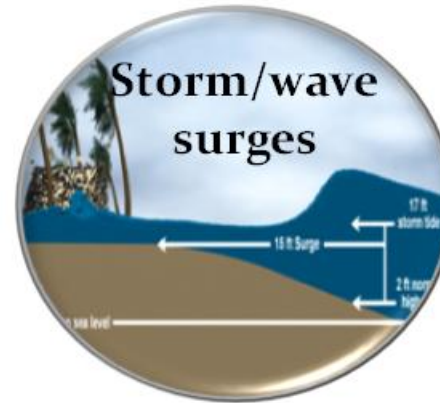


Development and Implementation of Integrated Ocean Forecast & Early Warning System and customized products for RIMES Member countries

Dr. Balakrishnan Nair. T. M
Scientist and Head
Indian National Center for Ocean Information Services (INCOIS)
Ministry of Earth Sciences, Government of India
bala@incois.gov.in

Oceanogenic Hazards



INCOIS Sanctioned Projects to RIMES

- 1) Development and Implementation of an Integrated Ocean Information System for the Indian Ocean Countries
- 2) Implementation of prioritized technical capacity development projects in RIMES for Afro Asian Region

Progress in implementation of the project

- Operationalised Ocean forecast System for Maldives, Seychelles and Sri Lanka
- Procurement of wave rider buoy & spares were completed .
- Completed validation and refinement of Ocean forecast system by deploying a wave rider buoy off Seychelles on 16.03.2016.
- Automated WRB Data sharing, Alerts & Forecast dissemination mechanisms activated .
- Spares for future maintenance activities transported to SNMS .
- National focal points were identified in Srilanka & Maldives.
- Identified locations for Wave rider buoy deployment in Srilanka.
- Responsibility of the organizations identified for buoy deployment maintenance at Seychelles.
- Development of forecast system for Comoros, Mozambique, Mauritius and Madagascar is completed and ready for operationalization.

Ocean State Forecast system for RIMES countries



Integrated Ocean Information and Forecast System

Sri Lanka



Integrated Ocean Information and Forecast System

SEYCHELLES



Home

Forecast Products

- Significant Wave Height
- Wave period
- Swell Height
- Swell period
- Wind
- Sea Surface Temperature
- Mixed Layer Depth
- D20
- Surface Currents
- Location Specific
- High Wave Alert
- OIL SPILL ADVISORY



Ocean State Forecast system for Sri Lanka and Seychelles in collaboration with RIMES, inaugurated on 10th July 2015

Ocean State Forecast

Location : **gaafu_dhaalu**

FROM SHORE 10 KM

Date	Time	Wave Height	Wave Direction	Wind Speed	Wind Direction
21-AUG-2017	06:30	9	SW	7	SE
21-AUG-2017	11:30	9	SE	8	SE
21-AUG-2017	17:30	9	SE	8	SE
21-AUG-2017	23:30	8	SE	14	SE
22-AUG-2017	06:30	8	SE	8	SE
22-AUG-2017	11:30	8	SE	11	SE
22-AUG-2017	17:30	8	NE	6	SE
22-AUG-2017	23:30	8	NE	6	SE
23-AUG-2017	06:30	8	NE	7	SE
23-AUG-2017	11:30	8	NE	9	SE
23-AUG-2017	17:30	7	NE	10	SE
23-AUG-2017	23:30	7	NE	10	SE

* Wave Height in Feet

* Wind Speed in Km/hr



Ocean State Forecast

Location : **kaafu**

FROM SHORE 10 KM

Date	Time	Wave Height	Wave Direction	Wind Speed	Wind Direction
21-AUG-2017	06:30	8	SW	18	SE
21-AUG-2017	11:30	8	SW	13	SE
21-AUG-2017	17:30	8	NW	17	SE
21-AUG-2017	23:30	8	SW	13	SE
22-AUG-2017	06:30	8	SW	13	SE
22-AUG-2017	11:30	8	NW	13	SE
22-AUG-2017	17:30	8	NW	12	SE
22-AUG-2017	23:30	7	NW	8	SE
23-AUG-2017	06:30	7	NW	16	SE
23-AUG-2017	11:30	7	NW	14	SE
23-AUG-2017	17:30	7	NW	20	SE
23-AUG-2017	23:30	7	NW	11	SE

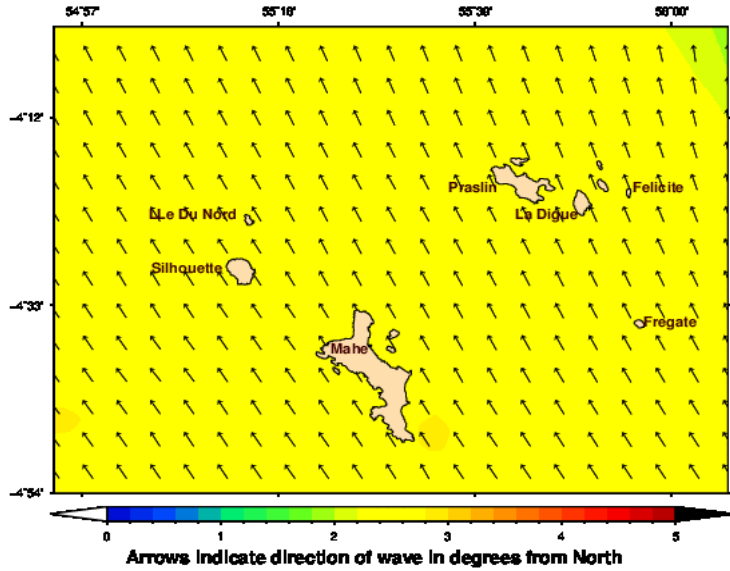
* Wave Height in Feet

* Wind Speed in Km/hr

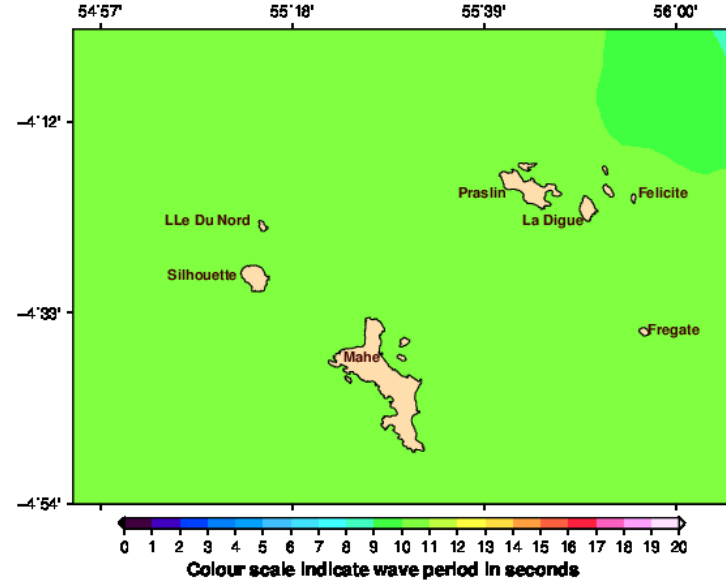


SEYCHELLES

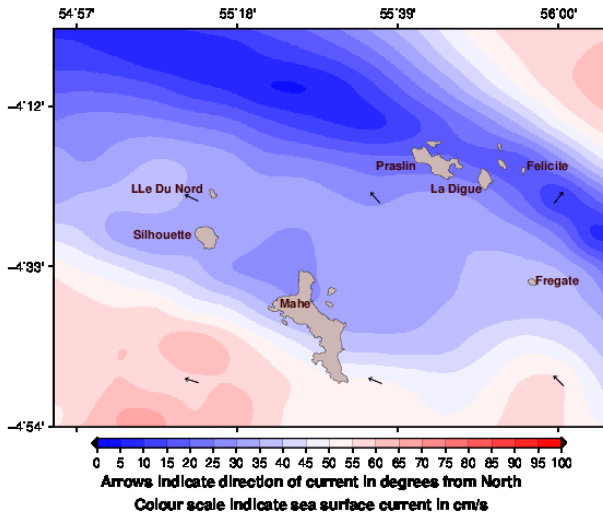
[Seychelles Island]
Significant Wave Height (m) and Direction (°)
Forecast for 01:00 SCT 21 Aug 2017



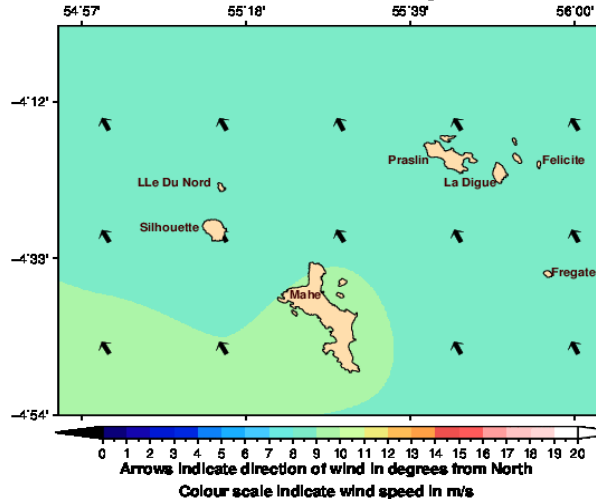
[Seychelles Island]
Swell Wave Period (s)
Forecast for 01:00 SCT 21 Aug 2017



[Seychelles Island]
Sea Surface Current (cm/s) and Direction (°)
Forecast for 01:00 SCT 21 Aug 2017



[Seychelles Island]
Wind Speed (m/s) and Direction (°)
Forecast for 04:00 SCT 21 Aug 2017



Air Strip(10km) Fishing harbour – Seychelles
 48 hr Sea State Forecast, Issued on: Sunday 20 August 2017



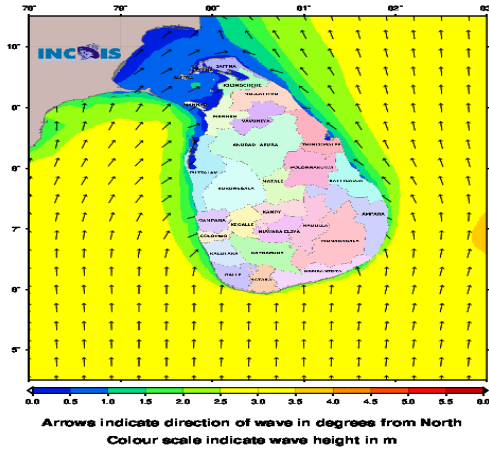
Date	Monday 21-08-2017								Tuesday 22-08-2017							
	01:00 AM	04:00 AM	07:00 AM	10:00 AM	13:00 PM	16:00 PM	19:00 PM	22:00 PM	01:00 AM	04:00 AM	07:00 AM	10:00 AM	13:00 PM	16:00 PM	19:00 PM	22:00 PM
Time (IST)	01:00 AM	04:00 AM	07:00 AM	10:00 AM	13:00 PM	16:00 PM	19:00 PM	22:00 PM	01:00 AM	04:00 AM	07:00 AM	10:00 AM	13:00 PM	16:00 PM	19:00 PM	22:00 PM
Significant Wave Height (m) & direction	2.6 NNW	2.5 NNW	2.4 NNW	2.3 NNW	2.1 NNW	2.1 NNW	2.0 NNW	2.1 NNW	2.1 NNW	2.1 NNW	2.1 NNW	2.1 NNW	2.1 NNW	2.1 NNW	2.1 NNW	2.1 NNW
Wave Period(s)	6	6	6	6	7	7	7	7	7	7	6	6	7	7	7	7
Significant Wave Height (m)																
Wind Speed(kmph) & direction	30 NNW	28 NNW	26 NNW	25 NNW	22 NNW	22 NNW	21 NNW	22 NNW	24 NNW	21 NNW	21 NNW	21 NNW	21 NNW	21 NNW	21 NNW	21 NNW
Swell Height (m) & direction	2.1 NNW	2.1 NNW	2.0 NNW	1.9 NNW	1.8 NNW	1.8 NNW	1.8 NNW	1.8 NNW	1.8 NNW	1.8 NNW	1.8 NNW	1.8 NNW	1.8 NNW	1.8 NNW	1.8 NNW	1.8 NNW
Time (IST)	04:00 AM	10:00 AM	16:00 PM	22:00 PM	04:00 AM	10:00 AM	16:00 PM	22:00 PM	04:00 AM	10:00 AM	16:00 PM	22:00 PM	04:00 AM	10:00 AM	16:00 PM	22:00 PM
Current (cm/s) & direction	22 SE	11 SE	6 SE	5 ESE	5 ESE	15 E	26 SW	22 NNW	11 SE	6 SE	5 ESE	5 ESE	15 E	26 SW	22 NNW	11 SE



Disclaimer: The forecast products and the conclusions drawn thereof are mainly based on different mathematical models being run at INCOIS.

SRILANKA

[Sri Lanka]
Forecast for 02.30 SLST 21 Aug 2017
Significant Wave Height (m) and Direction (°)

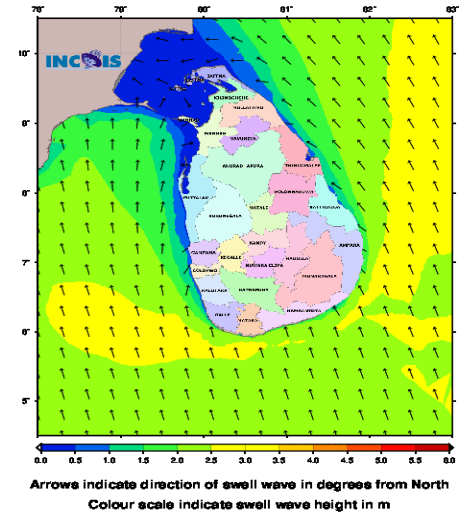


Chilaw(10km) Fishing harbour - Sri Lanka
48 hr Sea State Forecast, Issued on: Sunday 20 August 2017

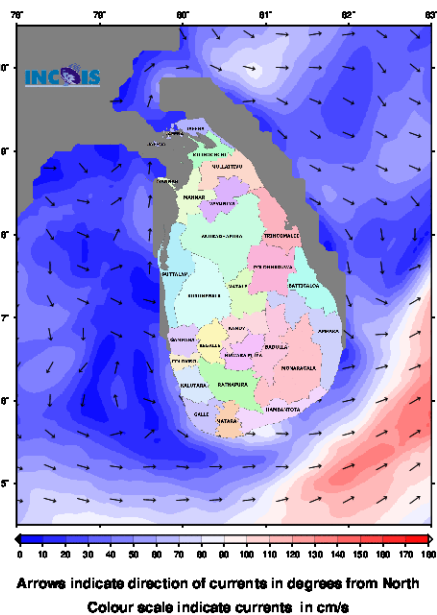
Date	Monday 21-08-2017								Tuesday 22-08-2017							
Time (SLST)	02.30 AM	05.30 AM	08.30 AM	11.30 AM	02.30 PM	05.30 PM	08.30 PM	11.30 PM	02.30 AM	05.30 AM	08.30 AM	11.30 AM	02.30 PM	05.30 PM	08.30 PM	11.30 PM
Significant Wave Height (m) & direction	1.5	1.5	1.7	1.7	1.7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Wave Period(s)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Significant Wave Height (m)	[Graph showing wave height over time]															
Wind Speed(kmph) & direction	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Swell Height (m) & direction	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Time (SLST)	02.30 AM	11.30 AM	05.30 PM	11.30 PM	02.30 AM	11.30 AM	05.30 PM	11.30 PM								
Current (cm/s) & direction	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15

Disclaimer: The forecast products and the conclusions drawn thereon are mainly based on different mathematical models being run at INCOIS.

[Sri Lanka]
Forecast for 02.30 SLST 21 Aug 2017
Swell Wave Height (m) and Direction (°)



[Sri Lanka]
Forecast for 02.30 SLST 21 Aug 2017
Currents Speed (cm/s) and Direction (°)

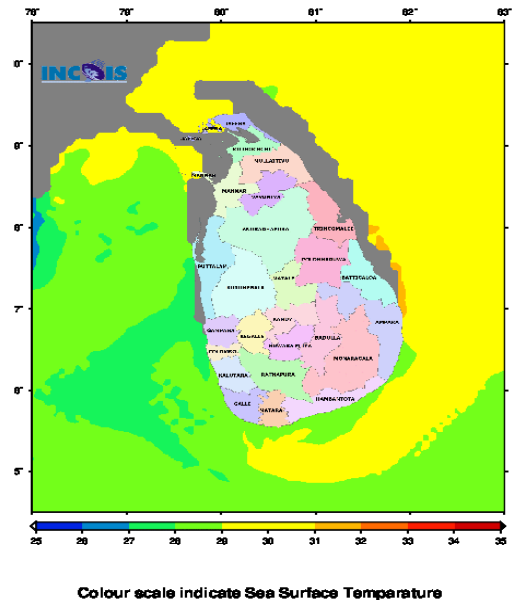


Dikkovita(20km) Fishing harbour - Sri Lanka
48 hr Sea State Forecast, Issued on: Sunday 20 August 2017

Date	Monday 21-08-2017								Tuesday 22-08-2017							
Time (SLST)	02.30 AM	05.30 AM	08.30 AM	11.30 AM	02.30 PM	05.30 PM	08.30 PM	11.30 PM	02.30 AM	05.30 AM	08.30 AM	11.30 AM	02.30 PM	05.30 PM	08.30 PM	11.30 PM
Significant Wave Height (m) & direction	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Wave Period(s)	5	6	5	5	5	5	6	5	5	5	5	5	5	6	5	5
Significant Wave Height (m)	[Graph showing wave height over time]															
Wind Speed(kmph) & direction	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Swell Height (m) & direction	1.2	1.2	1.3	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Time (SLST)	02.30 AM	11.30 AM	05.30 PM	11.30 PM	02.30 AM	11.30 AM	05.30 PM	11.30 PM								
Current (cm/s) & direction	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Disclaimer: The forecast products and the conclusions drawn thereon are mainly based on different mathematical models being run at INCOIS.

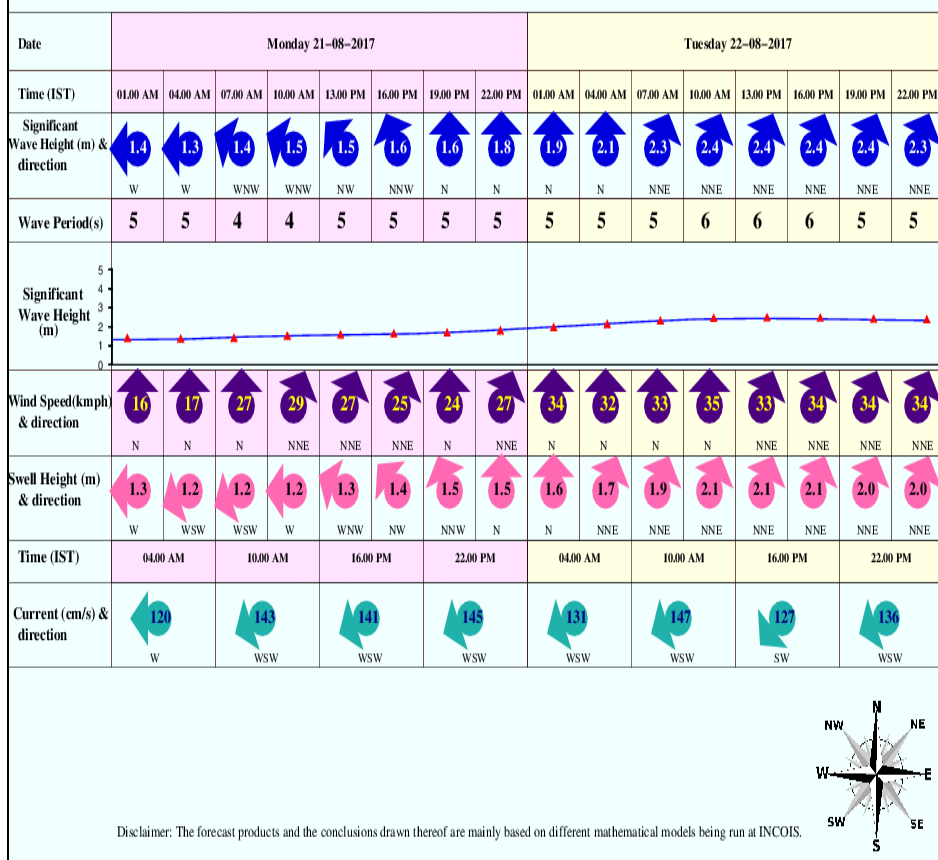
[Sri Lanka]
Forecast for 02.30 SLST 21 Aug 2017
Sea Surface Temperature (Deg. C)



COMOROS

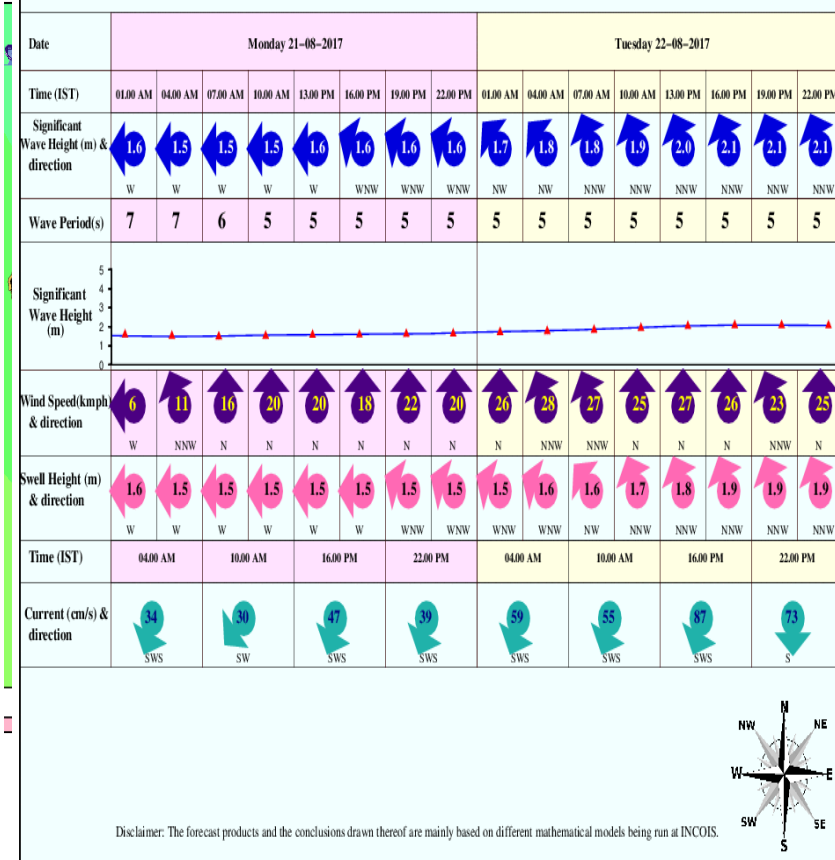
Ankibani(50km) Fishing harbour – Comoros

48 hr Sea State Forecast, Issued on: Sunday 20 August 2017



DAGI(20km) Fishing harbour – Comoros

48 hr Sea State Forecast, Issued on: Sunday 20 August 2017



MOZAMBIQUE

Angoche(20km) Fishing harbour – Mozambique

48 hr Sea State Forecast, Issued on: Sunday 20 August 2017



Date	Monday 21-08-2017								Tuesday 22-08-2017							
Time (IST)	01:00 AM	04:00 AM	07:00 AM	10:00 AM	13:00 PM	16:00 PM	19:00 PM	22:00 PM	01:00 AM	04:00 AM	07:00 AM	10:00 AM	13:00 PM	16:00 PM	19:00 PM	22:00 PM
Significant Wave Height (m) & direction	1.2 N	1.4 N	1.6 N	1.7 N	1.8 N	1.9 N	1.9 N	2.0 N	2.0 NNW	2.0 NNW	2.1 NNW	2.1 NNW	2.1 NNW	1.9 NNW	1.8 NNW	1.8 NNW
Wave Period(s)	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Significant Wave Height (m)																
Wind Speed(kmph) & direction	26 NNE	27 NNE	30 NNE	32 N	33 N	34 N	32 N	31 N	31 N	33 N	33 N	32 N	31 NNE	29 NNE	20 NNE	19 NNE
Swell Height (m) & direction	0.9 NNW	1.0 NNW	1.0 NNW	1.0 NNW	1.0 NNW	1.1 NNW	1.2 NNW	1.3 NNW	1.4 NNW	1.3 NNW	1.1 NNW	1.5 NNW	1.6 NNW	1.7 NNW	1.7 NNW	1.6 NNW
Time (IST)	04:00 AM		10:00 AM		16:00 PM		22:00 PM		04:00 AM		10:00 AM		16:00 PM		22:00 PM	
Current (cm/s) & direction	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N	-999 N



Disclaimer: The forecast products and the conclusions drawn thereof are mainly based on different mathematical models being run at INCOIS.

Ilha(10km) Fishing harbour – Mozambique

48 hr Sea State Forecast, Issued on: Sunday 20 August 2017



Date	Monday 21-08-2017								Tuesday 22-08-2017							
Time (IST)	01:00 AM	04:00 AM	07:00 AM	10:00 AM	13:00 PM	16:00 PM	19:00 PM	22:00 PM	01:00 AM	04:00 AM	07:00 AM	10:00 AM	13:00 PM	16:00 PM	19:00 PM	22:00 PM
Significant Wave Height (m) & direction	1.4 NW	1.4 NW	1.5 NNW	1.7 NNW	1.9 NNW	2.1 NNW	2.3 NNW	2.4 NNW	2.4 NNW	2.4 NNW	2.4 NNW	2.4 NNW	2.5 NNW	2.6 NNW	2.8 NNW	2.7 NNW
Wave Period(s)	4	4	4	4	5	5	5	5	5	5	5	5	5	5	6	6
Significant Wave Height (m)																
Wind Speed(kmph) & direction	36 N	38 NNE	38 NNE	41 N	40 NNW	41 NNW	45 N	46 N	47 NNE	45 NNE	43 N	45 N	43 NNW	42 NNW	47 NNW	44 N
Swell Height (m) & direction	0.9 W	1.0 W	1.1 W	1.0 W	1.0 W	1.1 W	1.2 W	1.4 W	1.6 W	1.6 W	1.7 NW	1.7 NW	1.5 NW	1.5 NW	1.4 NW	1.7 NW
Time (IST)	04:00 AM		10:00 AM		16:00 PM		22:00 PM		04:00 AM		10:00 AM		16:00 PM		22:00 PM	
Current (cm/s) & direction	35 S	43 SSE	53 SSE	52 SSE	43 S	48 SSE	55 S	53 SSE								

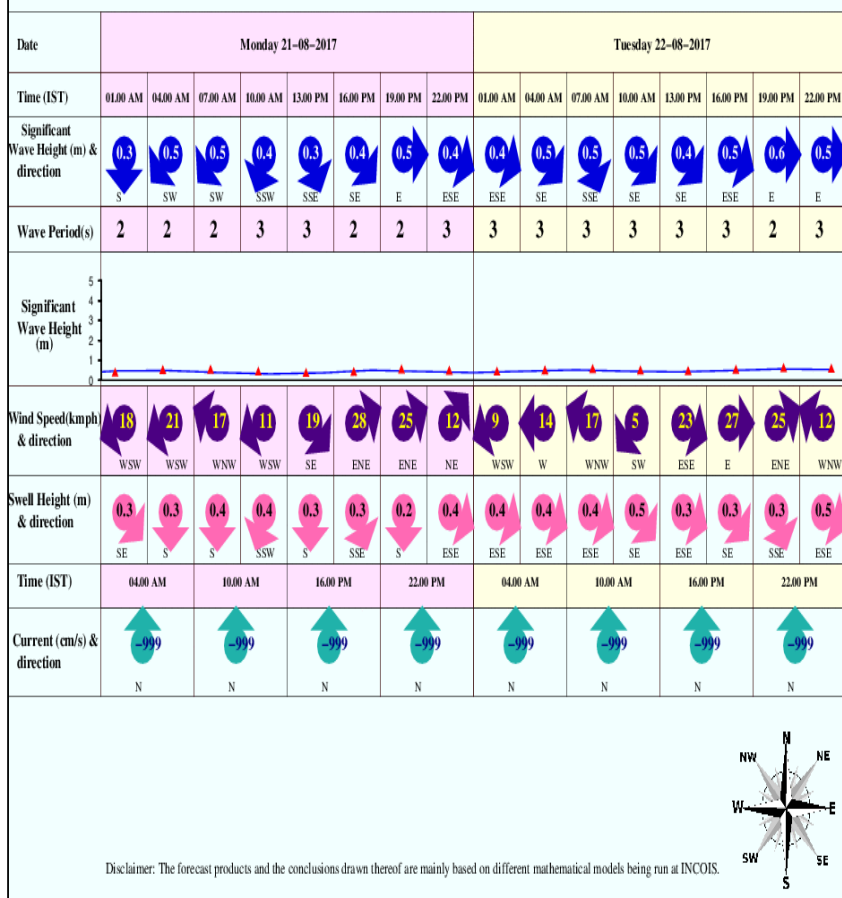


Disclaimer: The forecast products and the conclusions drawn thereof are mainly based on different mathematical models being run at INCOIS.

MADAGASCAR

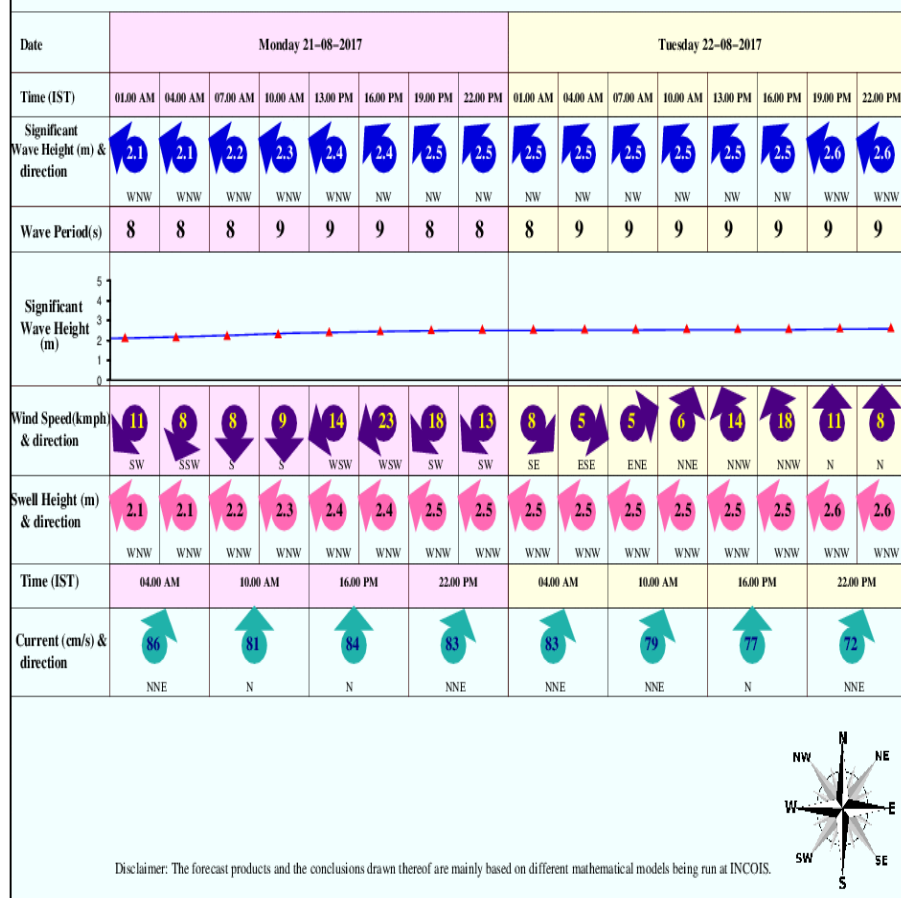
Mahajanga(10km) Fishing harbour – Madagascar

48 hr Sea State Forecast, Issued on: Sunday 20 August 2017



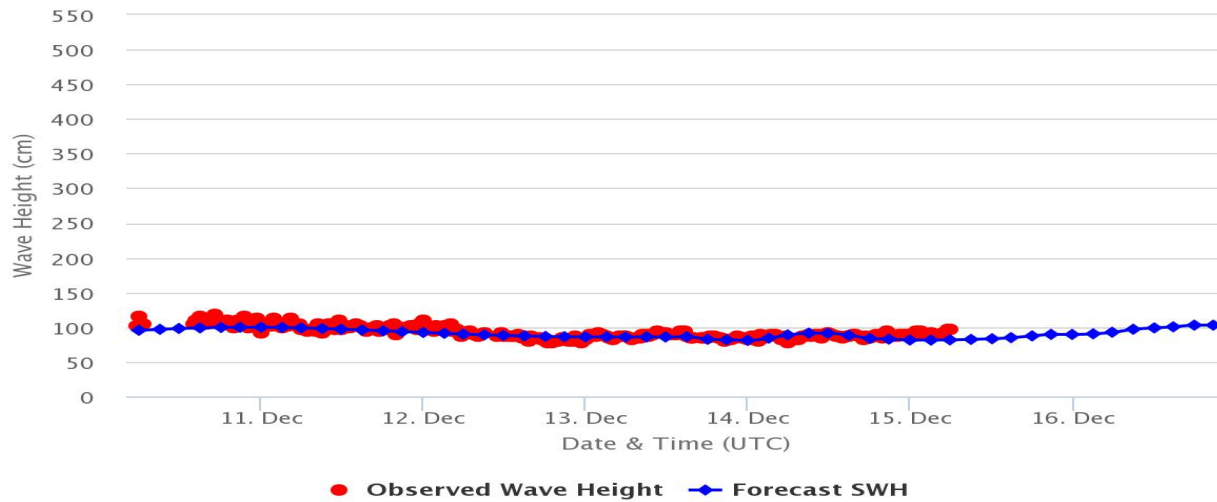
Nosy(50km) Fishing harbour – Madagascar

48 hr Sea State Forecast, Issued on: Sunday 20 August 2017

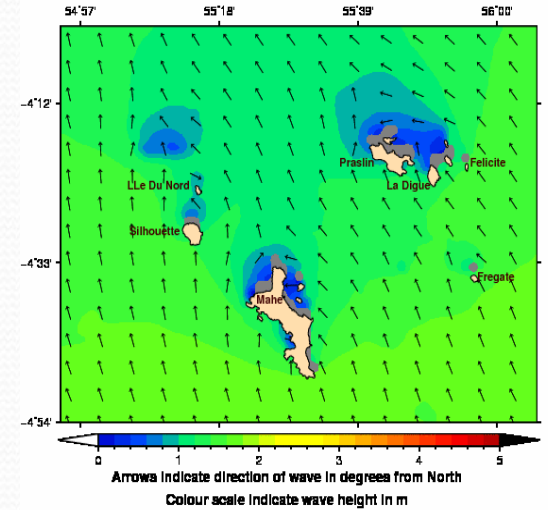


Ocean forecast Validation system for Seychelles

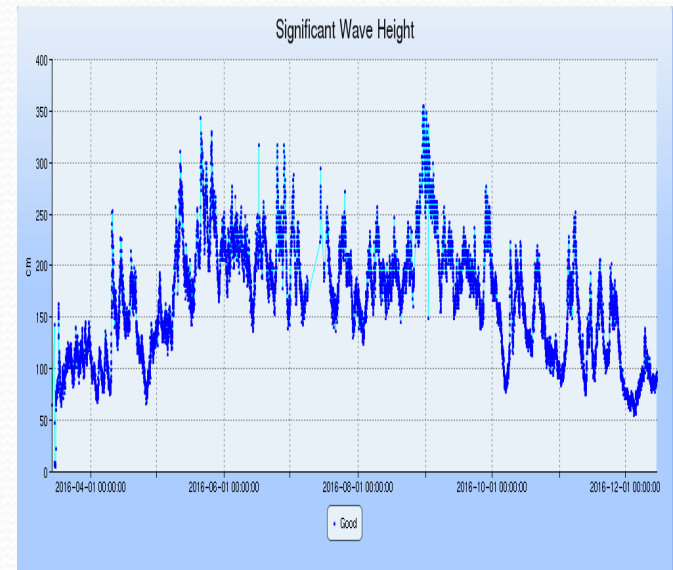
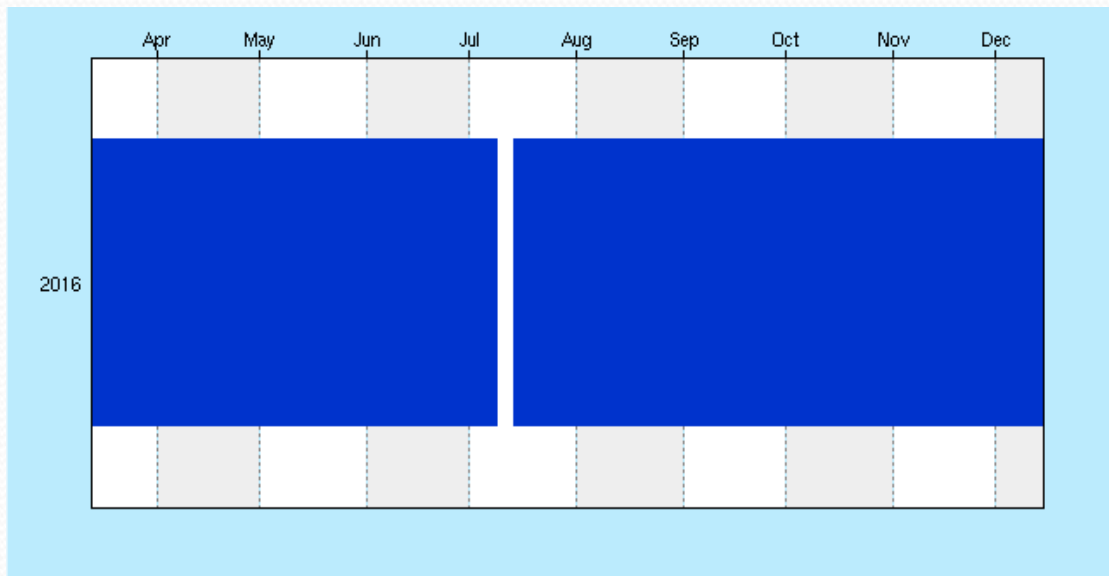
Forecasted and observed wave heights at Seychelles



[Seychelles Island]
Significant Wave Height (m) and Direction (°)
Forecast for 02.30 IST 02 Jul 2015



Wave Rider Buoy Data Availability



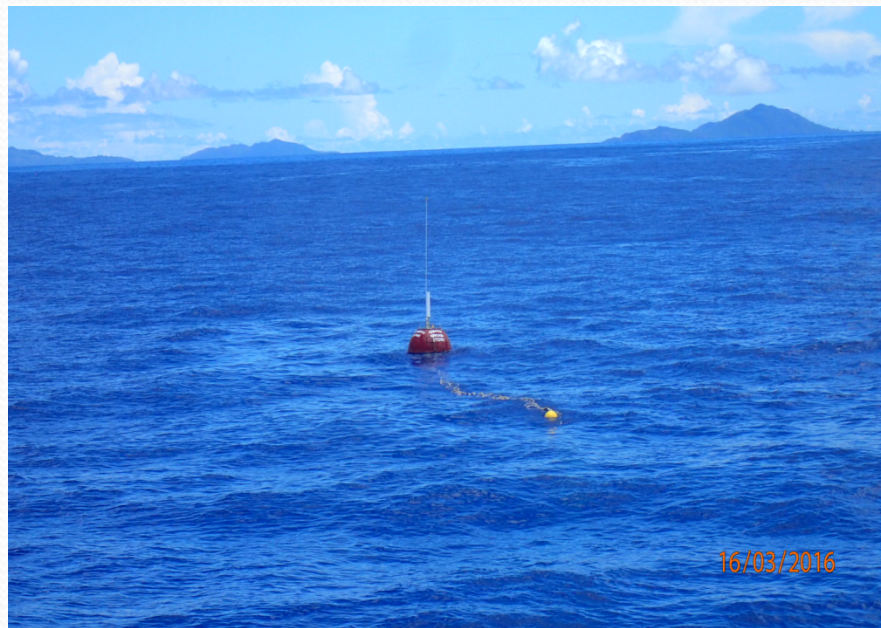
Validation of forecasts – Deployment of WRB



Deployment location



Reception Station

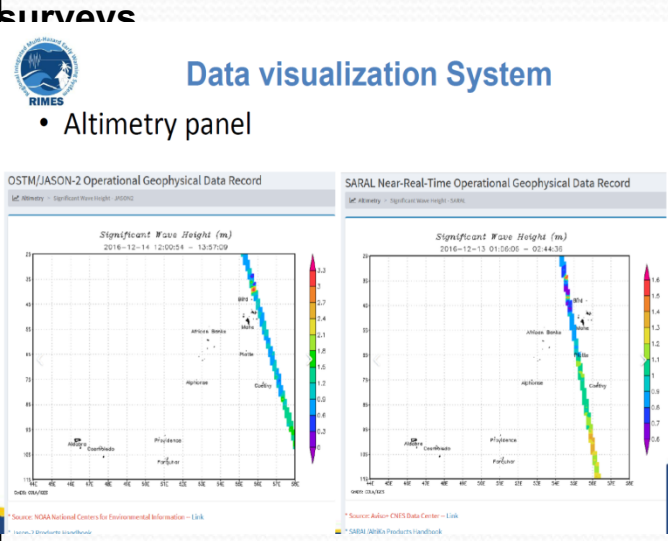


RIMES Project Progress (1st Project)

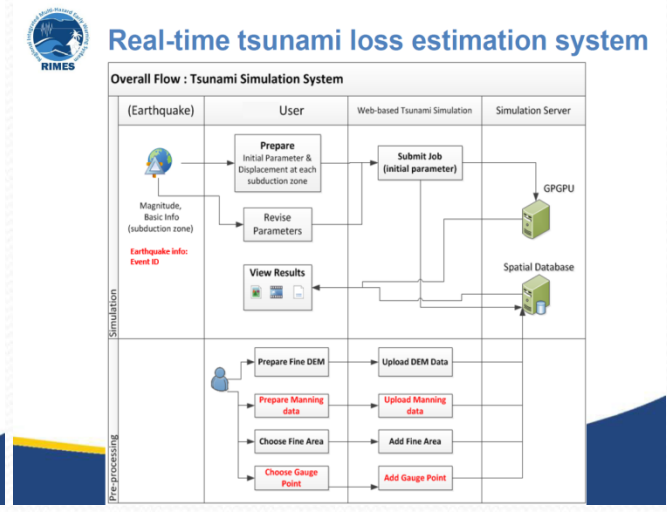


Training of regional trainers on near shore Integrated Ocean Information System bathymetric, topographic and exposure

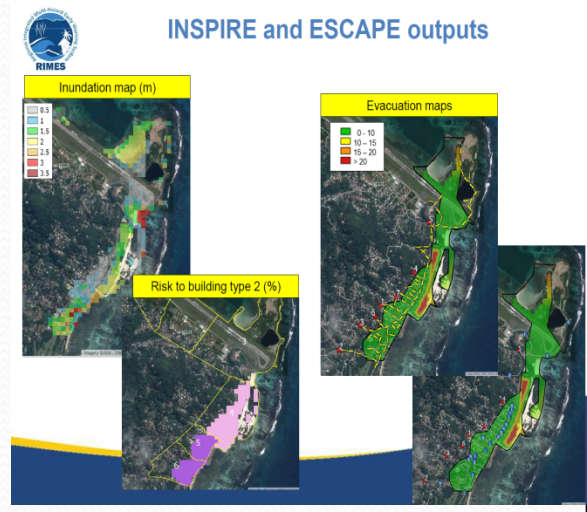
Deployment of Wave Rider Buoy Off Seychelles



Data Visualization System



Real-time tsunami loss estimation system



Training of regional trainers on INSPIRE and ESCAPE and outputs



Constructed Seismic stations for Broadband Seismometers, SMA and GNSS receivers

Seismic (Nanometrics)

- Trillium 120 QA BBS
- Titan SMA
- Centaur digitizer

cGPS (3 for Bhutan only)

- Trimble GNSS receiver with Met VAISALA PTU 300

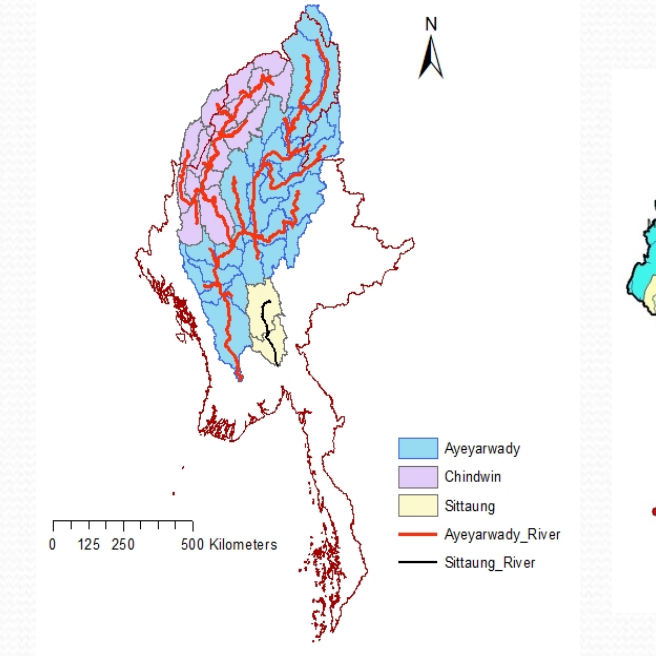
Telemetry (wireless modem)

- Sierra Wireless AirLink LS300

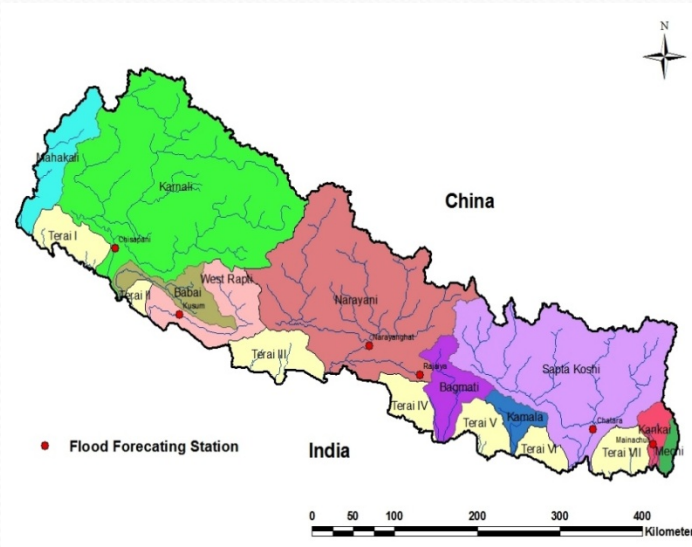
Enhancement of Observation and Monitoring Capacities by Seismic equipments



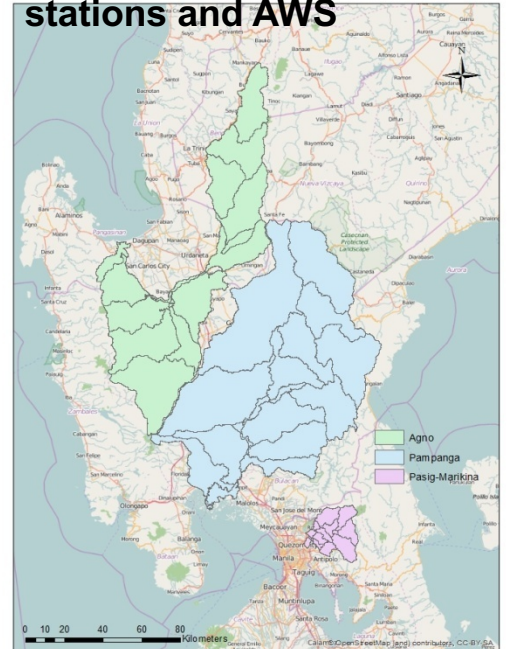
Enhancement of Observation and Monitoring Capacities by Hydromet stations and AWS



Ayeyarwady, Chindwin & Sittaung Basins in Myanmar



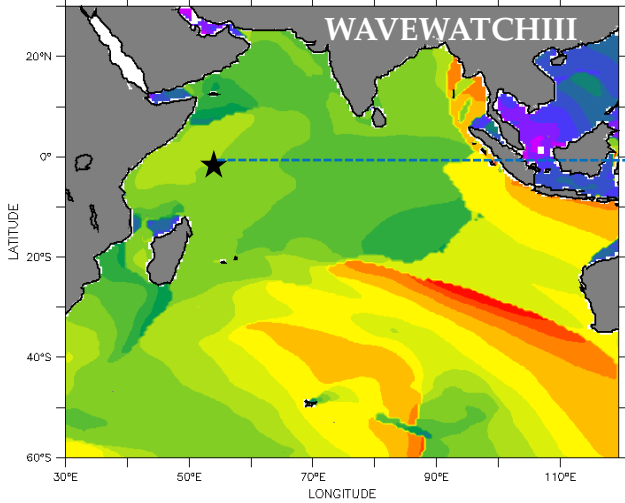
Karnali, Babai & Narayani Basins in Nepal



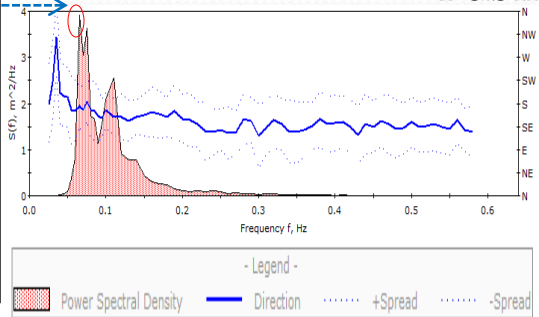
Agno, Pampanga and Pasig-Marikina Basins in Philippines

Swell Surge (Kallakadal) during 30 JUL. - 03 AUG., 2016

TIME : 28-JUL-2016 06:00



Seychelles,
2016-07-31 08:00 UTC



Swell surge during Unexpected sea surge at Alappuzha coast, 27 fishing boats washed away, Indian Express, Published: 02nd August 2016



Malayala Manorama

INCOIS high wave alert

➤ INCOIS has issued wave surge alert for low lying coastal areas of Kerala from 30 Jul. 2016- 03 Aug. 2016

➤ A high wave, surge alert for the West Bengal Coast valid from 08:30 hours on 02-08-2016 to 23:30 hours of 03-08-2016 was issued by INCOIS.

Feed back from users

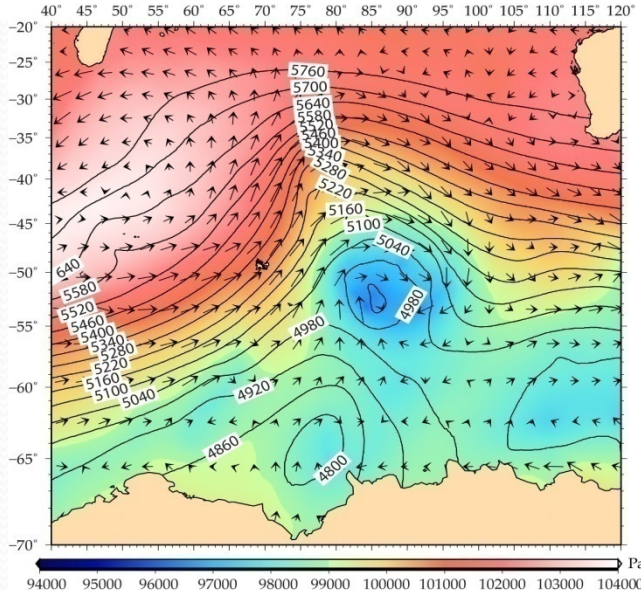


High waves topping the embankment at old Digha, 03 Aug 2016, West Bengal

The Kollam District administration (DMD) :Wave surge was reported in coastal regions of Alappad Village of Karunagapally Taluk on on 1st and 2nd of August, 2016

➤ This information sent to all concerned disaster Management authorities and directly to fishermen via SMS. Total SMS sent (Tamilnadu, Orissa, Kerala, West Bengal, Gujarat, Maharastra, Lakshadweep) – 6965 ; Number of SMS sent to Kerala Fishermen – 340; Lakshadweep – 25

Peak Wave Period (s)



The extra-tropical storm in the Southern Indian Ocean(27 Jul. 2016). Here, geopotential height at 500 hpa is in contours, sea level pressure is shaded and surface winds are shown as vectors.

Impact based products-SARAT



Search and Rescue Aid Tool (SARAT)

Home

New Request

Feedback

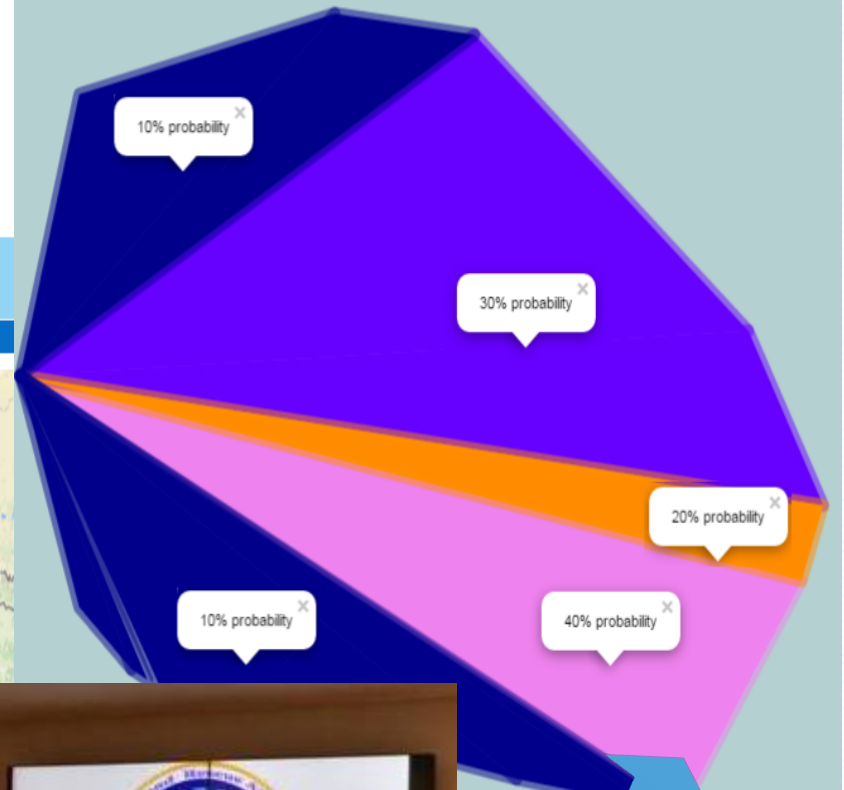
Logout

Enter Missing Object Information

Missing Object: Person In Water(PIW-1)

Last Known Time

From: 2016-02-12 05:30:00



ONLINE OIL SPILL ADVISORY SYSTEM



1. Developed Online Oil Spill Advisory system for RIMES Member States
2. OOSA will generate the predicted trajectory after submitting the details of the spilled oil. The trajectory will be displayed in an open layers web map indicating the nearby locations with respect to time.

INDIAN NATIONAL CENTRE FOR OCEAN INFORMATION SERVICES
(An Autonomous Body under the Ministry of Earth Sciences, Government of India)

ONLINE OIL SPILL ADVISORY (OOSA)

INCOIS Home OSF Home Service Description & User Manual Contact Us Logout

WELCOME TO OIL SPILL TRAJECTORY PREDICTION

USER INFORMATION

Name:*

Organisation:*

Email:*

Mobile No.:*

SPILL INFORMATION

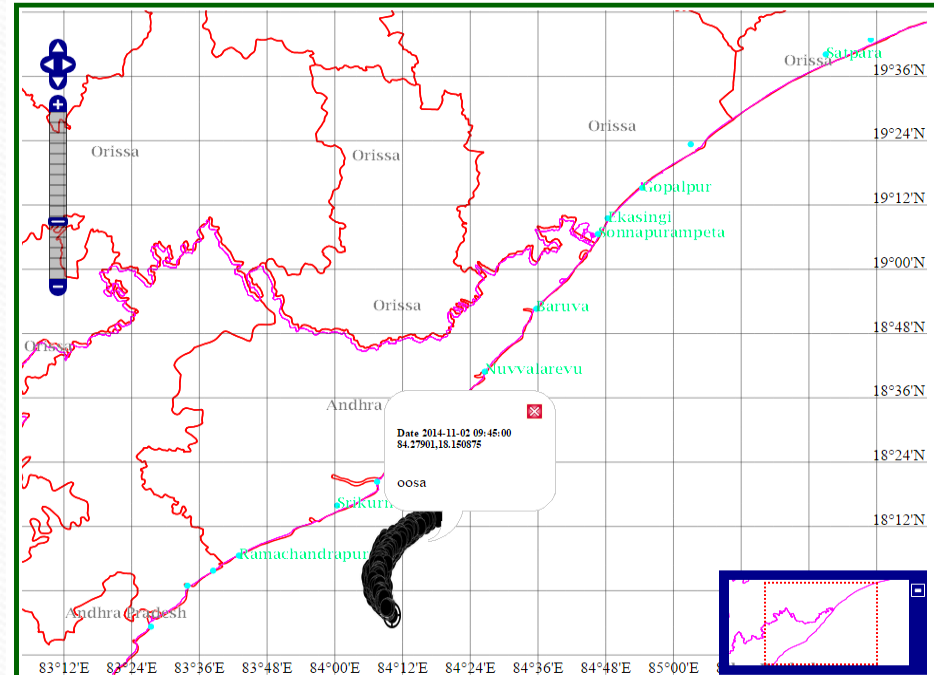
Region of Spill:*

Start Date:* 08/06/2014 12:29:00 End Date:* 08/06/2014 12:29:00

Start Position* Lon: Lat:

Pollutants:*

Quantity Released:* Units:



WAY AHEAD

- **Deployment of Real-time Observation System in RIMES countries in Refining customized products.**
- **Integrated Information System for South China Sea and Pacific Island Countries**
- **Robust mechanism for assessing location-specific risks vis-à-vis forecasts.**
- **Capacity building of staff and expansion of ocean observation network**
- **Enhanced linkages among various agencies for data sharing**
- **Capacity building of users in utilization of forecast**
- **Enhancement of dissemination network**
- **Development of user and country specified products**
- **Training in Ocean State forecast for RIMES member states**



THANK YOU