Decision-support systems for managing ocean risks/opportunities and earthquake impacts

Ocean state forecasting and advisories
Tsunami potential loss estimation
Rapid earthquake potential damage estimation

Ocean state forecasting and advisories

Ocean Information

Is it a good time for yachting?
Can my boat withstand the waves?

"No surf?"

Is it an ideal time for offshore reconnaissance survey?

Is it the best time for fishing?

Ocean Services

❖ Ocean information is *critical for effective management of maritime activities* e.g. maritime recreations, fisheries, disaster preparedness, etc.

❖ Access to such information is limited to global/regional scales

Objective: To strengthen capacities in the region by providing operational customized ocean forecast information through RIMES in collaboration with INCOIS, as well as real-time/near-real-time observation data, on local ocean/marine conditions
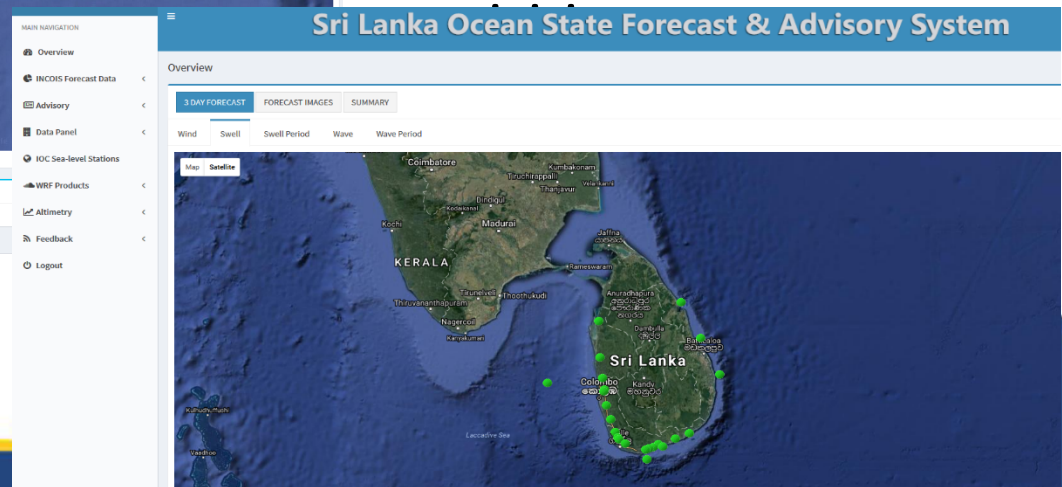
Ocean Services

Ocean state forecasting and advisory system (OSFAS)

- Customizable system and user-friendly interface
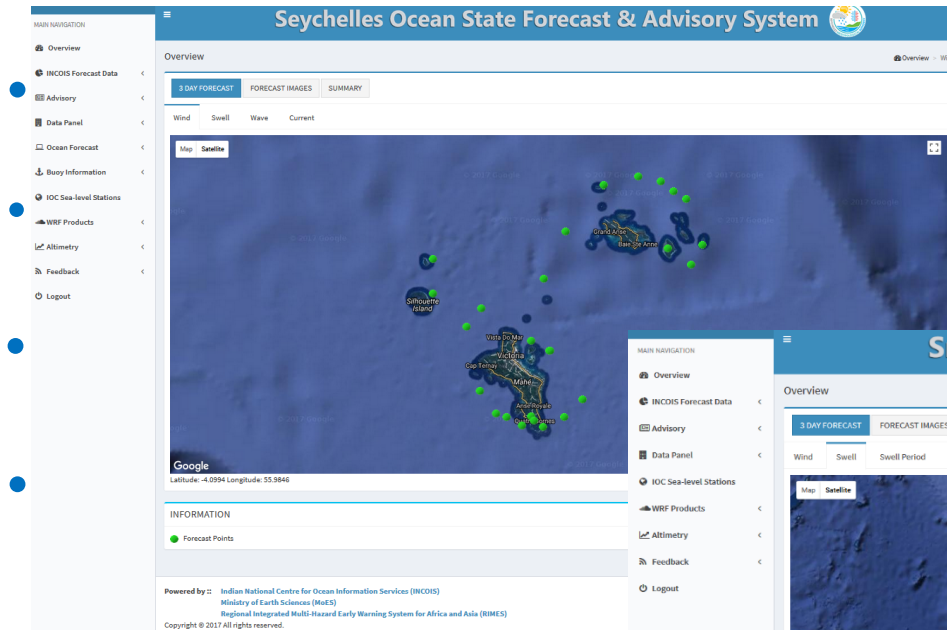
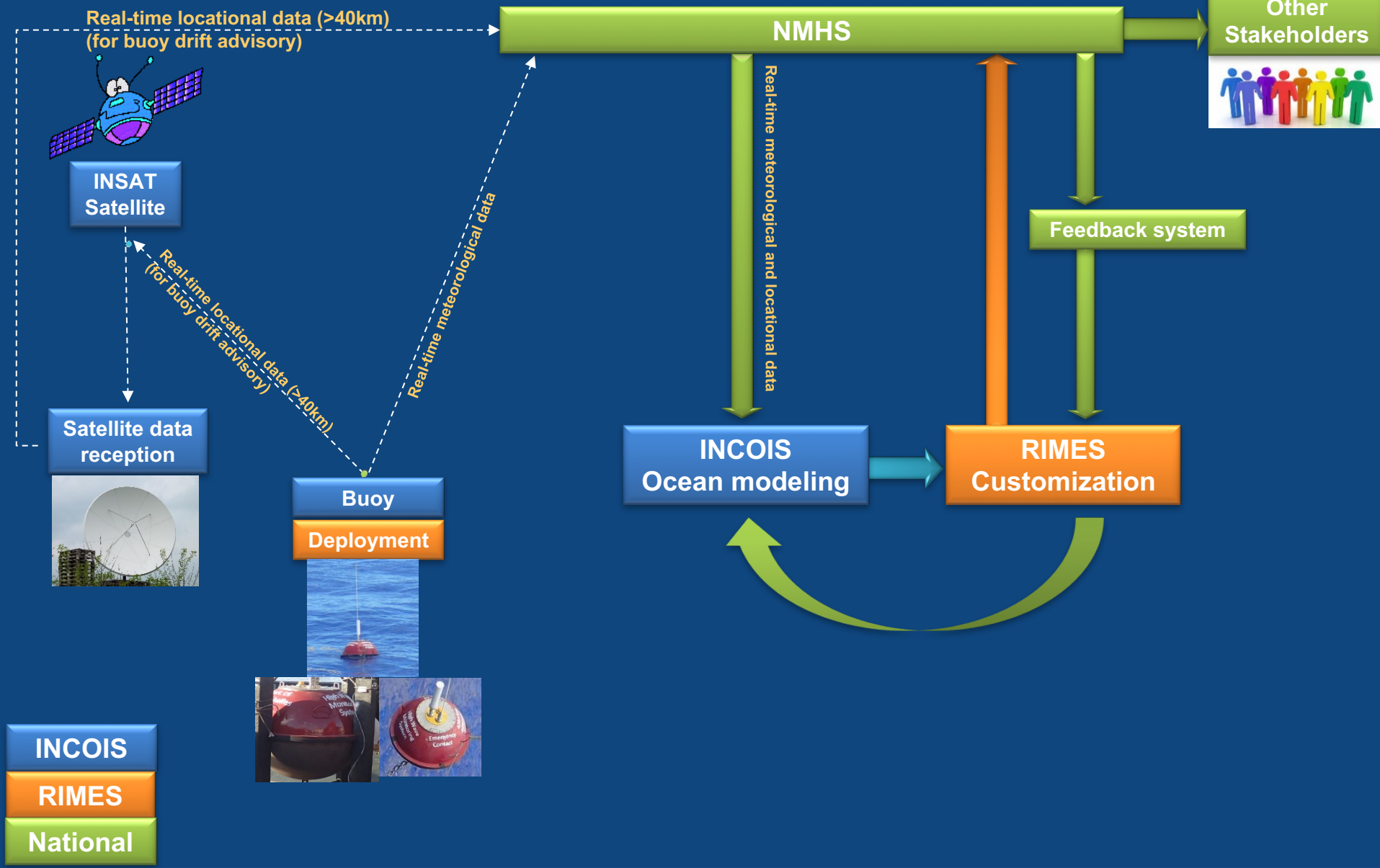...ific marine forecast information

Ocean Services

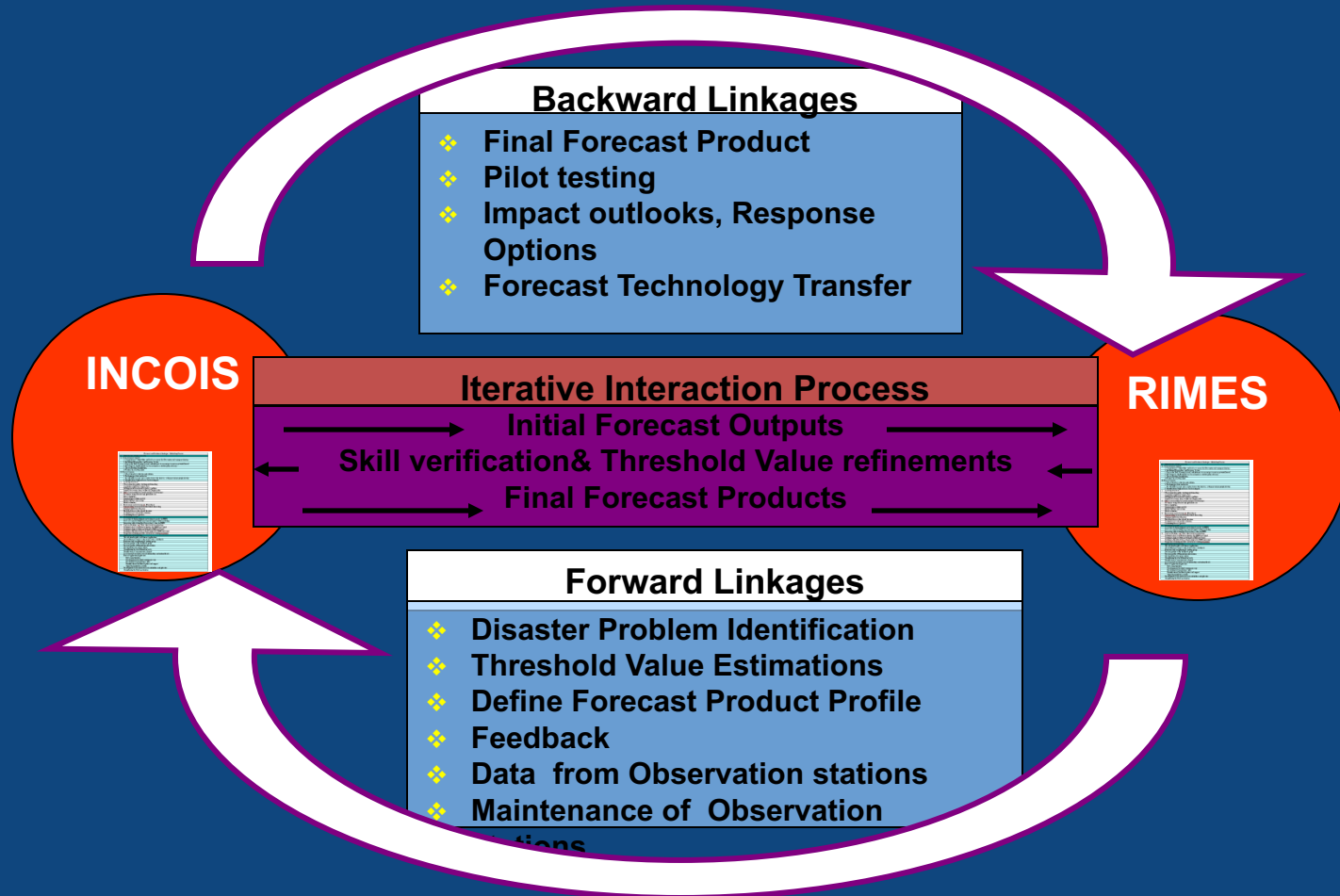## Ocean state forecasting and advisory system (OSFAS)

- Provision of real-time sea level data (IOC)

- Provision of weather forecast products e.g. precipitation, temperature, etc.

- Provision of near-real time satellite data e.g. altimetry, sea surface current, etc.

- User feedback system for allowing users to upload real-time data

- Formulation of warning bulletins for provision of advisories on 3-day ocean/marine forecast

- Warning dissemination through email, sms

Ocean Services

Coast guard,
Ports authority,
Maritime safety,
Fishermen groups,
Tourism,
Oil exploration, etc.

Other Stakeholders

NMHS

Real-time locational data (>40km)
(for buoy drift advisory)

INSAT Satellite

Real-time meteorological data

Real-time meteorological and locational data

Feedback system

Satellite data reception

Real-time locational data (>40km)
(for buoy drift advisory)

Buoy

Deployment

INCOIS
Ocean modeling

RIMES
Customization

INCOIS

RIMES

National

INCOIS and RIMES Interaction Process

Backward Linkages
- ❖ **Final Forecast Product**
- ❖ **Pilot testing**
- ❖ **Impact outlooks, Response Options**
- ❖ **Forecast Technology Transfer**

INCOIS

RIMES

Iterative Interaction Process

Initial Forecast Outputs

Skill verification& Threshold Value refinements

Final Forecast Products

Forward Linkages
- ❖ **Disaster Problem Identification**
- ❖ **Threshold Value Estimations**
- ❖ **Define Forecast Product Profile**
- ❖ **Feedback**
- ❖ **Data from Observation stations**
- ❖ **Maintenance of Observation**

Ocean Services

Customization process

- Integration of existing local bathymetric and topographic data by INCOIS into its forecasting system to generate customized ocean forecast products: 3-day wave, swell, wind and current forecasts

DEM for Seychelles

Elevation (m)

[Seychelles Island]
Significant Wave Height (m) and Direction (°)
Forecast for 04:00 SCT 17 Aug 2017

Arrows indicate direction of wave in degrees from North
Colour scale indicate wave height in m
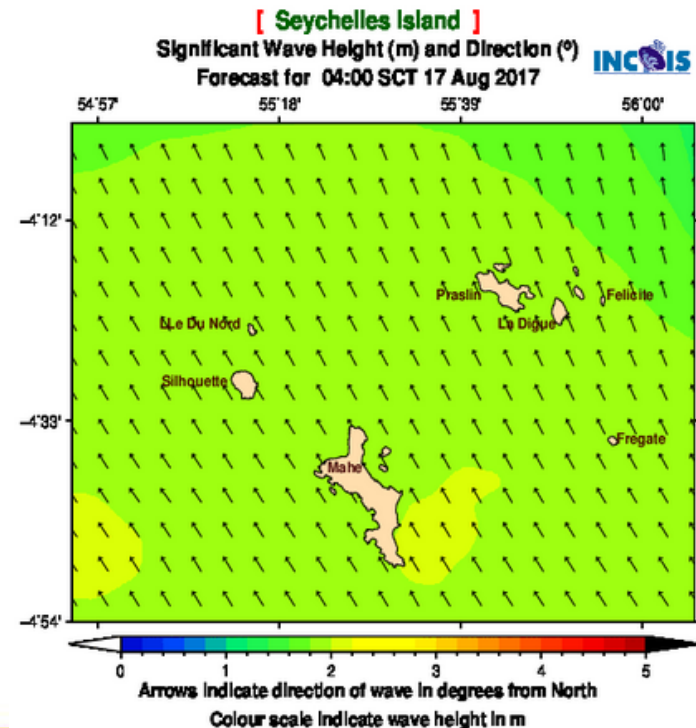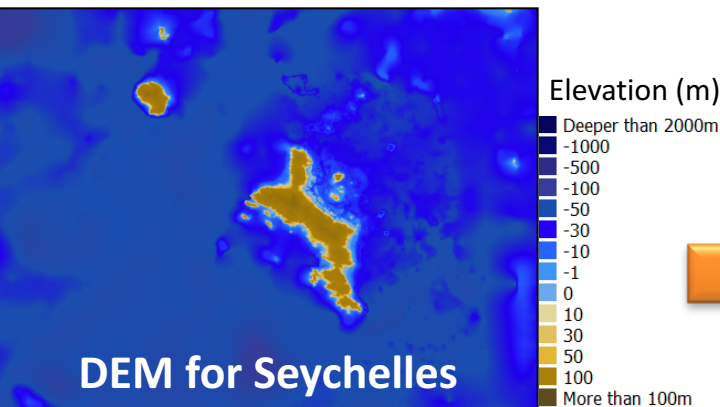
Ocean Services

Customization process

- Customizable location-specific marine forecast information

Ocean Services

Customization process

- Customization of alert categories to match existing alert definitions (e.g. 4 levels)

Wind Speed Alert

Data Panel > Wind Speed Alert

Parameter: Wind Speed (km/h)

Description	Minimum	Maximum	Alert-level	Edit/Delete
Calm	0.0	1.1	White	
Light Air	1.1	5.4	White	
Light Breeze	5.4	11.9	White	
Gentle Breeze	11.9	19.8	White	
Moderate Breeze	19.8	28.8	Yellow	
Fresh Breeze	28.8	38.9	Yellow	
Strong Breeze	38.9	50.0	Yellow	
High Wind, Moderate gale	50.0	61.9	Orange	
Gale, Fresh gale	61.9	74.5	Orange	
Strong gale	74.5	88.2	Red	
Storm, whole gale	88.2	102.2	Red	
Violent Storm	102.2	117.4	Red	
Hurricane force	117.4	1000000.0	Red	

Customized Beaufort scale for wind speed alert

High Wave Alert

Data Panel > High Wave Alert

Parameter: Significant Wave Height (m)

Description	Minimum	Maximum	Alert-level	Edit/Delete
Calm	0.0	0.1	White	
Smooth	0.1	0.5	White	
Slight	0.5	1.5	Yellow	
Moderate	1.5	2.5	Orange	
Rough	2.5	4.0	Red	
Very Rough	4.0	6.0	Red	
High	6.0	9.0	Red	
Very High	9.0	14.0	Red	
Phenomenal	14.0	10000000.0	Red	

Customized Douglas scale for high wave alert

Ocean Services

Customization process

- Integration of user feedback system – users can upload real-time

Ocean Services

Customization process

- Formulation of warning bulletins for provision of advisories on 3-day ocean/marine forecast
- Warning dissemination through email, sms

Ocean Services

Products

- 3-day ocean forecast on wind, wave, swell and current generated by INCOIS

Time series graph

Forecast image

Summary table

Ocean Services

Products

- Advisory

Web advisory
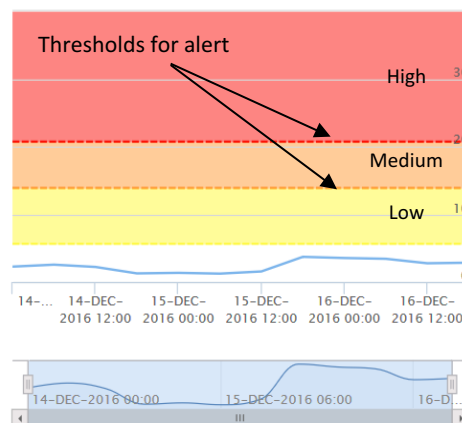
Bulletin advisory

Ocean Forecast Information Bulletin
Issued at Issued at 1253LT on Thu 17 Aug 2017

In an effort to improve our delivery and validation services please report any abnormal events to this telephone number: 4384349 as soon as possible.

Powered by ::
Indian National Centre for Ocean Information Services (INCOIS)
Ministry of Earth Sciences (MoES)
Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES)

Ocean Services

Products

- WRF products e.g. precipitation, temperature, MSL pressure)

- Near-real-time satellite data (e.g. altimetry, etc.)

- Real-time sea level data (IOC)

Significant Wave Height (m)
2016-12-10 00:59:50 – 02:38:06
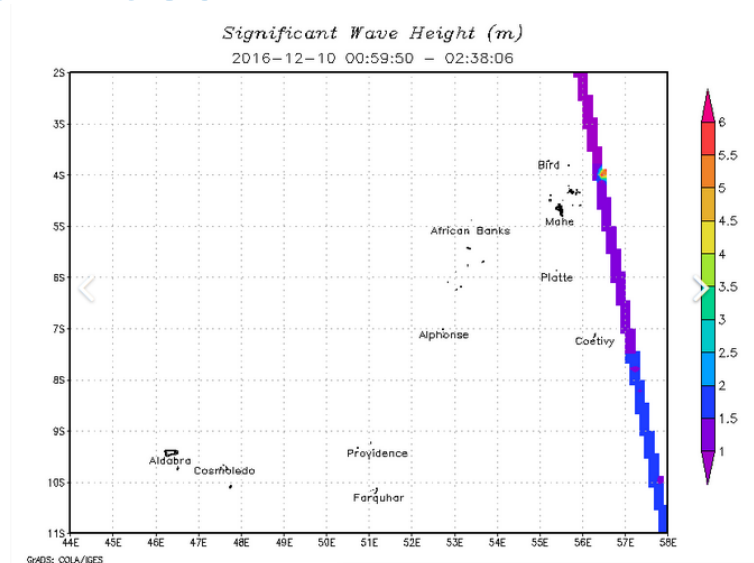
* Source: Aviso+ CNES Data Center -- Link
* SARAL/AltiKa Products Handbook

Near real-time altimetry data

Sealevel at Pt.LaRue station (offset: 6.145 m)
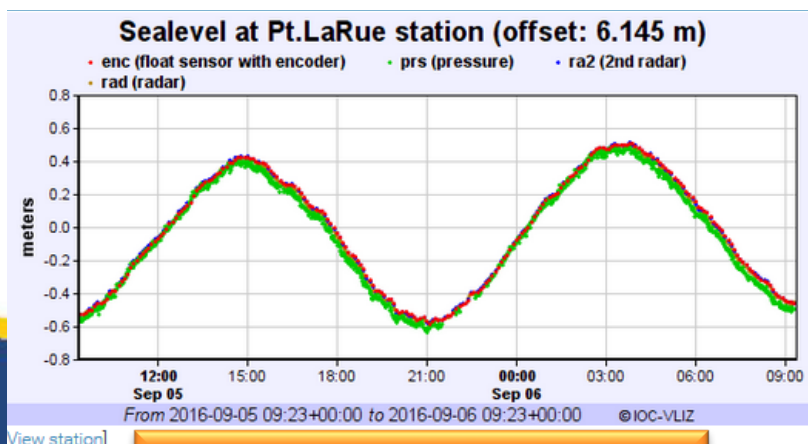
Real-time sea level data

Six Hourly Accumulated RainFall(in mm)
Forecast Length in Hours : 2017012912+66 Hours.

WRF
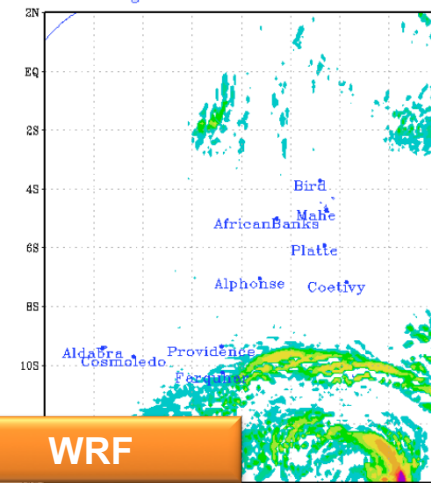
Ocean Se[rvices]

Real-time monitoring system

- Real-time ocean information

- Near-real time tracking of buoy location and alert messaging service in case of buoy drift

Alert!!! Seychelles Wave Rider Buoy drift

Inbox x

RIMES Buoy Watch <webmaster@rimes.int>   Mar 28

to buoy.watch

Report of Seychelles Wave Rider Buoy drift, Kindly act soon.
Time: 2017-03-28 10:00:00 UTC
Location: Seychelles
****

Drifted distance of INSAT: 15302m
Drifted direction of INSAT:
Current position of INSAT-lat: -4.6367025 lon: 55.7345867
Deployed position lat: -4.6446204 lon: 55.8724308
****

For more information about the buoy location, access http://ois.rimes.int/index.php/buoy/location, using the following log-in credentials:
username: guest
password: guest

--
For questions regarding this alert, please contact buoy.watch@rimes.int

Buoy Loc

Show/Hide
Last Observ

Map   Satellite

Google
Latitude: -4.6421 Longitude: 55.8710

◇ Seychelles wave rider buoy
△ Observed location (<300m)
▲ Observed location (≥300m)
Map data ©2016   50 m ⊢───┤   Terms of Use

Buoy Data

| From | 2016-09-06 | To | 2016-09-06 | | Show | Download |

hm0   ti   t1   tz   tc   tp   qp   dir   spr   nu   eps   ss

Significant wave height

Observation Time (UTC)
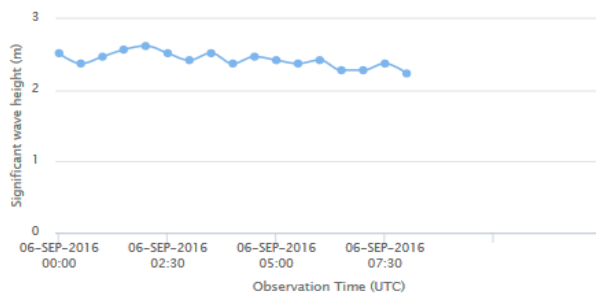
Date & Time (UTC)	Latitude	Longitude	hm0
06-SEP-2016 08:00	-4.6447062	55.8723235	2.2345674
06-SEP-2016 07:30	-4.6447062	55.8723879	2.3732347
06-SEP-2016 07:00	-4.6447170	55.8723879	2.2800695
06-SEP-2016 06:30	-4.6447170	55.8724093	2.2800695
06-SEP-2016 06:00	-4.6447277	55.8723879	2.4209204
06-SEP-2016 05:30	-4.6447277	55.8723450	2.3732347
06-SEP-2016 05:00	-4.6447492	55.8723235	2.4209204
06-SEP-2016 04:30	-4.6447814	55.8723021	2.4693572
06-SEP-2016 04:00	-4.6447814	55.8722162	2.3732347
06-SEP-2016 03:30	-4.6448135	55.8721948	2.5185566
06-SEP-2016 03:00	-4.6448243	55.8721089	2.4209204
06-SEP-2016 02:30	-4.6448886	55.8720875	2.5185566

06-SEP-2016 00:00   06-SEP-2016 02:30   06-SEP-2016 05:00

Ocean Services

Status

❖ Customizing for Comoros, Madagascar, Maldives, Mozambique, Seychelles, Sri Lanka

❖ Countries interested: Cambodia, Myanmar, Philippines, Vietnam

❖ Feedback system for validation of ocean information

❖ Dissemination through sms

Future Plan

❖ Mobile application

Tsunami potential loss estimation

Tsunami Potential Loss Estimation

❖ There is a need for emergency managers of operational tools that will provide accurate tsunami forecast as guidance for rapid, critical decisions when lives and property are at risk

❖ The use of a GPGPU system can enable the provision of real-time tsunami loss estimates by reducing processing time

Objective: To strengthen capacities in the region by providing operational tsunami potential loss estimation through RIMES with support from INCOIS, as per Service Level 3 requirements

Tsunami Potential Loss Estimation

❖ Provides tsunami Service Level 3 products within 20 minutes at the nearest pilot site in Sri Lanka

❖ Pilot sites: Comoros, Mozambique, Seychelles, Sri Lanka

❖ Integration of high resolution DEM for quality inundation outputs

❖ Integration of detailed population and building inventory (e.g. RC, wood)

Type	Non-solid buildings	Solid buildings
Structure (material)	Brick-built, block-built, or wooden	Reinforced concrete, steel
The number of floors	One or two	Two or more
Usage	Housing (commercial)	Public, commercial, or office
Image		

Tsunami Potential Loss Estimation

❖ Integration of tsunami vulnerability curves for estimation of potential loss of life and damage to buildings
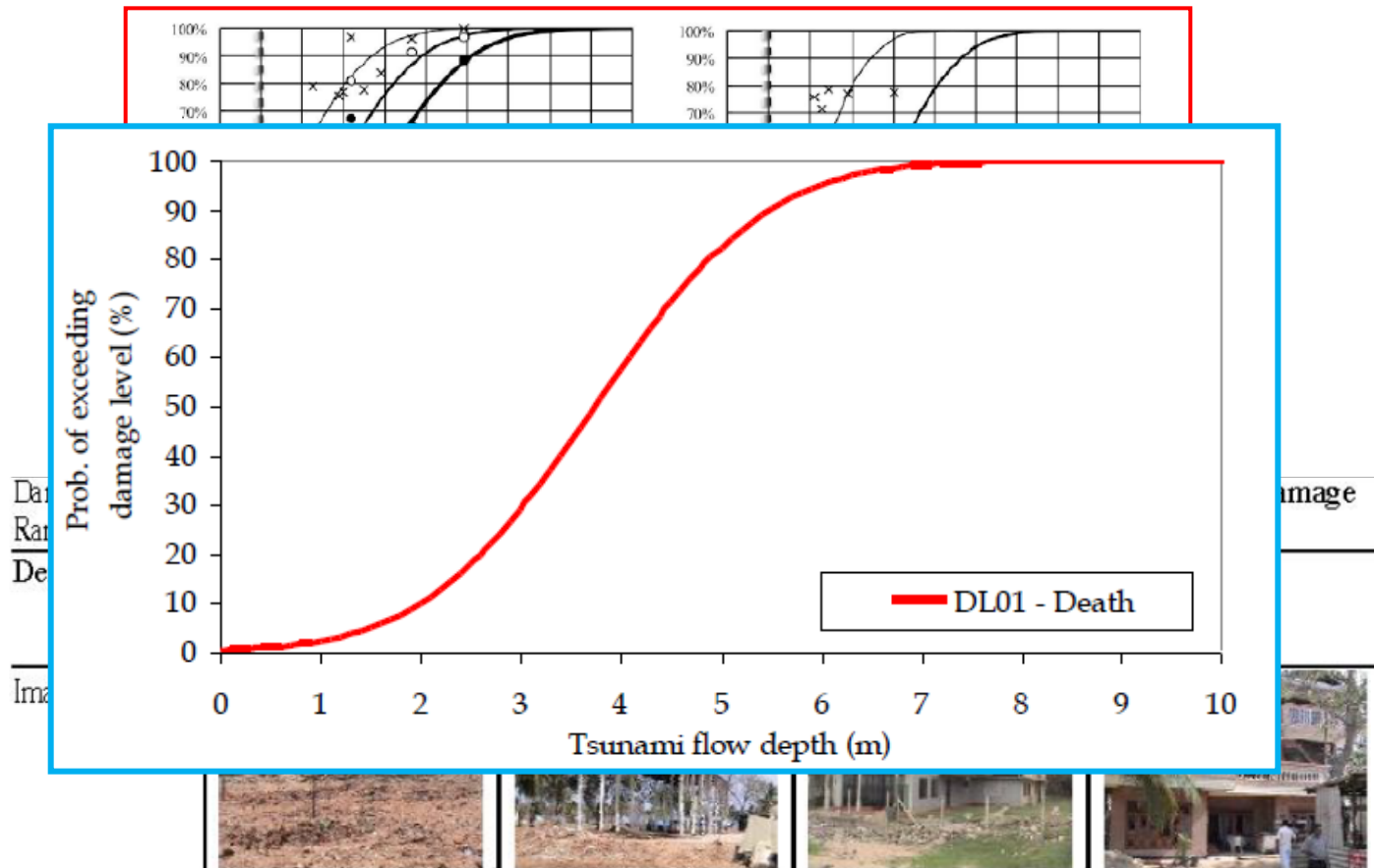
Tsunami Potential Loss Estimation

Products

- Uses the loss estimation component of the RIMES' INSPIRE tool to generate probabilities of casualties and damages to buildings

Select Loss Estimation: Summary of Casualty Per Zone

Zone No.	Total Population (person) %	Survival (person) %	Casualty (person) %
1	0	0	0
1	100	0	0
2	14072	13606	466
2	100	97	3
3	4	4	0
3	100	100	0
4	2240	2236	4
4	100	100	0
5	0	0	0
5	100	0	0
6	4548	4473	75
6	100	98	2
7	0	0	0
7	100	0	0

Rapid earthquake potential damage estimation

...ast
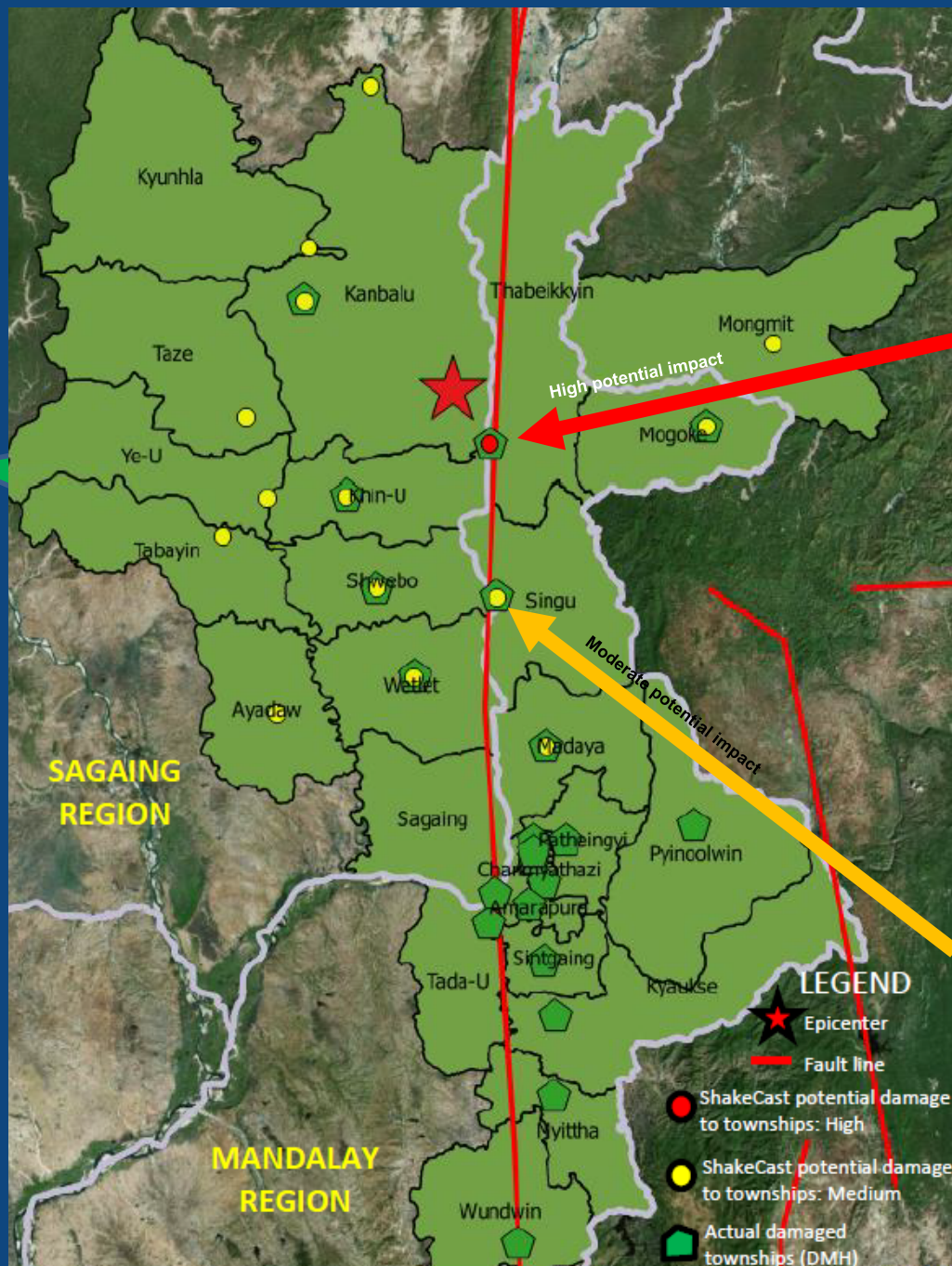
...ntial damage

...irst responders,
...licy makers

...nutes after
...to estimate risks
...cal facilities

...mation is sent to
registered users by sms, and email

High potential impact

Moderate potential impact

SAGAING REGION

MANDALAY REGION

Kyunhla

Kanbalu

Thabeikkyin

Mongmit

Taze

Ye-U

Mogoke

Khin-U

Tabayin

Shwebo

Singu

Ayadaw

Wetlet

Madaya

Sagaing

Pyincolwin

Patheingyi

Chanmyathazi

Amarapura

Sintgaing

Tada-U

Kyaukse

Nyittha

Wundwin

LEGEND

⭐ Epicenter

— Fault line

🔴 ShakeCast potential damage to townships: High

🟡 ShakeCast potential damage to townships: Medium

🟢 Actual damaged townships (DMH)

Summary report

cription	Facility Name	Location		POTENTIAL IMPACT	MMI
AGE	Kya Ku Ni, Mong Koe	Tachileik	99.9927, 20.6787	High	9.27
AGE	Law Hkar, Nar Yawng	Tachileik	99.9998, 20.7065	High	9.27
AGE	Nar Hpet (1), Nam Pang	Monghpyak	99.6268, 20.9307	Medium	6.26

	POTENTIAL IMPACT	MMI
2474, 22.7021	Medium	5.44
2383, 22.7089	Medium	5.43
0968, 22.0235	Low	4.85
1014, 22.0309	Low	4.85

POPULATION	Kanbalu (Tsp. pop. 295561)	43.57	23.2030	95.5170	Moderate	VI
STRUCTURE	Shwebo Myithar Pagen	40.99	22.5871	95.6994	Moderate	VI
POPULATION	Kyunhla (Tsp. pop. 104087)	50.19	23.5200	95.5516	Moderate	VI
STRUCTURE	Shwe Phyu Guest House	51.63	22.5715	95.6999	Moderate	VI

Earthquake Services: ShakeCast

- Levels of customization
  - Population (smallest administrative unit)
  - Building (location and usage)
  - Building properties (structure, material, etc.)
  - Country-based damage threshold
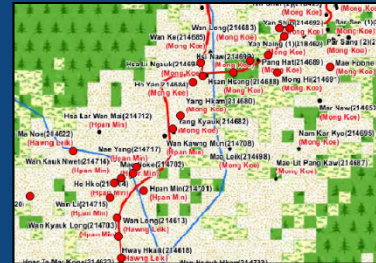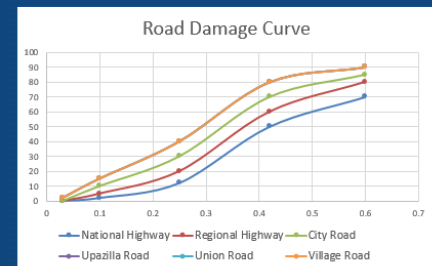

Population customized up to village level

Buildings customized for building usage from Google Earth

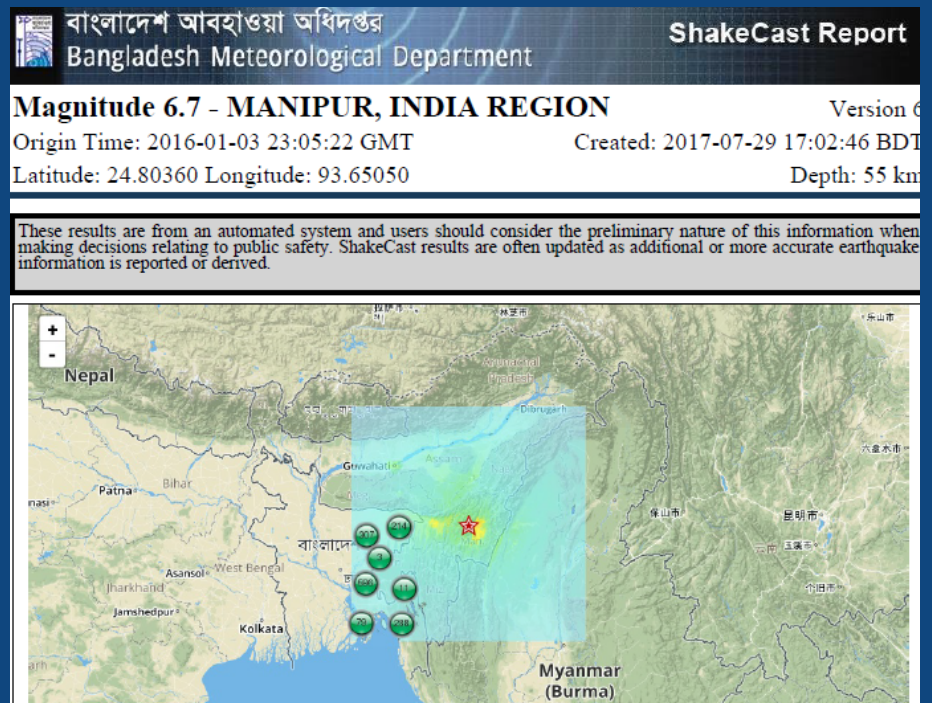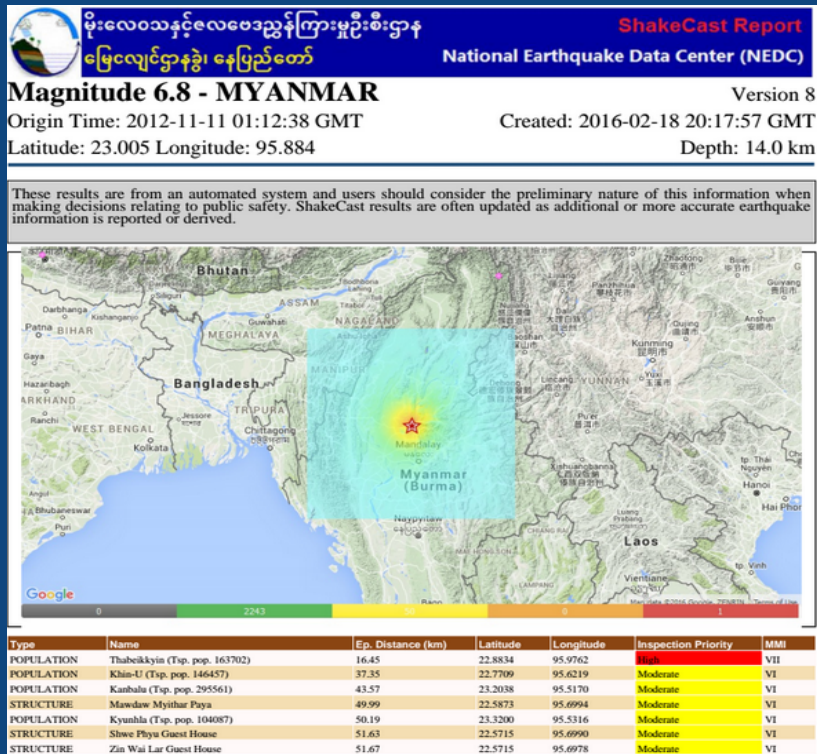Buildings customized for building structure from field survey

Country-based damage threshold

Earthquake Services: ShakeCast

Status

❖ Installed and customized for Myanmar

❖ Installed and ongoing customization for Bangladesh

Thank you for your attention

Seychelles Meteorological Authority