

# Case Study: Typhoon Haiyan in the Philippines

Jo Brienne Briones

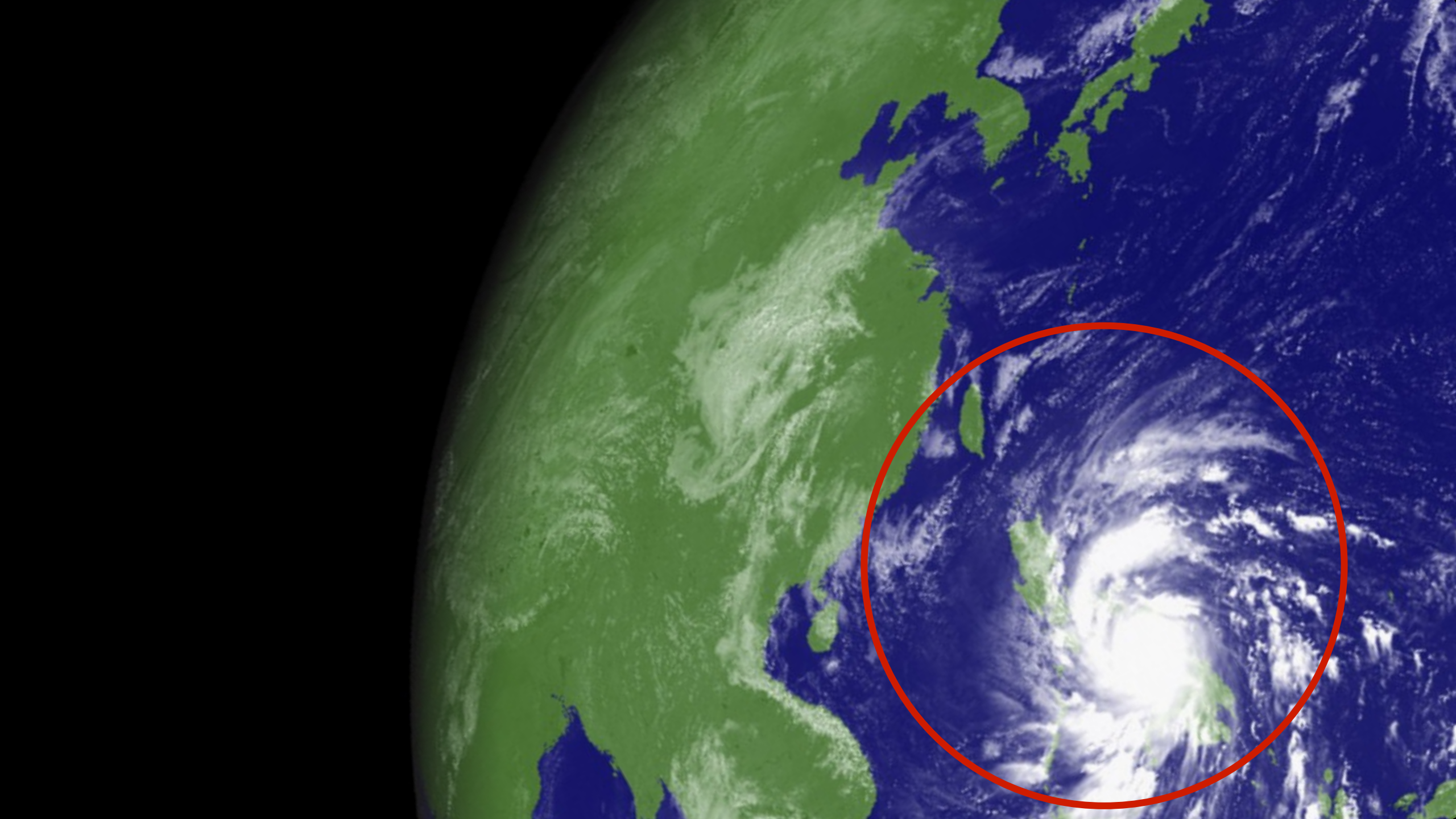
Project NOAH, Science Research Specialist I

Lower Mekong Initiative Workshop

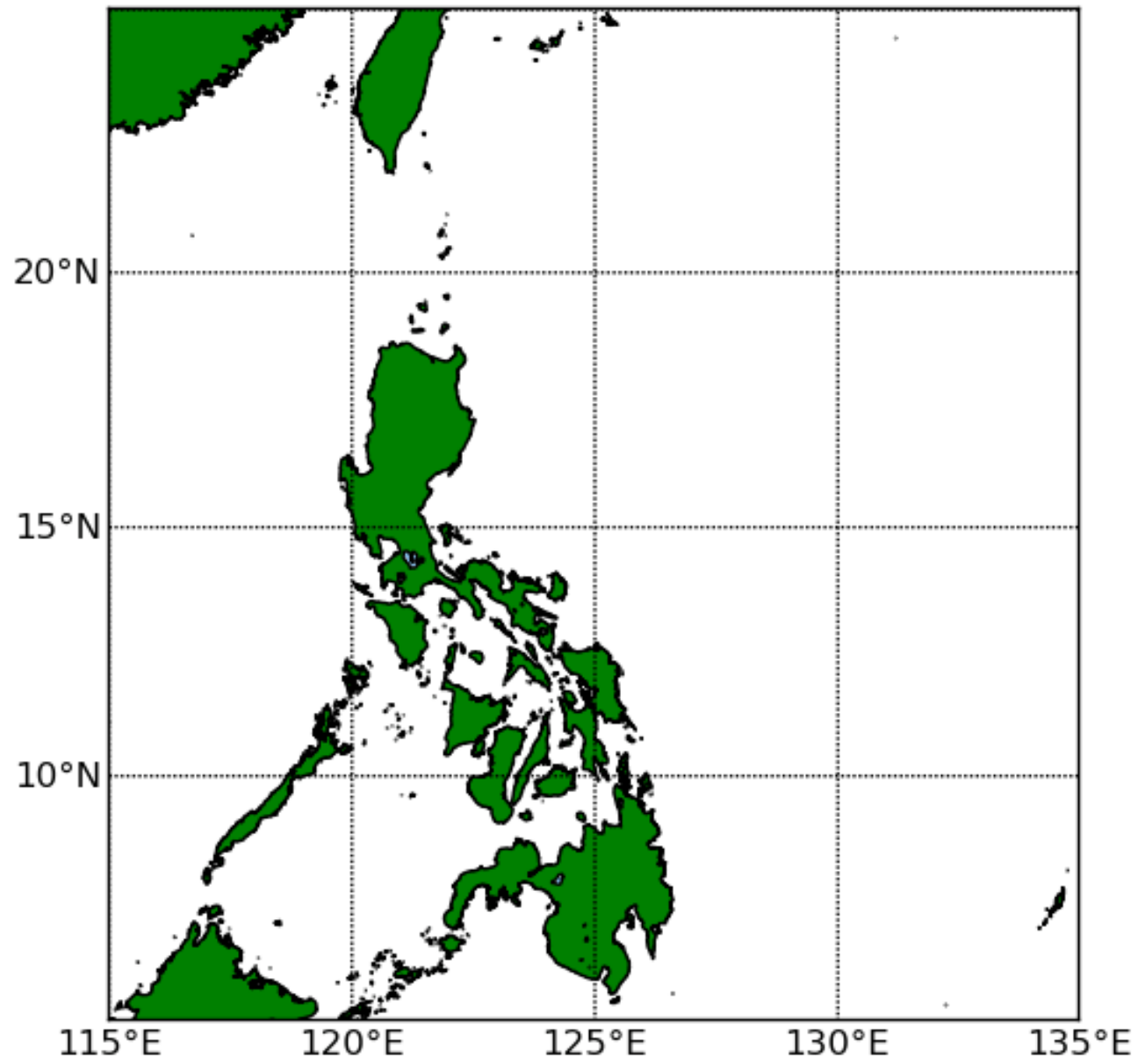
Hanoi, Vietnam

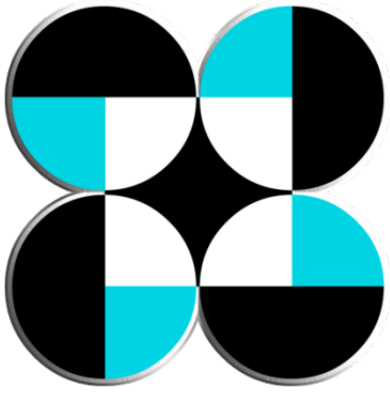
August 21, 2014





1951



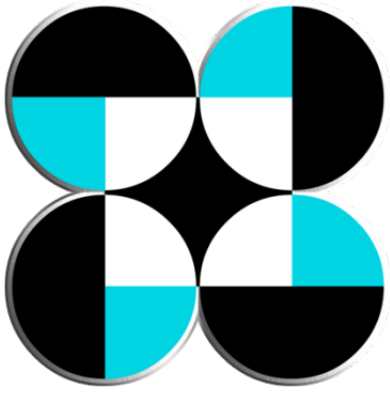


# What is Project NOAH?

In response to President Aquino's instructions to put in place a responsive program for:

- 1) flood mitigation, specifically targeting a 6 hour flood early warning system for communities along 18 major river systems;**
- 2) enhancement of geohazard maps and;**
- 3) enhancement of storm surge vulnerability maps**

the DOST is presenting the  
**Nationwide Operational Assessment of Hazards**



# What is Project NOAH?

- **Maps**

- High resolution topography via LiDAR
- Flood susceptibility
- Land slide susceptibility
- Storm surge susceptibility

- **Sensors**

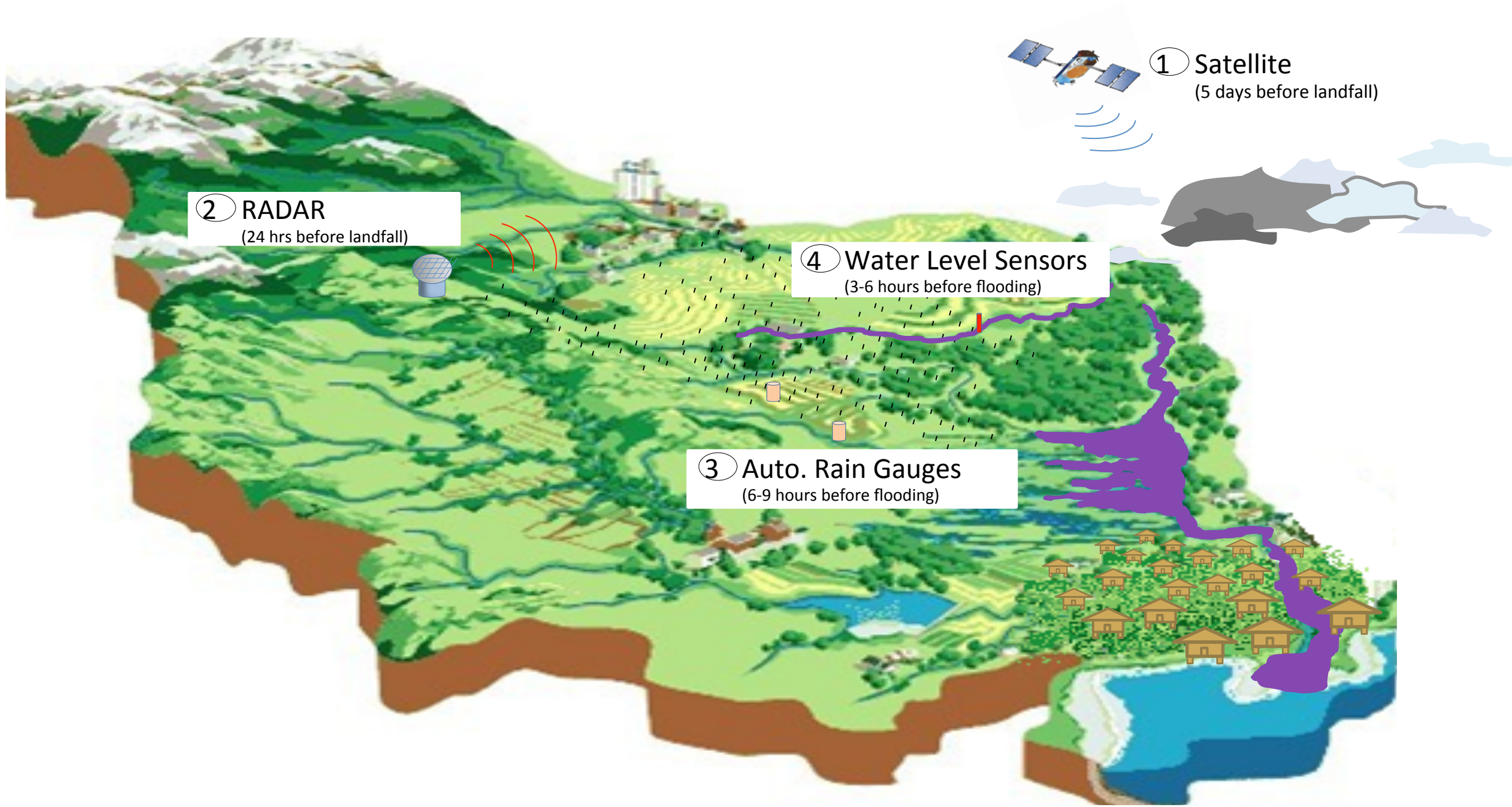
- Satellite
- RADAR
- Automated Weather Sensors
- Automated Water Level Sensors

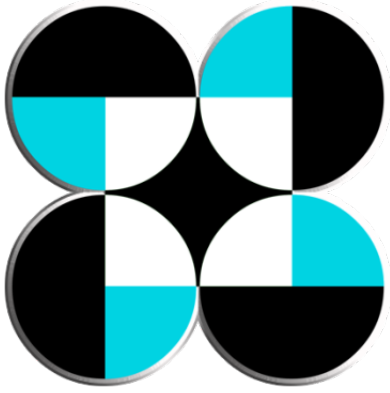
- **Forecasts**

- 4 hour rainfall
- 4 day rainfall
- Storm track

- **Information Education Campaigns**

- **Public website**

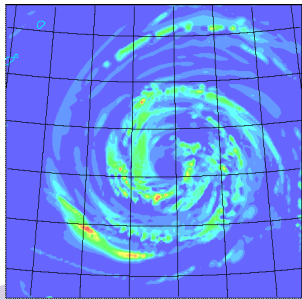




# What is the Storm Surge Component?

- SYSTEM TO IDENTIFY, QUANTIFY, AND MAP STORM SURGE THREAT TO PHILIPPINE COASTS



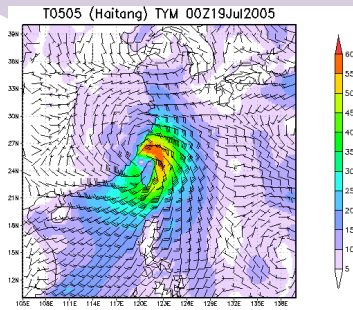


**Input**

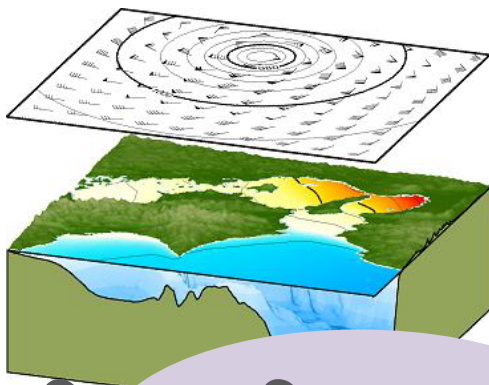
Best Track Data

or

GRIB File

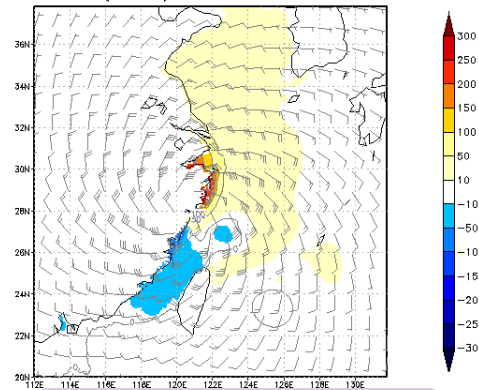


Bathymetry

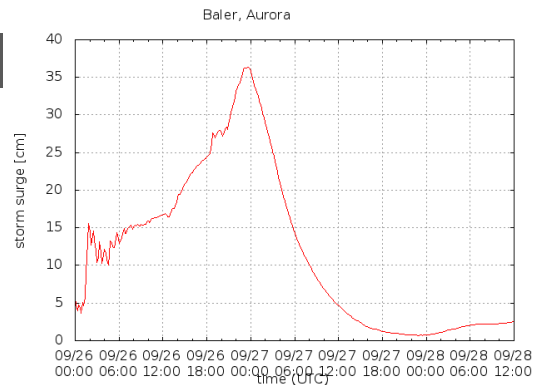


Storm Surge Model

TY Ranim (T0413) Best track 15Z12AUG2004



Storm Surge Map



Time Series

**Output**

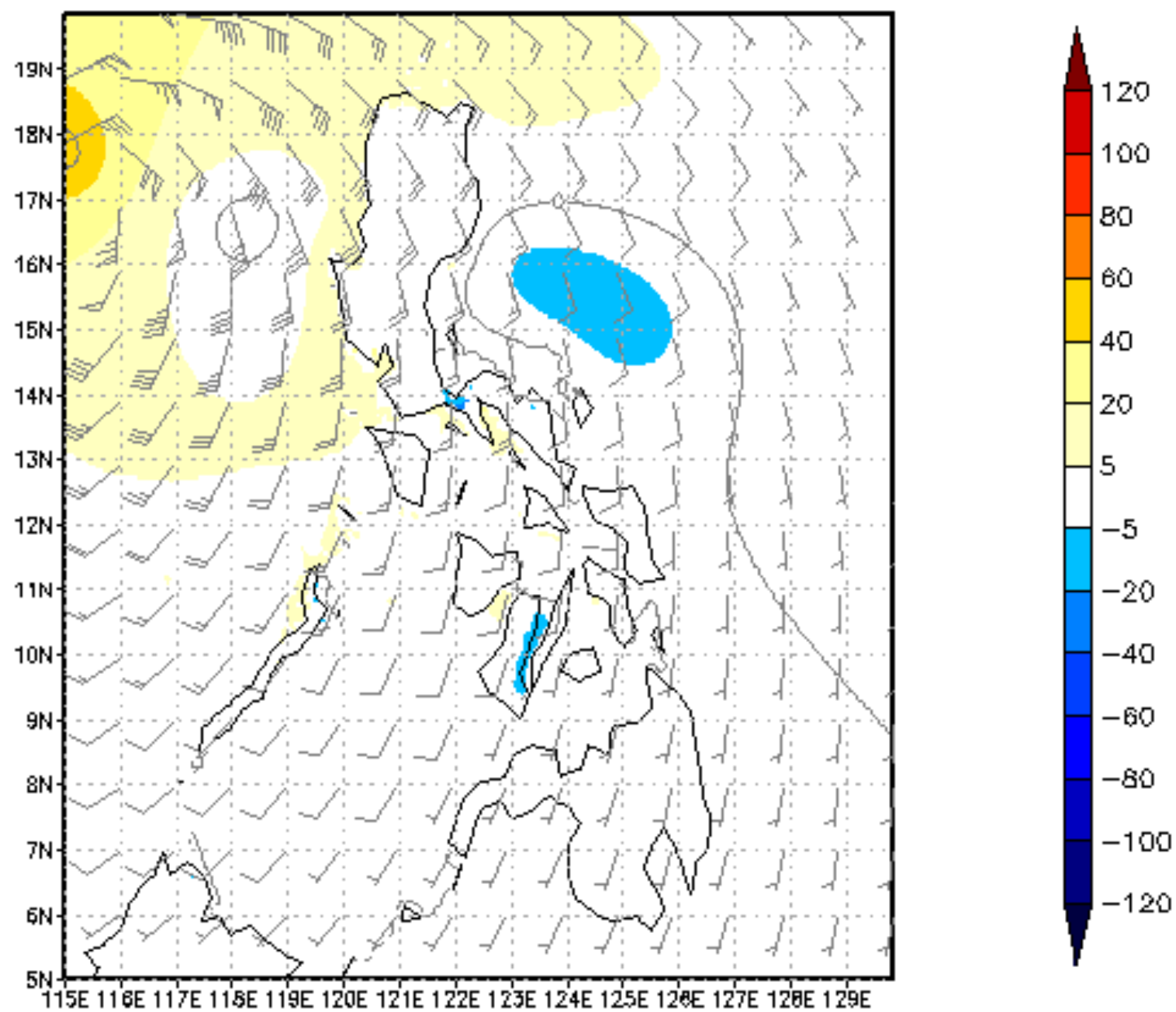
Adapted from:  
JMA Storm Surge Model  
Higaki, M.  
Office of Marine  
Prediction  
JMA



janjan@janjan-VirtualBox:~/Desktop/ss/JMA\_storm\_surge\$ ./

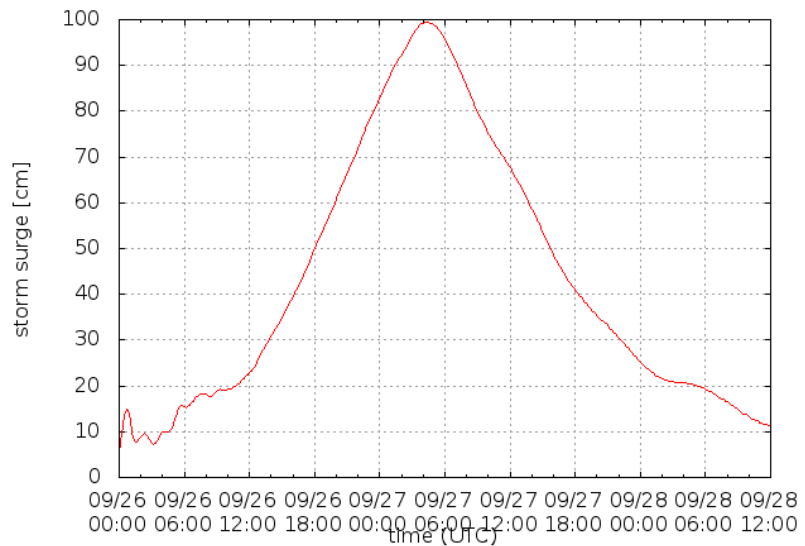


09Z28SEP2011

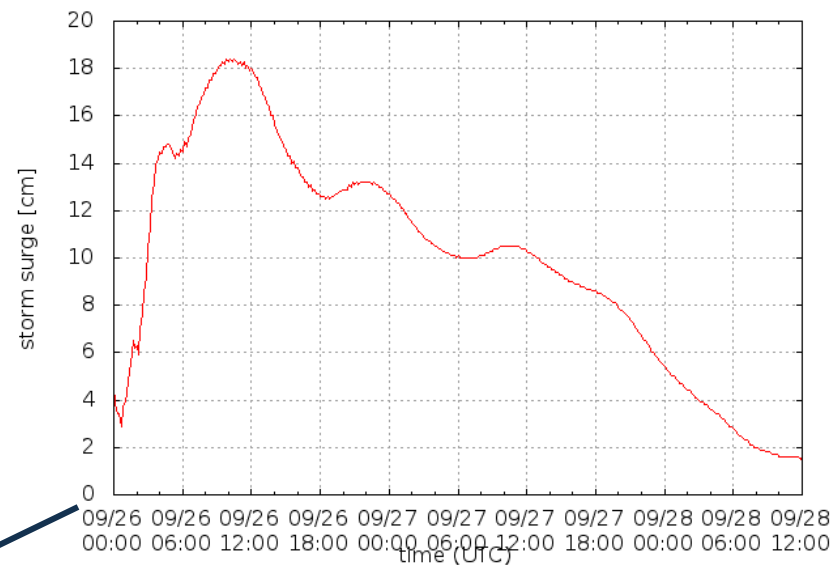




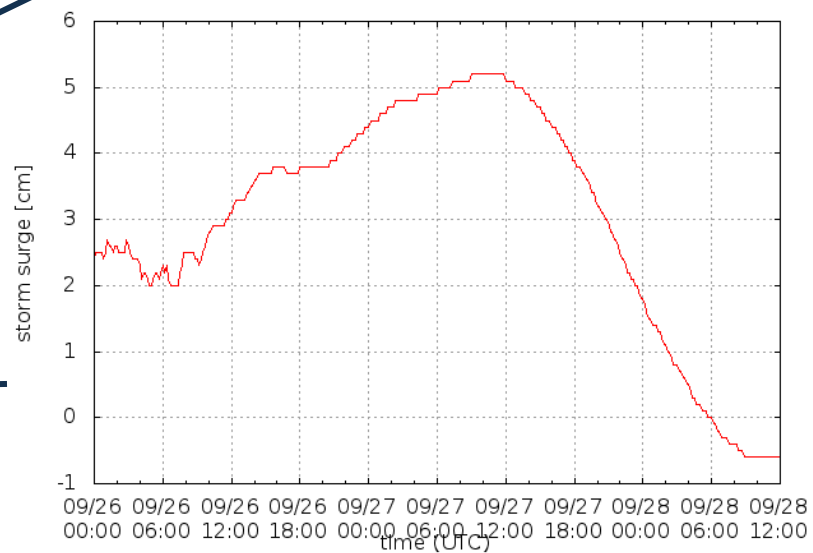
Manila Port Area, Philippines



Cebu City, Cebu



Zamboanga City, Zamboanga del Sur



Time Series



Yolanda, November 2013.



Haiyan storm track, Wikimedia Commons

▪ **2<sup>nd</sup> release: 120-hr storm surge forecasts generated for Typhoon Haiyan from 0000 UTC 06 Nov to 0600 UTC 11 Nov 2013**

**(0300 UTC 07 Nov Forecasted Track Data)**

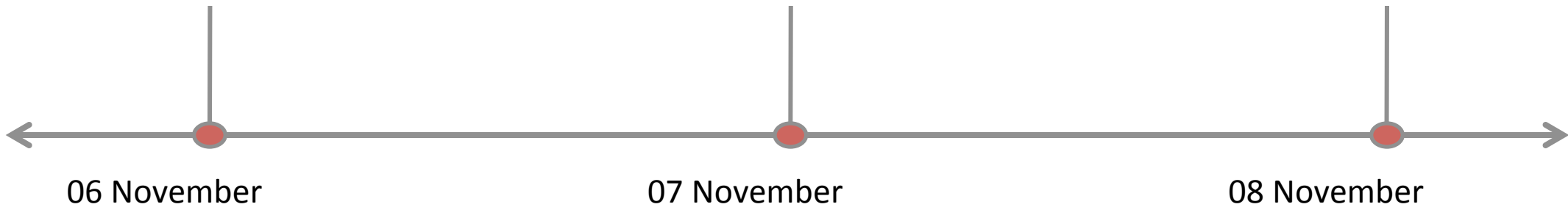
▪ **3<sup>rd</sup> release: 102-hr storm surge forecasts generated for Typhoon Haiyan from 0000 UTC 06 Nov to 0600 UTC 10 Nov 2013**

**(0900 UTC 07 Nov Forecasted Track Data)**

▪ **1<sup>st</sup> release: 96-hr storm surge forecasts generated for Typhoon Haiyan from 0000 UTC 06 Nov to 0000 UTC 10 Nov 2013**

**(0300 UTC 06 Nov Forecasted Track Data)**

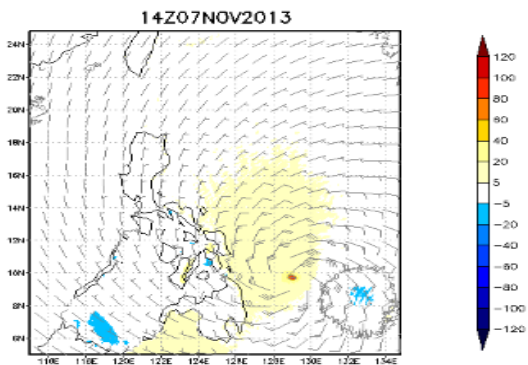
▪ **Typhoon Haiyan Landfall**





## Official list of localities: Typhoon Yolanda highest predicted storm surge and tide

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The model covers 12:00mn of 6 November 2013 to 12:00mn of 10 November 2013 (UTC). Units are in centimeters (cm).



**Project NOAH**  
Nationwide Operational Assessment of Hazards

This list is an update of today's earlier model run with more than 100 specified localities with storm surge + tide values. Updates to the simulation runs are made every 6 hours and details of the storm surge + tide heights can be seen in the [Project NOAH website](#) under the Weather Stations tab labeled YolandaPH Storm Tide Level.

Province	Location	Storm Tide (m)	Date and Time of Peak Height
Eastern Samar	Mata'nano Bay	5.3	11-08-2013 09:50
Biliran	Dona Island, Biliran Str	4.7	11-08-2013 12:10
Leyte	Tacloban, San Juanico Str	4.4	11-08-2013 11:00
Quezon	Port Pusig	4.4	11-09-2013 02:20
Eastern Samar	Andi's Island, Port Borongan	4.3	11-08-2013 09:50
Quezon	Santa Cruz Harbor	4.2	11-09-2013 02:20
Palawan	Port Barton	3.9	11-09-2013 02:00
Iloilo	Sarante	3.9	11-09-2013 02:10
Leyte	Palompon	3.6	11-08-2013 12:40
Leyte	Ormoc	3.8	11-08-2013 13:20
Eastern Samar	Mata'nano Bay	3.7	11-08-2013 09:10

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- [Briefing: Typhoon Glenda \(as of 21 July 2014\)](#)
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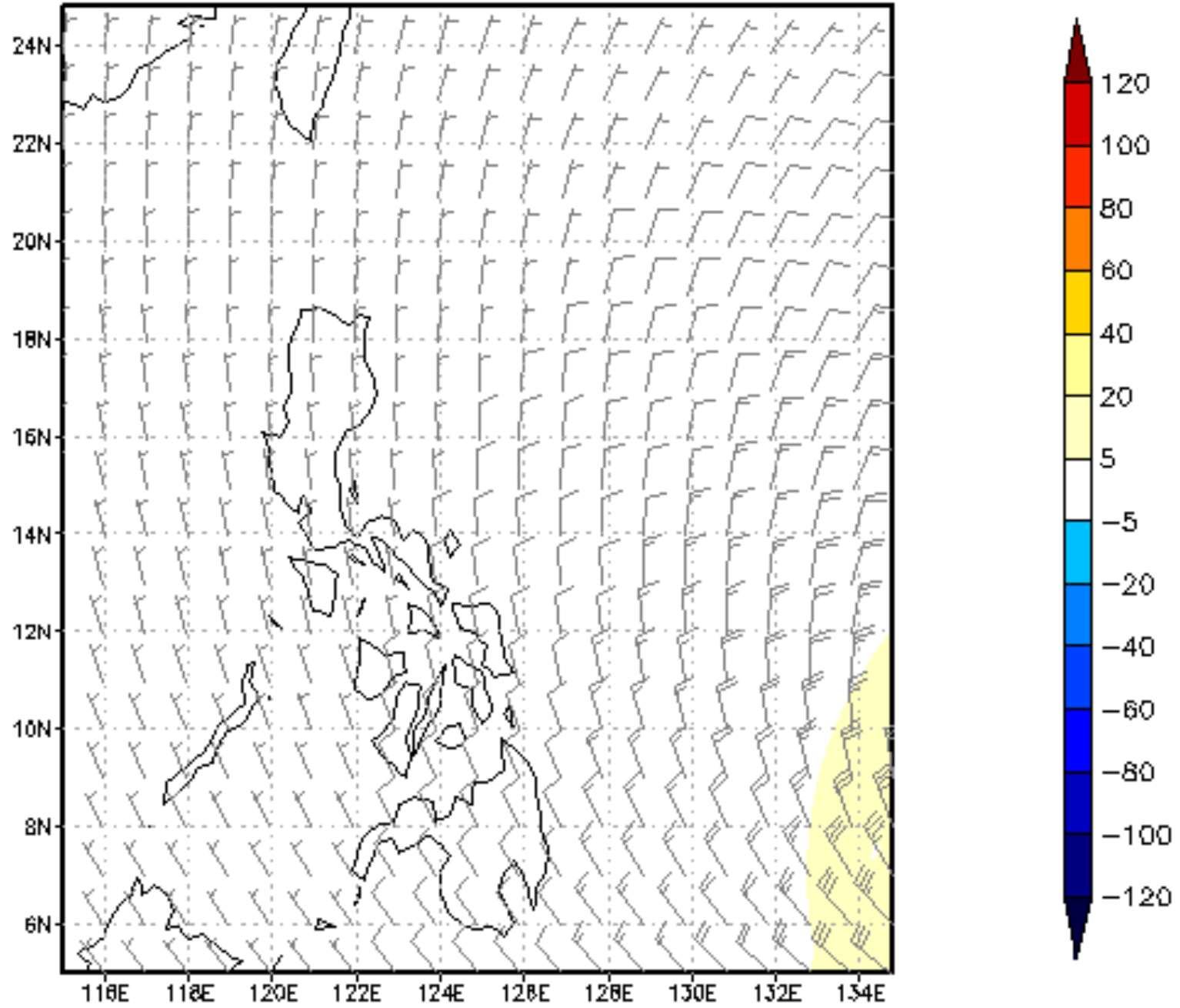
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00Z06NOV2013

Typhoon  
Haiyan  
JMA  
Storm  
Surge  
Simulation  
(height in cm)

(Released  
November 6,  
2013)





# Typhoon Haiyan Highest Predicted Storm Surge and Tide



## Project NOAH Nationwide Operational Assessment of Hazards

This list is an update of today's earlier model run with more than 100 specified localities with storm surge + tide values. Updates to the simulation runs are made every 6 hours and details of the storm surge + tide heights can be seen in the [Project NOAH website](#) under the Weather Stations tab labeled YolandaPH Storm Tide Level.

Province	Location	Storm Tide (m)	Date and Time of Peak Height
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Biliran	Poro Island, Biliran Str	4.7	11-08-2013 12:10
Leyte	Tacloban, San Juanico Str	4.5	11-08-2013 11:00
Quezon	Port Pusgo	4.4	11-09-2013 02:20
Eastern Samar	Andis Island, Port Borongan	4.3	11-08-2013 09:30
Quezon	Santa Cruz Harbor	4.2	11-09-2013 02:20
Palawan	Port Barton	3.9	11-09-2013 02:00
Iloilo	Banate	3.9	11-09-2013 02:10
Leyte	Palompon	3.9	11-08-2013 12:40
Leyte	Ormoc	3.8	11-08-2013 13:20
Northern Samar	Helm Harbor, Gamay Bay	3.7	11-08-2013 09:10
Cebu	Tuburan	3.2	11-08-2013 12:20
Negros Occidental	Himugaan River Entr	3.1	11-08-2013 14:00
Negros Occidental	Cadiz	3.0	11-08-2013 03:10
Masbate	Bogo Bay	3.0	11-08-2013 12:50
Camarines Sur	Cabagan Island, San Miguel Bay	2.9	11-08-2013 08:10

List of predicted storm tide levels for 68 coastal areas was sent to the Philippine National Risk Reduction and Management Council (NDRRMC) and the Office of Civil Defense (OCD) on November 6, 2013.

## [English] Statement of President Aquino on typhoon Yolanda, November 7, 2013

Published: November 7, 2013.

Statement  
of  
His Excellency Benigno S. Aquino III  
President of the Philippines  
On Typhoon Yolanda

[This is an English translation of the [statement delivered](#) at Malacañan Palace on November 7, 2013]

Good evening. We have just spoken to experts from DOST, PAGASA, and the Mines and Geosciences Bureau, who gave us the latest data on the current typhoon, as well as its projected effect on the country.

As you know, Yolanda has entered the Philippine Area of Responsibility. As with last year's Typhoon Pablo, I thought it best to speak to you to emphasize the gravity of the calamity our countrymen will face in these coming days, and to ask of everyone cooperation and solidarity.

Storm signal number 4 has been—and will be—raised over some areas because of this typhoon. Current data indicates that Yolanda will be stronger than Pablo; we pray that because of its speed, it will not linger over any of our provinces and intensify the damage. The typhoon has a 600-kilometer diameter. We expect it to make landfall on Samar and Leyte by midnight; it will traverse the provinces of Masbate, Cebu, Panay, Romblon, Mindoro, and Palawan, before it completely leaves the Philippine Area of Responsibility on Saturday night. Aside from strong winds, rain, the overflowing of our rivers, and the possibility of lahar in areas near the Mayon and Bulusan volcanoes, we are likewise monitoring the threat of storm surges in more than a hundred areas: Storm surges are expected in Ormoc, Ginayangan Ragay Gulf in Albay, and Lamon Bay in Atimonan. Waves in these areas may reach five to six meters.

Secretary Volts Gazmin and DILG Secretary Mar Roxas are already in Leyte to oversee preparations. All of our Disaster Risk Reduction and Management Councils—from the national, regional, and down to the municipal and city levels—are also making their own

## Aquino: PH ready to face supertyphoon 'Yolanda'

By Kristine Angeli Sabillo | INQUIRER.net 8:17 pm | Thursday, November 7th, 2013



President Benigno Aquino III AP FILE PHOTO

MANILA, Philippines — President Benigno Aquino III on Thursday assured the public of the government's readiness to face supertyphoon "Yolanda" which will directly hit Samar and Leyte at midnight.

Aquino said in a televised speech that the country's C130 aircrafts are fully mission capable to respond to those in need, adding that 32 airplanes and helicopters from the Air Force are on standby together with the Philippine Navy's 20 ships which are positioned in Cebu, Bicol, Cavite and Zamboanga.

He said that relief goods are also pre-positioned in many of the areas expected to be affected by the supertyphoon.

Disaster Risk Reduction and Management Councils, both national and local, have also been activated to mitigate the effects of the typhoon.

"Yolanda" is expected to bring winds and rain stronger than "Pablo," the last supertyphoon to hit the Philippines with wind speeds up to 280 kilometers per hour.

With a 600-kilometer diameter, the storm will most likely hit the provinces of Samar, Leyte, Masbate, Cebu, Panay, Romblon, Mindoro, and Palawan before leaving the Philippine area of responsibility Saturday evening.

Aquino warned the public of strong winds, rain and overflowing of bodies of water, in addition to the possibility of lahar and mudflows near Mayon and Bulusan volcanoes.

**"Storm surges in Ormoc, Ginayangan Ragay Gulf in Albay and Lamon Bay in Atimonan will bring grave danger. And waves in these areas may reach up to five to six meters high," Aquino said.**

The President advised Filipinos to monitor the websites of the *Philippine Atmospheric, Geophysical and Astronomical Services Administration*, Mines and Geosciences Bureau, and Project NOAH to determine which communities will be affected by the storm.

"Let this be a warning to local government units: Your constituents are facing grave danger. Let us do all we can while 'Yolanda' has yet to make landfall," he said.

Aquino asked the public to remain calm and to cooperate.

"Coordinate with and follow authorities. Evacuate if your area is in danger. To those near the shore: do not head towards the open sea," he said.

Aquino said Defense Secretary Voltaire Gazmin and Interior Secretary Manuel "Mar" Roxas II are in Leyte to supervise preparations when the storm makes landfall in the province.

*"... we are likewise monitoring the threat of storm surges in more than a hundred areas. Storm surges are expected in Ormoc, Ginayangan Ragay Gulf in Albay, Lamon Bay in Antimonan. Waves in these areas may reach five to six meters". – Pres. Aquino*

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**'Yolanda' to generate up to 17 feet storm surge**

By Louis Sacani (philstar.com) | Updated November 8, 2013 - 12:32am

Tweet 45 | Share 235 | googleplus 26 | Email



MANILA, Philippines - Super typhoon "Yolanda" will make landfall where high storm surges and tides have been predicted.

According to the latest data of the Department of Science and Tech (Nationwide Operational Assessment of Hazards), storm surges and meters (17 feet) is forecast in Ormoc, Leyte.

A total of 68 localities where storm surges have been predicted wh updated list.

"Kung kayo po ay nasa listahan ng predicted storm surge areas, se mapanganib ang alon ng dagat," Project NOAH's Dr. Mahar Lagm

In a televised address on Thursday evening, President Benigno Ac monitoring the threat of storm surges in more than a hundred area

"Storm surges are expected in Ormoc, Ginayangang Ragay Gulf in Atimonan. Waves in these areas may reach five to six meters," he

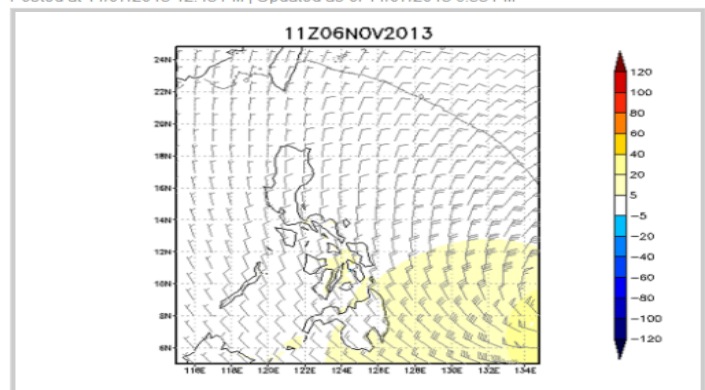
At 11 p.m. Thursday, Yolanda was spotted at 250 kilometers east Samar bearing maximum winds of 225 kilometers per hour near th knh

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**Storm signals in 42 areas due to 'Yolanda'**

By Dharel Placido, ABS-CBNnews.com  
 Posted at 11/07/2013 12:43 PM | Updated as of 11/07/2013 6:53 PM



A 72-hr storm surge forecast generated using Japan Meteorological Agency (JMA) numerical model. The model covers 12:00 mn of 6 November 2013 to 12:00 mn of 9 November 2013 (UTC). The legend indicates storm surge height in centimeters. Image from Project NOAH.

MANILA – Public storm warning signals have been raised in 42 areas as super typhoon "Yolanda" barrels towards the Philippines, weather bureau PAGASA said Thursday.

In its 11 a.m. update, PAGASA said Eastern Samar, Samar, Leyte, Southern Leyte, Siargao Island, and Dinagat Island have been placed under signal no. 3. These areas should experience 101-185 kilometers per hour (kph) winds in the next 18 hours.

Under signal no. 2 are Sorsogon, Masbate, Ticao Island, Northern Samar, Biliran Province, Bantayan Island, Camotes Islands, Northern Cebu, Cebu City, Bohol, Surigao Del Norte, Camiguin, Surigao Del Sur, and Agusan Del Norte.

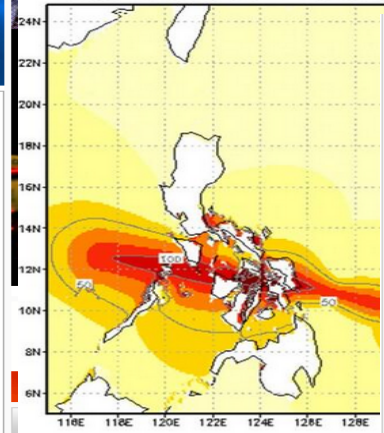
Camarines Norte, Camarines Sur, Catanduanes, Albay, Occidental Mindoro, Oriental Mindoro, Burias Island, Romblon, Marinduque, Calamian Group of Islands, Southern Quezon, Aklan, Capiz, Guimaras, Negros Occidental, Negros Oriental, Rest of

Track forecast for Typhoon Haiyan (Joint Typhoon Warning Center)

The ferocious storm, known as Yolanda in the Philippines, poses three clear and present dangers to life and property:

- 1) Storm surge: Haiyan's wind and waves will push ashore a wall of water, likely exceeding 10 feet just north of the center. This will lead to devastating coastal inundation and flooding of low lying areas.

00Z06NOV2013 – 00Z09NOV2013



Anthony Sagliani @anthonywx  
 MA surge model shows immense wate #YolandaPH/#Haiyan moves through.  
 2:54 PM - 7 Nov 2013  
 7 RETWEETS 5 FAVORITES

uartz's Holthaus adds this detail:

The country's meteorological service,

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**WATCH: How super typhoon Yolanda will hit Philippines**

ABS-CBNnews.com  
 Posted at 11/07/2013 2:30 AM | Updated as of 11/07/2013 2:42 AM


Typhoon Yolanda  
 Initiated on Nov 05 2013, 06 PST

3-hr Rainfall (mm)  
 0:00 / 0:07  
 YouTube

The Department of Science and Technology's Project Nationwide Operational Assessment of Hazards (NOAH) on Wednesday night uploaded a video simulation created by the UK's Met Office showing how super typhoon Haiyan (Yolanda) will slam into the country.

Project NOAH, in its blog, also listed hundreds of towns in Luzon, Visayas and Mindanao that will be affected by 60 mm to 100 mm 3-hour accumulated rainfall that will be brought by the tropical cyclone.

Project NOAH head Dr. Mahar Lagmay also issued a storm surge threat warning for coastal areas in the path of the typhoon.

ver Me  project NOAH

**Project NOAH**  
ng bagyong #YolandaPH. — **Project NOAH**  
#DobolBBalitangBalita  
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**oempa loompa** @tekhelet · Nov 7  
**Storm surge** data @jamewils RT @Ants\_SNEweather: This is fantastic DOST - **Project NOAH** noah.dost.gov.ph  
Expand Reply Retweet Favorite More

**Mik-Mik San Miguel** @mhikeSM · Nov 7  
#YolandaPH to generate up to 17 feet **storm surge**, tides acc. to DOST **Project NOAH** #PrayforThePhilippines philstar.com/nation/2013/11...  
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**PIA Neg Occ** @PIANegOcc · Nov 7  
Warning **storm surge**: see **Project Noah** website for areas affected.  
Updates to the simulation  
Expand

Followed by PIA Capiz  
**PIS BFP6** @bfp6\_pis · Nov 7  
#YolandaPH **storm surge** 3.8 meters. Libas, Capiz  
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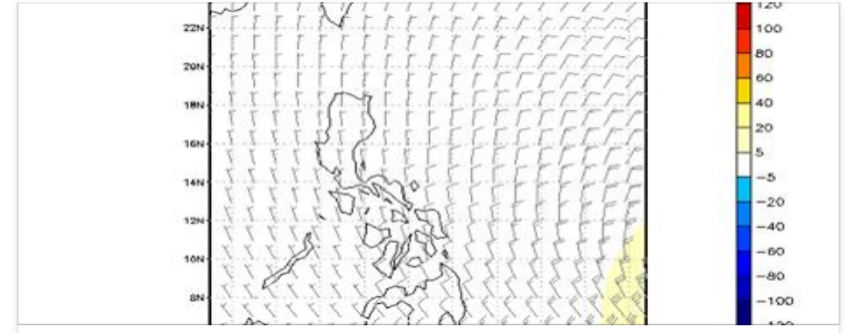
Retweeted by Barbie  
**Cebu Daily News** @cebudailynews · Nov 7  
WARNING: Highest **storm surge** tomorrow. #YolandaPH | v...  
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**Jojo Pasion Malig** @JojoPasionMalig · Nov 7  
**Project Noah** predicts '... Eastern Samar blog.noah...  
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**TJ Manotoc** @tjmanotoc · Nov 7  
Good lord. Parang Tsun... feet **storm surge** along...  
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**MetroTimes** @llo2MetroTimes · Nov 6  
Predicted **storm surge** height for coastal areas of Ormoc City on 8 November 2013. via Mahar Lagmay of **Project NOAH**... fb.me/6zKgq8Lfb  
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Jun Gonzales posted about this.





**Typhoon Yolanda highest predicted storm surge and tide - Capiz News**  
The list of places and graph with the details of high tide and its peak and...


**Cebu Daily News**  
November 7, 2013 ·  Like Page

WARNING: Highest storm surge in Tuburan, #Cebu: 3.2 m high at 12:20 nn tomorrow. #YolandaPH| via Project Noah <http://ow.ly/qAbOW>

**Typhoon Yolanda highest predicted storm surge and tide | Project NOAH Blog**  
Typhoon Yolanda highest predicted storm surge and tideYowee Gonzales / ...  
BLOG.NOAH.DOST.GOV.PH

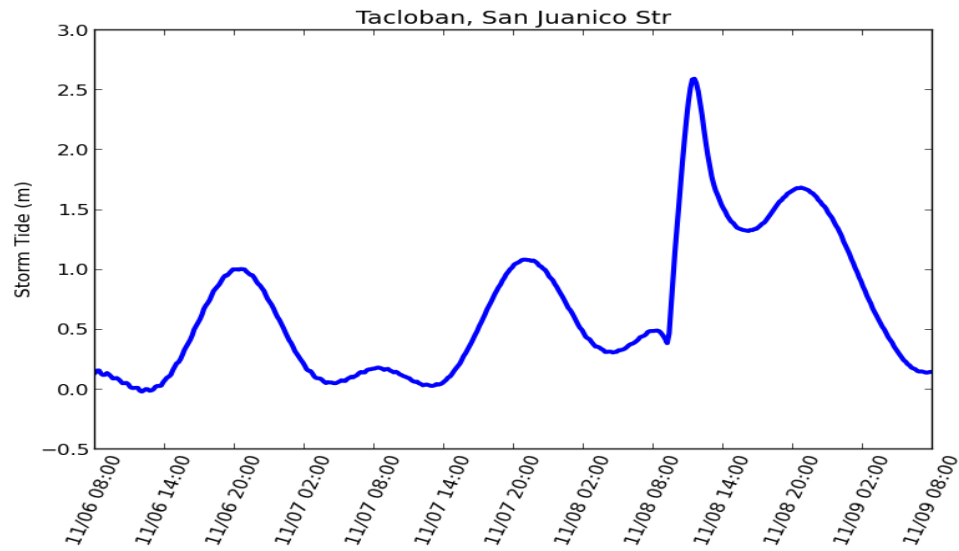
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Jun Gonzales ▸ **Capiz Facebook Community**  
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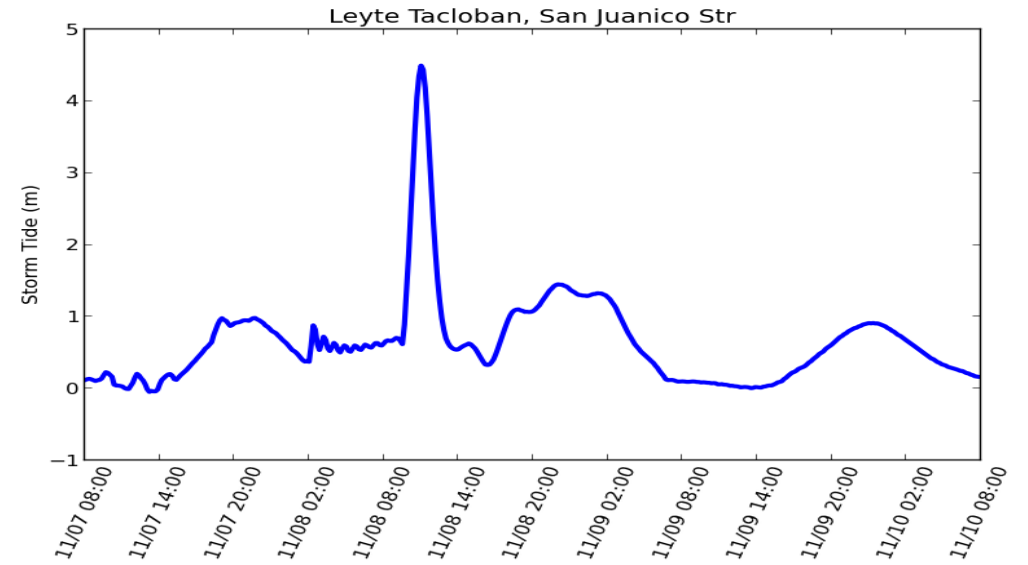
**PIA News Desk**  
November 7, 2013 ·  Like Page

RT @nababaha: #YolandaPH highest predicted storm tide  
<http://t.co/jN5DJQGbRq>

**Typhoon Yolanda highest predicted storm surge and tide | Project NOAH Blog**  
Typhoon Yolanda highest predicted storm surge and tideYowee Gonzales / 1...  
BLOG.NOAH.DOST.GOV.PH



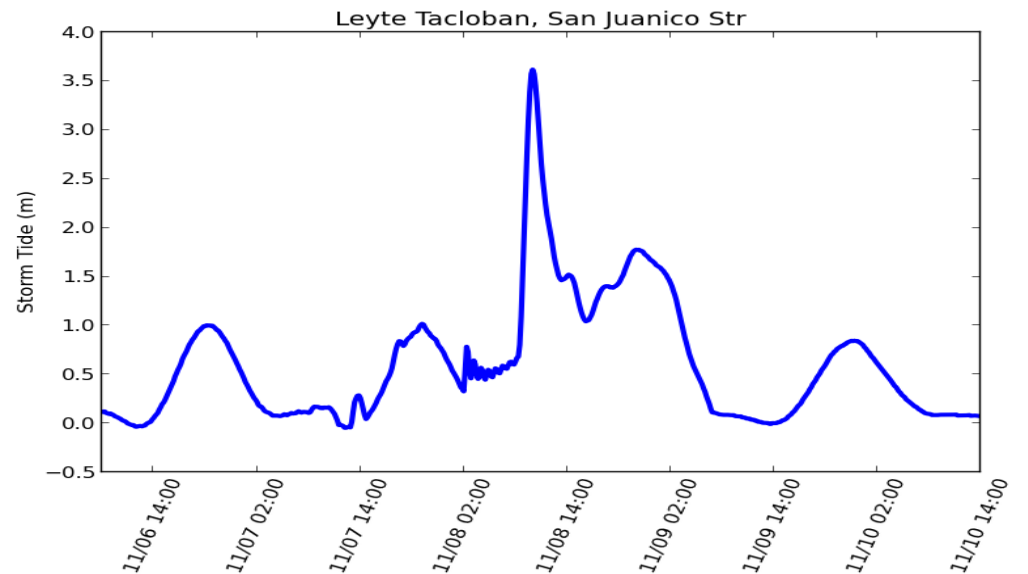
Time series plot using 0300 UTC 06 Nov JMA Forecasted Track Data



Time series plot using 0300 UTC 07 Nov JMA Forecasted Track Data



Tide Station: San Juanico Strait, Tacloban City, Leyte



Time series plot using 0900 UTC 07 Nov JMA Forecasted Track Data

Eyewitness footage of Typhoon Haiyan washing house away

<http://www.youtube.com/watch?v=rS0gv4Xbw7w>





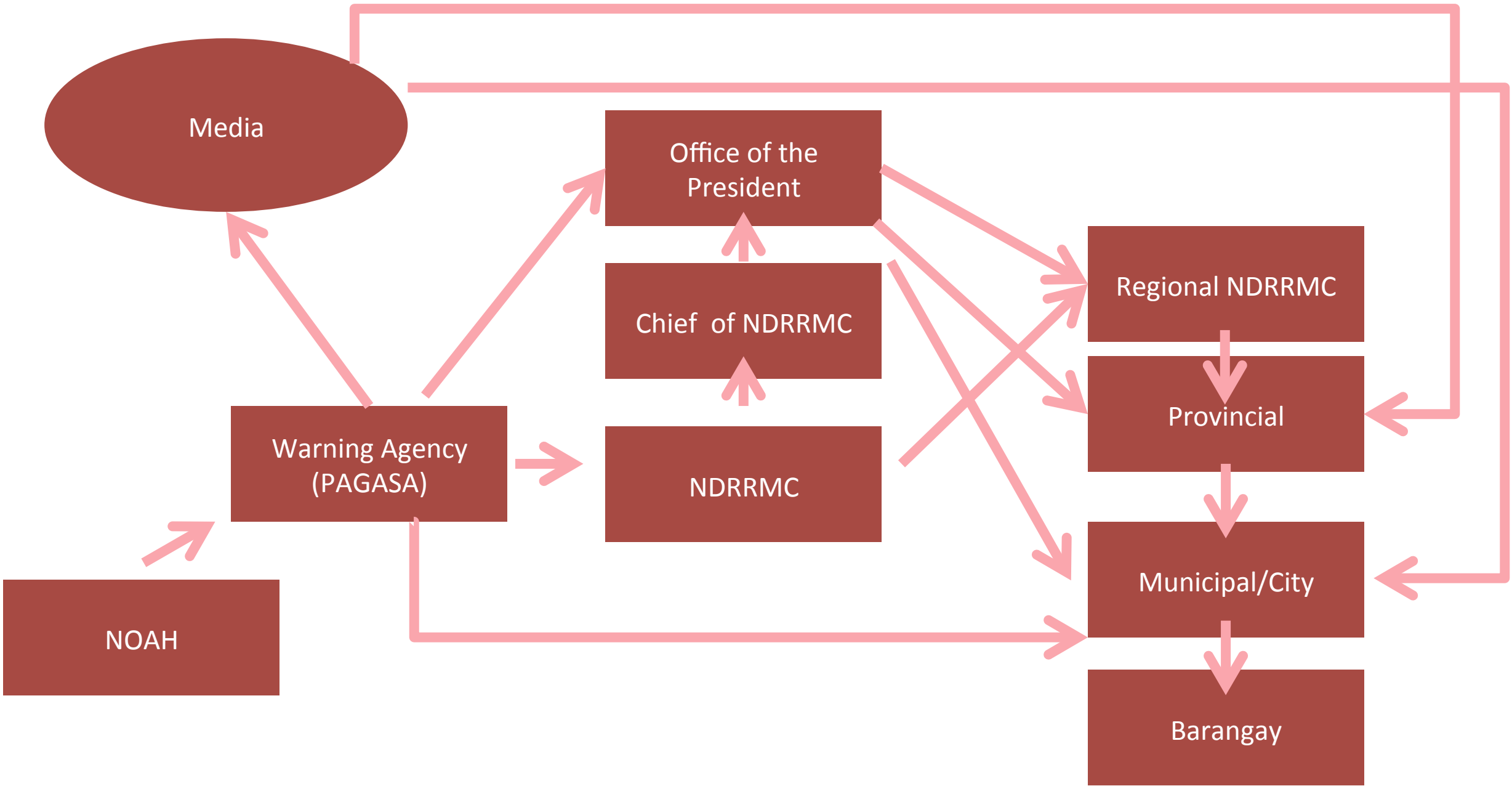
**6,201 dead  
28,626 injured  
1,785 still missing**

**PhP 39,821,497,852.17 worth of damages  
(USD 905,754,702.602 )**

*As of 14 January 2014  
According to National Disaster Risk Reduction Management Council (NDRRMC)*

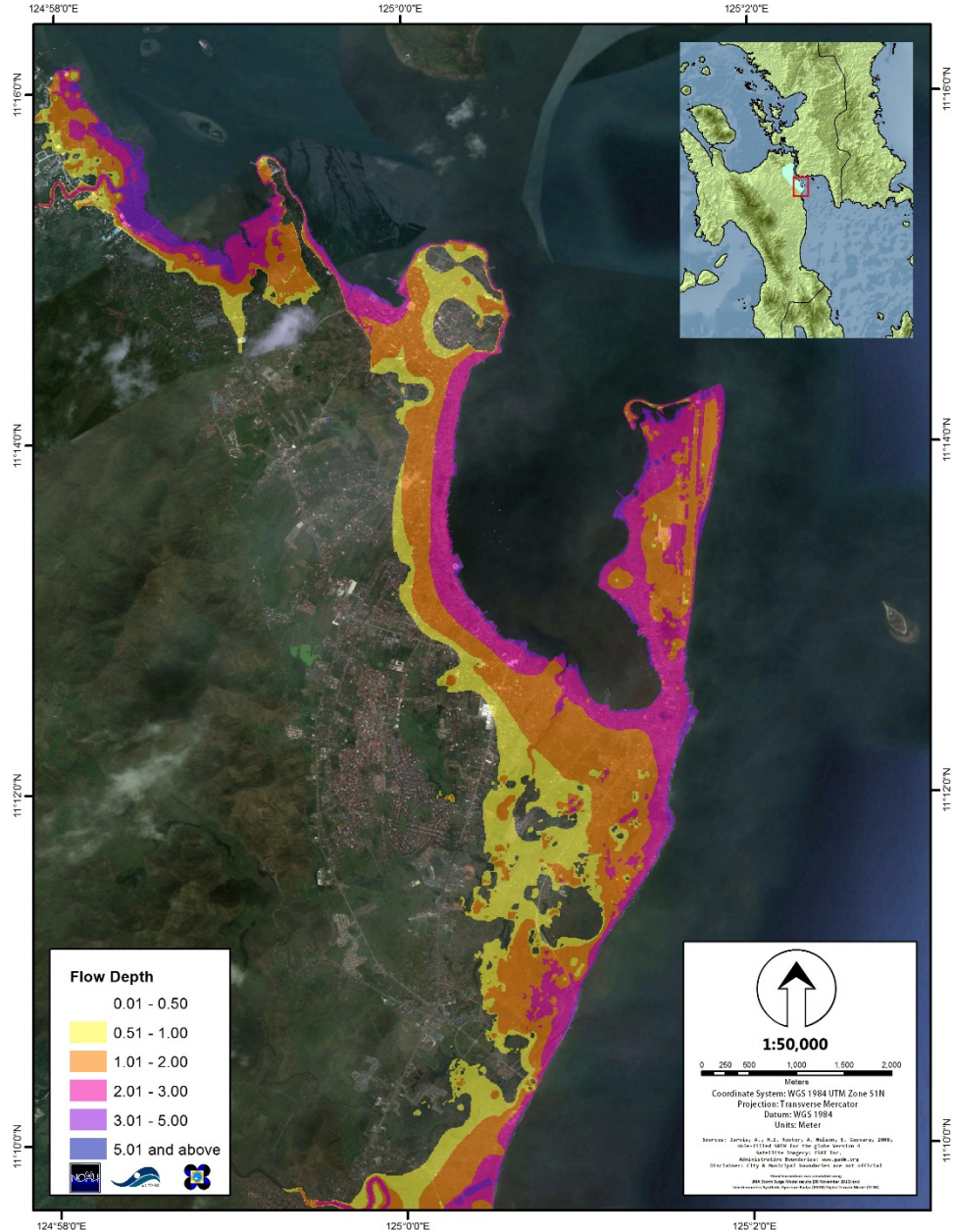
*Photos from rappler.com and bbc.co.uk*





# TYPHOON YOLANDA STORM SURGE + TIDE INUNDATION TACLOBAN CITY, LEYTE

## Tacloban City Inundation Map Using IfSAR



124°58'0"E

125°0'0"E

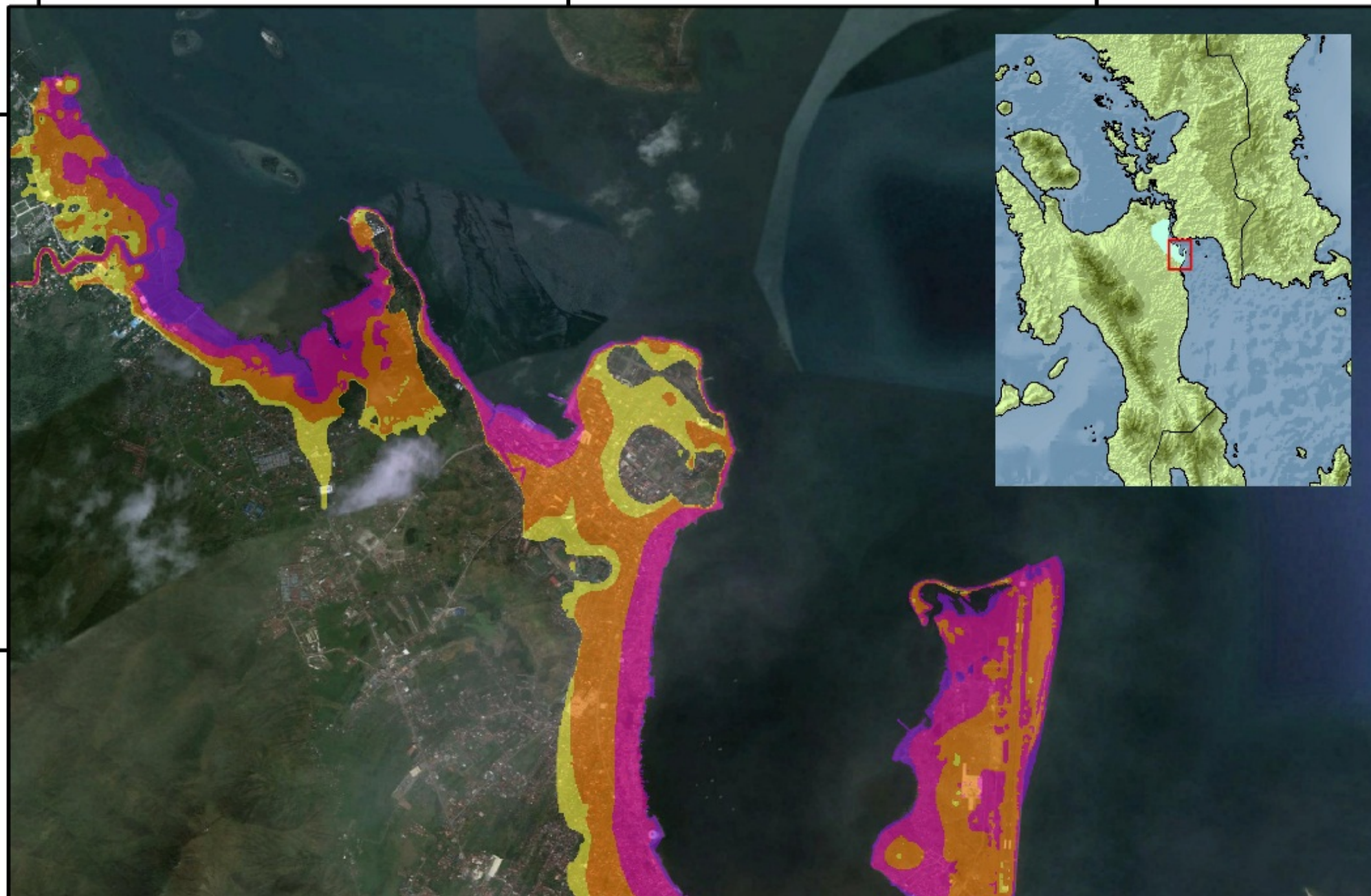
125°2'0"E

11°16'0"N

11°16'0"N

11°14'0"N

11°14'0"N



11°12'0"N

11°12'0"N

11°10'0"N

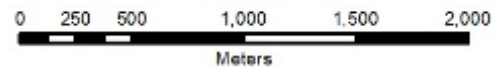
11°10'0"N

### Flow Depth

- 0.01 - 0.50
-  0.51 - 1.00
-  1.01 - 2.00
-  2.01 - 3.00
-  3.01 - 5.00
-  5.01 and above



**1:50,000**

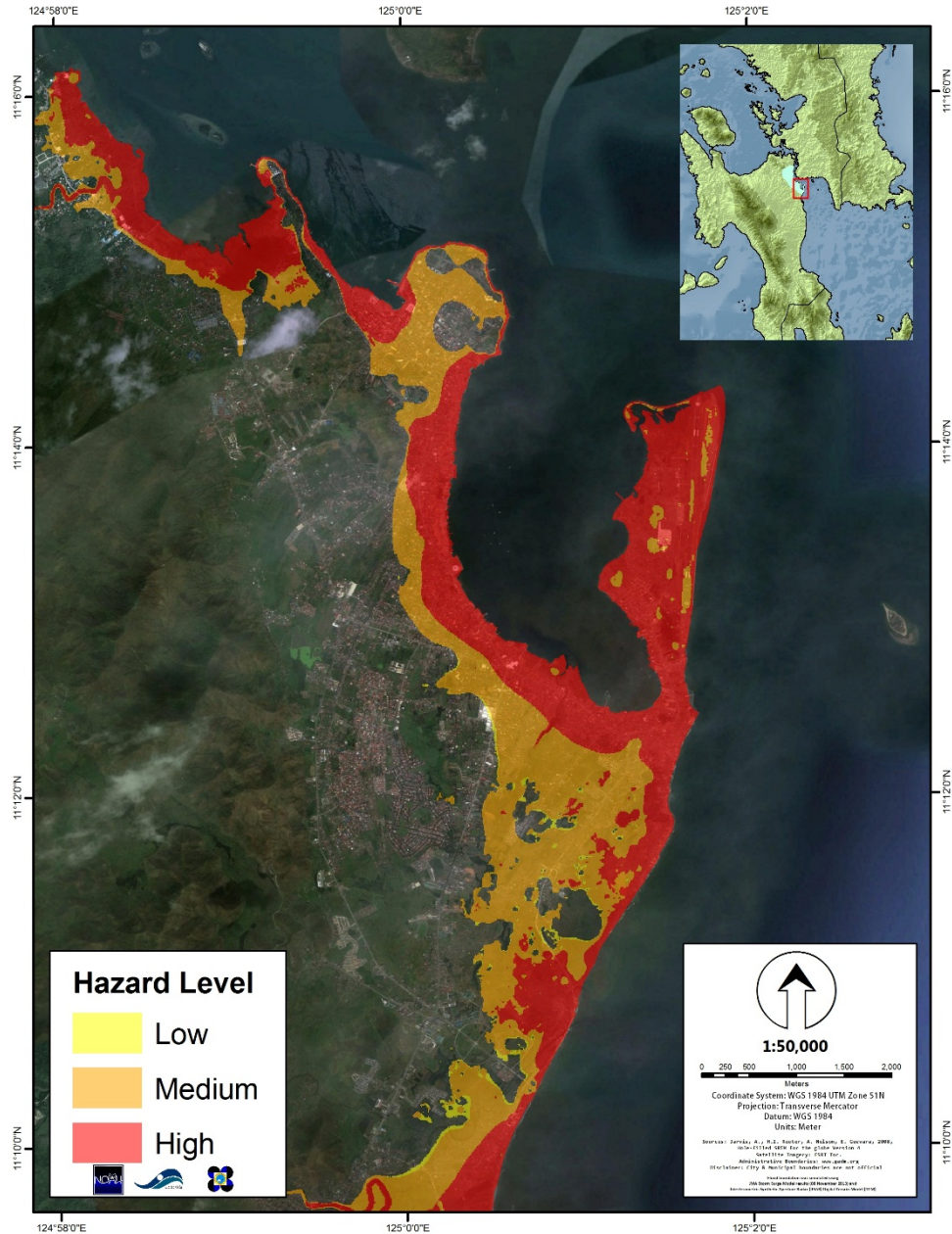


Coordinate System: WGS 1984 UTM Zone 51N  
 Projection: Transverse Mercator  
 Datum: WGS 1984  
 Units: Meter

Source: Jarvis, A., H.I. Reuter, A. Nelson, E. Guevara, 2008, *Multi-Resolution MERIT*, Version 1, <http://www.merit-project.org/>  
 Satellite Imagery: ESRI Inc.  
 Administrative Boundaries: [www.gulfport.org](http://www.gulfport.org)  
 Disclaimer: City & Municipal boundaries are not official  
 Model boundaries was created using:  
 JMA Storm Surge Model results (30 November 2012) and  
 NOAA Coastal System Response Model (CSRM) Digital Terrain Model (DTM)

# TYPHOON YOLANDA STORM SURGE HAZARD MAP TACLOBAN CITY, LEYTE

## Tacloban City Hazard Map Using IfSAR



124°58'0"E

125°0'0"E

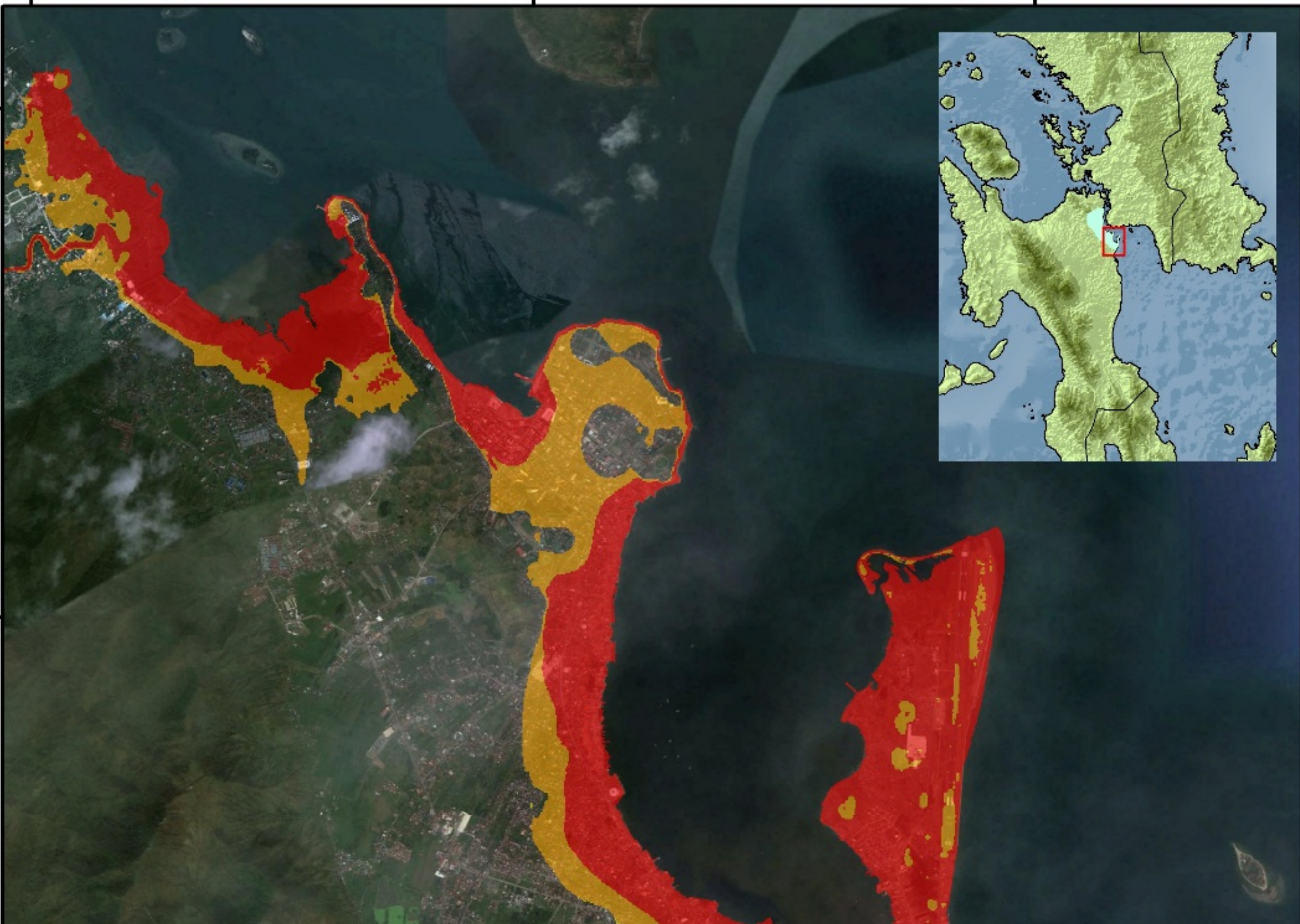
125°2'0"E

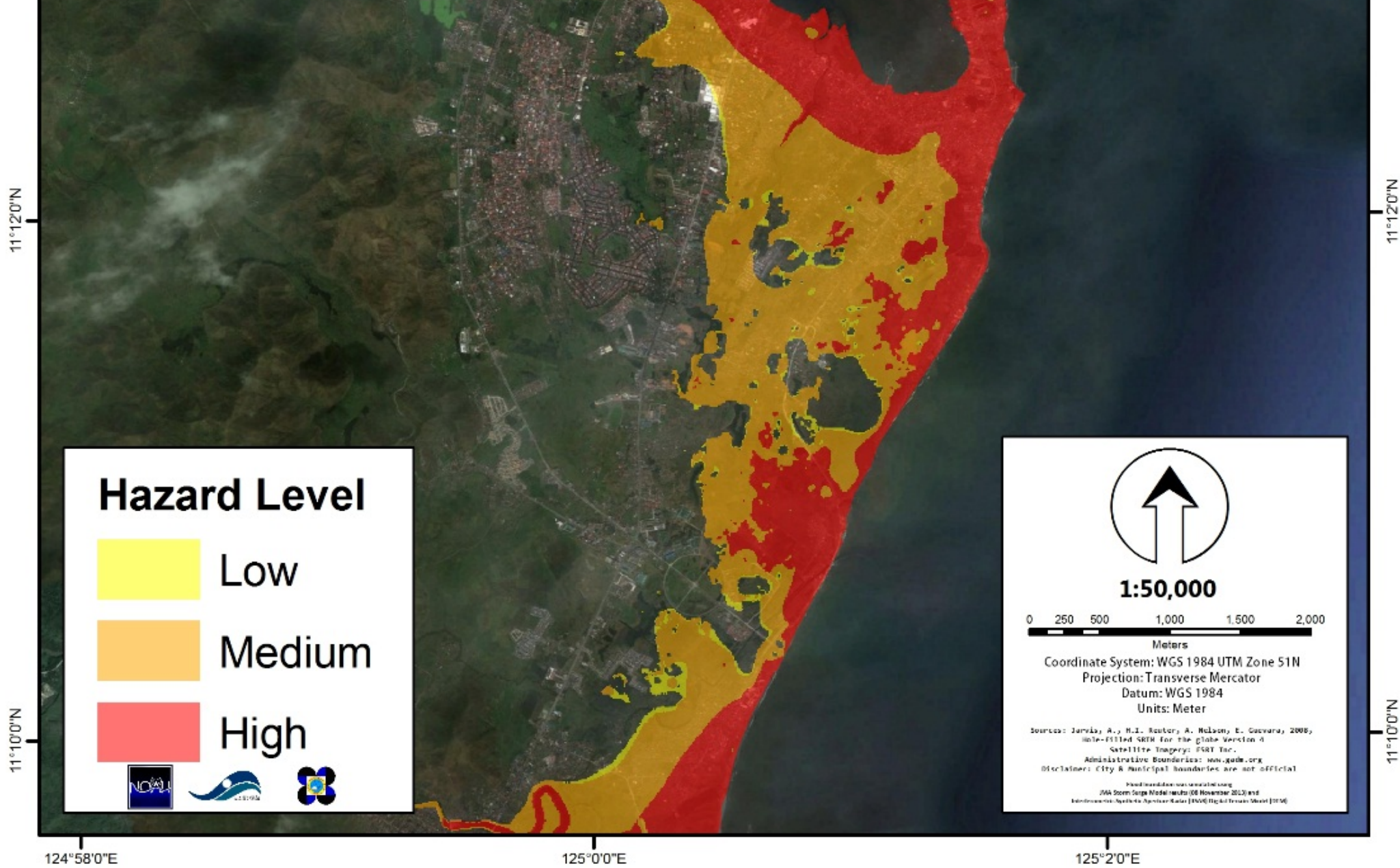
11°16'0"N

11°16'0"N

11°14'0"N

11°14'0"N





Date	Number of Pageviews	Event
1. November 8, 2013	117,821	Typhoon Yolanda
2. November 7, 2013	100,267	Typhoon Yolanda
3. December 4, 2012	89,445	Typhoon Pablo
4. July 15, 2014	59,315	Typhoon Glenda
5. August 20, 2013	49,250	Typhoon Maring

Project NOAH website dates of highest number of visits



# Stages in the Philippine Disaster Law


1. Prevention and Mitigation
2. Preparedness
3. Rehabilitation
4. Recovery

# In Glenda's aftermath, Albay records zero casualty

July 16, 2014 1:17pm

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1330

 g+1

0

Tags: Albay

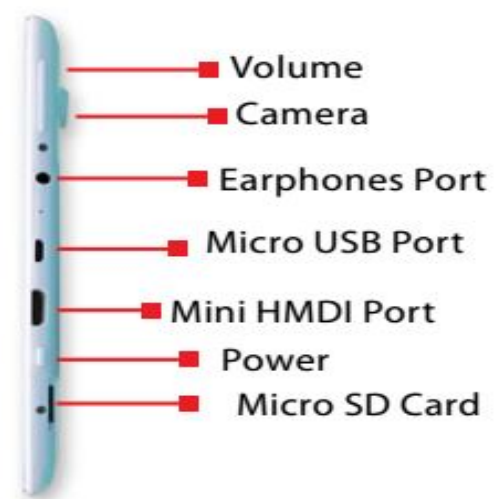
Although it was one of the provinces first hit by Typhoon Glenda (Rammason), Albay recorded zero casualty in the aftermath of the weather disturbance.

At a press conference on Wednesday afternoon, Albay Governor Joey Salceda said some of his constituents sustained only minor injuries due to strong winds and heavy rainfall brought by Glenda.

"Zero casualties. May mangilan-ngilang injuries pero hindi naman nirereport officially rito sa opisina," Salceda said during a briefing aired over GMA News TV's "Balitanghali."



**Sea travel canceled as 'Glenda' nears Albay.** Passengers bound for the island province of Catanduanes are stranded at the Tabaco Port in Tabaco City, Albay on Monday, July 14. The Philippine Coast Guard has canceled the trips of interisland vessels due to Typhoon Glenda. Storm Signal No. 3 is up Tuesday over Catanduanes, Albay, Sorsogon, Camarines Sur, Burias and Ticao Islands, and Northern Samar as Glenda was spotted 270 km east of Legazpi City, moving westwards at 20



Reset  
Dual SIM Slot

ITEM	PURPOSE
1. Camera	Capture images
2. Volume Controls	Increase or decrease audio sound
3. Power Button	Switch the device On/Off
4. Earphones Port	Connect to earphones or speakers
5. Micro USB Port	Connect to power adapter for charging
6. Mini HDMI Port	Connect HDMI cable to LCD screen for bigger image display
7. Micro SD Card Slot	Place the SD Card in the Tablet
8. Dual SIM Slot	Place SIM card
9. Reset	Force reset the Tablet

Tablet

# NOAH Version 2.0

The screenshot displays the NOAH Version 2.0 web application. At the top, the browser address bar shows the URL `54.255.61.179/#/`. The application header includes the NOAH logo, the text "DOST Project NOAH<sup>beta</sup>", and "Like" and "Share" buttons. Navigation links for "Home", "Blog", and "About" are also present. A search bar with the placeholder "Find a place..." and a "Google Maps Roadmap" button are located above the map. The map itself shows the Philippines with various cities and regions labeled, including Luzon, Mindanao, and the Spratly Islands. A vertical toolbar on the left side of the map contains several icons for map navigation and data visualization. At the bottom of the map, there is a data overlay showing rainfall information: "Rainfall Data as of 06/25/14 03:50 PM: Capiz, Brgy. Codingle : 30.48 mm/hour Capiz, Tapaz Bridge : 5.842 mm/hour". The footer of the map includes copyright information: "Data ng mapa ©2014 AutoNavi, Google, Kingway, MapIT, SKplanet, ZENRIN" and "Mga Tuntunin sa Paggamit".



# Mobile Applications

NOAH



ARKO

Flood  
Patrol



Raincheck  
PH