

Flood EViDEns: Near-real Time Flood Event Visualization and Damage Estimations for Geospatially-informed Decision Making in Times of Flooding



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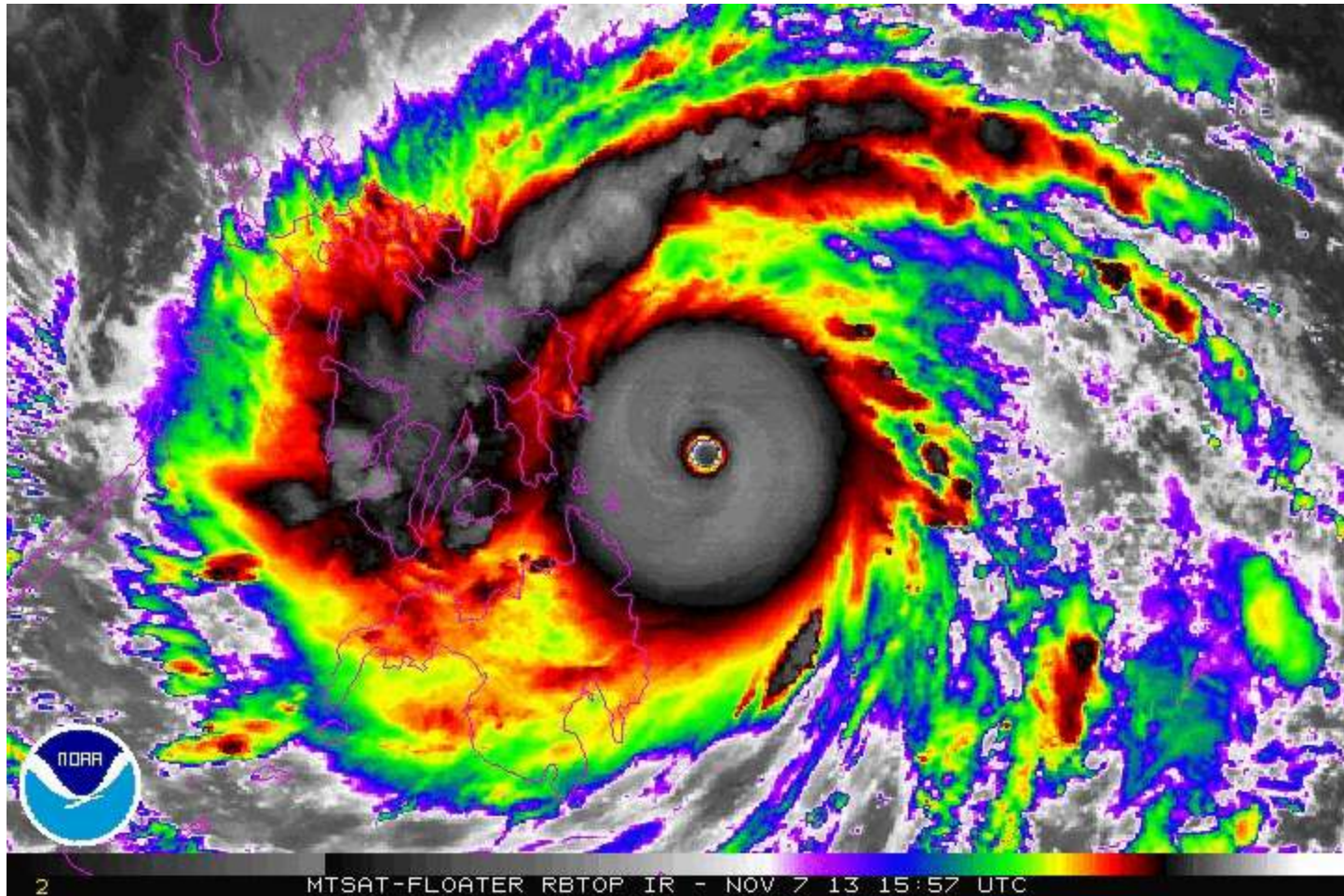
CSU Phil-LiDAR 1 Project
Caraga State University
Butuan City, Philippines



Presentation Outline

- Background
 - Why we developed Flood EViDEns
- Development of Flood EViDEns
 - Components
- App Implementation
 - Look and functionalities

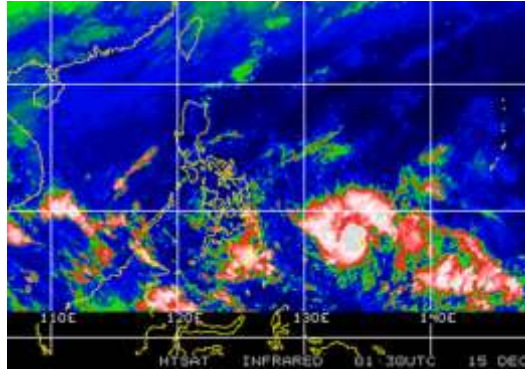
The Philippines is geographically prone to tropical storms/typhoons



The animation presents an enhanced infrared satellite loop of [Typhoon Haiyan](#) (also known as Typhoon Yolanda in the Philippines) from 15:57 UTC to 22:57 UTC on November 7, 2013. These images show the storm at peak intensity and making landfall over the islands of Samar and Leyte in the Philippines. (Source: Wikimedia)

Tropical Storms/Typhoons are common causes of Flooding in the Philippines

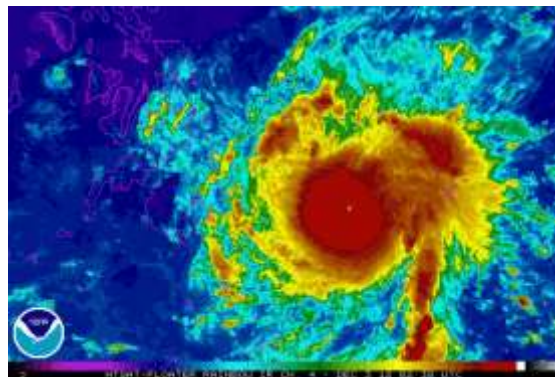
- Recent flood disasters have been associated with tropical storms that bring along rains of varying duration, volume and intensity
 - Tropical Storm (TS) *Ondoy* (International name: Ketsana; September 2009) dumped a month's worth of rain in less than 24 hours and caused flooding in Metro Manila, killing at least 300 people and displacing another 700,000 (Cheng, 2009).
- Similar flooding occurrences have become frequent and more intense, and has continued to negatively impact and bring **costly damages** to human lives and properties:
 - *Washi/Sendong* (2011)
 - *Bopha/Pablo* (2012)
 - *Lingling/Agaton* (2014)
 - *Jangmi/Seniang* (2014)



Satellite image of typhoon Sendong over Cagayan de Oro. (NOAA)



Aerial shot of Sendong floods along Cagayan River on December 17, 2011 by Elpidio M. Paras - See more at: <http://www.kagay-an.com/dpwh-funds-available-for-row-payments-for-jica-flood-control-project/#sthash.ULun8frf.dpuf>



Satellite image of typhoon Pablo over Compostela Valley. (NOAA)



http://ifg.org/v2/wp-content/uploads/2015/06/Philippine-Typhoon-Pablo-2eadd_600x450xpablo-aftermath.jpg.pagespeed.ic_a-HHFEpWKi.jpg

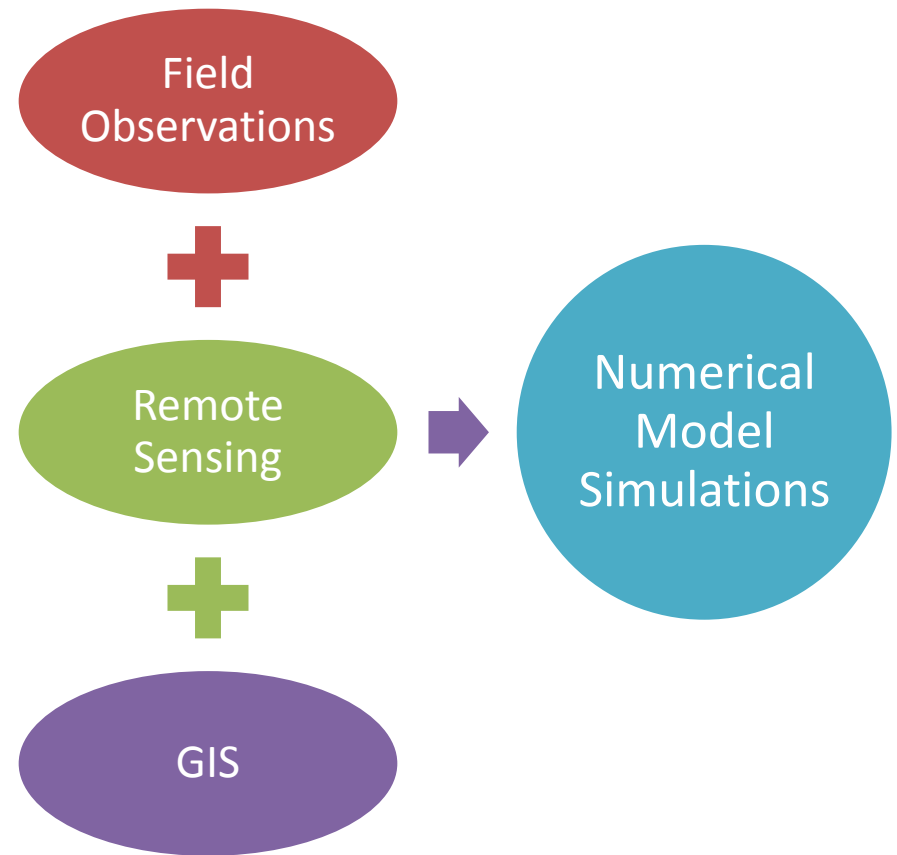
Basic Layers of Information Needed for Flood Disaster Management (**Before, During and After**)

- **Water Level Forecasts:** how water level will rise (or recede) at different locations along the river as rainfall events occur in the upstream watersheds
- **Expected extent and levels of flooding** based on the forecasted increase/decrease in water levels
- **Current extent and levels of flooding;**
- **Estimated number and locations of structures** (e.g., buildings) that are affected or can possibly be affected by future flooding event



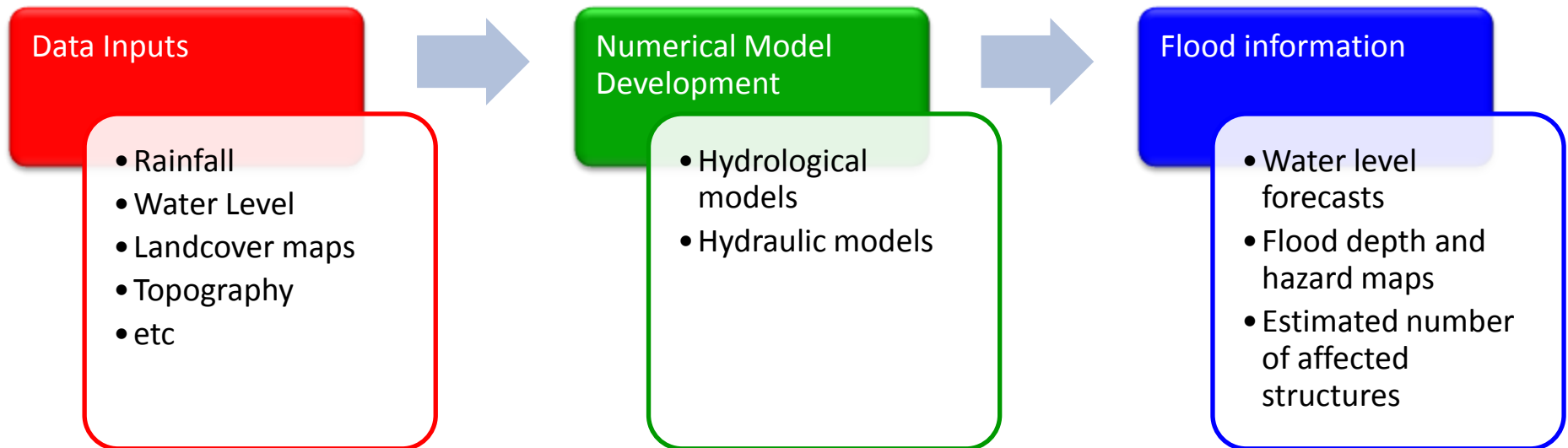
Role of Geospatial Technologies and Techniques

- **Field observations, Remote Sensing, GIS, and Numerical Simulation Models** can be integrated to generate flood information useful for disaster management

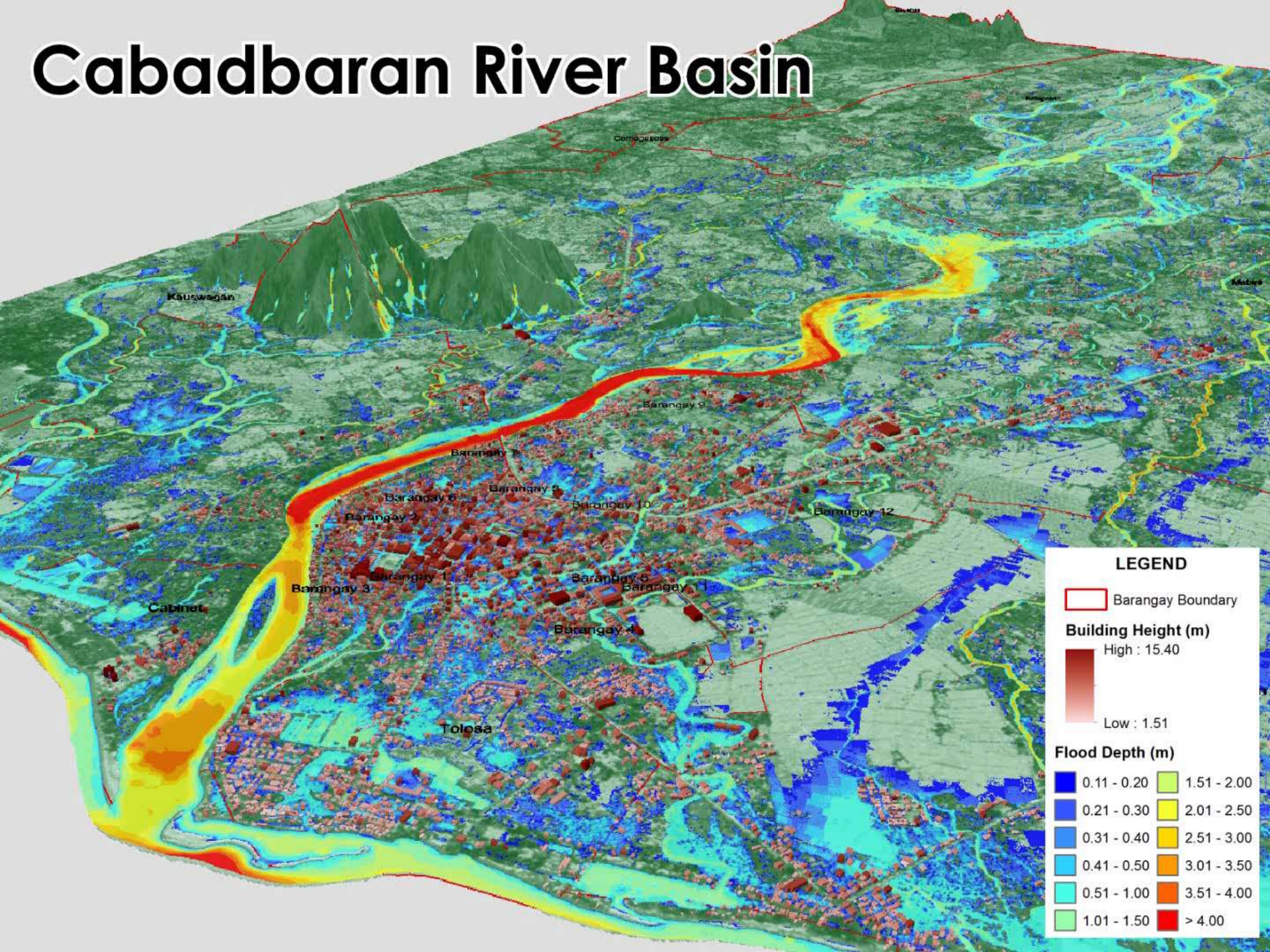


Flood Information Generation

- **Numerical simulation models** developed through GIS using RS data and field observations as inputs can be used generate:
 - water level forecasts, at least for the next 6 hours
 - current flood depths and extent
 - forecasted flood depth and extents
- **GIS techniques** can be used to manipulate flood information using spatial overlay analysis to determine/estimate location and number of affected structures



Cabadbaran River Basin



LEGEND

- Barangay Boundary
- Building Height (m)**
 - High : 15.40
 - Low : 1.51
- Flood Depth (m)**

0.11 - 0.20	1.51 - 2.00
0.21 - 0.30	2.01 - 2.50
0.31 - 0.40	2.51 - 3.00
0.41 - 0.50	3.01 - 3.50
0.51 - 1.00	3.51 - 4.00
1.01 - 1.50	> 4.00

3D Building Flood Hazard Exposure Map during Typhoon Agaton in Cabadbaran City

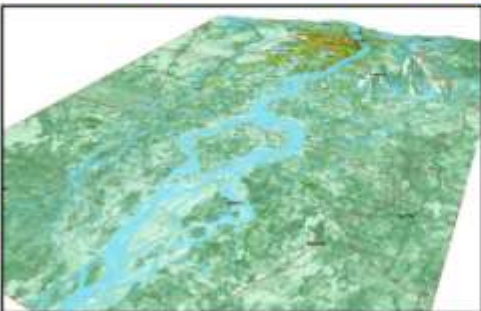
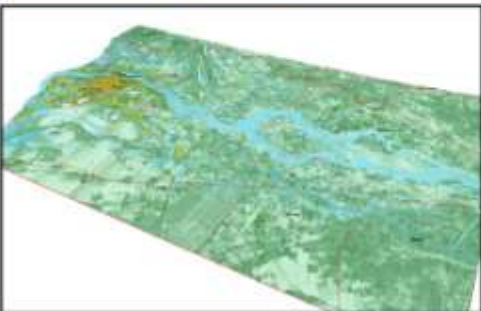
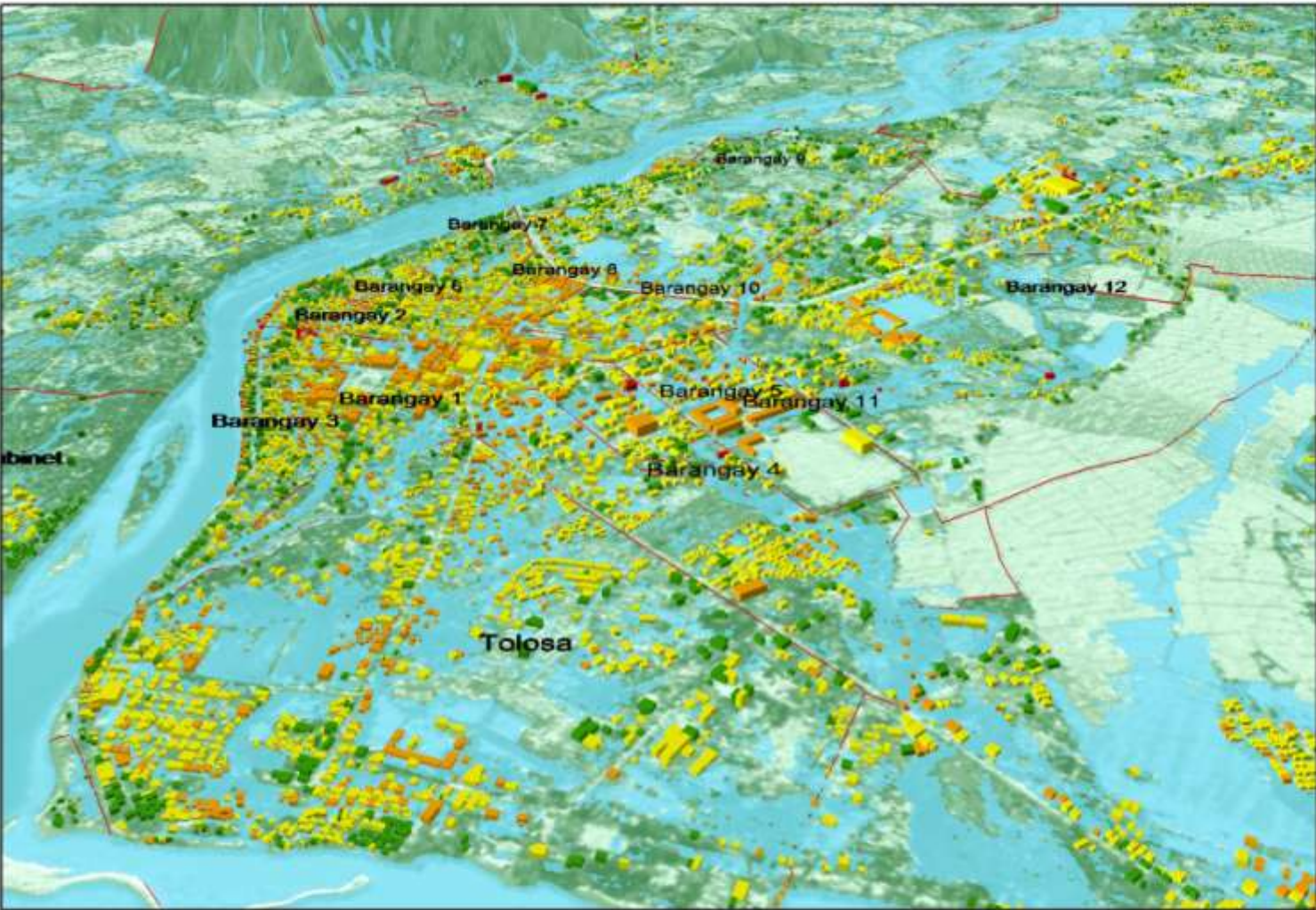
LEGEND

-  Flood Extent
-  Barangay Boundary
- Building Hazard**
-  Not Flooded
-  Low (< 0.50 m flood depth)
-  Medium (0.50 m - 1.50 m)
-  High (> 1.50 m)



This map is provided by the "CSU Phil-LIDAR 1: Flood Hazard Mapping of the Philippines using LIDAR: Caraga Region" project which is being implemented by Caraga State University (CSU), Ampayon, Butuan City and funded by the Department of Science and Technology (DOST).

To learn more about the project, visit our website at <http://carsulidar1.wordpress.com>



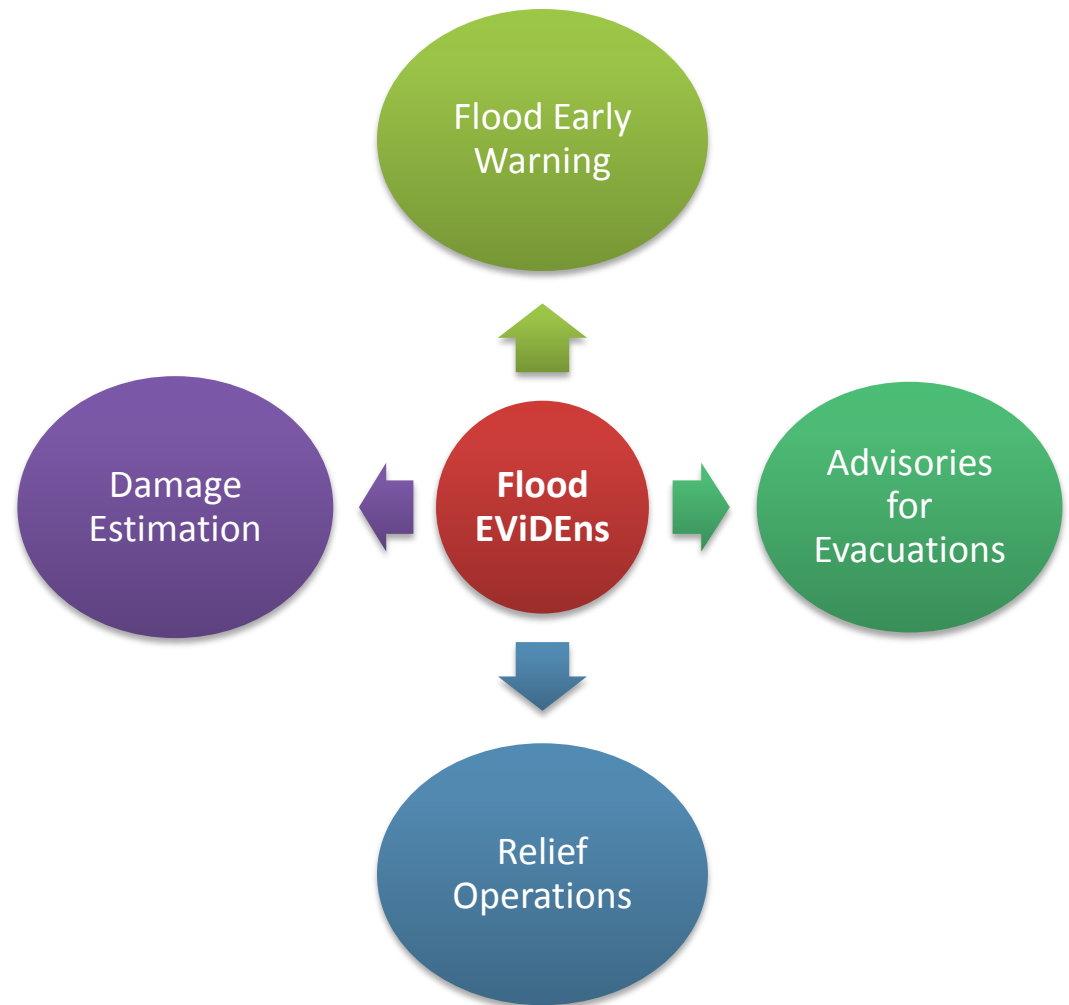
DISCLAIMER: The information presented in this map are results of the Flood Model of Cabadbaran River Basin developed through the CSU-Phil LiDAR 1 Project. The CSU Phil-LiDAR 1 project gives no warranty, express or implied, as to the accuracy, reliability, utility or completeness of this map. The CSU Phil-LiDAR 1 nor the Caraga State University shall not be held liable for improper or incorrect use of any or all information contained in this map.

Flood Information Generation is Possible but the Challenges are...

- **How to generate this information in a timely manner?**
 - When flooding occurs, we need to get updated of the flooding situation:
 - Where are the areas being flooded?
 - Where are the areas that are expected to be flooded in the next hours
 - How many have been affected?
 - How many will be affected in the next hours or days?
 - How much is the damage?
 - How much will be damaged in the next hours or days?
- **How to make the information accessible?**
 - Disaster managers and communities need to access flood information in order to respond **in a timely manner** to the expected and unexpected emergency situations

Flood EVIDEns: Flood Event Visualization and Damage Estimations

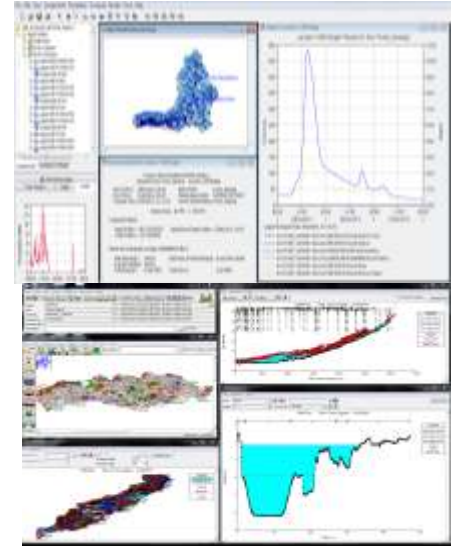
- Envisioned to be a **platform** where disaster managers and the community can easily access **localized flood information for near-real time assessment and geospatially informed decision making.**



App Design and Development

Flood Information Generation

Computers automatically running flood simulation models and generates flood information in near-real time (at a defined interval, e.g., 10 minutes)



Flood Information Storage

PostgreSQL (PostGIS)
Spatial Database



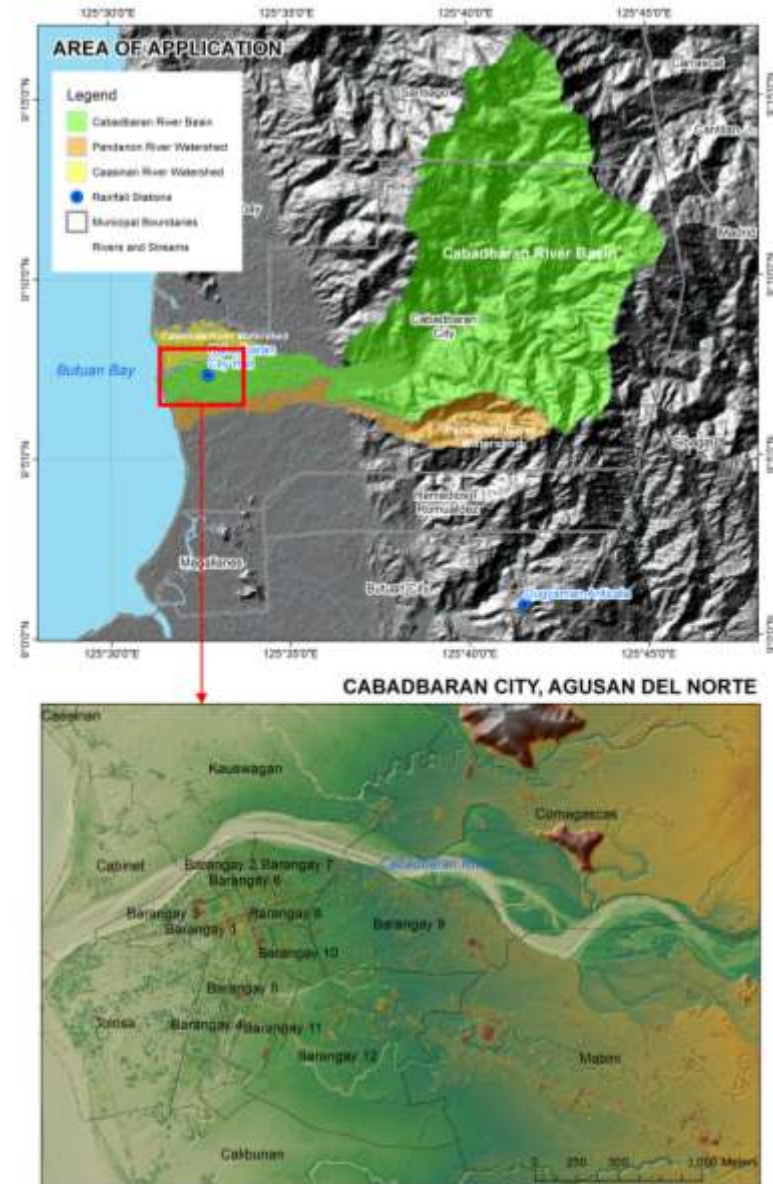
Online Visualization/Web Platform

Combination of Bootstrap, Javascripts, GeoDjango, GeoServer, OpenLayers and HighCharts to display flood information



App Implementation

- Initial area of application: **Cabadbaran River Basin in Mindanao, Philippines**
- Two Versions Available
 - **Full Version**
 - Provides near-real time flood visualization and damage estimations
 - Also includes historical and hypothetical flood events
 - Accessible only at the CSU Phil-LiDAR 1 project office
 - **Initial, public version**
 - Only includes visualization and damage estimations for historical and hypothetical flood events
 - Near-real time functionality not included as this is still being tested/enhanced
 - Accessible at <http://121.97.192.11:8082>



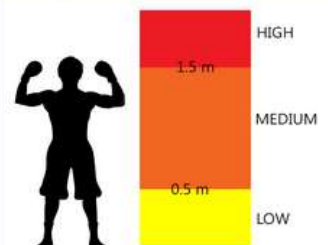
Flood EViDEns Web Interface (Full Version)

Flood Hazard Information

Select Flood Event:

Generalized Flood Information (Statistics of affected structures according to flood event)

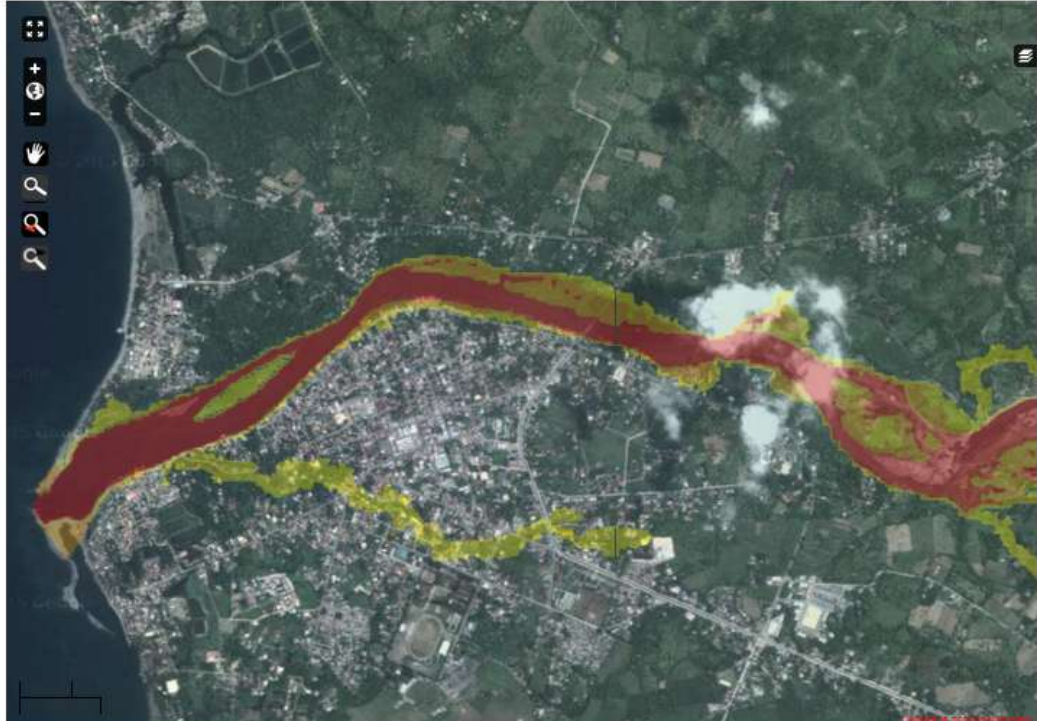
Legend



Flood Hazard Map Legend is based on Manny Pacquiao's height of 1.69 meters or 5'6 1/2 ft.

Water- Level Station

Map (10:6:29) Near-real Time: Load End. Grid:4x5



Map data ©2015 Google Imagery ©2013 CNES / Astrium, DigitalGlobe

Select Municipality Select Barangay Select Building Type

Web Map showing flooded areas and affected structures

Overlays

- Project Municipalities
- Project Barangay
- Water Level Station

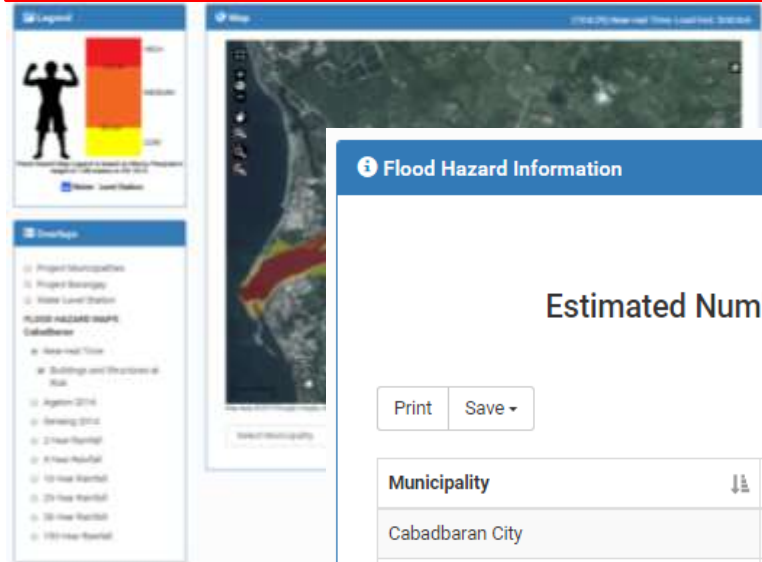
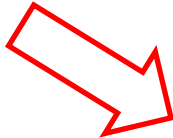
FLOOD HAZARD MAPS Cabadbaran

- Near-real Time
- Buildings and Structures at Risk
- Agaton 2014
- Seniang 2014
- 2-Year Rainfall
- 5-Year Rainfall
- 10-Year Rainfall
- 25-Year Rainfall
- 50-Year Rainfall
- 100-Year Rainfall

Localized (searchable) Flood Information

Map layers controls

Generalized Flood Information



Flood Hazard Information

Select Flood Event:

Estimated Number of Affected Structures (According to Flood Hazard Levels) for Agaton 2014

Search:

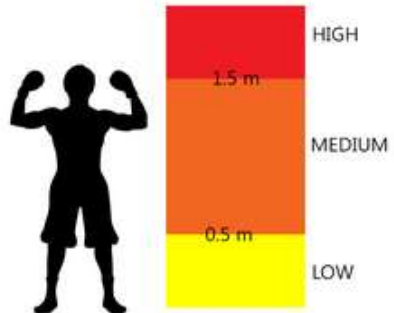
Municipality	Barangay	Low	Medium	High
Cabadbaran City	Barangay 4	393	70	1
Cabadbaran City	Mahaba	14	0	0
Cabadbaran City	Barangay 6	155	84	21
Cabadbaran City	Bay-ang	51	2	3
Cabadbaran City	Barangay 11	88	45	2
Cabadbaran City	Barangay 10	59	12	0
Cabadbaran City	Barangay 1	73	49	0
Cabadbaran City	Barangay 2	59	36	11
Cabadbaran City	Calibunan	492	145	2
Cabadbaran City	Barangay 9	372	70	8

Showing 1 to 10 of 23 entries

[Disclaimer](#)

Web Map, showing the extent of flooded areas and affected structures (categorized according to hazard levels)

Legend



Water- Level Station

Overlays

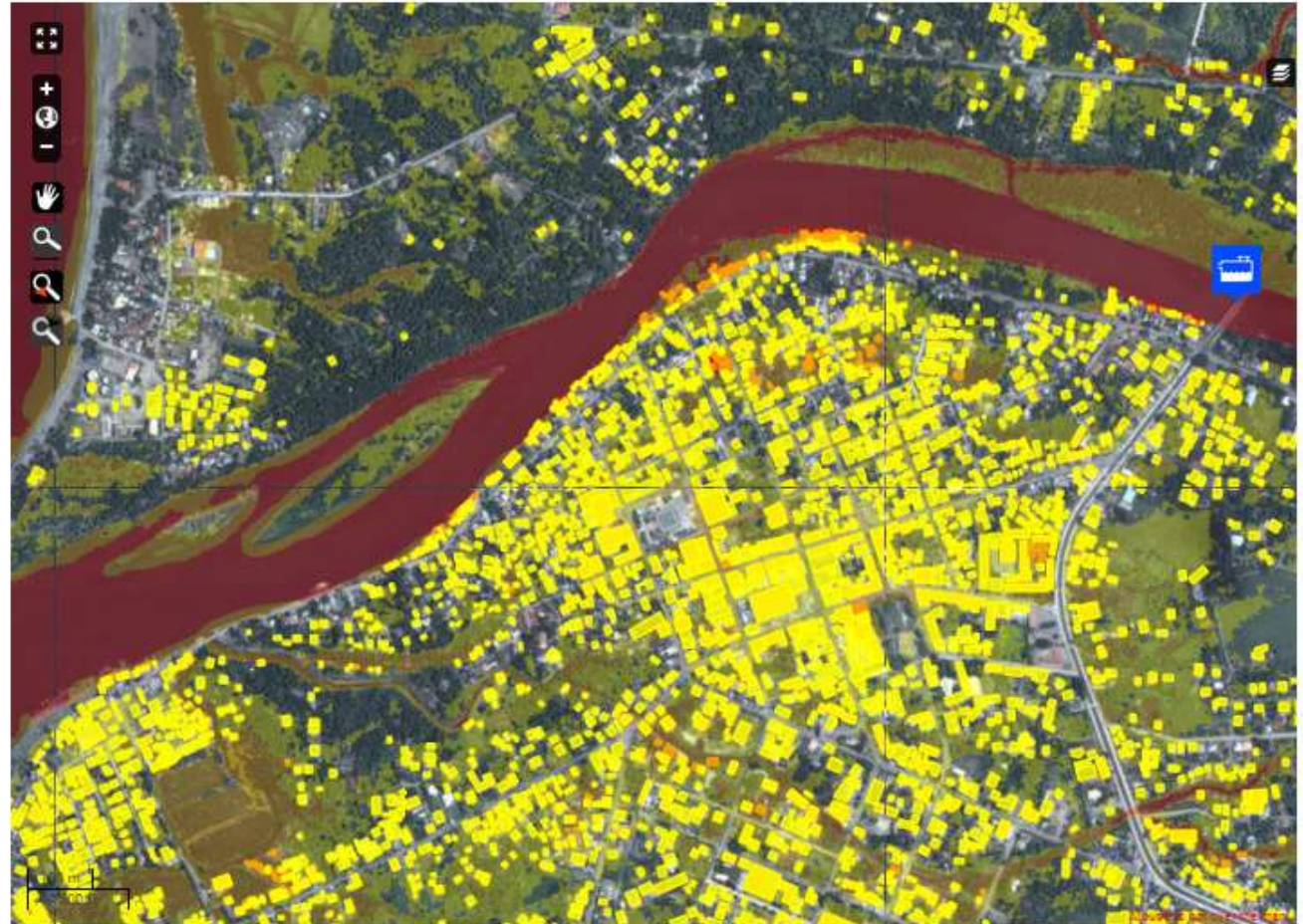
- Project Municipalities
- Project Barangay
- Water Level Station

FLOOD HAZARD MAPS Cabadbaran

- Agaton 2014
 - Buildings and Structures at Risk
- Seniang 2014

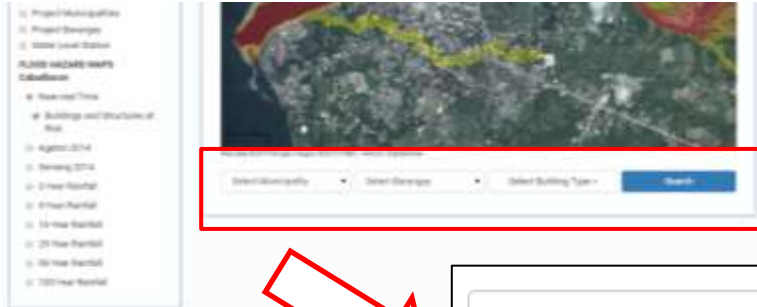
Map

(14:52:52) Agaton 2014: Load End. Grid:4x5



Map data ©2015 Google Imagery ©2015 CNES / Astrium, DigitalGlobe

Localized Flood Information



Select Municipality ▼ Select Barangay ▼ Select Building Type ▼ Search

**Estimated Number of Affected Structures() in Select Barangay , All Municipalities
as of January 19, 2014 02:00PM**

Show 10 ▼ entries Search:

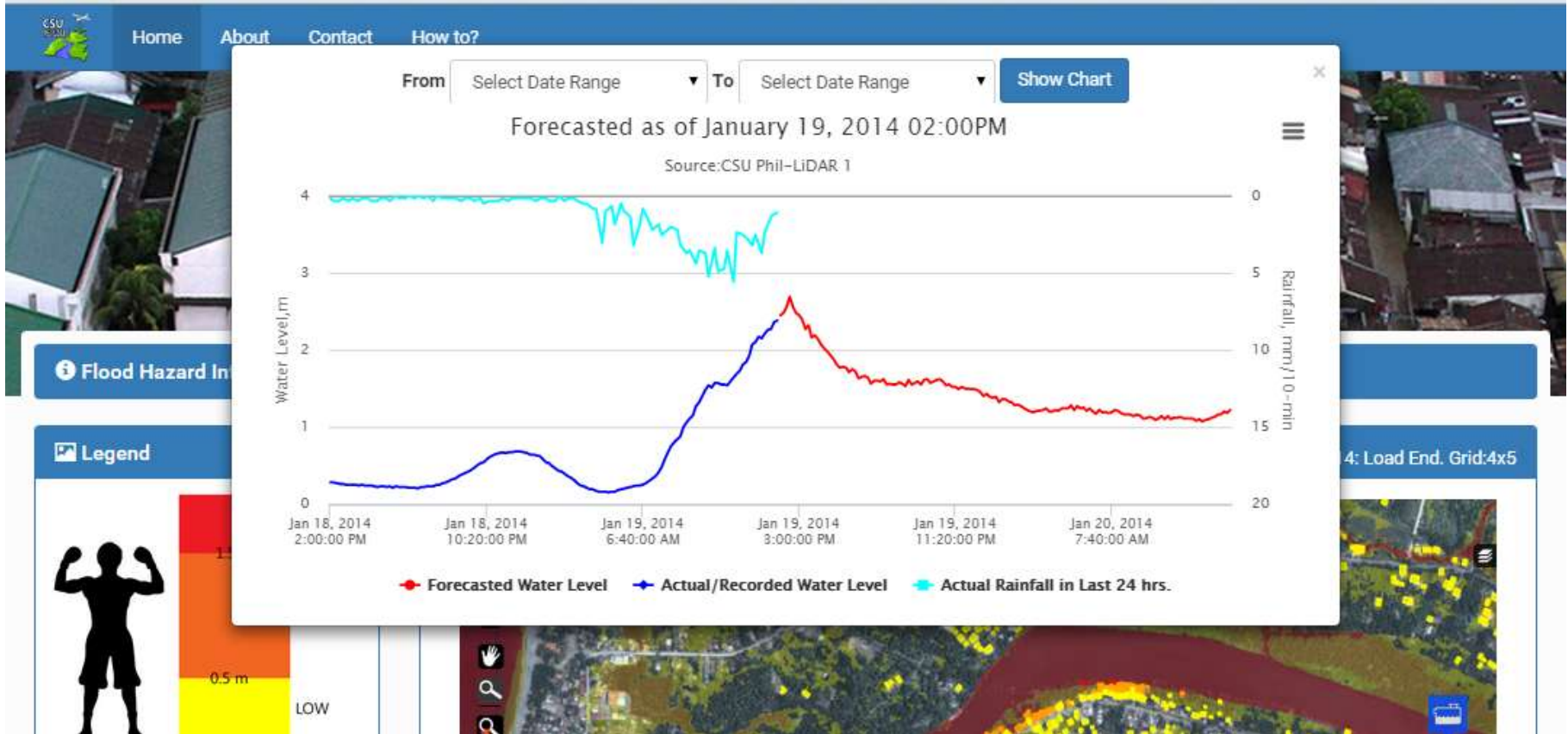
Building Name	Building Type	Count	Flood Hazard Level
Katugasan Elementary School	School	5	Low
Katugasan Multi-Purpose Gym	Sport Center/Gymnasium/Covered Court	1	Low
Rural Health Center	Other Government Offices	1	Low
Unknown	Residential	128	High
Unknown	Residential	243	Medium
Unknown	Residential	384	Low

Showing 1 to 6 of 6 entries

Previous 1 Next

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Water Level Forecast (Example)

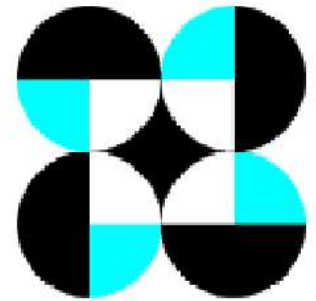


Concluding Remarks

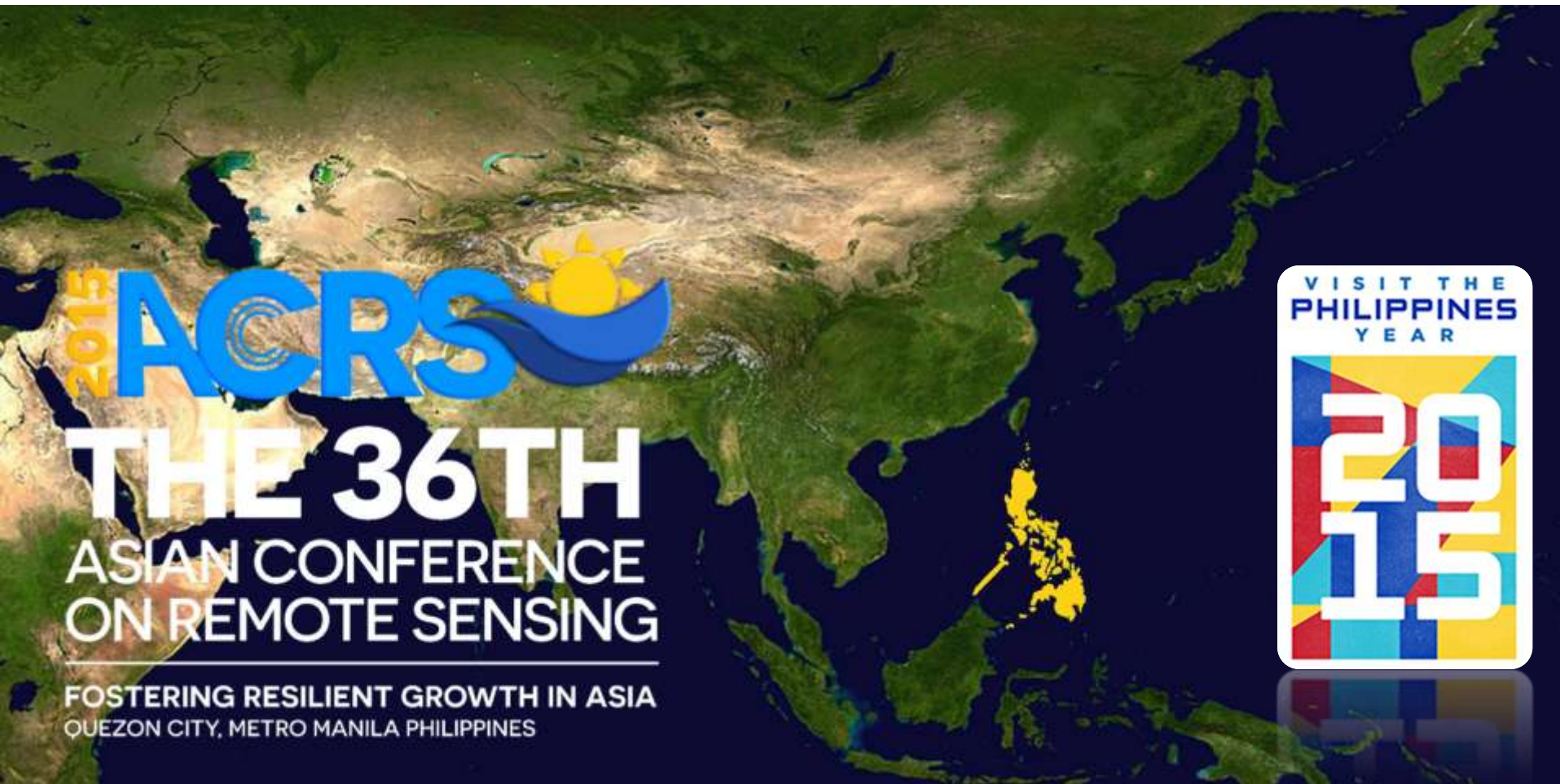
- The layers of information provided by Flood EVIDEns are important especially to Local Government Units and the community as it can:
 - Increase awareness and responsiveness to current and expected flood disasters
 - Assist in preparation for evacuations
 - In easily identifying areas that need immediate attention
 - In identifying areas that should be avoided
 - Estimating the severity of damage to people and infrastructures
- Undergoes continuous testing and improvement
- To be provided later on to Local Government Units who also acts as disaster managers

Acknowledgements

- This work is an output of the “Phil-LiDAR 1: Nationwide Hazard Mapping of the Philippines Using LiDAR: Caraga Region” project conducted by Caraga State University in collaboration with the University of the Philippines - Diliman
- We are grateful to the Department of Science and Technology (DOST) for the financial support.



Invitation to ACRS 2015



- Dates: **October 19-23, 2015**
- Venue: Crowne Plaza Manila Galleria in Quezon City, Metro Manila, Philippines
- More details: **www.acrs2015.org**