

Development of a Flood Hazard Simulation Model for Flood Risk Assessment

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As the climate change, are the key cities in the Philippines ready?

- A study by the World Wildlife Fund and the BPI Foundation assessing 16 of the country's major cities showed that the level of preparedness of local governments, businesses, and residents “Needs Improvement”.
- The Business Risk-Assessment and the Management of Climate Impacts, conducted from 2011 to 2014, found that local initiatives were mainly reactive, rather than proactive.



- The Philippine Information Agency (PIA) with the Department of Environment and Natural Resources (DENR) and the Dumaguete City Environment and Natural Resources Office in 2014 holds a series of “Climate Change Advocacy School Caravan” in eight high schools in Dumaguete City.
- With the tagline “Nagbabago na ang Panahon, Panahon na para Magbago”, the climate change advocacy campaign aims to raise the youth’s level of awareness on the different mitigation and adaptation measures to counter the negative effects of the ongoing climate crisis.
- The school caravan aims to **strengthen adaptation and mitigation measures with the youth sector in response to climate change, and to motivate active cooperation and participation of communities in taking steps to protect the environment and conserve natural resources**

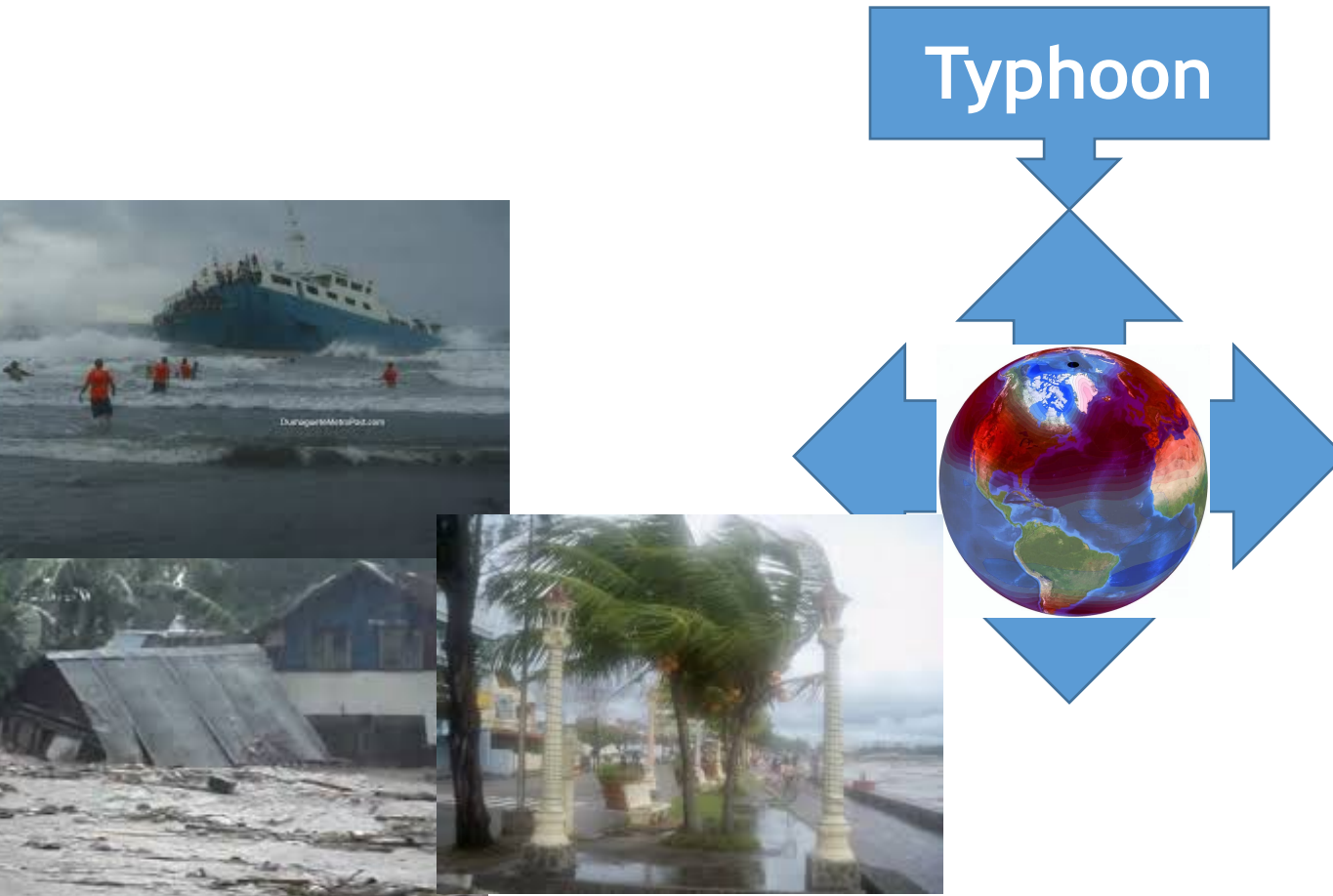


Brief Overview of Dumaguete City

- Dumaguete is a city in the Philippine province of Negros Oriental. It is the capital, principal seaport, and largest city of the province.
- Dumaguete is referred to as a university town due to the presence of 4 university and a number of colleges
- Demographic profile:
 - Total land area is 3,426 hectares divided into 30 barangays, with total population of 150,000 which increases to more than 200,000 during weekdays and school days
 - 54% (1,850 hectares) is classified as Residential
 - 25% (856) hectares) AGRICULTURAL
 - 8% (274 hectares) COMMERCIAL
 - 6% (205 hectares) Open space/conservation
 - 4% (137 hectares) Institutional
 - 2%(69 hectares) used by small scale industries
 - 1%(35 hectares) as Tourist commercial



Hazard Profile of the City

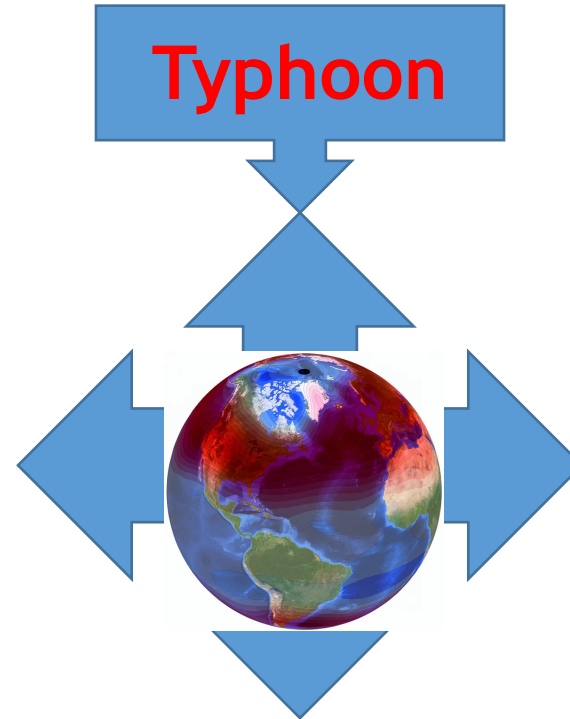


From 2011 up to the present, 3 significant typhoons passed through the city and the province which brought with it significant damage to the area

On December 17, 2011 almost 50% of the entire population of the city was affected by floods brought about by Typhoon SENDONG. Total estimated damages from the typhoon on infrastructures, agricultural crops and livestock, livelihood, lifelines and properties was around 60 million pesos as recorded by the Local Disaster Risk Reduction and Management Council of Dumaguete City



Hazard Profile of the City



Almost a year later, Typhoon PABLO struck Dumaguete on December 4, 2012

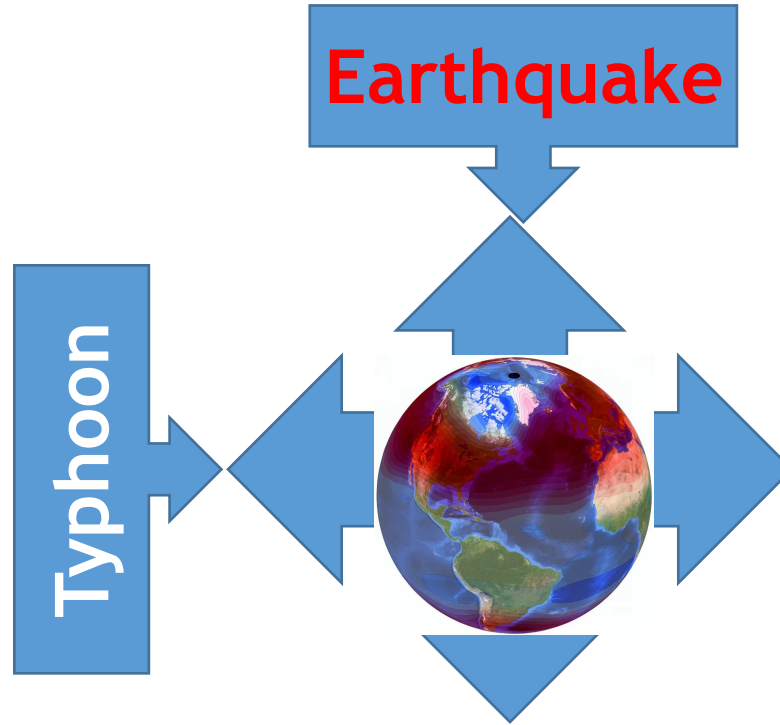
The typhoon hit with maximum sustained winds of 175 km per hours

More than 1,400 families were affected, 73 houses were totally damaged and over 1,300 homes considered partially damaged

Estimated around 40 million total damaged cost



Hazard Profile of the City



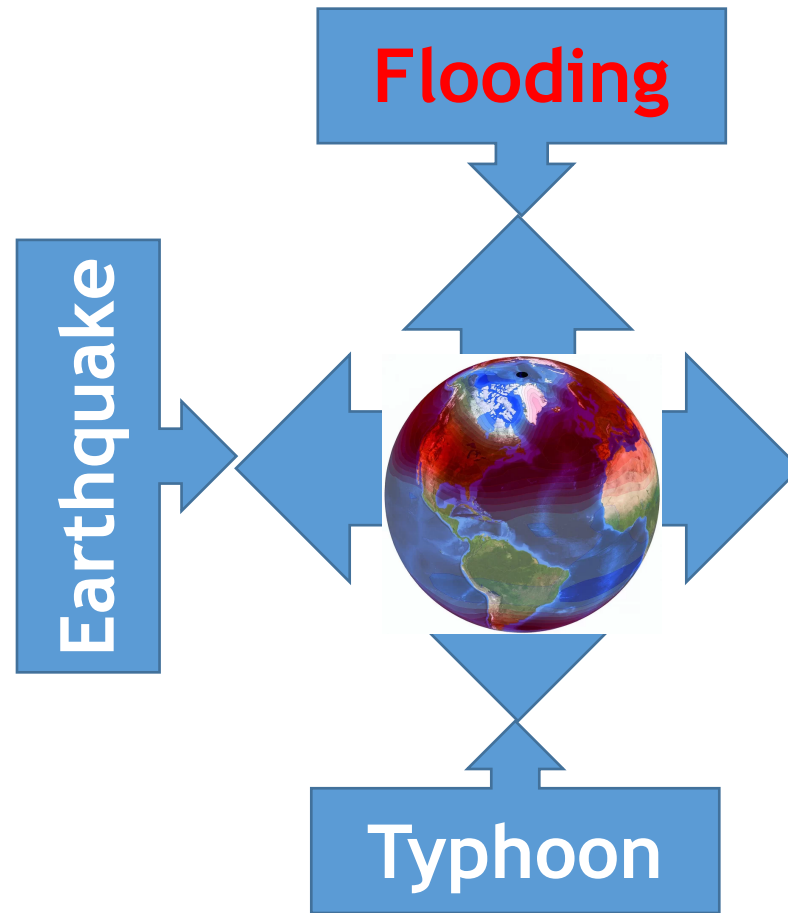
Nearly 2 months after SENDONG, the city was hit by a 6.9 earthquake at around 11:45am on February 6, 2012

Several houses, building and major bridges collapsed, while others sustained damages in vast areas

It also caused big cracks on major highways and triggered numerous landslides burying houses and people



Hazard Profile of the City



Dumaguete city is located in the downstream of 2 major river system.

Out of 30 barangays, 12 are consistently affected by floods of 0.5 to 2 meters high

Flooding category of the city varies from slow to very rapid occurrence (flash floods)

Flash flood events are highly influenced due to climate and land use changes (Posthumus et al 2008; Muis et al 2015; Kourgialas et al 2015)



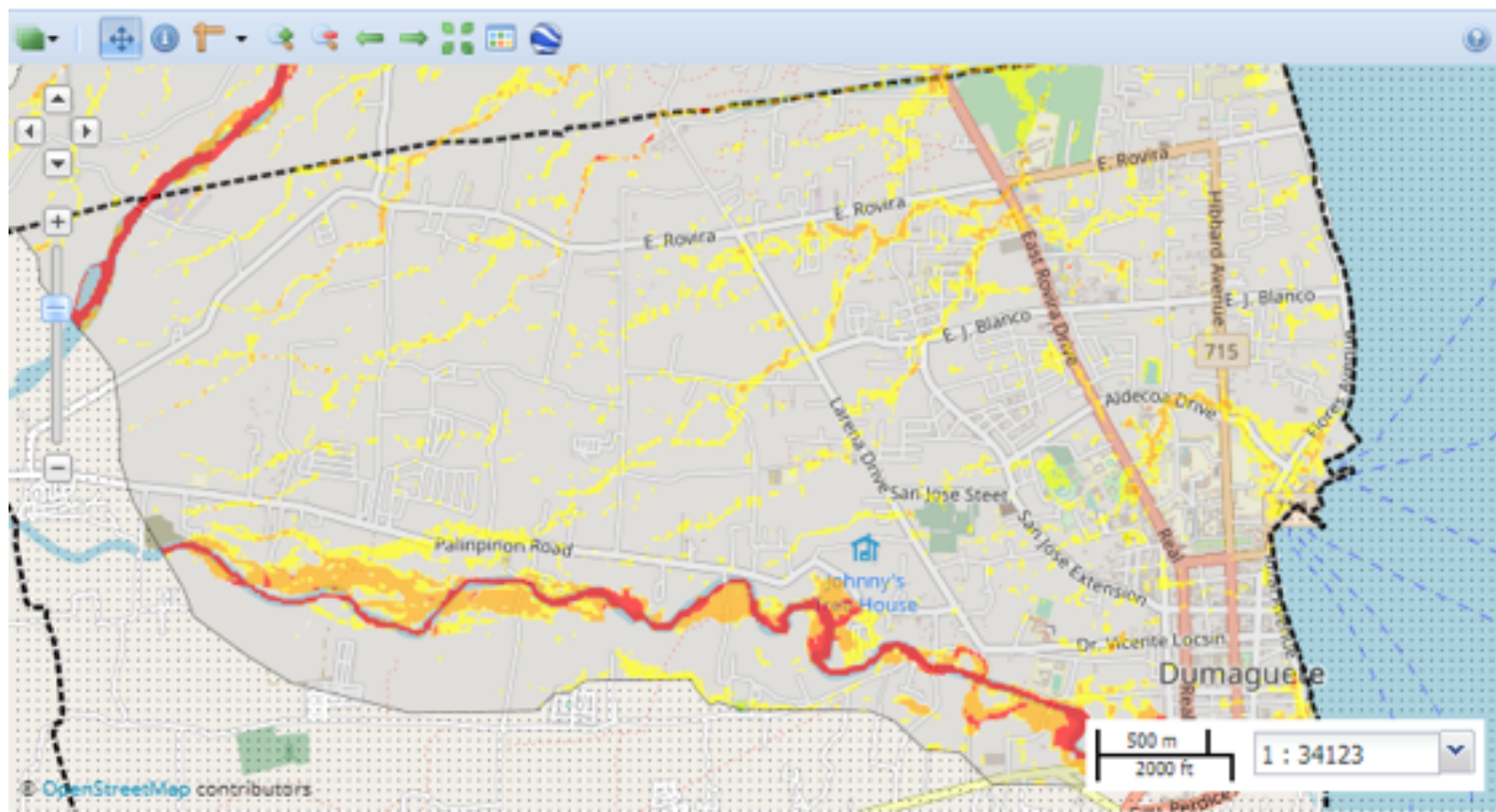
Dumaguete City 5 year flood hazard Map



LiPAD

LiDAR Portal for Archiving and Distribution

Publication Date May 31, 2017, 7:04 p.m.



This shapefile, with a resolution of 10 meters, illustrates the inundation extents in the area if the actual amount of rain exceeds that of a 5 year-rain return period.

Note: There is a 1/5 (20%) probability of a flood with 5 year return period occurring in a single year. The Rainfall Intensity Duration Frequency is 116.500mm.

3 levels of hazard:

Low Hazard (YELLOW)

Height: 0.1m-0.5m

Medium Hazard (ORANGE)

Height: 0.5m-1.5m

High Hazard (RED)

Legend

--- Municipal Boundary

Low

Medium

High

Area Assessed

Area Not Assessed



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Advantages of Technology

Identification of flood risk areas will

help inform
emergency
responses

help in the planning
of a more effective
emergency response

promote greater
awareness of the risk
of flooding

help identify the scale
of emergency and
clean-up operations

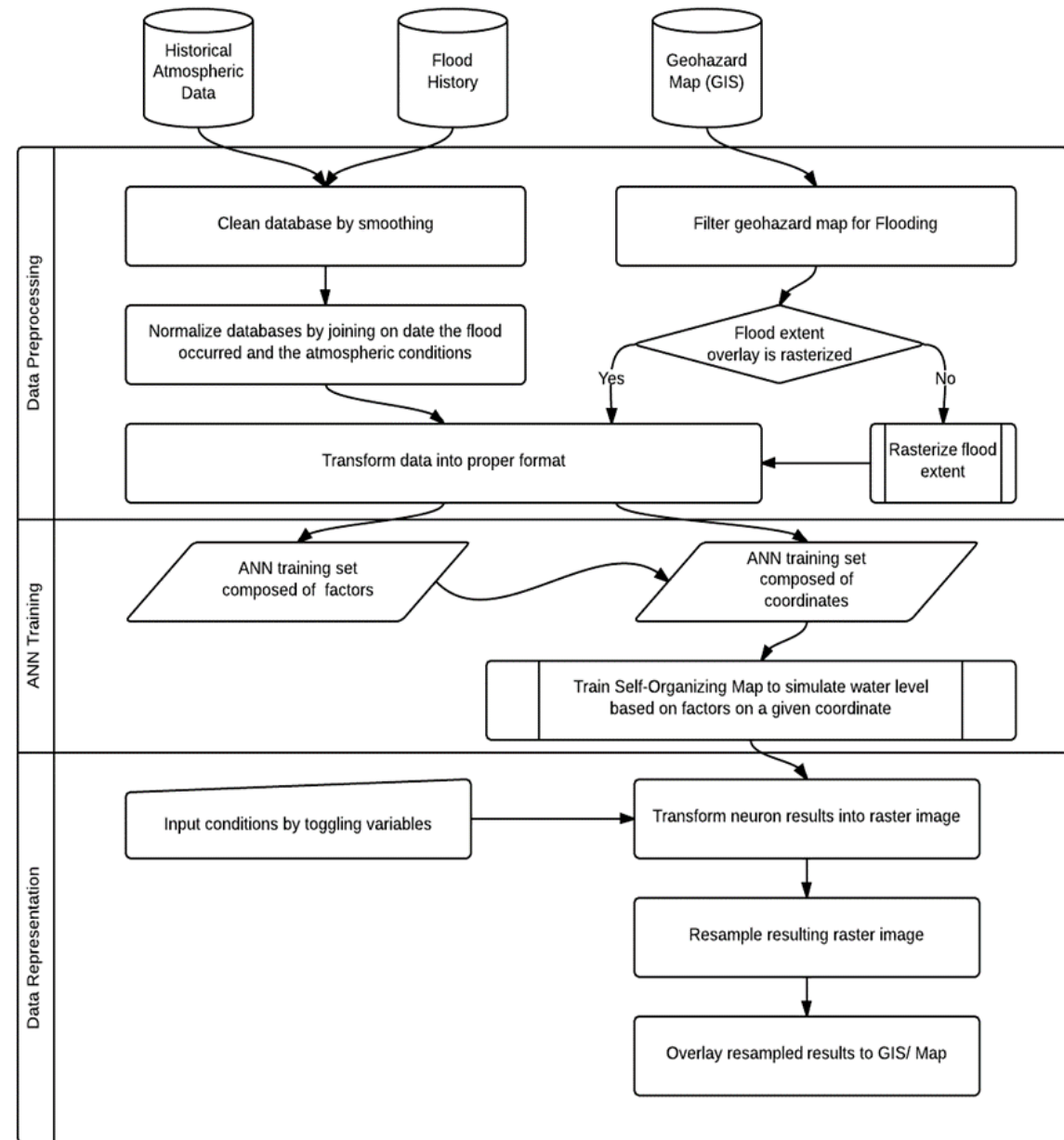


Project Context

- The main objective of our work was to propose an integrated and easy to apply Artificial Neural Network (ANN) and GIS modeling approach, able to provide flood hazard map of Dumaguete City.
- This study integrates the capabilities of ANN to Flood Hazard Mapping to simulate flooding by injecting the area's historical data into the system's training sets

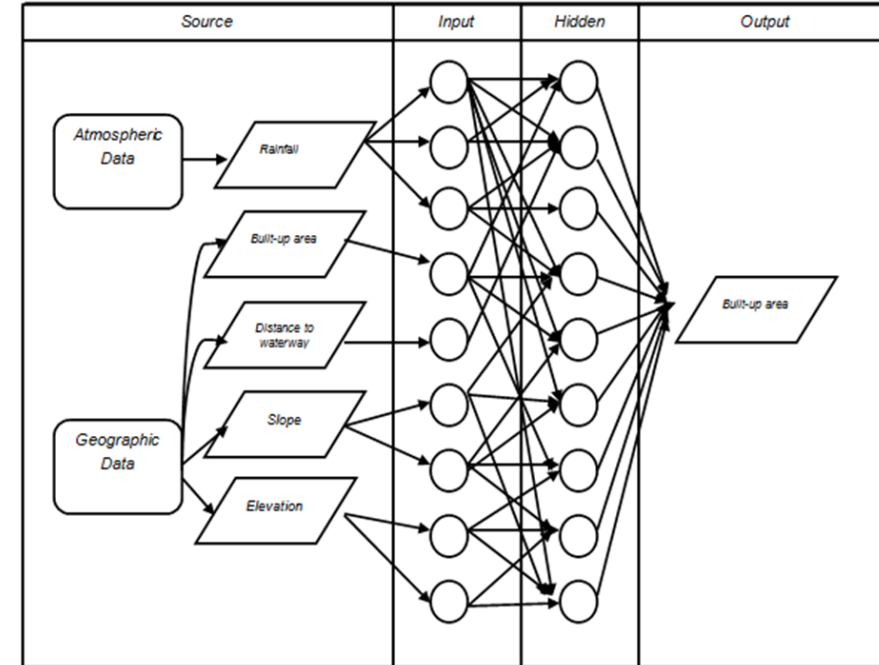


Conceptual Framework



The figure consists of three maps of Dumaguete City, each showing different geographical and administrative features:

- City of Dumaguete Road map:** This map displays the city's road network. Major roads are highlighted in red, while secondary roads are in black. The map shows the city's layout relative to the Municipality of Sibulan to the north, the Municipality of Bacorong to the south, and the Municipality of Malabon to the west. Key areas labeled include Candabayan, Balinguay, Miting, Davao, and the port area.
- Dumaguete City Rivers and Waterways:** This map illustrates the city's hydrological system. It shows the flow of water from the north (Municipality of Sibulan) through the city center, where several rivers converge, and then flow towards the south (Municipality of Bacorong). The map includes labels for various waterways and surrounding areas like Miting, Candabayan, and the port.
- Dumaguete City Topographic Map:** This map shows the city's terrain and elevation. Different shades of yellow and green represent varying levels of topography. The map includes labels for various areas and landmarks, such as the port, Candabayan, and the surrounding municipalities.

[illegible]

IT also consolidates ANNs techniques in order to face an important problem in a GIS multi-criteria analysis. This problems related to the determination of the weights of the involved factors, which in most cases are subject to the subjective estimation of the decision-maker.

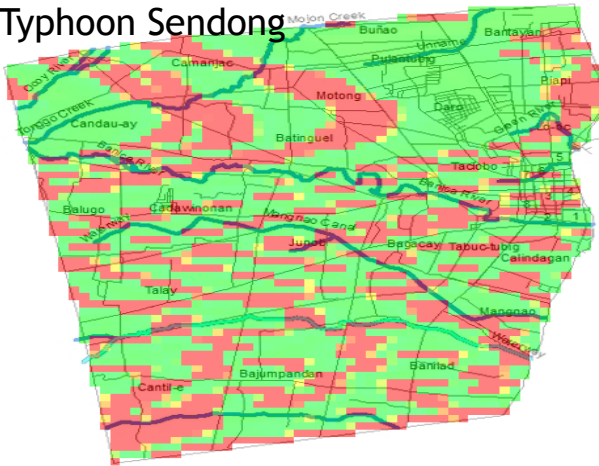
It is validated for different historical flood events



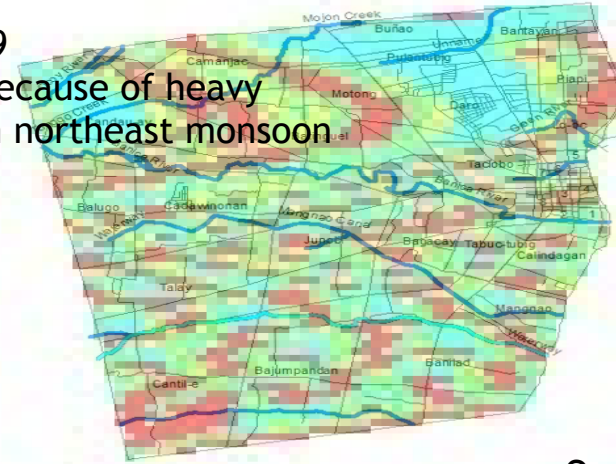
Test Results

tested on 50 different scenarios from selected dates from 2000 to 2014
prediction rate of 86%

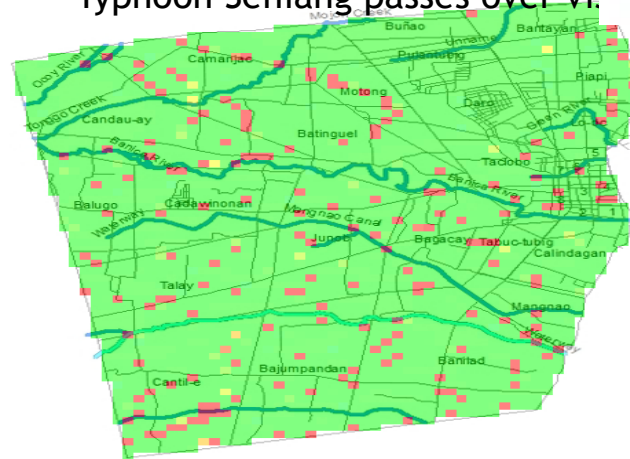
December 16-17, 2011
Typhoon Sendong



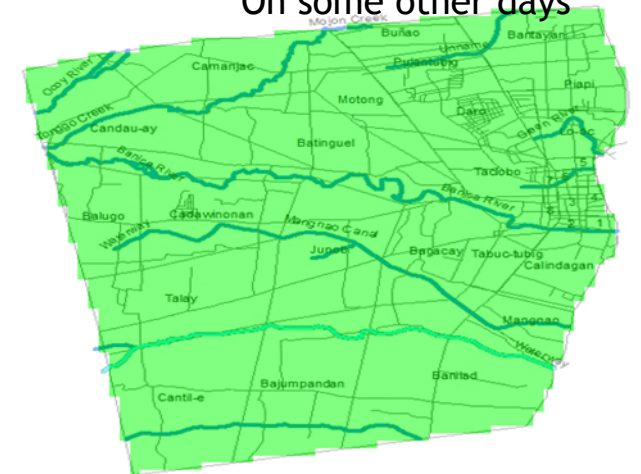
Feb 6-8, 2009
Flash flood because of heavy
rainfall from northeast monsoon



December 27-29, 2014
Typhoon Seniang passes over vi



On some other days



Observation of the result

- Most of the area around Banica River is supposed to be exposed to flooding but the researchers observed that there are gaps to the flood extent but still congregate near the rivers. The area in barangays Cantil-e and Talay show vulnerability to flood despite not being flood-prone barangays themselves albeit sparsely and not severe. The researchers have also observed few anomalies in some areas where it is not supposed to be flooded. However, there still is a possibility that these areas might have experienced flooding but not as severe as those areas that are documented.



Recommendation

- to reduce the distance between nodes. Reducing the distance may effectively assign the correct geographic points. With nodes closer to each other. Another alternative is using vectors in showing data in the GIS instead of nodes.
- adding more barangay to the testing sets. The neural network has predicted atmospheric properties but has not fully learned the geographic properties. Adding more barangay to the data set may improve the learning of the network.



Thank you for listening



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