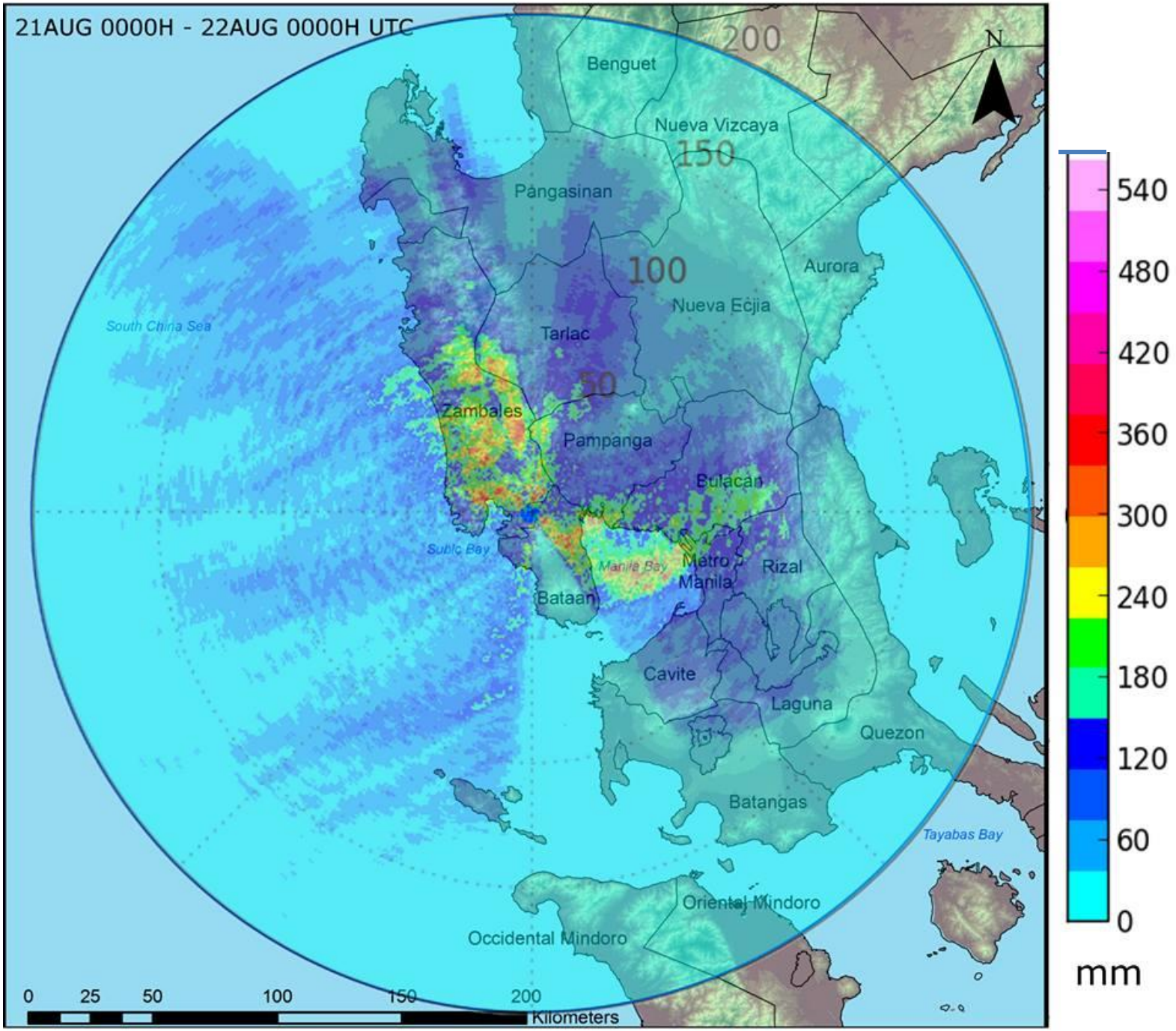
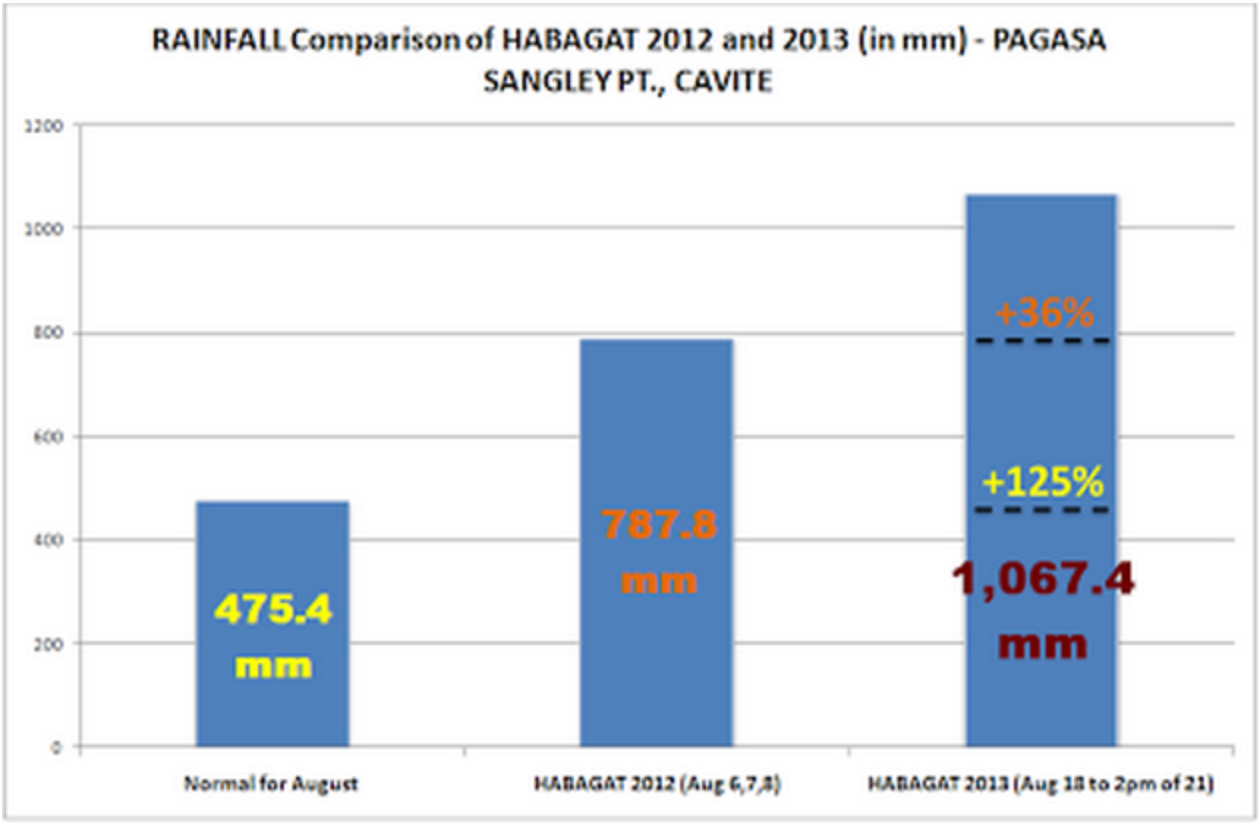
Project NOAH

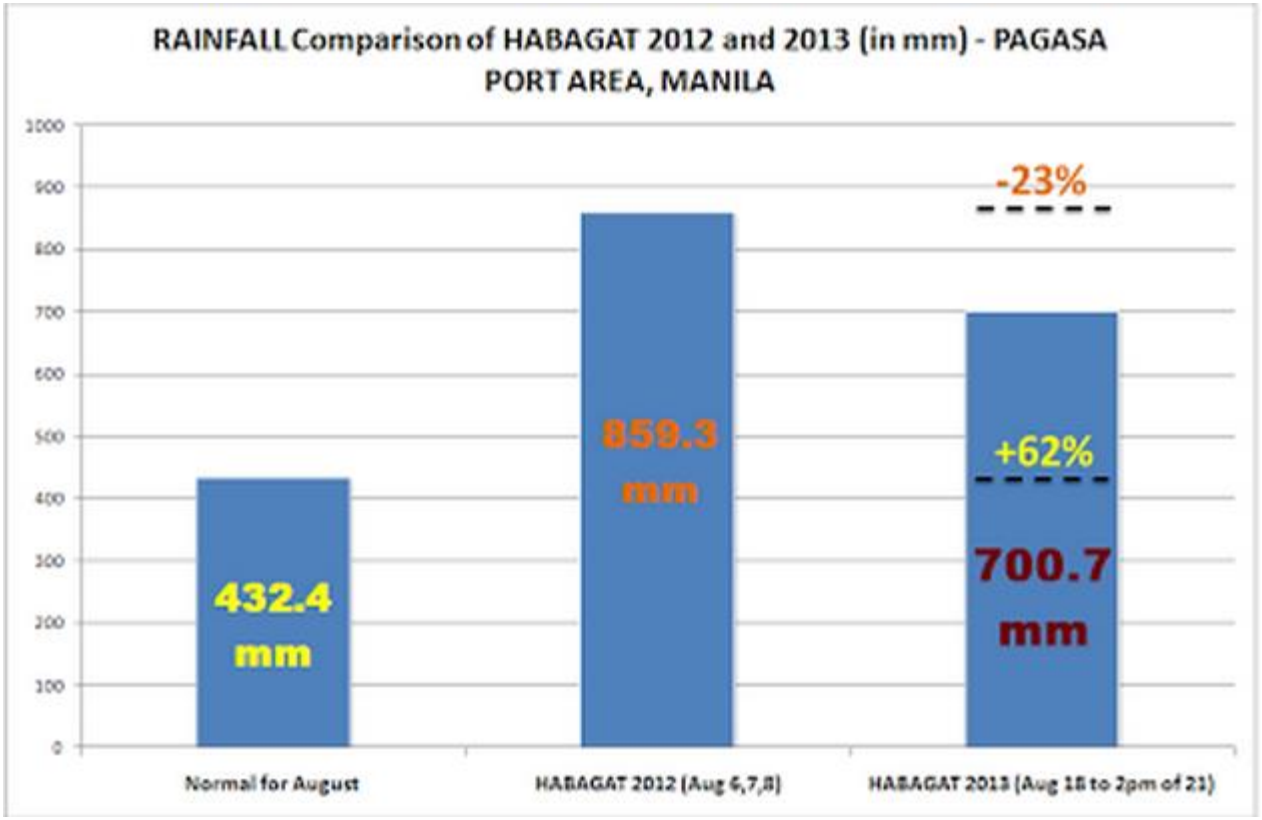
DOST Project NOAH team and collaborators


21AUG 0000H - 22AUG 0000H UTC
200
150
100
50
N
Benguet
Nueva Vizcaya
Pangasinan
Aurora
Nueva Ecija
Tarlac
South China Sea
Zambales
Pampanga
Bulacan
Subic Bay
Manila Bay
Metro Manila
Rizal
Bataan
Cavite
Laguna
Quezon
Batangas
Tayabas Bay
Oriental Mindoro
Occidental Mindoro
0 25 50 100 150 200
Kilometers
540
480
420
360
300
240
180
120
60
0
mm



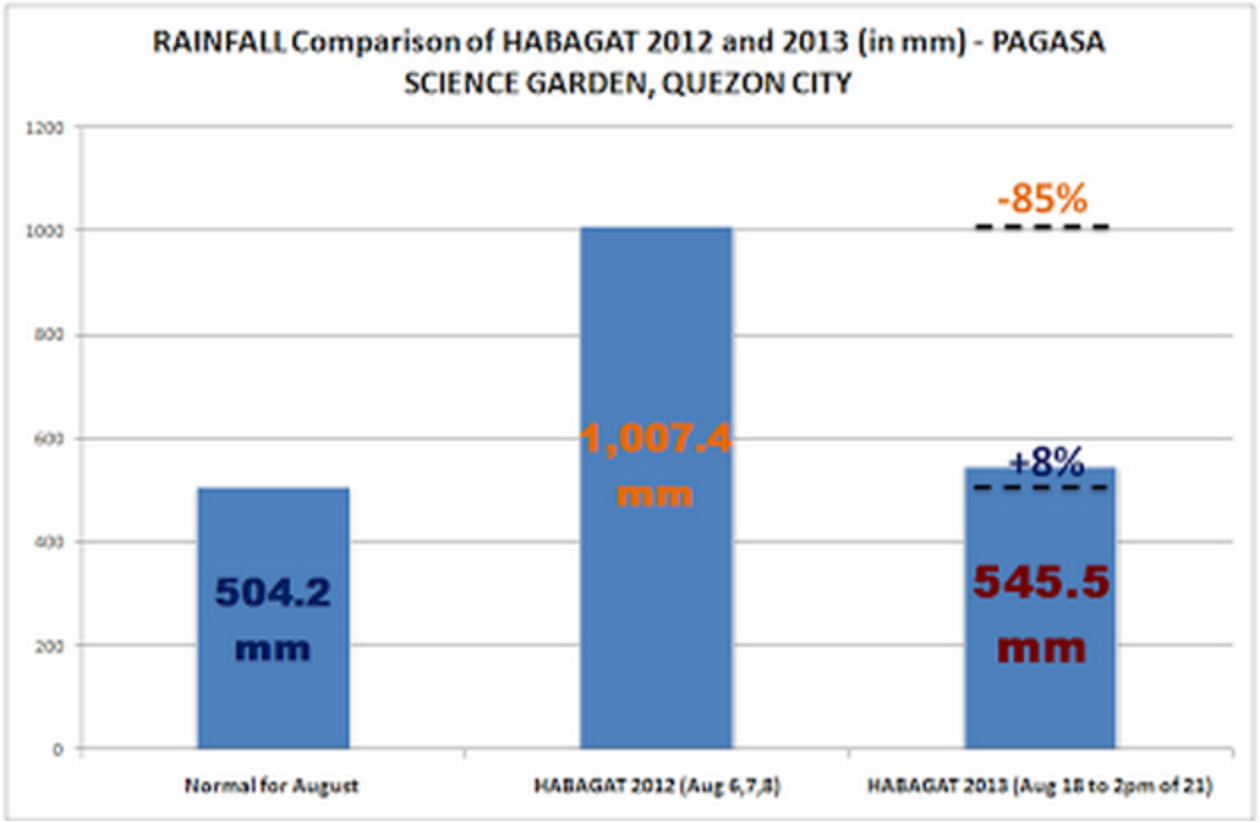
Rainfall Volume on PAGASA Sangley point in Cavite recorded a 2.25x higher compared to normal whole month of August causing flooding on Cavite-Laguna Area. GMA News from PAGASA data.

Note:
HABAGAT 2013 is taken on August 18,19,20 and until 2pm of 21, 2013
HABAGAT 2012 is taken on August 6,7 and 8, 2012



Compared to HABAGAT 2012, HABAGAT 2013 Rainfall is 23% much lower but still Manila is flooded everywhere because it is almost 2x the normal Rainfall for whole month of August. GMA News from PAGASA data.

Note:
HABAGAT 2013 is taken on August 18,19,20 and until 2pm of 21, 2013
HABAGAT 2012 is taken on August 6,7 and 8, 2012



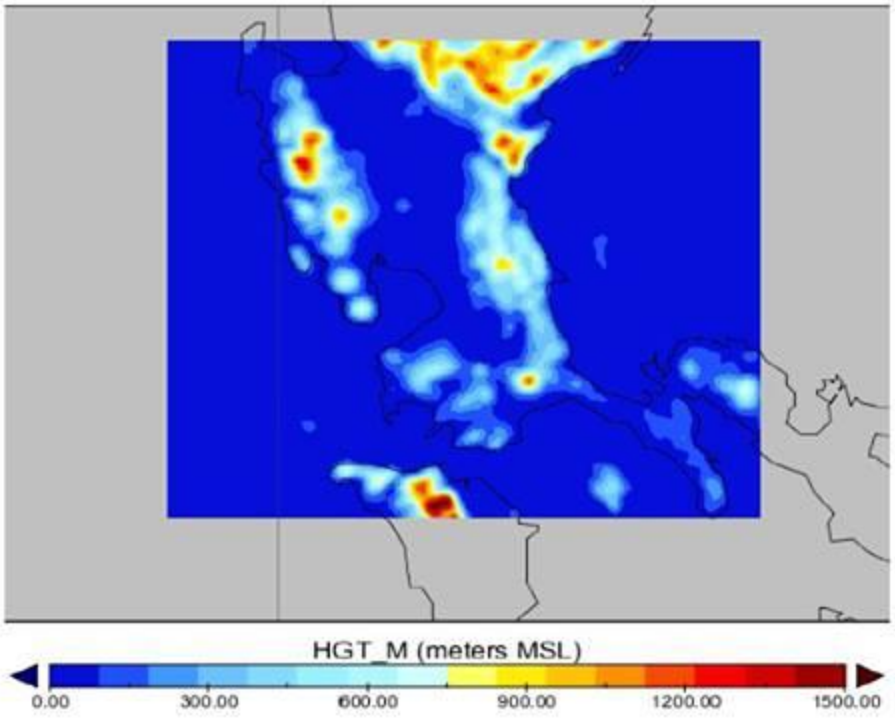
PAGASA Science Garden in Quezon City recorded 3 days HABAGAT 2013 Rainfall volume with the amount more than the whole month of August. GMA News from PAGASA data.

Note:
HABAGAT 2013 is taken on August 18,19,20 and until 2pm of 21, 2013
HABAGAT 2012 is taken on August 6,7 and 8, 2012

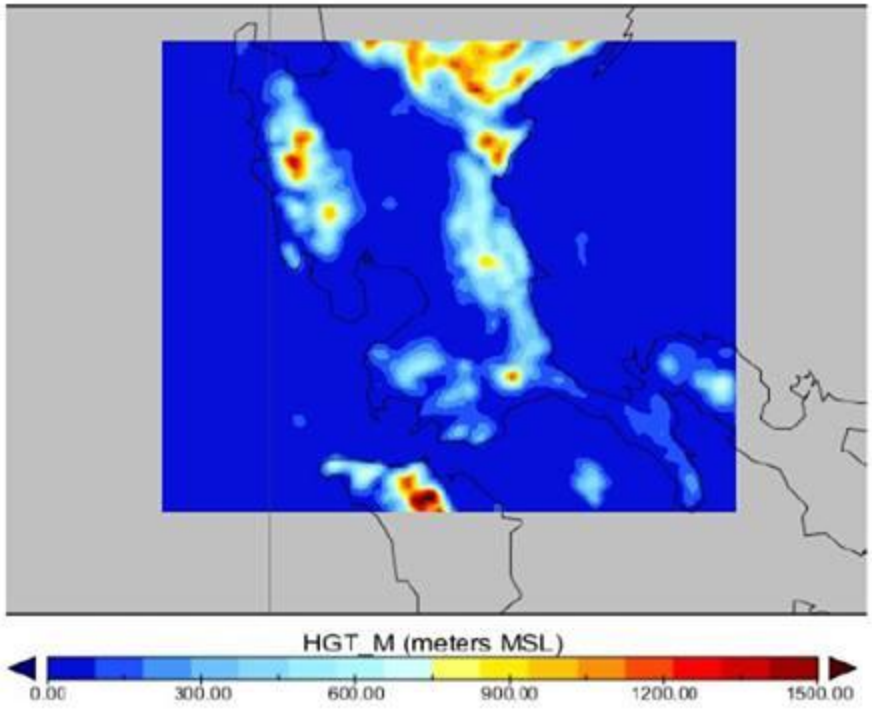
Case 1: control simulation
Case 2: 2 volcanoes removed

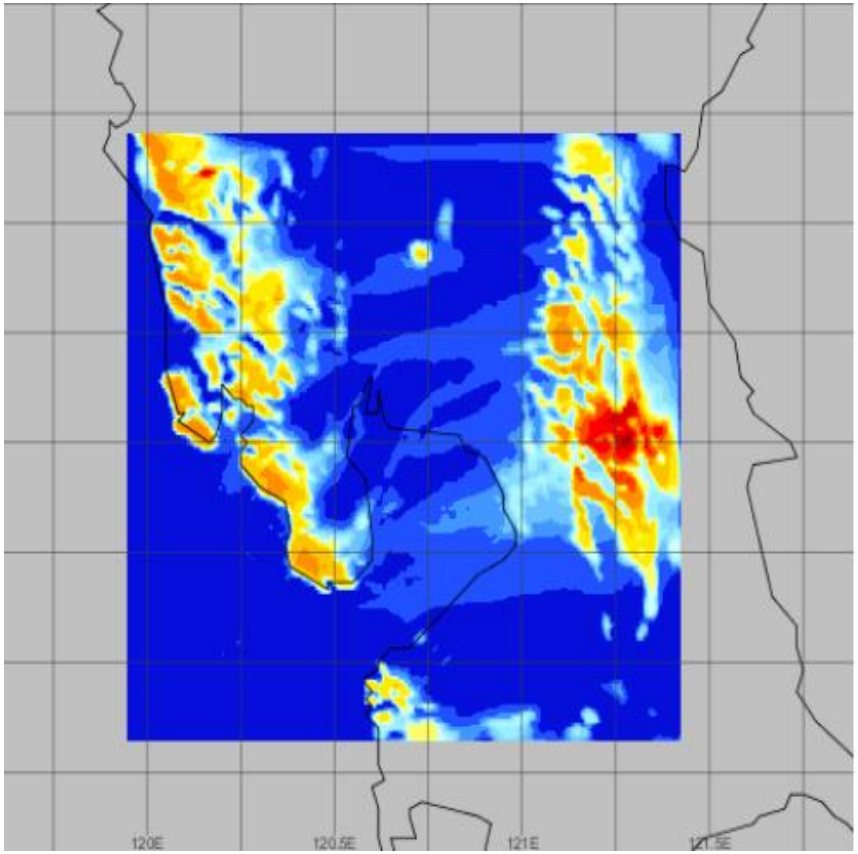
Topography used in simulation

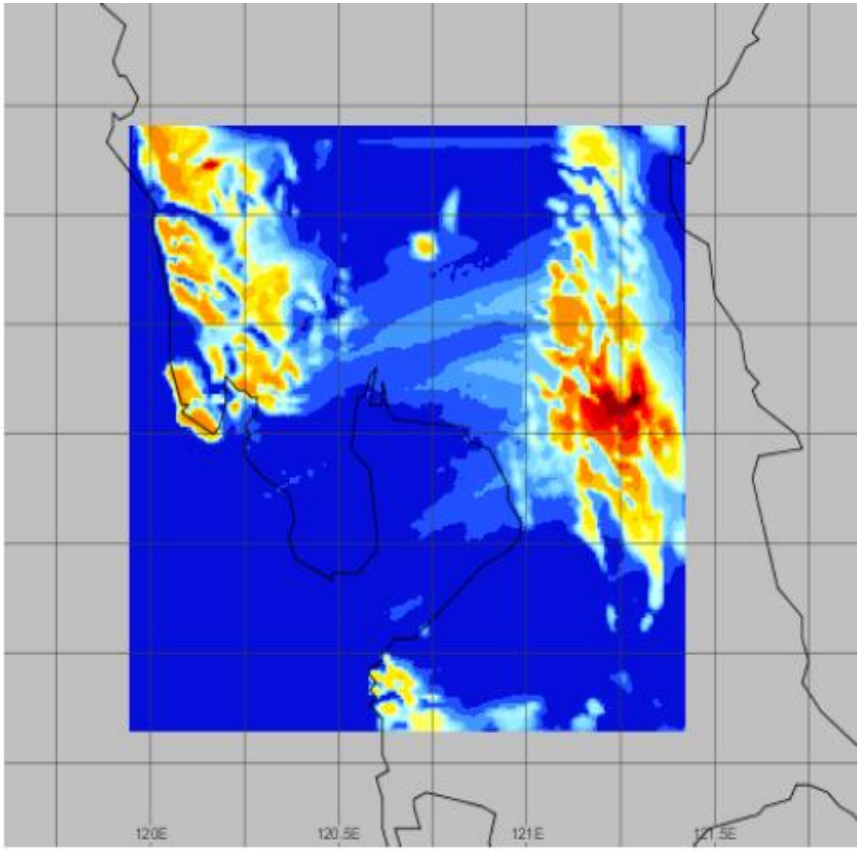
case 1

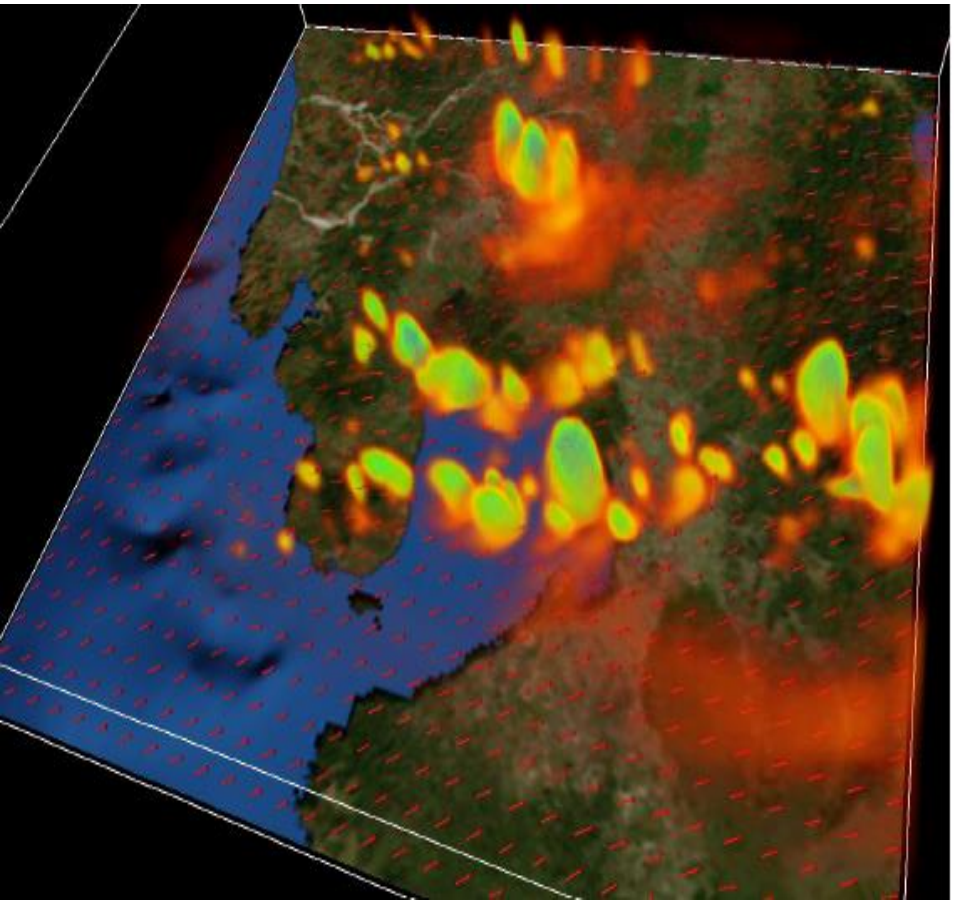


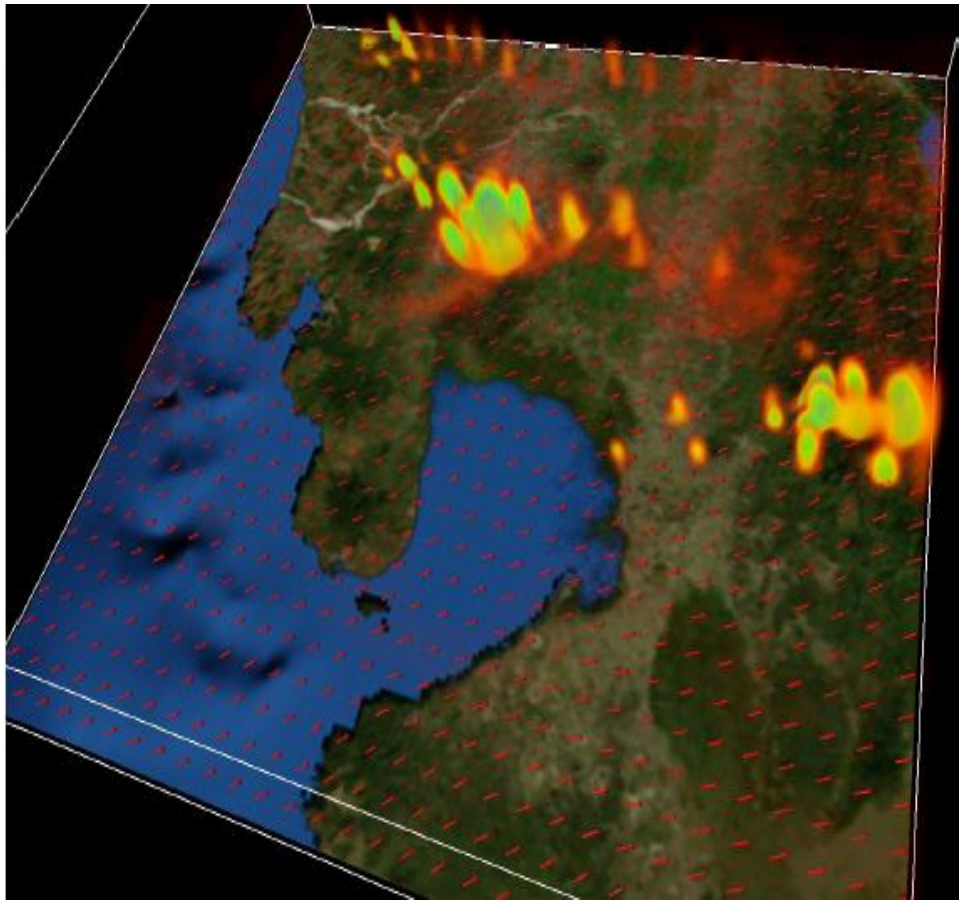
case 2



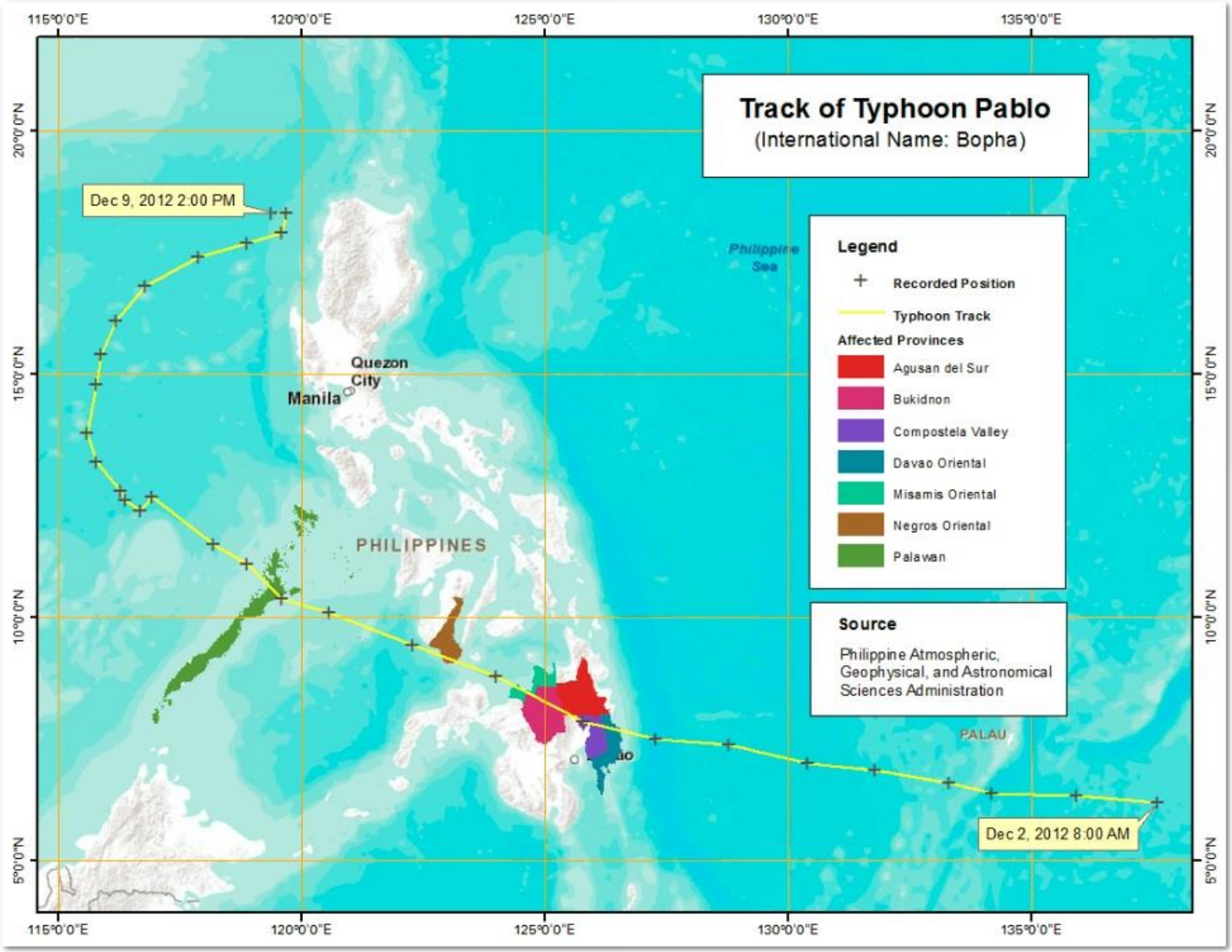

120E
120.5E
121E
121.5E


120E
120.5E
121E
121.5E

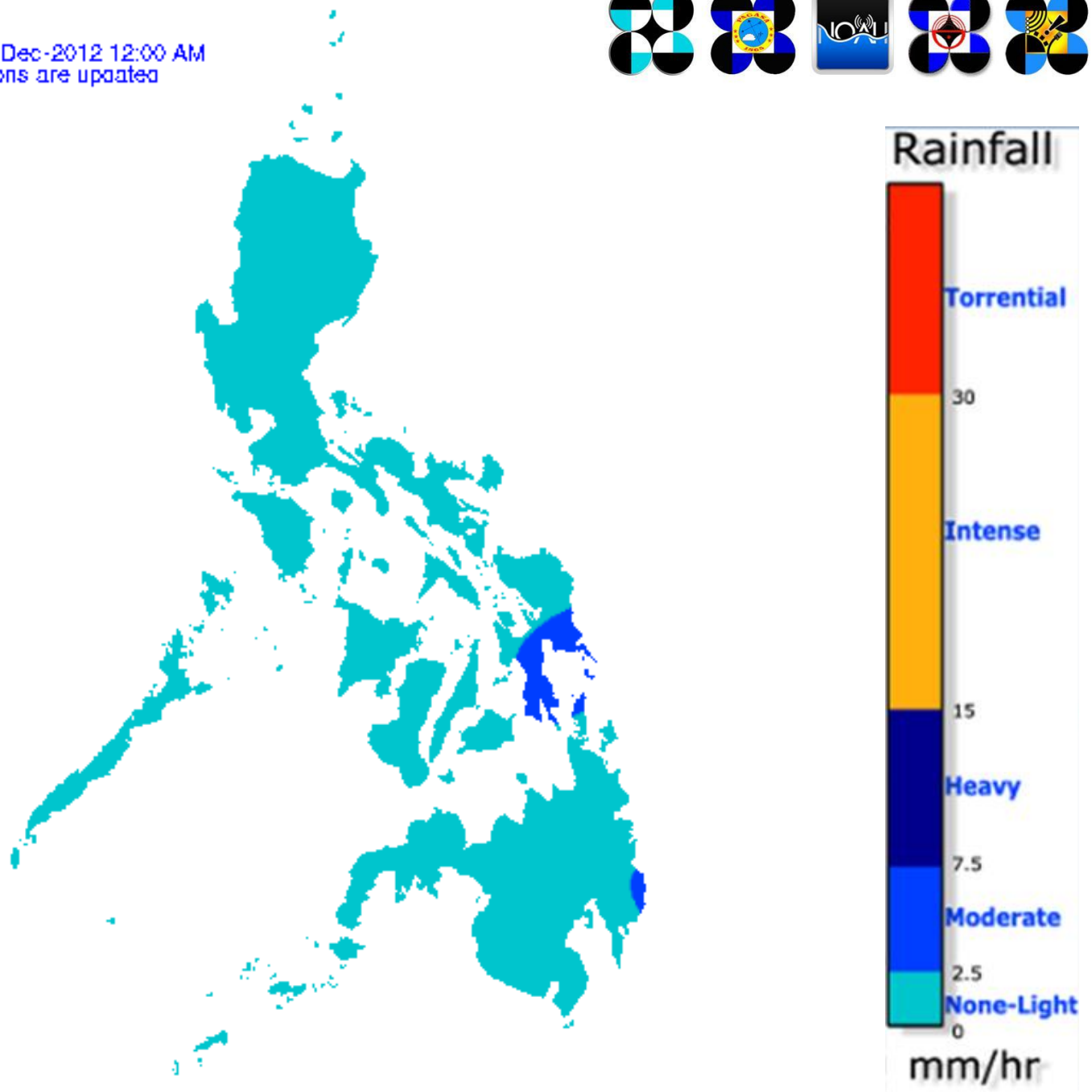




Lagmay et al., 2013



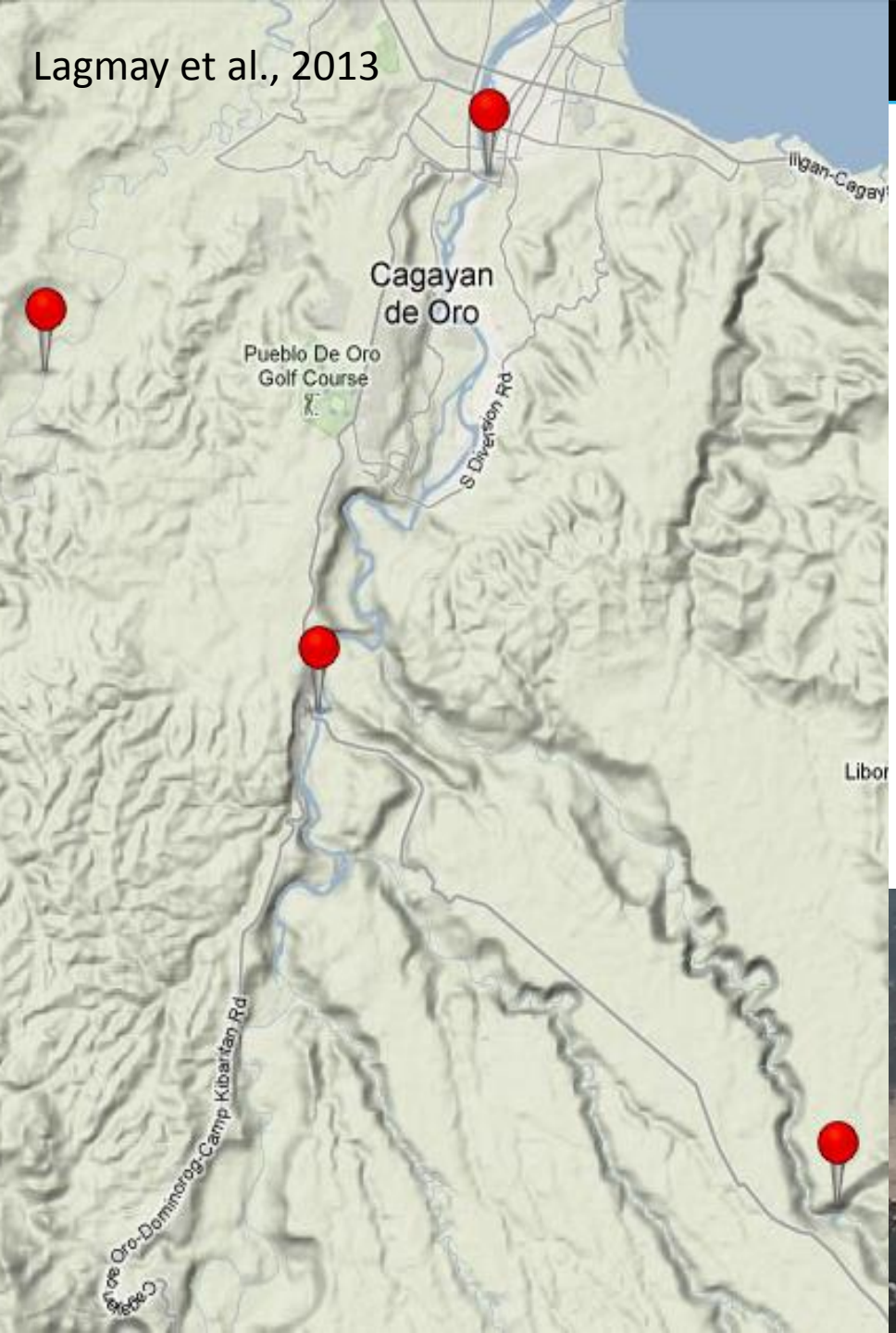
Lagmay et al., 2013

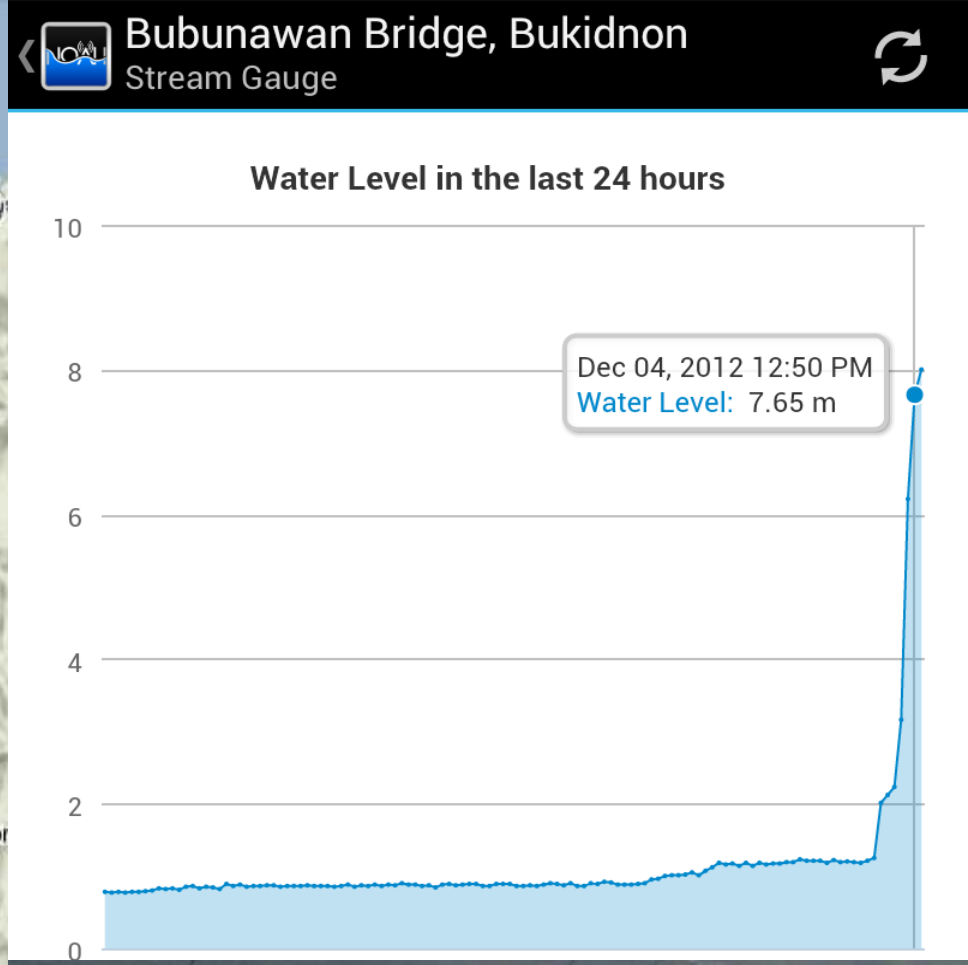


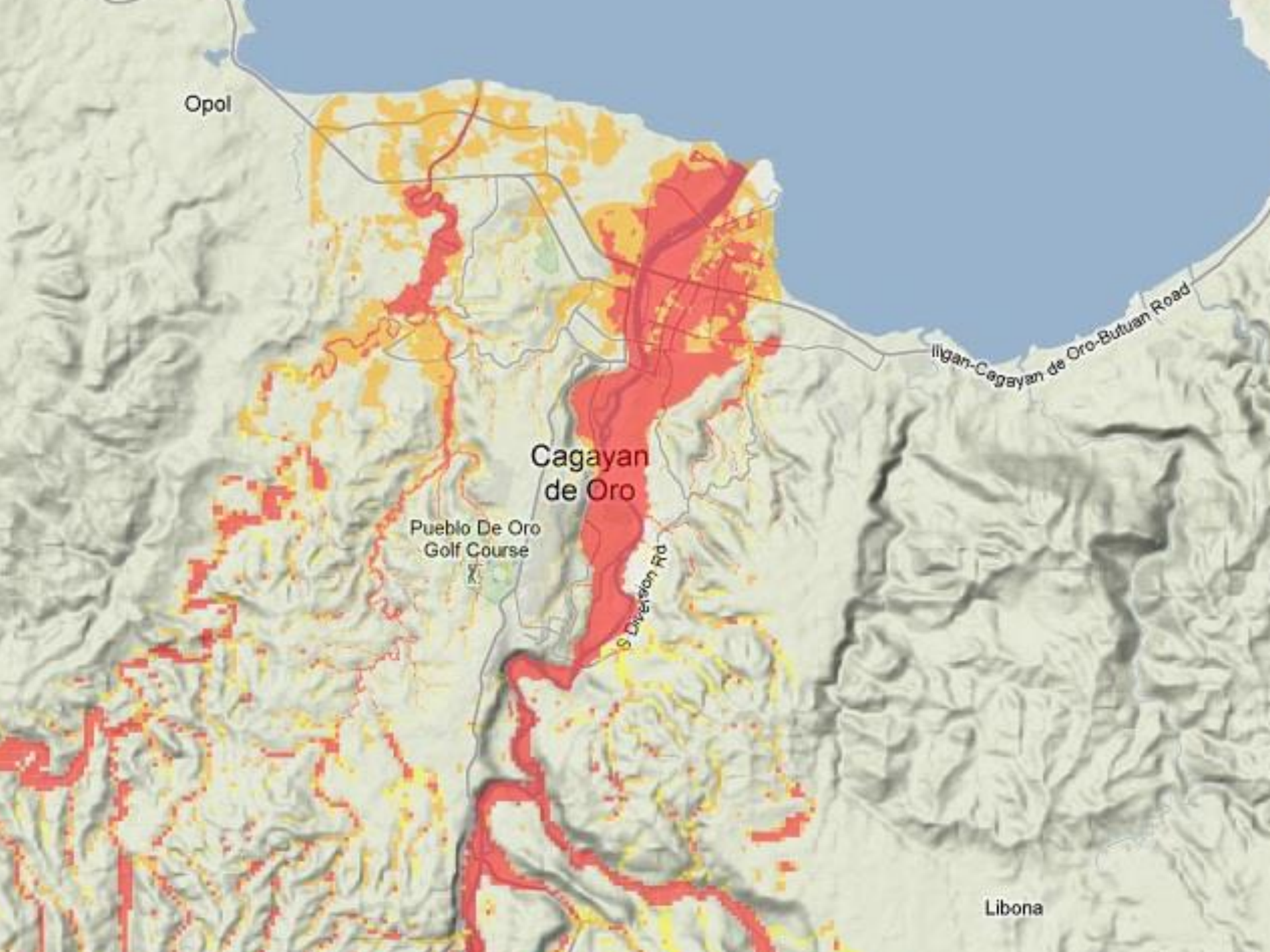
Rainfall contour map
On 4 December 2012


Ugiaban Bridge in Cagayan de Oro, Philippines
Washed out during typhoon Pablo

Lagmay et al., 2013

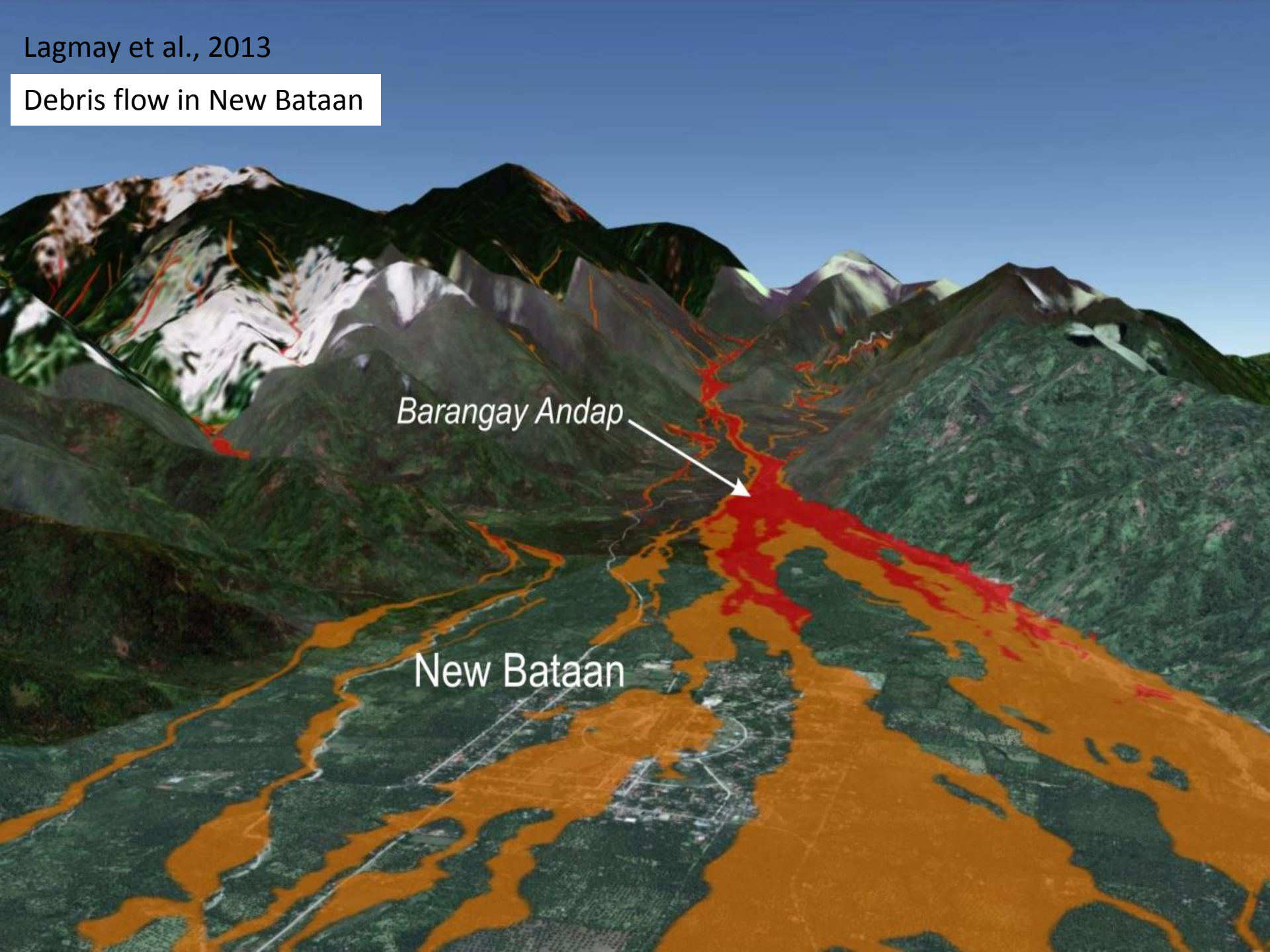





Opol
Iligan-Cagayan de Oro-Butuan Road
Cagayan
de Oro
Pueblo De Oro
Golf Course
S Diversion Rd
Libona

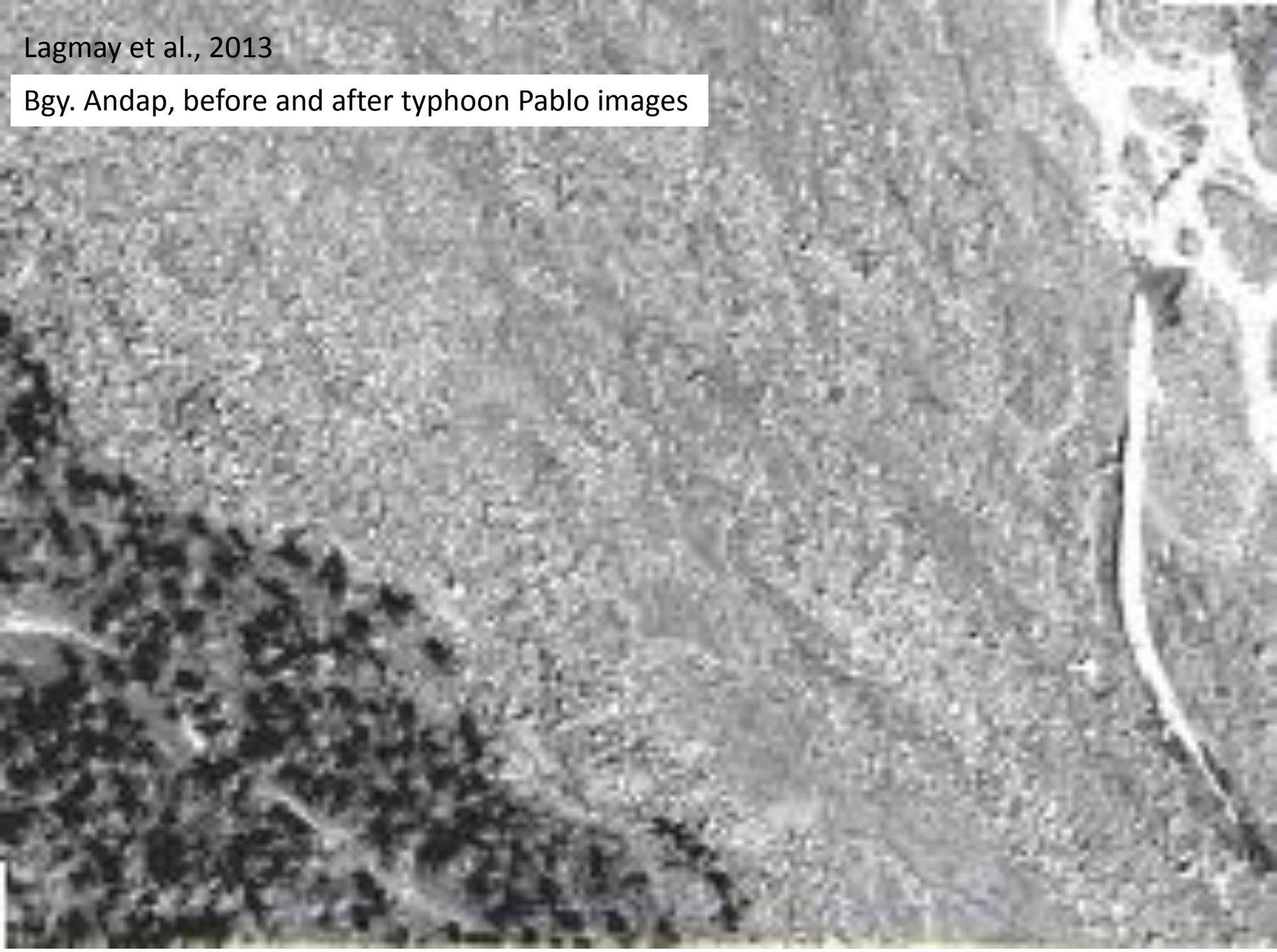
Lagmay et al., 2013

Debris flow in New Bataan



Lagmay et al., 2013

Bgy. Andap, before and after typhoon Pablo images



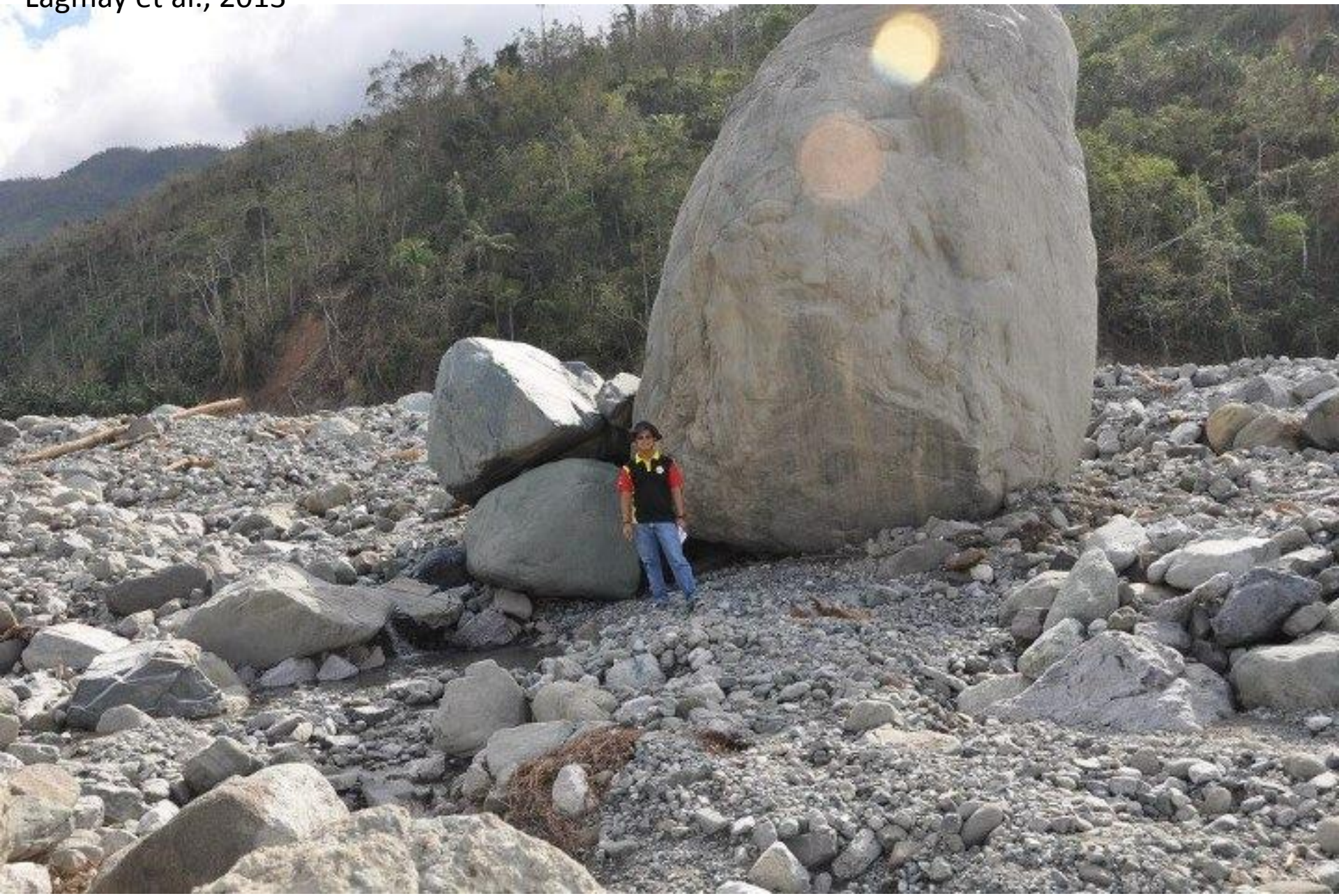
Lagmay et al., 2013

Debris flow field in New Bataan, Compostela Valley

Lagmay et al., 2013

Debris flow field in New Bataan, Compostela Valley

Lagmay et al., 2013



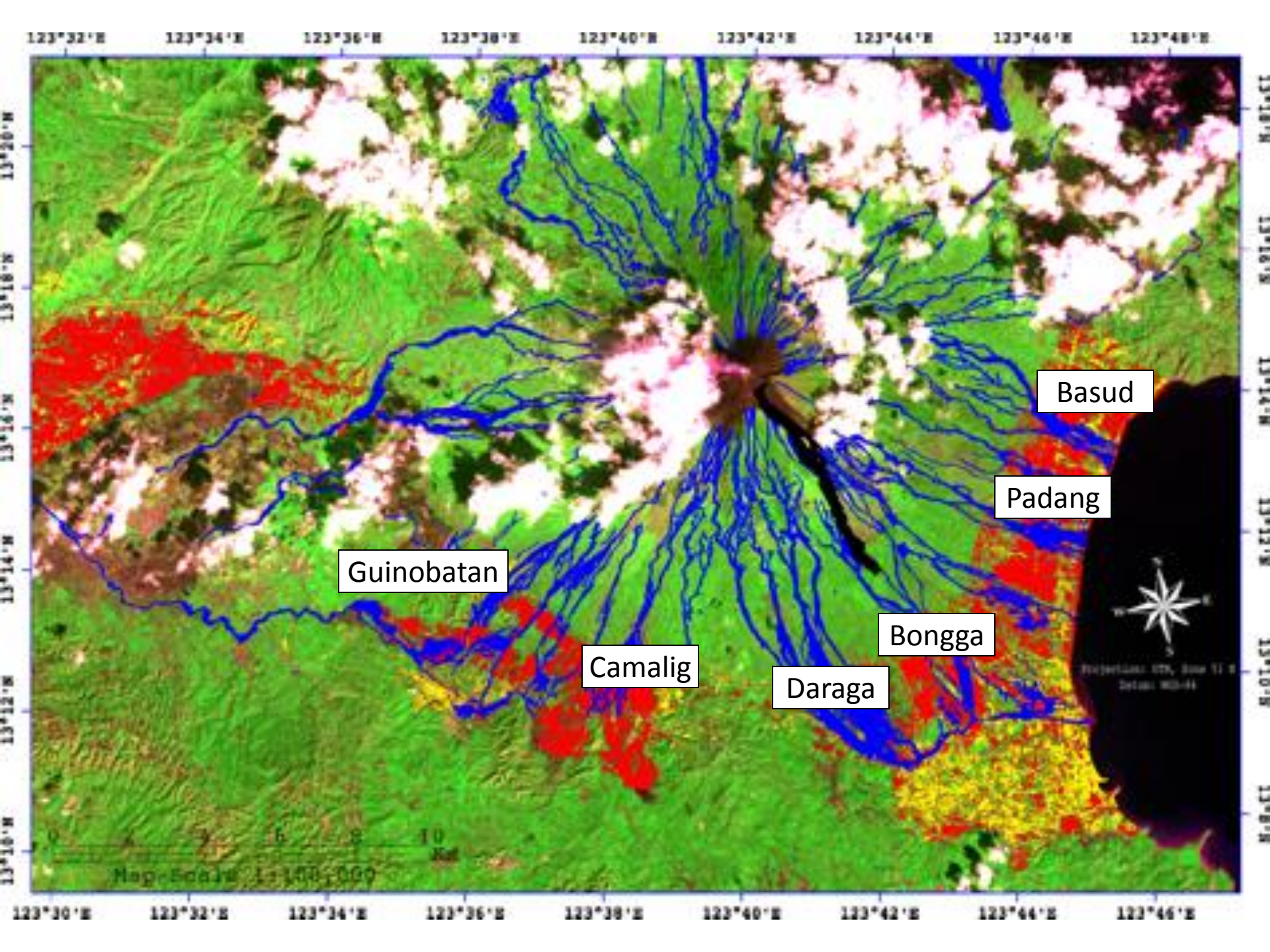
Debris flow field in New Bataan. Volume of deposit – 25-30 million cubic meters

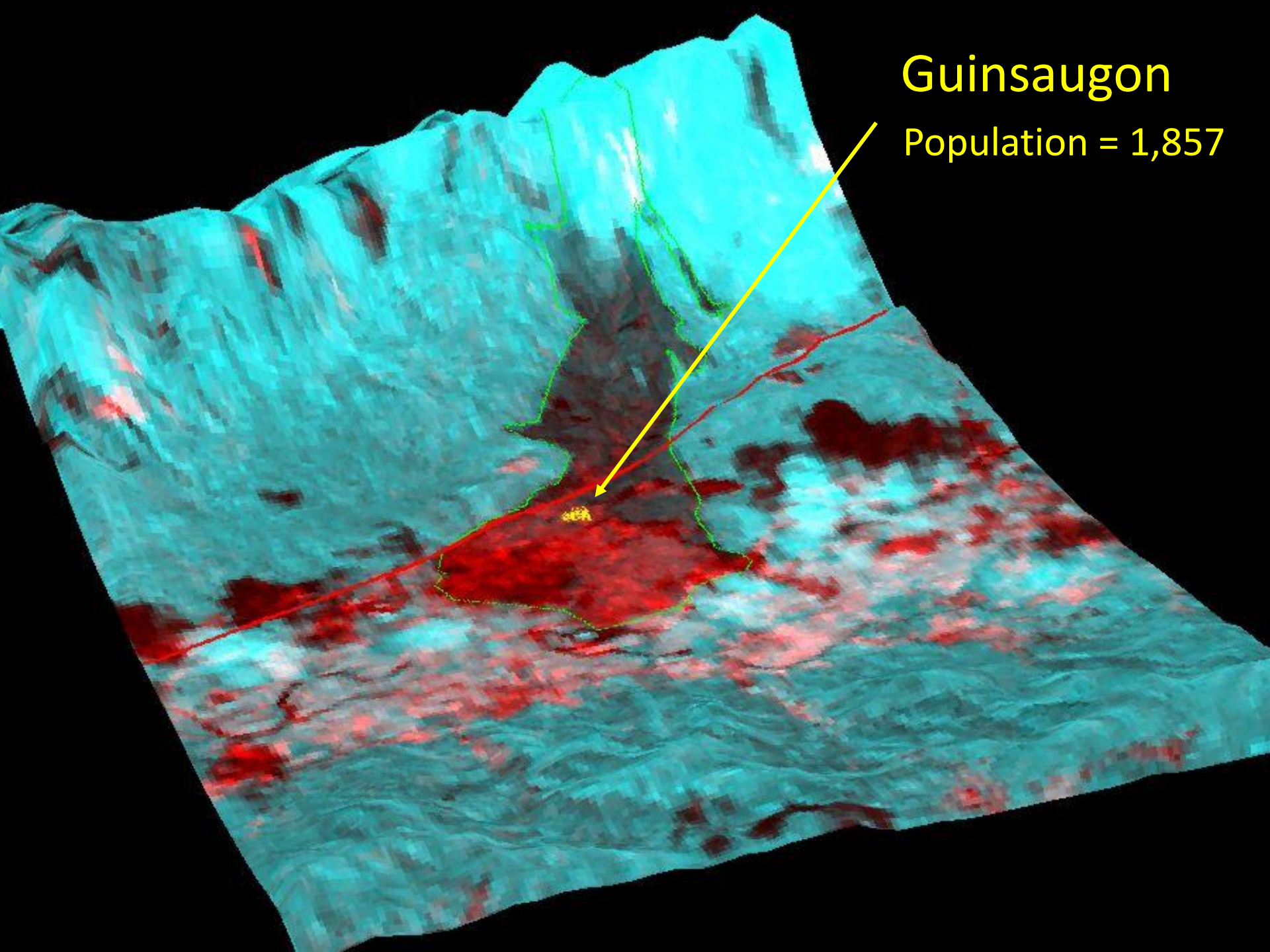
Debris flow field in New Bataan, Compostela Valley

Debris flow field in Cordillera de La Costa, Vargas, Venqezuela. 19,000 died in 1999

http://www.webpages.uidaho.edu/~simkat/cors220_files/lecture12.html

Mayon volcano lahars deposits . Lahars triggered by typhoon Durian in 2006


Basud
Padang
Guinobatan
Bongga
Camalig
Daraga


Guinsaugon
Population = 1,857

Feb. 17, 2006 Guinsaugon landslide 1126 dead US$ 2.203 million

15-20 million cubic meters

Day 6, Wed, 22 Feb 2006


Day 7, Thurs, 23 Feb 2006

Day 7, Thurs, 23 Feb 2006

RESCUE 505

Pedring and Quiel typhoons in 2011

NIGS

Google Earth

Sentinel Asia

Tropical storm Sendong


Orchids Home Subidivision, Santiago, Iligan
http://www.firmbuilders.com.ph/

Orchids Home Subidivision, Santiago, Iligan

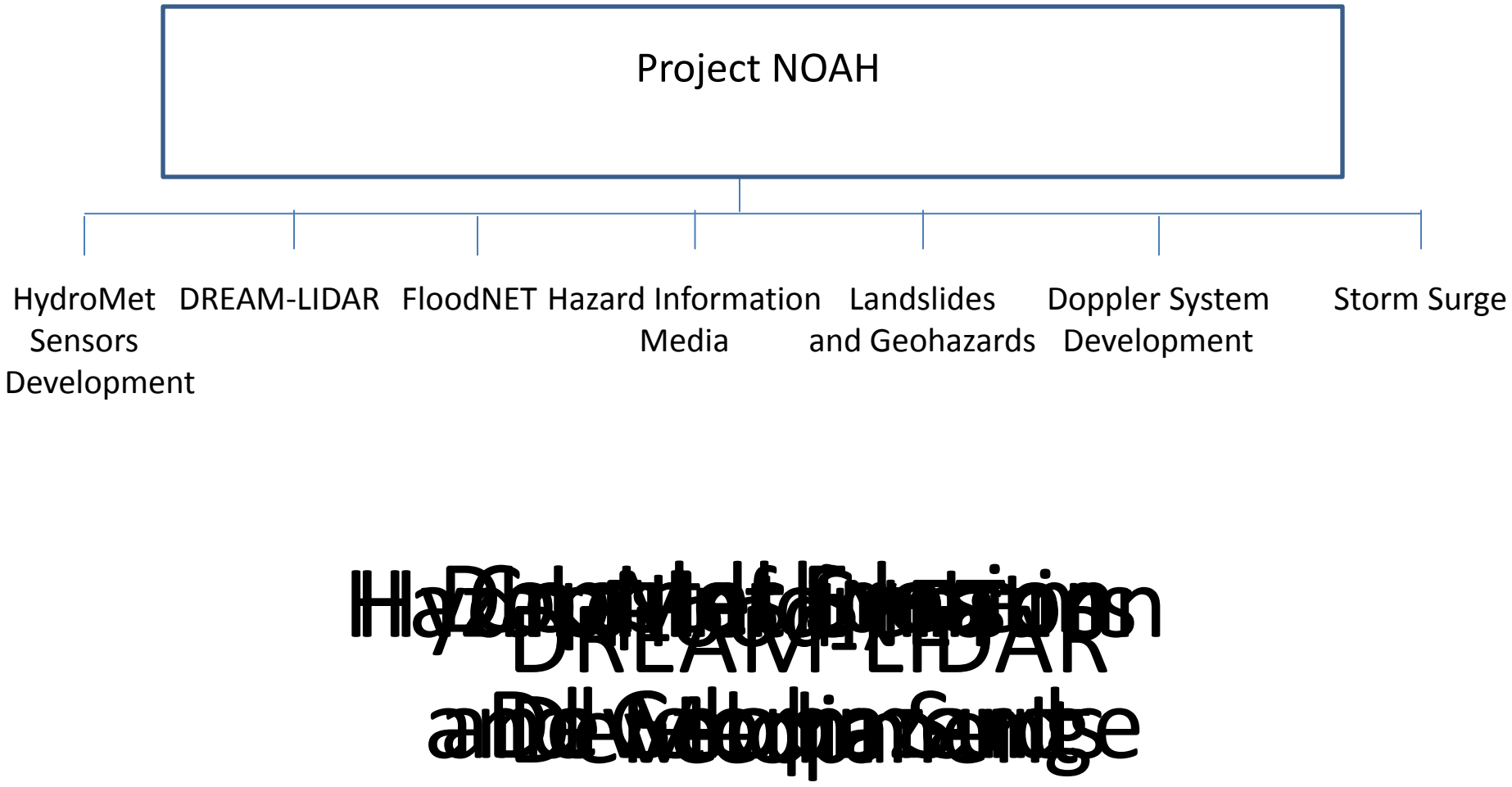
PRESIDENT'S DIRECTIVE

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) Improved weather forecasting and information dissemination

Nationwide Operational Asessment of Hazards

DOST PROGRAMS UNDER THE NOAH PROGRAM

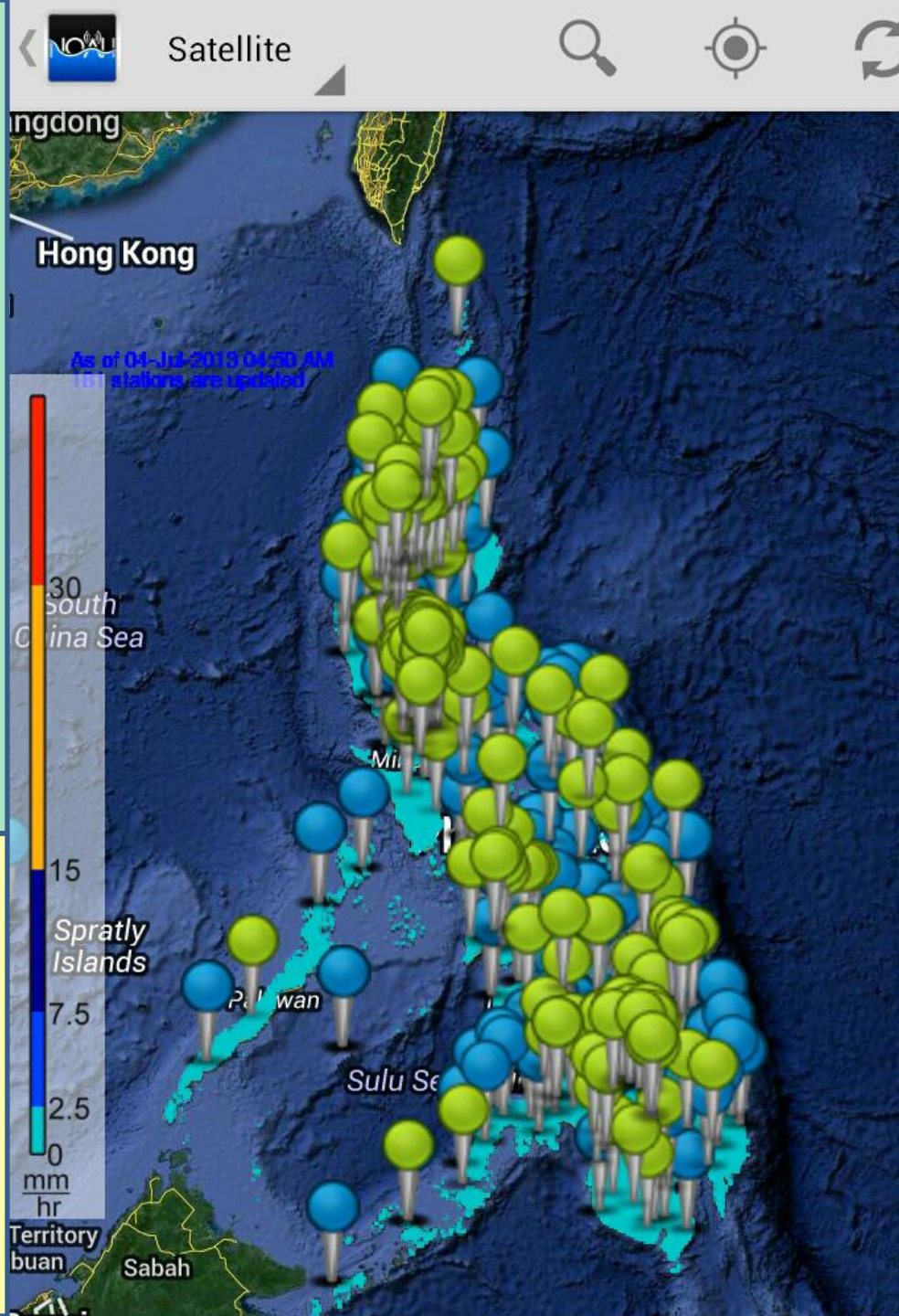


Installed

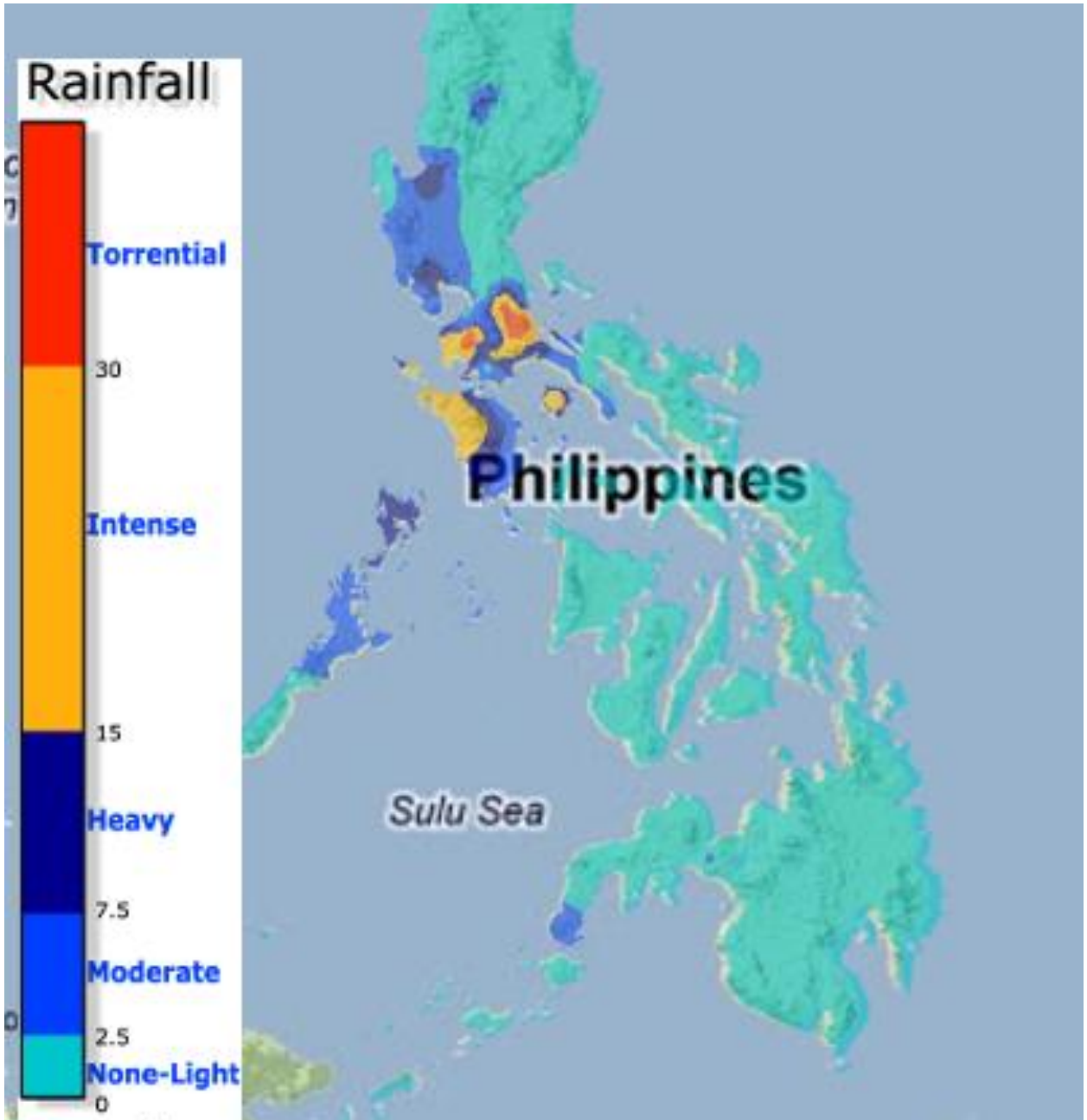
- **200** Automated Rain Gauges (ARG),
- **70** Automated Stream Gauges (ASG)
- **81** Automated Weather Stations (AWS)

Delivered

- **333** Automated Rain Gauges (ARG)
- **205** Automated stream Gauges

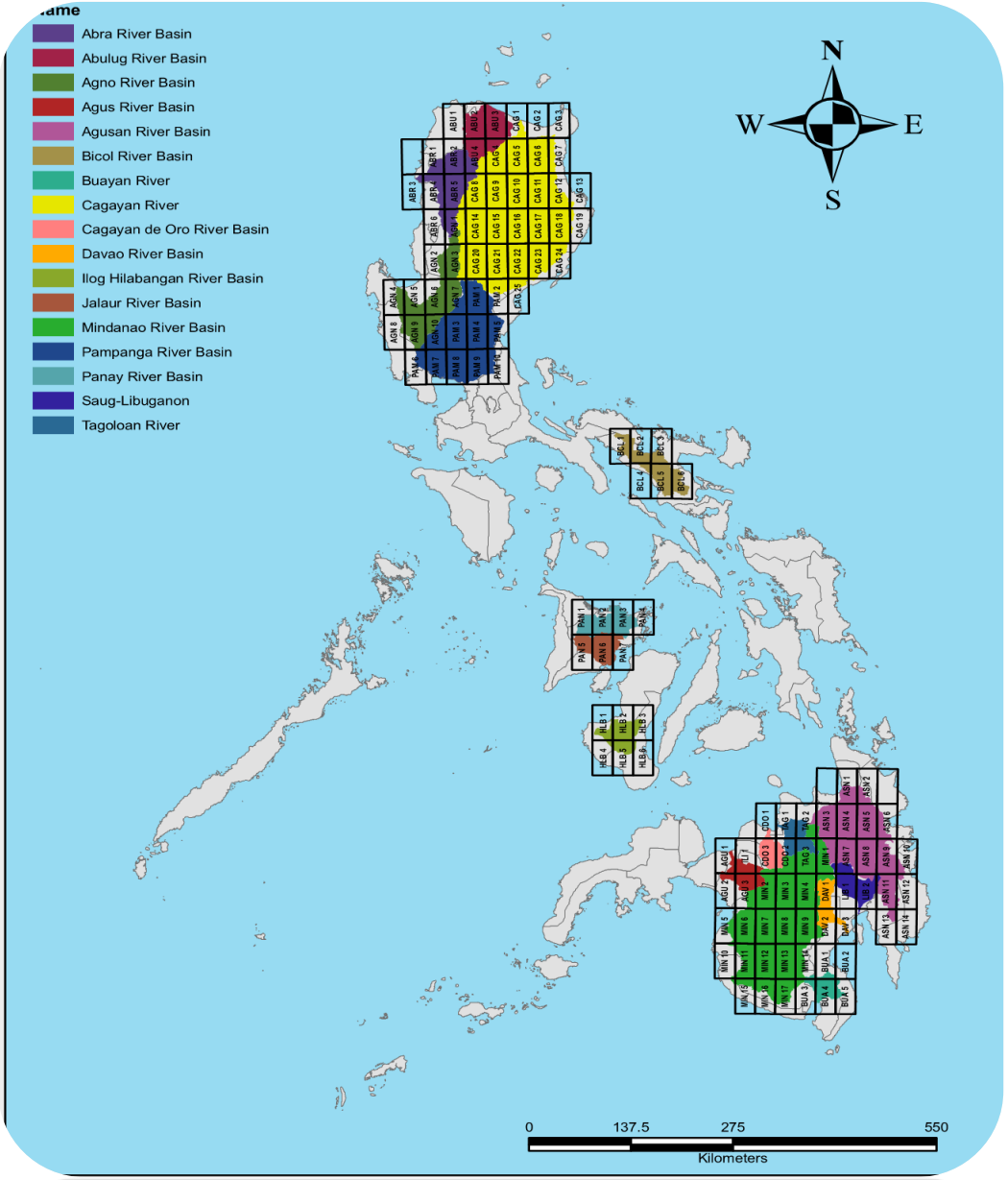


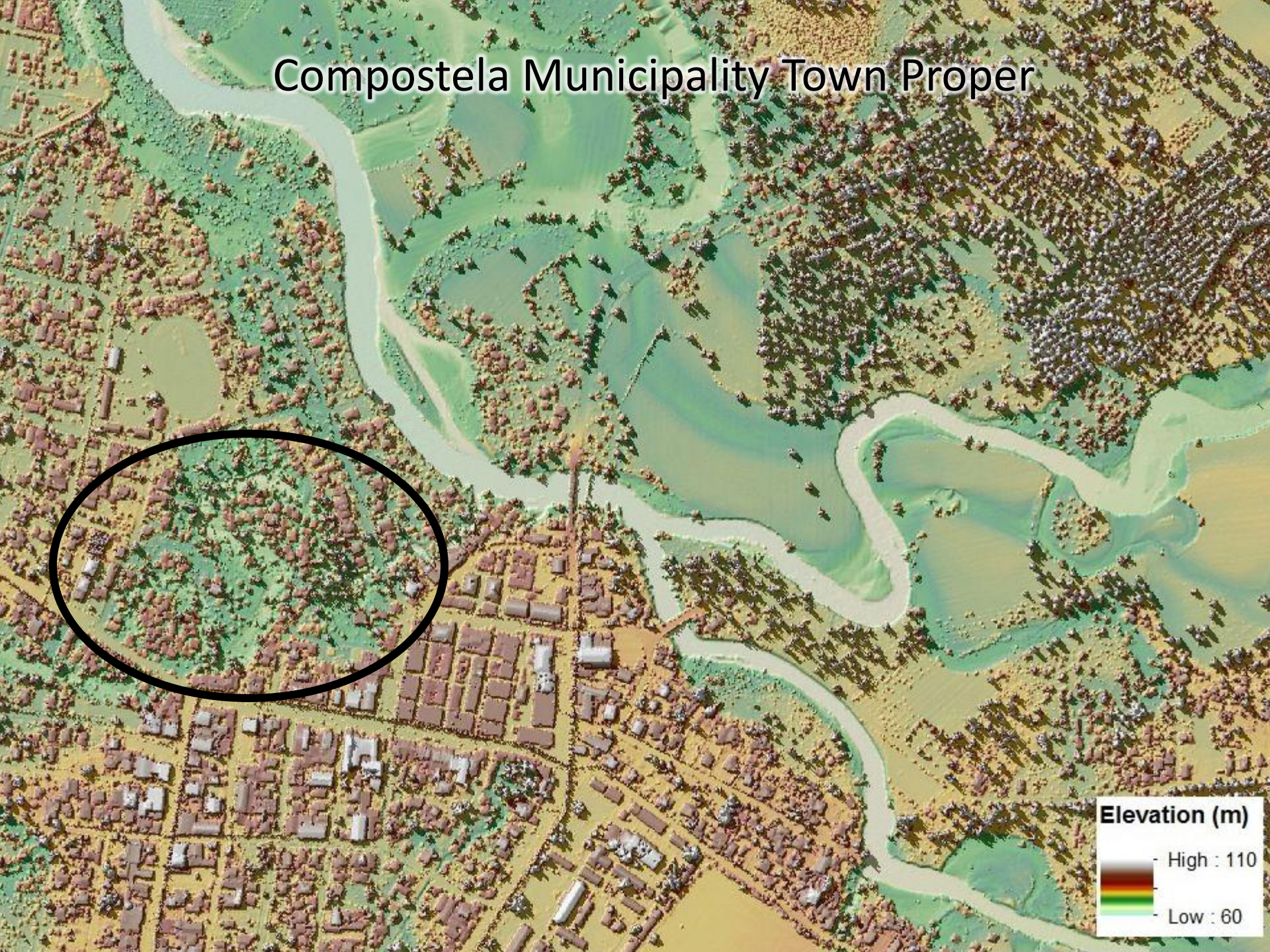
Tropical Storm Gorio

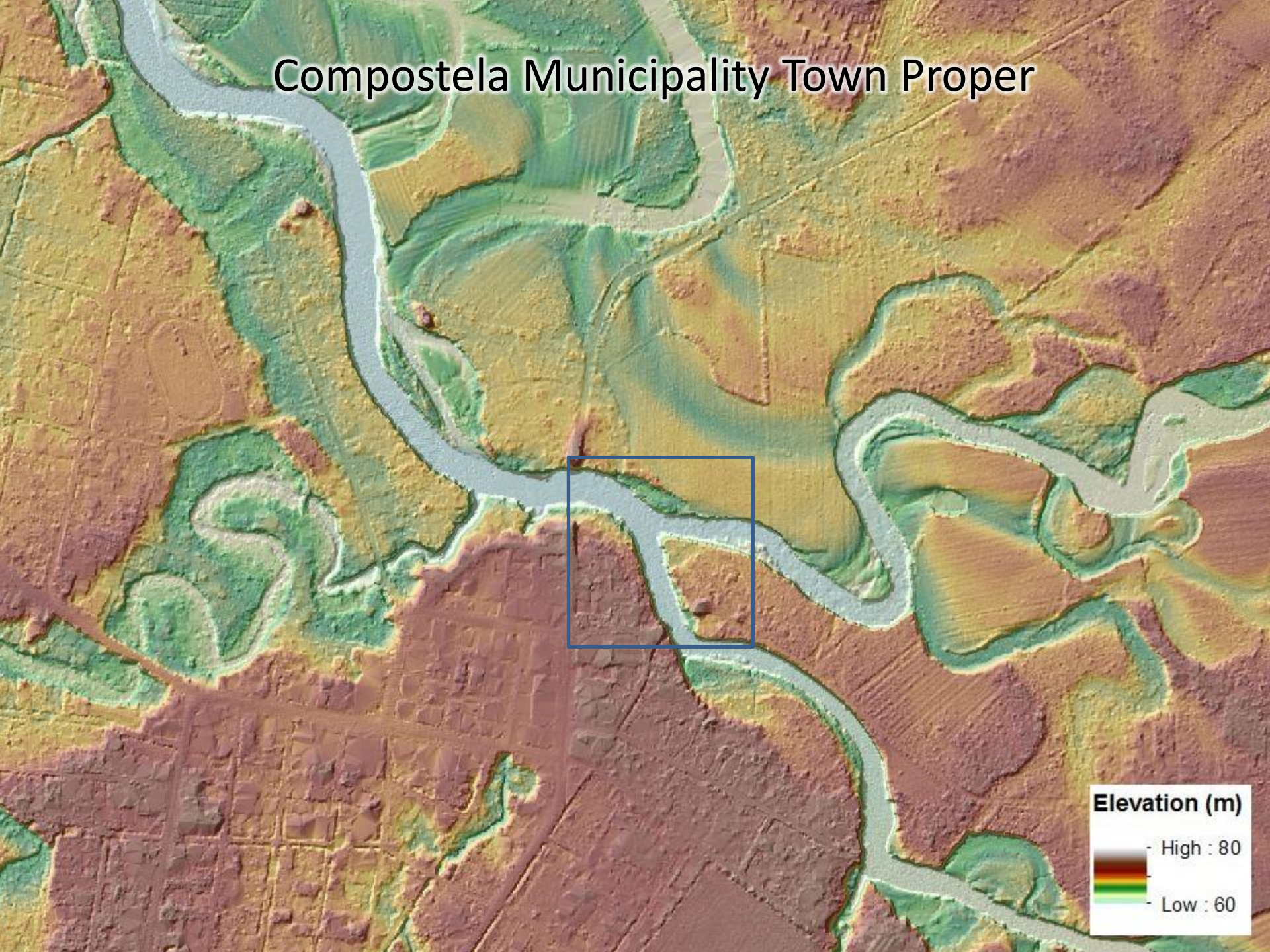


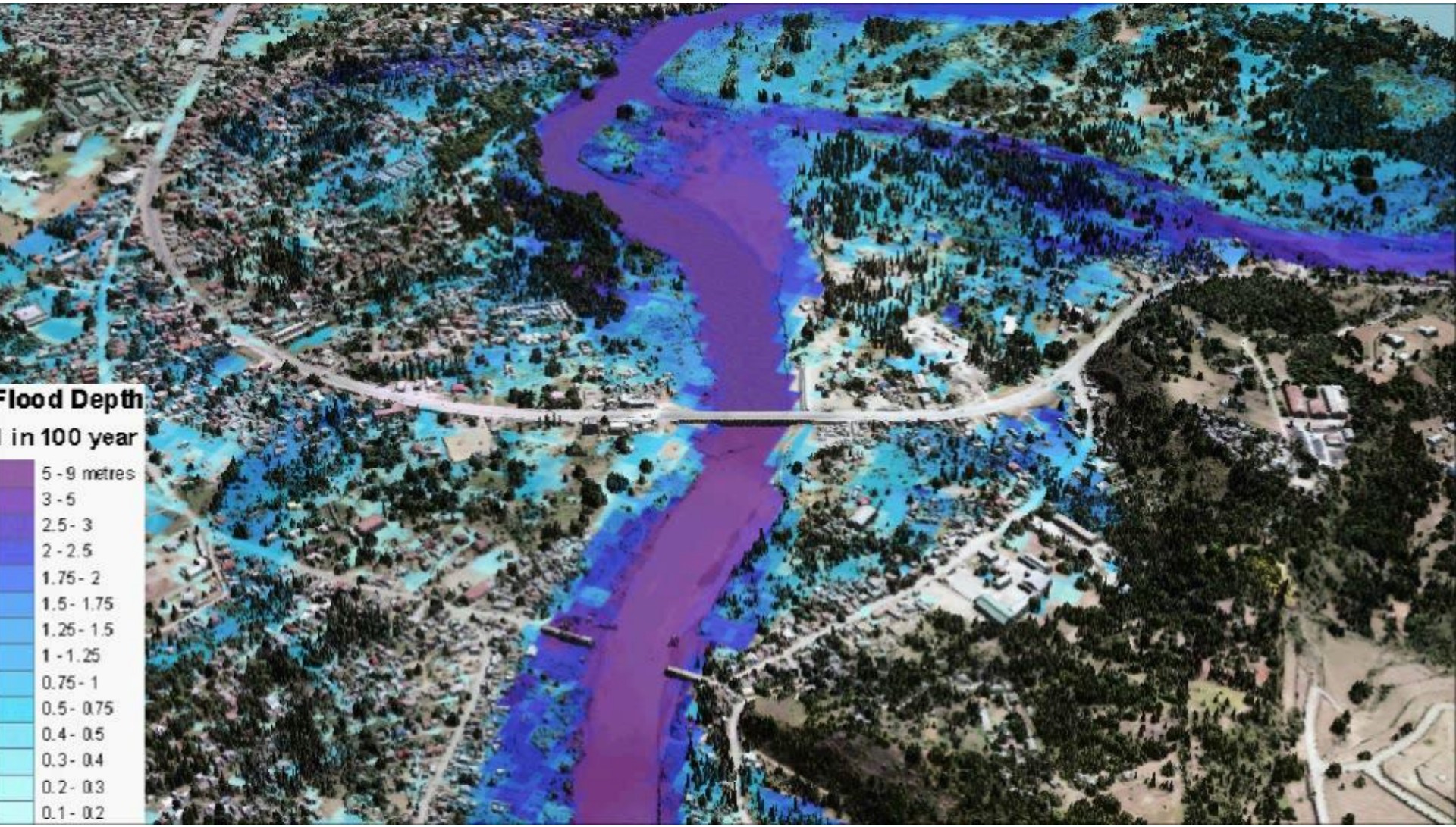
LIDAR

- 300 km^2 per day
- 12 out of the 18 major river basins have Lidar mapped floodplains




Compostela Municipality Town Proper
Elevation (m)
High : 110
Low : 60

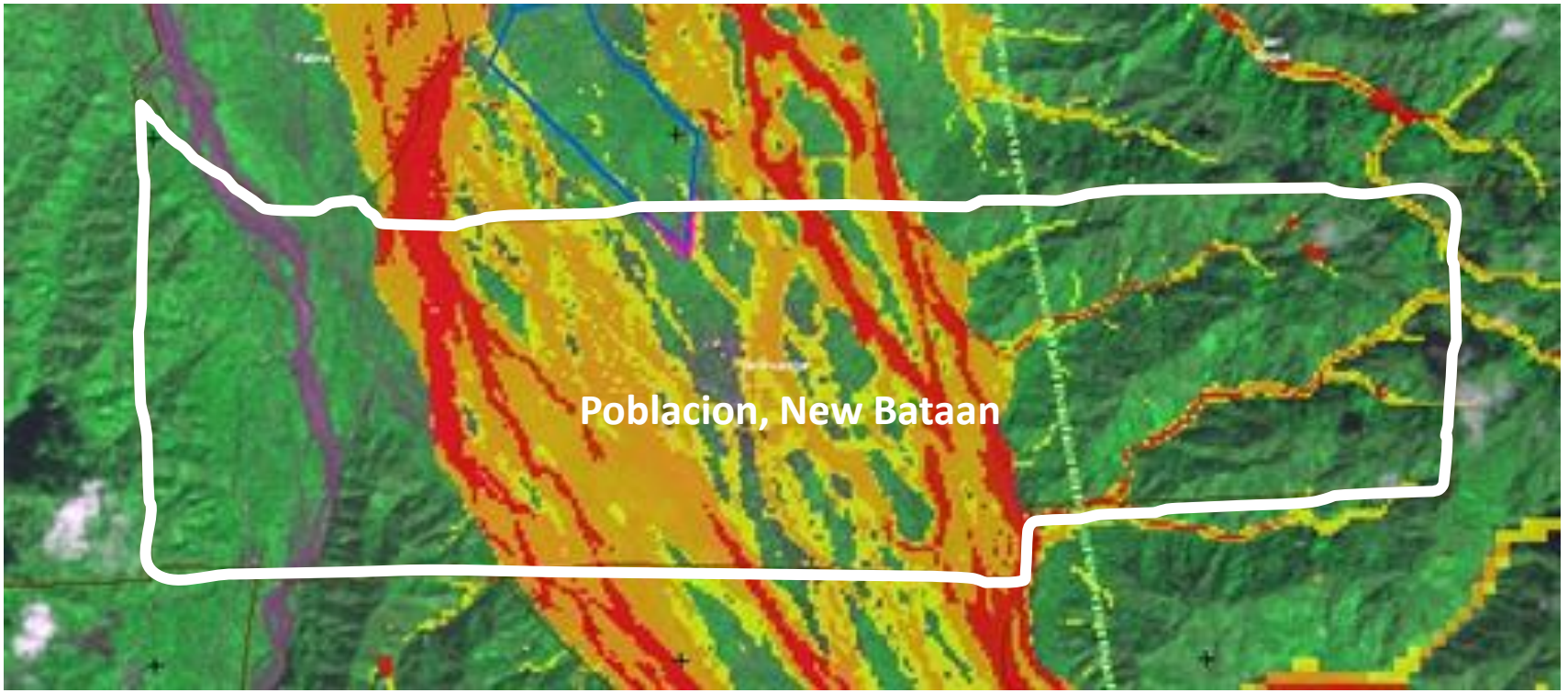

Compostela Municipality Town Proper
Elevation (m)
High : 80
Low : 60


Flood Depth
in 100 year
5 - 9 metres
3 - 5
2.5 - 3
2 - 2.5
1.75 - 2
1.5 - 1.75
1.25 - 1.5
1 - 1.25
0.75 - 1
0.5 - 0.75
0.4 - 0.5
0.3 - 0.4
0.2 - 0.3
0.1 - 0.2

Table

Barangays selection

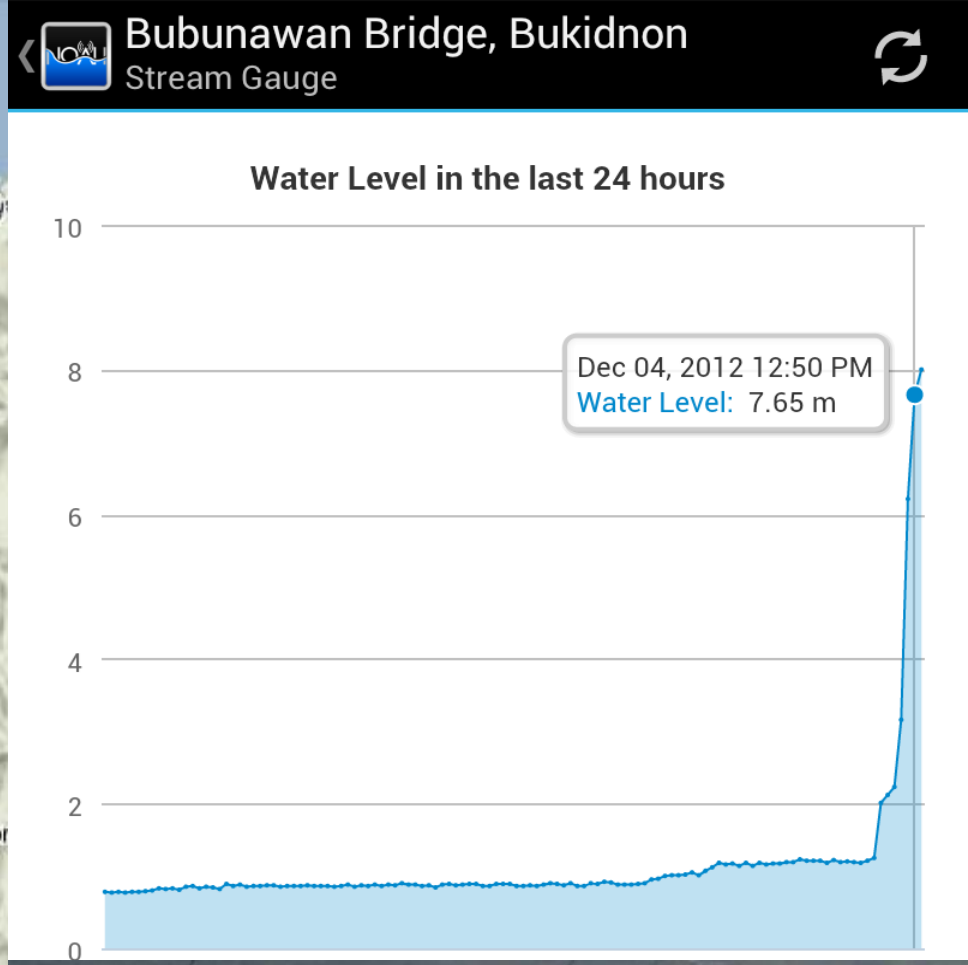
NAME_2	ID_3	NAME_3	NL_NAME_3	VARNAME_3	TYPE_3	ENGTYPE_3	PROVINCE	REGION
Pantukan	12196	Araibo			Barangay	Village	Compostela Valley	Davao Region (Region XI)
Pantukan	12200	Las Arenas			Barangay	Village	Compostela Valley	Davao Region (Region XI)
Pantukan	12205	Tag-Ugpo			Barangay	Village	Compostela Valley	Davao Region (Region XI)
New Bataan	12182	Andap			Barangay	Village	Compostela Valley	Davao Region (Region XI)
New Bataan	12183	Bantacan			Barangay	Village	Compostela Valley	Davao Region (Region XI)
New Bataan	12184	Batinao			Barangay	Village	Compostela Valley	Davao Region (Region XI)
New Bataan	12185	Cabinuangan		Poblacion	Barangay	Village	Compostela Valley	Davao Region (Region XI)
New Bataan	12186	Camanlangan			Barangay	Village	Compostela Valley	Davao Region (Region XI)
New Bataan	12187	Cogonon			Barangay	Village	Compostela Valley	Davao Region (Region XI)
New Bataan	12188	Fatima			Barangay	Village	Compostela Valley	Davao Region (Region XI)
New Bataan	12189	Kahayag			Barangay	Village	Compostela Valley	Davao Region (Region XI)
New Bataan	12190	Katipunan			Barangay	Village	Compostela Valley	Davao Region (Region XI)



Success story

- Provided two warnings several hours in advance of incoming Habagat floods
- 1007 mm of rain August 6-8, 2013
- Zero casualties in Marikina

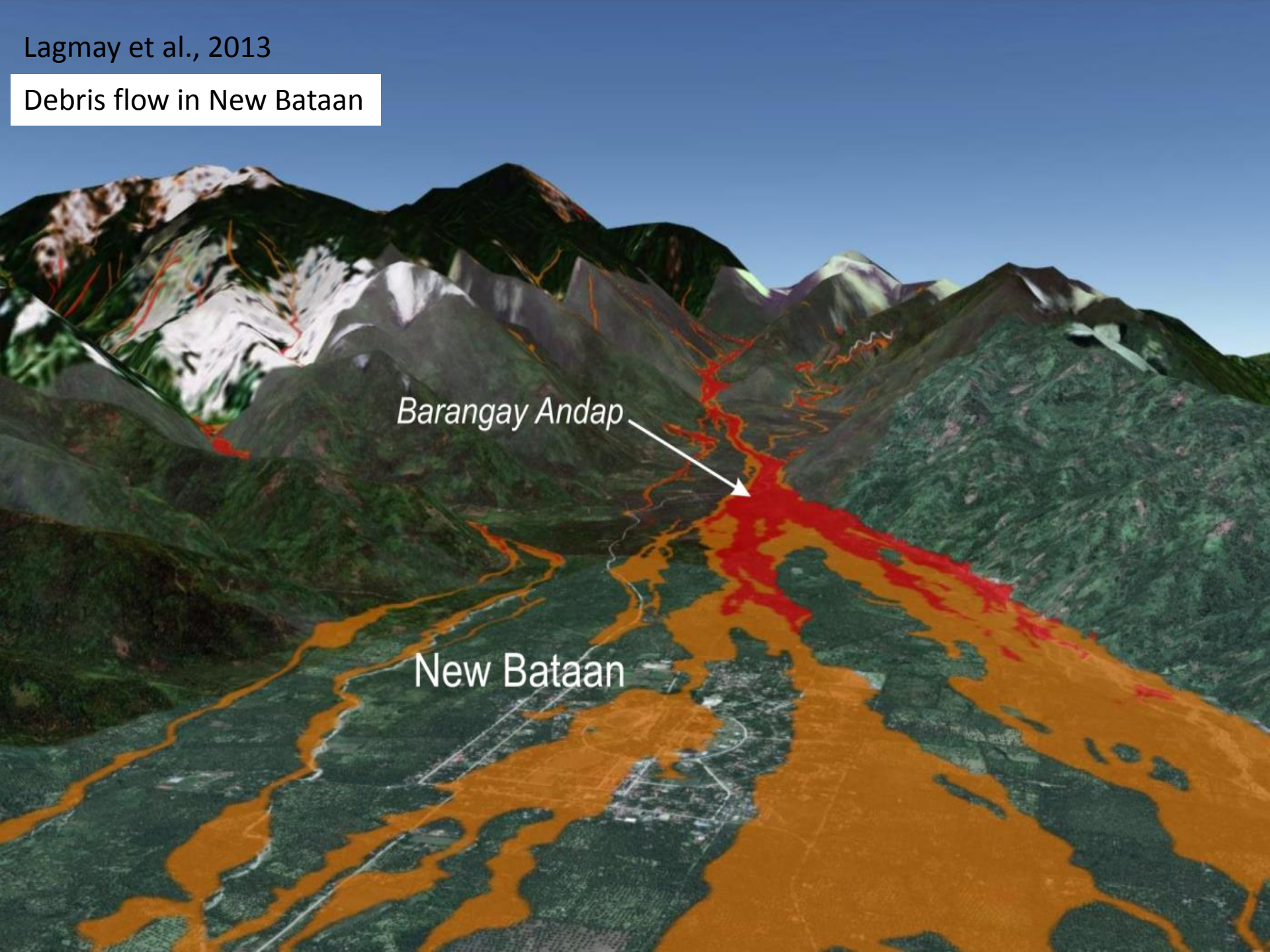
Lagmay et al., 2013

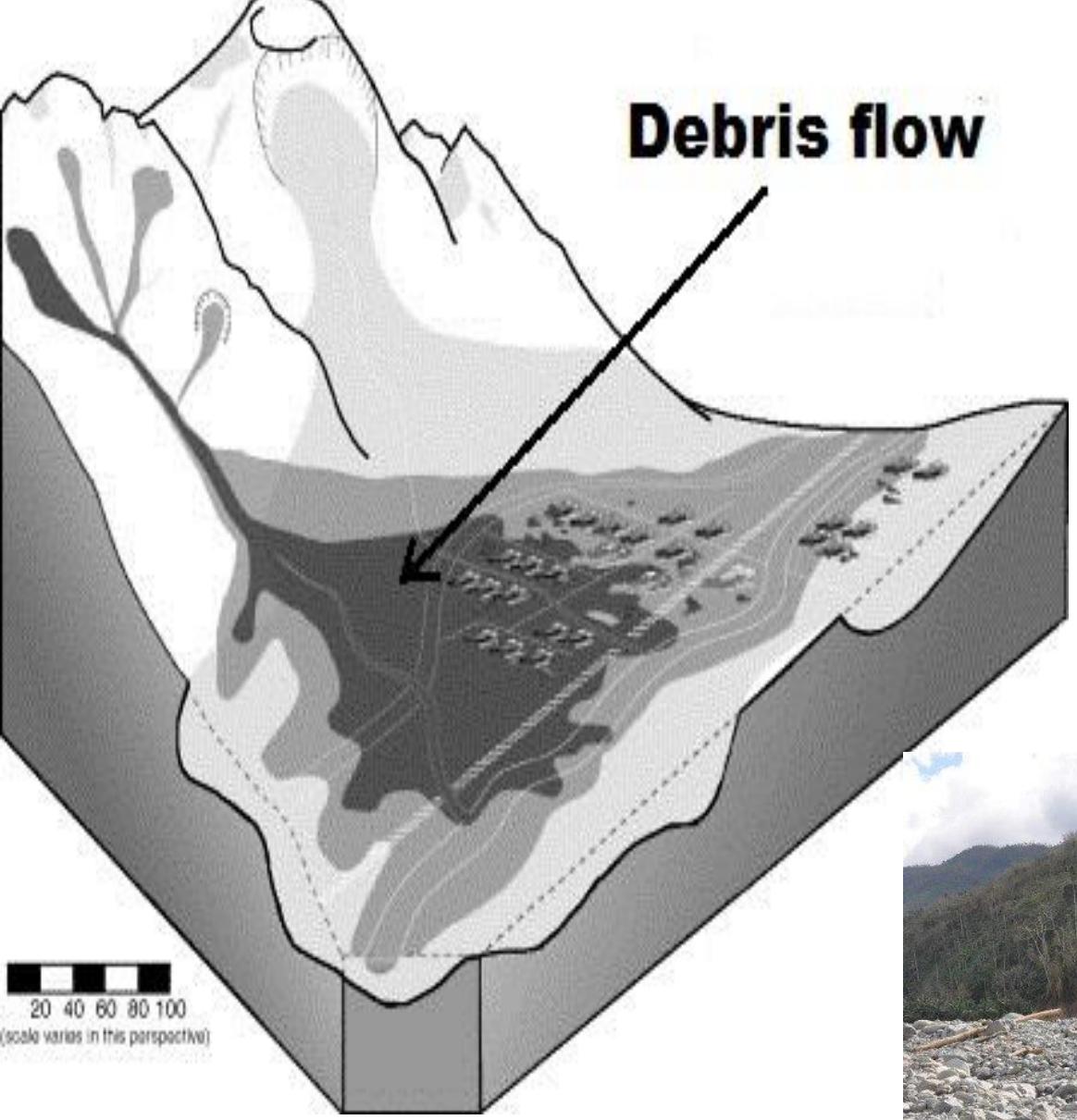


TY Pablo

Lagmay et al., 2013

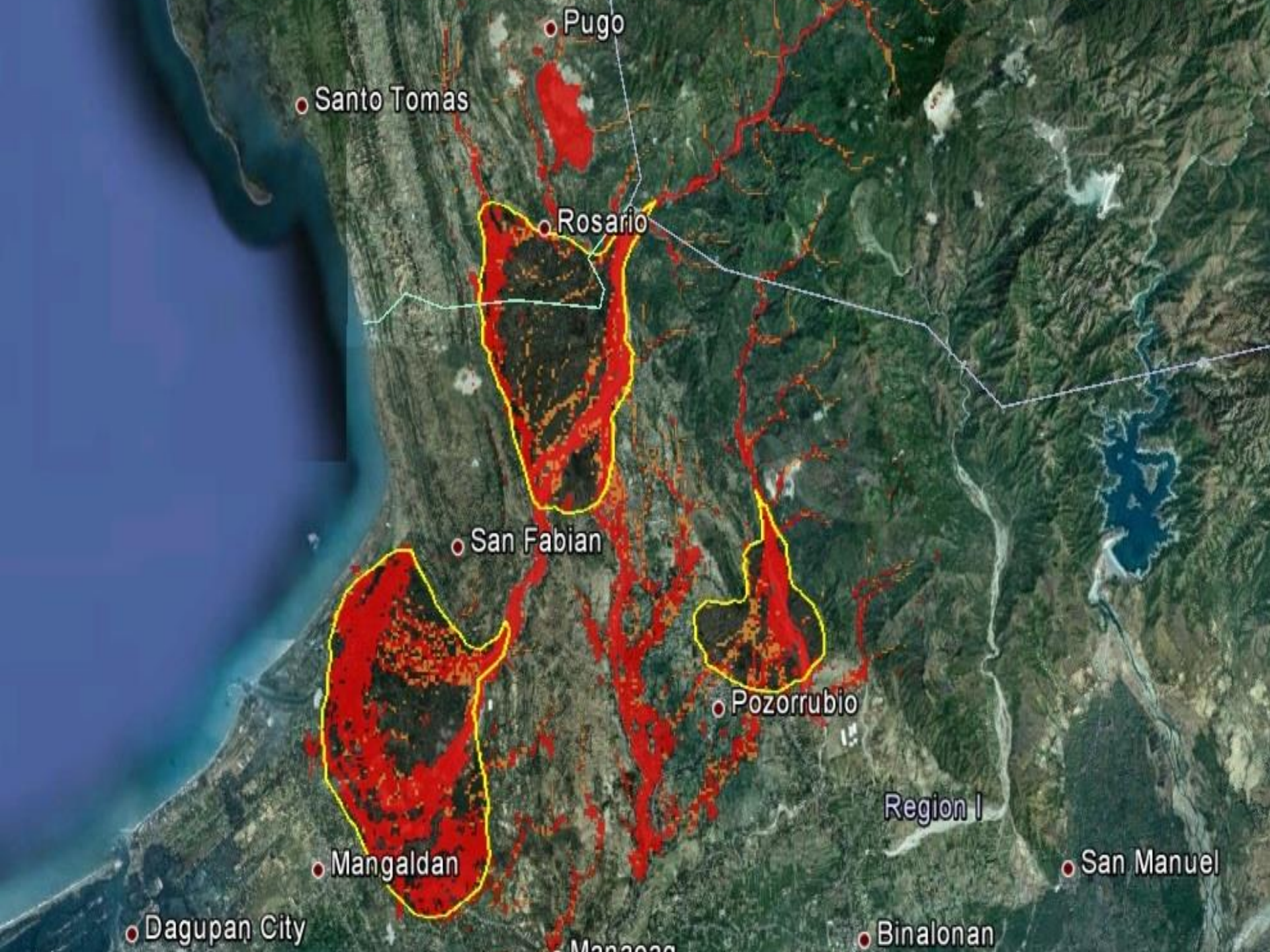
Debris flow in New Bataan

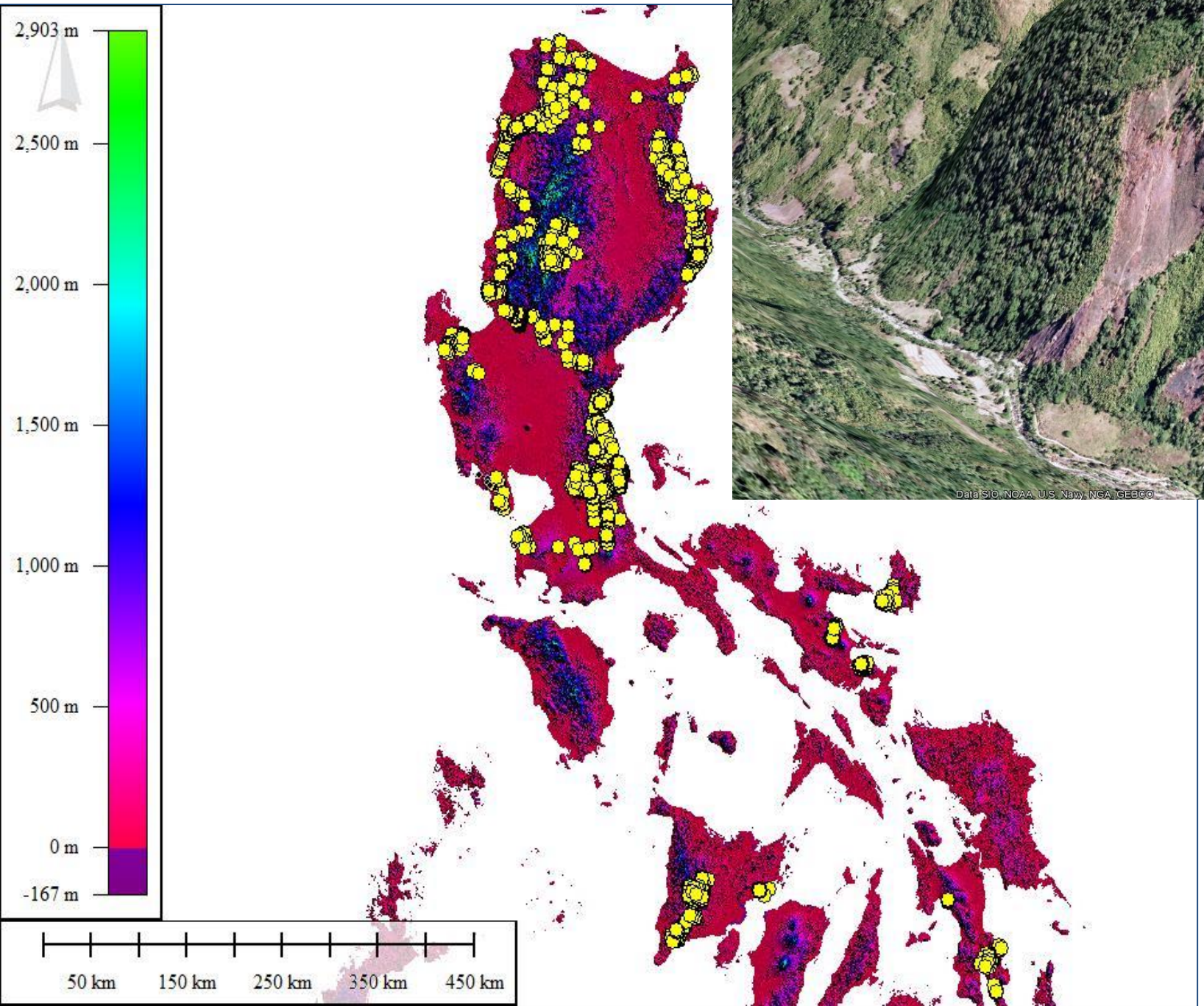




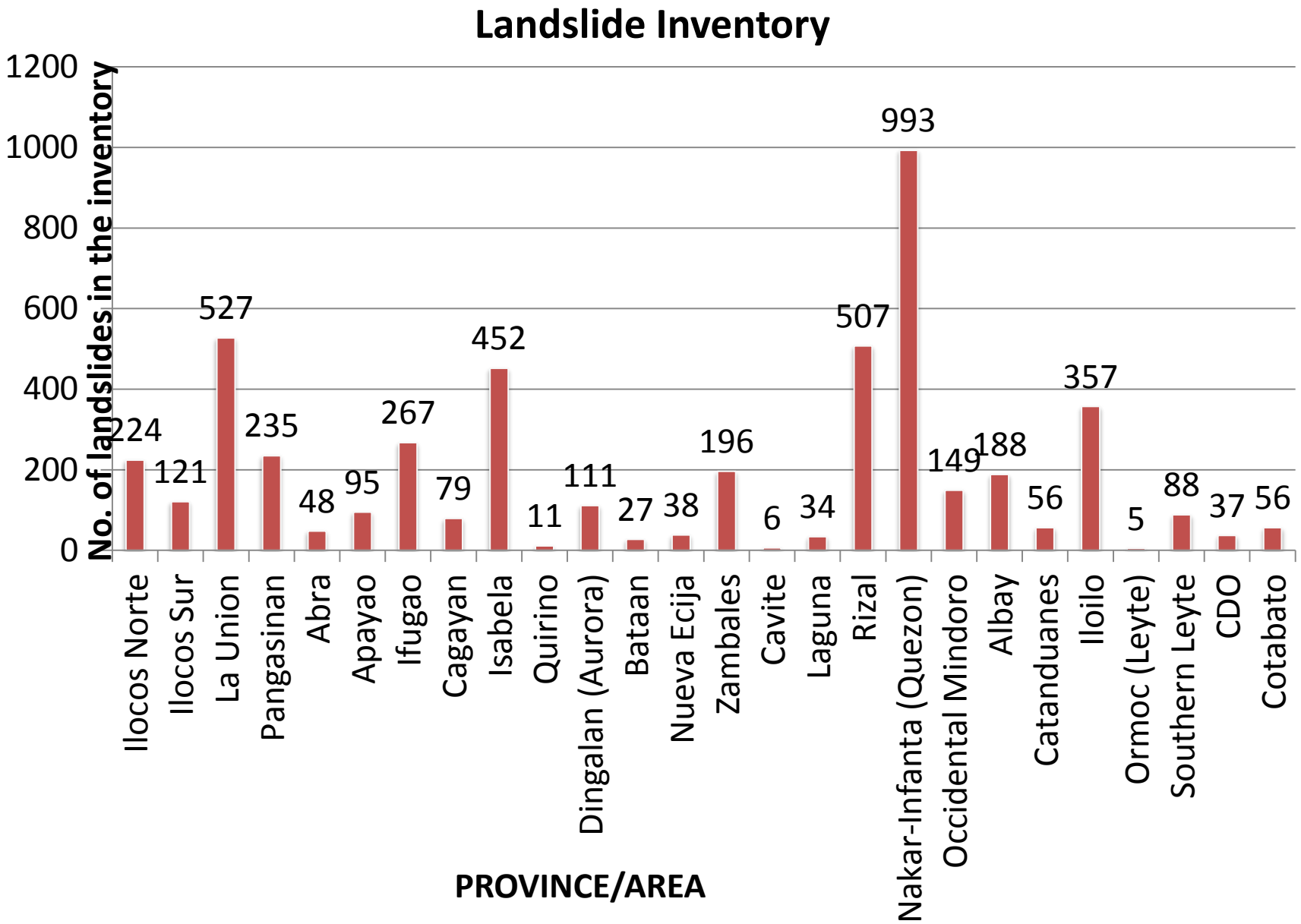
- 25-30 million cubic meter
- Max 9 meter thick deposit
- ~17 kilometers long
- 1 km wide


Tuba
Agoo
Pugo
Santo Tomas
Rosario
Sison
San Fabian
Pozorrubio
San Jacinto
Manaoag
Mangaldan


Pugo
Santo Tomas
Rosario
San Fabian
Pozorrubio
Region I
Mangaldan
San Manuel
Dagupan City
Binalonan

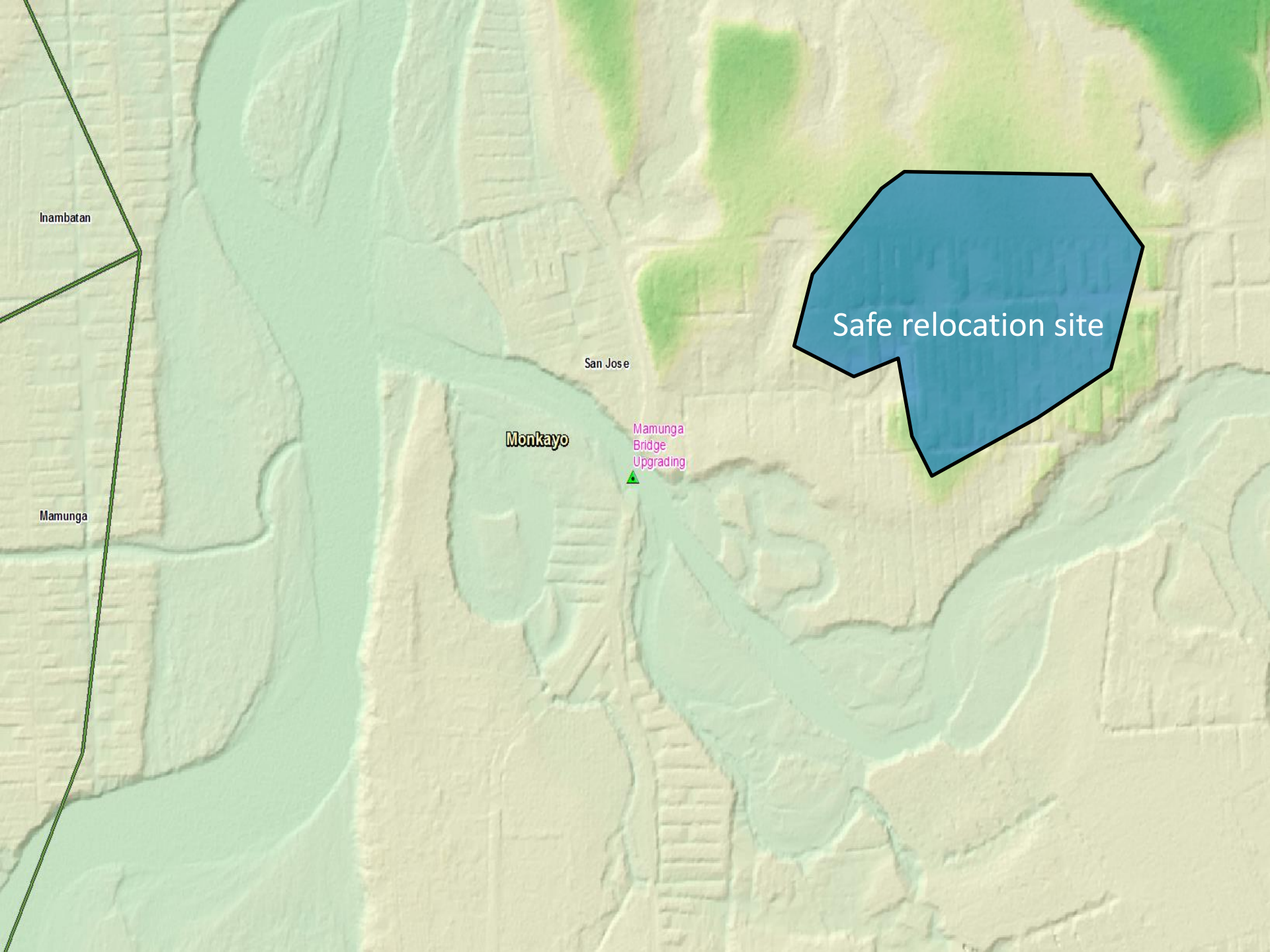

2,903 m
2,500 m
2,000 m
1,500 m
1,000 m
500 m
0 m
-167 m
50 km
150 km
250 km
350 km
450 km

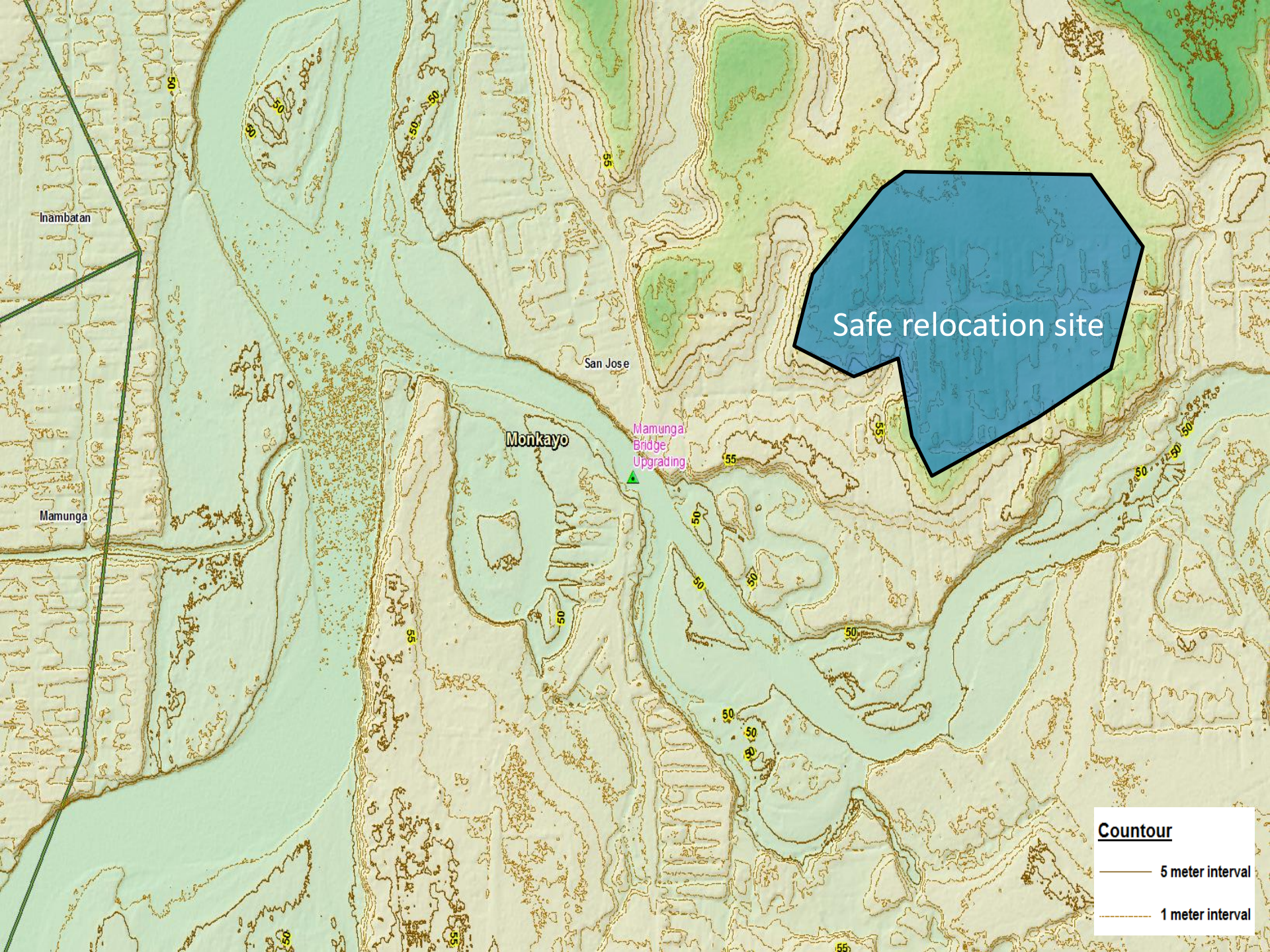
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

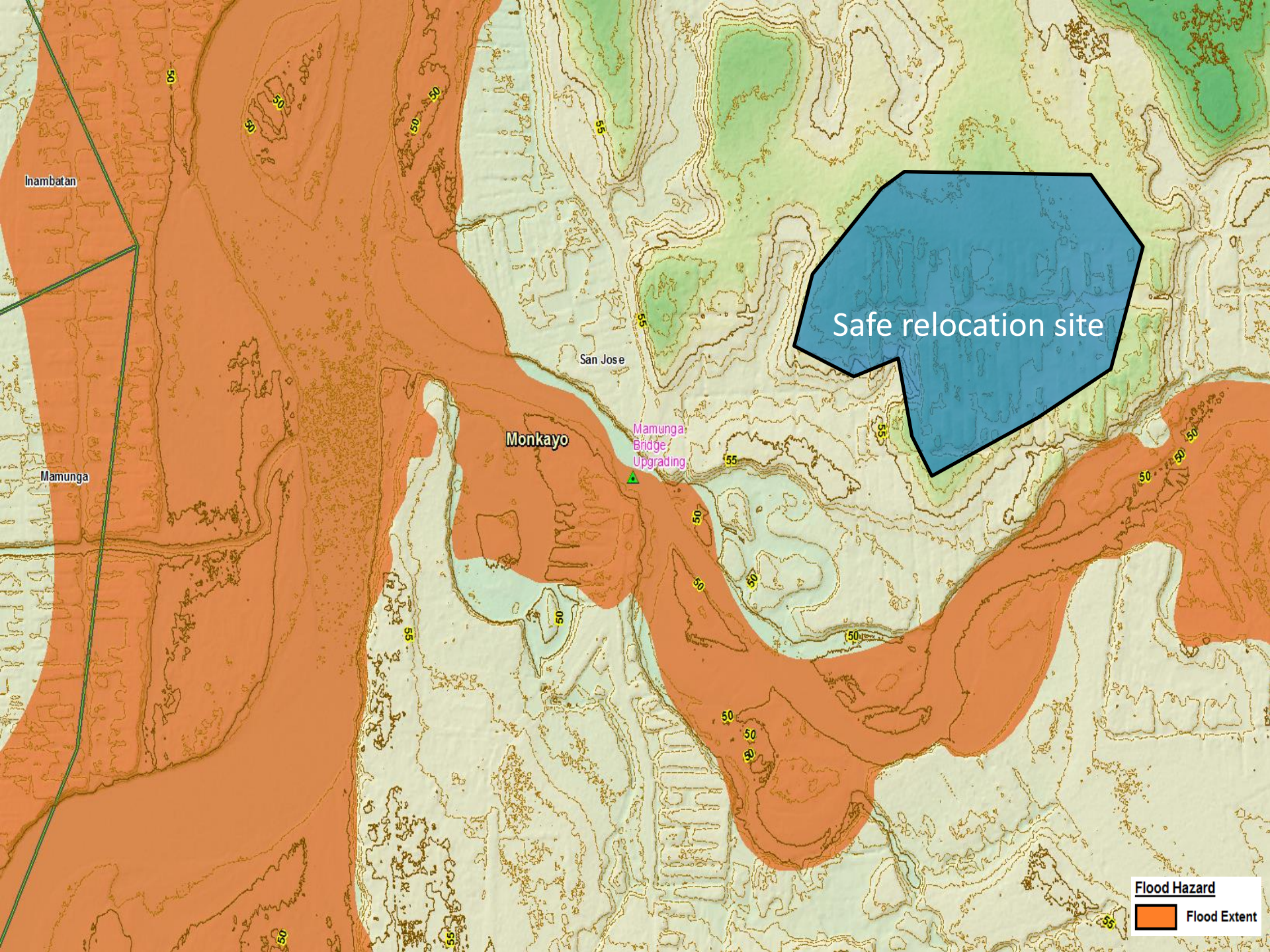


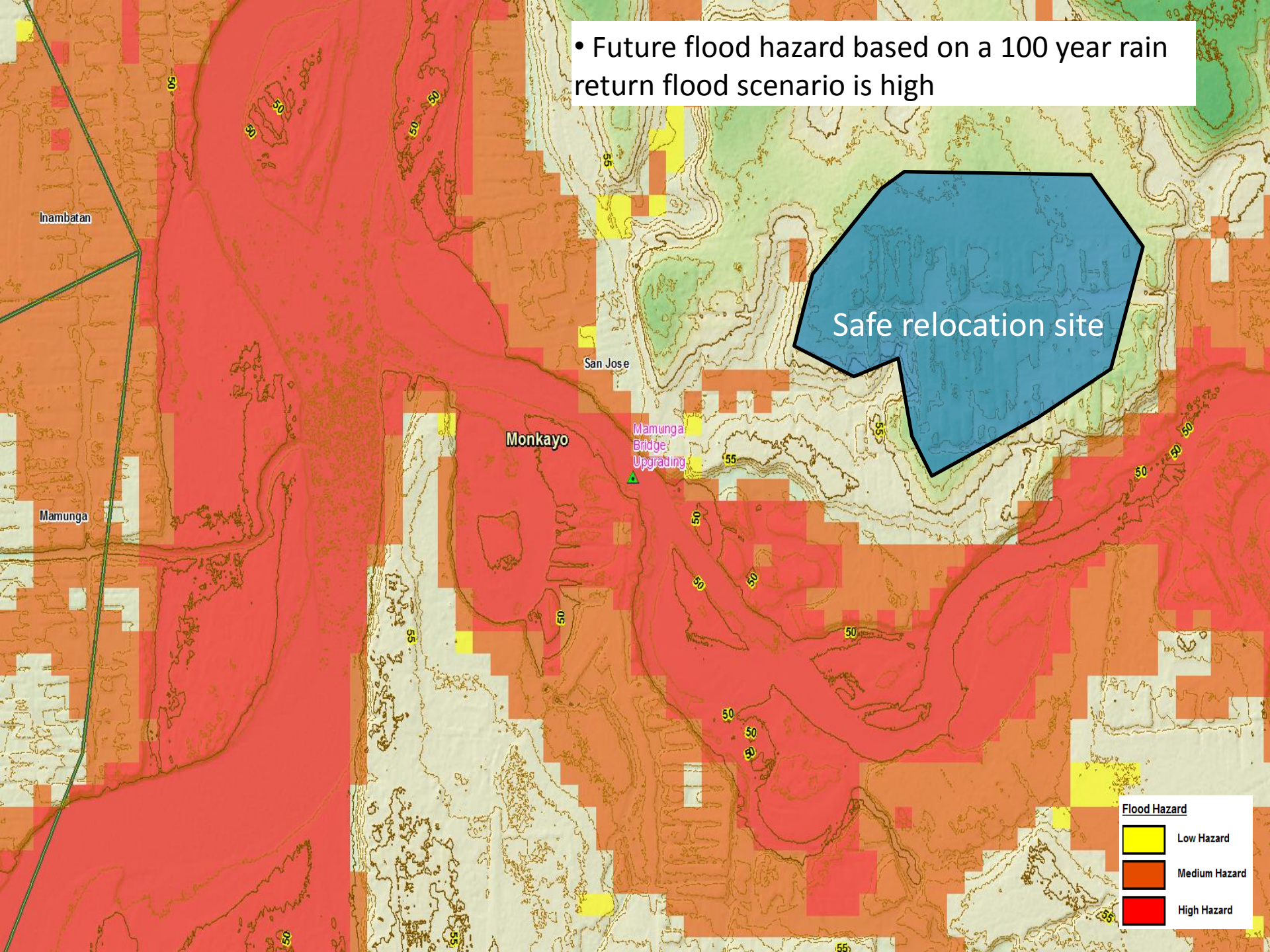
A total of 4,907 landslide occurrences from 2003 to 2013 were identified using satellite imageries.

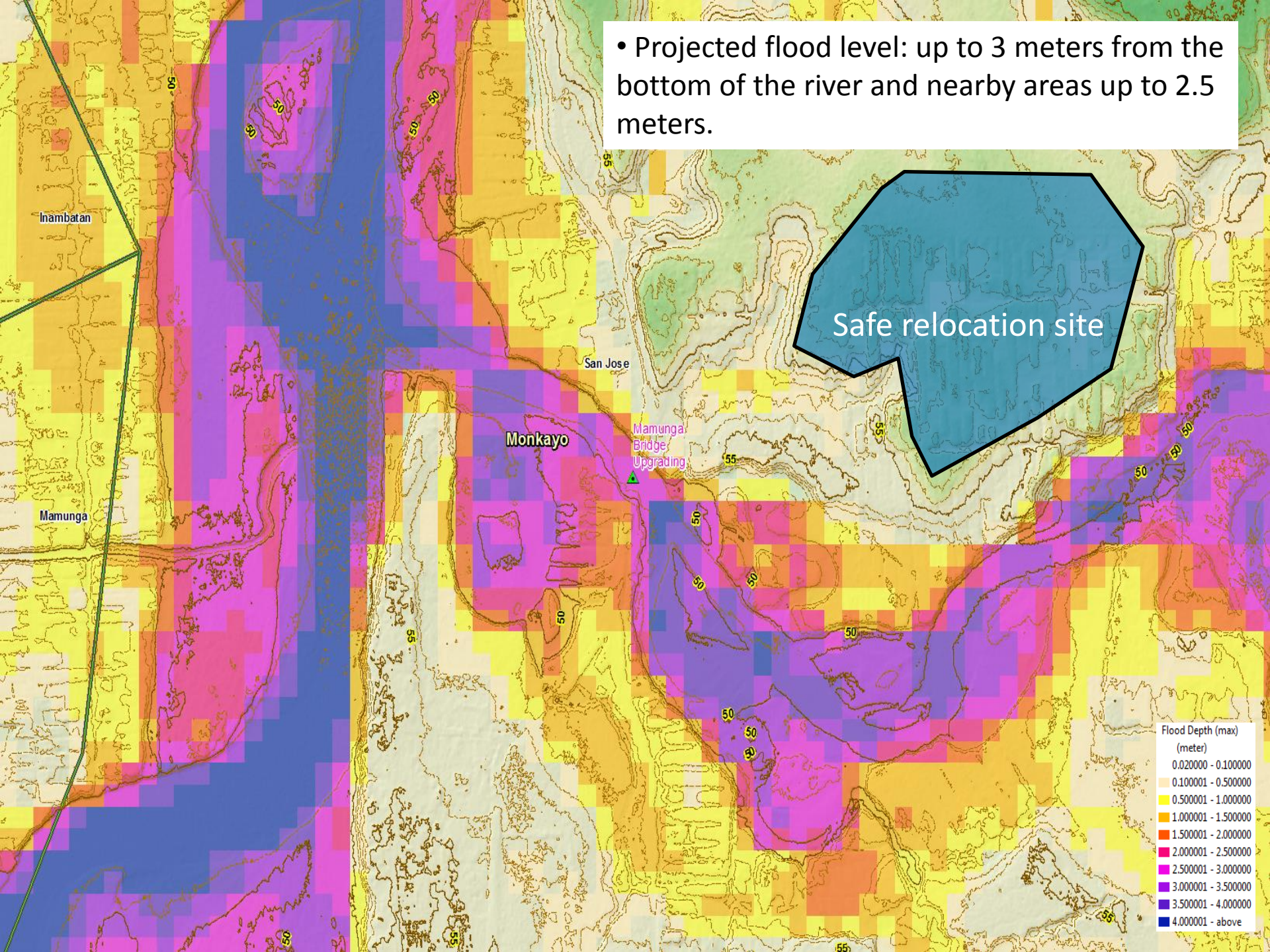

Inambatan
Mamunga
San Jose
Monkayo
Mamunga
Bridge
Upgrading
Safe relocation site


Inambatan
Mamunga
San Jose
Monkayo
Mamunga
Bridge
Upgrading
Safe relocation site


Safe relocation site
Inambatan
San Jose
Monkayo
Mamunga Bridge Upgrading
Mamunga
Countour
5 meter interval
1 meter interval


Safe relocation site
Inambatan
Mamunga
San Jose
Monkayo
Mamunga Bridge Upgrading
Flood Hazard
Flood Extent


• Future flood hazard based on a 100 year rain return flood scenario is high
Safe relocation site
Inambatan
San Jose
Monkayo
Mamunga Bridge Upgrading
Mamunga
Flood Hazard
Low Hazard
Medium Hazard
High Hazard


• Projected flood level: up to 3 meters from the bottom of the river and nearby areas up to 2.5 meters.
Safe relocation site
Inambatan
San Jose
Monkayo
Mamunga Bridge Upgrading
Mamunga
Flood Depth (max) (meter)
0.020000 - 0.100000
0.100001 - 0.500000
0.500001 - 1.000000
1.000001 - 1.500000
1.500001 - 2.000000
2.000001 - 2.500000
2.500001 - 3.000000
3.000001 - 3.500000
3.500001 - 4.000000
4.000001 - above

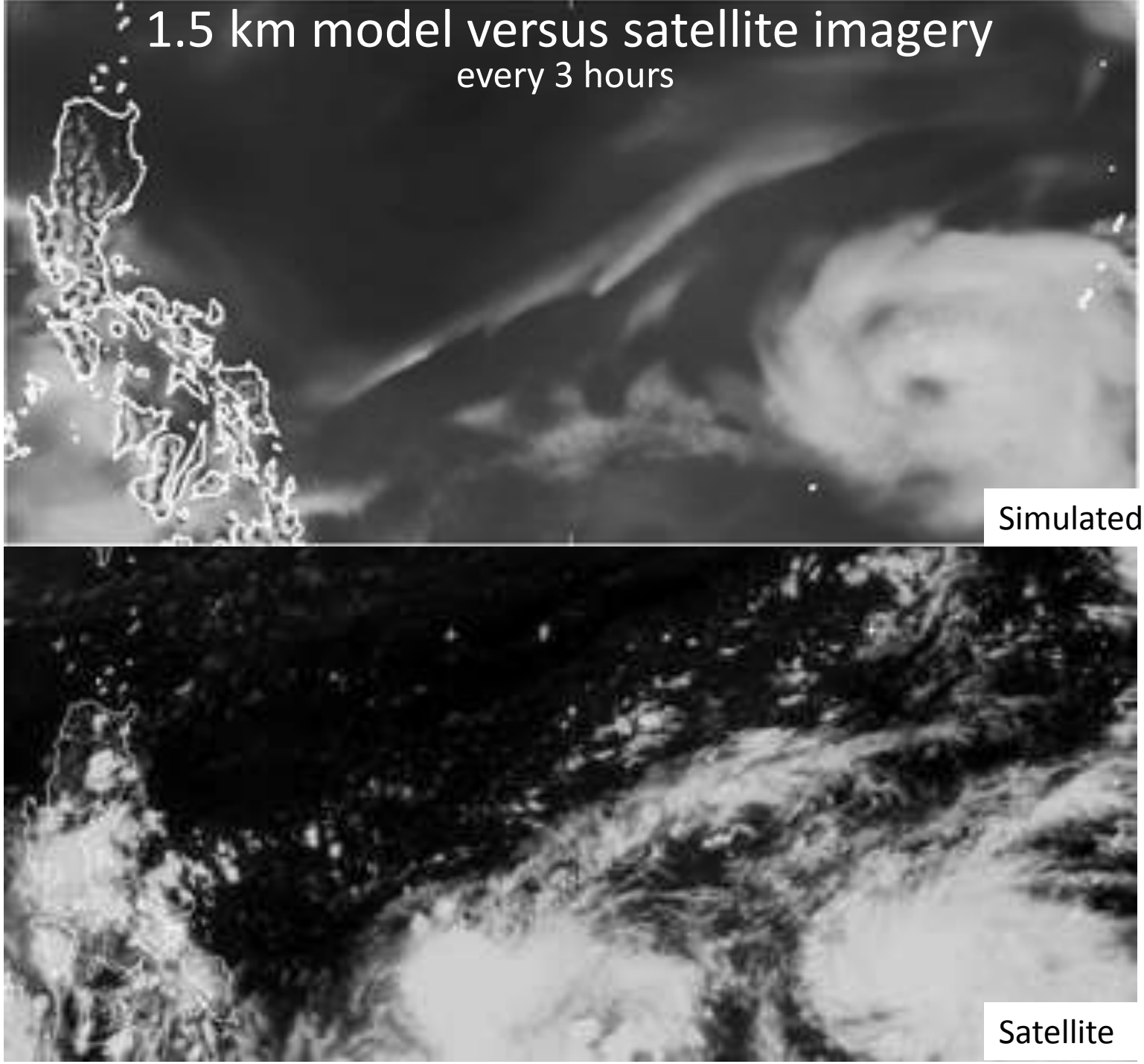
New Technologies

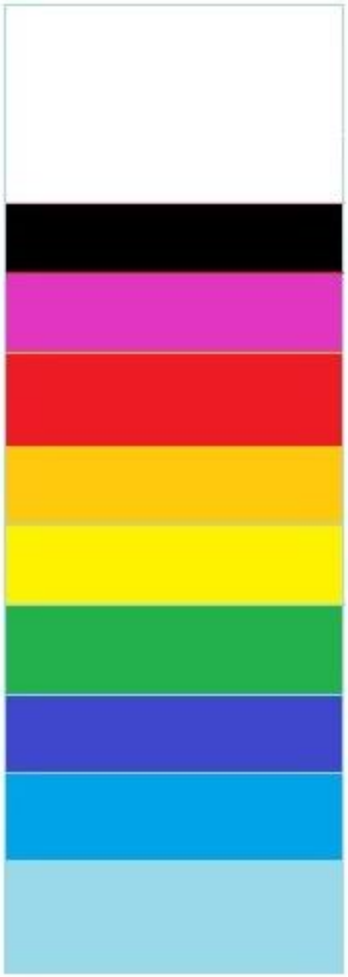
IBM Blue Gene supercomputer

- Generate 7-day weather forecast at 3 kilometer resolution
- Update the forecast every 3 hrs

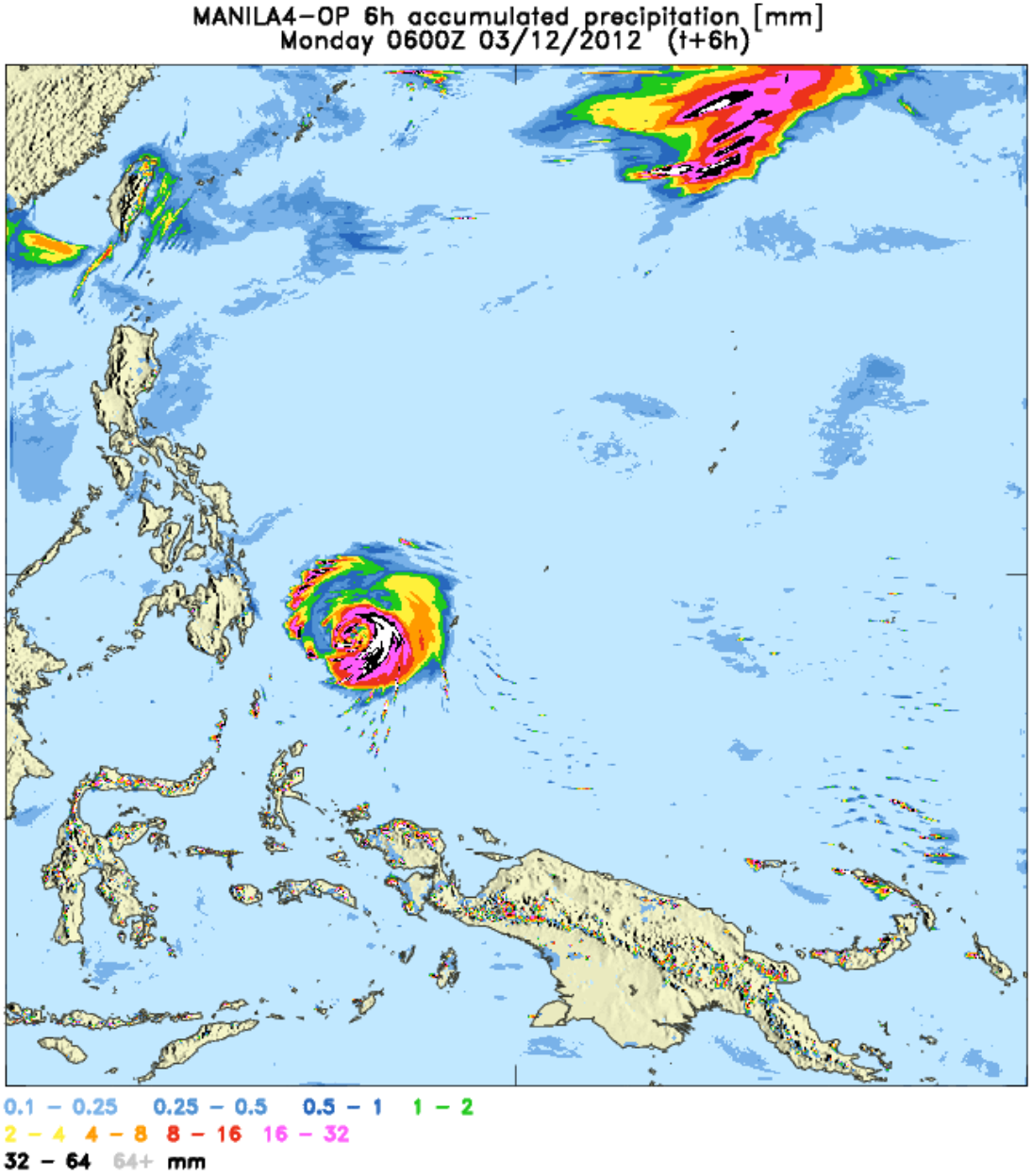
1.5 km model versus satellite imagery

every 3 hours



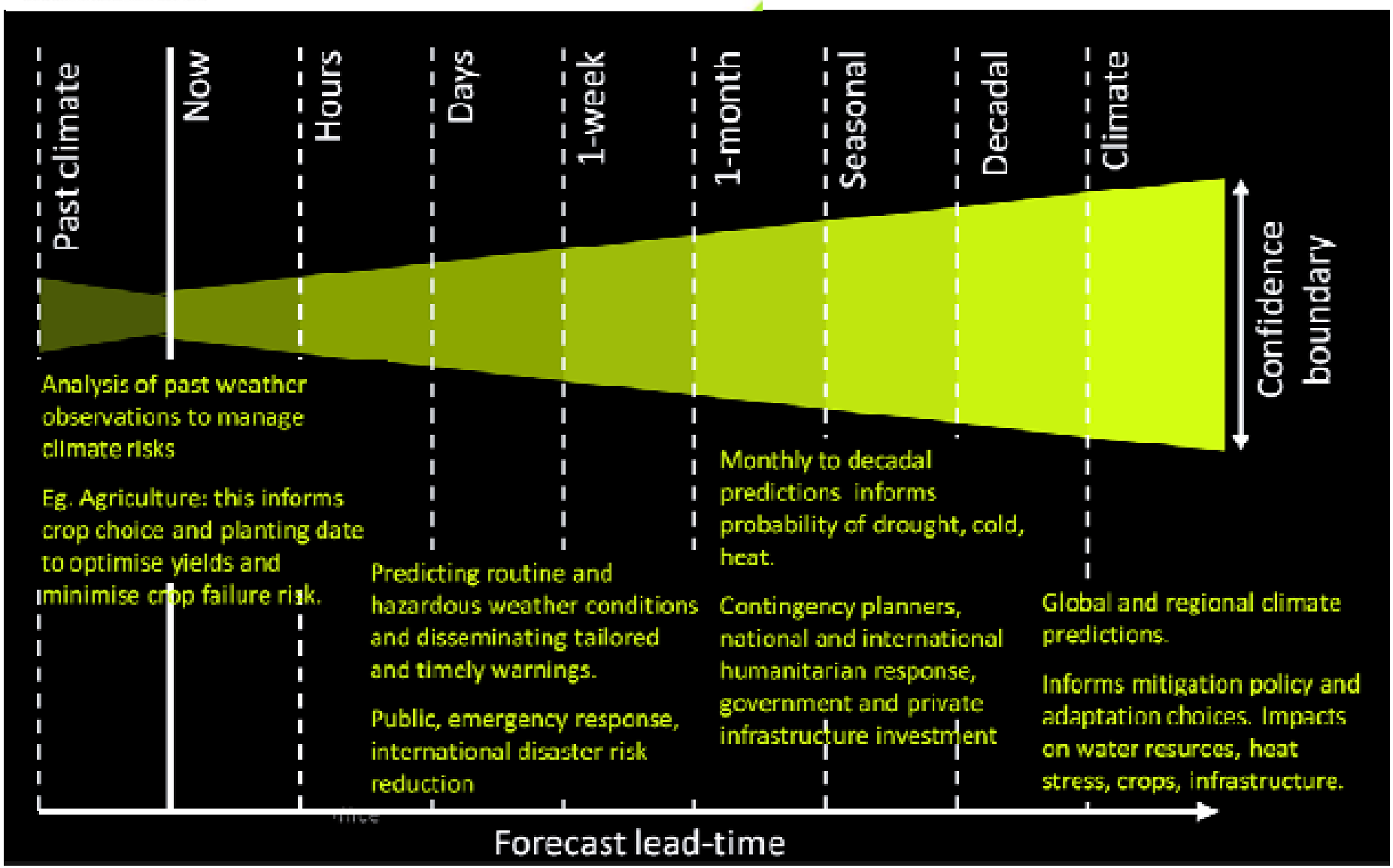


6 hours accumulated rainfall in millimeters (mm)



Unified Model capability for the Philippines

Met Office



Thank You