Was the Typhoon Yolanda Strongest in the Observation History in the Philippines?

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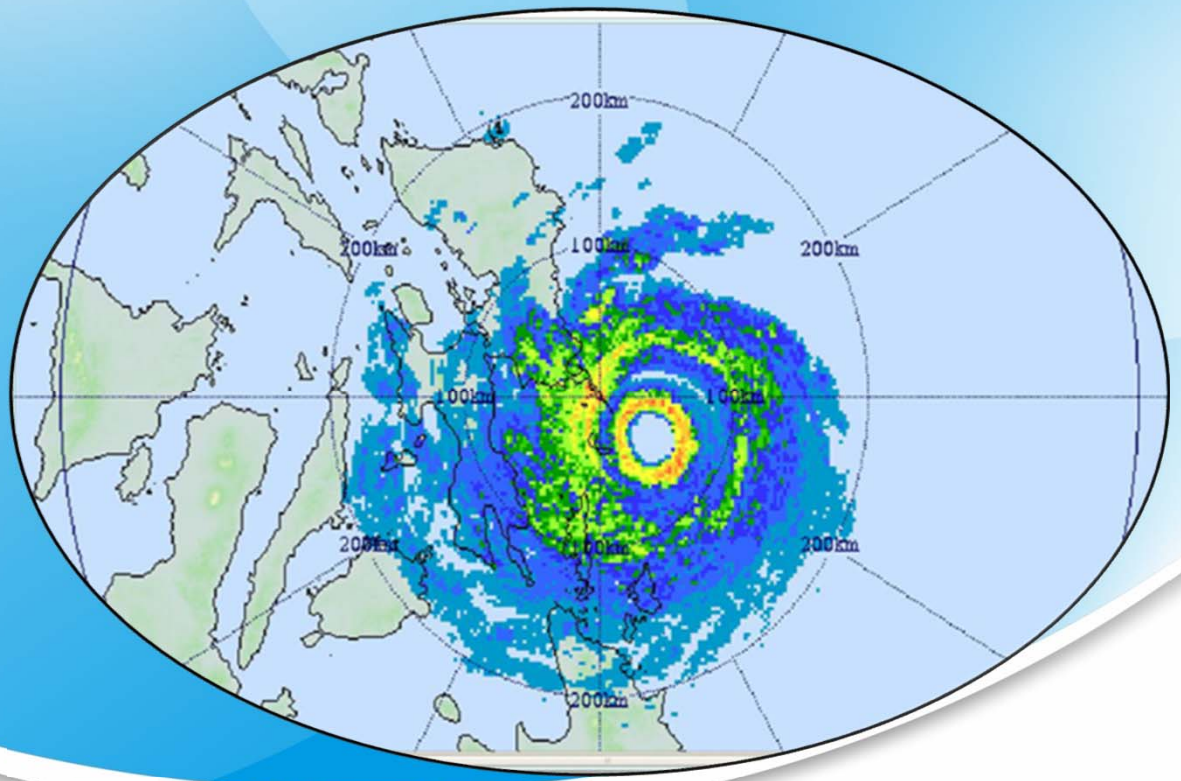
2: Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
3: Hokkaido University
4: Tokyo Metropolitan University
5: Salesian Polytechnic
6: Yokohama National University
7: Ateneo de Manila University

Japan–Philippine Urgent Collaborative Projects
regarding "Typhoon Yolanda" within the J-RAPID Program

JST Japan Science and Technology Agency

DOST PCIEERD

INTRODUCTION ON TYPHOON YOLANDA



PAGASA

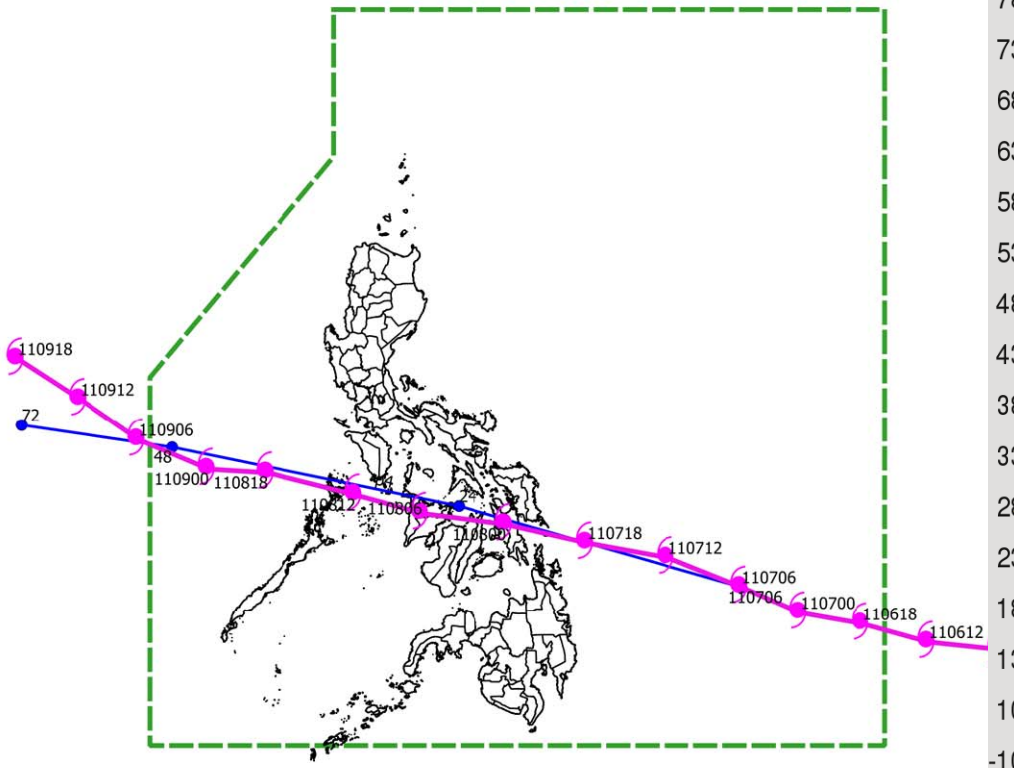
Philippine Atmospheric Geophysical and Astronomical Services Administration

Typhoon HAIYAN "YOLANDA"

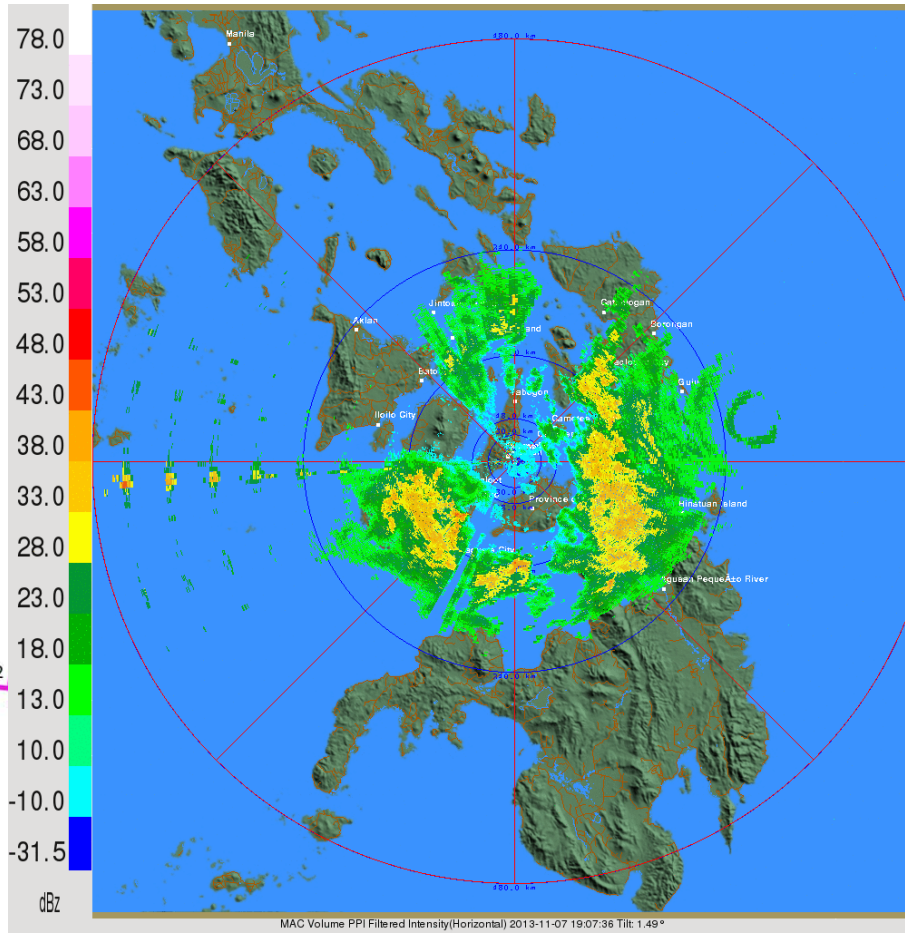
6-9 November 2013

24th Tropical Cyclone that entered PAR in 2013

The most devastating typhoon in Philippine history.

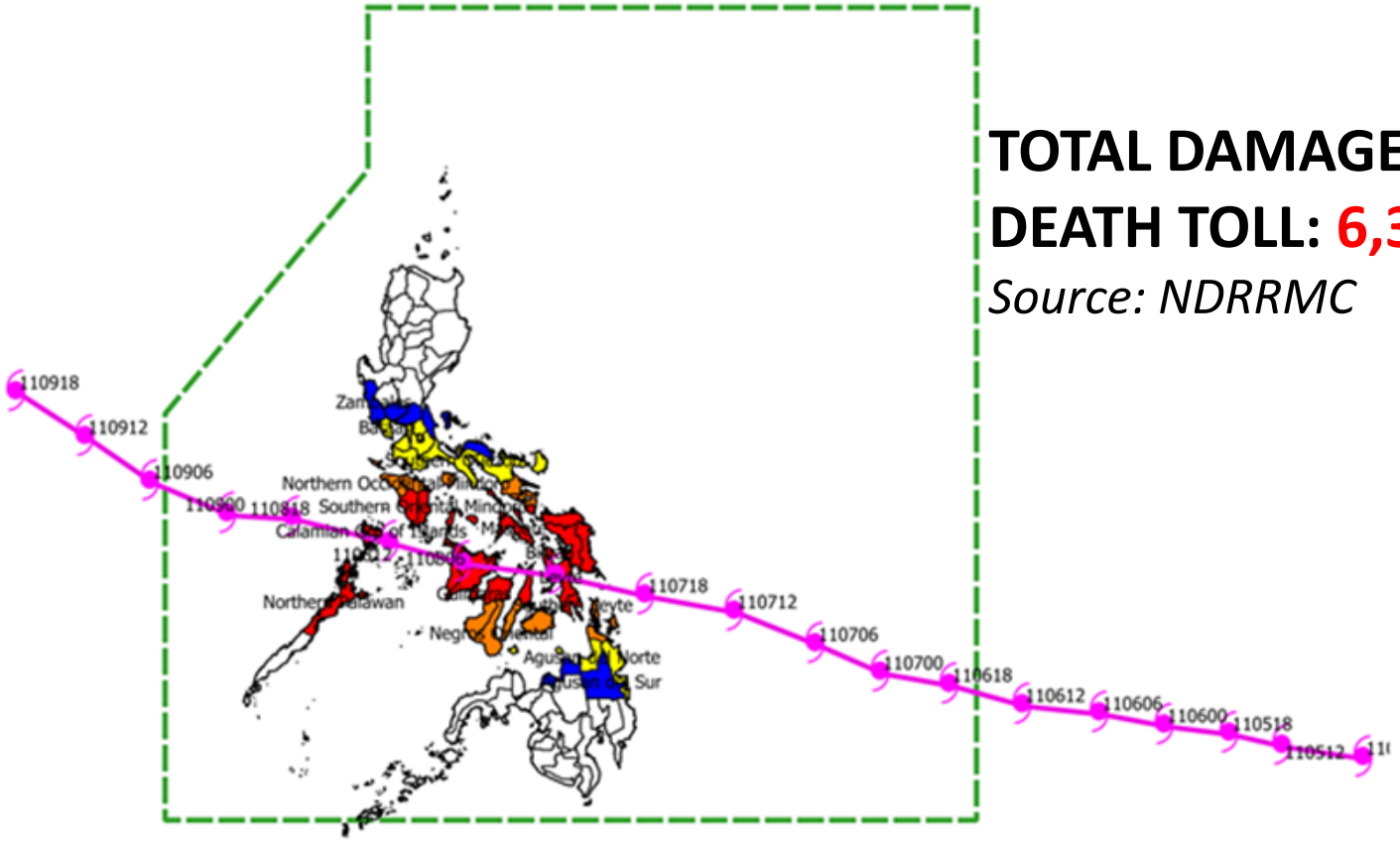


● Actual track VS ● Forecast track



Guiuan & Cebu Radar Animation

AREAS AFFECTED BY TY YOLANDA



Track & Warnings for TY Yolanda

TOTAL DAMAGES: PhP 89.6B

DEATH TOLL: 6,300

Source: NDRRMC

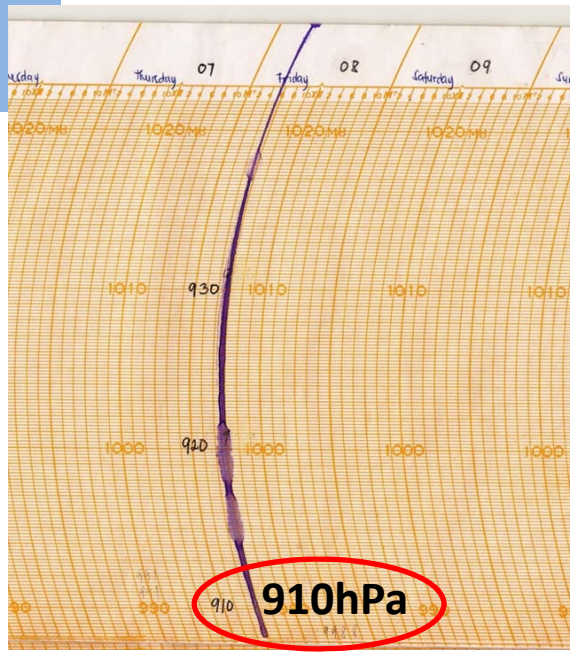
OBSERVED DATA

WINDS	MAX SUS.	GUSTINESS
Guiuan, E. Samar	160 kph	195 kph
Roxas City	130 kph	205 kph
Coron, Palawan	55 kph	160 kph
San Jose, Mindoro	75 kph	120 kph

STRONGEST, FASTEST TYPHOON???

SPEED =40 KPH

PRESSURE: Lowest in Guiuan Station = **910 hPa**
- Observed at 5:00AM, Nov.8, 2013
- Equivalent to **240** kph max. sus. winds & **280 kph** gustiness



POST SURVEY

STORM SURGE	HEIGHT	INUNDATION
Tacloban-Palo, Leyte	5-6 m	600-800 m
Basey, Samar	5-6 m	600-800 m
Guiuan-Hernani, E. Samar	6-7 m	800-1000m

HAIYAN'S FURY...

DAMAGES TO PAGASA

Equipment and Facilities: PhP74.24M (radar excluded)

- 11 Stations (buildings unroofed, shattered glass windows, etc.)
- Meteorological instruments (windvane, thermometer shelter, etc.)
- Meteorological Buoy in Bantayan Is.

Tacloban PAGASA Station

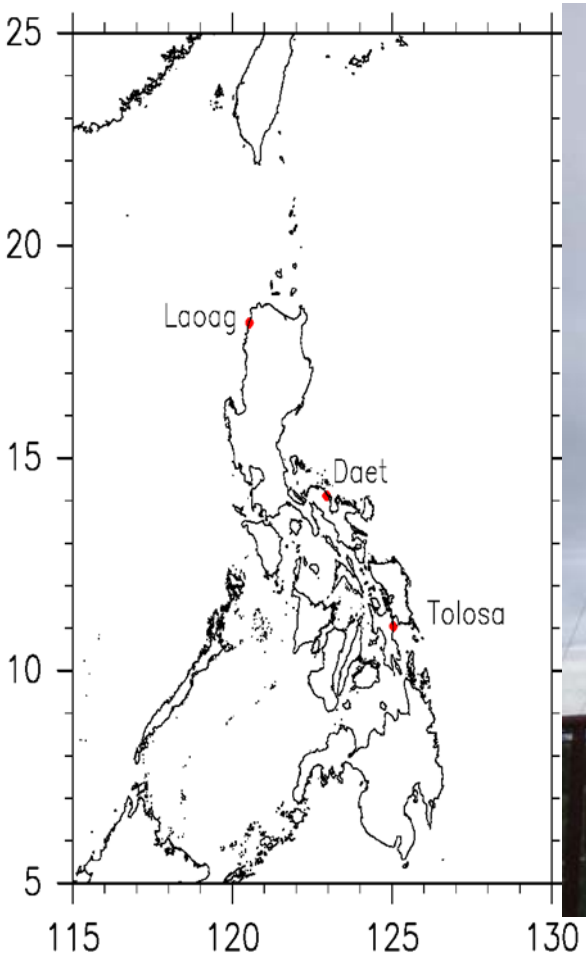
Guiuan PAGASA Station

Casualty: 1 Weather Observer

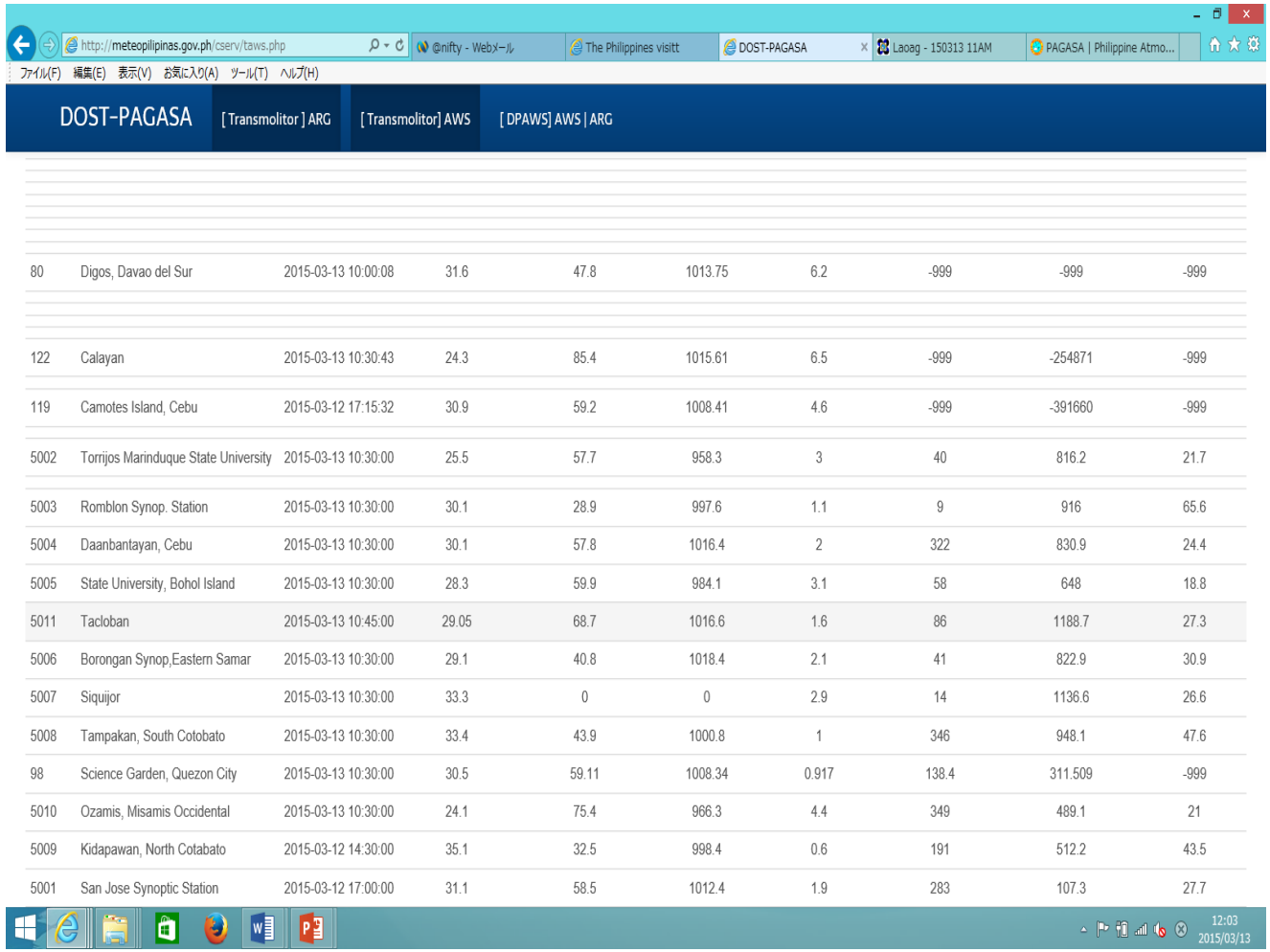
Initiatives after “YOLANDA”

J-RAPID Collaboration between JAMSTEC & PAGASA

Installation of AWS in Tolosa, Leyte



Tolosa (Tacloban) observation data



80	Digos, Davao del Sur	2015-03-13 10:00:08	31.6	47.8	1013.75	6.2	-999	-999	-999
122	Calayan	2015-03-13 10:30:43	24.3	85.4	1015.61	6.5	-999	-254871	-999
119	Camotes Island, Cebu	2015-03-12 17:15:32	30.9	59.2	1008.41	4.6	-999	-391660	-999
5002	Torrijos Marinduque State University	2015-03-13 10:30:00	25.5	57.7	958.3	3	40	816.2	21.7
5003	Romblon Synop. Station	2015-03-13 10:30:00	30.1	28.9	997.6	1.1	9	916	65.6
5004	Daanbantayan, Cebu	2015-03-13 10:30:00	30.1	57.8	1016.4	2	322	830.9	24.4
5005	State University, Bohol Island	2015-03-13 10:30:00	28.3	59.9	984.1	3.1	58	648	18.8
5011	Tacloban	2015-03-13 10:45:00	29.05	68.7	1016.6	1.6	86	1188.7	27.3
5006	Borongan Synop,Eastern Samar	2015-03-13 10:30:00	29.1	40.8	1018.4	2.1	41	822.9	30.9
5007	Siquijor	2015-03-13 10:30:00	33.3	0	0	2.9	14	1136.6	26.6
5008	Tampakan, South Cotobato	2015-03-13 10:30:00	33.4	43.9	1000.8	1	346	948.1	47.6
98	Science Garden, Quezon City	2015-03-13 10:30:00	30.5	59.11	1008.34	0.917	138.4	311.509	-999
5010	Ozamis, Misamis Occidental	2015-03-13 10:30:00	24.1	75.4	966.3	4.4	349	489.1	21
5009	Kidapawan, North Cotabato	2015-03-12 14:30:00	35.1	32.5	998.4	0.6	191	512.2	43.5
5001	San Jose Synoptic Station	2015-03-12 17:00:00	31.1	58.5	1012.4	1.9	283	107.3	27.7

10th National Meteorological -Hydrological Convention

November 19-20, 2014, Quezon City, Philippines

Theme: ***"Extreme Weather and Climate*: Impacts and Preparedness"**

SPONSORS: J-RAPIDS Project of JAMSTEC & PAGASA

Typhoon Yolanda landfall damages in Guiuan
（visit in Jun. 2014）

Guiuan radar
(antenna was blown out)

Aparri radar

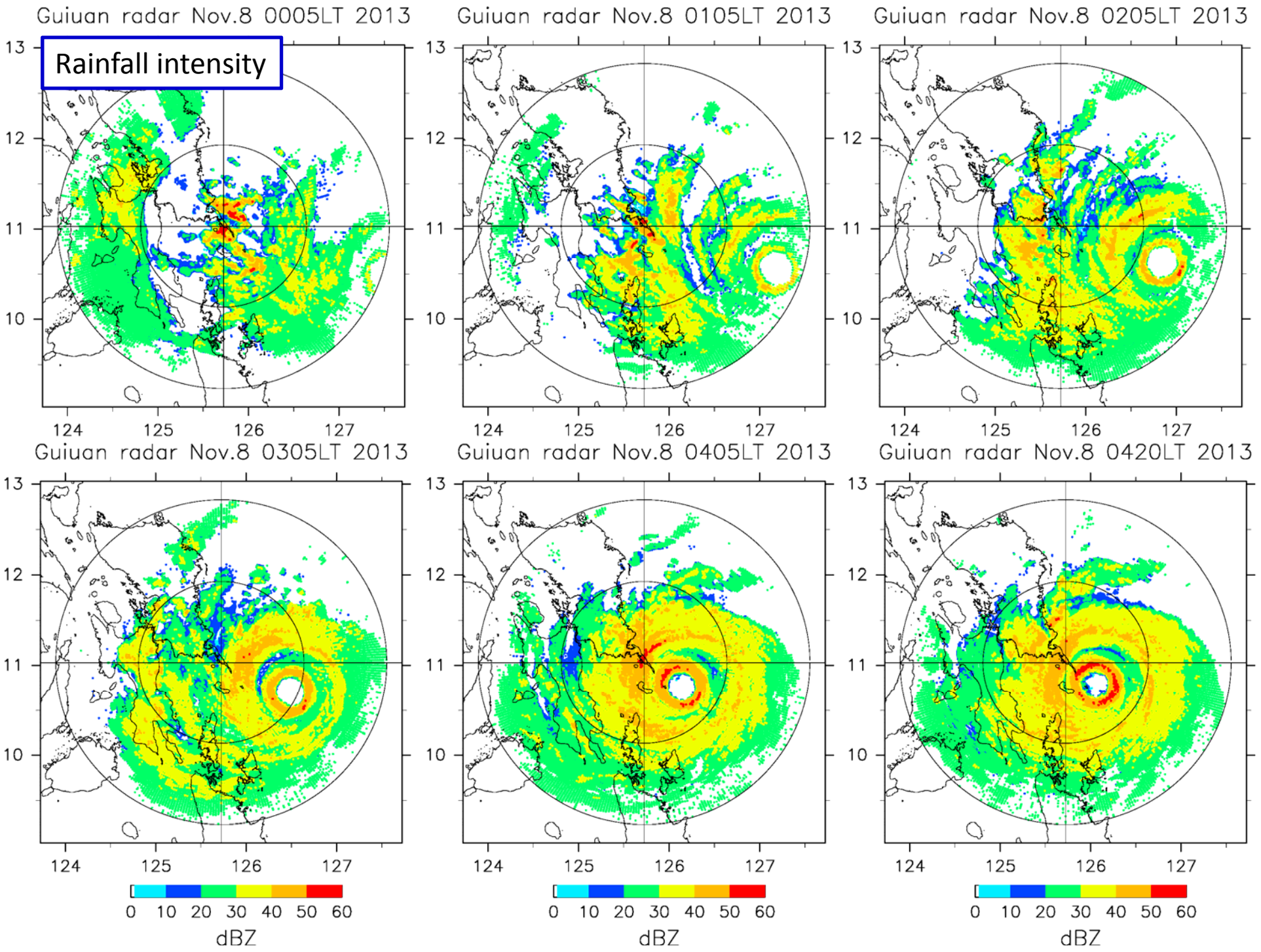
Guiuan city area from the top of Guiuan radar

East side

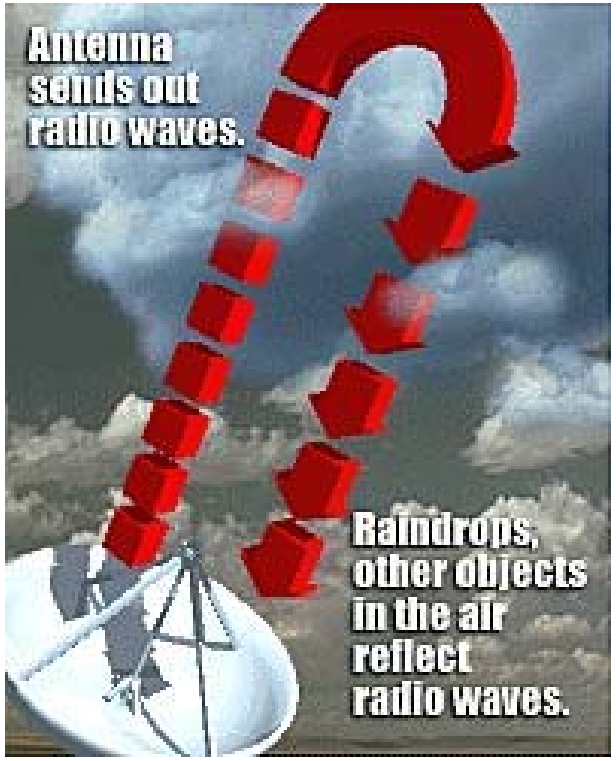
West side

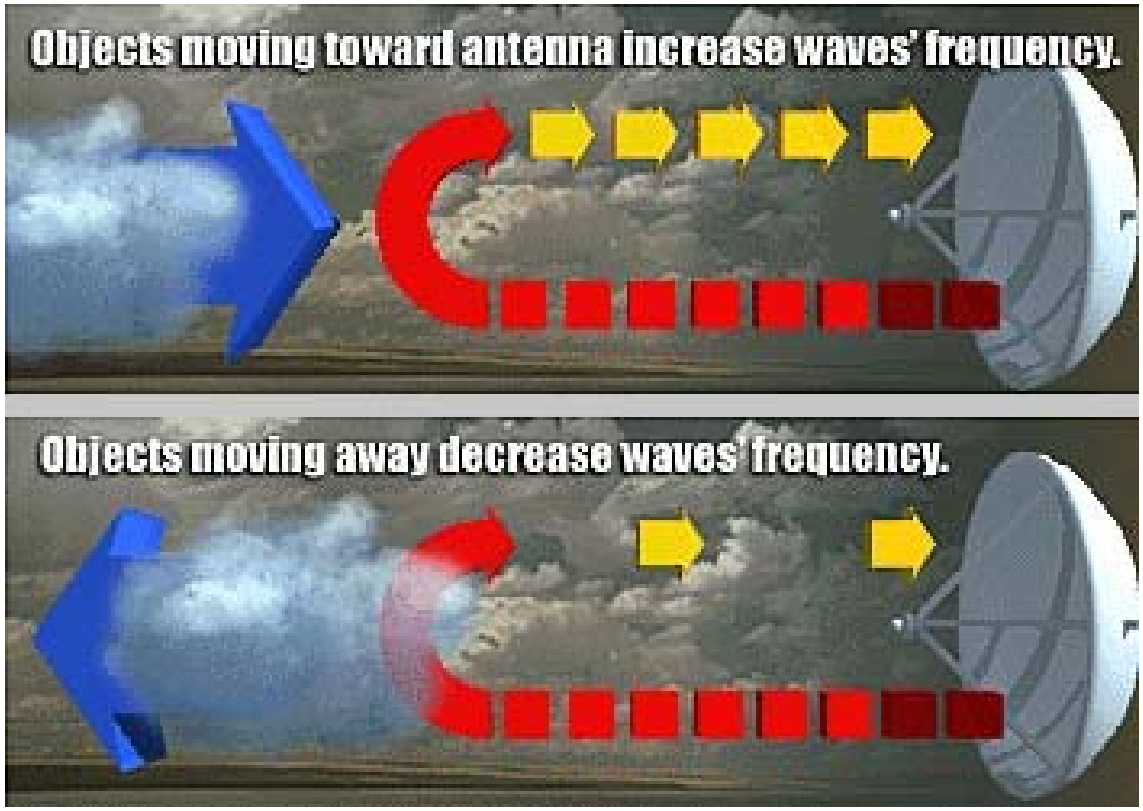
Guiuan radar antenna

Aparri radar antenna

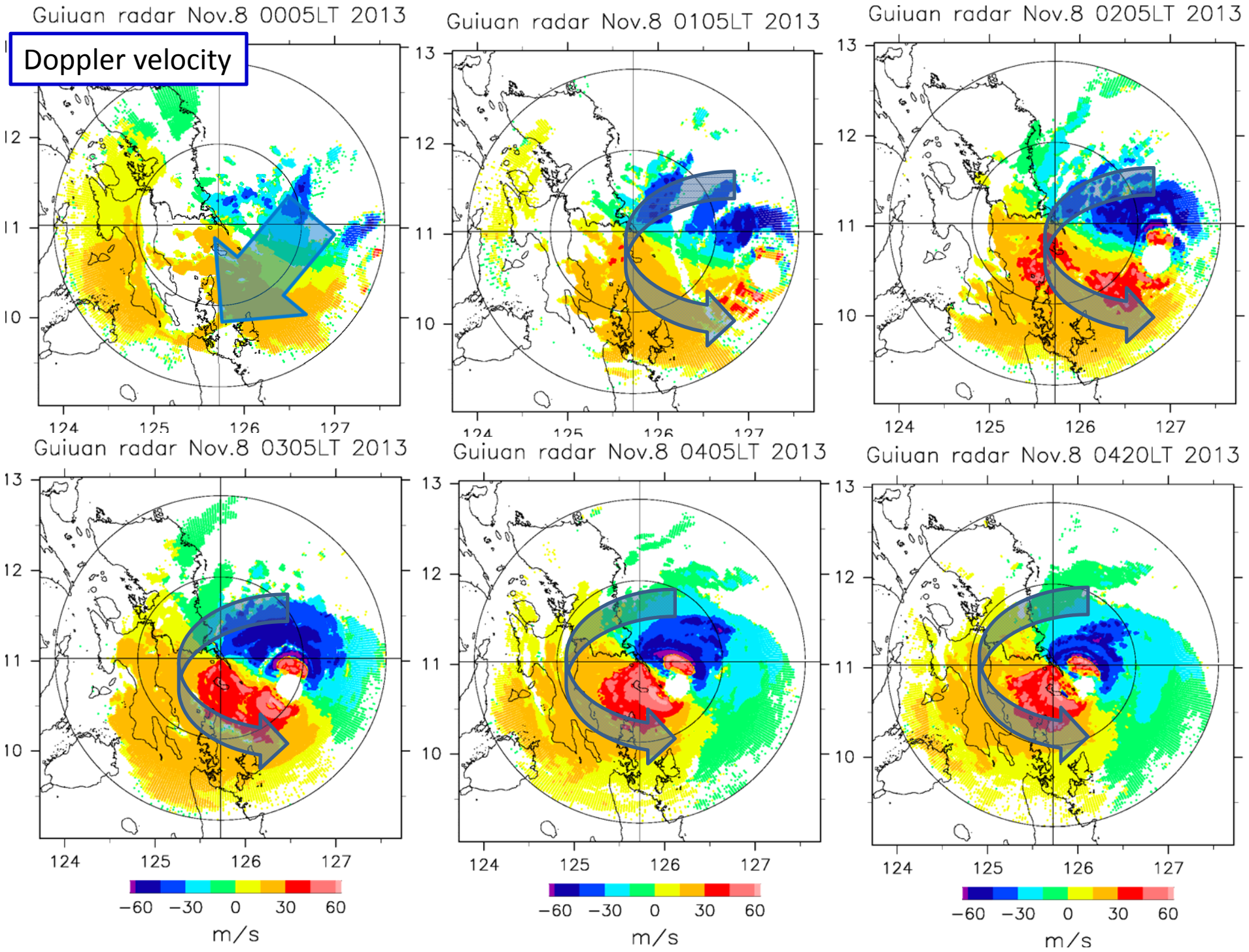

Rainfall intensity
Guiuan radar Nov.8 0005LT 2013
Guiuan radar Nov.8 0105LT 2013
Guiuan radar Nov.8 0205LT 2013
Guiuan radar Nov.8 0305LT 2013
Guiuan radar Nov.8 0405LT 2013
Guiuan radar Nov.8 0420LT 2013
13
12
11
10
124
125
126
127
0 10 20 30 40 50 60
dBZ

Doppler radar wind measurement



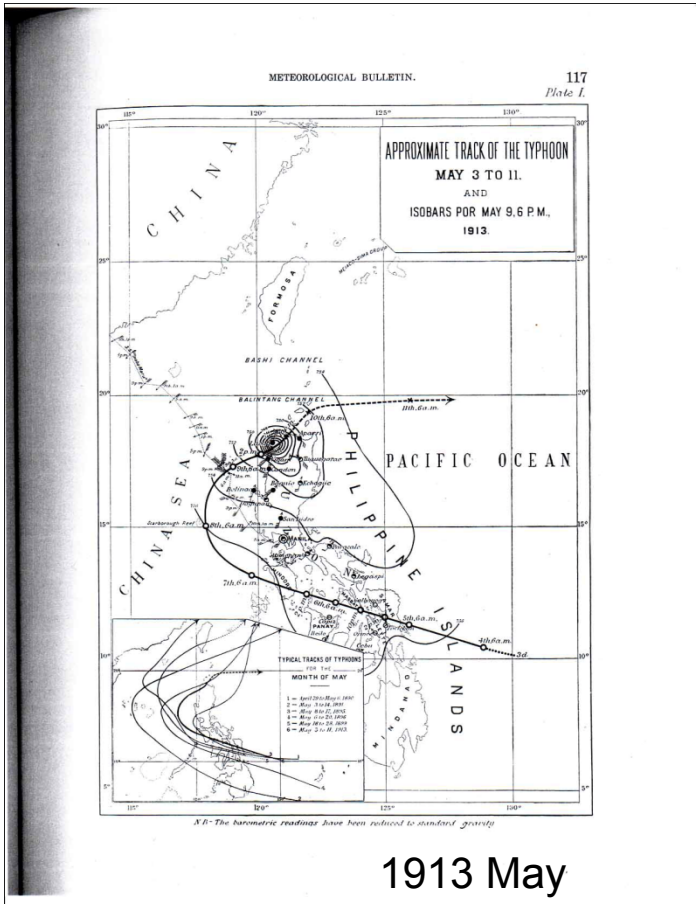


USA TODAY


Doppler velocity
Guiuan radar Nov.8 0005LT 2013
Guiuan radar Nov.8 0105LT 2013
Guiuan radar Nov.8 0205LT 2013
Guiuan radar Nov.8 0305LT 2013
Guiuan radar Nov.8 0405LT 2013
Guiuan radar Nov.8 0420LT 2013
124
125
126
127
10
11
12
13
−60 −30 0 30 60
m/s

Monthly Bulletins of Philippines Weather Bureau
(1901-1940)
stored in University of Hawaii
reported by American Meteorologists

300 stations observation data
Typhoon tracks over the WNP

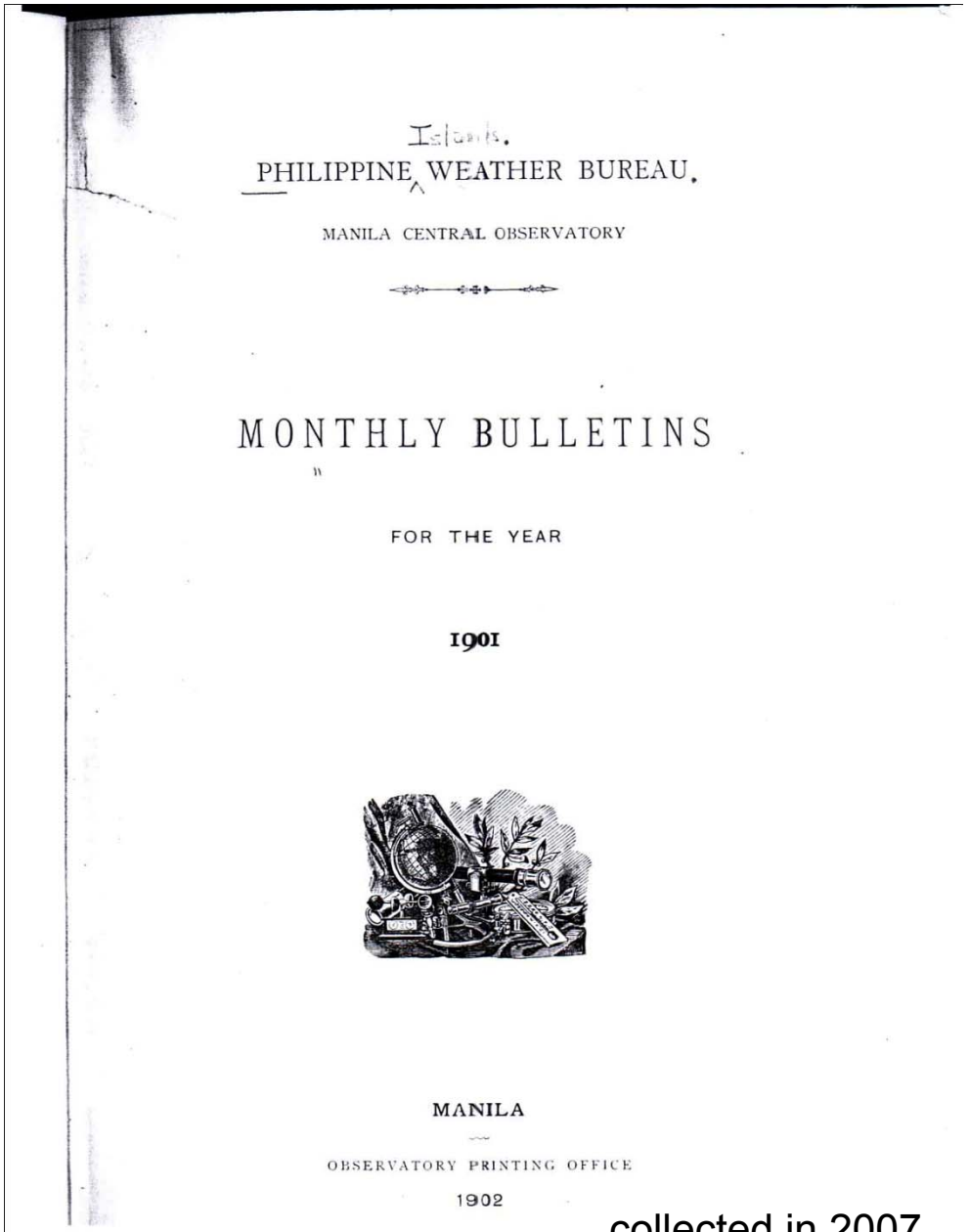

METEOROLOGICAL BULLETIN. 117
Plate I.

APPROXIMATE TRACK OF THE TYPHOON
MAY 3 TO 11.
AND
ISOBARS POR MAY 9.6 P.M.,
1913.

CHINA
FORMOSA
BASHI CHANNEL
BALINTANG CHANNEL
PACIFIC OCEAN
PHILIPPINE ISLANDS
CHINA SEA
TYPICAL TRACKS OF TYPHOONS
FOR THE
MONTH OF MAY

N.B.-The barometric readings have been reduced to standard gravity

1913 May


Islands.
PHILIPPINE WEATHER BUREAU.

MANILA CENTRAL OBSERVATORY

MONTHLY BULLETINS

FOR THE YEAR

1901

MANILA

OBSERVATORY PRINTING OFFICE

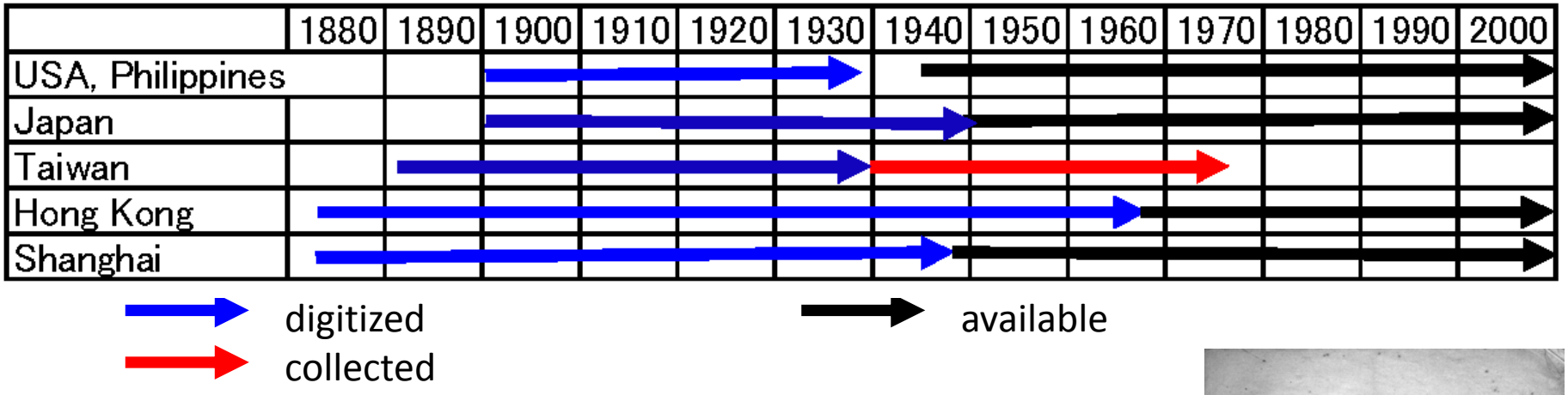
1902

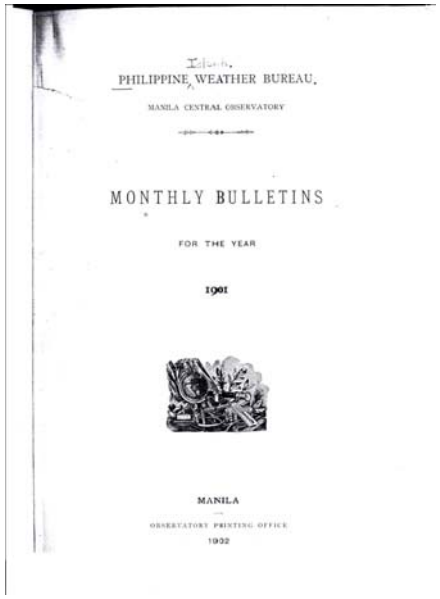
collected in 2007

Historical typhoon track data collected and digitized over the western north Pacific

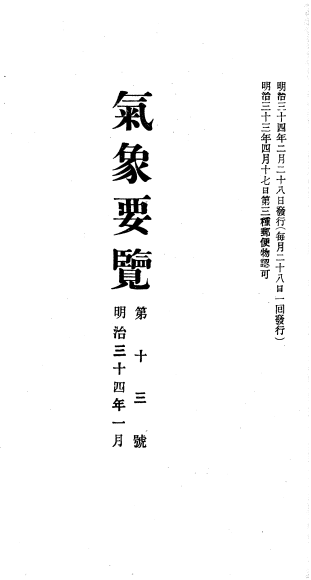
Kubota (2012)

Best track data over the Western North Pacific

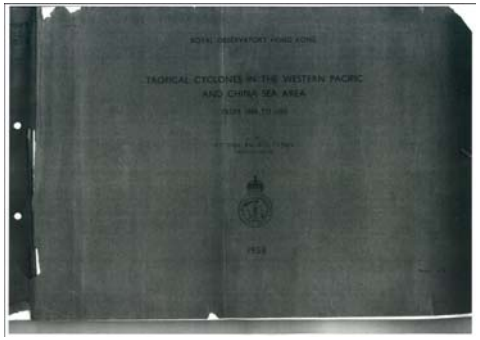




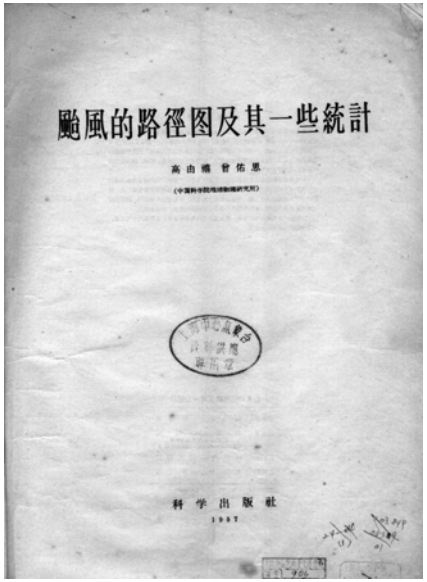
Philippines
(Univ. Hawaii)



Japan
(JMA library)



Hong Kong
(Hong Kong Observatory)
（1958 reedited）



Shanghai(Zi-Ka-Wei)
(Shanghai observatory)
（1957 reedited）

Digital Tropical Cyclone tracks over the Western North Pacific from 1902 to 1940

Data source

Monthly Bulletins of the Philippine Weather Bureau 1901-1940

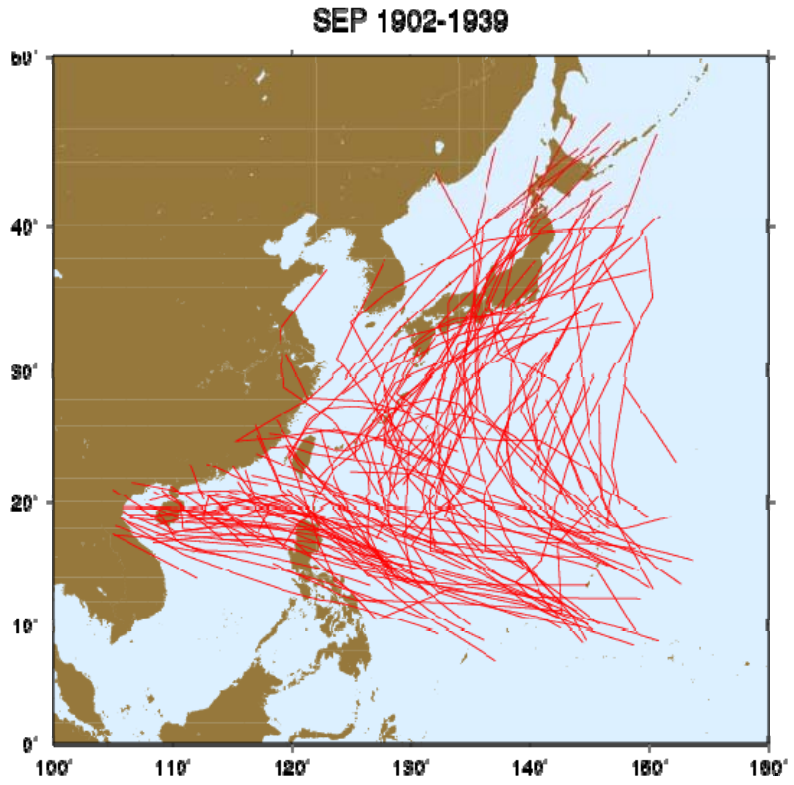
Datasets

TC (tropical cyclone) track locations

Data files

TYByyyymmdd.a.dat (for example: TYB19020706.a.dat)

yyyymmdd: It is the first date of each TC track.

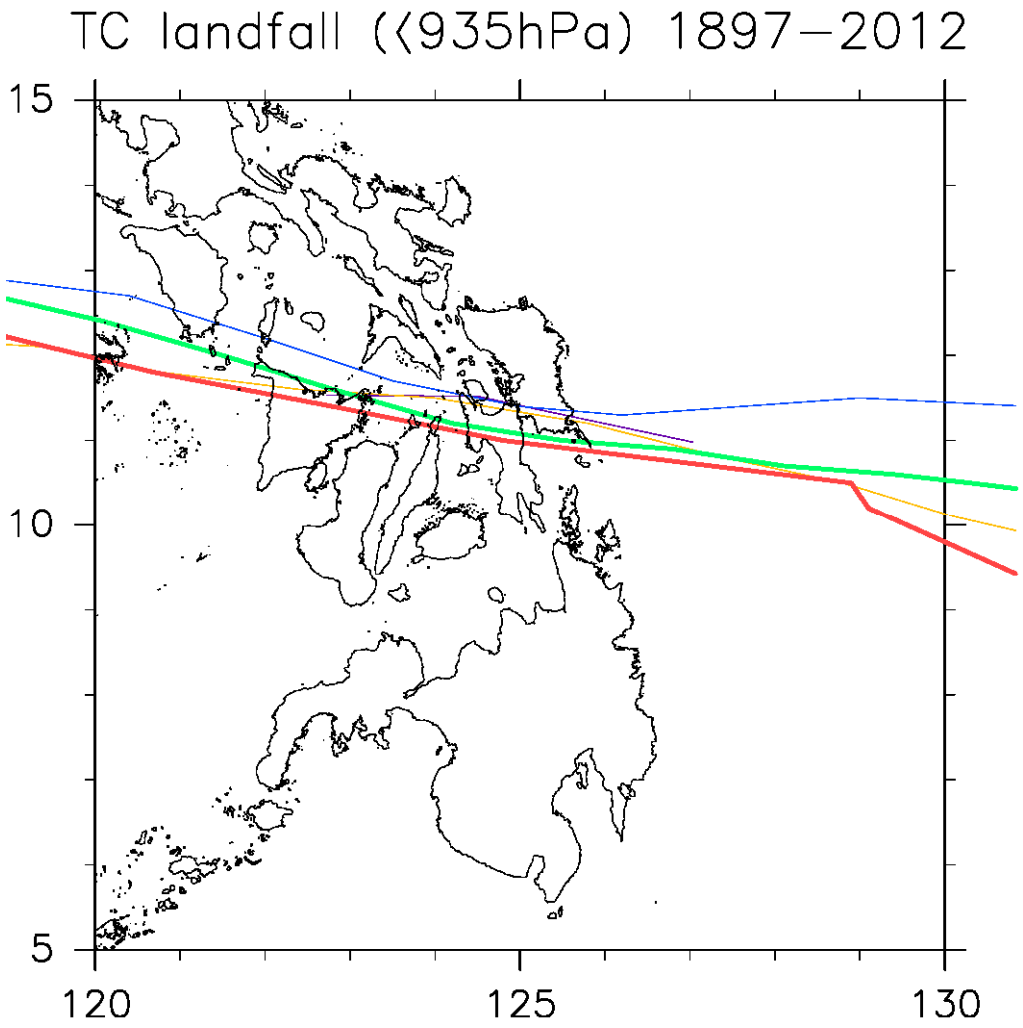


Data format

YYYYMMDDHH	lat	lon	type	flag
1902 7 6 12	12.19	128.34	2	1
1902 7 7 12	12.25	125.63	2	1
1902 7 8 12	12.57	123.54	2	1
1902 7 9 12	13.36	121.16	2	1
1902 7 10 12	14.70	118.30	2	1
1902 7 11 12	17.09	114.66	2	1

HH: Philippine local time (+8 hours GMT)

Resemble tracks to Haiyan (Yolanda)



1897 10.12 (925.2hPa)
(Fatalities 1300)

1912 11.24 (924hPa)

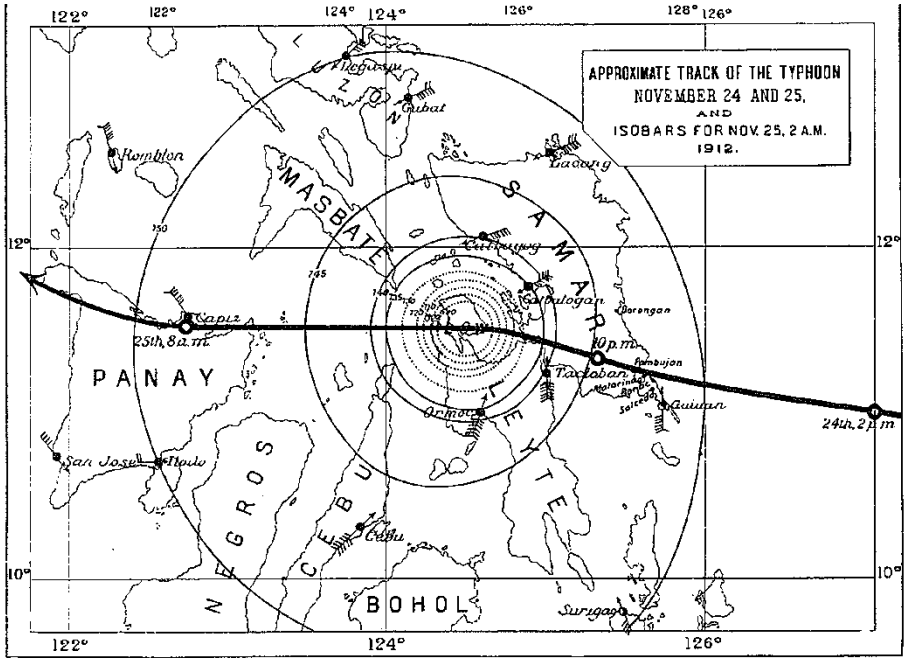
1952 10.27 Wilma (930hPa)
(Fatalities 444)

1984 11.4 Agnes (925hPa)
(Fatalities 1167)

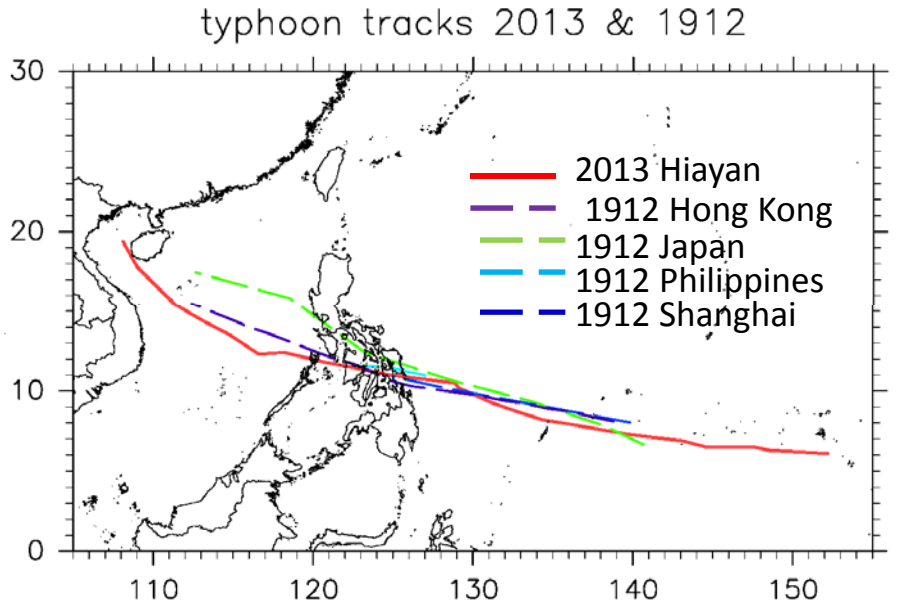
2013 11.8 Haiyan (895hPa)
(Fatalities 6241)

Storm surge was observed
In 1897 typhoon, 1912
typhoon and Haiyan (Yolanda)

TC track in Nov. 1912



Similar track to Typhoon Haiyan



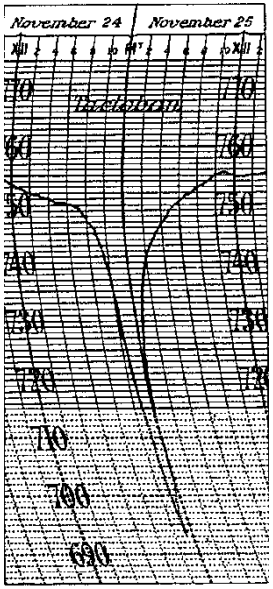
Landfall less than 920hPa

Water front, Tacloban.
EFFECTS OF THE TYPHOON IN LEYTE, NOVEMBER 24 TO 25.

Damage in Tacloban

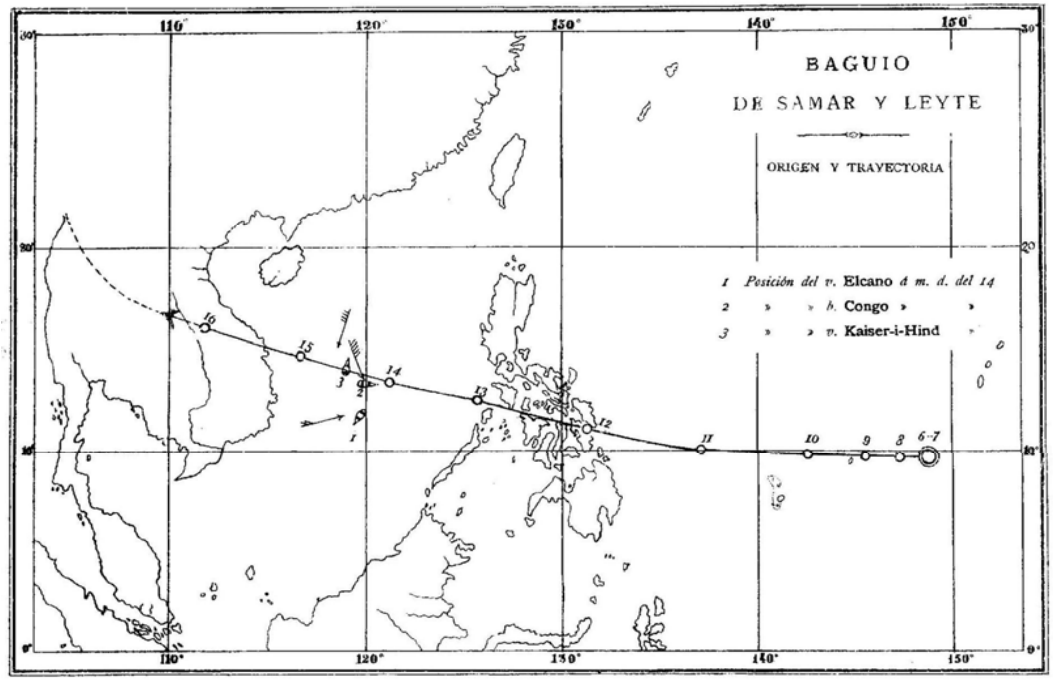
Provincial Building, Tacloban.

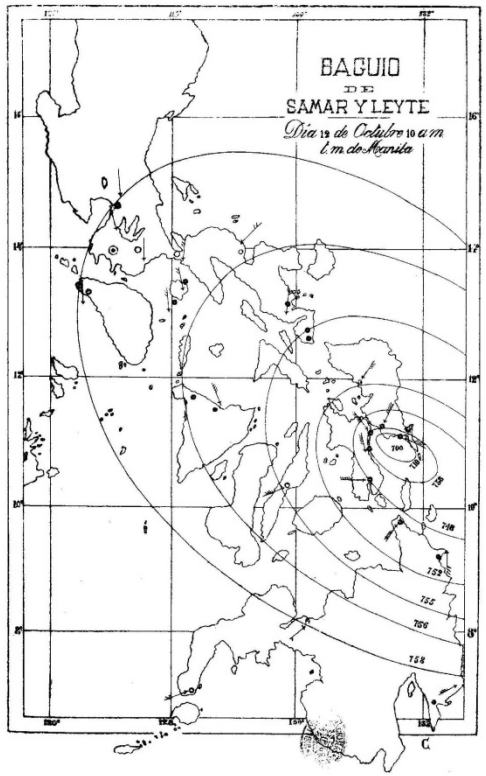
Algué (1912)

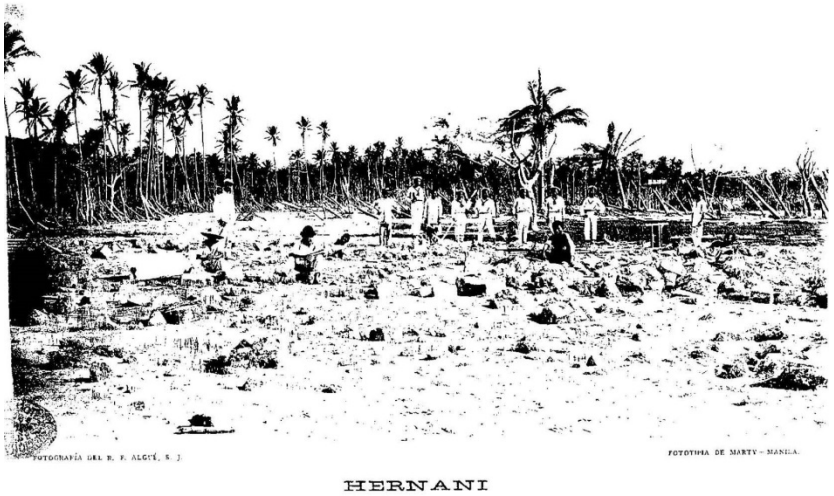


Pressure measurement in Tacloban

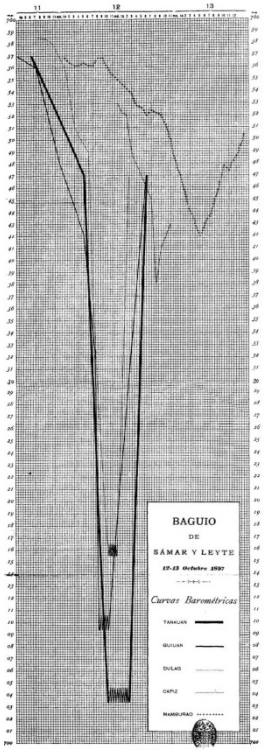
TC track in Oct. 1897






HERNANI

Pressure measurement in Tanauan



Storm surge damage in Hernani

Algué (1898)

Comparison between typhoon Haiyan (Yolanda) ,1912 typhoon, and 1897 typhoon

Haiyan (Yolanda) 2013	**1912 typhoon**	**1897 typhoon**
Maximum wind 44m/s(160kph) gust 54m/s (195kph) (Guiuan)	Maximum wind Beaufort scale 12 (Tacloban, Ormoc)	
Minimum station pressure 910.0 hPa (Guiuan)	Minimum station pressure 924.0 hPa (Tacloban)	Minimum station pressure 938.6 hPa (925.2hPa?) (Tanawan or Tanauan)
Storm surge damage Guiuan to Hernani 6-7m Tacloban to Palo 5-6m Basey 5-6m	Storm surge damage Santa Rita 7m Bobon, Tababao 6.1m Tacloban 2m Capiz 1m	Storm surge damage Hernani 7.3m Vasay 4.9m Guiuan 0.7m Tacloban 0.4m
(PAGASA)	(Algué 1912)	(Algué 1898)

Summary

- Typhoon Haiyan (Yolanda) hit Philippines in Nov. 2013 and storm surge damage was occurred in Visayas.
- Automatic weather system was installed in Tolosa near Tacloban to support meteorological observation where the PAGASA weather stations were destroyed by typhoon Yolanda.
- National Meteorological -Hydrological Convention was held in Manila with PAGASA and JAMSTEC in Nov. 2014 to share the researches.
- Observation data were collected during typhoon Yolanda and Doppler radar measured more than 100m/s (360kph) near Guiuan.
- Typhoon landfall in the Philippines were investigated for the past 120 years and similar tracks to typhoon Haiyan（Yolanda) with storm surge damage was observed in 1912 and 1897.
- There is a possibility of the risk of similar strong typhoon landfall at least once in 100 years.