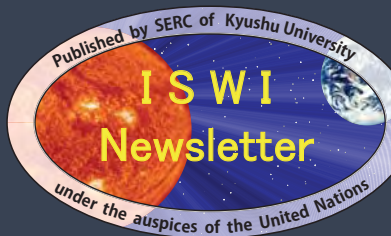


Climate Change-Related Meteorological Events in the Southern Philippines

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Presented at
United Nations/Indonesia International Conference on
Integrated Space Technology Applications to Climate Change
2-4 September 2013, Jakarta, Indonesia.



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file:///C:/Users/.../Downloads/Mindanao_Red.png [online image] Wikimedia. Retrieved from https://upload.wikimedia.org/wikipedia/commons/thumb/c/c0/Mindanao_Red.png/666px-Mindanao_Red.png



A Note on the Philippines

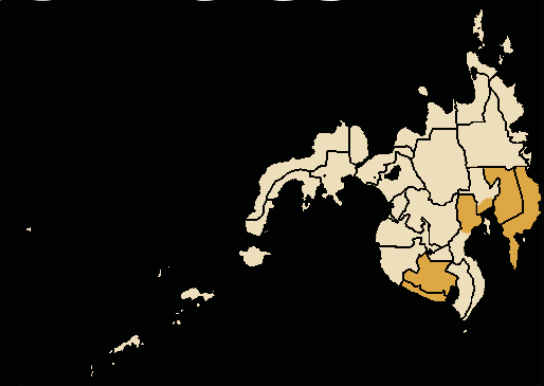
- South of Hong Kong & Taipei, north of Indonesia, east of peninsular Southeast Asia
- 11.3333°N , 123.0167°E
- Three regions: Luzon, Visayas and Mindanao
- We'll focus on **Southern Mindanao**
 - north of equator
 - 7.0644°N , 125.6078°E



file:///C:/Users/.../Downloads/Mindanao_Red.png [online image] Wikimedia. Retrieved from https://upload.wikimedia.org/wikipedia/commons/thumb/c/c0/Mindanao_Red.png/666px-Mindanao_Red.png

Meteorological Events & Adaptation Activities

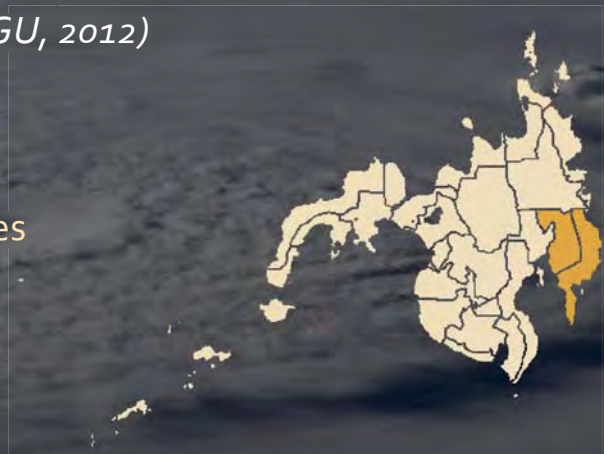
Extreme Events (Pablo & Matina Pangi)
Unusual Weather Patterns
Adaptation Activities



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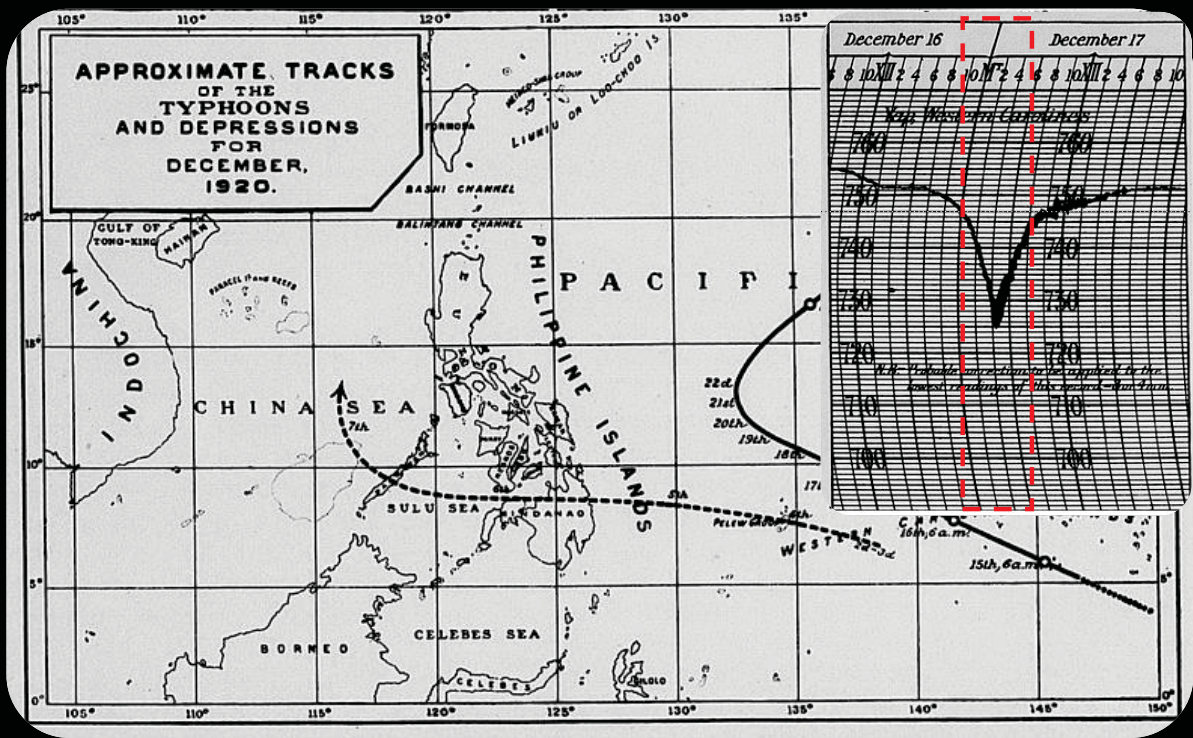
Extreme Events: Typhoon Pablo

- *International name: Bopha*
- *Landfall: December 2011, southeastern end of Mindanao*
- *The category 5 storm in numbers (AGU, 2012)*
 - ~1500 fatalities
 - ~150,000 damaged houses
→ ~61,000 "total loss" houses
 - ~USD 350 million in economic losses
 - ~5.5 million people affected



National Aeronautics and Space Administration. (2013) Super Typhoon Bopha. [Online image]. Flickr. Retrieved from https://farm.staticflickr.com/8628/81333668_8c933b79f0.jpg (2011) Mindanao, red. [online image]. Wikimedia. Retrieved from https://upload.wikimedia.org/wikipedia/commons/thumb/c/c0/Mindanao_Red.png/656px-Mindanao_Red.png





Why Mindanaoans Were Unprepared for Pablo

Manila Observatory, (1921). Approximate Tracks of the Typhoons and Depressions for December 1920. Retrieved from the Manila Observatory Archives.



Pablo's Effects: Agriculture - Banana Industry

Manuta, J. (2023). Enhancing Regional Capacity in Reducing Disaster Risk to Climate Related Hazards. [Unpublished Monograph Series], 1. Davao City: Ateneo de Davao University.





Pablo's Effects: Agriculture – Coconut/Palm Industry

Manuta, J. (2023). Enhancing Regional Capacity in Reducing Disaster Risk to Climate Related Hazards. [Untitled Monograph Series], 1. Davao City: Ateneo de Davao University.



Pablo's Effects: Agriculture – Coconut/Palm Industry

Manuta, J. (2023). Enhancing Regional Capacity in Reducing Disaster Risk to Climate Related Hazards. [Untitled Monograph Series], 1. Davao City: Ateneo de Davao University.





Pablo's Effects: Homes & Fisheries

Manuta, J. (2023). Enhancing Regional Capacity in Reducing Disaster Risk to Climate Related Hazards. [Untitled Monograph Series], 1. Davao City: Ateneo de Davao University.



Extreme Events: Matina Pangi River

Flood Monitoring Report								
Date	Monitoring Time	Water Level/Current	Time Evacuated	Evacuated Puroks	Evacuation Area	No. Of Families	Time Subsided	Remarks
28-Jun	9:31 PM	Level 3 S.C.		Teachers Village	Jesus is Lord Chapel	28		
	9:55 PM	Level 6.5 S.C.		Golden Valley	Higher ground area	35	4:15 of June 29	8:05 PM heavy rain started
	10:30 PM	Level 8 S.C.	9:55 PM	Conception	Barangay Hall 74-A	15		11:17 PM Balusong Bridge over flow
	11:03 PM	Level 13 S.C.		Lastima Compound	Km. 6 San Isidro Chapel	26		
	11:17 PM	OVERFLOW S.C.		Guadalupe		23		
				Santiago		14		

Source: Brgy. Disaster Risk Reduction Management Committee

Disaster Operation Center 74-A

Disaster Operation Center 74-A

Source: Brgy. Disaster Risk Reduction Management Committee



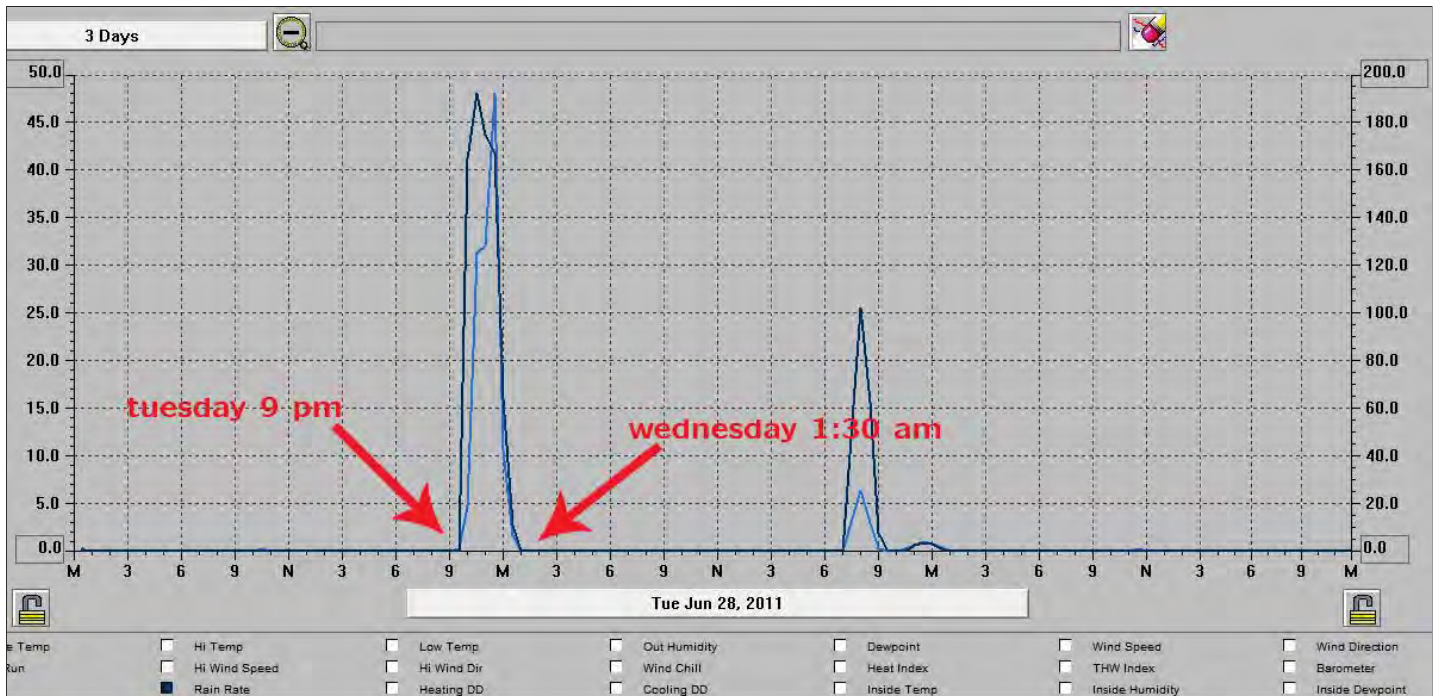
Extreme Events: Matina Pangi River

August 24, 2011

January 20, 2012



A. Og (2011) Mindanao_red. [online image]. Wikimedia. Retrieved from https://upload.wikimedia.org/wikipedia/commons/thumb/c/c0/Mindanao_Red.png/656px-Mindanao_Red.png



Extreme Events: Matina Pangi River - Water Level Gauge at Matina Bridge

Accumulated Rainfall during June 28, 2011: 127 mm



Unusual Rain Patterns

- *Usual Weather in Mindanao region*
 - warm sunny days
 - light rain at sundown that stops by nightfall
 - no storms or extreme events
 - *great* weather for agriculture
- *With climate change, first generation to not know a steady weather pattern*

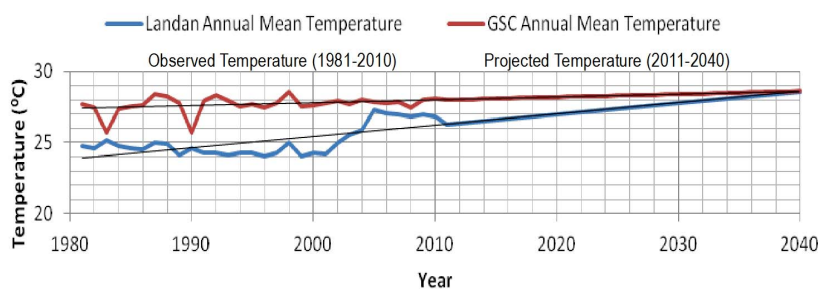


Bacangco, K. (2008) Mt. Matutum. [online image]. Flickr. Retrieved from https://farm4.staticflickr.com/3945/626652279_54044c64f_0.jpg
 Al.og. (2011) Mindanao_red. [online image]. Wikimedia. Retrieved from https://upload.wikimedia.org/wikipedia/commons/thumb/c/cb/Mindanao_Red.png/656px-Mindanao_Red.png



Unusual Rain Patterns

b.2) Climate Projections



Projected Temperature Change for 2011-2040

- The temperature is projected to increase by 0.69 °C in Landan compared to 0.18 °C in GSC for the next 30 years (2011-2040).
- Brgy. Landan will get warmer, more so in the relatively warmer summer months from periods 3-6. These increases are quite consistent in all parts of the country based on PAGASA projections.

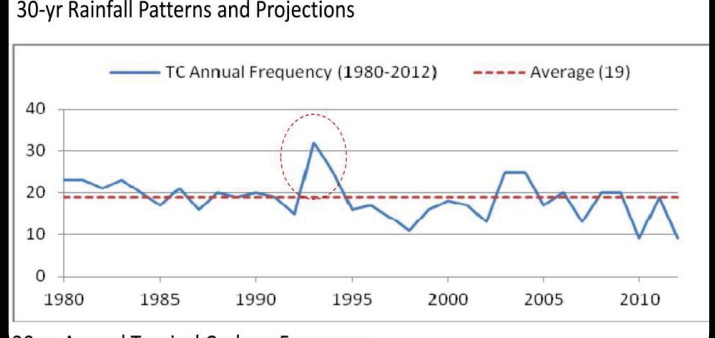
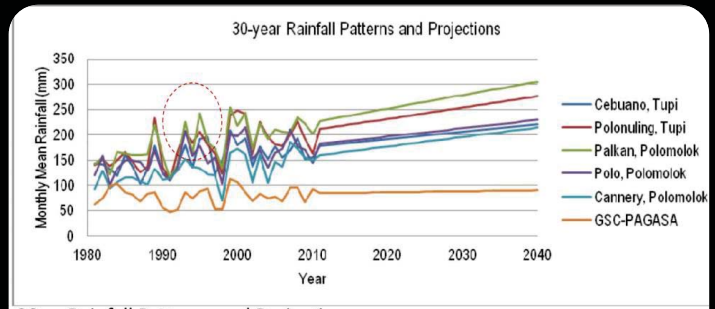
(Tubigon, 2012)

Possible scenario: city temperature (General Santos City) expected to be the same as agricultural area (Polomolok, South Cotabato) over time



Unusual Rain Patterns

- *Polomolok weather stations: increasing rainfall → increasing floods*
- *Issues: density and frequency*
 - Can have high rainfall at only one time in a month
 - Unusual events: Ondoy, Pablo



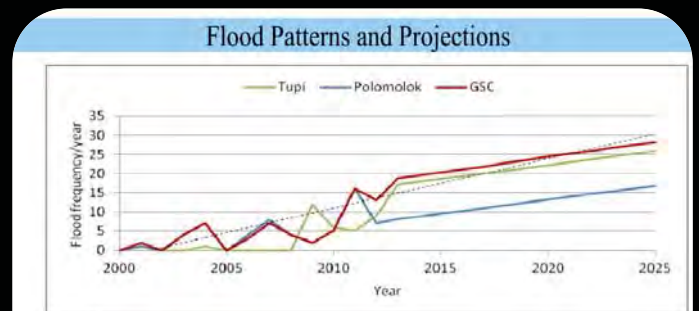
30-yr Annual Tropical Cyclone Frequency

(Tubigon, 2012)



Unusual Rain Patterns

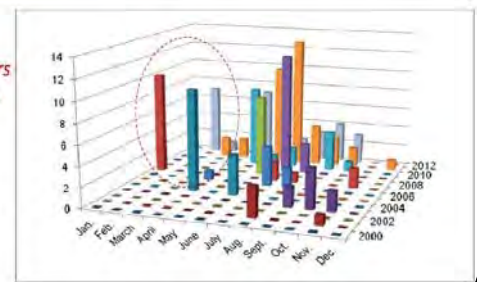
- *Regular flooding pattern in Polomolok: June – August*
- *Recent Polomolok flooding: two periods*
 - January – March
 - June – August
- *Flooding has increased in past ten years*
- *Different sectors affected*



Flood Frequency

>154 floods in 13 years
> 12 floods/year ave.

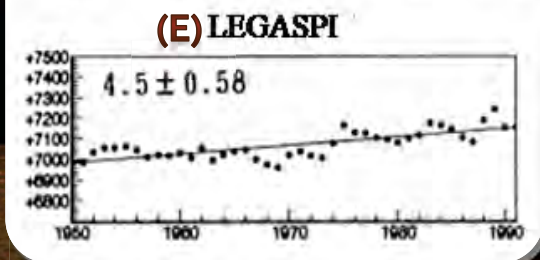
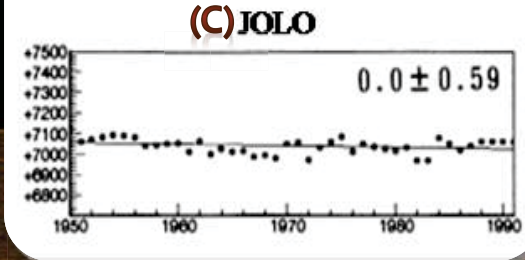
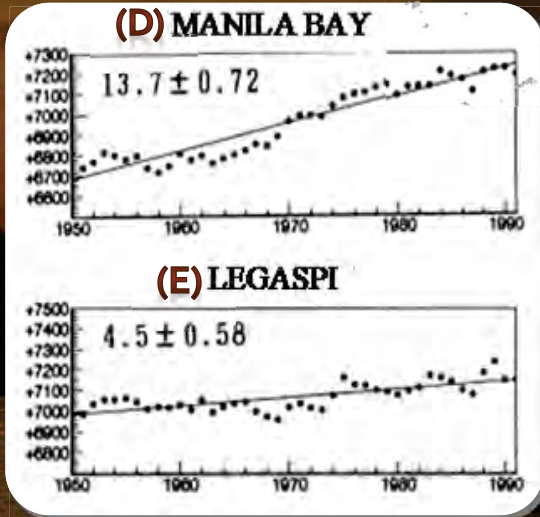
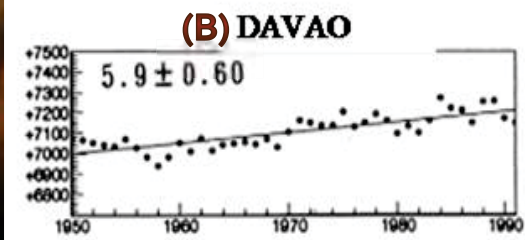
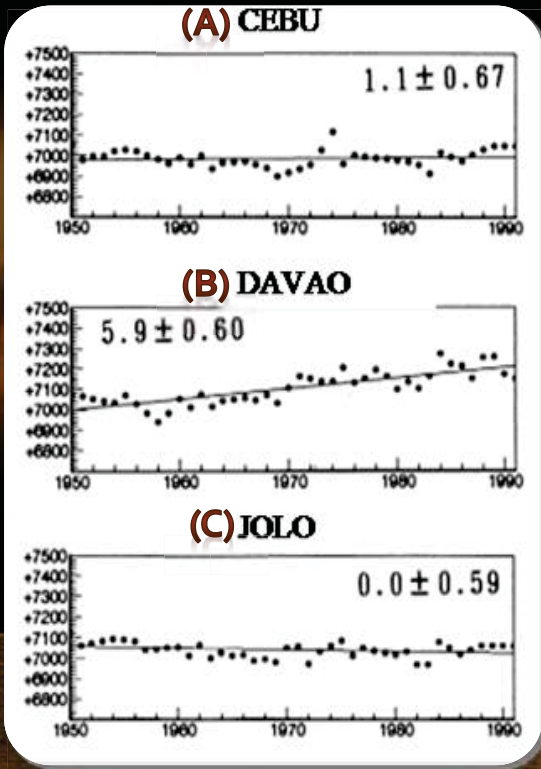
Change in Periodic Patterns



(Tubigon, 2012)



Sea Level Rise: 1950 - 1990



(Yanagi & Akaki, 1994)

Pinoyinfo, J. (2013) Flood in Davao City January 20, 2013. [online image]. Flickr. Retrieved from <https://secure.flickr.com/photos/121166@N00/8493215812size/1014photo20130120/>
 J. Og. (2011) Mindanao_red. [online image]. Wikimedia. Retrieved from https://upload.wikimedia.org/wikipedia/commons/thumb/0/c0/Mindanao_Red.png/666px-Mindanao_Red.png



J. Og. (2011) Mindanao_red. [online image]. Wikimedia. Retrieved from https://upload.wikimedia.org/wikipedia/commons/thumb/0/c0/Mindanao_Red.png/666px-Mindanao_Red.png

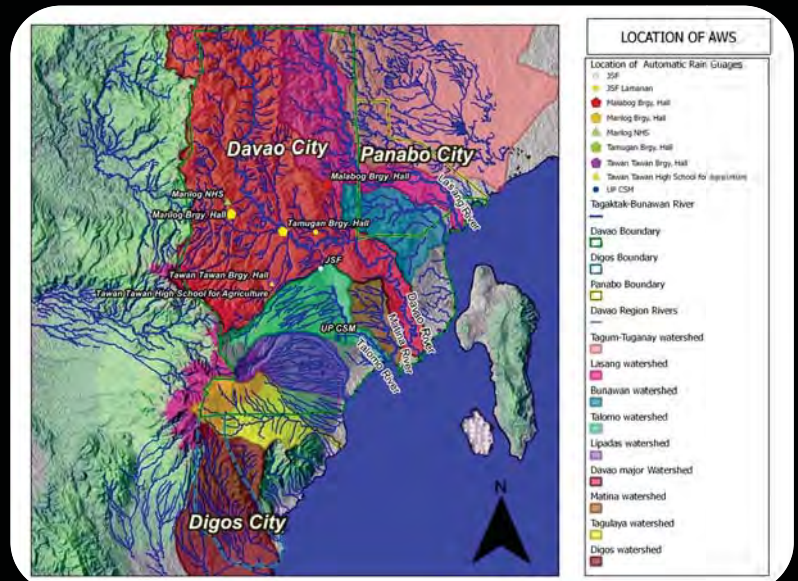


Sea Level Rise



Adaptation Activities

- Local weather stations to increase local rainfall data for pattern prediction
- Locally produced weather stations
- ADDU TROPICS and DOST, with local state and national universities
- Atmospheric vapor research
 - SCINDA
 - GPS
 - World Wide Lightning Location Network (University of Washington, Seattle)



file:///C:/Users/.../Downloads/Mindanao_Red.png (2013) Mindanao, red. [online image]. Wikimedia. Retrieved from https://upload.wikimedia.org/wikipedia/commons/thumb/c/c0/Mindanao_Red.png/656px-Mindanao_Red.png



Adaptation Activities

- Masters in Tropical Risk Management due to Climate Change
 - 2013: 2nd graduating class of government planning officials
 - Student project data collected into centralized databank for Mindanaoan science
 - Conducted in South Cotabato province
 - province is susceptible to climate change
 - Province is also known for tourism and agriculture (pineapple plantations)



file:///C:/Users/.../Downloads/Mindanao_Red.png (2013) Mindanao, red. [online image]. Wikimedia. Retrieved from https://upload.wikimedia.org/wikipedia/commons/thumb/c/c0/Mindanao_Red.png/656px-Mindanao_Red.png



Manila Observatory

*Mindanao (Davao) Station
Current Observatory Space Weather
Studies*

MO Main
(Manila)

MO Mindanao
Station
(Davao)

J. Og. (2011) Mindanao_red. [online image]. Wikimedia. Retrieved from https://upload.wikimedia.org/wikipedia/commons/thumb/c/c0/Mindanao_Red.png/656px-Mindanao_Red.png



Manila Observatory – Davao Station

- *Established: 1965*
- *Location: 7° 4' N; 125° 36' E;
133 m elevation*
- *Branch of the Manila
Observatory (MO)*
 - MO was established in 1865 in downtown Manila
 - MO functioned as the official Philippine weather bureau until 1948



Morales E. (2020). Untitled. [personal photograph]



Manila Observatory

– Davao Station

- *Current MO Davao Station studies and connections*
- IRIS (early tsunami warning system for the Pacific)
- MAGDAS (Kyushu University with Prof. Yumoto)
- World Wide Lightning Location Network
- Weather station
- SCINDA station

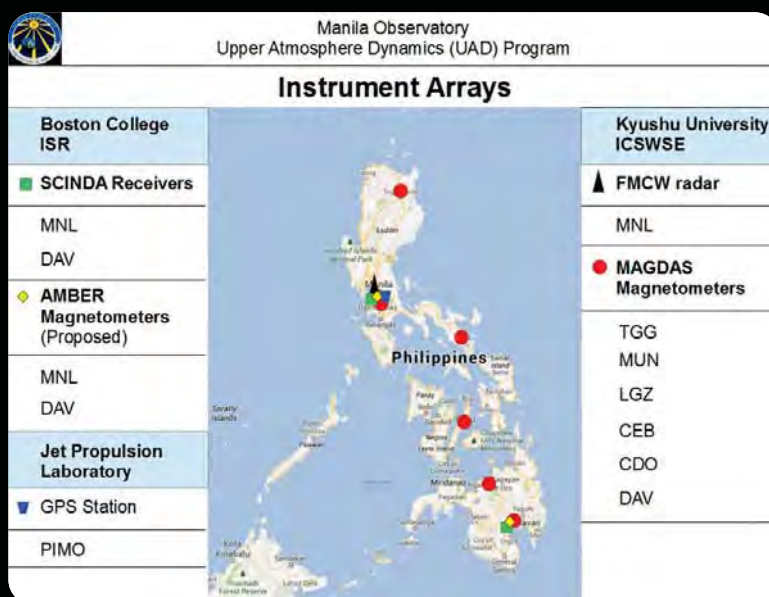


Morales E. (2020). Unlabeled. [personal photograph]



Manila Observatory Current Space Weather Studies

- **MAGDAS**
 - Kyushu University with Prof. Yumoto
 - Part of the nationwide network includes a Philippine government station
- *Weather station*
- *SCINDA station*
- *Upper Atmosphere/Space Weather (Boston College)*
- *GPS station (JPL)*

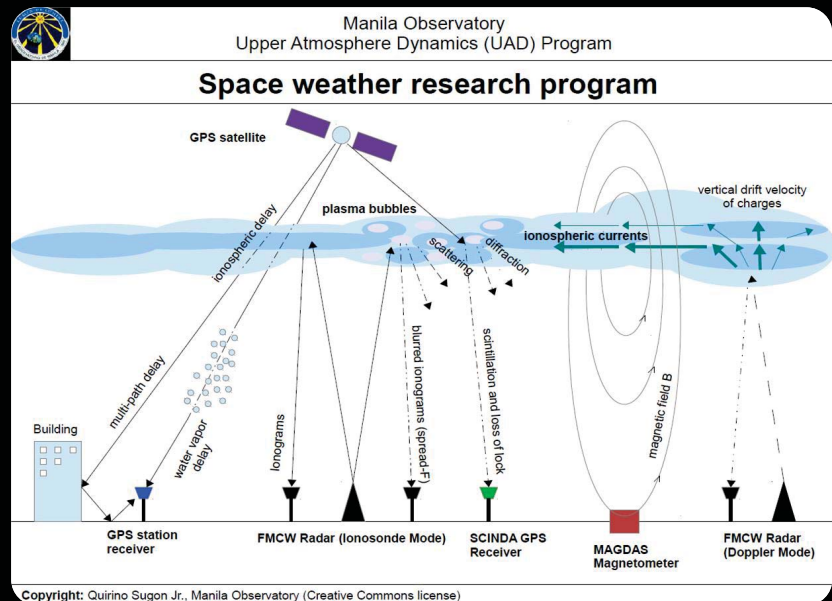


Manila Observatory. (n.d.) Unlabeled. [map]



Manila Observatory Current Space Weather Studies (UAD program)

- *in cooperation with Kyushu University*
- *looks at scintillation phenomenon, especially plasma bubbles*
- *makes use of ionosonde radar*

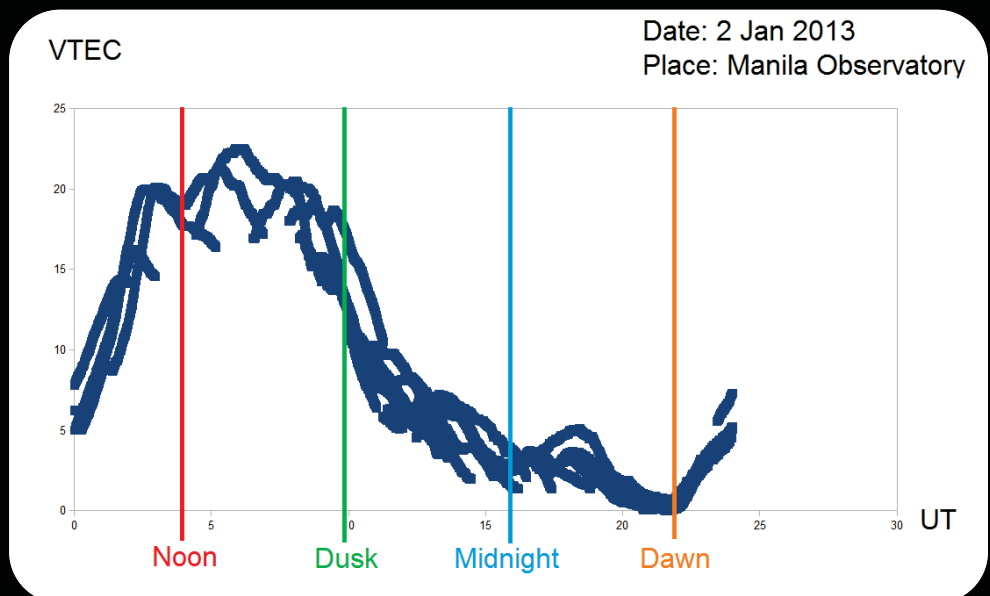


Sugon, Q. (n.d.) Space Weather Research Program. (graphic)

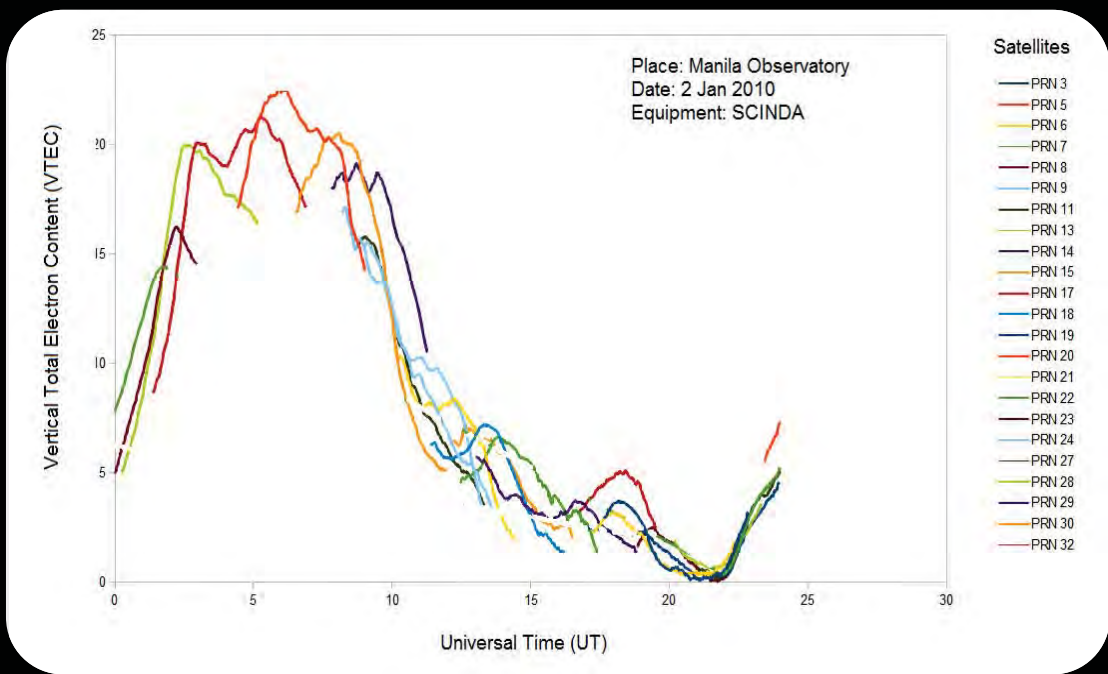
Manila Observatory Current Space Weather Studies

The Vertical Total Electron Content (VTEC) is obtained from GPS satellite measurements.

VTEC peaks at around 2 pm local time and goes to zero at around dawn (6 am local time).

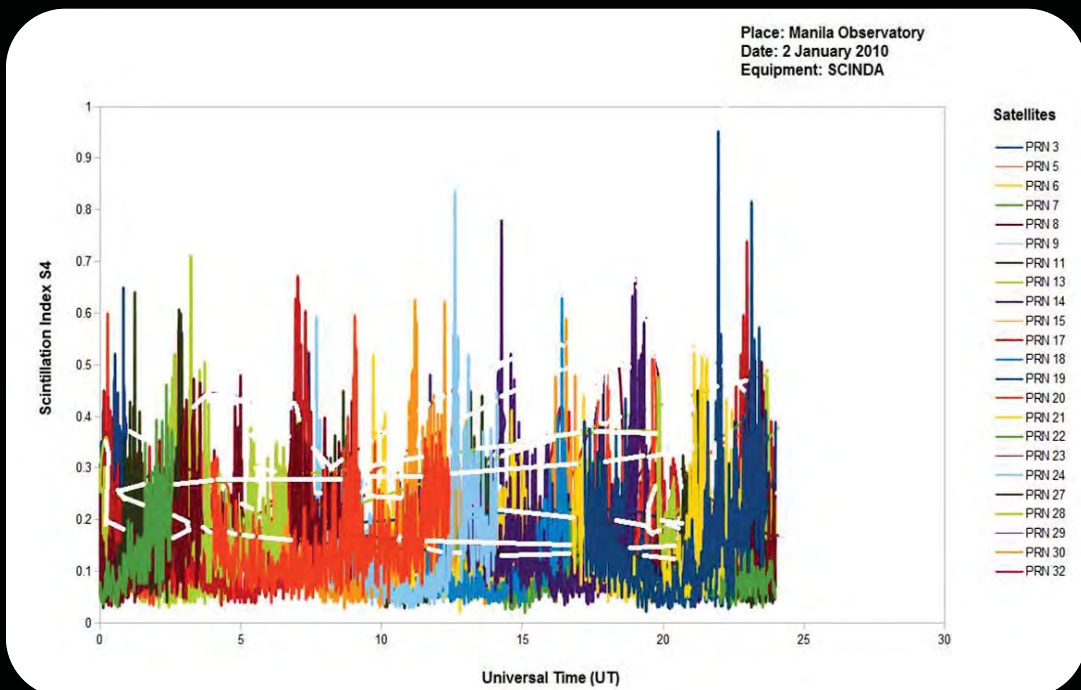


Sugon, Q. (2023) Unpublished. (graph)



Manila Observatory Current Space Weather Studies

Sugan, O. (2023) Unpublished. (graph)



Manila Observatory Current Space Weather Studies

Sugan, O. (2023) Unpublished. (graph)



Further Research and Questions

Discussion Session



Further Questions

- Could our weather phenomena be related to space weather? What connections are there between the ionosphere and troposphere?
- Given our station, developing country status and location, what other research could we undertake?
- Are we in the zone immediately affected by El Niño?
- Can the satellite data monitoring SST include temperatures as far east as Mindanao (125°E)?
- Should we be looking for upper atmosphere vapor currents, like the ones recently reported in Europe? (EOS, August 2013)



References

- Tubigon, J. C. Watershed Governance in Silway - Klinan River Systems. M.S. Thesis, Ateneo de Davao University, Davao City, Philippines, March 2013.
- Yanagi, T.; Akaki, T. Sea Level Variation in the Eastern Asia. *Journal of Oceanography*. 1994, 50, 643-51.



Thank you!

Questions?

