Proceedings
of the Philippine Meteorological Society

Volume 6 March 2023 ISSN 2599-5537

Abstract of Papers Presented in the

2023 PMS ANNUAL CONVENTION

Theme:

#PMS2023: Recent Advances and Applications of Meteorology and its Allied Sciences in the Philippines

ISSN 2599-5537

Published by the Philippine Meteorological Society, Inc.
PAGASA Science Garden Complex
Agham Road, Diliman, Quezon City
Tel. No.: (+63 2) 929-4570

Issue Editor: Engr. Lorenzo A. Moron
Layout and Design: Ms. Ma. Teresa M. Pajarillo

PMS Officers (2022–2023)

President:	Dr. Marcelino Q. Villafuerte II
Vice President:	Engr. Lorenzo A. Moron
Business Manager:	Mr. Robert B. Badrina
Internal Auditor:	Dr. Prisco D. Nilo
Board of Trustee:	Dr. Joseph Q. Basconcillo
Board of Trustee:	Mr. John Mark I. Dolendo
Board of Trustee:	Mr. Romeo B. Ganal, Jr.
Board of Trustee:	Engr. Bernard R. Punzalan II
Board of Trustee:	Ms. Ma. Rosario C. Ramos
Treasurer:	Ms. Aniceta B. Garcia
Asst. Treasurer:	Ms. Kristel Anne Valerie M. Villasica
Secretary:	Ms. Maria Krista Rona C. Borbon
Asst. Secretary:	Ms. Mary May Victoria M. Calimoso

Convention Committee

Over-All

Chair : Dr. Marcelino Q. Villafuerte
Vice-Chair : Engr. Lorenzo A. Moron

Convention Co-Chairs

Dr. Joseph Q. Basconcillo
Mr. John Mark I. Dolendo

Solicitation and Finance

Chair : Mr. Robert Badrina
Vice-Chair : Ms. Aniceta B. Garcia
Members : Mr. Mario Miclat
Ms. Ma. Teresa Pajarillo
Ms. Kristel Ann Valerie Villasica

Invitation: Resource Speaker

Chair : Engr. Lorenzo A. Moron
Vice-Chair : Dr. Marcelino Q. Villafuerte

Invitation: PAGASA and Non-PAGASA Participants

Chair : Dr. Joseph Q. Basconcillo
Vice-Chair : Ms. Krista C. Borbon
Ms. Kristel Ann Valerie Villasica
Ms. Rowena C. Rañola

Food, Venue, and Physical Arrangement

Chair : Engr. Bernard R. Punzalan II
Vice Chair : Ms. Aniceta B. Garcia
Member : Ms. Ma. Teresa Pajarillo
Mr. Raymart B. Gaintano
Mr. John Bryan M. Peconcillo
Ms. Patrixia Santos

Awards (Dangal ng PMS)

Chair : Mr. Romeo B. Ganal Jr.
Vice-Chair : Ms. Ma. Rosario C. Ramos
Members : Ms. Ma. Teresa Pajarillo
Mr. Mario Miclat

Secretariat

Chair	: Ms. Maria Krista Rona C. Borbon
Vice-Chair	: Ms. Mary May Victoria M. Calimoso
Member	: Ms. Aniceta B. Garcia
	Ms. Kristel Ann Valerie Villasica
	Ms. Ma. Teresa Pajarillo
	Mr. Mario Miclat
	Ms. Rowena Rañola
	Ms. Shalou-Lea Maratas
	Ms. Rosemarie A. Marasigan
	Mr. Fancis Go
	Ms. Hope Joyce Carpio

Session Committees

Opening and Closing Session

Chair	: Dr. Marcelino Q. Villafuerte
Rapporteur	: Engr. Lorenzo A. Moron
Member	: Ms. Krista C. Borbon

Session 1: Forecasting and Warning, Agrometeorology, Aviation, Satellite and Marine Meteorology

Chair	: Dr. Prisco D. Nilo
Rapporteur	: Ms. Rosemarie Ann A. Marasigan

Session 2: Climate Monitoring and Prediction, Climate Information and Services, Climate Variability and Change

Chair	: Ms. Rosemarie Ann A. Marasigan
Rapporteur	: Ms. Mary May Victoria M. Calimoso

Session 3: Water Resource Conservation and Management

Chair	: Mr. Romeo B. Ganal Jr.
Rapporteur	: Ms. Mary May Victoria M. Calimoso

Session 4: Climate and Weather Extremes and their Impacts

Chair	: Dr. Joseph Q. Basconcillo
Rapporteur	: Ms. Kristel Ann Valerie Villasica

Session 5: Application of Meteorology on Instrumentation and Engineering, Remote Sensing, Marine Science, Agriculture, Health, DRRM, Science Communication and Education

Chair	: Engr. Bernard R. Punzalan II
Rapporteur	: Ms. Rosemarie Ann A. Marasigan

Session 6: Astronomy and Space Weather

Chair : Ms. Ma. Rosario C. Ramos
Rapporteur : Engr. Bernard R. Punzalan II

Poster Session

Chair : Mr. Robert B. Badrina
Vice Chair : Ms. Kristel Ann Valerie Villasica
Member : Mr. John Bryan M. Peconcillo
Ms. Ma. Teresa Pajarillo

Contents

Session VI: Astronomy and Space Weather

POSTER SESSION

Society Profile

Oral Sessions

Station-based Rainfall Anomaly Index for Localized Southwest Monsoon Rainfall Monitoring in the Western Philippines

Kimberly Manauis[1]*, Raymond Jess Goliat[1], Nathaniel Servando[1], and Lorenzo Moron[1]

[1]*Department of Science and Technology - Philippine Atmospheric, Geophysical and Astronomical Services Administration*

Corresponding author's email address: kamanauis@up.edu.ph

The western region of the Philippines is susceptible to heavy precipitation events induced by the southwest monsoon (SWM) season during the months of June to September (JJAS). The influence of SWM on rainfall intensity in the western Philippines varies in three domains - northwestern, central, and southwestern area of the country. This study examines the spatio-temporal variability of the station-based Rainfall Anomaly Index (RAI) in monitoring SWM rainfall intensity for each selected domain from 1991 to 2020. Rainfall data from synoptic stations located under each domain are utilized to derive pentad (5-day) localized RAI from June to September. Climatological JJAS rainfall of the three selected domains are statistically different from each other at the 99% significance level, wherein northwestern Philippines are mostly exposed to intense SWM rainfall compared to southern regions. This domain recorded the highest frequency (34 pentads) of severe rainfall intensity for JJAS, peaking in the month of August, followed by the central Philippines with 30 pentads under severe intensity, peaking in July. In general, western Philippines frequently experienced mild rainfall intensity during the 30-year period, and the highest frequency of occurrence of severe rainfall intensity was recorded in 2018. Furthermore, climatological values of RAI showed a significant positive relationship ($r = 0.96$, $p<0.05$) with extreme rainfall events (99th percentile), particularly emphasized in each domain of interest. Overall results demonstrate the potential of utilizing RAI in characterizing localized SWM rainfall intensity, which can aid in monsoon monitoring and early warning systems in the country.

Keywords: Rainfall Anomaly Index, Southwest Monsoon, Western Philippines

Performance Assessment of Operational Global Spectral Model (GSM) for Rainfall in the Philippines

Robert Badrina[1]*, Jerome Tolentino[1], and Stephen Villejo[2,3]

[1]*Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA), Quezon City*

[2]*School of Statistics: University of the Philippines Diliman, Quezon City, Metro Manila*

[3]*School of Mathematics & Statistics: University of Glasgow, Glasgow, G12 8QQ, Scotland, United Kingdom*

Corresponding author's email address*: robert.badrina@pagasa.dost.gov.ph*

Numerical weather prediction models (NWP) are crucial in formulating weather forecasts. They serve as one of the bases for determining weather forecasts, particularly in a short period. The Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), as the National Meteorological and Hydrological Center (NMHC) of the Philippines, provides a daily 24-hour and 4-day extended weather outlook. Since the beginning of the 1990s, the agency has utilized the Global Spectral Model (GSM) as one of the tools for weather forecasting. Moreover, Japan Meteorological Agency (JMA) has operated GSM since March 1988 which has undergone continuous development (latest update in March 2021). In this study, we performed an operational assessment of the rainfall output of the model from 2020-2021 to the 55 synoptic stations of PAGASA. The GSM 0.25 data were interpolated using Inverse Distance Weighting (IDW) method to match the coordinates of the synoptic stations. The result shows a bias of greater than -8mm of rain from the 36th hour onwards whereas October observed the highest bias (-23mm - 72nd hour). The root mean square error (RMSE) ranges from 6mm to 53mm of rain; from October to December, we obtained the highest RMSE. In the dichotomous forecast where we set a 1.0mm of the rain threshold value, the SON (September-October-November) period observed a higher hit rate but also a higher false alarm rate (more than 40%). No significant difference was observed in the monthly miss rate. Generally, the result of the study shows a different performance of the model for each month where various synoptic systems are affecting the country. Although increasing the duration of the assessment is still needed further to understand the performance and dynamics of the model, this study can be an initial step to serve as a reference for operational forecasters when utilizing the GSM model.

Keywords: GSM model, rainfall, NWP model assessment

Evaluation of WaveWatch III (WW3) modeling in the Philippines using different source term packages

Alyssa V. Valerio*[1], Darwin R. Alejos Jr[1], John Mark I. Dolendo[1], Jehan Fe S. Panti[1], Maria Cristina C. Uson[1], and Esperanza O. Cayanan[1]

[1]*Philippine Atmospheric, Geophysical and Astronomical Services Administration*

Corresponding author's email address*: alyssa.valerio@obf.ateneo.edu*

The Wavewatch III (WW3), a third-generation wave model developed at NOAA/NCEP in the spirit of the WAM model, is a numerical simulation model used for ocean wind-wave studies. Modeling and forecasting of ocean surface waves under tropical cyclones (TCs) have been of great concern for many years because it can minimize the loss of life and property in maritime and coastal regions. Hence, accurate wave forecasts can contribute to understanding wind-wave and wave-current interaction physics under extreme winds, thereby improving tropical cyclones' intensity and structure forecasts. In this study, Tolman and Chalikov's (1996) (hereinafter ST2), Tolman's stabilization of the growth rate of deep-ocean waves in ST2 (2002) (hereinafter ST2+STAB2), and Ardhuin et al.'s (2010) (hereinafter ST4) are the source term packages used in the WW3 v 5.16 model sensitivity analysis for wave simulation in the Philippines for the period of June, July, and August (JJA) 2018. The Global Forecast System (GFS) model was utilized as the wind input parameter. The performance of the model was assessed by comparing the output simulation against the in-situ buoy data from the Central Weather Bureau (CWB) and the Global Ocean Wave Reanalysis Waverys satellite wave observation data from the Copernicus Marine System (CMS). Overall, biases reveal the tendency of the model to slightly overestimate wave heights during JJA 2018 (ST2=0.28, ST2+STAB2=0.06, and ST4=0.02). In addition, all three packages exhibit an underestimation during the non-TCs and an overestimation during the TCs.

Keywords: Wave Modeling, Wavewatch III, Tropical Cyclones, Global Forecast System

Influence of the Madden-Julian Oscillation on Drought Seasonality in Mindanao During the Boreal Spring of Neutral ENSO Years

Alan Perry Daen[1]*, Jason Kalaw[2], and John Christian Lequiron[3]

[1,3]*Department of Earth and Space Science, Rizal Technological University, Mandaluyong City, 1550, Philippines*

[2] *Center for Astronomy Research and Development, Rizal Technological University, Mandaluyong City, 1550, Philippines*

Corresponding author's Email Address: alapdaen@rtu.edu.ph or alanperrydaen@gmail.com

The Philippines is one of the Southeast Asian countries severely affected by drought. Mindanao, the country's southernmost and second-largest major island group, has been particularly hard hit by the drought often associated with El Niño. Yet, certain records indicate that droughts can occur even in the absence of an El Niño event. This study focuses on examining how the Madden-Julian Oscillation (MJO) influences meteorological drought, as measured by the Effective Drought Index (EDI), in Mindanao during the boreal spring of neutral El Niño Southern Oscillation (ENSO) years. Daily real-time multivariate MJO (RMM) index amplitudes from the Australian Bureau of Meteorology and daily rainfall data from PAGASA weather stations in Mindanao used in calculating EDI were collected to establish a significant relationship between MJO and EDI. All data were collected between 2001 and 2020. In the interpretation, spatial-temporal analysis using choropleth mapping and linear regression is utilized to show how MJO influences the seasonality of meteorological droughts in Mindanao. The study showed that: (a) for the past 20 years of neutral ENSO boreal spring, Mindanao experienced daily conditions that were nearly normal, with the exception of SOCCSKSARGEN region, which had severely dry daily conditions; (b) MJO significantly influenced the seasonality of daily drought in Mindanao during neutral ENSO boreal spring; and (c) very active MJO events that occurred 12 months prior to the neutral ENSO boreal spring MJO episode showed an enhanced convection phase in the western Pacific. Despite Mindanao's vulnerability to drought, the majority of the island experiences nearly normal daily weather throughout the boreal spring. The MJO and other intraseasonal climate oscillations can have an impact on these circumstances. Therefore, MJO must be integrated into the outlook of the Philippine Weather Bureau.

Keywords: Effective Drought Index, Enhanced convection, Intraseasonal Climate, Madden-Julian Oscillation, Neutral ENSO

Diurnal Cycle of Precipitation Amount and Duration over Cagayan Valley, Philippines

Erwin T. Molina*[1] and Gerry Bagtasa Ph.D.[2]

[1]*Mariano Marcos State University, City of Batac, Ilocos Norte*

[2]*University of the Philippines, Diliman, Quezon City*

Corresponding author's email address: etmolina@mmsu.edu.ph

Understanding the diurnal behavior of precipitation will aid in the understanding not only of the mechanisms involved in rain formation but also the mechanism of the local climate. It is also a crucial aspect for disaster risk reduction, hazard mitigation, water resource management, and policy making. This study aimed to examine the climatology of precipitation with higher spatial and temporal scale along Cagayan Valley, Philippines using hourly automated weather station data and Advanced Research – Weather Research and Forecasting model simulations from July 2013 to June 2017. Specifically, it aimed to describe the characteristics of the amplitude and phase of the diurnal and semidiurnal cycles of precipitation; and explain and elucidate the physical mechanisms involved in the diurnal and semidiurnal cycles.

Strong diurnal cycle signals are observed along the mountainous areas in Cordillera and Caraballo, while weaker signals are observed along the coasts and small islands of Batanes. Afternoon to evening (14 – 22 LST) precipitation predominates along the valley throughout the year, with relatively higher amplitudes during the April-May-June season and lower amplitudes during the October-November-December (OND) season. Furthermore, early morning (23 – 10 LST) precipitation predominates between the eastern Cordillera Mountain Range and western Caraballo during the January-February-March (JFM) season, and northern coastal areas during the JFM and OND seasons. These characteristics suggest a strong implication of diurnal rainfall to the hydrological cycle and agriculture. The phase of the diurnal cycle is closely related to the duration of precipitation. The afternoon to evening maxima were more prevailing in the short-term precipitation events lasting 1-3 hours, while the early morning maxima were more prevailing in the long-term precipitation events which persisted for more than three hours. Spatial analysis of wind vectors suggests that mesoscale weather systems such as the sea breeze mechanism, mountain-valley breeze, and propagating mesoscale convective systems, have a greater effect on the diurnal cycle observed, particularly during the AMJ season.

Keywords: precipitation, diurnal cycle, duration, Cagayan Valley

SatREx: Satellite-Based Monitoring of Extreme Rainfall in the Philippines in Near-Real-Time

Marcelino Q. Villafuerte II*, Mike A. Petaca, Wilmer Agustin, and Charlie Ray Pascua

Philippine Atmospheric, Geophysical and Astronomical Services Administration

Corresponding author's email address: mvillafuerte@pagasa.dost.gov.ph

Extreme rainfall-related disasters can be mitigated if there is a way to identify the event at any given time. This is particularly important in a highly vulnerable countries like the Philippines. Here, we describe an online platform, which is used for near-real-time monitoring of extreme rainfall events in the country. Satellite rainfall estimates from Global Satellite Mapping of Precipitation (GSMaP) provided by the Japan Aerospace Exploration Agency (JAXA) is used to monitor multi-hour and multi-day extreme rainfall events in near-real-time. Various return levels of 1-, 2-, 3-, and 6-hour, as well as 1-, 2-, 3-, and 5-day rainfall accumulations were derived and used as the thresholds to identify extreme events. Multiple interactive maps, which allow users to determine how much rainfall was received over an area, are displayed and made available on an internet browser. Pixel-wise color-coded shadings indicative of potential flood occurrence are also shown and updated automatically every 30 min. Initial evaluation indicates that recently reported floodings caused by low pressure systems, monsoon rains, and shear line were captured by the online monitoring system. While the initial results are promising, thorough evaluation and further improvements of the system are required to gain confidence in the reliability and usability of the information it can deliver.

Keywords: Extreme rainfall, satellite-derived precipitation, online platform, the Philippines

Improvement of Flood Forecasting for Strengthening Flood Resilience in the Agno River Basin

Ailene R. Abelardo[1*], Mamoru Miyamoto[2], Tomoki Ushiyama[2], and Fumio Takeda[3]
[1] Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), Quezon City, Philippines
[2]International Centre for Water Hazard and Risk Management (ICHARM), Tsukuba, Japan
[3]National Graduate Institute for Policy Studies (GRIPS), Tokyo, Japan

Corresponding author's email address: arabelardo05@gmail.com

The Philippines is one of the countries prone to different disasters, especially water-related disasters. In this study, the Global Climate Models (GCM) archived in the Data Integration and Analysis System (DIAS) of Japan were used to analyzed the impact of climate change in the Agno River Basin (ARB). The Rainfall-Runoff-Inundation (RRI) model was used to simulate the discharge, flood depth, and extent of the Past Climate (1981-2000) and Future Climate (2041-2060) in the basin. Results showed an increase of 1 meter and 151 square kilometers in the maximum flood depth and extent, respectively. The change in the magnitude of future flood poses a threat to the people living in the ARB and damage to properties. Thus, this study examined the capability of the Weather Research and Forecasting (WRF) model to predict discharge in the basin. The two domains of PAGASA-WRF were used and applied simple correction using the linear correlation equation. First, the RRI model simulated the river discharge at Carmen Station using the corrected forecast rainfall for Domain1 (12km) and Domain2 (3km) for the Tropical Cyclone (TC) Ompong (2018). The Nash-Sutcliffe Efficiency (NSE) was used to evaluate the performance of WRF with an acceptable value of 0.70. NSE value for both domains were greater than 0.80, indicating a good performance with 114-hour and 48-hr lead time for Domain1 and Domain2, respectively. Further investigation was conducted using TC Jenny (2019), TC Josie (2018), and Southwest Monsoon (August & September 2019). Domain2 showed a good performance except during the SWM case in August 2019. In contrast, Domain1 showing poor performance for the additional cases. Results showed that using RRI and WRF model can improve the issuance of flood warnings to warn the people for the possible threat of flood and minimizing the risk by increasing the lead time.

Keywords: RRI Model, NWP, GCM, WRF, flood forecasting

Integration Of Geographic Information System (Gis) in Mapping the Flood-Prone Streets of Legazpi City, Albay, Philippines

Angela Marie A. Salvidar[1]*, Celine Joyce A. Regnim[2], Jerome A. Azul[3]

[1,2]Department of Physics, Bicol University College of Science, Legazpi City, Albay
[3]Physics Faculty Department, Bicol University College of Science, Legazpi City, Albay

Corresponding author's email address: salvidarangelamarie@gmail.com

Legazpi City is a first-class component city and the capital of Albay province. Its topography and location make it susceptible to flooding especially in the streets and roads which causes a disruption to traffic, transport system, and people's lives. This study aimed to determine the flood-prone streets in the city and the contributing factors to flooding. These objectives were achieved through the integration of Geographic Information System (GIS) and analytical Hierarchy Process (AHP). The comparison matrix of AHP analysis from the judgment of seven local expert respondents obtained a consistency ratio of 0.025, hence, it was consistent and acceptable. The results revealed that the most important flood-causing factor is rainfall intensity (I) with the highest weight value of 33.49% followed by elevation (E), land use/land cover (U), flow accumulation (F), distance from rivers (D), slope (S), and geology (G) with ratings of 14.14%, 12.22%, 12.18%, 10.96%, 9.90% and 7.12% respectively. The reclassified maps of FIGUSED were overlaid in a GIS environment to create a flood susceptibility map of Legazpi with five categories: very low, low, moderate, high, and very high susceptibility. The map displayed that the streets in the urban area are most likely to be flooded compared to those in the north, near south, and southeast because it has low elevation and slope, high values of flow accumulation, received the most rainfall amount, located near the main rivers, and has built-up areas that favor overland flow of water. From this, the researchers suggest installing ten additional Automated Weather Stations (AWS) in different locations that met the criteria of the World Meteorological Organization (WMO) in selection of installation sites. To validate the results, the susceptibility map was compared with the City Planning and Development Office's flood hazard map where the identified flood-prone streets are indeed highly hazardous to floods.

Keywords: floods, remote sensing, GIS, AHP, Albay

Time Series Forecasting of Precipitation in Cabanatuan, Nueva Ecija Using Box Jenkins' Arima Model

Jhoana Melendrez[1*], and Henrison Sanchez[1]

[1]*Department of Engineering Sciences, Central Luzon State University, Science City of Muñoz, Nueva Ecija*

Corresponding author's email address: melendrez.jhoana@clsu2.edu.ph

Rainfall forecasting has gained increasing study interest in recent years because of its substantial impact on agriculture, public safety, and climate monitoring studies. Localized rainfall forecasting models are crucial as the Philippines is projected to have an increased number of heavy daily rainfall and extreme rainfall events in Luzon and Mindanao by 2020 and 2050. Hence, this study aimed to develop a time-series rainfall forecasting model in Cabanatuan, Nueva Ecija, using Box-Jenkins' autoregressive integrated moving average (ARIMA) model. Monthly rainfall data was sourced from Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) from 1990 to 2018. The time-series data was divided into two 80:20 ratios. The first 80% is for analyzing the characteristics of rainfall data and model construction, while the latter 20% is for the accuracy testing of the selected model. The Box Jenkins methodology for model identification, estimation, and diagnostic checking of the fitted model was iterated to establish an ARIMA model. Multiple ARIMA models were established, but the result showed that ARIMA (2,0,2) model is the best-fit model for the data with the lowest value of Mean Absolute Percentage Error (MAPE), Mean Absolute Error (MAE), and Root Mean Squared Error (RMSE). Furthermore, the Ljung-Box Test result shows that the residuals of the model are white noise which indicates that the established model does not lack fit.

Keywords: ARIMA, Box Jenkins Methodology, Rainfall Forecasting, Cabanatuan

Development of Drought Monitoring and Forecasting Tool for Northern Luzon

Angelo Benedict R. Ragunjan*[1], Nathaniel R. Alibuyog[1], Evangeline Galacgac[1]

[1]Mariano Marcos State University, City of Batac, Ilocos Norte

Corresponding author's email address: arragunjan@mmsu.edu.ph

Drought occurrence is due to persistent and abnormal moisture deficiency that affects vegetation health, water supply, and society. The agriculture sector is relying on the status of the atmosphere to anticipate the possible development of drought events. Understanding the mechanism of extreme events such as drought is essential for better mitigation of impact. In this study, an analysis of historical drought events in Northern Luzon was conducted using satellite data. Satellite-derived indices such as the Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), and Standardized Vegetation-Temperature Ratio (SVTR) were used for the analysis of agricultural drought and Percent of Normal Precipitation Index (PNI) and Standardized Rainfall Anomaly Index (SRA) were used as meteorological drought indices. The influence of different hydrometeorological variables was also analyzed in terms of the season and phases of ENSO.

Drought events in Northern Luzon mostly occurred during the dry season and coincide with El Niño. A transition from meteorological drought to agricultural drought was also found in Northern Luzon, especially during the dry season, and was longer during El Niño. Agricultural drought in Northern Luzon was also found to be influenced by high potential evapotranspiration and was manifested by lo evapotranspiration. Agricultural drought in rainfed areas was found to be sensitive to the effects of rainfall deficit and high potential evapotranspiration while the effect of evapotranspiration was higher for irrigated areas. Understanding the influence of different hydrometeorological variables and different climate drivers can be used in the development of drought monitoring tools and can provide better forecasting of drought in agricultural areas such as Northern Luzon.

Keywords: Drought, Remote Sensing, Agrometeorology

Influence of the West Pacific Subtropical High on Landfalling Winter Tropical Cyclones in the Philippines

Kevin Christopher B. Cordoviz[1,2]*, Gerry Bagtasa[2]

[1]*Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)*

[2]*Institute of Environmental Science & Meteorology, College of Science, University of the Philippines Diliman, Quezon City*

Corresponding author's email address: kbcordoviz@gmail.com

Impacts of the long-term changes of the Western Pacific Subtropical High (WPSH) on tropical cyclones (TC) in the Philippine Area of Responsibility (PAR) during the months of November to January for the years 1958 to 2021 were investigated. Changes in TC tracks passing through the PAR were observed, with an abrupt increase in TC landfall frequency in Visayas and Mindanao from 10.2 TCs making landfall during the 1950s, to 23 that made landfall during the decade 2011-2020. The increase was due to the intensification and southwestward propagation of the WPSH over the decades. The decadal mean of the 5870 gpm contour line's westernmost tip moved from 17°N-150°E to 14°N-80°E in the last six decades. Areal gpm means depicting the WPSH were calculated from the JRA55 reanalysis data, with the locations selected by comparing WPSH intensity during TC landfall dates versus TC non-landfall recurving dates as well as the location of WPSH extent intrusion into the Philippine Sea. They show links between WPSH intensity and likelihood of TC landfall.

Correlation maps were then used to analyze the trend and variability of WPSH. Results show that WPSH behavior is significantly correlated with SSTs of the East Indian Ocean ($r = 0.81$), and the West Philippine/South China Sea (SCS; $r = 0.80$). Time series analysis for WPSH areal means, SST differences and the Oceanic Niño Index (ONI) also showed similar patterns with peaks and dips occurring in similar years. WPSH intensity is significantly correlated with the SST difference between the EIO and the West-Central Pacific ($r = 0.59$), between the West-PH Sea/SCS and the West-Central Pacific ($r = 0.69$), and the ONI ($r = 0.59$) indicating a positive relationship among SST, ENSO and WPSH intensity. Once the intensification of the WPSH intruded the Philippine Sea, TCs making landfall in Visayas and Mindanao increased.

Keywords: *West Pacific Subtropical High, tropical cyclone tracks, northeast monsoon, Sea Surface Temperature, ENSO*

Environmental Conditions and Internal Dynamical Processes during the Rapid Intensification of Super Typhoon Goni (2020)

Jan Mark B. Diesta[1*], Henric R. Jandoc[1], Earl Jeffrey B. Dineros[1], Chian-Yi Liu[2], and Jason P. Punay[1]

[1]*Department of Physics, College of Science, Bicol University, Legazpi City, Albay, Philippines*

[2]*Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan*

Corresponding author's email address: janmarkbonagua.diesta@bicol-u.edu.ph

This study utilized Tropical Cyclone (TC) track, gridded models, and satellite data to characterize the environmental conditions and internal dynamics of TC Goni (2020), one of the most intense tropical cyclones on record, during its evolution from 25th October to 1st November. The study found that Goni developed and intensified under favorable conditions, including anomalously warm sea surface temperatures exceeding 29°C, moderate deep-layer and low-level vertical wind shears, and high relative humidity at both low and mid-tropospheric levels. Additionally, an inflow layer in the lower stratosphere may have induced an upper-level warm core, contributing to further intensification during the mature stages of the typhoon. The early stages of Goni's rapid intensification were characterized by unique radial locations of deep convective clouds (DCC) and precipitation, differentiating it from other intensification categories. The typhoon's evolution was largely driven by the deposition process, which led to efficient release of latent heat. Relatively strong upper-level heating was observed during the formation and initial stages of Goni, potentially contributing to its later intensification. Furthermore, the consistent fullness ratio of Goni during its early stages played a role in its extreme rapid intensification (ERI) later on. The study also revealed that Goni's wind structure during ERI period was near the optimal size configuration, corresponding to the highest intensification rates. This study provides important insights into the environmental conditions and internal dynamics critical to the intensification of tropical cyclones.

Keywords: rapid intensification, tropical cyclone, environmental conditions, deep convective clouds, cloud microphysics

Cloud Properties of Hot Towers During Slow and Rapid Intensification of Tropical Cyclones in the Western North Pacific

Jason Punay[1]* and Chian-Yi Liu[2]

[1]*Department of Physics, College of Science, Bicol University, Legazpi City, Philippines*
[2]*Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan*

Corresponding a*uthor*'s email address*: jppunay@bicol-u.edu.ph*

This study investigates the cloud properties of hot towers (HTs) during slow intensification (SI) and rapid intensification (RI) of tropical cyclones (TCs) in the western North Pacific. The wide abundance of deep convective clouds (DCCs) during RI is investigated by examining the cloud microphysical properties of the HTs nested in DCCs. In a matured HT, the vertical profiles of liquid water content (LWC) and ice water content (IWC) reveal that condensates [1] mostly form at upper levels; and [2] have strong correlations with vertical velocity. Higher concentration of cloud ice in the HTs of rapidly intensifying TCs as compared with that in slowly intensifying TCs is found and may be used to delineate the onset of RI from SI.

Keywords: tropical cyclone, rapid intensification, cloud microphysical properties

Analysis of Extreme Rainfall and Temperature Variability in Selected Provinces of Bicol Region, Philippines

Aiza Banania[1*], Judy-Ann Legaspi[1], Joycee Ann Vibar[1], and Jerome Azul[1]

[1]*Department of Physics, College of Science, Bicol University, Legazpi City, Albay*

Corresponding author's email address: aizacervantes.banania@bicol-u.edu.ph

Climate extremes variability may cause disruptive effects on many aspects of society, especially on the agricultural, social, and economic development in Bicol region. This study investigated the variability of rainfall and temperature extremes in Bicol over a 32-year period (1990-2021). Daily rainfall, maximum, minimum, and mean temperature data from the five selected synoptic and agrometeorological stations in the region were examined. For the preprocessing method, Multivariate Imputation by Chained Equations (MICE) was used to fill the missing value. The processed data were subjected to trend analysis using the Mann-Kendall trend test, the seasonal Mann-Kendall, and Theil-Sen's slope estimator. Further, to examine the changes in rainfall and temperature extremes and their standardized anomalies, eight rainfall and eight temperature indices from the Expert Team on Climate Change Detection and Indices (ETCCDI) were employed. The results showed a general increasing annual rainfall trend for all the stations, with 60% and 100% for wet and dry seasons, respectively. Whereas the annual and seasonal temperature trend manifested a statistically significant increase in Legazpi, Pili, and Virac stations, while a decreasing trend was observed only over Daet and Masbate. In addition, regionwide trends anomalies in the rainfall indices showed an increasing trend except for CWD, which implies an increase in intensity and frequency but decreased duration of rainfall in Bicol. On the other hand, regionwide trends anomalies in the temperature indices showed an increasing trend, with warm nights (TN90p) increasing and cool nights (TN10p) decreasing, which signifies a warming trend in the region. Thus, the presence of extreme rainfall and temperature indices in the area may indicate a changing climate in Bicol region. As a result, the present study suggests that the region must examine climate-related risks and implement appropriate methods for climate variability adaptation and mitigation.

Keywords: climate variability, extremes, rainfall, temperature, ETCCDI

Characteristics of dual-polarimetric radar variables retrieved from raindrop size distribution measurements in Metro Manila

Marco Polo A. Ibanez[1]*, Samuel C. Martirez[1], Alvin G. Pura[1], Ramjun A. Sajulga[1]

[1]*Research & Development and Training Division, Philippine Atmospheric, Geophysical, and Astronomical Services Administration, 214 BIR Road, Diliman, 1100, Quezon City, Philippines*

Corresponding author's email address: marcopoloibanez@gmail.com

This study investigates the impacts of raindrop size distribution (DSD) variability on the characteristics and utility of dual-polarimetric variables and relations. The polarimetric variables including radar reflectivity (Z_H), differential reflectivity (Z_{DR}), and specific differential phase (K_{DP}) were simulated for different radar frequencies by applying the T-matrix scattering method to the DSD measurements in Metro Manila during the Southwest monsoon period. Observations show that higher values of Z_H, Z_{DR}, and K_{DP} were observed during convective rainfall, which reflects the higher mass higher mass-weighted mean diameter (D_m), liquid water content (LWC), rain rate (R), and total drop concentration (N_t) of convective DSDs. This study was also able to produce dual-polarimetric relations for quantitative precipitation estimation (QPE) in different radar frequencies using a threshold-based algorithm derived from Tropical Ocean DSDs. Evaluation of the performance of the QPE relations with respect to C-band radar shows that R (K_{DP} , Z_{DR}) statistically outperformed all QPE relations including the conventional Marshall & Palmer relation $R(Z_{MP})$ for both stratiform and convective rainfall. These results show that the T-matrix scattering method is an effective tool in simulating dual-polarimetric variables and the relatively good performance of Z_{DR} and K_{DP} as rainfall estimators can be attributed to their lesser sensitivity to DSD variation compared to Z_H. The results presented in this study can provide possible improvements in the general rainfall retrieval operations of the country's dual-polarimetric radar networks.

Keywords: Dual-polarimetric radar, Disdrometer, Raindrop size distribution, QPE

Simulating the ash transport and deposition of the Taal 2020 eruption in Metro Manila

Gerry Bagtasa[a], Melliza Templonuevo Cruz[a,b], James Bernard Simpas[b,c], Robert Holz[d], Chung-Shin Yuan[e]

[a]*Institute of Environmental Science and Meteorology, University of the Philippines, Diliman, Quezon City,*
[b]*Manila Observatory, Quezon City*
[c]*Department of Physics, School of Science and Engineering, Ateneo de Manila University, Quezon City*
[d]*Space Science and Engineering Center, University of Wisconsin–Madison, Madison, WI, USA*
[e]*Institute of Environmental Engineering, National Sun Yat-Sen University, Kaoshiung, Taiwan*

Corresponding author's email address: Gerry Bagtasa – gbagtasa@iesm.upd.edu.ph

On January 12, 2020, the Taal volcano - one of the Sixteen Decade Volcanoes identified by the International Association of Volcanology and Chemistry of the Earth's Interior due to its history of large eruptions and its proximity to populated centers, eruption caused much concern in Metro Manila as visible tephra deposits were observed the day after. Despite the ashfall event, there was only a slight increase (8%) in $PM_{2.5}$ concentration and its components related to basaltic ash as observed in Metro Manila. The low $PM_{2.5}$ concentration was mainly due to the inhibited intrusion of ash into the stable nocturnal boundary layer as revealed by lidar observation and simulation results. The visible tephra deposits are likely due to the gravitational instabilities induced by density stratification in the main northeastward plume of Taal, resulting in ash aggregation that led to the distal fallout over Metro Manila. Simulation by the Weather Research and Forecasting (WRF) Chemistry (Chem) model with 10-ash size bin showed plume distribution, as well as tephra deposition, to be consistent with the isopach map estimated by Balangue-Tarriela et al. (2022) from crowed-sourced data. In addition, the detection of lightning in the plume and its umbrella region showed size segregation of ash particles that was well simulated in the WRF-Chem model. The WRF-Chem model was able to capture the distribution of both tephra advection and fallout, a first for Taal volcano, making it possible for use in the future ashfall forecasting.

Keywords: Metro Manila, particulate matter, Taal volcano, WRF model

Effect of assimilating conventional observations and radio occultation data on forecasting enhanced southwest monsoon rainfall over the Philippines

Gabriel Miro[1]*, Michael Simora[1], Heinritz Majella Miguel[1], Xander Andre Magtibay[1], and Louie Jane Taguinod[1]

[1] *Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), Quezon City, Philippines*

Corresponding author's email address: gabriel.miro@pagasa.dost.gov.ph

The western section of the Philippines experienced heavy rainfall last July 2021 when Typhoon In-fa caused a remote tropical cyclone (TC) effect which enhanced the southwest monsoon. This study investigates the effect of assimilating conventional surface and upper-air observations, and Global Positioning System Radio Occultation data (GPSRO) under the Weather Research and Forecasting Data Assimilation (WRFDA) three-dimensional variational (3DVAR) system utilizing a partial cycling approach with an assimilation window of six hours with three-hourly DA cycles. The resulting analysis fields are verified against the European Centre for Medium-Range Weather Forecasts (ECWMF) Reanalysis Version 5 (ERA5) data, while the rainfall forecasts are verified against satellite-derived estimates from the Integrated Multi-satellitE Retrievals for Global Precipitation Measurement (IMERG). The DA system is able to provide analysis fields that correspond better to observations compared to the background model fields. By assimilating GPSRO data, temperature and moisture fields can be updated over the ocean part of the model domain, where conventional observations are sparse. Verification against the reanalysis wind field shows weaker zonal wind speeds in the DA analysis fields compared to the control (no DA) analysis fields. This is due to the weaker wind speeds in the observations assimilated by the DA system. The DA system was also able to improve the negative bias in the near-surface moisture field in the analysis, resulting in generally reduced rainfall forecast errors compared to the control runs. Apparent improvement is also observed for the first few forecast hours, thus reducing the model spin-up effects.

Keywords: WRF, 3DVAR, data assimilation

A Multi-year Study of the Planetary Boundary Layer Height in Quezon City and its Relation to Particulate Matter Concentration

Munir Baldomero[1]*, Mylene Cayetano[2], Gerry Bagtasa[2] and Marcelino Villafuerte II[1]

[1]*Department of Science and Technology - Philippine Atmospheric Geophysical and Astronomical Services Administration, BIR Road, Central, Quezon City*
[2]*Institute of Environmental Science and Meteorology, College of Science, University of the Philippines, Diliman, Quezon City*

Corresponding author's email address*: mjbaldomero@alum.up.edu.ph*

One important parameter for air pollution research is the planetary boundary layer height (PBLH). It determines the air volume for aerosol dispersion and transport as well as how the atmosphere interacts with the underlying surface. The PBLH is examined in this study along with the particulate matter (PM) concentration over Quezon City. Using a technique based on the median of the maximum range adjusted sound-to-noise ratio (SnR) and maximum gradient potential temperature method, five-year PBLH were retrieved from the PAGASA wind profiler and radiosonde data. Using the data from the observations and the Weather Research and Forecasting (WRF) atmospheric model, spatiotemporal analysis was carried out from January to December 2015. Findings were compared to particulate matter measurements from the Institute of Environmental Science and Meteorology in 2014 and the Lung Center of the Philippines in 2015. The findings showed that radiosonde and wind profiler PBLH reacts to diurnal and seasonal change. The PBLH peaks for the wind profiler at 1000 PST (2308.7 m), and it reaches its lowest position at 0600 PST (1512.6). The PBLH typically reaches its maximum height in June (2648.3 m) and its lowest point in December (1072.7 m). WRF simulations exhibit behavior that is consistent with the observation, and it is dependent on seasonality and topographic features. Due to mechanical turbulence caused by moderate wind speed (5 ms-1 to 10 ms-1), considerable PBLH was seen over the Tanay mountain terrains during the northeast monsoon. For the remainder of the year, thermal convection rules over Metro Manila and the rest of Rizal's flat terrains. Fine particle counts (R = -0.42), $PM_{2.5}$ (R = -0.65), and PM_{10} (R = -0.65) were observed to moderately correlate with PBLH. This study provides more information on how PBLH impacts air quality and supports the link between meteorology and air quality.

Keywords: PBLH, wind profiler, radiosonde, particulate matter, air pollution

Operational training framework for meteorological and hydrological services

Michael S. Bala[1], John Carlo R. Lambrento[1*], and Lory Jean L. Canillo[1]

[1]*Department of Science and Technology - Philippine Atmospheric, Geophysical and Astronomical Services Administration (DOST-PAGASA)*

Corresponding author's email address: jcarlolambrento@gmail.com

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), aside from its mandate of delivering DRR/warning on meteorological and hydrological hazards to the country, is also recognized as a Regional Training Center of the World Meteorological Organization (WMO). The role entails the agency to provide unhindered capacity-building activities for its employees and other WMO member countries through operational training interventions. Here, we highlight the operational training strategy which is employed by the agency to meet the high demands and standards of PAGASA's technical workforce. Furthermore, key improvements in operational training technical infrastructure and mode of delivery utilized over the recent years are also presented, most notably the development of the Unified Learning and Advancement Platform. Lastly, the presentation discusses the impacts of the recent improvements in our training courses and the level of acceptability of our participants to the aforementioned improvements.

Keywords: operational training, online training, LMS, meteorology, human resource capacity building

Response of the Ionospheric Total Electron Content during St. Patrick's Day Geomagnetic Storm in 2015 over the Philippine–Taiwan Region

Merlin M. Mendoza[1], Ernest P. Macalalad[2]*

[1] *Department of Space Science and Engineering, National Central University, Taoyuan City, 320, Taiwan*
[2] *Department of Physics, Mapúa University, Manila, 1003*

Corresponding author's email address*: epmacalalad@mapua.edu.ph*

The ionospheric total electron content (TEC) response during St. Patrick's Day geomagnetic storm of 2015 (max Kp = 8) is an interest of study in the field of space weather since it is the strongest geomagnetic storm of Solar Cycle 24. The cause of this storm is a coronal mass ejection (CME) from the Sun on March 15, 2015 recorded by SOHO/LASCO and arrived at ~05:00 UT March 17, 2015. The CME speed is estimated at ~668 km/s. At the initial phase of the storm, the disturbance storm time (Dst) index rose from 15 nanoteslas nT at 03:21 UT to 56 nT at 05:31 UT. The main phase of the storm caused the Dst index to drop to minimum value of –223 nT from 05:31 UT to 22:33 UT of March 17, 2015. The recovery phase follows at 23:33 UT of March 17, 2015 and lasted until March 19, 2015. TEC enhancements of ~30 TECU and ~90 TECU was observed by Nava et. al at the American sector and by Ray et. al at the Indian sector respectively. In the Philippine – Taiwan sector, TEC during the main phase was enhanced by ~25 TECU on 10 GNSS receiver stationsand was depleted afterwards with a maximum depletion of ~33 TECU on PBAS. The recovery phase shown a TEC depletion on all stations for the whole day. The minimum dTEC (differential TEC) is observed at PBAS and the maximum percent depletion is observed at TWTF during the early hours of photoionization. Another study using GNSS data from an Asian sector at Macau, China showed a significant TEC decrease of 70 TECU, about 70% decrease compared to the quiet time, during March 18, 2015. Results from this study verified that GNSS TEC measurements along Asian sectors dropped significantly during St. Patrick's geomagnetic storm.

Keywords: GNSS, total electron content, coronal mass ejection, ionosphere

Spectral, Temporal, and Spatial Analysis of Low-Latitude Ionospheric Plasma Irregularities using GNSS/GPS and GNU-Radio Beacon Receivers over the Philippine Sector

Kyle Ezekiel S. Juadines, Ernest P. Macalalad*

Department of Physics, Mapúa University, Manila, 1003, Philippines

Corresponding author's email address*: epmacalalad@mapua.edu.ph*

Ionospheric plasma irregularity is known to cause disturbance on radio wave signals passing through the ionosphere, causing signals to experience rapid temporal fluctuations in their amplitude and or phase. These irregularities lead to a phenomenon called scintillation. Scintillation has been studied for years by different researchers, developing various methods and tools to observe and study this phenomenon; however, some data used are not accessible to most researchers. This study used six GNSS stations that operate in the L-band frequency and two GRBR stations that operate in the UHF/VHF from December 2015 to December 2016 in the Philippine sector. This paper used RoTI, the alternative ionospheric scintillation index (S4p-1 and S4p-2) for 1Hz GNSS receivers derived from the C/No data of the GPS satellites, the conventional scintillation index (S4) for GRBR receivers, and the ionospheric pierce points (IPP) while relating to some space weather parameters. These observed scintillation events were high during equinoctial months and low to none during solstitial months. Additionally, stations near the geomagnetic equator exhibited had higher occurrence rates than stations away. The alternative S4p-1 and S4p-2 showed a very high correlation with RoTI during strong scintillation events. Intense scintillation events affected frequencies from the L-band down to the UHF/VHF bands and exhibited disturbed lower frequencies than higher frequencies. Lastly, enhanced geomagnetic storms tend to suppress the formation of ionospheric irregularities during post-sunset hours, which could disrupt GPS signals. However, this does not guarantee to suppress other irregularities such as the ESF when its scale exceeds 500m. No scintillation was seen on GNSS stations but seen on GRBR stations.

Keywords: ionosphere; total electron content; ionospheric irregularities; ionospheric scintillation

Two-Dimensional Mapping of Ionospheric Total Electron Content over the Philippines using Kriging Interpolation

Vincent Louie L. Maglambayan, Ernest P. Macalalad *
Department of Physics, Mapúa University, Manila, 1003, Philippines

Corresponding author's email address*: epmacalalad@mapua.edu.ph*

Monitoring of ionospheric total electron content (TEC) was made possible with the help of satellite data, albeit in one dimension. However, ionospheric TEC maps can be produced from a collection of one-dimensional satellite data over a geographic area. Multiple mapping methods have been recognized; however, this study tried to test one of those methods: kriging interpolation. An algorithm was developed and used to reconstruct GIMs. The optimum number of stations and the semivariogram model were evaluated using GIM maps modeling 12 days of March 2015, accounting for different ionospheric conditions. This includes days of high scintillation and an ionospheric storm due to the St. Patrick's Day geomagnetic storm of 2015. It was found that 12 stations and the linear semivariogram model had the least mean error in 5 days and had the least standard deviation in 7 days, making it the optimum parameter set. This optimum set was then used to map and analyze the ionosphere using actual satellite data from the Philippine Active Geodetic Network (PAGeNet). From this, it was observed that there is a north–south gradient in VTEC in the region during the day. The VTEC in the north reaches more than 100 TECU, and, in the south, generally around 60–90 TECU depending on the ionospheric condition. VTEC was at a minimum during the night when the VTEC level decreases to around 10 TECU.

Keywords: ionosphere; total electron content; kriging

Poster Session

Evaluation of Multi-Week Grand-Ensemble Probabilistic Tropical Cyclone Forecasts in the Philippines

Joanne Mae B. Adelino*[1], Maria Czarina M. Tierra[1], and Marcelino Q. Villafuerte II[1]
[1]*Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA), Quezon City*
Corresponding author's email address: joannemaeadelino@gmail.com

Forecasting tropical cyclones (TCs) beyond the conventional timescales is now possible since most global ensemble prediction systems have lead times extended up to one month. With this, the study aims to produce multi-model grand-ensemble TC strike probability forecasts over the Tropical Cyclone Information Domain (TCID) with a 4-week lead time by combining the outputs of the models, namely: NCEP Coupled Forecast System version 2 (CFSv2), European Centre for Medium-Range Weather Forecasts Ensemble Prediction System (ECMWF), and NCEP Global Ensemble Forecast System version 12 (GEFSv12), which are downloaded from Taiwan's Central Weather Bureau (CWB) TC tracker. The resulting forecasts within the analysis period of 06 October 2020 – 31 October 2022 were then evaluated against the best-track data from the Joint Typhoon Warning Center (JTWC). The Relative Operating Characteristic (ROC) curves of the forecasts have shown that the probabilistic forecasts can distinguish between TC and non-TC occurrences, especially Week-1 forecasts. It has also been demonstrated that forecasts with shorter lead times, such as Week-1 and -2 forecasts, are reliable and can be used for decision-making for disaster-preparation measures. TC activity forecasts, such as tropical cyclone frequency (TCF) and accumulated cyclone energy (ACE), within the TCID, were also produced by clustering the tracks of the multi-model grand ensemble using the Spatial-Temporal Density-Based Spatial Clustering of Applications with Noise (ST-DBSCAN) algorithm. Evaluation has shown that the TCF and ACE forecasts are overestimated, which may have been caused by the overestimation of TC clusters. Overall, the probabilistic forecasts produced have demonstrated notable skill in predicting TC formation within the TCID of the Philippines and could be operationalized later on at longer Sub-seasonal-to-Seasonal (S2S) timescales. The probabilistic forecasts can also serve as a guide to determine how probable the detected TCs in the TCF forecasts are to occur.

Keywords: ensemble prediction systems, tropical cyclone strike probability forecasts, sub-seasonal-to-seasonal (S2S), Density-Based Spatial Clustering of Applications with Noise (DBSCAN)

Observational analysis of the variation and reliable period of tropical cyclone data between PAGASA and IBTrACS in the Philippine Area of Responsibility

Adrian Gelo Tianchon[1] and Joseph Basconcillo[1,*]
[1]*Philippine Atmospheric, Geophysical and Astronomical Services Administration, Department of Science and Technology, Quezon City 1100*
Corresponding author's email address: josephbasconcillo15@gmail.com

The Philippines, being situated at the Western North Pacific (WNP) basin, is an alley of tropical cyclones (TCs) that form in the said region. Annually, about 20 TCs enter the Philippine Area of Responsibility (PAR). However, responsible agencies in the WNP differ in TC records due to their varying criteria for TC classification and the data reliability during the pre-satellite period. Identifying weak TCs as a Tropical Depression or Tropical Storm was also a dilemma in earlier records but over time, the development and the use of satellites in TC observation has improved the data accuracy and reliability. The primary goal of this study is to analyze the variation of TC frequency data from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and the International Best Track Archive for Climate Stewardship (IBTrACS) v4 and determine the period of TC data reliability. The timeseries of the annual TC frequency data during 1960-2021 from PAGASA and IBTrACS were transformed and subsequently compared using statistical reliability analysis. Computing the running Cohen's d of the two TC datasets revealed that their effect size or measure of similarity/dissimilarity is large before 1975 which can be attributed to the pre-satellite period while it became relatively stable at a small Cohen's d value of 0.1-0.5 since 1975, which indicates that the difference of TC data from the two sources becomes statistically similar and reliable. Determining the reliable data period could help in further studies on long-term analysis of TC pattern and climate variability.

Keywords: tropical cyclone, Philippine Area of Responsibility, frequency, reliability, variation

Seasonal and intraseasonal variability of tropical cyclones in the Philippines

Sandra Julkanain[1,*] and Joseph Basconcillo[1]

[1]*Philippine Atmospheric, Geophysical and Astronomical Services Administration, Department of Science and Technology, Quezon City, Philippines*

Corresponding author's email address: josephbasconcillo15@gmail.com

To alleviate the potential impacts of tropical cyclones (TCs), empirical understanding of its nature, causes of variations, and relationship to climate variability and change is essential. Each year, billions of people around the world were threatened by TCs, especially those from coastal areas. The Philippines is one of these areas located in the Western North Pacific (WNP) - the most active TC basin worldwide. About 20 TCs each year form in the WNP and are experienced by the Philippines during the entire TC season that runs from June to November (JJASON). In this study, we investigate the intraseasonal variability of TC frequency in JJASON in the Philippine Area of Responsibility (PAR). While studies during the active TC season are more available, existing research on the intraseasonal variability of TCs in the PAR are less understood. Here we analyze and compare the variability of TC frequency between the boreal summer during June to August, (JJA) and the boreal autumn during September to November, (SON). Using the Cohen's d, which is a statistical measure of similarity/dissimilarity between two datasets, results show that the Cohen's d between JJA and SON TC frequency shows small effect size of dissimilarity by 0.28. This means that there is no considerable statistical difference in the timeseries of TC frequency in JJA and SON, respectively. However, we also show that there is no significant correlation between the TC frequency in JJA and SON ($r = 0.185$, $p = 0.167$). This further implies that there is a considerable intraseasonal variability of TC frequency within the active TC season in the PAR, which could ultimately assist in disaster risk reduction and mitigation.

Keywords: tropical cyclones, seasonal variability, intraseasonal variability, Philippines

Assessment on the capability of Convection (CI2) and Circulation Indices (WSI2, SSI2) in characterizing and monitoring the Philippine Southwest Monsoon using HIRS-OLR and ERA5-Wind datasets

Raymond Jess Goliat[1,*], Kimberly Manauis[1], Nathaniel Servando[1], and Lorenzo Moron[1]

[1]*Department of Science and Technology - Philippine Atmospheric, Geophysical, and Astronomical Services Administration , Science Garden Complex, Quezon City, 1100, Philippines*

Corresponding author's email address: rggoliat@up.edu.ph

The southwest monsoon (SWM) season affects mainly the western portion of the Philippines. It is associated with heavy rainfall events brought by moisture bearing winds from the southwest, which supplies the precipitation. The amount of rainfall that occurs over the western Philippines varies with respect to the corresponding characteristics of these prevailing winds. This study assessed the ability of existing global monsoon indices (GMIs) in characterizing the rainfall events during SWM and examined the potential of localizing the said indices using High-resolution Infrared Radiation Sounder (HIRS) and European Center Medium-Range Weather Forecast (ECMWF) Reanalysis Version 5 (ERA5) datasets. Outgoing longwave radiation (OLR) from HIRS was utilized as a proxy for convective activities to produce a convection index (CI2), while wind components (U, V) at 850hPa and 200hPa from ERA5 were utilized to capture wind circulation and derive westerly shear index (WSI2) and southerly shear index (SSI2) in pentads (5-day) during June to September (SWM season) from 2001 to 2020. In general, western Philippines experiences most rainfall events during SWM season varying in three different domains. Derived convection and circulation indices were evaluated with gridded rainfall anomalies over the same period and showed areas of significant ($p<0.05$) correlation reaching -0.66 and 0.68, respectively, mostly over the western Luzon. GMIs were localized for the Philippines by computing individual indices using the said regions and the validation of these indices with rainfall anomalies showed correlations ranging from -0.75 to -0.80 at 95% level of significance over each domain. In general, the results of the study indicated the capability of the localized convection and circulation indices in quantifying the SWM rainfall events. This can be beneficial in monitoring SWM events particularly on issuing advisories and early warning information on the impacts of monsoons.

Keywords: monsoon index, southwest monsoon, western Philippines, rainfall anomaly

Development of Z-R relationship for Radar Stations in the Philippines using the traditional matching method

Lester Kim M. Lagrimas[1], Pin-Fang Lin[2], Alyssa Dawn Castillo[1,4,*], Noel R. Bangquiao[1], John Grender C. Almario[1], Lorenzo A. Moron[1], Ben Jong-Dao Jou[3], Esperanza O. Cayanan[1]

[1]Philippine Atmospheric, Geophysical, and Astronomical Services Administration, PAGASA Science Garden Complex, BIR Road, Barangay Central, Quezon City, Metro Manila 1100, Philippines

[2]Central Weather Bureau, No. 64, Gongyuan Road, Zhongzheng Dist., Taipei City 10048, Taiwan

[3]National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Da'an Dist., Taipei City 10617, Taiwan

[4]University of the Philippines - Institute of Environmental Science & Meteorology, Diliman Quezon City

Corresponding author's email address: admcastillo7@gmail.com

The relationship between radar reflectivity and rain rate is widely used for effective rainfall estimation. The Marshall-Palmer (MP) relationship ($Z=200R^{1.6}$) has been utilized for precipitation estimation in the Philippines. However, there is no universal Z-R relationship that can be applied to all rainfall fields in a specific region because of the variability in drop size distribution. A new Z-R Relationship is sought to be introduced and adopted which will be suitable for the radar stations in the Philippines. Using the optimization approach, the measured radar reflectivity and rain gauge rainfall were matched using Traditional Matching Method (TMM). The reflectivity data used between June and December 2018 at the Subic radar, paired with the five (5) rain gauges within the fifty (50) km radius of the Subic radar of the same periods were used. A newly derived Z-R relationship (SUBI) in the form $Z = 409.78R^{1.21}$ was tested for its performance from June to December 2019 and it outperformed MP at higher rain rate. SUBI was used for Baguio Radar Quantitative Precipitation Estimation (QPE) from June to December 2019, a single polarization radar, located at the same climate classification type as Subic Radar. SUBI still outperform MP at higher rainfall rate. SUBI shows better performance at higher rainfall rate than MP.

Keywords: Radar, TMM, Z-R Relationship and Radar QPE

Deep Convolution General Adversarial Network for Multivariate Time-series air quality data of India, Malaysia and the Philippines

Jintu Borah[1], Mohd. Shahrul Mohd Nadzir[2], Mylene G. Cayetano[3]*, Shubhankar Majumdar[1]*

[1] *Department of Electronics & Communications Engineering, National Institute of Technology Meghalaya, Shillong, India*

[2] *Department of Earth Sciences and Engineering, University Kebangsan Malaysia*

[3]*Institute of Environmental Science and Meteorology, College of Science, University of the Philippines, Diliman, Quezon City*

Corresponding author's email address: shub@nitm.ac.in and mcayetano@iesm.upd.edu.ph

The detrimental effects on human health caused by air pollution have made the prediction of air quality a step of the utmost significance. The application of artificial intelligence is seen as promising. However, the challenges in the application of machine learning and deep learning algorithms in regression problems make testing these models necessary. The prediction accuracy of state-of the-art models varies with different pollutants and is acceptable for certain pollutants only. This work is focused on multidimensional time series prediction using the Deep Convolution Generative Adversarial Network (DCGAN). The proposed methodology illustrates the reliability of the architecture with "rolling window" approach for long-term prediction. The model is evaluated by comparison with traditional Machine Learning (ML) and state-of-art Deep Learning (DL) models such as gated recurrent units (GRU), convolutional neural networks (CNN) and long short term memory networks (LSTM). The R2 score of the model is found to be 0.99 with a train to test ratio of 4:1. The model is tested for PM10, PM2.5, NO. NO2, CO and O3. We've encountered challenges in correlational probabilistic statistical significance leading to unreliable observation when using ML approach. The DCGAN on the other hand, overcomes and outperforms the GRU, CNN and LSTM techniques at R2 score of 0.996978. Despite the minor difference in the metrics, long term prediction failure is a potential threat as the accumulation of variance problem.

Keywords: Airboxsense, AISTIC, machine learning, air pollution forecasting, criteria pollutants

Diurnal and Seasonal Analysis of Heat Index in Bicol Region

Vince Jay Seda[1,*], John Benedict Bendiola[1], Bianca Zara Mujar[1] , Larry Ger Aragon[1,a,b], John Ruel Locaba[1], Karen Conda-Botin[1], Jo-ann Cordovilla[1], Raymond Ordinario[2], Julie Mae Dado[3]

[1]*Physics Department, College of Science, Bicol University, Legazpi, Albay, Philippines*

[2]*Department of Science and Technology-Philippine Atmospheric Geophysical and Astronomical Services Administration (DOST-PAGASA), Quezon City, Philippines*

[3]*Regional Climate Systems Laboratory, Manila Observatory, Ateneo de Manila University, Quezon City, Philippines*

[a]*now at: School of Geography, Earth and Atmospheric Sciences, The University of Melbourne, Melbourne, Victoria, Australia*

[b]*now at: Australian Research Council Centre of Excellence for Climate Extremes, Melbourne, Victoria, Australia*

Corresponding author's email address: vincejaysatuito.seda@bicol-u.edu.ph

Extreme heat events have become more frequent in recent decades due to climate change, posing various health risks due to heat stress among individuals. In the Philippines, studies on heat stress are very limited, especially outside the country's metropolitan cities. Focusing on the Bicol Region, this study provides a climatological analysis of the Heat Index (HI), a heat stress indicator developed by the U.S. National Weather Service and adopted in the heat warning system in the Philippines. The seasonality, diurnal characteristics, and climatological trends of HI were analyzed using synoptic station observations and bias-corrected reanalysis dataset over the region for the periods 1951-2020. The highest monthly HI values above the Extreme Caution (32-41°C) level coincided with the warmest months of March-April-May across the synoptic stations. Such a warning level persisted until September, highlighting the contribution of humidity in increasing the HI values across the region during the transition of warm easterlies in May to moist southwesterlies from June to September. The annual average HI and sustained daily HI values above the Extreme Caution level are significantly increasing in urbanized areas of Daet (0.44°C/decade) and Legazpi (0.46°C/decade). The ERA5-Land dataset correlated well with observation data, and a simple linear regression equation was sufficient to improve the underestimated HI values of ERA5-Land. Majority of municipalities have daily HI values exceeding the Extreme Caution level from March until November in the recent decades. Daytime HI can reach 6-7°C higher compared to ambient air temperature, particularly during June-July-August months. Nighttime HI under Safe (<27°C) levels are also significantly decreasing throughout the region, indicating a reduced recovery period from daytime heat stress.

Keywords: Heat Index, seasonal analysis, diurnal analysis, trends, Bicol

ClimGridPh-Tx: The High-Resolution Gridded Dataset of Daily Maximum Air Temperature in the Philippines

Guile G. Saligo[1*], Michel G. Acosta, Ma. Czarina M. Tierra[1], Loren Joy D. Estrebillo[1] and Marcelino Q. Villafuerte II[1]

[1]*Philippine Atmospheric, Geophysical and Astronomical Services Administration, Department of Science and Technology, Quezon City, Philippines*
Corresponding author's email address: guilesaligo@gmail.com

The Philippines' susceptibility to disaster risk, exacerbated by global warming, necessitates a finer and accurate observation-based dataset to enable a more localized analysis of the temperature trends and extremes. This study introduces the newly developed high-resolution (0.01° × 0.01°) gridded dataset of daily maximum air temperature (Tx) in the Philippines, called the ClimGridPh-Tx. This dataset was created by merging the daily in-situ observations from the 47 synoptic stations of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) data with the fifth-generation and state-of-the-art reanalysis data (ERA5) of the European Center for Medium-range Weather Forecasting (ECMWF), covering the period from 1991 to 2020. Various methods of data merging and interpolation techniques were tested and eventually identified using the rigorous leave-one-out cross-validation (LOOCV) that the Simple Bias Adjustment (SBA) and Modified Shepard (SH) techniques are the best in capturing the country's maximum air temperatures. The ClimGridPh-Tx was validated using data from 32 independent stations (8 synoptic and 24 agrometeorological stations) and performed better than other gridded products in capturing the maximum air temperatures in the country. In the future, gridded datasets for mean and minimum temperatures will be developed using the same methods. These novel Philippine-based datasets will then support various climate-related research and applications.

Keywords: gridded temperature data, data merging, interpolation, the Philippines

Analysis of Particulate Matter Concentration in the City of Batac, Ilocos Norte

Angelo Benedict R. Ragunjan*[1], Shubhankar Majumdar[2], Mohd. Shahrul Mohd Nadzir[3], Mylene G. Cayetano[4], Maureen Sabit[5], Rochelle Paa[1]

[1] Mariano Marcos State University, City of Batac, Ilocos Norte

[2] Department of Electronics & Communications Engineering, National Institute of Technology Meghalaya, Shillong, India

[3] Department of Earth Sciences and Engineering, University Kebangsan Malaysia

[4] Institute of Environmental Science and Meteorology, College of Science, University of the Philippines, Diliman, Quezon City

[5] College of Science, University of Sto. Tomas

Corresponding author's email address: arragunjan@mmsu.edu.ph

Increasing greenhouse gases and particulate matter has been increasing due to the increasing emissions. This study focused on the analysis of the diurnal cycle of Particulate Matter (PM10 and PM2.5) in the Mariano Marcos State University, City of Batac, Ilocos Norte. The influence of temperature and relative humidity was also examined in this study. An AirboxSense was used to measure PM concentration which is installed at the National Bioenergy Research and Innovation Center (NBERIC) of Mariano Marcos State University (MMSU). The AirboxSense also measured other gas concentrations – nitrogen dioxide (NO2), ozone (O3), carbon monoxide (CO), and sulfur dioxide (SO2) - and meteorological variables, temperature, and relative humidity.

The results showed that PM10 and PM 2.5 peak during the morning rush hour (6:00-7:00 am) and afternoon rush hour (6:00 pm) and lowest during noon time (1:00 pm). The diurnal cycle of PM2.5 follows the diurnal cycle of PM10. For CO, the highest concentration occurred during the morning (7:00 am), and an observed increase in concentration during the afternoon (5:00 pm) to nighttime (9:00 pm). For O3, high concentrations occurred late in the morning (10 AM) until afternoon (5 PM) and it decreases afterward. The highest SO2 concentration peaked in the late morning (10 AM to 11 PM) and was lowest during the night to early morning. And for NO2, high concentrations occurred from late morning (11 AM) until the afternoon (5 PM). PM10 and PM2.5 have a positive influence on the NO2 concentration and CO concentration and a negative influence on the SO2 concentration. Furthermore, temperature and relative humidity have different influences on gas concentrations. The temperature has a positive correlation to the concentrations of NO2, O3, and SO2. On the other hand, relative humidity has a negative correlation with the NO2, O3, and SO2 concentrations.

Keywords: Particulate Matter, Air Quality, Ilocos Norte

Temporal Analysis of GNSS-Based Precipitable Water Vapor during Rainy Days over the Philippines from 2015 to 2017

Agana Louisse S. Domingo and Ernest P. Macalalad*

Department of Physics, Mapua University, Manila 1003, Philippines

Corresponding author's email address*: epmacalalad@mapua.edu.ph*

Precipitable water vapor (PWV) is a parameter used to estimate water vapor content in the atmosphere. In this study, estimates of PWV from PIMO, PLEG and PPPC global navigation satellite system (GNSS) stations are evaluated regarding the PWV obtained from its collocated radiosonde (RS) stations. GNSS PWV were highly correlated with RS PWV ($R \sim 0.97$). Mean bias error (MBE) between −0.18 mm and −13.39 mm, and root mean square error (RMSE) between 1.86 mm and 2.29 mm showed a good agreement between GNSS PWV and RS PWV. The variations of PWV are presented. Daily variations of PWV conformed to the daily data of rainfall which agrees to the climate types of Quezon City (Type I), Legaspi (Type II), and Puerto Princesa (Type III) based on the Coronas climate classification. Moreover, PWV monthly variation at all sites is high from May to October (~62 mm) and low from November to April (~57 mm). The relationship between PWV and rainfall at all stations showed positive correlation coefficients between +0.49 to +0.83. Meanwhile, it is observed that when PWV is high (low), its variability is low (high). This study shows the potential of GNSS to study water vapor and its contribution to weather analysis.

Keywords: global navigation satellite system (GNSS); precipitable water vapor (PWV); radiosonde (RS)

Characterizing Storm Surge Attenuation by Mangrove Forests in Gubat, Sorsogon During Typhoon Melor (2015) Using Delft3D Model

James Paul Resco[1], Jose Albert Gois[1,*], Manuel Baranda[1], Joshua Frankie Rayo[3], Jehan Fe Panti[2], Jerome Azul[1], and Vena Pearl Boñgolan[3]

[1]*Department of Physics, Bicol University College of Science, Legazpi City, Albay*

[2] *DOST-PAGASA Science Garden (HTMIRDS Division), Quezon City, Metro Manila*

[3] *Department of Computer Science, University of the Philippines Diliman, Quezon City, Metro Manila*

Corresponding author's email address: josealbertgraspela.gois@bicol-u.edu.ph

The consequences of climate change, manifested by sea level rise and rapid typhoon intensification, can exacerbate the impact of storm surges. Ecosystems such as mangrove forests are deemed significant for natural coastal protection, since they stabilize shorelines and mitigate the devastating impact of storm surges. This study used the Delft3D FLOW and WAVE coupled model to simulate typhoon-induced waves along the coasts of Gubat, Sorsogon, and characterize the storm surge wave attenuation by the mangrove forests during Typhoon Melor in 2015. The model was set up with topography, bathymetry, and land cover represented by Manning's n as inputs, while the typhoon profile was forced using Holland's parametric wind model. The mangrove forests were able to attenuate waves at rates of 0.42 to 0.83 m/km, as well as reduce the inundation extent. When the mangrove forest area coverage was hypothetically reduced, wave heights increased by up to 5%. The simulated peak water levels were comparable with the observed high water marks, with good correlation (r = 0.64), 0.85 m RMSE and 0.70 m mean absolute error. There is an overestimation of wind speed and air pressure at the synoptic observation station, but with high correlation values of 0.86 and 0.95, respectively. Overall, the Delft3D model was successful in recreating typhoon winds and storm surge scenarios on the study site, incorporating mangrove forest cover. Better law enforcement is necessary to protect and rehabilitate the mangrove sites, emphasizing their capacity for storm surge wave attenuation.

Keywords: storm surge, mangrove forest, Delft3D model, wave attenuation, forest extent

Mathematical modeling of solar panel generation using meteorological data

Lea Angela Saure[1*], Joshua Quides[1], Raymond Ordinario[1, 2], and Rhenish Simon[3]

[1]*Department of Physical Sciences, College of Science, Polytechnic University of the Philippines, Sta. Mesa, Manila, 1016, Philippines*

[2]*Weather Division, Philippine Atmospheric, Geophysical and Astronomical Services Administration, Quezon City, Metro Manila, 1100, Philippines*

[3]*Physics Department, College of Science, De La Salle University, Taft Avenue, Manila, 1004, Philippines*

Corresponding author's email address: lamsaure@iskolarngbayan.pup.edu.ph

Solar is a promising source of clean energy, but its generation through Solar Photovoltaic (PV) cells is sensitive to changing weather conditions. Creating a model can aid in optimizing the use of Solar technology in the Philippines. In this study, the variability of the energy generated by the Solar PV Panel is associated with the meteorological parameter using a Principal Component Regression (PCR) model. From preliminary calculations, we determined the parameters with the most effect on Solar energy generation, the parameters are Maximum Temperature, Relative Humidity, Mean Temperature, and Cloud Opacity. These are the features used to generate the PCR Model. The results suggest that the model accounts for 52.79% of the variation in the dataset. In addition, Maximum and Mean temperature shows positive correlation with Solar PV generation while relative humidity and cloud opacity shows negative correlation.

Keywords: Solar Photovoltaic Cells, Data Analytics, Meteorological Parameters

Environmental Conditions and Internal Dynamical Processes during the Rapid Intensification of Super Typhoon Goni (2020). Part I: Environmental Conditions

Earl Jeffrey Dineros[1*], Henric Jandoc[1], Jan Mark Diesta[1], Chian-Yi Liu[2], and Jason Punay[1]

[1]*Deparment of Physics, College of Science, Bicol University, Legazpi City, Albay, Philippines*

[2]*Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan*

Corresponding author's email address: earljeffreyboras.dineros@bicol-u.edu.ph

Considering the importance of internal dynamical processes in the variability of intensification, it is crucial to explore the environmental factors that create favorable circumstances for a tropical cyclone (TC) to intensify. The study used gridded model, satellite, and TC track data to characterize the various environmental conditions of Super Typhoon Goni (2020), the most intense landfalling TC in recorded history. By analyzing the mean and radial distributions, Goni was found to intensify over warm (> 29 °C) and anomalous (> 0.7 °C) sea surface temperatures with high moisture content (> 70%) and low vertical wind shear (deep-layer shear > 10 m/s, low-level shear > 2.5 m/s) within its vicinity. On the other hand, the weakening of Goni may have been influenced by a dry air intrusion and increasing vertical wind shear during the late stages. Lastly, outflow was efficient, and an upper-level warm core was likely induced by the presence of an inflow layer in the lower stratosphere which may have encouraged further intensification of Goni during the late stages. The findings of this study can be utilized to identify critical environmental factors that may encourage the intensification of extremely intense TCs.

Keywords: rapid intensification, tropical cyclone, environmental conditions, reanalysis

Environmental Conditions and Internal Dynamical Processes during the Rapid Intensification of Super Typhoon Goni (2020). Part II: Internal Dynamics

Henric Jandoc[1,*], Earl Jeffrey Dineros[1], Jan Mark Diesta[1], Chian-Yi Liu[2], and Jason Punay[1]

[1]*Department of Physics, College of Science, Bicol University, Legazpi City, Albay, Philippines*

[2]*Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan*

Corresponding author's email address: henricrosas.jandoc@bicol-u.edu.ph

Given that large-scale environmental conditions are insufficient to explain the variability of tropical cyclone (TC) rapid intensification (RI), it is necessary to investigate storm-scale internal dynamical factors linked to precipitation, convection, latent heating, and wind structure. Using a gridded model, satellite, and best track data, the selected internal dynamics of Super Typhoon Goni (2020), one of the most intense TCs on record, were explored in this study. Evaluation of the radial distributions of different internal dynamics with respect to TC intensity and intensification revealed that Goni, as a rapidly intensifying tropical depression (TD), had more deep convective clouds that were associated with colder temperatures and heavier rain rates. In addition, Goni maintained an efficient latent heating through deposition and condensation processes at the middle and upper tropospheric levels, with deposition generally dominating during TD stage and RI category. Furthermore, latent heating at the mid to upper levels during the early, non-intensifying stages may have facilitated the subsequent RI. Finally, the wind structure was found to be optimal for the promotion of RI during later stages. Findings from this study can be used to identify the controlling internal dynamics that drive the intensification of extremely intense TCs.

Keywords: rapid intensification, tropical cyclone, cloud microphysics, deep convective clouds, wind structure

Comparison of Land Surface Temperature Before, During, and After the COVID-19 Lockdown: Reduction of Human Activity in Metropolitan Manila

Nero Joaquin P. Rama[1, *] and Henrison C. Sanchez[1]
[1]Department of Engineering Sciences, College of Engineering, Central Luzon State University, Munoz, Nueva Ecija

Corresponding author's email address: rama.nero@clsu2.edu.ph

A strain of coronavirus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) caused a highly contagious respiratory illness named coronavirus disease 2019 (COVID-19), which has disrupted the lives of millions of people since the first quarter of 2020. A person affected by COVID-19 experiences different respiratory symptoms: runny nose, sore throat, cough, and fever. World leaders implemented preventive measures in response to the spread of COVID-19, resulting in a significant reduction in human activities. This study was conducted to examine the effect of reduced anthropogenic activities on land surface temperature (LST) in Metropolitan Manila. LST data were obtained from the Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS), and processed using QGIS 3.22.11 software. Satellite images without significant cloud cover for the year 2020 were compared with the images obtained for the baseline years, 2014 and 2017. Results showed that during the COVID-19 lockdown, the LST in Metro Manila exhibited relatively higher temperatures. After the easement of lockdown, the LST no substantial changes in the region. The results suggested that the lockdown in the region do not have a direct impact on the LST variations and may be affected by other factors aside from the reduced human activity.

Keywords: Land Surface Temperature, Landsat 8, remote sensing, GIS, COVID-19 pandemic

The Analysis of 2016 Drought Incidence in North Cotabato, Philippines

John Ralph F. Bismonte[1*], John Lloyd A. Bremen[1], Threcia Mae C. Spetimo[1], Jerome A. Azul[1]

[1]Department of Physics, Bicol University College of Science, Legazpi City, Albay
Corresponding author's email address: Johnralphfolmonte.bismonte@bicol-u.edu.ph

This study analyzed the occurrence of drought in North Cotabato, Philippines in 2016 through the utilization of four drought indices including the Standardized Precipitation Index (SPI), Percent of Normal Index (PNI), Modified Normalized Difference Water Index (MNDWI), and Enhanced Vegetation Index (EVI). The precipitation data for SPI and PNI were accumulated from POWER Data Access Viewer and were validated in comparison to the station data from PAGASA situated in the vicinity of North Cotabato using z-test, Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), and Pearson correlation coefficient. In addition, the soil moisture and vegetation data for MNDWI and EVI respectively were acquired from Moderate-resolution Imaging Spectroradiometer (MODIS). The analysis showed ≤ -2.0 SPI value classified as "extremely dry" during January in the southern portion of North Cotabato, due to an 83% reduction in the average precipitation. During January and March, "Extreme drought" with a PNI value <40 was experienced in the northern portions of the province with January (83%) and March (68%) obtaining the highest reduction of precipitation in 2016. Also, a decreasing MNDWI in March and April was illustrated on a provincial scale which can be related to higher initial stored soil water in the previous months. EVI depicts the deterioration of vegetation with a negative difference (≤ -1.00) in the lower outskirts, almost throughout the year.

Keywords: Drought indices, SPI, PNI, MNDWI, EVI

Land Suitability Analysis for Rice Production based on the Spatial Variation of Temperature and Rainfall in Albay, Philippines

Guinina Ericka Pesebre[1*], Shiela Marie Avila[1], Khriscel Tiamson[1], and Jerome Azul[1]
[1]*Department of Physics, Bicol University College of Science, Legazpi City, Albay*

Corresponding author's email address: guininaerickaesperanza.pesebre@bicol-u.edu.ph

A way to improve agricultural production is to identify the ideal land for the growth and development of a specific crop. Rice (*Oryza sativa)* needs to be grown where it is best suited; hence, maps with greater geographical depth and accuracy are needed to determine its suitability. This study assessed the suitable land for rice crops in Albay province's lowland irrigated and rainfed farming ecosystems using a geographic information system (GIS)-based multi-criteria decision approach through analytical hierarchy process (AHP). It focused on making two rice suitability maps with the following criteria: temperature and rainfall for climate; texture, pH, and drainage for soil; and slope for topography. Annual temperature and rainfall satellite data from WorldClim from 1989-2018 were interpolated using ArcGIS software and revealed that the average mean temperature in Albay varies from 25.2-27.2 °C while the total rainfall ranged from 2,750-3,861 millimeters. Furthermore, AHP analysis showed that the edaphic criteria had an 88% influence on suitability mapping for irrigated areas, while the climate criteria only had a 12% influence. For rainfed, the climatic factor has a 75% influence, while the edaphic component only contributed 25%. Based on the results, out of 107,573 hectares of the total lowland area of Albay, 68.81% and 76.24% were classified as generally suitable for rice production, with varying degrees of suitability for irrigated and rainfed, respectively. Farmers and other agricultural stakeholders may use this information to develop a plan to maximize the utilization of the land's potential, as it can still be improved and cultivated.

Keywords: land suitability analysis, geographic information system, multi-criteria decision approach, analytical hierarchy process, WorldClim

Relationship Between Madden-Julian Oscillation (MJO) and Boreal Winter Tropical Cyclone Genesis and Tracks in the Western North Pacific

Jayra Emeryl A. Blanche[1*], Maristalia Hannah N. Magpayo[1],
John Ruel L. Locaba[1], Jim E. Espinola[2], Jerome E. Escarcha[3]
[1]*Department of Physics, College of Science, Bicol University, Legazpi, Albay, Philippines*
[2]*University of the People, Pasadena, California, USA*
[3]*University of the Philippines, Diliman, Quezon City, Metro Manila, Philippines*

Corresponding author's email address: jayraemerylarciga.blanche@bicol-u.edu.ph

This study investigates the frequency of tropical cyclone (TC) genesis on various Madden-Julian Oscillation (MJO) phase pairs and the behavior of TC tracks in relation to MJO categories in the Western North Pacific (WNP) during the boreal winter months of ENSO-neutral years from December 1980 to February 2021. TC genesis frequency was quantified using Daily Genesis Rate (DGR). The results showed that TC genesis in the WNP during boreal winter was enhanced (suppressed) during the active (non-active) MJO phase. A probability density estimate of cyclogenesis location was performed using Kernel Density Estimation (KDE) to identify where the TCs mostly form. An eastward pattern in the cyclogenesis maxima was observed, corresponding to the propagation of MJO in the same direction. It started at 140°E (phases 4+5), peaked at 160°E (phases 6+7), and ended at 180°E (phase 8+1), which is when MJO decay happens over the Central Pacific. With three clusters separating the TC tracks, clustering analysis revealed that cluster 2 had the highest proportion of TCs in both the active and non-active MJO categories. It was also found that landfall activity occurred more frequently in the Philippines during the non-active MJO phase. The results of this study indicated that MJO had a significant impact on tropical cyclone frequency and behavior in the WNP.

Keywords: MJO, boreal winter, tropical cyclone, cyclogenesis, WNP

Society Profile

The **Philippine Meteorological Society (PMS)** is a non-stock, non-profit governmental organization dedicated to the advancement of the atmospheric sciences and related disciplines in the Philippines.

Objectives of the Society

- Formulates, implements and coordinates projects to strengthen education, research and development in the atmospheric and related sciences;
- Establishes linkages with universities/colleges, operational forecast centers/offices, meteorological societies, non-government organizations and the private sector;
- Conducts research and extension services in various sectors impacted by climate change;
- Conducts training, seminars, workshops, symposia, etc. on atmospheric science and related disciplines;
- Publishes and distributes results of research and other scientific information on atmospheric and other related fields;
- Promotes meteorology, hydrology, climatology, agrometeorology, and astronomy as a profession; and
- Administers gifts, grants and donations of cash, property and services that will redound to the benefit of the society.

Society's mission

- To develop and disseminate knowledge of meteorology and related hydrologic sciences (hereinafter referred to as "Meteorology")
- To promote and advance the professional application of Meteorology
- To encourage collaboration amongst Members of the Society, individuals, bodies both corporate and non-corporate who may share the Society's interest in Meteorology
- To promote among the public an understanding of weather and an appreciation of the value of Meteorology and its applications

Society's Structure

The Society's affairs are run by an elected Board of Trustees, within the constraints of the By-laws of the Society. The Society is served by Executive officers composed of a President, a Vice-President, Secretaries, a Treasurer, an Auditor and a Business Manager duly appointed by the Board of Trustees. In addition, the Board of Trustees appointed members to serve certain committees such as the Membership and Awards Committee.

Services Offered by the Society

- Consultancy (weather, climate, hydrology, air pollution and water quality assessment)
- Client-customized weather forecasts and extended outlooks
- Wind and wave forecast
- Capacity building in the mitigation of impacts of extreme weather and climate
- Conducts lectures, seminars and conference on current environmental issues

PMS Significant Milestones

Over the years, PMS conducted several activities to boost meteorology in the country through various trainings, conferences, and competitions, among others in partnership with several institutions, to wit:

- "MET-Innovation" and "MET-Education", conducted under MET4YOU Project for Ilocos Region held at Mariano Marcos State University (MMSU), City of Batac on 18 February 2023.
- "Virtual Research Clinic" for 4th Year BS Meteorology students of the Central Luzon State University (CLSU) on 02 December 2022
- "MET-Innovation" and "MET-Education", conducted under MET4YOU Project for Bicol Region held at Bicol University on 19 November 2022.
- Scientific Session on "Onset of the Southwest Monsoon in the Philippines: An Observational Study" conducted by Dr. Leoncio A. Amadore, in partnership with the National Research Council of the Philippines on 21 June 2022.
- "MET-Kaalaman: Video Contest" and "MET-Olympiad: Battle of the Brains", Competitions undertaken under MET4YOU Project conducted on 25 March 2022.
- 2022 PMS Annual Convention – 24-25 March 2022
  Theme: "Early Action: Responding to Hydrometeorological Challenges under the New Normal"
- 2021 PMS Annual Convention – 20-21 April 2021
  Theme: "Disastrous Hydro-Meteorological Events in the Middle of Pandemic: Challenges, Lessons Learned and Way Forward"

- Signing of the Memorandum of Agreement (MOA) between the Philippine Meteorological Society (PMS) and DOST-Science Education Institute (SEI) on the implementation of the Project "Meteorology for Young Scientists" of MET4YOU: Science, Technology and Innovations" – 14 April 2021
- Webinar on "Meteorology for Science Enthusiasts" – 24 March 2021
  As part of the 156th National and 71st World Meteorological Day Celebration
- Webinar on "Basic Meteorology for Teachers"
  Batch 1: 18 August 2020
  Batch 2: 21 August 2020
- 2020 PMS Annual Convention – 21-23 July 2020
  Theme: "Current Trends, Challenges and Opportunities in Meteorology"
- METeorology for YOUng Scientists (MET4YOU) – 6 March 2020
- 5th Pag-Asa Para sa mga Bata: A blood-letting Activity – 26 June 2019
- IEC to PAGASA Non-Technical Personnel (in line with the celebration of the 2019 Typhoon and Flood Awareness Week) 19 June 2019
- Essay Writing Contest (in line with the celebration of the 2019 Typhoon and Flood Awareness Week) 19 June 2019
- 4th Pag-Asa Para sa mga Bata: A blood-letting Activity – 26 March 2019
- Mangrove Tree Planting – 23 March 2019, Pagbilao Mangrove Experimental Forest, Pagbilao, Quezon
- 2019 PMS Annual Convention – March 20, 2019
  Theme: "Leveling up Meteorological Service to Meet Societal Needs"
- 2018 PMS Annual Convention – March 15, 2018
  Theme: "Recent Advances in Philippine Weather, Climate, and Hydrologic Information
- 12th National Meteorological Hydrological Convention – March 2, 2017
  Theme: "Shaping the Future of Philippine Meteorology and Local Governance"
- 11th National Meteorological Hydrological Convention – February 17-18, 2016
  Theme: "The Role of Meteorology in Disaster Prevention and Mitigation"
- 10th National Meteorological Hydrological Convention – November 19-20, 2014
  Theme: "Extreme Weather and Climate: Impacts and Preparedness"
- 9th National Meteorological Hydrological Convention – February 20-21, 2014
  Theme: "State-of-the-Art Technologies in response to Extreme Weather Climate Events"
- 8th National Meteorological Hydrological Convention – February 21-22, 2013
  Theme: "Today's Meteorologists: Scaling up Effective Early Warning Services (EWS)".
- 7th National Meteorological Hydrological Convention – November 17-18, 2011
  Theme: "Dots, Isobars and Meteograms: Understanding the Science of Meteorology"
- 6th National Meteorological Hydrological Convention - November 18-19, 2010
  Theme: "Adaptation Strategies: Building Blocks for a Climate Change Resilient Phil."

- 5th National Meteorological Hydrological Convention – November 19-20, 2009 Theme: "Understanding the Climate Change Issues: A Key to a better planning and investment." Makati Convention Hall
- 4th National Meteorological Hydrological Convention – November 27-28, 2008 Theme: "Connection and Fusion: Coping with Winds of Change."
- Co-Organized the Symposium titled "Rediscovering Philippine Setting: Meteorology and Mineralization and Tectonics" – October 2-4, 2008
- 3rd National Meteorological Hydrological Convention – March 26-27, 2008 Theme: "Climate Change: Local, Regional and Global Initiatives"
- 2nd National Meteorological Hydrological Convention – November 27-28, 2006 Theme: "Weather Climate and Water Implication to Sustainable Development."
- 1st National Meteorological Hydrological Convention – December 12-13, 2005 Theme: "Towards Understanding Weather, Climate and Consequences to Hydrology for Socio-Economic Development".
- PMS-ADPC National Workshop (May 15, 2003)
- Symposia on Tropical Cyclones in the South China Sea and Western North Pacific Ocean
- Extreme Climate Events (ECE)
- National Symposium on the Application of Weather and Climate information
- "3rd PAG-ASA para sa mga Bata: A Blood Letting Activity" in partnership with Weather Bureau Multipurpose Cooperative (WBMPC) – June 19, 2018
- Information, Education and Communication (IEC) Campaign for PAGASA employees entitled "IEC on PAGASA Products and Services for New PAGASA Personnel" – June 22, 2018

Philippine Meteorological Society
PAGASA Science Garden Complex
Agham Road, Diliman, Quezon City, Philippines 1100

philmetsoc.com

@phmetsoc