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PROCEEDINGS OF THE PHILIPPINE METEOROLOGICAL SOCIETY

Leveraging Meteorology for Sustainable Development and Strengthening Philippine Resiliency to Hydrometeorological Hazards

Philippine Meteorological Society
2025 Annual Convention
Novotel Araneta City, Quezon City
March 17- 18, 2025

2025 PMS CONVENTION

Abstracts of Papers presented during the 2025 PMS Annual Convention

Leveraging Meteorology for Sustainable Development and Strengthening Philippine Resiliency to Hydrometeorological Hazards

March 17 – 18, 2025
Novotel Manila Araneta City, Metro Manila

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PMS' 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.

Society's Objectives

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

Society's Mission

1. To develop and disseminate knowledge of meteorology and related hydrologic sciences (hereinafter referred to as "Meteorology")
2. To promote and advance the professional application of Meteorology
3. To encourage collaboration amongst Members of the Society, individuals, bodies both corporate and non-corporate who may share the Society's interest in Meteorology
4. 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" conducted under MET4YOU Project for CALABARZON held at University of the Philippines Los Baños (UPLB), at Los Baños, Laguna on 24 February, 2025.
- "MET-Innovation" and "MET-Education", conducted under MET4YOU Project for Cagayan Valley held at Isabela State University (ISU), at the Echague, Isabela on 22-24 January, 2025.
- Recognition with Good Standing status by the Securities and Exchange Commission as of December 17, 2024.
- 2nd PMS Lecture Series with the following topics: (1) Role of Meteorology in Achieving Sustainable Development Goal 14: Life Under Water, and (2) Aurora and Geomagnetic Storms with Emphasis on Recent Event, held online via Zoom and PMS Facebook page on 23 August 2024.
- 1st PMS Lecture Series in celebration with the Typhoon and Flood Awareness Week "Development of Institutional Meteorology and Typhoon Studies in the Philippines, 1860s - 1940s", held online via Zoom and PMS Facebook page on 21 June 2024.

- 2024 PMS Annual Convention held on 18-20 March 2024 at Camelot Hotel, Quezon City with theme, “Weather, Climate, and Society: Interdisciplinary Approaches to Challenges and Solution”.
- “MET-Innovation” and “MET-Education”, conducted under MET4YOU Project for Central Luzon held at Central Luzon State University (CLSU), at the Science City of Muñoz, Nueva Ecija on 26-27 January, 2024.
- “MET-Innovation” and “MET-Education”, conducted under MET4YOU Project for Eastern Visayas Region held at Visayas State University (VSU), Baybay City, Leyte on 23-26 November 2023
- Tackling Typhoon and Flood Vulnerability: A Typhoon and Flood Awareness (TFAW) Webinar on 21 June, 2023
- “MET-Innovation” and “MET-Education”, conducted under MET4YOU Project for IlocosRegion 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 • 5 th 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)”
- 7 th 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

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Master of Ceremony	John Ariel T. Rojas

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PROGRAMME

DAY 1

7:30 AM Registration
8:00 AM Opening Ceremony
Invocation and National Anthem

Welcome Remarks:		**Dr. Joseph Q. Basconcillo** PMS President
Keynote Address	:	**Hon. Risa Hontiveros** Senator, Senate of the Philippines
Keynote Message	:	**Hon. Renato U. Solidum JR.** Secretary, DOST
Message	:	**Mr. Ben Churchill** Director, Regional Office for Asia and the South-West Pacific, World Meteorological Organization (WMO)
Message	:	**Dr. Nathaniel T. Servando** Administrator, PAGASA
Message	:	**Dr. Nicole Kranz** GIZ SSCIS Chief Advisor
Message	:	**Dr. Jayeel S. Cornelio** Executive Director, DOST-SEI

9:30 AM Awarding of Certificates to Officials and Keynote Speaker

9:35 AM **Conferment of Dangal ng PMS Award**
Session Chair: **Mr. Robert Badrina**

GROUP PHOTO AND HEALTH BREAK

Special Session 1: MET4YOU Presentation
(Co-organized with DOST Science Education Institute)
Session Co-Chairs: **Dr. Rafaela Jane Delfino** & **Dr. John Manalo**

10:00 AM	**CO_2KOT**: Portable Self-powered Direct-air Carbon Capture Device Producing Potassium Carbonate Solution for Electricity Generation	**Team CO2KOT** Tuguegarao City Science High School, Cagayan Valley Region

10:20 AM	**SALIMBAY:** Smart Agricultural Lifeline for Innovative Management and Buoyancy-Assisted Yield	**Team CCSIS-Salimbay** Calamba City Science Integrated School, CALABARZON Region

Special Session 2a: Climate Information Services for Agriculture and Health
(Co-organized with GIZ-SSCIS)
Session Chair and Moderator: **Ms. Mari Trix L. Estomata, GIZ Ph**

10:40 AM	Enabling Farmers and Agriculture Extension Workers and Address Climate Change issues using Integrated Crop Modelling Tools and Smart Climate Information Service	**Dr. Orlando Balderama** Isabela State University
11:05 AM	Enhancing Meteorological Services for Resilience in Region II: A Study on Identifying Climate Information Service Gaps in Agriculture and Fisheries	**Dr. Maricel Villamayor** UPLB-INREM
11:30 AM	**OPEN FORUM**	

LUNCH BREAK

Special Session 2b: Climate Information Services for Agriculture and Health
(Co-organized with GIZ-SSCIS)
Session Chair and Moderator: **Ms. Mari Trix L. Estomata, GIZ Ph**

1:00 PM	Variability of Dengue Cases in Ilocos Norte from 2009 to 2023	**Mr. Alex Garibay** MMSU
1:25 PM	Practical insights and research directions in climate information in health	**Dr. Michelle Ylade** UPNIH
1:50 PM	A region-wide analysis of ENSO and its effect on dengue in Southeast Asia	**Dr. Xerxes Seposo** Hokkaido University
2:15 PM	**PANEL DISCUSSION & OPEN FORUM**	

HEALTH BREAK

Sub-theme 1: Advances in Severe Weather Observations and Predictions
Session Chair : **Dr. Gerry Bagtasa**
Rapporteur : **Ms. Karen Conda-Botin**

3:00 PM	On the Baseline Climatology of Severe Weather across the Philippines	**Generich H. Capuli** DOST-PAGASA
3:15 PM	Utilizing equivalent potential temperature and water vapor flux in assessing winter monsoon shear lines in the Western North Pacific	**Brian G. Añano** Visayas State University
3:30 PM	Frost susceptibility mapping in Benguet, Philippines	**Rafael Brian Padua** DOST-PAGASA

Special Session 3: PAGASA
Session Chair : **Dr. Joseph Basconcillo**
Rapporteur : **Mr. Henrison Sanchez**

3:45 PM	Identification of Synoptic System Affecting the Philippines: Case of DOST-PAGASA Weather Forecasting Center	**Daniel James, E. Villamil** DOST - PAGASA
4:00 PM	Post-flood assessment on the Debris Flow event in Talisay, Batangas due to Severe Tropical Storm Kristine on October 24, 2024	**Maria Czarina M. Tierra** DOST - PAGASA
4:15 PM	Microphysics and Dynamics of Hail Formation in Tropical Convective Systems: Modeling and Analysis of the 08 May 2020 Cabiao, Nueva Ecija Hail event	**Marco Polo A. Ibanez** DOST - PAGASA, RDTD-NMS

4:30 PM - 5:30 PM **Poster Session Day 1** (with 1-min Lightning Talks)
Session Chair : **Ms. Jehan Fe S. Panti**

Emcee: Mr. Ariel Rojas
PMS Member
ABS-CBN Resident Meteorologist

DAY 2

Special Session 4a: PMS
Session Chair : **Dr. Gerry Bagtasa**
Rapporteur : **Mr. Charlindo Torrion**

8:30 AM	Tropical Cyclone Event Attribution in the Philippines	**Dr. Rafaela Jane Delfino** PMS BoT Member UP IESM
8:45 AM	Influence of Urbanization to Atmospheric Variables: Implications for Climate Patterns in the Philippines	**Dr. John Manalo** PMS BoT Member DOST-PAGASA

Special Session 4b: OML Center
Session Chair : **Dr. John Manalo**
Rapporteur : **Ms. Jehan Fe S. Panti**

9:00 AM	Climate Science To Action: Experiences From A Civil Society Organization	**Dr. Rodel Lasco** Executive Director OML Center

HEALTH BREAK

Sub-theme 2: Understanding Climatological Patterns and Long-Term Trends in the Philippines
Session Chair : **Dr. Rafaela Jane Delfino**
Rapporteur : **Dr. John Manalo**

9:45 AM	Climatological Analysis of Rainfall over Hinatuan Surigao del Sur in eastern Mindanao—the wettest location in the Philippines	**Lyndon Mark P. Olaguera** Ateneo de Manila University
10:00 AM	Detecting and adjusting artificial biases on long-term rainfall and temperature records in the Philippines	**Noel R. Bangquiao** DOST-PAGASA
10:15 AM	Climatological Characteristics of Precipitating Clouds over the Eastern Coast of the Philippines during the Northeast Monsoon Season	**Yves Sheldon E. Ella** Ateneo de Manila University
10:30 AM	Climatology of Multiple Tropical Cyclone Events in the Philippines	**Alyssa Dawn M. Castillo** UP IESM
10:45 AM	Development of Flood Model with AI-based Data Integration for the Bicol River Basin	**Maureen A. De Jesus** DOST-PAGASA (AI4RP)

11:00 AM - 12: 00 NN **Poster Session Day 2** (with 1-min Lightning Talks)
Session Chair : **Mr. Charlindo Torrion**

LUNCH BREAK

Sub-theme 3: Atmospheric Dynamics and Environmental Interactions
Session Chair : **Mr. Henrison Sanchez**
Rapporteur : **Mr. Charlindo Torrion**

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Session Chair : **Ms. Karen Conda-Botin**
Rapporteur : **Mr. Henrison Sanchez**

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2:30 PM	Advancing Tropical Cyclone Research, Data Storytelling, and Meteorological Education Through High-Performance Computing	**Bernard Alan B. Racoma** UP IESM

2:45 PM	A Foundational Machine Learning Framework for Flood Hazard Mapping in Davao City	**Blase Christian Perez** Bicol University

HEALTH BREAK

CLOSING CEREMONY

3:15 PM **Awarding of Certificates**

3:45 PM Closing Remarks: **Ms. Jehan Fe S. Panti**
PMS 2025 Convention Chair

POSTER PRESENTATIONS

DAY 1: 4:00 PM - 5:00 PM
Session Chair: **Ms. Jehan Fe S. Panti**

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DAY 2: 11:00 AM - 12:00 NN
Session Chair: **Mr. Charlindo S. Torrion**

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Special Session 1: Meteorology for Young Scientists (MET4YOU)

CO_2KOT: Portable Self-powered Direct-air Carbon Capture Device Producing Potassium Carbonate Solution for Electricity Generation

Maria Gabriel G. Cusipag[1], Cohleen M. Pagallaman[1], Carl Azhlie Q. Domingo[1], Princess Wency S. Paned[1], Curbie Lance Gilbert B. Abig[1], Januard M. Palejo[1], and Ma. Ioana Louise S. Sy[1]

[1]*Tuguegarao City Science High School , Tuguegarao City, Cagayan*
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SALIMBAY: Smart Agricultural Lifeline for Innovative Management and Buoyancy-Assisted Yield

Orgen, Glenn Solomon B., Cobeng, Janelle Andrea L., Cueno, Adriel Rafael D., Huesca, Gerran O., Acosta, Rowena L., Detruz, Sarah Jane M.

Calamba City Science Integrated School
glennorgen14@gmail.com

The SALIMBAY project is an innovative floating agricultural system designed to address the vulnerability of Philippine agriculture to typhoons, floods, and droughts, ensuring climate resilience and sustainable crop production. This system integrates buoyant materials, smart sensors, and renewable energy to create a stable platform for cultivating high-yield crops, particularly coffee beans, which are widely grown in Batangas and Cavite. Utilizing coconut coir, biodegradable foams, or bamboo, the system takes advantage of coir's rot-proof, insect-resistant, and water-retentive properties, making it highly durable and sustainable (Schiavoni et al., 2016). A rainwater collection tank and underground storage system, equipped with moisture-sensor-triggered irrigation, efficiently conserves water and mitigates drought effects.

SALIMBAY also incorporates small solar panels to power sensors and irrigation, reducing reliance on external electricity sources. To enhance farmer accessibility, the system features real-time SMS-based data transmission, allowing farmers in remote areas with low connectivity to receive timely updates on crop conditions. The buoyancy ratio of 13:59 ensures the system can support 4.54 times its base weight, proving its effectiveness in flood-prone areas. By promoting eco-friendly farming practices and reducing water waste, SALIMBAY provides a cost-effective and scalable solution to support sustainable agriculture in the Philippines amidst climate change.

Special Session 2: Climate Information Services for Agriculture and Health

Enabling Farmers and Agriculture Extension Workers address Climate Change Issues using Integrated Crop Modeling Tools and Smart Climate Information Service

Orlando F. Balderama

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It is widely recognized that climate products should be user-centered to be useful in decision making. But more often, there is no systematic mechanism for the interaction between users and providers (WMO 2014). The major challenge is translating climate information into sectoral impacts and communicating response options to end users for their application.

This paper present results of a research undertaking in providing solution to corn farming in the Philippines in coping with climate variability through ICT-based climate information service. Methods employed were science tools such as simulation and climate modelling, integration of automated weather station for real-time weather data inputs and Short Messaging System (SMS) as decision support to government workers and farmers. Specifically, it aimed to develop a localized corn model; assess future corn production under climate change scenarios and; develop decision support system for corn production.

A local model was developed for climate change assessments and development of decision support for corn farmers. The model was able to predict the observed data on yield and timing of phenological events from the actual experiments and actual farmers field with high goodness of fit ranging from 91% to 98% for the calibration and 86% to 97% for the validation process. Moreover, applications of the model for climate change assessments indicated that corn yield in northern Philippines would be reduced by up to 35% in 2050 due to changes in rainfall amount and rise in temperature which are indicators of climate change.

The model was automated to provide decision support to farmer's operational decision making and crop and weather advisories. First test showed a positive impact of increasing the yield by 24%.

Keywords: Corn Model, Climate variability, Philippine Farmers, Climate Information Service

Enhancing Meteorological Services for Resilience in Region II: A Study on Identifying Climate Information Service Gaps in Agriculture and Fisheries

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Climate Information Services (CIS) play a crucial role in enhancing resilience by supporting effective decision-making, particularly in regions vulnerable to hydrometeorological hazards. In the specific context of the Cagayan Valley region, CIS plays a crucial role in enhancing resilience by supporting effective decision-making, particularly in regions vulnerable to hydrometeorological hazards. The agriculture and fisheries sectors in this region face significant risks due to extreme weather events such as typhoons, prolonged droughts, and severe flooding. This highlights the need for timely, accurate, and accessible climate information to minimize losses and ensure sectoral sustainability. However, despite the availability of CIS, challenges persist in its accessibility, usability, and integration into local decision-making.

To identify these gaps, a needs assessment was conducted within a Community of Practice (CoP) involving state universities and colleges (SUCs), local government units (LGUs), national government agencies (NGAs) and their regional offices, as well as farmers and fisherfolk, using focus group discussions (FGDs) and field surveys. The findings reveal several key barriers, including limited awareness of available CIS sources, restricted access to localized meteorological data, difficulty in interpreting climate information, and the absence of sector-specific CIS products tailored to the needs of farmers and fisherfolk. Additionally, institutional coordination, particularly in the province of Isabela, remains insufficient to effectively disseminate climate information.

To address these challenges, there is an urgent need to enhance CIS by improving data accessibility, developing localized and user-friendly CIS products, and fostering stronger collaboration among meteorological agencies, NGAs, LGUs, and end-users. Strengthening these services will ensure that climate information is available and actionable, facilitating climate-smart decision-making and adaptation within the agriculture and fisheries sectors of Region II. By aligning CIS with the specific needs of stakeholders, resilience will be strengthened, contributing to the long-term sustainability of these vital sectors.

Keywords: needs assessment, agriculture, fisheries, resilience and sustainability

Variability of Dengue Cases in Ilocos Norte from 2009 to 2023

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Dengue is a mosquito-borne viral infection that poses a significant global health threat, particularly in tropical and subtropical regions. About half of the world's population is now at risk of dengue with an estimated 100–400 million infections occurring yearly. Dengue is a major public health problem in the Philippines and is endemic in all regions. The study focused on the variability of dengue cases in Ilocos Norte from 2009 to 2023. Data were collected from the different MHOs of Ilocos Norte and were analyzed using different statistical treatments such as mean, standard deviation, and ANOVA. The data were further correlated and analyzed with the different meteorological parameters and climate drivers such as temperature and precipitation and El Niño Southern Oscillation.

Results indicate significant temporal variability in dengue incidence, with peak cases occurring during the June–August (JJA) season. Additionally, dengue cases were notably higher during the wet season compared to the dry season. Statistical analyses revealed a significant relationship between confirmed dengue cases and (a) precipitation, (b) temperature, and (c) ENSO events. These findings provide crucial insights into the climate-dengue relationship, serving as baseline information for policymakers in developing targeted disease prevention and control strategies. The results may also be applicable to other regions with similar climatic conditions.

Keywords: Dengue, Climate Variability, ENSO, Ilocos Norte

Practical insights and research directions in climate information in health

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Changes in climate significantly influence public health. It can affect disease patterns, healthcare infrastructure and public health responses. Climate information services (CIS) provide data for predicting, preventing, and managing climate-sensitive diseases such as malaria, dengue and cholera. The aim is to define research gaps in climate and health, identify practical applications of CIS for prevention of climate—sensitive diseases and identify challenges to having a robust CIS in health.

We conducted a systematic review to identify research gaps in climate and health research in the Philippines. We identified practical applications of climate information in health through a review of case studies. Challenges were identified based on the case studies in relation to our experiences.

We found increasing number of studies conducted on climate change and health, specifically on the topics of mental health, adaptation and gender-based vulnerability research. Majority were funded by foreign institutions, but studies conducted in Visayas and Mindanao remain underrepresented. Practical applications include early warning systems for dengue, cholera and malaria to pre-position medical supplies and deploy mosquito control measures, climate-informed vaccination strategies and climate-smart agriculture to reduce nutritional deficiencies that exacerbate these diseases. Challenges remain in data integration, ensuring data privacy, accuracy, accessibility and inter-sectoral collaboration.

Research gaps and challenges on data availability and processing should be addressed to further develop local CIS in heath. In the meantime, we recommend enhanced public awareness, education and advocacy through information and climate and health dissemination materials. Despite the gaps and challenges, CIS remains to be an important tool to support decision-making in the public health sector.

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A region-wide analysis of ENSO and its effect on dengue in Southeast Asia

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Dengue remains a major public health concern in tropical and subtropical areas. Southeast Asian (SEA) countries represent more than 40% of the estimated 50–200 million cases of dengue infections occur annually in the world. Weather and climate factors have been documented to affect dengue. Previous literatures have documented the role of regional climate variables such as El Nino Southern Oscillation (ENSO) and Indian Ocean Dipole on mosquitoes and dengue. While there are several studies, which have examined the role of regional climate variables such as ENSO on dengue, evidence from SEA region is scarce, and has been carried out in a single city or country setting. These studies have used a variety of techniques in examining the temporal association, which may be a limitation of comparability of effects estimates across studies and across locations. This study builds on this limitation by examining the effect of ENSO on dengue incidence using consistent methodologies, as well as estimating current dengue burden due to ENSO.

We utilized the monthly dengue incidence data from the Southeast Asia Research on Climate Change and Dengue (SEARCD), an 8-country research consortium, alongside the monthly ENSO anomalies in determining the 1) country-specific ENSO dengue association that was subsequently 2) pooled using a random effects meta-analysis in generating the SEA region ENSO-dengue association. We found that the direct effect of ENSO on dengue is nearly similar except for the case of Lao PDR. Dengue risks are more likely to increase during El Niño period, than La Niña periods, in comparison to the neutral phase. Results may be relevant to current and future initiatives related to ENSO and its effect on dengue, particularly developing a regional dengue risk warning system on dengue risk during ENSO periods, thereby inducing a pre-emptive approach from the health systems as a response.

Keywords: ENSO, dengue, Southeast Asia, multi-level analysis

Special Session 3: DOST-PAGASA

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Identification of Synoptic System affecting the Philippines: Case of DOST-PAGASA Weather Forecasting Center

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The Department of Science and Technology - Philippine Atmospheric, Geophysical and Astronomical Services Administration (DOST - PAGASA) is the Philippines' National Meteorological and Hydrological Center providing timely and reliable meteorological information. One of the products issued by the agency is the Public Weather Forecast (PWF) twice a day. In this product, a key component is the "synopsis" which indicates the synoptic system currently affecting the country. The type of weather system indicated in the synopsis serves as a guidance in the formulation of the forecast at the national and regional level. In this study, we present the systematic method of synopsis identification. This includes the use of persistence methods which correlate the past 12hr - 24hr synopses with the current isohyetal map, rainfall data, and other meteorological parameters. Nephanalysis is also utilized with the latest images from Himawari 9 satellite to aid in the identification of the synoptic system. In addition, manually analyzed surface and upper air charts are also used to identify the presence and extent of the system at various levels. Numerical weather prediction outputs, including other available synoptic and climatic indices are utilized to analyze the progression and development of the synoptic system. Finally, subjective evaluation is performed to verify the accuracy of the identified synoptic system affecting the Philippines.

Keywords: Operational Weather Forecasting, Synoptic Meteorology, Synoptic Analysis

Post-flood assessment on the Debris Flow event in Talisay, Batangas due to Severe Tropical Storm Kristine on October 24, 2024

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The passage of Severe Tropical Storm (STS) Kristine (International Name: "Trami") brought heavy rainfall in the municipality of Talisay in Batangas province on October 24, 2024, triggering debris flows in the western part of the municipality—an event recorded for the first time in the area. In the wake of the incident, the Hydro-Meteorology Division of the DOST-PAGASA conducted a post-event assessment to analyze the factors that contributed to the occurrence of debris flows and document the impacts of STS Kristine in Talisay. Analysis of rainfall data of the Ambulong synoptic station revealed that the tropical cyclone dumped 255 mm of rainfall in the area from midnight to 2 o'clock in the afternoon of October 24, when the debris flows were reported to occur. More intense rainfall falling at an average of 41.5 mm/hr was experienced about 6 hours before the debris flow was observed in the "ground zero" located in Brgy. Sampaloc. The topography of the western portion of Talisay, where Brgy. Sampaloc is situated, is characterized by steep slopes of the Tagaytay Ridge facing south toward Taal Lake. These factors, together with substantial surface runoff and river discharge in the small sub-catchments of Brgy. Sampaloc and nearby areas of Ambon-Ambon River and Caloocan River facilitated the debris flows and flash floods that occurred. Accounts from residents revealed that the front of the debris flow carried large boulders and logs and was accompanied by high-velocity runoff which lasted until early evening. The debris flows traveled generally southeast and reached the lakeshore, where high waves generated by the storm also impacted local communities. Towards the eastern portion of the municipality, where a more gently sloping terrain is found, flash floods caused by surface runoff and rapid rise in river waters were reported to occur.

Keywords: debris flow, flash flood, tropical cyclone, post-event assessment

Microphysics and Dynamics of Hail Formation in Tropical Convective Systems: Modeling and Analysis of the 08 May 2020 Cabiao, Nueva Ecija Hail event

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Hail occurrence in the Philippines remains understudied despite its significant impact on agriculture and infrastructure. This study presents a comprehensive analysis of hail events in the country, with a detailed investigation of the 08 May 2020 hailstorm in Cabiao, Nueva Ecija. Based on reports from 2006 to 2024, Northern and Central Luzon emerges as a hotspot for hail occurrences, particularly during the warm months of April and May. Hail events predominantly occur in the afternoon to early evening, driven by strong convection and high atmospheric instability. Orographic effects in Northern Luzon contribute to hail formation by lowering the freezing level (FZL), while in low-elevation areas like Central Luzon, high Convective Available Potential Energy (CAPE) and moisture availability support the development of larger hailstones. The Cabiao hailstorm featured some of the largest hailstones recorded in the region. Atmospheric soundings revealed a low lifted condensation level (LCL), steep lapse rates, and a dry mid-troposphere, enhancing evaporative cooling and storm intensity. WRF model simulations captured the increasing instability, with rising CAPE, strong moisture flux convergence (MFC), and intense updrafts reaching 12–13 km. The storm's microphysical processes involved mixed-phase hydrometeors, with high cloud water (Q_{CW}) and cloud ice (Q_{ICE}) mixing ratios near the FZL (~4 km), facilitating hail growth through riming and freezing cycles. As the first in-depth study of hail in the Philippines, this research underscores the need for enhanced hail monitoring and prediction. Expanding automated weather station (AWS) networks, integrating radar and satellite data, and refining numerical modeling efforts are crucial for improving forecasts. Future studies should explore parameterization schemes and sensitivity tests to better understand the environmental conditions leading to hail formation in tropical climates.

Keywords: Severe Weather – Hail, Philippines, WRF, Tropics

Special Session 4a: Philippine Meteorological Society

Tropical Cyclone Event Attribution in the Philippines

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Understanding how extreme weather, such as tropical cyclones, have changed and will change with global warming is an interesting scientific and computational challenge. Event attribution studies assess whether, and to what extent, climate change has influenced the intensity, frequency, or impact of extreme weather events. Using convection-permitting regional climate model simulations, we analyzed how recent highly damaging and extreme TCs in the Philippines would have differed if they had occurred in past climates or how they might evolve under future climate conditions. Our findings indicate that historical warming has already intensified extreme TCs such as Rai (2021), Goni (2020), Haiyan (2013) and Mangkhut (2018) leading to greater wind-related damage as quantified by the Cyclone Damage Potential (CDP) Index. Simulations also show changes in TC-associated rainfall rates and total accumulation. Future projections suggest that the most destructive TCs—such as Haiyan (2013), Bopha (2012), and Mangkhut (2018)—will become even more damaging. Under the SSP5-8.5 scenario, CDP is projected to increase by as much as 37%, primarily driven by stronger maximum winds. Additionally, TC-associated rainfall rates and total accumulation could rise by up to 26%, exacerbating flood and landslide risks. Moreover, a potential reduction in TC translation speed could further intensify flooding impacts. Analyzing CDP trends from 1980 to 2023, we also found an increasing trend, largely influenced by rising TC peak wind intensity and slower translation speed. These results highlight the escalating risks posed by TCs in a warming climate, emphasizing the need for enhanced adaptation and disaster preparedness strategies in the Philippines.

Keywords: event attribution, extreme events, tropical cyclones, cyclone damage potential

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Influence of Urbanization to Atmospheric Variables: Implications for Climate Patterns in the Philippines

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The rapid urbanization in the Philippines has resulted in significant changes to atmospheric variables, which in turn influence local and regional climate patterns. As urban areas expand, natural landscapes are replaced by built environments, leading to alterations in temperature, air quality, and humidity levels. The increase of vehicular emissions, industrial activities, and energy consumption within urban centers has contributed to increased concentrations of pollutants such as particulate matter (PM), nitrogen oxides (NOx), and carbon dioxide (CO2). These pollutants, combined with the urban heat island effect, exacerbate temperature fluctuations and rainfall patterns, influencing local weather conditions. This study examines the impact of urbanization on temperature and rainfall and its implications to heat index and urban heat island intensity. The findings underscore the need for sustainable urban planning and climate adaptation strategies to mitigate the negative consequences of urban expansion on the climate and to promote long-term environmental resilience.

Keywords: Urbanization, temperature, rainfall, urban heat island intensity

Special Session 4b: Oscar M. Lopez Center

Climate Science To Action: Experiences From A Civil Society Organization

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Given the Philippines' vulnerability to climate-related risks, harnessing scientific findings to build local and national resilience is crucial. One challenge is the limited uptake of research results by potential users such as national policymakers, local government officials, and civil society groups.

The Oscar M. Lopez Center (OML Center) aims to bridge the gap between climate science and action. In this presentation, we will share some of our experiences. First, we will present our approach and the key findings of the latest edition of the Philippines Climate Change Assessment (PhilCCA) reports. These reports were patterned after the global Intergovernmental Panel on Climate Change (IPCC) reports. We will also present key lessons learned in preparing the reports.

Second, we will share our attempts to translate these scientific publications and climate change information into actionable knowledge through open access adaptation tools. These tools, co-produced with key partners and stakeholders, aids local governments in planning and preparing better amidst impending climate risks.

Finally, we present the Center's efforts to communicate climate change to a broader audience through documentaries, short films, and educational resources, among others. These help not only in conveying the message of a warming planet through lived experiences, but also in imparting stories of hope and spurring communities to take action.

Keywords: knowledge to action; climate change assessments; climate change communication; adaptation tools

Sub-theme 1: Advances in Severe Weather Observations and Predictions

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On the Climatology of Severe Weather Events across the Philippines

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Because of the rudimentary reporting methods and general lack of documentation, the creation of a severe weather database within the Philippines has been difficult yet relevant target for climatology purposes and historical interest. Previous online severe weather documentation i.e. of tornadoes, waterspouts, and hail events, has also often been few, inconsistent, inactive, or is now completely decommissioned. In the Philippines, no previous climatologies of severe weather events (SWEs) have been developed, nor have reports been systematically collected. As a collaborative exercise with clear data attribution, avenues for augmentation, and a pioneering study, this presentation reports the methods necessary for archiving SWE information; both official and non-official sources, and provides a broader climatological analysis of spatio-temporal patterns in severe weather occurrence within the Philippine context. Specifically, SWEs in the Philippines demonstrate distinct temporal and spatial patterns. The severe weather season begins in March or April, peaks from May to August, and gradually diminishes by December. Peak activity occurs primarily between 2 to 4 PM (06-08 UTC/14-16 LST), with a secondary corridor from 4 to 6 PM (08-10 UTC/16-18 LST), aligning with global severe weather and rainfall climatologies. Regional hotspots, resembling to Tornado and Hail Alley in the Continental US, were identified, with tornadoes concentrated in Region III to Region IV-A, BARMM, SOCKSARGEN, and Western Visayas; hail events mainly occurring in Greater Metro Manila; and waterspouts prominently in Western Visayas. We also outline potential use cases for the data archived through Project Severe Weather Archive of the Philippines (hereafter SWAP), highlight project's current limitations as is to any other existing and far larger database, and emphasize the need for understanding these events' and their atmospheric environments, inline to the current severe weather climatologies across the globe.

Keywords: *Severe Weather Events (SWEs) – Tornadoes, Hail Events, Waterspouts; Baseline Climatology; Spatio-Temporal Analysis; Archiving*

Note: Abstract is adapted from Capuli, G. H. (2024). Project Severe Weather Archive of the Philippines (SWAP) Part 1: Establishing a Baseline Climatology for Severe Weather across the Philippine Archipelago. Annals of Geophysics, 67(5), GC554. 10.4401/ag-9151

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Utilizing equivalent potential temperature and water vapor flux in assessing winter monsoon shear lines in the Western North Pacific

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This study aims to assess the feasibility of using equivalent potential temperature (θ_e) and vertically integrated water vapor flux (WVF) to determine the location and linear extent, as well as the intensity, of shear lines during the winter monsoon season (WMS) in the Western North Pacific (WNP). Applied to a set of five cases, six-hourly data from the ECMWF Reanalysis v5 (ERA5) are utilized to compute the meridional gradient and thermal front parameter of 925 hPa θ_e ($\partial\theta_e/\partial y$ and TFP(θ_e)), as well as the convergence of WVF (conv(WVF)), which are then used to estimate the shear line's location and linear extent.

Preliminary results indicate that the shear line location and linear extent determined using $\partial\theta_e/\partial y$ closely corresponds to those identified in Himawari-9 satellite imagery—except during the early stages of shear line development and when it traverses rugged terrain, which complicates the analysis. In contrast, determining the shear line location using TFP(θ_e) and conv(WVF) proves challenging due to significant noise in the data field and poor agreement with satellite observations.

As an ongoing study, further data analysis will be conducted to include all cases, with an additional focus on θ_e and WVF anomalies. These anomalies will be computed based on a 30-year climatology and tested for statistical significance using a z-test at a 95% confidence level as a method for assessing shear line intensity. This research aims to contribute to the growing understanding of shear lines and support operational meteorology in the Philippines.

Keywords: shear line, winter monsoon, equivalent potential temperature, water vapor flux

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Frost Susceptibility Mapping in Benguet, Philippines

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Frost is often experienced in the province of Benguet, particularly during the northeast monsoon season. This study identifies the areas in the province that are at risk of frost to help the farmers, policymakers, and the local government units (LGUs) in their decision-making. It generally aims to assess the risk of frost by developing a susceptibility map based on the frost occurrences derived from the MODIS daily nighttime land surface temperature data of both Aqua and Terra from November to March (2005-2024). It also intends to generate a frost hotspot map to identify the areas prone to frost. The different indicators representing the key characteristics of the mountainous terrain of the province, such as the distance to water bodies, slope, elevation, potential insolation, and compound topographic index (CTI) were obtained using the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM). The relationship between these derived physiographic indicators and the frost occurrences was determined using the Principal Component Analysis (PCA) which was used in consideration for the mapping of the frost susceptibility map. The preliminary results of the study revealed that the areas receiving lower daily potential insolation (DPI) due to reduced morning potential insolation (MPI) in highly elevated terrains were found to have the most influence on frost occurrences. Furthermore, terrains with subtle slopes and concave landscapes highly contribute to frost occurrences due to cold air pooling. Although frost typically occurs in highly elevated terrains, we found that lower elevation areas in these high topography zones may also support the effect of the cold air accumulation. Moreover, the results showed that the areas receiving higher afternoon potential insolation (API) with lower MPI may also have a contribution to frost. By using remote sensing and modeling the topographic feature of Benguet, the frost susceptibility map was derived.

Keywords: Frost, land surface temperature, susceptibility, hotspot

Sub-theme 2: Understanding Climatological Patterns and Long-Term Trends in the Philippines

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Climatological Analysis of Rainfall over Hinatuan Surigao del Sur in eastern Mindanao—the wettest location in the Philippines

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This study analyzes the daily rainfall records from 43 synoptic stations of PAGASA from 1979 to 2019. This study reveals that the wettest station in the Philippines is in Hinatuan, Surigao del Sur, in eastern Mindanao in terms of the mean annual total rainfall. Despite being located at a low elevation, the mean annual total rainfall in this station is about 4554 mm, which is more than the mean annual total rainfall in Baguio City station, the station with the highest elevation in the country. Further analysis of the statistical characteristics of rainfall and comparison with other stations in terms of intensity, frequency, duration (i.e., short (1 – 2 days), medium (3 – 7 days), long (8 – 14 days), and very long (> 14 days) events), and 95th percentile extremes show that this station ranks first in terms of the frequency of wet months (200–500 mm month^{-1}) and heavy rainfall months (> 500 mm month^{-1}), mean monthly rainfall amounts from January to April, and the mean rainfall amount in the short duration category. The contributions of multiscale factors such as Tropical Cyclones (TCs), Low Pressure Systems (LPSs), and the Madden-Julian Oscillation (MJO) to the rainfall extremes over Hinatuan station are quantified and presented. The results of this study may serve as a basis for future characterization of the spatial variation of rainfall including the variations in extremes and their potential causes over the Philippines.

Keywords: Hinatuan, extreme rainfall, wettest location, multi-scale systems

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Detecting and adjusting artificial biases on long-term rainfall and temperature records in the Philippines

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Long-term climate data are in demand due to the recent focus on climate change research and policy-making decisions. The Philippine climate records are available through the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) network of synoptic stations. Stations change over time due to alterations in the surrounding environment, observational practices, instrument upgrades, and sometimes relocations, called non-natural factors. These factors are problematic, for they can create artificial abrupt and/or gradual shifts, called breakpoints in long meteorological time series. Identifying these breakpoints and assessing and correcting their impacts on climate time series is done using a process called "Data Homogenization." Homogenization was done on 60 (PAGASA) synoptic stations from 1951-2022 using the Climatol Package. Climatol is an open-source R-package for automatic homogenization of climate series. Breakpoints were found in three stations for rainfall, 48 for maximum temperature, and 53 for minimum temperature, respectively. The identified breakpoints were validated using the station metadata gathered from a series of PAGASA workshop-dialogues on data homogenization and station profiling. Only 25% of the breakpoints for rainfall coincided with station metadata, 36%, and 28% for maximum and minimum temperatures, respectively. Breakpoint occurrences are primarily due to instrument problems and station relocations. The homogenized dataset shows reduced variability and closely similar mean values compared to observed, particularly for temperature. Trend analysis using the Mann-Kendall test revealed significant warming in annual maximum (0.03°C/decade, $p < 0.01$) and minimum temperatures (0.08°C/decade, $p < 0.01$). In contrast, rainfall trends remain insignificant (11.87 mm/decade, $p = 0.097$). This study produced a long-term, quality-controlled, and homogenized dataset, expected to support decision-making, forecasting, and research on climate variability and change.

Keywords: Climate, Homogenization, Climatol

Climatological Characteristics of Precipitating Clouds over the Eastern Coast of the Philippines during the Northeast Monsoon Season

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This study investigates the climatological characteristics of precipitating clouds over the eastern coast of the Philippines during northeast monsoon (NEM) season. The NEM is the seasonal reversal of winds that brings surges of cold and dry air from the northeast direction, influencing the climate of the Philippines from November to February, and is characterized by significant rainfall over the eastern coast of the country. This study mainly uses precipitation radar data from the Tropical Rainfall Measuring Mission (TRMM) to characterize precipitating clouds, analyze spatial and temporal distribution of rainfall, determine dominant hydrometeors, and relate cloud formation with rainfall events during the northeast monsoon. The study focuses on three regions spanning the eastern coast of the Philippines (Luzon: 13°N to 19° N, 121.5° E to 125° E; Visayas: 10° N to 13.5° N, 124° E to 127° E; Mindanao: 6° N to 10° N, 125° E to 129° E) identified to have received the highest mean rainfall during the NEM season from 1998-2015. For all regions, despite the low frequency of days with heavy rainfall and the higher frequency of high outgoing longwave radiation values, heavy rainfall events were found to contribute more to the total seasonal rainfall. The low-altitude latent heating for all regions suggests that warm rain process is dominant for all regions. However, higher convection in Mindanao increases the possibility of mixed phase process, leading to the presence of more cloud ice, snow, and graupel and more intense convective rain, despite less cloud liquid water. The study aims to provide insight into the interplay between cloud microphysics and large-scale atmospheric dynamics, contributing a deeper understanding of monsoonal rainfall patterns in the region. Furthermore, this study enhances the limited knowledge on NEM-driven hydrological processes in the Philippines, offering potential implications for weather forecasting and climate adaptation strategies.

Keywords: northeast monsoon, microphysics, atmospheric dynamics

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Climatology of Multiple Tropical Cyclone Events in the Philippines

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Tropical cyclones (TCs) are among the most destructive weather events in the Philippines. While individual TCs cause significant damage, multiple TC events (MTCEs) lead to even greater destruction due to compounded impacts. The occurrence of successive TCs within a short period amplifies hazards, prolongs recovery efforts, and heightens socioeconomic vulnerability. Recent events highlight the growing threat of MTCEs. From October to November 2024, northern Luzon of the Philippines was hit by six consecutive tropical cyclones, mirroring a similar event for the same month in 2020. This study examines the climatology of MTCEs in the Philippines and other Asia-Pacific countries. Results show that out of 1141 recorded TCs in the western North Pacific (WNP) from 1980 to 2024, 454 were single TCs (STCs), and 267 developed alongside at least one other TC, leading to 687 MTCEs. Beyond the Philippines, other countries in the Asia-Pacific also experience frequent landfalling MTCEs, with China leading at 31%, followed by Japan at 25% and the Philippines at 24%. For most countries, the first TC in an MTCE with at least two landfalling TCs tends to be more intense than in an MTCE with only one. Among countries with the highest MTCE frequency, Japan records the most distance between two landfalling TCs at 980 km, with a time gap of 7 days and 6 hours, followed by China at 881 km over 5 days and 19 hours. The distance between landfalling TCs in the Philippines is 378 km, occurring over 5 days and 6 hrs. China has the highest MTC Hazard Index at 704, followed by Japan at 596 and the Philippines at 591. Meanwhile, the STC Hazard Index is highest in the Philippines at 490, with China at 399 and Japan at 258, highlighting the greater impact of MTCEs over STCs due to their compounded effects.

Keywords: the Philippines, multiple tropical cyclone events, climatology

Development of Flood Model with AI-Based Data Integration for the Bicol River Basin

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The Bicol Region is highly susceptible to flooding due to its exposure to various weather systems, including tropical cyclones (TC), shearline, and thunderstorms. This vulnerability has resulted in considerable damage to infrastructure, and agriculture, and has led to loss of life. The lack of high spatial and temporal resolution in existing data hampers the ability to provide an understanding of flood hazards in the area. To address this issue, this study aims to utilize AI-based precipitation forecast data as input to an integrated hydrological and hydraulic model to develop flood forecasts for the Bicol River Basin. The HEC-HMS (hydrological) and HEC-RAS (hydraulic) models were used to analyze and produce inundation forecasts for the flooding caused by TC Pepito (Man-Yi), particularly in the floodplain of Camarines Sur. Observed hourly rainfall from Bato, Buhi, Ombao, Camaligan, Balongay, Calzada, Malabog, and Sipocot stations, and water level data from Ombao and Sipocot stations were used to calibrate and validate the HEC-HMS model. The events used for calibration included TC Usman (2018) and TC Tisoy (2019), while shearline events from 2021 and 2022 were utilized for validation. For the hydrological model, the simulation results demonstrated a satisfactory correlation with the observed data, as indicated by the Nash-Sutcliffe Efficiency (NSE) coefficient. For the Ombao basin, the NSE coefficients were 0.818 (2018), 0.862 (2019), 0.889 (2021), and 0.964 (2022). In contrast, the Sipocot basin had coefficients of 0.653 (2018), 0.687 (2019), 0.503 (2021), and 0.632 (2022). A 3-hourly gridded precipitation with a 0.18Ox0.19O spatial resolution AI-based gridded precipitation forecasts from ATMO Inc. were then employed to simulate the flooding due to the heavy rainfall brought by TC Pepito on November 11-14, 2024. Overall, integrating AI-based precipitation forecasts with hydrologic and hydraulic models can potentially enhance flood forecasting capabilities in the Bicol River Basin.

Keywords: flood, Artificial Intelligence, HEC-HMS, HEC-RAS

Sub-theme 3: Atmospheric Dynamics and Environmental Interactions

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Investigating the effects of wind instrument location on wind velocity reading in a coastal terrain using CFD simulation: A case study in the Philippines

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The existing guide published by the World Meteorological Organization (WMO) on the siting of wind instruments is mostly applicable to open, level terrain, and there is minimal information about the siting of weather instruments over building structures or complex urban areas. The security of the wind instruments, the cost of construction and maintenance, and the complexities of urban microclimates are the other practical challenges in the siting of wind instruments. This study investigates the effect of positioning the wind instrument at various points on wind velocity reading in an actual case study site based on WMO recommendations. Three locations for wind instruments were considered in the study: two locations based on the WMO guide, and one location based on the practical consideration of security and installation cost. The box-shaped computational domain was simulated in Ansys Fluent, and the boundary conditions of the computational setup were based on actual meteorological data. The calculated wind velocity using the first two locations are 20.6082 m/s and 22.7013 m/s, and the calculated wind velocity using the unconventional location is 23.1205 m/s. Based on the results of the CFD simulation, the wind velocity at the proposed unconventional location is only 5.06% and 1.85% higher than the wind velocity value at the WMO-suggested locations. The difference between the computed wind velocity values at the WMO-suggested locations and the proposed unconventional location is considered too low to outweigh the practical advantages of the unconventional location. This study also investigates the wind velocity at other points in the computational domain where the wind instruments can be practically positioned. The results of this investigation using CFD simulation may serve as the basis for positioning wind instruments in coastal terrain and even in complex urban environments

Keywords: computational fluid dynamics, urban microclimate, automatic weather station, wind instrument, weather monitoring

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Assessment of Cooling Effects from Hypothetical Linear Tree Placements in CLSU New Community Market using Computational Fluid Dynamics (CFD) Modelling

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This study evaluates the cooling effects of hypothetical linear tree placements at the CLSU New Community Market using Computational Fluid Dynamics (CFD) modeling with ANSYS Fluent. The objective was to determine the influence of strategic tree configurations on air temperature distribution, airflow patterns, and thermal comfort during the dry season. Baseline simulations revealed high ambient temperatures reaching 36°C and poor ventilation within the market area. Hypothetical scenarios with linear tree rows were then simulated to assess their cooling performance. Results showed that tree placements reduced air temperatures by up to 2.8°C in shaded pedestrian zones, significantly enhancing thermal comfort. The Heat Index decreased by an average of 3.4°C, particularly during peak midday temperatures. Airflow patterns improved with a 5-10% increase in wind speed along pathways, promoting better ventilation and reducing heat accumulation. The tree canopies provided effective shading, mitigating direct solar radiation and creating cooler microclimates. Notable cooling effects were observed near market stalls and pedestrian walkways, where temperature reductions were most pronounced. These findings demonstrate the potential of strategic vegetation management to reduce heat stress in tropical environments. The study highlights the importance of optimized tree configurations in enhancing thermal comfort and supporting resilience.

Keywords: Computational Fluid Dynamics (CFD), ANSYS Fluent, Heat Index, Microclimate, Airflow Patterns

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Intensifying Tropical Cyclones in the Western North Pacific Part 1: Wind Structure and Deep Convective Clouds

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The wind structure of a tropical cyclone (TC) is one of the most crucial factors that affects TC intensification. Deep convective clouds (DCCs, infrared brightness temperature < 208 K) near the TC center, facilitates the intensification of weak storms. This study explores the spatial distribution and temperature of DCCs within the annular area between the radius of maximum wind and radius of 34-knot wind (storm strength), of intensifying TCs over the western North Pacific (WNP) from 2016 to 2023 at varying intensity. The study found that the wind structure parameters (i.e., tropical cyclone fullness, TCF; tropical cyclone critical fullness, TCFo; and fullness ratio, Rf) over the WNP slightly deviated from the optimal values as compared to that of the north Atlantic basin. Extremely rapid intensification (ERI) for major TCs (hurricane categories 3-5) are characterized by a high DCC percentage (DCC-P) of greater than 70% at TCF > 0.8 that corresponds to the coldest DCC temperature (DCC-T). Similar ERI characteristics are found for rapidly intensifying (RI) TCs but at lower TCF. TCs undergoing slow intensification (SI) have high DCC-P at TCF > 0.8 while cold DCCs are evident at TCF > 0.9. Major TCs have the greatest DCC-P (> 90 %) and coldest DCC-T at TCF > 0.8. Further, higher intensification rates (ERI and RI) follow the occurrence of colder and wider areal extent of this type of cloud. Minor TCs exhibit similar characteristics to that of major TCs, however, SI TCs have relatively cooler DCCs at TCF = 0.6-0.7, whereas TS show no distinct characteristics. The results in this study may be used to deepen the understanding of the importance of the TC wind structure and DCCs in the onset of TC rapid intensification in the WNP.

Keywords: deep convective clouds, environmental conditions, rapid intensification, western North Pacific, wind structure

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Intensification and Hydrometeor Distribution of Axisymmetric Hurricane Embedded in Various Vertical Wind Shear Environments

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This study investigates the impacts of various wind shear environments on the intensification and hydrometeor distribution of axisymmetric hurricane. Using Cloud Model 1, the study found that the absence of deep layer shear (DLS) promoted storms to reach hurricane category faster. Non-DLS environment allowed water vapor to be directly converted to supercooled water. Deposition and ice production from supercooled water were associated with hurricane's extreme rapid intensification. DLS facilitated the formation of snow and graupel in areas where high values of supercooled water were found. Graupel mixing ratio increased with storm's intensity, whereas slow intensification favored the formation of graupel.

Keywords: CM1, hurricane, tropical cyclone, hydrometeor budget, vertical wind shear

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Climate Change and Land Surface Dynamics: Impacts on Regional Runoff Variations

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To humanity, water is one of the basic and most important resources for the existence and advancement of civilization. Climate change, population growth, and land surface changes increasingly complicate water resource management. Better knowledge of these interactions between climate dynamics and land surface processes must offer much further insights into runoff changes in the future. This study analyzes changes in runoff predictions that integrate the Budyko framework and direct river discharge data, derived from various hydrological models coupled with regional and global climate models, concentrating on the Philippines.

We investigate the future changes in regional runoff using advanced Earth System Models from CMIP5 and CMIP6. The regional analysis in the Philippines shows an increase in runoff but with much more variability. Localized interactions between the land surface characteristics and the climate drivers explain this variability. The Philippines shows wide regional variations in runoff projections, underscoring the importance of localized models and data in getting these regional nuances. We analyze the mean river discharge in the Philippines by comparing the accuracy of CORDEX-driven hydrological simulations against CMIP5 and CMIP6 models. The results show that CORDEX simulation better estimates river discharges than CMIP5 and CMIP6 models by explaining the magnitude, variability, and long-term trends. The finer spatial resolution of CORDEX allows it to better account for regional climate variables and local topographical effects, leading to more accurate hydrological predictions. Incorporating the Budyko framework into mean river discharges demonstrates a strong alignment to CORDEX model outputs, enhancing the reliability of the CORDEX simulations. These results highlight the significance of using regionally downscaled models like CORDEX for future river discharge projections in the Philippines, as they provide a more dependable foundation for comprehending and managing water resources amid evolving climatic conditions.

Keywords: climate change, land surface, runoff, river discharges

Sub-theme 4: Innovative Technologies and Data for Disaster Risk Reduction and Climate Resilience

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Project CCHAIN: Open deep learning downscaling high-resolution climate model and data for 12 Philippine cities

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Understanding the growing climate risks in the Philippines begins with baseline studies, which heavily rely on open data as inputs. For climate-sensitive disease research in particular, local studies often use global coarse climate data, which lack the resolution needed for city- or barangay-level analysis. Enhancing the resolution through conventional climate downscaling methods require large computational resources and additional effort to incorporate observation data. However, recent advances in artificial intelligence have enabled models to enhance downscaling by learning and transferring patterns from high-resolution datasets to refine coarse data. To address these challenges, we developed a deep learning-based climate downscaling model as part of Project Climate Change, Health, and Artificial Intelligence (Project CCHAIN). The model methodology is designed with consideration for areas with limited station data coverage, and its error metrics are comparable to conventional downscaling. The output is a daily downscaled temperature and rainfall dataset covering up to 20 years (2003-2022) for 12 Philippine cities, improving spatial resolution of the base input reanalysis data from 0.25° to 0.02°. For temperature, a group of cities achieved good RMSE and MAE values of 0.4–1.0°C, while another group was less performant at >1.5°C RMSE and MAE. For rainfall, the model consistently improved rain/no-rain detection across all cities, but had 25%–50% higher error metrics than the coarse input data. While the model has not yet consistently outperformed the base input reanalysis data, it remains easy to iterate and tune due to its computational efficiency—it can be trained and deployed per city in just 10 minutes with low hardware requirements. We provide the code (https://github.com/thinkingmachines/project-cchain-climate-downscaling) and results as open-source products (https://thinkingmachines.github.io/project-cchain/) to democratize access and bridge the data gap for localized applications.

Keywords: open data, artificial intelligence, climate downscaling

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Advancing Tropical Cyclone Research, Data Storytelling, and Meteorological Education Through High-Performance Computing

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High-performance computing (HPC) has become an essential tool in meteorology, allowing researchers to process vast datasets, refine weather forecasts, and improve understanding of atmospheric processes. These computational advancements enable more detailed simulations of weather systems, helping scientists analyze trends, assess risks, and enhance predictions.

HPC has also expanded the ability to simulate meteorological phenomena at higher resolutions. Running numerical models at this scale demands significant computational power, making supercomputing facilities essential for handling large datasets. In my research, I have used HPC to study tropical cyclone rainfall and how terrain, particularly the Cordillera Mountain Range, influences its distribution. These simulations provide valuable insights into how orographic effects enhance or alter cyclone-induced rainfall, improving our understanding of extreme precipitation.

The availability of computing resources has made these advancements possible. JASMIN, UP Data Commons (UPDC), and COARE support large-scale meteorological analysis, while cloud-based platforms like Google Colab and Google Earth Engine offer accessible tools for machine learning and weather data processing. In my teaching, I focus on not just using these tools but applying them effectively—whether in research, forecasting, or decision-making. Beyond technical skills, I encourage students to consider how meteorological data can be communicated clearly to policymakers, disaster risk managers, and the public.

Data storytelling plays a key role in this effort. Turning complex meteorological datasets into intuitive narratives — through visualizations, interactive tools, or artistic representations—makes weather and climate science more engaging and actionable. This discussion explores how advances in HPC, Big Data, and Data Science are shaping meteorology while also highlighting the role of interdisciplinary approaches. Moving forward, integrating artificial intelligence, creative storytelling, and climate communication strategies can help translate meteorological insights into more effective disaster preparedness and resilience efforts.

Keywords: High-Performance Computing; Tropical Cyclones; Numerical Weather Modeling; Big Data; Data Storytelling

A Foundational Machine Learning Framework for Flood Hazard Mapping in Davao City

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Flooding poses serious risks to global development, particularly with rapid urbanization and climate change. This study developed a flood hazard mapping framework for Davao City using ensemble machine learning models: Random Forest (RForest), Adaptive Boosting (AdaBoost), and Extreme Gradient Boosting (XGBoost) to classify barangay-level flood hazards and identify key contributing factors. Using historical flood records and satellite-derived data, the study trained models on 70% of the dataset amd then used the remaining 30% for evaluation. Three experimental configurations were employed: a control or baseline model using the original set of hazard data as features; an augmented model with polynomial features; and (3) a model utilizing the top ten features as determined by mutual information gain. Model performance was evaluated using precision, recall, F1 score, and the naive Brier Skill Score, with evaluations conducted on both the original and a synthetically balanced testing set. Results indicate that flood hazards are concentrated in low-lying areas, highly developed regions, and locations near major waterways. RForest and XGBoost emerged as the most effective models for classifying floods, scoring similarly across all experiments. In addition, feature importance analysis revealed that RF prioritized complex interactions between vegetation and water accumulation, while XGBoost focused on topographic and soil-related factors. Despite these differences, both models consistently identified proximity to rivers as a primary determinant of flood hazard classification. Moreover, the flood hazard maps were calibrated based on historical flooding occurrences. This refinement provides a more reliable map for urban planners and disaster management practitioners, without directly tampering the model parameters. This study shows the potential of the proposed framework to classify flooding events, even when limited by the data. Hence, to develop a more holistic and sophisticated framework, future work should explore additional ensemble techniques with other ML models, hyperparameter optimization, and stronger feature engineering and selection.

Keywords: Machine learning models, flooding, flood hazard

Poster Presentations

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Evaluation of Standardized Precipitation Index in Leyte Island using Terraclimate Rainfall Data

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Understanding drought characteristics is essential for mitigating its impacts on agriculture and water resources. This study examines drought patterns in Leyte Island from 1994 to 2023 using the Standardized Precipitation Index (SPI) derived from TerraClimate rainfall data. The methodology includes data acquisition, validation against meteorological records, temporal drought analysis using Python, and GIS-based identification of drought-prone areas. Validation results showed a strong correlation (Index of Agreement > 0.8) between reanalysis data and ground-based records in Tacloban, Baybay, and Maasin, ensuring the reliability of SPI-based drought assessments. The analysis reveals varying drought characteristics across the three cities. Baybay City experienced 38 SPI-1 drought events spanning 58 months, with an average intensity of 1.52. SPI-12 droughts lasted 38 months with a magnitude of 8.59. In Maasin City, SPI-1 droughts covered 58 months across 39 events, while SPI-12 droughts lasted 47 months with a magnitude of 12.58. Tacloban recorded 42 SPI-1 droughts over 59 months, while SPI-12 droughts spanned 44 months with a magnitude of 9.87. Likewise, the findings highlight distinct drought patterns. Tacloban and Baybay frequently experience short-term droughts (SPI-1, SPI-3), indicating highly variable rainfall, while Maasin endures prolonged dry periods despite fewer extreme short-term events. SPI-12 droughts are most severe in Maasin, posing risks to water resources. Baybay exhibits the longest SPI-12 droughts and the highest SPI-1 and SPI-6 intensity. A teleconnection analysis revealed a significant correlation between SPI and the Oceanic Niño Index (ONI), confirming the influence of El Niño-Southern Oscillation (ENSO) on regional drought variability. The 2015–16 El Niño caused severe SPI-12 droughts, while the 2010–11 La Niña led to high SPI-12 values in Tacloban. Overall, Tacloban has the strongest ONI-SPI correlation, particularly in SPI-6 and SPI-12, whereas Maasin shows weaker ENSO influence. Increasing SPI trends indicate rising precipitation and reduced drought frequency. However, agricultural drought vulnerability remains high in northwestern and southern Leyte, necessitating region-specific mitigation strategies such as irrigation, soil conservation, agriculture conservation, and watershed management.

Keywords: Drought, Leyte Island, SPI, TerraClimate, ENSO, GIS

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Analyzing the Climate Characteristics of Temperature and Rainfall and How it Shapes the Climate Zones of Eastern Visayas using ERA5 Dataset

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Shifting climate dynamics have been evident in numerous studies, indicating a warming climate that may lead to more frequent severe weather events. This also raises concerns about the validity of existing climate classification systems, particularly the Modified Coronas Climate Classification (MCCC) used in the Philippines. This study aims to examine climatic patterns of temperature and rainfall in Eastern Visayas, determine trends in these variables, analyze their relationship, project future conditions, and delineate potential climate zones. Trend analysis through the Mann-Kendall Test revealed statistically significant increasing trends in temperature (0.14°C/decade) and rainfall (0.31 mm/decade) from January 1950 to August 2024. Using the Spearman's Rank Correlation Coefficient, a positive correlation was found between temperature and rainfall, indicating that convective rainfall is becoming a significant climate driver in the region. Projections via linear regression analysis forecasts continued increases in mean annual temperatures and rainfall, predicting significant changes by the year 2100. Furthermore, clustering analysis suggests potential shifts in climate zones, indicating that the MCCC may no longer accurately represent the evolving climate dynamics in Eastern Visayas. These findings accentuate the urgent need for improved climate adaptation strategies and emphasize the importance of reassessing the MCCC to better align with the changing climate dynamics in Eastern Visayas and possibly throughout the Philippines. By utilizing advanced data-driven methodologies and analyzing past trends, this study contributes essential insights into the regional climate dynamics.

Keywords: climate change, trends, climate projection, climate zones, Eastern Visayas

Analyzing Background Error Covariance through Pseudo-Single Observation Tests towards Optimizing WRFDA Accuracy

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Background error covariance (BEC) is a key component of a data assimilation system in which determines the spreading of observational information into the model grid points and the intensity of the increments/decrements in the model fields. In this study, the method used to estimate the BEC is the National Meteorological Center (NMC) Method, where it derives the climatological BEC based on the ensemble of differences between two forecasts of different lead times. Here we present the calculated background error covariance for the Philippine Atmospheric, Geophysical and Astronomical Services Administration Weather Research and Forecasting (PAGASA-WRF) domains using a year-long archive of the operational runs using the gen_be_v3 utility. Through pseudo-single observation test (PSOT), we analyze the effect of assimilating observations at level near 850-hPa for both 12-km and 3-km domains of PAGASA-WRF. The results after assimilating the pseudo-single observation of zonal wind for the 12-km, the wind fields (zonal, U and meridional, V) show a formation of cyclonic (anticyclonic) flow north (south) of the observation point. In terms of temperature and surface pressure fields it decreases (increases) north (south) of the observation point with relatively small temperature increments. The assimilation of the pseudo-single observation of meridional wind produces a similar pattern but with cyclonic (anticyclonic) flow forming to the right (left) of the observation point resulting in corresponding changes in temperature and surface pressure fields. Additionally, the assimilation of wind observations has no impact on moisture, as shown by the water vapor (Q_{Vapor}) fields in both cases. However, with the 3-km domain, the analysis increments are purely zonal and meridional as well as temperature, water vapor and refractivity.

Keywords: WRFDA, Philippines, Background Error Covariance, Numerical Weather Prediction model

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Characterization and Trends of Typhoons and Super Typhoons Affecting Eastern Visayas from 1993-2023

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Eastern Visayas (EV) is a region in the Philippines that is most vulnerable to typhoons (TY) and super typhoons (STY) as it is situated along the Pacific Typhoon Belt. From STY Haiyan (Yolanda) to STY Rai (Odette), our country suffered PHP 95.48 B and PHP 47.8 B, respectively, in damages, and 6,300 and 405 deaths were reported. Nonetheless, observational studies on the characteristics and trends of these TYs and STYs remain limited. This study analyzes the intensity, translational speed, movement, and trends of landfalling TYs and STYs that devastated EV using NCEI IBTrACS data from 1993 to 2023. The data was preprocessed and analyzed using R programming language. By plotting the tracks of Tropical Cyclones (TC) that entered EV with a maximum sustained wind speed of >64 knots, a total of 13 TCs were detected. Subsequently, only 10 TCs made landfall at any point inside the EV. The intensity of the TCs was analyzed by computing their Accumulated Cyclone Energy (ACE) and Landfall Dissipation Rate (LFDR) 24 hours before and after landfall. The ACE was then used to compute the LFDR. Eight of these TCs have lower LFDR, indicating less rapid TC weakening after their first landfall. Two TCs had shown a negative LFDR, indicating that the TCs were intensifying after landfall. Further, their translational speed was computed by finding the difference between the displacement traveled from the TC's current position and its previous 6-hourly position and dividing the distance by 6 hours. The TCs showed an intensifying trend after landfall as their translational speeds were about 15 to 80 knots, with STY Haiyan and STY Rai being fast-moving storms with high translational speeds. The TCs formed between 130°E and 165°E, had a west-northwestward movement, and dissipated over the West Philippine Sea—the findings of this study aid in identifying the criterion for TC intensification over Eastern Visayas.

Keywords: typhoon, super typhoon, Eastern Visayas, landfalling tropical cyclone

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Developing Seasonal Thresholds of Static Stability Indices and Thermodynamic Parameters for Rizal, Philippines

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Accurate local thunderstorm prediction is crucial in mitigating weather-related risks, particularly in the Philippines, where severe weather events are frequent. Traditional forecasting methods rely on static stability indices and thermodynamic parameters (SSITPs); however, their predictive accuracy remains underexplored in the country. Despite significant regional and seasonal variations in climate and topography, only a uniform set of SSITP thresholds is applied nationwide, potentially limiting forecasting precision. This study examines the relationship between selected SSITPs and thunderstorm occurrences in Rizal, Philippines, utilizing data from the PAGASA Tanay Upper-Air Station and Earth Networks Total Lightning Network (ENTLN). Seasonal distribution of thunderstorms was analyzed through box plots in relation to Convective Available Potential Energy (CAPE), Convective Inhibition Energy (CIN), Lifted Index (LI), Showalter Index (SI), K Index (KI), and Total Totals (TT) Index. Rank-biserial correlation analysis identified key predictors across the Southwest Monsoon (Habagat), Northeast Monsoon (Amihan), and their transition periods, while optimal seasonal threshold values were determined using a 2×2 contingency matrix and skill scores. Key findings indicate that CAPE exhibits the strongest positive correlation with thunderstorm activity among other SSITPs, with a moderate association during the NE–SW transition ($\rho \approx 0.52$) and weaker correlations during the NE ($\rho \approx 0.32$) and SW ($\rho \approx 0.23$) periods. Optimized thresholds improved predictive performance relative to PAGASA's existing values, with CAPE (>1199 J/kg) and LI (<-3.6) proving optimal during the NE–SW transition, and CAPE (>1742 J/kg) and LI (<-3.5) being the most reliable during the SW period. In contrast, SSITPs exhibited limited predictive reliability during the NE and SW–NE transition periods. Notably, CIN demonstrated inconsistent behavior across all periods. These findings contribute to the refinement of thunderstorm forecasting in the Philippines by providing season-specific SSITP thresholds, which can enhance predictive accuracy and support more localized and adaptive weather risk mitigation strategies.

Keywords: Stability Indices, Thermodynamic Parameters, Optimal Threshold, Seasonal Variations, Rizal Philippines

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Signature of Cloud Optical Thickness in Rapidly Intensifying Tropical Cyclones

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Tropical cyclone (TC) intensification is concurrent with changes in the characteristics of convective clouds near the TC center. Deep convective clouds (DCCs; Infrared Brightness Temperature, IRBT ≤ 208 K) play a crucial role in the rapid intensification (RI) of TCs. Ice condensates are formed together with the release of latent heat, which fuels the intensification of weak TCs. This study investigates the ice condensates within DCC as a precursor to RI. Using satellite observations of TCs from the western North Pacific (NWP) during 2016-2023, the cloud optical thickness (τ), cloud effective radius (re), and cloud top height (CTH) near the TC center across intensity and intensification categories were examined. In particular, τ was used as a proxy for ice water path (IWP); τ of DCCs were extracted and were compared with the average optical thickness of the whole TC. The study found that smaller cloud particles are associated with higher intensification rates. DCCs, regardless of intensification, prefer a particular CTH (14-16 km), whereas the CTH of warm clouds increases with intensification. These indicate that stronger convective activity, implied by greater DCC percentage, smaller re, and higher CTH, are observed near TC center on the onset of RI, as compared to other intensification categories. Generally, optically thicker clouds are found in very deep convective clouds (VDCC; IRBT ≤ 192 K) and DCCs. A weak correlation between the ratio of τ of VDCC and DCC to the whole TC with the intensification rate is found. The vertical spatial distribution of cloud ice and liquid water condensates showed that TC on the onset of RI has a greater ice water at 300-100 hPa levels. The findings of this study may be used to enhance our understanding on the role of IWP within DCCs in the RI of the TCs in the NWP.

Keywords: rapid intensification, deep convective cloud, cloud properties, cloud optical thickness

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Characteristics of the Precipitation Microphysics of Rapidly Intensifying Tropical Cyclones in the Western North Pacific

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The precipitation microphysics in rapidly intensifying (RI) tropical cyclones (TCs) are often poorly understood in numerical weather prediction models. Using the Global Precipitation Measurement (GPM) mission Dual-frequency Precipitation Radar (DPR), 64 TCs from 2014-2023 over the Western North Pacific Ocean were used to investigate the characteristics and microphysical processes of TC precipitation in different intensities, intensifications, and annular distances in order to improve RI TC prediction. Observations within the radius of maximum wind to the radius of 34-knot wind (storm strength region) demonstrate that RI TCs have a higher frequency of light precipitation (<1 mm h^{-1}), especially above the freezing layer for minor (category 1-2 hurricanes) and major (category 3-5 hurricanes) TCs, as compared to intensifying neutral (IN) and slowly intensifying (SI) TCs. Moreover, higher frequency of reflectivity, mass weighted mean diameter, and normalized intercept parameter are also found for RI TCs. Below the melting layer, when TCs are ranked based on percentage for a particular process across intensification categories, TCs are found to have a dominant microphysical process that is coherent all throughout the storm strength (coalescence for W, size sorting evaporation and coalescence for IN, and breakup and breakup-coalescence balance for SI), with the exception of RI TCs. This implies that a rapidly intensifying TC changes its dominant microphysical process with increasing distance from the center. These results show the unique characteristics of RI TC's microphysical properties, which can aid in the improvement in model forecasting of TCs.

Keywords: rapidly intensifying, microphysical processes, GPM-DPR, storm strength, precipitation

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Assessment of Static Stability Indices and Thermodynamic Parameters (SSITP) in Thunderstorm Prediction in Tanay, Rizal

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This study evaluates the effectiveness of Static Stability Indices and Thermodynamic Parameters (SSITP) in predicting thunderstorm occurrences in Tanay, Rizal, Philippines, across various time scales: monthly, annual, seasonal, and ENSO phases. Using fifteen years (2010–2024) of upper-air and synoptic station data, the study assesses the predictive capabilities of CAPE, CIN, LI, SI, KI, and TTI based on established thresholds from the National Oceanic and Atmospheric Administration (NOAA) and point-biserial correlation analysis, validated using historical thunderstorm occurrence data from the Tanay synoptic and upper-air station. Results indicate that TTI is the strongest predictor with 72.6% accuracy and 68.2% precision, correctly predicting 67.43% thunderstorms. Across all time scales, CAPE is the most reliable in predicting thunderstorms, with a correlation of 0.43 and an accuracy of 70% and 78.7% precision. The highest correlation for CAPE is observed in April (0.37), July (0.29), during the transition season (0.30), and the El Niño phase (0.47). KI show a moderate correlation with thunderstorm occurrences, having a correlation of 0.26. Although KI has high precision (76%), it is more effective for confirming thunderstorms rather than detecting them with 95% recall and 19% for no-TS. TTI and KI show the highest correlations in May (0.32 and 0.35, respectively), the transition season (0.28 and 0.27), and the Neutral ENSO phase (0.30 and 0.29). CIN, LI, and SI perform poorly in terms of accuracy and recall, exhibiting low correlations with thunderstorms, indicating that these indices are not reliable as standalone predictors. In ENSO-based analysis, CAPE consistently exhibits high correlations across all phases, followed by KI and TTI, with seasonal analysis yielding similar findings. The study highlights the need for further refinement of SSITP thresholds suited to the climatological of Tanay, Rizal. These findings contribute to local weather research, disaster risk reduction, and improvements in thunderstorm forecasting in the Philippines.

Keywords: Static Stability Indices and Thermodynamic Parameters (SSITP)**,** El Niño Southern Oscillation (ENSO), Habagat, Amihan, Thunderstorm (TS)

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Analysis of Lightning Frequency and Intensity Patterns in Central Luzon, Philippines, during El Niño-Southern Oscillation (ENSO) Phases and Monsoon Season

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Lightning, a powerful atmospheric phenomenon, presents significant hazards yet remains insufficiently studied in the Philippines. Its occurrence is influenced by large-scale climate drivers, including the El Niño-Southern Oscillation (ENSO), monsoonal shifts, and regional meteorological conditions that govern atmospheric instability and convective dynamics. This study examines the spatial distribution of lightning frequency and intensity across Central Luzon, considering different ENSO phases and monsoon seasons, using the data from the Earth Networks Total Lightning Network (ENTLN). Kernel Density Estimation (KDE) in QGIS was employed to identify lightning hotspots and discern patterns in frequency and intensity. The analysis reveals distinct spatial distributions of lightning activity during various ENSO phases. During El Niño, cloud-to-ground (CG) lightning is most prevalent in Zambales, Tarlac, and Bulacan, while intra-cloud (IC) lightning is concentrated in Tarlac, Nueva Ecija, and Bulacan. During La Niña, there is a noticeable increase in CG lightning activity, particularly in northern Zambales and southern Bulacan, while IC lightning remains dominant in Tarlac and Nueva Ecija. In the neutral ENSO phase, CG lightning frequency persists but with reduced intensity, while IC lightning continues to be concentrated in the same regions. Monsoonal influences further shift the lightning activity in the region, with the southwest monsoon (Habagat) enhancing lightning occurrences in Zambales and Bulacan, and the northeast monsoon (Amihan) driving the increased lightning frequency in Tarlac and Nueva Ecija. The observed spatial patterns of lightning activity suggest that certain regions in Central Luzon are more susceptible to lightning strikes, emphasizing the importance of targeted monitoring and mitigation strategies. Continuous observation and adaptive risk management measures are therefore essential to minimize the potential hazards associated with lightning in these high-risk areas.

Keywords: lightning frequency, lightning intensity, ENSO, monsoon season, Central Luzon

Sensitivity of WRF-Solar Global Horizontal Irradiance Forecasts to Shortwave Radiation and Microphysics Schemes over the Manila Observatory, Philippines

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The transition to solar energy in the Philippines requires reliable solar forecasts. However, there is currently a lack of studies assessing solar forecasts in this region. This study addresses this by testing the sensitivity of Global Horizontal Irradiance (GHI) forecasts produced by the Weather Research and Forecasting (WRF)-Solar on three Short Wave Radiation (SW) schemes (Dudhia, Goddard, RRTMG), and six Microphysics (MP) (Kessler, Purdue Lin, WRF Single-Moment 6-Class, Goddard, Thompson, Aerosol-aware Thompson) Schemes. Day-ahead forecasts were compared against measured GHI from a solar pyranometer installed at the Manila Observatory (14.64° N, 121.08° E) installed during the CAMP^{2}Ex CHECSM Campaign. The root mean square error (RMSE), relative RMSE (rRMSE), mean bias error (MBE), relative MBE (rMBE), mean absolute error (MAE), relative MAE (rMAE), and the Pearson correlation coefficient (*r*) of the forecasts were assessed. The best-performing combination of schemes for all-sky, clear-sky and cloudy conditions were RRTMG SW and WSM6 MP, RRTMG SW and Thompson MP, and Dudhia SW and WSM6 MP. The advantage of RRTMG SW and WSM6 MP during all-sky conditions may be attributed to the better representation of the dry attenuation by the RRTMG SW scheme and the better representation of effective radii of hydrometeors of the WSM6 MP. Overall, this study showed that WRF-Solar can adequately predict the amount of solar irradiance in clear and cloudy conditions and thus will be critical as the country transitions to a more renewable future.

Keywords: Solar Forecasts, GHI, Metro Manila, WRF-Solar, shortwave, microphysics

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Comparison of Detection and Tracking Methods of Tropical Depressions in the Philippine Sea using NCEP-GFS Model Forecasts

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Tropical Depressions (TDs) that form in the Philippine Sea produce torrential rains over the Philippine archipelago each year which bring about widespread flooding and landslides that result in casualties, agricultural loss, and damage to infrastructure. Notably, meteorological agencies in the Western North Pacific Basin have threshold discrepancies for categorizing TDs which resulted in disagreements between forecast model outputs and best tracks. This study compares existing tracking algorithms in the 0.25° x 0.25° NCEP-GFS Forecast Model (3-hourly up to 120-h) such as Pressure Reduced to MSL, Relative Vorticity 850 hPa, and Stream Function 850 hPa in their effectiveness in detecting and tracking selected TDs in the Philippine Sea. Stream Function 850 hPa has been selected as it removes the rotational noise associated with Relative Vorticity. Tracking algorithm thresholds are taken from related literature due to the small sample size of selected TDs. The model outputs are then compared to Joint Typhoon Warning Center (JTWC) 6-hourly Best Track using Along Track Error (ATE) and Cross Track Error (CTE) for Positional Error, and Intensity Bias Error. The initial results for Pressure reduced to MSL show up to 40% increased direct position error (DPE) over land, inherent positive bias for translational speed, positive intensity bias of up to 2 hPa.

Keywords: tropical cyclone, tropical depression, Philippine Sea, detection

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Intensifying Tropical Cyclones in the Western North Pacific Part 2: Environmental Conditions

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Environmental conditions that favor the intensification of tropical cyclones (TCs) were identified using reanalysis data along with the TC wind structure and deep convective clouds from 2016 to 2023 over the western North Pacific (WNP). The results showed that the mean relative vorticity concentration (RV) within the storm strength, the ring region between the radius of maximum wind and radius of 34-knot wind, (R34), is more indicative of TC intensification as compared to the RV values outside R34. Sea surface temperature (SST) is important for further intensification of TS and categories 1 and 2 systems (Minor TCs) but becomes a poor representative for hurricane categories 3, 4, and 5 (Major TCs). Moreover, SST appears to be more important for TCs undergoing higher intensification rate (extremely rapid intensification, ERI; and rapid intensification, RI). Intensifying TCs are usually embedded in a high relative humidity environment with > 85% in low-level and > 80% in mid-level. This abundance in moisture over the low and mid-troposphere sustains storms' further intensification. Deep-layer vertical wind shear values (VWS) for SI, RI, and ERI TCs were below the threshold value detrimental for intensification. ERI TCs were nested in the weakest low-level VWS environment as compared to RI and SI TCs. The findings in this study may be used to better understand the environmental conditions that promote intensification of the TCs over the WNP basin.

Keywords: deep convective clouds, environmental conditions, rapid intensification, western North Pacific, wind structure

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Determining Frost Affected Areas in Benguet, Philippines

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Frost events pose a significant threat to agriculture in Benguet, Philippines, particularly affecting highland crops. This study aims to identify the areas and crops impacted by frost and assess the changes in crop vegetation during frost events using the Normalized Difference Vegetation Index (NDVI). Temperature data from Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) ground stations and Sentinel-2 NDVI analysis, were used to monitor frost events and their effects on vegetation. Reports from the Department of Agriculture and local farmers provided additional insights into mitigation practices, time of planting, and optimal and minimum temperatures of crops. Results indicate that municipalities such as Mankayan, Atok, Buguias, Kabayan, and Kibungan are the most affected areas, with NDVI values showing significant declines post-frost.

Keywords: *Frost, crops, NDVI, Sentinel-2, Agriculture*

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Estimating Rice Areas Using Modified Community Level-SARAI Enhanced Agricultural Monitoring System (CL-SEAMS) in Lupao, Nueva Ecija, Philippines

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The rising demand for food intensified by extreme weather events necessitates continuous improvement of food production systems which can be done through effective agricultural monitoring. The Community Level-SARAI Enhanced Agricultural Monitoring System (CL-SEAMS) uses free remotely sensed images and geographic information system (GIS). Full adoption of CL-SEAMS was not realized during the SARAI project implementation. As such, this study pooled all possible inputs to develop an improved version of the CL-SEAMS methodology and were used to monitor rice production areas in Lupao, Nueva Ecija, Philippines. There were three (3) components of the improved methodology, namely: rice mask generation, NDVI and EVI threshold determination and agricultural monitoring through rice area estimation. Rice mask was generated using 10 bands of Sentinel-2 images processed through SCP with manual digitization techniques in QGIS. Intraseasonal, short-term, site-specific NDVI and EVI thresholds were determined after ground validation in the 42 established DGCPs. NDVI and EVI throughout the cropping season were used to estimate the rice planted areas and compared with those reported by the Lupao MAO. The improved CL-SEAMS methodology was found to be useful and valid in terms of intraseasonal and short-duration satellite and ground data collection for estimating rice production areas.

Keywords: rice area estimation, NDVI, EVI, GIS, remote sensing

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Econometric Estimation of Farmers' Willingness to Pay (WTP) for Forest Reforestation: A Policy Implication for Climate Resilience

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Farmers in Baragay Tagumpay have suffered from the devastating consequences of historic flood events. This study assessed the determinant variables for farmers' willingness to pay (WTP) for forest reforestation as a strategy to prevent flood risk at Barangay Tagumpay, Naujan, Oriental Mindoro. The study used both quantitative and qualitative research design to collect and analyze the data. An econometric estimation using multiple regression model was employed to analyze which variable among the socio-demographic and economic characteristics of the farmers predict the willingness to pay of the farmers. The results indicate that gender and household income are significant predictors of the farmers' WTP. Specifically, the analysis shows that as household income increases, the WTP also increases. Additionally, the results suggest that gender plays a role in the WTP, with the regression model indicating a positive relationship between being female and a higher WTP. The data reveals that farmers are willing to pay a significant amount for a one-year reforestation program, with the estimated total bid amount reaching ₱123,625.00 when using the National Food Authority (NFA) price of ₱23.00/kg for palay with 14% moisture content and ₱84,065 when using the traders' price of ₱17.00/kg for fresh harvest palay. These figures demonstrate that farmers recognize the importance of reforestation and are willing to allocate a portion of their produce towards this cause. Furthermore, the mean (WTP) values provide additional evidence of farmer commitment. The mean WTP for the NFA price is ₱1,454.41, while the mean WTP for the traders' price is ₱989.00. These figures suggest that, on average, farmers are willing to participate and contribute a substantial amount of their income towards reforestation efforts. The results indicate that farmers are willing to invest in reforestation efforts, and that policies and programs targeting this willingness could be an effective strategy for addressing environmental challenges towards climate resilience.

Keywords: Econometric Estimation, Farmers' WTP, Forest Reforestation, Policy implication, Climate Resilience

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Spatiotemporal Analysis of Land Surface Temperature (LST) in Puerto Princesa City, Palawan to Investigate existence of Surface Urban Heat Island (SUHI) using Landsat 8

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The proven persistency of urban sprawl (κ = 0.8136) in Puerto Princesa City has significantly altered its land surface temperature (LST) thereby intensifying urban climatological phenomenon such as urban heat island (UHI) effect whereas urban regions experience considerably higher temperatures than its surrounding rural areas— in which UHI is often overlooked due to existing gaps in literature. This study employs spatiotemporal analysis on land surface temperature (LST) in Puerto Princesa City, with data extracted using Quantum Geographic Information System (QGIS) from satellite imagery retrieved from United States Geological Survey (USGS). Seasonal composite imagery spanning from 2013 to 2023 covering both Amihan and Habagat seasons was generated to delineate urban thermal patterns with the aim of characterizing UHI phenomenon by primarily examining the spatial and temporal variations of LST in aspect of urban expansion. Transect analysis observed that thermal gradient between the urban and rural regions is more pronounced during Amihan season which exhibited UHI average intensity of 2.40°C, compared to 1.99°C during Habagat season. Moreover, Getis-ord Gi* assessment discovers 4 cold spots and located 22 hotspots predominantly concentrated in urban center, likely due to high building density and intense human activities. Whilst composite analysis observed significant changes in LST values due to recorded El Niño phenomena which causes the elevated temperature in rural regions and suggest that the mitigating effect of vegetation in the regions became suboptimal in countering the increasing temperatures especially on Alienable and Disposable (A&D) lands. The resulting outputs has underscored the impact of climatic seasonality and urban morphology on thermal dynamics but, also provided compelling evidence that UHI phenomena persist in Puerto Princesa City despite its extensive vegetation cover. Lastly, the study displayed the robustness of spatiotemporal analysis on LST which offers replicable framework in conducts of UHI studies and other LST-related investigations.

Keywords: Land Surface Temperature, United States Geological Survey (USGS), Urban Heat Island Effect, Spatiotemporal Analysis, Urban Climate Dynamics, Getis-Ord Gi*

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Investigating the Factors Influencing the Typhoon-Induced Storm Surge Along San Pedro Bay: A Case Study of Super Typhoon Haiyan (2013)

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The frequency and rapid intensification of typhoons, combined with sea level rise are expected to exacerbate storm surges posing a significant risk to coastal regions. The catastrophic impacts of Super Typhoon Haiyan (Yolanda) in 2013 emphasized the susceptibility of Eastern Visayas, particularly San Pedro Bay to storm surges. With this, the study investigates the influence of the key typhoon parameters: size, angle of approach, forward speed, and wind speed of Super Typhoon Haiyan in the amplification of surge in San Pedro Bay. To evaluate the effects of each factor, a sensitivity case experiment of the individual typhoon parameters was simulated using the coupled Delft3D FLOW and Wave. A numerical simulation of the original parameters was conducted to simulate the storm surge for model accuracy. The model was then compared to the observed data and showed an RMSE of 0.36 and R2 of 0.93 showing that the model was able to simulate the observed storm surge peaks accurately. However, the peak surge was overestimated with a normalized bias error of 0.0636. Nonetheless, the model demonstrates high reliability in replicating the surge height. After the model validation, individual tweaking was followed. Results show that a 20% increase in wind speed and size, as well as a 20% decrease in forward speed significantly increased the surge height by 1.46, 0.86, and 0.59 meters, respectively. This was evident on the north coast of the bay entering the San Juanico Strait. In contrast, the parallel angle of approach reduced the surge heights. Overall, each parameter played a vital role in the amplification of storm surge along San Pedro Bay. These findings underscore the need for policymakers, disaster response teams, and coastal planners to incorporate detailed and localized storm surge modeling in risk management strategies.

Keywords: storm surge, DELFT3D, sensitivity analysis, Super Typhoon Haiyan

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Parametric Sensitivity Analysis of Typhoon-Induced Storm Surge in San Pedro Bay: A Case Study of Super Typhoon Haiyan (2023)

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In recent years, storm surges have become more prevalent as typhoons intensify—posing a threat to coastal areas. Despite this, limited studies have analyzed the combined effects of typhoon parameters on storm surge generation, particularly in the Philippines. In this case study, a sensitivity analysis of storm surge height to different typhoon parameters including size, angle of approach, forward speed, and wind speed was investigated in the semi-enclosed San Pedro Bay. Super Typhoon Haiyan (2013) served as the reference typhoon for the simulation and model validation. The study utilized the coupled Delft3D FLOW and WAVE in simulating the surge and JTWC best-track archive data as the source of the reference typhoon parameters. Validation against observed storm surge peaks yielded an RMSE of 0.36 and an R2=0.93, demonstrating strong model performance. However, a mean normalized bias of 0.0636 revealed a slight overestimation of the simulation. Nonetheless, the model closely reproduced the surge peak. Results show that for all the parametric combinations, combined effects of increased (20%) wind speed and size showed a significant amplification of the surge by 1.61 meters to 3.58 meters. In addition, increasing the wind speed and decreasing the forward speed by 20% also increases the surge by 0.1 to 1 meter. From this experiment, wind speed has shown a consistent influence on the surge enhancement. Lastly, a scenario-based spatial extent map was produced for all the combinations of parameters, which can be used for disaster preparedness and planning; specifically for coastal areas and bays. Furthermore, consideration of other typhoon parameters can be also explored for future research.

Keywords: storm surge, typhoon parameters, sensitivity analysis, Delft3D

Spatiotemporal Analysis of Tropospheric NO_2 and SO_2 with Near-Surface Winds using Satellite Observations over Albay

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Over the years, the increasing levels of air pollutants have led to poor air quality where a rapid scale-up of air quality management and action is urgently needed. The unavailability of air quality monitoring networks hinders large-scale, long-term geographical, and temporal air quality observations. This research focuses on the Province of Albay, aiming to fill the gap in air pollution monitoring by employing satellite data. The study first examined the reliability of Nitrogen Dioxide (NO_2) and Sulfur Dioxide (SO_2) data used through the given quality assurance threshold value (qa_value > 0.75). This study then analyzed the seasonal and annual concentrations of SO_2 and NO_2 from December 2018 to November 2023, along with near-surface winds. The data sources for gaseous pollutants and wind data are retrieved from the SENTINEL-5 Precursor TROPOspheric Monitoring Instrument (TROPOMI) and the European Centre for Medium-Range Weather Forecasts Reanalysis version 5 (ERA-5), respectively. Results indicate that the highest number of days with quality-assured data occurred in the March-May (MAM) season while the Northeast Monsoon (December-January) season produced the lowest turnout. Additionally, days when the data did not meet quality assurance standards coincided with tropical cyclone occurrences. The spatiotemporal maps reveal that the highest concentrations of NO_2 were observed during the pre-COVID-19 months (December 2018 - February 2019). During the height of the community lockdown, there is a noticeable decline in NO_2 concentrations– mainly due to reduced anthropogenic emissions. On the other hand, the SO_2 concentrations were highest near the vicinity of Mayon Volcano. Moreover, the seasonal variability of the concentrations was found to be affected by the present prevailing wind. The key findings can aid in designing effective pollution control measures for Albay, accounting for its unique environmental factors: having an active volcano in its vicinity and a province frequently affected by numerous typhoons.

Keywords: air pollution, Albay, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), sentinel-5p

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Assessment of Land Cover Change Induced by Tropical Cyclones in Albay, Philippines Using Remote Sensing Techniques Part I: Spatial Analysis of TC-Driven Damages

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Over the years, tropical cyclones (TCs) have greatly changed the environment of the areas they hit. Therefore, TC-induced damage assessment is crucial in post-disaster response and recovery efforts. While extensive previous studies exist on TC impacts on natural vegetation, studies examining the impacts of TCs in the general land cover changes in Albay remain limited. Hence, this study investigated TC-driven land cover changes in the province from 2000 to 2020, as well as the trend of these alterations. Landsat images before and after each TC event within the study period were used to determine the spatial extent of damages. Tropical cyclones were classified according to the Saffir-Simpson Hurricane Scale; only TCs whose winds exceeded 95 knots were included in the study. The images were processed using GIS software to generate pre- and immediately post-disaster maps and quantify cyclone-induced changes. A 20-year land cover classification matrix was also generated to provide insights on general land cover changes in Albay. Results show a significant expansion in barren, cropland, and built-up areas— with an increase of 0.06%, 0.81%, and 4.49%, respectively. The increase in built-up areas reflects urbanization while the notable growth in barren areas may suggest land degradation. Meanwhile, the TC damage assessment indicates consistent decline in built-up, vegetation, and agricultural areas both for single and multiple TC events. Vegetation and agriculture areas are converted into barren areas, suggesting that these areas are susceptible to TC disturbances such as winds, floods, and erosion. Among the five classes, barren areas frequently experience most of the gain, suggesting that after the TC event, areas lost from other classes are converted into barren land. This analysis of typhoon-induced land cover changes will provide valuable insights into the nature and extent of these effects, strengthening strategies for resilience and sustainable development in Albay.

Keywords: Albay, remote sensing techniques, TC-induced damages, land cover change

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Assessment of Land Cover Change Induced by Tropical Cyclones in Albay, Philippines Using Remote Sensing Techniques Part II: Spatiotemporal Analysis of Post Cyclone Land Recovery

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Tropical cyclones (TCs) are known to have significant influence on landscape change processes. Thus, assessing TC-induced damage is crucial for understanding the extent of typhoon-induced impacts to land cover. While previous studies have primarily concentrated on the effects of typhoons on natural vegetation, information on the impacts of TCs to the land cover of Albay is limited. Therefore, this study investigates TC-induced land cover changes in said province. Landsat images before and after each major tropical cyclone within 20 years (2000-2020) were used to determine the spatio-temporal extent of damages. The images were then processed using GIS software to generate pre-, immediately post-, and post- disaster maps, quantify cyclone-induced changes, and highlight recovery patterns. Among the five classes, barren areas experience an increase after a TC event, suggesting that the area lost from other classes are converted into barren land. Notably, a year impacted by two major cyclones exhibited significantly greater land cover loss than those with a single event, suggesting that consecutive TC events in a short period can exponentially amplify land cover destruction. Recovery assessments a year later revealed a significant reduction in barren land, indicating natural regeneration or land conversion. In 2015, agriculture recovered by 55.3%, up from 33.0% in 2004, while barren areas decreased by -0.1%, compared to a -59.7% reduction in 2004. However, vegetation and agricultural cover showed varying trends, reflecting differences in recovery rates and possible lingering effects of cyclone damage. This analysis of TC-induced land cover changes provides valuable insights to the extent and patterns of cyclone damage which supports the development of targeted reforestation programs, climate-adaptive agricultural practices, and improved land use planning to enhance the province's resilience and sustainable development.

Keywords: Albay, Remote Sensing Techniques, Tropical Cyclone, Recovery Assessment, Land Cover, Landsat

Spatio-temporal Suitability Analysis for Red Onion (*Allium cepa* L.) Production in Nueva Ecija Using the Analytical Hierarchy Process

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In previous years, the Philippines experienced a significant price spike in onion due to the shortage of supply which leads to the volume of 101.68 thousand metric tons or worth Php 844.18 million of importation in 2021. It is therefore necessary to increase the number of suitable areas for onion production. In this study, a spatio-temporal suitability analysis for onion production in Nueva Ecija was conducted with the aid of Geographic Information System (GIS) and Analytical Hierarchy Process (AHP). Suitability maps for each of the crop growing stage were generated based on different criteria (elevation, slope, land cover, distance to the river, temperature, and rainfall) and expert input that is used to weight the criteria appropriately. Findings showed that meteorological factors (52.8%) outweigh the physical land variables (47.2%) by a 5.6% margin, suggesting the significant influence of climate on onion production. The results of this study revealed the province's land areas that are suitable for onion production. These generated maps will help to identify the most suitable areas for onion production; thus, the yield gaps will decline and assure food security to a greater extent. The findings will provide significant information that can be utilized by the local farmers in identifying and selecting the most suitable areas for onion production. The maps can also help field workers, policymakers, and planners in reinvigorating the onion industry by innovating techniques and policies.

Keywords: Analytical Hierarchy Process (AHP), Geographic Information System (GIS), Suitability Map, Onion

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Assessment of the Retrieved NO_2 and SO_2 Data from Sentinel-5p Satellite

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The level of air pollution is a crucial indicator of environmental and public health in developing regions. Air quality monitoring through air quality monitoring stations helps address urban air pollution problems. However, the limited coverage of these stations restricts extensive spatial and temporal air quality observations. The use of remote sensing techniques aids in addressing these limitations by providing broader spatial coverage. This research focuses on the Province of Albay, aiming to fill the gap in air pollution monitoring by employing satellite data. This study analyzed the Near-Real-Time (NRT) vertical column products of Nitrogen Dioxide (NO2) and Sulfur Dioxide (SO2) retrieved from the SENTINEL-5 Precursor (SENTINEL-5P) satellite from December 2018 to November 2023. This study examines the reliability of SO_2 and NO_2 data through the given quality assurance (qa_value > 0.75) threshold value. Results indicate that the highest number of days with quality-assured data occurred in March, April, and May (MAM), while the Northeast Monsoon (December-January) season produced the lowest turnout. Satellite data from SO2 has higher days of quality-assured data compared to NO2. The study also classified the satellite data according to days with and without tropical cyclone (TC) activity. A correlation was observed between TC occurrences and days when the data did not meet quality assurance standards. The results indicate that the prevalence of cloud cover during TC days and monsoon season affects the percentage of accepted images. The study aims to contribute valuable insights on satellite-based air quality monitoring, specifically using SENTINEL-5P in Albay.

Keywords: air pollution, nitrogen dioxide (NO2), sulfur dioxide (SO2), sentinel-5p, quality assurance

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Effects of Aerosol Optical Depth Black Carbon Concentrations on Meteorological Parameters in Koronadal City, Philippines

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Black carbon (BC) is a significant atmospheric aerosol with critical implications for air quality and atmospheric processes. This study investigated the temporal variability of BC-related aerosols in Koronadal City (2010–2022) by utilizing the derived Aerosol Optical Depth (AOD_{BC}) data of BC from the Aerosol Robotic Network (AERONET) as a proxy for BC concentrations and compared with Moderate Resolution Imaging Spectroradiometer (MODIS). AOD data was employed to explore the relationships between BC-related aerosols and local meteorological parameters due to the absence of direct ground-based BC measurements. Data analysis included trend analysis, seasonal decomposition via LOESS, and correlation and regression techniques. The findings reveal significant seasonal variability in BC-related aerosol concentrations, with slightly higher AOD_{BC} values observed during the dry season, likely due to reduced wet deposition and potentially elevated emissions. Meanwhile, lower AOD values were observed during the wet season, primarily driven by precipitation-induced removal. Long-term trends indicate a gradual increase in AOD_{BC}, presumably due to post-pandemic economic recovery, increased industrial activity, and biomass burning, despite emission controls and regulatory policies. Correlation analysis shows a weak but significantly positive relationship between AOD_{BC} and temperature, suggesting BC-related aerosols may contribute to atmospheric warming. Negative correlations with precipitation and relative humidity highlight the effect of wet deposition in aerosol removal. Regression analysis confirms these trends, indicating potential implications for cloud microphysics and precipitation processes. The study indicates that while BC-related aerosols influence meteorological parameters, its effects remain moderate, indicating contributions from other atmospheric and environmental factors. Additionally, MODIS estimated higher AOD_{BC} values than AERONET. These findings highlight the need for improved BC monitoring by integrating AOD data with ground-based measurements to enhance air quality assessments and better understand aerosol impacts on regional and global climates.

Keywords: Aerosol Optical Depth, Black Carbon, Air Pollution, AERONET, Koronadal City

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Risk Analysis of Urban Heat Island Intensity in Legazpi City, Albay during the MAM (March, April, May) Season from 2015-2024

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The Urban Heat Island (UHI) effect is recognized as an environmental hazard that is exacerbated by climate change, particularly in urban areas. In regions with warm climates, the combined effects of heatwaves and adverse weather conditions can significantly impact the health and well-being of urban populations. Understanding and assessing areas vulnerable to hazard is essential for effective urban planning and public health management. This study aims to analyze the spatial distribution of UHI and identify regions where vulnerable populations are most at risk, specifically during the March, April, and May (MAM) season. Remote Sensing (RS) techniques using Landsat 8 imagery were employed to estimate spatiotemporal variations in Land Surface Temperature (LST) and UHI trends over a 10-year period (2015–2024). Geographic Information System (GIS) software was used to process the hazard and population data, generating a spatial risk assessment map. The results show that LST during the MAM season is consistently higher compared to other seasons. In 2024, shows an increase in LST by 1.5°C and UHI values rising by 0.14. Furthermore, the study reveals that the majority of the vulnerable population resides in urban areas, where heat-related health risks are significantly amplified. These findings highlight that UHI changes significantly influence the hazard's intensity, emphasizing the need for sustainable urban planning to mitigate heat stress and protect vulnerable populations.

Keywords: Urban Heat Island, Geographic Information System, MAM, Heat Stress

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Spatial Distribution of Urban Heat Island to Land Use/Land Cover in Legazpi City, Albay from 2015-2024

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Urbanization has caused significant landscape changes, leading to environmental degradation and intensified Urban Heat Island (UHI) effects due to increased built-up areas and human activities. As cities expand, the replacement of vegetation with impervious surfaces amplifies heat absorption and retention, exacerbating this phenomenon. Understanding hazard-prone areas is crucial for effective urban planning to mitigate the adverse impacts of UHI. This study investigates the spatial distribution of the hazard and its correlation with Land Use/Land Cover (LULC) categories. Using Landsat 8 imagery, Remote Sensing (RS) techniques were applied to assess spatiotemporal changes in Land Surface Temperature (LST) and UHI trends from 2015 to 2024. Geographic Information System (GIS) software was used to generate a spatial distribution map for analysis. Legazpi City was classified into five major LULC classes Built up areas, croplands, water bodies, forests vegetations, and bareland. The results revealed both increase and decrease of the different LULC classes from 2015 through to 2024. Significant shifts from some classes to others was also observed. Specifically, higher UHI values is prominent to densely built-up areas which expanded in the surrounding existing urban barangays. These findings emphasize the impact of LULC changes on the hazard's intensity, highlighting the need for sustainable urban planning to address the growing environmental challenges.

Keywords: Urban Heat Island, Land Use/Land Cover, Remote Sensing, Geographic Information System

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PROJECT AGILA: An Aerial-Surveillance Ground Control System with Infrared Locating Aptitude

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In the Philippines, search and rescue operations agencies are often in action due to the disaster prone-area of the country. This vulnerability is compounded by its diverse topography, dense population, and socioeconomic challenges, which can exacerbate the impacts of these natural disasters. As a result, the country faces significant risks to infrastructure, livelihoods, and public safety, underscoring the need for comprehensive disaster preparedness, response strategies, and resilience-building measures to mitigate the effects of such events.

The study aims to mitigate search and rescue operations with the help of Unmanned Aerial Vehicle (UAV) with Infrared locating imagery to make the navigation and monitoring much easier with the use of materials such as drones, ground control systems, thermal sensors, and global positioning systems (GPS). The thermal camera was assembled together with the ground control systems which the researchers programmed with an autopilot system and navigating system.

In order to locate victims with improved visibility using thermal imaging systems to spot people who might be hidden or covered in debris and in difficult-to-reach areas, as well as for speed efficiency—which allows it to cover large areas quickly, greatly cutting down on search times—and maneuver through difficult obstacles to locate victims inside buildings and small hazard areas, this study looked at the importance of thermal drones in search and rescue operations. Results indicate that the device shows much accurate search and rescue operations due to its thermal sensor and drone architecture, because of its small sized structure, the drone was able to enter difficult-to-reach areas. It prioritizes safety using drones to keep rescue teams out of potentially hazardous situations.

Keywords: Thermal cameras, drones, Search and Rescue operations, obstacle avoidance, algorithms

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Sensitivity Analysis of Microphysics and Cumulus Parametrization in Simulating Consecutive Typhoon Tracks using WRF Model

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During the first three weeks of November 2024, the northern part of the Philippines was hit by four consecutive typhoons: Yinxing (Marce), Toraji (Nika), Usagi (Ofel), and Man-yi (Pepito). Yinxing and Usagi made landfall at Cagayan on November 7 and 14, respectively. On the other hand, Toraji and Man-yi arrived at Aurora on November 11 and 17, respectively. These typhoons prompted the government to raise severe wind and storm surge warnings at the coastlines of Luzon. After the onslaught of Man-yi, a field survey was conducted at Aurora to record the damages to the residential structures due to storm wind and waves. To understand the hazards that caused these damages, hindcasting of the storm winds and waves is usually done by isolating each typhoon event. However, it is important to investigate the influence of nearby typhoons in the overall simulation to aid in understanding the effect of consecutive typhoons hitting the same area. Thus, a 15 km grid domain was set-up covering the tracks of Yinxing, Toraji, Usagi, and Man-yi using the Weather and Research Forecasting (WRF) model. The ERA5 3-hour reanalysis pressure and single levels were used as meteorological input. A total of 6 runs were performed using different microphysics (Lin, Thompson, and WRF Single-Moment 6-Class Microphysics schemes) and cumulus parameterizations (Kain-Fritsch and Grell-Freitas convection schemes) with a simulation period from November 4 to 18. The trend of tracks of Yinxing and Man-yi as it approached the Philippines was captured in all runs, with the Thompson and Grell-Freitas pair producing the least deviation. However, none of the runs was able to capture well the tracks of Toraji and Nika. This poses the challenge of simulating typhoons that are within the Philippine Area of Responsibility at the same period. More sensitivity analysis and downscaling are recommended to be conducted.

Keywords: consecutive typhoons, numerical simulation, sensitivity analysis, WRF model

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