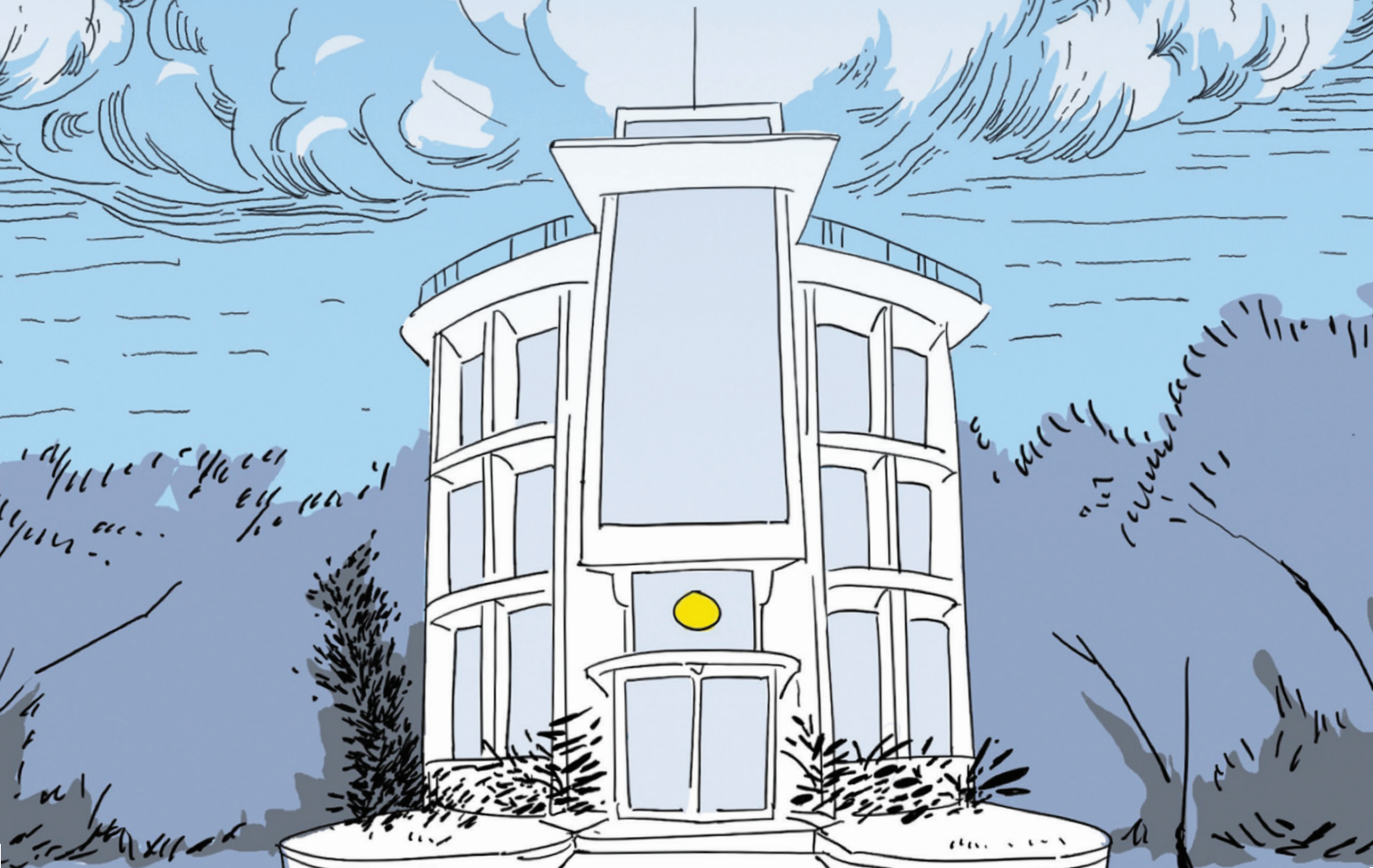
MANILA OBSERVATORY

2024 ANNUAL REPORT



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HIGHLIGHTS OF 2024

HIGHLIGHTS OF 2024

As predicted, the warmest year on record, 2024, was supercharged with a strong El Niño that reached its peak in the first quarter of the year. The Philippines was not spared as summer temperatures breached the observational record. This extreme climate event only spurred us on to carry out the scientific and social mission of the Manila Observatory with a greater sense of urgency.

In 2024, through its five laboratories and the Klima Center, the Manila Observatory as a climate observatory focused its efforts on sustaining past commitments, developing new projects, and forging key partnerships.

On climate prediction, the Observatory continues to serve as leader of the network of high-resolution climate modeling groups in Southeast Asia. Most of the year was spent coordinating collaborative efforts in "downscaling" the latest global climate models and localizing the broad and general predictions of these models to finer scales. The ambition is to draw global climate change down to the city, and even intra-city or barangay level.

The effort to achieve higher granularity is not a theoretical exercise. Philippine climate is driven not only by the rise in carbon levels in the air but also by local variations in land use and topography, land-water boundaries, and even biodiversity. Understanding our local climate vis a vis changes in global climate will help us design better adaptive and nature-based solutions in the face of record heat levels that are bound to shift the norm in years to come.

This year also saw the publication of the "2024 Philippine Climate Change Assessment: The physical science basis", which is the Filipino equivalent of the global IPCC (or Intergovernmental Panel on Climate Change) Working Group 1 report. Scientists from the Manila Observatory and PAGASA authored this latest assessment.

We are happy to announce that we have finally inked a formal agreement with PAGASA to work together on climate research, training, and outreach. This partnership promises to be beneficial to our people as both institutions cooperate to advance climate research and capacity in this part of the world.

This year, we were also approached by the World Climate Research Programme to host the Support Unit of its Academy. Launched here at MO in October 2024, this unit gives us the mandate to be a hub for training in climate science, especially for the Global South.

With our partners in disaster risk resilience in the BARMM, we developed anticipatory action triggers not only for drought (which we did last year) but also for flood and tropical cyclones. Anticipatory action helps communities mobilize resources before disaster strikes, thus reducing the pain and cost of post-disaster relief. We hope to share and replicate what we have learned in other parts of the country.

We are truly grateful to our partners in the private sector who support our nationwide network of automated weather stations (AWSs). These AWSs provide direct, onsite, and timely weather data that will not be found in remotely sensed satellite or cloud-based platforms. Without hard observational data over long time frames, AI-based forecasts (and nowcasts) will be limited since climate change is notably a pattern breaker. From our partners in local government, we have learned that the AWS in their locality can also be a live and effective teaching tool for disaster risk reduction. Our plan in the coming years is to bring the AWS to schools not only to heighten climate awareness but also to strengthen the STEM skills of our young people and teachers.

As the DENR is the designated repository of climate change-related data and information, we have worked closely with the agency in setting up and organizing its climate change information management system (CCIMS). The second phase of the CCIMS, begun in 2024, focused on improving system design, building its databases, and training users of the system. The ultimate goal is to provide communities and decision makers with the informational and analytical tools they need to devise locale-appropriate measures in climate adaptation/mitigation and disaster risk resilience.

HIGHLIGHTS OF 2024

On risk resilience, the Manila Observatory in 2024 also helped a number of cities in mapping flood and landslide risks, and in assessing coastal vulnerability. The latter included the identification of high risk areas due to diminishing mangrove buffers, low coastal slopes, and insufficient or maladaptive infrastructure. Working with colleagues in the geological sciences and with fisherfolk in grassroots coastal communities, we came up with modified vulnerability indices that factor in climate-related variables such as tidal range, wave direction, and sea level change. The pilot domain for this work was in the coastal areas of Cotabato City.

Knowing that aerosols or fine particles in the air are important drivers of air pollution and climate, the Manila Observatory has worked with colleagues in NASA and other allied groups in Asia to understand aerosol impacts on planetary warming and public health. The Observatory continues to maintain a long-term record of the aerosol loading of the tropical and urban atmosphere. In 2024, with partners in Korea and Southeast Asia, we installed sensors to supplement our observational effort and provide "ground truthing" to satellite measurements of fine particle pollution.

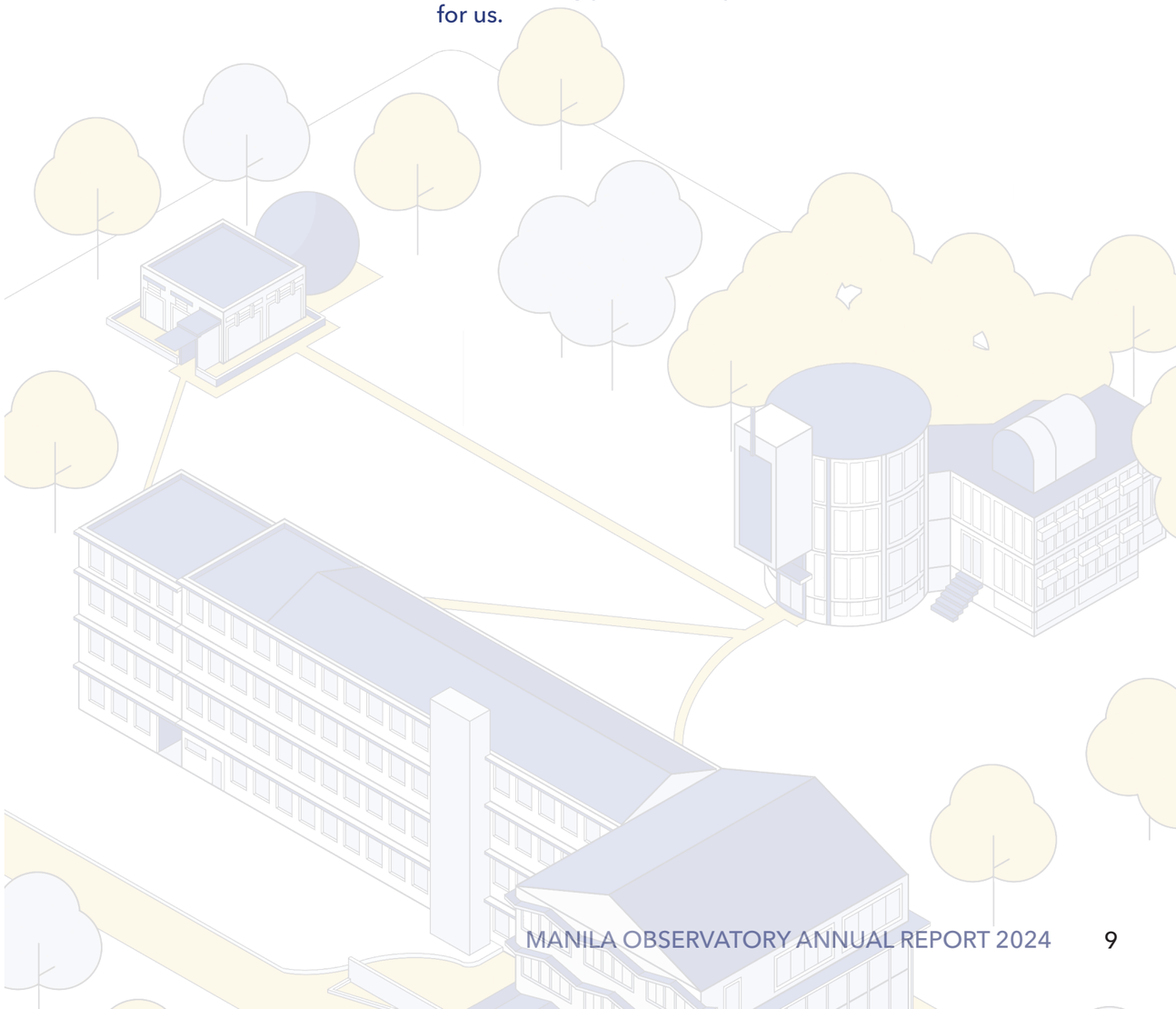
An important milestone this year was the formal agreement we made with the DENR-EMB on the air quality station that has been on the Observatory's premises for two decades now. The goal is to transform this station into a world class reference station outfitted with globally-recognized standard instruments and gases, which can then be used to calibrate the many air quality sensors now deployed all throughout the country.

On the climate policy and advocacy front, the Manila Observatory, through its Klima Center, hosted several climate and energy gatherings among the youth in support of a just transition to renewable energy. Anticipating the surge in mining for so-called green minerals, we also embarked on a transparency and accountability initiative that entailed the creation of digital portals to help stakeholders understand and negotiate better agreements in mining these minerals for the energy transition.

We have always and in various capacities supported the work of the UN Framework Convention on Climate Change. For several years now, the Manila Observatory has been privileged to play a key role in the international negotiations on climate finance and the complex issue of Loss & Damage.

In publications and presentations, we are happy to report a bountiful harvest in 2024 of 15 Scopus-indexed journal articles, 33 presentations, one conference paper, and three major reports.

We know that the record warmth of 2024 will be surpassed in the coming years. Clearly then, we have our work cut out for us.



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RESEARCH AND SOCIETAL ENGAGEMENT

/ Air Quality Dynamics
/ Data and Sensor Development
/ GeoDynamics Research
/ Geomatics for Environment and Development
/ Regional Climate Systems
/ Klima Center

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RESEARCH AND SOCIETAL ENGAGEMENT

The mission of the Manila Observatory is carried out by its five laboratories and a center that is its social engagement arm. These groups are:

01 Air Quality Dynamics (AQD) Lab

AQD provides scientific guidance to air quality assessment and management through its atmospheric monitoring, data analysis, and modeling activities.

02 Data and Sensor Development (DSD) Lab

DSD deploys sensors, data, systems, and analytics research to support the Manila Observatory's instruments and observational network.

03 GeoDynamics Research (GDR) Lab

GDR develops climate-friendly geo-materials and studies land surface changes that arise from climate change.

04 Geomatics for Environment and Development (GED) Lab

GED taps satellite and mapping technologies to observe, understand, and connect socio-environmental change to climate action and disaster risk governance.

05 Regional Climate Systems (RCS) Lab

RCS conducts high-resolution climate research using numerical modeling and data analysis to strengthen climate adaptation, mitigation, and disaster risk resilience.

06 Klima Center (KLIMA)

KLIMA works on global/local climate policy and advocacy to bring about effective action on climate change in accordance with climate justice.

Air Quality Dynamics

The AQD Lab provides scientific guidance to air quality assessment and management through its atmospheric monitoring, data analysis, and modeling activities.

In 2024, the AQD Lab focused mainly on contributing to international collaborative campaigns such as the Airborne and Satellite Investigation of Asian Air Quality (ASIA-AQ) and the Health Investigation and Air Sensing for Asian Pollution (Hi-ASAP) Initiative. The latter aims to understand local air quality issues and its adverse impacts on human health.

Additionally, long-term air quality monitoring instruments under the Aerosol Robotic Network (AERONET) and Pan-Asia Partnership for Geospatial Air Pollution Information and the Pandora Asia Network (PAPGAPI-PAN) projects were also installed at the Manila Observatory. The AQD Lab continues its regular monitoring of $PM_{2.5}$ concentrations in the atmosphere, while strengthening its collaboration with the Department of Environment and Natural Resources - Environmental Management Bureau (DENR-EMB). The Lab presented its work at several international gatherings in 2024.

Airborne and Satellite Investigation of Asian Air Quality (ASIA-AQ)

The Manila Observatory participated in the Philippine leg of the Airborne and Satellite Investigation of Asian Air Quality (ASIA-AQ) campaign from 1-14 February 2024. The ASIA-AQ campaign is led by the National Aeronautics and Space Administration (NASA) and joined by scientists from the Philippines, Taiwan, Thailand, and South Korea.

Figure 1. (a) The MO AQD team with Dr. Gerry Bagtasa of the University of the Philippines, (b) Dr. Melliza Templonuevo Cruz and (c) Ms. Paola Bañaga aboard the DC-8 Airborne Science Laboratory, (d) Dr. Maria Obiminda L. Cambaliza going on board the Gulfstream GIII Aircraft, and (e) Dr. James Bernard B. Simpas reunite with the DC-8 Airborne Science Laboratory after 25 years. Dr. Simpas previously collaborated on the Airborne Tropospheric Hydrogen Oxides Sensor (ATHOS) aboard NASA's DC-8 aircraft during the SAGE III Ozone Loss and Validation Experiment (SOLVE) in the Arctic winter of 1999-2000.

Initial results from the campaign will be discussed in the Science Team Meeting in Malaysia on 20-24 January 2025. This will be followed by a country synthesis report in mid-2025. Prior to the campaign and in collaboration with the DENR-EMB, the AQD Lab deployed Aerosol Robotic Network (AERONET) sun photometers in Muntinlupa and Meycauayan, Bulacan.

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Health Investigation and Air Sensing for Asian Pollution (Hi-ASAP)

The Health Investigation and Air Sensing for Asian Pollution (Hi-ASAP) Initiative aims to understand the health effects of $PM_{2.5}$, particularly on populations exposed to distinct Asian sources. Under Hi-ASAP, a regional collaborative campaign was conducted to understand the characteristics of indoor and outdoor fine particulate matter (PM_1 and $PM_{2.5}$) in urban areas in Asia. This campaign was participated in by the Philippines, Vietnam, Taiwan, Bangladesh, Indonesia, Myanmar, Malaysia, Mongolia, and Thailand. In each country, two sites were selected – one residential and one impacted by traffic emissions. In Metro Manila, these two sites were in Marikina City. The AS-LUNG-P sensors collected indoor and outdoor PM_1 and $PM_{2.5}$ every 15 seconds. Using MiniVol Tactical Air Samplers (TAS), 24-hour $PM_{2.5}$ samples were also collected on quartz filters for elemental and organic carbon analyses. These sampling activities were conducted for seven days during the dry and wet season.

Another project under the Hi-ASAP Initiative aims to assess indoor air quality in households of varying economic conditions in Metro Manila and its association with heart rate variability, changes of which are an indicator of increased risk of cardiovascular disease. The project is jointly funded by the International Science Council and the Department of Science and Technology. To date, several participants have completed the data gathering of both the heart rate variability and the $PM_{2.5}$ concentrations that they were exposed to. Figure 2 shows the AQD Lab members explaining the project and its data gathering methodology to potential participants.

Figure 2. AQD Lab members, headed by Dr. Maria Obiminda L. Cambaliza, and potential participants on the project entitled "Association between exposure to PM2.5 and heart rate variability changes in selected households: An indoor air quality case study in Brgy. Loyola Heights, Quezon City".

Aerosol Robotic Network (AERONET)

Figure 3. The collocated AERONET sun photometer and Clarity Node-S (also on the inset) on the rooftop of the Manila Observatory main building.

A Clarity Node-S sensor was installed at the Manila Observatory to be collocated with the Aerosol Robotic Network (AERONET) sun photometer. The Clarity Node-S is an air quality monitoring instrument that measures $PM_{2.5}$ and NO2 in near real-time. The collocation of these two sensors, shown in Figure 3, aims to provide a deeper understanding of the relationship between near-surface and atmospheric column-integrated particulate matter loading.

Findings from the 15-year AERONET sun photometer measurements at the Manila Observatory and the Notre Dame of Marbel University in South Cotabato were presented at the AERONET Science and Application Exchange (ASAE) held at the University of Maryland in the US.

The measurements from 2009-2023 show that average aerosol optical depth (AOD) at 500 nm at the Manila Observatory was 43% higher than in NDMU, clearly reflecting the difference in urban atmospheres and pollution sources in MO and NDMU.

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Pan-Asia Partnership for Geospatial Air Pollution Information and the Pandora Asia Network (PAPGAPI-PAN)

The Pan-Asia Partnership for Geospatial Air Pollution Information and Pandora Asia Network (PAPGAPI-PAN) project is an international cooperation on air pollution that involves monitoring, data-sharing, and capacity-building activities. As part of the monitoring activities, a Pandora spectrometer was installed at the Manila Observatory. The Pandora instrument measures columnar amounts of ozone (O3), nitrogen dioxide (NO2), and formaldehyde (CH2O) in the atmosphere. Aside from monitoring air pollution, the Pandora spectrometer measurements are also used to validate the measurements of the Korean Geostationary Environment Monitoring Spectrometer (GEMS) aboard the GEO-KOMPSAT-2B satellite.

Figure 4 shows the instrument and people from the Embassy of the Republic of Korea, Korea International Cooperation Agency, Philippine Space Agency, and the Manila Observatory during the ceremonial turnover of the instruments to the Philippines.

Figure 4. Clockwise from top left: The Pandora head sensor and sun tracker; the main control box which contains the spectrometer and computer; and representatives from the Embassy of the Republic of Korea, Korea International Cooperation Agency, Philippine Space Agency, and the Manila Observatory during the ceremonial turnover. The head sensor and sun tracker are on the rooftop while the main control box is in a temperature-controlled room on the 3rd floor of the Manila Observatory main building.

A workshop was held in September 2024 in Cebu City to build the capacity of the PAPGAPI-PAN Philippines project members on the operation and maintenance of the Pandora instrument as well as on data analysis, particularly the use of the GEMS Application Tool (GEMSAT). The 3rd workshop of the Pandora Asia Network was also held this year in Bangkok, Thailand, where members presented the status of their respective networks.

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Other Activities

The AQD Lab continued its regular monitoring of $PM_{2.5}$ using the Minivol TAS and the AS-LUNG-O sensor. It also monitored the urban atmosphere during the 2024 New Year celebrations, as part of its long-term record of measurements. A noticeable decrease in concentrations can be observed in the current decade (2015-2024) compared to the previous decade (2005-2014). For example, the Manila Observatory site had an average concentration of 252 µg/m3 from 2005 to 2014 but only 73 µg/m3 from 2015 to 2024. This corresponds to a 71% decrease in PM2.5 concentrations between the two decades. This decrease may be attributed to government restrictions and campaigns against the use of pyrotechnic devices. However, even with this decrease, $PM_{2.5}$ levels are still in the "Unhealthy" category.

The Lab also presented the initial results of last year's study on the $PM_{2.5}$ exposure of university students and staff as well as findings from the 2019 CAMP2Ex campaign at the 16th International Commission on Atmospheric Chemistry and Global Pollution (iCACGP) Symposium and 18th International Global Atmospheric Chemistry (IGAC) Science Conference (2024) in Kuala Lumpur, Malaysia. Also, the Lab presented at the 2024 7-SEAS and KPEx Workshop in Taipei, Taiwan, and at the Asian Regional Exchange for Clean Air in Beijing, China. The 7-SEAS program aims to foster research on the interaction between aerosols, meteorology, and climate. The discussions at the Asian Regional Exchange focused on the scientific basis of air quality management programs. Photos from these events are shown in Figure 5.

Figure 5. Clockwise from top left: AQD Lab members at the iCACGP-IGAC Conference 2024, Asian Regional Exchange for Clean Air, AERONET Science and Application Exchange, and the 2024 7-SEAS and KPEx Workshop.

Finally, the Manila Observatory and the Environment Management Bureau – National Capital Region (EMB-NCR) signed a Memorandum of Agreement detailing the roles and responsibilities of both parties concerning the Ambient Air Quality Monitoring Station (AAQMS) in MO. In this connection, the EMB and MO conducted a joint inspection of the AAQMS (Figure 6) in October this year. The goal is to make this station a reference station for calibrating other air quality instruments in the country.

Figure 6. Fr. Jose Ramon T. Villarin SJ and Dr. James Bernard B. Simpas join representatives from the DENR-EMB Central and NCR offices in inspecting the Ambient Air Quality Monitoring Station (AAQMS) at MO.

Data and Sensor Development

DSD deploys sensors, data, systems, and analytics research to support the Manila Observatory's instruments and observational network.

The DSD Lab is tasked with the operation, maintenance, and reconditioning of the Automated Weather Stations (AWSs) in various parts of the country. In 2024, the Lab's activities focused on improving the AWSs in the SM Mall network and reconditioning the Palawan sites of Pilipinas Shell Foundation Inc, as part of the High Definition Clean Energy, Climate, and Weather Forecasts for the Philippines (ECW) Project.

The Lab was involved in the Climate Resilient Cities (CRC) Project through its help with the AWSs in Batangas, Legazpi, Borongan, and Cotabato cities. The Lab also helped upgrade the Global Navigation Satellite System (GNSS) receiver by refurbishing the system's server room and its antenna cable layout. Events in the ionosphere during the solar maximum of solar cycle 25 were detected by the Vertical Incidence Pulsed Ionospheric Radar (VIPIR) instrument.

The Lab participated in international workshops such as the Applications of Global Navigation Satellite Systems organized by the United Nations Office of Outer Space Affairs and presented at the 7th Asia Oceania Space Weather Alliance.

High-definition Clean Energy, Climate, and Weather Forecasts for the Philippines (ECW)

An upgrade for the battery power system for the Lufft AWS has been deployed to SM Mall sites and Palawan Province. This power system upgrade has decreased the occurrence of Lufft AWS going offline due to low power status. For the project, both Lufft and Davis AWS models are still the composition of the AWS network. Figure 7 shows the sites where the AWS are located.

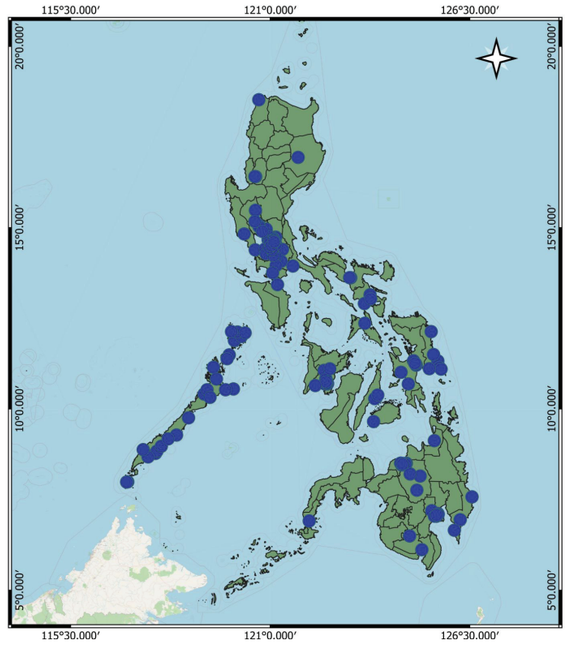

Figure 7. Location of Automated Weather Station Sites of Manila Observatory.

The network is composed of 181 stations, 92 of which are Davis, and 89 are Lufft weather stations. Some stations remain offline because of challenges in gaining access to them, such as permitting issues from organizations that own the properties where the stations are located. Many of these problematic sites are in the Magat Dam area and former Weather Philippines Foundation partners.

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Figure 8. MO AWS team and Palawan PDRRMO team at the rooftop of Roxas, Palawan Public Market with the reconditioned Lufft AWS.

Through its AWS reconditioning efforts, the Lab has reached out to the Marikina City LGU and Mapakalamidad, an NGO that develops crowd-sourced web application platforms for real-time disaster information sharing. Formal agreements were made with Mapakalamidad and Marikina in December 2024 to respectively improve disaster advisories for the public using web and social media platforms, and collaborate on strengthening the disaster risk reduction and management capacity of the city.

The Lab participated in the Asia-Pacific Ministerial Conference on Disaster Risk Reduction (APMCDRR) as co-exhibitor with the Pilipinas Shell Foundation Inc. In this Conference, the Lab showcased the growing network of AWSs in the Philippines. The AWSs gained the attention of LGUs who were looking into having an AWS in their own areas.

Global Navigation Satellite System (GNSS)

Kirsten Arnell of Earthscope Consortium visited the GNSS receiver station and worked with DSD's Jonas Jickain and MO's Facilities and Logistics Office on replacing the antenna receiver and laying new cables from the receiver to the server room in MO.

A new equipment cabinet and uninterruptible power supply were also installed to ensure the continuous operation of the GNSS station.

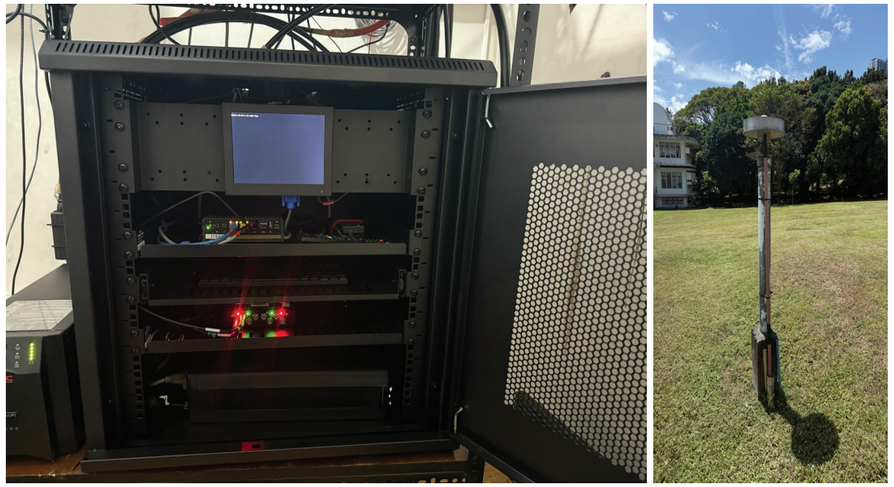

Figure 9. Server cabinet for GNSS (left) and new cabling installed to antenna (right).

Vertical Incidence Pulsed Ionospheric Radar (VIPIR)

Regular vertical soundings of the ionosphere from the VIPIR instrument in MO were presented to the 7th Asia Oceania Space Weather Alliance (AOSWA) Workshop on 8-11 October 2024 in Bangkok, Thailand. This was attended by DSD's Lalaine Asares who showed our measurements during the space weather and terrestrial events within the solar cycle 25. A solar cycle has an 11-year period and we are presently on the 25th cycle, counting from the time reliable sunspot observations were made in 1755.

Figure 10. Poster presentation session at the 7th AOSWA in Bangkok, Thailand.

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Other activities included data analysis and technology sharing; discussion of recent achievements in observational, theoretical, modelling, forecasting efforts; applications of space weather; and fostering connections with different experts in the field which is realized by joining the Joint Spatio-Temporal Ionospheric Mapping Initiative (JSTIMI) by Boston College as a Space Science Partner.

The Lab attended a United Nations/Philippines workshop on the applications of GNSS on 22-26 April 2024 that was organized by the Office for Outer Space Affairs (UNOOSA) in cooperation with the National Mapping and Resource Information Authority (NAMRIA) and the Philippine Space Agency.

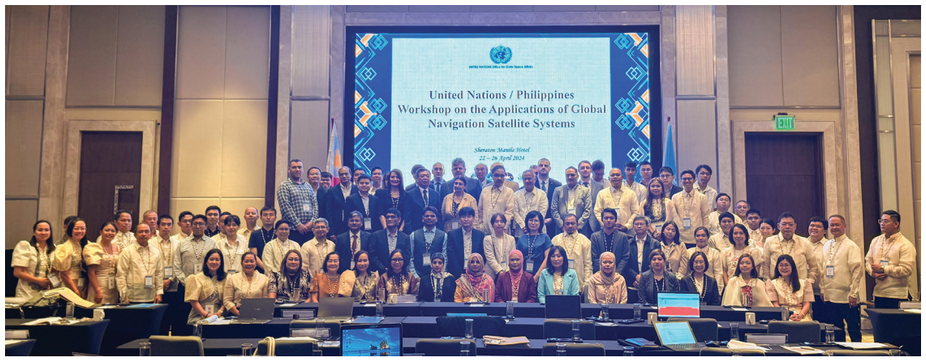


Figure 11. Participants of the UN/Philippines Workshop on the Applications of GNSS

Participants in this workshop represented 23 Member States of the UN. GNSS-based technology and applications to disaster risk reduction and space weather were presented in this workshop. As one of the station operators of the GNSS global network, the MO maintains these GNSS observations to complement ground-based ionosonde data for the Equatorial Plasma Bubbles research.

Climate Resilient Cities (CRC)

For the phase 2 of the project, the packetWEATHER AWSs from Packetworx were pulled out of the cities of Batangas, Borongan, Cotabato, and Legazpi. They were replaced with new sensors and system platforms provided by Komunidad, a private company that provides software platforms for climate mitigation and adaptation. The participation of MO in the deployment of new AWS sensors was confined to Borongan and Cotabato cities.

The DSD Lab participated in the Internet-of-Things (IoT) Conference 2024 organized by Packetworx. In this conference, Dr Sherdon Uy (DSD Lab head) was a resource speaker in the IoT for Agriculture and Disaster Management session.

Figure 12. Panel discussion on IoT applications to agriculture and disaster management.

MO website and web technologies development

A new website has been developed in order to update the current MO site. New content has been added to update the ongoing activities of the institution. The new website is also being designed to serve as a portal for the public to access MO's different data and knowledge offerings, such as climate/weather, solar and wind power, air quality, geographic maps, and the like. Through the developments in the API endpoint, interested parties and stakeholders are now able to access data stored from our measuring instruments to MO servers.

GeoDynamics Research

GDR develops climate-friendly geo-materials and studies land surface changes that arise from climate change.

In 2024, the GeoDynamics Research (GDR) Lab's research focused on characterizing geomaterial composites made from various waste materials and analyzing their strength using Experimental and Computational Fracture Mechanics. We used a model to determine the strength of the material from the emission of sound and light that accompanies the fracturing process.

Additionally, the GDR Lab contributed to the Climate Resilient Cities (CRC) Project by assessing the coastal vulnerability of Cotabato City, which meant identifying high-risk areas due to diminishing mangroves, low coastal slopes, and insufficient engineering protections.

Grain Size Analysis confirmed the coastal soil to be composed of fine to medium-sized sand particles, adding to the coast's susceptibility to erosion. Lastly, preparations were made for the installation in 2025 of the first PHIVOLCS seismic borehole station at MO to enhance earthquake monitoring in the country.

Geomaterials characterization: Computational and Experimental Fracture Mechanics

In 2024, the GDR Lab worked on strength analysis and materials characterization of geomaterial composites (cement mortars) made from waste oyster and scallop shells, sugarcane bagasse and rice husk ash, waste glass powder, volcanic ash, and discarded face masks. In 2023, the work focused on the design, fabrication, and implementation of self-healing cement mortars. This year, the focus was on using Experimental and Computational Fracture Mechanics, based on the Rabinovitch Surface Oscillation Model, to correlate the compressive strength of materials with the emission intensity of electromagnetic radiation (EMR) and acoustic fracturing (AF). In other words, we cracked materials and measured the amount of light and sound energies emitted during the fracturing process.

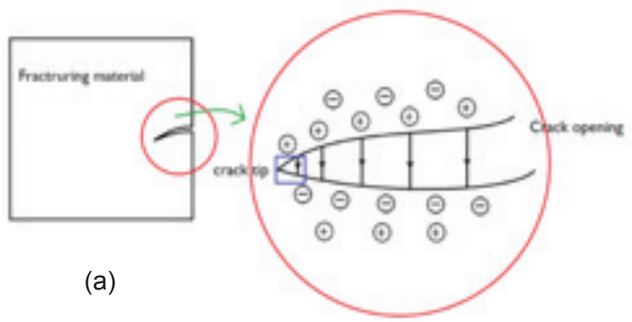
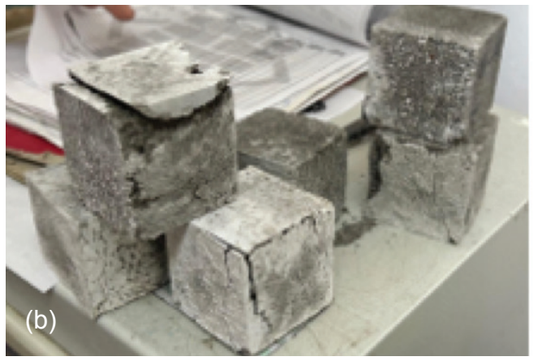


Figure 13. (a) Charged atoms on a propagating crack surface emit electromagnetic radiation according to the Rabinovitch Surface Oscillation Model in Computational Fracture Mechanics; (b) Fractured standard ASTM cement mortar cubes, and (c) Fracture from the impact loading of a mortar sample.



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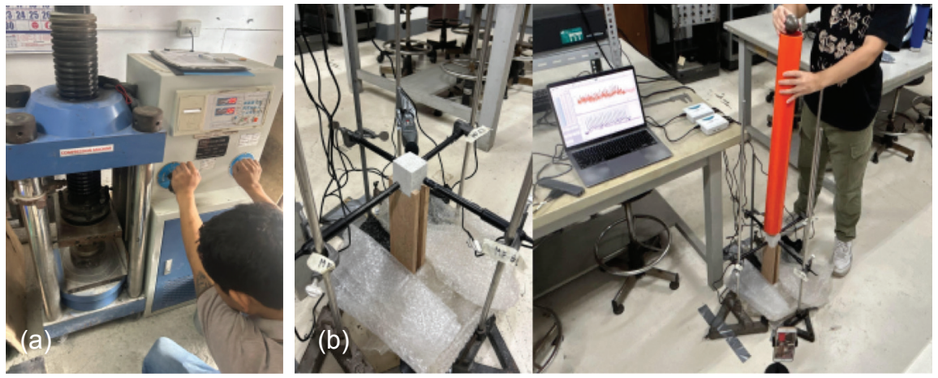

Figure 14. Dichotomous Testing Methodologies: (a) Measuring compressive strength using a standard Compression Testing Machine and (b) Impact Loading setup using magnetic field sensors, computer interface, and laptop.

We are able to analyze the strength of materials using the Rabinovitch Surface Oscillation Model. Our experiments show a negative correlation between composite strength and EMR emissions. In other words, the weaker the material, the greater the EMR emissions. The stronger the material, the lesser the EMR emissions. Furthermore, there is a recorded time lag between acoustic and electromagnetic emissions. This time lag is positively correlated to the strength of the material. That is, the stronger the material, the longer the time lag between the peaks of sound and light emissions.

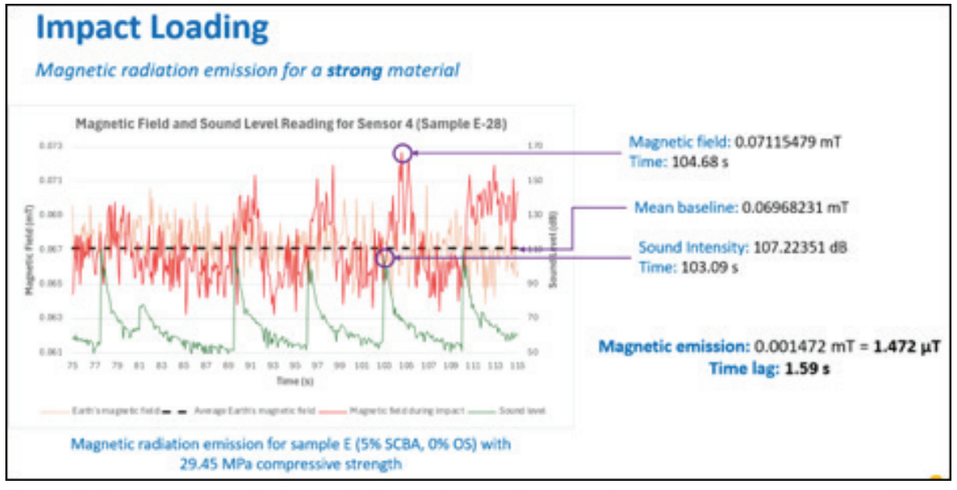

Figure 15. Electromagnetic Radiation (EMR) and Acoustic Emissions for a strong cement mortar with 5% sugarcane bagasse ash and 0% oyster shells.

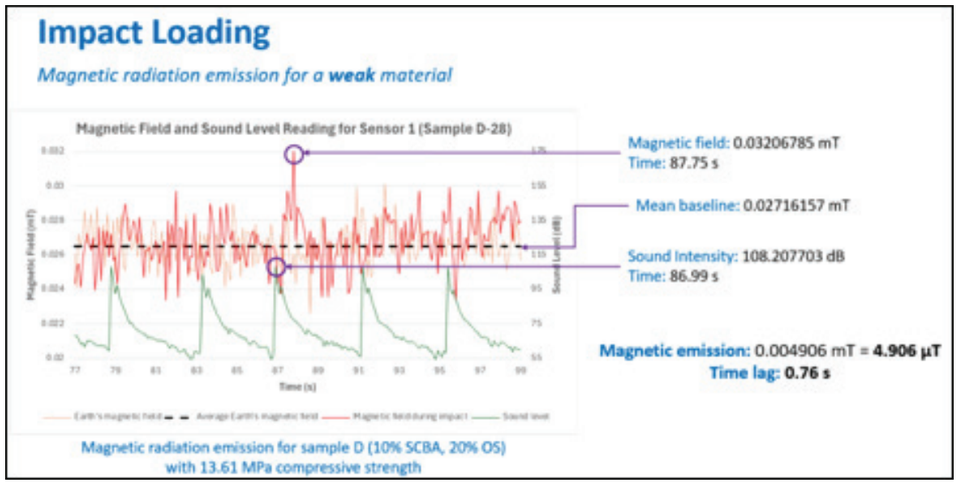

Figure 16. Electromagnetic Radiation (EMR) and Acoustic Emissions associated with weak cement mortar with 10% sugarcane bagasse ash and 20% oyster shells.

Coastal Vulnerability Assessment (CVA) of Cotabato City

The GDR Lab has been a major player in the USAID Climate Resilient Cities (CRC) Project through its assessment of the vulnerability of coastal communities in hazard-prone areas such as those in Cotabato City. Three coastal barangays in this city were assessed: Kalanganan Mother, Kalanganan I, and Kalanganan II. After desktop studies were conducted using remote sensing data from Google Earth Pro and generated risk maps, the GEO-Geo team composed of MO, the LGU and CRC Project representatives, set out to do field work from 2 to 6 September 2024. Among the parameters assessed were the geomorphology, shoreline change, coastal slope, natural buffers, engineering structures (and human activities), coastal alignment, and mean tidal range.

Initial results of the field work indicate a relatively high vulnerability of Cotabato City to coastal hazards due to dwindling natural buffers (e.g. mangroves), existing geomorphology (mudflats and low coastal slope), and lack of stable engineering structures to protect the coastline from extreme events such as tsunamis, storm surges, and long-term sea-level rise. The goal of the project is to assign a coastal vulnerability index (CVI) that matches both remote sensing (satellite) data and field work data. Coastal hazard risk maps are then created for the government, LGU, community leaders, and other stakeholders.

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Figure 17.
The GEO-Geo Team
in Mother Barangay
Kalanganan, Cotabato
City, 04 September 2024.

Figure 18. (a) Mudflats and Forest Vegetation; (b) Boat ride across the Rio Grande, Cotabato City;
(c) Coastal Communities by the shoreline fringes; (d) Fragmented un-zoned Mangroves.

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Grain Size Analysis of Cotabato City Soil

Using the Grain Size Analysis test, coastal soil in Cotabato City was observed to be fine to medium sand in classification. Because the coastal slope of Cotabato is minimal (i.e. almost flat), sand grains are readily rolled back and forth by sea waves and broken into smaller fragments. Knowing the size distribution of these grains will help us determine the erosion characteristics of the coastal surface.

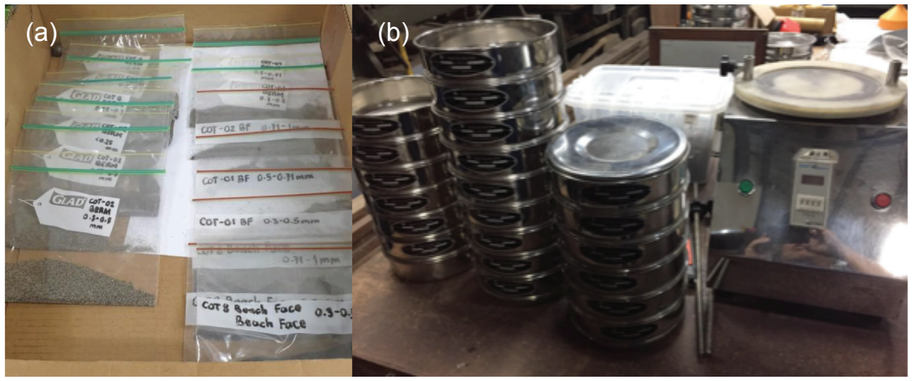

Figure 19. (a) Sample Soil from the Kalanganan I, II, and Mother coasts, (b) EM Shaker and Sieves used.

Table 1.
Soil Classification based on particle size range (USCS)

Soil type		Particle Size (mm)
Clay		<0.002
Silt		0.002-0.075
Sand	Fine	0.075-0.42
	Medium	0.42-2.0
	Coarse	2.0-4.75
Gravel		4.75-75

Table 2.
The sieves typically used in the Grain Size Analysis test

Sieve #	Opening Diameter (mm)
4	4,75
10	2
20	0,85
40	0,425
60	0,25
100	0,15
140	0,105
200	0,075

Figure 20. The Trillium 120 Borehole Seismometer: for deep-earth deployments in cased boreholes.

Update on the First PHIVOLCS Seismic Borehole Station at MO

The Memorandum of Agreement between MO and PHIVOLCS was finalized in 2024 and the construction of the first seismic borehole station in the Philippines has been set to commence in early 2025. It shall be located near MO's Seismic Vault on a circular land area of about 30 cm diameter with depth of about 30 meters. The latest generation of the Trillium 120 instrument shall be housed in a stainless steel enclosure and will be more efficient, cutting energy consumption by more than half. Other borehole-related sensors and tools will be housed in MO's Seismic Vault.

The seismic borehole station will measure four main wave properties: velocity, amplitude, frequency, and attenuation, which are then used to interpret subsurface earthquake waves. This station at MO will allow us to more accurately detect earthquakes by sensing the vertical propagation of underground seismic waves to the surface.

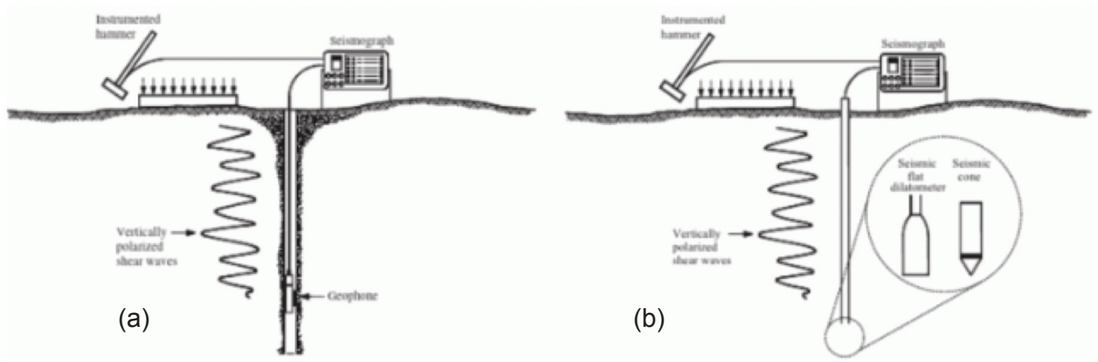

Figure 21. Schematic of the down-hole test: (a) using a borehole, and (b) using the seismic cone.

Geomatics for Environment and Development

GED taps satellite and mapping technologies to observe, understand, and connect socio-environmental change to climate action and disaster risk governance.

The Geomatics for Environment and Development (GED) Lab has been working with the Department of Environment and Natural Resources (DENR) to develop a Climate Change Information Management System (CCIMS) that helps decision-makers create climate action plans using maps and data.

In 2024, phase 2 of the project focused on improving the system's design, building its content, and training users of the system.

The Lab also contributed to climate resilience efforts, including mapping flood and landslide risks in various cities and assessing coastal vulnerability in Batangas, Borongan, and Cotabato. Additionally, GED improved the GEO MS system, a mapping tool that helps track disaster risks using Microsoft Azure and open-source technology.

The team presented these projects at various conferences and continues to refine them to support efforts in climate adaptation and mitigation, and disaster management.

Support to the Establishment of the Climate Change Information Management System (CCIMS) and Other DENR Information Systems

The collaboration with the DENR started as phase 1 in June 2023 and continued to phase 2 in the last quarter of 2024. Phase 1 was concluded and all of the outputs were submitted including the proof-of-concept for the CCIMS-DEVCalque v.1 analytical dashboard and geospatial database.

Phase 2, entitled "Refinement, Pilot Implementation, and Capacity-Building on CCIMS-DEVCalque v.1," continues the incorporation of new content and the improvement of the dashboard design and functionalities. The decision support system (DSS) in the CCIMS applies geospatial information, tools, and methods to climate governance and action. This system supports the use and implementation of the National Climate Change Action Plan (NCCAP) 2011-2018 and the National Adaptation Plan (NAP) 2023-2050, both of which are taken into account by the National Climate Change Expenditure Tagging (NCCET) system.

The conceptual framework (Figure 22) is composed of four modules that feature the requisite workflows needed to generate Geospatial Climate Change Action Plans (GCCAPs). These modules can be iterated, depending on the need to assimilate new data and information.

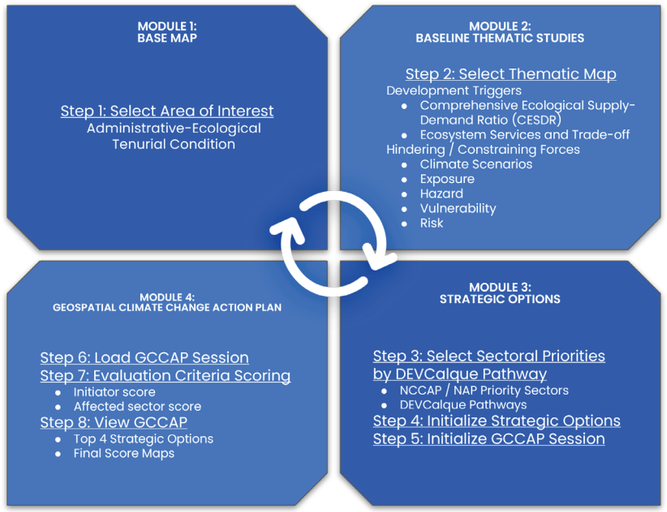

Figure 22. CCIMS-DEVCalque flow diagram.

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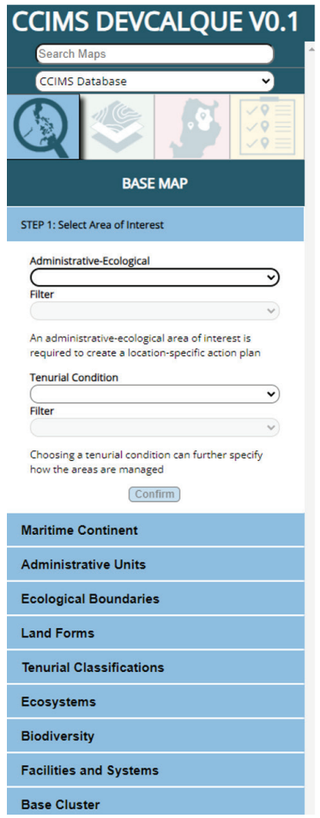
In module 1 (Figure 23), the user selects an area of interest (AOI) that is pegged to administrative-ecological boundaries and/or tenurial conditions.

In module 2 (Figure 23), the baseline thematic map has two categories: (i) development triggers, and (ii) hindering-constraining vs helping-enabling forces. The former is usually affected by population growth and migration, which drive the supply and demand of resources, including ecosystem services and trade-offs. The latter contains information on climate risk as a function of climate-related hazards, exposures, and vulnerabilities. Users can select thematic maps of interest for the chosen AOI.

Module 1



Module 2

Figure 23. Module 1 (or AOI) and module 2 (or baseline thematic studies).

Module 3 (Figure 24) is all about the generation of strategic options. The priority sectors based on NCCAP and NAP are identified, both of which contain adaptation and mitigation plans to reduce the impact of climate change. In addition, DEVCalque pathways are selected to help resolve competing resource demands and development priorities related to disaster risk resilience and sustainable development. Upon selection and initialization of priority sectors and DEVCalque pathways, strategic options or action plans in geospatial format are generated. These strategic options are then mapped geospatially, thus enabling the assessment of their site suitability.

Module 3

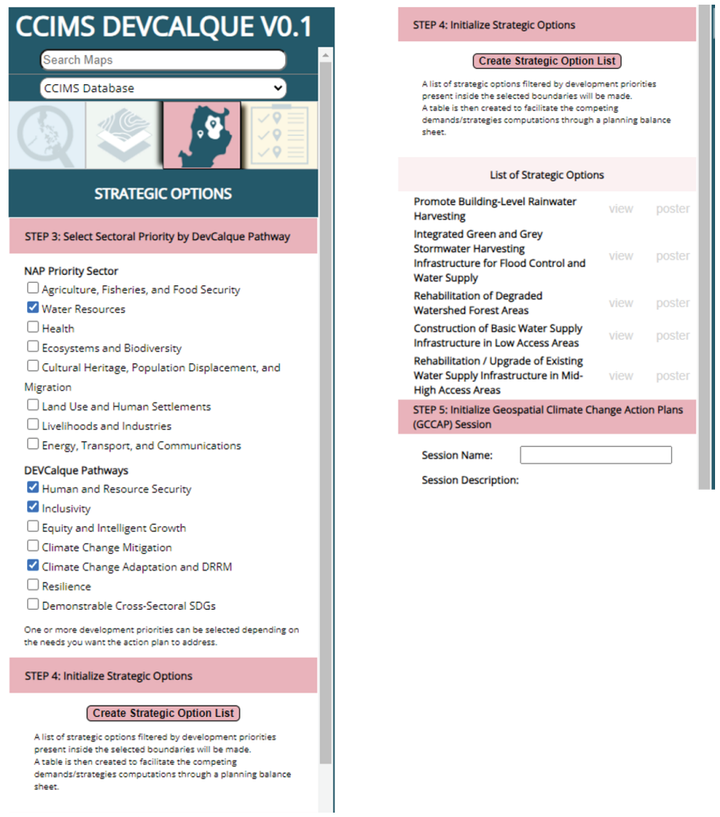


Figure 24. Module 3 or strategic options.

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In module 4 (Figure 25), the options generated from module 3 are presented to stakeholders who are asked to rank these options based on their experience and expert judgment. An evaluation criteria scoring system facilitates the ranking done by two types of stakeholders: the initiator and affected sectors. The overall output of this module are the top four strategic options, GCCAP maps, and other related documents. These are designed to guide decision-makers on which climate action plans to prioritize and implement in their AOI.

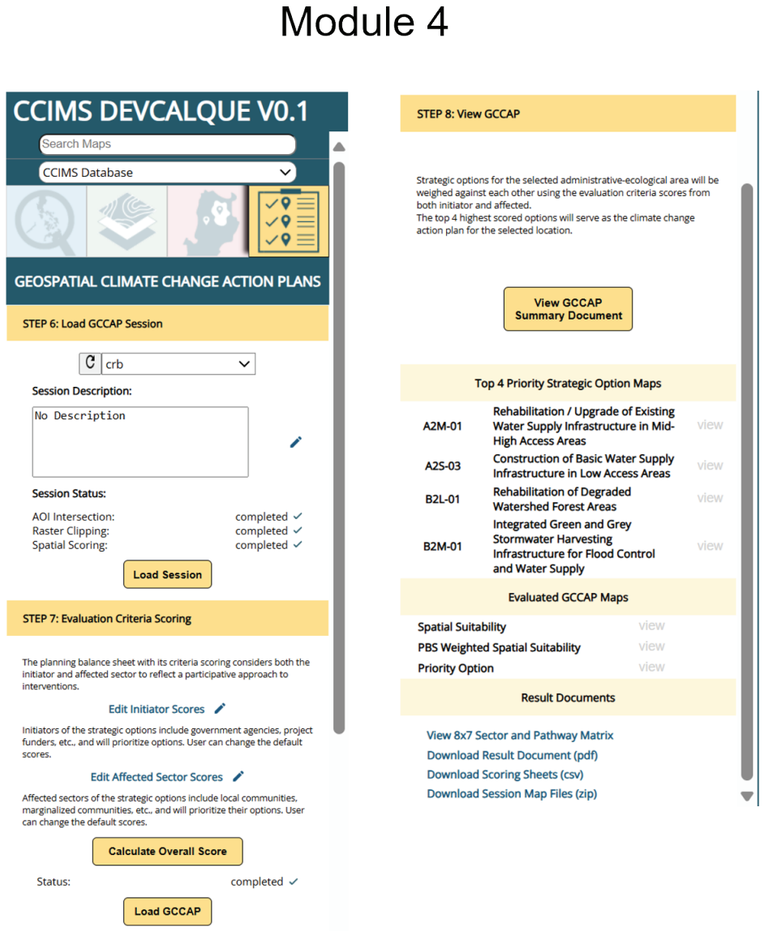

Figure 25. Module 4 or geospatial climate change action plan (GCCAP).

CCIMS DEVCalque utilizes Microsoft Azure, a cloud provider, and other open-source resources. Among the Phase 2 deliverables was dashboard testing and capacity building, as shown in Figure 26. Moreover, continuing consultations with the DENR all throughout 2024 were done to improve the CCIMS (Figure 27).

Figure 26. CCIMS DEVCalque dashboard beta testing conducted on 22 November 2024.

Figure 27. CCIMS DEVCalque presentation to DENR.

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Climate Resilient Cities (CRC)

The objective of the Climate Resilient Cities (CRC) project is to enhance the ability of the cities to adapt to, mitigate, and manage the impacts of climate change and disasters, ultimately improving the resilience of the community.

The initial phase of MO's engagement in the CRC project was on generating climate-adjusted hazard maps, specifically maps of rainfall-induced landslides and flooding. In 2023, the GED Lab, together with field geologists, went to various study sites to conduct field validation of the initial results of these climate-adjusted hazard maps.

The general methodology involves logically combining the baseline hazard susceptibility map and the rainfall map, which serves as the trigger for the hazard. While climate change-modified hazard maps were generated, it was observed that despite a clear comparison of rainfall data across different cities using the same threshold, some cities showed no significant changes. This prompted mappers to experiment with rainfall data to determine which index would most accurately reflect ground conditions in the cities. The location of the AWSs that collect rainfall data was also taken into account. For instance, the station nearest to Batangas City is in Ambulong Tanauan, which is a lake away from the city. The station in Borongan City did not have a decade-long dataset, unlike other cities. This raised concerns about the significance of the collected data for each city.

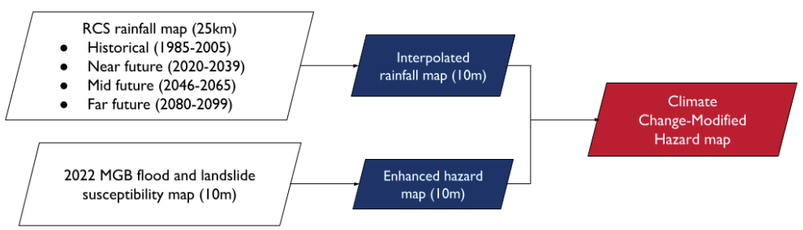

Figure 28. The general methodology for generating the climate change-modified hazard maps combines rainfall data with enhanced hazard information.

After thorough analysis of the data and of how the methodology varied according to local context, the climate-adjusted hazard maps were finalized. These were presented to project partners and the LGUs during the launch of the Private Sector Engagement Playbook for Climate Resilience and Local Government Energy Resilience Handbook on 27 November 2024.

Representatives from each city noted how these climate change-modified hazard maps were important data for their local development plans. For example, these maps will be presented to communities living in riverbank areas to inform and guide people to act on such a climate-related risk.

Figure 29. Presentation of landslide observations in one of the field validation sessions.

Figure 30. RS-GIS specialists from the GED Lab (2nd and 4th from the left) during the presentation of climate-adjusted hazard maps, together with other geologists who did the field validation.

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Climate Change-Modified Coastal Vulnerability Maps

The second phase of MO's involvement with the CRC project entailed assessing the coastal physical vulnerability of the cities of Batangas, Borongan, and Cotabato. Unlike the first phase, Zamboanga City was not included in the coastal vulnerability assessment (CVA) due to its extensive coastline, which could not be amply covered by the team. The GED Lab collaborated with the DENR's Mines and Geosciences Bureau (MGB) since the latter is the government agency responsible for the type of CVA that uses the Coastal Vulnerability Index (CVI).

The MGB methodology focuses mainly on the physical aspects of coastal vulnerability, which can be broadly categorized into two: natural coastal conditions and anthropogenic factors that impact these natural conditions. The parameters considered are the following:

- Shoreline Change
- Geology and Geomorphology
- Coastal Alignment relative to Wave Direction
- Coastal Slope
- Human-Induced Activities
- Natural Buffers
- Mean Tidal Range

These MGB CVI maps became the reference points of the study, and were subsequently modified with the inclusion of parameters affected by climate change, e.g. mean tidal range, coastal alignment relative to wave direction, and sea level change. Prior to assessing Cotabato City's coastal physical vulnerability, MGB held a workshop last 16 July 2024. In this workshop, the desktop study and fieldwork process were explained.

The desktop study included ranking each parameter using satellite images and other relevant data, along with the Analytical Hierarchy Process (AHP) where parameters were weighted according to importance. The maps generated were then used in the three-day field work in Cotabato last September. The fieldwork, done with the help of the Mines and Geosciences Services (MGS), included assessing the physical features of the coastal area and obtaining experiential accounts from the community.

The final CVI maps were generated by adjusting the rankings and weights in AHP according to ground conditions. The baseline CVI maps were developed using historical observed data, while the climate change-modified maps were generated based on future projections of the three parameters mentioned above. Figure 31 shows a sample of these CVI maps for Cotabato.

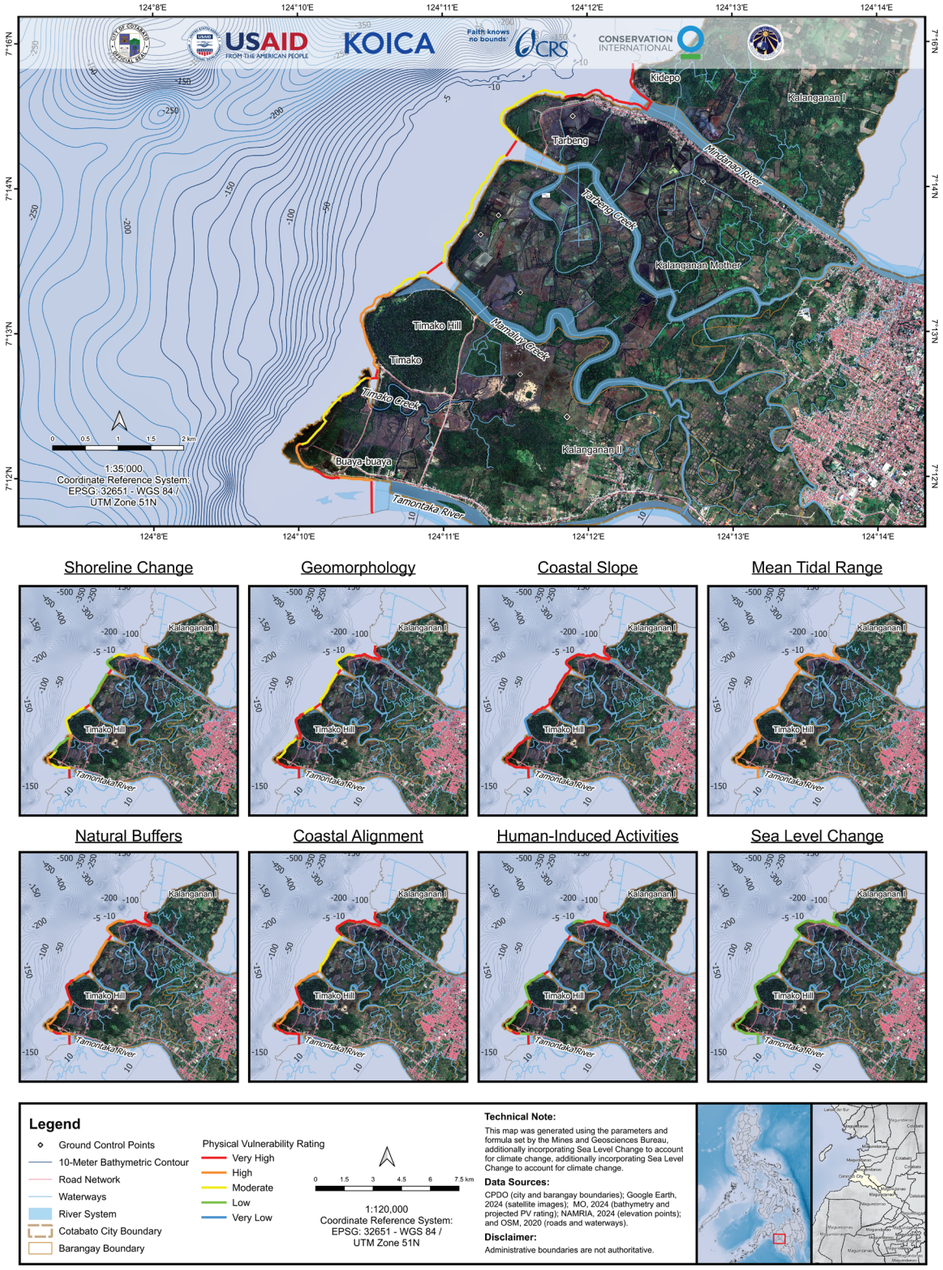

Figure 31. Future coastal (physical) vulnerability maps of Cotabato by mid-century.

Optimizing the Microsoft Planetary Computer for Emergency Observation and Mapping (GEO MS)

The system architecture of the GEO MS dashboard has been substantially improved since 2022. Figure 32 shows the initial architecture with services and resources from Microsoft Azure. In 2024, challenges were encountered that were related to code development and implementation, map processing and visualization, handling and rendition of large geospatial files

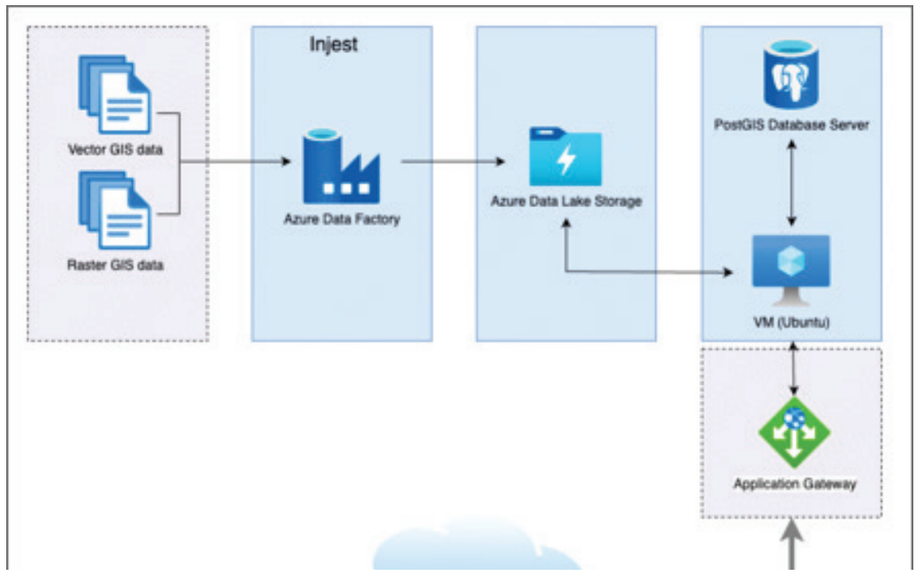

Figure 32. Initial system architecture of the GEO MS project.

Project developers explored other ways to enable faster map processing, lightweight output files, and user-friendly visualization. The modified system architecture is shown in Figure 33. This modification has a client and server side that utilizes Microsoft Azure and open-source services. This modification enables smooth map rendering and navigation on the dashboard.

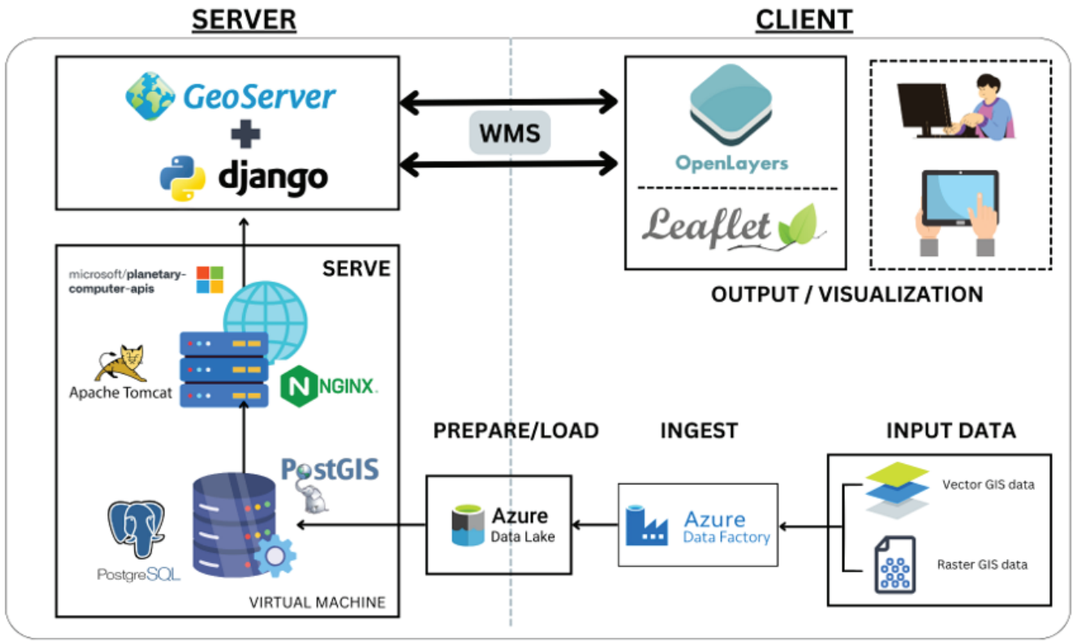

Figure 33. Modified system architecture of GEO MS project.

One of the activities of this project is the development of code that automates map processing at various scales, from national to regional and selected AOI level. The code for exposure and vulnerability maps was done in 2024, while the code for hazard and risk maps is ongoing. As an example, the maps for Tropical Cyclone Vamco (Ulysses) in the Metro Manila AOI are shown on the dashboard in Figure 34.

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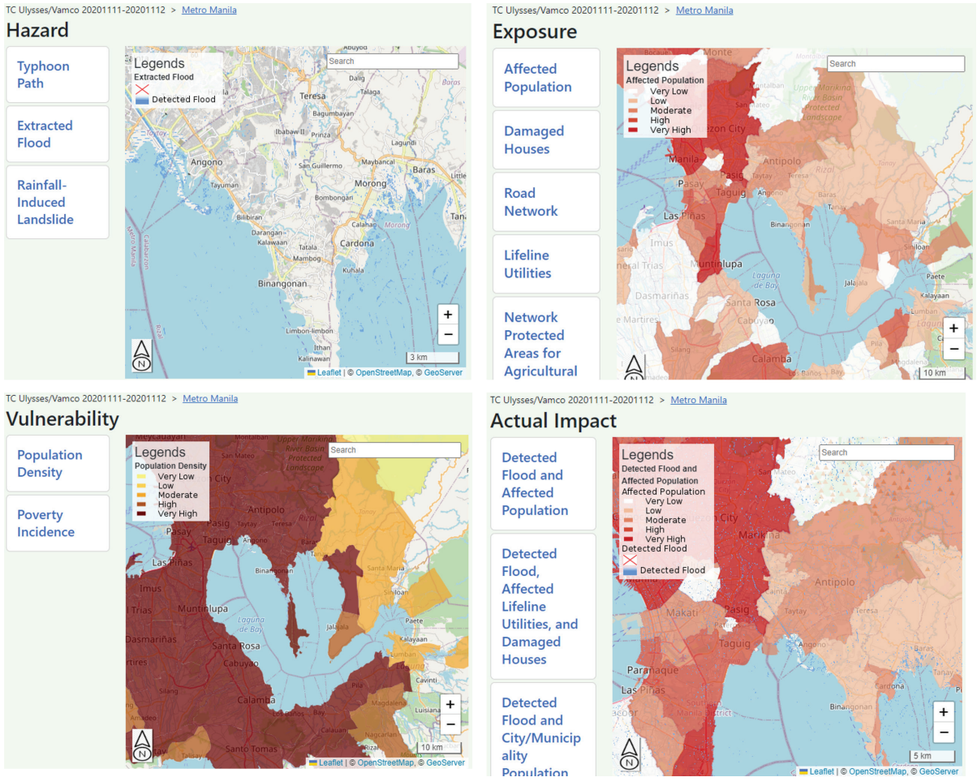

Figure 34. Hazard, exposure, vulnerability, and impact maps for Tropical Cyclone Vamco (Ulysses) in 2020.

Other activities in 2024

Through the GED Lab, MO actively engaged participants through an interactive booth at the Breakthrough Resilience: An Urban Resilience Conference, organized by the Catholic Relief Services Philippines last April 24-25. The booth showcased recent projects and advocacy initiatives on climate resilience and disaster risk. One notable project was the Informal Livelihood Survey of Coastal Cities at Risk in the Philippines, which focused on the informal economy along Commonwealth Avenue in Quezon City.

This survey did a spatial analysis of the area, highlighting both visible patterns and distributions, as well as the underlying relationships among informal livelihood units. The project examined the characteristics of the area, the residents' experiences with hazards, their perceptions of safety, and the adaptation strategies they employ to cope with challenges.

Additionally, the GEO MS project was presented in the 9th Joint Project Team Meeting for Sentinel Asia STEP-3 (JPTM 2024), 5 to 7 November 2024 at the Novotel Manila Araneta City, Quezon City. The presentation showcased the improved system architecture as well as the available Metro Manila AOI maps on the dashboard

Regional Climate Systems

RCS conducts high-resolution climate research using numerical modeling and data analysis to strengthen climate adaptation, mitigation, and disaster risk resilience.

In 2024, the RCS Lab continued to enhance and provide relevant information on extreme weather and climate under the ECW project. Anticipatory action triggers for drought, flood and tropical cyclones that were developed under the SUPREME BARMM project were shared with the BARMM PDRA Analyst Team and project consortium. The RCS Lab also explored new downscaling approaches to generate higher resolution climate information for Philippine cities. This includes statistical downscaling under the CCHAIN project, as well as the use of a land surface physics-based downscaling model under the CARE for SEA megacities project. The Lab also processed and analyzed present-day and future climate data relevant for the assessment of physical vulnerability of coastal cities under the USAID CRC project.

Collaborative work within and outside MO yielded 11 journal publications in 2024. A key publication is the "2024 Philippine Climate Change Assessment: The physical science basis", which provides updated information on the state of climate science in the Philippines. The formalization of the research partnerships with DOST-PAGASA and Yokohama University is also a significant step towards strengthening and advancing climate research in the country. RCS also held exploratory meetings with the ASEAN Centre for Biodiversity and the Philippine Eagle Foundation to develop a project on climate and biodiversity.

Strengthening Resilience through Early Warning System, Enhanced Anticipatory Actions and Multi-risk Landscape Approach in Bangsamoro Autonomous Region in Muslim Mindanao (SUPREME BARMM)

In 2024, the Manila Observatory, together with consortium partners in the SUPREME BARMM project, developed triggers for anticipatory action (AA) for drought, flood and tropical cyclones to support anticipatory and humanitarian action in the BARMM region. Led by Oxfam Pilipinas (OPH) and funded by the European Civil Protection and Humanitarian Aid Operations (ECHO), the project's objective was to strengthen pre-disaster policies and protocols in the region as well as foster collaboration among stakeholders in the Mindanao River Basin (MRB).

During the peak of El Niño in the first quarter of 2024, early action protocols were implemented by the consortium once the AA triggers were reached, which helped deliver the necessary aid to partner communities in BARMM in anticipation of drought impacts. Feedback from experience on the ground has helped refine these triggers. With the end of El Niño and transition to La Niña, efforts shifted to the formulation of AA triggers for flood and tropical cyclones, which were developed in consultation with the project consortium and BARMM AA Technical Working Group and Pre-Disaster Risk Assessment (PDRA) teams. A capacity building workshop with the BARMM PDRA team was conducted in Davao City last 19-20 September 2024 to discuss the AA triggers before its official turnover in Cotabato City last 24 September 2024 (Figure 35).

Figure 35. Capacity building workshop on anticipatory action triggers for drought, flood and tropical cyclone in the BARMM, conducted last 19-20 September 2024 in Davao City.

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High-definition, Clean Energy, Climate, and Weather Forecasts for the Philippines (ECW)

As part of ongoing efforts in solar energy forecasting, a statistical post processing approach called the Kalman-Filter (KF) method was found to improve the solar irradiance forecast for clear sky days during June to August (JJA) 2020 at the Manila Observatory (Figure 36).

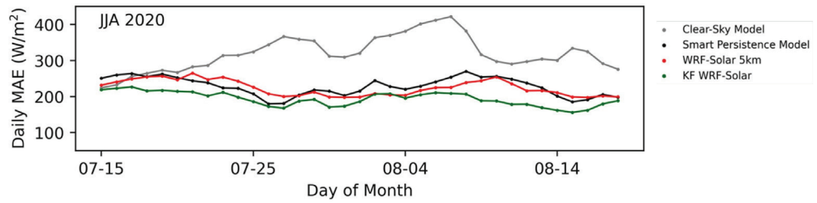

Figure 36. 7-day moving average of mean absolute error (MAE) in global horizontal irradiance (GHI) for JJA 2020 for the Ineichen and Perez clear sky model (gray lines), smart persistence model predictions (black lines), WRF-Solar 5 km (red lines), and KF WRF-Solar (green lines). (Source: Fig 9b of Visaga et al., 2024).

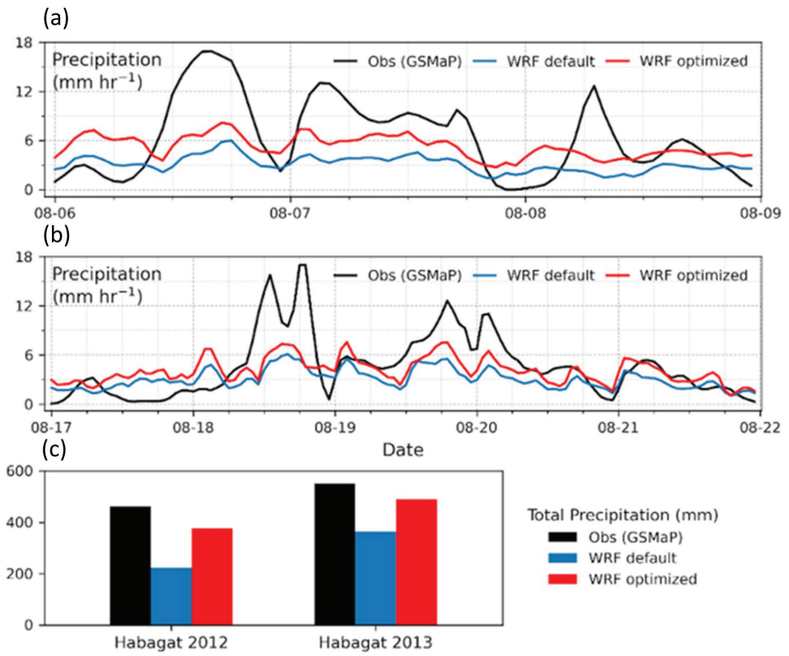

Figure 37. Time series of hourly precipitation area-averaged over Metro Manila for the observed (black), default model settings (blue), and optimized model settings (red) for the (a) Habagat 2012 and (b) Habagat 2013. (c) Comparison of accumulated precipitation averaged over Metro Manila for the simulation days in both cases. (Source: Fig 9g-9i of Henson et al. 2024).

The team also continued its research on improving the skill of the weather forecast system, especially for extreme weather events. Model experiments show improvements in the simulation of rainfall over Metro Manila by 42% and 27% for Habagat 2012 and 2013, respectively, using optimized parameters (Figure 36).

In collaboration with CORDEX Southeast Asia, plans for data processing and analysis of the latest downscaled climate projections from CMIP6 global climate models are underway as the model simulations are completed.

Research outputs from this project are documented in journal publications, as well as shared in international conference presentations. These findings are key to enhancing the information delivered to partner stakeholders and to the public.

Together with the Observatory's communications team, extreme weather bulletins (EWB) have been issued during extreme rainfall and tropical cyclone events, such as the Low Pressure Area (LPA) in January 2024 that caused flooding and landslides in CARAGA and Davao Regions, and TD Aghon in May 2024. EWBs were also issued during STY Gaemi (Carina) on 19-29 July 2024, TC Yagi (Enteng) on 31 Aug - 9 Sep 2024, and Typhoon Bebinca (Ferdie) on 9-18 Sep 2024, which severely affected Metro Manila, Naga City, and the Zamboanga peninsula, respectively, as well as for the following events which occurred within a span of a few weeks:

- Severe Tropical Storm Trami (Kristine): 19 -29 Oct 2024
- Typhoon Yinxing (Marce): 3 -12 Nov 2024
- Typhoon Toraji (Nika): 8 - 15 Nov2024
- Typhoon Usagi (Ofel): 9 - 16 Nov 2024
- Typhoon Man-yi (Pepito): 9 - 20 Nov 2024

EWBs are routinely provided to our partners to supplement the information from PAGASA. These bulletins include TC tracks and intensity, but also extreme rainfall forecasts for the next five days, and accumulated rainfall for the past seven days, which are critical to knowing possible impact areas of these extreme events.

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The drought bulletins that were first issued in April 2023 in preparation for the El Niño event were continued until June 2024 when La Niña "Watch" was raised by the APEC Climate Center. These bulletins included information such as the El Niño-Southern Oscillation (ENSO) status, forecast rainfall and temperature for the next six months, associated risks for each province, as well as historical impacts to agriculture, food security, economy and health in the January 2024 issue. The May 2024 issue featured impacts such as increased heat-related illnesses, fire incidents, power demand, water supply disruptions and damage to agriculture and fisheries. The last bulletin in June 2024 listed the damage and losses attributed to the drought event based on data from the National Disaster Risk Reduction Management Council (NDRRMC) and the Department of Agriculture.

Climatic hazard Assessment to enhance Resilience against climate Extremes for Southeast Asian megacities (CARE for SEA megacities)

CARE for SEA megacities is the latest project of CORDEX Southeast Asia. Funded by the Asia-Pacific Network for Global Change Research and led by MO, this 3-year project aims to generate city-scale climate hazard information under multiple scenarios that can be used in plans to enhance the climate resilience of the Southeast Asian megacities of Bangkok, Hanoi, Jakarta, Kuala Lumpur and Manila.

In the first year of the project, a training workshop was held in Kuala Lumpur last 14-16 May 2024 to build the capacity of researchers in statistical and urban climate downscaling. This was followed by efforts to configure the land surface physics-based downscaling model to represent the local conditions of each city by updating its land cover and conducting sensitivity runs with this model. At the start of the second year of the project, updates on research progress were shared with project collaborators and invited stakeholders during a special session in the 4th International Vietnam Conference on Earth and Environmental Sciences (iVCEES-2024) in Quy Nhon, Vietnam last 26-28 November 2024.

Figure 38. CARE for SEA megacities: Training workshop in Kuala Lumpur, Malaysia last 14-16 May 2024.

Figure 39. CARE for SEA megacities and CORDEX-SEA: A Special Session in the 4th International Vietnam Conference on Earth and Environmental Sciences (iVCEES-2024) in Quy Nhon, Vietnam last 26-28 November 2024.

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Climate Change, Health and Artificial Intelligence (CCHAIN)

In this project led by Thinking Machines Data Science and supported by the Lacuna Fund, the RCS Lab contributed to the creation of an open-sourced linked dataset of climate, health, environment and socio-economic data at the barangay level in 12 Philippine cities for the years 2003-2022 (https://thinkingmachines.github.io/project-cchain/).

An online roundtable forum was held last 26 June 2024 to formally launch the dataset, which can now be accessed and used to inform local climate risk assessments, health services management and risk reduction plans in the Philippines. As a next step, the Lab also explored different statistical downscaling approaches for future applications.

Climate Resilient Cities (CRC)

Following the climate change-modified landslide and flood hazard maps generated last year, the RCS Lab processed present-day and future climate data relevant for the physical vulnerability assessment of coastal cities of Cotabato, Batangas and Borongan.

Maps of the climate-adjusted coastal vulnerability index (CVI) can help identify the relative susceptibility of coastal areas to current and future coastal hazards, which are useful in adaptation planning. The Lab also delivered lectures on climate downscaling and the use of climate data for adaptation planning in workshops conducted by the Klima Center of MO in Borongan City and Batangas City.

MO-PAGASA Partnership

Figure 40. Fr Jose Ramon Villarin SJ (MO Executive Director) and Dr Nathaniel Servando (PAGASA Administrator) with Dr Sherdon Niño Uy (DSD Lab Head) and Dr Marcelino Villafuerte II (PAGASA Deputy Administrator for Research and Development) at the signing of the MOA between PAGASA and MO in PAGASA Central Office on 19 July 2024.

Through a Memorandum of Agreement, the Manila Observatory and DOST-PAGASA have strengthened their partnership and collaboration through data sharing, joint research, and training activities related to climate change and weather.

Klima Center

KLIMA Center works on global/local climate policy and advocacy to bring about effective action on climate change in accordance with climate justice.

Klima played a key role in international climate negotiations through the Allied for Climate Transformation by 2025 (ACT2025) project, contributing to COP 29 discussions on climate finance and Loss & Damage. The Center also strengthened local climate resilience efforts with workshops on Loss & Damage for indigenous and local communities.

In renewable energy, Klima launched the youth-led RENDER platform, hosting climate and energy gatherings all over the country and producing publications like Renderzine. The Center also supported net-zero transition efforts and developed energy transition policy roadmaps for Dumaguete City. Additionally, Klima led transparency initiatives on energy transition minerals through the Just Energy Transition (JET) Minerals Challenge.

Klima became the host of the World Climate Research Program (WCRP) Academy Support Unit, marking the first WCRP office in the Global South to advance training in climate science. It also expanded legal capacity for climate justice through the Climate Justice Capacity Initiative (CJCI) and conducted research on environmental defenders and the challenge of disinformation.

Allied for Climate Transformation by 2025 (ACT2025)

The flagship work of Klima in 2024 continues to focus on international climate negotiations in the UN Framework Convention on Climate Change (UNFCCC). This year COP 29 was held in Baku, Azerbaijan. This work was made possible through the Allied for Climate Transformation by 2025 (ACT2025) project, which is now in Year 4. Through the Center's efforts, the MO co-organized ACT2025's Call to Action titled "Unlocking Finance for Climate-Nations at COP 29 and Beyond" that was launched on 22 May 2024. In COP 29, a Loss & Damage (L&D) side event and a New Collective Quantified Goal (NCQG) high-level gathering was organized by the consortium led by MO.

Loss & Damage through the Samdhana Institute Partnership

A workshop on "Climate Change Loss and Damage: Understanding Local Needs, Endeavoring to Influence International Negotiations" was held in March 2024 at Heyden Hall of MO, with LGU participants from QC, Laguna, Bohol, and Cagayan de Oro. The portfolio for this partnership included a (1) workshop on "Enhancing the Capacities of Indigenous Peoples Mandatory Representatives of the Calamianes Tagbanwa' in March; (2) Paralegal Training in Palawan: "Empowering the Calamian Tagbanwa", Coron, Palawan in May; and (3) drafting of a training program composed of three modules to strengthen the capacity of civil society organizations to negotiate on L&D. On the third, the three modules are:

- Module 1: Introduction to Loss and Damage
- Module 2: Understanding Non-Economic Loss and Damage
- Module 3: Documenting Loss and Damage at the Local Level

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Renewable Energy and Developing Ecological Responsibility (RENDER)

The TARA Foundation-funded RENDER (Renewable Energy and Developing Ecological Responsibility) platform represents the energy transition engagement of Klima. It is a youth-led climate mitigation and renewable energy platform under MO. In 2024 a supervisory board of young directors was formed to steer the overall direction of the RENDER platform. It also held Climate and Energy Convenings through our partner schools in various parts of the country, namely:

- Quezon City - Ateneo de Manila University
- San Fernando, La Union - Union Christian College
- Bacnotan, La Union - Don Mariano Marcos Memorial State University
- Dumaguete City - Silliman University
- Davao City - Ateneo de Davao University
- Angeles Pampanga - Holy Angel University

Klima also participated in ASEAN renewable energy and sustainability conferences and forums such as:

- Youth Sustainability Forum 2024 - Johor Bahru, Malaysia
- REaltalk Southeast Asia (The Climate Reality Project) - Bali, Indonesia
- Asia Clean Energy Forum - Asian Development Bank

Knowledge products were also developed through Renderzine, a multidisciplinary effort that features art, poetry, and essays on energy transition interpretations of the youth. This was created by university students, researchers, and artists. The Renderzine is an anthology of art and literary pieces that convey climate and energy messages. Through this platform (renderclimate.org), thought pieces and research articles were produced, covering climate mitigation and renewable energy issues, such as:

- Dumaguete City on its way to Net Zero by 2050 through the Renewable Energy Strategic Roadmap
- Ano ang Climate Mitigation?
- We Need to Demystify Climate Mitigation
- From the Perspective of the Youngest People in the Room: A Look at ADB's ACEF 2024
- Publication in Progress: *Strategic Spatiotemporal Movement Against Coal-Fired Power Plants (CFPP) in the Luna, La Union Energyscape* (Working Title)

Supplementing all this was an on-the-ground project under the USAID Energy Secure Philippines (ESP) Activity, which created and published the Sustainable Energy Transition Roadmap - Enabling a Sustainable Energy Transition in Dumaguete City (ESETD) and the Sustainable Energy Policy Blueprint for the Dumaguete LGU. Figure 40 shows the modeled energy savings for the LGU.

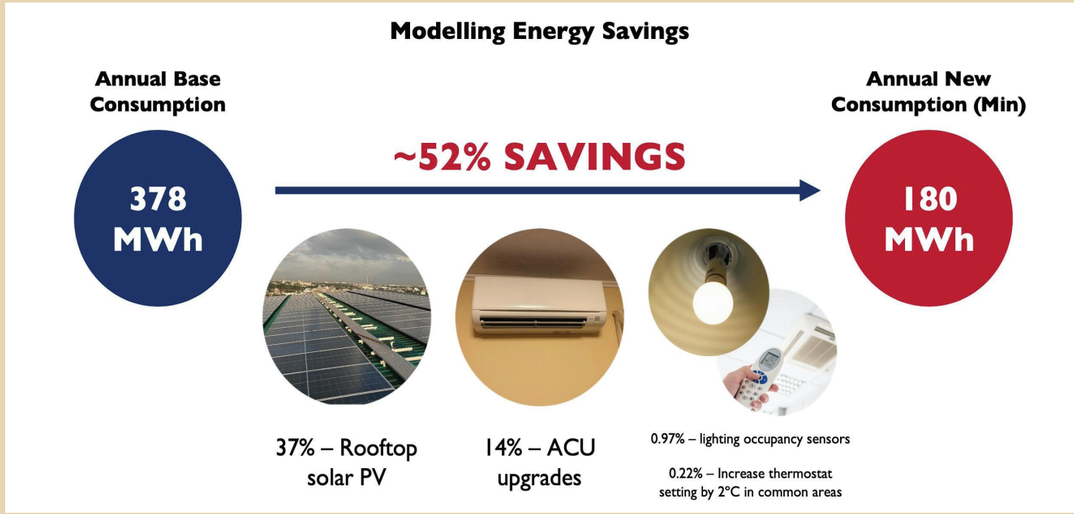

Figure 41. Modeled energy solutions and corresponding energy savings for Dumaguete City Hall Compound according to the ESETD roadmap.

Just Energy Transition (JET) Minerals Challenge

In the Energy Transition field, MO also serves as host to the Community Development Agreements Digital Innovation Hub, in partnership with the Sustainable Development Strategies Group (SDSG) and the Government Data Initiative (GDI). This is a transparency and accountability project that focuses on the so-called energy transition minerals. In 2024, several capacity building and paralegal training workshops were held on this particular topic. Pilot sites were in Toledo, Cebu and Batarazza, Palawan. This project features the DISCLOSE (or Digital Innovation to Support Communities, Leveraging Openness and Sustainability in Extractives) and PREDICT (or Projecting Revenues from the Extractives for the Development and Investment in Communities Tool) portals which were developed to help stakeholders understand and negotiate better agreements in energy transition mining (and mining in general).

02/

RESEARCH AND SOCIETAL ENGAGEMENT

WCRP Academy Support Unit

Given its research track record in climate science, the Manila Observatory, through Klima, has been chosen to host the Support Unit of the World Climate Research Programme (WCRP) Academy. Officially launched at MO on 7 October 2024, this Support Unit is the first such WCRP unit in the Global South. The event (pictured in Figure 41) featured MO's climate research work and the Academy's mission to promote climate science training and action, with a focus on climate change impacts on vulnerable communities and regions.

Figure 42. Key figures from the WCRP and Manila Observatory at Support Unit Launch in October 2024. Drs Narelle van der Wel, Melissa Hart, and Christopher Lennard of the WCRP and MO's Dr Ma Laurice Jamero discussed the Academy's goals and future plans.

Other Activities

On climate justice, there has also been some work on climate environmental litigation through the Climate Justice Capacity Initiative (CJCI). Phase 2 of the Initiative started in 2024 and focused on renewable energy. The previous phase included building capacity and partnerships with Ateneo law schools in Manila, Naga, Davao, and Cagayan de Oro.

The objectives of the project include increasing (a) the country's legal capacity for environmental, energy, and climate law practice, (b) the number of communities of law and climate practice, (c) the adoption of green legal clinics in schools, and (d) the interest in environmental lawyering as a profession for law students and practitioners. The legal clinics and production of research outputs are slated to begin in the first quarter of 2025.

Finally, for the Resistance and Resilience: Disinformation Against Environmental Defenders, a project which is hosted by the Association for Progressive Communications (APC), and with partner organisations from Mexico, Brazil, and Africa, MO is doing extensive research work for two communities in the Philippines: for the peoples of Cordillera and the Lumads, to produce a Philippine Country Report on environmental defenders and disinformation. MO also attended the Community gathering of APC members and partners in Chiang-Mai, Thailand, in May 2024.

03/

RESEARCH PUBLICATIONS AND PRESENTATIONS

/ Journal publications
/ Presentations and reports

03/

RESEARCH PUBLICATIONS AND PRESENTATIONS

Journal Publications

Aragon, L.G.B., Ibañez, M.P.A., Ordinario, R.C., Simpas, J.B.B., Cambaliza, M.O.L., Dado, J.M.B., Maquiling, J.T., Reid, E.A. (2024). Seasonal characteristics of raindrop size distribution and implication for radar rainfall retrievals in Metro Manila, Philippines. Atmospheric Research, 311, 107669. **https://doi.org/10.1016/j.atmosres.2024.107669**

de los Santos, A.S., Guzman, M.A.L.G., Vicente, M.C.T.M., Mijares, J.M.J., Del Castillo, M.F.P., Estiva, J.A.N. (2024). Application of remotely sensed data in estimating aboveground biomass and carbon stocks. Philippine Journal of Science, 153 (6B), 2399-2414. **https://philjournalsci.dost.gov.ph/images/pdf/pjs_pdf/vol153_No6B_Dec2024/application_of_remotely_sensed_data_in_estimating_aboveground_biomass_.pdf**

Del Castillo, M.F.P, Fujimi, T., Tatano, H. (2024). Estimating medium-term regional monthly economic activity reductions during the COVID-19 pandemic using nighttime light data. International Journal of Applied Earth Observation and Geoinformation, 135, 104223. **https://doi.org/10.1016/j.jag.2024.104223**

Henson, K.C., Olaguera, L.M.P., Cruz, F.A., Villarin, J.R.T. (2024). The Sensitivity of extreme rainfall simulations to WRF parameters during two intense southwest monsoon events in the Philippines. Asia-Pacific Journal of Atmospheric Sciences, 60, 741-757. **https://doi.org/10.1007/s13143-024-00380-6**

Latif, M.T., Purhanudin, N., Afandi, N.Z.M., Cambaliza, M.O., Halim, N.D.A., Hawari, N.S.S.L., To Thi, H. et al. (2024). In-depth analysis of ambient air pollution changes due to the COVID-19 pandemic in the Asian Monsoon region. Science of The Total Environment, 941, 173145. **https://doi.org/10.1016/j.scitotenv.2024.173145**

Llorin, A.G., Olaguera, L.M.P., Cruz F.T., Villarin, J.R.T. (2024). Improved WRF simulation of surface temperature and urban heat island intensity over Metro Manila, Philippines. Atmospheric Research, 310, 107644. **https://doi.org/10.1016/j.atmosres.2024.107644**

Llorin, A.G., Olaguera, L.M.P., Magnaye, A.M.T., Cruz, F.A., Dado, J.M.B., Gozo, E.C., Topacio, X.G.V.M., Uy, S.N., Simpas, J.B.B., Villarin, J.R.T. (2024). Quantifying the influence of updated land use/land cover in simulating urban climate: A case study of Metro Manila, Philippines. Theoretical and Applied Climatology, 155, 9941-9960. **https://doi.org/10.1007/s00704-024-05216-x**

Ngo-Duc, T., Nguyen-Duy, T., Desmet, Q., Trinh-Tuan, L., Ramu, L., Cruz, F., Dado, J. M., Chung, J. X., Phan-Van, T., Pham-Thanh, H., Truong-Ba, K., Tangang, F. T., Juneng, L., Santisirisomboon, J., Srisawadwong, R., Permana, D., Linarka, U.A., Gunawan, D. (2024). Performance ranking of multiple CORDEX-SEA sensitivity experiments: towards an optimum choice of physical schemes for RegCM over Southeast Asia. Climate Dynamics, 62, 8659-8673. **https://doi.org/10.1007/s00382-024-07353-5**

Olaguera, L.M.P., Llorin, A.G., Magnaye, A.M., Cruz F.T., Villarin, J.R.T., Topacio X.G.V. (2024). Observed characteristics and seasonality of the diurnal patterns of precipitation over Metro Manila, Philippines. Theoretical and Applied Climatology, 155, 1123–1138. **https://doi.org/10.1007/s00704-023-04684-x**

Olaguera L.M.P., Manalo, J.A., Bathan, A., Matsumoto, J. (2024). Quantifying the influence of the Madden–Julian oscillation on rainfall extremes during the northeast monsoon season of the Philippines. Atmospheric Science Letters, p.e1232. **https://doi.org/10.1002/asl.1232**

Olaguera, L.M.P., Manalo, J.A. (2024). Climatological analysis of rainfall over Hinatuan City, Surigao del Sur in eastern Mindanao – the wettest location in the Philippines. Theoretical and Applied Climatology, 155, 10069-10085. **https://doi.org/10.1007/s00704-024-05186-0**

Olaguera, L.M.P, Manalo, J.A. (2024). Objective determination of the withdrawal dates of the southwest monsoon (Habagat) season of the Philippines using cumulative rainfall. Philippine Journal of Science, 153 (5), 1579-1591. **https://philjournalsci.dost.gov.ph/images/pdf/pjs_pdf/vol153_No5_Oct2024/objective_determination_of_the_withdrawal_dates_of_southwest_monsoon_.pdf**

Plando, F.R.P., Maquiling, J.T. (2024). Construction potential of rice husk ash as eco-friendly cementitious material in a low-water demand for self-compacting concrete. Construction and Building Materials, 418, 135407. **https://doi.org/10.1016/j.conbuildmat.2024.135407**

Taña, E.A.S., Olaguera, L.M.P., Llorin, A.G.A., Dado, J.M.B., Cambaliza, M.O., Cruz, F.A., Villarin, J.R.T., Matsumoto J. (2024). Patterns and drivers of heavy and extreme hourly rainfall events over Metro Manila, Philippines. Theoretical and Applied Climatology, 155, 5015-5029. **https://doi.org/10.1007/s00704-024-04899-6**

Visaga, S.M., Pascua, P.J., Tonga, L.P.S., Olaguera, L.M.P., Cruz, F.T., Alvarenga, R., Bucholtz, A., Magnaye, A.M., Simpas, J.B., Reid, E., Uy, S.N., Villarin, J.R.T. (2024). Application of Kalman filter for post-processing WRF-Solar forecasts over Metro Manila Philippines. Solar Energy, 283, 113050. **https://doi.org/10.1016/j.solener.2024.113050**

RESEARCH PUBLICATIONS AND PRESENTATIONS

Presentations and Reports

Air Quality Dynamics Lab

[Report] Avendaño, M.D., Cainglet, Z.M., De Francisca, A.M., Bañaga, P.A., Cruz, M.T., Simpas, J.B., Cambaliza, M.O., Villarin, J.R., & McNamara, D. (2024). New Year 2024 Particle Pollution Measurements in Metro Manila and Other Local Urbanized Areas. https://www.observatory.ph/2024/02/14/new-year-2024-particle-pollution-measurements-in-metro-manila-and-other-local-urbanized-areas/

Avendaño, M.D., Cambaliza, M.O., Cruz, M.T., Simpas, J.B., Diskin, G.S., DiGangi, J.P., Ziemba, L.D., Flynn, J.H., Alvarez, S.L., Yoon, S., & Reid, J.S. (2024). Investigating the sources of air pollution in an emerging economy in the Philippines using multiple vertical profiles from the 2019 CAMP2Ex airborne field campaign. 16th International Commission on Atmospheric Chemistry and Global Pollution (iCACGP) Symposium and 18th International Global Atmospheric Chemistry (IGAC) Science Conference (iCACGP-IGAC Conference 2024), Kuala Lumpur, Malaysia, September 9-13, 2024.

Cambaliza, M. O., Acero, A.J., Topacio, X.G.V., De Francisca, A.M., Leung, G.F., Hilario, M.R., Cruz, M.T., Simpas, J.B., Reid, J.S., DiGangi, J., Diskin, G.S., Ziemba, L., Crosbie, E., & Shook, M. (2024). Spatial Distribution of Aerosols over the Urban Sprawl of Metro Manila, Philippines during the CAMP2Ex Airborne Mission in the Maritime Continent. 16th International Commission on Atmospheric Chemistry and Global Pollution (iCACGP) Symposium and 18th International Global Atmospheric Chemistry (IGAC) Science Conference (iCACGP-IGAC Conference 2024), Kuala Lumpur, Malaysia, September 9-13, 2024.

Cruz, M.T., Rabaja, O.E., Simpas, J.B., & Cambaliza, M.O. (2024). Determinants of personal exposure to PM2.5 among university students and employees in Metro Manila, Philippines. 16th International Commission on Atmospheric Chemistry and Global Pollution (iCACGP) Symposium and 18th International Global Atmospheric Chemistry (IGAC) Science Conference (iCACGP-IGAC Conference 2024), Kuala Lumpur, Malaysia, September 9-13, 2024.

Cruz, M.T., Uy, S.N., Lagrosas, N., Tobias, V.R., Dorado, S., Lorenzo, G.R., Algo, J.L., Cambaliza, M.O., & Simpas, J.B. (2024). AERONET measurements and applications in the Philippines. AERONET Science and Application Exchange, Maryland, USA, September 17-19, 2024.

Cruz, M.T., Cambaliza, M.O., & Simpas, J.B. (2024). Air Quality Studies in Metro Manila, Philippines. 2024 7-SEAS and KPEx Workshop, Taipei, Taiwan, November 11-15, 2024.

Cruz, M.T., Cambaliza, M.O., & Simpas, J.B. (2024). Updates on Air Quality Management in the Philippines. Asian Regional Exchange Program for Clean Air, Beijing, China, November 18-21, 2024.

Ibañez, M.P., Aragon, L.G., Ordinario, R., Simpas, J.B., Cambaliza, M.O., Dado, J.M., Maquiling, J., & Reid, E. (2024). Raindrop Size Distribution (DSD) characteristics: Environmental influences on observed seasonal DSD patterns in Metro Manila, Philippines. Proceedings of the Samahang Pisika ng Pilipinas 42, SPP-2024-1D-02 (2024). https://proceedings.spp-online.org/article/view/SPP-2024-1D-02

Miech, J.A., Digangi, J.P., Diskin, G.S., Choi, Y., Li, S., Chayawat, C., Koedkurang, K., Cambaliza, M.O., & Simpas, J.B. (2024) Biomass Burning and Fossil Fuel Apportionment via Greenhouse Gas Enhancement Ratios Over Southeast Asia as Measured During ASIA-AQ. 16th International Commission on Atmospheric Chemistry and Global Pollution (iCACGP) Symposium and 18th International Global Atmospheric Chemistry (IGAC) Science Conference (iCACGP-IGAC Conference 2024), Kuala Lumpur, Malaysia, September 9-13, 2024.

Data and Sensor Development Lab

Asares, L.A.E., Bennett, C.D., Bullett, T., Mabie, J., Uy, S.N. (2024). Ionospheric observations during quiet and disturbed days in Solar Cycle 25 using two collocated instruments in Manila. Asia Oceania Space Weather Alliance (AOSWA) 7th AOSWA Workshop, Bangkok, Thailand, October 8-11, 2024.

Uy, S.N. (2024). Disaster Resilience. 2024 League of Corporate Foundations Corporate Social Responsibility (LCF-CSR) Conference and Expo, Makati, Philippines, July 4-5, 2024.

Uy, S.N. (2024). Internet-of-Things Applications on Agriculture and Disaster Management. Internet-of-Things Conference 2024, Pasay, Philippines, October 28-28, 2024.

GeoDynamics Research Lab

Felicidario, R.J.M., Maquiling, J.T. (2024). Measurement of the Electromagnetic Radiation Emission for the Compression Strength Analysis of Fractured Mortar with Sugarcane Bagasse Ash and Crushed Oyster Shells. 2024 American Geophysical Union (AGU) Fall Meeting, Washington, D.C., December 9-13, 2024.

03/ RESEARCH PUBLICATIONS AND PRESENTATIONS

Geomatics for Environment and Development Lab

Montajes, J., Peralta F.M. (2024). Optimizing the Microsoft Planetary Computer for Emergency Observation and mapping (EO/M). The 9th Joint Project Team Meeting (JPTM2024), Novotel Manila Araneta City, Quezon City, Philippines, November 5-7, 2024.

Vicente, M.C.T., Montajes, J., Dimain, M.R., Peralta, F., Lagrosas, J.C., Cajilla, C.A., Torres, J.L.G., del Castillo, M.F., Dado, J.M., Cruz, F.A., Uy, S.N., Gozo, E., Avila, F., Teodoro, R., Lo, D., Vallente, J. (2024). Emergency Observation and Mapping for Risk-informed Extreme Weather Bulletins in the Philippines. 2nd WMO/WWRP Weather and Society Conference, online, February 26-March 1, 2024.

Vicente, M.C.T., del Castillo, M.F., Reyes, S.R., Muzones, D., Domingo, S. Jr., Montajes, J., Biguerras, M., Flores, P.C., Cañada, A.K., Familara, A., Dimain, M.R., Agad, A., Alemania, M.K., Dela Paz, M.A., Jacela, J., Austria, R.V., Gonzaga, R.E., Palicpic, J.M., Pascual, A.M., Sebastian, A.V., Abundo, M.L., Anastacio, N.J., Jaojoco, A.K., Ang, M.R.C., Chalkiadakis, C., Doliente, S., Ocon, J., Ong, J.B., Payonga, L.R., Sarmiento, C.J. (2024). The Development of Spaced-Based Renewable Energy Decision Support System (RE DSS). Asia Clean Energy Forum 2024, ADB Headquarters, Mandaluyong City, Metro Manila, Philippines, June 3-7, 2024.

Regional Climate Systems Lab

Avila, F. (2024). Resource speaker on "Climate Change Adaptation and Disaster Risk Reduction: Agriculture & Fisheries". A conversation with members of Fastenaktion, online, October 29, 2024.

Avila, F. and Teodoro, R. (2024). Resource speakers on "El Niño-induced Drought: Signs and Triggers for Anticipatory Action and Response" in seminar "Facing Drought Together: Understanding and Action" organized by BRAC Philippines, Cotabato City and online, May 21, 2024.

Bañares, E., Bañaga, P.A., Gozo, E., Lorenzo, G.R., Topacio, X.G.V., Llorin, A.G., Avila, F.B., Cruz, F.A., Simpas, J.B., Uy, S.N., Villarin J.R.T. (2024). Current practices and challenges in managing automated weather station data and networks in Philippine cities. Asia Oceania Geosciences Society (AOGS) 21st Annual Meeting, Gangwon-do, South Korea, June 23-28, 2024.

Cruz, F. (2024). Understanding the need for high-resolution regional climate projections. ASEAN Specialised Meteorological Centre - World Meteorological Organization Forum: Towards a Weather-Ready and Climate-Resilient ASEAN, Singapore, September 4-6, 2024.

Cruz, F. (2024). Looking back and looking forward: Reflections from CORDEX Southeast Asia. 4th International Vietnam Conference on Earth and Environmental Sciences (iVCEES-2024), Quy Nhon, Vietnam, November 26-28, 2024.

Cruz, F. (2024). High resolution regional climate projections for Southeast Asia. 2024 Asia Pacific Malaria Elimination Network Vector Control Working Group Annual Conference, online, December 2-4, 2024.

Cruz, F., Uy, S.N., Olaguera, L.M., Dado, J.M., Avila, F., Magnaye, A., Llorin, A.G., Henson, K., Loqueloque, D., Gozo, E., Teodoro, R., Villarin, J.R. (2024). Supporting climate and disaster resilience in the Philippines through energy, climate and weather forecast research. GEWEX Open Science Conference, Sapporo, Japan, July 7-12, 2024.

Cruz, F., Dado, J.M., Gozo, E. (2024). Enhancing Climate Change Information through Co-production. 5th Ateneo Social Sciences Conference 2024, Quezon City, Philippines, April 25-26, 2024.

Dado, J.M.B. (2024). High resolution regional climate projections towards decision-making in Southeast Asia. Scientific Forum for Numerical Simulation of Asian Regional Climate Change and Earth System Process, Suzhou Campus of Nanjing University, China, October 14-16, 2024.

Dado, J. (2024). Evaluation of climatic impact-drivers in the Philippines from CORDEX SEA CMIP6 downscaled data. 4th International Vietnam Conference on Earth and Environmental Sciences (iVCEES-2024), Quy Nhon, Vietnam, November 26-28, 2024.

Dado, J.M., Aragon, L.G., Cruz, F.A., Villarin, J.R., Simpas, J.B., Cambaliza, M.O., Banares, E., Visaga, S.M., Apostol, G.L. (2024). Spatiotemporal assessment of heat stress indices in Metro Manila, Philippines. GEWEX Open Science Conference, Sapporo, Japan, July 7-12, 2024.

Ella, Y.S., Olaguera, L.M.P., Climatological Characteristics of Precipitating Clouds Over the Eastern Coast of Luzon Island Philippines during the Northeast Monsoon Season. 4th International Vietnam Conference on Earth and Environmental Sciences, Quy Nhon, Vietnam, November 26-29, 2024.

Loqueloque, D., Dado, J.M., Cruz F.A., Uy, S.N., Gozo, E., Villarin, J.R.T. (2024). Enhancing extreme rainfall monitoring in the Philippines using average recurrence interval and regional frequency analysis approach. Asia Oceania Geosciences Society (AOGS) 21st Annual Meeting, Gangwon-do, South Korea, June 23-28, 2024.

03/ RESEARCH PUBLICATIONS AND PRESENTATIONS

Olaguera, L.M., Tonga, L.P. (2024). Numerical simulation of the effects of Davao Oriental Mountain range in Mindanao Island, southern Philippines on the heavy rainfall associated with Typhoon BOPHA (2012): Preliminary Analysis. Invited Speaker at JAMSTEC, Yokohama Japan and Typhoon Science and Technology Research Center, Yokohama National University, February 8-22, 2024.

Pe, T., Olaguera, L.M.P., Comparison of different methods in detecting and tracking tropical depressions in the Philippine Sea using NCEP-GFS. 2nd International Workshop of the Typhoon Science and Technology Research Center, Yokohama Japan, November 27-28, 2024.

Petilla, C.E., Olaguera, L.M.P.,The unique features of Typhoon Rai (2021): An observational Study. 2nd International Workshop of the Typhoon Science and Technology Research Center, Yokohama Japan, November 27-28, 2024.

Tibay, J. (2024). Performance evaluation of land surface physics-based downscaling with high-resolution land data assimilation system (HRLDAS) during April 2024 over Metro Manila, Philippines. 4th International Vietnam Conference on Earth and Environmental Sciences (iVCEES-2024), Quy Nhon, Vietnam, November 26-28, 2024.

Tonga, L.P., Olaguera, L.M.P.,The impact of vertical resolution in WRF to Typhoon Bopha (2012) during its landfall. 2nd International Workshop of the Typhoon Science and Technology Research Center, Yokohama Japan, November 27-28, 2024.

[Report] Villarin, J.R.T., Perez, R.T., Cruz, F.T., Olaguera, L.M.P., Villafuerte II, M.Q., Agustin, W.A., Avila, F.B., Basconcillo, J.Q., Calde, D.M., Dado, J.M.B., Duran, G.A.M., Jamero, M.L.P., Lambrento, J.C.A., Magnaye, A.M.T., Manalo, J.A., & Tibig, L.V. (2024). 2024 Philippine climate change assessment: The Physical science basis. The Oscar M. Lopez Center for Climate Change Adaptation and Disaster Risk Management Foundation, Inc.

[Report] Zachariah, M., Clarke, B., Barnes, C., Kimutai, J., Sivanu, S., Ybañez, R.L., Otto, F., Philip, S., Arrighi, J., Falk, K., Cruz, F.A., Avila, F., Olaguera, L.M., Petilla, C.E. (2024). Reducing vulnerability and improved land management needed with increasing heavy rainfall in Mindanao Island, southern Philippines. https://doi.org/10.25561/109543

Klima Center

Jamero, M.L. (2024). WCRP Academy: Addressing climate training needs starting with the Global South. 4th International Vietnam Conference on Earth and Environmental Sciences (iVCEES-2024), Quy Nhon, Vietnam, 26-28 November 2024.

WHO WE ARE

04/

Our Research Scientists

Francia B. Avila, PhD
weather and climate extremes, extreme event risk analysis and communication

Maria Obiminda L. Cambaliza, PhD
atmospheric composition, air quality, health impacts of air quality

Faye Abigail T. Cruz, PhD
regional climate downscaling, climate services, land-atmosphere interactions

Melliza T. Cruz, PhD
air quality monitoring and chemical analysis, emission inventories, aerosol modeling

Julie Mae B. Dado, PhD
climate downscaling, land-ocean-atmosphere interactions, and climate extremes

Ma. Flordeliza Del Castillo, PhD (Incoming Research Scientist)
disaster economic impacts, remote sensing applications, water quality assessment

Emilio C. Gozo, MS
high-performance computing, and extreme weather analysis

Ma. Laurice P. Jamero, PhD
disaster risk resilience, sustainability and small islands

Joel T. Maquiling, PhD
geophysics, geomaterials engineering, and disaster science

Jezleer T. Montajes
forestry, remote sensing, and geographic information systems

Lyndon Mark P. Olaguera, PhD
Monsoon Climatology, High-Impact Weather and Climate Events, Weather and Renewable Energy Forecasting

James Bernard B. Simpas, PhD
air quality, atmospheric chemistry and physics, and instrumentation

Sherdon Niño Y. Uy, PhD
instrumentation, renewable energy, and space weather

May Celine Thelma M. Vicente, PhD
geo-information systems, emergency observation, environmental decision support

Jose Ramon T. Villarin, SJ PhD
climate risk analysis, atmospheric instrumentation, and greenhouse gas inventories

Our Research Fellows

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Laurence L. Delina, PhD (HKUST, Hong Kong)
Le Anh Nguyen Long, PhD (Univ of Twente, Netherlands)
Denise Margaret S. Matias, PhD (Eberswalde Univ for Sustainable Development, Germany)
Jun Matsumoto, PhD (Tokyo Metropolitan Univ, Japan)
Andrea Monica D. Ortiz, PhD (Univ of Concepcion, Chile)
Genevieve Rose L. Pearson, PhD (Univ of Miami, USA)
Rosa T. Perez, PhD (Ateneo de Manila Univ)
Emma E. Porio, PhD (Ateneo de Manila Univ)
Kelvin S. Rodolfo, PhD (Univ of Illinois, USA)
Fernando P. Siringan, PhD (UP)
Manuel Peter S. Solis, PhD (Deakin Univ, Australia)
Clod Marlan Krister V. Yambao, PhD cand. (Ghent Univ, Belgium)

Our Klima Center

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environmental law, climate change, human rights, and institutional governance

Yla Gloria Marie P. Paras, JD MSc
environmental policy, climate finance, energy law and policy

Our Research Support

Cesario A. Aguinaldo
Facilities and Logistics

Marilou P. Ordoñez
Accounting

Dionie J. Salamat
Human Resources and Administration

Randell G. Teodoro
Communications

Mariel T. Uy
Library and Archives

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LIST OF FIGURES AND TABLES

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LIST OF ACRONYMS

AA	Anticipatory Action
ACT2025	Allied for Climate Transformation by 2025
AERONET	Aerosol Robotic Network
AOD	Aerosol Optical Depth
AOI	Area of Interest
AWS	Automated Weather Station
CAMP²Ex	Cloud, Aerosol, and Monsoon Processes-Philippines Experiment
CARE for SEA Megacities	Climatic hazard Assessment to enhance Resilience against climate Extremes for Southeast Asian megacities
CCHAIN	Climate Change, Health and Artificial Intelligence
CCIMS	Climate Change Information Management System
CJCI	Climate Justice Capacity Initiative
COP28	Conference of Parties - 28th United Nations Climate Change
CORDEX	Coordinated Regional Downscaling Experiment
CRC	Climate Resilient Cities
CRS	Catholic Relief Services
CVI	Coastal Vulnerability Index
DENR-EMB	Department of Environment and Natural Resources - Environmental Management Bureau
DISCLOSE	Digital Innovation to Support Communities, Leveraging Openness and Sustainability in Extractives
DSS	Decision Support System
CVA	Coastal Vulnerability Assessment
EO/M	Emergency Observation and Mapping
ESETD	Enabling a Sustainable Energy Transition in Dumaguete City
EWB	Extreme Weather Bulletin
GCCAP	Geospatial Climate Change Action Plan
GEO MS	Group on Earth Observation Microsoft Planetary Computer
GNSS	Global Navigation Satellite System
HEVRI	Hazards, Exposures, Vulnerabilities, Risks, and Impacts
Hi-ASAP	Health Investigation and Air Sensing for Asian Pollution
IoT	Internet of Things
L&D	Loss and Damage
MGB	Mines and Geosciences Bureau
NAP	National Adaptation Plan
NCCAP	National Climate Change Action Plan
NCCET	National Climate Change Expenditure Tagging
PAPGAPI-PAN	Pan-Asia Partnership for Geospatial Air Pollution Information and the Pandora Asia Network
PM	Particulate Matter
PREDICT	Projecting Revenues from the Extractives for the Development and Investment in Communities Tool
RENDER	Renewable Energy and Developing Ecological Responsibility
RS-GIS	Remote Sensing - Geographic Information Systems
SUPREME BARMM	Strengthening Resilience through Early Warning System, Enhanced Anticipatory Actions and Multi-risk Landscape Approach in Bangsamoro Autonomous Region in Muslim Mindanao
TAS	Tactical Air Samplers
TC	Tropical Cyclone
UNFCCC	United Nations Framework Convention on Climate Change
VIPIR	Vertical Incidence Pulse Ionosphere Radar

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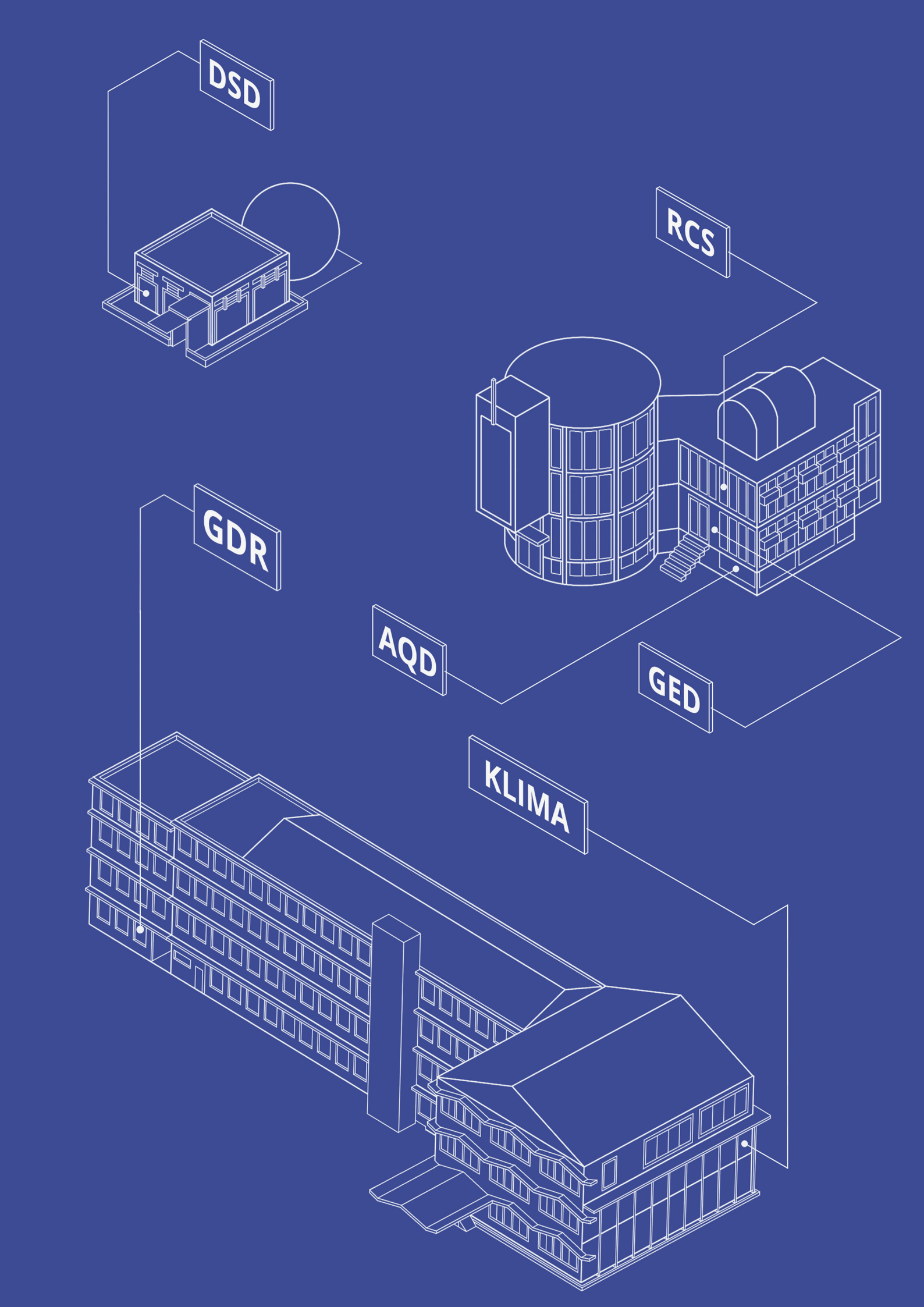
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