2023
ANNUAL
REPORT

MANILA OBSERVATORY
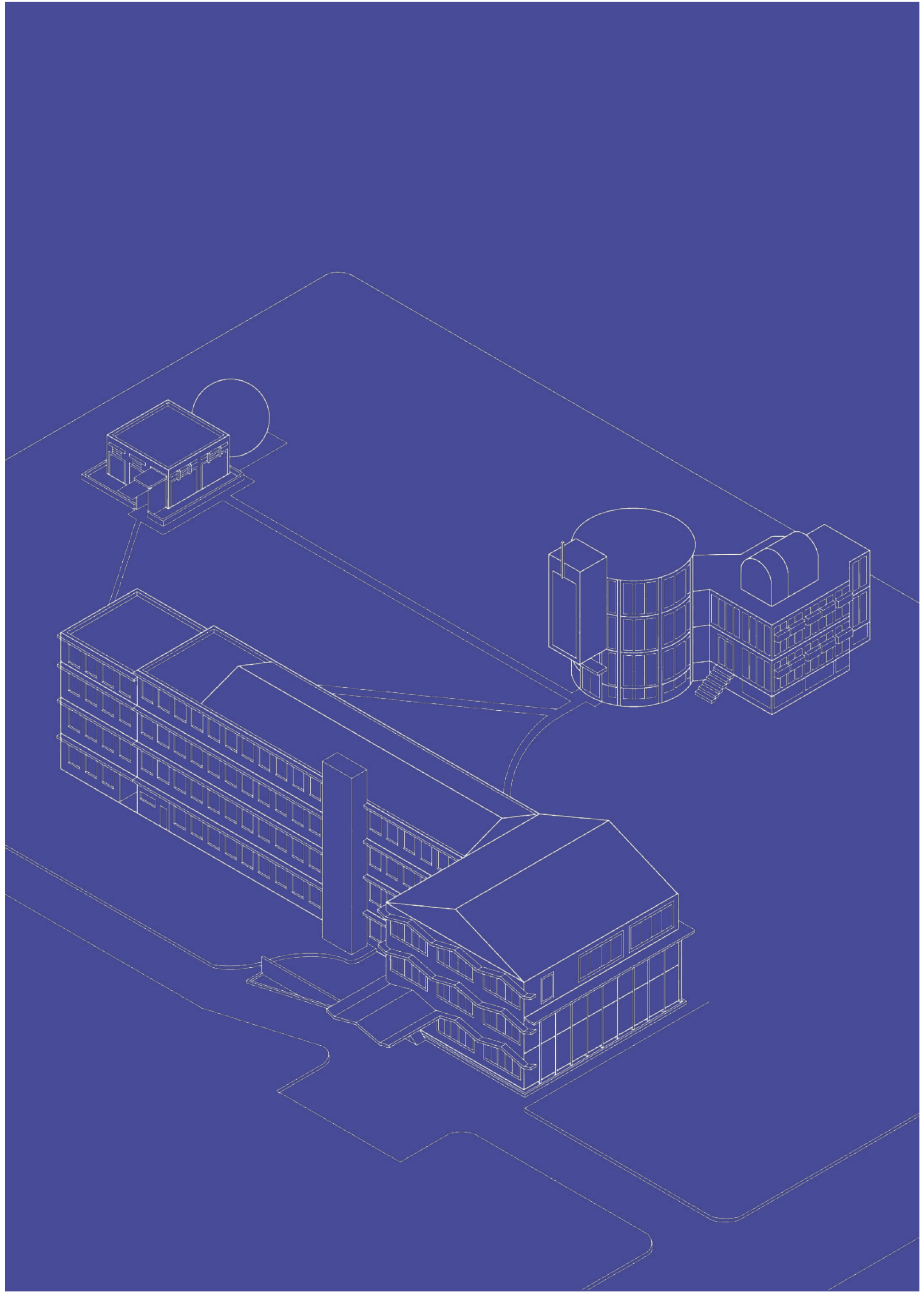
CONTENTS

Executive Summary

The year 2023 saw the establishment of the fifth and newest laboratory of the Manila Observatory, namely the GeoDynamics Research (GDR) Laboratory in June 2023. Led by Dr Joel Maquiling, the GDR Lab continues the scientific work of Fr Sergio Su SJ albeit now with closer linkage between climate change and geophysics. Guided by its twin goals of geomaterials engineering and topographic change forecasts, the Lab has already achieved promising results in the six months it has been operational.

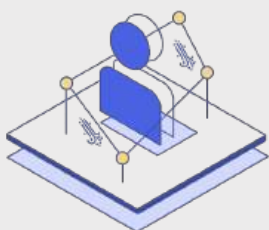We are also happy to report that the Air Quality Dynamics (AQD) Laboratory continues its important work on aerosols, which are ultra-fine particles in the atmosphere that affect air pollution and climate change. In 2023, the AQD Lab published the Manila Observatory's long-term record of $PM_{2.5}$ (particulate matter, 2.5 microns in diameter) levels from 2000 to 2023 in the Metro Manila atmosphere. A highlight of this study is the observed decreasing trend of PM levels which may be attributed to policy interventions such as stricter vehicle fuel standards. The Lab also continued to analyze data that were collected from ground-based and airborne sensors in the previous CAMP²Ex campaign to improve our understanding of aerosol sources in Metro Manila.

The highlight of the Data and Sensor Development (DSD) Laboratory's accomplishments in 2023 was the addition of automated weather stations (AWS) to the Observatory's existing network with the inclusion of the several stations in Palawan that were not readily accessible in the past. This has increased the number of stations from 105 in 2022 to 116 in 2023, thus expanding our observation network to include the western part of the country. With the University of Colorado, the Lab also continues its monitoring of the ionosphere, the upper layer of the atmosphere (about 60 to 300 km above us) that is important for satellite communication and space weather.
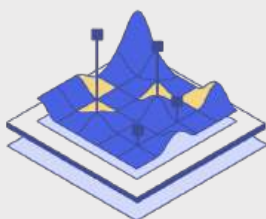
In 2023, the Geomatics for Environment and Development (GED) Laboratory began its work with the DENR on setting up a Climate Change Information Management System (CCIMS). This system is being designed as a science-based tool to aid decision makers by incorporating timely information from remote sensing, geographic information systems, and climate change data in the formulation of responsive policies and measures. The GED also concluded most of its emergency observation and mapping work using the Microsoft Planetary Computer to generate the information shared with the Observatory's stakeholders through the Extreme Weather Bulletins.

El Niño-related drought and extreme heat were key research themes for the Regional Climate Systems (RCS) Laboratory in 2023. For BARMM region of Mindanao, the Lab developed anticipatory action triggers for drought, based on climate risk assessment and in consultation with partners and stakeholders. These triggers aim to help mobilize assistance before disaster strikes. The Lab has been tasked to lead the Climatic hazard Assessment to enhance Resilience against climate Extremes for Southeast Asian megacities (CARE for SEA megacities) project, in collaboration with climate modeling groups in the region. What has also kept the Lab busy in 2023 are projects on climate and health, climate-adjustment of flood and landslide hazard maps for select Philippine cities, fine-tuning of weather/climate models, and the downscaling of the latest large-scale global climate model projections to finer scales at the local level.
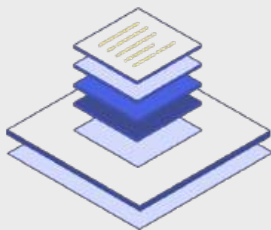
Klima Center, which serves as the Observatory's interface between science and society, continued to expand its work on international and regional collaboration. It has been involved in strengthening the negotiating capacity of partner groups in the climate convention. This entailed providing technical assistance and promoting science-based advocacy. Priority themes include climate justice, loss and damage, land and climate litigation, inclusion of persons with disabilities in climate action, and renewable energy transition.
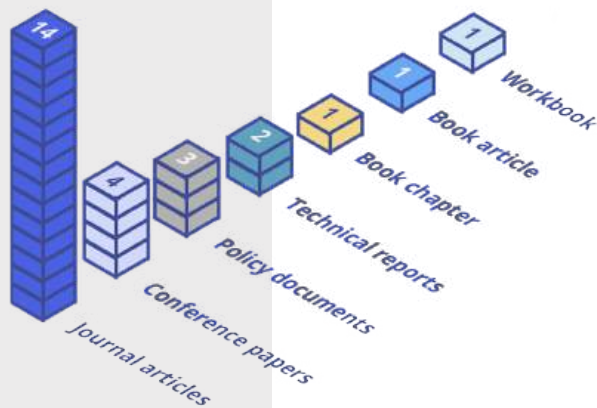
Regarding publications, for 2023, we are happy to report that the Manila Observatory produced a total of:

14 journal articles,
4 conference papers,
3 policy documents,
2 technical reports,
one book chapter,
one book article, and
one workbook.

In terms of engagements and partnerships in 2023, the Observatory formalized its collaboration with the ASEAN Centre for Biodiversity to explore the link between climate change and biodiversity in Southeast Asia. With support from the Asia Pacific Network, we now lead a network of climate modeling groups in Southeast Asia that are focused on urban impacts of climate change. We have also joined the Consultative Group of Experts of the Philippines' National Adaptation Plan. As members of the Philippine delegation, we took part in the 58th session of the Intergovernmental Panel on Climate Change (IPCC) and the 28th session of the UNFCCC Conference of the Parties.
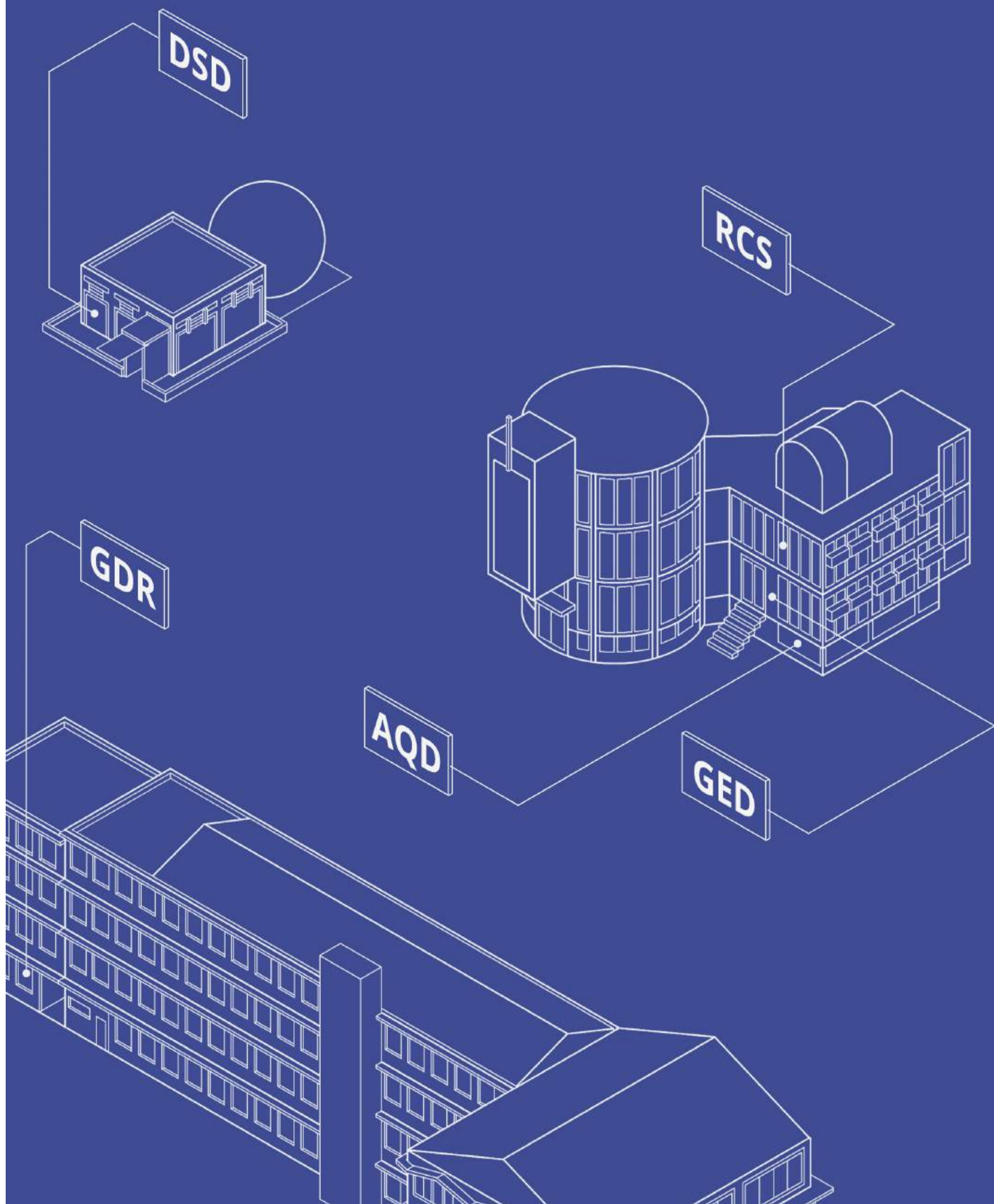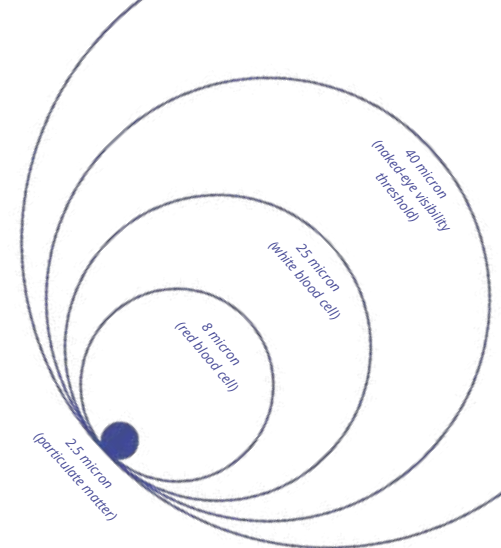
02 \ Research Activities

\ Air Quality Dynamics Laboratory

\ Data and Sensor Development Laboratory

\ GeoDynamics Research Laboratory

\ Geomatics for Environment and
Development Laboratory

\ Regional Climate Systems Laboratory

Air Quality Dynamics Laboratory

AQD provides scientific guidance on air quality assessment and effective air quality management through its monitoring and modeling activities.

40 micron
(naked-eye visibility threshold)

25 micron
(white blood cell)

8 micron
(red blood cell)

2.5 micron
(particulate matter)

The AQD Lab's work in 2023 focused on continuing and strengthening its local and international collaborative efforts through data collection, analysis, reports, and publications. Ground-based remote sensing data from AERONET and *in-situ* airborne measurements from the CAMP²Ex campaign were collected to provide information on aerosol sources in Metro Manila. The publication in 2023 of the long-term record of $PM_{2.5}$ concentrations in MO provides insights on the impact of policy interventions such as vehicle fuel standards on urban air quality. Lastly, aerosol chemical characterization and $PM_{2.5}$ exposure data from the Hi-ASAP initiative as well as measurements during pollution episodes were used as input to health impact assessments.

Aerosol Robotic Network (AERONET)

Since 2009, the MO has been an Aerosol Robotic Network (AERONET) site. This global ground-based remote sensing network studies the optical, microphysical, and radiative properties of aerosols from sun photometer measurements. A sun photometer unit that directly sends data to the network was installed this year, replacing the old system in which data had to be uploaded manually. The analysis of long-term data by Lorenzo et al. (2023) from measurements in MO showed that aerosol optical depth (AOD) was highest from August to October (*Figure 1*). The AOD is indicative of the amount of aerosol present in a column of air.

This was attributed partly to fine urban aerosol particles (including soot) and transported smoke from insular Southeast Asia during the southwest monsoon season.

In collaboration with the Department of Environment and Natural Resources – Environmental Management Bureau (DENR-EMB), site scoping was also done for additional AERONET sites in support of the upcoming Airborne and Satellite Investigation of Asian Air Quality (ASIA-AQ) campaign in 2024. Suitable sites, i.e. areas north and south of Metro Manila within the ASIA-AQ flight path, were set up in Meycauayan City and Bilibid, Muntinlupa.

Figure 1 Monthly characteristics of aerosol optical depth (AOD) as measured by the AERONET sun photometer from January 2009 to October 2018 (Lorenzo et al., 2023)
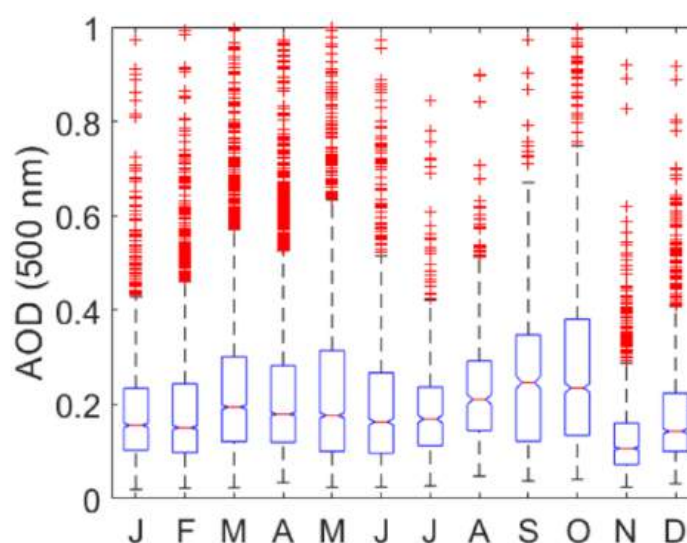
Cloud, Aerosol, and Monsoon Processes-Philippines Experiment (CAMP²Ex)

Analysis of data collected during the CAMP²Ex campaign continued this year, particularly those from aircraft-based measurements over Metro Manila. As expected, high concentrations of black carbon (BC), total organics, and water-soluble inorganic species (e.g., sulfates, nitrates, and ammonium) were observed downwind of Metro Manila, Cavite, and Batangas. Elevated levels of these species within and above the boundary layer during certain periods show the contribution of local sources and long-range transport, respectively. *Figure 2* shows the concentrations of the different aerosol species measured upwind and downwind of Metro Manila in October 2019, as described in the paper of Acero (2023)*.

In addition, a summary of the preliminary results of CAMP²Ex in terms of the relationships between tropical meteorology, aerosol lifecycle, convection, and radiation has been published by Reid et al. (2023).

Figure 2 Concentrations of black carbon (BC), total organics, and water-soluble inorganic species measured above Metro Manila on October 4, 2019 (Acero, 2023)
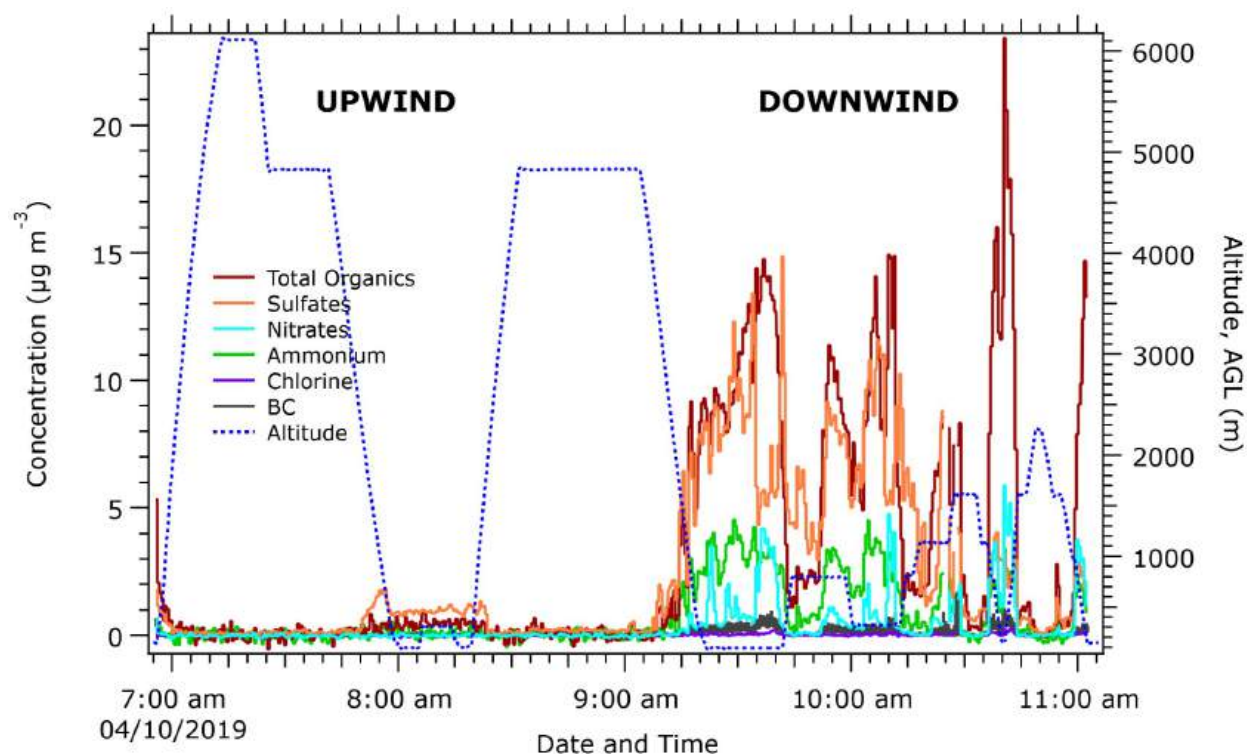
*Acero, A.J.A. (2023). Characterization and sources of organic and inorganic particulate matter using aircraft-based measurements over Metro Manila, Philippines. Undergraduate thesis, Ateneo de Manila University

Figure 3   Members of the AQD Lab trying out the AS-LUNG monitors slung over their shoulders for the PM$_{2.5}$ personal exposure study

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

In 2023, the AQD Lab participated in a regional measurement campaign under the Health Investigation and Air Sensing for Asian Pollution (Hi-ASAP) initiative. This study aims to collect information on the levels and composition of PM$_{2.5}$ in different Asian cities to help us understand aerosol sources and the associated health impacts. PM$_{2.5}$ samples were collected on Teflon and quartz substrates during the dry and wet seasons in Metro Manila as well as during a characteristically high pollution period. The latter was identified to be in December given the severe traffic congestion during the Christmas holiday rush. The collected samples were sent to Academia Sinica in Taiwan for analysis of ionic species, elemental and organic carbon, water–soluble organic carbon, sugars, polycyclic aromatic hydrocarbons (PAHs), and organic acids.

Also under the umbrella of the Hi-ASAP initiative, data gathering related to the PM$_{2.5}$ exposure of university students and employees was carried out from October to November 2023. In this study, 30 participants carried a personal aerosol sampler each for seven days. The participants also monitored their activities and the places they frequented during the study period using a time-activity diary. *Figure 3* shows the members of the AQD Lab trying out the Academia Sinica-LUNG (AS-LUNG) personal aerosol samplers. The results of this study are expected to provide valuable information on PM$_{2.5}$ exposure in various indoor and outdoor micro environments that may be useful for health impact assessments.

Other research activities

Long-term PM$_{2.5}$ monitoring in MO continued this year. *Figure 4* shows a decreasing trend in PM$_{2.5}$ concentrations although annual average levels still exceed the World Health Organization's (WHO) guideline value of 5 μg/m³. The lowest concentrations were recorded in 2020 when strict lockdown measures that lasted for almost three months were implemented to prevent the spread of the SARS-CoV-2 virus. The evident drop in concentrations in 2011 may be attributed to the implementation of the Euro 2 emission standards in 2008 and the stricter emission standards for new, in-use, rebuilt, and imported used motor vehicles implemented in 2010. Similarly, the drop in PM$_{2.5}$ concentrations in 2017 was possibly due to the implementation of the Euro 4 emission standards in 2016 (Cambaliza et al., 2023).

Aside from its regular, long-term air quality monitoring activities, the AQD Lab also investigated air pollution events in 2023. During the 2023 New Year celebration, 24-hour average PM$_{2.5}$ concentrations increased by up to 57% in the Parañaque site and about 35% in MO. In terms of air quality index, the concentrations in most of the monitoring sites reached unhealthy levels. These findings reflect the "return to normal" activities since the lifting of COVID-19-related restrictions (Cainglet et al., 2023). In Cruz et al. (2023), we reported an increase in concentrations of certain metallic components typically used as pyrotechnic propellant and/or colorants during New Year 2020. These metals are associated with cancer risk as well as various developmental, respiratory, and immunological effects. Lastly, the Lab investigated the 22 September 2023 haze event in Metro Manila and nearby provinces. Analysis of pollution and wind data showed that Metro Manila was not downwind of the Taal plume and that elevated PM$_{2.5}$ concentrations and poor visibility coincided with periods of low wind speed, indicative of poor dispersion and pollution accumulation.

The AQD Lab's collaboration with Clean Air Asia on the Quezon City Air Quality Management Project's emissions inventory of criteria air pollutants, greenhouse gasses, and short-lived climate pollutants ended in 2023. The Lab provided technical guidance on emissions inventory methods and approaches, source categories, emission factors, and data analysis and interpretation.

Figure 4   Boxplot of PM$_{2.5}$ concentrations at the Manila Observatory (n.b. no data collected in 2022)
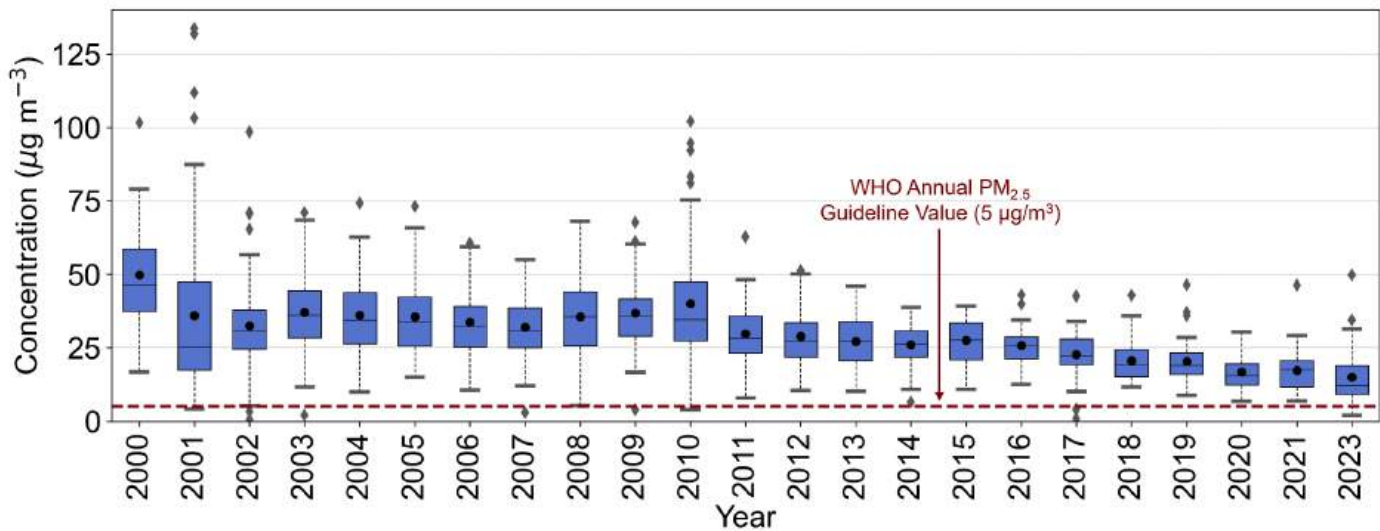
Data and Sensor Development Laboratory

DSD works on sensors, data, systems, and analytics research as it develops and operates the Manila Observatory's observational network.

In 2023, DSD Lab reached out to remote areas that required Automated Weather Station (AWS) reconditioning, especially in Palawan Province. Collaboration with the University of Colorado Boulder enabled the Lab to continue its ionospheric research. For the Observatory, DSD expanded the storage capacity of the institution's computing infrastructure. It also developed a microsite with the Human Resources and Administration Office to digitize and streamline administrative and human resources work.

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

The DSD Lab performed regular maintenance on existing Automated Weather Station (AWS) sites that are with the project partners but also included in the MetroWeather Network with Chevron. DSD reconditioned 23 AWSs in almost all municipalities of Palawan in 2023. Traveling to these far-flung areas was challenging and resource-intensive but the support from and timely coordination with the provincial government enabled the Lab's Operations and Maintenance Team to reach these areas. This difficulty in logistics prevented the team from reaching Magsaysay and Cagayancillo for this year. There are currently 116 AWSs that are operational. Connectivity to our database servers continues to be a challenge.

Through this project, the Observatory strengthened its partnership with Marikina City and Iloilo City on the operation and maintenance of AWS networks in these cities. The relationship with UC1 Corporation has been reestablished as a site partner where their company-owned AWSs at Parasat Cable TV, in Seven Seas Waterpark, and Dahilayan Adventure Park have been added to the Manila Observatory's AWS network. An Application Programming Interface or API has been developed for the website so that the data and forecast maps may be incorporated by external partners and third-party developers into their web apps.

Space Geodesy - Global Navigation Satellite System (GNSS)

The new receiver unit has been installed as part of the upgrade done for the station in MO. This has improved signal reception of the GPS. The carrier frequency from different satellites that reaches the receiver is now being utilized for cross-validation of the ionograms generated from the VIPIR measurements. These ionograms record the ground transmitted radio signals that are reflected from different layers in the ionosphere.

Internal projects

The Lab developed a microsite for MO administration to facilitate requests such as procurement, leaves, and accounting services. It also started working on the development of a new institutional website in collaboration with the MO Communications Office.

Vertical Incidence Pulse Ionosphere Radar (VIPIR)

Ionospheric research has been part of the Observatory's scientific mission since the 1950s. Beginning with an audio oscillator installed in 1952, the Manila Observatory now hosts the VIPIR, an ionosonde or a radar instrument that measures the ionosphere. This instrument, which is being operated in collaboration with Dr Justin Mabie of the University of Colorado Boulder, is part of a network of 20 VIPIR stations around the globe.

Measuring ionospheric activity has major implications for telecommunications and navigation systems. These technologies are highly dependent on radio signals that propagate through the ionosphere, which is the layer of the atmosphere that makes global radio communication possible. However, there are natural phenomena yet to be understood, such as the presence of equatorial plasma bubbles in the ionosphere that disrupt radio transmission and reception. The function of VIPIR is to help us understand these plasma bubbles.

In 2023, the DSD Lab upgraded the receiver unit and control system server. It proved to be successful as the Observatory ionosonde has been continuously receiving signals in a consistent manner since 8 November 2023. At present, it is already receiving signals from the VIPIR station in Palau as determined from tests conducted between the Palau and MO VIPIR instruments.

USAID Climate Resilient Cities Project

The Operations and Maintenance Team of the DSD Lab deployed AWSs to the five partner cities of the project, namely Batangas, Borongan, Cotabato, Iloilo, and Legazpi. Through a collaborative effort with the LGUs of these cities and Catholic Relief Services (CRS), the Internet of Things (IoT)-based AWSs were installed at strategic locations for weather and climate monitoring.

GeoDynamics Research Laboratory

GDR focuses on developing climate-friendly geo-materials and predicting topographic changes that arise from climate change.

From its start in June 2023, the GeoDynamics Research (GDR) Laboratory has focused on (1) developing novel composites using geomaterials from natural and industrial waste and (2) preparing for coastal vulnerability assessments as part of its goal to set up topographic forecasts related to extreme weather/climate events. With the Physics Department of Ateneo de Manila, the Lab has acquired material testing equipment for analyzing aggregate rocks, concrete, mortars, and soil. Four publications were produced, one of which was awarded the Louis V. Berkner Award by the American Geophysical Union (AGU) in December 2023. The replacement of cement by crustacean shell waste, water hyacinth and rice husk ash, and other promising materials is projected to reduce carbon footprints and strengthen infrastructure. Collaborative linkages with Yokohama National University and National Taiwan Normal University were also made this year to help strengthen the Lab's work on creating new geomaterials for environmental sustainability and disaster resilience.

In 2023, the Manila Observatory's Solid Earth Dynamics (SED) Laboratory was renamed the GeoDynamics Research (GDR) Laboratory. The change in name reflects the two-fold research focus on geomaterials engineering of granular matter composites using green technology and geologic hazard forecasts related to extreme weather and climate events.

In particular, the two directions with their respective goals of the GDR Lab are:

**Integrate green technology in composite manufacturing**

Develop composite materials that are stronger and longer lasting through advanced composite manufacturing techniques that incorporate materials such as rice husk/hull ash, volcanic ash, water hyacinth ash, pulverized glass, etc. Explore composites based on materials with self-healing properties (e.g. crustacean shells containing chitin).

Foster knowledge sharing and collaboration by establishing partnerships with green technology research groups, composite manufacturers, and land use agencies.

Improve topographical forecasts for areas at risk of weather and climate disasters

Conduct soil stability tests and analysis in disaster-prone areas, and predict the physical behavior of the topographic surface under the action of an external agent such as rainfall.

Figure 7   (a) Mixing, (b) Molding, (c) Curing, and (d) Self-healing of mortars with waste materials as cementitious replacement

MORTAR SAMPLE	DAY 0	DAY 7
5% TVA + quicklime (from SS)		
5% TVA + quicklime (from SS)		
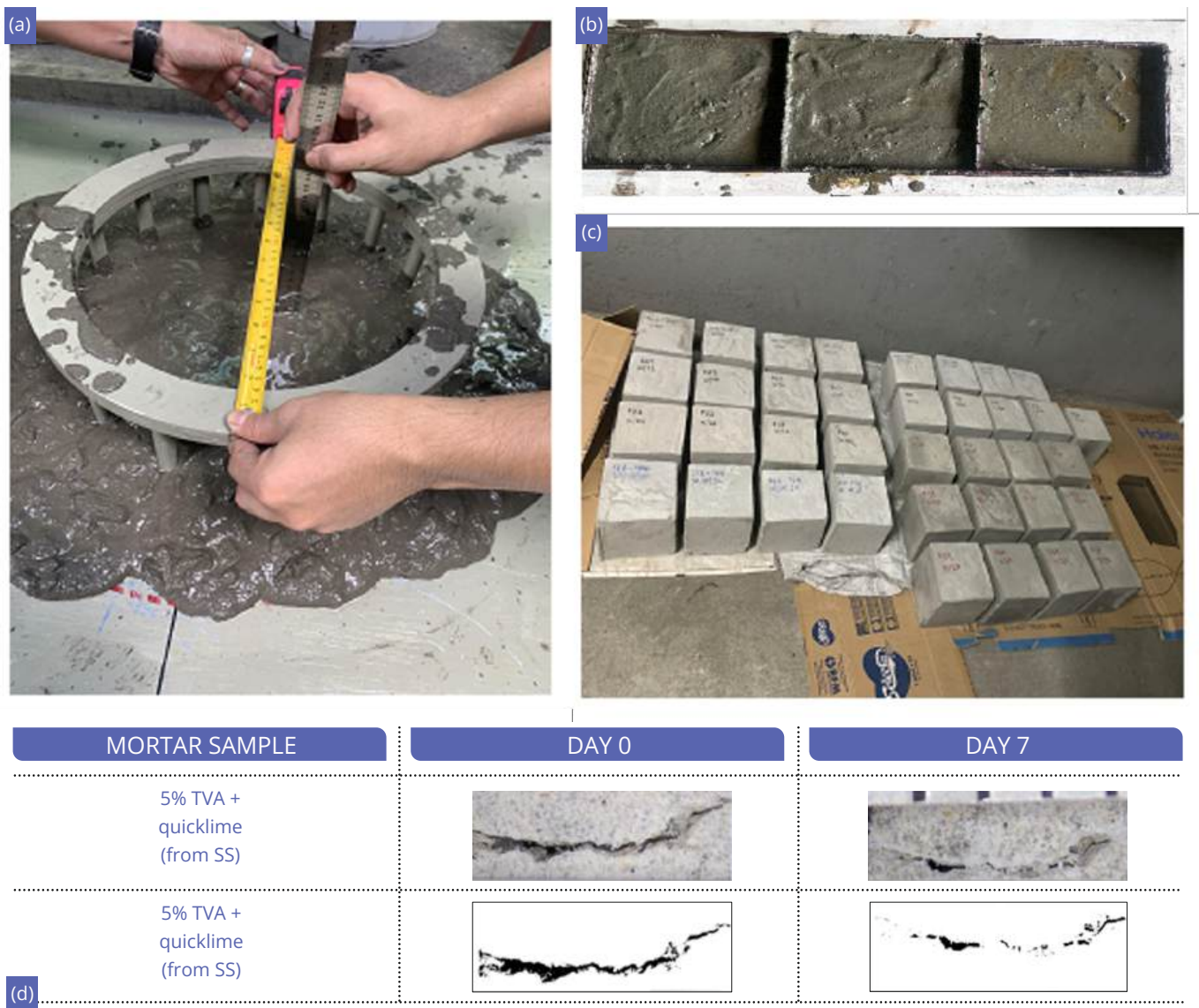
Design, Fabrication, and Implementation of Green Concrete for Sustainability

Aligned with the research direction of geomaterials science and engineering, the aim of the GDR Lab is to explore the use of alternative pozzolanic (i.e., cementitious) materials from waste crustacean shells, pulverized glass, volcanic ash, rice husk ash, and other industrial by-products. Research on alternatives that are expected to have lower carbon footprints, higher mechanical strength, and autogenous or self-healing properties has commenced.

02\ RESEARCH ACTIVITIES

Working closely with the Department of Physics, School of Science and Engineering of the Ateneo de Manila University, the GDR Lab has acquired equipment for the physical, technical, and engineering analysis of geomaterials.

Figure 8   Geophysical, geotechnical, and geoengineering equipment found in the GDR (Photos by Perine Nyssa Bianzon)

Figure 9   Designated GDR Lab workshop for analysis of geomaterials

Topographic hazard forecasts

In preparation for Coastal Vulnerability Assessments that are being asked of the Manila Observatory, students in the GDR were trained to use satellite data from Google Earth Pro to analyze and evaluate various coastal regions in the Philippines that are prone to coastal hazards.

Milestones in 2023

Dr Joel T Maquiling, attended relevant conferences in 2023 in Yokohama, Japan, and Taipei, Taiwan in preparation for heading the GDR Lab. These conferences yielded fruitful collaboration and linkages, as well as graduate and undergraduate student achievement in research seminars, and other related gatherings.

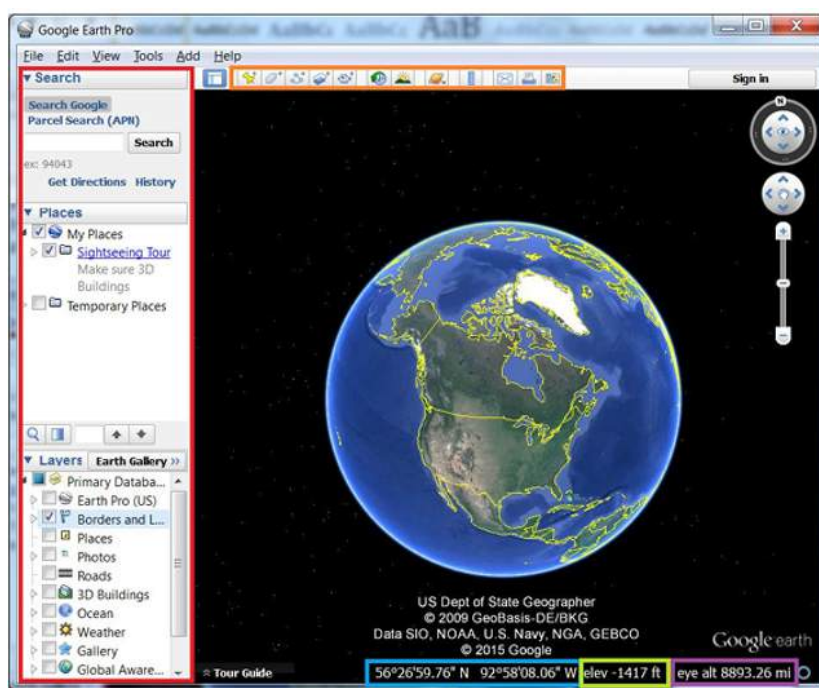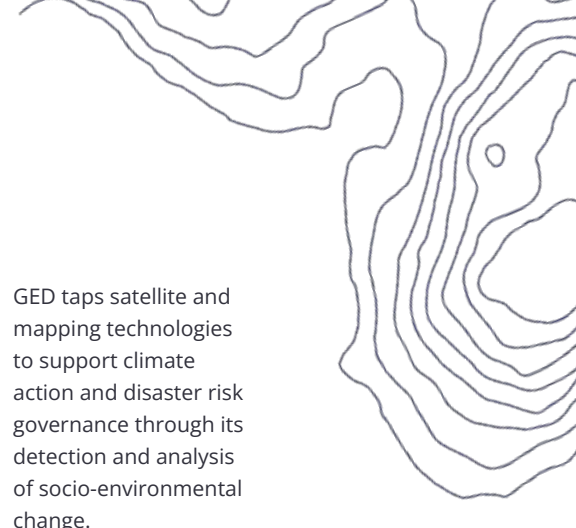*Figure 10   Google Earth Pro Tutorials for Coastal Vulnerability Assessment (CVA)*

Figure 11   Research and Education Forum, 26-29 September 2023, in NTNU, Taipei, Taiwan, attended by Dr Joel T Maquiling (top photo, extreme right)

Figure 12   Dr Joel T Maquiling with Ms Joyce S Candidato whose research work on self-healing granular composites was recognized in the 2024 Ateneo SOSE Outstanding Research Awards
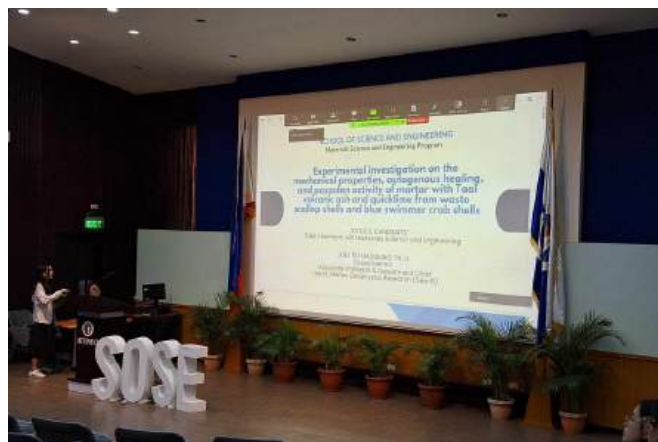
Geomatics for Environment and Development Laboratory

GED taps satellite and mapping technologies to support climate action and disaster risk governance through its detection and analysis of socio-environmental change.

In 2023, the GED Lab made notable strides in developing space-based decision support through geomatics applications. For the DENR in particular, the proof-of-concept for a framework technology of geomatics tools, methods, and services was demonstrated. The GED Lab also worked with the RCS Lab in climate-adjusting flood and landslide maps of Batangas, Borongan, Zamboanga, and Cotabato cities. Emergency observation and mapping (EO/M) of tropical cyclones (TCs) have been optimized in the Microsoft (MS) Planetary Computer using a test case for risk sensitivity. Programming the timely delivery of hazard, exposure, vulnerability, risk, and impact (HEVRI) maps are at the national-regional and local scales. The former coverage prioritizes the rational selection of Areas of Interest (AOIs) for satellite-based Emergency Observation Requests (EORs); the latter, having more focused geographic extent, enables the integration of verifiable geospatial information pre- and post-disaster via space-based RS-GIS processing.

Department of Environment and Natural Resources Climate Change Information Management Systems (DENR CCIMS) Phase 1

DEVCalque is a framework technology of geomatics tools, methods, and services, which aims to address constraints to climate action and disaster risk governance. The geospatial nature of these constraints enable the observation and analysis of competing demands on ecosystem resources. These demands may arise from diverging sectoral priorities found in various scales and milieu. As a result, resilience and sustainable development plans have become challenging to formulate and implement.

In 2023, DENR commissioned the RCS and GED Labs to support the establishment of CCIMS and other information systems for the Department. The CCIMS became the first use case for DEVCalque. The CCIMS-DEVCalque was designed to host geospatially relevant data, information, and knowledge that will be useful for the DENR's Climate Change Service (CCS) and Knowledge and Information Systems Service (KISS) and other attached agencies, as well as Local Government Units (LGUs). The RCS and GED Labs also started populating the CCIMS and other DENR databases – such as the One Control Map and the River Basin Information Management System (RBIMS) – with updated weather and climate scenarios.

The CCIMS-DEVCalque demonstrates climate change action planning that is risk-sensitive and responsive to complex challenges that arise from diverse sectoral priorities and resource management conflicts. These challenges are driven by population growth and migration, resource supply vs. demand, and ecosystem service trade-offs between the urban and rural milieu. On the one hand, hindering/constraining situations exist, such as hazards, exposures, vulnerabilities, risks, and impacts (HEVRI), GHG emissions, and loss and damage. On the other hand, there are helping/enabling factors including benchmarks for climate action and transformative risk governance. Ultimately, CCIMS-DEVCalque provides a structured protocol toward more convergent and resolute resilience and sustainable development planning, especially in the context of climate action (SDG 13) and other SDGs.

The conceptual framework of CCIMS-DEVCalque is shown in *Figure 13*, with four iterative modules, namely, (i) Base Maps, (ii) Baseline Thematic Studies, (iii) Strategic Options, and (iv) Geospatial Climate Change Action Plans. Table 1 indicates the manner these CCIMS-DEVCalque modules facilitate sectoral prioritization amidst unsuitable resource use and/or conflicting interests in resource use. Functionalities of the analytical dashboard are map visualization, benchmarking, spatial analyses, and communication of other related information. The pilot implementation of CCIMS-DEVCalque v.1 is currently underway.

The output of CCIMS-DEVCalque v.1 for 2023 were as follows:

- Inception Report, which describes the rationale and specifications for the CCIMS-DEVCalque v.1

- Incorporation and submission of available datasets from MO to DENR

- Proof-of-concept for the CCIMS-DEVCalque v.1 analytical dashboard and geospatial database

Figure 13   The conceptual framework of the CCIMSS-DEVCalque v.1 consists of four modules that are applied iteratively
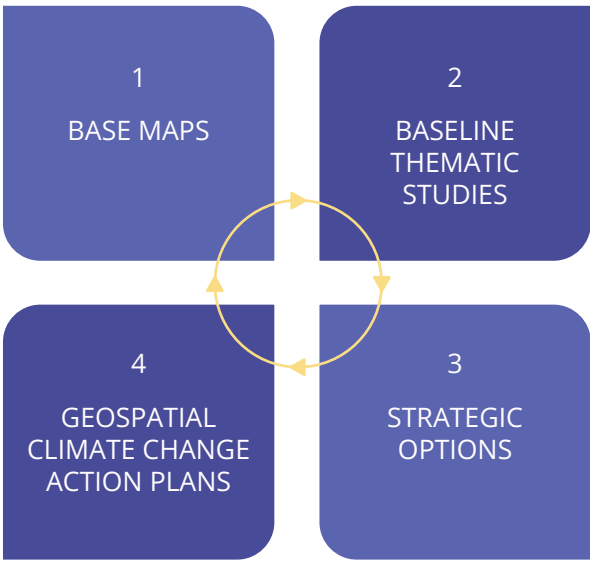

Table 1   How the four CCIMS-DEVCalque v.1 modules help to resolve competing resource demands due to disparate development priorities

Module 1 **Base Maps (Spatial Units)**	Identifies different politico-ecological zones by which to peg climate governance, resource management and sustainable development
	Downstream political boundaries remain disputed and provisional
	Separated from protected areas, public domain or alienable and disposable (A&D) lands drive haphazard land use and cover change within the urban and rural milieu. Roads along A&D lands open up areas for rapid population growth and urbanization, stressing ecosystem services and constraining ecological balance
Module 2 **Baseline Thematic Studies (Parameters of CCAPs)**	Shows development triggers (rural-urban population growth and migration) influencing supply vs demand of resources, including stresses on ecosystem services and trade-offs
	Includes location and timeframe of hindering/constraining vs. helping/enabling forces on sustainable development
Module 3 **Strategic Options (8 Sectoral Priorities x 7 DEVCalque Pathways)**	Demonstrates the cross-cutting menu of more responsive strategic options in space and time (that may be adaptive, optimized, streamlined and/or reconfigured)
	Reveals the gaps in strategic options by DEVCalque pathway that still need to be addressed and integrated
Module 4 **Geospatial Climate Change Action Plans**	Allows participatory evaluation and monitoring as well as improvement of time-bound strategic options making up geospatial climate change action plans
	Ascertains how strategic options may be enhanced and integrated with no-regrets and greater benefit
	Allows tracking of situations on the ground and how these are transformed because of ongoing NCCAPs/ NAPs-DEVCalque Pathways

Figure 14   Prototype of strategic options on water sufficiency
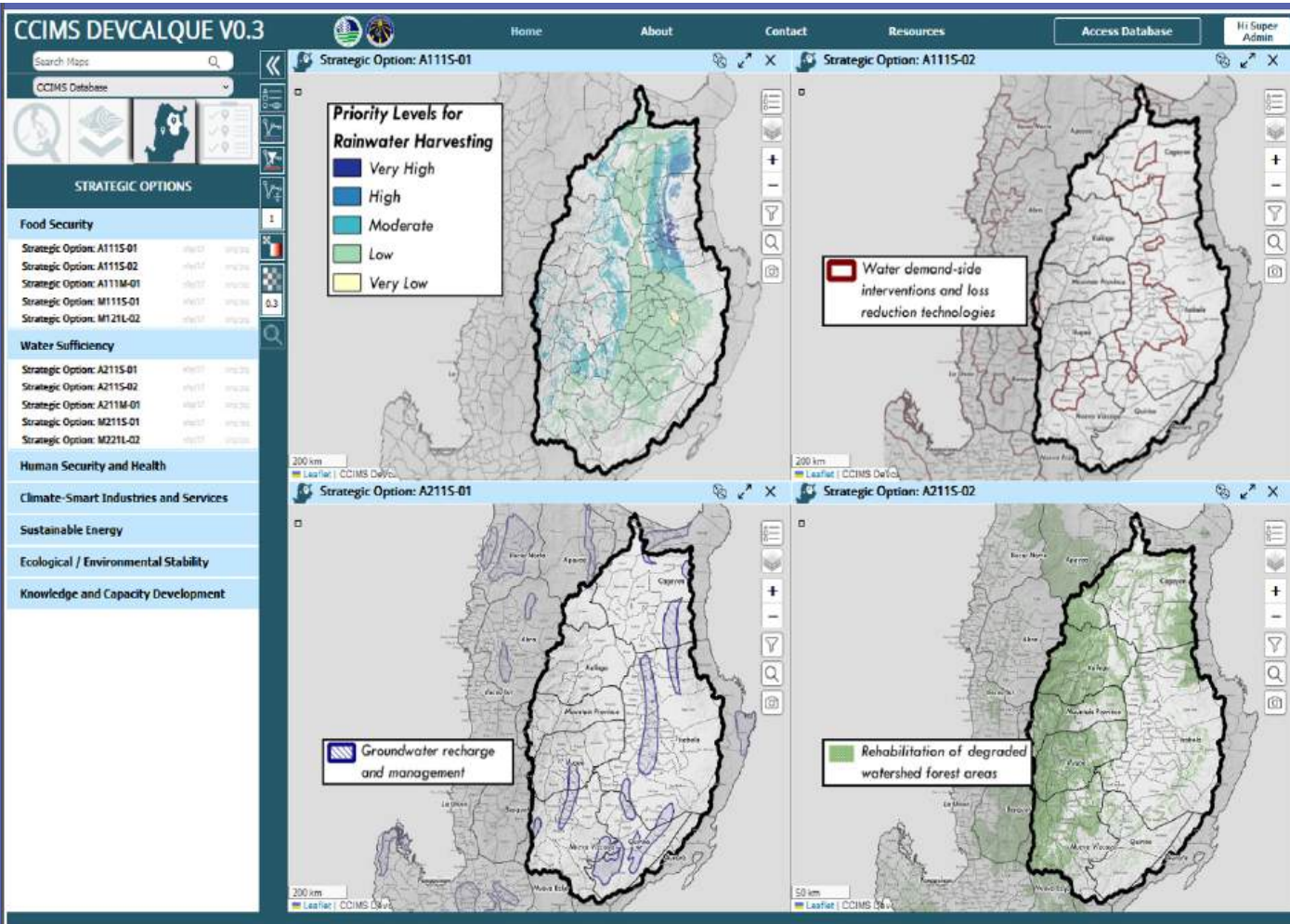
USAID CRS Climate Resilient Cities (CRC) Project

The MO's contribution to the Climate Resilient Cities project is the evaluation of how future climate changes will affect hydrometeorological hazards in four study sites, namely the cities of Batangas, Borongan, Cotabato, and Zamboanga. In 2023, the project specifically focused on floods and rainfall-induced landslides. Its objective is to provide climate-modified hazard maps that will be useful for local risk assessments and adaptation.

In August 2023, the GED RS-GIS specialists, along with partner geologists,

visited Borongan, Batangas, and Zamboanga to validate the preliminary results of climate change-modified hazard maps. Before the fieldwork, the researchers held consultation meetings with LGU representatives where they presented the preliminary maps and identified the critical areas for field validation. With the assistance of city officials, these areas were visited and analyzed.

The hazard maps were validated using reference maps from the Mines and Geosciences Bureau (MGB) of the DENR. The field geologists then adjusted the hazard data according to ground conditions and criteria.

This research helped develop multi-stakeholder capacity for climate information generation, analysis, and application for climate change adaptation and mitigation, disaster risk reduction and management.

Hazard assessment reports that included enhanced and rainfall-adjusted hydrometeorological hazard maps were prepared for Batangas, Zamboanga, Borongan, and Cotabato cities. In particular, these reports gave an overview of potential flood and landslide hazards in each city as verified on the ground. The pattern of future rainfall changes in a warming climate and how these might modify hydrometeorological hazards were analyzed.

Figure 15   MO fieldwork team meeting with the LGU representatives in Zamboanga City

Figure 16   MO fieldwork team and the local CDRRMO on site visits to validate data and information on identified critical areas in Borongan and Batangas cities

GEO MS Optimizing the MS Planetary Computer for EO/M Project

The Group on Earth Observation Microsoft Planetary Computer (GEO MS) Project is a one-year grant from 1 September 2022 to 31 August 2023, with three years of Azure cloud credits from September 2022 to June 2025. The goals of GEO MS were to enhance extreme weather bulletins with GIS-based typhoon and hydrometeorological risk maps, determine specific areas of interest for satellite emergency observation requests, implement emergency observation and mapping (EO/M) protocols on the GEO MS Planetary Computer, improve remote sensing - geographic information systems (RS-GIS) methodologies for EO/M, and develop an enhanced EO/M application for end-users and stakeholders.

This research had three time frames corresponding to a year each. Activities under timeframe 1 were as follows:

Enhancement of EO/M workflows,

RS-GIS applications engineering for EO/M,

Optimal automation of EO/M workflows applying RS-GIS,

EO/M simulation, further enhancement, evaluation, and final implementation, and

Capacity building and outreach

Timeframes 2 and 3 had the following activities:

Real-time tropical cyclone (TC) EO/M application,

Maintenance and improvement, and

Stakeholder outreach workshop

Figure 17   GEO MS project initial output. Flood areas were detected through automated satellite image processing
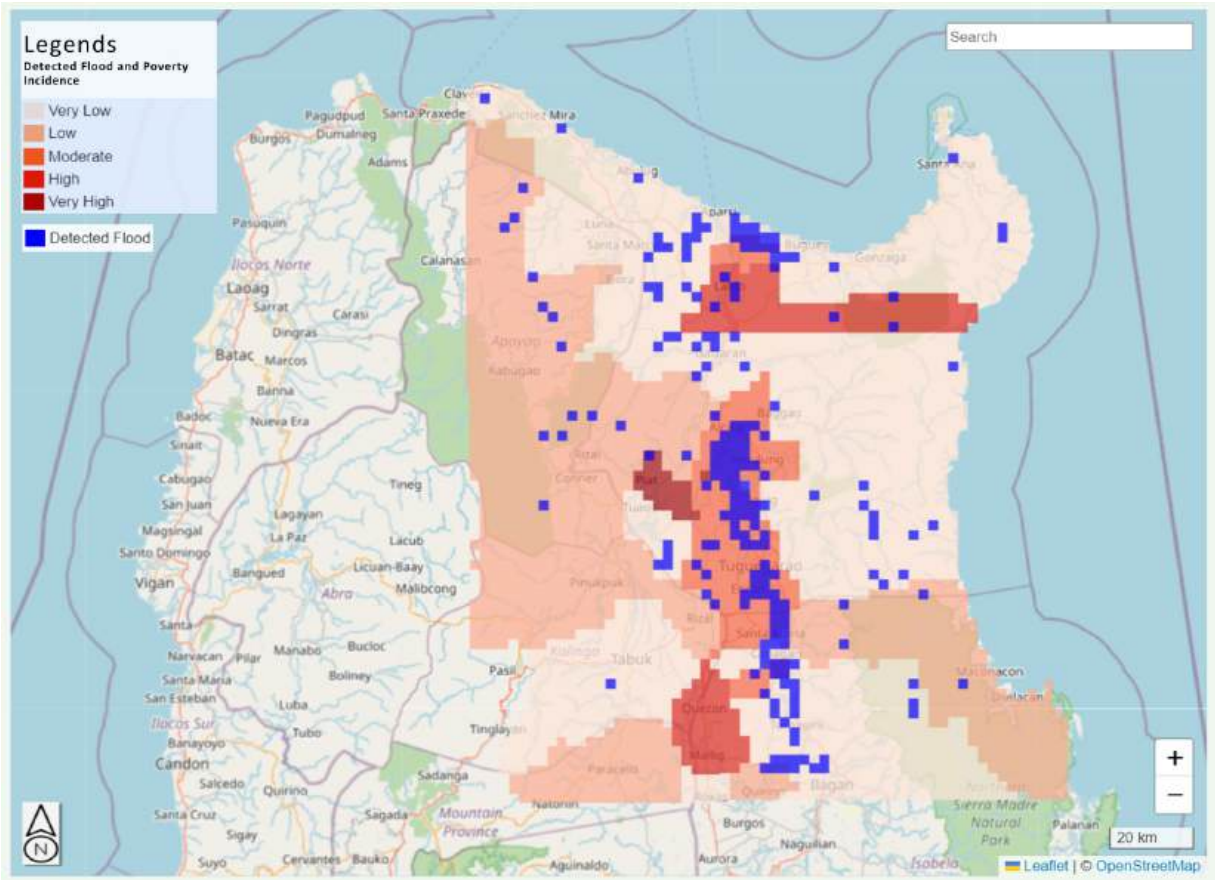
Some of the challenges encountered during the development of the dashboard were differences in jargon among disciplines (i.e., geomatics, climate/ weather, and information technology), code development and implementation, map processing and visualization, large file handling, and spatial data rendition.

Timeframe 1 of 3 was concluded in 2023. Examples of what were accomplished are shown in *Figures 17* and *18*. The automatically extracted flood areas in blue (*Figure 17)* around the central and northern portions of the Cagayan River Basin are comparable to the manually generated map in *Figure 18*.

Figure 18   EO/M impact mapping output. Flood areas were detected through manual satellite image processing

CAGAYAN Typhoon Vamco Barangay Population Density (2015)
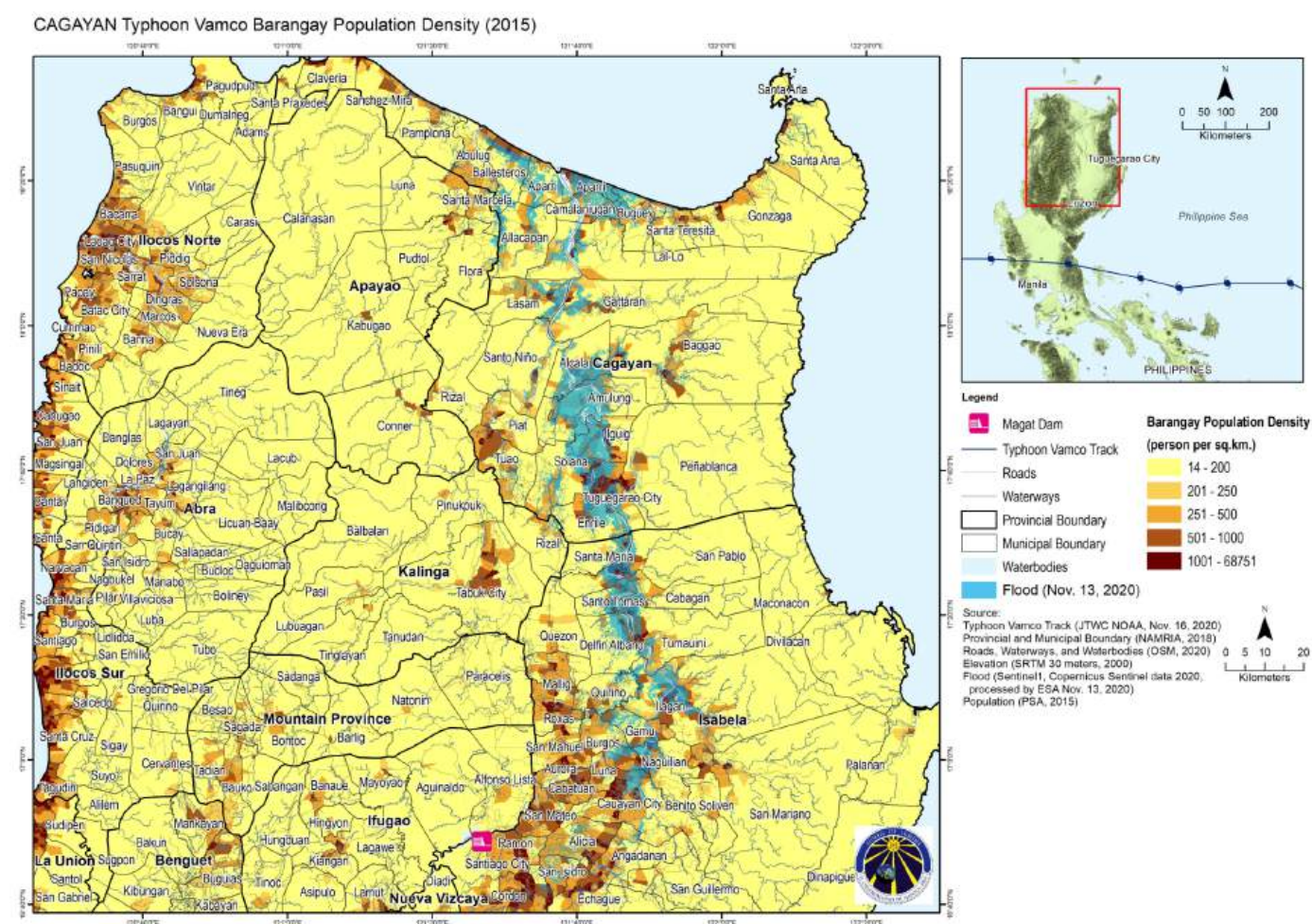
Regional Climate Systems Laboratory
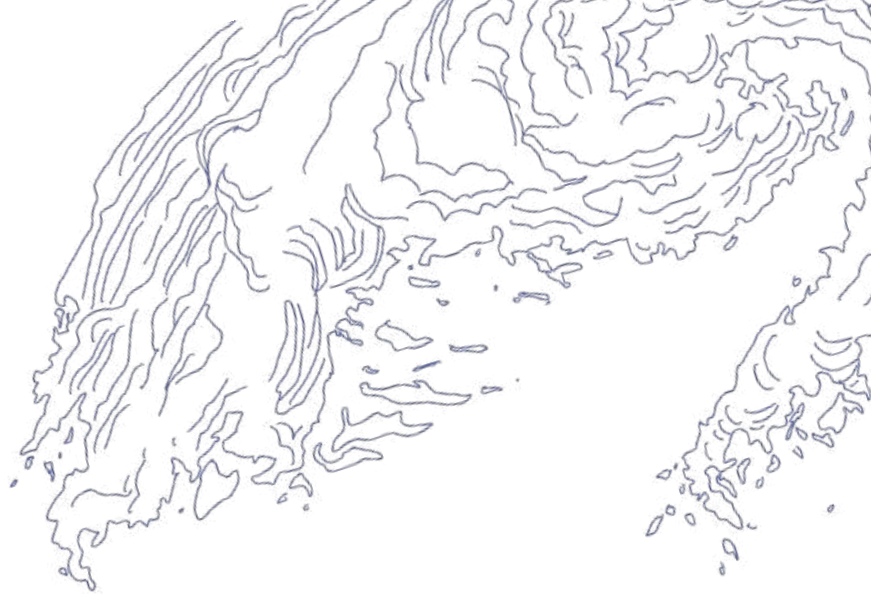
RCS does high-resolution climate research using numerical modeling and data analysis to strengthen climate adaptation, mitigation, and risk resilience planning.

The year 2023 was reported to be the world's warmest year thus far. It also ended with the peak of a strong El Niño, which was predicted as early as the first half of the year. El Niño, drought, and extreme heat were key research themes of the RCS Lab in 2023. The RCS Lab prioritized the development of anticipatory action triggers for drought under the SUPREME BARMM project. It also issued Drought Bulletins to provide updates on current and forecast conditions (e.g., temperature, rainfall, drought and their impacts) to help inform early action. Finally, it also processed and analyzed past and future climate data for a climate risk assessment system (DENR-CCIMS Phase 1 project), and for projects that examine the potential impacts of climate change on: (1) flooding and rainfall-induced landslide hazard susceptibility in cities (CRC project), and (2) health (CCHAIN project).

Research collaboration has been instrumental in the growth and development of the RCS Lab, which also yielded five international journal publications in 2023. Last year marked a milestone for CORDEX Southeast Asia with the beginning of its latest APN-funded project (CARE for SEA megacities) under the leadership of MO. A new research partnership with the ASEAN Centre for Biodiversity was also formalized last October 2023, to investigate the connection of climate change and biodiversity.
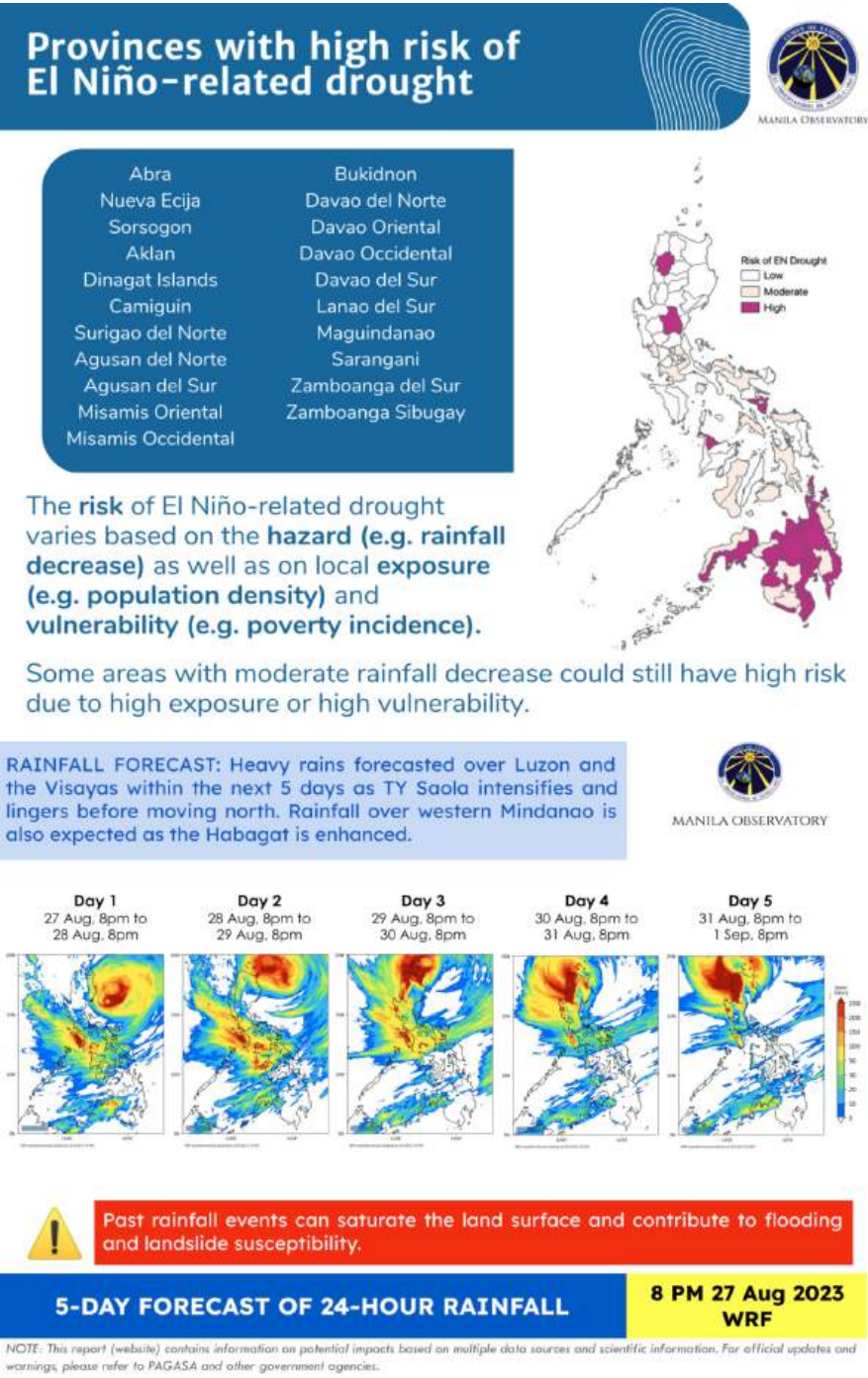
High-definition, Clean Energy, Climate, and Weather Forecasts for the Philippines (ECW)

With the automated weather forecast system in place, the RCS Lab focused on improving model forecast skill using a diagnostic process. For example, impacts of initial and boundary conditions – including soil texture, water vapor, and winds – on temperature, humidity and heat index during extreme heat days were examined to further reduce systematic biases in the model.

In response to El Niño that was forecast in the first half of 2023, and in addition to the extreme weather bulletins that were periodically issued, the RCS Lab together with the Observatory's communications team also started releasing monthly drought bulletins to provide risk information designed to inform early action (*Figure 19*).

Projections from CMIP6 global climate models using the latest Shared Socioeconomic Pathway (SSP) scenarios have also been dynamically downscaled over Southeast Asia, in collaboration with CORDEX Southeast Asia.

Figure 19 Drought and Extreme Weather Bulletins

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

In this project, the RCS Lab led the research on anticipatory action (AA) triggers for drought, flood, and tropical cyclones to support anticipatory and humanitarian action in the BARMM region. This work included a desk review of existing triggers and historical impacts in the region, and the conduct of consultation meetings, workshops, and discussions with the BARMM AA Technical Working Group and Pre-Disaster Risk Assessment teams, SUPREME BARMM consortium, and partners (*Figure 20*). In preparation for El Niño that developed in the latter part of 2023, the development of AA triggers for drought was prioritized, and the Lab participated in outreach activities (e.g., online talks, radio interview, bulletins) to share information about El Niño and its potential impacts with the public.

Climate Resilient Cities (CRC)

Hydrometeorological hazard maps are essential for city planning, but these maps typically do not include information on the future impacts of climate change on these hazards. The RCS Lab contributed to the USAID CRC Project by processing historical and future rainfall data that was then used in the climate change-modified landslide and flood hazard maps for four cities: Batangas, Zamboanga, Borongan, and Cotabato. The Lab also delivered climate downscaling lectures through workshops conducted by the Observatory's Klima Center in the cities of Legazpi, Iloilo, Zamboanga and Cotabato. These lectures explained the process, use, and limitations of datasets for adaptation planning.

Figure 20 Consultation meetings and workshops with BARMM AA TWG and SUPREME BARMM consortium

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

In October 2023, CORDEX Southeast Asia started its latest project, CARE for SEA megacities, which is funded by the Asia-Pacific Network for Global Change Research. Led by MO, this three-year project aims to generate city-scale climate hazard information for the Southeast Asian megacities of Bangkok, Hanoi, Jakarta, Kuala Lumpur and Manila under multiple emissions scenarios that would be useful for decision and policy making. The goal of this project is to enhance the climate resilience of cities in the future.

An inception workshop and stakeholder consultation were held in Bangkok, Thailand last 22-24 November 2023 to introduce the project and for climate scientists and stakeholders to identify priority climate hazards in SEA megacities (*Figure 21*).

Climate Change, Health and Artificial Intelligence (CCHAIN)

With the support of Lacuna Fund, Project CCHAIN aims to develop a linked dataset that can be used to examine the impacts of climate change on health in the Philippines and to inform local climate risk assessments, health services management and risk reduction plans. In collaboration with Thinking Machines Data Science, EpiMetrics, and Philippine Action for Community-Led Shelter Initiatives, Inc., the Manila Observatory through the RCS Lab extracted climate data from various sources that were used in the creation of an open-sourced linked dataset of climate, health, environment and socio-economic data at the barangay level across 12 Philippine cities for the years 2003-2022. A comprehensive survey of open-source climate data was first conducted, followed by an evaluation of the datasets against observed station data where available, to identify the best dataset to meet the project's objective.

Figure 21 CARE for SEA megacities: Inception workshop and stakeholder consultation. Bangkok, Thailand, 22-24 November 2023
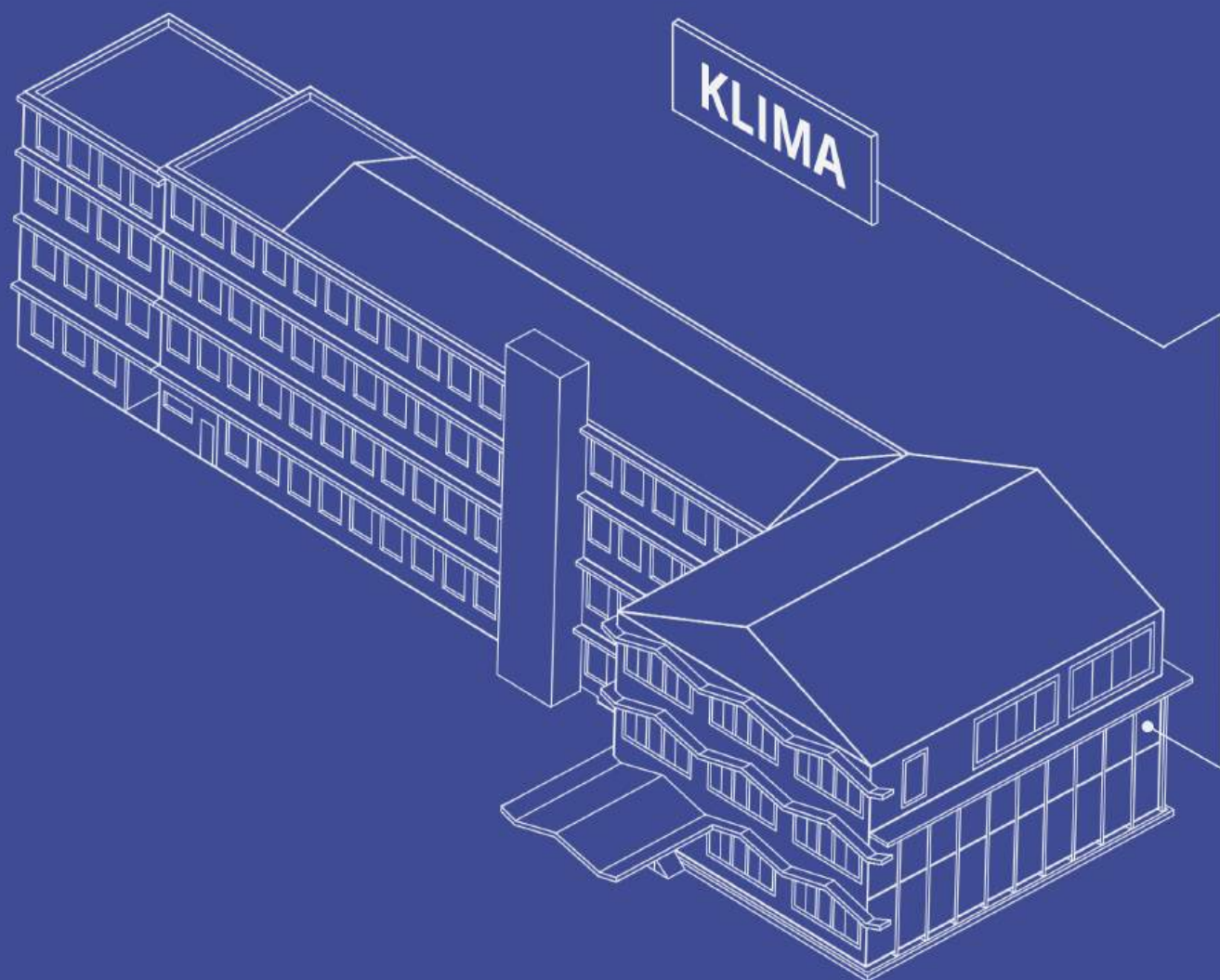
03 \ Societal Engagement
 \ Klima Center

Klima Center

Recognizing the need to work with local partners, the Klima Center widened its national reach. It continued its work on the Conventions in the international negotiations, but also broadened its partnerships at the local level. The priorities of Klima were on providing technical assistance to partner organizations and promoting science-based advocacy. Internationally, it has remained to be a member of the Allied for Climate Transformation by 2025 (ACT2025); regionally, it continued its work with The Samdhana Project, led a regional discussion on Loss and Damage under the Heinrich Böll Stiftung project, and released a workbook on the need to amplify the priorities of Persons with Disabilities (PWDs) in regional climate action; nationally, it concluded the Climate Justice Capacity Initiative (CJCI) project and began work on Land and Climate Litigation. Other projects of the Center include RENDER, which capacitates young researchers in the area of renewable energy transition, and WE-DEFEND, as well its projects in partnership with the other laboratories, such as the Climate Resilient Cities and the SUPREME BARMM project.

Allied for Climate Transformation by 2025 (ACT2025)

Allied for Climate Transformation by 2025 (ACT2025) is a consortium of Global South think tanks working on climate action. The Manila Observatory has been part of the consortium since 2020, and has led discussions on Ambition and Loss and Damage.

In February 2023, Deputy Director of Klima Yla Gloria Marie Paras and Atty Jameela Joy Reyes attended the ACT2025 retreat in Turkey. The goal of the retreat was to strengthen the relationships among consortium members to come up with a clear framework and streamlined understanding of thematic priorities and positions.

MO co-authored the consortium's Call to Action for COP28 and co-organized a side event at the UNFCCC SB58 in Bonn, Germany. The side event, entitled "Implementing Climate Justice: Solidarity with Vulnerable Countries on the Road to COP28", was a panel discussion where the speakers, leading negotiators and climate justice advocates, talked about the need to evaluate the current progress in international climate negotiations and what else is needed to accelerate climate action moving forward, knowing that vulnerable countries are already disproportionately feeling the worst of the impacts of an increasingly warmer world. MO also co-wrote an article on The Global Stocktake.

Figure 22   Members of the ACT2025 Consortium
(Photo from: Fahad Hossain, International Centre for Climate Change and Development)

Figure 23   Workshop on the operationalization of the L&D Fund. Participants represented a wide range of sectors, including government, civil society, youth, women, and indigenous peoples (Photo from: Bernadine de Belen)

Samdhana Project

For Year 2 of the Samdhana Project, Klima focused on capacity-building and increasing its technical capacity by attending the Glasgow Dialogues in the UNFCCC Subsidiary Bodies in Bonn, Germany, as well as taking part in the Loss and Damage (L&D) discussions in COP28 in Dubai, United Arab Emirates. COP28 was a historic COP as it led to the operationalization of the Loss and Damage Fund. For Year 3, Klima aims to strengthen local partnerships and take the lead in discussing L&D for civil society and LGUs.

Advocacy Support for Loss & Damage Campaign in SEA

Through a partnership with the Heinrich Böll Stiftung - Southeast Asia, with co-funding support from The Samdhana Institute, and in view of the discussions on the L&D Fund, Klima held a workshop in Bangkok, Thailand, ahead of COP28. The workshop, entitled "Southeast Asian Perspectives on the Operationalization of the Loss and Damage Fund", was a two-day workshop where participants, who represented various sectors from different Southeast Asian countries, discussed
(1) the role of science in the operationalization of the L&D Fund,

(2) mapping the L&D Fund within the UNFCCC and the Paris Agreement, (3) the progress of and pending questions before the Transitional Committee, and (4) options and considerations on the L&D Fund and Funding Arrangements.

As a result of the workshop, Klima was able to produce two documents. First, a Submission to the Transitional Committee on the operationalization of the Fund, and second, a Policy Brief that laid down the key takeaways of the participants from the workshop.

Climate Change and Persons with Disabilities in the ASEAN: A Review of Gaps in Existing Climate Policies

Klima drafted a workbook for the ASEAN Disability Fund which laid down the existing gaps in climate policies in the Southeast Asian region with regard to Persons with Disabilities (PWDs). The document discusses the causes behind poor PWD-inclusive disaster management, the impacts of climate hazards on PWDs, the frameworks catering to disabled communities, and policies for an anticipatory framework. The workbook concluded with policy recommendations for the ASEAN vis-a-vis PWDs.

Figure 24   Cover page of the workbook, sensitivie to those who have visual disabilities
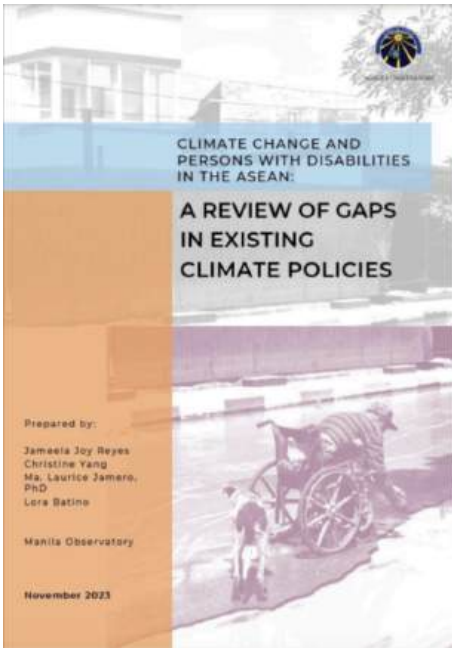
Climate Justice Capacity Initiative (CJCI)

CJCI concluded in 2023. A highlight of the project was the Knowledge Exchange event that took place in Davao which gathered the different Ateneo Law Schools all over the country. CJCI was also officially launched in COP28 in Dubai during the Climate Law and Governance Day.

Furthermore, CJCI released a Policy Report entitled "Lost and Damaged? Opportunities, limitations, and gaps of loss and damage finance, looking into science and the law" which historicized loss and damage and looked at the scientific and legal regimes that surround it, with the eventual goal of drawing solutions to operationalize and implement loss and damage on the ground, taking the Philippine experience as a jumping point.

Figure 25   Left: Klima Director Dr Antonio La Viña and Atty Raz Rañeses from the Ateneo de Naga School of Law speaking about the CJCI. Right: Klima team outside the CLG event
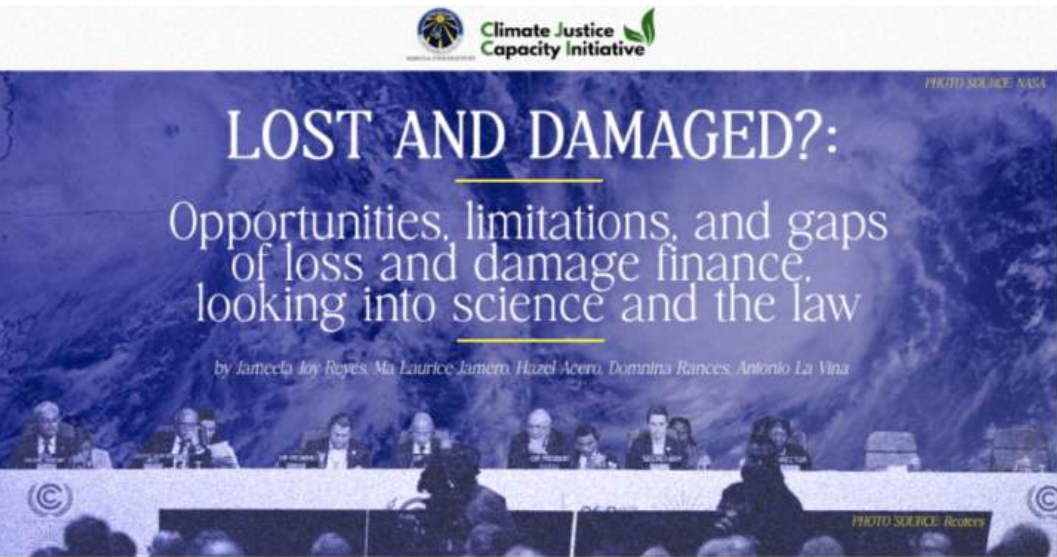
Other projects and partnerships

- The Manila Observatory continued its work with The Asia Foundation on the WE-DEFEND Project, and have started refining the climate playbook.

- RENDER, which empowers young researchers to enter the renewable energy transition field, was expanded. RENDER is supported by the TARA Grant.

- More progress was created in Land and Climate Litigation initiatives, which is primarily supported by The Samdhana Institute. The litigation work assists environmental defenders, indigenous peoples, and local communities.

- In COP28, Atty Jameela Joy Reyes, Technical Advisor for Klima, spoke at a side event co-organized with Aksyon Klima Pilipinas, Living Laudato Si' and Greenpeace Philippines, entitled the "People's Museum of Climate Justice". Klima also supported and co-organized side events at the Philippine Pavilion during COP28.

- Klima continued to assist the other labs of the Manila Observatory in implementing projects such as CRC and SUPREME BARMM. Dr Laurice Jamero and Atty Jameela Joy Reyes from Klima served as Training Specialist and Facilitator respectively for trainings held in Legazpi, Iloilo, Cotabato, and Zamboanga cities.

Figure 27   Photo from Greenpeace Philippines

04 \ Research Publications and Presentations

Research Publications

Air Quality Dynamics Laboratory

Cambaliza, M.O., Yu, L., Latif, M.T., Lestari, P., Wu, X. (2023). Regional and urban air quality in Southeast Asia: maritime continent. In: Akimoto H, Tanimoto H, editors. Handbook of Air Quality and Climate Change. Springer, Singapore. https://doi.org/10.1007/978-981-15-2527-8_68-1

Collado, J.T., Abalos, J.G., de los Reyes, I., Cruz, M. T., Leung, G.F., Abenojar, K., Manalo, C.R., Go, B., Chan C.L., Gonzales C.K.G., Simpas J.B.B., Porio E.E., Wong J.Q., Lung S.C.C., Cambaliza M.O.L. (2023). Spatiotemporal assessment of $PM_{2.5}$ exposure of a high-risk cccupational group in a Southeast Asian megacity. Aerosol and Air Quality Research, 23, 220134. https://doi.org/10.4209/aaqr.220134

Cruz, M.T., Simpas, J.B., Holz, R., Yuan, C.-S., & Bagtasa, G. (2023). Characteristics of particulate matter during New Year's eve fireworks and Taal volcano ashfall in Metro Manila in January 2020. Urban Climate, 50, 101587. https://doi.org/10.1016/j.uclim.2023.101587

Cruz, M.T., Simpas, J.B., Sorooshian, A., Betito, G., Cambaliza, M.O., Collado, J.T., Eloranta, E.W., Holz, R., Topacio, X.G.V., Del Socorro, J., Bagtasa, G. (2023). Impacts of regional wind circulations on aerosol pollution and planetary boundary layer structure in Metro Manila, Philippines. Atmospheric Environment, 293, 119455. https://doi.org/10.1016/j.atmosenv.2022.119455

Lorenzo, G.R., Arellano, A.F., Cambaliza, M.O., Castro, C., Cruz, M.T., Di Girolamo, L., Gacal, G.F., Hilario, M.R.A., Lagrosas, N., Ong, H.J., Simpas, J.B., Uy, S.N., Sorooshian A. (2023). An emerging aerosol climatology via remote sensing over Metro Manila, the Philippines. Atmospheric Chemistry and Physics, 23, 10579-10608. https://doi.org/10.5194/acp-23-10579-2023

Reid, J.S., Maring, H.B., Narisma, G.T., van den Heever, S., Di Girolamo, L., Ferrare, R., Lawson, P., Mace, G.G., Simpas, J.B., Tanelli, S., Ziemba, L., van Diedenhoven, B., Bruintjes, R., Bucholtz, A., Cairns, B., Cambaliza, M.O., et al. (2023). The coupling between tropical meteorology, aerosol lifecycle, convection, and radiation, during the Cloud, Aerosol and Monsoon Processes Philippines Experiment (CAMP²Ex). Bulletin of the American Meteorological Society, 104(6): E1179–E1205. https://doi.org/10.1175/BAMS-D-21-0285.1

GeoDynamics Research Laboratory

Plando, F.L.P., Maquiling, J.T. (2023). Microstructural characterizations and strength development of self-compacting concrete using rice husk ash. Romanian Journal of Physics, 68(5-6).

Plando. F.L.P., Gili, M.B., Maquiling, J.T. (2023). Microstructural characterizations and radiation shielding quantities of rice husk ash-based self-compacting concrete and its precursors. Radiation Physics and Chemistry, 208, 110916. https://doi.org/10.1016/j.radphyschem.2023.110916

Gumayan, E.G., Dimzon, I.K.D., Maquiling, J.T., Janayon, R.V., Dulpina, C.P., Guerrero, R.A. (2023). Bioplastic diffraction gratings based on chitosan from crab shell waste incorporated with starch and plasticizer. Frontiers in Optics + Laser Science, Technical Digest Series (Optica Publishing Group), paper FD1.4. https://doi.org/10.1364/FIO.2023.FD1.4

Beroya-Eitner, M.A., Vicente, M.C., Dado, J.M., Dimain, M., Maquiling, J.T., Cruz, F.A. (2023). Climate change as modifier of landslide susceptibility: case study in Davao Oriental, Philippines. In: Alcántara-Ayala I, Arbanas Z, Huntley D, Konagai K, Arbanas SM, et al., editors. Progress in Landslide Research and Technology, 2(2). Springer, Cham. p. 247-257. https://doi.org/10.1007/978-3-031-44296-4_12

Research Publications

Regional Climate Systems Laboratory

Chung, J.X., Juneng, L., Santisirisomboon , J., Ngo-Duc, T., Phan-Van, T,. Trinh-Tuan, L., Cruz, F.A., Dado, J.M., et al. (2023). Future changes in mean and extreme precipitation over Peninsular Malaysia using CORDEX-SEA 5 km simulations. APN Science Bulletin, 13(1). https://doi.org/10.30852/sb.2023.2348

Magnaye, A.M.T., Aragon, L.G., Dado, J.M., Cruz, F.T., Olaguera, L.M.P., Narisma, G.T., Tangang, F., Juneng, L., Ngo-Duc, T., Phan-Van, T., Santisirisomboon, J., Singhruck, P., Gunawan, D., Aldrian, E., and Sopaheluwakan, A. (2023). Process-based analysis of the impacts of sea surface temperature on climate in CORDEX-SEA simulations. Climate Dynamics, 61, 4749–4771. https://doi.org/10.1007/s00382-023-06826-3

Olaguera, L.M.P., Matsumoto, J., Manalo, J.A. (2023). The contribution of non-tropical cyclone vortices to the rainfall of the Philippines. International Journal of Climatology, 43(4), 1871–1885. https://doi.org/10.1002/joc.7950

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Petilla, C.E.R., Tonga, L.P.S., Olaguera, L.M.P., Matsumoto, J. (2023). Changes in intensity and tracks of tropical cyclones crossing the central and southern Philippines from 1979 to 2020: an observational study. Progress in Earth and Planetary Science, 10, 32. https://doi.org/10.1186/s40645-023-00563-1

Klima Center

Ortiz, A.M., Jamero, M.L., Crespin, S.J., Ramirez C.S., Matias, D.M.S., Reyes J.J., Pauchard, A., La Viña, A.G. (2023). The land and sea routes to 2030: a call for greater attention on all small islands in global environmental policy. npj Biodiversity, 2, 18 . https://doi.org/10.1038/s44185-023-00023-5

Presentations and Reports

Air Quality Dynamics Laboratory

[Technical Report] Cainglet, Z.M., De Francisca, A.M., Bañaga, P.A., Visaga, S.M., Cruz, M.T., Simpas, J.B., Cambaliza, M.O., Villarin, J.R., McNamara, D. (2023). Particle pollution measurements in Metro Manila (New Year 2023). Manila Observatory, Quezon City, Philippines. https://www.observatory.ph/2023/03/10/particle-pollution-measurements-in-metro-manila-new-year-2023/

GeoDynamics Research Laboratory

[Conference] Plando, F.R., Maquiling, J.T. (2023). The Influence of rice husk ash in achieving durable and sustainable self-compacting concrete in a mix-design development. AGU Fall Meeting 2023, Session: Science and Society, held in San Francisco, CA, 11-15 December 2023.

[Conference] Culaba I.B., Maquiling J.T., delos Santos R.M. (2023). Fabrication and applications of a novel and multi-feature spectroscope. Journal of Physics: Conference Series. XV International Conference on Mathematics, Science and Technology Education, Kryvyi Rih, Ukraine. https://doi.org/10.1088/1742-6596/2611/1/012012

[Conference] Gutierrez, A.J., Dingel, B.B., Maquiling J.T., Dagohoy, J.L., Bambalan, D.J.P. (2023). Phasor analysis of the Symmetric Crisscrossed-assisted Coupled-Ring Reflector. 32nd Wireless and Optical Communications Conference (WOCC), Newark, NJ, USA, 2023, pp. 1-5. https://doi.org/10.1109/WOCC58016.2023.10139652

[Conference] Gutierrez, A., Dingel, B., Maquiling, J.T., Sy, W.J., Bennett, C.D. (2023). 'Ultraslow-light' and flipping property of the Crisscrossed-assisted Coupled-Ring Reflector. IEEE Silicon Photonics Conference (SiPhotonics), Washington, DC, USA, pp. 1-2. https://doi.org/10.1109/SiPhotonics55903.2023.10141905

Geomatics for Environment and Development Laboratory

[Technical Report] Vicente, M.C., Montajes, J.T., Dimain, M.R., Peralta, F.M., Lagrosas, J.C., Cajilla, C.A., Torres, J.L.G., del Castillo, F., Dado, J.M., Cruz, F.A., Uy, S.N., Gozo, E., Avila, F.B., Teodoro, R., Lo, D., Vallente, J. (2023). Optimizing the Group on Earth Observation Microsoft Planetary Computer (GEO MS) for Emergency Observation and Mapping (EO/M). Manila Observatory, Quezon City, Philippines.

Klima Center

[Policy Brief] Jamero, M.L., Reyes, J.J., Gamboa, J., de Belen, B., Acero, H. (2023). Southeast Asian perspectives on the operationalization of the loss & damage fund. Manila Observatory. https://www.observatory.ph/wp-content/uploads/2023/10/Policy-Brief-Draft-For-Circulation.pdf

[Policy Report] Reyes, J.J., Jamero, M.L., Acero, H., Rances, D., La Viña, A.G. (2023). Lost and damaged? opportunities, limitations, and gaps of loss and damage finance, looking into science and the law. Manila Observatory. https://www.observatory.ph/wp-content/uploads/2023/08/MO_CJCI_Lost-and-Damaged-Opportunities-limitations-and-gaps-of-loss-and-damage-finance-looking-into-science-and-the-law.pdf

[Policy Brief] Reyes, J.J. (2023). The Case for net-zero in the Philippine context of just energy transition. Aksyon Klima Pilipinas. https://drive.google.com/file/d/1O9u9N4GsglVRbV4x9oX4Es5_dcRw6lzu/view

[Workbook] Reyes, J.J., Yang, C., Jamero, M.L., Bation, L. (2023). Climate change and persons with disabilities in the ASEAN: a review of gaps in existing climate policies. Manila Observatory. https://www.observatory.ph/wp-content/uploads/2023/12/ADF-MO-GGF_final2023.pdf

AA	Anticipatory Action
ACT2025	Allied for Climate Transformation by 2025
AERONET	Aerosol Robotic Network
AWS	Automated Weather Station
BC	Black Carbon
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 Climate Downscaling Experiment
CRC	Climate Resilient Cities
CRS	Catholic Relief Services
EO/M	Emergency Observation and Mapping
EWB	Extreme Weather Bulletin
GEO MS	Group on Earth Observation Microsoft Planetary Computer
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
PM	Particulate Matter
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
TC	Tropical Cyclone
UNFCCC	United Nations Framework Convention on Climate Change
VIPIR	Vertical Incidence Pulse Ionosphere Radar

We are truly grateful to our partners and benefactors for their generous support of our work as an environmental observatory that shares in the urgent mission to care for our common home

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Ateneo de Manila University
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Who
we
are

Established in 1865 under the auspices of the Jesuit mission in the Philippines, the Manila Observatory was the country's official meteorological and seismological agency until operations were handed over to the Philippine government in the aftermath of World War II.

Since then, as a nonprofit research institution, we have become a climate observatory focused on our part of the planet that is not well-studied and is at high risk of climate-related disasters.
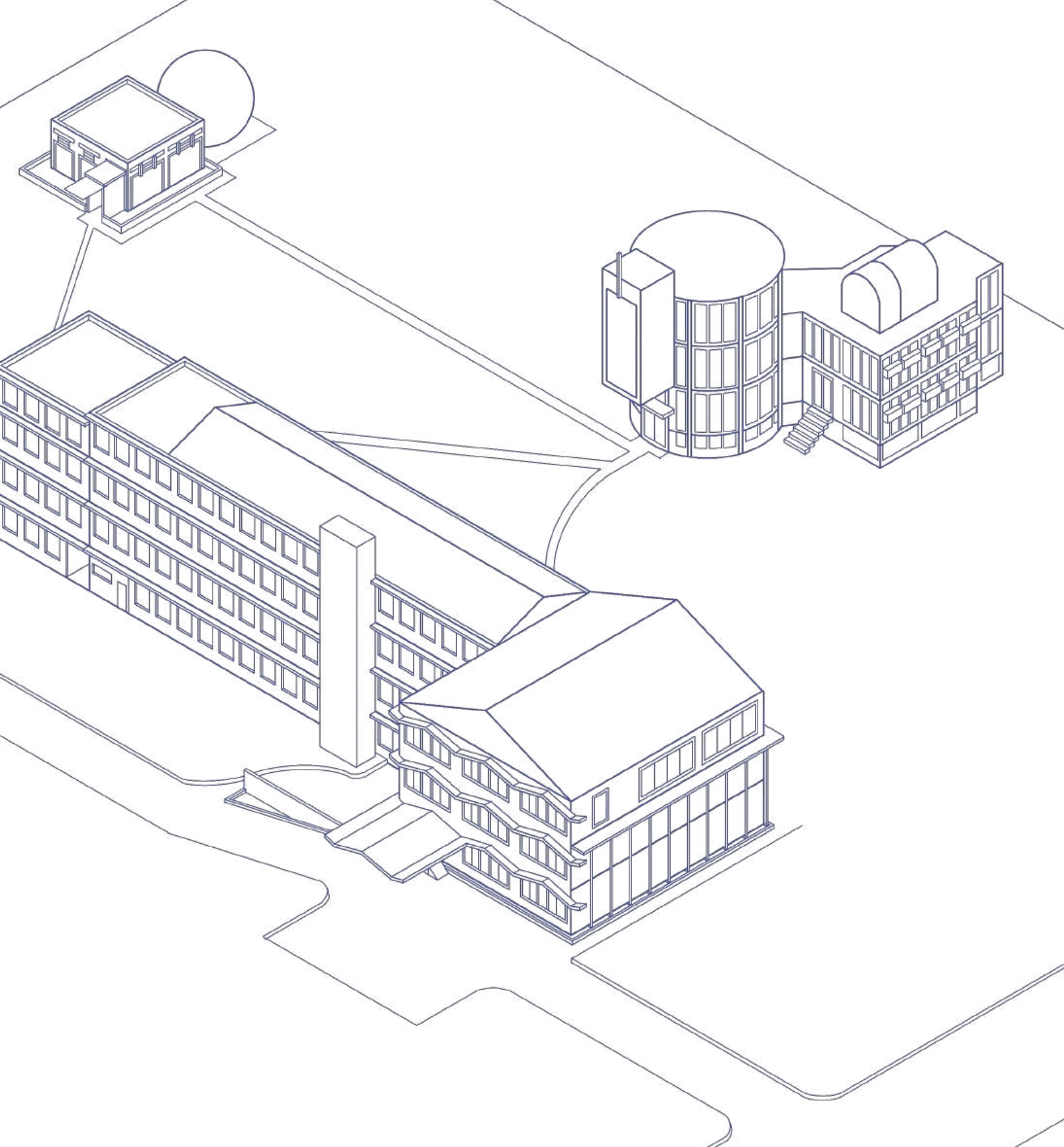
We deploy the atmospheric and earth sciences, remote sensing technologies, the instrumentation and data sciences to help communities respond to climate change.

The data and information and knowledge we provide can be transformed into wise decisions and actions that take better care of people and our common home.
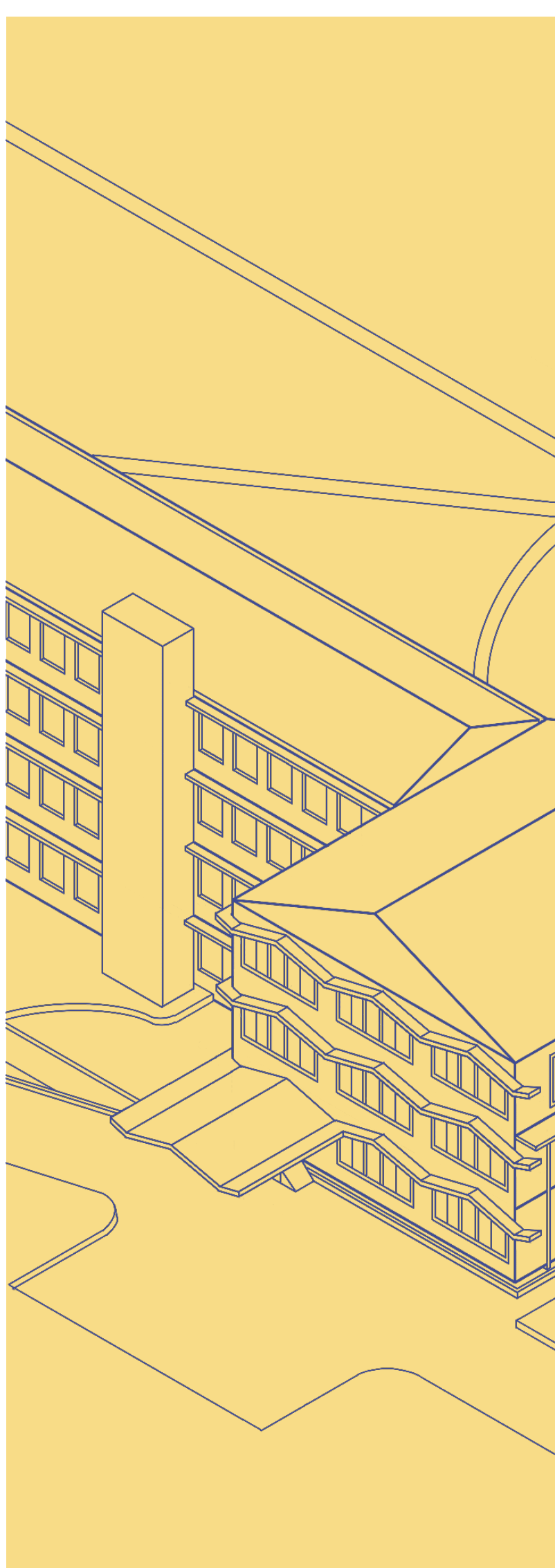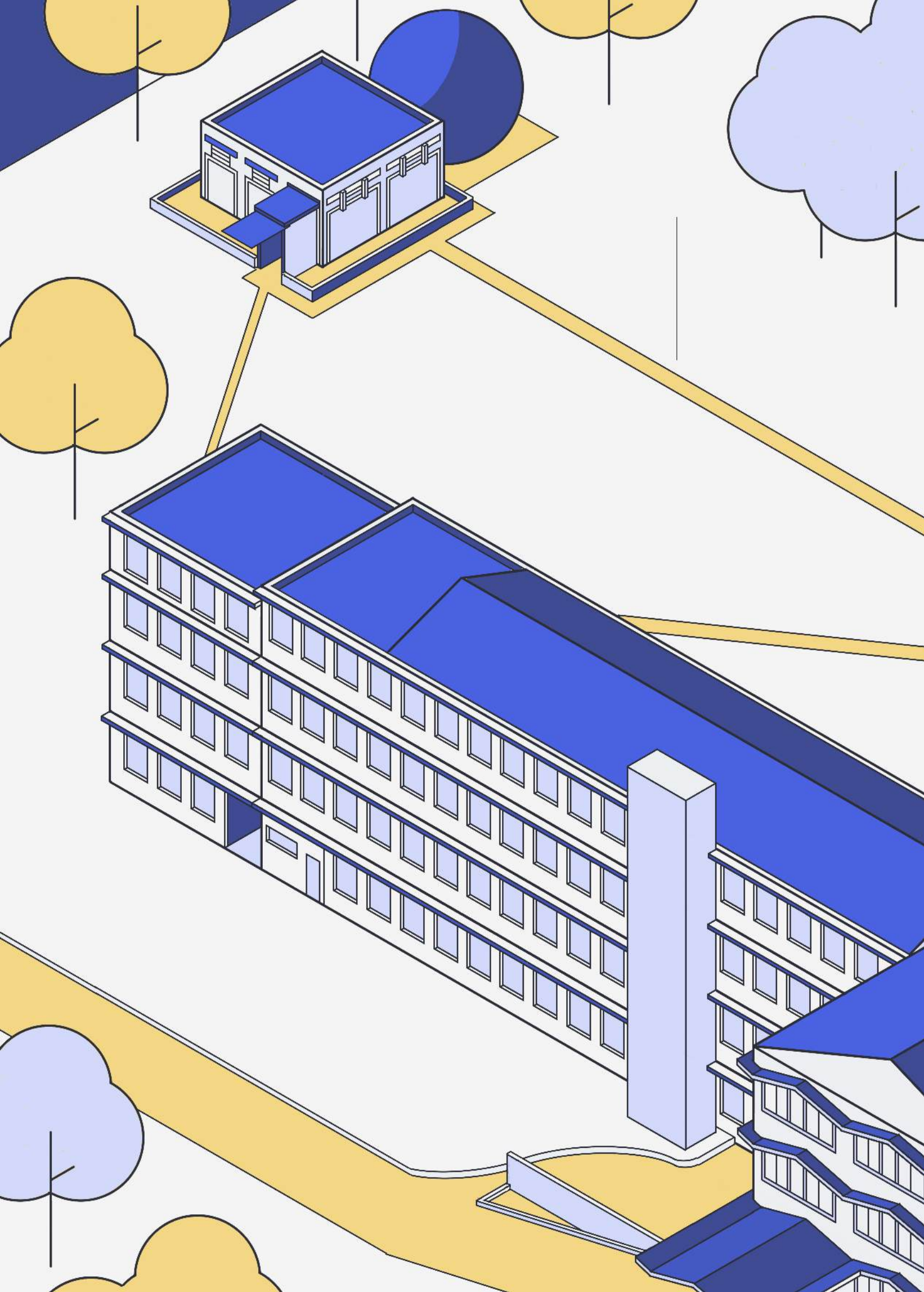
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