

**UN-ESCAP Expert Group Meeting on space-derived
data for air pollution monitoring**

Country Report: Philippines



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Nominated Participant, Philippine Space Agency

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Resource Persons



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Philippine Space Agency (PhilSA)

- Established on 8 August 2019 by virtue of RA 11363 “Philippine Space Act”

- Mandate

Primary policy, planning, coordinating, implementing, and administrative entity of the Executive Branch of the government that will plan, develop, and promote the national space program in line with the Philippine Space Policy.



PhilSA Director General Joel Joseph Marciano, Jr.
with UNOOSA Director Simonetta de Pippo

PhilSA Operations

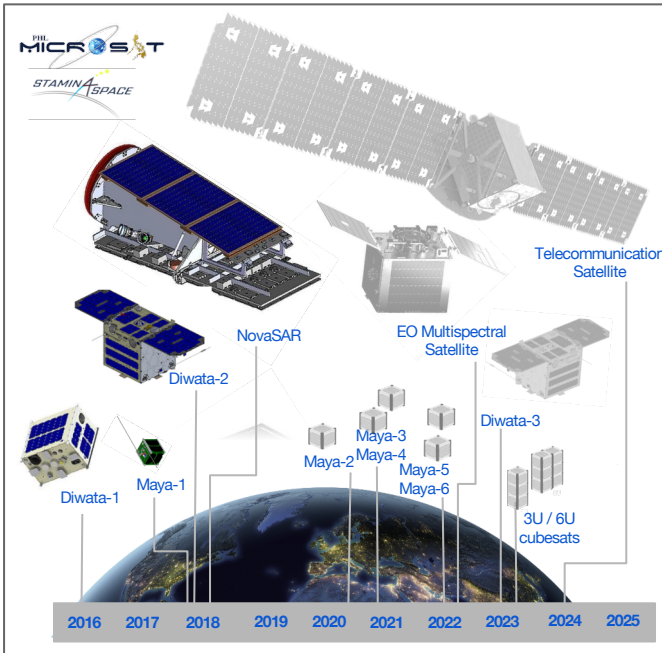
- Space Science, Technology, & Applications (SSTA) Program

- Research and Development and Capacity-building
- Technical Operations and Services
- Promotion, Policy Planning and International Cooperation

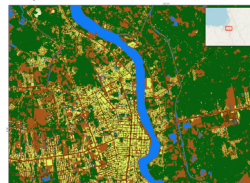
- Organizational Outcome

Enhanced national security, ecological integrity, economic opportunities and evidence-based decision-making from SSTA utilization, capacity-building, innovations and workforce.

SSTA Activities: DOST → PhilSA



Map of Land Cover Classes



Drought Monitoring



Legend



Cartographic Information

Coordinate System: WGS 84/ UTM
Scale: 0 0.75 1.5 3.0 km

Water Extent Monitoring



What satellite-derived data is used for air pollution monitoring?

- Research and Development/ Proof of Concept

- CO₂ - OCO-2 and GOSAT-2
- Aerosol - Terra/Aqua MODIS, Himawari-8
- NO₂ , SO₂ – Sentinel-5P TROPOMI

- Operational

- CO₂ product development
 - Provide data for calibration of GOSAT-2 and OCO-2
 - Total Carbon Column Observing Network (TCCON): calibration site in Burgos, Ilocos Norte (2017-present)

Future plans in using satellite-derived data for air pollution monitoring

- Government

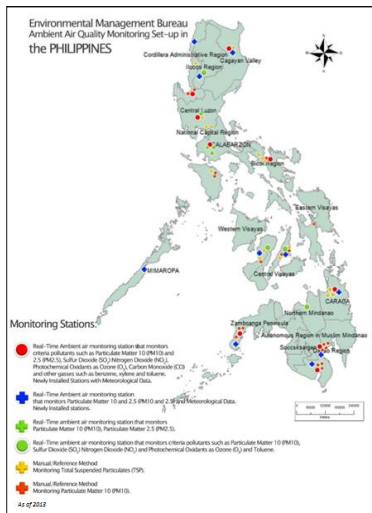
- Department of Environment and Natural Resources (DENR) Environmental Management Bureau (EMB)
 - National Air Quality Report (2016-2018) recommends the use of satellite data for AQ monitoring
- Department of Science and Technology
 - R&D proposals under review: AIRCAMMP, etc
- Local Government Unit (LGU) initiatives
 - Quezon City – C40 (proposal integrating satellite with ground data for mapping hotspot for monitoring and decision meeting)
 - National Capital Region - AIRSHED governing board

- Private

- Clean Air Asia
- Rotary Club of Makati (airtoday.ph)
- Manila Observatory

Air Quality Monitoring Network

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES (DENR) ENVIRONMENTAL MANAGEMENT BUREAU (EMB)



DENR-EMB Annual Report for CY 2018



DOAS equipment installed in PNP compound
(San Fernando, La Union - February 2016)

Type of Stations	No. of Stations
CAAQMS-DOAS	21
CAAQMS-PMS	27
CAAQMS-Conventional	47
Manual	47
Wet Deposition	1
Total	102*

*As of 2018

Note:

CAAQMS – Continuous Ambient Air Quality Monitoring Stations

DOAS – Differential Optical Absorption Spectroscopy

PMS – Particulate Matter System



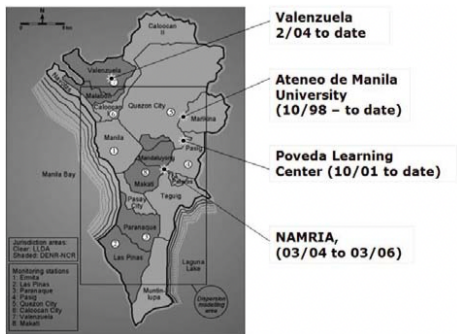
Government



Linked to space-derived data

Air Quality Monitoring Network

DEPARTMENT OF SCIENCE AND TECHNOLOGY (DOST) PHILIPPINE NUCLEAR RESEARCH INSTITUTE (PNRI)



Pabroa et al., Atmospheric Pollution Research (2011)

- Twice weekly sample collection using Gent sampler
- Multi-element analytical technique using Kevex ED-771 and Panalytical Epsilon 5 Energy Dispersive X-ray Fluorescence spectrometer (E5 EDXRF)
- Black carbon analysis using the M34D Smokestain Reflectometer
- Pollutant source apportionment

Additional Stations*

Boracay Island

Batan, Aklan

*As of 2018



Government

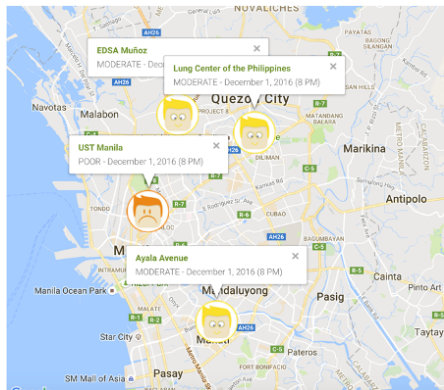


Linked to space-derived data

Air Quality Monitoring Network

UNIVERSITY OF THE PHILIPPINES (UP) DILIMAN INSTITUTE OF ENVIRONMENTAL SCIENCE AND METEOROLOGY (IESM)

airtoday.ph



Point of Contact: Dr. Mylene Cayetano



www.grimm-aerosol.com

Parameters*

PM_{2.5}

PM₁₀

Chemical characteristics

Source apportionment

**2015 to present*



Academic Institution



Private (Rotary Club of Makati)



Linked to space-derived data

Air Quality Monitoring Network

UNIVERSITY OF THE PHILIPPINES (UP) DILIMAN INSTITUTE OF ENVIRONMENTAL SCIENCE AND METEOROLOGY (IESM)



PM_{2.5} Port Area



PM_{2.5} and atmospheric mercury Hg, Burgos

Location

Port Area (2018-2020)

Burgos, Ilocos Norte (2015-2017)

Parameters

PM_{2.5}

PM₁₀

Chemical characteristics

Source apportionment

Point of Contact: Dr. Gerry Bagtasa



Academic Institution



International Collaboration (National Sun Yat-Sen University)



Linked to space-derived data

Air Quality Monitoring Network

UNIVERSITY OF THE PHILIPPINES (UP) DILIMAN INSTITUTE OF ENVIRONMENTAL SCIENCE AND METEOROLOGY (IESM)

Total Carbon Column Observing Network (TCCON), 2017 to present



Burgos, Ilocos Norte

Equipment

Light Detection and Ranging (LiDAR)

Fourier-transform Infrared Spectroscopy (FTIR)

Parameters

CO₂

Aerosol

Clouds

Point of Contact: Dr. Gerry Bagtas

- ✓ Academic Institution
- ✓ International Cooperation (NIES, Japan)
- ✓ Linked to space-derived data (GOSAT-2, OCO-2)

Air Quality Monitoring Network

MANILA OBSERVATORY

DOAS



LIDAR



PM Sample Collection*



*Monitoring Sites

2000-2004	2004-2007
Good Shepherd, Antipolo	Manila Observatory, QC
Manila Observatory, QC	Cebu City
National Printing Office, QC	Gabaldon, Nueva Ecija
Philippine General Hospital, Manila	
Pasig	



Research Institution



Linked to space-derived data

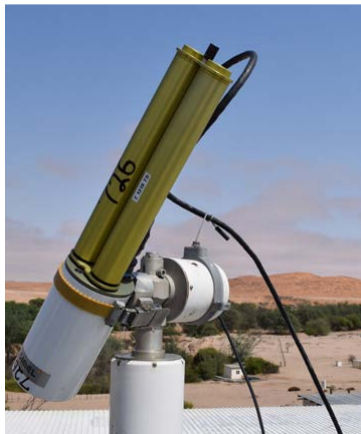
GR Lorenzo, "Urban Air Quality Monitoring Activities in Metro Manila"

UNOOSA presentation, 12 Sep 2007

Air Quality Monitoring Network

MANILA OBSERVATORY

Aerosol Robotic Network (AERONET)



Location	Observation Period
Manila Observatory, Quezon City	January 2009 – present
El Nido Airport, Palawan	July 2012 – June 2013
Notre Dame of Marbel University, Koronadal City	January 2001 – present

- ✓ Research Institution
- ✓ Academic Institution
- ✓ International Cooperation (NASA)
- ✓ Linked to space-derived data

Air Quality Monitoring Campaign

Manila Aerosol Characterization Experiment (MACE) - March to June 2015



wiki.tropos.de

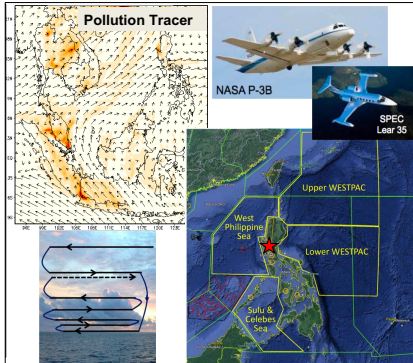
Instrumentation

Particle number size distributions
Total particle number concentration
Single wavelength absorption
Multiple wavelength absorption
Aerosol light scattering
Mixing state of aerosol particles
Weather station
Berner impactor samples
Mini Vol sampler
Cascade impactor

- ☒ Academic Institution (IESM UP Diliman, De La Salle University)
- ☒ Research Institution (Manila Observatory)
- ☒ International Cooperation (TROPOS, RescueAIR)
- ☒ Government (PNRI)
- ☐ Linked to space-derived data

Air Quality Monitoring Campaign

Cloud, Aerosol, and Monsoon Processes Philippine Experiment (CAMP²EX) - 2019



KC Henson Presentation: IMPACT-PH

Instrumentation

Advanced Microwave Precipitation Radiometer
Airborne Third Generation Precipitation Radar
Advanced Vertical Atmospheric Profiling System
BroadBand Radiometers
Differential Aerosol Sizing and Hygroscopicity Spectrometer Probe
Diode Laser Hygrometer
FIMS
High Spectral Resolution Lidar 2
Langley Aerosol Research Group Experiment
Research Scanning Polarimeter
SPEC Cloud Probes
Solar Spectral Flux Radiometer

espo.nasa.gov

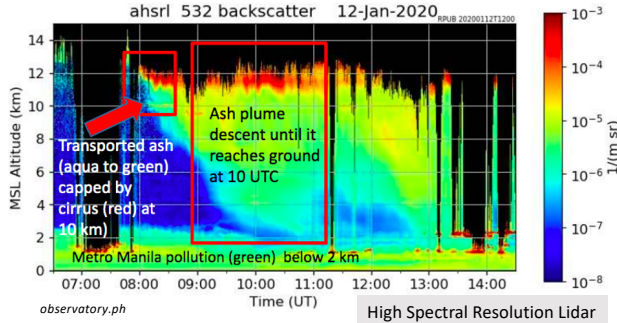
✓ Research Institution (Manila Observatory)

✓ International Cooperation (NASA, NRL)

✓ Linked to space-derived data

Air Quality Monitoring Campaign

Interaction of Monsoon, Precipitation, Aerosol Composition and Transport - Philippines (IMPACT-PH) – 2019 to present



KC Henson Presentation: IMPACT-PH



Research Institution (Manila Observatory)



Linked to space-derived data



International Cooperation (NRL, University of Wisconsin, University of Arizona)

NIER Questionnaire

1. GEMS Data Sharing

- a) Baseline GEMS products prioritization: **1-Aerosol; 2-Cloud; 3-O₃; 4-NO₂; 5-SO₂; 6-HCHO; 7-CHOCHO; 8-Surface Reflectivity; 9-UVI**
- b) GEMS products and algorithm development
 - Experience in processing L1 to L2: **Yes**
 - Interested in **both** developing/improving own data processing tools and receiving/using GEMS products
- c) Priority applications: **AQ Monitor, Top Down Emission, Public Health, Urban Pollution, Crop yield Impact Study**

2. Pandora Asia Network

- a) Pandora measurements
 - Focus area: **satellite validation**
 - Other activities of interest: **post-calibration of ground-based monitoring instruments**
- b) Joining Pandora Global Network: **Yes**

ICT Capacity on processing system and interpretation of the satellite-data

INFRASTRUCTURE

- Computing and Archiving Research Environment (COARE)
 - High-Performance Computing
 - 1,760 CPU cores = 30 TFlops
 - 23,040 GPU logical cores = 72 TFlops
 - Storage: 506 TB
 - 28 TB RAM
- Internet data transfer rate
 - Up to 100 Gbps
- GRS antenna (PEDRO)

Equipment	Size	Data Transfer Rate
Quezon City	3.7 m	800 Mb/s
Davao City	7.3 m	2.4 Gb/s

<https://asti.dost.gov.ph/pedro>



<https://asti.dost.gov.ph/projects/coare/>

ICT Capacity on processing system and interpretation of the satellite-data

PROGRAMMING EXPERTISE

- Satellite data processing and mapping
 - IDL
 - ENVI
 - PCI Geomatica
 - SNAP
 - SarProz
 - ArcGIS
 - QGIS
- Data analytics, modelling, and visualization
 - R
 - C++
 - Python
 - Matlab
 - Origin Lab
 - Julia
 - US EPA PMF v5.0

Need assessment for 2020-2025, including policy related to air pollution

- Identify Air Quality attainment and non-attainment areas
 - Visualization output data from satellite and ground
 - Source apportionment
- Emission Inventory
 - Local emission factors

Concluding Remarks

- With the SSTA activities being transitioned by DOST to PhilSA, the agency is prepared to undertake the Pan-Asia Partnership for Geospatial Air Pollution Information project in the Philippines
- Current air quality monitoring network/system in the country is mostly ground-based
 - Integrating with space-based observation will lead to comprehensive coverage
 - Serve as useful resource for satellite validation
- Expertise in air quality studies abound in identified government organizations, academic and research institutions, hence PhilSA can partner with them in the implementation of this project