Multi-Hazard Early Warning System (MHEWS) in the Philippines

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Outline

Early Warning System
- ✓ Risk Knowledge
- ✓ Observation and Monitoring
- ✓ Information and Communication Technology (ICT)
- ✓ Model and Forecasts
- ✓ Risk Communication
- ✓ Response Capacity

GCF Multi Hazard IBF-EWS
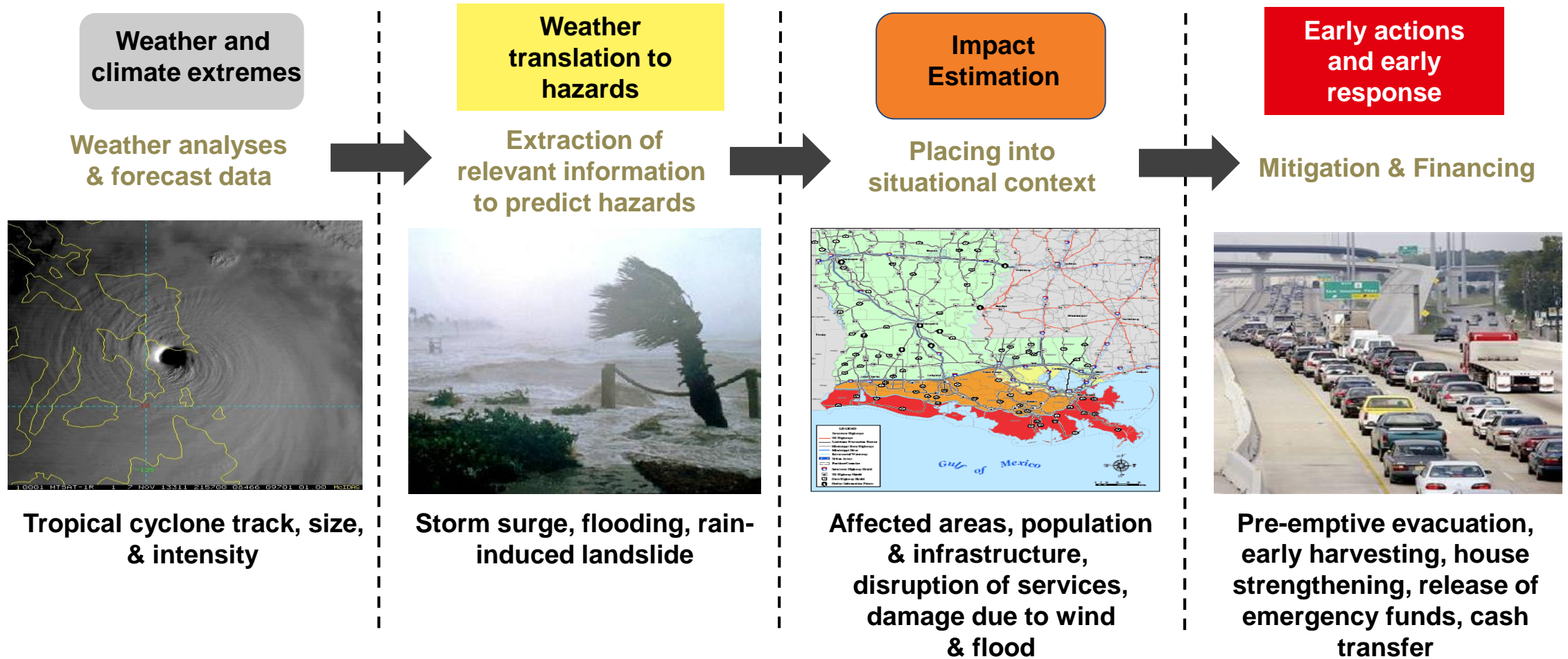
Gaps

Way Forward

Hazard/Risk Maps and Assessments
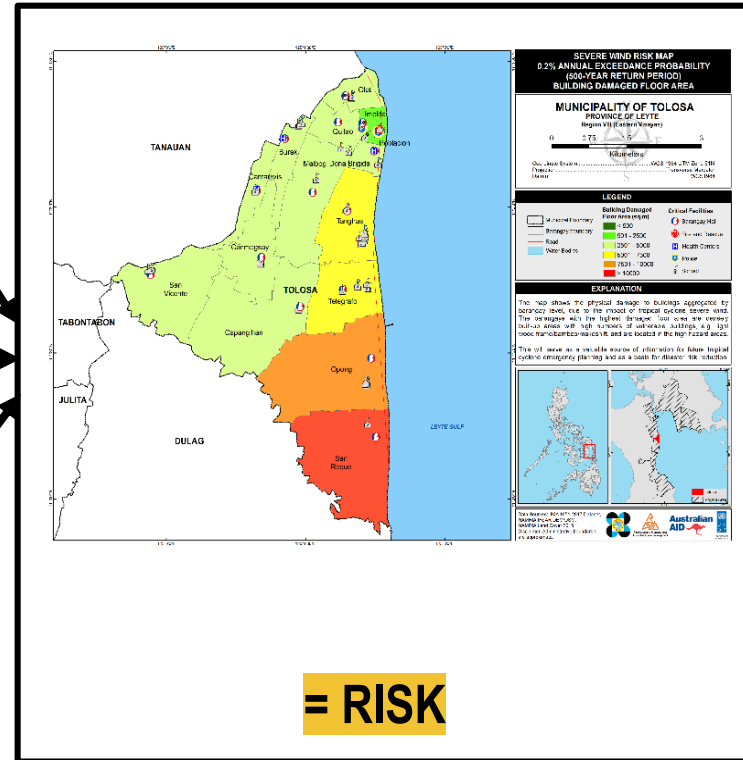
Current Initiatives

• **Enhancing Risk Analysis Capabilities for Flood and Tropical Cyclone Severe Wind for Greater Metro Manila Area**
  Flood Risk Maps at different return periods

• **Tropical Cyclone Severe Wind Risk Maps**
  a. Severe Wind Damage Floor Area
  b. Severe Wind Damage Cost Area (0.2% AEP, 0.5% AEP, 1% AEP, 2% AEP, 5% AEP)
  c. Tropical Cyclone Severe Wind Hazard Maps

• **10K Flood Hazard Maps for Different Areas in the Philippines**

• **Storm Surge Hazard Maps for Different Areas in the Philippines**

IMPACT-BASED FORECASTING AND EWS MODEL

Transforming from "What the Weather will Be" to "What the Weather Will Do"

Weather and climate extremes	**Weather translation to hazards**	**Impact Estimation**	**Early actions and early response**
Weather analyses & forecast data	**Extraction of relevant information to predict hazards**	**Placing into situational context**	**Mitigation & Financing**

Tropical cyclone track, size, & intensity

Storm surge, flooding, rain-induced landslide

Affected areas, population & infrastructure, disruption of services, damage due to wind & flood

Pre-emptive evacuation, early harvesting, house strengthening, release of emergency funds, cash transfer

Source: WMO, 2016

Hazard/Risk Maps and Assessments

EXPOSURE

HAZARD

VULNERABILITY

= RISK

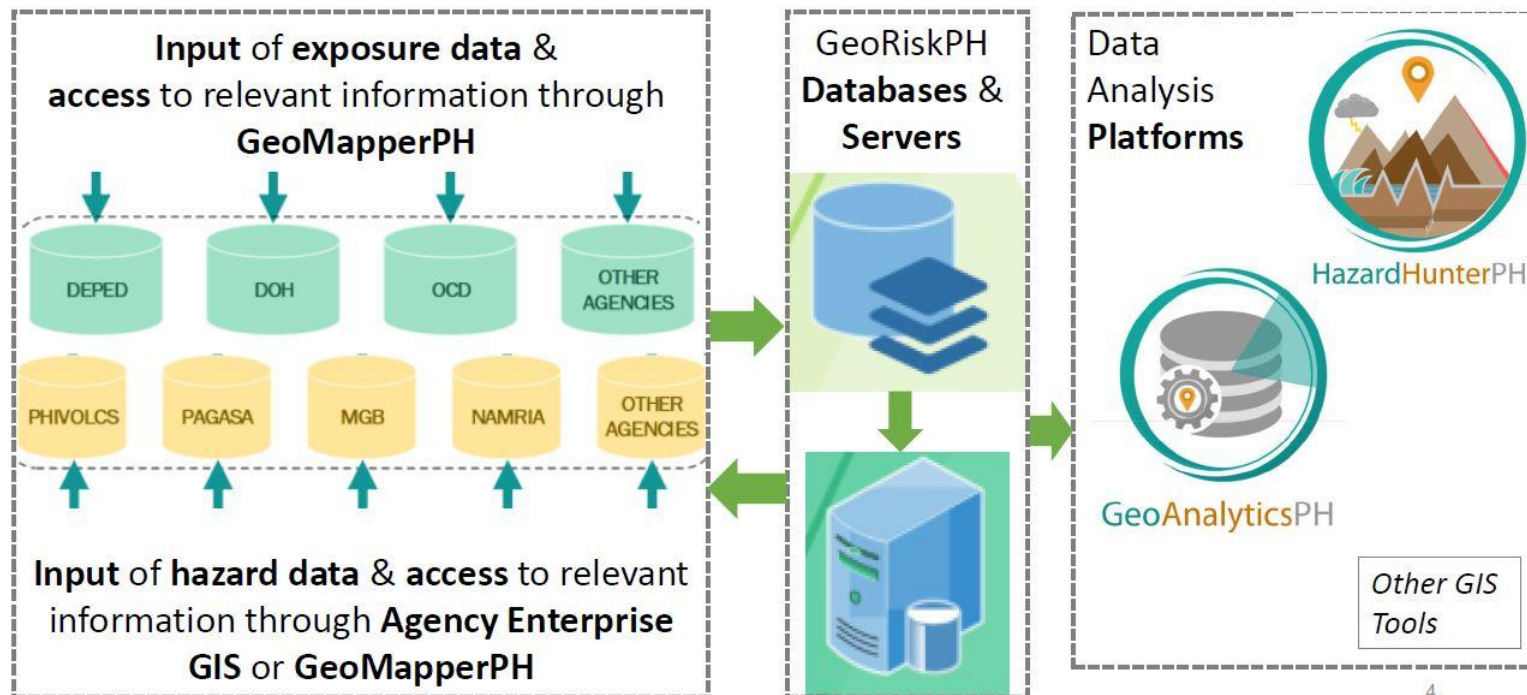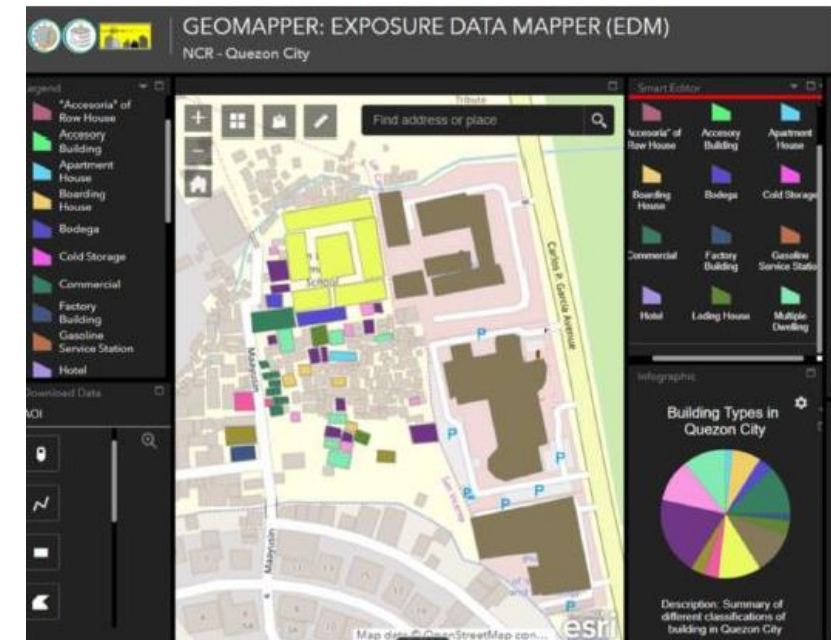Physical Damage

Building Damage Cost
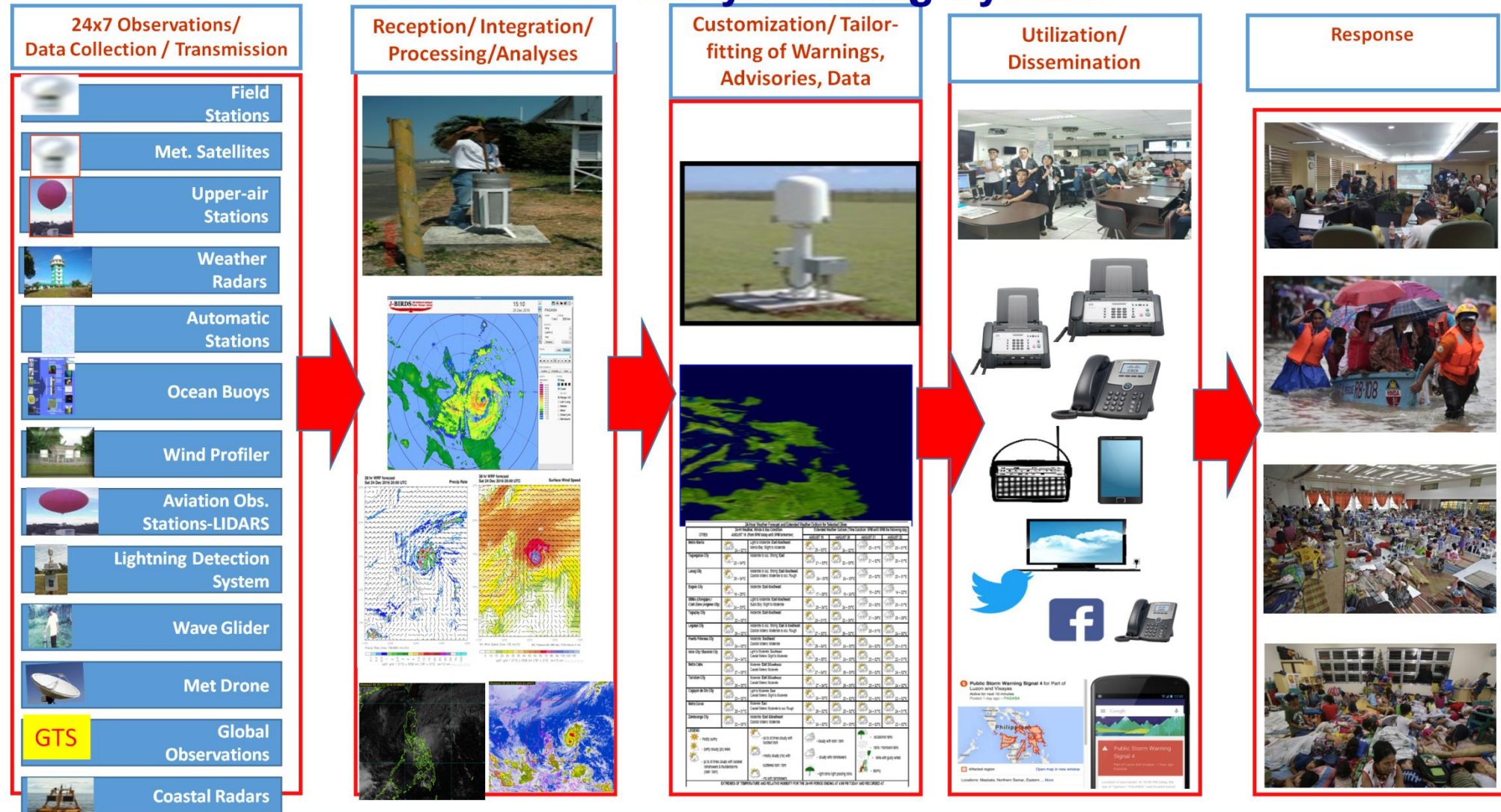

Population Affected
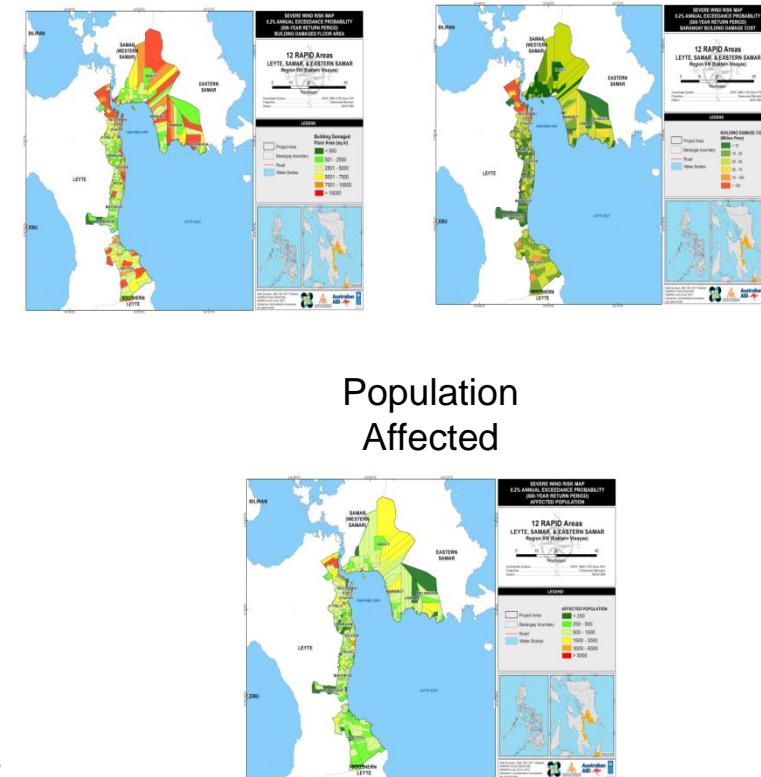
The **risk estimations** allow us to **estimate the damages that a tropical cyclones could cause to buildings, the cost of damaged buildings and the number of population being affected by tropical cyclones** .

Hazard/Risk Maps and Assessments

GeoRiskPH Integrated System

Web Application for Pre- & Post-Fieldwork Input & Analysis

Observation and Monitoring Networks
End-to-End Early Warning System

24x7 Observations/ Data Collection / Transmission	Reception/ Integration/ Processing/Analyses	Customization/ Tailor-fitting of Warnings, Advisories, Data	Utilization/ Dissemination	Response

24x7 Observations/ Data Collection / Transmission:
- Field Stations
- Met. Satellites
- Upper-air Stations
- Weather Radars
- Automatic Stations
- Ocean Buoys
- Wind Profiler
- Aviation Obs. Stations-LIDARS
- Lightning Detection System
- Wave Glider
- Met Drone
- GTS — Global Observations
- Coastal Radars

Observation and Monitoring Networks

Monitoring Technologies	Number	Remarks
Surface Weather Stations (Synoptic and Agromet)	76	Additional 15 stations to operate soon
Satellite Receiving Facility (Himawari, Modis, FY-2G, NOAA, COMS)	9	5 At Central office, 4 at Field Offices
Wind Profiler	1	At Central Office
Upper Air Stations	12	11 stationary/1 mobile
Automatic Weather Stations (AWS1 & AWS2)	219	10min/15min Observation (Temp, Humidity, Pressure, 10m/2m wind, Rain Solar Radiation)
Automatic Rain Gauge	196	96 installed by PAGASA & 100 by ASTI
High Frequency Doppler Radar (HFDR)	25	Installed at Coastal areas to monitor significant wave heights
Disdrometer-Parsivel	22	For Z-R adjustment and Radar Calibration
Doppler Radar	19	7 C-Band/9 S-Band/3 Xband Mobile
Lightning Detection System	28	Automatic Warning for individual alam areas
Flood Forecasting and Warning Centers	18	
Ozone Monitoring	1	Installed in Baguio

Observation and Monitoring Networks

Surface Weather Stations
(Synoptic & Agromet)
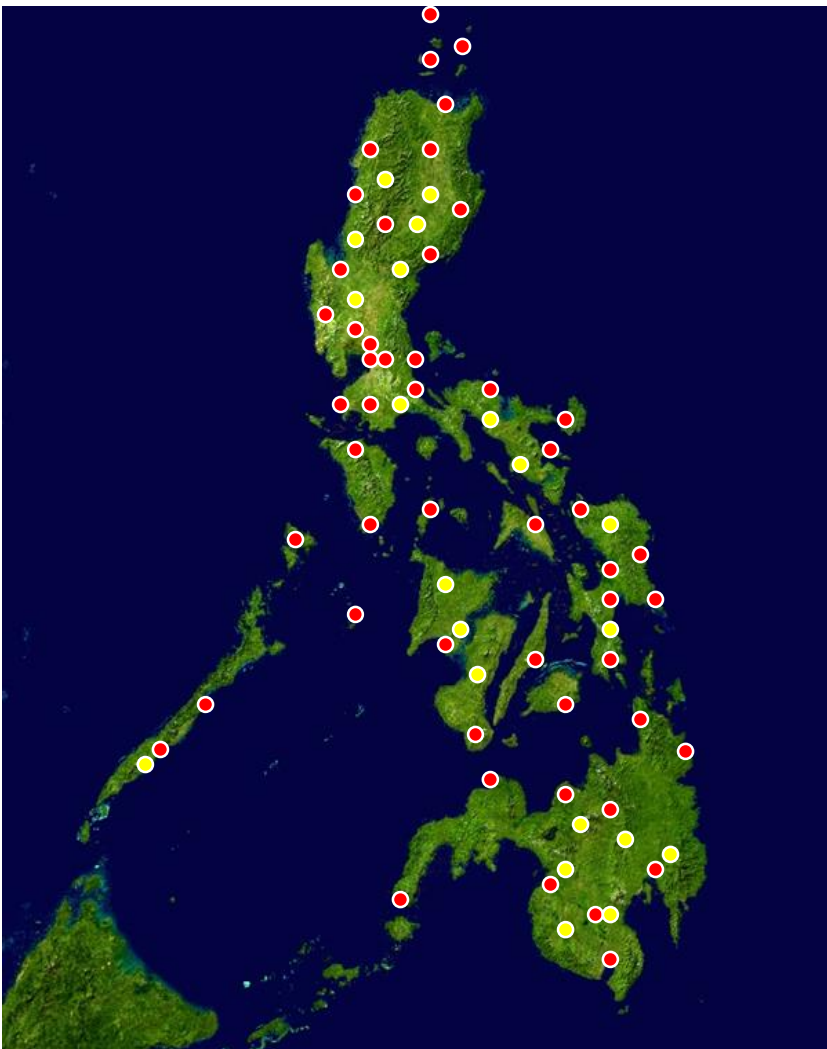
Satellite Receiving Facility

Wind Profiler

Observation and Monitoring Networks

Upper Air Stations

AWS and ARGs

HFDRs

LEGEND
- PAGASA AWS Observation Network
- DOST-ASTI-PAGASA AWS Project

REPUBLIC OF THE PHILIPPINES
Department of Science and Technology
Philippine Atmospheric, Geophysical and
Astronomical Services Administration (PAGASA)

AUTOMATIC WEATHER STATION OBSERVATION NETWORK

Sheet No.
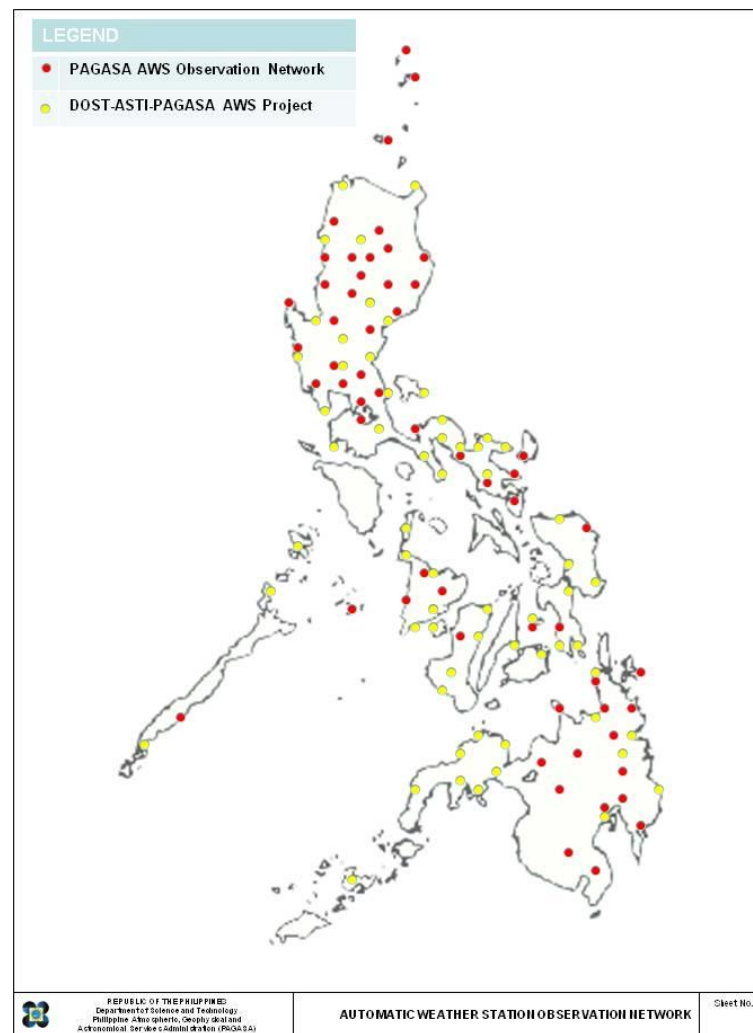
NWP Model	Developer
WRF	Weather Research and Forecasting Network
Global Spectral Model	Japan Meteorological Agency
Global Forecast System	NOAA
Navy Operational Global Atmospheric Prediction System	Fleet Numerical Meteorology and Oceanography Center (FNMOC)
Unified Model	UKMO
Flood and Storm Surge Model	
Storm Surge Model	Japan Meteorological Agency (JMA)
Flood Model	Mike/Hecras/IFas
Messir	COROBOR-Malaysia
Metra	New Zealand Met Service
TOOLS	
SWFDP	WMO Project

Weather Research Forecasting (WRF)

Typhoon Nina – December 25, 2016

http://www.pagasa.dost.gov.ph/index.php/numerical-weather-prediction
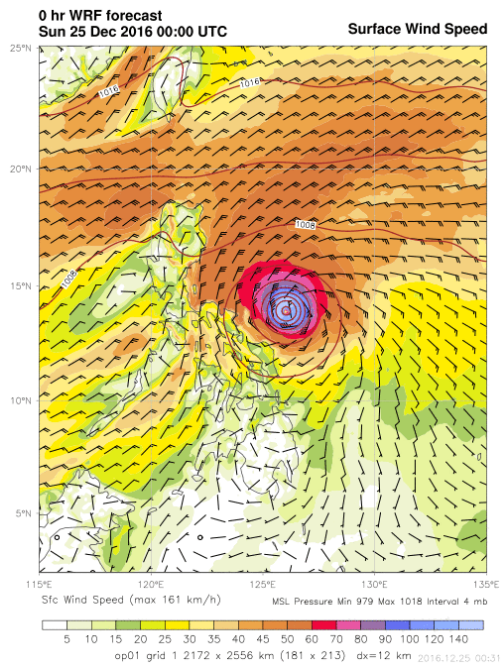
Surface Wind Speed
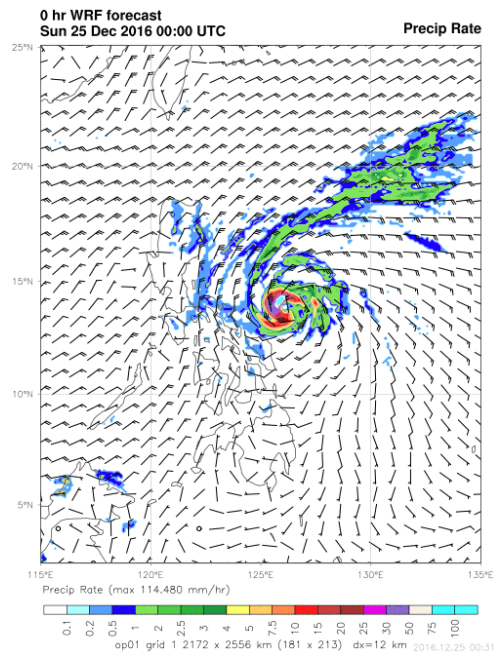
Precipitation Rate
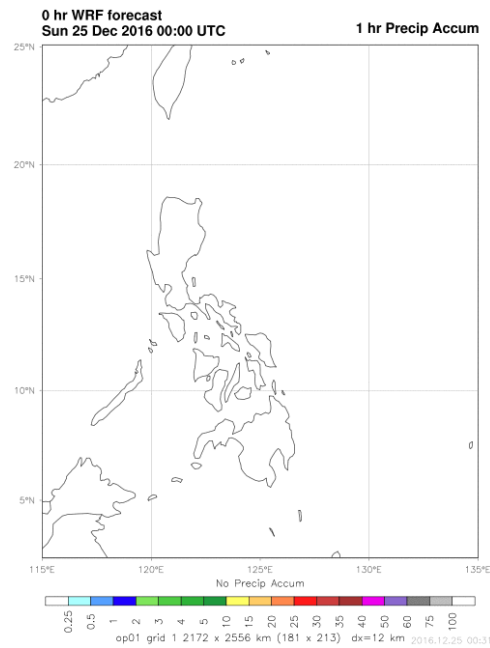
1-hr Precipitation Accumulation
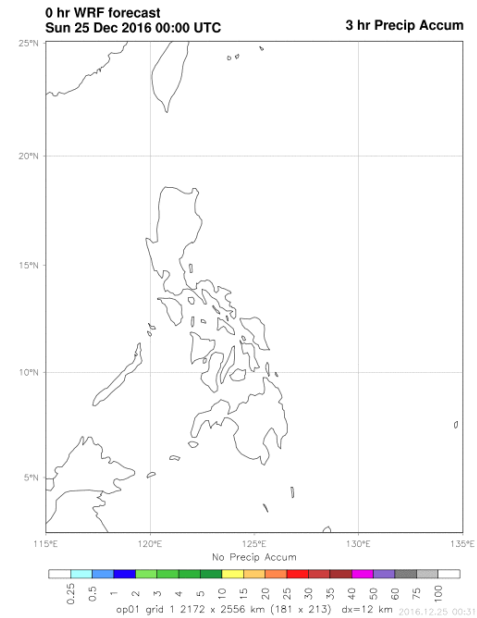
3-hr Precipitation Accumulation
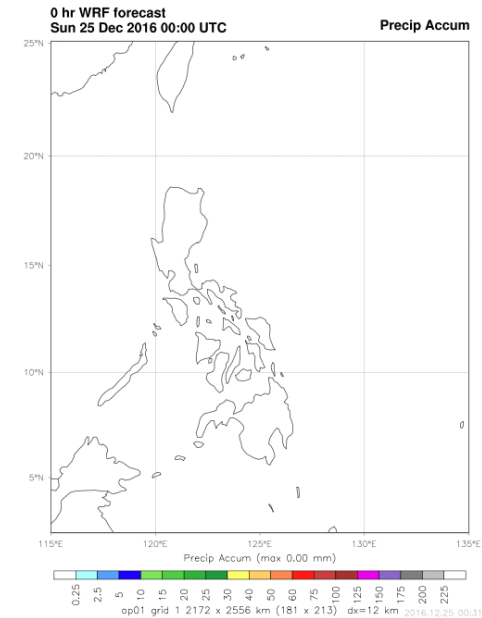
Precipitation Accumulation

Models and Forecasts

- ## Global Spectral Models (JMA)
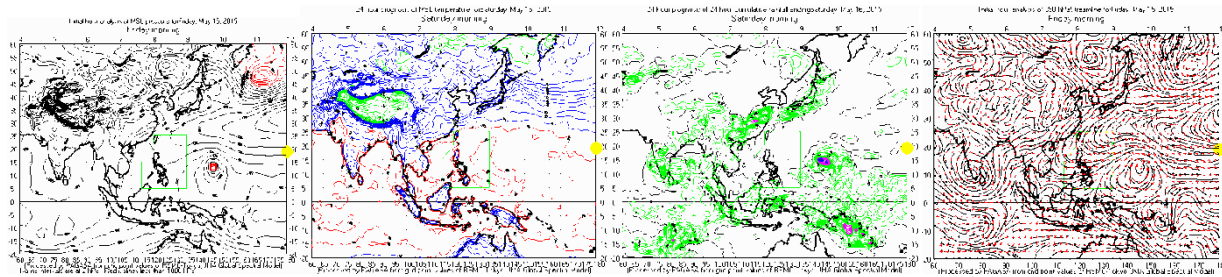
- ## Global Forecast System (GFS)
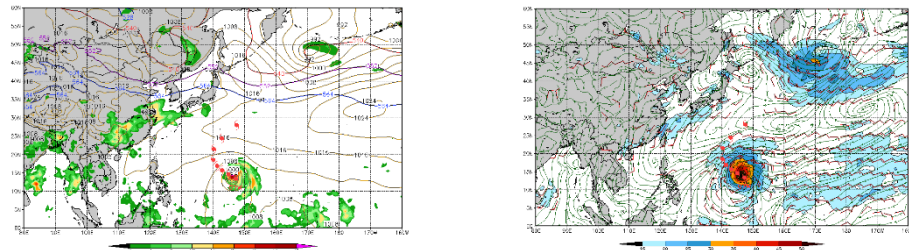
- ## NAVGEM (US)
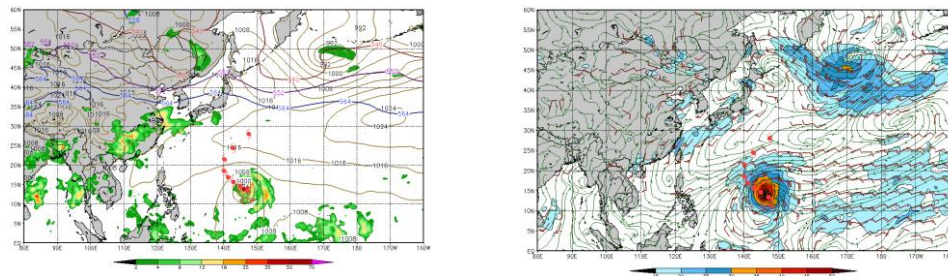
- ## Global/Regional UM Model (UKMO)
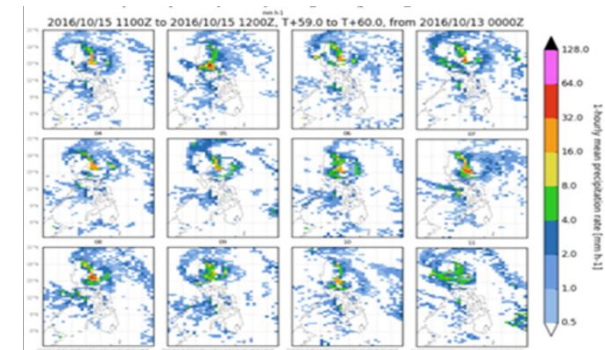
T+60 for 1 hourly mean precipitation rate

JMA Storm Surge Model

1AM NOV 07 2013
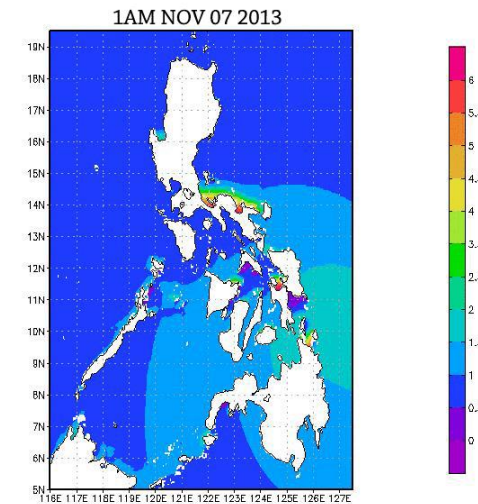
ICT (Communication Link and Data Transmission)

DATA COLLECTION & PROCESSING
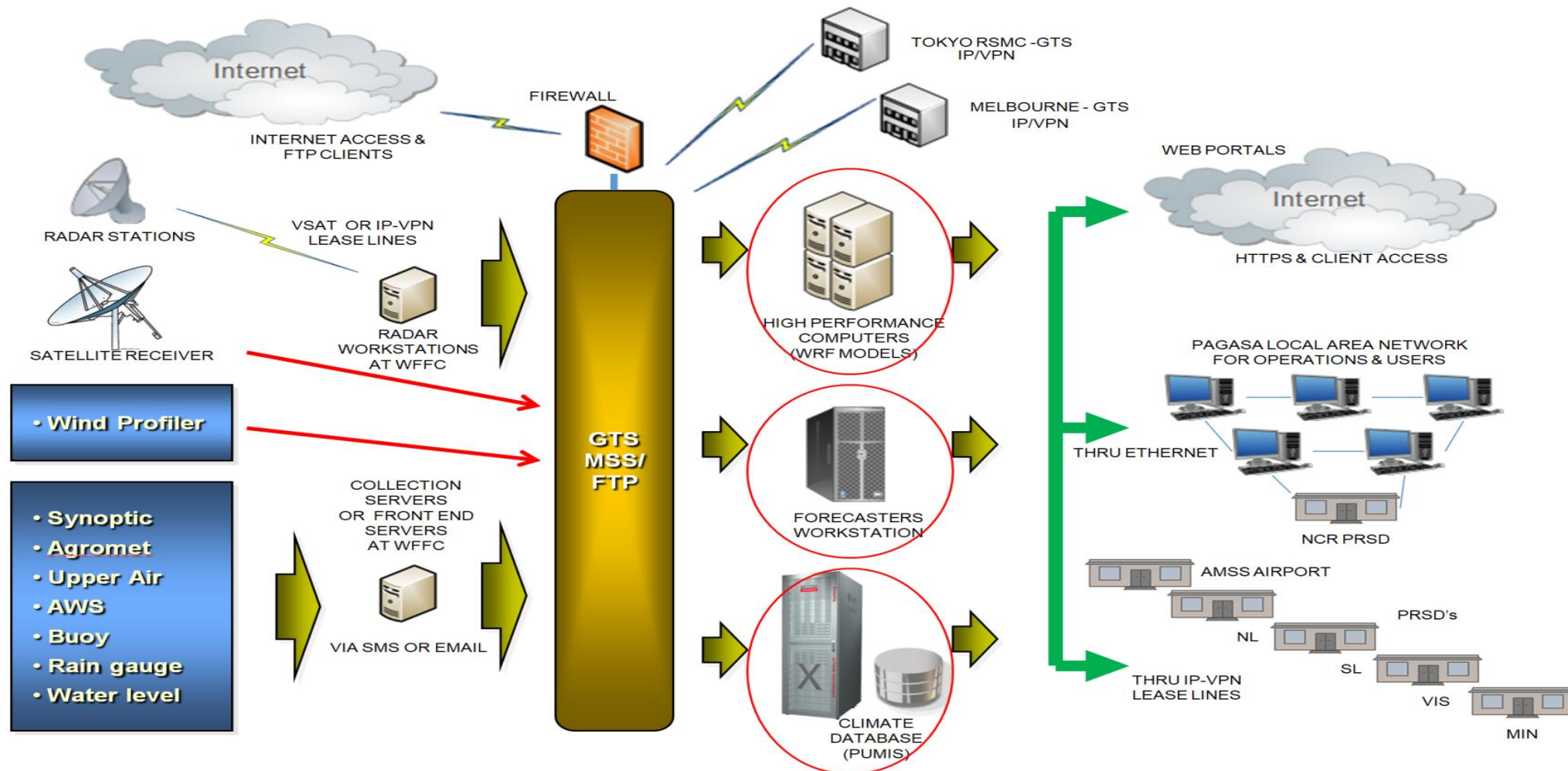
Pre-Disaster Risk Assessment

- It is a process to evaluate a hazard's level of risk, assessing the possible impacts of the hazard to the community and is used to determine the appropriate level of response action from the national to the local government.

Pre-Disaster Risk Assessment

Tuesday, September 13th, 2016

Cordillera RDRRMC on red alert for TY Ferdie

Effective 11AM on September 12 (Monday), the **Cordillera Regional Disaster Risk Reduction and Management Council (RDRRMC)** raised its **alert level status from white to red** in preparation for the **impending threats** brought about by Typhoon Ferdie. During the **Pre-Disaster Risk Assessment (PDRA)** meeting, members of the CRDRRMC reported **actions taken of their respective agencies.**

Communication System

Telephones and Mobile Phones

Internet (Website, Facebook, Twitter)

GSM-GPRS

Telefax

Dedicated Leased Lines

High frequency/Single side band radio

Telecommunication network

Very small aperture terminal

Data Collection Platforms used to transmit data from AWSs

Global Telecommunication System (WMO-GTS)

Meteosat Second Generation Satellite system

Other satellite system

Local Radio

Email

Print Media

National TV and Commercial TV

Bulletins

Communication and Dissemination Flow

Legend:

National
Regional
Local

PAGASA →
NDRRMC →
OP →

Office of the President

NDRRMC / OCD

PAGASA

PAGASA Regional Centers

National Media

DRRMCs

Local Government Units

PAGASA Local Stations

Local Media

General Public
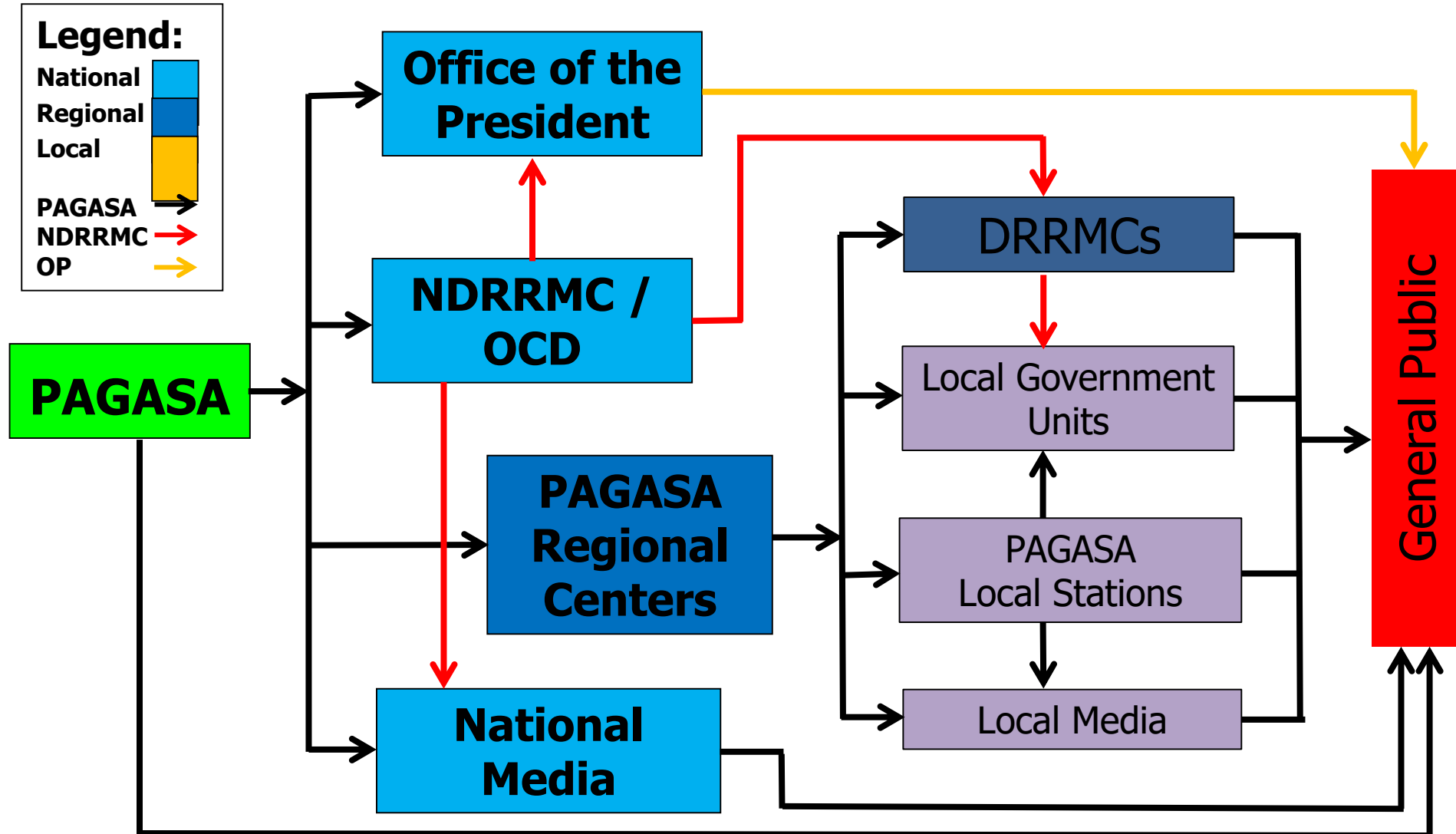
The Philippine Disaster Reduction and Management Act outlines measures aimed at enhancing the country's response capacity prior to, during and after disasters. This includes:

    a. Formation of multi-agency, multi-sectoral Disaster Risk Reduction and Management Council at the national level and committees at provincial and local levels
    b. Creation of a Disaster Risk Reduction and Management Office at province and local levels
    c. Development of Disaster Management Plans at national to local levels,
    d. Use of calamity fund to support DRR, mitigation, prevention and preparedness activities

PAGASA is actively engaged in various IECs for:

i) public awareness campaigns on weather- and climate-related hazards,
ii) conduct of flood drills and information drive for flood-prone areas including those adjacent to monitored dams
iii) holding of typhoon and flood awareness week,
iv) participation in exhibitions in school, government agencies and other institutions, and
v) conduct of seminars/workshops on hydro-meteorological hazards for the media and other stakeholders. PHIVOLCS also holds similar activities for geological hazards. Similarly, the OCD conducts similar awareness-raising activities, drills as well as exercises to assess certain components of the EWS.

Information, Education and Communication Campaign

Mock Simulation/Drills

Multi-Hazard Impact-Based Forecasting and Early Warning System (MH-IBF-EWS) for the Philippines – GCF Funded Project

National Designated Authority: (NDA)	**Climate Change Commission**
Executing Entity (EE) :	**Department of Science and Technology - Philippine Atmospheric Geophysical and Astronomical Services Administration (DOST-PAGASA)**

Co-Executing Entities (CoEE) :	1) **Mines and Geo-Sciences Bureau (MGB)**
	
	2) **Office of Civil Defense, National Disaster Risk Reduction Management Council (OCD, NDRRMC)**
	
	3) **Department of Interior and Local Government (DILG)**
	
	4) **Local Government Units of:**
	  - **Tuguegarao City, Cagayan**
	  - **Legazpi City, Albay**
	  - **Palo, Leyte, and**
	  - **New Bataan, Davao de Oro**
	
	5) **World Food Programme (WFP)**

Accredited Entity (AE) :	**Land Bank of the Philippines (LBP)**
Project Duration :	**Five (5) years**

Project Sites

Tuguegarao, Cagayan
(Severe Wind & Flood)

Legazpi City, Albay
(Severe Wind & Flood)

Palo, Leyte (Severe (Severe Wind & Storm Surge)

New Bataan,
Davao de Oro
(Severe Wind & Landslide)

The Newly Grant GCF-Funded Project

Multi-Hazard Impact-Based Forecasting and Early Warning System (MH-IBF-EWS) for the Philippines

Impact

- **Increased resilience and enhanced livelihoods of the most vulnerable people, communities, and regions**

Outcome

- Increased generation and use of climate information in decision-making
- Strengthened adaptive capacity and reduced exposure to climate risks
- Strengthened institutional and regulatory systems for climate-responsive planning and development

Objectives

- To reduce the exposure of vulnerable communities to climate-induced hydrometeorological hazards;
- To strengthen their absorptive and adaptive capacities to better manage or adjust to impacts brought about by climate shocks and climate change, and implement long-term climate risk reduction and adaptation measures.

Outputs

1	2	3	4
Science-based multi-hazard weather and climate risk information	MH-IBF-EWS supported by a Knowledge and Decision Support System.	National and local capacities in implementing a people-centered MH-IBF-EWS and Fina	Mainstreamed climate risk information and MH-IBF-EWS in development and investment planning and policy-making processes and institutionalized people-centered MH-IBF-EWS for a more proactive and inclusive climate risk management.

The Newly Grant GCF-Funded Project

Multi-Hazard Impact-Based Forecasting and Early Warning System (MH-IBF-EWS) for the Philippines

1 - **Orange warning** for rain with a **medium likelihood** of **significant impacts**

2 - **Yellow warning** for rain with a **high likelihood** of **minor impacts**

Potential Impacts

Very low	Low	Medium	High
Minimal disruption	**Minor disruption**	**Significant disruption**	**Severe disruption**
• Generally no widespread impact, however there may still be;	• Localised flooding of land and roads – risk of aquaplaning	• Flooding affecting properties and parts of communities	• Widespread flooding affecting a significant number of properties and communities
• Isolated and minor flooding of low-lying land and roads	• Localised flooding could affect individual properties	• Damage to buildings/structures is possible	• Danger to life from fast flowing and / or deep water. Significant wave overtopping or inundation on the coast.
• Isolated instances of spray/wave overtopping on coastal promenades	• Individual properties in coastal locations affected by spray and/or wave overtopping	• Possible dangers from fast flowing and / or deep water. Significant wave overtopping or inundation on the coast.	• Collapse of buildings and / or structures is possible
• Little or no disruption to travel although wet road surfaces could lead to difficult driving conditions	• Localised disruption to key sites identified in flood plans (e.g. railways, utilities)	• Potential disruption to infrastructure (e.g. railways, utilities)	• Widespread disruption or loss of infrastructure (e.g. railways, utilities, hospitals)
	• Local disruption to travel – longer journey times	• Disruption to travel network is expected. A number of roads are likely to be closed.	• Large scale evacuation may be required
			• Severe disruption to travel networks. Risk of motorists becoming stranded

Residual Gaps	
Policy and Institutional Framework	✓Technical assistance to local governments in developing/implementing their DRRMPs ✓Guidance in designing local DRR programs and/or early warning early action (EWEA) projects for LGUs including the development of the budget vis-à-vis available funds for preparedness and EWEA ✓Assistance in developing PAGASA's masterplan and blueprint in line with the agency's modernization program and strategic plan as well as with WMO standards
Linkage and Cooperation	✓Define roles, responsibilities and accountabilities in issuing warnings and local advisories ✓Enhance collaboration with sectoral agencies in the development of sectorspecific impact forecasts to enhance risk use of weather and climate data in planning and decision-making ✓Capacity-building for sectoral agencies and LGUs to enhance local action ✓Establish mechanisms to take stock of all on-going (and future) DRR, EWS, CCA programs and/or projects for integration, convergence and increased synergies among involved agencies and organizations
Hazard, exposure, vulnerability and risk assessment	✓ Develop interactive, multi-hazard, exposure, resource (facilities) and risk maps, and assessments accessible through an integrated web-based portal capable of generating impact forecasts and advisories for *i) disaster preparedness (i.e., early warning, early action),* *ii) emergency management,* *iii) post-disaster assessment, and* *iv) long-term DRR - Inter-agency collaboration and sharing of base maps, exposure and vulnerability data* ✓Sustained capacity in hazard mapping, exposure database development, vulnerability and risk assessment as well as in updating these maps and assessments

Residual Gaps

Monitoring systems and data products	✓ - Replacement and timely calibration of instruments in remote stations - Upgrade of maintenance and calibration equipment components - Enhance observation network including rain-making facilities/equipment for agricultural purposes - Provision of equipment maintenance staff at regional levels - Data rescue of historical climate data - High performance Data Quality Management system to support NWP system - Integrated database system for NWP data assimilation - Reliable and low-cost observation data communication system
Forecasts and warnings	✓ Radar and satellite data assimilation and remote sensing-based and observation product development ✓ Development of human resources in weather and climate modelling (NWP and climate models) and verification ✓ Flood forecasts that define height and limits of inundation area, thereby showing exposed population, structures and facilities ✓ Extended hydrological forecasts for enhanced preparedness ✓ Capacity-building of regional staff on generating sub-seasonal forecasts ✓ Tailor-made forecasts and advisories for various sectors to enhance understanding and application of early warning information ✓ Statistical verification of, and improvements in, accuracy of forecast products in collaboration with various stakeholders to package and disseminate actionable forecast products more effectively ✓ Enhancement of quantitative rainfall forecast accuracy Improve forecasts of extreme weather events
EWS expertise	✓ Operational staff to utilize R&D outcomes, and manage the latest technology instruments and systems ✓ Capacity-building on impact forecasting specific to climate-sensitive sectors (e.g., agriculture, water resources, disaster management, health, etc) ✓ Experts to research and develop sectorspecific information products and services

Way forward

- ✓ PAGASA has adopted some of the latest equipment and technologies available to increase forecast accuracy and further add value to its services.

- ✓ The existing gap may be attributed, to some extent, to the lack of appreciation and understanding of the impacts and consequences brought by various hydrometeorological hazards.

- ✓ R&D Development of Improved Impact-based Forecasting Approaches- Newton Agham project with UKMO

- ✓ Develop user-oriented Impact based forecast through building partnership (High impact weather and Climate extremes(ENSO))

- ✓ Close engagement and interaction with Stakeholders to further refine current impact warnings

- ✓ Need to develop a unified format and language describing impacts of a particular hazard (i.e. Storm surge, flooding, heavy rainfall, etc)

- ✓ Feedback on the efficiency of the Impact-based Warning System

- ✓ Conduct Information Education Campaign (IEC) to prepare users with the new warning system

- ✓ Lectures, Campaign materials (flyers, comics, posters, video presentations)