NASA DEVELOP National Program
2017 Spring Project Proposal

NOAA National Centers for Environmental Information
Philippines Disasters
Utilizing NASA and NOAA Earth Observations to Enhance the United Nation's Office for the Coordination of Humanitarian Affairs Storm Preparation and Disaster Relief Planning Methods

Project Overview

***Project Synopsis*:** The objective of this project is to create tropical cyclone vulnerability maps of the Philippines using data from NASA's Global Precipitation Measurement (GPM) mission, NOAA's Precipitation Estimation from Remotely Sensed Information Using Artificial Neural Networks - Climate Data Record (PERSIANN-CDR), and historic tropical cyclone data in conjunction with demographic information. These maps will assess areas that are at the highest risk of storm impacts such as: inundation and wind damage, as well as populations that are the most vulnerable to extreme weather events. This project will utilize historical tropical cyclone data from the International Best Track Archive for Climate Stewardship (IBTrACS) archives to create a comprehensive cyclone climatology for the Philippines, measuring typical storm tracks, intensity, precipitation, and duration. Population demographics data, provided by the United Nation's Office for the Coordination of Humanitarian Affairs (UN-OCHA), and the cyclone climatology will be used to develop cyclone vulnerability maps via a hotspot analysis.

Community Concern: In the Philippines cyclones are common natural hazards with extensive societal consequences. Following such events, communities typically experience population displacement leading to serious health, social, and economic consequences. In November of 2013, the Philippines were hit by the category five Tropical Cyclone Haiyan. Killing at least 10,000 people, the storm is the deadliest Philippine typhoon on record. Approximately 19 tropical cyclones enter the area surrounding the Philippines with an average of six to nine cyclones making landfall in the Philippines each year (Shoemaker 1991). Affected by multiple cyclones every year, the Philippines seeks to improve their ability to prepare for and recover from such traumatic events.

Source of Project Idea: Communication began when Dr. DeWayne Cecil met with Rohini Swaminathan, a former DEVELOP Center Lead currently employed by the United Nations Institute for Training and Research's Operational Satellite Applications Program (UNITAR-UNOSAT). The two discussed possible international projects that would partner with UNOSAT as well as utilize International Space Station data like those from projects and programs funded by CASIS. It was determined that a project focused on cyclones aligned best with current efforts undertaken at both NASA and NOAA.

National Application Areas Addressed: Disasters, Weather
Study Location: Philippines
Study Period: September 2014 to December 2016

Advisors:
Dr. Carl Schreck (Cooperative Institute for Climate and Satellites-North Carolina)
Dr. L. DeWayne Cecil (Global Science & Technology; National Centers for Environmental Information)

Partner Overview

Partner Organizations:

Organization	POC (Name, Position/Title)	Partner Type	Boundary Org?
United Nations Office for the Coordination of Humanitarian Affairs (UN-OCHA)	Rowena Dacsig, Gender Advisor	End-User	No
Visidyne Inc.	A.T. Stair, Owner	End-User	No
United Nations Institute for Training and Research's Operational Satellite Applications Program (UNITAR-UNOSAT)	Rohini Swaminathan, UNITAR GIS Technical Expert	Collaborator	Yes

End-User Overview

End-User's Current Decision-Making Process:

In the Philippines the UN-OCHA is working on creating an earthquake hazards vulnerability map to better prepare for disasters. They currently work with governmental technical image processing groups that utilizes satellite images to respond to disasters. As co-investigators of the CyMISS mission on the International Space Station (ISS) Visidyne will use results of this project to validate their current methodology and explore the potential of incorporating A-Train satellite data.

End-User's Capacity to Use NASA Earth Observations:

United Nations Office for the Coordination of Humanitarian Affairs *(UN-OCHA)* – Our partner at UN-OCHA works closely with governmental mapping groups and United Nations satellite groups (i.e. UNOSAT) that utilize NASA Earth observations. However, UN-OCHA have not yet utilized NASA Earth Observations or NOAA data.

Visidyne – This partner is familiar with NASA Earth Observations and is currently serving as co-investigator on the ISS mission CyMISS. This project will build Visidyne's capacity by introducing them to NASA Earth Observations and NOAA Climate Data Records that they are not familiar with.

Collaborator & Boundary Organization Overview

Collaborator Support:

United Nations Institute for Training and Research's Operational Satellite Applications Program *(UNITAR-UNOSAT)* – This partner will provide the team with guidance on cyclone monitoring techniques, data acquisition, and image processing.

Dissemination by Boundary Organizations UNITAR-UNOSAT will connect the project team and end-users within the study region. Additionally, they will facilitate collaboration among various UNOSAT offices and end-users throughout the term, as well as disseminate the project results to regional end-users such as UN-OCHA in the Philippines.

Project Communication & Transition Overview

***In-Term Communication Plan*:** The team will communicate via teleconference weekly, or bi-weekly as needed, with advisors and project partners. The Center Lead and team lead of this project will be the primary points of contact for the partner organizations with assistance from UNOSAT for regional end-user communication.

***Transition Plan*:**
At the end of the first term, the team will disseminate project results and hand off decision support tools, including the Philippines Tropical Cyclone Climatology and the Vulnerability Maps & Figures, via a web conference. The team will work closely with end-users to incorporate the project results into their current cyclone disaster planning and relief practices. The team will also lead informational meetings to inform local groups (i.e. governmental GIS groups and disaster relief decision makers) within the Philippines about project results. We intend to use mostly open source software for all data processing and results. UNOSAT will also help to connect with local partners within our study regions and facilitate the transfer of results. A second term will use the vulnerability maps and methodology developed in the first term to further analyze storm intensity predictions by utilizing ISS data to measure tropical cyclone characteristics including: cyclone eyewall cloud characteristics, cyclone size, and storm intensity. This methodology will build the capacity of Visidyne and tropical cyclone monitoring agencies in the Philippines.

***Letters of Support*:** Einar Bjorgo, Manager, UNITAR-UNOSAT

Earth Observations Overview

Earth Observations:

Platform & Sensor	Parameter(s)	Use
Global Precipitation Measurement (GPM) Mission Constellation GMI & DPR	Precipitation Estimates	Precipitation estimates will be used to analyze potential flooding impacts.
Precipitation Estimation from Remotely Sensed Information Using Artificial Neural Networks - Climate Data Record (PERSIANN-CDR)	Precipitation Estimates	Precipitation estimates will be used to analyze potential flooding impacts.
Tropical Rainfall Measuring Mission (TRMM)	Precipitation Estimates	Precipitation estimates will be used to analyze potential flooding impacts.
International Space Station CyMISS & CATS	CyMISS Tropical Cyclone Images – Storm Intensity and storm eye characteristics derived CATS LiDAR distribution of aerosol and cloud	Images will be used to calculate recent storm intensity and cyclone eye characteristics.
Aqua MODIS	Temperature, surface reflectance	Temperature and reflectance data will help determine cloud and cyclone characteristics.

Ancillary Datasets:

International Best Track Archive for Climate Stewardship (IBTrACS) records – Tropical climatology for the Philippines creation
UN-OCHA – Philippines Population Demographic Data – Cyclone hazards risk map creation
NCEI - Global Historical Climatology Network – Validation of satellite precipitation estimates
NCEI - Hurricane Satellite Data (HURSAT) – Validation of CyMISS tropical cyclone images

Software & Scripting:

QGIS - Raster manipulation/analysis, map creation
ESRI ArcGIS - Raster manipulation/analysis, map creation
R - Statistical comparisons
Python/Arcpy - Index calculation, statistical comparisons

Decision Support Tool & End Product Overview

End Products:

End Product(s)	Partner Use	Datasets & Analyses	Software Release Category
Philippines Cyclone Climatology Maps & Figures	Climatology maps & Figures will be used by UN-OCHA to better understand typical cyclone tracks, intensity, and impacts	IBTrACS and archived tropical cyclone data/images	N/A
Cyclone Hazards/ Vulnerabilities Map	Hazard maps will be used by UN-OCHA for storm preparation and response	CyMISS, CATS, Infrared & Water Vapor (GOES), IWP, IWC, temperature archived tropical cyclone data, Philippines population demographics data	N/A
Case Study of CyMISS & CATS Data Compared to Archived Cyclone Data	Testing the use of CyMISS methodology and CATS collaboratively in storm monitoring for Visidyne	CyMISS, CATS, and HURSAT archived tropical cyclone images	N/A

End-User Benefit: UN-OCHA will be able to use The Philippines Cyclone Climatology Maps & Figures as a reference for expected cyclone strength, track, and precipitation during certain seasonal conditions. The climatology maps can also be used as communication tools. The Cyclone hazards and vulnerabilities map will be integrated into UN-OCHA's current preparation and mitigation practices for annual storm impacts in the Philippines.
The case study analysis will evaluate the use of CyMISS and CATS data for monitoring tropical cyclone characteristics such as: storm size and eyewall cloud characteristics. Maps and figures will highlight the strengths and weaknesses of using imagery from the ISS to monitor tropical cyclones and complete some foundational analyses for the second project term that will focus on methodology to measure cyclone intensity.

Project Timeline & Previous Related Work

Project Timeline: 2 Terms: 2017 Spring (Start) to 2017 Summer (Completion)

Multi-Term Objectives:

- **Term 1 (Proposed Term):** 2017 Spring (NCEI) – Philippines Disasters I
    - The first project term will create a tropical cyclone climatology of the Philippines using archived cyclone data from January 1986 to December 2016. The team will then use population demographic data, remote sensing precipitation estimates, and the cyclone climatology to perform a natural disaster vulnerability analysis. The created climatology and cyclone vulnerability maps & figures will serve as a reference and planning guide for natural disaster mitigation groups in the Philippines. CyMISS images and CATS LiDAR data will be used to analyze the size, intensity, and impacts of recent storms (September 2013-January 2017).
- **Term 2:** 2017 Summer (NCEI) – Philippines Disasters II
    - A second term will further test the capabilities of CyMISS and CATS information from the ISS to monitor tropical cyclone intensity and characteristics. The team will attempt to narrow down methodology for combining CyMISS images, CATS LiDAR, and various A-Train satellite datasets to measure the intensity of storms. The first term will perform a validation of this methodology using past reports and damage assessments from UN-OCHA in the Philippines.

Related DEVELOP Work:

Fall 2015 & Spring 2016 (Wise County Court of Clerks) - African Great Lakes Weather I & II: Utilizing NASA Earth Observations to Identify Indicators to Help Predict Deadly Storms over the African Great Lakes

Notes & References:

***Notes*:** The datasets utilized in this project will be narrowed down based on partner needs, data availability, and term time limits. An additional collaborator from Visidyne Inc. may also become involved with the project.

References:

United Nations: InterAgency Standing Committee, Operational Guidelines on Human Rights and Natural Disasters. Washington: Brookings-Bern Project on Internal Displacement, June 2006.

Watson, John T., Gayer, Michelle, & Connolly, Maire A., 2007, Epidemics after Natural Disasters, Emerging Infectious Diseases; 13(1): 1-5. Doi: 10.3201/eid1301.060779 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2725828/

Joint Typhoon Warning Center. Appendix B: Characteristics of Tropical Cyclones Affecting the Philippine Islands (Shoemaker 1991).Retrieved on 2008-04-20.