**NASA DEVELOP National Program**

****NASA Goddard Space Flight Center

**Spring 2016**

**Short Title: Gulf of Mexico Health & Air Quality**

**Subtitle:** Utilizing NASA Earth Observations to Manage Air Quality and Pollutants over the Gulf of Mexico

**VPS Title:** Send in the Clouds: Examining Air Quality in the Gulf of Mexico

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

Dr. Robert Levy (NASA GSFC)

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**Partner Organizations:**

Bureau of Ocean Energy Management (End-User), POC: Dr. Jose Hernandez; Boundary Organization

NASA ARSET (Collaborator), POC: Dr. Pawan Gupta

**Project Details**

**Applied Sciences National Application Addressed:** Health & Air Quality

**Study Area:** Outer Continental Shelf (OCS) of the Gulf of Mexico including onshore areas of TX, LA, MS, and AL

**Study Period:** January 2000 - December 2015

**Earth Observations & Parameters:**

Terra, MODIS – Aerosol Optical Depth (AOD) at 550nm wavelength

Aura, OMI – Nitrogen Dioxide (NO2) and Sulfur Dioxide (SO2)

**Ancillary Datasets Utilized:**

* Bureau of Ocean Energy Management Gulfwide Emissions Inventories (2000, 2005, 2008, 2011) – Annual emissions estimates
* NASA AERONET – Quality assurance and validation of satellite data

**Software Utilized:**

ArcGIS – Raster manipulation/analysis, image enhancement & map creation of Terra MODIS and Aura OMI data

Microsoft Access – Conversion of data into Microsoft Excel format for upload into ArcGIS

Microsoft Excel – Platform measurements of aerosols, NO2, and SO2 for upload into ArcGIS

Python – Extraction and processing of Terra MODIS and Aura OMI data

**Project Overview**

**80-100 Word Objectives Overview:**

The objectives of the Gulf of Mexico Health and Air Quality project were to map and analyze airborne pollutant concentrations of PM2.5 aerosol, nitrogen dioxide (NO2), and sulfur dioxide (SO2) using remotely sensed data from NASA’s Terra MODIS and Aura OMI satellite instruments. *In situ* data were obtained from the Bureau of Ocean Energy Management’s (BOEM) annual emissions inventories and compared to satellite data to determine correlations between these pollutants and primary emissions sources. Methodology was developed for the continuation and expansion of emissions monitoring utilizing NASA Earth observations.

**Abstract:**

The Outer Continental Shelf (OCS) of the Gulf of Mexico houses over 3,000 offshore oil and gas production facilities. These facilities emit criteria pollutants that are known to have both human health and environmental impacts. The Bureau of Ocean Energy Management (BOEM) is tasked with monitoring the onshore impacts of these emissions under federal regulations. Current practice requires that facility operators collect monthly emissions inventory data which is used to model air quality. NASA Earth observations were utilized to produce a long-term, regional study in the Gulf of Mexico to monitor changes in air quality. Terra Moderate Resolution Imaging Spectroradiometer (MODIS) and Aura Ozone Monitoring Instrument (OMI) data were used to create emissions profiles for PM2.5, nitrogen dioxide, and sulfur dioxide for the Gulf of Mexico. These data were then validated against ground truth data using NASA’s AERONET dataset comparison and correlation tool. Post validation, time series, and time averaged maps were created to illustrate emissions over the 2000 – 2015 timeframe. Lastly, satellite data were extracted and correlated with data provided by BOEM’s platform sites to identify areas where emissions levels are above the permitted thresholds. The project methodology will allow BOEM to incorporate satellite data for monitoring atmospheric plumes associated with offshore drilling by oil and natural gas platforms to address future environmental concerns in the Gulf of Mexico.

**Community Concerns:**

* Offshore oil and natural gas drilling in the Gulf of Mexico, on over 3,000 platforms, produces aerosols, nitrogen dioxide, and sulfur dioxide emissions.
* Emissions from offshore drilling can impact onshore air quality, causing health impacts for species living along the coastline of the Gulf of Mexico.
* Point data from individual platform and non-platform sources do not provide the regional coverage necessary to answer larger scale scientific questions regarding the Gulf of Mexico.

**Current Management Practices & Policies**:

To make a decision regarding air quality, offshore facility operators must include air emissions information when they submit exploratory, development, and production plans. The Bureau of Ocean Energy Management applies laws presented in the 30 Code for Federal Regulations 550.302 through 304, and, in general, follows the National Ambient Air Quality Standards defined by the U.S. EPA. The EPA defines threshold amounts of PM2.5, nitrogen dioxide and sulfur dioxide that must not be exceeded. BOEM developed a baseline criteria pollutant and greenhouse gas emissions inventory in 2000 for all OCS oil and gas production sources in the Gulf of Mexico and have produced subsequent inventories every 3-5 years. While BOEM is able to monitor air quality through their monthly inventories of platform and non-platform emissions, this type of data is cost prohibitive in producing long-term, regionally scaled studies.

**Decision Support Tools & Benefits:**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Time Series Analysis: monthly, seasonal, and annual maps of PM2.5, NO2, and SO2 pollutants  | Terra MODIS, Aura OMI | Determine long-term emissions trends; validation of facility operator modeling input data |
| Methodology workflow to analyze concentration profiles of pollutants | None | Decision support to effectively monitor and allocate resources for regional evaluation of future emission scenarios and potential disaster events |

**Project Imagery**

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**Caption:** 2005 Terra MODIS Aerosol Optical Depth (AOD) measurements and corresponding annual time series showing high emissions hotspots of BOEM PM2.5 measurement emissions in red. Image Credit: Gulf of Mexico Health & Air Quality Team.

**Image:** Spring2016\_GSFC\_GulfofMexicoHealthAQ\_VPSImage.jpeg

**Software Release Requirements**

What category do the tools your project is creating fall within? Category I