Environmental Studies Program: Ongoing Studies

Study Area(s): National

Administered By: Headquarters

Title: Use of Satellite Data for Offshore Air Quality Applications (NSL #NT-17-01)

BOEM Information Need(s) to be Addressed: BOEM is required to analyze Outer Continental Shelf (OCS) oil and gas activities air quality impacts to the states as mandated by the Outer Continental Shelf Lands Act (OCSLA) and these assessments are used by BOEM in National Environmental Protection Act (NEPA) Environmental Assessments (EAs) and Environmental Impact Statements (EISs). Any improvements to or additions of the data for these assessments would support BOEM's air quality regulations and NEPA analyses. This interagency agreement involves working with NASA's Atmospheric Chemistry and Dynamics Laboratory at Goddard Space Flight Center to assess the probability of use of satellite data for air quality applications, specifically through the estimation and monitoring of offshore ground level concentrations of pollutants and through improvements and validations in the BOEM's existing emissions inventories and photochemical modeling.

Total Cost: (in thousands) $500 **Period of Performance:** FY 2017-2020

Conducting Organization(s): NASA Goddard Space Flight Center

Principal Investigator(s): Bryan Duncan, bryan.n.duncan@nasa.gov

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Description:

Background: The Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (USEPA) to set the National Ambient Air Quality Standards (NAAQS) for widespread pollutants from numerous and diverse sources considered harmful to public health and the environment. The law also requires the USEPA to periodically review the standards to ensure that they provide adequate health and environmental protection, and to update those standards as necessary. The USEPA has set standards for six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter ($PM_{2.5}$ and PM_{10}), and sulfur dioxide (SO_2). Volatile organic compounds (VOCs) perhaps should also be assessed as ozone is formed through photochemical reactions involving both NO_2 and VOCs.

The OCSLA requires BOEM to ensure compliance with the NAAQS to the extent that OCS oil and gas exploration, development, and production activities significantly impact the air quality of any state. BOEM is tasked with analyzing OCS oil and gas activities air quality impacts pre- and post-lease for NEPA documents. BOEM has oil and gas facilities in the Pacific and Gulf of Mexico (GOM) Regions, and has issued leases in the

Alaska and Atlantic Regions, for oil and gas and renewable development respectively. Satellites could be an essential tool to aid BOEM in conducting these assessments.

Satellites have become increasingly capable of identifying and measuring the quantity of certain criteria NAAQS, their precursors, and accessing visibility. Although this capability has been identified, it has not yet been employed in the offshore environment.

Objectives: The purpose of this Inter-agency Agreement is to conduct a scoping study:

1. To assess the applicability of existing satellite datasets to support BOEM's air quality regulations and NEPA analyses. Specifically this scoping study would determine the feasibility of using satellite data in offshore environments in the GOM, Pacific, Atlantic and Alaska Regions for estimating and monitoring long term trends of the ground level concentrations of criteria NAAQS, precursors, and visibility pollutants where there are no monitors in the GOM and Pacific Regions, along with estimating and monitoring background concentration data in the Alaska and Atlantic Regions before oil and gas or renewables development.

2. To validate the satellite data with offshore monitoring in a field campaign.

3. To use the results of the above purposes to validate BOEM's existing air quality model output including the photochemical modeling results at multiple vertical atmospheric heights and pollutant concentrations in areas surrounding the largest emission sources in the GOM, relative to the quantity of inventory estimates.

4. To collect satellite data in the GOM region during the same time as the BOEM's field tracer study in an effort to obtain a comprehensive offshore dataset.

Methods: The study will entail a partnership with NASA to assess the feasibility of using satellite data of various air pollutants to derive estimates for the criteria NAAQS, precursors, and visibility pollutants offshore. BOEM envisions two main parts of this Inter-agency Agreement: 1) a scoping study assessing current satellites ability to estimate offshore NAAQS, precursors, and visibility pollutants, and 2) an offshore monitor field campaign to validate the satellites.

The scoping study will consist of two parts. First, NASA will prepare a document summarizing the current state of observing air pollutants over open water. These pollutants include CO, NO_2, SO_2, and PM. Satellite data of O_3 and VOCs will likely not be useful as will be detailed in the report. The document will also include discussions on other useful satellite datasets, such as visible imagery, land vegetation, lights versus flares, and oil slicks. It will include information on current satellite capabilities and upcoming satellite datasets with an emphasis on their potential for BOEM objectives. Second, NASA will improve the operational NO_2 data product, addressing several issues that will likely improve the use of the data over open water. For example, the operational product relies on some parameters that are only available at coarse resolution. For smaller domains, higher-resolution inputs (e.g., a-priori NO_2 profiles, surface reflectivity) will be created to improve results of the standard satellite data. In addition, new improvements to the processing algorithms can detect smaller signals

than are typically detected by the operational algorithm. With an improved NO_2 product, the study will 1) estimate NO_2 concentrations around offshore facilities, 2) determine the contribution of onshore emissions (e.g., specific refineries, power plants, and cities) to offshore air quality and vice versa by analyzing wind flow patterns and daily NO_2 data, and 3) derive long-term trends over the last decade. Several of these improvements to NO_2 may also benefit other pollutant datasets as well if applied.

Second, validation will consist of observations using NASA equipment to measure the same constituents observed by satellite. A minimum set of species will include O_3, CO and NO_2, and column NO_2 determined spectrophotometrically. The latter is ground-truth for the specialized column NO_2 that NASA is producing. For this validation, a sampling platform with standard meteorological parameters (Automated Weather System, AWS) for interpretation of transport and sources will be needed. Given the focus of the exploratory study on GOM NO_2 and detailed BOEM distributions of OCS, supply ship, non-supply marine and land-side NO_2 sources, the preferred platform is a ship operating in its normal supply route configuration for 10-15 days during peak O_3 production season (July-early October). The principal objective is to sample NO_2 and other trace gas gradients from coast to the shelf limit and back and to collect statistics over several complete supply legs without disruption to supply ship operations. Power requirements to operate standard Air Quality instruments are minimal; berthing is needed for two operators.

Current Status: This project has been named SCOAPE, or Satellite Continental and Oceanic Atmospheric Pollution Experiment. NASA has begun drafting the scoping study document through research assessing the use of current satellite data for air quality purposes over water. NASA has also started coordinating logistics on the cruise to validate the satellite data by obtaining ship time in the summer of 2018 in the Gulf of Mexico Region, consolidating necessary equipment, and reviewing the *Year 2014 Gulfwide Emissions Inventory Study* results to determine possible transects to sample emissions. Lastly, NASA is drafting a webpage to share the projects goals and progress.

Final Report Due: FY2020

Publications Completed: None

Affiliated WWW Sites: None

Revised Date: February 5, 2018