**NASA DEVELOP National Program**

**** Wise County Clerk of Circuit Court’s Office

*Summer 2017*

**Short Title: Texas Health & Air Quality**

**Subtitle:** Monitoring Exceptional Air Pollution Events in Texas Using NASA Earth Observations

**VPS Title:** Houston, We Have Pollution!

**Project Team**

**Project Team:**

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**Advisors & Mentors:**

Dr. Kenton Ross (NASA Langley Research Center)

Dr. L. DeWayne Cecil (NOAA National Centers for Environmental Information, Global Science & Technology, Inc.)

Bob VanGundy (The University of Virginia’s College at Wise)

Dr. Travis Knepp (NASA Langley Research Center)

**Project Overview**

**80-100 Word Objectives Overview:**

This project performed 3-D spatial-temporal tracking of the transport and deposition of aerosols produced by wildfires in Texas, U.S. (August 2011 and May-October, 2015-2017) using NASA Earth observations. Earth observations utilized included Terra MODIS for Aerosol Optical Depth (AOD), CALIPSO CALIOP for vertical profiles of aerosols, Terra MOPITT for carbon monoxide (CO) volume mixing ratio and total column measurements, and Suomi NPP VIIRS for fire detection. The Texas Commission on Environmental Quality (TCEQ) will use these products to enhance their technicity in remote sensing for locating sources of exceptional events and to augment their current methods of monitoring aerosols.

**Abstract:**

Wildfires in Texas have the potential to impact not only the areas of origin but also the entire state. Smoke plumes from wildfires travel across the state with trajectories that are greatly influenced by meteorological conditions. The plumes transport pollutants, which include those present in the ambient atmosphere, like volatile organic compounds and nitrous oxides, as well as those produced by wildfires, like aerosols. Aerosols have several negative effects on the environment and human health. Smoke plumes have the potential to negatively impact numerous lives when meteorological conditions allow them to reach highly populated metropolitan areas. For these reasons, the U.S. Environmental Protection Agency (EPA) has set standards to regulate the levels of these pollutants in the atmosphere. Observations from field monitors assist the Texas Commission on Environmental Quality (TCEQ) in ensuring that these standards are met. When these standards are exceeded, the TCEQ can claim an exceptional event, but it is often difficult to use *in situ* data alone to trace the origins of the pollutants that caused this. This project used data from Terra MODIS and CALIPSO CALIOP to observe the aerosol optical thickness and vertical composition of plumes, respectively, and to perform 3-D spatial-temporal plume tracking. Data from Terra MOPITT were used to distinguish smoke plumes from ambient air and thermal anomaly maps from Suomi NPP VIIRS were used for fire detection. The products of this project helped the TCEQ observe wildfire smoke plumes and monitor the origin, transport, and deposition of wildfire aerosols.

**Keywords:**

Terra, MODIS, MOPITT, CALIPSO, CALIOP, Suomi NPP, VIIRS, Texas wildfires, smoke plume tracking, 3-D aerosol transport, HYSPLIT

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Texas Commission on Environmental Quality, Air Quality Division | David Westenbarger, Senior Engineering Specialist | End User | No |

**Community Concerns:**

* Smoke from wildfires can be transported both short and long distances and often reaches metropolitan areas, depositing a variety of pollutants that include aerosols.
* Aerosols are the main cause of haze in the United States and particles smaller than 10 micrometers can cause respiratory and cardiac issues. Larger particles can irritate eyes, nose, and throat.
* Wind-borne aerosols can settle on ground or water, damaging ecosystems, waterbodies, and agricultural land.
* Aerosols interfere with the amount of solar radiation reaching the Earth, causing atmospheric warming and cooling and affecting precipitation.

**Current Decision-Making Practices & Policies**:

The TCEQ is responsible for maintaining clean water, air, and secure waste disposal in accordance with the standards of state and federal laws. Concentrations of ozone, carbon monoxide, aerosols, and other atmospheric pollutants are measured by ground monitors throughout the state of Texas. When pollutant concentration levels exceed standards, the EPA is notified and a State Implementation Plan (SIP) is put into place. To help identify exceptional air quality events, the TCEQ uses remote sensing in their photochemical modeling.

**Decision Support Tools & Benefits:**

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software****Release** |
| Aerosol Transport Map | Terra MODIS, CALIPSO CALIOP  | The TCEQ will use this in addition to their network of ground monitors for exceptional event area source identification.  | N/A |
| Exceptional Event Potential Source Report | Suomi NPP VIIRS, Terra MOPITT | This report will serve as the TCEQ’s basis for determining wildfire-based exceptional events that led to ozone and particulate matter concentration increase in Houston and El Paso.  | N/A |

**Project Benefit to End User**:

NASA DEVELOP products and services will aid the TCEQ in its continual efforts to ensure air quality standards are constantly being met within the state of Texas. Improving current TCEQ competencies with NASA Earth observations will contribute to increased analytical efficiencies, allowing staff to devote more time to documenting transported pollution and to improve scientific understanding of characteristics of these phenomena. NASA DEVELOP will support the TCEQ’s development and implementation of effective strategies to avoid potentially extensive and expensive consequences for residents and businesses.

**Project Details**

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

**Study Area:** Texas

**Study Period:** August 2011, 2015-2017 (May – October)

**Earth Observations & Parameters:**

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| Terra MODIS | Aerosol Optical Depth | This platform will be used to monitor ambient aerosol optical thickness. |
| Suomi NPP VIIRS Aerosol EDR | Fire and thermal anomalies | This platform will be used to detect fire and thermal anomalies. |
| CALIPSO CALIOP | Aerosol and cloud profiles and properties | This platform will be used to observe vertical composition of aerosols in smoke plumes. |
| Terra MOPITT | Global measurements of tropospheric CO | This platform will be used to yield atmospheric profiles of CO volume mixing ratio and total column values. |

**Ancillary Datasets Utilized:**

* TCEQ Continuous Air Monitoring Sites Sensor Data – CO, ozone, PM 2.5

**Models Utilized:**

* NOAA Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) Model

**Software Utilized:**

* Esri ArcGIS – raster manipulation and analysis
* Microsoft Excel – HDF5 file manipulation
* VOCAL (Visualization of CALIPSO) – tool for visualizing CALIOP data
* Exelis ENVI – import, analysis and manipulation of MODIS L2 data

**Project Handoff Package**

**Transition Plan:**

The Texas Health & Air Quality team will coordinate and host a WebEx meeting on August 10th, 2017 and perform a screen share with David Westenbarger, Senior Engineering Specialist at TCEQ, to explain the project materials being delivered. The project materials will be handed off via email with the partner point of contact. The materials being handed off include: Project Summary, Technical Paper, Presentation, Poster, Project Video, Map Package, and a Tutorial for downloading and processing data.

**Team POC:** Eric White, ericwhite6315@gmail.com

**Partner POC**: David Westenbarger, david.westenbarger@tceq.texas.gov

**Handoff Package:**

* Project Summary
* Technical Paper
* Presentation
* Poster
* Project Video
* Tutorial for downloading and processing data
* Map package
* Exceptional event potential source report