**NASA DEVELOP National Program**

**** NASA Langley Research Center

*Summer 2017*

**Short Title: CALIPSO Cross-Cutting**

**Subtitle:** Enhancements to *Visualization of CALIPSO* (VOCAL) through Case Studies of Saharan Dust

**VPS Title:** Just Deserts: Using Case Studies of Saharan Dust to Improve the Usability of VOCAL

**Project Team**

**Project Team:**

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**Project Overview**

**80-100 Word Objectives Overview:**

Over multiple terms, CALIPSO Cross-Cutting project teams have built an interactive visualizer for CALIPSO data named *Visualization of CALIPSO* (VOCAL). Through this project, enhancements to VOCAL expanded on its functionality. The end user has voiced that a more natural “magic wand” selection tool would be easier to use. Furthermore, VOCAL updates will incorporate multiple levels of CALIPSO data and make data input and output more flexible. Additionally, this project provided the CALIPSO Science Team with a case study of Saharan dust transport to test these enhancements to VOCAL and allow them to further verify their Level 2 (L2) data algorithm.

**Abstract:**

The Cloud-Aerosol LiDAR and Infrared Pathfinder Satellite Observation (CALIPSO) satellite’s CALIOP sensor generates vertical LiDAR profiles of the atmosphere at a global scale. Currently, the standard visualization tool for these data is written in Interactive Data Language (IDL), a proprietary language that does not support features for tracking aerosols, selecting data, or sharing those selected sections. This makes working with CALIPSO data difficult for researchers and does not allow them to visually identify aerosol features from these data. Previous DEVELOP teams have built a working version of the *Visualization of CALIPSO* (VOCAL) software, a Python language replacement for this IDL-based software. During this term, the team enhanced VOCAL by improving the shape drawing tool, adding the capability to view multiple levels of data, and more flexible data inputs and outputs that support a decentralized database in the form of a CSV file. These features will increase the usability of VOCAL, expediting the process of visually identifying features and analyzing the resulting subsets of data. Finally, the DEVELOP team conducted a case study with Saharan Dust transport over the Atlantic Ocean to test the capabilities of the VOCAL software and to produce a database of dust events. The database and case study will help members of the CALIPSO Science Team compare the performance of classification algorithms used to create Level 2 (L2) CALIPSO data products, and will also support preliminary analysis of the atmospheric interactions and consequences related to long range dust transport.

**Keywords:**

Aerosol, VOCAL, CALIPSO, CALIOP, LiDAR, Saharan dust, Open source, Earth observations

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| NASA CALIPSO Science Team | Dr. Charles “Chip” Trepte, CALIPSO Project Scientist | End User | No |

**Community Concerns:**

* The current standard visualization tool is written in IDL, a proprietary language that inhibits collaboration and makes it difficult to track aerosols. VOCAL will solve these issues.
* The CALIPSO Science Team has used VOCAL in a case study and noted that the features described would make VOCAL more useful and accessible.
* Saharan dust storms cause nutrient loss from dry lands, and carry pollution-laden dust hundreds of miles over the Atlantic Ocean. Like other aerosols, dust also contributes to the radiation budget.

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

The CALIPSO Science Team currently uses a tool to visualize CALIPSO data that is written in IDL, a proprietary language that has only a few features and is difficult to update. Additionally, the program does not allow for sharing results among researchers electronically, which inhibits collaboration beyond in-person meetings. The end-user, a member of the CALIPSO Science Team, requested the aforementioned software and is overseeing its beta-testing. Before it is adopted by the group at large, more improvements must be made.

**Decision Support Tools & Benefits:**

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software**  **Release** |
| *Visualization of CALIPSO* (VOCAL) | CALIPSO CALIOP | The CALIPSO Science Team will use this software as a replacement for their current visualization tool. This will allow them to track aerosols by identifying, annotating, and exporting region of interest for collaborative purposes. | V |
| Saharan Dust Case Study | CALIPSO CALIOP | The CALIPSO Science team will use this case study and database to analyze the algorithm used to convert L1 data into various L2 data products. | II |

**Project Benefit to End User**:

The enhancements described above will save the user time and increase ease of use in the process of manually identifying aerosols for the purpose of theses validations. An improved drawing tool will make selecting data faster and more intuitive. Additionally, ease of collaboration will be improved through a more flexible scheme for data output, decentralizing the location of drawn polygons. Finally, the case study of Saharan dust transport will help the CALIPSO Science Team verify their data and calculations for the interpretation of L2 data.

**Project Details**

**Applied Sciences National Applications Addressed:** Cross-Cutting, Health & Air Quality

**Study Area:** Global

**Study Period:** May 2006 – June 2017

**Earth Observations & Parameters:**

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| CALIPSO | CALIOP | CALIPSO captures a vertical profile of the atmosphere using LiDAR, results in an image of aerosols. This will allow us to analyze the shape, size, location, and makeup of dust in the atmosphere. |
| Aqua MODIS | Aerosol Product | The MODIS Aerosol Product monitors the ambient aerosol optical thickness over the oceans globally and over the continents. This will allow us to locate dust event times and locations. |
| Terra MODIS | Aerosol Product | The MODIS Aerosol Product monitors the ambient aerosol optical thickness over the oceans globally and over the continents. This will allow us to locate dust event times and locations. |

**Models Utilized:**

* NASA Worldview

**Software Utilized:**

* Python 2.7 – software development
* VOCAL – data analysis for aerosol case study
* SQLite3 – database management

**Project Handoff Package**

**Transition Plan:**

During the course of the 10-week term, the team will push updates to the VOCAL GitHub page including the tools and features mentioned above, as well as documentation on how to use it. At the end of the term, the team will present the case study of Saharan dust to the CALIPSO Science Team in person, along with a digital copy of the event database.

*Software Release Plan*: VOCAL has already gone through software release and is available on GitHub.

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**Handoff Package:**

* Tech paper
* Presentation on the new features in VOCAL and the methodology and findings of the case study
* Case study findings
* Completed Code and Documentation on GitHub