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# Porting a Parallel Program from the NASA Center for Climate Simulation (NCCS) Discover Supercomputer to SWOSU Clusters for Validation of the Multi-Sensor Aerosol Products Sampling System (MAPSS)

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## Timeline

Jan 2016: The SWOSU Organized Research Grant and the NASA EPSCoR Travel Grant fund six students and two faculty to meet with Dr. Charles Ichoku at the NASA Goddard Space Flight Center. The SWOSU toured the facility and received briefings from Sen. Barbara Mikulski, as well as technical presentations from a dozen NASA researchers.

The NASA and SWOSU teams agreed the students should begin a validation study of the MAPSS project. The NASA team began working to release their software to SWOSU

May 2016: SWOSU students received an Oklahoma NASA EPSCoR Research Initiation Grant. Students formed a summer research team. The students selected LaTeX for documentation of all efforts, and GitHub as their knowledge management tool. All students focused on their expertise. Some began a literature review, others began developing Python code from scratch. Charles Sleeper began developing Raspberry Pi Clusters to support future research partnerships with area High Schools.

Jun 2016: Jack Guillory and Charles Sleeper, along with other SWOSU students attend XSEDE Summer Bootcamp workshop to kick start HPC programming efforts. Students were introduced to parallel computing concepts, OpenMP, MPI, and OpenACC. Students toured the OU Supercomputing Center for Education & Research, including their $2M Supercomputer. Students also ran code on the $10M Bridges supercomputer at the Pittsburgh Supercomputing Center, ran by Carnegie Mellon University.

Jun 2016: Students were provided access to NASA's Multi-sensor Aerosol Products Sampling System (MAPSS) program. This software was built over two decades by a team of software engineers for the NASA Goddard team, and had been tuned to their Discoverer 12 super computer.

Jack Guillory led the team of SWOSU students working to convert the NASA code to run on any cluster in Oklahoma.

## References


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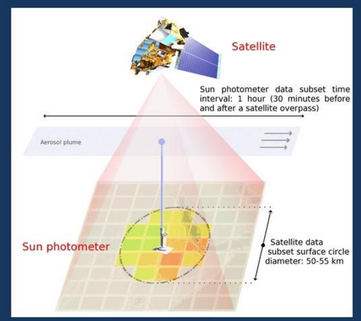
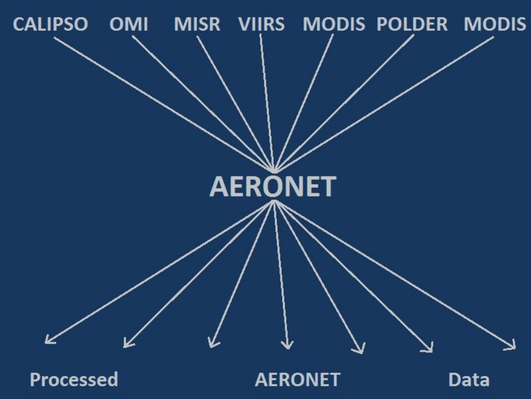
## Atmospheric Aerosol Data Collection

Space-based sensors took measurements looking down to Earth, while ground-based sensors took measurements looking up. Statistics for each of the aerosol products involved extracting measurements that fall within 27.5 km of the chosen locations, and within 30 minutes of each satellite fly over.




http://disc.gsfc.nasa.gov

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## Research Questions

Do NASA satellites sensor platforms produce similar readings to ground-based sensors?

Can NASA research be verified by undergraduate researchers?

What level of Cyberinfrastructure resources are necessary to examine a data set of this size?

## Research Challenges

The MAPSS software contained hundreds of source files written in several programming languages over two decades by multiple authors.

Testing the code optimized for supercomputers targeted larger data files and resulted in several time consuming runs.

Some files for the software are automatically generated by the NASA supercomputer are not automatically generated within a standard installation of Linux Mint. These files were manually recreated from error messages.

## Results

Tool currently functions with:

- Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO)
- Aerosol Robotic Network(Aeronet)
- Multi-angle Imaging SpectroRadiometer (MISR)
- Ozone Monitoring Instrument (OMI)

In Progress

- Polarization and Directionality of the Earth's Reflectances (Polder)
- Visible Infrared Imaging Radiometer Suite (VIIRS)
- Moderate Resolution Imaging Spectroradiometer(MODIS)

SWOSU students were able to successfully run the MAPSS software.

A desktop computer could complete analysis on the smallest allowed data set in about a week.

The current process is automated on Linux mint.

Next steps

- Run analysis on SWOSU Intel cluster computers and publish results
- Run analysis on SWOSU Raspberry Pi cluster computers and expand analysis: Larger sensor radius, different sensor fusion models.