

HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM

RESEARCH PROJECT #: HPCMP-HIP-24-033

Acceleration of the Navy Aerosol Analysis and Prediction System for Long Time Series Experiments

About U.S. Naval Research Laboratory (NRL):

The Marine Meteorology Division of the Naval Research Laboratory conducts cutting-edge research on atmospheric prediction, including numerical modeling, satellite data assimilation, and basic science research on atmospheric physics, optics, and composition. The team of scientists leverages high-performance computing resources to aid in simulations and process large scientific datasets. They are seeking motivated students with an interest in atmospheric prediction and computational applications.

RESEARCH LOCATION: Monterey, CA

PROJECT DESCRIPTION:

The Navy Aerosol Analysis and Prediction System (NAAPS) is a dynamic model of atmospheric particles driven by the Navy Global Environmental Model (NAVGEM). NAAPS is used operationally by the Navy for short-range and medium-range prediction of visibility-reducing events. Additionally, NAAPS is a tool for science, aiding a variety of projects to understand the nature and variability of the atmosphere. Science uses of NAAPS frequently demand long (>1year) integrations of the NAAPS model, which can be time-consuming and computationally expensive. The intern will explore, implement, and test methods to reduce inefficiencies in the NAAPS model and permit faster integration for long time series simulations.

The NAAPS model code is currently in Fortran 90, with configuration tasks done in a combination of shell scripts and Python, including the cyclic software used for task scheduling. The NAAPS model uses hybrid parallelization leveraging both OpenMP and MPI parallel processing. Investigations of the computational efficiency of NAAPS indicate that large potential speedups may be possible with improved architecture and some refactoring. The proposed project is to explore potential modifications to the NAAPS code that will maintain or increase scientific fidelity of the NAAPS simulations while reducing the requirements of time and computation.

Under the guidance of mentors, the intern will:

- Use documented instructions to obtain, compile, and run the NAAPS model
- Apply profiling tools to identify potential inefficiencies in the NAAPS code
- Implement candidate upgrades to improve computational performance of NAAPS
- Verify the impact or non-impact of candidate modifications on NAAPS scientific output
- Verify the impact or non-impact of candidate modifications on NAAPS computational performance
- Report on changes showing positive impact on computational efficiency with no degradation of scientific output
- document final recommendations, including demonstrating potential improvement in throughput / computational requirements of NAAPS model

ANTICIPATED START DATE:

June 2024 – Exact start dates will be determined at the time of selection and in coordination with the selected candidate.

QUALIFICATIONS:

Basic programming experience is preferred. Experience with code profiling tools is desirable but not necessary.

ACADEMIC LEVEL:

Degree received within the last 60 months or currently pursuing:

- High School Diploma/GED
- Associate's
- Bachelor's
- Master's
- Doctoral

DISCIPLINE NEEDED:

- Computer, Information, and Data Sciences
- Earth and Geosciences
- Environmental and Marine Sciences
- Mathematics and Statistics
- Science & Engineering-related