Opportunity Title: AI/ML Emulators and Dynamic Time Interpolators for km-scale Earth System Models
Opportunity Reference Code: 0315-NPP-MAR26-GSFC-EarthSci

Organization National Aeronautics and Space Administration (NASA)

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How to Apply All applications must be submitted in Zintellect

Please visit the NASA Postdoctoral Program website for application instructions and requirements: How to Apply | NASA Postdoctoral Program (orau.org)

A complete application to the NASA Postdoctoral Program includes:

1. Research proposal
2. Three letters of recommendation
3. Official doctoral transcript documents

Application Deadline 3/1/2026 6:00:59 PM Eastern Time Zone

Description **About the NASA Postdoctoral Program**

The NASA Postdoctoral Program (NPP) offers unique research opportunities to highly-talented scientists to engage in ongoing NASA research projects at a NASA Center, NASA Headquarters, or at a NASA-affiliated research institute. These one- to three-year fellowships are competitive and are designed to advance NASA's missions in space science, Earth science, aeronautics, space operations, exploration systems, and astrobiology.

Description:

This opportunity is closed to applicants who are Senior Fellows (5-years or more past PhD).

Observing System Simulation Experiments (OSSEs) have been the cornerstone behind science-based observing system design. While much progress has been made in recent decades, grand challenges remain. In particular, the lack of global cloud-resolving simulations representing convection and cloud-aerosol interaction processes, and the integrated analytic tools that would permit proper simulations of the synergistic measurements and their relevance to applications and science-based decision making.

While OSSE capabilities exist at NASA, technical barriers have previously prevented practical deployment of a cloud-resolving nature run, since the high spatial and temporal resolution needed to capture the relevant processes can lead to a prohibitive amount of output data. For example, cloud-resolving model at 1 km resolution with an output frequency of 1 minute needed to resolve convective time scales would require O(1~exabyte)/year. Clearly, such an I/O-based approach for generating nature runs is unsustainable as we increase the complexity and resolution of our Earth system models. Unlike traditional OSSE system where a

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Nature Run (NR) is performed once and a pre-determined set of gridded output fields is written to disk, we have adopted a 2- phase approach. In the first phase, the model is run with very limited output, except for frequent checkpoints and a number of browse product for case selection. On a second phase, the model is rerun from spun up checkpoints of interest with output sampled at the footprint of the observing system being simulated. The primary goal of this project is to explore AI/ML models for emulating this second phase with a much lower computational footprint.

Unlike exiting AI/ML foundation models for whether and climate which typically have much lower spatial resolution (nominally 25 km) or simulate a small number of variables on a very limited set of vertical levels, our requirements call for a different type of model: one which emulate the full km-scale, non-hydrostatic state of the atmosphere, including the full vertical column. For the OSSE problem at hand we focus on a dynamic time interpolator that given 2 atmospheric states at times “t” and “t+dt” (typically 1-day apart), reconstruct the atmospheric state for the times in between, every minute. Such a device provides a fast and accurate data compression mechanism that is of particular relevance for very high-resolution km-scale, non-hydrostatic simulations. A prototype model based on CNN-Transformers with Laplacian eigenmap embeddings already exist for a starting point. The successful applicant will also have the opportunity to work on AI/ML methods for data assimilation, including emulation of the analysis averaging kernel.

Field of Science: Earth Science

Advisors:

Arlindo da Silva
arlindo.m.dasilva@nasa.gov
(301) 614-6174

Applications with citizens from Designated Countries will not be accepted at this time, unless they are Legal Permanent Residents of the United States. A complete list of Designated Countries can be found at: https://www.nasa.gov/oiir/export-control.

Eligibility is currently open to:

- U.S. Citizens;
- U.S. Lawful Permanent Residents (LPR);
- Foreign Nationals eligible for an Exchange Visitor J-1 visa status; and,
- Applicants for LPR, asylees, or refugees in the U.S. at the time of application with 1) a valid EAD card and 2) I-485 or I-589 forms in pending status

Questions about this opportunity? Please email npp@orau.org

Point of Contact Mikeala

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Eligibility Requirements

- **Degree:** Doctoral Degree.