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Opportunity Title: ICAR - Habitability Space: Exploring a New Frontier via Climate Models and Planetary Statistics
Opportunity Reference Code: 0030-NPP-MAR26-ABProg-Astrobio

Organization National Aeronautics and Space Administration (NASA)

Reference Code 0030-NPP-MAR26-ABProg-Astrobio

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:

Can we define the "habitability space" of observed rocky planets and possible icy moons in a manner that is both rigorous and consistent so that the astrobiology community can predict with confidence which potential planetary targets are more likely to also be potential habitability targets? Using a set of recognized habitability parameters (e.g., host star & planet/moon characteristics) and climate cases from Solar System history and present day icy moons, we can define a "habitability space" to predict the likelihood a given exoplanet or exomoon would be potentially habitable as well as observable, given current and future observational capabilities.

This is accomplished by combining a 3-D coupled land-ocean-atmosphere model (the ROCKE-3D GCM, or R3D) with statistical methods that define populations of habitable planets. Our approach entails interactions between broad research themes and explicit tasks that involve comparative planetary climatology, deep ocean icy moon habitability, statistical sampling techniques and synthetic spectra generation.

Our experience using R3D to explore past habitable conditions of our solar system's rocky planets informs our understanding of the dynamic processes characterizing the range of climates that can support life as we know it alongside ocean extensions to R3D that allow exploration of the deep ocean icy moons of the solar system. We will build a public library of

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potentially habitable climate states guided by our current understanding of planetary demographics, Earth's habitability through time, as well as the long-term evolution of both Venus & Mars and deep ocean worlds. Simulating all possible planetary climate states is impractical since the parameter space is enormous. We will identify a key subset of planetary system parameters to design a series of perturbed parameter ensembles of simulations. We will then use sophisticated sampling techniques to lower the dimensionality of our search space providing key subsets of planetary system parameters to be modeled with R3D. GCMs provide a highly realistic technique to assess habitability defined by a planet or moon's energy characteristics, along with dynamical controls on multiple climate variables. Our analysis will allow us to identify where Solar System rocky planet and icy moon habitable states fit within the predictions of the ensemble and where they do not, allowing us to adjust the parameter space accordingly and identify additional ensembles needed. From our R3D climate simulations we will use NASA's Planetary Spectrum Generator to create a public library of synthetic spectra. Advanced statistical techniques will be used to identify which of our library of potentially habitable worlds best match present exoplanet observations. Finally, the icy moon component discussed above requires some development of the R3D ocean model to include geothermal heating via tidal dissipation of the moon's solid body, and tidal forcings within the ocean itself and the surrounding ice shell.

Field of Science: Astrobiology

Advisors:

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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

Point of Contact Mikeala

Eligibility Requirements

- **Degree:** Doctoral Degree.