LEAP REU Information Session - Outline

- Overview of LEAP
- Overview of LEAP REU Program
  - Goals
  - Program elements
  - Summer 2022 Projects
  - Eligibility Requirements
  - Application Requirements
- Dates & Deadlines
- COVID-19 Policies
- Frequently Asked Questions
Strategic Vision: Climate Data Science to revolutionize climate projections
LEAP forward in the reliability, utility, and reach of climate projections through synergistic innovations in data science and climate science.

- **Reliability:** Establish data-driven climate projections
- **Utility:** Launch platform for bidirectional knowledge transfer between science + society
- **Reach:** Strengthen pipeline by training diverse climate data scientists
- **Novelty:** LEAP will leverage + advance data science across the entire climate model pipeline
LEAP Roadmap

Climate data science

Next-generation projections

Bidirectional knowledge transfer

Broadening participation

Data infrastructure: LEAPangeo

CS1

CS2

CS3

CS4

CS5
Science Challenge 1: Develop Next-Generation climate model

- **Challenge:** Create high-reliability climate projections
- **Solution:** Harness new ML + data to transform the open NSF-funded Community Earth System Model (CESM) - we have proofs of concept
Science Challenge 2: Create Next-Generation Algorithms

- **Challenge:** ML algorithms need to respect physics, better extrapolate + be interpretable
- **Solution:** Include **physical + causal knowledge** to robustly extrapolate + understand

New Algorithms

\[ \frac{\partial c}{\partial t} + \mathbf{v} \cdot \nabla c = 0 \]

Better Extrapolation, Generalization + Interpretability

Deputy Director Galen McKinley
Chief Convergence Officer & Education Director Tian Zheng
Data Science Director Carl Vondrick
Geoscience Director Laure Zanna
Education Objectives: Equitably + Inclusively Train Climate Data Scientists

• **Challenge:** Distinct fields + vocabularies limit collaborations + progress
• **Solution:** Forge the new climate data science discipline via convergence between education + research

- **Research-integrated** transdisciplinary curricula, with immersive research experiences
  - LEAP graduate fellowships and a REU program
  - A graduate certificate in Climate Data Science
  - A summer program for K-12 teachers

- **Increase representation** of URMs in climate data science through Bridge programs and partnerships (e.g., SOARS).

- **Integrate DEI** across recruitment, research, education
Overview of LEAP REU Program: Goals

- LEAP STC is committed to building a diverse research community at the intersection of geosciences and data sciences.

- Research experiences will introduce undergraduate participants to transdisciplinary science at Columbia.

- Participants will engage in team learning around a meaningful project, and participate in professional development activities.

- Participants will build learning and professional relationships through vertically integrated mentoring in a world-renowned research environment.
Overview of LEAP REU Program Elements

- Offers summer undergraduate research experiences (SUREs) on synergistic innovations in data science and climate science under the supervision of a LEAP expert

- Offers opportunities to work on impactful projects at the intersection of geoscience and data science

- Offers a wide array of enrichment learning and networking opportunities, plus training in data science

- Offers collaborative partnerships with the Summer at SEAS program, the DSI Scholars program, and the Significant Opportunities in Atmospheric Research and Science (SOARS) program at UCAR

- Stipend and summer housing cost support
LEAP REU Program: Summer 2022 Projects

- Potential LEAP REU research project topics include:
  - Physics-informed and causally-informed machine learning (ML)
  - Novel ML-based subgrid parameterizations for Earth System Models
  - Global parameter inference
  - New ML-based diagnostics and metrics for evaluating these models, with a focus on the Community Earth System Model (CESM)
An Example Project

<table>
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<tr>
<th>Constraints phenotype with machine learning</th>
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<td>Principal Investigators (PIs)</td>
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<td>![Image]</td>
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| Name: Pierre Gentine                      |
| Affiliation: Columbia University          |
| Research Interests: Hydrologic cycle,    |
| land-atmosphere turbulence, soil         |
| moisture.                                 |
| [Research Website](#)                    |

| Name: David Lawrence                      |
| Affiliation: NCAR                         |
| Research Interests: Land surface processes and climate change |
| [Research Website](#)                    |

| Name: Katie Dagon                         |
| Affiliation: NCAR                         |
| Research Interests: Climate change on land-atmosphere interactions and the terrestrial hydrologic cycle. |
| [Research Website](#)                    |

**Project Description** - The REU project will focus on the prediction of phenotype on the dataset curated by doctoral students. We envision comparing complex models to different vanilla methods first that will be used as baseline.

**Learning outcomes and deliverables** - build machine learning experience using the datasets.

**Pre-requisite preparation** - Familiarity with Python.
LEAP REU Program: Eligibility Requirements

● Students who will be a rising sophomore, junior or senior in Fall 2022 at LEAP partner institutions:
  ○ Columbia/Barnard
  ○ NYU
  ○ University of California at Irvine
  ○ University of Minnesota

● Students who are current SOARS Protégés

● Students must be a US Citizen or Permanent Resident
LEAP REU Program: Application Requirements

- Main application is available on LEAP’s Education webpage: https://leap.columbia.edu/education/

- Requirements include:
  - Resume
  - Transcript (unofficial is acceptable)
  - Statement of interest (maximum 500 words) about your goals for research this summer and your future plans
  - One reference who will provide a recommendation letter
LEAP REU Program: Dates & Deadlines

- **February 17**: Application opens

- **March 3**: Applications due by 11:59pm EST (*recommendation letter may be submitted after March 3*)

- **March 24**: Application decision notification

- **March 24 - March 31**: Admitted students matched with a project

- **June 6 - July 29**: Summer REU Program (*dates may vary for different projects*)
COVID-19 Policies

● COVID-19 vaccinations and boosters are mandatory for all who are present on campus. We will be requiring documentation of this if you are accepted to the program.

● Other protocols currently include: face coverings required indoors (cloth masks are no longer allowed) and physical distancing

● Acceptable proof of vaccination includes, but is not limited to, the following: CDC COVID-29 vaccine card, or WHO vaccine booklet. All documentation must be submitted in English.

● Columbia accepts evidence of vaccinations that have been approved by the World Health Organization.
Can students reach out to LEAP researchers directly, or submit applications directly to the project PI?

Will this program be in person, virtual, or hybrid?

Are rising Seniors eligible to apply?

Will summer housing be provided? Are housing costs covered by the program?

I am interested in two research projects. Can I work on two projects this summer? Should I submit two applications?
Questions?

Please contact us at leap@columbia.edu