





LEARNING THE EARTH WITH ARTIFICIAL INTELLIGENCE & PHYSICS

COLUMBIA | NYU | UC IRVINE| U.MINNESOTA | TEACHERS COLLEGE | NCAR | NASA

2023 CLIMATE BUSINESS+ INVESTMENT CONFERENCE April 28, 2023

Prof. Pierre Gentine, Director Prof. Vanessa Burbano, Corporate Engagement Director



- **1. Overview of LEAP Center**
- 2. Engagement with Public and Private Sectors
- 3. LEAP-CarbonPlan Data Platform
- 4. Q & A



GLOBAL LAND-OCEAN TEMPERATURE INDEX

Data source: NASA's Goddard Institute for Space Studies (GISS). Credit: NASA/GISS



Change in Annual Temperature from historical anthropogenic climate forcing



Global temperature is rising ...

Disconnect: Data used for global policy (Paris agreement)

but not uniformly

... Data needed to understand what people experience



Major changes in climate extremes...



Heat Wave Frequency

US Environmental Protection Agency



...and those extreme events are expensive...

Drought Flooding Freeze Severe Storm **Tropical Cyclone** Wildfire Winter Storm Number of Disasters





...to all of us, but we're not impacted equally.

Why Climate Change Affects Poor Neighborhoods The Most

HEALTH + RESEARCH

Poor communities emit less but are impacted *the most*





Getty Image



Climate Mitigation Climate Adaptation

Preventing and reducing change. Change is happening and can't be stopped, so how do we adapt?

Too late to halt for now (need Climate Tech), we must now adapt to a warming world.



To adapt, we need *reliable* projections.

Climate Projections
Using climate models
to understand
what will happen
+
when it will happen





To adapt, we need *reliable* projections.

Accurate 50-year predictions of climate changes will inform investment, research, public policy, urban planning, cultural and behavioral change ...





We need reliable projections ... but we don't have them.

• Current climate models are too uncertain



Global Air Temperature - Climate Model Intercomparison Project

• (Uncertain) Projections do not translate into actionable adaptation



Climate models are uncertain because of ... *small-scale processes*.



Unresolved Processes: Major Sources of Uncertainty

Photosynthesis





Climate models are even more uncertain at the regional scale – the scale of adaptation







\Xi 🔐 World Africa Americas Asia Australia China Europe India Middle East United Kingdom

Climate change is fueling deadly heat waves in India. It's putting the country's development at risk, study says

By Helen Regan, CNN Published 3:33 AM EDT, Thu April 20, 2023

AY ZO



How do we improve accuracy of our predictions?



Maximizing use of more data (volume, diversity) + the ability to harvest those data



Taking a LEAP in Climate Projections

Current Climate Models



Current

LEAP's climate model



Too uncertain Do not efficiently use data LEAP in accuracy Optimally integrate wealth of data (e.g. satellite) New discipline: Climate Data Science Modern data infrastructure



Why is this possible now?

1. Massive data from Earth observation



2. High-resolution (process-resolving) models



3. Progress in machine learning











LEAP's Revolution 1: Climate Modeling with AI

CHALLENGE

Highly reliable climate projections

LEAP SOLUTION

Harness new ML + big data to transform climate models



<u>Gentine</u> et al., 2018 *Geo Res Letters*; Newsom, <u>Zanna</u> et al., 2020 *Geo Res Letters*; Bronselaer + <u>Zanna</u>, 2020 *Nature*;



LEAP's Revolution 2: Climate Data Infrastructure

CHALLENGE

Massive + heterogeneous datasets Climate data for scientists only

LEAP SOLUTION

LEAP Pangeo, open-cloud computing For research, education and outreach

Download Model



Data-Proximate Computing





Create and Train Climate Data Scientists

CHALLENGE

Distinct fields and vocabulary Limited collaborations

LEAP SOLUTION

Create new discipline Train cross-disciplinary scientists





LEAP's Strategic Vision and Mission

Strategic Vision

The Science & Technology Center Learning the Earth with Artificial Intelligence and Physics (LEAP) will *revolutionize climate projections* for informed climate adaptation.

Mission

LEAP's mission is to increase the *reliability*, *utility*, and *reach* of climate projections through the integration of climate and data science.



Current



LEAP's Cross-Disciplinary Team

Leadership team + ~ 30 scientists





More reliable projections is one problem ... effective climate adaptation is another problem altogether



Translating science for social good

How do we ensure meaningful use and application of LEAP science to address the evolving needs of society?



Reliable projections will be critical for business

VIDER



The impact of the Covid pandemic on the global supply chain has been widely reported. But extreme weather, from floods to wildfires, is increasingly hammering ports, highways, and factories worldwide, and experts warn these climate-induced disruptions will only get worse.

BY JACQUES LESLIE · MARCH 10, 2022



Reliable projections will be critical for business





Reliable projections will be critical for business

The New York Times Companies See Climate Change Hitting Their Bottom Lines in the Next 5 Years





Reliable projections will support adaptation in ...





Reliable projections will be important for issues related to environmental justice

- Black + Hispanic communities are exposed to more air pollution than they produce
- Climate change will cause the most economic harm in the nation's poorest counties, home to mostly people of color
- Coastal (largely Black) communities in the South face the greatest risk from sea level rise
- Discriminatory housing policies (e.g., "redlining") are tied to Black communities having more pavement, fewer trees + higher average temperatures (and have fewer resources to respond to extreme heat)



Climate change x inequity = degree of impact

Bronx 10F warmer than Central Park in heatwaves; 7F warmer than Upper East Side







Provide a variety in content and format of knowledge outputs to ensure relevance for a range of public & private sector audiences



Granularity of Knowledge Output of Relevance

Low

Raw datasets + tutorials

High

Aggregated data in exec-friendly format Executive summaries of findings "translated" for a private & public sector audience

Research-informed tools for communication + design of initiatives







LEAP's Planned Process for Engagement with Private and Public Sector

- Solicit input from partners & broader set of public and private sector entities on the nature and format of LEAP outputs that would be most valuable
- Iterate/adjust LEAP research & climate information portal based on perceived usefulness of format/data
- Exploring synergies with private sector organizations
 - On the research
 - Summer internship placements for LEAP students
 - Fellowships for LEAP students
 - Data/projects for LEAP students
 - Support of LEAP, facilitating community & nonprofit access, etc.
- Exploring synergies with public, government and community groups
 - Climate & climate data science education
 - Facilitate equitable access to climate data & climate data science



	LEAP	Pangeo 🔅	
High ≪	Granularity of Knowledge Output of Relevance		Low
Raw datasets + tutorials	Aggregated data in exec-friendly format	Executive summaries of findings "translated" for a corporate & public sector audience	Research-informed tools for communication + design of initiatives
LEAP-CarbonPlan Data Platform			





We appreciate your feedback



