

Fragile Earth: AI for Climate Mitigation, Adaptation, and Environmental Justice

Naoki Abe
nabe@us.ibm.com
IBM Research

Kathleen Buckingham
kathleen@tentree.com
veritree

Bistra Dilkina
dilkina@usc.edu
University of Southern California

Emre Eftelioglu
efteli@gmail.com
Amazon Inc.

Auroop R. Ganguly
auroop@gmail.com
Northeastern University

James Hodson
hodson@ai4good.org
AI for Good Foundation

Ramakrishnan Kannan*
kannanr@ornl.gov
Oak Ridge National Laboratory

Rose Yu
roseyu@eng.ucsd.edu
U. C. San Diego

Abstract

The Fragile Earth Workshop is a recurring event that gathers the research community to find and explore how data science can measure and progress climate and social issues, following the framework of the United Nations Sustainable Development Goals (SDGs).

Fragile Earth 2022: AI for Climate Mitigation, Adaptation, and Environmental Justice is a workshop taking place as part of the ACM's KDD 2022 Conference on research in knowledge discovery and data mining and their applications. The dates for the Conference are August 14-18, 2022

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1 WORKSHOP TOPIC

Since 2016, the Fragile Earth Workshop has brought together the data science research community to explore opportunities for social and environmental progress in the framework of the United Nations Sustainable Development Goals (SDGs). Over the years, the Fragile Earth workshop has focused on SDGs. This year we also focus on

Environmental Justice, which in the scope of scientific research can be defined as the effort to “document and redress the disproportionate environmental burdens and benefits associated with social inequalities” [1], as well as SDG 13: Climate Action. In 2021, the Intergovernmental Panel on Climate Change (IPCC) released their report on a “physical science basis” stating that climate change was caused “unequivocally” by human action [3], while in 2022, they followed that up with their latest report on “Impacts, Adaptation, and Vulnerability” emphasizing that the time for action is now [4]. These reports, parts of the Sixth Assessment Report (AR6), provide new estimates of the chances of crossing global warming thresholds, discuss the urgent need for adaptation pathways, and find that unless there are immediate, rapid, and large-scale reductions in greenhouse gas emissions, limiting warming will be beyond reach. The ramifications of these climate scenarios are devastating for the planet. As we fail to reach mitigation and adaptation targets, we will witness the triggering of more frequent sweltering heat waves, stronger storms, higher floods, severe droughts, and drastic ecosystem shifts, with disastrous consequences for human lives, economies, and health, as well as biodiversity. Meanwhile, the UN’s Decade of Action for the SDGs will close. In our Fragile Earth Workshop, we invite ML and AI researchers, social and behavioral scientists, as well as natural scientists and engineers, to convene and discuss interdisciplinary solutions for progress towards the SDGs, Environmental Justice, and climate change mitigation and adaptation.

The Workshop will target both methodological and applied research agendas within these areas of investigation. The methodological agenda of interest include but are not limited to: the integration of physics into data-driven modeling; the use of machine learning to enhance physical simulations; model explainability, uncertainty quantification, privacy and fairness questions in environmental modeling; causal learning in the complex physical world as foundations for model trustworthiness; ML applications at low energy edge devices; frameworks for helping the scientific and KDD communities to work together; combining predictive and prescriptive tasks; and multi-agent systems for participatory modeling that integrate stakeholders into knowledge creation and decision processes. The application problems and agenda of interest include the Sustainable Development Goals, accelerating progress on the United

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Nations' 2030 agenda, envisioning solutions for climate mitigation and adaptation, and measuring and diminishing the inequitable benefits and burdens across socioeconomic groups. In particular, the workshop has maintained a strong focus and community in the following areas: food security, sustainable agricultural practices and supply chains, ecosystem restoration, water management, sustainable energy, climate action and adaptation, socioeconomic equality, and disaster resilience.

2 AUDIENCE

As the target audience, we have in mind the scientific community across Machine Learning, Data Mining, Knowledge Discovery, and Statistics, as well as key professional stakeholders, policymakers, agronomists, crop scientists, hydrologists, environmental scientists, climatologists, agricultural practitioners (farmers, cooperatives), industrial players (seed producers, equipment manufacturers, fertilizer producers, energy utility companies, water companies, consumer products manufacturers and retailers, insurance companies), and food, energy, and water and sustainability-related government agencies and policymakers in the public sector (e.g. UN, USGS, NASA, EPA). With a focus on Environmental Justice, we hope to also attract behavioral and social scientists and policymakers. The workshop will offer opportunities for in-depth discussion, sharing of methodology, and the release of new data/algorithmic resources.

The goals of this workshop (series) are three-fold: 1. To continue the conversation on the application of data science to sustainable development in the KDD community; 2. To inspire the KDD community to apply their research and capabilities to societal and environmental progress; 3. To apply new technologies, as well as leverage existing KDD technology where appropriate, to address the international crisis of climate change and its ramifications on society.

3 RELEVANCE

The Fragile Earth Workshop was one of three workshops associated with the planned Earth Day event at KDD 2019 (organized by our OC members, Shashi Shekhar and James Hodson), provided keynotes and panels for Earth Day in 2020, and has been a recurring workshop at the annual KDD conference for the past six years. We hope to continue this tradition in 2022. The workshop theme, as described below, is central to that of "Earth Day," envisioning a better world through the framework of appropriate resource allocation and innovation through Artificial Intelligence. The affiliated workshop series has had strong industry interest and endorsement, including from the Midwest Big Data Hub, Cargill, AI for Good Foundation, and Syngenta, and has taken place at KDD every year since 2016. The Fragile Earth workshop provides the KDD community with a touchpoint for stakeholders outside of the community, including scientists, technologists, and policymakers, as evidenced by a special issue on the topic of "Big Data for Food, Energy and Water" in the *Frontiers in Big Data* journal, based on a collection of previous workshop papers (<https://www.frontiersin.org/research-topics/8733/big-data-for-food-energy-and-water>).

4 MOTIVATION

Climate change has been a known issue to international leadership, such as the United Nation, for decades; however, it has proven exceedingly difficult to undergo the decisive, systemic changes necessary to slow and halt our march towards and past global warming of 1.5 degrees Celsius. Therefore, it has never been more necessary for the data science and innovative technologies communities to take up the helm, and provide as much research and insights as possible to make the necessary global changes feasible. Our workshop centers Environmental Justice because the decades have shown that the brunt of climate change is not felt equally across the globe. Already, global warming has increased worldwide economic inequality due to its disparate impacts on the Global south [2]. It is the responsibility of the research and data science community to not only think of the inequalities that are perpetuated as climate change worsens, but to actively seek out opportunities and risks associated with these effects as well. It is not enough to advance Climate Mitigation and Adaptation; we must center justice in the process.

5 Workshop Program Sketch

Fragile Earth 2022 is a full-day workshop with an approximate duration of 6 hours, consisting of the following agenda. (a) Two keynote talks for 30 minutes each. (b) twelve regular research paper presentations for 15 minutes each (c) a panel discussion for 60 minutes. We are in discussion with a journal for a special issue.

6 PROGRAM COMMITTEE MEMBERS

The program committee consisted of the members of the workshop organizers (Naoki Abe, Kathleen Buckingham, Bistra Dilkina, Emre Eftelioglu, Auroop R. Ganguly, James Hodson, Ramakrishnan Kannan, Rose Yu) as well as additional reviewers: Dongxia Wu, Salva Ruhling Cachay and Rui Wang (UC San Diego). Workshop Coordinator: Lindsey Asis (AI for Good Foundation).

7 STEERING COMMITTEE MEMBERS

Vipin Kumar (U. Minnesota), Thomas E. Potok (ORNL), Shashi Shekhar (U. Minnesota), Raju Vatsavai (NCSU), Angel Hsu (Yale U.), Arindam Banerjee (U. Minnesota), Marta Gonzalez (U.C.Berkeley), Peder Olsen (Microsoft Research).

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