

Fragile Earth: AI for Climate Sustainability - from Wildfire Disaster Management to Public Health and Beyond

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ABSTRACT

The Fragile Earth Workshop is a recurring event in ACM's KDD Conference on research in knowledge discovery and data mining that gathers the research community to find and explore how data science can measure and progress climate and social issues, following the United Nations Sustainable Development Goals (SDGs) framework.

ACM Reference Format:

Naoki Abe, Kathleen Buckingham, Yuzhou Chen, Bistra Dilkina, Emre Eftelioglu, Auroop R. Ganguly, Yulia R. Gel, James Hodson, Ramakrishnan Kannan, Kyo Lee, Jiafu Mao, and Rose Yu. 2023. Fragile Earth: AI for Climate Sustainability - from Wildfire Disaster Management to Public Health and Beyond. In *Proceedings of the 29th ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD '23)*, August 6–10, 2023, Long Beach, CA, USA. ACM, New York, NY, USA, 2 pages. <https://doi.org/10.1145/3580305.3599217>

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 United Nations Sustainable Development Goals (SDGs) framework. This year we address a wide spectrum of agenda on climate sustainability and planetary health, ranging from wildfire disaster management to public

health and beyond. In 2021, the Intergovernmental Panel on Climate Change (IPCC) released its report on a “physical science basis” stating that climate change was caused “unequivocally” by human action [2], while in 2022, they followed that up with their latest report on “Impacts, Adaptation, and Vulnerability” emphasizing that the time for action is now [3]. 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, planetary health recognizes that human health and civilization depend on natural systems, which unfortunately have been degraded to an unprecedented extent in human history. Specifically, wildfires are now posing one of the major natural hazards in the United States (especially, California, Oregon, and Washington), Canada, Australia, and Mediterranean countries, further sweeping across the developing countries in Africa and resulting in major property damages and human life losses. The magnitude and severity of wildfires tend to increase dramatically due to climate change. For instance, the United National Environment Programme (UNEP) noted, a 50% global increase in wildfires is expected by 2100. Developing early warning mechanisms and more efficient strategies to extinguish the fires are the key to mitigating wildfire risks, boosting preparedness against uncontrollable fires, saving human lives, and preventing major economic, ecological and social damages. In the

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KDD '23, August 6–10, 2023, Long Beach, CA, USA.

Fragile Earth Workshop, we invite ML and AI researchers, social and behavioral scientists, natural scientists, and engineers to convene and discuss interdisciplinary solutions for progress toward the SDGs, from Wildfire Disaster Management to Public Health and beyond.

The Workshop will target both methodological and applied research agenda 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 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, wildfire, public health, 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), health care providers and public health practitioners.

The goals of this workshop (series) are three-fold: 1. To continue the conversation on applying 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 and leverage existing KDD technology where appropriate to address the international climate change crisis and its ramifications on society such as wildfire and public health.

3 RELEVANCE

The Fragile Earth Workshop was one of three workshops associated with the 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. The workshop theme is central to the “Environment Day” at KDD 2023,

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 the community, including scientists, technologists, and policymakers. Papers from the workshop have also been invited and included in multiple journal special issues, including most recently the Environmental Data Science journal.

4 MOTIVATION

Climate change has been a known issue to international leadership, such as the United Nations, 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 on AI for Climate sustainability because the decades have shown that the brunt of climate change is not felt equally across the globe. Global warming has increased worldwide economic inequality due to its disparate impacts on the Global South [1]. It is the responsibility of the research and data science community to not only think of the inequalities perpetuated as climate change worsens, but to actively seek out opportunities and risks associated with these effects. It is not enough to advance Climate Mitigation and Adaptation.

5 WORKSHOP PROGRAM SKETCH

Fragile Earth 2023 is a full-day workshop consisting of the following agenda.

- 3 Keynote talks
- Panel discussion on wildfire mitigation
- Poster session
- 3 regular research paper presentation sessions

6 PROGRAM COMMITTEE MEMBERS

The program committee consists of the members of the workshop organizers (Naoki Abe, Kathleen Buckingham, Yuzhou Chen, Bistra Dilikina, Emre Eftelioglu, Auroop R. Ganguly, Yulia R. Gel, James Hodson, Ramakrishnan Kannan, Kyo Lee, Jiafu Mao, Rose Yu) as well as additional invitees.

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