Abstract

Bioethanol crops have the potential to meet future energy demands and mitigate climate change by partially replacing fossil fuels. However, the large-scale cultivation of these crops may also impact climate change through changes in terrestrial water and energy balances, carbon and other nutrient dynamics, and their interactions. This represents a pivotal challenge within the Food-Energy-Water System (FEWS) nexus. Our study estimates potential bioethanol yield across the US based on crop field studies and conversion technology analyses for three crops, corn, Miscanthus, and two switchgrass cultivars (Cave-in-Rock and Alamo). This presentation will provide a detailed analysis of the implications of expanding bioethanol crops for water and energy resources, as well as GHG emissions. Additionally, the presentation will examine how the increasing severity of extreme climate events, including droughts and heat waves, is shaping these critical factors. While the results are presented for the United States, the analytical framework linking bioenergy production with land, water, and climate interactions can be applied to other regions, including emerging bioenergy systems in India and other parts of the Global South.

Speaker Bio: Dr. Atul K. Jain

Throughout his distinguished career, Prof. Jain excelled as a global leader in comprehensively understanding and quantitatively modeling the bidirectional interactions of human activity with the global climate system. His research accomplishments are pioneering in the development and application of climate modeling systems essential to understanding and predicting the future of our planet. Prof. Jain’s ongoing work aligns precisely with the efforts needed to address the drastic changes humans are causing to our planet, offering hope for successful adaptation and mitigation.

Given these accomplishments and his standing as a Fellow of the American Association for the Advancement of Science (AAAS) and the American Geophysical Union (AGU), it is no surprise that Prof. Jain is known and recognized for his contributions and leadership to national and international assessments of climate change, such as the UN IPCC. In 2021, Reuters listed him as one of the “World’s Top Climate Scientists. In 2025, Prof. Jain was named to the annual Clarivate Analytics Highly Cited Researchers list for the fifth consecutive year, recognizing individuals whose research has been exceptionally influential. He received the Distinguished Alumni Award from IIT Delhi in 2024.

Professor Atul Jain received his Ph.D. (1988) in Atmospheric Sciences from IIT Delhi. He is currently a Professor in the Department of Climate, Meteorology, and Atmospheric Sciences at the University of Illinois, Urbana-Champaign, USA. Earlier, he worked at the University of Muenster, Germany, and at Lawrence Livermore National Laboratory in California, USA.