Microsoft

AI for Earth Grantee Profile

Natural Capital Project

Detecting and mapping dams and reservoirs

Summary

A team of researchers at the Natural Capital Project, based at Stanford University, is combining remote sensing data with machine learning to develop a model that can detect smaller dams and reservoirs. Knowing where the dams and reservoirs are located will contribute to mitigating their impact, to conserving and managing hydrological ecosystem services, and to planning development more sustainably.

Detecting and mapping small dams and reservoirs

Around the globe, millions of dams and reservoirs play a vital role in providing drinking water or supporting hydropower generation. Together, they can have a significant impact on the surrounding environment, such as on freshwater biodiversity. Without careful management of watershed ecosystem services, their intended functions can degrade over time. For example, deforestation and poor farming practices often lead to soil erosion, causing reservoirs to silt up and therefore minimize their capacity.

> Millions of dams and reservoirs around the world deliver drinking water and hydropower generation, but if not built and managed thoughtfully, they can pose risks to the environment.

One of the big challenges to understanding the impact of dams and reservoirs is that only the largest have been systematically mapped. In many countries, no accessible central inventory exists. A team at Stanford University's Natural Capital Project—Gretchen Daily (co-founder and faculty director of the Natural Capital Project), Lisa Mandle (lead scientist), Richard Sharp (software architect), and Charlotte Weil (data scientist)—want to fill this void. Knowing where the dams and reservoirs are located is the first step in being able to quantify their impact and dependence on nature, thereby guiding investments in green growth that benefit both people and the environment. It's about understanding how to minimize dams' impacts and secure vital watershed ecosystem services.

The team is combining remote sensing data with machine learning to develop a model that can detect smaller dams and reservoirs. To do this, they will locate thousands of already-mapped dams on high-resolution satellite images using the dams' coordinates. Then, they'll use machine learning to project where other dams are located based on shared characteristics in the satellite imagery. With hundreds of thousands of images to analyze, the team will use Azure resources made available through an AI for Earth and National Geographic grant for both data storage and processing power.

> Knowing where the dams and reservoirs are located will contribute to mitigating their impact, to conserving and managing hydrological ecosystem services, and to planning development more sustainably.

The result will be an open-source algorithm for detecting dams and reservoirs, as well as sample results—all made freely available to the broader conservation and sustainable development community. The algorithm will work both in new geographies and for repeat analyses over time to identify where new reservoirs are constructed. As team member Mandle explains, "Our results will contribute to efforts by researchers, non-governmental organizations, and governments to understand and mitigate the impacts of dams, to conserving and managing hydrological ecosystem services, and to sustainable development planning."

About the Natural Capital Project team

Gretchen C. Daily is the Bing Professor of Environmental Science at Stanford University, where she also serves as Senior Fellow in the Stanford Woods Institute for the Environment; Director of the Center for Conservation Biology; and co-founder and faculty director of the Natural Capital Project. An ecologist by training, Daily's research spans a range of topics that involve harmonizing people and nature: biodiversity dynamics and conservation, land use and agriculture, and livelihoods; the production and value of ecosystem support for human health, prosperity, and overall well-being; and policy and finance innovation for integrating conservation and human development. Daily has published hundreds of scientific and popular articles. Her books include *Nature's Services: Societal Dependence on Natural Ecosystems*, *The New Economy of Nature: The Quest to Make Conservation Profitable*, and *Natural Capital: Theory and Practice of Mapping Ecosystem Services*, among others. She is a fellow of the US National Academy of Sciences, the American Academy of Arts and Sciences, and the American Philosophical Society. Daily serves on the boards of The Nature Conservancy and the California Academy of Sciences. She has won numerous international honors for her work, including the Blue Planet Prize in 2017.

Lisa Mandle is a lead scientist with the Natural Capital Project. Her research aims to understand the impacts of infrastructure and land management on ecosystem service benefits to people. She works with governments, multi-lateral development banks, and non-governmental organizations to incorporate this information into development decisions, with a focus on Latin America and Asia. She led development of a decision-support software tool for biodiversity and ecosystem service offsets in Colombia, and guidance for the Inter-American Development Bank on integrating natural capital into road planning and investment. With training in ecology, anthropology, and conservation biology, she holds a PhD in botany from the University of Hawaii at Manoa.

Rich Sharp is the Natural Capital Project's software architect, where he leads software development projects that support ecosystem service assessment and planning. Previously he was an assistant professor of computer science at St. Lawrence University, and earned his PhD in computer science from Ohio State University. His research interests include developing computational software for natural science applications, high performance computing applications, cloud computing, and scientific visualization.

Charlotte Weil is a data scientist at the Natural Capital Project, modeling food resilience and developing interactive visualization tools to improve sustainable decision-making. She is passionate about building efficient and meaningful solutions to drive social and environmental transformation. An environmental engineer by training, she holds a Master of Science degree with distinction of academic excellence from the Swiss Institute of Technology in Lausanne, Switzerland.

Resources

Websites

AI for Earth

Press

Microsoft and National Geographic Society announce AI for Earth Innovation grantees