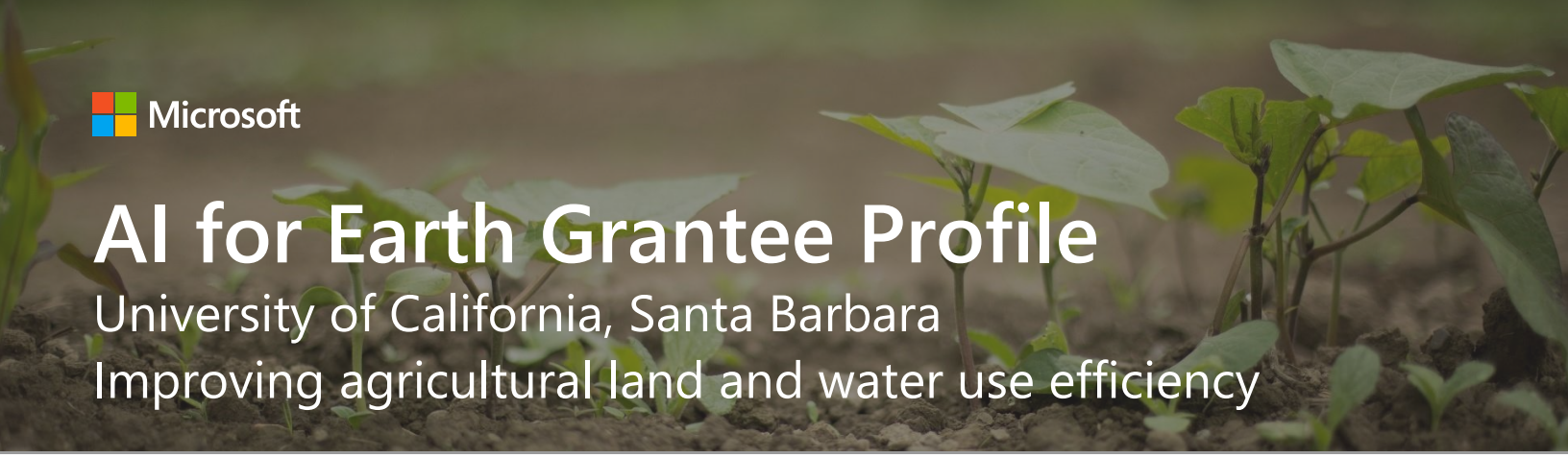

Microsoft

AI for Earth Grantee Profile

University of California, Santa Barbara

Improving agricultural land and water use efficiency

Summary

An increase in center-pivot irrigation is straining groundwater resources and disrupting ecosystems, and too many wells already exist to effectively measure their water usage individually with sensors. Professor Kelly Caylor at the University of California, Santa Barbara devised a different method of monitoring, by applying machine learning and analysis to satellite imagery to identify and measure changes in field use, weather, and crop growth over time. With that information, water usage can also be estimated, and policies for more efficient agricultural land and water use can be implemented.

Improving agricultural water use efficiency with AI

As climate change disrupts weather patterns, rainfall is becoming more unreliable. Farmers are turning to more groundwater sources, and drilling wells for center-pivot irrigation—a method of crop irrigation where equipment rotates around a pivot and crops are watered with sprinklers—is becoming more common. However, the environmental impact is significant: lowered or even drained water tables, salination of coastal aquifers, land subsidence, and disruption to ecosystems.

> The environmental impact of center-pivot irrigation is significant: lowered or drained water tables, salination of aquifers, subsidence, and disruption to ecosystems.

Kelly Caylor, a professor of ecohydrology at the University of California, Santa Barbara, is hoping to shed light on how water is being used from these groundwater sources and how it can be used more efficiently. It'd be practically impossible to deploy sensors across all the wells to measure. However, Caylor realized a better way is available: simply monitoring crop growth through high-resolution satellite imagery.

Mapping land and water use with machine learning

Caylor is developing an online map of the expanding use of agricultural center-pivot irrigation (and water) globally from the mid-1980s to present. The map uses machine learning to identify active crop fields in satellite

imagery, and geospatial analysis tools to monitor how they change over time. Knowing where and how long the crops are growing, and correlating that to weather data, the system can also infer how much water is being used. The open-source nature of the project will allow researchers to apply pre-trained models to identify center-pivots, train their own models to identify land change, and conduct their own regional analysis of surface and groundwater use and climate change.

> "Farmers, water resource managers, policy makers, and the public will have access to intelligence to inform more land- and water-efficient agriculture globally."

With a better understanding of how much groundwater is being used by center-pivot irrigation will come opportunities to develop more optimal and efficient uses of water and also policies for better water stewardship. As Caylor explains, the online map and tools will appeal to a wide audience: "Farmers, water resource managers, policy makers, and the public will have access to intelligence to inform more land- and water-efficient agriculture globally."

About Kelly Caylor

Professor Kelly Caylor is the Director of the Earth Research Institute and Professor of Ecohydrology in the Department of Geography and the Bren School of Environmental Science and Management at the University of California, Santa Barbara. He attended the University of Virginia, where he received both a BA and a PhD in Environmental Sciences. Caylor's research seeks to develop improved insight into the way that land use and climate change are interacting to affect the dynamics and resilience of global drylands. His primary research sites are in sub-Saharan Africa, where he is focused on understanding the vulnerability of pastoral and subsistence agricultural communities to current and future changes in hydrological dynamics.

Kelly Caylor, director of the Earth Research Institute and professor of Ecohydrology in the Department of Geography and the Bren School of Environmental Science and Management at the University of California, Santa Barbara. [Photo courtesy of Kelly Caylor]

His teaching experience and interests include field courses in Kenya, earth system sciences, environmental biophysics,

and environmental sensing and sensor development. He is a co-founder of Arable Labs, Inc., a company focused on enhancing agricultural decision making and improving in-field data availability for agriculture. Caylor conducts research at a number of spatial and temporal scales; from small-scale experiments during individual rainfall events to continental-scale analyses of climate trends. A major focus of his research is the development of new methods to improve the measurement and prediction of water use and water efficiency in both natural and agricultural landscapes.

Caylor has served on the editorial board of Water Resources Research, the Journal of Geophysical Research—Biogeosciences, Vadose Zone Journal, and Environmental Research Reviews, Environmental Research Letters. He was a recipient of an Early Career Award from the NSF, and was the inaugural recipient of Early Career Award in Hydrological Sciences given by the American Geophysical Union (AGU).

Resources

Press

Microsoft and National Geographic Society announce AI for Earth Innovation grantees
On World Water Day, Microsoft is delivering new approaches to ensure we leave no one behind