Microsoft

AI for Earth Grantee Profile

DHI GRAS

Irrigation efficiency in Uganda

Summary

At DHI GRAS, Dr. Torsten Bondo and Dr. Radoslaw Guzinski—a small Denmark-based company focused on Earth observation and satellite imaging—are using machine learning and satellite remote sensing to measure the rate of water evaporation from soil and plant surfaces into the atmosphere from fields. Their goal is to help Ugandan farmers reduce water use by knowing more precisely how much water their crops really need.

Improving crop water efficiency in Uganda

Water shortages and drought conditions are on the increase around the globe—challenging farmers who depend on water to irrigate crops. Agriculture uses 70 percent of the world's available freshwater, though in Africa that percentage is around 80 percent. And yet, according to the United Nations, 75 to 250 million people in Africa will live in regions experiencing high levels of water stress by 2030.

> As much as 60 percent of water withdrawn for irrigation is wasted.

Facing water restrictions and community scrutiny, farmers need to make sure that they don't waste a single drop. On the flip side, however, irrigated crops are nearly twice as productive as non-irrigated crops. With the global population predicted to reach over 10 billion by 2050, the world will need to increase agricultural production by an estimated 70 percent in the same timeframe. Farmers face a conundrum—they are under increasing pressure to reduce water withdrawals for irrigation, and yet they need to increase crop yields, which will almost certainly require irrigation.

Part of the answer lies in boosting irrigation efficiency. The UN Food and Agriculture Organization estimates that as much as 60 percent of water withdrawn for irrigation is wasted, through runoff or evapotranspiration (water that evaporates from the soil and plant surfaces into the atmosphere). Reducing these losses will help both reduce the impact of agriculture on freshwater sources and boost agricultural productivity.

One key to irrigation efficiency is knowing how much water crops really need—something that can be determined by measuring the evapotranspiration (or ET) rate. Without knowing the ET rate, farmers are most likely watering too much or not enough. But how can they measure it?

Measuring evapotranspiration using machine learning and satellite imagery

That very question is inspiring Dr. Torsten Bondo and Dr. Radoslaw Guzinski in their work at DHI GRAS, a small Denmark-based company focused on Earth observation and satellite imaging. The two are exploring how they can help farmers determine the right amount of water to use to effectively irrigate crops. Their goal is to generate field-level ET measurements using machine learning and satellite imagery. Their focus is in Uganda, where water is becoming scarce due to the soaring population and climate change. They are collaborating with Geo Gecko, a geo-intelligence company in East Africa, to provide water-reducing advice for a large Ugandan irrigation scheme in the Mubuku, Kasese district.

> Measuring field-level evapotranspiration rates could reduce water use by up to 30 percent.

Specifically, they are developing an open-source algorithm that will merge data from three sources to measure the ET rate for individual fields: optical satellite images, with full global coverage every five days, pulled from the Sentinel 2 satellites run by the Copernicus program in the European Union; thermal satellite data showing land surface temperatures daily; and meteorological data, such as wind speeds and air temperatures. The challenge that they face is that although the optical satellite data is available at the field level (10 to 20 meters), the thermal data is only available to a scale of 1 kilometer, which is insufficient for field-level analysis. They plan to use machine learning models to fuse the optical and thermal data and produce ET data maps for individual fields.

Working with such huge volumes of satellite data will be computationally intensive. The AI for Earth Innovation Grant from Microsoft and the National Geographic Society will enable them to use Microsoft Azure as the main platform from start to finish—including storing and processing the field data used for validation, storing and processing the input satellite data, and storing the outputs.

Reducing irrigation water requirements in drought-prone regions globally

The team predicts that this novel technique could reduce water use by up to 30 percent for the same yield within the district. They view the collaboration between Microsoft and National Geographic—and the combined reach of the organizations—as a significant opportunity that will help make their technique mainstream. Ultimately, they want it to become widely known, hoping it will pave the way for better irrigation practices in other drought-prone areas around the globe (for example, countries such as Denmark, parts of the United States, and Australia) and help save water for generations to come.

About the team

Dr. Torsten Bondo and Dr. Radoslaw (Rado) Guzinski work together at DHI GRAS, where Dr. Bondo is a business development manager and senior remote sensing engineer.

Dr. Bondo's lifelong interest in science and space led him to work with applications of satellite images in agriculture, forestry, urban, and marine environments. Since June 2018, he has served as one of 14 members of the Danish National Space Committee. From 2015–2017, Dr. Bondo was a co-founder of Sensonomic, a company using modelling of satellite images and *in situ* data to develop services for the private agricultural sector. He has also worked in the European Space Agency (ESA)'s industry section, as well as at Rambøll, DTU Space, Copenhagen University, and Ticra.

With a background in computer science and engineering and a passion for environmental topics, maps, and geography, Dr. Guzinski earned his PhD in 2014 for research into the monitoring of plant water use based on satellite observations. He has extended this research to include the help of physical and machine learning models in his work at DHI GRAS as well as during a two-year research fellowship with the ESA.

Resources

Website

AI for Earth

Publications

Guzinski, R., & Nieto, H. (2019). Evaluating the feasibility of using Sentinel-2 and Sentinel-3 satellites for high-resolution evapotranspiration estimations. Remote Sensing of Environment, 221, 157–172. https://doi.org/10.1016/j.rse.2018.11.019

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Press

Microsoft and National Geographic Society announce AI for Earth Innovation grantee

Documentation

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