Microsoft

AI for Earth Grantee Profile
Joseph Cook
Gaining a better understanding of Earth's melting glaciers

Summary

Joseph Cook, a polar scientist from the United Kingdom (UK), is applying machine learning to optical data from drones and satellites to explore the changing cryosphere of Arctic glaciers. By training the algorithms to recognize how the different surfaces reflect certain wavelengths of light—wavelengths that can be measured by satellites as well as by drones—precision study of vast areas becomes feasible. After testing the algorithms on imagery from custom-built drones, Cook's team will then apply them to satellite remote-sensing data, enabling them to scale up to entire glaciers.

Gaining a better understanding of Earth's melting glaciers

Melting glaciers provide some of the clearest visual evidence of the Earth's warming temperatures. Measuring this change is likely to provide important information about the pace and magnitude of climate change. Unfortunately, this is not straightforward because there are complex feedbacks occurring on the ice surface that control how quickly melting occurs. Today these processes are only understood relatively crudely, making it tricky to measure glacier surface change and melt rates, never mind project those changes into the future.

That's something that polar scientist Joseph Cook hopes to change. From a young age, Cook's love of rock climbing and mountaineering stirred a passion for understanding wild landscapes and led his scientific interests toward extreme environments. In the last decade, he has conducted more than 13 Arctic field expeditions, mostly in field camps on the Greenland ice sheet, and pumped out findings and research insights in scientific journals, documentaries, and conferences around the globe.

The tool that gives him hope is machine learning—specifically, applying it to optical data from drones and satellites to explore the changing cryosphere. With the funding through AI for Earth and National Geographic, Cook will generate an important new dataset and algorithms that will produce high-resolution mapping of ice surfaces. The key is capturing the complexity of ice surface evolution, from pristine snow to dust-covered, algae-covered, and waterlogged ice. By training the algorithms to recognize how the different surfaces reflect certain wavelengths of light—wavelengths that can be measured by particular satellites as well as by drones—precision study of vast areas becomes feasible. After testing the algorithms on imagery from custom-built

drones, Cook's team will then apply them to satellite remote sensing data, enabling them to scale up to entire glaciers.

Cook is making use of a Microsoft Azure virtual machine to analyze images of the Greenland Ice Sheet from the European Space Agency's Sentinel-2 satellite, including masking out non-ice areas, classifying the ice surface and visualizing and reporting spatial statistics. The next step is to scale over time as well as space to analyze temporal trends and then start applying the workflow to mountain glaciers and well as the major ice sheets. Cook is also planning the logistics for field work in July 2019 to collect training data from the ice surface using drones.

Joseph Cook, polar scientist from the United Kingdom. [Photo courtesy of Joseph Cook]

Recently, Cook has presented some of his work at the National Geographic Explorer Festival in London and also has related papers currently under review. He has been writing about his experiences onboarding with Azure on his personal website (http://tothepoles.wordpress.com). Of those experiences, Cook says, "I'm pleased to report that the coding aspects of the project have advanced quite a lot faster than I anticipated.... the support from the Microsoft team has been amazing and I am feeling incredibly privileged to be involved in this."

Ultimately, Cook hopes to provide the polar science community with a powerful new open-source tool and training data for understanding Earth's melting glaciers, and through educational resources to inspire school

students into computer science and environmental science as well. With deeper knowledge, broader scientific investigation, and further public interest, we can better protect the ice that's fundamental to preserving our climate.

About Joseph Cook

Joseph Cook is a polar scientist best known for his work on biological feedbacks on glaciers and ice sheets. In the past few years, his interests have widened to include application of machine learning technology to optical data from drones and satellites for exploring the changing cryosphere. In 2016, he became a researcher on the UK National Environmental Research Council's "Black and Bloom" project that aims to quantify the role of biological growth in accelerating the melting of the Greenland ice sheet. Also in 2016, he received a prestigious Rolex Award for Enterprise and used the support to produce a documentary about the melting Greenland ice sheet. Building on this, in 2018 he founded a polar science communication organization called "Ice Alive" whose mission is to use a range of media and a diverse community of affiliates to bring cutting-edge polar science to a global audience. In 2018, he became a World Frontiers Forum Global Pioneer and a National Geographic Explorer and began working on his AI for Earth project.

Resources

Websites
[To the Poles](#)—Cook's blog

Press
[Microsoft and National Geographic Society announce AI for Earth Innovation grantees](#)