Drones a Vital Tool in Climate Change Research

Drones are playing a crucial role in vital work to better understand the effects of climate change in the Arctic. Dr Joseph Cook, a glaciologist at the University of Sheffield, is conducting major research projects in Greenland, exploring the impact of global warming on glacier and ice-sheet dynamics. To help these studies, Dr Cook and his team are harnessing the power of drones, including a DJI Mavic Pro.

As part of these investigations, Dr Cook has turned to UAV expert Heliguy for equipment and industry advice. Heliguy recently interviewed Dr Cook to find out more about his work in the Arctic and to learn about how drones are playing an important role in the research.

Exploration at the End of the Earth

Dr Cook, 32, has been working on the general theme of melting glaciers since 2005. He has mostly worked from on-ice camps on the Greenland Ice Sheet, but his research has also taken him to Svalbard, north of Iceland, and he will soon be heading south to Antarctica.

He has published 30 scientific papers and his work is currently supported by Rolex, Microsoft, National Geographic and the UK National Environmental Research Council. He also runs a polar science organization called Ice Alive. Dr Cook is currently working on a number of different projects, all of which use drone mapping to some extent. The most relevant is the Microsoft/National Geographic AI for Earth project; which puts Microsoft cloud and AI tools in the hands of those working to solve global environmental challenges and build a sustainable future.

“This project runs until early 2020 and aims to use drones to gather training data that can be used to train AI tools to map glaciers from space using satellite imagery. The AI for Earth grant will help us to understand glacier and ice-sheet dynamics in a warming world. My idea is to use a form of machine learning known as supervised classification to map ice surfaces from drone images and then at the scale of entire glaciers and ice sheets using multi-spectral data from the European Space Agency’s Sentinel-2 satellite.” said Dr Cook.

“Over a billion people rely directly upon glacier-fed water for drinking, washing, farming or hydropower. The sea-level rise resulting from the melting of glaciers and ice sheets is one of the primary species level existential risks we face as humans in the 21st century, threatening lives, homes, infrastructures, economies, jobs, cultures and traditions. The major contributing factors to a sea-level rise are thermal expansion of the oceans and melting of glaciers and ice sheets, which in turn is primarily controlled by the ice albedo, or reflectivity. However, our understanding of this is still fairly basic and our ability to observe the ice surface changing over time is limited, which in turn limits our ability to make better predictions. I hope to contribute to tackling this problem with AI for Earth.” added Dr Cook.

Harnessing the Power of Drones

“My basic science set-up is a small quadcopter – a modified Steadidrone Mavrik M – controlled using a Taranix XD9 radio controller and fitted with a multispectral camera. The landing gear has been swapped out for some skis to help the drone land safely on snow or uneven ice. At the same time, I usually also carry a DJI Mavic Pro for popping up high to select field sites, survey the surroundings or even check for polar bears. It is also extremely useful for gathering film footage for presentations, and wherever I need RGB images and footage instead of multispectral data.” said Dr Cook.

Explaining some of the science behind his work, and how drones can contribute, he continued “I am using drones to help understand how glaciers and ice sheets melt. Melting ice is much more complicated than it seems – there is no simple relationship between temperature and melt rate for glaciers and ice sheets because melting is accelerated by a suite of amplifying feedbacks. One such feedback is the darkening of the glacier due to contaminants. The darker the ice becomes, the more solar energy it can absorb and the faster it melts. Recently, we have discovered that melting causing algae to grow on the ice surface, which in turn darkens the ice and causes more melting, causing more growth. I’m working on ways to map these feedbacks using drones and satellite data so we can make better predictions about how glaciers will melt in a warmer world.”

As well as capturing vital information from above, drones help to cover large expanses of land – with the Greenland ice sheet almost the same size as Mexico. Drones allow greater stretches to be mapped, over and above what is achievable on foot. After all, there is a limit to how much can be discovered from the ground.

Dr Cook added “The drone effectively adds a dimension to what we are doing. It is not just a point on the ground anymore. We can fly back and forth above a grid on the ice sheet and create pictures in different wavelengths of light that show where life is. If we only had the ground measurements, we would lack understanding of how the ice changes over space and time, and if we only had the satellite data, we would lack detail of the processes operating at the surface. The drones allow us to combine these two data sources as they can make measurements at centimetre scale resolution but cover hundreds of metres, meaning they can be used to check the satellites are really

seeing what we think they are, and also to upscale manual measurements over large spaces."

Cinematic Shots for Educational Video

As part of the work, Dr Cook has helped to produce a 20-minute feature video, called Ice Alive. Working in collaboration with Rolex Awards for Enterprise and Proudfoot Media, the educational piece showcases the latest research into the surprising hidden biology shaping the Earth's ice.

With the aim of creating a piece of content which was engaging for the public, as well as school and university students, Dr Cook said that the team went to great lengths to make a visually striking feature. To help with this, the crew used the cinematic capabilities of the DJI Mavic Pro, proving that drones can be used as a quality photographic tool, as well as for data collection.

Dr Cook said "The Mavic Pro was used to shoot the stunning aerial shots in the video, including tracking the team's science drone in the air to get the mesmerising shots looking down on the science drone in flight. The story is told by young UK Arctic scientists with contributions from guests including astronaut Chris Hadfield and biologist Jim Al-Khalili. We went to great lengths to make this a visually striking film that we hope is a pleasure to watch and communicates the otherworldly beauty and incredible complexity of the Arctic glacial landscape. We aim to educate, entertain and inspire others into exploring and protecting this most sensitive part of our planet in their own ways."

Flying in Harsh Environments

Drone technology has advanced at a rapid rate, allowing pilots to fly in increasingly challenging conditions. Several DJI drones have self-heating batteries for example, while some UAVs can stay airborne in temperatures below freezing. This was beneficial for Dr Cook and his team. But, when it comes to harsh environments, there aren't many which are more severe than the Arctic. With this in mind, how does Dr Cook plan his missions and what does he need to consider before taking to the skies above Greenland?

"Temperature is an obvious one – it is more difficult to fly in gloves and I have to be careful not to stand still flying for too long at a time. It is also a challenge to maintain a safe operating temperature for the LiPos used to power the drones. The battery life is shorter in the cold, so flight plans are adjusted accordingly. On glaciers, there is usually a katabatic wind (wind flowing downslope) that can be mild or very strong, so closely monitoring the local wind speed is important. At the same time, icing on the props, airframe and components can be a real issue, so I keep a close eye on the temperature and humidity at the field site and err on the side of caution. Finally, it is quite common to have no internet access, so I simply have to plan missions with waypoints in text documents and ensure all my firmware is up to date before leaving home!" said Dr Cook.

So, challenges do persist, but when the drone is in action, it is proving to be a vital tool for understanding this complex Arctic habitat and the impacts of global warming; an extremely important topic with future implications.

You can follow Dr Cook's work on the Ice Alive website or on Twitter/Instagram via @tothepoles.

This article was written by Heliguy.

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https://www.gim-international.com/content/article/drones-a-vital-tool-in-climate-change-research