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Monitoring Glaciers with Drones

Global warming is a problem that is affecting the world in many different ways. One specific way is the effects on glaciers and ice sheets. The glaciers and ice sheets are melting at a fast rate. Scientists and glaciologists are now using drones to monitor the glaciers and ice sheets melting progress. The drones are being used all over the world in places like Greenland, Iceland, Peru, and the Himalayas to monitor the ice caps and glaciers for melting. These drones are specially equipped to fly in these areas and use high-definition cameras. There have been various glaciologists who have used the drones.

One such person is Dr. Joseph Cook, a glaciologist, who has used drones to study the effects of climate change in the Arctic. He is exploring the impact of global warming on glacier and ice sheets dynamics. He has a fleet of drones he uses to monitor the ice melt and check for polar bears in the area. The drones enable him to access difficult to reach areas, to cover large swaths of land, and to provide accurate results. He has mostly worked on ice caps in Greenland and Iceland and will be heading south to Antarctica (Willoughby, 2020).

Dr. Cook aims to use drones to gather training data which can be used to train artificial intelligence (AI) tools to map glaciers from space using satellite imagery. He also uses the drone for mapping the glaciers and ice sheets to understand their dynamics in a warming world. The focus is on climate change and the drone is an essential part of the field kit. He uses Microsoft/National Geographic AI for Earth project which uses Microsoft Cloud and AI tools to solve global environmental challenges and to build a sustainable future. Dr. Cook maps the ice surfaces from drone images and then combines them to the scale of entire glaciers and ice sheets

using multi-spectral data from the European Space Agency's Sentinel-2 satellite (Willoughby, 2020).

This is all-important because Dr. Cook says that the Earth is heating up and that is a problem for places with ice. Over one billion people rely directly upon glacier-fed water for drinking, washing, farming, and hydropower. As the glaciers melt, the sea levels rise threatening lives, homes, infrastructures, economies, jobs, cultures, and traditions. Melting glaciers and thermal expansion of oceans are major contributing factors to sea-level rise (Willoughby, 2020).

Drone use in these areas is not easy. The drones must be set up properly. Dr. Cook uses a small quadcopter, a modified Steadidrone Mavrik M controlled with a Taranix XD9 radio controller. It has a multispectral camera and landing gear is changed to skis to land safely on snow and uneven ice. He also uses the DJI Mavic Pro for flying high to select field sites, survey surroundings, and to check for polar bears (Willoughby, 2020).

Dr. Cook is using drones to understand better how glaciers and ice sheets melt which is more complicated than it seems. There is no simple relation between temperature and melt rate. The darkening of a glacier can accelerate the melting because more solar energy can be absorbed. It was discovered that the melting of a glacier causes algae, which darkens the ice, which causes more melting, which causes more algae. The map feedback using drones and satellite data can make better predictions of melting ice (Willoughby, 2020).

Drones can cover larger expanses of land. The Greenland ice sheet is the size of Mexico. The drone can map greater stretches than they can cover on foot and is less dangerous. The drones can add dimensions to what they are seeing. They fly back and forth above grids and create pictures in different wavelengths of light that shows where life is. The drones provide bridges between measurements of the scientists on the ground and the measurements made by

satellites. With only ground measurement, there is a lack of understanding of how the ice changes over space and time. With only satellite images, there is a lack of detail of processes operating at the surface. The drone combines the two to get a better picture of the process. The drone can also capture cinematic shots for educational videos (Willoughby,2020). The drone makes getting imagery of glacial changes safe and reliable. It can also watch Greenland's ice sheets fracture in real-time (How Scientists Are Using Drone Technology to Monitor Ice Caps).

Flying in the harsh environment of the Arctic can be difficult. Advanced technology has made this possible with self-heating batteries and drones can stay airborne in below-freezing temperatures. There are some problems and plans are adjusted as needed. Battery life is shorter, and one may need to fly with gloves on and not stand still for long periods. Internet access is a problem in these remote areas, so firmware needs to be up to date and need waypoints in text documents. The pre-flight prep must be thorough (Willoughby, 2020). Harsh weather and dangerous condition prevent scientists from regularly studying and generating quality results. The satellites are not precise, and planes are too expensive (How Scientists Are Using Drone Technology to Monitor Ice Caps).

The drones are being used in the Peruvian Andes. The drones are used at high altitudes of 5000 meters above sea level to monitor and map glaciers in the Andes. The glacier melt from the Andes provides 50% of the water during the dry season. The drones are fitted with time-lapse thermal cameras to capture footage of the glaciers. This footage is used to make decisions about local water management. The drones overcome difficult terrain, cloud cover, and thin air to get this footage (Gaskell, 2016).

The drones used in the Andes can record images to a resolution of 10 centimeters and only cost a few thousand dollars. Thermal, infrared cameras can monitor temperatures of

glaciers over time and create a dataset. They can record the temperature everywhere rather than one or two spots as you would on foot (Gaskell, 2016).

A new 3D process involves old aerial photos and modern-day drone photography to shed light on accelerated ice loss from Iceland's largest glacier. They compare views from the 1980s to modern-day photos captured on state-of-the-art technology. The old photos and models are aligned with current day drone photographs to highlight the impact of climate change on the region. This is modeled in 3D (Dundeeuni).

Drones were used in another study down on the Himalayan glacier. They used a small drone to study a glacier that was 3.5 kilometers long. The drone was used to understand how the glacier behaves during the monsoon season and after the monsoon season. Drones were essential to know what was happening on the ground. High-resolution images were used. They used a point and shot camera on the drone and a swinglet for mapping the glacier. They flew over the glacier at 36 km/hr. The drone also was fitted with a GPS and it was programmed to fly certain patterns over the glacier. The on-board software told the camera to take photographs at predetermined points. It was difficult because the drone needed to be stable for the clicks, therefore it was done in the morning to avoid high winds (Gupta, 2015).

There is one more study done by Rosie Bisset in South America, which used drones to study glaciers. She used thermal imaging data to understand how the surface cover of glaciers is affecting the melt rate. The thermal camera can look at the debris covering the glacier. This can affect the melt rate depending on the thickness. A thin layer enhances the melt rate by darkening the ice and causing sunlight to be absorbed. A thicker layer has the opposite effect by acting as an insulator and preventing heat from reaching the surface of the ice. By measuring the surface temperature, one can model the thickness of debris and determine how it influences the melt rate.

Once again, the drone provides a higher resolution than the satellite. Skytech Aerial specializes in custom drones and finds solutions for flying with thermal cameras which adds weight and flying at high altitudes where propellers must spin faster in thin air (Researchers Study Retreating Glaciers using Thermal Drone Imagery).

Drones are particularly useful in monitoring glaciers and ice sheets for melting and global warming. There are certain considerations to flying drones in these harsh and sometimes high-altitude conditions. The drones require special equipment and programs, but with new technology it is possible. Drones offer a more accurate picture of the glacier and its condition than on foot or satellite techniques. They are especially useful in the studies of glaciers and ice sheets and global warming.

1452 words

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