IS GREENLAND GETTING DARKER?

CLIMATE CHANGE MODELS RELY ON REMOTE SENSING DATA FOR ACCURATE PREDICTIONS. BETSY KENASTON REPORTS ON A PROJECT IN GREENLAND TO COMPARE MODIS IMAGERY WITH RESULTS ON THE GROUND

The Greenland ice sheet has recently experienced accelerated glacier melting, causing a global sea level rise. Along with warming Arctic temperatures, melting may be increased by a darkening snow surface – if the ice and snow on the surface is dark, it will absorb solar radiation more quickly, warm up and melt causing a massive sea-level rise that would put many of the world's cities underwater.

But many of the climate models and ice cores monitoring Greenland's ice sheets are severely outdated, and getting researchers out in the field is difficult and expensive. As a result, scientists haven't been able to determine if, and why, Greenland's snow is getting darker.

However, last spring, a research project began to explore that very question, as well as how much it's snowing, where it's snowing, how much snow is melting and how far the sea level will rise as a result. It began studying the recent changes in surface mass balance on the western Greenland ice sheet percolation zone and included snowmobiling about 3,000km across Greenland to investigate how the massive ice sheet is changing and why.

To gather crucial data, PhD candidate Gabriel Lewis used an ASD FieldSpec 4 spectroradiometer. He selected the instrument because it is portable, rugged, and easy to transport and use in the field. It can also measure albedo – the ratio of incoming and outgoing radiation of the snow – at multiple frequencies (in this case, 350-2,500nm) with high resolution and accuracy, providing a more detailed and complete picture. It can also be used with a contact probe to measure the optical grain size of snow grains – a vital piece of information to determine if the snow has darkened.

As well as measuring albedo and the optical grain size of the snow, the research group collected continuous ice-penetrating radar and seven 25-30m firn cores, as well as 373 albedo measurements and snow samples. The group then analysed the samples to measure their dust and soot impurities. Through laboratory analysis, the group was able to measure the quantity of impurities, their origin and whether their creation was natural or man-made.

The project also used remote sensing data, comparing their findings on the ground against current scientific theories gleaned from regional climate models (RCMs) and the Moderate-Resolution Image Spectroradiometer (MODIS) satellite. The project is set to be completed in late 2017, but thus far, Lewis and his team have found similarities between the data taken from satellites and data collected on-site on the glaciers.

The preliminary results show that RCM and MODIS albedo data accurately capture albedo spatial variability and agree well with field measurements. The results also show a negative correlation between optical grain size and albedo, but no correlation between impurity mass and albedo. These results are consistent with recent studies, where snow grain size has been shown to be five to 10 times more important in albedo reduction than black carbon content or snow density.

"It's great to know that we are on the right track," says Lewis. "The albedo measurements in Greenland agree nicely with many of the satellite and climate model measurements, which is wonderful."

There are many uncertainties surrounding what's going to happen to the ice sheets — they're complex and hard to model and predict — so if the climate models can accurately represent what's happening today, it becomes much easier for scientists to have confidence in using the models to predict what's going to happen in the future.

"The data I am helping to gather and analyse will help us understand the impact of climate change on Greenland, and what it means for the future of the planet," says Lewis.

Betsy Kenaston is a marketing specialist at ASD (www.asdi.com)

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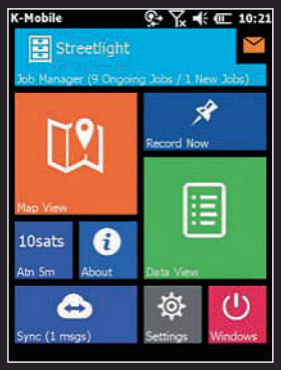

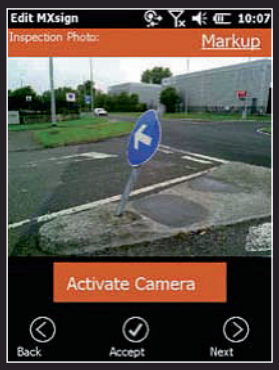

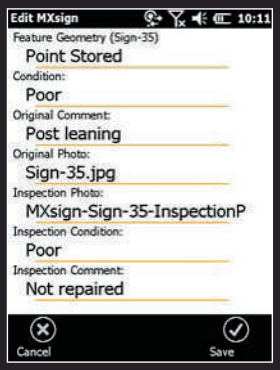

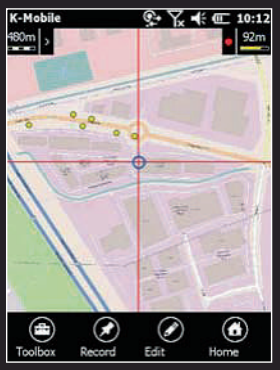

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