Up in the clouds

Daniel Cziczo and colleagues experimented with electronics at over 3,000-m altitude to reduce the uncertainty in aerosol–cloud interactions.

PAUL DEMOTT

Storm Peak Laboratory — 3,200 m above sea level. These photographs show the station in and out of cloud, separated by only a few minutes during the field study.

What was the objective of the work?
Our objective was to determine the characteristics — specifically the composition and size — of those atmospheric particles that are most effective at forming ice and mixed-phase clouds. The most recent report from the Intergovernmental Panel on Climate Change states that the interaction between particles and clouds is one of the greatest uncertainties in our current understanding of global climate, and we were hoping to reduce this uncertainty with our experiments. As we obtained our data, we realised that we could also say something about the source (natural versus anthropogenic), and this became the central topic of the manuscript.

Why did you choose this particular location for the fieldwork?
Traditionally, studies such as ours are performed from aircraft platforms. The problem with aircraft, however, is that they can only ever provide instantaneous or short-term observations. We wanted to find a fixed location at high altitude with minimal local influence to sample air masses that are similar to what one might find from an aircraft — but for extended periods of time. We were fortunate to learn about our two locations — the observatories at Jungfraujoch in the Swiss Alps and Storm Peak in the Colorado Rocky Mountains — through earlier research that had been conducted at these two locations.

What sorts of data or samples were you looking for?
We collected two types of samples. First, we used cloud chambers to make ice clouds by mimicking the atmospheric conditions at which they form. Second, we collected ice crystals directly from real atmospheric clouds containing both water and ice. Once we collected the ice crystals we then evaporated the water so that we were left with only the particle inside. These particles were analyzed either *in situ* with mass spectrometry or brought back to the laboratory for analysis in an electron microscope.

Did you encounter any difficulties?
Perhaps the greatest challenge resulted from the high altitude of the field sites. Electronics, for example, behave very differently at the low pressures found over 3,000 m above sea level — overheating and arcing were common, and had to be overcome with cooling, fans and redesign. Power was never as constant as it is in a laboratory and we often had to restart or repair our instruments. But it was not only the instrumentation. Indeed, many of the scientists felt the effects of altitude — headaches and nausea, mainly. Some people were unable to get past these symptoms and had to return to lower altitude.

Did you have encounters with dangerous animals?
Luckily, any bears in the area were hibernating!

Any low points, close misses?
Transportation was always an issue. Instruments had to be brought up to Storm Peak by Snowcat in a harrowing ride up the mountain. Scientists travelled to and from the laboratory using a snowmobile or on skis. Severe snowstorms meant being stuck — either in the lab, sometimes for several days, or at the base of the mountain, unable to perform experiments. At Jungfraujoch, we could always reach the laboratory by train, but a bumpy helicopter ride was required to lift instruments to the station.

What was the highlight of the expedition?
The difficult transportation to the research stations meant that instruments had to be broken down and carefully packed for shipment. This resulted in a considerable amount of time required not only to rebuild the instruments at the field site, but also to recalibrate after the bumpy ride. When the first data were finally acquired it was as if a weight had been removed from everyone's chest!

Did you learn anything new about yourself or your team members?
Most often the team stayed at the research station for days or weeks at a time. This meant taking turns cooking and cleaning. We quickly found out who the best chefs were and they started to find their names on the cooking list more and more often as the fieldwork wore on. In fact I still receive requests for my gnocchi recipe, and Stephane Gallavardin for his peach torte.

This is the Backstory to the work by Daniel Cziczo and colleagues, published on page 333 of this issue.