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UNH Scientist Leads Team to Greenland to Probe a Piece of Earth's Climate Puzzle

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DURHAM, N.H. -- In the summer of 1998, a team of scientists led by Jack Dibb of the University of New Hampshire was measuring levels of nitrogen oxides above the permanent snowfields at Summit, Greenland. The researchers expected to find only small amounts of these gases, which, among other things, play an important role in the formation of ground ozone or smog. But readings taken eight meters (26 feet) above the snow were surprisingly high, with readings taken closer to the snow surface even higher. “Finally,” recalls Dibb, “we stuck the inlet right into the snow and the numbers were astronomical.”

This discovery, and a similar, serendipitous find by a different team at the South Pole later that same year, opened up a new avenue of scientific inquiry. Dibb, an atmospheric chemist at UNH’s Institute for the Study of Earth, Oceans, and Space (EOS), is returning to Summit as the vernal equinox approaches to dig further into the mystery, which begins, he surmises, when sunlight hits the surface of the snow and “photolyzes” impurities in the snow pack. Some of the reactive compounds produced are thereby made available to circulate and participate in atmospheric processes.

Of the research Dibb says, “This is a recently recognized field of tropospheric chemistry. The whole issue of a lot of reactive gases pouring out of the snow into the atmosphere wasn’t even on anybody’s radar screen before the late ‘90s. The thinking was that when it rained or snowed these reactive gases were taken out of the atmosphere and that was the end of the story.”
But the story is being rewritten, and this has significant implications for, among other things, understanding ice core records and just how accurately they provide insight into Earth’s past climate. “Based on what we’ve discovered, obviously, when stuff hits the snow it doesn’t just sit there, it starts getting chewed up by photochemical reactions, or new compounds that weren’t even in the atmosphere at the time get formed. This makes it more difficult to invert ice core records for some chemical species,” Dibb says.

In addition, since this newly discovered source of reactive gases is not plugged into current climate models, those simulations, used for understanding past climate as well as predicting what may lie ahead, are incomplete at best. Says Dibb, “If you have this large area source of reactive chemicals that isn’t considered in any current understanding of the functioning of the troposphere, models may be getting the ‘right’ answers for the wrong reasons.”

At Summit, Dibb and 12 other researchers from Georgia Tech, UC Irvine, UC Davis, the

University of Arizona, the National Center for Atmospheric Research, the Cold Regions Research and Engineering Laboratory, and NASA, will measure these gases at a time when the frozen landscape begins to emerge from months of perpetual darkness. They will work at Summit from mid-March, when the average daytime temperature will be minus 45 degrees Celsius (-49 Fahrenheit), to early May.

Says Dibb, who specializes in the chemistry of air-snow exchange, “Ideally, in a scientific sense, we would be there now – really catching time when it is dark and then seeing the sun come back. But logistically and probably even physically, I’m not sure we could make all these instruments work at minus 70 or 80 C.”

While Dibb has been going to the scientific research facility at Summit annually since 1989, with funding from the National Science Foundation, this is the first time a large contingent of researchers will operate in such extreme conditions in an effort to make measurements at the site. Adds the scientist, “If we’re not including this widespread nitrogen oxide source then there’s a hole in understanding how the atmosphere is functioning. It may be that this is not important on a global scale, but we need to understand whether this flux of reactive chemicals out of the snow really matters.”