

TRANSCRIPT

Noah Molotch Explains Research At Steamboat Ski Resort

What role can the ski industry play in preserving snow?

I think there is a huge opportunity for the ski industry to really seize on sustainable tourism. That's becoming popular in other parts of the world in terms of recreational tourism, and I think the ski industry has a real opportunity to really grab on to this idea of sustainability and educating the public about it. A lot of the major ski resorts are already doing that. The Steamboat Ski and Resort Corporation has been partnering with the Storm Peak Laboratory through the Desert Research Institute to forge new understanding of climate science in a very major and impactful way. The ski industry uses a lot of energy, it uses a lot of water, it generates a significant amount of waste. And I think in general, the ski industry is pretty aware that they want to be responsible stewards of the lands that they manage and to think globally and act locally.

Can you talk more about the partnership with Steamboat?

Just to the left of us here is the mid-mountain snow stake where the ski corporation observes the data that they report on the website. And then over here to my right is a stand of trees where we have a number of instruments that are placed to measure snow depth in different conditions, different slope angles, different positions with regard to trees, and that is giving us information about how representative this measurement right here is. So the ski resort is actually interested in understanding where should snow measurements be made in the context of informing the public about how much it has actually snowed.

The scientific enterprise that we are doing that is very unique here at Steamboat is focused on understanding how clouds affect climate. And the biggest source of uncertainty in global climate models about how the climate will change in the future, our biggest lack of understanding, is the role of

clouds. Clouds are white and bright, so they reflect a lot of sunlight from the earth. So that is a cooling effect on the climate. But clouds also trap heat. And so that gives them a warming effect on the climate. And the net effect, whether those clouds have a net cooling effect or a net warming effect on the planet is the biggest source of uncertainty in how the climate will change in the future. And the detailed physics that goes on inside of clouds, those are the critical processes for understanding how the climate will change in the future. And here at the top of Steamboat, we are able to make measurements of the processes that go on inside of clouds. Because we are actually up inside of cloud. And to do that where you are not in a mountain system, you have to charter an airplane. And make those measurements in an airplane that is flying through the cloud. So it is a very unique environment that allows us to have much easier logistics than using an airplane in that we can ride up a few chairlifts and get into a building where we have the instruments that measure the processes that go on in the context of cloud formation and the formation of ice crystals within clouds.

What exactly are you measuring here then?

Inside of a cloud, you have water vapor, you water droplets, and you have ice crystals. And the growth of those ice crystals occurs through processes that we actually understand very little about. And that growth process has a big impact on whether those clouds have a net warming or cooling effect on the climate. Here in Steamboat we have some very unique measurements for measuring the properties of those ice crystals and the dust particles and in general what we call aerosols that are at the center, they are the nucleus of the ice crystals. And so here in Steamboat, we are able to observe these ice condensation nuclei, to observe what they are, how efficient they are at forming ice crystals within clouds and how they affect overall amounts of snowfall.

How do processes inside of clouds affect the snowpack?

One of the things about the work that is being done here and the setting here is that we have a number of coal-fired power plants upwind of this location along the Colorado Plateau. One of the things that we really wanted to understand is associated with how the particulates that come out of those coal-fired power plants impact amounts of snowfall in the Colorado River Basin. And one of the interesting results that's come from work here at the Storm

Peak Laboratory that I personally was not involved in but that I am aware of because it is a very interesting and important finding is that with the enhanced aerosol loading into the atmosphere and the abundance of ice condensation nuclei within clouds here, it reduces the total amount of what we call rhiming. Rhiming is when supercooled water droplets in clouds freeze on to ice crystals. And snowfall is increased greatly if you have more rhiming. So if you get more of these water droplets freezing on to ice crystals, those ice crystals will grow more and they will fall out of those clouds more efficiently and you get more snowfall as a result.

Now, because we have this abundance of ice condensation nuclei within the clouds because of these coal fired power plants, we reduce the amount of overall rhyming. So we end up with more ice crystals, but with lower mass in those ice crystals because there is less of the water droplets freezing on to them. And as a result, they don't fall out of the clouds and more of those ice crystals and snowflakes are carried over the mountain range as spillover into the adjacent watershed. So it actually changes where the snowfall occurs. And so you can actually get less on one side of the mountain and more on the other side of the mountain.