

TRANSCRIPT

Conversation With NCAR's David Gochis About Cloud Seeding

What is cloud seeding?

One of the things that the lower basin states have done is they have actually actively invested in Colorado's cloud seeding program. Cloud seeding is a technology that seeks to enhance, over natural causes, the fraction of precipitation that comes out of each storm. The idea is that there is a certain amount of moisture flowing over the mountains, and only a fraction of that moisture falls out in Colorado due to natural processes. But if we can seed the clouds and try to stimulate more snow crystal growth, a bit more precipitation and snowpack will fall out.

How do you do that?

It is actually a technology, an area of work that's been done since the late 1940s on the back of some early defense research as well as just basic physical process research. But you put particles into the atmosphere which attempt to stimulate crystal growth. It gets pretty complicated pretty quick. But the idea is that in the atmosphere there is supercooled liquid water, which is in this metastable state, ready to crystalize onto something. But there is not enough things for it to crystalize onto, so it just stays in the atmosphere and it flows.

If you could inject additional particles into the atmosphere that would initiate crystal growth, those crystals could grow and then fall out. And that is the theory and premise behind cloud seeding. The practice of course is how do you do that, and how do you get the snow to fall where you want it, in your watershed, given how complicated airflow is over complex terrain, given how snowpack piles up once it hits the ground, how it melts out, things like that. NCAR has actually done a long history of cloud seeding research, and just last year they wrapped up an eight-year study with the state of Wyoming, looking at cloud seeding effectiveness and what some of the impacts are in terms of expected streamflow and runoff from that.

What these lower basin states are doing is saying, We know it is really hard and expensive to try to do legal battles to acquire new water rights and store new water, what if we tried to increase supply from the clouds? That is essentially the logic.

Now, while cloud seeding works in theory, it is very difficult in practice to get the efficiency you want out of it. While the lower basin states will sponsor cloud seeding activities in the headwaters in Colorado and in Wyoming, the return on that investment is always quite ambiguous. But they view it as a low enough cost option that they still continue to invest in it.

What kind of money are we talking about?

That is a good question. I don't think that is fully known, because a lot of those entities don't necessarily have to publicly disclose their budgets.

Is it private entities who do this?

No, but a lot of the large water districts, like the Metropolitan Water District of Southern California, the Central Arizona Project and things like that, they do have portions of their budget that are clear and transparent, but not every item of those things. It is not clear. The state of Colorado though does manage a permit program for cloud seeding. You can't just do this without a permit.

We've been involved with the state of Colorado as well as the state of Wyoming and try to look at the effectiveness of this purely from a scientific standpoint. If you were to do this type of thing, what would you expect to get — not just in terms of additional precipitation but also other factors like the additional snowpack, although it isn't one to one, and also in terms of the runoff, which comes from the snowpack. Because that also is a minus, it also isn't a one to one. Each step you go through, there is a decrease of the efficiency as you go through that.

What were the findings of those studies?

It was a modest up to five percent increase in precipitation. But for very tightly managed, well-known cloud seeding operations. You could potentially

get more efficiency out of that. But given the natural variability of storms and differences in the different types of cloud seeding operations they use and then how you try to validate that on the ground, there is still a lot of statistical uncertainty. So those were some of the estimates in terms of precipitation you would get. And then right now we are working on a study — I don't have the results for those yet — about what, as you basically put that precipitation on the landscape, what fraction of that comes out as increases or decreases in streamflow? The decreases happen because the atmosphere is a chaotic system where you might increase one area, other areas — because you have changed the atmosphere — may have somewhat of a decrease. That is also a very contentious issue, whether there is any out of area effects of cloud seeding, whether they are increases or decreases in precipitation.

Ski areas do it quite a bit. They are one of the major investors. But a lot of it is water conservancy districts, irrigation districts, and then these lower basin states. Because again, they view it as, even though it is unknown what exactly they are getting out of it in terms of return on investment, it is still cheap compared to building a lot of new infrastructure. It is economics which is driving this right now more than it is them being able to establish a very firm, quantifiable right to that water.

You said the state is giving out permits — so anybody with the knowledge and equipment could do this in their backyard?

It obviously has its body of regulations on it. They are not super lengthy. To look through. There is definitely a skill and knowhow and an incredible standard of practice about this. There is a weather modification association that holds scientific conferences. But it is not very mainstream. It is still quite debated both in terms of the scientific and the ethical activity. But it is having a resurgence. It was very big in the 60s and 70s. But then for a lack of concrete results plus a few high profile legal cases that happened, federal funding for cloud seeding research and a lot of other things basically dried up. There just wasn't that much stomach or interest for it. But starting in the late 80s and into the 90s, you saw a few more entities supporting these kinds of operations.

And then really more in the last ten or 15 years in these high-elevation areas in the Western United States, particularly Colorado and Wyoming, up into Idaho too — Idaho power has a big cloud seeding operation, power utility, have taken

an interest in this, again, as a fairly low cost way for them to be able to augment their snowpack compared to other methods.