



METER  
ENVIRONMENT

## WHY MESONETS MAKE WEATHER PREDICTION MORE ACCURATE

### THE STAGGERING COST OF MONTANA'S "FLASH DROUGHT"

Some people figured it was climate change. One statistician said it was a part of a [cyclical trend](#) for poor crop years. Whatever the cause, the 2017 [flash drought](#) that parched the entire state of Montana and most of South Dakota, severely impacted the profitability of ranchers and farmers. In western Montana, fires burned some of the largest acreages in recent history. It resulted in one of the biggest wildfire incident reports ([over one-million acres](#)) and caused virtually 100% crop loss in northeastern Montana. The U.S. Dept. of Agriculture estimated the crop loss to be in the [hundreds of millions](#) of dollars, and one question was on everybody's mind—why did no one see it coming?

### GETTING THE RIGHT WEATHER DATA

The 2017 Montana Dept. of Natural Resources and Conservation spring [drought report](#) indicated plenty of water: "By the end of the month, almost all drought concern was removed from the state, with the exception of Wibaux and Fallon Counties....As of May 9, 2017, Montana was 98.45% drought free." But in late May, an abrupt shift in weather conditions led to one of the hottest, driest summers on record.

The problem, says Kevin Hyde, Montana State Mesonet Coordinator, lies not only in the need for more weather data but in obtaining the *right* kind of data. He says, "One of the reasons drought was missed was because we're still thinking you measure drought by snowpack and how much water is in the river, which is really great if you've got water rights. But we've got a lot of dryland out there."

In addition to [weather station](#) monitoring, Hyde is a big proponent of adding soil moisture and NDVI measurements to each of the Montana Mesonet stations he oversees. He says, "The conventional weather station only measures atmospheric

conditions. But ultimately, to make any decisions, we've got to know not just how much water comes into the system, but how much goes into the soil. And even that's not enough...because what we really need to know is how the water situation is going to affect plants."

Hyde says more data are needed to warn growers and ranchers about upcoming weather risks. He points to the fact that increasing evapotranspiration got missed leading up to the summer of 2017. "We realized that if we were looking carefully at reference ET, we might have seen it about a month earlier. What would people have done? They would have changed their calf purchases. They would have figured out what kind of forage they needed to buy. These are the types of decisions people can make if they know the information sooner."



Figure 1. TEROS 12 soil moisture sensor

## WAS THE DROUGHT OVER? SOIL MOISTURE ILLUMINATES THE BIGGER PICTURE

Heavy rains came mid-September of 2017, which led some people to believe the drought was over. However, changes in soil moisture told a different story. Very little of the rain made it into the soil. "At the Havre, MT station you can see we had some heavy precipitation events. Then we had early October snows. So people expected

good soil water recharge. But at the end of the day, we didn't get it. On Sept. 15th, we had a big [soil moisture](#) response at the surface but only a marginal response at 8 inches." The melt of early October snows onto the soil, still damp from the September rain, drained to 20 inches or more. But as the snowmelt dissipated there was minimal net gain going into the winter.

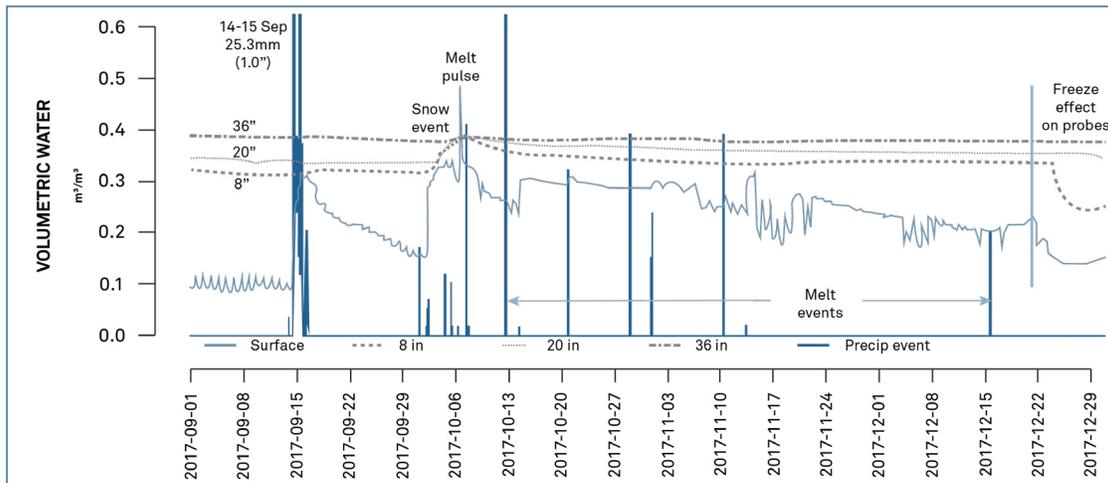


Figure 2. Soil moisture traces at the Havre, MT weather station using METER [soil moisture sensors](#)

## PREDICTIVE MODELS NEED MORE COVERAGE TO BE EFFECTIVE

Typically in the U.S., the National Weather Service (a division of NOAA) puts out a network of weather monitoring stations spaced out across the country, and that data gets fed into forward-looking models that help predict the weather. Dr. Doug Cobos, research scientist at METER says, "What people are finding out is that putting in a sparse network of very expensive systems has done really well. It's been a good thing. But the spatial gaps in those networks are a problem, especially for agriculture producers and ranchers. They need to know what's happening where they are."

Hyde agrees, adding that we need better predictive tools that help growers and ranchers make practical decisions based on data rather than guessing. "January 1st is when the decision has to be made—do I buy cows? Do I sell cows? Do I need more pasture? But many predictions start on April 1st. As one rancher puts it, 'We don't bother with Las Vegas. We sit around the dining room table at the beginning of the year and put a million dollars on one shot.'"

## MESONETS IMPROVE SPATIAL DISTRIBUTION

Mesonets present a practical solution for the need to fill in data gaps between large, complex weather stations. The Montana Mesonet currently has 57 stations interspersed throughout the state, and through partnerships with both the public and private sector, they're adding more stations every year.

At each location, the Montana Mesonet team installs METER [ATMOS 41](#) all-in-one weather stations, [soil moisture sensors](#), [NDVI sensors](#) and [data loggers](#) that integrate with [ZENTRA Cloud](#): an easy-to-use web software that seamlessly integrates into third-party applications through an API. He says the system enables better spatial distribution and reliability. "When we were deciding on equipment we asked ourselves: What kind of technology should we use? It had to provide high data integrity. It had to be easy to deploy and maintain. And it had to be cost effective. There's not a lot of people in that sector. METER systems are low profile, they're affordable, and the reliability is there. I look at some other mesonets, and they cannot afford to build out further because they are relying on large, complex, expensive systems. That's where the METER system comes into play."



Figure 3. ATMOS 41 microclimate weather station

## BETTING ON THE FUTURE

The Mesonet team and its partners are excited to see how their data will mesh with the available predictive tools to be the most useful and practical for growers and ranchers throughout the state, and they realize that there is still much work to do. "It's not enough just to get the instrumentation out there. The overall crux is: how do we build the information network, and how do we build a relationship with the producers so that we can have an iterative and interactive conversation?" says Hyde,

“We know there needs to be an education in how to use and interpret the data, for example, what is NDVI, and what can we learn from it? A lot of what we need to do is translate science into practical terms.” But he adds that it doesn’t need to be perfect. “What the farmers have said to us is, ‘We don’t need exact numbers. We’re gamblers. Give us probability. Teach us what it means, and we’ll make the decision.’”

Discover METER [ATMOS 41](#) weather stations, [soil moisture sensors](#), and [NDVI sensors](#)

Explore which [weather station](#) is right for you.