CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

J0808

Project Title

Supercool Streams: Flowing with Frazil

Abstract

Objectives/Goals

I wanted to find out if a mountain stream would stay liquid at temperatures that freeze an alpine lake. My hypothesis was that moving water would be able to stay liquid at temperatures that freeze still water.

Methods/Materials

I chose three different sites at 7000 feet in elevation in Mono County, California near Mono Lake: Lundy Lake, Mill Creek, and Wilson ditch. At each site I took air, still water, and turbulent water temperatures. At my Mill Creek site I took observations and I placed a time lapse camera to record whether ice formed. To take the temperatures I waterproofed small thermometers called iButtons and recorded about a month of a winter data. I added additional thermometers to investigate the formation of spray ice. Then I retrieved and downloaded them so I could develop an analysis of my data.

Results

From my data I found that moving turbulent water stayed liquid when still water froze, proving my hypothesis correct. Air temperatures at Mill Creek were almost always below freezing, but they did not freeze the moving water, even when the air was as cold as -15 degrees C. The water was usually below 3 degrees, but even when the water supercooled to -0.5 degrees C my data and camera pictures showed that the creek was always flowing. Still water at Wilson ditch and Lundy Lake froze solid at these same low temperatures. A type of ice I call spray ice formed on the edges of the creek and on my equipment. My data show that spray ice forms when cold water sprays out of the creek and lands on something that is below 0 degrees C. Another type of ice called frazil formed in supercooled turbulent water. I observed three episodes of frazil ice formation, at air temperatures below -10 degrees C.

Conclusions/Discussion

I learned that although a creek might be flowing in the winter, it's not the same as a creek that you might swim in during the summer, because there is a lot ice in and around the creek. The ice in the creek, frazil ice, is very powerful. It helps create a healthy creek by shaping the stream channel, but it can also destroy measuring flumes and take down bridges. Understanding creek dynamics in the winter is important because bridges and other structures need to be built strongly enough to withstand the force of frazil ice.

Summary Statement

I found that turbulent flowing water stayed liquid at air temperatures that froze still water, but unusual types of stream ice formed.

Help Received

Dr. Connie Millar was my science adviser and let me borrow iButtons. Yosemite Geologist Greg Stock discussed turbulent water and supercooling with me. My dad helped me safely conduct my experiment in the field. My mom helped me with design and proofreading.