

Temperature Induced Dry Snow Avalanches

By Doug Chabot

Statements of “warming” triggered dry snow avalanches have become common in the last few years. The public mentions it frequently and it is increasingly referred to in avalanche advisories and classes. The evidence presented includes increased creep rates, wild swings in net solar radiation and avalanche activity occurring naturally and with human triggers due to warming temperatures. These statements occur with certainty and regularity but with scant data. In order to witness temperature induced avalanches a perfect lab would be one where large temperature swings occur consistently along with year round snowfall. One of the best places on the earth to witness the effect of diurnal temperature changes on a snowpack are in the highest mountains of the world, where I’ve been lucky enough to spend my spring or summers over the last 20 years. While alpine climbing in the Karakorum, Himalaya and Alaska Ranges I’ve experienced the uncomfortable effects of rapid and dramatic temperature swings: t-shirt to down parka in minutes. These ranges are natural labs. If cooling or warming are big factors in triggering avalanches it would be witnessed here.



A powder cloud across the glacier from Latok 1 Pakistan dusts camp.

High mountains are an extreme radiation environment, with large amounts of incoming solar radiation during sunny days, and huge losses in longwave radiation at night. I’ve routinely seen evidence of this daily flip-flopping through the formation of diurnal recrystallization facets, formed faster at high altitudes than I’ve ever seen in Montana. Although cooling or warming air temperatures are parts of the energy balance, the energy balance for the snow is driven largely by the *radiation* balance. I don’t carry scientific gear with me into the mountains. I do not have a robust data set, nor do I pretend to know exactly what happens to the snow with large air temperature changes. But I have never seen what I would interpret as a temperature induced dry snow avalanche. That’s to not say I can’t or won’t, but it’s certainly not a primary or even secondary avalanche concern.

Since the 1990s I’ve spent more than two years living on glaciers, climbing, watching and doing my best to not get caught in avalanches. In this time I’ve seen a hundred or more dry snow avalanches and even triggered a few. All of them were due to at least one of these *big three* factors: it snowed, the wind blew or there was poor snow structure, matching what I’ve seen for fifteen years as an avalanche specialist on the Gallatin National Forest. These three things are a recurring problem the world over and it’s what I concentrate on.



Diurnal recrystallization at high altitudes creates facets quickly. These were formed in India at 19,000 feet within 24 hours and were buried the next day. Three climbers died in an avalanche on a nearby peak when the new snow slid.

Temperature changes are real, but the best available information we have indicates that their effect on triggering dry snow avalanches only exists if the snowpack is already very close to instability. Every day the sun sets and the temperature plummets; the next day it rises and warms. Yet avalanches don’t happen daily. It’s an extremely rare event when multiple factors with weather and snowpack line up to be influenced by a temperature swing. Consequently, I’ve relegated warming to a low level concern, something that may increase instability at a very minor level as a secondary contributor to the big three.



An avalanche releases down an unnamed ridge near Latok 2.



Schweitzer and Jamieson said as much in their 2010 ISSW poster “On Surface Warming and Snow Stability”.

Weird, unexplainable, head scratching avalanche cycles will always happen and challenge our thinking. As avalanche professionals it’s our duty to look into these cycles, but as professionals it’s our duty to speak with clarity and not confuse the public. It’s dangerous to pretend to know something we don’t. Avalanches scare me because I can never understand them as well as I’d like. Pretending otherwise can kill me as a climber and skier. Pretending otherwise can kill others in my job as an avalanche specialist. Let’s keep our eyes on the obvious red flags. People die in avalanches because of new snow, wind and poor snow structure, not because they were out at 1 p.m. on a sunny mid-winter day. Focusing on the nuances of temperature induced avalanches can muddle our message as avalanche

forecasters and is a dangerous distraction for those with a less complete understanding of avalanches.