CENTER FOR SNOW & AVALANCHE STUDIES

CODOS 2012 Updates > March 14-17 Tour Overview

MARCH 14-17, 2012 CODOS TOUR SUMMARY

Greetings from Silverton -

The CSAS crew has completed our first CODOS field campaign visiting all ten of the CODOS sites in our circuit and returning to Silverton on Saturday, March 17. Illness prevented one of our team from participating in the tour so we were unable to publish our findings "on the fly', site by site. Since returning we have generated site-specific Updates which are available to CODOS program participants at dust.snowstudies.org . Those site-specific reports provide descriptions of our snow profile observations, current Snotel data, photographs, and other details about snowpack conditions.

These were our overall observations during this 1,301 mile circuit, facilitated by sunny and clear weather:

- The D4-WY2012 (March 6th) dust layer was found at the snowpack surface at all of our CODOS sites and on surrounding terrain, south to north and east to west - a rare (in our experience) case of the same dust layer being exposed statewide, simultaneously, in March, ten days after deposition. The heaviest depositions of D4 were observed near Muddy Pass and the east side of Rabbit Ears Pass, and on Grand Mesa.
- Several sites also presented other dust layers in the lower half of the snowpack, including what appeared to coincide with the D1 layer near the ground.
- The impact of D4 on snow albedo ranged in intensity but was sufficient to result in additional absorption of solar radiation at all locations; all sites exhibited significant melt/freeze activity in the upper snowpack and many sites showed deep infiltration of free water and wetting fronts.
- As a result of dry and warm weather, and reduced snow surface albedo over an extended period (March 7-17), and resulting flux of heat into the underlying snowpack (as free water), some CODOS sites have become or are very nearly isothermal at 0 C throughout, including Wolf Creek Pass, Willow Creek Pass, Rabbit Ears Pass, McClure Pass, and Grand Mesa.
- The remaining five CODOS sites including Park Cone, Spring Creek Pass, Hoosier Pass, Grizzly Peak, and Berthoud Summit, and our Swamp Angel Study Plot at Red Mountain Pass, will also quickly approach or become isothermal given another sustained episode of exposed dust at the surface, which appears imminent (see below).

Since our CODOS tour we have received another significant dust-on-dust event - D5-WY2012, on Sunday, March 18. Dust fell for several hours entrained in Sunday's new snow (but may have began as dry deposition on Saturday night). According to early reports, this D5 dust event has fallen onto the exposed D4 surface we observed during our circuit, at most or all CODOS sites. The National Weather Service expects sunny skies and unseasonably warm temperatures to resume soon after this storm clears (Tuesday).

Under the combination of strong solar radiation and warm air temperatures later this week, settlement of this dusty new snow will be very rapid and quickly merge the new D5 and D4 layers. Where snowpacks are already at or very near isothermal temperatures, solar energy absorbed by the emerging D5/D4 dust will accelerate snowmelt rates and SWE losses. Where snowpacks still retain cold content, energy absorbed by the merged D5/D4 dust will accelerate snowpack warming to isothermal. At that time, snowmelt rates and SWE losses would also accelerate, given continued exposure of the D5/D4 layer to radiative forcing.

More soon,
Chris

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CODOS UPDATE FOR BERTHOUD SUMMIT: VISITED MARCH 15, 2012

Summary | Snowpack | Melt Rate | Forecast | Earlier Updates | pdf

SUMMARY

Dust layer D4 (March 6) was observed, with its characteristic brown/pink color, at the surface of the snowcover at our Berthoud Summit CODOS site and on surrounding terrain, where snowcover was present. The very large proportion of exposed bare ground in the Front Range is also likely contributing some additional "local" dust and vegetation material to adjoining snow covered terrain during wind events. Melt-freeze effects on the snowpack were limited to the surface and the snowpack retains some cold content. Since our site visit, a new D5 dust event (March 18) has landed on the D4 surface, entrained in just a few inches of new snow (dust was also reported in Boulder on Sunday, March 18). Dust-enhanced radiative forcing of snowpack warming will resume later this week as D5/D4 re-emerge.

SNOWPACK DISCUSSION

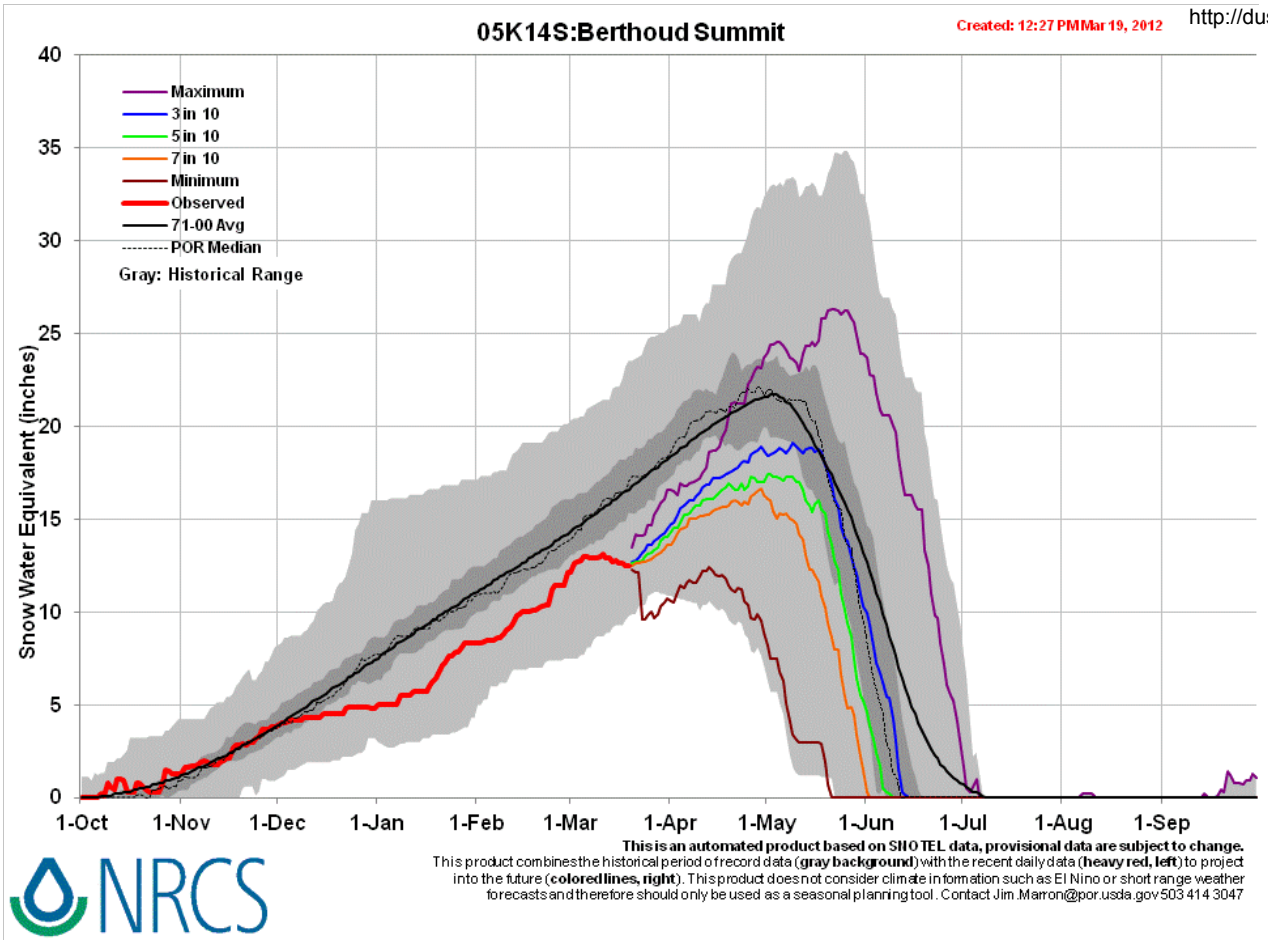
Total snow depth in this snow profile (pdf) was 44" and mean density of the snowpack was 308 kg/m3 (30.8% water content). Diurnal melt-freeze cycles had produced a strong melt-freeze crust at the snowpack surface, and some ice lenses in the top 8" of the snowpack, but the remainder consisted of increasingly weak, with depth, snow. The coldest snow temperature was -6.9° C, four inches below the surface, and the mean snow temperature was -2.6° C. As at the Grizzly Peak site, an additional dust layer, perhaps corresponding to event D1, was discernible five inches above the ground and another potential dust layer was located 17" above the ground.






MELT RATE

Berthoud Summit Snotel has reported virtually static SWE since the D4 event, March 6, and no measurable increase of SWE was reported with the new snow on Sunday, March 18, in association with D5. If the D5 event was deposited with any new snow, that D5 dust will rapidly merge with D4, enhance radiative forcing, and accelerate the warming of the snowcover to isothermal. At that time SWE losses would also accelerate, given that D5/D4 remains exposed at the snowpack surface.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday, March 20). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of any new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where the snowpacks in this locale are at or near isothermal temperatures, solar energy absorbed by the merged D4/D5 dust will begin and/or accelerate snowmelt rates and SWE losses. Where the snowpack retains cold content, energy absorbed by that D5/D4 dust will continue to accelerate warming of the higher elevation snowcover.

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CODOS UPDATE FOR GRAND MESA: VISITED MARCH 16, 2012

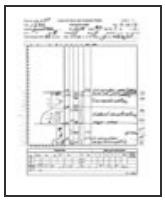
Summary | Snowpack | Melt Rate | Forecast | Earlier Updates | pdf

SUMMARY

Dust layer D4 (March 6) was easily observed, with its characteristic brown/pink color, at the snowpack surface at our Grand Mesa CODOS site and on surrounding terrain. Grand Mesa rivaled Rabbit Ears Pass for the heaviest concentrations of D4 observed during this circuit. The snowpack was nearly isothermal and was wet or moist throughout. Deep runneling and other wet snow features characteristic of a late spring snowpack were observed on the south flank of Grand Mesa. Since our site visit, a new D5 dust layer (March 18) has landed on the D4 surface, entrained in just a few inches of new snow. With the merged D5/D4 layer at the surface, dust-enhanced radiative forcing of snowpack warming will resume later this week and the snowpack will quickly become fully isothermal. Given continued sunny and dry weather, snowmelt rates will then accelerate.

SNOWPACK DISCUSSION

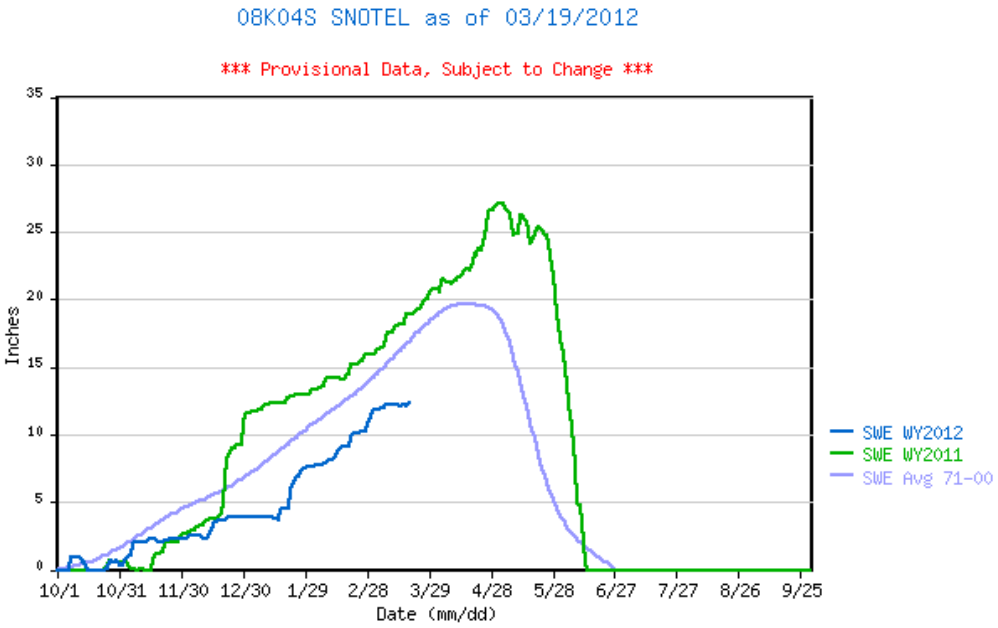
Total snow depth in this snow profile (pdf) was 57” and mean density of the snowpack was 346 kg/m3 (34.6% water content). The upper two-thirds of this snowpack consisted of strong layers of wetted, round grains, and the remainder of wetted “depth hoar” and other weak snow. The coldest snow temperature in this profile was -0.9° C, in the depth hoar, and the mean snow temperature was -0.3° C. Dust layer D4 was present at the snow surface and two additional dust layers were observed near the bottom of the snowpack.






MELT RATE

Mesa Lakes Snotel, the nearest Snotel to our site, has reported a slow decline in SWE since the D4 event, March 6, until a very small increase in SWE on Sunday, March 18, in association with D5. Any new snow associated with D5 dust will rapidly settle and enable D5 to merge with D4 and rapidly bring the snowpack throughout the Grand Mesa to isothermal, enabling snowmelt rates to accelerate.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday, March 20). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of any new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where the Grand Mesa snowpack is already isothermal, solar energy absorbed by the merged D4/D5 dust will accelerate snowmelt rates and SWE losses. Where the snowpack retains some cold content, free water percolating down from the D5/D4 dust will quickly warm the highest elevation snowcover to isothermal.

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CODOS UPDATE FOR GRIZZLY PEAK: VISITED MARCH 15, 2012

Summary | Snowpack | Melt Rate | Forecast | Earlier Updates | pdf

SUMMARY

Dust layer D4 (March 6) was observed, with its characteristic brown/pink color, at the surface of the snowcover at our Grizzly Peak CODOS site and on surrounding terrain, where snowcover was present. The very large proportion of exposed bare ground in the Front Range is also likely contributing some additional "local" dust and vegetation material to adjoining snow covered terrain during wind events. Melt-freeze effects on the snowpack were limited to the surface and the snowpack retains cold content. Since our site visit, a new D5 event (March 18) has landed on the D4 surface, entrained in just a few inches of new snow (dust was also reported in Boulder on Sunday, March 18). Dust-enhanced radiative forcing of snowpack warming will resume later this week as D5/D4 re-emerge.

SNOWPACK DISCUSSION

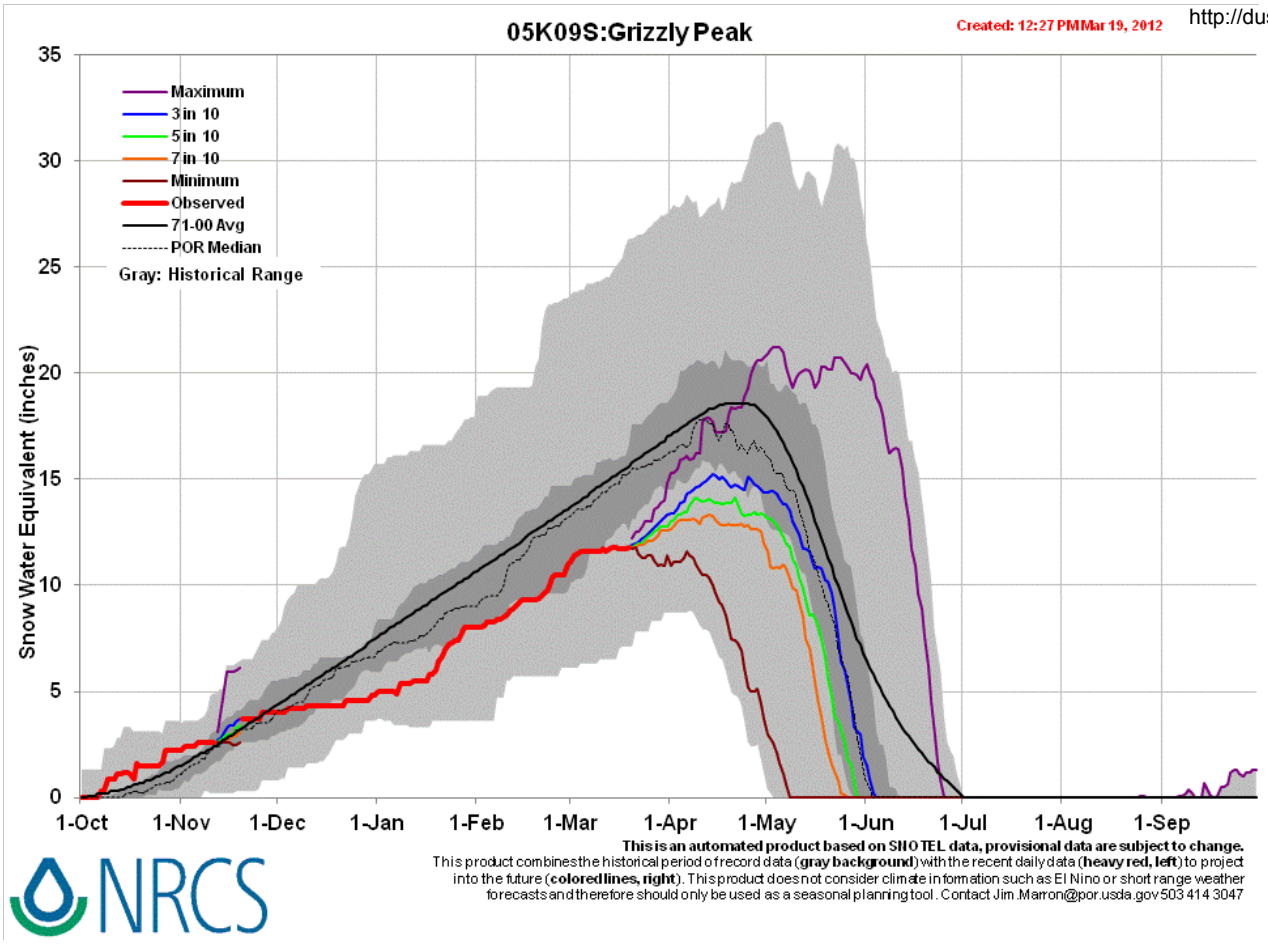
Total snow depth in this snow profile (pdf) was 41" and mean density of the snowpack was 290 kg/m3 (29.0% water content). Diurnal melt-freeze cycles had produced a strong melt-freeze crust at the surface but the remainder of the snowpack consisted of dry and generally weak "depth hoar" grains. The coldest snow temperature was -10.0° C, four inches below the surface, and the mean snow temperature was -4.6° C. D4 was found in concentrated deposits at the snow surface at this site and in surrounding terrain, where it had deposited in depressions or patches. An additional dust layer, perhaps corresponding to event D1, was clearly discernible six inches above the ground. Another potential dust layer was located 16" above the ground.





MELT RATE

Grizzly Peak Snotel has reported virtually static SWE since the D4 event, March 6, and tallied only a trace of new SWE on Sunday, March 18, in association with D5. If D5 was deposited with new snow, that D5 snow will rapidly settle and enable D5 dust to merge with D4, enhance radiative forcing, and accelerate the warming of the snowcover to isothermal. At that time, snowmelt rates and SWE losses would also accelerate, given that D5/D4 remains exposed at the snowpack surface.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday, March 20). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of any new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where snowpacks in this locale are at or near isothermal temperatures, solar energy absorbed by the emerging D4/D5 dust will begin and/or accelerate snowmelt rates and SWE losses. Where the snowpack retains cold content, energy absorbed by that D5/D4 dust will continue to accelerate warming of the snowcover.

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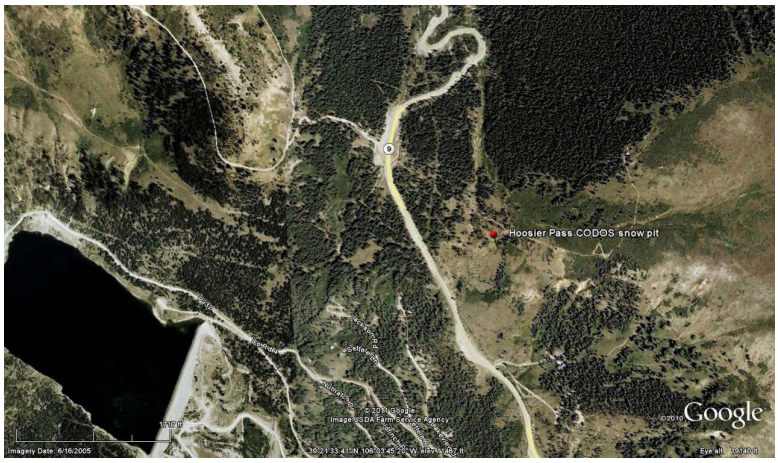
CODOS UPDATE FOR HOOSIER PASS: VISITED MARCH 14, 2012

Summary | Snowpack | Melt Rate | Forecast | Earlier Updates | pdf

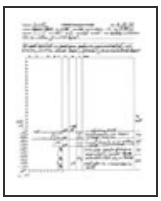


SUMMARY

Dust layer D4 (March 6) was observed, with its characteristic brown/pink color, at the surface of the snowcover at our Hoosier Pass CODOS site and on surrounding terrain, where snowcover was present at all. The very large proportion of exposed bare ground in the Mosquito and Ten Mile Ranges is also likely contributing some additional "local" dust and vegetation material to adjoining snow covered terrain during wind events. Melt-freeze cycles and free water percolation had modified the upper snowpack but the snowpack still retains cold content. Since our site visit, a new D5 event (March 18) has landed on the D4 surface, entrained in just a few inches of new snow. Dust-enhanced radiative forcing of snowpack warming will resume later this week as D5/D4 re-emerge.

SNOWPACK DISCUSSION

Total snow depth in this snow profile (pdf) was 41" and mean density of the snowpack was 273 kg/m3 (27.3% water content). Diurnal melt-freeze cycles had produced a light melt-freeze crust at the surface, and an ice layer some 8" below the surface, but the remainder of the snowpack consisted of very weak, dry "depth hoar" grains. The coldest snow temperature was -7.0° C, just below the surface and the mean snow temperature was -3.7° C. D4 was found in concentrated deposits at the snow surface at this site and in surrounding terrain, where it had deposited in depressions or patches. Only one additional possible dust layer was discernible lower in the snowpack, a few inches above the ground.

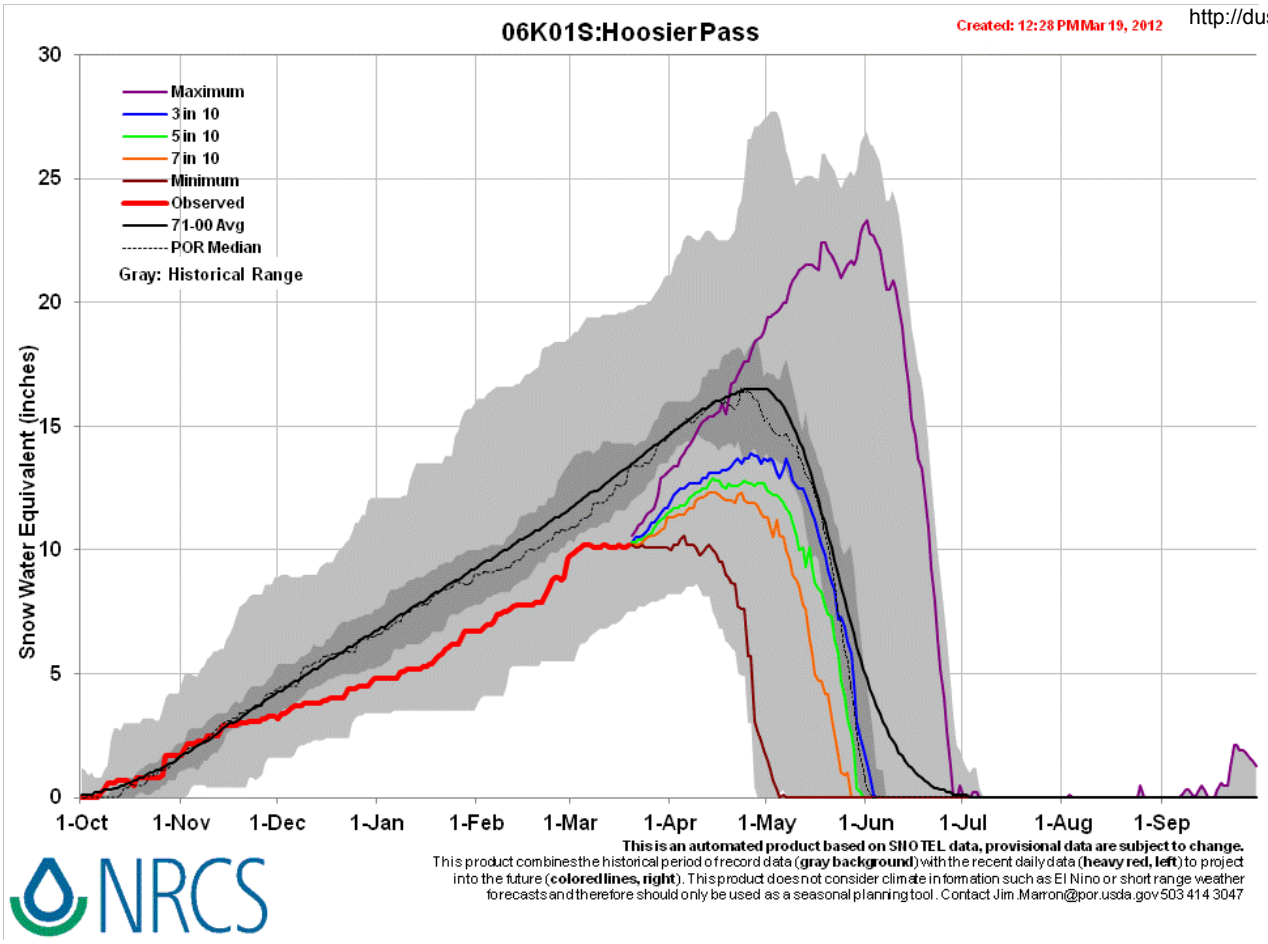






MELT RATE

Hoosier Pass Snotel has reported virtually static SWE since the D4 event, March 6, until receiving a few inches of new snow Sunday, March 18, in association with D5. This new snow containing D5 will rapidly merge with D4 and solar energy absorbed by that dust will continue to accelerate the warming of the snowcover until becoming isothermal. At that time SWE losses would also accelerate, given that D5/D4 remains exposed at the snowpack surface.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday, March 20). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where snowpacks in this locale are already at or very near isothermal temperatures, solar energy absorbed by the emerging D4/D5 dust will begin and/or accelerate snowmelt rates and SWE losses. Where the snowpack retains cold content, energy absorbed by that D5/D4 dust will continue to accelerate warming of the snowcover.

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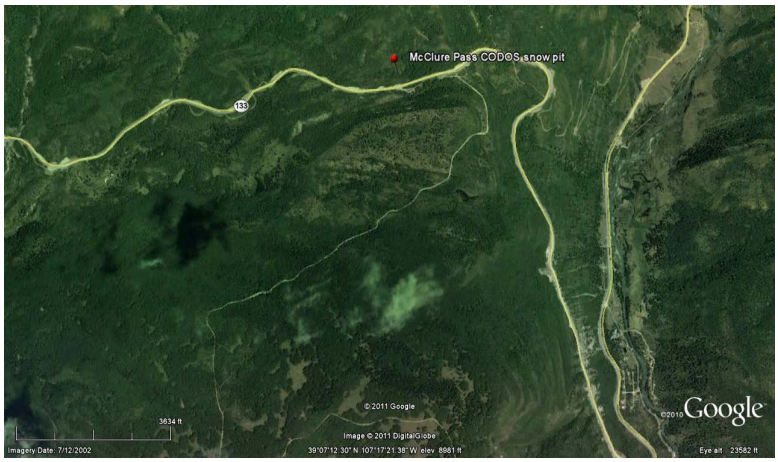
CODOS UPDATE FOR MCCLURE PASS: VISITED MARCH 16, 2012

Summary | Snowpack | Melt Rate | Forecast | Earlier Updates | pdf



SUMMARY

Dust layer D4 (March 6) was observed, with its characteristic brown/pink color, at the surface of the shallow snowcover at our McClure Pass CODOS site and on surrounding terrain. The snowpack at our site was isothermal and wet throughout. Since our site visit, a new D5 dust layer (March 18) has landed on the D4 surface, entrained in just an inch or two of new snow. With the merged D5/D4 layer at the surface, dust-enhanced radiative forcing of snowmelt runoff will quickly resume later this week.

SNOWPACK DISCUSSION

Total snow depth in this snow profile (pdf) was 29” and mean density of the snowpack was 351 kg/m3 (35.1% water content). In contrast to most of our other sites, this snowpack showed increasing strength with depth, even in the chains of “depth hoar” seen at the base of this snowpack. Free water was transforming all grain types into wet forms. The snow temperature throughout this profile was 0.0° C. Besides D4 at the surface, a second dust layer was discernible in the middle of the snowpack, and a third just four inches above the ground.

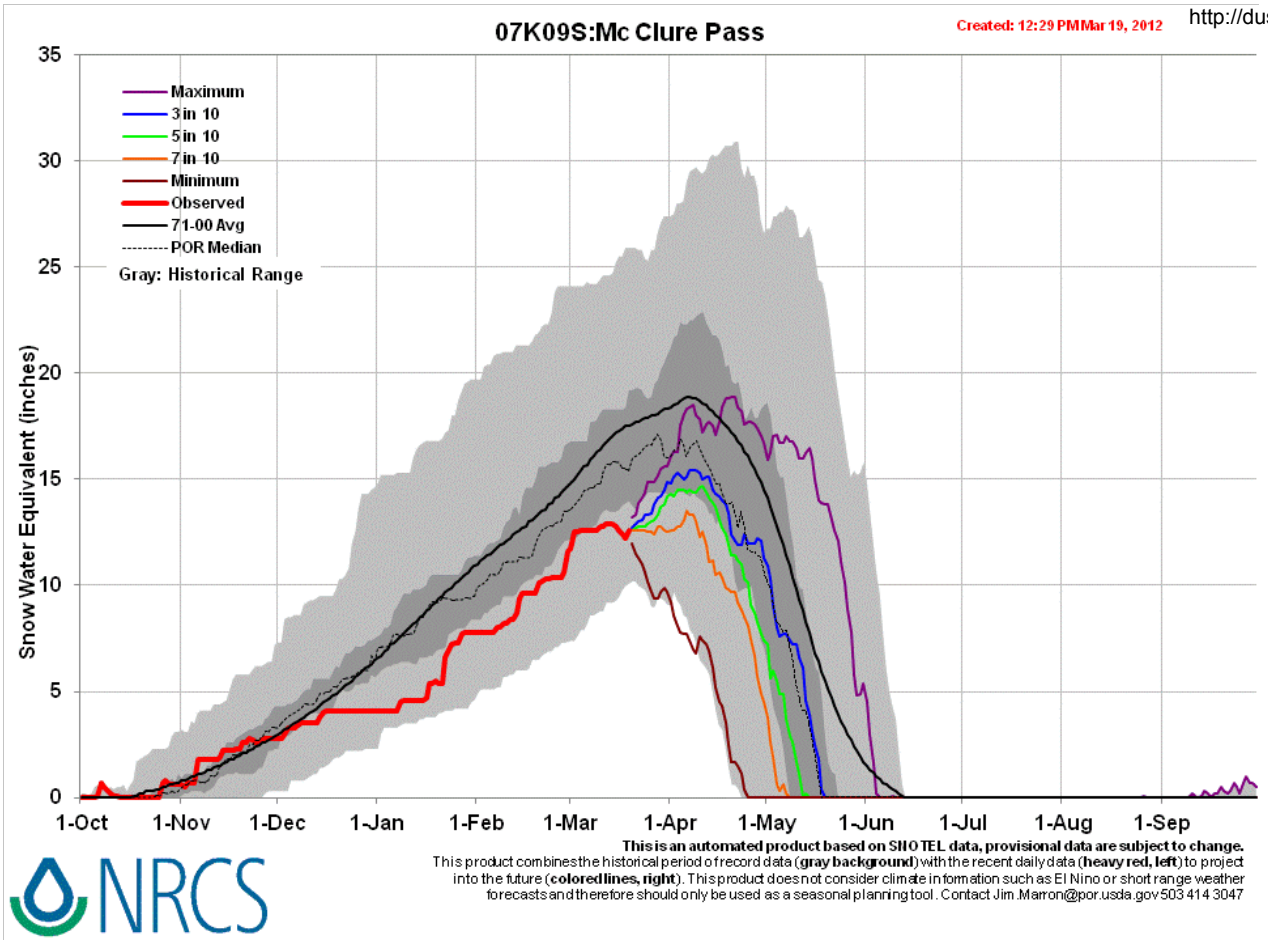






MELT RATE

McClure Pass Snotel has reported a slow decline in SWE since the D4 event, March 6, until a small increase in SWE and snowpack depth on Sunday, March 18, in association with D5. Any new snow associated with D5 dust will rapidly settle and enable D5 to merge with D4, enhance radiative forcing, and accelerate snowmelt rates.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday, March 20). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of any new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where the snowpacks in this locale are at or near isothermal temperatures, solar energy absorbed by the merged D4/D5 dust will begin and/or accelerate snowmelt rates and SWE losses. Where the snowpack retains cold content, energy absorbed by that D5/D4 dust will continue to accelerate warming of the higher elevation snowcover to isothermal.

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CODOS UPDATE FOR PARK CONE SITE: VISITED MARCH 14, 2012

Summary | Snowpack | Melt Rate | Forecast | Earlier Updates | pdf

SUMMARY

Dust layer D4 (March 6) was observed, with its characteristic brown/pink color, at the surface of the shallow snowcover at Park Cone and in the Taylor Reservoir vicinity. Melt had occurred at the snow surface but most of the snowpack remained cold and dry at this north-facing site. Since our site visit, a new D5 event (March 18) has landed on the D4 surface, entrained in a small accumulation of new snow. Radiative forcing of snowpack warming and snowmelt will resume and increase later this week.

SNOWPACK DISCUSSION

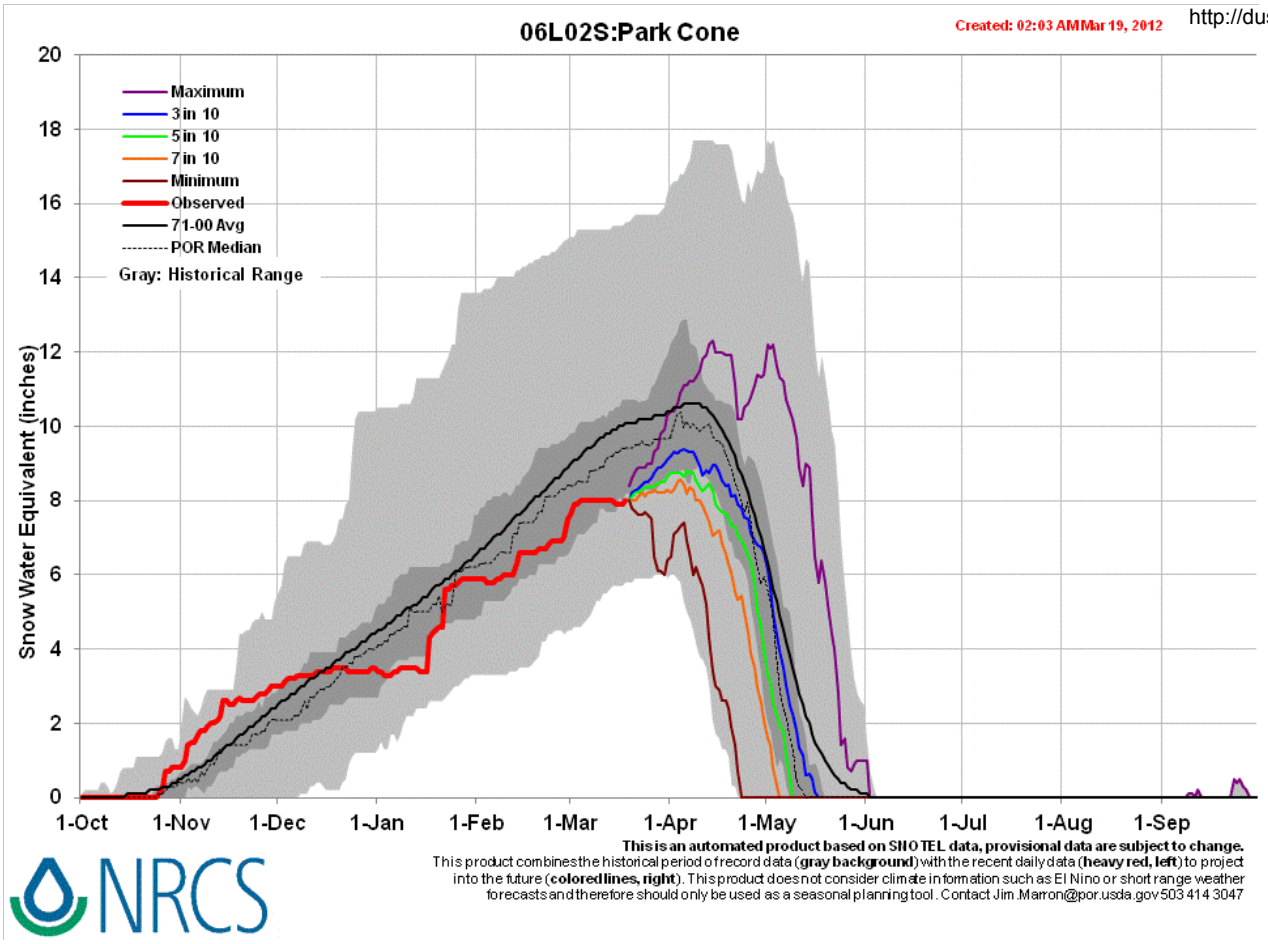
Total snow depth in our snow profile (pdf) was just 28" and most of the snowpack consisted of very weak "depth hoar" grains; mean density of the snowpack was just 238 kg/m3 (23.8% water content). We plunged to the ground when stepping off our skis. Diurnal melt-freeze had occurred in the upper few inches of the snowpack, and the surface was wet at the time. However, the rest of the snowpack was dry and the coldest snow temperature was -7.5° C; the mean snow temperature was -3.7° C. D4 was apparent at the snow surface but no other dust layers were discernible lower in the snowpack.





MELT RATE

Park Cone Snotel has reported virtually static SWE since the D4 event, March 6, until receiving an inch or two of new snow Sunday, March 18, in association with D5. When D4 re-emerges, perhaps augmented by D5, energy absorbed by that dust will continue to accelerate the warming of the snowcover until becoming isothermal. At that time SWE losses would also accelerate, given that D5/D4 remains exposed at the snowpack surface.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of any dusty new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where snowpacks in this locale are already at or very near isothermal temperatures, solar energy absorbed by the emerging D4/D5 dust will begin and/or accelerate snowmelt rates and SWE losses. Where the snowpack retains cold content, energy absorbed by that dust will continue to accelerate warming of the snowcover. As always, the lowest elevation snowpacks (now generally isothermal) will most rapidly respond to radiative forcing.

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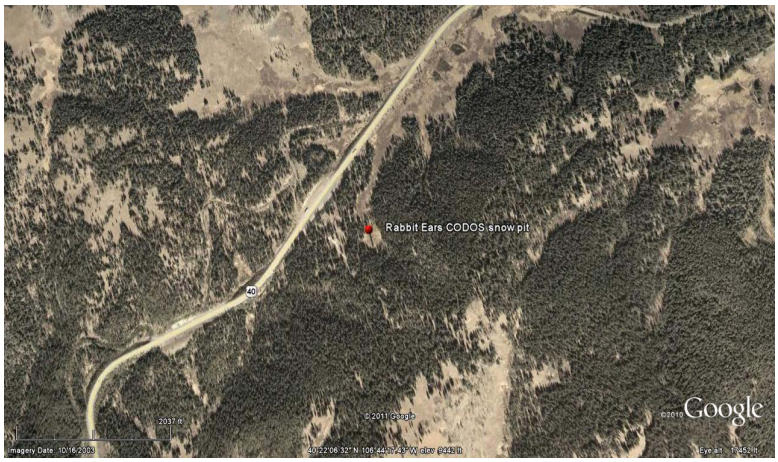
CODOS UPDATE FOR RABBIT EARS PASS: VISITED MARCH 15, 2012

Summary | Snowpack | Melt Rate | Forecast | Earlier Updates | pdf



SUMMARY

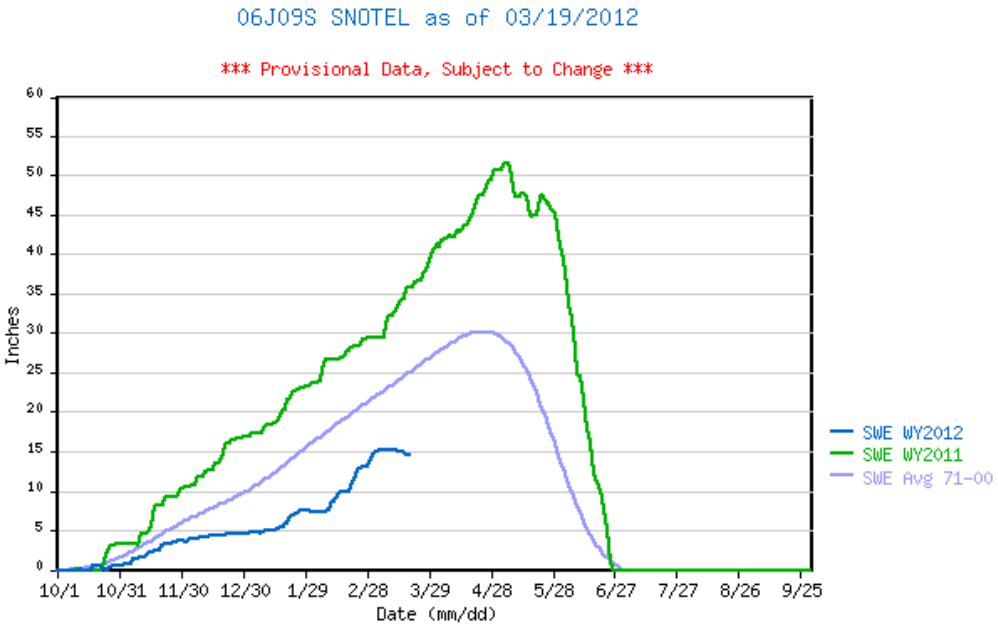
Dust layer D4 (March 6) was observed, with its characteristic brown/pink color, at the surface of the snowcover at our Rabbit Ears Pass CODOS site and on surrounding terrain. The snowpack at our site was rapidly approaching isothermal and was wet or moist throughout the upper two-thirds. Since our site visit, a new D5 dust layer (March 18) has landed on the D4 surface, entrained in just a few inches of new snow. With the merged D5/D4 layer at the surface, dust-enhanced radiative forcing of snowpack warming will resume later this week and the snowpack will quickly become isothermal.

SNOWPACK DISCUSSION

Total snow depth in this snow profile (pdf) was 60” and mean density of the snowpack was 322 kg/m3 (32.2% water content). Underneath the thawed melt/freeze layer of polycrystals at the surface, a thick layer of strong but moist snow contained numerous seeps of free water and ice lenses. The ubiquitous “depth hoar” seen throughout the state was also present at the base of this snowpack, and was still dry. The coldest snow temperature in this profile was -2.0° C, twenty-nine inches below the surface, and the mean snow temperature was -1.0° C. D4 was present at the snow surface and one possible additional dust layer was discernible, about 24” above the ground, at the top of the depth hoar layer.

MELT RATE

Rabbit Ears Pass Snotel has reported a slow decline in SWE since the D4 event, March 6, until a very small increase in snowpack on Sunday, March 18, in association with D5. Any new D5 dust will rapidly merge with D4, enhance radiative forcing, and accelerate the warming of the snowpack on the Rabbit Ears Pass plateau to isothermal. At that time, snowmelt rates and SWE losses would accelerate, given that D5/D4 remains exposed at the snowpack surface.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday, March 20). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of any new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where the snowpacks in this locale are at or near isothermal temperatures, solar energy absorbed by the merged D4/D5 dust will begin and/or accelerate snowmelt rates and SWE losses. Where the snowpack retains cold content, energy absorbed by that D5/D4 dust will continue to accelerate warming of the higher elevation snowcover to isothermal. As always, the lowest elevation snowpacks (now isothermal) will most rapidly respond to radiative forcing.

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CODOS UPDATE FOR SPRING CREEK PASS: VISITED MARCH 17, 2012

Summary | Snowpack | Melt Rate | Forecast | Earlier Updates | pdf

SUMMARY

Dust layer D4 (March 6) was observed at the surface of the shallow snowcover at Spring Creek Pass and in the upper Rio Grande valley. Melt had occurred at the snow surface at our northeast-facing snowpit site but most of the snowpack remained cold and dry. Since our site visit, a new D5 event (March 18) is likely to have landed on the D4 surface, entrained in a small accumulation of new snow. Radiative forcing of snowpack warming and snowmelt will resume and increase later this week.

SNOWPACK DISCUSSION

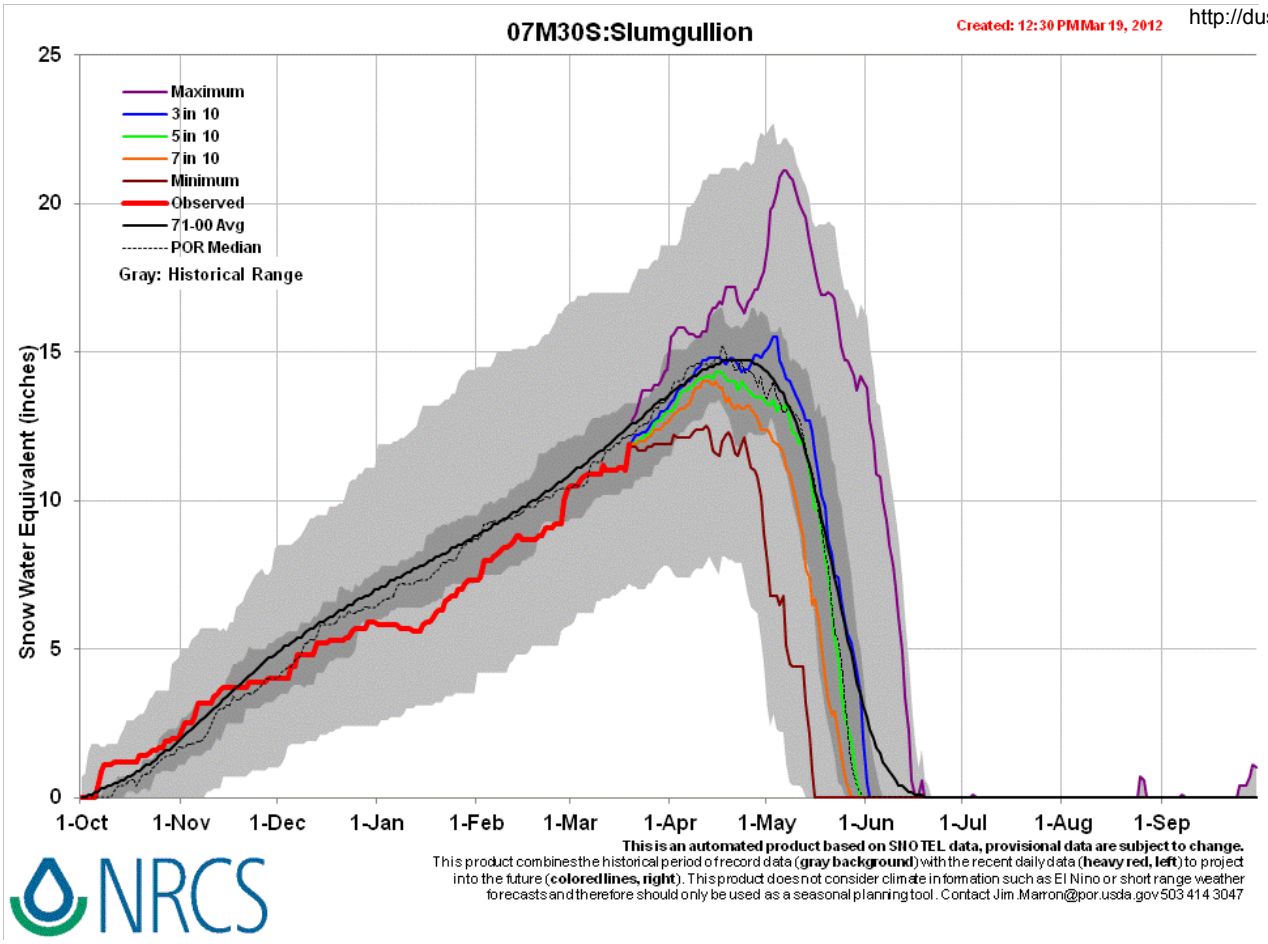
This snow profile (pdf) was a near-perfect replica of the Park Cone snow profile. Total snow depth was just 28" and most of the snowpack consisted of very weak "depth hoar" grains; mean density of the snowpack was just 242 kg/m3 (24.2% water content). We plunged to the ground when stepping off of our skis, as at Park Cone. Diurnal melt-freeze had occurred in the upper few inches of the snowpack and had deposited a layer of ice some three inches below the surface, which was wet at the time. However, the rest of the snowpack was dry and the coldest snow temperature was -3.6° C; the mean snow temperature was -1.6° C. D4 was apparent at the snow surface but no other dust layers were discernible lower in the snowpack.






MELT RATE

Slumgullion Pass Snotel, the nearest Snotel, has reported virtually static SWE since the D4 event, March 6, until receiving several inches of new snow Sunday, March 18, in association with D5. This new snow containing D5 will rapidly merge with D4 and solar energy absorbed by that dust will continue to accelerate the warming of the snowcover until becoming isothermal. At that time SWE losses would begin to accelerate, given that D5/D4 remains exposed at the snowpack surface.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of any dusty new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where snowpacks in this locale are already at or very near isothermal temperatures, solar energy absorbed by the emerging D4/D5 dust will begin and/or accelerate snowmelt rates and SWE losses. Where the snowpack retains cold content, energy absorbed by that dust will continue to accelerate warming of the snowcover. As always, the lowest elevation snowpacks (now generally isothermal) will most rapidly respond to radiative forcing.

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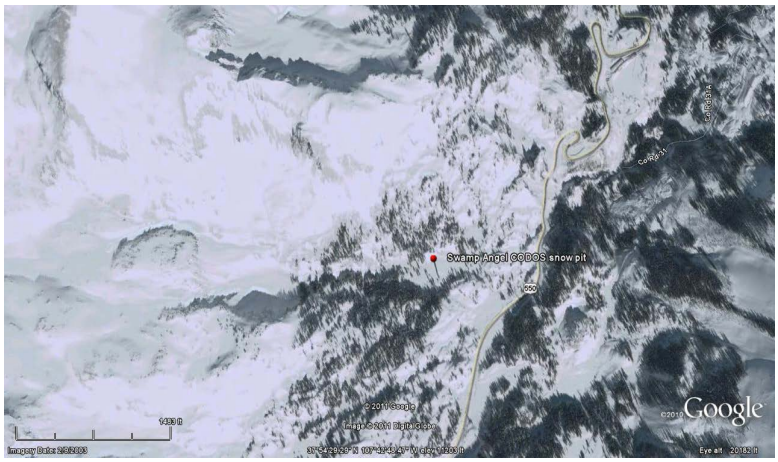
CODOS UPDATE FOR SWAMP ANGEL: MARCH 5-16, 2012

Summary | Snowpack | Melt Rate | Stream Flows | Forecast | Earlier Updates | pdf

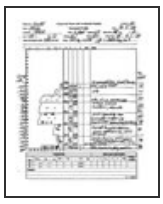


SUMMARY

Immediately after our last formal snow profile at Swamp Angel Study Plot, on March 5, dust event D4 (March 6) was deposited "dry" (without associated precipitation) and immediately reduced snow albedo, increasing radiative forcing at the snow surface. However, the snowpack on March 5th retained considerable cold content. D4 remained fully exposed until Sunday, May 18, when the first precipitation since March 2nd delivered dust event D5 entrained in a foot of new snow. Snowpack warming which occurred as a result of D4 radiative forcing of snowmelt at the snowpack surface will be largely conserved, insulated by this new snow layer. A sustained return to sunny skies and warm temperatures beginning Tuesday, March 20 will rapidly settle this new snow, revealing the D5 dust, quickly merge it with D4, and resume the warming of the snowpack, now approaching isothermal at 0° C throughout.

SNOWPACK DISCUSSION

Total snow depth in our March 5 snow profile (pdf) was 69". Total SWE was 19.45" (compared to 16.2" at the Red Mountain Pass Snotel) and mean density of the snowpack was 282 kg/m3 (28.2% water content). The middle of this snowpack consists of stronger, mid-winter layers, deposited since mid-January. Recent new snow layers topped the snowpack, and much weaker "depth hoar" snow comprised the lower 26" of the pack. The coldest snow temperature was –14.3° C, a few inches below the snow surface; the mean snow temperature was still cold, at -5.1° C. The only clearly discernible dust layer visible in this snow pit was layer D1, four inches above the ground; previously observed layers D2 and D3 had faded from faintly visible to not clearly visible. An unusual episode in preceding days of heavy local haze from Grand Valley pollution had not produced deposition that we could definitively identify at the time, but a very weak deposition became apparent the following day, prior to the deposition of event D4 on March 6 (which began that night). Since March 5, this snowpack has warmed and, until the D5 storm, had shown gradual settlement. This snowpack may become isothermal during the expected period of prolonged sunny and warm weather beginning Tuesday (March 20).

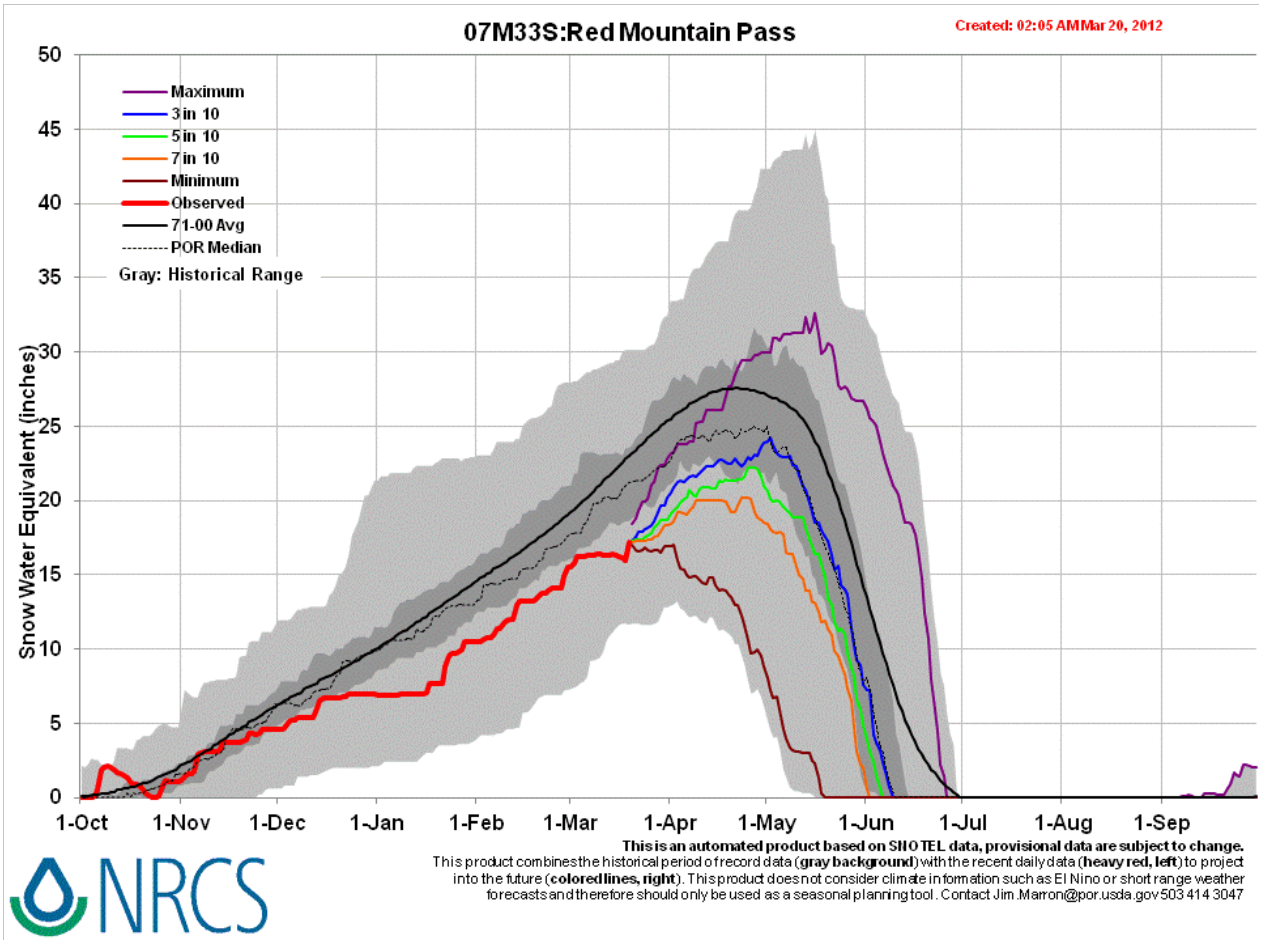





MELT RATE

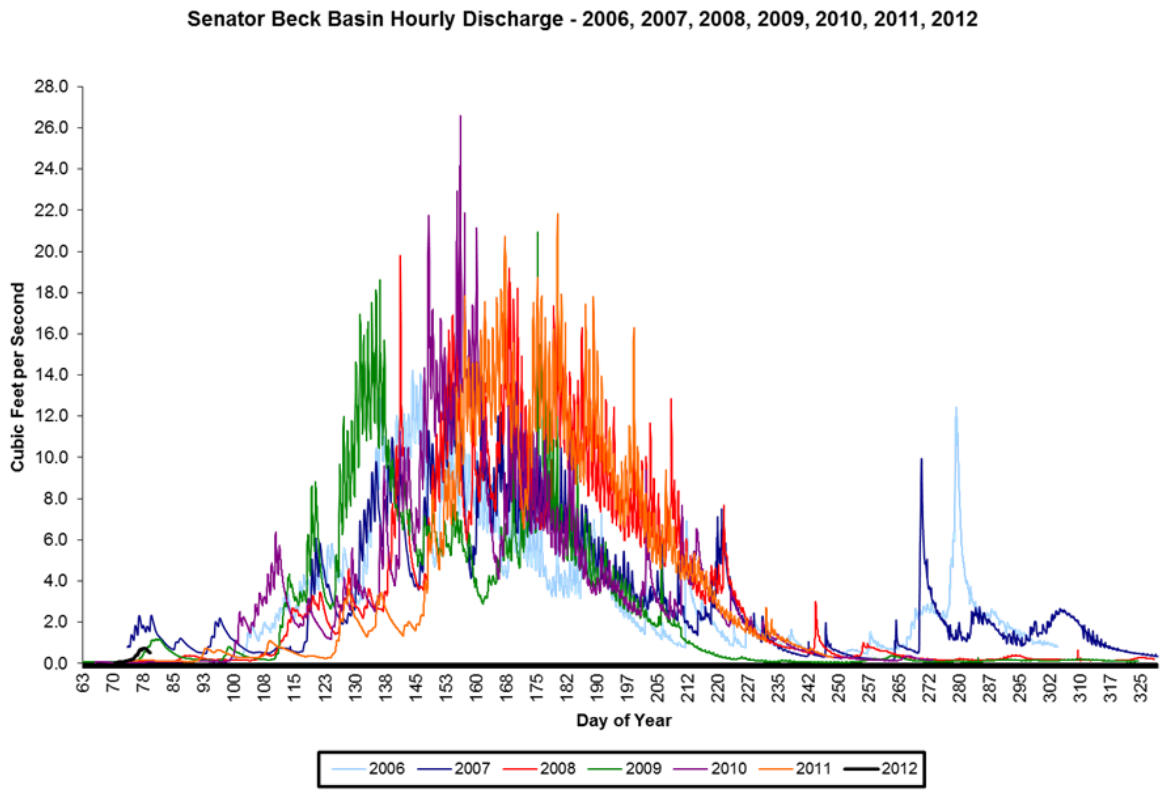
The nearby Red Mountain Pass Snotel reported virtually static SWE from the date of our snow profile, March 5, until the 15th, when a very slow decline in SWE began. Then, the storm bearing dust event D5 added 15" of new snow containing 1.7" of SWE to the snowpack at the Snotel site (14" of snow containing 1.5" of SWE at Swamp Angel Study Plot). Dust was entrained in the new snow during the beginning of this storm but snow during the latter portion of this storm was clean. This clean, new snow surface will initially restore and high snow albedo to the surface but settlement will be rapid and solar energy will soon reach the dust-contaminated snow underneath, rapidly ablating the clean snow and merging the D5 with D4.

Snowpack warming will then resume and, if sunny weather and unseasonable warm temperatures are sustained, higher rates of SWE loss will commence.



STREAM FLOWS

The Senator Beck Basin Stream Gauge was returned to operation on March 11, under very low (base) flows (0.05 cfs). Our timing was good since flows subsequently increased during the next several days reaching a daily average of 0.70 cfs on March 18, then dropped as the storm delivering dust event D5 arrived. During that period both the Animas (at Durango) and Uncompahgre (at Ridgway) rivers showed diurnally ratcheting flow increases matching, in pattern, those at our gauge. That rise in flows at the Senator Beck Stream Gauge was driven by initial snowmelt on the lowest elevation sunny slopes in our study area; low elevation snowmelt in the lowest snowcovered areas in the Animas and Uncompahgre watersheds, enhanced by D4 at the surface, also contributed to those increasing flows.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday, March 20). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of the new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where snowpacks in western San Juan Mountains are already at or very near isothermal temperatures, solar energy absorbed by the emerging D4/D5 dust will accelerate snowmelt rates and SWE losses. Where the snowpack retains cold content, energy absorbed by that dust will continue to accelerate warming of the snowcover to isothermal at 0° C. As always, the lowest elevation snowpacks (now generally isothermal) will most rapidly respond to radiative forcing and quickly contribute to increased streamflows.

CENTER FOR SNOW & AVALANCHE STUDIES

CODOS UPDATE FOR WILLOW CREEK PASS: VISITED MARCH 15, 2012

Summary | Snowpack | Melt Rate | Forecast | Earlier Updates | pdf

SUMMARY

Dust layer D4 (March 6) was observed, with its characteristic brown/pink color, at the surface of the snowcover at our Willow Creek CODOS site and on surrounding terrain. The snowpack was effectively isothermal at our site, and wet throughout. Since our site visit, a new D5 dust event (March 18) has landed on the D4 surface, entrained in just a few inches of new snow. Dust-enhanced radiative forcing of snowpack warming will resume later this week as D5/D4 re-emerge.

SNOWPACK DISCUSSION

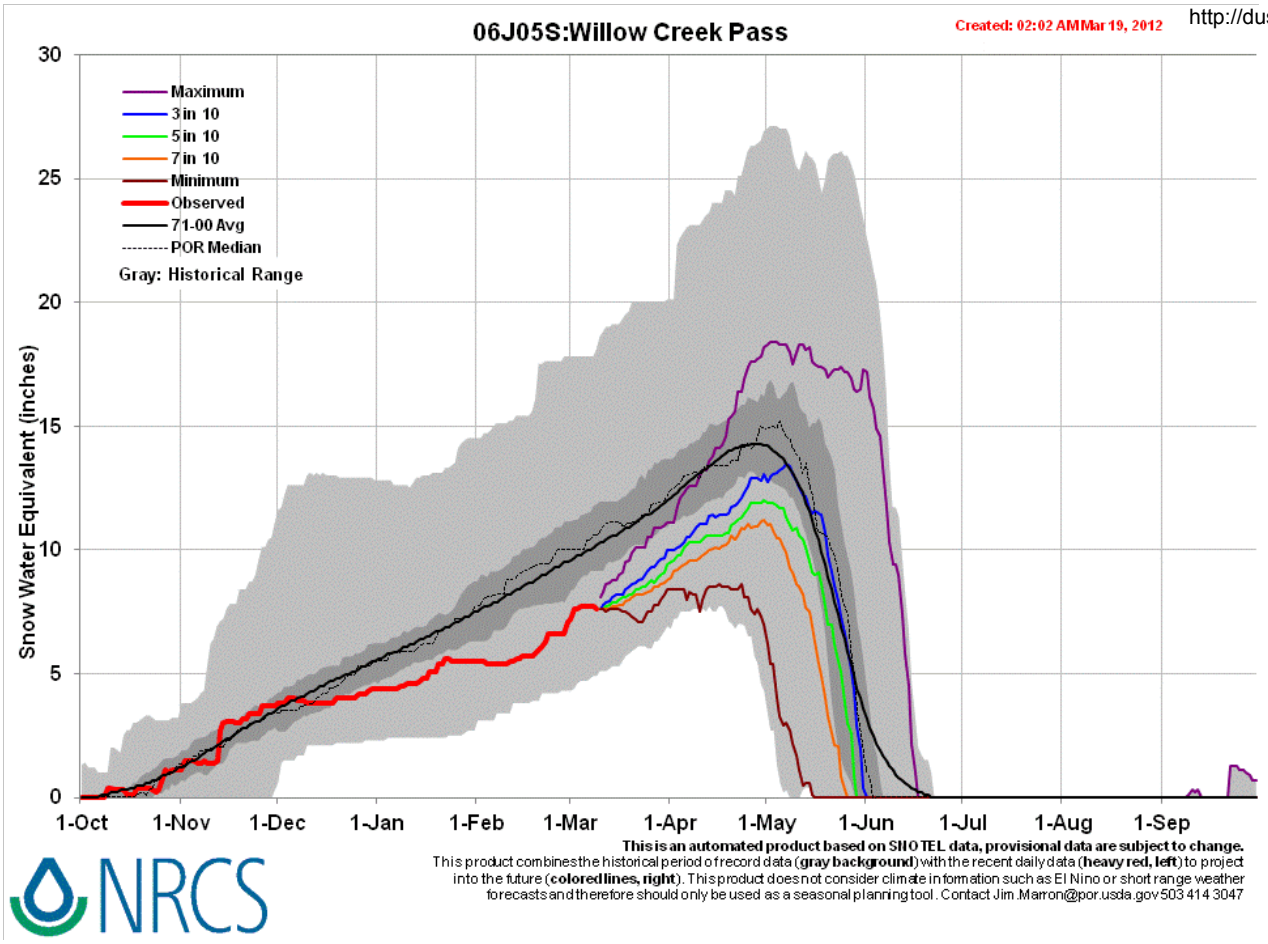
Total snow depth in this snow profile (pdf) was 29” and mean density of the snowpack was 285 kg/m3 (28.5% water content). Aside from an ice layer just below the surface, this snowpack consisted of wet and very weak “depth hoar” snow converting to melt forms. We triggered very large collapses on our approach to the site, dropping 4-5”. The coldest snow temperature in this profile was -0.4° C, nine inches below the surface, and the mean snow temperature was -0.1° C. Other than D4, no additional dust layers were discernible.






MELT RATE

Willow Creek Snotel has reported static SWE since the D4 event, March 6, and no increase of SWE or new snow on Sunday, March 18, in association with D5. Any new D5 dust will rapidly merge with D4, enhance radiative forcing, and accelerate snowmelt rates and SWE losses in the already-isothermal snowpack in much of this watershed, given that D5/D4 remains exposed at the snowpack surface.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday, March 20). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of any new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where the snowpacks in this locale are at or near isothermal temperatures, solar energy absorbed by the merged D4/D5 dust will begin and/or accelerate snowmelt rates and SWE losses. Where the snowpack retains cold content, energy absorbed by that D5/D4 dust will continue to accelerate warming of the higher elevation snowcover. As always, the lowest elevation snowpacks (now isothermal) will most rapidly respond to radiative forcing.

CENTER FOR SNOW & AVALANCHE STUDIES

CODOS UPDATE FOR WOLF CREEK PASS: VISITED MARCH 17, 2012

Summary | Snowpack | Melt Rate | Forecast | Prior Update | pdf

SUMMARY

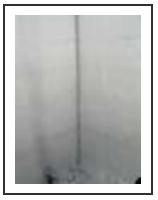
Dust layer D4 (March 6) was observed at the surface of the snowcover at our Wolf Creek Pass CODOS site and on both sides of the Pass as far down as snowcover extended. Intensive cycles of melt-freeze had wetted the entire snowpack and snow temperatures were nearing isothermal. Since our site visit, a new D5 event (March 18) is likely to have landed on the D4 surface, entrained in new snow. Radiative forcing of snowpack warming and snowmelt will resume and increase later this week.

SNOWPACK DISCUSSION

Total snow depth in this snow profile (pdf) was 63” and mean density of the snowpack was 348 kg/m3 (34.8% water content). Diurnal melt-freeze cycles had produced 6” of laminated ice layers and melt-freeze “polycrystals” (corn snow), and the remainder of the upper one-half of the snowpack consisted of strong layers of fine round grains. The lower half was composed of weaker depth hoar grains, albeit strengthening. Ice layers and vertical “flow fingers” of clear ice were observed throughout the moist snowpack. The coldest snow temperature was -2.9° C, just below the surface. However most of the snowpack was warmer and the mean snow temperature was -0.7° C. D4 was apparent at the snow surface at this site and in surrounding terrain. Four additional dust layers were also discernible lower in the snowpack, at 6”, 24”, 45” and 57” below the surface, respectively. With five total dust layers, this site presented one more dust layer than we’ve observed at our Swamp Angel Study Plot.

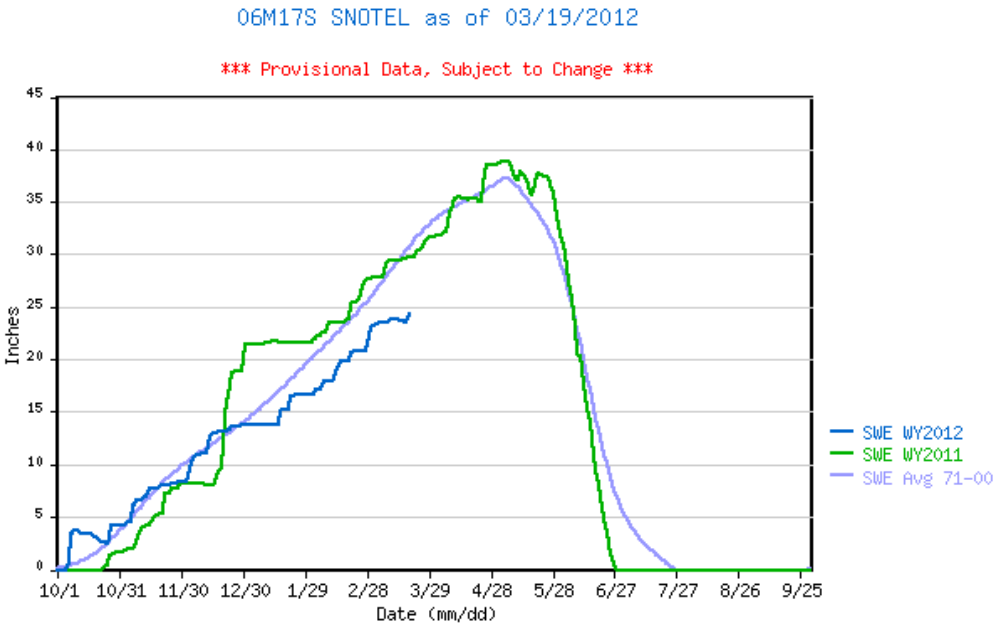





MELT RATE

Wolf Creek Summit Snotel has reported virtually static SWE since the D4 event, March 6, until receiving several inches of new snow Sunday, March 18, in association with D5. This new snow containing D5 will rapidly settle and enable D5 to merge with D4. Solar energy absorbed by that merged dust will continue to accelerate the warming of the snowcover until becoming isothermal. At that time SWE losses would begin to accelerate, given that D5/D4 remains exposed at the snowpack surface.



FORECAST

The National Weather Service expects sunny skies and unseasonably warm temperatures to return soon after the current storm clears (Tuesday, March 20). Under the combination of strong solar radiation and warm air temperatures later this week, settlement of new snow containing D5 will be very rapid and D5 will quickly merge with the D4 layer. Where snowpacks in this locale are already at or very near isothermal temperatures, solar energy absorbed by the emerging D4/D5 dust will begin and/or accelerate snowmelt rates and SWE losses. Where the snowpack retains cold content, energy absorbed by that D5/D4 dust will continue to accelerate warming of the snowcover. As always, the lowest elevation snowpacks (now generally isothermal) will most rapidly respond to radiative forcing