# 2013/2014 Snow Pack Summary Archive

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Agassiz Peak Station (APS) at 11500' Snowslide Canyon Snotel (SCS) at 9700'

# Friday, March 21, 2014 - Happy Spring!

This summary will conclude the weekly Snow Summaries for winter 2013-2014, unless a significant event warrants an update. Thank you for your interest and support. Please let us know of any suggestions, compliments or criticisms so we can improve for next season. There's still great spring skiing to enjoy, and April may provide more snow storms.

# **Precipitation:**

Other than snow transported by wind, only a trace of precipitation has fallen from the clouds during the last week. SCS reports a base of 87.5 cm (35''). Arizona Snowbowl is reporting an undisturbed base of 97.5 cm (39'') at 10800', west aspect; and a total snow accumulation of 275 cm (110'') since October 1, 2013. The seasonal snow accumulation average at this location is 662.5 cm (265'') giving us approximately 40% of our seasonal mean.

# Wind:

It has been a breezy week, with hardly a break following last weekend's strong winds out of the east and north. Wind gusts approaching 70 mph were recorded at APS on March 16 and 17 with sustained wind in the 40s (mph). Following the weekend, wind directions eventually shifted to a more zonal flow out of the west and south with velocities in the high teens to mid 30s reported at APS.



Ablation feathers near treeline.

Most of the available snow for transport moved during the weekend, and ridge-top snow plumes have subsided. Near treeline, textured ablation feather patterns in the snow surface are appearing giving evidence of significant loss of cover due to evapo-sublimation rather than melting.

#### **Temperature:**

Temperatures throughout the week were seasonally average to above average. APS reported low temperatures in the 20s°F throughout the week and above freezing conditions(in the mid 30s°F.) midday on March 16 though the 21, however melting was moderated by the wind chill.

# **Summary**



Unstable pockets of wind slab observed on a variety of aspects last weekend have bonded reasonably well to the snow below. Last weeks wind slab column failures have stabilized to moderate strength, with quality 2 shears (example CT 15 Q2). However, particularly on cooler aspects (north, northeast and northwest) sudden collapse of overlaying slab, down into the basal depth hoar layer was observed at similar strengths (CT 26 Q2) on North Core Ridge and above Upper White Lightning. Distribution of these instabilities continues to be variable, but skier-triggered avalanches on steep, cold, wind loaded terrain is possible.

As we have advised throughout the winter, a conservative approach is best. Skiers and boarders are advised to avoid traveling on hard wind slab, particularly if it has a hollow (or drum-like) feel/sound when weighted. Midday warming will weaken slab strength, increasing the likelihood of triggering persistent slabs.



Fairly warm daytime maximum temperatures and below freezing nights characterized the second half of last week, and these conditions are forecast to continue at least into the first half of the coming week. On warmer aspects where snow still remains, this diurnal warming and cooling will hopefully initiate the characteristic springtime corn cycle. The big question is, will the corn develop before what little snow we have melts or sublimates away? This cycle will subsequently progress onto cooler aspects if these weather conditions persist.

Generally, melting and refreezing produces more predictable instabilities than cold winter snowpack. The key to safety is getting off slopes as they start to get too sloppy and moving to cooler slopes as warm ones deteriorate. Keep in mind that snow rollers and deep ski penetration are important factors to observe and indicative of excessive warming of the snowpack. Also, remember that snow conditions change quickly at this time of year. An hour can be the difference between great spring skiing and quickly rising wet snow instability. **Southern and western aspects are most prone to wet slide activity**.

Backcountry skiers and boarders should be particularly mindful of warm nights when the snow may not gain full strength, because refreezing between grains may not occur.

Checking the weather links for when low temperatures fail to reach the freezing point; and timing your adventures for early in the day to avoid slopes as they become saturated are good spring skiing strategies. Additionally several consecutive days of unseasonably warm weather or significant rain on the snowpack can increase the likelihood of wet slide activity.

As mentioned last week, melt-water percolating down through the snowpack can travel in a linear fashion along density breaks and crusts, or at the ground interface, potentially causing release of an entire slab as a unit on this watery weak layer.

**Into the future:** The conditions described above are likely to characterize what one can expect for the remainder of the snow season: the spring corn cycle. Typically, wet avalanche conditions will gradually diminish as the snowpack gains evermore density, consolidates and becomes mature ripened granular snow; or more likely vanishes by melting or evapo-sublimation, leaving bare ground.

The exception will be instability created by any significant new snowfall or windblown redistribution of new snow. How well new snow bonds with whatever lies below will once again

determine potential hazards.

Travel above treeline and access to the Inner Basin has become more challenging as snow disappears from ridge-lines and south aspects. However, an enjoyable ski tour is still possible. There will be great views, but some hiking on the bare patches may be required...

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

# Friday, March 14, 2014

#### **Weather**

#### **Precipitation:**

A fairly dry short wave trough passed through our region late this week, creating flurries on Thursday afternoon. Surprisingly, wrap-around moisture blessed us with 6-9 inches of fairly dense power early Friday morning. During the day on Friday, more snow continued to trickle down mainly in the form of graupel, giving our snowpack a welcome lease on life, renewed excellent skiing and fresh appearance. Looking forward, the forecast predicts a return to springtime conditions, characterized by cool nights and warm sunny days, as we approach the end of the calendar winter on March 20th.

SCS reports a base of 101 cm (41") with the addition of just over 1/2 inch of SWE (Snow Water Equivalency) in the past 24 hours. Arizona Snowbowl is reporting an undisturbed base of 112 cm (45") at 10800', west aspect; and a total snow accumulation of 275 cm (110") since October 1, 2013. The seasonal snow accumulation average at this location is 662.5 cm (265") so we are still only about 40% there.

#### Wind:

Breezy southerly winds were reported by Arizona Snowbowl on Tuesday and throughout the week, but little significant redistribution of snow was observed. Thursday nights storm fell with little wind, however, strong Northerly winds are predicted for Saturday and Saturday night, raising the likelihood of redistribution of the new snow. Winds will diminish on Sunday as high pressure builds and establishes itself for the upcoming week.

#### **Temperature:**

Temperatures throughout the week were seasonally average to cooler than average. APS reported low temperatures in the 20s°F throughout the week and near or above freezing (32°F) daytime

temperatures on Mar.  $8^{th}$  and  $10^{th}$ , but cooler (below freezing) highs on the  $11^{th}$ - $13^{th}$ . SCS recorded temperatures ranging between 15 and  $51^{\circ}$  F.

# <u>Summary</u>



Widely distrusted pockets of potentially reactive wind slab may still remain below the new snow, but will be sparsely distributed. Distribution of these potentially problematic areas is highly variable and challenging to assess, now hidden below new snow. The added load of the new snow will enhance the likelihood of skier triggering by stressing the slab closer to the failure threshold.

As we have advised throughout the winter, avoid traveling on hard wind slab, particularly if it has a hollow (or drum-like) feel/ sound when weighted. The new snow will dampen this effect making such assessment even harder. In the near future, staying off of pillowed wind loaded areas near ridge tops is probably best.



Reactive windslabs below treeline on March 13, 2014. Northerly aspect on Doyle Peak. Snowboard for scale.



Above average daytime high temperatures (approaching 50°F at 11500') and below freezing nights are in the forecast for the coming week, producing melting in the afternoons – i.e. weakening of bonds between grains and free-water percolation during the heat of the days, and refreezing and strengthening of the snowpack at night. Such melt/freeze cyclic conditions are typical of the season as spring arrives.

Generally, melting and refreezing produces more predictable instabilities than cold winter snowpack. The key to safety is either moving to cooler aspects and getting off of slopes as they start to get too sloppy. Snow rollers and deep ski penetration are important factors to observe. Also, remember that snow conditions change quickly at this time of year. An hour can be the difference between great spring skiing and quickly rising wet snow instability. **Southern and western aspects** are most prone to wet slide activity.

Backcountry skiers and boarders should be particularly mindful of warm nights when the snow may not gain full strength, because refreezing between grains may not occur.

Checking the weather links for when low temperatures fail to reach the freezing point and timing your adventures for early in the day to avoid slopes as they become saturated are good spring skiing strategies. Additionally several consecutive days of unseasonably warm weather or significant rain on the snowpack can increase the likelihood of wet slide activity.

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The exception will be instability created by any significant new snowfall or windblown redistribution of new snow. How well new snow bonds with whatever lies below will once again determine potential hazards.

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# Sunday, March 9, 2014

# **Weather**

# **Precipitation:**

Last weekend a wet and warm storm blanked the San Francisco Peaks area with approximately 5cm (2") of SWE (snow water equivalent). Snowfall totals were highly variable. By Sunday, March 2nd, SCS reported 30cm (12") and 5cm (2") of SWE from the storm.

SCS reports a base of 101 cm (40"). Arizona Snowbowl is reporting an undisturbed base of 101 cm (40") at 10800', west aspect; and a total snow accumulation of 264cm (104") since October 1, 2013. The seasonal snow accumulation average at this location is 673cm (265").

# Wind:

Light to Moderate southerly winds were reported by Arizona Snowbowl during the onset of last weekend's storm. The APS anemometer was rendered non-functional by rime early during the storm. SCS reported light and variable winds with moderate gusts during the storm.

# Strong Northerly winds up to 50 mph were reported at APS on Saturday March 8.

# **Temperature:**

APS reported a low temperature of 16°F on March 2 and near or above freezing (32°F) daytime temperatures for much of the week. SCS recorded temperatures ranging between 19 and 48° F.

# Summary



Strong Northerly winds raked the Peaks on Saturday March 8, transporting any remaining available snow from the previous weekend's storm. Significant sublimation (snow being transported aloft and evaporating) and potential wind slab formation above treeline, along ridges and cross loading along terrain features occurred. Watch for hollow sounding slabs, shooting fractures or 'whumpfing' sounds as signs of wind slab.

The much needed precipitation of March 1 arrived as a 'right side up' storm, with warm and moist conditions prevailing Friday February 28, and a rain/snow line as high as 8000'. The storm cooled throughout Saturday with minimal wind, resulting in up 20" of snow in favored locations.

2" of SWE (snow water equivalent) is a significant load on the existing snowpack. On South aspects, the new snow fell mostly on the rocky bed surface or a melt freeze crust, which has quickly bonded, become saturated or melted due to the warm temperatures following the storm. Roller balls and heating from rocks were observed Sunday, March 2 as the Arizona sun quickly heated southerly exposed aspects.

On shaded and sheltered upper elevation aspects, a shallow, 100 cm or less, faceted snowpack received the load. Tests recorded on Saturday March 1 and Friday, March 7, revealed moderate to high reactivity on facets midway through the snowpack on a Northwest aspect at treeline, 11600'. This layer was the surface of the shallow snowpack prior to the storm of February 1st, and has retained facets despite a return to an equilibrium snowpack temperature regime as spring approaches (a temperature gradient of less than 1 degree C/10 cm overall).



Facets March 7, 2014 – The slab has been flipped here to observe the failure plane. The snowpack is highly variable and spatially diverse, but knowing a potential weak layer exists is worth investigating whenever approaching avalanche terrain on north aspects.

Several observations from the Inner Basin Monday, March 3, reported excellent conditions with minimal signs of instability other than warming and roller balls on south aspects.



Northerly Slopes of Hard Core Ridge in the Background - March 3, 2014



Warm temperatures approaching 50°F at 11500' returned mid week, consolidating or melting the new snow and saturating the snowpack on sunny aspects. With enough warming, wet slab activity could be an issue. Check the weather links for evenings/nights which have not achieved freezing temperatures and time your adventures for early in the day to avoid slopes that are saturated. Melt water percolating through the snowpack can travel in a linear fashion along

density breaks and crusts, or to the ground and release the slab as an entire unit. Roller balls and pin wheels are warning signs and indicators to travel on cooler slopes and lower slope angles.

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Thank you to everyone who helped with the <u>Mikee Linville Snowdance Party on Saturday</u> <u>March 8th</u>. Great music from Joel Rieck, Diamond Down String Band and the Shindaggers; good friends and food! Special thanks to Uncle Buzz for his vision and vigor inspiring this event!

More scholarships available for avalanche courses and Wilderness First Responder for next winter...check the Mikee Linville Scholarship page under the 'Education' link.

Friday, February 28, 2014

# The Weeks Weather in Review

#### **Precipitation:**

None until the last 24 hours, which brought the first of two low pressure systems into the region; the second of which will continue through the weekend with significant snowfall forecast for the San Francisco Peaks (up to 2 inches SWE). Before this storm cycle, it has been about 3 weeks since any significant precipitation.

We may post a "Storm Update" if noteworthy accumulations, rates of precipitation or wind transported snow become realities. Winter continues until the Spring Solstice on March 20th... so a month of winter on the way and more snow to look forward to. Maybe the tide is turning – we will see.

SCS reports a base 89cm (35"). Arizona Snowbowl is reporting an undisturbed base of 84cm (33") at 10800', west aspect; and a total snow accumulation of 208cm (82") since October 1, 2013. The seasonal snow accumulation average at this location is 673cm (265").

#### Wind:

During the week, winds have been characterized by light to moderate zonal flow out of the southwest with increase velocity on the afternoon of February 27th, when gusts near 40 mph were recorded.

# **Temperature:**

Temperatures have been seasonally normal with APS reporting a high temperature of 36°F on Wednesday, February 26, and low temperatures consistently in the mid to upper 20s °F. Over the last 5 days, SCS recorded temperatures ranging between 22 and 47° F.

# **Summary**

Seasonal temperatures and light to moderate winds characterized conditions earlier in the week. Thursday brought encouraging signs of a pattern change and a dusting of new snow and windy southwesterly flow. **Above treeline, new snow will accumulate on highly variable substrate** ranging from bare ground and boulder fields, to areas of deep partially bonded facets, sun baked isothermal snow, and wind slab. This variability is somewhat predictable, primarily by aspect and wind sheltering, with facets on shaded northerly slopes, sun baked snow on southern slopes, and slabs in areas protected from the strong northwest winds that transported snow after the storm three weeks ago.

The questions of importance are: 1) How well will the new snow bond to the old? 2) Will enough snow be deposited to create dangerous slab avalanche conditions?



The current primary concern is storm snow avalanches releasing before sufficient bonding occurs with the snow below. Where snow is now accumulating on bare ground, storm snow avalanches are unlikely however, where new snow is falling on old, there may be a problem. High spatial variability old snow coverage and remembering where it was prior to being covered by new snow, makes accessing avalanche terrain potentially challenging. As always, the best rule of thumb is waiting and giving new snow a chance to bond with the old snow before skiing or riding it.

A review of red flag snow accumulation rates and amounts might be prudent.

- Snowfall of 1 inch or more per hour for 6 hours with wind
- Snowfall of 8 inches in 12 hours
- Snowfall of 12 inches in 24 hours
- Total snow water equivalency of more than 1 inch (SWE)
- Rain on snow event

If any of these thresholds become reality in this ongoing storm cycle, waiting at least 24 hours (for bonding to take place) before traveling in avalanche terrain is highly encouraged.



A secondary concern is slabs of new snow that may have accumulated above old facets and depth hoar. These old persistent weak layers can still be found in shaded areas below treeline and on northerly slopes above. Although most of these crystals are gaining strength by bonding and rounding, there is still potential for large avalanches to occur with the addition of significant new snow load – possibly releasing to the ground.

Additionally, recent investigations have found near surface faceting in the old surface snow at high elevation on northern and northwest aspects. On Thursday morning before the storm picked up, a pit dug on a northwest facing slope in Hidden Valley revealed recycled powder (tinny near surface facets formed by diurnal temperature fluctuations) in the top 30 centimeter of the snowpack. Once covered by new storm slab, these tiny crystals could represent a potentially dangerous weak layer.



~NE through SE aspects of Humphreys Cirque on February 20, 2014. A reminder and idea of where snow still remained prior to the current storm cycle.

As mentioned last week, remembering (and mentally mapping) where old snow remained can have benefits in accessing the potential hazards created by new snow on top.

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Join us for the 4th annual <u>Mikee Linville Snowdance Party on Saturday March 8th</u>! Safe travels and check out <u>KPAC's Facebook page</u> for event updates. Thank you for your interest and participation!

# Friday, February 21, 2014

# The Weeks Weather in Review

#### **Precipitation:**

None. It's been about 2 weeks since any significant precipitation. SCS reports a base of 91cm (36"). Arizona Snowbowl is reporting an undisturbed base of 33" at 10,800', west aspect; and a total snow accumulation since October 1 of 82".

The seasonal snow accumulation average for the San Francisco Peaks is 265" at 10800'. Winter continues until the Spring Solstice March 20th...so a month of winter on the way and more snow to look forward to.

#### Wind:

APS recorded strong and extremely strong southwesterly and northwesterly winds with gusts up to 65 mph Thursday morning, February 20. SCS recorded variable and moderate winds with some strong gusts.

# **Temperature:**

APS reported a high temperature of 42 (°F) on Saturday, February 15, and did not dip below freezing the previous night. Over the last 5 days, APS temperatures ranged between 17 and  $35^{\circ}$  F, and SCS recorded temperatures between 19 and  $49^{\circ}$  F.

# Summary

# **Overall:**

Seasonal temperatures and breezy conditions have characterized the past 5 days. Drought conditions continue with no guaranteed end in sight, but a conditionally hopeful storm is forecast to arrive next Thursday. Little snow is available for wind transport since it has all moved

previously, and is now locked up in slab, has sublimated or melted away. Snow coverage in the backcountry is sparse, with the predominant hazards related more to encountering terrain obstacles and poor coverage.

Advanced facets and depth hoar can still be found in shaded areas below treeline and on northerly slopes above, but even at these locations, crystals are slowly gaining strength and rounding. Recent investigations revealed strengthening of most faceted layers and depth hoar to at least four-finger hardness. On Thursday, a pit dug on a north facing slope near the ridgeline above Flagstaff Springs (just below the saddle between Agassiz and Humphrey's Peaks), revealed a meter of cold faceted snow, mostly well bonded with relative strength – four fingers throughout.

Surprisingly, given enough force, we were able to propagate an Extended Column Test (ECT) with a score of 28 producing sudden collapse to the ground. This indicates low likelihood of skier triggering, but still lingering possibilities of significant avalanching to the ground still remain, particularly if we eventually receive significant precipitation. These conditions may be representative of more remote locations such as northerly aspects of Abineau Canyon and Fremont Peak.

On most other aspects in open terrain, the snowpack has reached near isothermal conditions (the same temperature throughout the snowpack) or disappeared altogether. In snow that still remains, further faceting is unlikely in the near future, and bonding and strengthening is slowly taking place. Shaded areas, on the other hand, range from crusty to pure cold facets, depending on aspect, canopy density, and elevation. Bare ground is the dominant condition below 9000 feet on most aspects. **Spatial variability remains high, but nothing alarming has been observed recently.** 



~NE through SE aspects of Humphreys Cirque on February 20, 2014.

Mapping snow coverage is important in assessing potential weak layer distribution in the event that significant snowfall blesses us in the future.

An anticipated warming trend during the upcoming week may bring renewed threats of wet avalanches on southern and western aspects in the rare locations where deep snow remains, such as wind pillows and loaded pockets.

There is still some skiing and riding out there, but backcountry users are **carrying their skis and boards for significant distances to find adequate snow coverage** – **bare ground is quickly winning the battle.** 

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Safe travels and check out <u>KPAC's Facebook page</u> for event updates. Thank you for your interest and participation!

A special thank you and HAPPY BIRTHDAY to KPAC Web Master and Peaks Splitboarding Guru Troy Marino!

# Friday, February 14, 2014 Happy Valentines Day!

#### **The Weeks Weather in Review**

"June-uary" is back to visit with a return to high pressure this week. Warm temperatures, spring like conditions and strong northerly winds characterized this weeks' weather.

#### **Precipitation:**

Little more than flurries occurred last Monday, quickly followed by high pressure rebuilding over the region.

#### Wind:

APS at 11500' recorded sustained winds in the upper 20 mph from the north and northwest and strong gusts exceeding 50 mph on Wednesday and Thursday, February 12-13. This was confirmed by reports of saltation and turbulent suspension of snow above treeline and along ridge crests above Arizona Snowbowl.

#### **Temperature:**

Heat wave – we are experiencing unseasonably and even record-breaking high temperatures for this time of year. Over the last few days APS reported low temperature in the twenties (°F) and

highs at or near 40° F. In the last few days, SCS recorded temperatures between 15 and 49° F at 9700' – significantly warmer than the previous week.

# Summary

**Overall:** In locations not transformed to wind slab, last week's new snow seems to have bonded well to the old snowpack below. The exception is where new wind slab has recently formed, resulting from strong mid-week northerly winds. These were recorded at **prime velocities to move snow onto southern aspects and build cross-load deposits on leeward flanks of gullies near and above treeline. Observers noted significant saltation (near surface windblown snow redistribution) particularly on Wednesday February 12.** 

Also, a series record-breaking or near **record-breaking warm days** (end of the week and into the weekend) are likely to raise the potential for wet avalanches. These will emanate from exposed rock bands, especially on southerly aspects where radiant heat gain is greatest.



Once again **wind slabs are a concern.** We encourage avoidance of wind slabs (soft or hard), which are perched on persistent weak snow below. These persistent weak layers remain on cooler aspects at and above treeline, however newly formed wind slabs are most prevalent on southern facing slopes where depth hoar seems to be slowly rounding and bonding. Still spatially varied pockets of dangerous wind slab remain.

Good skiing and riding can be found near and below treeline in zones where coverage remains sufficient in depth – albeit a diminishing commodity. Stability tests on protected areas, where recent wind loading has not occurred show signs of strength and good bonding between new and old snow. Compression tests have either not failed (CTN) or collapsed to the ground on old depth hoar with a lot of force (CTH 28, Q3).



**AVALANCHES** As the snowpack heats up in the afternoon, backcountry travelers must be aware of snow rollers and wheels coming down the slopes as point and release avalanches. These are clear indicators of free water within the snowpack and **increasing wet slide potential.** In locations with wind slab, these could take the form of wet slab avalanches, which move slower than dry avalanches, but due to the high density of snow entrained, pack tremendous punch.

We encourage backcountry travelers to **move to cooler terrain and lower angle slopes** as these signs of warming in the snowpack become apparent. Warming slabs tend to be more sensitive to triggering, particularly when the surface reaches the melt/freeze boundary. This is known as **"Thaw Instability"** among avalanche professionals. Planning your adventure for early in the day or on cooler aspects is a prudent strategy for safety, as springtime conditions arrive.

Transition from a cold winter snowpack to a springtime isothermal snowpack is perhaps the most worrisome timeframe from a wet avalanche perspective. Our current heat wave should be respected by backcountry travelers . Snowpacks react poorly to the rapid change represented by our current spike in temperatures. Keep avalanche eyeballs wide open.

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Safe travels and check out <u>KPAC's Facebook page</u> for event updates. Thank you for your interest and participation!

Saturday, February 08, 2014

#### The Weeks Weather in Review

This past week's weather has been a return to winter...a welcome relief after the "June-like" January!

# **Precipitation:**

On Friday, January 31, the first of a series of storm systems began moving through northern Arizona. Over the last eight days, 48cm (19") of new snow was reported near 10800' at Arizona Snowbowl, and ~35cm (14") reported near 9700' at the Snowslide Canyon Snotel (SCS).

Arizona Snowbowl reports a settled base of 89cm (35"). SCS shows a 101cm (40") of snowpack depth and 10.30" of snow water equivalent.

# Wind:

Agassiz Peak Station (APS) near treeline recorded **moderate westerly/southwesterly winds with strong gusts on Tuesday, February 4 – this was confirmed by reports of snow saltating up the slopes of Arizona Snowbowl**. APS reported light and moderate westerly and northwesterly winds during the early mornings of Wednesday and Thursday, February 5 and 6. During the early morning hours of Friday, February 7, APS reported light southwesterly winds. By Saturday, February 8 winds became northwesterly with some strong gusts into The sheltered SCS recorded light, variable winds with occasional moderate gusts throughout the week.

# **Temperature:**

Over the last 8 days SCS recorded temperatures between -3 and 30° F at 9700', and APS recorded temperatures between -19 and 19° F at 11500'. By Saturday, February 8 temperatures reached  $32^{\circ}F(0^{\circ}C)$  or higher at both stations.

NOAA forecast for Northern Arizona as of 10 AM Saturday, February 8.

EXPECT WARM AND DRY CONDITIONS OVER THE WEEKEND WITH PERIODS OF HIGH CLOUDS. A WEAK DISTURBANCE WILL MOVE ACROSS NORTHERN ARIZONA ON MONDAY BRINGING CHANCES FOR RAIN AND SNOW SHOWERS MAINLY NORTHEAST OF FLAGSTAFF. HIGH PRESSURE WILL THEN REBUILD OVER THE WEST FOR THE REMAINDER OF NEXT WEEK...WITH ABOVE NORMAL TEMPERATURES AND DRY WEATHER CONTINUING AFTER TUESDAY.

# **Summary**

# **Overall**:

**1-2 feet of new snow has been added to the avalanche starting zones** near and **above treeline**, with snow totals tapering rapidly toward 8000'. This weeks precipitation has accumulated with relatively little wind effect in sheltered areas until Saturdays' wind event with Northwest winds transporting snow onto south and southeast aspects.

**Ridge-top winds have been ideal for creating wind slabs and we encourage you watch for soft (or firm) wind slabs perched on weak snow** – especially on northeasterly through southeasterly aspects. Due to cross-loading and micro-climate affects, isolated wind slabs may exist on any aspect.

On Wednesday, February 5, we observed **moderately reactive soft slabs collapse on weak facet layers** in our 42° test pit on an ENE slope at ~11900' in Snowslide Canyon. A single extended column test had results of ECTP 12 Q2 – a fracture propagated across the entire column, however the soft-slab did not slide even on the steep 42° slope. Using a modified Rutsch Block test, we isolated a larger column (~90cmX90cm) and with the impact of a person jumping on it from above, the entire column fractured and slid into the test pit... with the person riding on top.

Below treeline on northerly aspects the temperature gradient is stabilizing and the facets in the lower half of the snowpack have undergone bonding/rounding processes, with the exception of large 2-4 mm depth hoar at the base of the snowpack in some upper elevation locations. Two extended column tests on a 27° slope at 10100' did not produce any reactions – ECTX. Note that larger temperature gradients, facets and graupel were observed in the top half of the pit. Test pit at 10100'.

Compression tests at 11400' on Northwest and west aspects in sheltered trees showed low reactivity and low energy. Northern aspects retain a relatively weak structure due to the extensive kinetic metamorphism in the thin snowpack thus far this season. Temperature gradients have generally abated with the spring-like weather.

The **snowpack is still thin** and snow depths of less than 100cm is common. Snow depths greater than 100cm can be found near treeline ( $\sim 10500' - 11500'$ ) and generally on aspects that are more northerly than southerly. Most of the snowpack on southerly aspects was lost during our warm and dry January.

With the forecast warming trend for the coming week(s), slopes that receive sufficient solar radiation may become wet and unstable.

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Safe travels, and enjoy the new snow! Please join KPAC at <u>Karma Sushi</u> this Tuesday February 11. 10% of the proceeds go to KPAC. See you there!

Saturday, February 01, 2014

# The Weeks Weather in Review

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# <u>Summary</u>

# Overall:

**1-2 feet of new snow has been added to the avalanche starting zones** near and **above treeline**, with snow totals tapering rapidly toward 8000'. This weeks precipitation has accumulated with relatively little wind effect in sheltered areas until Saturdays' wind event with Northwest winds transporting snow onto south and southeast aspects.

**Ridge-top winds have been ideal for creating wind slabs and we encourage you watch for soft (or firm) wind slabs perched on weak snow** – especially on northeasterly through

southeasterly aspects. Due to cross-loading and micro-climate affects, isolated wind slabs may exist on any aspect.

On Wednesday, February 5, we observed **moderately reactive soft slabs collapse on weak facet layers** in our 42° <u>test pit on an ENE slope at ~11900' in Snowslide Canyon</u>. A single extended column test had results of ECTP 12 Q2 – a fracture propagated across the entire column, however the soft-slab did not slide even on the steep 42° slope. Using a modified Rutsch Block test, we isolated a larger column (~90cmX90cm) and with the impact of a person jumping on it from above, the entire column fractured and slid into the test pit... with the person riding on top.

Below treeline on northerly aspects the temperature gradient is stabilizing and the facets in the lower half of the snowpack have undergone bonding/rounding processes, with the exception of large 2-4 mm depth hoar at the base of the snowpack in some upper elevation locations. Two extended column tests on a 27° slope at 10100' did not produce any reactions – ECTX. Note that larger temperature gradients, facets and graupel were observed in the top half of the pit. Test pit at 10100'.

Compression tests at 11400' on Northwest and west aspects in sheltered trees showed low reactivity and low energy. Northern aspects retain a relatively weak structure due to the extensive kinetic metamorphism in the thin snowpack thus far this season. Temperature gradients have generally abated with the spring-like weather.

The **snowpack is still thin** and snow depths of less than 100cm is common. Snow depths greater than 100cm can be found near treeline ( $\sim 10500' - 11500'$ ) and generally on aspects that are more northerly than southerly. Most of the snowpack on southerly aspects was lost during our warm and dry January.

With the forecast warming trend for the coming week(s), **slopes that receive sufficient solar** radiation may become wet and unstable.

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Safe travels, and enjoy the new snow! Please join KPAC at <u>Karma Sushi</u> this Tuesday February 11. 10% of the proceeds go to KPAC. See you there!

# **The Weeks Weather in Review**

# **Precipitation:**

After 39 days of no precipitation, and mostly warm high-pressure... the spell has been broken! On Friday, January 31, the first of a series of storm systems began moving through northern Arizona. By Saturday morning, the Snowslide Canyon Snotel (SCS) at 9700' reported **25cm** (10") of new snow, and Arizona Snowbowl reported 10-20 cm (4-8") of new snow. SCS shows 101cm (40") of snowpack depth, with 9.70" of snow water equivalent. Arizona Snowbowl reports a settled base of 81cm (32").

90+% humidity levels on Thursday and Friday helped to form an inch or more of rime on surfaces facing south and southwest.

# Wind:

During the Friday storm, Agassiz Peak Station (APS) near treeline reported light winds and moderate gusts. On Thursday, prior to the storm, southwest winds of of 20+ mph were recorded. The sheltered SCS recorded light and variable winds throughout the week, and some moderate gusts on Thursday and Friday.

# **Temperature:**

Mild winter temperatures dominated early this week. By Saturday morning, APS reported temperatures at 4° F, and SCS reported temperatures at 14° F.

The NOAA forecast predicts continued cool weather and chances of precipitation through the week.

# <u>Summary</u>

**Overall:** Avalanche conditions have not been significantly affected by the recent precipitation. Much of the above treeline terrain, which is the majority of avalanche starting zones on the Peaks, especially South aspects, had little snow prior to Friday's storm. Thus the recipe for an avalanche to occur: **slab, weak layer, trigger, and slope** is missing the slab ingredient in these areas.

Friday's snow arrived with very little wind affect. A mixture of graupel initially (similar to small 1-2mm styrofoam balls) and then stellar dendrite crystals accumulated through the storm but exhibited little wind transport or wind slab formation. The new snow is much appreciated in the community, and some soft turns can be found in the protected terrain where this winters' snow has persisted.

Testing this week after Friday's precipitation yielded little reactivity at 11450', West aspect. Compression test scores of CT 23, 26 and an Extended Column Test, score 26, no propagation, were associated with a melt/freeze wind crust underneath 15 cm of new snow. Sheltered North and West aspects typically have a shallow 30-60 cm snowpack depending upon elevation, comprised of weak facets and 10-20 cm of depth hoar above the ground. Wind slabs remain in some locations along ridge tops or terrain features where crossloading has previously occurred. These isolated wind slabs typically overly a thin snowpack of less than 100cm which is prone to kinetic metamorphism, or facet growth below the wind slab. Previous tests of this wind slab/facet layer contact have yielded moderate reactivity and are worthy of monitoring with increased loading.

Friday's precipitation is starting the snowpack anew in areas where it disappeared during the 39 day drought. With more precipitation, the snowpack may build and restore the terrain to skiable condition.

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Safe travels, and enjoy the new snow!

Saturday, January 25, 2014

# The Weeks Weather in Review

# **Precipitation:**

The current precipitation drought continues as it is now 5 + weeks since the last storm (Dec. 20-22) deposited ~30cm of snow near 10800'. As of January 25, the Snowslide Canyon Snotel (SCS) at 9700' is reporting a 78cm (31") snowpack depth, with 8.70" of snow water equivalent. Arizona Snowbowl reports a settled base of 55cm (22").

Total snow accumulation this winter at 10,800', Northwest shaded and sheltered aspect is 158 cm (63"). The San Francisco Peaks annual snow total average is 650 cm (260"). Hopefully this translates into another 500 cm (200") of snowfall in our future. Something to look forward to!

# Wind:

Wind this week was mostly moderate, with the exception of increasing North Northwest wind Saturday January 25 reported at the Agassiz Peak Station, at 11,500', gusting into the 20 mph range.

Snowslide Canyon Snotel site, sheltered in the Inner Basin at 9730', recorded light winds throughout the week.

# **Temperature:**

Another week of relatively mild temperatures. The Agassiz Peak Station recorded temperatures

between 24 and 42° F, not dipping below freezing Tuesday, January 21st. Recorded temperatures at Snowslide Canyon (9730') have been between 15 and 46°F.

A cooling trend and chance of possible snow showers is forecast for later this week.

# **Summary**

**Overall:** This weeks' summary continues our trend: Snow depth is minimal. With the exception of isolated wind loaded areas and direct north facing protected terrain, snowpack depth is shallow (between 30-50 cm) and exposures of rocks and bare ground are expanding with warmer, spring like temperatures earlier in the week. No signs of avalanche activity have been observed.



View of terrain from 11,600', Upper Bowl catwalk from Arizona Snowbowl looking toward the Humphrey's Cirque in the background.

It's been five weeks since the last significant precipitation. Most high elevation ridgetop and south facing terrain is free of snow or clinging to patches of wind loaded slabs. Where snow remains, it is generally thin and susceptible to faceting due to kinetic metamorphism. Thin snow packs at high elevations exhibit strong temperature gradients, increasing depth hoar and facet growth, resulting in a weak snowpack.

South facing terrain is mostly free of snow with the exception of wind loaded or shaded pockets.

Snow profiles on a northwest aspect at 11,600' reveal a weak snowpack structure of low density facets with a wind slab comprising the top 10- 15 cm of a 95 cm snowpack. This surface slab failed in compression tests with results of CT 13 and 14, Q2 and Q3 shears. Similar to last weeks observations but with slightly more strength, near surface faceting at this horizon has occurred in the snowpack, creating a weak layer just beneath the wind slab. This layer is worthy of continued monitoring as a potential future problem when new loading arrives.

Within 100 meters of the profile described above on a similar aspect and elevation, a 45 cm depth snowpack without the surface wind slab was tested. Weak facets typify the snowpack on North to Northwest sheltered locations. Snow depths are variable with the rugged bed surface beneath, creating a myriad of facets and depth hoar with temperature gradients of 2 degrees C per 10 cm. Compression test results of CT 2 and 12, Quality 3 were recorded on the large 2-5 mm depth hoar at the base of the snowpack. The snowpack is generally very weak and cohesion-less, and easily collapses with little consistency or slab strength. See photo below:



Weak and thin snowpack at 11,600', Northwest aspect. 45-60 cm depth depending upon where measured among the rocky facet garden.

Testing of a direct west facing slope at 11,100' reveal a depth of 60 cm, with a denser crust midway through the snowpack at 30 cm. Compression test results of CT 27 and 25, Q 2 and 3, failing on 2 mm facets just below the crust, demonstrate the facet/crust interplay in the thin

snowpack and the role that kinetic metamorphism plays in creating weak layers when a significant temperature gradient exists.

**Droughts are the architects of weak layers**. North and west facing terrain continues to develop facets which may present future issues, with the probability of increasing hazard when new snow finally arrives.

Especially in shaded terrain, the weak snow structure may not support the weight of a skier or rider, resulting in bottoming out in the shallow snow onto the ground, trees or rocks. Travel in the backcountry continues to be challenging as the snowpack decreases.

Level I, level II, and level I refresher avalanche education opportunities for February are contingent on the arrival of more snow. Stay tuned...

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Safe travels, and enjoy the snow! It's still winter!

# Saturday, January 18, 2014

# The Weeks Weather in Review

#### **Precipitation:**

The current drought continues. It's been 4 weeks since the last storm (Dec. 20-22) deposited  $\sim$ 30cm of snow near 10800'. As of January 17, the Snowslide Canyon Snotel (SCS) at 9700' is reporting a 79cm (31") snowpack depth, with 8.70" of snow water equivalent. Arizona Snowbowl reports a settled base of 61cm (24").

#### Wind:

Strong northerly winds continue to rake the high elevation terrain. Gusts up to 60 mph were recorded by the Agassiz Peak Station (APS) at 11500'. Wind speeds were consistently in the 20-35 mph range Sunday through Tuesday, January 12-14.

Northerly gusts up to 24 mph were recorded Sunday, January 12, at 9700' at the Snowslide Canyon Snotel site. Otherwise, winds were variable and overall 5-15 mph.

# **Temperature:**

Relatively mild and above normal temperatures have predominated this week. The Agassiz Peak

station recorded temperatures between 18 and 35°F. Recorded temperatures at SCS have been between 18 and 48°F.

# Summary

**Overall:** This weeks' summary is somewhat a repeat of the conditions from last week: Snow depth is minimal. With the exception of isolated wind loaded areas and direct north facing protected terrain, snowpack depth is shallow (between 30-50 cm) and exposures of rocks and bare ground are expanding with warmer, spring like temperatures. No signs of avalanche activity have been observed. The ingredients to form snow avalanches seem rare at this time without new snow loading in the form of precipitation or wind transport.

It's been four weeks since the last significant precipitation. Winds have blown out of the North with vigor. Little snow remains available to be moved around as most of it is locked into wind slab or hidden in shaded areas below treeline or in protected pockets. The snowpack (where it remains) is either locking together and bonding, or converting to facets via kinetic metamorphism. Interestingly, observers have found these diametrically opposed conditions in the snowpack within close proximity to one another; highlighting the **continued spatial variability** we have discussed in previous summaries.

South facing terrain is either devoid of snow or contains a variety of wind and sun melt freeze crusts. Temperature gradients in unshaded south facing terrain are now less than 1 degree C/10 cm, and the snow pack is strengthening and diminishing. Shaded pockets still exhibit a variety of crusts with facets sandwiched between, transitioning to larger depth hoar facets near the base of the snowpack.

Snow profiles on a northwest aspect at 11,367' reveal a weak snowpack structure of low density facets with a wind slab comprising the top 15 cm of a 100 cm snowpack. This surface slab showed some sensitivity in two compression tests with results of CT 7, Q2 and Q3 shears. Near surface faceting at this horizon has occurred in the snowpack, creating a weak layer just beneath the wind slab. This layer is worthy of continued monitoring as a potential future problem.

At the base of the snowpack on north aspects are large 2-3 mm depth hoar facets. The entire column failed on isolation in two tests on these unstable, cohesion-less angular grains.



large 2-3 mm depth hoar facets at the base of north aspects

**Droughts are the architects of weak layers**. High elevation north facing terrain continues to develop facets which may present future issues, with the probability of increasing hazard when new snow finally arrives.

Especially in shaded terrain, the weak snow structure may not support the weight of a skier or rider, resulting in bottoming out in the shallow snow onto the ground, trees or rocks. Travel in the backcountry is becoming more challenging as the snowpack continues to decrease.

Level I, level II, and level I refresher <u>avalanche education opportunities</u> for February are contingent on the arrival of more snow. Stay tuned...

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Safe travels, and enjoy what snow we have!

# Friday, January 10, 2014

#### **The Weeks Weather in Review**

#### **Precipitation:**

None this week. It's been 3 weeks since the last storm (Dec. 20-22) deposited ~30cm of snow near 10800'. As of January 10, the Snowslide Canyon Snotel (SCS) at 9700' is reporting a 79cm (31") snowpack depth, with 8.70" of snow water equivalent. Arizona Snowbowl reports a settled base of 66cm (26").

#### Wind:

Moderate to extremely strong northerly winds have been recorded by Agassiz Peak Station (APS) at 11500'. Light and variable winds and some moderate to strong gusts have been recorded at 9700' by the sheltered SCS.

#### **Temperature:**

APS has recorded temperatures between 16 and 35°F. Recorded temperatures at SCS have been between 18 and 43°F.

#### **Summary**

**Overall:** Snow depth is minimal. With the exception of isolated wind loaded areas and direct North facing protected terrain, snowpack depth is shallow (between 30-50 cm) and exposures of rocks and bare ground are expanding rapidly. No signs of avalanche activity have been observed. **Except for Northerly aspects, the ingredients to form snow avalanches seem rare**.

It's been three weeks since the last significant precipitation. Winds have been brisk, but in reality little snow remains available to be moved around; most of it is locked into wind slab or hidden in shaded areas below treeline or in protected pockets above. The snowpack (where it remains) is either locking together and bonding, or converting to facets via kinetic metamorphism. Interestingly, observers have found these diametrically opposed conditions in the snowpack within close proximity to one another; highlighting the **continued spatial variability** we have discussed in previous summaries.

Where the snowpack has received significant <u>insolation</u> (incoming solar radiation), surface crusts and sublimation textures characterize the surface. Pits in these areas reveal an absence of threshold temperature gradient (1 degree C/10 cm) to produce significant faceting, and the

snowpack is generally gaining strength through bonding. There are also a series of crusts throughout the pack.

Often within meters of the condition just described, there are **shaded areas** that tell a different story. These cooler pockets reveal significant temperature gradients, greater than 1 degree C /10 cm, which promotes facet growth throughout the snowpack. These areas have turned to pure facets (larger 3+ mm depth hoar at the bottom, progressing toward finer crystals at the surface).

Snow profiles on wind protected north aspects at 11,000' revealed a weak snowpack structure of low density facets with low energy results. Compression test results of CT 14 and ECTN (no failure), with low to moderate quality shears.

Compression tests conducted recently on slopes comprised of pure facets and others characterized by crusts, melt freeze clusters and rounded grains on **Southeast and Southwest aspects** at between 11,000 and 11,500 did not fracture (CTN).

**However, wind-loaded northerly aspects could still be sensitive** where residual slabs overlay facets and depth hoar. It is also possible but not probable, that isolated areas of steeper north facing terrain with cohesion-less facets could sluff and carry a skier or rider into trees, rocks or over a cliffband.

It is **IMPORTANT to keep in mind that droughts are the architects of weak layers**. Areas where facets have and are continuing to develop are creating future issues, with the probability of increasing hazard when new snow finally arrives...

Especially in shaded terrain, the weak snow structure may not support the weight of a skier or rider, resulting in bottoming out in the shallow snow onto the ground, trees or rocks. Travel in the backcountry is becoming more challenging as the snowpack continues to decrease.

# INTRODUCTION TO AVALANCHES – FREE TONIGHT!

January 10th – Friday 5:00PM Arizona Snowbowl Hart Prairie Lodge

Check out our <u>upcoming classes</u> for level I, level II, and level I refresher avalanche education.

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Safe travels, Team KPAC!

# Friday, January 03, 2014 - Feliz Año Nuevo!

#### The Weeks Weather in Review

Persistent high pressure, warm temps, and clear skies have been the flavors this week.

# **Precipitation:**

None. It's been nearly 2 weeks since the last storm (Dec. 20-22) deposited ~30cm of snow near 10800'. As of January 1, the Snowslide Canyon Snotel (SCS) is reporting a 81cm (32") snowpack depth, with 8.70" of snow water equivalent. SCS continues to show a "suspect" quality control flag; however recent nearby measurements show that the temperature and snow depth readings appear to be fairly accurate for the 9700ft range. The suspect readings may only be limited to the humidity and dew point which erroneously indicate that it has been continually snowing.

# Wind:

Some strong gusts, but mostly light to moderate northerly winds have been recorded by Agassiz Peak Station (APS) at 11500'. Light and variable winds have been recorded at 9700' by the sheltered SCS.

# **Temperature:**

Low temperatures at APS have climbed from ~17 into the high  $20s^{\circ}F$ , while high temperatures have climbed from ~28 to near  $40^{\circ}F$  over the past week. Recorded temperatures at SCS have been between 8 and  $44^{\circ}F$ .

#### **Summary**

#### **Overall:**

The overall snow depth is minimal in the backcountry. **Anticipate that rocks and logs lurk beneath** every turn... The snowpack is highly variable due to wind and sun.

Warm above freezing mid-day temperatures have moderated some temperature gradients in the snowpack. As a result, weaknesses created by near surface facets (NSF) are not as pronounced – especially in areas that have received significant solar radiation.

Temperature within the snowpack on Southern and Western aspects are nearly isothermal, meaning that temperatures recorded throughout the snowpack are within 1.5°C of freezing (0°C). Daytime warming and melting and nighttime freezing have added significant strength to the snowpack by bonding grains together not only within specific layers, but also at boundaries between layers. Stability tests reveal moderately favorable structure, and low propagation energy. Test scores of CTM 12 Q3 are typical and failures are once again at the interphase between bonded grains and basal facets (depth hoar) rather than in the upper snowpack as noted last week.

Strong near surface temperature gradients still remain on shaded and northerly aspects.

#### Treeline and exposed terrain:

Some wind skins and wind slabs have been observed this week. However, those that we encountered were small, isolated and with low energy. The snowpack remains quite weak and faceted on some Northerly slopes, including weaker depth hoar underlying firmer snow. East, west and southern slopes have taken on spring characteristics – including melt freeze crusts and isothermic temperatures. Warm temperatures on southeasterly slopes caused some minor sluffs and bowling-ball sized rockfalls on Thursday, January 2.

On the same day, at 11700 on an ENE slope in Dunham canyon, rounding facets and temperature gradients of  $0.75^{\circ}$ C/10cm were observed in the lower 60cm of snow. The snow depth at this location was approximately 80cm with nearly uniform hardness of ~ 4 fingers. A single extended column test had no results – ECTX.

#### Below treeline and sheltered terrain:

On Monday, December 30, soft and hard wind slabs were observed overlying weaker near surface facets on NE slopes near Doyle peak. These weak layers had low to moderately reactivity: CT11 Q3 45cm down and ECTN27 Q2-Q3 45cm down at 10000; ECTN12 Q2-Q3 ~30cm down at 11000. Temperature gradients of 1.5°C/10cm were recorded near the (45cm down) facet layer at 10000.

Snow has melted off slopes that have received significant sun.

Check out our <u>upcoming classes</u> for level I, level II, and level I refresher avalanche education.

At 6pm on **Tuesday, January 7, we will have the general KPAC meeting at <u>Ski Lift Lodge</u> <b>Restaurant**. Feel free to join in and help steer the vision of KPAC.

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Safe travels, Team KPAC!

#### Saturday, December 28, 2013 - Happy Holidays

#### **The Weeks Weather in Review**

#### **Precipitation:**

No precipitation has been recorded since last weekend's storm (Dec. 20-22) deposited ~30cm of snow near 10800'.

As of December 28, the Snowslide Canyon Snotel (SCS) is reporting a 33" snowpack with 8.80" of snow water equivalent. SCS continues to show a "suspect" quality control flag.

#### Wind:

Moderate and strong northerly winds have been recorded by Agassiz Peak Station (APS) at 11500'. Light and variable winds have been recorded at 9700' by the sheltered SCS.

# **Temperature:**

APS has fluctuated between 20 and 38°F since Monday, December 23. During the same time period, SCS recorded temperatures between 14 and 41 °F. There has been a strong night-time inversion this week.

# **Summary**

# **Overall:**

Last weeks snow has now redistributed as a result of many days of strong ridge top winds mainly out of the North Interesting conditions have developed this week. At high elevation, most of last weekends new snow has been redistributed by the effects of strong ridge top winds out of the north and northeast. Wind velocities (25-35 mph) have optimized saltation of snow. Below treeline the snowpack remains relatively thin, with favored locations on northerly shaded and wind sheltered aspects; tapering to rocks on southerly aspects and elevations below 10,000 ft.



The bad news is, much of last week's **snow was transported onto southern, southeastern and southwestern facing slopes where it built slabs over weak layers**.



Positive Propagation Saw Test (PST) in Upper White Lightning illustrates propagation energy between the thin slab and near surface facet (weak layer) below. Results here were PST 70/100 to end Photo – David Lovejoy

Observations and pit data have revealed isolated pockets of hard to soft slab sitting on weak near surface faceted (NSF) crystals. The bonding between slabs and NSF is poor, and due to the nature of this form, unlikely to improve very quickly. This weak structure has proved to be surprisingly reactivate, showing significant propagation energy. Results from Extended Column Tests (ECT) and Propagation Saw Tests (PST), as well as field observations of cracking and whopping support this finding.

**Natural avalanche debris were observed** threes days ago in high elevation starting zones on south and southeast aspects in the Inner Basin and elsewhere. <u>Contributors to KPAC's</u> <u>observation page</u> have added valuable information and insights during this period of increased instability.

Backcountry travelers are urged to be especially diligent in practicing safe travel procedures and conservative route finding. Avoiding traveling on wind slabs is of paramount importance at this time.

# Treeline and exposed terrain:

Most of the current problem exists near and above treeline. Wind slabs that have formed are highly variable in hardness and thickness. Numerous thin slabs (less than 10 cm in thickness) have been reported and considered relatively benign due to their lack of mass. However, keep in mind that slab thickness can increase in a few meters of travel, providing enough mass of sliding snow to easily injure or bury a skier or snowboarder. High spatial variability in wind slab emplacement and thickness seems to characterize current conditions, but reactivity of high elevation slabs (where they have formed) seems more uniform. Observed weak layers are somewhat variable in nature, with crust/near surface facet sandwiches on warmer slopes and a fine layer of small near surface facets (1 mm in size) at the slab/base inter-phase on more easterly and westerly facing slopes.

Of continuing but diminishing concern is snow on north and northwest aspects at 11600'. These still reveal low to moderate strength, but low reactivity on a very weak basal facet layer. These facets are 3-4 mm in size and have little cohesion. Two compression test columns failed on isolation on this layer last week and this condition is likely to heal very slowly.

#### Below treeline and sheltered terrain:

Approximatly 80+ cm of snow can be found in sheltered and shaded locations above 11000'. Stability tests show an overall weak structure on North aspects, with moderate energy. On Western aspects and at lower elevations, the snowpack is a Duke's mixture of supportable, breakable and even pockets of wind-buffed snow.

The overall snow depth is minimal. Anticipate that rocks and logs lurk beneath every turn...

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Check out our <u>upcoming classes</u> for level I, level II, and level I refresher avalanche education.

Thank you for the observations submitted to the discussion boards – this site is a community resource and your observations help to inform and educate.

Safe travels and Happy Holidays!

**Sunday, December 22, 2013 Update: Strong northerly winds** have been recorded on Agassiz Peak. Here is the <u>near treeline forecast</u> from NOAA.

#### Saturday, December 21, 2013 - Welcome to the Winter Solstice!

#### **The Weeks Weather in Review**

High pressure and above normal temperatures dominated earlier this week. At 11500', Agassiz Peak Station (APS) reached 43°F on Monday, December 16. Late in the week a low pressure system moved across Southern Arizona with moderate snowfall amounts.

#### **Precipitation:**

Snow began to accumulate December 19, Thursday evening, and by Friday morning 6" of new snow and 0.90" of snow water equivalent was recorded at the Snowslide Canyon Snotel (SCS) at 9700'. This station is still showing suspect readings. The snow-stake at Arizona Snowbowl showed 10" of new snow at 10800' on Friday morning.

#### Wind:

Agassiz Peak Station recorded moderate to strong northerly winds last weekend, and moderate southerly winds over the last few days. The low pressure system that began moving through Arizona on Thursday, December 19, has been accompanied by light southerly winds. The new snow settled with virtually no wind affect throughout Thursday and Friday's storm.

#### **Temperature:**

Agassiz Peak Station temperatures rose above freezing Sunday through Thursday this week – December 15-18. The temperature rose to 40°F at APS on Dec 16-18. SCS temperatures reached 48 and 49°F on December 17 and 18, respectively. As a low pressure system moved across Southern Arizona, temperatures have dropped to <20°F. at APS and <30°F at SCS on Thursday and Friday (December 19 and 20).

#### **Summary**

#### **Overall:**

The snowpack remains thin, with favored locations on northerly shaded and wind sheltered aspects at 70-80 cm depth; tapering to rocks on southerly aspects or wind affected terrain. Snow stability tests performed this week have revealed an overall weak structure with moderate to low reactivity.

Thursday and Friday's precipitation provided up to 30 cm of undisturbed snow on top of a variable surface crust developed from this weeks warmer temperatures. This crust is currently serving as a semi supportable layer above the weaker faceted snow and rocks below.

Watch for wind transport and potential wind slab formation over the weekend, as wind speeds are forecast to increase.

# Above treeline and exposed terrain:

Prior to Friday's precipitation, above treeline terrain was predominately a mix of rocks with patches of snow remaining in wind and sun sheltered locations.



3+mm basal facets, or depth hoar

The majority of snow stability tests on North and Northwest aspects at 11,600' reveal low to moderate strength in the column and low reactivity, but a very weak basal facet layer. These facets are 3-4 mm in size and have very little cohesion. Two compression test columns failed on isolation on this layer.

# Below treeline and sheltered terrain:

Up to 80 cm of snow can be found in sheltered and shaded locations above 11,000'. Stability tests show an overall weak structure on North aspects, with moderate energy results of CT 10-14 on the 10-15 cm basal facet layer.

The snowpack becomes more supportable with a mix of weak crusts and facets on western aspects.

Watch out for **hazards hiding in the shallow snowpack.** The overall snow depth is minimal. Anticipate that rocks and logs lurk beneath every turn...

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Check out our <u>upcoming classes</u> for level I, level II, and level I refresher avalanche education.

Thank you for the observations submitted to the discussion boards...this site is a community resource and your observations help to inform and educate.

Safe travels and Happy Holidays!

# Saturday, December 14, 2013

#### The Weeks Weather in Review

This week's weather was notable for a 6-10" storm last weekend and very cold temperatures through mid week.

#### **Precipitation:**

Last weekends storm (December 7 and 8) deposited approximately **9 inches of snow and over 1" of SWE** at the Snowslide snotel site at 9730' (note that this station is indicating suspect readings). For the same storm, **Arizona Snowbowl reported totals of 8-12" between 9500' and 10800'.** 

Total precipitation for the season is 50" at 10,800' in wind sheltered terrain. Actual snow depth varies greatly with exposure to wind, sun, and general snow settling. Total snow water equivalent peaked at 7.60 inches at the Snowslide Spring snotel site.

#### Wind:

**Moderate to strong winds were reported out of the South-Southwest during the storm**. Strong post-storm winds from the **North-Northwest over 55 MPH were recorded on December 9th**. Winds moderated through the week but increased Friday December 13 after sunset with 20-30 mph North winds.

#### **Temperature:**

During the storm of December 7-8, temperatures ranged between **5 and 10 F** at the 11500' Agassiz station. **A low of 0 degrees F** was recorded overnight on Monday December 9, and temperatures did not approach 32 degrees F until mid day Wednesday the 11th.

Nightly inversions over the last few days have kept temperatures near 25 F. at treeline (~11500').

#### Summary

Overall, snowpack depth is a meter in the deepest locations, with much less being the rule. Stability tests this week showed a relatively weak snowpack with low to moderate energy. The **primary concerns** are **localized wind slabs and the continuing growth of weak faceted snow throughout the snowpack.** 

Monday and Tuesday's **single digit overnight temperatures** combined with a **thin snowpack** conspired to "dry out" the snow and make it less supportable. Significant temperature gradients in the snowpack create weak, angular grains which have little to no cohesion. Faceted grains can persist in the snowpack and are considered a primary weak layer worthy of monitoring.

# Above treeline and exposed terrain:

Generally, much of the snow has been stripped at and above treeline, 11,500'. A variety of wind hardened surfaces and crusts exist where snow has resisted the scouring power of the wind. Areas of wind slab remain along some ridgelines and around terrain features.

As a reminder, wind slabs should be treated with caution, as they may support the weight of a skier or rider initially but fail when a person is further out on the slope. Any collapsing, cracking or whoomphing noises are signs of potential slab failure.

# Below treeline and sheltered terrain:

Stability testing on a sheltered North facing slope at 11,300' yielded **mixed results**: Compression tests of CT 17 and 22, Quality 2 were recorded, indicating moderate strength and low energy; however, also recorded was a CTV, as the column failed on isolation at the lower 15 cm of 2-3 mm depth hoar. Total snowpack depth in this location was 80 cm.

The current shallow snowpack is highly variable and snowpit data reveals what is occurring in that exact location. Stability test results are one of several tools to use in assessing the snowpack.

The discussion boards have a report of a "huge whoomph" from a tour off South Core Ridge in the Inner Basin. This is indicative of a weak layer failure which did not propagate and fracture. See the <u>report from raisingarizona</u>. Many thanks for sharing your observations and informing the community.

There are reports of ok to good skiing in the Cinders Hills east of the San Francisco Peaks.

# It's early-season Arizona skiing – watch out for hazards hiding in the shallow snow, especially as the snowpack weakens and is less supportable.

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

We should have our site updated in the next week – allowing you to register online for our <u>upcoming classes</u>.

# Friday, December 6, 2013

# The Weeks Weather in Review

The first week of December brought more snow, **very cold temperatures**, and wind to the Peaks.

3-6" of **new snow** fell this Wednesday, December 4. 6" of snow accumulated at higher elevations and as reported at the Snowslide Spring weather station in the Inner Basin (9730'). This has added up to 1" of Snow Water Equivalent (SWE) weight to the snowpack.

**Temperatures** were moderate for the week until the onset of the storm, dropping abruptly on December 4 to single digits at 11,500'. This trend has continued with a maximum temperature of 13 degrees F and minimum of -2 this morning.

**Wind** was from the South and Southwest during the December 4 storm with periods of 30+ mph and significant snow transport and sublimation. The Agassiz Peak weather station at 11,500', stopped recording during the storm, probably due to riming of the anemometer, so maximum wind speeds are not available for this time period. However, the Snowslide Spring station reported winds up to 27 mph.

**Current forecasts** call for continued low temperatures on the Peaks of near 0 degrees F, with high temperatures over the weekend of 13 degrees F. Winds will continue from the **West and Southwest gusting up to 55 mph** Saturday afternoon. **Wind chill values as low as -24 are possible.** 

**Snow accumulations** are predicted to be **10+ inches** beginning Saturday with the bulk of precipitation Saturday evening and a chance of continued snow showers Sunday.

#### **Summary**

#### **Above Treeline and Exposed Terrain:**

Post storm observations from December 5 revealed that above treeline and exposed terrain has suffered scouring from the robust South and Southwest winds of December 4. A variety of wind hardened crusts and scattered pockets of wind slab remain, particularly along ridge lines.

The remaining snowpack above treeline is at most 3 feet deep in wind loaded areas, and generally thinner. The wind slabs have weak, poorly bonded snow underneath which is susceptible to accelerated faceting due to large temperature gradients in the snowpack.

Wind slabs are deceptive as they may support the weight of a rider initially, yet fail when a person is out in the center. Wind slabs can sound hollow. Be alert to any collapsing or cracking and always travel one at time in suspect terrain, on the way up and down.

# **Below Treeline and sheltered terrain:**

Stability tests this week were conducted near 11,000' and below. Results show the **primary concern** to be a failure between last weeks dense storm snow and weak basal facets, which make up the lower portion of the snowpack on North and Northwest aspects. Compression test and Extended Column test results of 11 and 13, with a sudden collapse initiated in the Extended Column test indicating increased energy and fracture propagation potential in the snowpack at this interface.

**Potential Problem: Current below freezing temperatures** will promote **more facet growth** in our shallow, early season snowpack. Temperature gradients recorded this week are double what is required for faceting to occur, which is a 1 degree Celcius per 10 cm gradient. Facets at the base of the snowpack are also known as **depth hoar** and are loose, angular grains which can grow to several millimeters.

These large faceted grains have very little cohesion and are a primary weak layer culprit in avalanche accidents. Temperature gradients throughout the snowpack can promote facet growth around crusts and near the surface. Facets can **persist** in the snowpack for some time, especially this time of year as temperatures remain low and hours of sunlight decreases.



Forecast accumulations for Saturday of 10+ inches of snow at higher elevations and strong South and Southwest winds may result in rapid wind loading and wind slab formation.



It's still early-season Arizona skiing – watch out for those **snow gremlins hiding in the shallow snowpack and in plain site**!

As a reminder, we have not had ample opportunity to thoroughly investigate all aspects and elevations – so please **treat this summary with appropriately guarded skepticism, make your own assessments**, and contribute to our body of knowledge by <u>reporting your observations</u>.

Please consider joining KPAC staff for:

#### 'Introduction to Avalanches' free two hour seminar:

When: Wednesday December 11, 6:00 pm Where: Leaf Auditorium, Coconino County Search and Rescue, 911 Sawmill Rd. (just south of New Frontiers Plaza) Flagstaff, AZ 86001 \*USFS 2013-14 Backcountry permits are available at the presentation.

# Friday, November 29, 2013

#### The Weeks Weather in Review

Precipitation began in earnest last weekend with up to 30" of snow at 10500' and above. The storm cycle lasted from Thursday November 21 through Sunday November 24, with a **variable rain/snow line fluctuating** between 6500' and 9700', and light to moderate winds. Approximately **3.5**" of water weight fell during this storm (recorded in snow water equivalent) at the Snowslide Spring Snotel site located at ~9700' in the Inner Basin.

Temperatures were relatively warm at the outset of the storm, 33 F. degrees at 9500', resulting in a denser layer of snow initially and gradually becoming colder as the weekend progressed. This trend resulted in a preferred **'right side up' snowpack:** dense heavy snow on the bottom and lighter powder snow on top.

However, by Monday, November 25, post storm **North and Northwest winds increased to near 40 mph** at tree line (11500'), stripping higher elevations of easily transported powder snow and **loading it onto south aspects and terrain features**.

**Wind slabs** can form when there is no actual precipitation as snow is transported from windward to leeward slopes. This is especially pronounced along ridgelines and may form in localized pockets near terrain features.

The last few days were clear with highs in the 40's at 9500', with cold clear nights.

Current conditions will continue through the weekend with high pressure, some light clouds, and moderate temperatures. A cold front is anticipated beginning Tuesday, December 3 with a chance of precipitation continuing through the week.

# Summary

Last weekend's storm provided the genesis of our **constantly metamorphosing snowpack**.

**Current snowpack depths** range from: three feet (~1 meter) in wind loaded high elevation terrain; about two feet (60 cm) in sheltered areas in the trees at 11000'; to none on South aspects and wind scoured areas.

**Overall**, snowpack stability tests have shown moderate to good slab strength and moderate to minimal weak layer failure propagation energy.



# **Above Treeline and exposed terrain:**

Monday's North and Northwest winds stripped windward aspects to bedrock and transported large amounts of snow forming wind slabs above treeline on South aspects and along the leeward margins of terrain features. The slab varies in thickness from 1 to 10 inches, alternating locally between breakable to supportable.

Stability test results from Sundance Bowl, 11500' west aspect, revealed the main weakness to be between the surface wind slab and softer snow beneath. Though not currently reactive, this slab should be monitored as the season progresses.

Much of the highest terrain has lost snow due to wind and sun exposure.

# Below Treeline and sheltered terrain:

Prior to this recent storm, some snow from October lingered in shaded North and Northwest

aspects above 10000'. This snow is now a **well faceted basal weak layer** and forms the lower few inches of the snowpack in those locations where it persisted.

Snowpack observations at 11000', in sheltered trees on North and Northwest aspects reveal approximately 20-30" of powder snow on top of 4-6 inches of **weak facets**. Below the new snow is a breakable crust which comprises the top of the faceted layer and is reactive to compression tests with scores of CT 9 and CT 12, with the new snow releasing as a block with moderate quality shears on the loose facets.

**Facets** are angular grains which do not bond well to each other and create a problematic weak layer. They can grow to several millimeters in size and linger in the snow pack, especially this time of year as we continue to experience short days and long cold nights as we approach the winter solstice. Cold clear nights promote facet growth as well as possible surface hoar formation. These two grain types are **primary weak layers** and responsible for a majority of avalanche accidents, thus **worthy of monitoring throughout the season**. Shallow snowpacks are particularly susceptible to facet growth due to large temperature gradients between the 'warm' ground (32 degrees) and much colder night time air temperatures.

At lower elevations, from 10000–9000', snow depth varies from 1.5 feet on North aspects to none on South aspects. Above freezing daytime temperatures around 9500' have settled the snowpack considerably and is melting the snowcover on unshaded terrain.

# Keep in mind the snow depth is very minimal overall and many hazards lurk just below the surface!

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<u>Sign-up</u> to get notified when we update the summary. <u>Snow Pack Summary Archive</u> <u>KPAC public observation/discussion boards</u>