SnowNews

2015-2016

SMI

TECHNOLOGY OF SNOW: THE SCIENCE OF SNOWMAKING

NEW PRODUCTS: THE SUPER PUMA

CUSTOMER STORIES: JEONGSEON KOREA 2018 ALPINE OLYMPIC VENUE

SNOW UNIVERSITY: CLIMATE AND WEATHER PATTERNS

SMI SNOW CLINIC: VIVA LAS VEGAS

VINTAGE SNOWNEWS: 1970'S SNOWMAKING

Joe VanderKelen
President, Snow Machines, Inc.

EDITORIAL

Your team of SMI people from around the world continue to work hard developing, producing and supporting the best and highest performing snowmaking equipment and services in the industry.

We are pleased to introduce the Super Puma in 2015 in various mobile and tower mounts. The Super Puma snow production and ease of use move it to the top of the class for big throw and most productive fully automatic snowmaker.

In this SnowNews issue, you will read about some of the basics of the science of snowmaking and some El Niño weather facts and perspective. Also included is SMI's project at the new 2018 Korean Olympic Alpine Venue.

Snowmaking continues to be a huge factor in resort success and provide the best snow surfaces possible. Our planning and engineering teams provide experience for master planning your custom snowmaking system. The 2015-16 snowmaking year is upon us and once again the weather windows appear to be shorter with more volatile patterns. Annual snowmaking investments to make snow faster and in more marginal conditions is the industry direction. So take note of your snowmaking system performance this year and let us know how we can help. Take some time and check out snowmakers.com, it is packed with interesting and helpful information.

Thanks for helping SMI remain successful and a leader in the industry. We promise to keep investing in new products and people to continue to earn your business.

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TECHNOLOGY OF SNOW

THE SCIENCE OF **SNOWMAKING**

Snowmaking has become a critical aspect of mountain resort operations worldwide, highly appreciated – and even expected - by beginners and Olympic skiers and boarders alike. Natural snow flakes are often formed over days or hours of suspended time in the air. In contrast, Snowmaking has only 3 to 15 seconds to freeze the water.

There's a lot of science that goes into the snowmaking process – which involves breaking water into small particles, cooling the water below 0°C (32°F), removing the heat of fusion for the phase change from liquid to solid, and nucleation or seeding.

The primary forces in this equation are evaporative and convective cooling. The first involves mass loss from liquid to vapor. When this happens, these molecules carry heat away with them, leaving the remaining non-evaporated water droplets much cooler and ready to freeze as snow. Convective cooling is the warm water droplet releasing into the cold ambient air of the slopes, which can also cause a drop in temperature.

SMI Snowmakers' engineers carefully and constantly analyze each and every aspect of this process in a variety of environments, using both natural and mechanical forces in the most efficient way, and thus providing the best quality snow for every desired situation and location.

Evaporative cooling is necessary and its main secondary effect is water loss. Water loss can also happen due to other factors, including wind drifting, sublimation and shorter hang times. SMI's technology has been carefully engineered to minimize these factors by using some of the most powerful snowmaking equipment on the market, capable of landing snow on the targeted slopes, using bigger nozzles to control sublimation and fighting winds, while maintaining unique hang times and perfect snow density as needed.

SMI's commitment to the science doesn't stop with high-quality product lines. For the past 40 years, the company has emphasized the value of well-educated resort operators who not only understand this science, but actively participate in its improvement and perfection.

There's a lot that resort operators can do to maximize snowmaking and minimize losses, besides choosing the right snowmaking equipment.

Maximizing snowmaking

Cooling the water to 1.8°C (34°F) may be one of the most important steps in helping the entire snowmaking process. Sprayers, bubblers and water circulators can help as part of the less expensive cooling concepts recommended by SMI. Water cooling towers

are very effective, but add extra capital and operating costs.

To enable the correct water particle size and distribution among the nozzles, it is very important to use appropriate water pressures for the snowmaking equipment. Using powerful fan snowmaking can help fight the wind on medium and wide slopes, while LowE sticks are typically best utilized on narrow, colder weather or lower priority slopes.

SMI's latest automation advances can be used for a fast start (when conditions are met), consistent snow quality via the constant adjustment to changing weather conditions, and for a fast stop in order to avoid degrading the beautiful quality snow which has just been achieved.

Minimizing losses

Early in the season, the ground is usually not completely frozen and has latent heat, which causes faster melting. To avoid this, consider making an insulating layer of wetter snow that can help freeze the ground more effectively and create an insulating blanket from the warm ground. This layer will last longer and help cool the air above, while protecting the top layer of snow from melting due to the ground's warmer temperatures (see Illustration 1).

Always try to make the desired density snow to help minimize wet snow drainage and cure times – this is very dependent upon resort location, weather forecasts and other factors (tubing slopes, Nordic slopes, race slopes, and so on). Curing is a concept usually ignored by many users, but it is an important part of the science of snowmaking. Snow is typically produced in piles to allow the water droplet extra time to completely freeze. With SMI's technology, most snow is 100% frozen upon hitting the ground. However, for many different reasons and regardless of the technology used, some drops are only frozen like an eggshell. These take

1 The December sun is at a low angle and fresh snow reflects 90% of this visible sunlight.

2 Less energy absorbed means cooler air temperatures during the day.

3 Snow radiates energy efficiently at infared wavelengths.

4 On a clear night, this energy loss from snow-covered ground enhances the cooling of air near the surface.

After snow falls, temperatures follow suit.

Illustration 1

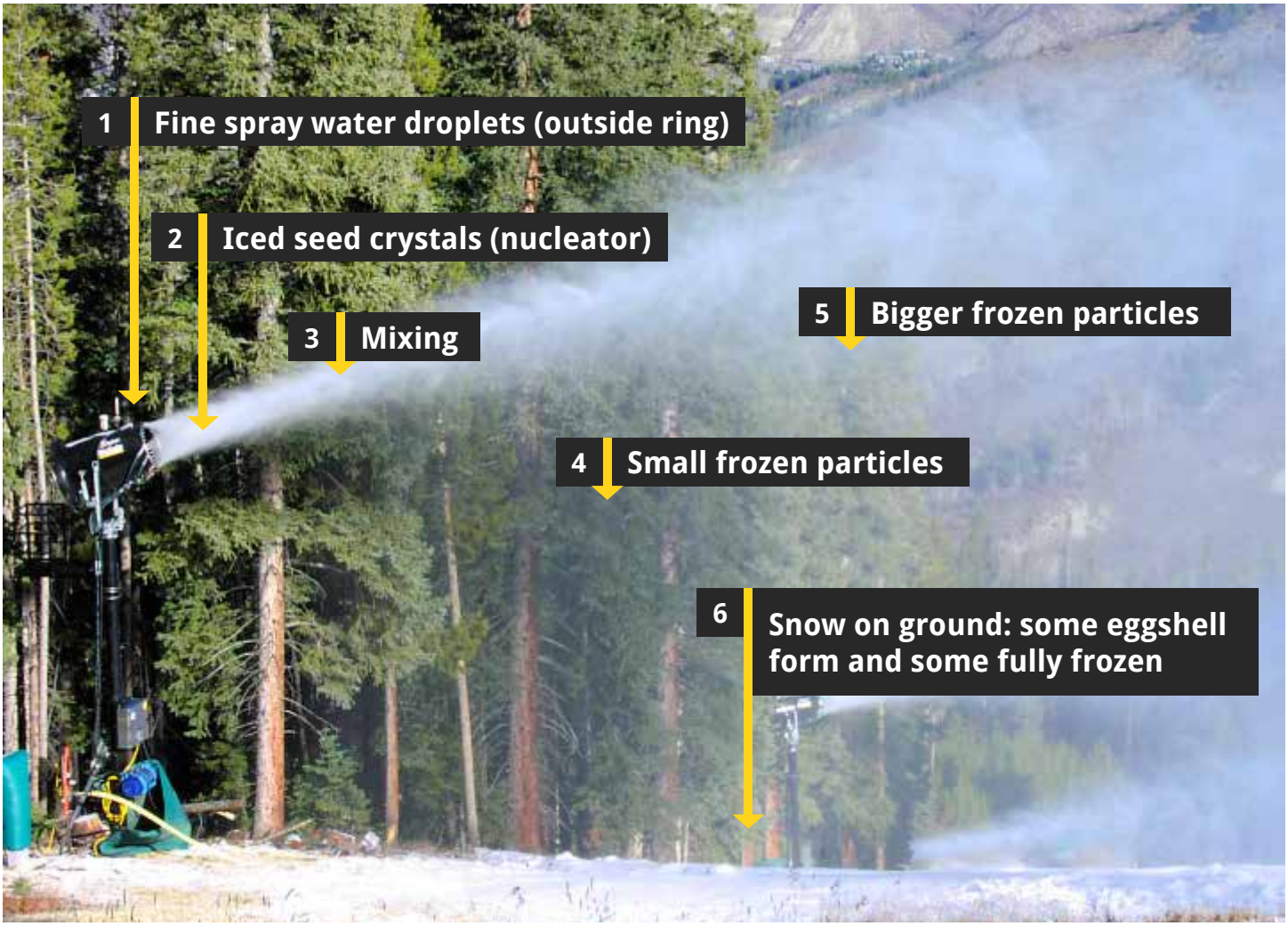


Illustration 2

more time to freeze completely as a result of the cooling forces of the snow pile (see Illustration 2). Most expert resorts prefer to leave snow in piles to cure for 6-36 hours before pushing them out. Cure time is very situational, depending on the day of the week, the timelines for season openings, storage needs for rainy weather, as well as a number of other factors.

Real-life experience

SMI's experienced team of engineers, designers and experts take these real-life situations into consideration when designing the latest SMI prototypes and products. The most advanced snowmaking technology available on the market today is applied so that every SMI machine can make snow that is very dry, if desired, and totally frozen within seconds of leaving the snow gun in a variety of conditions. With hundreds of innovative ideas, such as using 360° oscillation or carefully written auto flow algorithms at the heart of the machine, SMI snow can be produced on the exact spot needed and skied on during production, while providing the highest quality dry snow that skiers love and expect. After all, when it comes to perfect snow, one person's ideal may be wetter or drier than another's.

For the past 40 years, SMI has emphasized the value of well-educated resort operators who not only understand this science, but actively participate in its improvement and perfection.

Please contact SMI or your local representative for more information and to see the Super Puma

snowmakers.com/super-puma-snowmaker.html

NEW PRODUCTS

THE SUPER PUMA **SNOWMAKER**

SMI is pleased to introduce the Super Puma Snowmaker and Snowtower for the optimal fully automated big throw snowmakers.

The Super Puma excels in all conditions, but has been developed for marginal conditions. Utilizing a 25 HP (19 kw) custom designed fan with 75 water and 27 peripheral nucleator nozzles. A 5 HP rotary vane compressor is standard along with center water feed, 359° oscillation, a custom low and tight center of gravity packaging.

SMI's best in class automation offers a color touch screen display at eye level, easy to use menu driven logic incorporated into SMI's strong SmartSnow™ software.

The Super Puma can be mounted on 3-wheeled frame, on jacks only, or on various tower lengths and mounts.

CUSTOMER STORIES

2018 JEONGSEON KOREA ALPINE OLYMPIC VENUE

SMI has been selected as the snowmaking supplier for the 2018 Olympic Alpine Ski Resort in Gangwon-do Province in South Korea.

A new mountain and resort is being developed that will host the downhill, Super G and slalom events for the 2018 Winter Olympic Games. The slopes are being carved from a forested area that covers over 25 meters (2700') of vertical on this rugged and rocky mountain.

The resort requires new roads, buildings, power and communications to support over 200 broadcast towers. A new 128,000m3 (33M gallons) pond is being constructed along with a new base area.

The slopes will be covered by a fully automated SMI snowmaking system. Torrent is providing the 3750 gpm (850m³/hr) pumping equipment, 2300 gpm (520m³/min) water cooling towers, and 2235 gpm (520m³/hr) booster pumping equipment. 170 automatic hydrants will feed this water to 90 full auto Super PoleCat towers, and 20 mobile Super and Kid PoleCat fully automated fans. A fiber optic communication backbone will distribute the SmartSnow™ powered software and intelligence system.

2018 will be SMI's 8th Winter Olympic Games being the lead provider of snowmaking products and services.

2018 will be SMI's 8th Winter Olympic Games making us the lead provider of snowmaking products and services.

We are proud of this history and tradition, and your resort can be confident that SMI remains a top snowmaking company that is rock solid.

SNOW UNIVERSITY

SNOW UNIVERSITY
"GODZILLA" EL NIÑO

As Snowmakers, we have to be prepared for immediate action at any time without warning. That's why we're constantly looking at the weather, reviewing and analyzing at least a half dozen forecasts daily – and why we get to know our resort's micro-climates in great detail.

But understanding our local or domestic weather patterns is not enough. There are macro global events occurring year after year that can modify our precious snow levels and affect our snowmaking production.

This year, more than ever, we are experiencing and identifying major weather patterns across the oceans that could and will indeed modify, for good or bad, skiing and boarding conditions all over the globe.

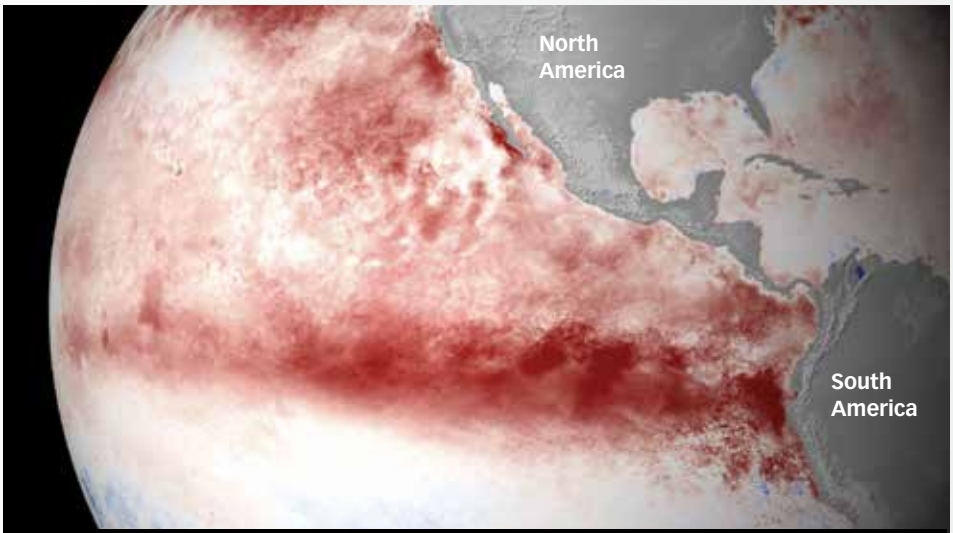
El Niño and La Nina are current topics in the news as we approach one of the strongest El Niño events ever. Many weather experts are predicting the possibility of several extreme events from major droughts to enormous floods, as well as colder and drier, to milder and wetter winters, depending on the area of the globe.

Snowmakers and resort operators should know about these macro events and how they could potentially disadvantage or benefit your resort. These patterns have been repetitive over the years and can provide important insights into how to prepare for your next season.

Why "El Niño"?

A couple hundreds years ago, South American sailors coined this term to describe a warm southward water current that appeared almost annually around Christmas time, near the Peruvian coast. Hence the name El Niño, Spanish for "The Child" which refers to the Christ Child.

During the rest of the year a northward cool current prevails because of the trade winds, causing upwelling of cool, nutrient rich water. But during late December this upwelling relaxes,



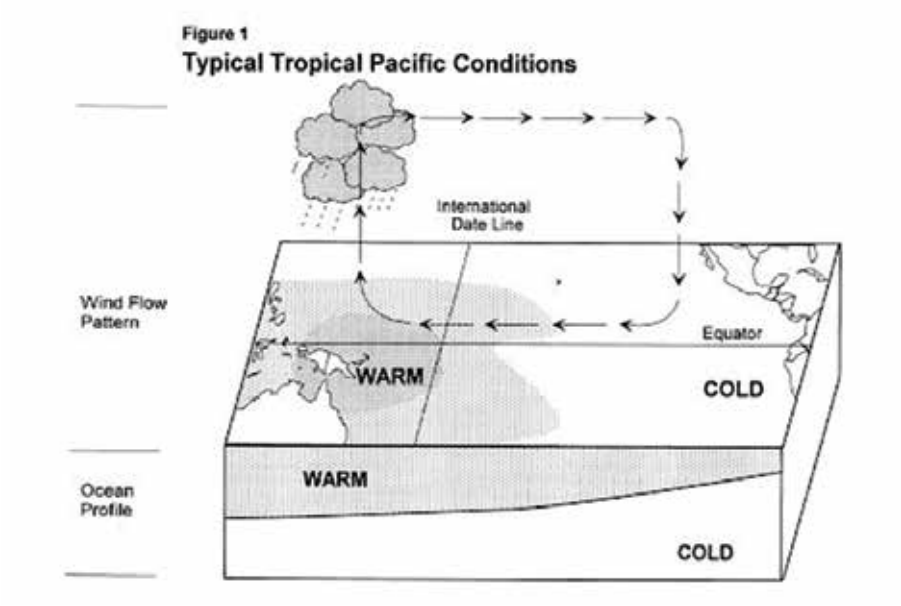
El Niño is a warming of the eastern Pacific Ocean, mainly along the Equator. The thick red belt in this satellite photo indicates waters that are warmer than normal.

causing warmer nutrient-poor water that signals the end of the fishing season. When El Niño arrived, the fishing was over.

Scientists in the early 1960s concluded that these events were associated and strong ones occurred inter-annually.

As the El Niño event begins, the easterlies relax, reducing the amount of upwelling and allowing the western warm water to move eastward towards America. When weather patterns are normal or there are typical cold currents it is called La Nina.

climatological flow to the new tropical energy sources. Associated with them is a circulation of mass and energy in the atmosphere that extends several thousand miles pole-ward well into the subtropics. From here, a big wave-like pattern in a perturbed flow is where it starts affecting our ski resorts.



Consequences of El Niño

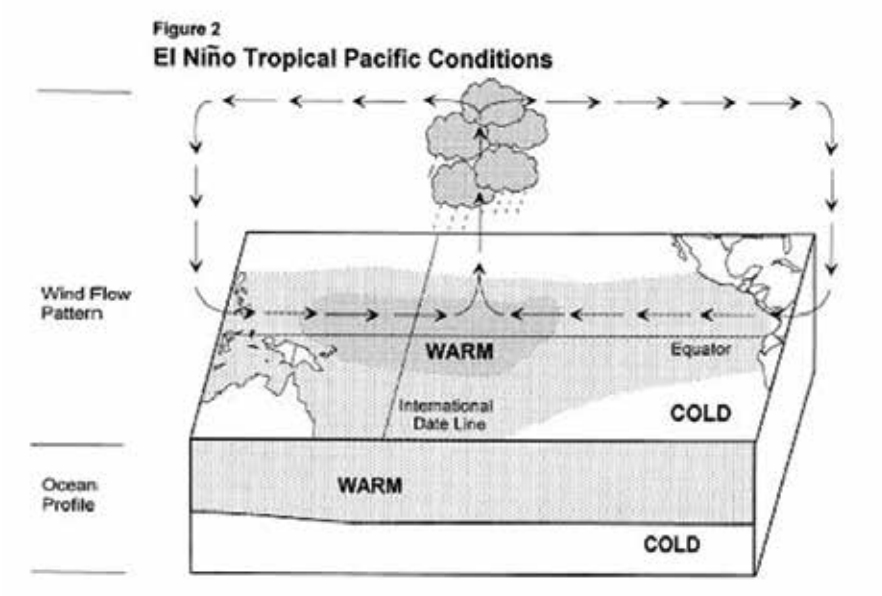
Dense tropical rain clouds distort the air flow aloft (5–10 miles above sea level) much as rocks distort the flow of a stream, or islands distort the winds that blow over them, but on a horizontal scale of thousands of miles!

The waves in the air flow, in turn, determine the positions of the monsoons and the storm tracks and belts of strong winds (commonly referred to as jet streams) that separate warm and cold regions at the Earth's surface. This is what induces warmer, colder, drier or wetter winters, where either plenty of snow may fall or cold dry snaps, ideal for snowmaking, could be possible.

Since then, the term "El Niño" (or warmer episode) has described not only the local warm current, but a warming of the tropical Pacific surface waters occurring every two to seven years and associated with changes in the atmospheric circulation in the tropical Pacific and ultimately worldwide.

El Niño's presence, involves the sensitivity of the atmosphere's circulation to shifts in organized cumulonimbus convection. Atmospheric wave motions adjust the

AccuWeather's global weather center said the world could be facing the strongest El Niño phenomenon in 50 years.



Most El Niño winters are mild over western Canada and parts of the northern United States, and wet over the southern United States from Texas to Florida. El Niño affects temperate climates in other seasons as well.

2015-16 Winter

We are not into forecasting your season, but within this brief explanation of El Niño events, the US National Weather Service in August issued an advisory giving 90% chance of one of the strongest on record El Niño weather patterns. NASA scientists took it a step further saying the 2015-16's El Niño has a Godzilla potential, which will accentuate every possible consequence.

A big El Niño pattern will offer equal chances for above normal temperatures in the Northeast, Mid-Atlantic, portions of the Midwest and Southern California. Warmer temperatures seem most likely in Illinois, northern California and Washington State. There's also an expectation for above normal precipitation chances from New York down the East Coast to Florida, as well as in dry Southern California. Illinois, Michigan and other parts of the Midwest may see a drier-than-normal winter.

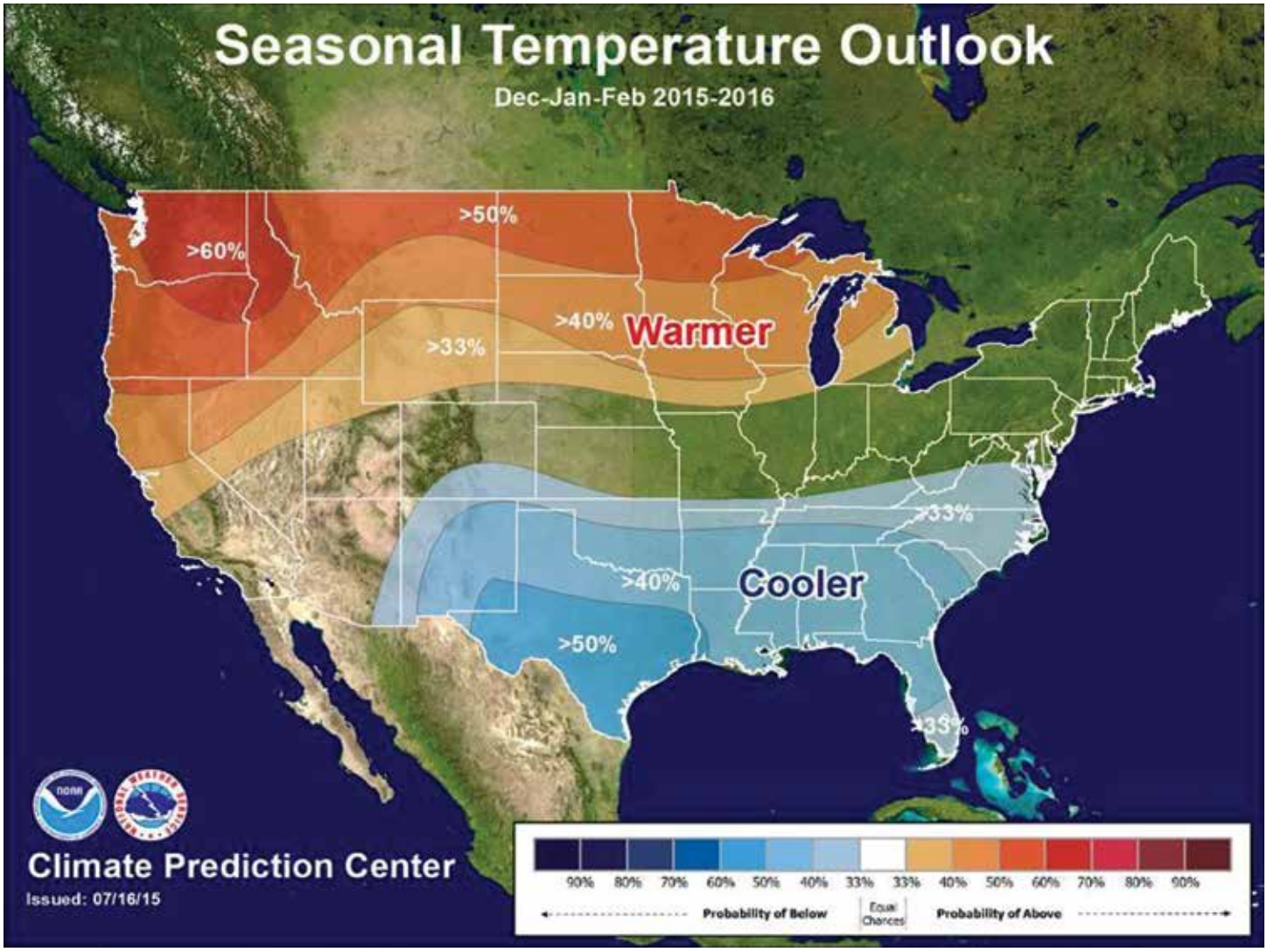
The European Niño

Research suggests that the main impact in Europe, is more likely to be felt in winter, causing colder, drier conditions in Northern Europe, and wetter, milder winters through southern Europe and the Mediterranean.

As an example, during the not so long ago 2009-10 Niño, the winter across Europe was exceptionally cold. But there are many other variables that affect Europe's climate and there was a deep, protracted solar minimum at the same time, which is known to increase the likelihood of colder winters. And despite El Niño of 2006/2007, Europe's winter was mild.

Asia-Pacific El Niño

Forecasts are not the best when we speak about super-sized El Niño for



Asia and the Pacific. The 2015 typhoon season is on pace to surpass average numbers and could challenge the record number of super typhoons since 1959.

El Niño will keep waters warmer than average in the part of the Pacific Ocean where tropical systems usually develop. The rising air in this region leads to a high probability of tropical system formation. During 1965 and 1997 seasons, there were 11 super typhoons. AccuWeather meteorologists are forecasting nine super typhoons this year, which will be the third most active season on record. And the Typhoon season is forecasted to extend well into the winter, until December, which is usually a quiet month for these types of events. Strongest El Niño ever, really.

The 2015-16 season may bring one of the strongest El Niño events on record, comparable with the one in 1997, which was distinguished by record-breaking warm sea surface temperature anomalies. Using this comparison, you can look up your resort records from back then and prepare for this snow season accordingly.

One of the other main consequences of the predicted El Niño later this year would be to boost global temperatures.

It could mean either 2015 or 2016 will become the hottest year globally on record. In fact AccuWeather's global weather center said the world could be facing the strongest El Niño phenomenon in 50 years.

One way or the other, El Niño will certainly have the potential to grab the headlines later this year. Although there are no guarantees, a Monster Niño like this surely provides an uncommon opportunity for us Snowmakers to anticipate the climate and tendencies well in advance.

Now that you know what El Niño and La Niña means, start preparing your pumps and SMI Snow machines and get ready to have the best season ever!! As even during wintertime, El Niño is only one of a number of factors that influence temperature and climates. Make Snow, Go Skiing and have the Most Vertical Fun!!

If you are interested in more info about a specific topic, would like to comment or have something to share, please forward any comments and ideas to snowuni@snowmakers.com

Baltazar Sanchez
International Commercial Director

SMI CLINIC 2015
VIVA LAS VEGAS

SMI was pleased to host the 2015 SMI Clinic in Las Vegas, NV from September 23rd to September 25th. Our primary goal of the clinic was to increase understanding of our equipment while introducing fellow snowmakers from around the world. Day 1 was hosted by Las Vegas Ski and Snowboard Resort and consisted of maintenance and training of the Super PoleCat and Puma. Day 2 was hosted by the SMI Auto crew who went through electrical, auto and SmartSnow trainings. SMI would like to thank everyone in attendance for their enthusiasm and positive spirit that made this this event successful.

Snowmaking Today

WHAT PRICE ENERGY? The choice is yours!

While the nation hotly debates a national energy program, we can all be certain of one thing: the outcome will affect all of us because in the ski area business, energy is money. Big money!

Any price hikes to force conservation will hit us big in the area where it hurts the most — right in the pocketbook!

So we listened intently when several scientific types recently discussed the energy pros and cons of various snowmaking systems.

One theorized that excluding water pumps, vehicles and manpower, one should theoretically be able to convert one gpm of water into snow for every horsepower expended at 20°F.

The other took a much more practical view and said, heck, let's just look at the field results.

He calculated that, on average, compressed air snowmakers using proven guns now get about 1 gpm per 2½ horsepower.

In contrast, the SMI 320, Boyne Snowmaker and Hedco Standard get about 1 gpm using ½ horsepower. That's a whopping 5 to 1 differential!

What does this mean to the economics of a ski area? Just this. If snowmaking energy use now constitutes 3% of the overall budget, this 3% can be reduced to a mere .6 of 1%.

Considered in dollar terms, if the area's present snowmaking energy costs are running $30,000 annually with compressed air, this amount can be reduced to only $6,000 annually by using airless equipment. All the savings can be tacked right on to profits!

With favorable economics like these to work with, an area operator can easily convert from one system to the other over a period of two or three years on just the savings alone.

All our major industries — steel, chemical, aluminum, automotive — have waged an all-out war on energy waste. "I wonder", asked the first scientist, "when a majority of ski area operators will start asking themselves the same hard questions with respect to their own energy use."

Many well-managed areas, of course, have already started converting to the energy saving airless systems, and fewer still have completed their installations.

One word of caution, though. Like in all things, check things out carefully before you proceed. Be sure you're not buying yourself a new maintenance headache.

VEHICLES FOR SNOWMAKERS

Each area operator has his own ideas on what kind of vehicles, if any, his snowmakers should have or need. Approaches vary widely.

In some areas, snowmaking personnel simply ride the lifts up and walk down while hooking up and checking guns.

Other areas provide snowmobiles, or they provide their snowmakers with an allowance for buying their own snowmobiles and keeping them in repair. Still others provide Thiokols, Tuckers or Bombadiers.

What's best for you?

We can't really say, but we suggest you spend a few nights with your snowmakers to help make up your mind.

Snowmaking is hard, cold demanding work. It is often frustrating, as well, and you may just decide your snowmakers deserve every consideration you can give them. The right transportation could go a long way to making them more efficient, better workers.

"Now that you're married," said the insurance agent to the bridegroom, "I suppose you'll want some additional insurance on yourself."

"I don't see why," replied the new husband. "She's not dangerous."

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WHEN ALL IS SAID AND DONE; THERE'S MORE SAID THAN DONE.

What was the most common problem in snowmaking last season?

Not enough water!! Area after area ran out of water, hundreds of thousands of gallons, millions of gallons. Matt Baker characterized it the best: Matt says figure the acreage and depth you want to cover and divide by 2. This is the amount of water snowmaking needs.

For example, if one is going to cover 40 acres with 12 inches of snow, one needs a lake 40 acres by 6 inches deep or one acre by 20 feet deep. Of course, the amount of make-up water available can be deducted from this.

BOYNE SNOWMAKER doing what it does best: quietly producing snow in scandalous quantities!

VINTAGE SNOWNEWS

Snowmaking Today

THE WIND/CHILL FACTOR ON SNOWMAKING . . . a Scientist's View

In our last issue, we discussed the very real chilling effect that high winds have on people. Why wouldn't the same winds also have a chilling effect on water particles and help turn them into snow?

Here is a follow-up to that article from the leading scientist on the subject.

Effect on People

The wind/chill factor is an attempt to calculate the heat loss from a human body at given wind velocities. In order to be relevant, the object (in this case, the human body) must be producing heat or be at a temperature higher than the surrounding air temperature.

This being so, each combination of air temperature and wind velocity is labelled with the particular air temperature which alone would produce a like heat loss without any wind.

All the wind velocities in these calculations refer to the relative velocities between the object being cooled and the air. A person standing still, for example, is subject to the entire wind velocity and will experience substantial heat losses due to the wind.

Effect on Snowmaking

A water droplet, on the other hand, is carried along by the wind and is subject to much lower heat loss forces.

Furthermore, the speed of the air from an SMI 320 SnowStream and most other snowmakers is somewhere between 60 to 100 miles per hour. This high speed air stream is unlikely to be influenced to any measurable degree by wind speeds which are much slower.

Relative humidity, on the other hand, has a much greater effect on the cooling of droplets because of the rapid evaporation of water into the air at low relative humidities. If high winds in an area combine with a low relative humidity, an observer can easily be misled into concluding the increased snow production is caused by wind velocity rather than the low relative humidity.

It is my opinion that wind has only a very negligible effect on snowmaking. The effect is probably *less* than the probable error for making the measurements involved in determining snow quantity and quality.

Alden W. Hanson

(Before his retirement, Mr. Hanson was a scientist of Dow Chemical Company for over 30 years in basic and applied research. He is the holder of U. S. Patent No. 2,968,164, the pioneer airless snowmaking patent. He is also the holder of 100 other patents and is the father of Denny and Chris Hanson – the founders and manufacturers of Hanson ski boots. Ed.)

TO GROOM OR NOT TO GROOM

The problem of grooming — what's too little or what's too much — is one that every ski area operator must answer for himself while the arguments go on endlessly.

Is there a practical alternative?

There is. Both Jack Kurlander at Hidden Valley and Nelson Sears at Mt. Belleayre avoid risking their grooming equipment on their steep slopes altogether. Instead, they lay down a fresh covering of snow every night.

Each of these areas has extensive SMI boom installations, and they have found that skiers really look forward to skiing that new snow every morning!

This gem from a ski area in Colorado Springs: Guest without reservation to Room Clerk: "If the President of the United States came, would you find room for him?" The Room Clerk allowed as how he would. Guest: "Well, he isn't coming so let me have his room."

SMI SNOWMAKING all over the globe

The good news: All indicators point to a great season coming up. Skiers are ready and willing!

The bad news: Insurance rates, energy and equipment costs are up, too!

With operating costs looming ever larger in the profitability picture of most ski areas, many managements are taking a second and even a third hard look at ways to improve efficiency and reduce costs.

NOTE TO MANAGEMENT . . . give credit where credit is due

The success of any ski area takes a great deal of team effort with every department doing its appointed job with enthusiasm and competence.

But don't forget the fellows out back. The guys who get cold and wet in the middle of the night, whose work is conspicuous to everyone, but who labor alone under every handicap subject to every whim of the weather.

These are the guys who have to work with complicated systems, compromises and dangers in the dead of night with little or no recognition and under the most difficult conditions. In fact, as a manager, you will not really understand their problems until you have actually been out there with them 2 or 3 nights (not 2 or 3 hours), started the pumps, fixed the leaks, thawed out frozen sections, positioned the guns, moved them, tested the snow, changed the various settings, and just generally defined the problems with your system.

Some areas are spending as much as $500 an hour making snow yet the boss man hasn't been in the pump house or on the slopes all season during snowmaking. To be an effective manager, he should have a close personal familiarity with his snowmaking system in order to give proper recognition to his people who man them.

The quality and quantity of snow is one of the most important facets of a ski area operation, one of its biggest costs and one of the few aspects of his operation that can be scientifically controlled. Hence, snowmaking should receive the recognition and management time it deserves!