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Funding for WRDS and the creation of this electronic document was provided by the Wyoming Water Development Commission
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WYOMING • WIND RIVER RANGE WEATHER MODIFICATION PROGRAM



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R a n g e



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WYOMING WATER DEVELOPMENT
C O M M I S S I O N

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Cheyenne, WY 82002

**Cloud Seeding Operations in the
Wind River Range of Wyoming
2015-2016 Season**

ANNUAL REPORT

prepared by

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for the

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October 2016

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EXECUTIVE SUMMARY

Funding for cloud seeding operations in the Wind River Range (WRR) for the winter of 2015-2016 was provided in part by the Wyoming state Legislature's "Omnibus Water Bill – Construction" approved by the 2015 Wyoming State Legislature. Per the legislation, the appropriate funds could only be expended once formal cost sharing agreements were in place with other Colorado River Basin water users. Wyoming's cost share was capped at 25% to reflect the benefits expected to be accrued to the State. Funding partners in support of continued weather modification activities in the Wind River Range during the winter of 2015-2016 include the Southern Nevada Water Authority, the Central Arizona Project (CAP), the Colorado River Board of California - Six Agency Committee, and the Arizona Department of Water Resources.

The same ten ground-based ice nucleus generators (ground generators) that were employed during the preceding season were deployed for the 2015-2016 season. The White Acorn Ranch generator is shown in Figure 1. Nine generators were sited on the west, southwest, and southern flanks of the range. The tenth was sited on the southeastern flank, southwest of Lander. As would be expected based on the ground generator locations, the majority of seeding was conducted when winds were from the west or southwest. A number of seeding events also occurred when winds were easterly, supporting the activation of the single ground generator near Lander. During the season, operations were conducted twenty-four hours a day, seven days a week. There were a total of 27 seeding events during the season, which varied widely from month-to-month.



Figure 1. The ice nucleus generator sited at White Acorn Ranch on the southwest flank of the Wind River Range (WMI photograph). For the locations of all the generators, see Figure 4.

For seeding to have been conducted, the wind direction had to be such that seeding agent released from each specific generator would carry seeding aerosol (silver iodide, AgI particles) upslope into cold but yet-unfrozen clouds at speeds sufficient to ensure that transport would occur. The seeding rate is about 25

grams of silver iodide per generator, per hour. The results discussed in the report show a variance in the number of generators used from event-to-event. This variance is due to situations when the wind direction was such that only some of the generators needed to be activated. The two other requisite conditions were that water clouds had to have been present, and the temperature of the clouds aloft had to be cold enough (-6°C or colder) that the seeding agent would actually nucleate ice, thus starting precipitation development. This is discussed in greater detail in the body of the full report.

The requisite temperature and wind criteria necessary to initiate seeding operations were primarily satisfied through the release of weather balloons. A total of 25 weather balloons were released during the 5.5 month project. The presence of a water cloud was established by a radiometer sited near Cora, WY. The high-resolution numerical weather model operated by the National Center for Atmospheric Research (NCAR) in previous seasons was not available, so the forecasters instead relied on model output publicly available on the web.

Overall, the 2015-2016 winter offered more storms than in the 2014-2015 winter season.

Additional and more detailed information is provided in the pages that follow, and the attached appendices. For increased ease of reading, a glossary of terms and acronyms is also provided.

ACKNOWLEDGMENTS

Weather Modification, Inc. (WMI) is pleased to acknowledge the following persons and entities who made the 2015-2016 operations possible.

The Wyoming Water Development Office (WWDO) coordinated the entire effort and contributed 25% of the costs. The WWDO also acquired additional funding from the Colorado River Board of California – Six Agency Committee, the Central Arizona Project, the Southern Nevada Water Authority, and the Arizona Department of Water Resources.

Ms. Kathy Raper of the Sublette County Conservation District arranged for local students to visit the WMI facilities in Pinedale to learn about the program and observe weather balloon launches. WMI greatly appreciates the opportunity to continue providing educational training and community outreach.

WMI also acknowledges all the WMI staff who contributed to the success of the program, specifically meteorologists Dan Gilbert and Jason Goehring, technicians Michael Paul, Jeremy Silvey, William Hocker, Rich Keely, and Ryan Richter, and all the administrative support provided by Erin Fischer, Thuy Tran, Dennis Afseth, and other Fargo-based WMI staff.

1. BACKGROUND AND OVERVIEW

1.1 Background

Atmospheric water transformed to precipitation is one of the primary sources of fresh water in the world. However, a large amount of water present in clouds never is converted into precipitation that makes it to the ground. This has prompted scientists and engineers to explore the possibility of augmenting water supplies by means of cloud seeding.

From 2006 through the spring of 2014, cloud seeding operations in the Wind River Range were conducted within the context of the Wyoming Weather Modification Pilot Project (WWMPP). Eight of the ten ground-based cloud seeding generators used in that project were funded by the Wyoming State Legislature through the Wyoming Water Development Commission (WWDC). The two additional generators were funded by the Lower Colorado River Basin States.

Though the WWMPP concluded in the spring of 2014, local and regional interest in continuing operations remained. In recognizing this interest, the Wyoming Water Development Commission (WWDC) obtained legislative support and the funding for a 2014-2015 operational cloud seeding program in the Wind River Range. This interest remained, and operations continued through this venue during the winter of 2015-2016. Funding provided by the 2015 Wyoming Legislature enabled the State of Wyoming, through the WWDC, to provide 25% of the operational cost. Additional funding came from other sources as discussed in Section 1.4.

1.2 Scientific Basis

Clouds in the lower troposphere form when, in cooling air, water vapor condenses upon cloud condensation nuclei (CCN), forming cloud droplets. The size of the droplets produced depends on the amount of water vapor present, and the character of the CCN. If the CCN are large or have properties that attract water (such as salt), the resulting droplets will be of increased size. All this happens on a very small scale, as illustrated in Figure 2. About one million (10^6) typical cloud droplets are required to produce a single, 1 millimeter (mm) raindrop.

Precipitation forms in two ways. The simpler process involves the collision and coalescence of cloud droplets until the droplet becomes large enough to fall as precipitation. Thus, the initially tiny cloud droplets grow in size, becoming drizzle, and with continued growth, rain. This process is known as the *collision-coalescence* or *warm rain* process.

The alternative path to precipitation development is through the formation of ice versus rain, and it is this process that plays a significant role in winter clouds in Wyoming. For ice to form the cloud must be colder than 32°F (0°C). However, ice does not form spontaneously at temperatures colder than 32°F (0°C). In the absence of ice nuclei, water can become “supercooled” (SLW); meaning the water in the cloud remains in liquid form at temperatures well below zero Celsius. To most persons this is surprising, as we are accustomed to seeing water (at the surface) freeze whenever temperatures fall “below freezing.” Freezing happens at the surface because there are lots of substrates (substances or materials) present that encourage nucleation of the ice phase—freezing, and these substrates are largely absent in the free atmosphere.

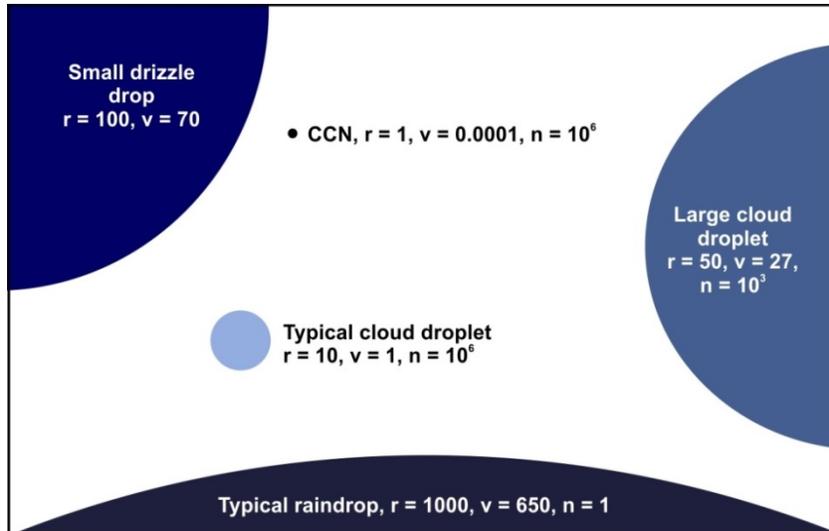


Figure 2. Relative characteristics of particles involved in cloud processes. For each, the radius (r, microns), fall velocity (v, cm per second), and number concentration (n, per liter) are given (after Wallace and Hobbs 1977). The raindrop shown (radius = 1000) is a 2 mm diameter raindrop.

Nature’s solution to the lack of substrates available to encourage the freezing process in clouds comes in the form of tiny particles called *ice nuclei*. Ice nuclei provide microscopic “templates” for supercooled liquid water to follow, and become the hard crystalline form known as ice. The shape of an ice nucleus plays an important role in determining which atmospheric conditions will be better suited for the formation of ice crystals in clouds.

Once ice forms in a cloud, the crystals grow quickly. Initially, growth occurs through water vapor deposition directly on the nascent ice crystal, producing six-sided crystals. Within five minutes, these tiny ice crystals grow large enough to begin to fall. As they fall, growth by deposition continues, but because the ice crystals are heavier than the nearby SLW droplets they collect them as they fall. Upon contact with the ice crystals, the SLW droplets freeze. As they grow ever larger, the ice crystals may encounter each other and become tangled, forming aggregates known as snowflakes.

When clouds grow colder than about -5°C , but do not immediately form ice crystals, they can be treated with silver iodide-based ice nuclei which immediately initiate ice crystal formation, thus starting the ice-phase precipitation process. Ground-based seeding is commonly used in orographic applications, especially when the prevailing wind flow is roughly perpendicular to the mountain range, so that seeding agent is lofted immediately upward into the targeted clouds. This orographic seeding technique was the prime strategy used to seed winter clouds throughout the WWMPP, and continued to be the main approach utilized in the Wind River Range in 2014-2015, and again in the winter of 2015-2016.

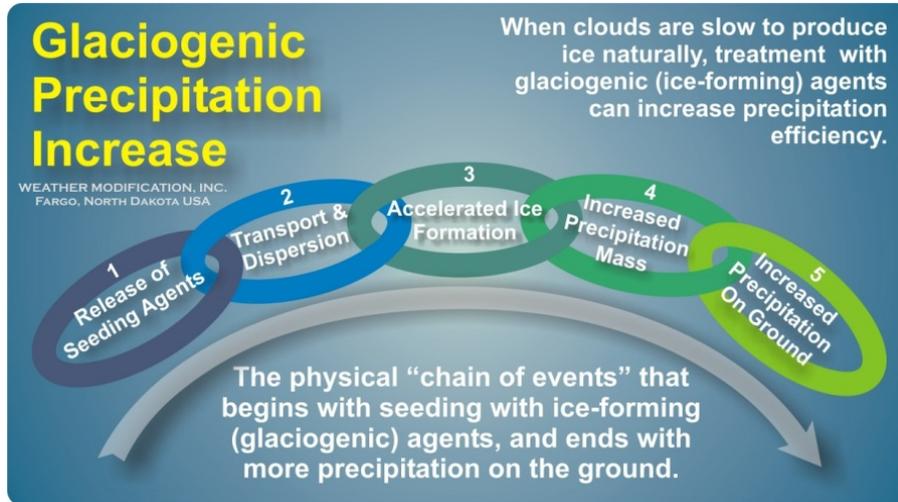


Figure 3. The physical chain-of-events that begins with release of ice-forming seeding agents, and culminates with increased precipitation.

Given the chain-of-events illustrated in Figure 3, effectiveness of seeding operations depends upon three things:

- The clouds of interest must contain liquid water.
- The cloud temperature at the level where liquid water is present, typically in the neighborhood of 10,000 feet MSL, must be colder than +23°F. Natural ice nuclei, such as crystalline soil particles, do not act to form ice crystals until the cloud is much colder (at least as cold as +5°F). The AgI seeding agent, by virtue of its crystalline shape being very close to that of ice, begins to form ice crystals much sooner, at about +23°F. As a result, precipitation formation within the cloud starts sooner, allowing more time for the ice crystals to grow and transform into snow.
- The wind direction and speed must be such that the seeding agent released from the ground-based generators will be transported up the mountain slope and into the target clouds.

1.3 Operations

The three criteria above were the same as those used in the WWMPP research, except the temperature criterion for seeding during the WWMPP was slightly colder (+17.6°F /-8°C). A colder temperature threshold was used in the research to ensure that more of the seeding agent would activate in the cloud and produce a strong seeding signature.

In operational seeding, the temperature criterion can be met in warmer conditions as long as some of the ice nuclei still produce ice crystals. This being said, it must be noted that the magnitude of the seeding effectiveness will diminish as temperatures warm. Seeding should not occur when temperatures aloft are warmer than +23°F (-5°C). Widening the temperature window for seeding increases the number of seeding opportunities. Most operational (vs. research) seeding programs use this warmer temperature criterion.

1.4 2015-2016 Funding

In addition to the 25% of funding costs provided by the State of Wyoming, funding for the 2015-2016 operations was also provided by the following organizations/agencies.

Southern Nevada Water Authority. The Southern Nevada Water Authority (SNWA) is a cooperative agency formed in 1991 to address Southern Nevada's unique water needs on a regional basis. SNWA officials are charged with managing the region's water resources and providing for Las Vegas Valley residents' and businesses' present and future water needs. With Colorado River water currently representing 90% of SNWA's water supply, the SNWA partners with other Colorado River Basin states to optimize and enhance Colorado River water supplies.

The Central Arizona Project. The Central Arizona Project (CAP) delivers Colorado River water via a 335-aqueduct system to customers in Maricopa, Pinal, and Pima Counties in Arizona, home to 80% of Arizona's population. The CAP diverts more than 1.6 million acre-feet annually, providing water to cities, towns, irrigation districts, Native American communities, and stores water underground for future use during times of drought or shortage. The CAP manages its Colorado River resources for current and future residents in central Arizona, and continuously seeks collaborative approaches with partners in the Colorado River Basin to protect and augment the water supplies in the Colorado River System.

Colorado River Board of California - Six Agency Committee. The Six Agency Committee was created in 1950 through an agreement among Palo Verde Irrigation District, Coachella Valley Water District, San Diego County Water Authority, Imperial Irrigation District, the Metropolitan Water District of Southern California and the City of Los Angeles Department of Water and Power. The Six Agency Committee provides funding to support actions to safeguard the members' rights and interests in the Colorado River system and for the Colorado River Board of California.

The Arizona Department of Water Resources also contributed to operations in the Wind River Range for the 2015-2016 season, to help further the goals of a larger Colorado River Basin flow augmentation strategy, and improve system conditions.

2. STAFF AND FACILITIES

2.1 Personnel

The primary project personnel were the project forecasters who monitored the weather and made the decisions regarding which ice nucleus generators should be used, and when each should be turned on and off, and the project technicians who supplied, maintained, and operated the generators.

Meteorologists. Two meteorologists staffed the 2015-2016 operations season. Mr. Daniel Gilbert was located on site in Pinedale, WY throughout the project. In addition to coordinating data collection for the project, he also operated the weather balloons (the upper air sounding system). The second meteorologist was Mr. Jason Goehring, who worked off-site from his home, using weather resources available via the Internet. Both Gilbert and Goehring are Weather Modification Association Certified Operators. Between the two of them, Gilbert and Goehring completed all the daily forecasting, weather monitoring, and implementation of seeding operations.

Technicians. Four technicians participated in the 2014-2015 operations. On-site technical work was conducted primarily by Mr. Michael Paul, Mr. Jeremy Silvey, and Mr. Bill Hocker, who were occasionally assisted by Mr. Rich Keely. Mr. Ryan Richter was available to provide counsel and direction from the WMI home office in Fargo. Safety guidelines require that two technicians travel into the field together, largely in the event of equipment failure (*i.e.*, a snowmobile breakdown), but also because two persons are sometimes required to complete tasks such as adding seeding solution to a generator.

2.2 Siting of Seeding Equipment

Seeding equipment was placed at ten sites for the 2015-2016 project, as shown in Figure 4. These sites were unchanged from those utilized in the WWMPP and the 2014-2015 season.

The generator placement was such that individual generators could be activated according to wind direction, and as storms passed and conditions changed. As shown in Figure 4, nine of the ten generator sites wrapped around the western to southwestern side of the mountain range, beginning with the Green River site on the west and ending with the Anderson Ridge site at the extreme southern end. These locations allowed targeting of the range when wind directions were within the southwestern quadrant. The tenth site, Enterprise, allowed targeting when winds were easterly. All sites were on state-owned or private lands. Permissions were established through the Wyoming Office of State Lands and Investments or private memoranda of understanding, accordingly.

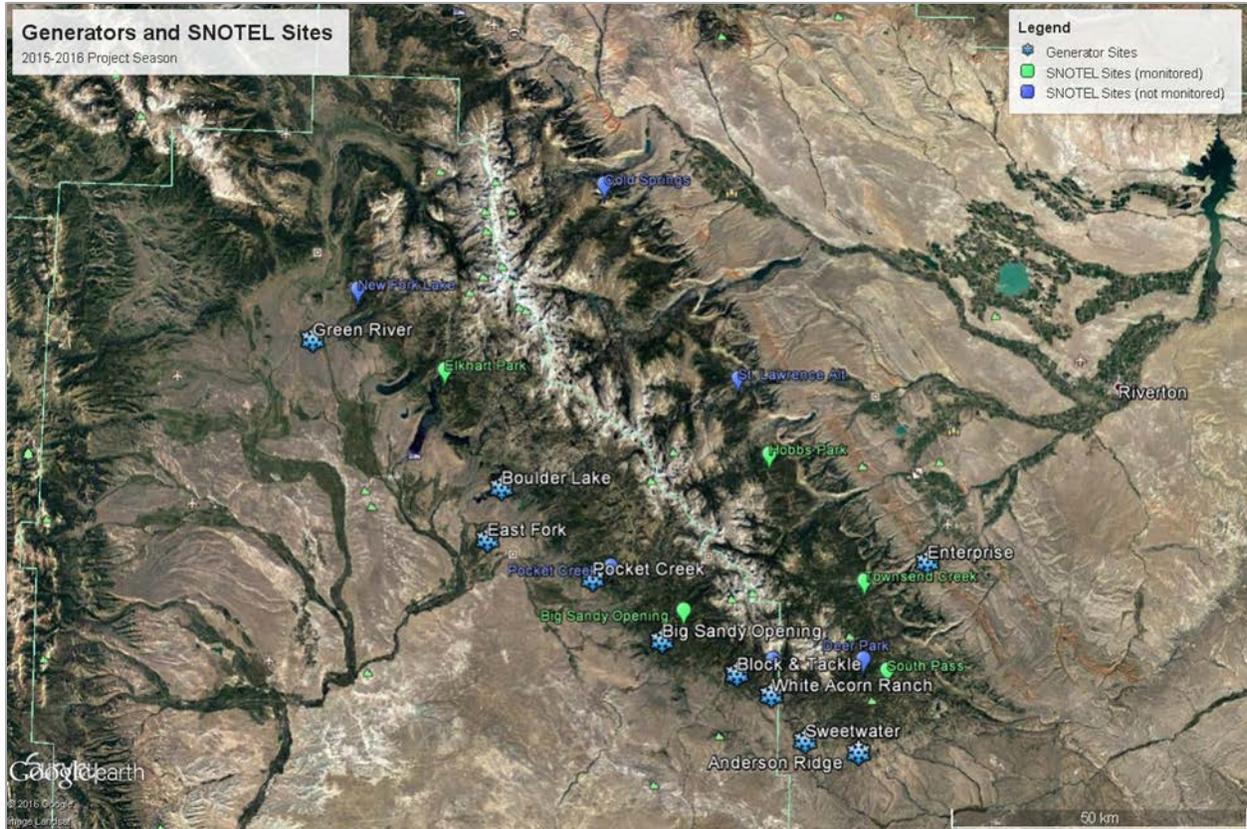


Figure 4. The locations of the ground-based ice nucleus generators are indicated by the snow crystal symbols. The green “balloons” indicate the locations of Natural Resources and Conservation Service (NRCS) snow telemetry (SNOTEL) sites used in monitoring snowpack during the 2015-2016 season. The blue balloons show the locations of additional SNOTELs that were not used because of proximity to sites that were used, or a short period of record (they were relatively new sites).

2.3 Ice Nucleus Generators

The ice nucleus generators were designed and fabricated by WMI. The primary components are shown in Figure 5.

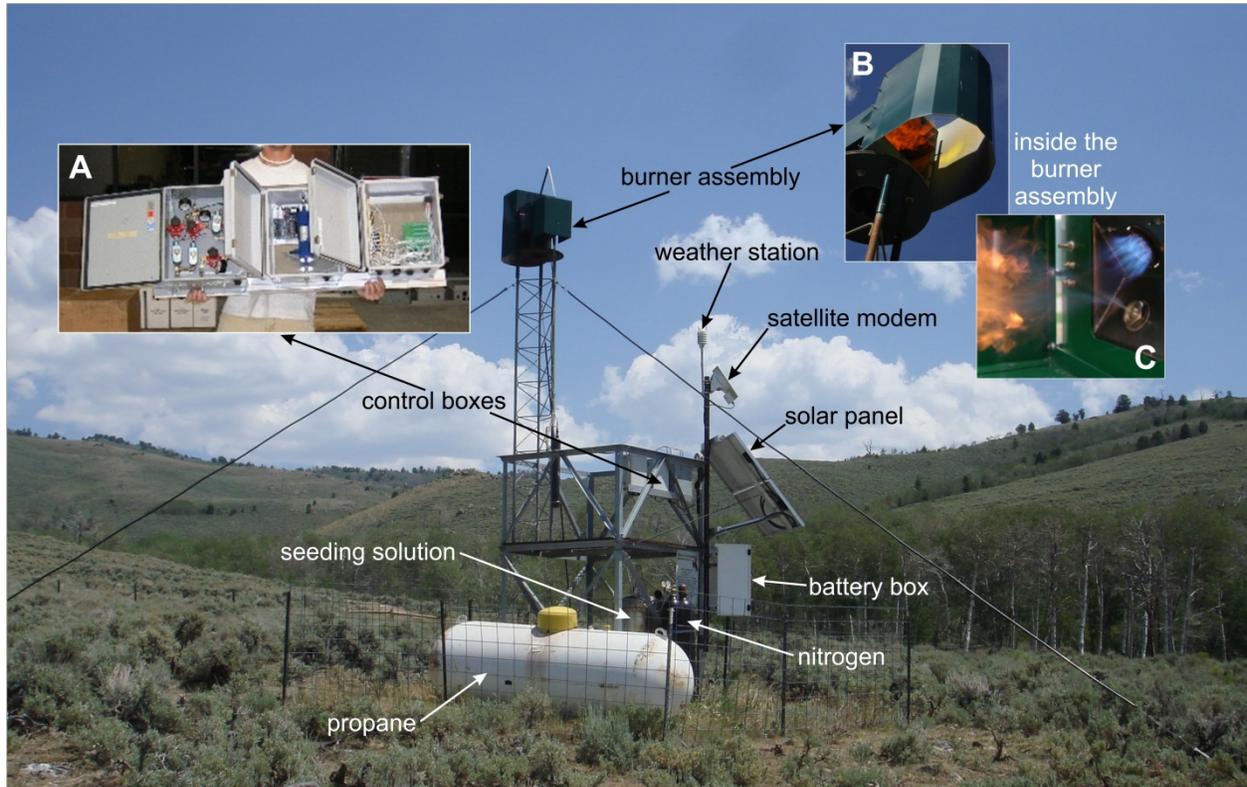


Figure 5. The primary components of the WMI remotely controlled ground-based ice nucleus generator are illustrated. Inset A, shows the contents of the control boxes. From left to right, these are: relays (electronic valves) to turn flows on and off, seeding solution flow rate regulation and measurement, and computer interface with the satellite modem. Inset B, provides a view up and into an ignited generator, and Inset C, shows how the seeding solution is atomized through a nozzle (silver disk, lower right) and into the burning propane (blue flame) and ignited (bright orange flame).

The Wind River Range generators are fully independent, controlled via satellite, and powered by batteries charged by solar power. This provides the ability to site generators at higher elevations, significantly improving delivery of seeding agent to the clouds. Being remotely-controlled means that the generators can be activated and deactivated as weather conditions warrant. This results in less seeding agent being dispersed unnecessarily, as can occur with manually operated generators. All of the generator lines and fittings are made of corrosion-resistant stainless steel, necessary when high-performance seeding solutions, which contain oxidizers, are used. The generators are robust; designed to function in extreme temperatures, winds and precipitation.

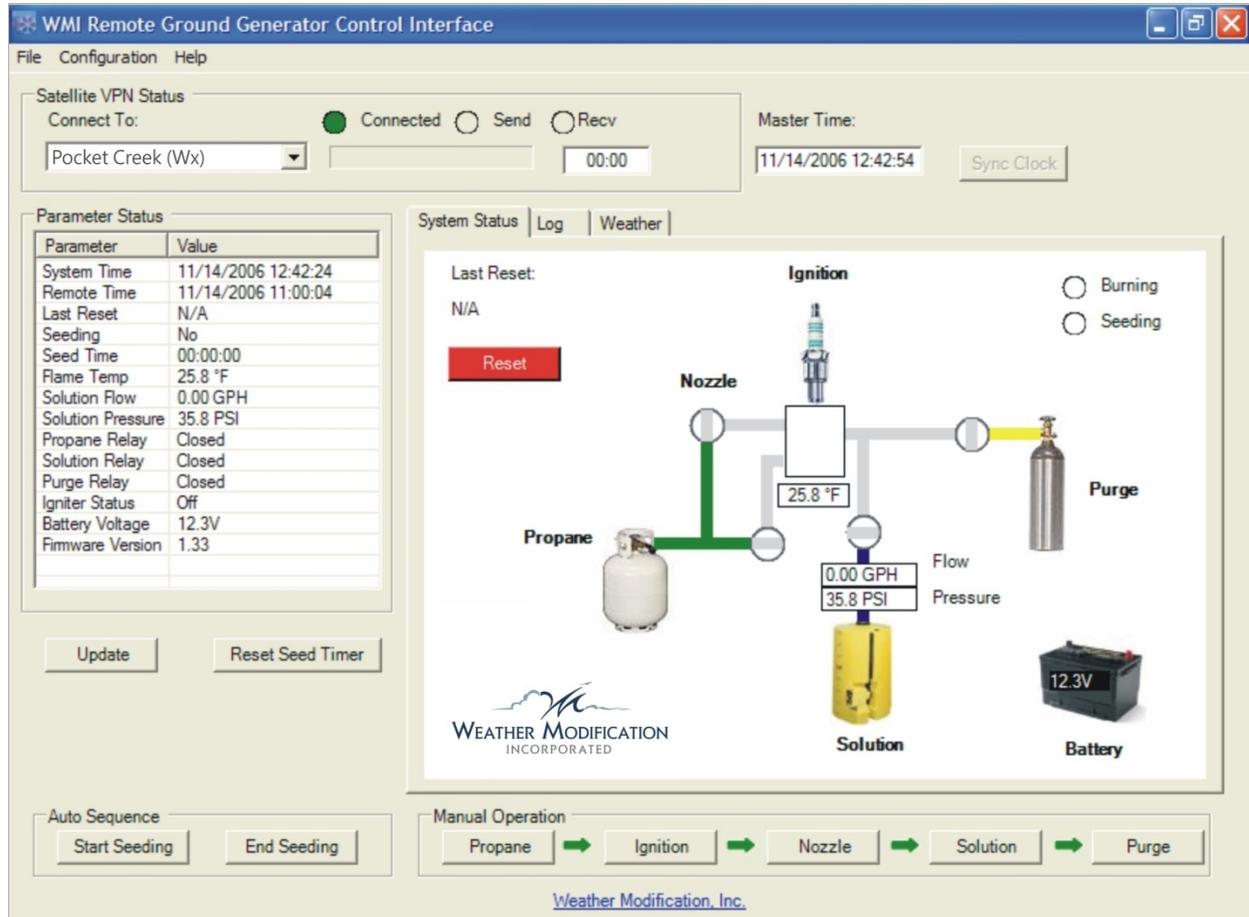


Figure 6. The control interface for the WMI remotely-controlled ground-based ice nucleus generator is shown, after connection is established via satellite, but before the generator is turned on. All flow valves are off, seeding solution flow is zero, but system status is fully reported.

The computer interface used to control the generators is shown in Figure 6. The status of the entire generator system (voltage, pressure, relay (valve) status, and flame temperature) is available for inspection by the technician immediately upon connection to the satellite.

Clicking the Start Seeding button (lower left on the interface, Figure 6 and 7) automatically sequences the generator start-up. At the generator, a valve will open to allow propane to flow. Ignition of the propane is confirmed on the interface by a rapid increase in indicated flame temperature. When the generator is not burning, the “flame temperature” is actually that of the ambient air. Once the generator is burning, the seeding solution is atomized by the nozzle and sprayed as an aerosol into the propane flame (Figure 5, Inset C). As the solution burns, particles of silver iodide are transported by the wind into the clouds over the mountains. Several of these steps, such as the flow rate of the seeding agent, can be confirmed by the technician utilizing the WMI remote-controlled ice nucleus generator interface, as shown in Figure 7.

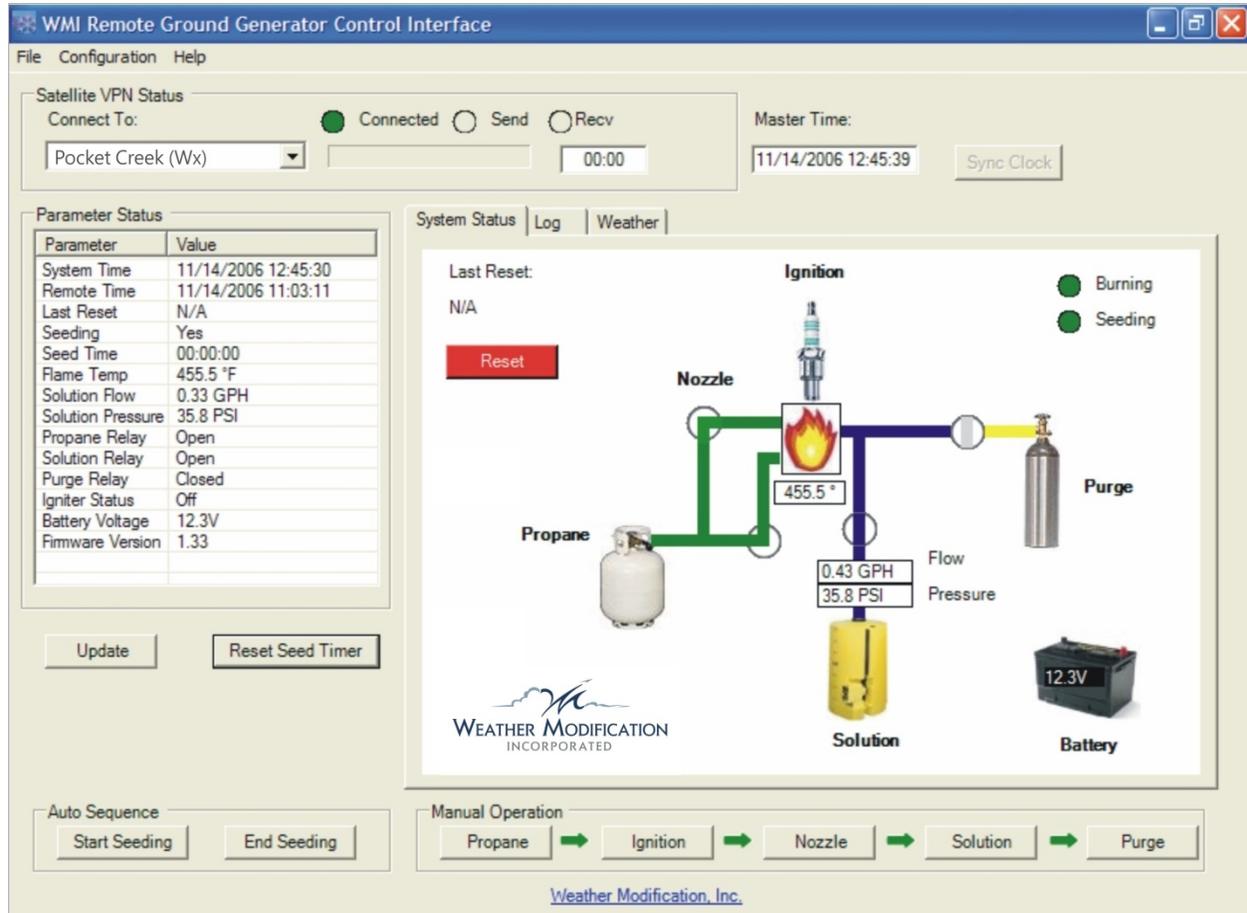


Figure 7. The WMI remote-controlled ice nucleus generator interface is shown, as it appears during seeding operations. Valves are open, the flame is known to be burning, and the seeding solution flow rate is also known. Seeding is certain.

2.4 Seeding Solution

The high performance seeding solution itself was tested at the Colorado State University Cloud Simulation and Aerosol Laboratory by DeMott (1997). Those tests determined that colder cloud temperatures produce a bigger yield of active ice nuclei per gram of AgI burned. As shown in Figure 8, the yield increases markedly from -6°C (+21.2°F) to -8°C (+17.6°F), and even more at -10°C (+14°F). In the course of the WWMPP, a -8°C temperature at the 700 hPa altitude (about 10,000 ft, approximate mountain top) was used as the threshold for seeding. At that temperature about 2×10^{13} ice nuclei are active for each gram of AgI burned. In English, this is 20,000,000,000,000, or 20 trillion nuclei. At -6°C, only 3×10^{11} nuclei are active, just 300,000,000,000, or 300 billion. Although the results indicate that cloud seeding efficiency decreases with warmer temperatures, the temperature criteria used in an operational program is typically warmer than those used in research based applications. Research studies provide the foundation for the design of operational programs. Operational programs in the western United States commonly commence seeding operations at -5 or -6°C. As in 2014-2015, the 2015-2016 Wind River operations used a temperature criterion of -6°C at 700 hPa (about 10,000 feet above sea level).

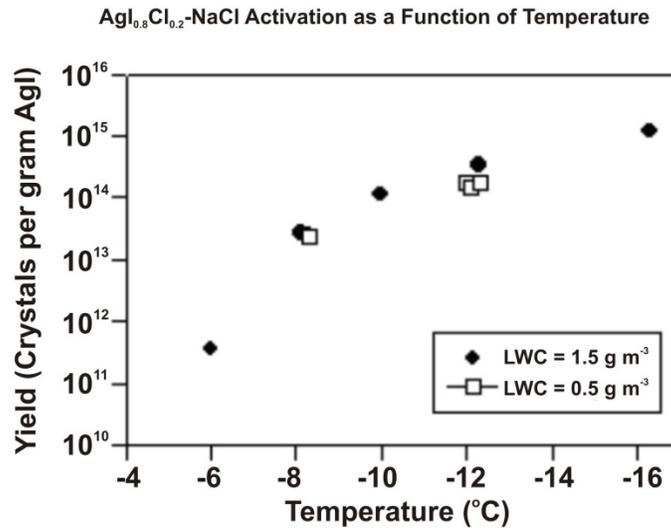


Figure 8. Yield as measured by the number of active ice nuclei per gram of silver iodide (AgI) burned, is shown as a function of temperature (DeMott 1997). These nuclei are comprised of silver iodide, silver chloride, and salt (NaCl).

It was previously mentioned that this seeding solution is “high-performance”. This means that unlike simpler solutions that produce a pure AgI nucleus, this “high performance” solution also contains salt, which enables it to function by the condensation-freezing mechanism. The non-salty, simple AgI nucleus functions by the contact-freezing mechanism. The differences between the two are as follows:

Contact-freezing. For this freezing process to occur, the ice nucleus must come into contact with a supercooled cloud droplet ($\geq -5^{\circ}\text{C}$). The speed at which this type of nucleation occurs depends upon the density of the water droplets in the cloud. Clouds with a lesser liquid water content contain fewer droplets, so it takes much longer for the chance collisions between the AgI nuclei and water droplets to occur, resulting in slower nucleation of the cloud. In clouds with a greater liquid water content, cloud droplets are plentiful, so nucleation occurs more quickly. After the ice nucleus and supercooled water droplets make contact, the droplets freeze and can continue to grow by other ice-phase growth processes: deposition, accretion, and aggregation.

Condensation-freezing. Nuclei of this type attract water vapor and immediately form water droplets, eliminating the requirement for collisions between ice nuclei and cloud droplets. As soon as the droplets containing these nuclei cool to at least -5°C , freezing results. Unlike the contact-freezing process, the speed at which this type of nucleation occurs *does not* depend upon the density of the water in the cloud. As soon as freezing occurs, the new ice particle can grow by other ice-phase growth processes.

The nucleation advantage of the more complex solution used in the Wind River operations is considerable, especially in clouds having lesser liquid water. The sole disadvantage of the complex seeding solution is that, containing salt, it is more corrosive than the simpler solution. Using the more complex seeding solution requires generators designed to burn it. The generators must be equipped with corrosion-resistant stainless steel tanks, lines, and fittings to avoid operational failure, and require more frequent maintenance.

2.5 Atmospheric Soundings (Weather Balloons/Rawinsondes)

Weather balloons were released from the WMI shop, in Pinedale, WY to help determine whether or not weather conditions were suitable for seeding. Each balloon carried a miniaturized weather probe that measured temperature, humidity, and pressure. In addition, the GPS position of the balloon was also recorded. The atmospheric sounding data (Figure 9) were recorded and compared to the operating criteria to verify that observed weather conditions were sufficient to initiate cloud seeding procedures.

Each sounding required approximately one hour to travel from the surface to the 100 hPa level (an altitude of about 53,000 feet). Upon completion, the sounding data were immediately shared via e-mail with NCAR, the National Weather Service Offices in Riverton and Cheyenne, and the State of Wyoming's Water Resources Data System (WRDS). All of the soundings were archived, and are available for any post-analysis efforts that might be undertaken.

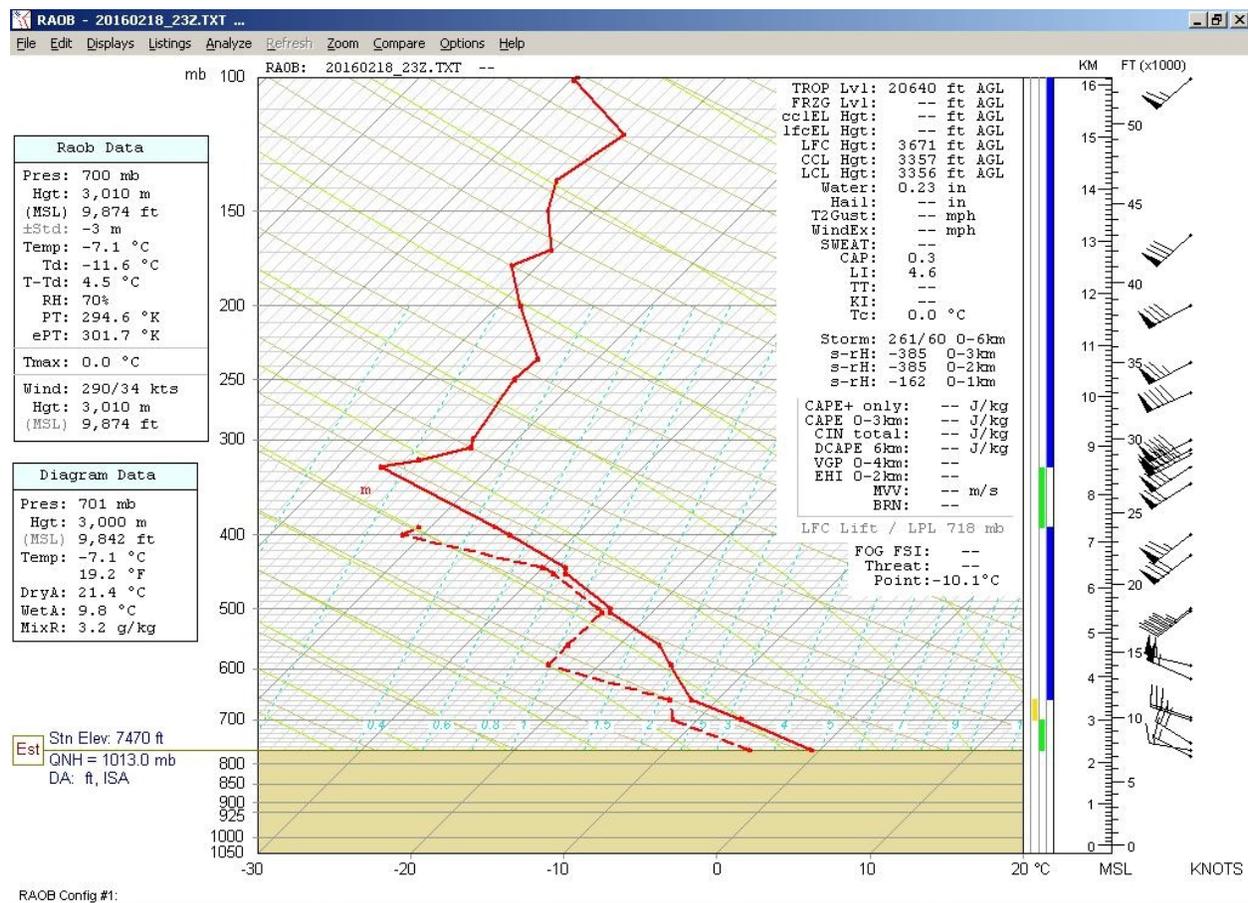


Figure 9. A plot of the upper-air sounding obtained from the weather balloon released from Pinedale, WY at 4:00 pm on February 18, 2016. The temperature at 700 hPa level (approximately 10,000 feet) was -6.7°C (+19.9°F), and the wind speed was from 275° (west) at 15 knots (17 miles per hour), both within the acceptable range for seeding.

2.6 Weather Stations

Five of the ten generator sites were equipped with Vaisala WXT-510 weather stations. These compact, tower-mounted instruments measured temperature, humidity, pressure, and wind speed and direction. Data storage of each station was limited to 8 hours; therefore technicians downloaded the data at regular intervals during seeding events, using the connection afforded by the generator satellite modem.

2.7 Shop and Site Servicing

Throughout the season WMI maintained a shop in Pinedale that provided storage and served as a staging area for generator service and the preparation and release of weather balloons.

The shop housed WMI's 4x4 truck, snowmobiles/trailers, spare generator parts, trouble-shooting equipment, and replacement nitrogen tanks. The Vaisala Digicora rawinsonde system used for the calibration and tracking of the weather balloons was also at the shop, as well as all the upper air consumables: helium, balloons, and rawinsondes. Internet service was available, allowing immediate sharing of upper air data with other interested parties (NWS, WRDS).

3. FORECASTING AND OPERATIONAL DECISION-MAKING

3.1 Meteorological Data Sources

The bulk of the weather information used for forecasting and weather monitoring was obtained from the Internet. Among these sites were those of RAP Real-Time Weather, the National Center for Environmental Prediction (NCEP), the College of DuPage, European Community satellite imagery, Northern Illinois University, and Unisys. While many of the web-based weather products (*i.e.*, National Weather Service (NWS) products) were publicly available, some data sources were project-specific.

Radiometer. A radiometer was deployed at the meteorologist's residence near Cora, WY (Figure 10). Since the presence of liquid water in the clouds over the target area is essential for successful seeding, this measurement was most helpful.



Figure 10. The radiometer sited near Cora, WY. The instrument does not transmit, but passively measures the atmospheric liquid water and water vapor. (WMI photograph by Daniel Gilbert)

Atmospheric Soundings. The atmospheric soundings (weather balloons/rawinsondes) were discussed in Section 2.5. Data from the soundings were immediately shared with the NWS and WRDS.

3.2 Timetables and Routines

If seeding was not underway at dawn, the following daily routine ensued.

WMI furnished a daily “first glance” update that provided an outlook into the probability of seeding operations taking place that day. This very simple form, sent to all project personnel, provided an early look at the weather expected each day. Four time periods were specified, from issuance until noon, from noon until sunset, from sunset until midnight, and from midnight until dawn the next day. The probability of seeding operations occurring in each of these time periods was rated by the forecaster as *no chance*, *unlikely*, *possible*, or *probable*. Technicians used this outlook to help inform equipment operation and maintenance decisions. In instances when seeding operations were already active in the morning, the “first glance” outlook would still be issued, reflecting the status of current operations.

The early update was followed by a much more detailed forecast and weather briefing, typically disseminated to the WWDO and all funding partners by late morning via email. These daily briefings included a summary of the preceding day’s weather and seeding activities, a summary of the current synoptic-scale weather pattern, and conditions likely to exist for the next 24 hours in the Wind River Range. Oftentimes weather conditions would vary sufficiently during the day that evening forecast updates were warranted and provided. The Daily Wyoming Wintertime Scale (DWWS), shown in Table 1, numerically categorized the probability of seeding operations occurring.

DWWS	SEEDING	METEOROLOGICAL DESCRIPTION
-3	No	Clear skies, or clear with isolated upper-level cloudiness.
-2	No	Occasionally clear, with cirrus, cirrostratus; or altostratus with bases above mountains.
-1	No	Limited coverage or short-lived orographic clouds, not enough temporal or spatial extent to warrant seeding activities.
0	Possible	Some orographic clouds or stratiform cloud deck(s) over mountain tops. SLW likely insufficient for seeding operations or winds clearly unfavorable.
+1	Yes	Orographic clouds and/or stratiform cloud deck(s) enshrouding mountain tops, winds favorable and SLW likely sufficient for seeding operations.
+2	Yes	Persistent orographic clouds and/or stratiform cloud deck(s) enshrouding mountain tops, SLW probable, winds favorable. Lengthy operations possible.

The seeding criteria were straightforward. First, 700 hPa temperature, meaning temperature near the cloud elevation at about 10,000 feet, had to be equal to, or less than -6°C (+21.2°F). Secondly, there had to be SLW present in the clouds. Finally, wind speeds needed to be strong enough to transport seeding agent from the generator upward into the mountains. Wind direction was also taken into account, as it helped inform which generators would be activated.

The first criterion, temperature, was confirmed by a weather balloon sounding released from Pinedale, WY (Section 2.5, Figure 9). In lieu of the sounding, the prognostic numerical model output was used, supplemented by prognostic, synoptic scale, upper air weather charts. The presence of SLW was confirmed by the real-time data from the radiometer (Figure 10) located near Cora, WY. The wind speed and direction were confirmed by the atmospheric sounding

When all three conditions were satisfied, seeding was initiated by the meteorologist and the generator technician. The meteorologist would communicate to the technician which generators would be activated, when, and for how long. The length of time a generator was activated depended upon how long weather conditions were expected to remain favorable. Once seeding was initiated, the meteorologist would begin tracking the real-time weather conditions that would impact seeding duration. If wind direction changed, some generators could be deactivated while others would be turned on. When favorable weather conditions ended, the technician would be directed to shut down all remaining active generators.

The service and maintenance of generator sites occurred when weather conditions were not suitable for seeding, therefore, field days tended to run long in order to get to as many sites as possible. Many maintenance trips ended as shadows lengthened in the setting sun (Figure 11), and some, after darkness fell.



Figure 11. The return from the field often requires four wheel drive! The use of sleds requires first getting to snow deep enough to use them. On the south end of the Wind River Range, roads like this are quite typical. (WMI photograph by Michael Paul)

4. OPERATIONS

Seeding operations were conducted on twenty-seven occasions, as enumerated in Table 2.

November had three seeding opportunities, one at project start-up, and two more near the end of the month. While the first event utilized seven generators, the last two events used only the Enterprise generator on the east slope.

The most active month was December, when favorable conditions developed seven times, and the most seeding agent was released (10.2 kg). Only one of the seven events occurred in easterly flow, when the Enterprise generator operated solo.

January was the second most active month with five events, all of which were quality opportunities in which at least seven generators were operated. A total of 8.8 kg of seeding agent was released.

Four seeding events occurred in February, half of which were Enterprise-only, east-slope opportunities.

There were six seeding events in March, and like February, half of the events were Enterprise-only, east-slope opportunities.

The WRR cloud seeding season ended with easterly upslope events dominating the scene. East-slope events persisted through the end of March, and the only two events that occurred in April were short-lived opportunities, utilizing only the Enterprise generator.

TABLE 2. Wyoming Weather Modification Wind River Range 2015-2016 Seeding Summary					
<i>Date</i>	<i>Number of Generators Utilized</i>	<i>Length of Seeding (hours)</i>	<i>AgI Released This Date (kg)</i>	<i>AgI Monthly Total (kg)</i>	<i>AgI Season Total (kg)</i>
19-Nov-15	7	9.6	1.507		0.000
25-Nov-15	1*	24.8	0.708		0.000
28-Nov-15	1*	7.1	0.195	2.409	2.409
11-Dec-16	7	4.5	0.670		3.079
14-Dec-16	1*	18.5	0.517		3.596
17-Dec-16	9	4.2	0.883		4.479
20-Dec-16	7	10.3	1.915		6.395
21-Dec-16	9	20.2	4.251		10.646
23-Dec-16	9	5.6	1.250		11.896
24-Dec-16	9	2.6	0.700	10.187	12.596
14-Jan-16	7	7.5	1.392		13.988
17-Jan-16	6	3.1	0.497		14.485
20-Jan-16	8	12.6	1.994		16.479
23-Jan-16	9	8.1	1.658		18.137
30-Jan-16	9	18.5	3.221	8.762	21.358
1-Feb-16	1*	25.9	0.677		22.035
19-Feb-16	6	15.4	2.524		24.559
20-Feb-16	7	7.3	1.324		25.883
22-Feb-16	1*	11.9	0.283	4.808	26.166
14-Mar-16	7	3.9	0.712		26.878
15-Mar-16	7	7.8	1.450		28.328
18-Mar-16	1*	6.0	0.160		28.488
24-Mar-16	7	10.4	1.947		30.436
29-Mar-16	1*	22.9	0.572		31.007
31-Mar-16	1*	11.1	0.290	5.131	31.297
16-Apr-16	1*	3.5	0.092		31.389
18-Apr-16	1*	6.4	0.164	0.256	31.553
<i>*seeding event with easterly flow, utilizing only the Enterprise generator</i>					

Table 3 summarizes operations by month and provides season totals. In total, 31.6 kg of seeding agent were released. Generators were operated for 1,173 hours.

TABLE 3. Summary of Seeding Events During the 2015-2016 Winter Season					
<i>Month</i>	<i>Events () easterly flow</i>	<i>Event Averages</i>		<i>Seeding Agent (kg)</i>	
		<i>Number of Generators</i>	<i>Generator Hours*</i>	<i>Average Released per Event</i>	<i>Total Released</i>
November	3 (2)	3.0	28.8	1.75	2.409
December	7 (1)	7.3	53.6	3.26	10.187
January	5	7.8	65.8	4.00	8.762
February	4 (2)	3.8	45.2	2.75	4.808
March	6 (3)	9.0	31.9	1.94	5.131
April	2 (2)	4.0	5.0	0.30	0.256
<i>Totals/Averages</i>	<i>27 (10)</i>	<i>1.0</i>	<i>257.8 / 42.9</i>	<i>1.012</i>	<i>31.553</i>
<i>*generator hours = sum of the hours each generator was run for each event, e.g., 4 generators each operated for 3.5 hours = 14 generator hours.</i>					

Table 4 shows the activity of each of the ten generators on a case-by-case basis. Each seeding event has two rows, the top indicates whether or not each generator was requested (REQ), and the bottom whether or not the generator ran (RAN). Ideally, every time a generator was requested it would run for the entire duration of the event.

However, the complexity of the generators and the extreme weather pretty much preclude perfection, for we see in Table 4 five red “NO”s, and eleven yellow “PARTIAL”s. Only once did more than one generator fail completely in the same event; that occurred on 20 February 2016. Four generators ran perfectly all season: Sweetwater, Anderson Ridge, Enterprise, and East Fork. Sweetwater and Anderson Ridge are located at the southern end of the range and were used less frequently than some of the others. Of the other six, the Green River generator failed completely only once, and the White Acorn and Pocket Creek generators failed completely only twice. Note that none of the generators suffered from recurrent problems, for when a problem arose, maintenance technicians quickly addressed the issue. The generator performance for the season was very good, resulting in 93.3% functionality, a decrease of 0.5% from the previous season, in spite of a 25% increase in seeding hours. This is testimony to the diligence and skill of the technicians. During the 2015-2016 season generators ran 1,173 hours, whereas the 2014-2015 season total was 876 hours.

TABLE 4. 2015-2016 Ice Nucleus Generator Activity

Wind River Range		WR01 Big Sandy	WR02 Block & Tackle	WR03 White Acorn	WR04 Sweetwater	WR05 Anderson	WR07 Enterprise	WR09 Boulder Lake	WR10 East Fork	WR12 Pocket Creek	WR13 Green River	#Ggens Called	#Ggens Active	
20151119	WRR0022	REQ	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	7	
		RAN	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES		7
20151125	WRR0023	REQ	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	1	
		RAN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO		1
20151128	WRR0024	REQ	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	1	
		RAN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO		1
20151211	WRR0025	REQ	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	7	
		RAN	YES	PARTIAL	PARTIAL	NO	NO	NO	PARTIAL	YES	YES	YES		5.75
20151214	WRR0026	REQ	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	1	
		RAN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO		1
20151217	WRR0027	REQ	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9	
		RAN	YES	YES	YES	YES	YES	NO	PARTIAL	YES	YES	YES		8.5
20151220	WRR0028	REQ	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	7	
		RAN	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES		7
20151221	WRR0029	REQ	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9	
		RAN	PARTIAL	YES	YES	YES	YES	NO	PARTIAL	YES	YES	YES		8
20151223	WRR0030	REQ	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9	
		RAN	YES	YES	YES	YES	YES	NO	PARTIAL	YES	YES	YES		8.5
20151224	WRR0031	REQ	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9	
		RAN	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES		9
20160114	WRR0032	REQ	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	7	
		RAN	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES		7
20160117	WRR0033	REQ	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	7	
		RAN	YES	YES	NO	NO	NO	NO	YES	YES	YES	YES		7
20160118	WRR0034	REQ	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9	
		RAN	YES	PARTIAL	NO	YES	YES	NO	YES	YES	YES	YES		7.5
20160123	WRR0035	REQ	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9	
		RAN	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES		9
20160130	WRR0036	REQ	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9	
		RAN	PARTIAL	YES	YES	YES	YES	NO	YES	YES	YES	PARTIAL		7.25
20160201	WRR0037	REQ	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	1	
		RAN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO		1
20160219	WRR0038	REQ	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	7	
		RAN	YES	YES	YES	NO	NO	NO	YES	YES	NO	YES		6
20160220	WRR0039	REQ	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	9	
		RAN	YES	YES	YES	YES	YES	NO	YES	YES	NO	NO		7
20160222	WRR0040	REQ	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	1	
		RAN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO		1

20160314	WRR0041	REQ	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	7		
		RAN	YES	YES	YES	NO	NO	NO	PARTIAL	YES	YES	YES		6.75	
20160315	WRR0042	REQ	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	7		
		RAN	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES		7	
20160318	WRR0043	REQ	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	1		
		RAN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO		1	
20160324	WRR0044	REQ	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	7		
		RAN	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES		7	
20160329	WRR0045	REQ	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	1		
		RAN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO		1	
20160331	WRR0046	REQ	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	1		
		RAN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO		1	
20160416	WRR0047	REQ	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	1		
		RAN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO		1	
20160418	WRR0048	REQ	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	1		
		RAN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO		1	
20160430	PROJECT ENDED														

UTC (zulu) Dates

PARTIAL = generator ran at least 75% of expected runtime.
NO = generator ran less than 25% of expected runtime, or not at all.

TOTALS	145	135.25
RUN =	93.3%	
FAIL =	6.7%	

5. OUTREACH

Whenever possible WMI likes to be receptive to requests to educate those showing an interest in our field efforts. During the 2015-2016 season such interest was made known through the Sublette County Conservation District (SCCD), which arranged for local students to visit the shop and learn about upper air soundings, and even to participate in the release of a weather balloon (Figure 12).



Figure 12. Pinedale home schooled students and parents learn how to release weather balloons at the WMI shop during a 2016 public outreach event. Meteorologist Dan Gilbert (right) inflates the balloon with helium while the students guess when the balloon is large enough. (WMI photograph by Bruce Boe)

Additional outreach was achieved through the presentation of project activities at Wyoming weather modification Technical Advisory Team (TAT) meetings. The technical advisory team, initially organized by the WWDO for the WWMPP, is comprised of representatives of interested State and Federal agencies. Wyoming agencies include the State Engineer's Office, the Department of Environmental Quality, the Department of Transportation, the University Office of Water Programs, and the Game and Fish Department. Federal agency representation includes several different forests (Bridger-Teton, Shoshone, and Medicine Bow), the U.S. Geological Service, the NWS Riverton and Cheyenne offices, the Bureau of Land Management, and the NRCS. The TAT met in Cheyenne on 27 January 2016. At this meeting, WMI presented an update on the current 2015-2016 Wind River operational seeding efforts.

6. SUMMARY

The 2015-2016 cloud seeding effort in the Wind River Range began on 19 November 2015, and concluded on 30 April 2016, a duration of nearly 5.5 months. The season started four days later than normal (15 November) due to a delay in finalizing the collaborative weather modification agreements.

Twenty-seven seeding events were conducted. Seventeen events involved four or more generators, seeding in westerly or southwesterly flow. The other ten were solo events using the Enterprise generator, in easterly upslope flow. A total of 31.55 Kg of silver iodide was released in the course of 1,173 hours of generator operations.

The ice nucleus generators operated reliably, seeding as intended over 93% of the time. Generator failures occurred infrequently, in fact, only one generator, Pocket Creek, experienced two operational issues during the course of the season.

In terms of seeding opportunities, the winter was 25% more active than the 2014-2015 season. Flow from the northwest is parallel to the Wind River Range axis rather than across it, so seeding isn't possible, even though snow may be falling over the range. As temperatures increased in April, seeding opportunities decreased. The final seeding event occurred on 18 April in easterly flow, and utilized only the Enterprise generator.

7. LIST OF TERMS AND ACRONYMS

Where applicable, definitions are those provided by the *Glossary of Meteorology*, published by the American Meteorological Society (2000), and are used by permission.

Accretion	See <i>riming</i> .
Aerosol	A system in which particles, either solid or liquid, are dispersed in within a gas, usually air.
Ag	The chemical notation for silver.
Agl	See <i>silver iodide</i> .
Aggregation	The process of clumping together of snow crystals following collision as they fall, to form snowflakes.
AGL	Above ground level
ASCE	American Society of Civil Engineers
BTAC	Bridger-Teton Avalanche Center
CAP	Central Arizona Project
CCN	Cloud condensation nucleus
CSU	Colorado State University
DWWS	Daily Wyoming Wintertime Scale, a number from -3 to +2 indicating the likelihood of seeding operations.
GPS	Global Positioning System
Glaciogenic seeding	Cloud seeding with ice-forming aerosols
Ground generator	See <i>ice nucleus generator</i> .
hPa	Hectopascal, equivalent to one millibar, the common unit used to measure atmospheric pressure. Pressure decreases as altitude increases; standard sea level pressure is 1,013.25 hPa, 850 hPa equates to approximately 5,000 feet (1,500 m) elevation, and 700 hPa, about 10,000 feet (3,000 m) above mean sea level.
Ice nucleus	Any particle that serves as a nucleus leading to the formation of ice crystals, without regard to the particular physical processes involved in the nucleation.
Ice nucleus generator	The remotely-controlled machines that burn a silver iodide solution to produce the ice nuclei that “seed” clouds containing <i>supercooled liquid water</i> .
IN	See <i>ice nucleus</i> .
mb	Millibar, same as hectopascal (<i>hPa</i>)
MOU	Memorandum of Understanding
MSL	Above mean sea level
NaCl	The chemical notation for sodium chloride, common table salt
NCAR	National Center for Atmospheric Research, Boulder, CO

NCEP	National Centers for Environmental Prediction, a set of NOAA research centers.
NOAA	National Oceanic and Atmospheric Administration, U.S. Department of Commerce
NRCS	Natural Resource Conservation Service, an agency of the U.S. Department of Agriculture
NWS	National Weather Service, U.S. Department of Commerce
OSLI	Office of State Lands and Investments
PNA	The airport and meteorological station identifier for Pinedale, Wyoming.
Precipitation efficiency	Expressed as a percentage, the ratio of the quantity of precipitation produced by a cloud to the total water condensate produced by the cloud.
Prognostic	A model used to predict future weather conditions. For example, model output showing the expected conditions over a specific area at a specified future time. The <i>RT-FDDA</i> model was run in a predictive mode.
Radiometer	A passive (non-transmitting) instrument that measures liquid water and water vapor in the atmosphere.
RAL	Research Applications Laboratory, NCAR, P.O. Box 3000, Boulder, CO 80307
Rawinsonde	Commonly called a <i>weather balloon</i> , the rawinsonde is a small package of weather instruments carried aloft by balloon. Vertical profiles of temperature, humidity, and winds are obtained as a function of pressure.
Riming	The growth of an ice particle by the collision with <i>supercooled</i> cloud droplets that freeze wholly or partially upon contact.
RIW	The airport and meteorological station identifier for Riverton, Wyoming.
RT-FDDA	Real-time Four Dimensional Data Assimilation, a version of the WRF model run by NCAR
Silver iodide	An inorganic chemical compound, AgI, that has a crystalline structure (symmetry, lattice spacing) similar to ice and a very low solubility in water, and can be easily generated as an aerosol.
SLW	See <i>supercooled liquid water</i> .
SNOTEL	Sites instrumented, operated, and maintained by the <i>NRCS</i> , to measure precipitation, <i>SWE</i> and other related parameters in the mountains.
SCCD	Sublette County Conservation District, Pinedale, WY
Supercooled liquid water	Liquid water at a temperature below the freezing point.
SWE	Snow water equivalent, the water content of snow, commonly expressed in depth (inches)
TAT	The Wyoming Weather Modification Pilot Project <i>Technical Advisory Team</i> , comprised of representatives of federal, state, and local agencies interested in or affected by the project.
Upslope	A term describing flow from a direction other than the climatological norm that produces orographic cloudiness and precipitation. In this report, the term refers to easterly flow against the Wind River Range, contrary to the westerly flow that generates the majority of the range's precipitation.

USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
UTC	Universal Time Coordinates, formerly known as Greenwich Mean Time, and Zulu time.
UW	The University of Wyoming
WMI	Weather Modification, Inc., 3802 20 th Street North, Fargo, ND 58102
WRDS	Water Resources Data System, University of Wyoming, Dept. 3943, 1000 E. University Ave., Laramie, WY 82071
WRF	The Weather Research and Forecasting numerical model
WRR	Wind River Range, Wyoming
WSEO	Wyoming State Engineer’s Office, responsible for the issuance of Wyoming cloud seeding permits
WWDC	Wyoming Water Development Commission, the state body directing the WWDO
WWDO	Wyoming Water Development Office, 6920 Yellowtail Road, Cheyenne, WY 82002
WWMPP	Wyoming Weather Modification Pilot Project

8. REFERENCES

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Appendix A. Daily Operations Summaries

Wyoming Weather Modification Wind River Range 2015-2016 Season – WMI Daily Project Summary	
19 November 2015, Thursday	
<p>Thick orographic clouds blanketed the range throughout the afternoon and overnight hours. The 700mb temperatures became too warm for seeding during the late evening and much of the overnight hours. Temperatures cooled to within seeding limits again in the early morning, but winds had shifted to the north precluding any additional seeding operations.</p> <p>Max/Min temperatures PNA: 30/10 LND: 43/14 FWZ: 30/12 Observed DWWS: +2</p>	<p>Seeding event WRR0022 was called at 1335 MST on 11/19/2015 and began at 1347 MST.</p> <p><u>Event WRR0022</u> Generators: WR01, WR02, WR03, WR09, WR10, WR12, WR13 Time: 13:45 to 21:00 MST 20:45 to 08:00 UTC Duration: 8:00, 54:30 Total Time Seeding: 1362.50g silver (24.77 gallons)</p>
20 November 2015, Friday	
<p>Waves of precipitation passed through during the morning and afternoon. There were intervals with marginal orographic clouds and low stratus during the day, particularly over the southern half of the range. The wind direction was northerly and not favorable for seeding. Cloud cover cleared out in the evening and overnight hours. Thin midlevel cloud cover then overspread the area in the morning. No seeding occurred.</p> <p>Max/Min temperatures PNA: 32/0 RKS: 36/14 LND: 29/10 FWZ: 30/5 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
21 November 2015, Saturday	
<p>Midlevel clouds passes over the range moving toward the south throughout the morning and afternoon. Cloud cover diminished in the evening, and skies were clear throughout the night. There were no orographic clouds, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 27/-13 RKS: 37/12 LND: 39/2</p>	<p>No ground-based seeding was conducted.</p>

FWZ: 30/5 Observed DWWS: 0	
22 November 2015, Sunday	
The range was completely clear during the day. Overnight, thin upper level clouds passed over while orographic arch clouds formed above the peaks, stretching well east of the range. Skies cleared again around dawn. Max/Min temperatures PNA: 43/9 RKS: 48/23 LND: 45/19 FWZ: 43/28 Observed DWWS: -1	No ground-based seeding was conducted.
23 November 2015, Monday	
The sky was clear over the area until arch clouds formed in the early afternoon and lasted until after midnight. High and mid level clouds also passed through during the evening and early nighttime hours. Max/Min temperatures PNA: 43/3 RKS: 47/15 LND: 47/23 FWZ: 41/30 Observed DWWS: -2	No ground-based seeding was conducted.
24 November 2015, Tuesday	
Areas of thin upper level clouds were over the area during the morning and early afternoon. Widespread mid level clouds moved in from the west in the mid afternoon and continued until a little after midnight. Thin, low and orographic clouds developed during the evening and lasted through the night into Wednesday. The temperature and wind flow precluded seeding operations. Max/Min temperatures PNA: 37/5 RKS: 47/20 LND: 45/22 FWZ: 36/30 Observed DWWS: 0	No ground-based seeding was conducted.
25 November 2015, Wednesday	
Thick clouds had developed Tuesday night. The wind flow	Seeding event WRR0023 was called at 0955 MST on

<p>became favorable for seeding throughout the morning hours and seeding began at 958 MST. A few short-lived lulls in snowfall occurred during the early afternoon, but favorable seeding conditions lasted throughout the entire day.</p> <p>Max/Min temperatures PNA: 34/19 RKS: 37/11 LND: 31/14 FWZ: 32/5 Observed DWWS: +2</p>	<p>11/25/2015 and began at 0958 MST.</p> <p><u>Event WRR0023</u> Generators: WR07 Time: 10:00 (11/25) to 10:45 (11/26) MST 17:00 (11/25) to 17:45 (11/26) UTC Duration: 24:45, 24:45 Total Time Seeding: 618.75g silver (11.63 gallons)</p>
<p>26 November 2015, Thursday</p>	
<p>Thick clouds existed in the early morning but the clouds quickly thinned over the range. Thick cloud coverage with light snowfall remained for the afternoon and evening to the east on north of the range, while only thin, broken clouds were over the range.</p> <p>Max/Min temperatures PNA: 19/-11 RKS: 14/6 LND: 16/10 FWZ: 10/3 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>27 November 2015, Friday</p>	
<p>During the daylight hours, a few low clouds passed overhead, but the region was mainly clear. Thick cloud cover and snow moved up from the south overnight starting around 10z. Thick orographic clouds formed on the eastern slopes and remained through morning. Wind direction favored seeding with the Enterprise ggen. Seeding began when the winds became light and northeasterly with poor plume trajectories.</p> <p>Max/Min temperatures PNA: 16/-18 RKS: 15/5 LND: 17/-2 FWZ: 14/3 Observed DWWS: +2</p>	<p>Seeding event WRR0024 was called at 0300 MST on 11/28/2015 and began at 0303 MST.</p> <p><u>Event WRR0024</u> Generators: WR07 Time: 03:00 (11/28) to 10:00 (11/28) MST 10:00 (11/28) to 17:00 (11/28) UTC Duration: 7:00, 7:06 Total Time Seeding: 177.50g silver (3.20 gallons)</p>
<p>28 November 2015, Saturday</p>	
<p>Waves of thick cloud cover were present over the eastern side of the range throughout the day. Only scattered clouds were present on the west side. Snowfall continued on the east slopes throughout the day, but weak</p>	<p>No ground-based seeding was conducted.</p>

<p>northerly low level winds were not favorable for orographic clouds or for proper plume transport. The clouds thinned out overnight, and only some thin low level clouds were present by morning. No seeding occurred.</p> <p>Max/Min temperatures PNA: 18/-8 RKS: 18/-1 LND: 17/-3 FWZ: 18/9 Observed DWWS: 0</p>	
<p>29 November 2015, Sunday</p>	
<p>The range had light snow showers throughout the period. Waves of thick cloud layers passed overhead all day and all night. The low level winds were from the NNE and not favorable for orographic cloud formation. Plume trajectories remained parallel to the range throughout the period. No seeding occurred.</p> <p>Max/Min temperatures PNA: 21/-15 RKS: 14/-4 LND: 18/4 FWZ: 18/9 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>30 November 2015, Monday</p>	
<p>Low clouds passed over throughout the afternoon, and then the range cleared out briefly around sunset. In the evening, upper level overcast overspread the range which lingered through around dawn. After dawn, skies became mainly clear except for some thin low cloud on the east side of the range. There were no seedable clouds, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 19/-11 RKS: 18/5 LND: 17/3 FWZ: 19/9 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>01 December 2015, Tuesday</p>	
<p>Thin, mid level clouds were on the NE side of the range during the morning, but they diminished shortly after noon. The range was clear during this time and for the rest of the day too, except for a band of high clouds that passed through during the night.</p>	<p>No ground-based seeding was conducted.</p>

<p>Max/Min temperatures PNA: 30/-6 RKS: 24/10 LND: 27/0 FWZ: 32/12 Observed DWWS: -2</p>	
<p>02 December 2015, Wednesday</p>	
<p>The sky was clear until the mid afternoon, when high and mid level clouds moved in from the west. Widespread mid level clouds were over the area until the mid evening hours. Some thin, low clouds existed during this time too. The sky was then clear overnight.</p> <p>Max/Min temperatures PNA: 28/-8 RKS: 32/12 LND: 20/-2 FWZ: 32/23 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>03 December 2015, Thursday</p>	
<p>High clouds moved into the area during the late morning hours and continued through the afternoon. Mid level clouds then came in during the evening and persisted through the night.</p> <p>Max/Min temperatures PNA: 30/3 RKS: 36/16 LND: 27/5 FWZ: 36/25 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>04 December 2015, Friday</p>	
<p>Areas of mid level clouds were around during the morning, then an orographic cloud developed over the range by noon. The orographic cloud with light snowfall lasted through the afternoon but the temperature was too warm for seeding. By the time the temperature cooled enough, the cloud was diminishing and precipitation was waning. Thin, low and mid level clouds lasted to the middle of the night, clearing by sunrise.</p> <p>Max/Min temperatures PNA: 32/9 RKS: 34/16 LND: 34/11 FWZ: 36/23 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>

05 December 2015, Saturday	
<p>The range was mostly clear through the late night hours. In the very early morning, layers of broken high and midlevel clouds overspread the region from the west. Early morning arch clouds were also observed downwind of the peaks.</p> <p>Max/Min temperatures PNA: 32/1 RKS: 32/15 LND: 37/15 FWZ: 30/19 Observed DWWS: -2</p>	No ground-based seeding was conducted.
06 December 2015, Sunday	
<p>The range was mostly clear in the morning and early afternoon. Thin orographic clouds formed later in the day and became somewhat thicker and more widespread through the evening and overnight. Waves of midlevel cloud cover passed through after sunset with some light snow. The cloud thickness and coverage were not sufficient for seeding operations. No seeding occurred.</p> <p>Max/Min temperatures PNA: 32/-4 RKS: 30/11 LND: 37/9 FWZ: 34/23 Observed DWWS: 0</p>	No ground-based seeding was conducted.
07 December 2015, Monday	
<p>Very thick orographic clouds with abundant liquid water blanketed the range throughout the period while waves of upper level clouds passed overhead. The 700mb temperature was too warm for seeding. No seeding occurred.</p> <p>Max/Min temperatures PNA: 36/5 RKS: 44/13 LND: 46/20 FWZ: 36/18 Observed DWWS: 0</p>	No ground-based seeding was conducted.
08 December 2015, Tuesday	
<p>Once again, thick orographic clouds and excellent liquid water content were observed. A mix of snow and rain was observed throughout the day, and then snow overnight. 700mb temperatures remained too warm, and no seeding occurred.</p> <p>Max/Min temperatures</p>	No ground-based seeding was conducted.

<p>PNA: 39/30 RKS: 45/35 LND: 51/33 FWZ: 37/30 Observed DWWS: 0</p>	
<p>09 December 2015, Wednesday</p>	
<p>Widespread mid and high clouds in the morning gave way to a brief clear period in the early afternoon before a thick orographic cloud set up over the range. The orographic cloud with decent snowfall remained through the evening, but the temperature was too warm for seeding. By the time the temperature cooled, the wind shifted and the cloud diminished.</p> <p>Max/Min temperatures PNA: 45/21 RKS: 53/34 LND: 57/30 FWZ: 39/28 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>10 December 2015, Thursday</p>	
<p>A thick orographic cloud developed over the range in the late morning hours and persisted until the evening hours. The temperature was too warm for seeding from the morning to the mid evening, but by the time it cooled the cloud was diminishing. After a short lull, snowfall re-developed over the range then lasted until the middle of the night, allowing for a seeding period.</p> <p>Max/Min temperatures PNA: 32/14 RKS: 44/27 LND: 50/26 FWZ: 36/25 Observed DWWS: +1</p>	<p>Seeding event WRR0025 was called at 2125 MST on 11/10/2015 and began at 2141 MST.</p> <p><u>Event WRR0025</u> Generators: WR01, WR02, WR03, WR09, WR10, WR12, WR13 Time: 21:40 (12/10) to 02:10 (12/11) MST 04:40 (12/11) to 9:10 (12/11) UTC Duration: 4:30, 23:42 Total Time Seeding: 592.5g silver (11.02 gallons)</p>
<p>11 December 2015, Friday</p>	
<p>Widespread mid level clouds were over the south central WY throughout the day. The clouds stayed just outside the WR range most of the time, but there were periods over mid level clouds passing over. No low clouds and no precipitation occurred.</p> <p>Max/Min temperatures PNA: 30/3 RKS: 30/18 LND: 40/22 FWZ: 27/18 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>

<p>12 December 2015, Saturday</p>	
<p>The range was clear during the afternoon. High clouds came in during the evening hours and then some mid level clouds moved through overnight. No low clouds existed over the range.</p> <p>Max/Min temperatures PNA: 28/1 RKS: 30/12 LND: 36/17 FWZ: 28/16 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>
<p>13 December 2015, Sunday</p>	
<p>The range was mostly clear during the day. After sunset, upper level clouds overspread the region and some thin orographic clouds developed with bases well above the peaks. There were a few brief periods of light snowfall and flurries, but conditions were intermittent and not sufficient for seeding. An evening sounding indicated wind direction was not favorable. No seeding occurred.</p> <p>Max/Min temperatures PNA: 28/3 RKS: 32/14 LND: 39/14 FWZ: 36/12 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>14 December 2015, Monday</p>	
<p>Thick low cloud cover blanked the range throughout the period. Low level flow was from the east favoring the Enterprise generator. Seeding began in the afternoon and continued through Tuesday morning.</p> <p>Max/Min temperatures PNA: 28/19 RKS: 32/21 LND: 31/18 FWZ: 28/16 Observed DWWS: +2</p>	<p>Seeding event WRR0026 was called at 1415 MST on 12/14/2015 and began at 1420 MST.</p> <p><u>Event WRR0026</u> Generators: WR07 Time: 14:20 (12/14) to 08:50 (12/15) MST 21:20 (12/14) to 15:50 (12/14) UTC Duration: 18:30, 18:27 Total Time Seeding: 461.25g silver (8.49 gallons)</p>
<p>15 December 2015, Tuesday</p>	
<p>Thick clouds with favorable seeding conditions continued during the morning. The clouds were breaking up by noon. Cloud layers blanketed the range through the late night. Cloud cover started to diminish in the early morning hours.</p> <p>Max/Min temperatures PNA: 28/12 RKS: 23/15</p>	<p>Seeding event WRR0026 continued until 0847 MST on 12/15/2015.</p>

<p>LND: 23/10 FWZ: 18/12 Observed DWWS: +1</p>	
<p>16 December 2015, Wednesday</p>	
<p>Thin orographic clouds lingered over the range through the afternoon. In the early evening, thicker clouds developed, and seeding occurred for a short time. Seeding ended in the late evening as winds became unfavorable. Cloud cover diminished overnight, and the range was nearly clear by morning.</p> <p>Max/Min temperatures PNA: 21/9 RKS: 20/11 LND: 25/5 FWZ: 18/9 Observed DWWS: +1</p>	<p>Seeding event WRR0027 was called at 1710 MST on 12/16/2015 and began at 1744 MST.</p> <p><u>Event WRR0027</u> Generators: WR01, WR02, WR03, WR04, WR05, WR09, WR10, WR12, WR13 Time: 17:45 (12/16) to 21:15 (12/16) MST 00:44 (12/17) to 04:15 (12/17) UTC Duration: 3:30, 31:04 Total Time Seeding: 776.67g silver (14.52 gallons)</p>
<p>17 December 2015, Thursday</p>	
<p>Only a few high clouds were around during the daylight hours, with high and mid level clouds coming in right around sunset. Shallow orographic clouds existed over the range during the night but it was not enough development for seeding operations.</p> <p>Max/Min temperatures PNA: 18/-6 RKS: 19/4 LND: 20/7 FWZ: 14/1 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>18 December 2015, Friday</p>	
<p>A shallow orographic cloud was over the range in the morning, but precipitation was very limited, with only a few flurries and wind flow was not favorable for seeding. The cloud slowly diminished during the afternoon and was gone shortly after sunset. Mid level clouds moved in after midnight with a few, small low clouds forming over the range by sunrise.</p> <p>Max/Min temperatures PNA: 32/3 RKS: 37/18 LND: 37/4 FWZ: 30/12 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>19 December 2015, Saturday</p>	
<p>A small orographic cloud developed over the range during</p>	<p>Seeding event WRR0028 was called at 0110 MST on</p>

<p>the afternoon with areas of light snowfall and it persisted through the evening. The temperature was too warm for seeding during this time. The cloud was enhanced with more snowfall after midnight and the temperature cooled, allowing for seeding.</p> <p>Max/Min temperatures PNA: 34/5 RKS: 41/19 LND: 43/13 FWZ: 32/27 Observed DWWS: +1</p>	<p>12/20/2015 and began at 0132 MST.</p> <p><u>Event WRR0028</u> Generators: WR01, WR02, WR03, WR09, WR10, WR12, WR13 Time: 01:30(12/20) to 11:45 (12/20) MST 08:30 (12/20) to 18:45 (12/20) UTC Duration: 10:15, 68:35 Total Time Seeding: 1713.25g silver (31.48 gallons)</p>
<p>20 December 2015, Sunday</p>	
<p>Thick clouds with favorable seeding conditions continued over the range during the morning. The cloud coverage was inconsistent with a few areas of light snowfall during the afternoon. Mid level clouds came in during the evening then there was a brief period of thick low clouds during the middle of the night.</p> <p>Max/Min temperatures PNA: 30/10 RKS: 32/21 LND: 36/17 FWZ: 28/16 Observed DWWS: +1</p>	<p>Seeding event WRR0028 continued until 1147 MST on 12/20/2015.</p>
<p>21 December 2015, Monday</p>	
<p>Thick low orographic clouds blanketed the range from early afternoon through the rest of the period. Seeding began in the mid afternoon and continued through the night utilizing all of the western generators.</p> <p>Max/Min temperatures PNA: 30/0 RKS: 35/21 LND: 40/14 FWZ: 27/12 Observed DWWS: +2</p>	<p>Seeding event WRR0029 was called at 1350 MST on 12/21/2015 and began at 1425 MST.</p> <p><u>Event WRR0029</u> Generators: WR01, WR02, WR03, WR04, WR05, WR09, WR10, WR12, WR13 Time: 14:25 (12/21) to 09:30*/10:30(12/22) MST 21:25 (12/21) to 16:30*/17:30 (12/22) UTC <i>*WR05 was shut off early due to changing weather conditions.</i> Duration: 19:05/20:05, 160:32 Total Time Seeding: 4013.33g silver (69.88 gallons)</p>
<p>22 December 2015, Tuesday</p>	
<p>Marginal orographic clouds were in place throughout the period, but coverage and thickness were not quite right for seeding. No seeding occurred.</p> <p>Max/Min temperatures PNA: 27/10 RKS: 34/17</p>	<p>No ground-based seeding was conducted.</p>

LND: 40/15 FWZ: 28/14 Observed DWWS: 0	
23 December 2015, Wednesday	
Thick seedable orographic clouds were present from forecast time through the midafternoon. Marginal orographic clouds lingered through the evening and overnight hours, but cloud coverage and water content were insufficient for any additional seeding. Max/Min temperatures PNA: 18/-2 RKS: 22/9 LND: 23/6 FWZ: 19/9 Observed DWWS: +1	Seeding event WRR0030 was called at 0935 MST on 12/23/2015 and began at 0951 MST. <u>Event WRR0030</u> Generators: WR01, WR02, WR03, WR04, WR05, WR09, WR10, WR12, WR13 Time: 09:50 to 15:25 MST 16:50 to 22:25 UTC Duration: 5:35, 47:07 Total Time Seeding: 1177.92g silver (20.54 gallons)
24 December 2015, Thursday	
There were a few hours in the afternoon with thick seedable clouds. Seeding occurred briefly during the afternoon. Marginal cloud cover was in place through the evening and overnight, but coverage was not sufficient for additional seeding. Max/Min temperatures PNA: 18/-11 RKS: 23/6 LND: 30/9 FWZ: 14/5 Observed DWWS: +1	Seeding event WRR0031 was called at 1305 MST on 12/24/2015 and began at 1322 MST. <u>Event WRR0031</u> Generators: WR01, WR02, WR03, WR04, WR05, WR09, WR10, WR12, WR13 Time: 13:20 to 16:15 MST 20:20 to 23:15 UTC Duration: 2:55, 25:39 Total Time Seeding: 641.25g silver (11.51 gallons)
25 December 2015, Friday	
Shallow low clouds were around the range during the morning. Widespread, mid level clouds pushed in from the south during the afternoon, but remained thin. The mid level clouds moved away by late evening, but shallow low clouds continued through the night. Precipitation was very limited and the wind flow was not favorable for orographic forcing. Max/Min temperatures PNA: 19/-2 RKS: 16/7 LND: 23/7 FWZ: 18/3 Observed DWWS: 0	No ground-based seeding was conducted.
26 December 2015, Saturday	
There was a small area of shallow low level clouds over	No ground-based seeding was conducted.

<p>the NE tip of the range during the morning. These clouds had diminished by noon and then the sky was clear the rest of the day.</p> <p>Max/Min temperatures PNA: 18/-18 RKS: 12/-3 LND: 22/3 FWZ: 14/3 Observed DWWS: -1</p>	
<p>27 December 2015, Sunday</p>	
<p>The sky was clear during the morning and afternoon except for one band of high clouds for a short time in mid afternoon. More widespread broken high clouds were around during the evening and overnight. Pinedale had a high temperature of 10 while South Pass was able to warm to 36, indicative of the strong inversion.</p> <p>Max/Min temperatures PNA: 10/-18 RKS: 7/-14 LND: 15/-5 FWZ: 36/7 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>
<p>28 December 2015, Monday</p>	
<p>High clouds were around during the daylight hours with mid level clouds coming in during the evening. Thin low clouds developed over the range but virtually no precipitation fell. The inversion was again evident with South Pass warmer than the surrounding plains.</p> <p>Max/Min temperatures PNA: 10/-18 RKS: 2/-15 LND: 13/-8 FWZ: 27/9 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>29 December 2015, Tuesday</p>	
<p>Low and midlevel cloud layers passed through the region all day and night. Winds were not favorable for plume transport or development of any seedable orographic clouds, but thin orographic clouds were in place throughout the period. Some brief flurries were observed in the evening. No seeding occurred.</p> <p>Max/Min temperatures</p>	<p>No ground-based seeding was conducted.</p>

<p>PNA: 14/-13 RKS: 10/-3 LND: 20/7 FWZ: 14/7 Observed DWWS: 0</p>	
<p>30 December 2015, Wednesday</p>	
<p>The range was partly sunny during the day with a few low clouds passing overhead. During the overnight hours, more widespread low clouds passed through moving toward the southeast bringing some flurries. Flow was not favorable for seeding, and no significant orographic clouds were observed. No seeding occurred.</p> <p>Max/Min temperatures PNA: 14/-11 RKS: 16/0 LND: 23/3 FWZ: 12/5 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>31 December 2015, Thursday</p>	
<p>After the low clouds on the east side of the range cleared out around forecast time, skies were totally clear all day and all night.</p> <p>Max/Min temperatures PNA: 14/-18 RKS: 10/-7 LND: 23/4 FWZ: 12/1 Observed DWWS: -3</p>	<p>No ground-based seeding was conducted.</p>
<p>01 January 2016, Friday</p>	
<p>The range was entirely clear throughout the period.</p> <p>Max/Min temperatures PNA: 18/-22 RKS: 5/-20 LND: 20/-2 FWZ: 25/12 Observed DWWS: -3</p>	<p>No ground-based seeding was conducted.</p>
<p>02 January 2016, Saturday</p>	
<p>There were only a few mid level clouds during the daylight hours. Arch clouds developed after sunset with more widespread mid and high level clouds coming in</p>	<p>No ground-based seeding was conducted.</p>

<p>during the night.</p> <p>Max/Min temperatures PNA: 21/-20 RKS: 7/-12 LND: 20/-3 FWZ: 30/10 Observed DWWS: -2</p>	
<p>03 January 2016, Sunday</p>	
<p>High and mid level clouds were around throughout the period.</p> <p>Max/Min temperatures PNA: 28/-6 RKS: 13/-6 LND: 25/6 FWZ: 36/25 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>
<p>04 January 2016, Monday</p>	
<p>Mid level clouds were around throughout the day. There were some flurries over the peaks of the range for a few hours in the late morning and early afternoon, and then some short periods in the evening and nighttime.</p> <p>Max/Min temperatures PNA: 32/-2 RKS: 21/2 LND: 24/8 FWZ: 36/27 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>05 January 2016, Tuesday</p>	
<p>There was a short period of flurries over the range during the morning. The afternoon, had small areas of light snowfall over the peaks, but this was from stratus clouds. The wind flow was too light for orographic forcing and also not favorable for plume transport. The stratus clouds broke up during the evening and no snow fell overnight.</p> <p>Max/Min temperatures PNA: 28/12 RKS: 26/7 LND: 27/10 FWZ: 32/27 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>06 January 2016, Wednesday</p>	
<p>Low stratus was in place throughout the period with</p>	<p>No ground-based seeding was conducted.</p>

<p>intermittent snow flurries. Winds and temperatures were not favorable for seeding operations. No seeding occurred.</p> <p>Max/Min temperatures PNA: 32/23 RKS: 30/7 LND: 29/11 FWZ: 32/23 Observed DWWS: 0</p>	
<p>07 January 2016, Thursday</p>	
<p>Thick low stratus was present throughout the period. Light snow occurred throughout most of the day and night. Wind speed and direction were not favorable for proper plume transport, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 30/18 RKS: 29/19 LND: 32/20 FWZ: 30/19 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>08 January 2016, Friday</p>	
<p>Once again, low thick stratus clouds were in place over and around the range with intermittent light snow through most of the period. Winds were not favorable for proper plume transport, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 27/19 RKS: 24/15 LND: 25/7 FWZ: 21/14 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>09 January 2016, Saturday</p>	
<p>Scattered low clouds surrounded the range during the day. Thin orographic clouds were observed with bases well above the peaks. Skies gradually cleared overnight. There were no thick orographic clouds or precipitation. No seeding occurred.</p> <p>Max/Min temperatures PNA: 27/-4 RKS: 24/13 LND: 19/1 FWZ: 21/16 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>

10 January 2016, Sunday	
<p>The sky was clear during the daylight. High clouds came in from the north after sunset and continued through all night with some mid level clouds too by morning.</p> <p>Max/Min temperatures PNA: 21/-13 RKS: 19/4 LND: 8/-11 FWZ: 28/10 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>
11 January 2016, Monday	
<p>The sky was mostly clear during the daylight hours except for a very few high clouds. Mid level clouds came in from the west during the night with a few, thin low clouds over the range by morning.</p> <p>Max/Min temperatures PNA: 27/-4 RKS: 19/10 LND: 11/-6 FWZ: 37/18 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
12 January 2016, Tuesday	
<p>There were a few thin, mid level clouds around the range in the late morning and early afternoon hours. By late afternoon, widespread, thick mid level clouds came into the area from the west but only lasted for the few hours. The evening and night saw waves of high and mid level clouds passing though, with arch clouds forming by sunrise.</p> <p>Max/Min temperatures PNA: 27/0 RKS: 29/12 LND: 35/-8 FWZ: 32/10 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>
13 January 2016, Wednesday	
<p>There were arch clouds on the NE side of the range through the afternoon (thus LND hit 41, 17 degrees warmer than RIW) and a few other mid level clouds around during the daylight hours. Thick orographic clouds with favorable seeding conditions developed in the late evening and continued through the night. Around sunrise, the wind shifted to NW and the cloud diminished.</p> <p>Max/Min temperatures PNA: 30/-2</p>	<p>Seeding event WRR0032 was called at 2350 MST on 01/13/2016 and began at 0021 MST on 1/14/2016.</p> <p><u>Event WRR0032</u> Generators: WR01, WR02, WR03, WR09, WR10, WR12, WR13 Time: 00:20 (01/14) to 07:50 (01/14) MST 07:20 (01/14) to 14:50 (01/14) UTC Duration: 7:30, 51:28 Total Time Seeding: 1,286.67 silver (22.88 gallons)</p>

<p>RKS: 31/14 LND: 41/8 FWZ: 32/16 Observed DWWS: +2</p>	
<p>14 January 2016, Thursday</p>	
<p>The range had thick stratus and marginal orographic clouds late in the day. There were a few hours in the late afternoon with some light snow over the southern range, but the northwest winds were not quite right for seeding. Intermittent waves of midlevel snow passed through overnight.</p> <p>Max/Min temperatures PNA: 30/1 RKS: 31/16 LND: 39/18 FWZ: 28/14 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>15 January 2016, Friday</p>	
<p>Stratus clouds were present along the western slopes throughout the period. The peaks and eastern slopes were clear for much of the day. Winds remained northwesterly and unfavorable for orographic lift and snow. The entire range became obscured by low and midlevel cloud during the late night hours. No seeding occurred.</p> <p>Max/Min temperatures PNA: 23/1 RKS: 23/12 LND: 32/11 FWZ: 23/10 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>16 January 2016, Saturday</p>	
<p>Stratus was in place for much of the period with a few brief intervals of blue sky during the afternoon. Wind direction was right on the borderline of seedability around 290-300 degrees for most of the day. There were a few hours with decent orographic clouds and snow during the evening. Seeding occurred for a few hours with seven western ground generators. Winds were too northerly for seeding overnight.</p> <p>Max/Min temperatures PNA: 27/3 RKS: 29/8 LND: 24/7 FWZ: 23/12 Observed DWWS: +1</p>	<p>Seeding event WRR0033 was called at 1655 MST on 01/16/2016 and began at 1728 MST.</p> <p><u>Event WRR0033</u> Generators: WR01, WR02, WR03, WR09, WR10, WR12, WR13 Time: 17:30 to 20:30 MST 00:30 (01/17) to 03:30 (01/17) UTC Duration: 3:00, 18:28 Total Time Seeding: 461.67g silver (8.17 gallons)</p>

17 January 2016, Sunday	
<p>Stratus covered the western slopes for much of the day with a few intervals of clearing. Overcast upper level cloud layers moved in overnight. The winds remained northwesterly and unfavorable for seeding throughout the day. Winds gradually became more westerly in the late night hours, but then it became too warm for operations.</p> <p>Max/Min temperatures PNA: 30/7 RKS: 31/19 LND: 39/9 FWZ: 32/21 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
18 January 2016, Monday	
<p>There were thick cloud layers over the area from the morning through most of the evening. Total snowfall was fairly light over the range. A sounding in the early morning determined the temperature was warmer than the seeding threshold and it did cool. The clouds moved away from the area overnight.</p> <p>Max/Min temperatures PNA: 32/12 RKS: 35/23 LND: 41/20 FWZ: 30/18 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
19 January 2016, Tuesday	
<p>Only a few high clouds were around during the daylight hours and then mid level clouds came in after sunset. Orographic clouds began forming in the late evening and favorable seeding conditions lasted throughout the night.</p> <p>Max/Min temperatures PNA: 27/-6 RKS: 31/12 LND: 33/16 FWZ: 28/18 Observed DWWS: +2</p>	<p>Seeding event WRR0034 was called at 2150 MST on 01/19/2016 and began at 2216 MST.</p> <p><u>Event WRR0034</u> Generators: WR01, WR02, WR03, WR04, WR05, WR09, WR10, WR12, WR13 Time: 22:15 (01/19) to 02:00*/10:45 (01/20) MST 05:15 (01/20) to 09:00*/17:45 (01/20) UTC <i>*WR04 and WR05 were shut off early due to changing weather conditions.</i> Duration: 3:45/12:30, 77:21 Total Time Seeding: 1933.75g silver (32.77 gallons)</p>
20 January 2016, Wednesday	
<p>Thick orographic clouds with favorable seeding conditions had existed Tuesday night into Wednesday morning, but were diminishing by the late morning. Scattered, shallow low clouds remained over the range during the afternoon</p>	<p>No ground-based seeding was conducted.</p>

<p>but snowfall was very limited. There were thicker clouds with light snowfall on the north side of the range during the afternoon too, then all clouds cleared by mid evening.</p> <p>Max/Min temperatures PNA: 27/9 RKS: 29/18 LND: 42/15 FWZ: 30/18 Observed DWWS: 0</p>	
<p>21 January 2016, Thursday</p>	
<p>Some, thin low clouds moved into the NW portion of the range in the early afternoon but no precipitation occurred and the clouds were short-lived. Mid and high clouds then existed from the late afternoon into Friday morning.</p> <p>Max/Min temperatures PNA: 30/1 RKS: 28/12 LND: 36/16 FWZ: 36/18 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>22 January 2016, Friday</p>	
<p>Waves of high and midlevel clouds passed over the range throughout the period. There were no significant orographic clouds. No precipitation was observed, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 30/0 RKS: 31/9 LND: 31/13 FWZ: 37/23 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>
<p>23 January 2016, Saturday</p>	
<p>Thick orographic clouds and snowfall developed in the late afternoon and lasted through the evening. Winds then became northerly by late evening and were unfavorable for seeding the rest of the night.</p> <p>Max/Min temperatures PNA: 28/-2 RKS: 30/8 LND: 33/13 FWZ: 34/27 Observed DWWS: +1</p>	<p>Seeding event WRR0035 was called at 1445 MST on 01/23/2016 and began at 1512 MST.</p> <p><u>Event WRR0035</u> Generators: WR01, WR02, WR03, WR04, WR05, WR09, WR10, WR12, WR13 Time: 15:10 to 21:30 MST 22:10 (01/23) to 04:30 (01/24) UTC Duration: 6:20, 60:44 Total Time Seeding: 1518.33g silver (27.25 gallons)</p>

24 January 2016, Sunday	
<p>Scattered high and midlevel clouds were observed through most of the period with some low stratus on the east side of the range during the day. Cloud cover diminished overnight, and skies were mostly clear in the morning. Winds remained northerly throughout the period and unfavorable for orographic development and plume transport. No seeding occurred.</p> <p>Max/Min temperatures PNA: 30/9 RKS: 30/18 LND: 37/22 FWZ: 28/18 Observed DWWS: 0</p>	No ground-based seeding was conducted.
25 January 2016, Monday	
<p>Some thin high-based orographic clouds were observed over the southern end of the range in the early afternoon with otherwise clear skies above. A wave of thin midlevel clouds passed through in the late afternoon. Skies were clear during the evening and overnight hours. No seeding occurred.</p> <p>Max/Min temperatures PNA: 27/7 RKS: 23/11 LND: 34/16 FWZ: 21/14 Observed DWWS: -1</p>	No ground-based seeding was conducted.
26 January 2016, Tuesday	
<p>There were a few, thin high clouds during the afternoon and evening hours. Thick, stratus clouds moved through the area during the night lasting into Wednesday morning.</p> <p>Max/Min temperatures PNA: 30/9 RKS: 25/10 LND: 28/10 FWZ: 37/18 Observed DWWS: -1</p>	No ground-based seeding was conducted.
27 January 2016, Wednesday	
<p>A small area of low clouds developed over the far NW corner of the range in the early afternoon and persisted until after sunset. The only other cloud coverage over the range was some mid level clouds during the night.</p>	No ground-based seeding was conducted.

<p>Max/Min temperatures PNA: 36/3 RKS: 32/16 LND: 34/11 FWZ: 37/23 Observed DWWS: -1</p>	
<p>28 January 2016, Thursday</p>	
<p>The sky was pretty much clear during the daylight hours and most of the evening. A band of low and mid level clouds moved through from the late evening to the middle of the night. Light snowfall occurred, but the temperature and wind flow were not favorable at the same time for seeding operations.</p> <p>Max/Min temperatures PNA: 36/5 RKS: 38/14 LND: 45/15 FWZ: 41/30 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>29 January 2016, Friday</p>	
<p>Two snow squalls moved through the area during the afternoon, but snowfall was short-lived over the range. After sunset, the wind became SW and continuous snowfall from a thick orographic cloud formed. Favorable seeding conditions then persisted into Saturday morning.</p> <p>Max/Min temperatures PNA: 32/18 RKS: 37/27 LND: 47/25 FWZ: 32/23 Observed DWWS: +2</p>	<p>Seeding event WRR0036 was called at 1830 MST on 01/29/2016 and began at 1852 MST.</p> <p><u>Event WRR0036</u> Generators: WR01, WR02, WR03, WR04, WR05, WR09, WR10, WR12, WR13 Time: 18:45 to 22:10*(01/29)/13:15 (01/30) MST 01:45 to 05:10*/20:15 (01/30) UTC <i>*WR04 and WR05 were shut off early due to changing weather conditions.</i> Duration: 3:25/18:30, 120:56 Total Time Seeding: 3023.25g silver (52.95 gallons)</p>
<p>30 January 2016, Saturday</p>	
<p>Thick orographic clouds blanketed the range in the morning. Seeding was ongoing from the previous night. By early afternoon, winds were becoming a bit too northerly for proper plume transport, and seeding ended. Marginal orographic clouds persisted through the rest of the period.</p> <p>Max/Min temperatures PNA: 32/-2 RKS: 37/11 LND: 44/20 FWZ: 32/10 Observed DWWS: +1</p>	<p>Seeding event WRR0036 continued until 1319 MST on 01/30/2016.</p>

31 January 2016, Sunday	
<p>Some low stratus surrounded the range for much of the period while thin upper level clouds passed overhead. Very late in the forecast period, a northeast flow was setting up and orographic precipitation and clouds then became favorable for seeding.</p> <p>Max/Min temperatures PNA: 19/-9 RKS: 24/6 LND: 30/11 FWZ: 21/10 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
01 February 2016, Monday	
<p>Thick orographic and upper level cloud blanketed the range throughout the entire period. Low level winds were from the NNW favoring the Enterprise generator. Seeding occurred throughout the entire period with Enterprise and just ended a short time ago.</p> <p>Max/Min temperatures PNA: 21/-6 RKS: 18/12 LND: 22/15 FWZ: 12/10 Observed DWWS: +2</p>	<p>Seeding event WRR0037 was called at 0845 MST on 02/01/2016 and began at 0847 MST.</p> <p><u>Event WRR0037</u> Generators: WR07 Time: 08:47 (02/01) to 10:38 (02/02) MST 15:47 (02/01) to 17:38 (02/02) UTC Duration: 25:51, 25:51 Total Time Seeding: 646.25g silver (11.12 gallons)</p>
02 February 2016, Tuesday	
<p>Snow showers were observed for much of the day with some thin low clouds and a few cumulus towers as well. Winds remained unfavorable for seeding as they were mostly light and variable or parallel to the range. Most of the low clouds diminished overnight while scattered high and midlevel clouds passed overhead. By morning, conditions were almost clear except for a very thin diffuse layer of low clouds and fog around the range. No seeding occurred.</p> <p>Max/Min temperatures PNA: 19/-2 RKS: 17/2 LND: 24/5 FWZ: 14/5 Observed DWWS: 0</p>	<p>Seeding event WRR0037 continued until 1038 MST on 02/02/2016</p>
03 February 2016, Wednesday	

<p>The sky was clear during the daylight hours, then some high clouds existed during the evening and overnight night. Towards sunrise, widespread mid level clouds moved in with some thin, low clouds and a few areas of flurries over the range beginning around sunrise.</p> <p>Max/Min temperatures PNA: 19/-13 RKS: 17/-3 LND: 25/2 FWZ: 14/3 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>04 February 2016, Thursday</p>	
<p>There were mid level clouds over the area with light flurries during the morning and early afternoon but cloud base was above the peaks. Small low clouds developed during the afternoon over the range with some periods of light snowfall but the wind was not favorable for seeding and the clouds did not fully cover the range. These clouds then diminished during the evening.</p> <p>Max/Min temperatures PNA: 23/-13 RKS: 23/5 LND: 32/2 FWZ: 23/10 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>05 February 2016, Friday</p>	
<p>Only a few high clouds were around at times during the daylight and evening. Some mid level clouds came through after midnight, then more widespread cloud coverage closer to sunrise. Only a few low clouds existed over the range for a short time around dawn.</p> <p>Max/Min temperatures PNA: 28/5 RKS: 26/11 LND: 35/11 FWZ: 30/14 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>06 February 2016, Saturday</p>	
<p>There were mid level clouds around the region for the afternoon but not much coverage over the range until after sunset. Some low clouds existed during the evening for a short time but no precipitation occurred except over the far NW corner of the range. Only a few high clouds were left by Sunday morning.</p>	<p>No ground-based seeding was conducted.</p>

<p>Max/Min temperatures PNA: 32/10 RKS: 33/18 LND: 43/12 FWZ: 32/18 Observed DWWS: -1</p>	
07 February 2016, Sunday	
<p>A few high and midlevel clouds passed through early in the period. Skies became mostly clear in the afternoon and evening. More scattered upper level clouds then moved in during the late night hours. No orographic clouds and no seeding.</p> <p>Max/Min temperatures PNA: 34/18 RKS: 33/23 LND: 34/14 FWZ: 34/21 Observed DWWS: -2</p>	No ground-based seeding was conducted.
08 February 2016, Monday	
<p>High and midlevel clouds passed overhead throughout the day and much of the night. Skies cleared in the late night and early morning. There were no orographic clouds, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 37/27 RKS: 37/24 LND: 38/14 FWZ: 43/23 Observed DWWS: -2</p>	No ground-based seeding was conducted.
09 February 2016, Tuesday	
<p>The region was clear all day and most of the night. High temperatures were unseasonably warm. A narrow band of high and midlevel clouds passed through in the morning. There were no orographic clouds, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 45/14 RKS: 40/26 LND: 39/19 FWZ: 50/34 Observed DWWS: -2</p>	No ground-based seeding was conducted.
10 February 2016, Wednesday	
A few high and midlevel clouds passed through early in	No ground-based seeding was conducted.

<p>the period. Skies were mostly clear during the afternoon. Move upper level clouds passed overhead during the evening and overnight hours. There were no orographic clouds, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 43/7 RKS: 45/19 LND: 52/19 FWZ: 46/36 Observed DWWS: -2</p>	
<p>11 February 2016, Thursday</p>	
<p>A few mid level clouds existed during the afternoon with more coverage developing by sunset. High and mid level clouds then continued over the area throughout the evening and night.</p> <p>Max/Min temperatures PNA: 45/12 RKS: 43/28 LND: 54/26 FWZ: 45/30 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>
<p>12 February 2016, Friday</p>	
<p>There were only a few high clouds around during the afternoon. There were thin mid level clouds during the evening, then a band of thicker clouds came through late in the night and early Saturday morning. This thicker period was short-lived and only a few flurries reached the ground.</p> <p>Max/Min temperatures PNA: 46/19 RKS: 48/29 LND: 44/26 FWZ: 41/32 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>13 February 2016, Saturday</p>	
<p>Low clouds developed over the peaks of the range beginning around noon and lasted until the early evening hours. Precipitation was limited and the cloud did not fully cover the range. High and mid level clouds passed through overnight with low clouds moving back over the range Sunday morning.</p> <p>Max/Min temperatures PNA: 41/19 RKS: 44/28 LND: 53/26</p>	<p>No ground-based seeding was conducted.</p>

FWZ: 39/23 Observed DWWS: 0	
14 February 2016, Sunday	
There were small areas of light snowfall over the range for much of the day but the low clouds did not fully enshroud the range. The wind flow was not favorable for proper plume transport or good orographic development. Max/Min temperatures PNA: 36/19 RKS: 38/28 LND: 49/22 FWZ: 36/18 Observed DWWS: 0	No ground-based seeding was conducted.
15 February 2016, Monday	
Thick orographic clouds and upper level cloud layers blanketed the range in the morning and early afternoon with some snowfall observed. It was too warm for seeding. Cloud cover waned in the late afternoon, particularly over the southern half of the range. Cloud cover continued to thin out through most of the night, and then another big wave up upper level clouds moved in before dawn. No seeding occurred. Max/Min temperatures PNA: 37/27 RKS: 39/32 LND: 56/28 FWZ: 41/25 Observed DWWS: 0	No ground-based seeding was conducted.
16 February 2016, Tuesday	
Marginal low and orographic clouds were in place during the morning, but the range became mostly clear for the afternoon through the late night hours. Around 12z, thick overcast cloud cover overspread the region from the west. There were no clouds suitable for seeding, and it was much too warm for operations. Max/Min temperatures PNA: 43/27 RKS: 44/33 LND: 56/28 FWZ: 39/28 Observed DWWS: 0	No ground-based seeding was conducted.
17 February 2016, Wednesday	
Cloud cover increased through the day and evening hours. Thick orographic clouds were present in the late	No ground-based seeding was conducted.

<p>evening through the overnight hours. Rain and some high-elevation snow were observed overnight. It remained much too warm for seeding operations. No seeding occurred.</p> <p>Max/Min temperatures PNA: 45/21 RKS: 51/31 LND: 54/30 FWZ: 41/27 Observed DWWS: 0</p>	
<p>18 February 2016, Thursday</p>	
<p>Thick orographic clouds and upper level cloud layers enshrouded the entire range throughout the day and night. Convection was observed along the western slopes in the afternoon with lightning, snow, and rain. As temperatures cooled to within seeding limits, seeding began around sunset and continued until the clouds thinned out after dawn Friday morning.</p> <p>Max/Min temperatures PNA: 41/19 RKS: 47/26 LND: 53/34 FWZ: 32/23 Observed DWWS: +2</p>	<p>Seeding event WRR0038 was called at 1710 MST on 02/18/2016 and began at 1724 MST.</p> <p><u>Event WRR0038</u> Generators: WR01, WR02, WR03, WR09, WR10, WR12, WR13 Time: 17:20 (02/18) to 08:45 (02/19) MST 00:20 to 15:45 (02/19) UTC Duration: 15:25, 92:12 Total Time Seeding: 2305.00g silver (41.49 gallons)</p>
<p>19 February 2016, Friday</p>	
<p>Low clouds from Thursday night diminished during the morning, then only scattered high and mid level clouds existed during the afternoon and evening. Thick, orographic clouds developed over the range after midnight but the temperature was too warm for seeding operations until closer to sunrise.</p> <p>Max/Min temperatures PNA: 37/25 RKS: 42/23 LND: 54/32 FWZ: 32/21 Observed DWWS: +1</p>	<p>Seeding event WRR0039 was called at 1107 MST on 02/20/2016 and began at 1127 MST.</p> <p><u>Event WRR0039</u> Generators: WR01, WR02, WR03, WR04, WR05, WR09, WR10, WR12, WR13 Time: 04:25 to 11:40 (02/20) MST 11:25 to 18:40 (02/20) UTC Duration: 7:15, 50:57 Total Time Seeding: 1273.75g silver (21.76 gallons)</p>
<p>20 February 2016, Saturday</p>	
<p>Favorable seeding conditions continued from Friday night through the morning. The clouds quickly cleared after a cold front moved through around noon with only scattered low clouds over the range through the afternoon. The evening and night had high and mid level clouds passing through.</p> <p>Max/Min temperatures</p>	<p>Seeding event WRR0039 continued until 1146 MST.</p>

<p>PNA: 32/21 RKS: 37/24 LND: 47/26 FWZ: 30/18 Observed DWWS: +1</p>	
<p>21 February 2016, Sunday</p>	
<p>There were a few high and mid level clouds in the morning but those were gone by noon and the sky was clear during the afternoon. More high and mid level clouds moved in during the evening and continued through the night.</p> <p>Max/Min temperatures PNA: 34/12 RKS: 39/19 LND: 41/21 FWZ: 32/14 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>
<p>22 February 2016, Monday</p>	
<p>There was a brief period of low clouds near the range in the morning, but those didn't last long. After noon, the wind became favorable for orographic forcing from the north and an area of light snowfall persisted through the afternoon. Heavy snowfall over the whole range existed during the evening then the clouds diminished after midnight, with clear skies by sunrise.</p> <p>Max/Min temperatures PNA: 34/16 RKS: 39/25 LND: 46/26 FWZ: 30/18 Observed DWWS: +2</p>	<p>Seeding event WRR0040 was called at 1210 MST on 02/22/2016 and began at 1248 MST.</p> <p><u>Event WRR0040</u> Generators: WR07 Time: 12:48 (02/22) to 00:44 (02/23) MST 19:48 (02/22) to 07:44 (02/23) UTC Duration: 11:56, 11:56 Total Time Seeding: 298.33g silver (4.65 gallons)</p>
<p>23 February 2016, Tuesday</p>	
<p>Skies were completely clear all day and all night. In the morning, a wave of high and midlevel cloud moved in from the west just before 11am. No seeding occurred.</p> <p>Max/Min temperatures PNA: 32/7 RKS: 31/15 LND: 42/23 FWZ: 28/14 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>
<p>24 February 2016, Wednesday</p>	
<p>Thin cloud layers were moving in during the morning. High, low, and midlevel clouds gradually filled in</p>	<p>No ground-based seeding was conducted.</p>

<p>throughout the day becoming thick overcast by sunset, particularly over the southern end of the range. Most of the upper level clouds cleared out after midnight while a few low clouds remained. Skies became mostly clear by dawn.</p> <p>Max/Min temperatures PNA: 36/5 RKS: 37/18 LND: 41/18 FWZ: 32/18 Observed DWWS: -2</p>	
<p>25 February 2016, Thursday</p>	
<p>The range was mainly clear throughout the period. The only exception was a small wave of midlevel clouds that moved through around sunset. There was nothing remotely suitable for seeding.</p> <p>Max/Min temperatures PNA: 43/19 RKS: 47/24 LND: 52/19 FWZ: 37/25 Observed DWWS: -2</p>	<p>No ground-based seeding was conducted.</p>
<p>26 February 2016, Friday</p>	
<p>The region saw clear skies through the daylight hours with very warm temperatures. Small waves of upper level clouds passed through overnight with some arch clouds observed east of the range as well. In the morning hours, upper level cloud coverage increased, and some low orographic clouds started to form. Just before forecast today, some very light precipitation/virga was evident over the western slopes on the RIW radar. No seeding occurred.</p> <p>Max/Min temperatures PNA: 45/14 RKS: 49/25 LND: 58/25 FWZ: 43/28 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>27 February 2016, Saturday</p>	
<p>An orographic cloud developed over the range during the morning, becoming thick with heavy precipitation by late morning. The precipitation continued through the afternoon but warm temperature prevented seeding operations. By the time the temperature cooled the wind was becoming unfavorable. The cloud coverage thinned during the evening and diminished overnight. No seeding</p>	<p>No ground-based seeding was conducted.</p>

<p>occurred.</p> <p>Max/Min temperatures PNA: 41/18 RKS: 54/28 LND: 59/27 FWZ: 39/28 Observed DWWS: 0</p>	
<p>28 February 2016, Sunday</p>	
<p>The sky was clear from the morning to the middle afternoon, when widespread mid level clouds spread over the region. An orographic cloud with light snowfall developed over the range during the night. The temperature was too warm for seeding until sunrise and by then the conditions were deteriorating. No seeding occurred.</p> <p>Max/Min temperatures PNA: 41/19 RKS: 47/26 LND: 58/27 FWZ: 37/27 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>29 February 2016, Monday</p>	
<p>Shallow, low clouds were over the range during the morning, then thicker development occurred after noon. There were scattered areas of light snowfall over the range during the afternoon and early evening, but this was due to mid level forcing since the wind flow was mainly NW. The clouds diminished by late evening and only high clouds existed overnight. No seeding occurred.</p> <p>Max/Min temperatures PNA: 36/21 RKS: 43/24 LND: 50/28 FWZ: 32/21 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>01 March 2016, Tuesday</p>	
<p>There were scattered low clouds in the morning becoming more continuous in the afternoon with plenty of mid level cloud coverage but precipitation was very limited. Continuous snowfall fell overnight as a thick band of low and mid level clouds passed through but the temperature was too warm for seeding until after the snowfall ended. Low clouds re-developed after sunrise with high bases.</p> <p>Max/Min temperatures</p>	<p>No ground-based seeding was conducted.</p>

<p>PNA: 37/14 RKS: 46/23 LND: 50/22 FWZ: 34/19 Observed DWWS: 0</p>	
<p>02 March 2016, Wednesday</p>	
<p>Low clouds and intermittent snowfall were present through the day. Low clouds diminished in the evening and precipitation ended, but upper level clouds were in place for most of the night. No seeding occurred.</p> <p>Max/Min temperatures PNA: 39/19 RKS: 46/31 LND: 55/31 FWZ: 34/27 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>03 March 2016, Thursday</p>	
<p>The range was somewhat clear at forecast time, and then low and upper level cloud layers were present for the afternoon through late night hours. Some light precipitation was observed from afternoon through late evening. Cloud cover diminished at 10z, and skies became clear by morning. Conditions remained too warm for seeding throughout the period.</p> <p>Max/Min temperatures PNA: 50/14 RKS: 56/28 LND: 62/25 FWZ: 43/27 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>04 March 2016, Friday</p>	
<p>The region was mostly clear through sunset. High and midlevel cloud layers overspread the range in the evening and remained through the night. Arch clouds were observed east of the peaks during the night. Low clouds arrived in the morning.</p> <p>Max/Min temperatures PNA: 50/23 RKS: 54/32 LND: 61/31 FWZ: 43/32 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>05 March 2016, Saturday</p>	
<p>Low broken cloud cover was in place over the range</p>	<p>No ground-based seeding was conducted.</p>

<p>throughout the day with light precipitation. I remained much too warm for seeding operations. Cloud cover diminished around midnight, and only scattered upper level clouds were present overnight. A large band of thick overcast cloud layers and mixed precipitation was just beginning to overspread the range at the end of the period around forecast time.</p> <p>Max/Min temperatures PNA: 50/21 RKS: 59/36 LND: 64/32 FWZ: 45/32 Observed DWWS: 0</p>	
<p>06 March 2016, Sunday</p>	
<p>Thick clouds moved into the area in the late morning and continued through the afternoon and evening, with decent precipitation over the range. The clouds thinned after midnight as the wind was shifting to northerly flow. By sunrise, thick clouds with snowfall had developed over the northerly slopes. The temperature was too warm for seeding operations.</p> <p>Max/Min temperatures PNA: 41/21 RKS: 50/31 LND: 58/32 FWZ: 43/32 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>07 March 2016, Monday</p>	
<p>Thick clouds were over the range and areas north from the morning through the afternoon with decent snowfall rates. The temperature and wind flow were just slightly unfavorable for seeding. The clouds thinned in the early evening hours with mid level clouds continuing overnight.</p> <p>Max/Min temperatures PNA: 34/19 RKS: 36/27 LND: 44/26 FWZ: 32/23 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>08 March 2016, Tuesday</p>	
<p>The sky was clear until the mid afternoon when a few low clouds developed and some high clouds moved in from the west. Mid level clouds existed during the evening then a short period of light snowfall over the range occurred around midnight. More light snowfall came just before sunrise but the wind flow was not favorable for</p>	<p>No ground-based seeding was conducted.</p>

<p>seeding.</p> <p>Max/Min temperatures PNA: 41/14 RKS: 45/25 LND: 43/22 FWZ: 32/21 Observed DWWS: 0</p>	
<p>09 March 2016, Wednesday</p>	
<p>Thin, low clouds with small areas of light snowfall were over the range during the morning, but the wind flow was not quite right for seeding. The clouds became broken to scattered by noon with only a few areas of snowfall throughout the afternoon. Some more low clouds developed overnight, but precipitation was very limited and the temperature had warmed.</p> <p>Max/Min temperatures PNA: 36/21 RKS: 41/27 LND: 48/26 FWZ: 32/23 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>10 March 2016, Thursday</p>	
<p>A few low clouds were in place early in the period. Skies became mostly clear in the afternoon, and then broken high and midlevel clouds passed over the range during the evening and overnight hours. There were no orographic clouds or precipitation, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 50/21 RKS: 59/36 LND: 64/32 FWZ: 45/32 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>11 March 2016, Friday</p>	
<p>There were a few thin orographic clouds at times, but nothing remotely suitable for seeding. Broken to overcast high and midlevel cloud layers blanketed the range throughout the period. No seeding occurred.</p> <p>Max/Min temperatures PNA: 54/27 RKS: 57/35 LND: 65/35 FWZ: 45/36 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>

12 March 2016, Saturday	
<p>Low and upper level cloud cover was in place early in the period. Skies cleared in the early afternoon allowing for cumulus development and some convective showers in the midafternoon through the evening. Overnight, skies cleared again for a few hours, but then low and upper level layers overspread the region in the late night hours through the morning.</p> <p>Max/Min temperatures PNA: 52/28 RKS: 58/35 LND: 65/35 FWZ: 46/37 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
13 March 2016, Sunday	
<p>Low and upper level clouds were present throughout the period. Some cumulus was in place throughout the day as well. Mixed precipitation occurred during the day, and then light snow continued through the night. It remained too warm for seeding until after dawn.</p> <p>Max/Min temperatures PNA: 43/21 RKS: 52/29 LND: 57/29 FWZ: 37/30 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
14 March 2016, Monday	
<p>Thick clouds over the range with continuous snowfall were over the range in the morning and the temperature finally cooled allowing for seeding operations until the clouds broke apart in the early afternoon. There were periods of light snowfall during the evening and overnight, but the wind flow was not quite right for seeding and the conditions were not consistent.</p> <p>Max/Min temperatures PNA: 34/21 RKS: 39/22 LND: 52/32 FWZ: 32/19 Observed DWWS: +1</p>	<p>Seeding event WRR0041 was called at 1005 MDT on 03/14/2016 and began at 1028 MDT.</p> <p><u>Event WRR0041</u> Generators: WR01, WR02, WR03, WR09, WR10, WR12, WR13 Time: 10:15 to 14:00 MDT 16:15 to 20:00 UTC Duration: 3:45, 25:19 Total Time Seeding: 632.92g silver (11.70 gallons)</p>
15 March 2016, Tuesday	
<p>Broken, light areas of snowfall existed during the morning. The coverage became more continuous in the early afternoon as the wind became more favorable for</p>	<p>Seeding event WRR0042 was called at 1315 MDT on 03/15/2016 and began at 1350 MDT.</p>

<p>orographic forcing. Light snowfall continued until the evening when the wind was shifting to more NW flow. Scattered snowfall existed over the range during the night, ending by sunrise.</p> <p>Max/Min temperatures PNA: 30/12 RKS: 34/20 LND: 42/22 FWZ: 23/14 Observed DWWS: +2</p>	<p><u>Event WRR0042</u> Generators: WR01, WR02, WR03, WR09, WR10, WR12, WR13 Time: 13:50 to 21:30 MDT 19:50 (03/15) to 03:30 (03/16) UTC Duration: 7:40, 54:00 Total Time Seeding: 1350.00g silver (23.84 gallons)</p>
<p>16 March 2016, Wednesday</p>	
<p>The wind flow remained too northwesterly to produce any thick orographic cloud coverage during the afternoon and early evening. Thin clouds existed with a few snow showers. In the late evening, there was a brief period of snowfall. Thin, clouds with a few showers existed again overnight. No seeding occurred.</p> <p>Max/Min temperatures PNA: 30/7 RKS: 37/20 LND: 44/20 FWZ: 27/12 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>17 March 2016, Thursday</p>	
<p>Light snowfall began over the range before noon but with a weak wind the snowfall was limited to scattered showers and not continuous. The wind strengthen in the early evening creating continuous light snowfall and allowing for proper seeding plume transport. The wind weakened after midnight and the snowfall became less continuous.</p> <p>Max/Min temperatures PNA: 28/1 RKS: 38/21 LND: 36/21 FWZ: 23/14 Observed DWWS: +1</p>	<p>Seeding event WRR0043 was called at 2010 MDT on 03/17/2016 and began at 2013 MDT.</p> <p><u>Event WRR0043</u> Generators: WR07 Time: 20:13 (03/17) to 02:11 (03/18) MDT 02:13 to 08:11 (03/18) UTC Duration: 5:58, 5:58 Total Time Seeding: 149.17g silver (2.63 gallons)</p>
<p>18 March 2016, Friday</p>	
<p>Some marginal orographic clouds and low cloud was in place for most of the day along with some spotty light snowfall. The low level winds were not favorable for seeding. Cloud cover cleared out overnight, and skies were totally clear by morning. No seeding occurred.</p> <p>Max/Min temperatures PNA: 27/-4</p>	<p>No ground-based seeding was conducted.</p>

RKS: 35/15 LND: 33/19 FWZ: 23/9 Observed DWWS: 0	
19 March 2016, Saturday	
Skies remained clear throughout the period. Max/Min temperatures PNA: 30/-6 RKS: 41/13 LND: 42/15 FWZ: 32/7 Observed DWWS: -3	No ground-based seeding was conducted.
20 March 2016, Sunday	
The region was completely clear through sunset. During the evening and overnight hours, waves of high and midlevel clouds passed through. Thin orographic clouds developed overnight, but they did not cover the entire range. It remained too warm for seeding operations throughout the period. Max/Min temperatures PNA: 46/3 RKS: 57/19 LND: 60/19 FWZ: 43/30 Observed DWWS: -1	No ground-based seeding was conducted.
21 March 2016, Monday	
Marginal orographic clouds were in place throughout the afternoon while upper levels remained clear. Thicker orographic clouds and snow were observed overnight while thick overcast layers overspread the region from the west. Arch clouds were observed on the east side of the range throughout the period. It remained much too warm for seeding all day and all night. Max/Min temperatures PNA: 52/21 RKS: 61/37 LND: 67/35 FWZ: 43/34 Observed DWWS: -1	No ground-based seeding was conducted.
22 March 2016, Tuesday	
A large, deep system brought thick cloud coverage over the area with continuous snowfall in the range throughout the day. The temperature was too warm for seeding until the evening, but by then the wind was weak	No ground-based seeding was conducted.

<p>and unfavorable for seeding. The wind slowly switched to northerly flow overnight, but by the time it was right for seeding the storm was diminishing.</p> <p>Max/Min temperatures PNA: 37/28 RKS: 48/27 LND: 46/31 FWZ: 41/27 Observed DWWS: 0</p>	
<p>23 March 2016, Wednesday</p>	
<p>The large, deep system had moved away from the project area in the mountains but continued over eastern WY through the afternoon. There were small areas of light snowfall over the range during the afternoon and a short period overnight, but the wind flow was not favorable for seeding operations.</p> <p>Max/Min temperatures PNA: 37/27 RKS: 36/26 LND: 38/25 FWZ: 27/23 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>24 March 2016, Thursday</p>	
<p>Some light snowfall began over the peaks of the range around noon then a thicker orographic cloud formed in the following hours. This thick orographic cloud with continuous snowfall and favorable seeding conditions persisted through the evening. The wind flow shifted to NW just before midnight and the cloud diminished.</p> <p>Max/Min temperatures PNA: 37/21 RKS: 41/24 LND: 51/23 FWZ: NA Observed DWWS: +2</p>	<p>Seeding event WRR0044 was called at 1335 MDT on 03/24/2016 and began at 1350 MDT.</p> <p><u>Event WRR0044</u> Generators: WR01, WR02, WR03, WR09, WR10, WR12, WR13 Time: 13:50 (03/24) to 00:10 (03/25) MDT 19:50 (03/24) to 06:10 (03/25) UTC Duration: 10:20, 72:15 Total Time Seeding: 1806.25g silver (32.01 gallons)</p>
<p>25 March 2016, Friday</p>	
<p>An area of light snowfall began over the SE part of the range in the late morning. More areas of snowfall developed in the early afternoon and continued through the evening. The wind was too weak and not favorable for seeding operations. The clouds were diminishing overnight, but some small areas of light snowfall persisted until sunrise. No seeding occurred.</p> <p>Max/Min temperatures PNA: 34/14</p>	<p>No ground-based seeding was conducted.</p>

RKS: 35/25 LND: 41/29 FWZ: NA Observed DWWS: 0	
26 March 2016, Saturday	
Thin low clouds were in place throughout the day. In the late afternoon, convective snow squalls were observed along the west side of the range. Skies cleared in the late evening. During the overnight hours, some small thin orographic clouds were observed for a short time, but the range was otherwise clear through the morning. No seeding occurred due to unsuitable cloud conditions and northwesterly low level winds parallel to the range. Max/Min temperatures PNA: 37/14 RKS: 38/22 LND: 43/26 FWZ: no data Observed DWWS: 0	No ground-based seeding was conducted.
27 March 2016, Sunday	
Skies were mainly clear early in the period, but low level cloud cover gradually increased throughout the day. Arch clouds were observed downwind of the range starting in the late afternoon. Thick cloud layers blanketed the range throughout the night along with thick orographic clouds and snowfall. It remained too warm for seeding. Max/Min temperatures PNA: 43/12 RKS: 50/22 LND: 53/21 FWZ: no data Observed DWWS: 0	No ground-based seeding was conducted.
28 March 2016, Monday	
Thin orographic clouds were in place through midafternoon. Thick orographic clouds and thick overcast blanketed the range from late afternoon through the night with moderate to heavy snowfall. As temperatures dropped into seeding limits in the late evening, seeding began with the Enterprise GGEN. Max/Min temperatures PNA: 43/32 RKS: 49/35 LND: 56/31 FWZ: no data Observed DWWS: +2	Seeding event WRR0045 was called at 2327 MDT on 03/28/2016 and began at 2338 MDT. <u>Event WRR0045</u> Generators: WR07 Time: 23:38 (03/28) to 22:46 (03/29) MDT 05:38 (03/29) to 04:46 (03/30) UTC Duration: 23:08, 22:55 Total Time Seeding: 572.92g silver (9.40 gallons)

29 March 2016, Tuesday	
<p>Thick orographic and overcast thick clouds blanketed the range throughout the period. Moderate to heavy snow was observed throughout the entire period as well. The heaviest snow fell on the east side of the range. Seeding occurred throughout the morning, afternoon, and evening hours utilizing Enterprise.</p> <p>Max/Min temperatures PNA: 34/32 RKS: 36/27 LND: 34/30 FWZ: no data Observed DWWS: +2</p>	<p>Seeding event WRR0045 continued until 2246 MDT on 03/29/2016.</p>
30 March 2016, Wednesday	
<p>There were areas of light snowfall over the range during the morning and afternoon hours but the wind flow was not right for seeding operations. That snowfall had ended by sunset but another brief period came in the late evening. More continuous snowfall moved in from the north during the night and the wind flow was favorable for seeding with the Enterprise GGEN.</p> <p>Max/Min temperatures PNA: 43/27 RKS: 32/24 LND: 40/30 FWZ: NA Observed DWWS: +1</p>	<p>Seeding event WRR0046 was called at 0405 MDT on 03/31/2016 and began at 0408 MDT.</p> <p><u>Event WRR0046</u> Generators: WR07 Time: 04:08 to 15:12 (03/31) MDT 10:08 to 21:12 (03/31) UTC Duration: 11:04, 11:04 Total Time Seeding: 276.67g silver (4.76 gallons)</p>
31 March 2016, Thursday	
<p>Favorable seeding conditions continued from Wednesday night into the mid afternoon. At that time, the snowfall was becoming more scattered and the wind flow was too weak for proper plume transport. Scattered, areas of light snowfall continued through the evening with only some high and mid level clouds overnight.</p> <p>Max/Min temperatures PNA: 43/27 RKS: 33/25 LND: 36/30 FWZ: NA Observed DWWS: +1</p>	<p>Seeding event WRR0046 continued until 1512 MDT on 03/31/2016.</p>
01 April 2016, Friday	
<p>There were a few high and mid level clouds around during the morning and then scattered cumulus developed over</p>	<p>No ground-based seeding was conducted.</p>

<p>the range in the early afternoon. More continuous low clouds had formed by late afternoon and remained through the evening, but precipitation was very limited and the temperature was too warm for seeding operations. More mid level clouds came in during the evening. The clouds moved away overnight and the sky was clear by sunrise.</p> <p>Max/Min temperatures PNA: 46/21 RKS: 38/20 LND: 43/22 FWZ: NA Observed DWWS: 0</p>	
<p>02 April 2016, Saturday</p>	
<p>The sky was clear until isolated cumulus clouds appeared for a short period in the mid afternoon, with clear skies by sunset. There were some brief appearances of low clouds in the late evening, overnight and Sunday morning.</p> <p>Max/Min temperatures PNA: 52/19 RKS: 53/28 LND: 53/31 FWZ: NA Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>03 April 2016, Sunday</p>	
<p>The range was mostly clear in the morning and early afternoon, and then cumulus and thin low clouds developed in the later afternoon. Low cloud cover continued to increase through the evening with some thin spotty orographic clouds observed as well. Skies cleared during the overnight hours. No seeding occurred.</p> <p>Max/Min temperatures PNA: 44/23 RKS: 60/36 LND: 54/28 FWZ: no data Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>04 April 2016, Monday</p>	
<p>Only a few thin low clouds were observed in the morning and early afternoon, and then thick cloud layers moved in during the midafternoon. Thick overcast clouds remained in place through dawn along with some periods of low orographic clouds with snow. Afternoon convective snow squalls were also observed over the region. Cloud cover began to clear out around dawn, and only some fair weather cumulus and thin orographic cloud was in place</p>	<p>No ground-based seeding was conducted.</p>

<p>in the morning hours. No seeding occurred.</p> <p>Max/Min temperatures PNA: 55/27 RKS: 63/32 LND: 58/32 FWZ: no data Observed DWWS: 0</p>	
<p>05 April 2016, Tuesday</p>	
<p>During the day, low orographic clouds were observed over some parts of the range while convective clouds were widespread over the area. Some snow showers occurred off and on through the afternoon. Skies cleared out after sunset, and then some waves of midlevel cloud passed through overnight. It remained much too warm for seeding.</p> <p>Max/Min temperatures PNA: 41/25 RKS: 47/31 LND: 52/33 FWZ: no data Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>06 April 2016, Wednesday</p>	
<p>A few thin high and midlevel clouds passed through during the day. Some high based small orographic clouds were observed in the evening. Skies were then mostly clear overnight. There were no clouds suitable for seeding.</p> <p>Max/Min temperatures PNA: 54/23 RKS: 60/31 LND: 68/29 FWZ: no data Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
<p>07 April 2016, Thursday</p>	
<p>Throughout the period, a very thin layer of high level scattered clouds passed over the range. There were no low or midlevel clouds, and skies were otherwise clear.</p> <p>Max/Min temperatures PNA: 61/23 RKS: 64/36 LND: 63/36 FWZ: no data Observed DWWS: -3</p>	<p>No ground-based seeding was conducted.</p>

08 April 2016, Friday	
<p>Mostly clear skies. High clouds came into the region from the south by sunset and continued until a little after midnight.</p> <p>Max/Min temperatures PNA: 63/21 RKS: 65/35 LND: 66/34 FWZ: NA Observed DWWS: -3</p>	No ground-based seeding was conducted.
09 April 2016, Saturday	
<p>Clear skies in the morning gave way to multiple cloud layers in the early afternoon, with convective clouds SW of the range. Broken to scattered cloud layers continued through the evening and night with a few areas of light precipitation but the temperature was too warm for seeding operations.</p> <p>Max/Min temperatures PNA: 61/23 RKS: 63/39 LND: 73/37 FWZ: NA Observed DWWS: -1</p>	No ground-based seeding was conducted.
10 April 2016, Sunday	
<p>A band of precipitation was over the range during the morning hours. Scattered, light showers existed during the afternoon with most of the precipitation over the range ending in the early evening hours. The temperature was too warm for seeding operations. Most of the clouds moved away shortly after midnight but some low clouds continued through the night into Monday morning.</p> <p>Max/Min temperatures PNA: 54/34 RKS: 57/39 LND: 54/38 FWZ: NA Observed DWWS: -1</p>	No ground-based seeding was conducted.
11 April 2016, Monday	
<p>Cumulus clouds had begun developing by late morning, then a lot more popped up shortly after noon and continued into the early evening. There was some light precipitation, but no significant coverage occurred. The temperature was too warm for seeding operations.</p> <p>Max/Min temperatures PNA: 54/34</p>	No ground-based seeding was conducted.

<p>RKS: 56/37 LND: 66/32 FWZ: NA Observed DWWS: -1</p>	
<p>12 April 2016, Tuesday</p>	
<p>Fair weather cumulus surrounded the range during the afternoon and early evening hours. Isolated convective rain showers were observed over the range during the afternoon. After sunset, the cumulus cleared out and there were a few hours with clear skies over the mountains. Marginal orographic clouds developed in the late night hours while low and midlevel clouds passed through from the west. It remained much too warm for operations, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 61/27 RKS: 63/38 LND: 69/40 FWZ: NA Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>13 April 2016, Wednesday</p>	
<p>Thick overcast cloud blanketed the range throughout the period. Intermittent rain occurred throughout the period. Frozen precipitation was only observed at the highest peaks. Rainfall was heavy at times. It remained much too warm for seeding throughout the period, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 50/27 RKS: 61/39 LND: 64/41 FWZ: NA Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>14 April 2016, Thursday</p>	
<p>Thick overcast clouds blanketed the range all day and evening. A wave of convection pushed through around noon bringing lightning and thundersnow as a cold front passed through. Light mixed precipitation continued through the early evening with warm 700mb temps. Precipitation tapered off by late evening as winds became northerly. Most of the cloud cover cleared out after midnight. No seeding occurred.</p> <p>Max/Min temperatures PNA: 46/25</p>	<p>No ground-based seeding was conducted.</p>

<p>RKS: 59/29 LND: 67/37 FWZ: NA Observed DWWS: 0</p>	
<p>15 April 2016, Friday</p>	
<p>Skies were mostly clear in the morning and early afternoon. Convective showers developed in the midafternoon. Marginal orographic clouds developed on the east slopes in the evening. Conditions were suitable for seeding with Enterprise for a few hours in the late evening with precipitation over the southern end of the range. Winds became unfavorable for seeding overnight.</p> <p>Max/Min temperatures PNA: 45/25 RKS: 49/27 LND: 56/28 FWZ: NA Observed DWWS: +1</p>	<p>Seeding event WRR0047 was called at 2155 MDT on 04/15/2016 and began at 2206 MDT.</p> <p><u>Event WRR0047</u> Generators: WR07 Time: 22:06 (04/15) to 01:36 (04/16) MDT 04:06 to 07:36 (04/16) UTC Duration: 3:30, 3:30 Total Time Seeding: 87.50g silver (1.51 gallons)</p>
<p>16 April 2016, Saturday</p>	
<p>There were periods of light snowfall over the range during the morning, afternoon and evening. The wind flow was light and northerly but not quite favorable for seeding operations. Overnight, there were only mid and high clouds over the range with widespread snow to the east of the range.</p> <p>Max/Min temperatures PNA: 46/23 RKS: 44/27 LND: 44/30 FWZ: NA Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>17 April 2016, Sunday</p>	
<p>There was only thin cloud coverage over the range during the morning and afternoon. Right around sunset, the wind flow strengthened, producing orographic snowfall over the southeastern part of the range. The wind weakened during the night but light snowfall continued into Monday morning.</p> <p>Max/Min temperatures PNA: 37/21 RKS: 41/27 LND: 47/31 Observed DWWS: +2</p>	<p>Seeding event WRR0048 was called at 1925 MDT on 04/17/2016 and began at 1934 MDT.</p> <p><u>Event WRR0048</u> Generators: WR07 Time: 19:34 (04/17) to 01:58 (04/18) MDT 01:34 to 07:58 (04/18) UTC Duration: 6:24, 6:24 Total Time Seeding: 160.00g silver (2.69 gallons)</p>

18 April 2016, Monday	
<p>There was widespread snow on the NE side of the range during the morning. There were only scattered showers during the afternoon and early evening, then more widespread snow from the mid evening through the night into Tuesday morning. The wind was too light and unfavorable for seeding plus the temperature was slightly warmer than the seeding threshold.</p> <p>Max/Min temperatures PNA: 45/23 RKS: 41/28 LND: 42/32 Observed DWWS: 0</p>	No ground-based seeding was conducted.
19 April 2016, Tuesday	
<p>Widespread snowfall over the range and areas to the north during the morning gave way to scattered showers over the range during the afternoon. There were more areas of snow during the evening but not continuous. Thin, low clouds were over the range during the night, clearing just after sunrise. The temperature was too warm for seeding operations all day.</p> <p>Max/Min temperatures PNA: NA RKS: 47/32 LND: 46/32 Observed DWWS: 0</p>	No ground-based seeding was conducted.
20 April 2016, Wednesday	
<p>Low clouds and some fog were present in the morning in the low level areas surrounding the range. The mountains were mainly clear in the morning. Cumulus cloud cover developed in the afternoon, and a few convective showers occurred. Clouds diminished in the evening, and skies were mostly clear overnight. There were no clouds suitable for seeding, and it remained much too warm for operations.</p> <p>Max/Min temperatures PNA: 61/36 RKS: 62/38 LND: 64/36 Observed DWWS: 0</p>	No ground-based seeding was conducted.
21 April 2016, Thursday	
<p>The range remained clear throughout the day and into the evening. There were a few cumulus clouds in the southwestern part of the state, but they did not spread</p>	No ground-based seeding was conducted.

<p>northward into the WR region. Thin high and midlevel cloud moved in from the west starting around 10Z. This upper level cloud remained through morning. There were no orographic clouds, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 63/28 RKS: 67/39 LND: 72/38 Observed DWWS: -2</p>	
<p>22 April 2016, Friday</p>	
<p>Waves of thick overcast and broken clouds passed over the range throughout the period with intermittent rain/snow mix. High based orographic clouds were in place for most of the period. Afternoon cumulus and convective showers were observed as well. It remained much too warm for operations, and no seeding occurred.</p> <p>Max/Min temperatures PNA: 68/32 RKS: 70/43 LND: 75/41 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>23 April 2016, Saturday</p>	
<p>Thick overcast layers blanketed the range throughout most of the period while low orographic clouds covered the peaks. Convective clouds were present around the range during the afternoon hours. Rain and snow were observed intermittently throughout the period as well.</p> <p>Max/Min temperatures PNA: 55/32 RKS: 61/35 LND: 70/43 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
<p>24 April 2016, Sunday</p>	
<p>Low clouds existed throughout the period. During the morning and afternoon, the coverage was inconsistent and no precipitation occurred. The evening brought more widespread coverage with some light snowfall and then inconsistent coverage again overnight. The temperature was warmer than the seeding threshold.</p> <p>Max/Min temperatures PNA: 50/34 RKS: 54/35 LND: 54/40 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>

25 April 2016, Monday	
<p>Snowfall was developing over the NE slopes of the range during the morning with only scattered snowfall over the peaks until the late afternoon. There was nearly continuous snowfall over the NE slopes and the top of the range through the evening and overnight. The temperature was too warm for seeding operations.</p> <p>Max/Min temperatures PNA: 46/30 RKS: 56/33 LND: 51/36 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
26 April 2016, Tuesday	
<p>Widespread snowfall over the region for most of the day from a strong low in CO and western NE. The snowfall over the range became lighter over the night and had mostly ended by sunrise. The temperature was too warm for seeding operations until the conditions were diminishing.</p> <p>Max/Min temperatures PNA: 37/30 RKS: 37/31 LND: 37/32 Observed DWWS: 0</p>	<p>No ground-based seeding was conducted.</p>
27 April 2016, Wednesday	
<p>There were areas of light snowfall over the range during the afternoon, evening and part of the night. The snowfall was never continuous and the temperature was too warm for seeding operations during the afternoon and evening.</p> <p>Max/Min temperatures PNA: 46/30 RKS: 46/32 LND: 38/31 Observed DWWS: -1</p>	<p>No ground-based seeding was conducted.</p>
28 April 2016, Thursday	
<p>There were thin, low clouds around during the daylight hours, but the precipitation was non-continuous and mainly on the NE side of the range. Thicker clouds existed during the evening over the range but then it was thin overnight until sunrise, when thick clouds with precipitation moved in from the south. Warm temperatures and weak wind flow prevented seeding operations.</p> <p>Max/Min temperatures PNA: 45/30</p>	<p>No ground-based seeding was conducted.</p>

RKS: 35/30 LND: 37/31 Observed DWWS: 0	
29 April 2016, Friday	
Thick overcast layers and orographic clouds were present throughout much of the period. Winds were not favorable for seeding, and temperatures were just slightly too warm. No seeding occurred, although conditions were very close to suitable for this time of the season. Max/Min temperatures PNA: 43/28 RKS: 41/29 LND: 40/32 Observed DWWS: 0	No ground-based seeding was conducted.
30 April 2016, Saturday	
Continued, widespread cloud coverage over most of the state from a strong low in western NE. There was snowfall over the range for most of the period and rain to areas NE of the range. The temperature was just a little too warm for seeding operations. Max/Min temperatures PNA: 48/30 RKS: 40/31 LND: 40/33 Observed DWWS: 0	No ground-based seeding was conducted.

Appendix B. National Oceanic and Atmospheric Administration Final Operations Report

Silver iodide seeding agent amounts are stated in grams.

NOAA FORM 17-4A (4-81)		U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION				Form Approved OMB No. 0648-0025 Expires 03/31/08							
INTERIM ACTIVITY REPORTS AND FINAL REPORT This report is required by Public Law 92-205; 85 Stat. 735; 145 U.S.C. 330b. Knowing and willful violation of any rule adopted under the authority of Section 2 of Public Law 92-205 shall subject the person violating such rule to a fine of not more than \$10,000, upon conviction thereof.		NOAA FILE NUMBER 15-1668											
		<input type="checkbox"/> INTERIM REPORT		<input checked="" type="checkbox"/> FINAL REPORT									
Complete in accordance with instructions on reverse and forward one copy to: National Oceanic and Atmospheric Administration Office of Oceanic and Atmospheric Research 1315 East-West Highway SSMC-3 Room 11216 Silver Spring, MD 20910		REPORTING PERIOD FROM 11/15/2015 TO 04/30/2016											
MONTH	(a) NUMBER OF MODIFICATION DAYS	(b) NUMBER OF MODIFICATION DAYS PER MAJOR PURPOSE				(c) HOURS OF APPARATUS OPERATION BY TYPE		(d) TYPE AND AMOUNT OF AGENT USED					
		INCREASE PRECIPITATION	ALLEVIATE HAIL FOG		OTHER	AIRBORNE	GROUND	SILVER IODIDE	CARBON DIOXIDE	UREA	SODIUM CHLORIDE	OTHER	
JANUARY	5	5					50	8,762					
FEBRUARY	4	4					61	4,808					
MARCH	6	6					62	5,131					
APRIL	2	2					6	256					
MAY													
JUNE													
JULY													
AUGUST													
SEPTEMBER													
OCTOBER													
NOVEMBER	3	3					42	2,409					
DECEMBER	7	7					66	10,187					
TOTAL	27	27	0	0	0	0	286	31,553	0	0	0	0	0
TOTALS FOR FINAL REPORT	27	27	0	0	0	0	286	31,553	0	0	0	0	0
DATE ON WHICH FINAL WEATHER MODIFICATION ACTIVITY OCCURRED (For Final Report only.)													
CERTIFICATION: I certify that all statements in this report on this weather modification project are complete and correct to the best of my knowledge and are made in good faith.							NAME OF REPORTING PERSON Bruce A. Boe						
AFFILIATION Weather Modification, Inc.							SIGNATURE <i>Bruce A. Boe</i>						
STREET ADDRESS 3802 20th Street North							OFFICIAL TITLE Vice President - Meteorology						
CITY Fargo				STATE ND	ZIP CODE 58102		DATE 05/06/2015						

Appendix C. Project Contact List (redacted)

WYOMING WEATHER MODIFICATION - WIND RIVER MOUNTAINS WMMWRM 2015-2016 <i>Last Revised 17 March 2016</i>			
WYOMING WATER DEVELOPMENT OFFICE (WWD0)- CHEYENNE, WYOMING			
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Last Updated: 03/17/2016