Extreme Winter: Weaving Weather and Climate into a Narrative Through Laura Ingalls Wilder

Barbara Mayes Boustead

Abstract The Hard Winter of 1880–1881 was featured in the Laura Ingalls Wilder historical fiction account, *The Long Winter*, as well as in several local histories across the region. Both meteorological records and historical accounts indicate that the winter was particularly long, snowy, and cold. As a result, homestead settlers in the Great Plains and Upper Midwest regions of the United States were stranded for weeks or months at a time, many in inadequate shelters and with fuel and food supplies that ran short. The compelling narrative of Wilder's perspective on the Hard Winter, linking scientific information about the winter of 1880–1881 to a cultural icon, provides a natural vehicle with which to communicate weather and climate concepts. A narrative constructed around *The Long Winter* and other books authored by Wilder provides a means of audience engagement and interest in weather- and climate-related topics, which was at least partially quantified by surveying audiences of the narrative. Overall, the extreme winter weather, combined with a familiar narrative voice, transmits weather and climate understanding to a wide audience.

Keywords Winter · Blizzard · Cold · Laura Ingalls Wilder · Narrative · Historic extreme weather

Blinding snow, driven by winds gusting to 40, 50, 60 miles per hour. Bitter cold. Deep snowpack. Homebound for days, with school canceled and stores closed. Dangerous travel. Cold and snow dragging on and on.

These words could describe winters such as 2009–2010, 2013–2014, or 2014–2015, depending on the part of the country in question. They also could describe a winter written into infamy in one book among a series of children's books—*The Long Winter*, authored by Laura Ingalls Wilder (1940) and written to describe the winter of 1880–1881 in east central South Dakota. The series of books,

B.M. Boustead (✉)
Omaha/Valley Weather Forecast Office, National Oceanic and Atmospheric Administration/National Weather Service, 6707 North 288th Street, Valley, NE, USA
e-mail: Barbara.mayes@noaa.gov

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collectively called the *Little House* series, inspired a very popular American television series, *Little House on the Prairie* (1974–1983).

1 A Famous Mid-American Author

Laura Ingalls Wilder (1867–1957), renowned for her children's books centered on her pioneering childhood, was more than an author—she is a part of the cultural fabric of America. Her stories, detailed in a series of eight books, encompass her life experiences in a pioneering family across the central United States from ages 3 to 18. One additional book published posthumously describes her first four years of marriage. As a family, the Ingalls family—comprising Pa, Ma, Mary, Laura, Carrie, and Grace Ingalls—built homes and lives in Wisconsin, Kansas, Minnesota, and Dakota Territory (South Dakota) through the series of books. Four of the books provide insight into the family during their settlement in the town of De Smet, originally in the Dakota Territory and in present-day South Dakota, while Laura was ages 13–18. It was here that Laura met and married Almanzo Wilder, 10 years her senior, gave birth to their daughter Rose, and began her own family life. The experiences in the *Little House* book series were based on events from Laura's own childhood, interspersed with some fictionalized elements woven among the actual events to enrich the tapestry of the stories. Significant weather and climate events, such as the Hard Winter of 1880–1881, were a major part of the book series.

Historians and literary scholars have conducted extensive research on biographical information about Laura Ingalls Wilder (Zochert 1976; Anderson 1992; Miller 1998; Hill 2007; Fellman 2008) and have published books in popular literature. The research has focused on historical facts that support the information presented in the *Little House* books, as well as missing and incorrect information; the life of Laura Ingalls Wilder and her family through her adulthood. Several works (such as Miller 1998; Hill 2007) cover the writing of the *Little House* series, including Wilder's strong collaboration with her daughter, author Rose Wilder Lane. Interest in the life of Laura Ingalls Wilder and her family spills over into related topics, too—even some information about the town of DeSmet, South Dakota (Miller 1994), site of four books in the *Little House* series and one more published posthumously.

Many of the events (including and beyond the weather and climate events) throughout the *Little House* book series can be verified, and the veracity of those events provide a context of trust in her narratives, even when other events are revealed as fiction or fictionalized representations of actual events. In that respect, the Laura Ingalls Wilder books highlight the role that extreme weather played during the late 1800s on the people and places of the upper Midwestern American prairie.

2 Setting the Stage for the Hard Winter

In the fall of 1880, the Ingalls family moved into what would become east central South Dakota along the Chicago and North Western rail line. Settlement followed the narrow steel lines of the railroad into a region of only sparse settlers of European descent amid the landscape formerly occupied by Native Americans. With little history among white settlers and little information exchange with Native Americans to learn more about the region as it was being settled in 1870s–1880s, settlers knew dangerously little about the climatology of the region. Settlers who moved west from New England, the Mid-Atlantic, and the Great Lakes had little or no experience with the blizzards, the more frequent tornadoes, or the periods of drought that had been, at most, rare events in their home climatologies (Schwartz and Schmidlin 2002; Brooks et al. 2003; Namais 1983).

In just the second year that the Ingalls were settled in the area, and the first year that the town of De Smet was incorporated, a brutal winter unfolded across much of the north central United States. Dubbed the "Starvation Winter" (Clark 1893), the "Hard Winter" (Robinson 1904), or the "Snow Winter" in most historical sources, the region was overwhelmed by a series of blizzards and cold snaps (Mayes Boustead 2014). The barrage lasted for six long months in most of the region, and the result was one of the coldest and snowiest winters since settlers of European descent arrived in the region, along with some of the worst flooding ever recorded in the region. Wilder wrote about the hardships of the Ingalls and Wilder families in *The Long Winter*, which was the sixth of her eight-book series. The publisher rejected her original book title, *The Hard Winter,* because it was too scary-sounding for her young audience, but the content was largely unaltered from draft to publication.

Among scholars who study Wilder and her writings, *The Long Winter* is often considered to be the most complete of her stories and is often cited as a fan favorite; it includes the overarching narrative of a family struggle and narrow defeat against the terrifying winter. By the time *The Long Winter* was published in 1940, Wilder's previous books had received national recognition and awards, and she was a well-known author who received fan mail and requests for speaking engagements. Like several of her other books in the *Little House* series, *The Long Winter* was recognized with a Newberry Honor Medal in 1941. Published during and after the Great Depression, the *Little House* books are often cited for their timeless themes that keep them popular to this day. *The Long Winter* contains a dramatic story arch, with a clear villain (the winter weather) that threatens the Ingalls family and a very real threat of harm. The threat encompassed limits to settler mobility and access to food in the American Plains and Upper Midwest.

3 Overview of the Hard Winter of 1880–1881

The foreshadowing of the Hard Winter to come starts early in Wilder's story, beginning in the late summer of 1880. Pa (Charles Ingalls), her father, observes birds flying south early and quickly and muskrats building particularly thick shelters. Wilder's draft manuscript hammers home these themes more than the final published version of the story, painting Pa as a nature-reading sage who knows that the winter will be hard before a fictitious Native American visits town to provide his forecast.

Sure enough, winter began early as a mid-October blizzard swept over the family in their thin-walled claim shanty. A claim shanty can be described as a simply constructed home that many of the early settlers on the Plains used to stake a claim to their property (Herbert Hoover Presidential Library 2015). A cold rain on October 14, 1880, changed to snow overnight, deteriorating to a blizzard that lasted from October 15–17 (Fig. 1).

Climatological data during the Hard Winter are available from several sites in the Plains and Upper Midwest regions, though none that were close to De Smet. The closest sites to De Smet with continuous records that predate 1880 and extend to the current date are Omaha, Des Moines, and Minneapolis/St. Paul. Historical military quarters in Fort Sisseton (about 25 miles west of Sisseton, South Dakota),

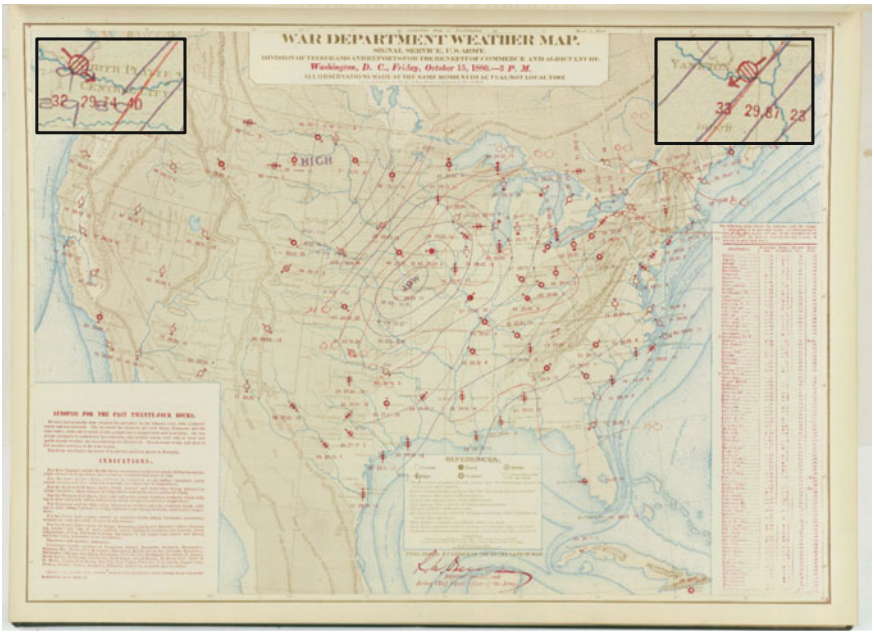

Fig. 1 Surface weather analysis at 2000 UTC (3 PM Eastern Standard Time) 15 October 1880. Yankton, South Dakota (*upper right*), and North Platte, Nebraska (*upper left*), stations are in *insets*

Fort Bennett (under present-day Lake Oahe in central South Dakota), Fort Randall (70 miles west of Yankton, South Dakota), and Yankton have short periods of historical records that were digitized by the former Climate Database Modernization Project. Climate records for Huron began in July 1881, just after the Hard Winter ended.

Observers at Forts Sisseton, Bennett, and Randall indicated that rain changed to snow late on October 14, 1880, with precipitation falling as snow for the next two days, and with gusty winds continuing through October 18. Mild weather returned quickly after the blizzard passed, but winter had struck its warning note. Historically, an October blizzard hits South Dakota roughly once every five years, but these are usually west of the Missouri River (personal communication with the National Weather Service offices in Sioux Falls and Rapid City, South Dakota, 2012). Thus, blizzards in October are rare, though more benign snowfall in October is more common. Even so, in the book *The Long Winter*, the blizzard was enough to scare the character Pa into moving the Ingalls family to town for the winter. As with most other settlers, Pa had moved in from the East, where October blizzards were much rarer, and he was unfamiliar with the climatology of his new home.

Laura's tale, combined with historical weather records, suggest that after the October blizzard, a relatively mild spell settled into the region. During that time, the Ingalls family moved from their claim shanty to the more substantial shelter of Pa's office building in downtown De Smet. Historical records point to numerous snow events from mid-November through December 1880. Laura herself counted four blizzards, from a blizzard that struck during school around early December until a Christmas blizzard marred the holiday. With no routine weather records within about 100 miles of De Smet, it is challenging to identify specific events that would have affected De Smet. However, records around the region clearly indicate no fewer than three snow events at any one site during that time. Minneapolis/St. Paul experienced as many as six individual snow events, with 0.10 inches or more of liquid equivalent precipitation falling while temperatures were below freezing, including eight consecutive days with snow from December 19–26 as liquid equivalent totaled 1.63 inches. Even a climatologically average snow-to-liquid ratio of 13 to 1 would equate to around 22 inches in those eight days alone.

Sometime around early to mid-December in Wilder's account of the Hard Winter, Laura, her sister Carrie, and several other children were caught at school when a blizzard struck. While the veracity of this specific event is uncertain, it is certainly plausible that it did happen in De Smet, as it did in many Plains winters around the region. In Wilder's tale, Laura and the rest of the students stumbled behind the teacher, hoping to run into a building to guide them back to Main Street. Laura herself runs into a building just on the edge of town, saving the children from wandering out into the open prairie where they surely would have been lost. The event as described by Wilder is reminiscent of David Laskin's *The Children's Blizzard* (Laskin 2004). Laskin describes a single blizzard in which hundreds lost their lives, mostly children and teachers stranded at schools when the blizzard struck. Whether the schoolhouse event happened to Laura herself or was a reflection of stories told around the prairies during the Hard Winter, it is symbolic of one

of the dangers of blizzards to human life: the sudden arrival and lack of visibility could strand people, including children, away from home, with their lives endangered by venturing out into the storm to find their way home. Weathering the storm by staying in a location would be challenged when shelters, such as schoolhouses, did not have adequate food, fuel, or water to sustain people through a multi-day winter storm.

With all sites reporting snow on December 25–26, 1880, Wilder's memory of a blizzard beginning late on Christmas day is confirmed with high confidence. By the end of December into early January, the vital Chicago and North Western train line had been blockaded by snow from Minnesota westward into South Dakota (Stennett 2007). The last train of the winter passed through De Smet in late December, with snow blockades holding back train traffic at least through April (Fig. 2) and, in some locations, through early May. After late December, the town of De Smet was on its own for food, fuel, and survival.

Fig. 2 Cleaning snow away from the railroad tracks at Kelly's Cut, 0.8 km (0.5 miles) west of Sleepy Eye, Minnesota, in March 1881. Image courtesy of Chicago and North Western Archives

By late December, the town of De Smet already had burned through its supply of coal. The trains were not refreshing the supply as expected, and the prairies lacked trees to burn for fuel. The Ingalls family, like many settlers, resorted to an alternative and much less desirable fuel source: twisting fast-burning hay into sticks that would burn slightly less quickly. Coal was not the only supply that was running short by the new year, though. Food was scarce, as well. Most settlers to De Smet were brand new, as the town itself was not established until the railroad was built in the summer of 1880. New homesteaders had not arrived in time for a full crop in most cases, planting just a few garden vegetables and small fields of crops to store in the pantry and feed the livestock through the winter.

The settlers expected that the train would bring food supplements to help them survive until spring, when they would plant full crops and gardens. When the trains ceased, De Smet and other towns were forced to turn inward to find enough food for their citizens. The manuscript of *The Hard Winter*, the draft version of *The Long Winter*, indicates more of a variety of food on the Ingalls' table than *The Long Winter* implies, with some preserves and stored vegetables breaking up the potato and bread monotony. Even so, a diet consisting largely of a slice of bread for lunch and a potato for a mid-afternoon dinner, with perhaps a dab of preserves or a root vegetable in the mix, is hardly a healthy and complete diet. With such low-calorie consumption, the Ingalls family and others in their situation no doubt suffered from low energy and fatigue, not to mention weakened immune systems and complications of any chronic illnesses (Fig. 3).

In *The Long Winter*, Laura's future husband, Almanzo Wilder, and his friend Cap Garland saved the town of De Smet (and the Ingalls family) from starvation by seeking a farmer who had raised wheat south of town, purchasing his seed wheat to bring back to town for food. Whether this trip occurred is a matter of some controversy among Ingalls and Wilder historians, but there is evidence to support the possibility that it occurred. In Laura's story, the trip occurred on a lone clear February day between blizzards, with a full moon aiding visibility, and with especially cold temperatures. In February 1881, the full moon fell on February 14, in the midst of a particularly active weather period even by Hard Winter standards. All sites in the area received snow on February 14–15. On February 16, the high temperature in Yankton, South Dakota, reached a mere –3 °F, while Fort Randall reached 8 °F. Daily minimum temperatures in the South Dakota sites ranged from –23 °F at Yankton to –34 °F at Fort Bennett. Light snow arrived again on February 17 at Omaha, Yankton, and Minneapolis/St. Paul. Thus, February 16 is a likely candidate for the seed wheat trip, at least meteorologically and astronomically.

In Laura's recollection, the blizzards from around late January through March 1881 ran together into one series of snow storms that assaulted De Smet, letting up for just short breaks before attacking again. Given the frequency of snow events at sites around the region, it is no surprise that her recollection of individual events became blurry. From late January through the end of February, only seven days were snow-free at all sites in the area, indicating a persistent barrage of snow events with little respite. In March, Laura noted that "there might be three days of clear cold, or even four days, before the blizzard struck again." Her recollection that

Fig. 3 Snow blockade along the railroad lines on March 29, 1881, near Winona, Minnesota. Photo courtesy of Chicago and North Western Historical Society Archives, with gratitude to Mr. Joe Piersen

blizzards became less frequent in March is accurate, as breaks between events grew longer and temperatures rose above freezing for increasingly long durations. In fact, historic weather records indicate that March 17–30, 1881, was snow-free across the area, with temperatures above freezing even at the coldest site, Fort Sisseton, for eight consecutive days.

Winter returned for one last gasp between March 31 and April 12, 1881, with four separate snow events that marched across the region. Temperatures dipped below freezing during the events, rising again in between to the 40s and 50s. The last freezing temperature of the season at any site in the region fell on April 16, as winter disappeared just as quickly as it had arrived. Temperatures flipped abruptly to a warm pattern beginning around April 15, and they largely stayed above freezing in the region from that date forward in the spring. While not chronicled in detail in

Laura's book, other than a mention of soggy roads, the abrupt warm-up with such a deep snow pack on the ground contributed to significant and even record-setting flooding. Flooding came in two waves: ice jam flooding initially, as ice broke on the rivers inundated with early melting, followed by extensive river flooding as snow melt swelled rivers from the Dakotas to the Mississippi River mainstem. The floods of the spring of 1881 set records that stood for decades and even into this century, with impacts ranging from the creation of a new oxbow lake near Omaha, Nebraska, to the inundation of numerous towns, including Vermillion, South Dakota.

Though records are scant and likely incomplete, tales of widespread deaths due to blizzard exposure from the Hard Winter are rare. This is in striking contrast to the blizzard of 1888, known as the "Children's Blizzard" because so many schoolchildren died as a result of one storm (Laskin 2004). Speculation could include that no individual storm in 1880–1881 was as intense as that in 1888, or that storms were so frequent during the Hard Winter that fewer people ventured out and thus few people were caught exposed. Whatever the reason, the Hard Winter is not associated with reports of high mortality. It is, however, associated with food deprivation, as the "Starvation Winter" moniker would attest, which certainly influenced the health of those who survived the winter both in the near term and potentially for life.

4 Meteorological Causes and Context of the Hard Winter of 1880–1881

While temperature and the liquid equivalent of precipitation have been recorded in much the same way since the late 1880s, snowfall and snow depth were not routinely measured and reported until around the 1940s in most locations. Thus, describing the severity of the Hard Winter of 1880–1881 scientifically is challenging. While it is relatively straightforward to rank winter seasons by their coldness, it is a little more challenging to try to rank snowfall with such limited snowfall data, and it was unprecedented to rank or classify winters in a way that incorporated both temperatures and snowfall. The Accumulated Winter Season Severity Index (AWSSI, pronounced "aussie;" Mayes Boustead et al. (2015) provided a tool to allow just such a ranking of winter seasons, including the Hard Winter, by their severity. The AWSSI incorporates temperature, snowfall, and snow depth data, assigning a "score" to each day of winter that is summed through the season to create a final tally, and it includes an algorithm to calculate snowfall and snow depth based on temperature and precipitation data to fill in the gaps of historical snow data.

Based on AWSSI rankings, the Hard Winter of 1880–1881 was among the top five most extreme winters at many locations in the region that have reliable and continuous records, such as Minneapolis/St. Paul, Minnesota, Des Moines, Iowa, Omaha, Nebraska, Detroit, Michigan, and Lansing, Michigan. In fact, the Hard

Winter was the most extreme winter since records began in 1872–1873 at Minneapolis/St. Paul.

In addition to allowing the ranking of historical winters like the Hard Winter, the AWSSI allows scientists to place some of the more modern severe winters into context, as well. At Detroit, for example, the winter of 1880–1881 ranks as the second most severe since records began in 1874–1875, nudged out of first place by the winter of 1911–1912 (Mayes Boustead et al. 2015). Of the 10 most extreme winters on record, four occurred during the 19th Century and two more during the late 1970s, both periods well recognized for their cold and snowy winters in the region. The more recent winter of 2013–2014 ranks as the fourth most extreme on record, slightly less extreme than the winter of 1978–1978 and just a bit harder than the winter of 1882–1883. Long-term analysis shows that winters reaching a severity of 1100 or greater in the AWSSI index—the 18 most extreme winters in Detroit—were heavily loaded toward the early period of observations, from the late 19th Century into the early 20th Century. Winters that extreme can and do still occur, as citizens of Detroit in 2013–2014 knew well, but they are less common (see Fig. 4).

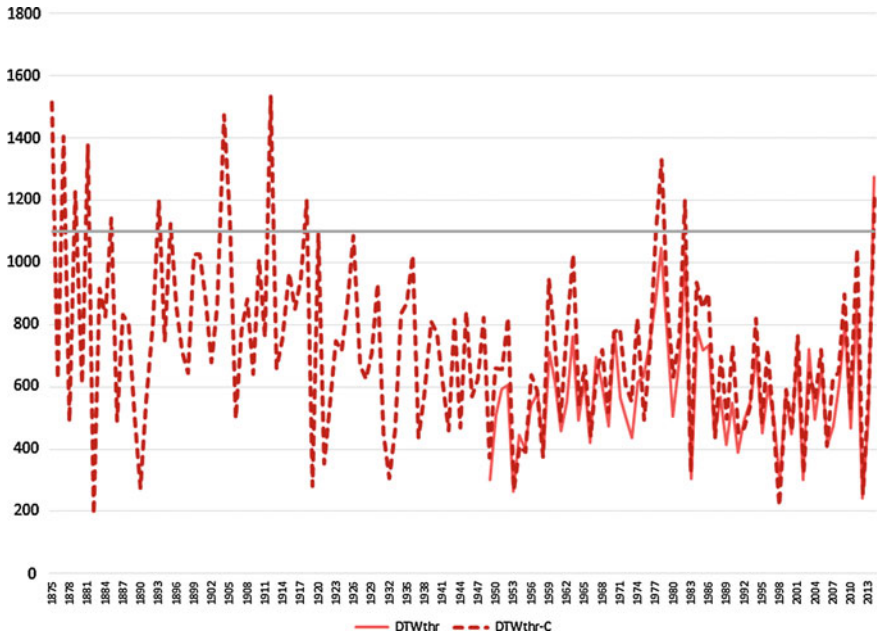

Fig. 4 Accumulated Winter Season Severity Index (AWSSI) historical record for Detroit, Michigan. Note that winters over 1100 in severity, such as the winter of 2013–2014, were more frequent from the 1870s through the 1910s, then rare in the decades since then

4.1 Climate Patterns During the Winter of 1880–1881

The winter of 1880–81 was characterized by two predominant climatological patterns: (1) a very strongly negative North Atlantic Oscillation (NAO), and (2) a weak to moderate El Niño. The North Atlantic Oscillation is defined by a surface air pressure difference between Iceland and the Azores in the North Atlantic Ocean. When that pressure difference is unusually weak (the negative phase), the jet stream tends to be more meandering, allowing north-to-south flow to dump cold air into the eastern and central United States. On the other side of the planet, the El Niño—Southern Oscillation (ENSO) is governed by temperature anomalies in the ocean surface near the equator in the eastern to central Pacific Ocean. When those temperatures are running warmer than usual for a prolonged period—the El Niño phase—they can force the jet stream away from its usual seasonal tracks, sparking temperature and precipitation patterns to change, as well.

On average, the negative phase of the NAO tends to be associated with colder than average temperatures across most of the eastern to central United States, with more negligible effects on precipitation. El Niño, by contrast, tends to be associated with warmer than average temperatures across the northern tier of the U.S., along with a slight tilt toward drier than average conditions in the northern Plains and wetter than average conditions in the southern Plains to Ohio River valley. The opposing tendencies in the northern U.S. can behave like equals in an arm wrestling match when both patterns are weak, sometimes oscillating between tendencies and sometimes with one weakly dominating. But if one pattern is strong and the other is weak, the arm wrestling starts to look like one of the opponents is a weightlifter and the other isn't—the stronger pattern tends to dominate. A recent example of this is in the winter of 2009–2010; the impact of a strongly negative NAO overwhelmed the influence of a moderate El Niño. The result was an NAO-influenced colder-than-normal winter across much of the north central United States, areas that tend to tilt toward warmer-than-average conditions during El Niño winters.

The negative NAO of 1880–1881 was among the strongest since records began in 1864 (Hurrell 2013). The combination of a very strongly negative NAO and an El Niño has occurred in two other winters: 1968–69 and 2009–10. In both of those winters, snowfall in the central United States was above normal and temperatures were near to below normal. The winter of 2009–2010 is particularly close in memory for many in the United States. That winter was marked by several early-season blizzards across the central and eastern United States, a cold snap in January that reached as far south as the Gulf Coast and Florida, and extensive flooding during the spring melt across the central and northern Plains and upper Midwest. The patterns in 1880–1881, however, occurred on a colder background climate state than those in 2009–2010, in the midst of a very cold decade. With the strongly negative NAO, an El Niño, a colder climate, and other factors yet to be accounted, a "perfect storm" of contributing factors pushed the winter of 1880–81 off the charts in severity, ingraining it into the memory of those early settlers and into the storybooks of the beloved Laura Ingalls Wilder. The winter conditions of

1880–1881 clearly impacted the lives and community context for those who experienced them and were significant enough to provide the environmental setting and context for writers in that time and place.

5 Pioneers and Modernistas: Information and Impacts Then and Now

Unlike the fictionalized "Indian warning" tale spun in *The Long Winter*, the De Smet settlers and others in the region had no warning of an impending severe winter or even of any individual blizzard. Their lead time was a matter of minutes to hours, driven by watching for advancing clouds and near-ground white-outs. Even in the modern era, our signals for the potential of a severe winter are often murky and provide little lead time, though we are able to provide accurate forecasts and timely warnings for individual storms. Today, rather than waiting to see the storm, we can view computer models that foretell winter storms days in advance. In that sense, our communities have the advantage of weather predictions that earlier communities lacked. We like to think that we would be more prepared to handle a harsh winter in modern times than our pioneer forerunners, but in truth, modern society remains vulnerable to the impacts of a long, cold, and snowy winter. Winter weather—ranging from cold snaps to snow and ice events—routinely cause injuries and fatalities, in addition to economic loss. Rather than modern society being more or less vulnerable than late 19th Century settlers, we can consider where vulnerability is different.

The moniker "Starvation Winter" was no accident, nor was it an exaggeration. Homesteaders were far more likely than modern citizens to store food to last for long durations. Gardens were picked clean, with fruits and vegetables canned and preserved and root vegetables stored in the cellar. Grains were harvested and stored for both seed and feed, and livestock right on the homestead provided milk and meat. All of these, however, were more indicative of established homesteads with well-broken sod and years of planting and raising livestock. Most of the settlers near De Smet in 1880–1881 were new to the area within just the year, with newly broken sod and small scratched-out gardens. Settlers like the Ingalls family intended to supplement their more meager stores with train-supplied goods brought to local merchants and sold in town. When the trains stopped running, the food supply in small towns like De Smet became exhausted long before winter weather ceased. Settlers pooled their resources to help neighbors stay fed, and they ground their seed wheat into flour or mush to stay alive. Their diets were monotonous and lacked in both vegetables and proteins.

In the modern era, our pantries may have some stored food, with a small array of perishable food in the refrigerator and perhaps a small supply of meat and vegetables stored in the freezer. Rarely do modern citizens, especially in urban and suburban locations, fill the pantry to last through a winter season. We simply do not

have the need; grocery stores are abundant, with ever-refreshing stock of perishable and non-perishable fresh and processed foods. Additionally, few urban and suburban dwellers have the space for more than a small garden or perhaps a few chickens, limiting their likelihood to can, preserve, or store food they have grown and raised. Starvation in the United States is a threat limited to poor and underserved populations, concentrated mainly in the most urban and rural of locations and out of sight of the majority of the modern population.

5.1 Vulnerability During Extreme Winter Weather

In a prolonged and severe winter like the Hard Winter, the scattered settlements of the pioneer era were vulnerable to being cut off for extended periods of time. Transportation relied on train, horse or other pack animal, or foot travel, all of which were vulnerable to cutoff during inclement weather. The stoppage of the Chicago and North Western train line during the Hard Winter exemplified the vulnerability of train travel to the elements, as snowplow equipment could not keep up with maintenance. Lines were further blocked or damaged by spring flooding, which was not described in *The Long Winter* but had a significant impact in the region that lingered through the spring. Additionally, human and animal lives were endangered by attempts to travel by foot or pack animal, as the duration of time spent traveling was significantly longer than train travel and left the traveler open to exposure and disorientation while traveling. Pioneer-era settlers were more likely than their modern counterparts to shelter in place during extreme winter weather, relying on their stores of food and fuel to endure prolonged periods of cold and snow.

The flip side of staying sheltered during extreme weather was the threat of isolation. During the Hard Winter, isolation contributed to mental health vulnerability; the downward spiral into depression was captured in *Giants in the Earth: A Saga of the Prairie* (Rolvaag 1927), among other narratives. The isolation of prairie life was difficult enough, and this was even highlighted by Laura herself in the book *These Happy Golden Years* (Wilder 1943), as her host family on her first teaching assignment was led by a woman driven so mad by the isolation that she wielded a knife on her husband in the middle of the night. During the Hard Winter of 1880–1881, the isolation was worsened by the treacherous winter conditions, with impacts ranging from settlers who gave up their homesteads following that winter to those who experienced a form of "madness" from the extreme isolation and ever-present winds.

Transportation in the modern era remains vulnerable in the modern era, perhaps the most vulnerable aspect to extreme winter weather in our society. Modern society emphasizes being unstoppably mobile, and despite cautions from weather and transportation officials, citizens frequently venture into the elements even in the worst of conditions. Vulnerability during travel ranges from running off a rural road in low-visibility conditions to multi-vehicle pile-ups on interstates, all of which can

lead to casualties due to trauma caused by incidents or exposure afterwards. Urban and suburban roads are rarely blocked for more than a day or two, but rural roads can remain blocked by snow for several days or more, with isolation still a risk in rural communities.

Closely related to transportation is the threat of exposure to harsh winter weather conditions, due to either being outside in the elements or in an underheated home during cold weather. Pioneer settlers were susceptible to exposure not only during attempts to travel, but also during everyday household chores such as tending to livestock in the barn or gathering water or fuel. White-out conditions made it possible to become disoriented even in the short distance from barn to home, let alone between school or church and home. The infamous Children's Blizzard of 1888 (Laskin 2004) claimed hundreds of victims, mostly children, who were either caught outside during the multi-day blizzard or trapped in schoolhouses without enough fuel.

Citizens today are threatened with exposure largely by leaving their homes to travel. Unlike settlers' homes, which were stocked with fuel to last longer periods if not a full season, modern homes mostly rely on either electricity or gas brought into the home in a network of pipes and wires. A small subset of homes has a back-up heat source such as a wood-burning stove, but these are the exception. In a failure of the power or gas grid, many citizens rely on gas-powered generators or kerosene heaters to warm their homes. The risk of exposure in one's own home has been exchanged for a risk of carbon monoxide poisoning due to improper ventilation while using back-up heat sources. Exposure risk during travel remains at least as widespread of a hazard for modern citizens as it was for settlers, with modern society more reluctant to stay home during extreme winter weather.

With technology such as phones and the internet, modern citizens are rarely truly cut off even when they are stranded at home during extreme winter weather. Even the most rural citizens can remain engaged with society, community, and family from the confines of their homes. Season-long isolation was a greater hazard, by far, in the pioneer era, especially for homesteading settlers who lived too far from the nearest towns to travel safely in inclement weather. Today, schools may be shut down for a day or two, maybe even up to a week during the most extreme winter weather; school buses might skip a few routine stops but generally run as long as school is open. By contrast, schools on the frontier, often a center of community interaction, may have been shut weeks at a time or longer, depending on the travel distances required by the students (usually on foot). If school was open, students still may have been withheld from attending due to the concerns of their parents for safe travel.

6 Narratives and Stories as a Communication Tool

Scientists increasingly are asked to not only perform basic research, but also communicate that research effectively to a range of potential audiences, rather than simply among other subject matter experts. It is incumbent upon the science community to communicate more effectively to a wide range of audiences. Public trust in scientists is fragile and can depend on the interaction between the framing of information and whether the information is being processed by recipients in a heuristic, faster-encoding but lower-elaboration processing pathway or a systematic, high-elaboration pathway (Goodwin and Dahlstrom 2011). Somerville and Hassol (2011) cite specific means for more effective science communication, including using clearer language and inverting the typical pyramid of science communication by starting with a focus on the results and meaning before broadening the message with supporting details about methodology and background information.

Obstacles to communicating climate and weather concepts abound, especially when communicating about climate. Low science literacy may make such communication challenging, though it is just one potential obstacle to understanding climate change and may not be the primary obstacle to addressing it. Scientific literacy among American adults is similar to their European counterparts, answering roughly two-thirds of basic factual scientific knowledge questions correctly (National Science Board 2014). That said, only 74 % of Americans in the National Science Board study correctly answered that the Earth revolves around the Sun. When a quarter of the American population cannot correctly recall a scientific fact taught in elementary science, it is likely that the population will struggle to grasp more abstract scientific concepts.

Audience-tailored topics, or frames, can convey weather and climate information and potentially address some of these obstacles to understanding. Such a vehicle allows non-meteorologists and non-climatologists to gain understanding about weather and climate as it applies to the topic. The rich stories woven by Laura Ingalls Wilder are an ideal frame for communicating weather and climate concepts. The *Little House* books are engrained in American culture, and particularly the Plains and Midwest regions featured in the books; adults and children alike recognize and respond to the stories. The books, which are historical fiction based strongly on the life of the author, provide a common ground from which lessons in weather and climate can be drawn. Weather events and climate extremes are featured prominently throughout the series, though nowhere as strongly as in *The Long Winter*. Other extreme weather and climate events throughout the books include tornadoes, prolonged drought, grasshopper plagues, cold snaps, and blizzard events outside of the Hard Winter. The books thus provide a vehicle for discussing numerous weather and climate events to which a population could be vulnerable.

A narrative can be constructed, through the characters, plots, and settings of the *Little House* series, which enables the communication of weather and climate concepts that range from interesting tidbits, such as documenting correspondence

between Wilder's description of individual storms and meteorological records of the events, to complicated concepts, such as localizing impacts of climate change. The concept of bridging between science and the community would benefit from a methodology, an example, and an investigation of how to apply the concept in practice. Thus, there is a need to see the process through from beginning, as a scientific investigation, to end, as a tool for education and communication. The narrative constructed about the weather and climate events in the *Little House* books will be referred to as the "Wilder Weather narrative" through the rest of this chapter.

It is no mystery that a well-crafted story will capture the attention of its audience more than a list of facts. Jones and McBeth (2010) described the relationship between narrative communication and its impact on the attitudes of its audience. A narrative, as described by Jones and McBeth (2010), is a story with a sequence of events, including the elements of setting or context, plot, characters (including both a hero and a villain), and a moral of the story. While it has been noted in many studies that people are inclined to respond to and be persuaded by information that most closely matches their own expectations, it is possible to move people beyond those expectations.

A story that exhibits congruence, or similarity to the life experiences of the listener, is more likely to be received. A break with expectations about the way things should be, referred to as a "breach," is hypothesized to contribute positively to persuading the listener. Likewise, the ability of the storyteller to transport listeners is key to persuasion; the narrative should draw the audience into the narrative so that they become involved with the protagonists, allowing the audience members to "get lost" in the story and return changed by it. Finally, listeners are more likely to be persuaded by a story if they trust the storyteller or source. In particular, Jones notes that the depiction of the hero is critical (Pitzer 2010); if listeners like and relate to the hero, then they are more willing to believe other facets of the story. Jones noted that scientists are reluctant to accept storytelling as a valid means of communicating information (Vergano 2010), specifically citing an instance in which he presented the research to National Weather Service meteorologists, who resisted the idea of telling a story over listing facts. Meteorologists tend to be conservative and reluctant to stray outside their science, besides being among the most reluctant of physical scientists to view climate change as a concern (Doran and Zimmerman 2009). Nonetheless, narratives can be an effective tool to communicate to a non-scientist or non-specialist audience when applied for reasons that include increased comprehension and persuasion to reduce controversy, and with high levels of accuracy (Dahlstrom and Ho 2012).

6.1 The Wilder Weather Narrative

The *Little House* books, and particularly *The Long Winter*, provide a strong narrative foundation to which a storyteller can connect weather and climate

information. They include a protagonist or hero, Laura Ingalls Wilder, who is well known and even beloved by multiple audiences. The stories are familiar to their readers, and adding information about weather and climate beyond what is provided in the books or that corrects information in the books allows a credible breach from a story that otherwise meets expectations. Thus, the only element remaining is credibility in the storyteller, an element that can be achieved via affiliation, academic credibility, shared interest in the underlying narrative, and exposure to and comfort with audiences. Collectively, this Wilder Weather narrative can be shaped to the audience and time allotted, expanded as needed, and delivered via multiple media.

From the scientific basis, the goal of the Wilder Weather narrative was to raise weather and climate literacy by focusing on three broad takeaway messages:

1. Know your local climatology; understand and prepare for the range of potential extremes.
2. Climate has changed from the late 19th Century to the present and will continue to change in the future; human activities have caused most of the observed and predicted changes.
3. Know your sources of weather and climate information, and ask questions of meteorologists and climatologists to better understand weather and climate concepts, both in the Laura Ingalls Wilder books and in other experiences.

These messages were conveyed using details from the stories, as well as supporting information from weather and climate research to provide scientific context. For example, the concepts of the El Niño—Southern Oscillation (ENSO) and the NAO were introduced as contributing factors to the severity of the Hard Winter of 1880–1881 (Boustead 2014).

The *Little House* books provide the structure needed to frame the message in a storytelling context. Wilder herself serves as the hero of the story, and weather and climate events are personified as villains. The setting varies by book; in the case of *The Long Winter*, the setting is at the homestead near and in the town of De Smet, Dakota Territory (present-day South Dakota). The conflict or problem in the narrative is that Wilder and her family did not have complete information; resolution is found by determining what we know now about weather and climate events that impacted Wilder and her family. Variants of the Wilder Weather narrative include allowing the storyteller to serve as a detective to uncover the full story behind the clues left by Wilder, establishing Wilder as an early weather and climate observer, comparing awareness and preparedness tactics in Wilder's time to modern efforts, and describing Wilder as an example of living an environmentally-friendly lifestyle.

6.2 *Testing the Wilder Weather Narrative*

The Wilder Weather narrative was presented to a number of audiences, ranging from Laura Ingalls Wilder fans to meteorologists and climatologists, for the

purposes of outreach, education, and engagement regarding weather and climate events in the *Little House* books. A survey evaluation was conducted with three specific audiences, specifically for the purpose of gathering information about perceptions of climate information before and after the presentation. Surveying these audiences with varied backgrounds provided an overarching view of the level of interest in framing weather and climate information with a Laura Ingalls Wilder narrative.

The first audience consisted of fans and scholars of Laura Ingalls Wilder at the LauraPalooza 2012 conference on 12 July 2012 in Mankato, Minnesota. Approximately 75 audience members were present, many of whom had engaged previously with the storyteller at LauraPalooza 2010 via social media and online discussion, by reading *The Homesteader* newsletter features about the work, and/or as an audience of an internet radio show, Trundlebed Tales. Thus, the majority of LauraPalooza attendees already were exposed to and familiar with the Wilder Weather narrative as well as to the storyteller. The LauraPalooza 2012 audience members received updated and more in-depth information that built on previous interactions. The results of these surveys were compared to a survey of a more general audience—rural Nebraskans—who had not been exposed to the Wilder Weather narrative.

For both the second and third audiences, the interaction was the first time that members had heard any part of the Wilder Weather narrative. The second audience was a subset of the National Association of Interpreters Region V meeting in Aurora, Nebraska, in April 2013. The audience of approximately 15 members included national, state, and local park interpreters, extension specialists, master naturalists, and high school to college students. The third audience, students of a graduate-level Climate and Society course in the School of Natural Resources at University of Nebraska during Spring 2013, included a blend of graduate and advanced undergraduate students with a range of climate-related background and experience. In both cases, this was the first engagement of the storyteller with the audiences, and the audiences had a range of exposure to the *Little House* books from no previous experience to high familiarity with the books.

Survey results indicated that audience members who were exposed to the Wilder Weather narrative exhibited high trust in the National Oceanic and Atmospheric Administration (NOAA), other federal agencies, and scientists in general regarding climate information. This high level of trust provides a foundation of trust from audience members in a storyteller who is a scientist representing NOAA or another science-based federal agency. Audience members who completed the survey more correctly identified that a high percentage of scientists agree with the statement that climate change has human causes. Additionally, the narrative audiences perceived significantly greater health, economic, and environmental risks due to climate change than the more general population used for comparison. When asked a series of questions about how they felt during the Wilder Weather presentation given to them, the audiences exhibited particularly high levels of inspiration, focus, careful consideration of all options, thorough consideration of issues, creativity, understanding perspectives different from one's own, and relating the topic to ones

already known. The audience groups also exhibited particularly low levels of desire to do something else, boredom, anger, irritation, disinterest, and frustration.

In addition to the quantifiable survey results, more qualitative measures of interest and engagement have been noted through the narrative development and engagement process. The narrative was picked up in 2011 by national (Vergano 2011; Associated Press 2011) and local (Abourezk 2011) media sources. Interest continued as new stories were written (Koerth-Baker 2012) and interviews were conducted (Stateside Staff 2014), particularly during the winter of 2013–2014 that was perceived as another "hard" winter. The author also maintains a blog, *Wilder Weather* (http://www.bousteadhill.net/wilder_weather/), with intermittent postings of articles that either loosely or closely tie weather and climate to Laura Ingalls Wilder, as well as a Facebook presence, "Wilder Weather," with 449 followers as of 12 September 2015, to engage interest and to add visibility to blog articles. While direct measurements of readership of all articles and blog entries is not possible, the continuation of interest in new articles and new angles of press coverage indicates public interest in the narrative.

Does this mean that the Wilder Weather narrative is working? The results at least imply that audiences are attentive and engaged when exposed to the Wilder Weather narrative, especially an audience that has a strong interest in the subject of the narrative as was the case with the LP audience. The level of predisposition of the narrative audiences to be more likely to accept climate change and perceive risks is unknown, but the strong skew toward higher perceived risk and higher perceived consensus among scientists is notable. The audiences exhibited high trust in scientists, and particularly in NOAA, but whether the high level of trust is a result of exposure to a storyteller with a NOAA affiliation is unknown.

The Wilder Weather narrative demonstrates the notion that a scientifically technical research project can be bridged to a general audience, given an effective narrative framework. Such narratives can increase the scientific literacy of general and targeted audiences by raising scientific awareness when enveloped in the frame of a comfortable and effective narrative. Results in this study indicate that the narrative selected could be expanded to other potential audiences, including teachers and students who are reading *Little House* books in the classroom, adults who read the books when they were children, and historians whose interest is sparked by the documentation of past events. Such interactions can help promote awareness of weather and climate topics ranging from hazardous weather preparedness and safety to climate variability and change risk perception that may lead to steps toward adaptation and mitigation.

7 Moral of the Story

Extreme winters, whether historical ones like the Hard Winter of 1880–1881 or more modern ones like those in 2013–2014 and 2014–2015, create a range of impacts on health, safety, and economy. Those impacts may have changed

somewhat from the pioneer era to the modern era, but modern technology and understanding of weather and climate does not eliminate the risks faced by citizens during extreme winter conditions. The Accumulated Winter Season Severity Index (AWSSI) does provide the ability to score a winter's severity, allowing impacts to be scaled to that score and providing a means to compare winters through the history of a site as well as among sites. Meteorological analysis also allows the ability to link teleconnection patterns like ENSO and NAO to winter severity, providing clues that might give advance notice to an impending severe winter and allow citizens to prepare. Even so, knowledge that the upcoming winter may be severe still does not alleviate all impacts to society, whether the warning comes from muskrats or meteorologists.

8 Best Practices: Using Narratives for Weather and Climate Engagement

Based on the available research, suggestions for successful engagement on weather and climate topics using narratives with an audience include:

- Develop a narrative based on a recognized story or story archetype.

One of the reasons that the Wilder Weather narrative resonated with audiences is that the author built the narrative around family, as well as Midwestern and Great Plains prairie life, which are integral to the cultural fabric of the United States. An archetype, or a familiar character, theme, setting, symbol, or situation that represents universal patterns of human nature. Common archetypes include "the hero," "the traveler," and the battle of man against nature. Laura Ingalls Wilder is recognized by her own name as well as by the *Little House* name, and her stories include such archetypes. Whether they read the *Little House* book series or watched the related television series, the name and the stories are familiar and comfortable. The narrative serves as a communication bridge from the scientific facts and evidence to be presented to multiple audiences. Similar narratives could be used to convey how past communities have experienced and responded to instances of extreme weather, providing a useful education tool for children and adults alike. By connecting to a known story, or a comfortable archetype, a scientist can reach a more personal connection with an audience.

- Maintain author credibility, including scientific knowledge and honest interest in the narrative topic.

A narrative is most effective when the audience trusts the storyteller, in addition to relating to the story's main character. For this reason, it is important for the storyteller—the scientist—to be a trusted figure. The trust can originate with credentials, such as affiliation with a trusted organization, but audience trust is often built over time and with continued exposure. A storyteller can earn the trust of an

audience by exuding genuine interest in the narrative topic, allowing the engagement to become a conversation between peers.

- Weave take-home points of scientific interest into the narrative.

The Wilder Weather narrative pulls weather- and climate-related stories from the *Little House* books, then pulls weather and climate lessons that are relevant to those stories. The stories and lessons are woven together, blending Laura's observations with take-home messages that range from winter weather safety to climate change. By attaching take-home messages to a familiar story, the potential for both increased audience interest and retention increases.

In conclusion, this chapter has highlighted the central role that narrative can play in conveying information about extreme weather. Narrative is a tool that, if used effectively, can elicit powerful human response. It has the capability to educate and prepare populations for adapting to extreme weather conditions in a variety of environmental settings.

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