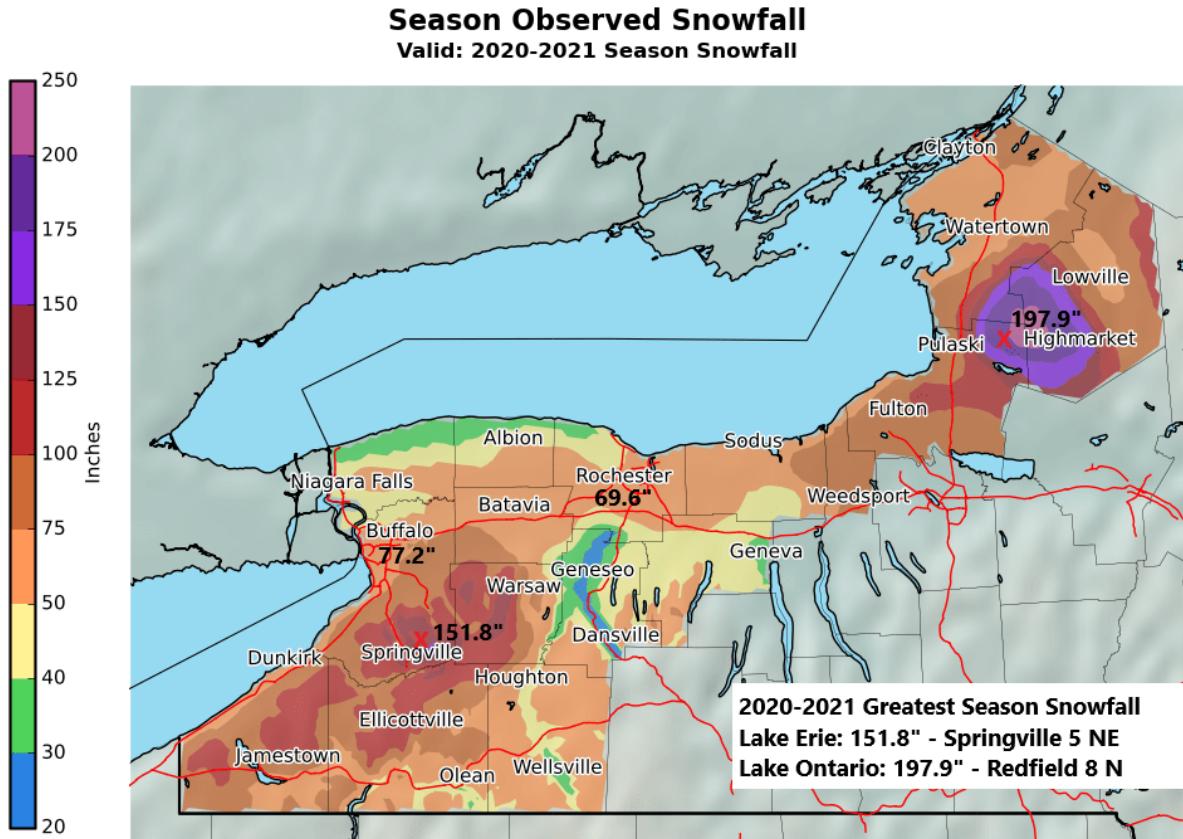


Winter Summary 2020-21



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The winter of 2020-21 was again a moderate winter, featuring below normal snowfall and above normal temperatures. The heart of this winter season occurred from roughly mid-January to the end of February, a time period featuring blasts of cold air, several lake effect snow events and lasting snowpack for the winter season. The winter season lacked the bitter arctic air that usually falls upon the region. Both the Buffalo and Rochester climate sites failed to register a subzero temperature reading, and many climate sites had the lowest temperature reading of the winter season finish among the top 10 mildest on record.

Temperatures for the winter season averaged above normal, with just the month of February featuring widespread below normal temperatures. The winter started warm with November through January featuring temperatures around 4 degrees above normal. Following the cold February, early Spring mildness returned for March reducing what precipitation that fell to mostly just plain rain.

Though a mild winter, the Eastern Great Lakes did manage to produce 9 lake effect snow events, which is just one less than normal. The bulk of the lake effect snow events (6) occurred during the cold stretch of mid-January to mid-February. The event with the greatest impact, but not greatest snow amounts, occurred just after Christmas with heavy snowfall upon the Buffalo region during December 26th. This event managed a daily record of 18.4 inches at the airport, while also producing the first precipitation record for the calendar year. In total around 18 to 22 inches of snow fell across Metro Buffalo, and around a foot and a half fell across the Watertown region. Later in the season, during mid-January, nearly three feet of snow fell east of Lake Erie across snow country during an event that spanned the 17th to the 19th. However most of this snow fell during the night time, with less impact during daytime travel.

The mild winter brought little ice cover to area streams and creeks. As a result there were no ice jam flooding issues this winter. Additionally most rivers remained in their banks during early spring rains and snowmelt. Following a winter when Lake Erie did not freeze, ice did return for a brief period of time for early 2021. The Lake froze on February 13th and remained frozen through March 21st. In seasons when ice does form on the Lake, this was one of the shortest periods (36 days) of ice cover, with only 2005-06 having a shorter period (22 days) of ice cover.

Snowfall

Snowfall finished below normal for the entire region, with only a few pockets in the interior Southern Tier and upper Genesee Valley finishing close to normal. However, these locations are not within the typical snow belts, and their overall total was on the lower end of the snowfall spectrum across our region. Lake effect snow started on the earlier side, with the first event occurring November 2nd and 3rd. It would then remain quiet until a synoptic system grazed our western zones with nearly a foot of snow on the last few hours of November and into early December. One of the notable winter events occurred during a lake effect event over the Christmas holiday, one that produced up to 22 inches of snow across Metro Buffalo and 18 inches across northern Jefferson County. This event, starting off as widespread synoptic snow across the region, transitioned to plumes of heavy snow later on Christmas Day. Snow events occurred more frequently during mid-January to mid-February when 6 of the 9 lake effect snow events happened. The greatest event was over the Martin Luther King holiday weekend when several inches of synoptic snow east of Lake Ontario Saturday transitioned to lake effect snow Saturday Night through Tuesday Night. Close to 3 feet of snow fell east of Lake Erie, with nearly

2 feet of snow accumulating on the Tug Hill east of Lake Ontario. The last major snow event was a lake effect snow storm primarily east of Lake Erie where 2 and a half feet of snow fell across Ski Country. Light snow events continued through March and April, with several trace or light snow accumulations occurring in the month of May.

Temperatures

In what became a moderate La Nina winter, temperatures favored above normal through the winter months of November to March. Each month did have one or two brief periods of below average temperatures, with the longest stretch of below normal temperatures occurring mid-February with a solid 2 weeks remaining below the normal temperature. This stretch of below normal temperatures occurred a few weeks after a series of stratospheric warming events. It was a mild winter, with both Buffalo and Watertown finishing within the Top 10 for warmest November to March time periods, and Rochester within the Top 20 for warmest November to March time periods. There were few temperature records to speak of. Of these temperature records, most occurred during the bookend months of November and March. Area wide only February featured below normal temperatures, with virtually all stations for the region above normal for the months of November, December, January and March.

Winter Statistics for Buffalo and Rochester

Buffalo

Average Temperature, November – March: 34.9F (7th warmest)

Snowfall: 77.2" (61st least snowiest)

Days with 1" or more of snow on ground: 59 (Normal 73 days)

Rochester

Average Temperature, November – March: 33.9F (18th warmest)

Snowfall: 69.6" (49th least snowiest)

Days with 1" or more of snow on ground: 55 (Normal 76 days)

Monthly Highlights

November

November started damp with rain on the 1st changing to snow late in the day and into the 2nd. The first measurable snow for Buffalo and Rochester occurred on the 2nd with 0.2 inches recorded. Later on the 2nd and 3rd a band of lake effect snow formed east of Lake Ontario and produced just over a foot of snow across the southern Tug Hill region. This was the first lake effect snow event of the season. After this a series of surface high pressure systems anchored over the Great Lakes and Northeast and provided a beautiful stretch of dry weather. A sharp cold front crossed the Eastern Great Lakes region late on Tuesday the 10th and into Wednesday the 11th. Rainfall of a quarter to half an inch occurred across the region, with even a few rumbles of thunder during the early morning hours of the 11th. On the 15th a much stronger surface low passed by to the west and north of Buffalo, bringing wind swept rain showers and a peak wind gust of 67 mph. During this high wind event on Sunday the 15th, a seiche on Lake Erie remarkably reached 11.12 feet above low water datum, the second highest peak on record. Within a deepening cold air mass, gusty winds continued into Monday the 16th and lake effect snow lightly coated the hills of the Southern Tier and also the Tug Hill region. A few weak disturbances crossed the Eastern Great Lakes at the end of the third week in November, with temperatures moderating back into the 60s. The fourth week returned back to typical November weather with cloudy and damp days, including light rain and drizzle on Thanksgiving Day the 26th. The last weekend in November was dry allowing for late autumn outdoor work to be completed. The final day of November began as the first day in the month, with a prolonged soaking rain event.

December

Light snow fell during the morning rush hours of the 1st and 2nd across Western New York, slowing morning traffic. The snow cover was short-lived as high pressure brought the return of sunshine and temperatures back into the 40s for the afternoon of the 2nd through the 4th. Low pressure brought a bit of light rain showers to the region on the 5th, and behind a cold front a period of below normal temperatures returned to Western New York. Another wave of low pressure brought the return of wet snow to Western New York on the 9th, and though snow totals only reached a few inches, the timing again during the morning rush hour brought a slow commute. Like earlier in the month the snow cover was short-lived as temperatures quickly soared into the lower 50s by the late morning hours of the 11th. These temperatures erased what snow cover remained. The warm, moist air mass over the cooler ground developed widespread fog from Niagara Falls to Rochester through the morning hours of the 12th. Later on the 12th, a storm system passed by to the west and north of Western New York, bringing a stiff breeze late on the 12th and into the 13th, and also starting a falling trend to air

temperatures on the 13th. It was not until the 15th that below normal temperatures occurred and these below normal temperatures remained until the 19th, with daily nuisance snows. Temperatures began to increase again in the week leading up to Christmas, with what little remaining snowpack erased by the above freezing air mass.

A strong storm system slowly passed through the Great Lakes on Christmas Eve, sending a swath of rain across Western New York. Colder air arrived just in the nick of time with this system to change rain over to snow for Buffalo, with nearly 5 inches of snow on the ground Christmas morning. To the east a lingering warmer air mass kept falling precipitation as plain rain, including east of Lake Ontario where 2 to 3 inches of rain fell across the Black River Basin with field flooding and high creek flows. After a brief break in the precipitation, a cold southwest flow over the eastern Great Lakes brought a prolonged period of lake effect snow downwind of both Lake Erie and Ontario later Christmas Day and through the following day, Boxing Day. In total nearly 2 feet of lake effect snow occurred downwind of Lake Erie across the 'south-towns', the city of Buffalo and towards the airport. Meanwhile to the east of Lake Ontario nearly a foot and a half fell on the Tug Hill. A few days later on the 28th and early hours of the 29th a northwest flow event, with 2 inch per hour snowfall rates, brought around a foot of fresh snow to areas southeast of Lake Ontario, while little snow accumulated east of Lake Erie where a slightly warmer air mass resided. A little light rain on the 28th, and then a heavier rain event with gusty winds on the 30th and early 31st greatly reduced the snowpack across the region.

January

It was an active start to the New Year as rain pushed across the Lower Great Lakes late on the 1st and into the 2nd day of the year. Embedded within this rain were rumbles of thunder, with most lightning flashes south of Buffalo. Rain continued into the 2nd day of January ending as a little light snow.

A mild and mundane weather pattern then emerged on the 3rd and continued through the 11th with grey cloudy skies, and all but one day rising above the freezing mark across Western New York, and all but 2 days rising to near the freezing mark east of Lake Ontario. Sunshine finally broke free of the clouds on Saturday the 9th. A mix of freezing drizzle and snow on the 12th brought a thick icy glaze over surfaces that was then coated by snow at night. A storm system slowly passed over our region on the 16th with light snow showers, accumulating several inches east of Lake Ontario. However as this system reached New England it pulled a colder air mass across the eastern Great Lakes during the second half of the Martin Luther King holiday weekend. This cold air mass from late on the 17th through the 20th yielded lake effect snow with significant accumulations east of both Lakes. Additional lake effect snow fell to the southeast of the Lakes on the 21st and 22nd, with 7 to 9 inches accumulating around Metro

Rochester and Ski Country with slightly higher amounts on the Tug Hill. Bands of snow generally missed the Buffalo and Niagara Falls corridor. A few quiet days followed this event with high pressure settling across the region. A storm system brought widespread, but light snow to our region on the 26th. Colder air began to pour across the region on the 27th, sending the final 5 days of the month below freezing with typical nickel and dime snow showers.

February

February started on a quiet note with just some light snow around the Eastern Great Lakes on the 1st and the 2nd. Surface high pressure then arrived on the 3rd and 4th, producing beautiful blue sky and full days of sunshine. A strong cold front swept across the region on the 5th, with a little snow, and then considerably more snow later on the 5th and into the 6th as bands of lake effect snow formed on a southwest wind within an arctic air mass. On the tune of 1 to 2 inch per hour snowfall rates, the core of this lake effect snowband produced 8 to 14 inches of snow across Erie county and towards Genesee county, and just over a foot of snow on the Northern Tug Hill. It was a fluffy snow with activity falling overnight with little impact to peak commute. On Sunday the 7th another cold front crossed Western New York which reinforced the cold air mass and maintained the light snow accumulation across Buffalo and Rochester. Locally on the night of the 7th behind the cold front a narrow band of snow formed across Oswego County that produced a foot of snow. Surface high pressure brought another partly sunny and dry day on the 10th. Fair but cold weather closed the second week of February. A storm system that brought winter storm warnings from Texas to Maine struck the Eastern Great Lakes region on the 16th. This system brought 4 to 7 inches of very wet snow to the northern Niagara Frontier, with lower amounts to the south and east where more sleet and freezing rain mixed in. On the 19th-20th heavy lake effect snow fell to the south of Buffalo with nearly two and a half feet falling across the Boston Hills. Very little snow fell east of Lake Ontario, with just a few inches falling across Wayne and northern Cayuga Counties. This proved to be the last significant lake effect snow event of the season. Surface high pressure crossed the region on the 21st that sent snow producing clouds eastward and bright sunshine returning. Temperatures rose above freezing on the 22nd for Buffalo and Rochester, for the first time since the 5th, a span of 16 days. A wet snow fell across Western New York late on the 21st and into the 22nd. Though snow amounts were minor, just a few inches, the timing could not be much worse, with the snow falling during the morning rush hour. This brought numerous accidents across the metro regions. Another, more minor snow event occurred about 24 hours later on Tuesday the 23rd. Milder air brought the first early taste of spring on the 24th with this being the warmest day since the day before Christmas for many areas. A little light rain fell on the 27th. The mild end to February brought some ice movement on Buffalo area creeks and rivers, but nothing too bad that resulted in flooding. After some early rain showers on Sunday the 28th, the last day of the month finished pleasant with temperatures warming nicely into the upper 40s.

March

The new month started on the mild side, but this warm air mass was short-lived as a strong cold front dropped across Western New York in the mid to late afternoon. Temperatures plunged and a blustery wind brought snow squalls across the area. The cold air mass continued into the 2nd, but by the 3rd, temperatures rose above freezing and melted what little snowpack that started the month for the Buffalo and Rochester areas. Cold air, scattered flurries and light snow showers remained across Western New York through the 8th. Following the passage of a surface high pressure, southerly winds brought in milder air with the afternoon temperature on the 8th rising into the lower 50s. By the 10th, early spring activities were enjoyed as temperatures soared into the upper 60s with abundant sunshine. A cold front produced a line of showers and thunderstorms that passed through Western New York late on the 11th, though rainfall was minimal. Following this cold front another chilly air mass gripped Western New York, but sunshine through this period took the edge off the chill during the daylight hours. Another milder air-mass pushed northward by Sunday the 21st with temperatures reaching into the 60s again. The Lake Erie water temperature also reached 35°F on this date, marking an end to the ice cover on the lake. This date of ice out on Lake Erie is about three and a half weeks ahead of normal. Southerly winds supported day to day warming this third week of the month. Light rain showers fell these two days, but the dormant grass remained brown and the ground dry. A morning line of storms aided in beneficial rain for the 26th, with over an inch of rain falling across the region. Isolated damage and power outages in the morning from the thunderstorms became a little more widespread by late morning and afternoon as synoptic winds increased to around 60 mph across the lake plain. This rainfall returned the sogginess back to the usual wet spring grounds and turned the grass green in the following days. The last of the month's snow flurries flew on the 29th of the month. Breezy winds, with gusts into the 30 to 40 mph range occurred the final 4 days of the month sending March out like it started, like a lion.

April

Snow showers flew across the region the first couple days of the month giving both Buffalo and Rochester another April with snow. Snow has occurred at these climate locations every April on record, except for one year (1998) for Rochester. A late season snow event occurred on the 21st with 2 to 5 inches of snow falling across the region. This set daily snowfall records for the two primary climate stations of Buffalo and Rochester. Outside of a few May flurries and hill top light snow, this snow that occurred on the 20th through the 22nd of April was the last widespread accumulating snow of the winter season.

Hemispheric Discussion

Relatively 'warm' weather with below normal snowfall characterized the winter of 2020-21. While a forecasted weak ENSO did verify, the high amplitude pattern often characteristic of a weak La Nina event did not. Without any persistent blocking, the result was a dominant zonal flow that maintained a stream of modified Pacific air across the Great Lakes region. This was most noticeable at the start and end of the winter season when the low amplitude flow supported the greatest positive temperature departures. Breaking this down on a month to month basis...

Not only was there an anomalously strong west to east oriented arctic jet anchored over the southern half of Canada during the month of November, but there was an equally impressive subtropical jet that persisted from the Southern Plains to the Great Lakes region. The former served to block any early season cold air intrusions from pushing south of 50 degrees latitude, while the latter maintained a conveyor belt of warm air from of the Desert Southwest and Southern Plains. The month ended up being 5 to 6 degrees F above normal for western and north central New York with little in the way of any early season lake effect snow.

While a weakening of the Arctic jet over Canada allowed for minimal amplification in the overall flow during the month of December, an absence of any downstream blocking and an active storm track from the Deep South to the Mid-Atlantic states kept temperatures over our region from settling below normal. In fact, the mercury remained above normal by 3 to 4 deg F with lake snows largely being held in check until after Christmas.

There were then signs of change late in December into January, when a pair of sudden stratospheric warming events (SSWs) took place. These events involve the notorious polar vortex, a persistent feature found near the intersection of the troposphere (where our sensible weather takes place) and the stratosphere. Several times in a decade, the stratosphere above the poles will warm and winds that normally flow from west to east around the pole will dramatically weaken and even reverse direction. There is a corresponding breakdown or distortion of the polar vortex, and this can eventually cause the jet stream in the lower portion of the atmosphere to weaken. This often allows cold air that has been bottled up near the poles to push south into the United States, Europe and parts of Asia. It is worth pointing out that while SSW's can signal a period of much colder weather in the Great Lakes region, the change usually takes several weeks to occur.

In the meantime, the month of January continued to feature a low amplitude flow over the continent with subtle ridging over the Pacific coast and broad minimal troughing over eastern Canada. This pattern still supported above normal temperatures throughout the lower 48, as the mercury remained some 3 to 5 deg F above normal. The pattern was still not conducive for significant lake snows, so snowfall for the month of January ended up being at least six inches

to a foot below normal with deficits of multiple feet found for some areas in the lake snow belts.

True wintry weather finally set in during the month of February, as the Sudden Stratospheric Warming events prompted a weakening of the arctic jet. This likely supported the westward shift (retrograde motion) of the west coast ridge to the longitude centered on the Gulf of Alaska. The subsequent downstream trough over the eastern half of the continent then deepened somewhat, and this allowed for cold air to spill south of 50 deg N where it had been locked in place up to this point in the season. For the only month of the 2020-21 winter, temperatures for February dropped below normal. The notably colder air then interacted with largely ice free lake surfaces to generate several significant lake snow events. Despite the increase in lake snows though, the monthly snowfall for the major metropolitan areas in Buffalo and Rochester once again fell short of normal.

The effects of the SSWs were short lived though. A low amplitude, near zonal flow returned to areas south of 50N during the month of March. This pattern and the ensuing weather were very similar to that of November, when temperatures across our forecast area were roughly 5 deg F above normal values.