Leveraging Known Impacts to Florida's Citrus Industry from Historical Hurricane and Hard Freeze Events to Enhance Future Public Safety Messages

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Constrains of Hurricanes and Freezes on Florida Citrus

The State of Florida is historically responsible for half of all citrus production in the United States. This production takes place across the central peninsula, a vibrant area known as Florida's Citrus Belt. The Citrus Belt sits at the crossroads of tropical storms and hurricanes as they track toward the state, bringing a higher risk for extreme damaging winds from the south, and wintertime cold air outbreaks from the north that produce long durations of sub-freezing temperatures. The link between cold air outbreaks and damage to citrus groves has been well documented throughout Florida's history, most notably after the five devastating freezes of the 1980s.

Catastrophic damage to citrus trees can occur when temperatures fall below 28°F for 4 hours or more, devastating fruit yield and degrading fruit quality. Similarly, tropical cyclones are typically large enough to place much (if not all) of the Citrus Belt at risk. As winds increase branches and large limbs can be torn off, trunk and root systems severely stressed, and trees uprooted and destroy many trees. Tropical cyclones also bring excessive rain, which can result in flooding of low-lying groves that results in root rot if not treated quickly.

		Growing districts					*Indian River District (IRD) counties*					
Season	*State of Florida*	*Northern*	*Central*	*Western*	*Southern*	*IRD*	*Volusia*	*Brevard*	*Indian River*	*St. Lucie*	*Martin*	*Palm Beach*
1978/1979	−2.24%	−17.27%	[–][b]	−74.51%	309.89%	−1.77%	−17.66%	−6.96%	2.39%	−5.49%	3.16%	−0.78%
1979/1980	23.18%	57.97%	[–][b]	24.74%	11.23%	11.96%	58.82%	17.21%	11.40%	13.76%	10.44%	9.93%
1980/1981	−15.86%	−31.78%	[–][b]	−16.82%	−12.88%	1.90%	−29.63%	1.34%	−0.72%	1.59%	6.11%	2.97%
1981/1982	−20.69%	−29.79%	[–][b]	−25.22%	−20.67%	−9.51%	−34.22%	−26.90%	0.31%	−6.56%	−21.07%	−4.97%
1982/1983	2.32%	29.58%	[–][b]	15.03%	−6.98%	−8.74%	30.69%	13.09%	−13.74%	−8.29%	−9.27%	−15.70%
1983/1984	−12.43%	−47.20%	[–][b]	−36.97%	4.55%	9.81%	−49.76%	−34.74%	14.17%	10.96%	25.34%	17.26%
1984/1985	−6.28%	−96.58%	[–][b]	−40.46%	11.24%	23.31%	[–][c]	−3.85%	28.54%	25.89%	18.74%	19.37%
1985/1986	10.77%	13.33%	[–][b]	327.84%	−51.19%	−24.37%	[–][c]	−0.11%	−1.68%	−6.55%	8.62%	15.33%
1986/1987	3.13%	13.39%	360.39%	4.05%	−14.00%	−2.55%	[–][c]	31.66%	10.87%	8.92%	11.34%	1.38%
1987/1988	12.43%	37.18%	14.64%	27.39%	1.11%	8.24%	37.44%	7.32%	6.79%	10.61%	−0.38%	−0.55%
1988/1989	4.78%	54.58%	2.13%	11.50%	−2.17%	2.35%	6.55%	1.60%	1.06%	4.21%	−2.05%	−14.22%
1989/1990	−27.90%	−76.06%	−30.78%	−30.03%	−17.48%	−22.51%	−44.34%	−32.15%	−21.36%	−23.07%	−20.60%	−18.96%
1990/1991	33.39%	−92.49%	−17.37%	65.48%	86.46%	24.13%	18.02%	28.66%	22.79%	26.37%	69.26%	58.75%
1991/1992	−6.73%	965.36%	15.52%	−12.13%	−11.73%	−12.61%	−3.94%	−23.34%	−12.86%	−10.81%	−16.40%	−20.28%
1992/1993	31.14%	187.36%	42.96%	37.24%	22.89%	19.20%	29.74%	13.08%	18.36%	20.38%	16.39%	11.43%
1993/1994	−6.27%	44.47%	−2.17%	−2.31%	−9.62%	−15.40%	−5.53%	−21.71%	−16.24%	−13.02%	−21.89%	−32.07%
1994/1995	14.96%	44.87%	4.79%	10.71%	17.89%	23.27%	42.68%	26.90%	14.81%	28.81%	23.74%	4.68%
1995/1996	−2.08%	−0.56%	15.28%	−7.60%	−1.01%	−14.12%	−11.14%	−24.56%	−14.81%	−12.23%	−11.39%	−4.42%
1996/1997	11.28%	−2.46%	3.42%	14.89%	11.82%	19.52%	12.87%	26.09%	17.82%	20.42%	11.61%	9.10%
1997/1998	3.09%	52.39%	13.56%	7.71%	−9.17%	−6.46%	19.30%	−10.08%	−6.11%	−7.56%	−5.99%	−17.66%
1998/1999	−20.13%	−35.87%	−26.34%	−24.27%	−10.77%	−14.20%	−29.41%	−17.19%	−12.56%	−13.97%	−18.32%	−13.55%
1999/2000	22.73%	46.86%	30.12%	20.52%	19.47%	16.56%	31.94%	22.79%	14.37%	16.30%	21.76%	9.65%
2000/2001	−6.58%	−15.34%	−9.93%	−10.08%	5.82%	−12.44%	−14.74%	−12.36%	−11.73%	−11.87%	−2.20%	−4.17%
2001/2002	3.03%	14.66%	12.70%	8.78%	−10.93%	2.96%	33.02%	−1.08%	6.01%	1.48%	−9.05%	−16.93%
2002/2003	−12.62%	−11.59%	−6.76%	−16.22%	−9.15%	−21.66%	−18.79%	−20.18%	−22.58%	−21.23%	−10.16%	−15.92%
2003/2004	16.25%	14.02%	17.42%	20.51%	12.63%	15.04%	23.43%	−5.25%	16.59%	15.86%	11.37%	−23.32%
2004/2005	−42.00%	−35.88%	−40.88%	−52.39%	−14.00%	−76.22%	−60.88%	−60.96%	−75.79%	−75.58%	−33.91%	−57.00%
2005/2006	3.16%	31.00%	23.04%	47.07%	−47.82%	63.47%	68.64%	−3.40%	79.73%	46.81%	−33.98%	−57.31%
2006/2007	−7.19%	−43.09%	−30.37%	−21.43%	37.07%	48.78%	−19.30%	39.14%	63.49%	43.97%	23.93%	58.88%
2007/2008	25.76%	55.03%	38.38%	28.44%	16.88%	9.88%	36.09%	21.13%	12.51%	6.73%	3.59%	−34.51%
2008/2009	−7.16%	−12.27%	−3.18%	−1.67%	−9.30%	−18.23%	−6.71%	−23.60%	−17.24%	−13.38%	−24.96%	−29.04%
2009/2010	−15.78%	−3.82%	−7.76%	−15.43%	−26.98%	−17.08%	−9.25%	−26.67%	−16.01%	−17.11%	−41.01%	−58.65%
2010/2011	4.20%	−9.91%	6.71%	−2.26%	13.95%	−0.67%	−7.55%	7.78%	6.07%	−3.99%	−23.15%	[–][d]
2011/2012	2.98%	6.14%	3.86%	5.23%	3.82%	−6.39%	−14.29%	0.00%	−8.02%	−4.41%	−23.02%	[–][d]
2012/2013	−8.63%	−16.15%	−20.20%	−2.74%	4.56%	−11.86%	−16.19%	−7.85%	−11.91%	−9.34%	−7.07%	[–][d]
2013/2014	−20.55%	−23.75%	−20.58%	−24.90%	−21.55%	−6.37%	−8.52%	−18.57%	−5.40%	−7.79%	−35.13%	[–][d]
2014/2015	−9.14%	−21.20%	−15.35%	−3.65%	−4.87%	−10.53%	−12.42%	−20.08%	−12.00%	−7.07%	−27.84%	[–][d]
2015/2016	−16.47%	−35.64%	−24.73%	−13.23%	−10.82%	−11.21%	−21.28%	−12.30%	−13.17%	−8.14%	−15.14%	[–][d]
2016/2017	−17.06%	−41.10%	−5.89%	−9.15%	−24.37%	−30.79%	−27.93%	−68.06%	−28.08%	−32.02%	−33.92%	[–][d]
2017/2018[a]	−36.62%	−32.46%	−18.53%	−34.44%	−57.96%	−32.89%	−32.50%	−32.18%	−38.51%	−30.26%	−44.25%	[–][d]

[a]2017/2018 season data is preliminary.
[b]The growing area data for the period 1978/1979 to 1985/1986 are sorted differently from the data for the period 1986/1987 to present.
[c]Severe freeze damage to county crop resulted in no reported data for the 1984/1985 and 1985/1986 growing seasons.
[d]No county data was reported after the 2009/2010 growing season.

Table 1. This table shows the percent change (increase or decrease) in all-citrus production relative to the previous growing season for a 40 year period from 1978-79 to 2017-18. The decline is caused by a mix of abiotic (weather-related) and biotic (pests, diseases etc.) factors. Years with decline are shaded in green; decline greater than 13% (deemed impactful) is shaded in yellow; decline greater than 19% (deemed significantly impactful) is shaded in red.

From Impacts To Messaging

Public safety messaging by local NWS meteorologists to protect life and property becomes very important during extreme events. Communication of threats and impacts must take into account what sectors of a community's infrastructure can collapse, and where resiliency might be measured by the subsequent effect on the local economy itself - in other words, how quickly can a community "bounce back" from disaster. It can be difficult for local meteorologists to express these threats in relatable terms that inspires protective action(s) from the public. The NWS Melbourne faced this challenge in 2016 when Hurricane Matthew (Category 4) threatened after an 11-year drought of no major hurricane wind impacts. More so, December 2019 was the 30th anniversary of the 1989 Christmas Freeze - the last major freeze to widely impact the state. More recently, central Florida has been threatened by Hurricanes Irma (2017) and Dorian (2019). The following are examples of how we can use impacts from past events (visual, personal, and factual manners) to enhance future public safety messaging. Additionally, we glance at a series of "real-time" situational awareness social media posts on the 20th Anniversary of the 1998 Central Florida Tornado Outbreak.

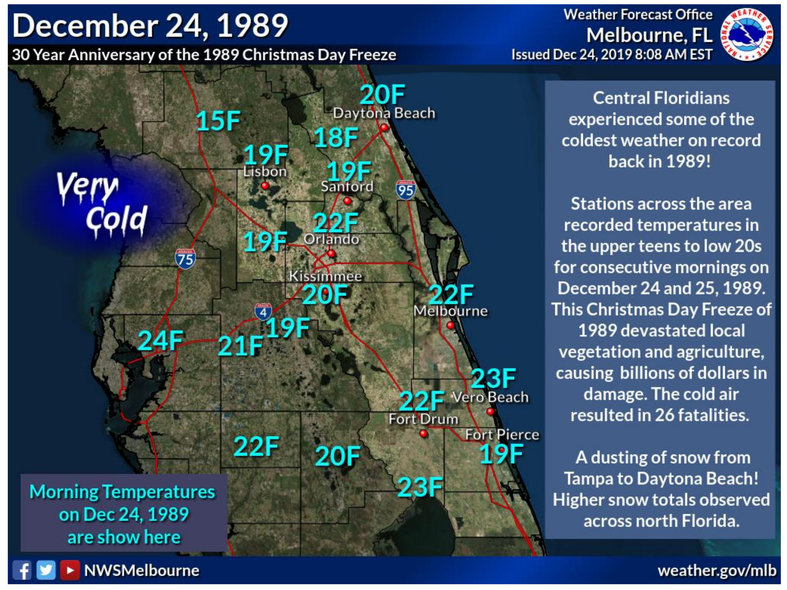
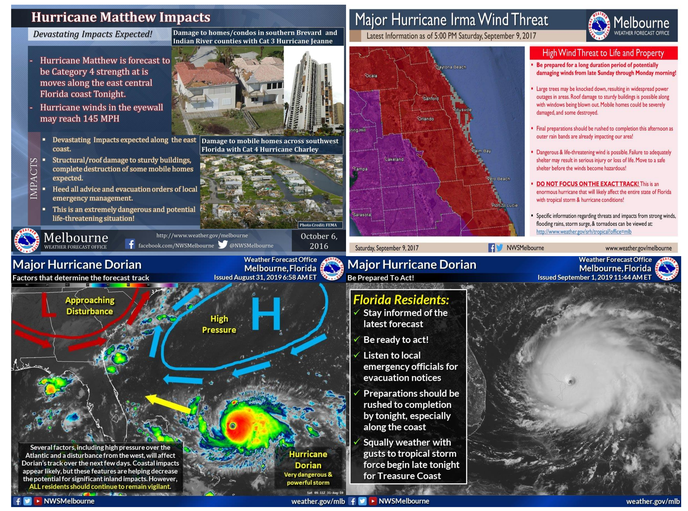


Image 1. NWS Melbourne social media post on 12/24/2019. Created to engage the public who were around 30 years prior, and to share stories and experiences from this historic event. The post garnered over one hundred comments on social media, with many speaking to the impacts experienced – and how something like this has not occurred in the local area since.

Public Recollection of 1989 Christmas Day Freeze

- *"Had fire sprinkler systems/pipes freezing all over the area when the power went out and freezing temps hit hard. A lot of space heater fires all over the central FL area too. Was a rough time on first responders; PD, EMS, FD, power company repair crews were all out taking care of business."* ***– Dennis Marshall, Maitland Fire Rescue.***
- *"We were driving from Stuart to Gainesville. It started snowing halfway through the Ocala National Forest. The bridges were icing over and power lines hung heavy with ice….By the time I arrived the power was out and it was 17 degrees!"* ***– Dianne Boomhower (public)***
- *"I remember the snow flurries that year. (In) Lake Lizzie, the first 10-12" of the edge of the lake had a layer of ice over it."* ***– Grant Collins (public)***
- *"My tropical yard on Merritt Island froze to death!"* ***– Kevin Ghiloni (public)***
- *"We lost more than half of our mango grove to that freeze."* ***– Dawn Crowe (public)***

Images 2-4. In Indian River County (left image, source: Palm Beach Post), impacted groves lost a majority of their fruit after the 2004 Hurricanes (Frances and Jeanne) swept through the area. Growers once again realized the devastating impacts of hurricane-force winds when Hurricane Irma crossed the Citrus Belt in September 2017 (center image, source: Tampa Bay Times). Wintertime freezes can have similar, if not worse, impacts to affected groves. A citrus farmer picks oranges from a frozen grove (right image, source: Orlando Sentinel) a freeze in Lake County and surrounding areas.



Images 5-8. NWS Melbourne public social media posts evolving and improving through the years by leveraging uncertainty and past events to increase public awareness and preparedness actions. Hurricanes Matthew (top left, 2016), Irma (top right, 2017), and Dorian (bottom, 2019).

Images 9-13. NWS Melbourne social media posts on 2/22/2018 for the 20th Anniversary of the February 1998 tornado outbreak that resulted in 41 fatalities and hundreds of injuries. This was a situational awareness campaign that sought to get residents thinking about their own preparedness and life-saving actions in the event of a significant tornado outbreak in central Florida.

References:
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