

“Analysis Suggests Widespread ‘False Spike Gust’ QC Issue in Professional WeatherFlow, Inc. Weather Station Data Causing Exaggerated Wind Gust Maxima.” (1/30/2022)

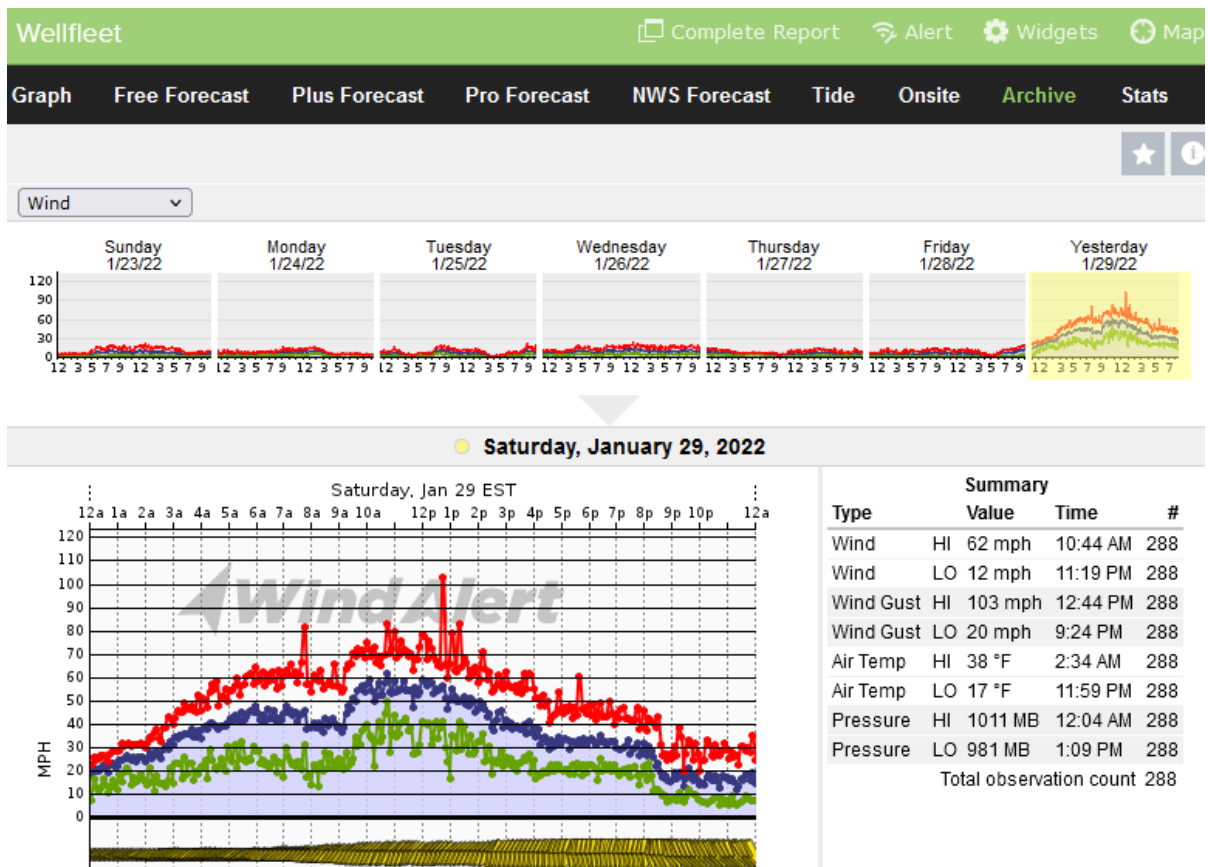
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Abstract

A close examination of recent coastal New England WxFlow station wind gust data undermines the credibility of WxFlow-reported wind gust maxima associated with, e.g., the 10/27/21 and 1/29/22 Nor’easters. This analysis is offered in a spirit of collaboration, transparency, and scientific discipline.

General statement

During high wind events, a software or electrical error in WxFlow weather station data processing has been causing “False Spike Gusts” to contaminate the record of true 5-minutely maximum 3-sec-avg. wind gust speeds as shown evidently in, e.g., the following graph of WxFlow’s Wellfleet weather station during the 1/29/22 Nor’easter, alleging incredibly that a “103mph” gust occurred:

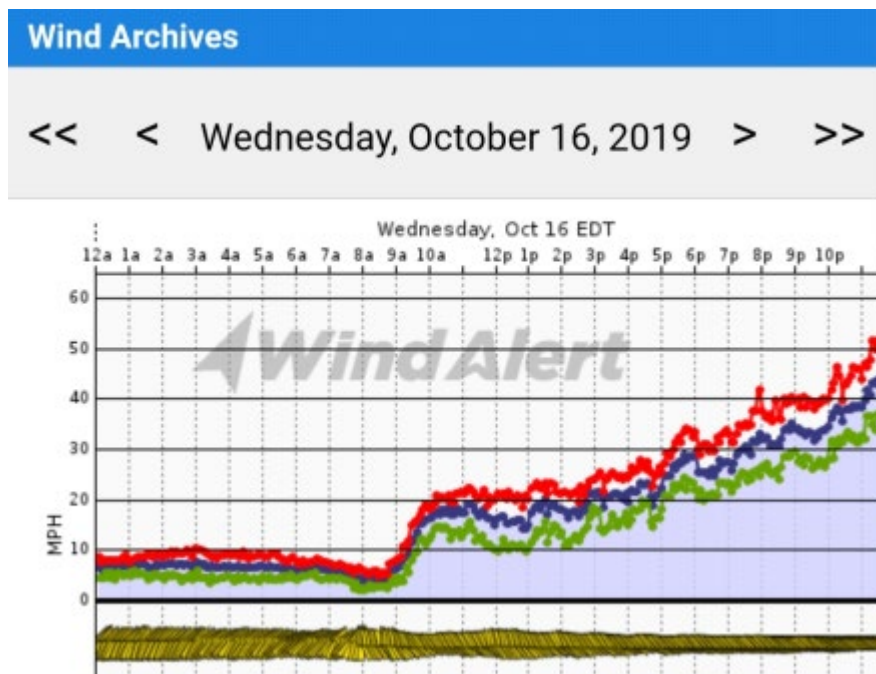


Natural wind speed timeseries data is turbulent and chaotic. WxFlow stations 1) use helicoid propeller RM Young anemometers, 2) use 3-second averaging periods for gust reporting according to WxFlow statements, and 3) are positioned well above ground level, often exceeding the WMO standard 10m height. These three factors favor high laminarity of wind sampling and should combine to reduce variability of sample-to-sample wind gust timeseries values to a small amount, as demonstrated hereinafter. WxFlow’s usage of wide 5-minute reporting intervals further minimizes the expected individual sample-to-sample variation in max 3-second-average wind gust values.

Recent high-wind events have triggered the “False Spike Gust” phenomenon and caused false high-wind readings at WxFlow stations at Scituate, Duxbury, and Wellfleet, MA, *inter alia*. The phenomenon appears associated exclusively with higher wind speeds and often unnoticeable during most days’ timeseries wind datasets from WxFlow stations.

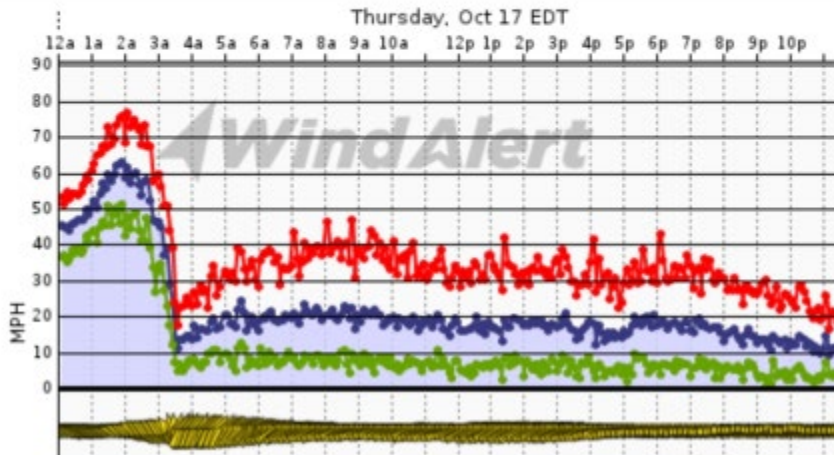
Control dataset: Wellfleet, MA WxFlow Station Data Before the “False Spike Gust” Phenomenon

The following graph of the Wellfleet WxFlow station wind data during the 10/16-17/19 Nor’easter demonstrates clean, correct, credible data in the absence of the new common ‘False Spike Gust’ phenomenon alleged, the difference to which will be palpable in comparison:



Wind Archives

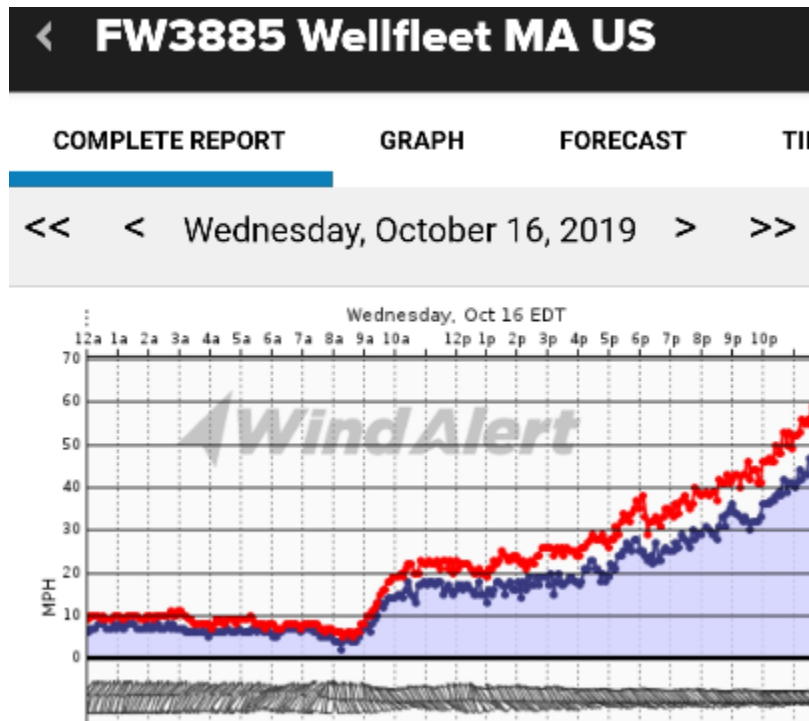
<< < Thursday, October 17, 2019 > >>

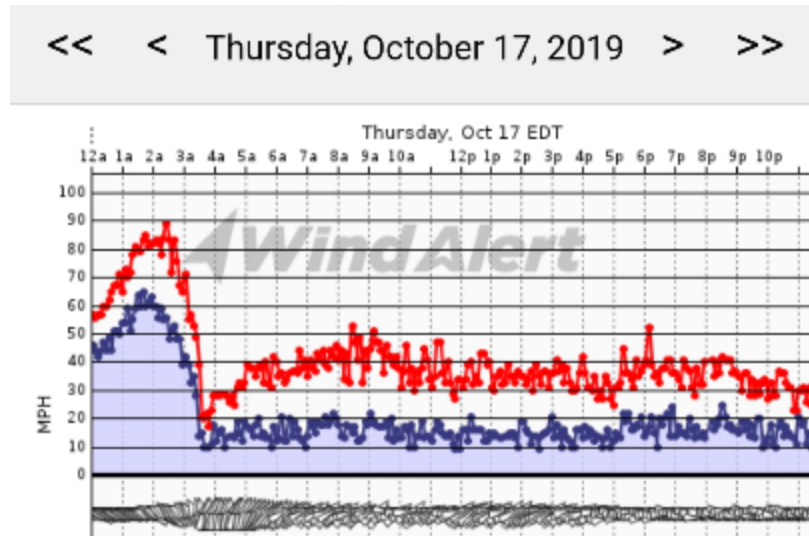


Usefully, MAREPAM station XMRPM1 / Wellfleet is only 1 mile to the north of WxFlow's Wellfleet station pictured above. Both stations are comparable in elevation (MAREPAM 89ft / WxFlow 88ft) and in sensor height (MAREPAM ~12ft / WxFlow 20ft). XMRPM1 also employs, *inter alia*, an identical RM Young 05103 propeller anemometer. The two stations should not therefore radically differ in reported wind data especially during large winter synoptic-scale atmospheric events such as the passage of a Nor'easter. The following map depicts their proximity.



Returning to the October 2019 control dataset (*i.e.*, unaffected by the False Spike Gust phenomenon, for the purpose of comparison to modern corrupt WxFlow data), the expected harmony between the two proximate stations is evident. The WxFlow Wellfleet station peaked at 77mph (3-sec. average). This corresponds perfectly to the MAREPAM station's 89mph instantaneous maximum and to its actual 83mph 1-sec. average max not shown in the CWOP-only data feed display below. In 2019, MAREPAM controllers did not yet directly compute 3-sec. average gusts as they have since 2020. However, the known-measured 10/17/19 MAREPAM Wellfleet 83mph 1-sec. average is amply sufficient to show the correctness of WxFlow's nearby 77mph 3-sec. average, the latter possessing an expectable 6mph difference to the MAREPAM 1-sec. average and a 12mph difference to the MAREPAM instantaneous, well within a normal high gust timescale averaging distribution.



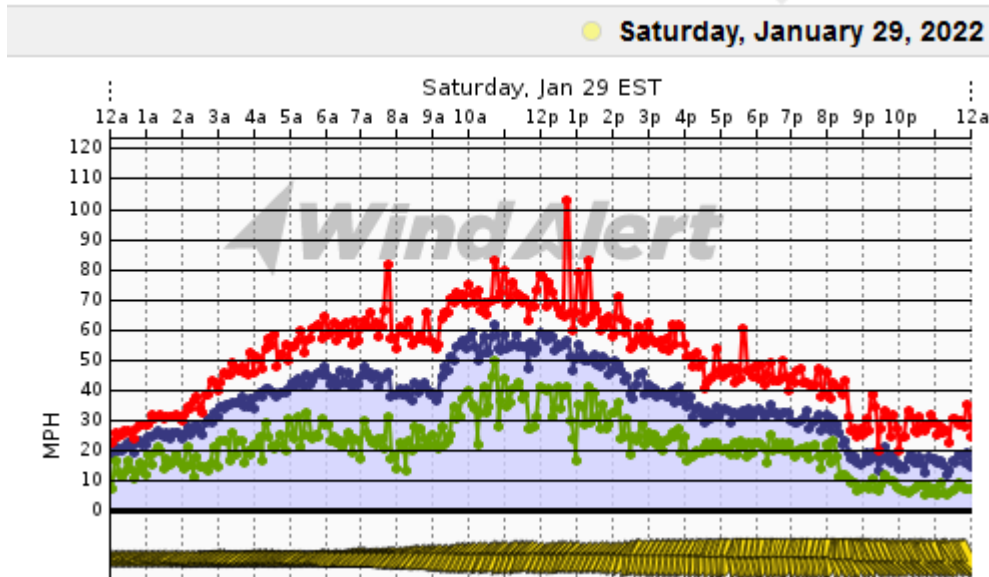


This comparison shows both proximate Wellfleet stations recorded clean, accurate, credible data prior to the onset of the WxFlow “False Spike Gust” phenomenon alleged hereinafter. During the high wind event pictured, there was a natural surge of wind culminating before 0230 10/17/19 EDT but without any majorly aberrant sample-to-sample deviations. Since the display of this MAREPAM station in WxFlow WindAlert’s same app uses the CWOP feed from XMRPM1 (ID FW3885), and since CWOP specifies instantaneous gust maxima, the MAREPAM Wellfleet wind gust graph should represent instantaneous max gust whereas the WxFlow station graph should represent 3-second average gusts as WxFlow alleges they use.

The October 2019 storm control shown data above fits these presuppositions perfectly. But in recent events, the same comparison has yielded a drastically different result.

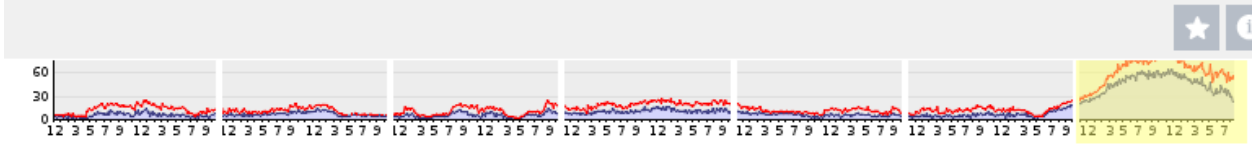
Onset of WeatherFlow False Spike Gust Phenomenon

Although the recentness and nature of onset of the issue is not fully explored, modern WxFlow wind datasets are shown here to be visibly contaminated. The problem is shown hereinafter to exist at multiple WxFlow stations. In fact, all WxFlow stations may be affected. The first exemplum follows (WxFlow Wellfleet daily wind graph for 1/29/22, alleging a “103mph” wind gust):

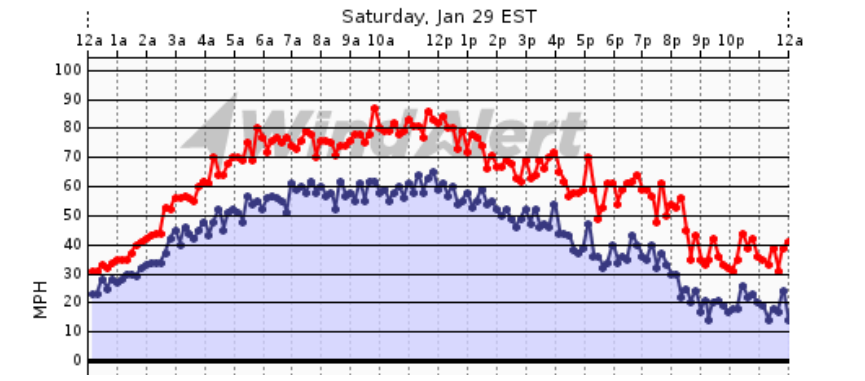


The dataset is visibly contaminated by the False Spike Gust phenomenon because a natural wind speed distribution would yield far more consistent gusts building-up to 103mph and coming down from 103mph if valid. Note the dataset claims the second-highest gust was only ~82mph, a drastic 21mph lesser difference from 103mph. That this disparity strongly suggests the falsity of the 103mph gust spike is evident from review of high-quality MAREPAM wind datasets and even by self-comparison to the same WxFlow station's past performance in, e.g., October 2019 above. In the said 2019 high wind event graphs shown prior, the same WxFlow station did not exhibit any spikes of such magnitude and matched the nearby XMRPM1 MAREPAM dataset perfectly.

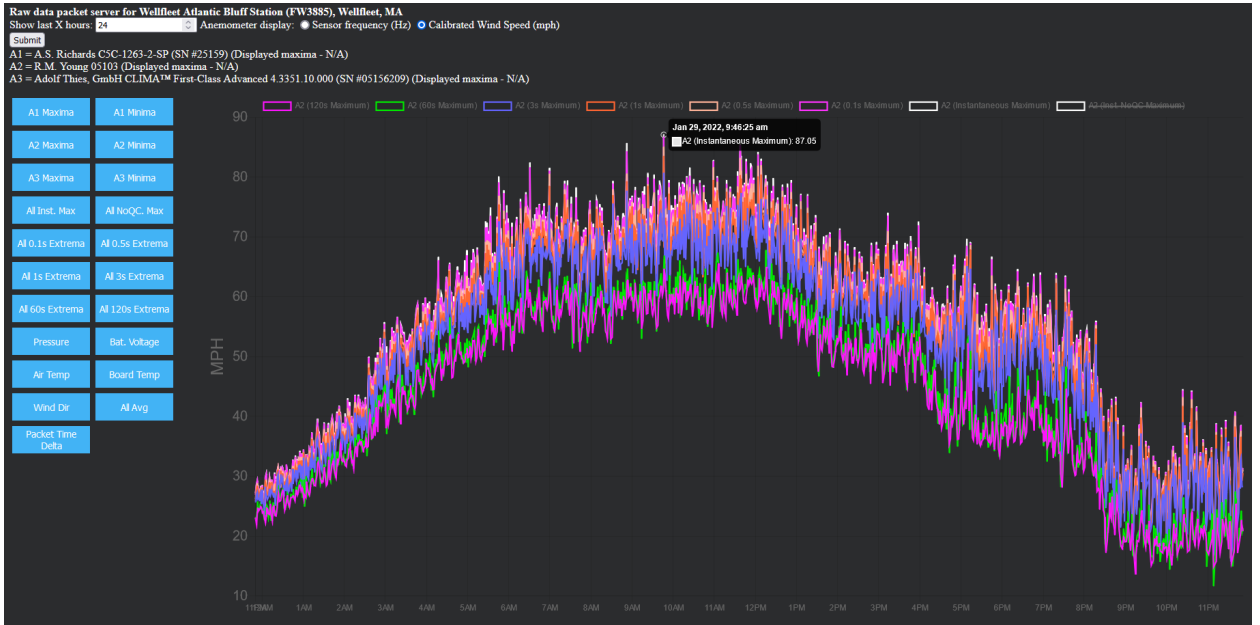
By comparison, the 1/29/22 WxFlow False Spike Gust values are invalidated by comparable *in situ* observations from nearby MAREPAM XMRPM1. The latter's daily wind graph is visualized below in both the same WindAlert app (using CWOP feed, 10-minutely instant maxima) and with native full-resolution MAREPAM display (minutely full timescale gusts from AN2 / RM Young 05103 at XMRPM1):



Saturday, January 29, 2022



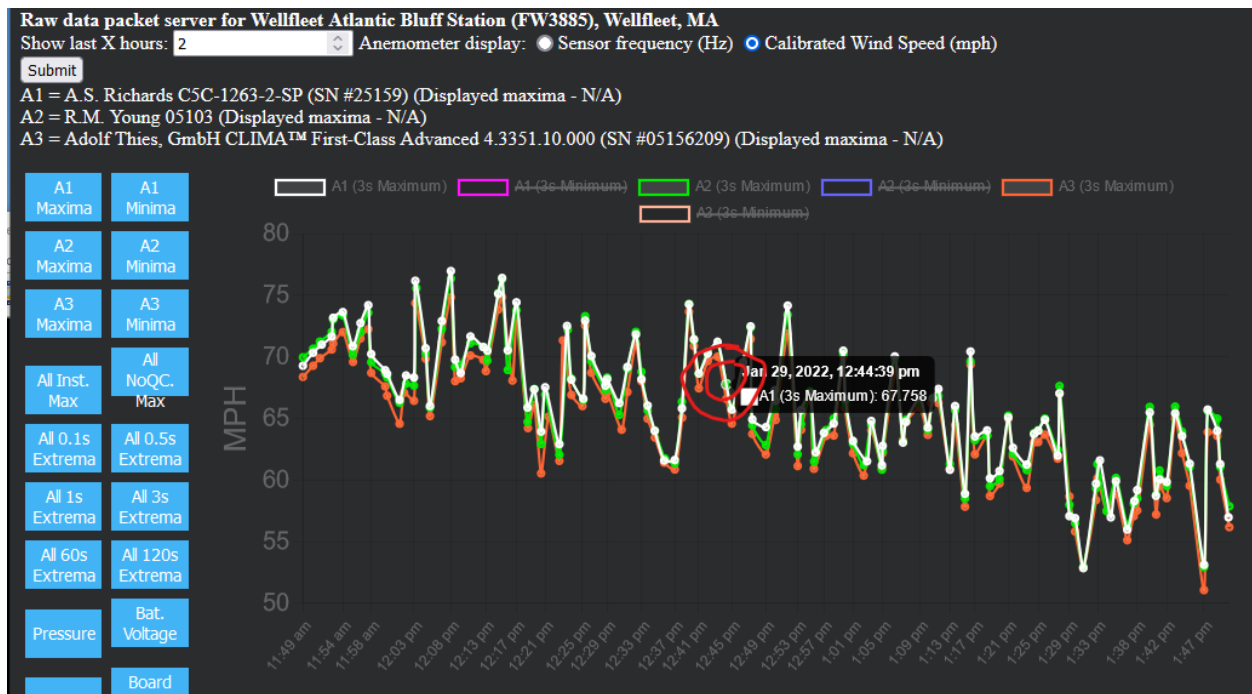
Summary			
Type	Value	Time	#
Wind	HI 65 mph	11:49 AM	144
Wind	LO 14 mph	9:15 PM	144
Wind Gust	HI 87 mph	9:49 AM	144
Wind Gust	LO 31 mph	12:09 AM	144
Air Temp	HI 37 °F	2:09 AM	144
Air Temp	LO 16 °F	11:49 PM	144
Total observation count 144			



This comparison strongly indicates the WxFlow False Spike Gust phenomenon for multiple reasons. The first altogether ignores comparing wind magnitudes. The high-resolution MAREPAM dataset shows there were no special orographic, synoptic, convective, or turbulent atmospheric phenomena in the area by which such remarkably isolated, short spikes of high wind could have been naturally present. By comparison, the wind gust maximum on the RM Young sensor at

MAREPAM Wellfleet station was only very closely greater than its second highest gust maximum, and the same was followed by yet another close third highest gust, etc. *I.e.*, a histogram of the minutely gust values largely obeys a natural Gaussian distribution, whereas the few evident high-frequency harmonic False Spike Gust values in the WxFlow dataset occupy far-removed histogram bins unsupported by close shoulder values.

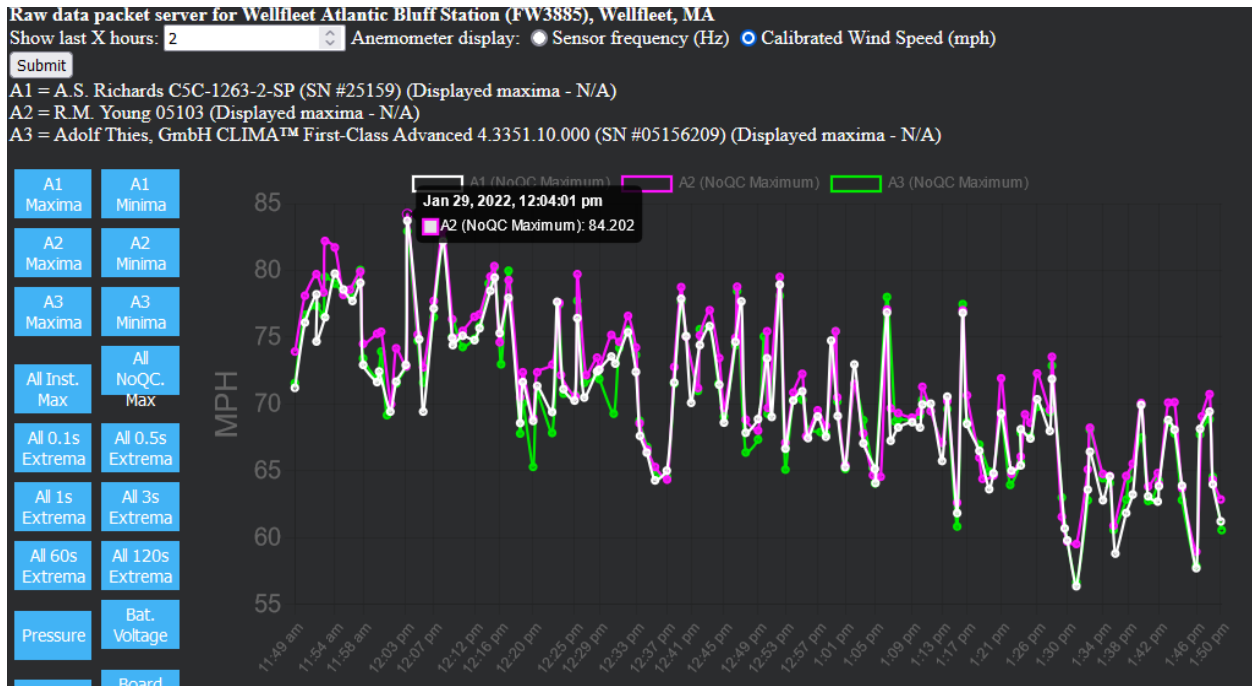
In fact, there was no “blip” of high wind recorded at all, of any magnitude, at 12:44pm EST 1/29/22 at the MAREPAM Wellfleet station 1 mile north of the WxFlow station when the latter allegedly recorded a 103mph 3-second average wind gust. The following graph shows 2 hours of high-resolution, minutely 3-second average gust maxima from each 3 wind sensors at MAREPAM XMRPM1, the middle of which (“AN2”) is an RM Young 05103 identical to that in use at WxFlow’s Wellfleet station:



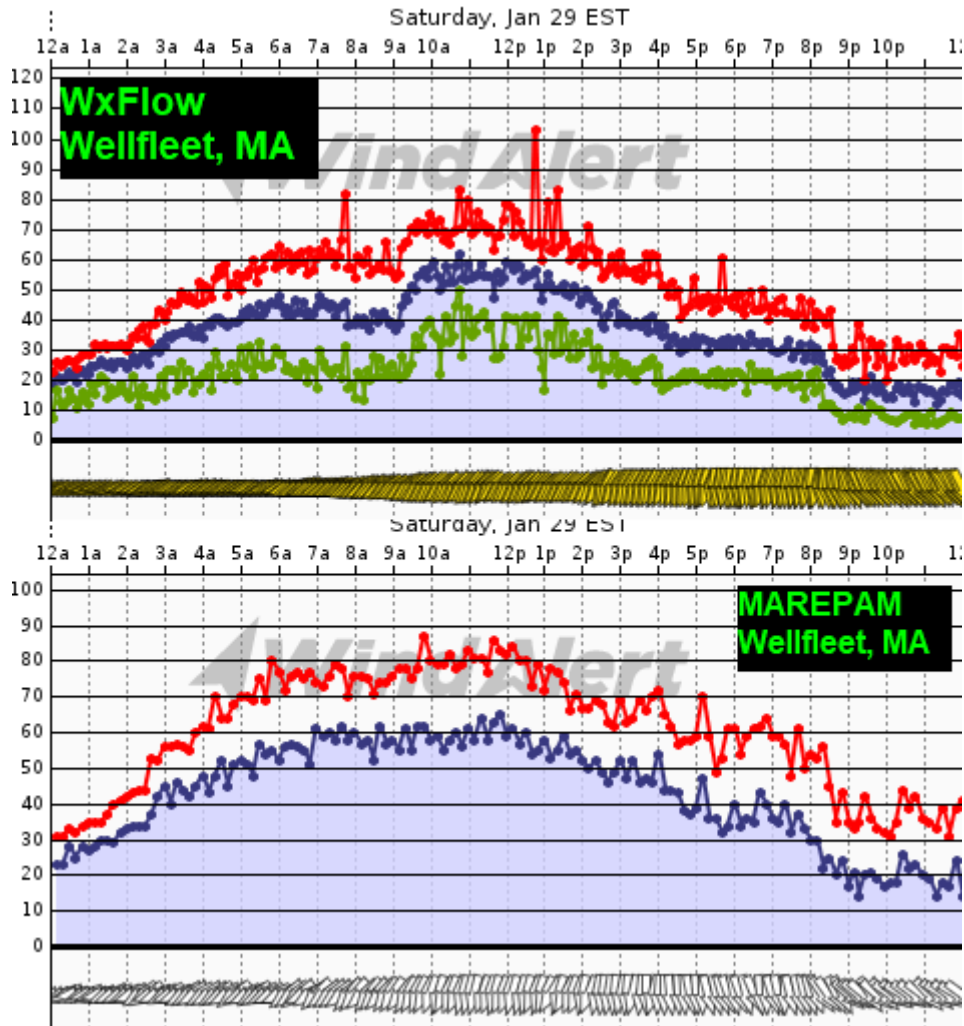
Annotated is the 12:44pm datapoint contemporaneous to WxFlow’s incorrect 103mph reading. As evident, all gusts during this time period remained well within the statistical margins of chaotic/turbulent atmospheric noise, with maximum gusts having very close secondary and tertiary neighbor values. The graph suggests there were no special atmospheric phenomena present whereby an isolated gust far higher than any of its secondary and tertiary predecessors was naturally possible.

Secondly, the absolute wind magnitudes observed discredit WxFlow’s reported max gusts.

The graph above depicts that, in the entire 2-hour period approximately centered around the time of WxFlow's incorrect 103mph reading, the MAREPAM Wellfleet station did not report any 3-second average wind gust speed over 77.0mph (AN1 at 12:08:41pm). Even the instantaneous maximum for this period was only 84.2mph (AN2 at 12:04:01pm), let alone whatever instantaneous maximum gust would have to occur under conditions where a 103mph full-3-second average gust was correctly measured one mere mile away with near-identical equipment and exposure:



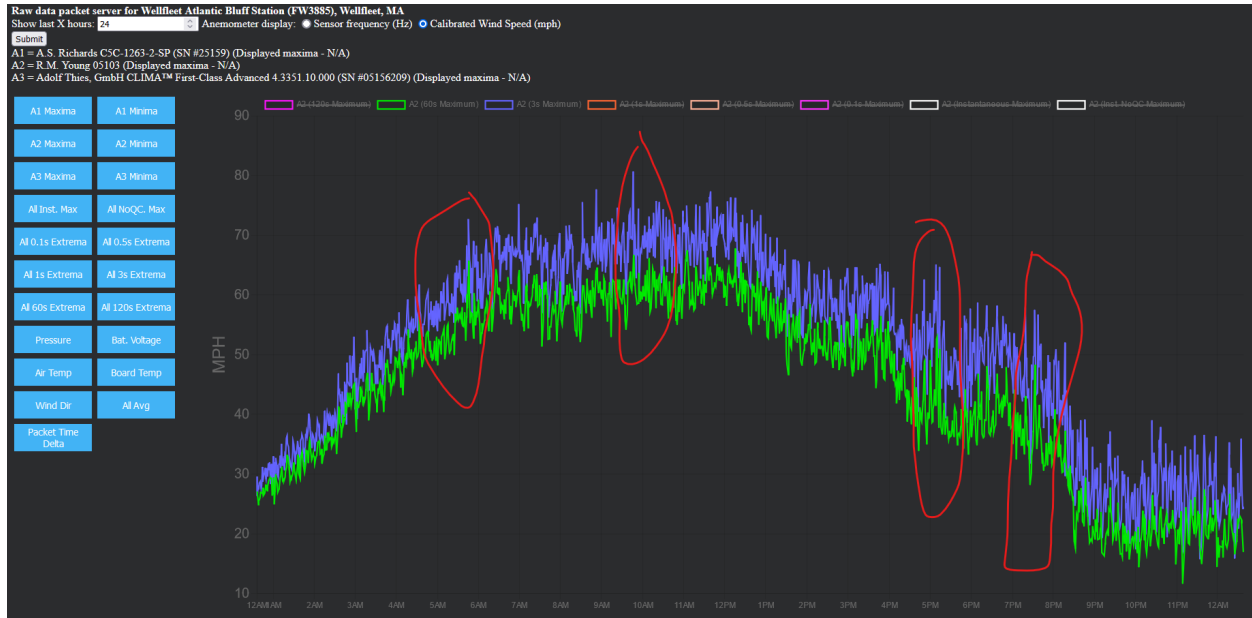
To further the comparison visually, the following cropped graphic depicts WxFlow's Wellfleet station wind data and that of nearby MAREPAM XMRPM1 (CWOP feed, 10-minutely instantaneous max) over 1/29/22:



WxFlow False Spike Gusts Unsupported by Corresponding High Sustained Values

Another revelatory datum is the implausible attenuation or altogether lack of higher sustained wind values corresponding to the putative False Spike Gusts within the same 5-min reporting interval. The alleged 103mph 3-second average gust at 12:44pm was not occasioned by the highest sustained wind of the day reported from WxFlow's Wellfleet, MA station (62mph at 10:44am; see blue line in windalert.com display graph versus red line). The contaminated WxFlow dataset alleges, even though the maximum sustained wind of the day of 62mph was accompanied by an ~82mph maximum 3-sec. average gust in the same 5-minutely period, that the sustained wind accompanying the alleged 103mph gust was less than 60mph. This requires an unnatural and physically unlikely deviation in gust factor which does not correspond to 1) the viscosity of air, 2) historical data from this same station before the onset of the False Spike Gust phenomenon, and 3)

comparative contemporaneous *in situ* data from the nearby MAREPAM Wellfleet station as shown above. The following graph of max minutely 1-min sustained average vs. max minutely 3-sec. average gusts from the identical RM Young 05103 sensor at MAREPAM Wellfleet on 1/29/22 is illustrative:

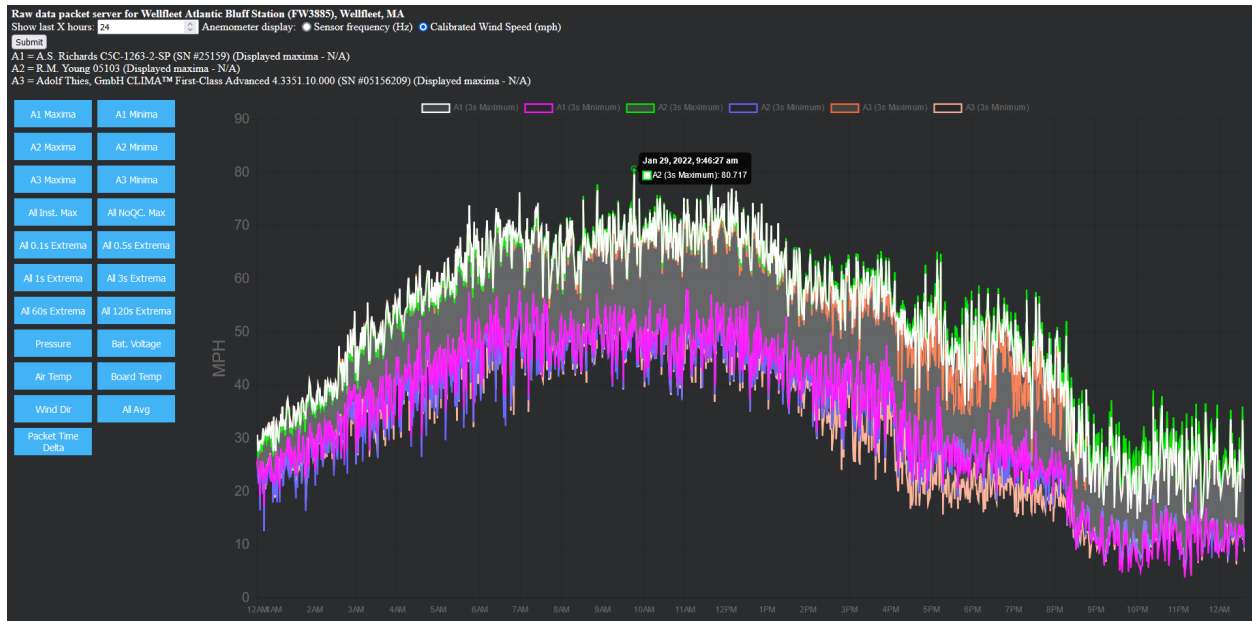


The red-circled areas are exempla of minor, validly measured, naturally occurring “spikes” in wind speed far less in statistical deviation than WxFlow’s alleged data corruption. They demonstrate in every annotated instance the corresponding increase in 1-min sustained wind to their high 3-sec. average gust maxima (see green line jump in relative proportionality with blue line, suggesting a largely stable gust factor throughout the event).

The graph above radically contradicts WxFlow’s corrupt timeseries wind gust dataset which, by comparison, does not show a stable gust factor in the datapoints believed to constitute False Spike Gusts from electrical/sampling issues as opposed to valid natural aeolian phenomena.

Furthermore, the graph above discredits WxFlow’s reported 103mph Wellfleet gust by comparison of absolute sustained wind values. The maximum 60-sec. average sustained wind recorded on 1/29/22 at MAREPAM Wellfleet on the identical RM Young 05103 anemometer was 67.8mph at 12:15:30pm EST, compared to 62mph at 10:44am EST at the WxFlow Wellfleet. That is, the MAREPAM Wellfleet sustained maximum was in fact slightly higher than WxFlow’s (68mph vs 62mph), indicating, if anything, that the MAREPAM station is somewhat better exposed to wind of the two stations. This would favor an expectation that the MAREPAM station record higher maximum 3-second average gust values in general than the nearby WxFlow

station. WxFlow’s incorrect 103mph daily max wind gust upends this reasonable expectation, when compared to the corresponding daily 3-sec. average max gust at MAREPAM Wellfleet of 80.7mph at 9:46:37am on an identical RM Young sensor:

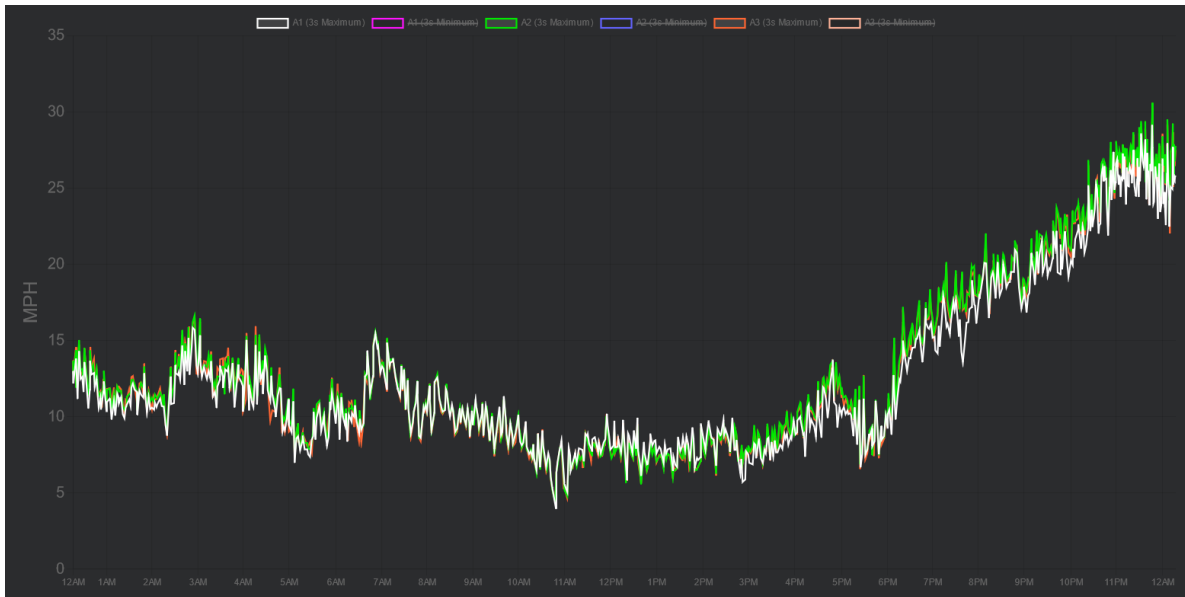
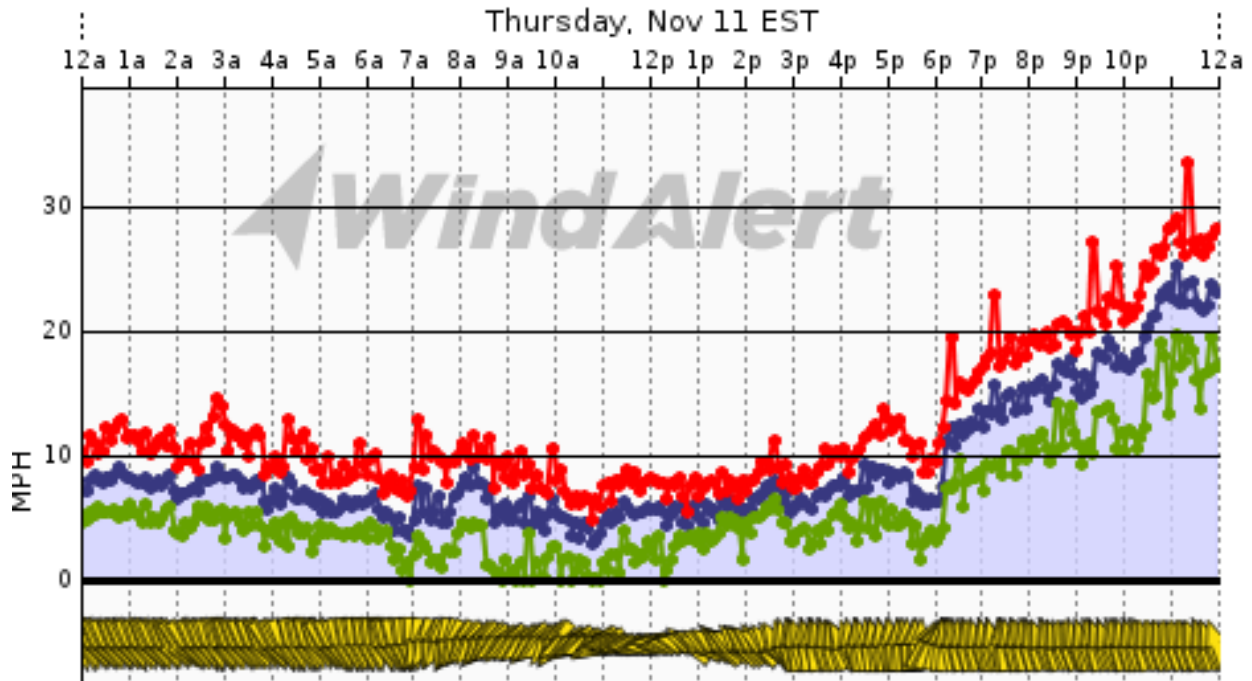


To conclude this last point, if a 103mph 3-sec. average maximum wind gust were validly recorded at WxFlow Wellfleet when another station 1 mile distant only recorded an analogous 80.7mph 3-sec. average maximum wind gust with identical hardware and exposure, then the maximum sustained wind at the latter location would also likewise be far lower, and not 9.4% higher, than that recorded at the 103mph-measuring station. Since the putative False Spike Gust phenomenon affects only WxFlow reported wind gust and not wind speed values (the former being far more susceptible to data quality issues), this comparison underscores the unlikelihood of an alternative explanation besides the WxFlow wind gust data quality issue alleged.

False Spike Gusts Reported 11/11/21 at WxFlow Wellfleet, MA

The following two graphs compare WxFlow Wellfleet 11/11/21 wind timeseries data to MAREPAM Wellfleet 3-sec. average max minutely timeseries gust data for 11/11/21:

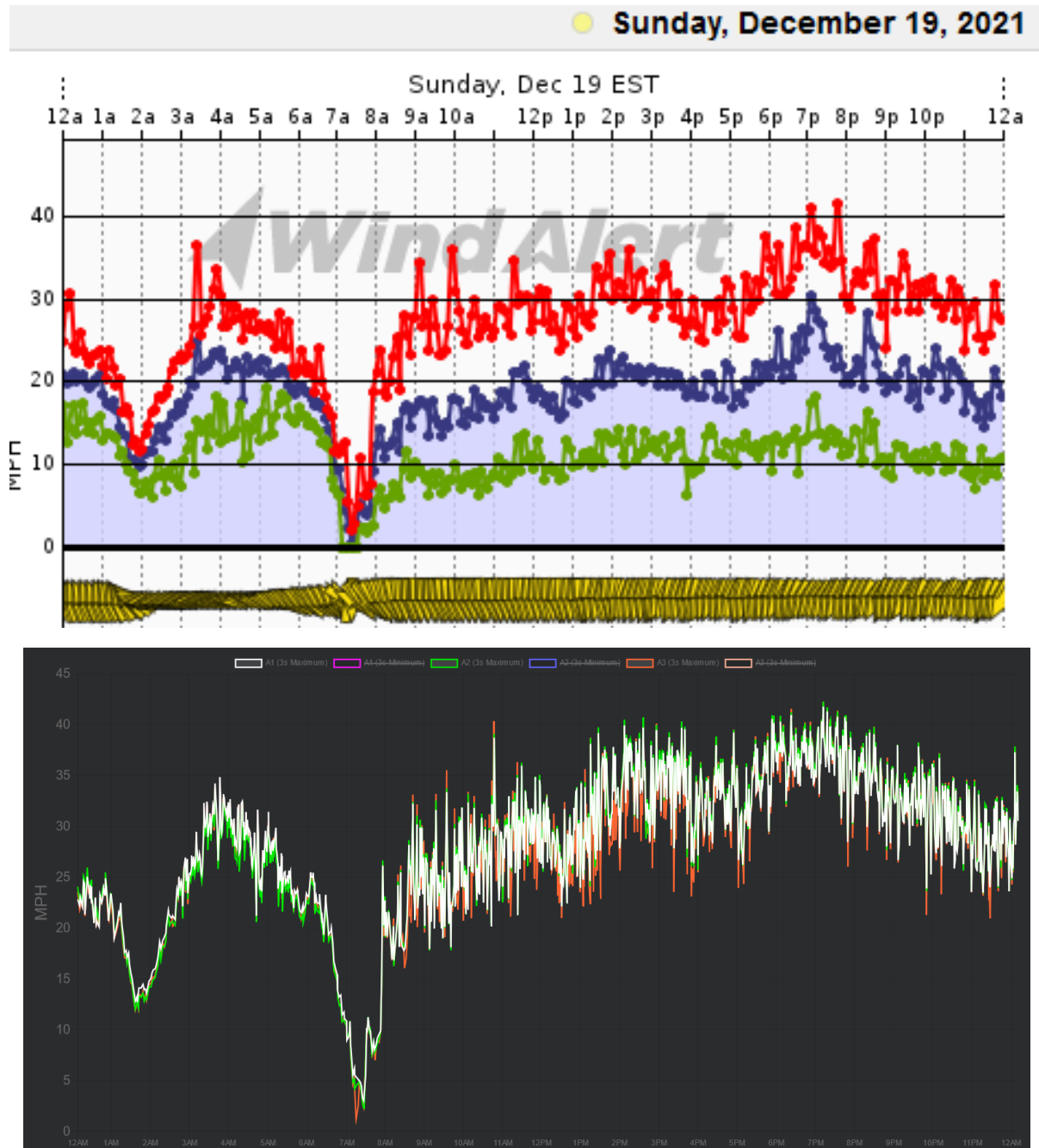
Thursday, November 11, 2021



Four occurrences of the WxFlow False Spike Gust phenomenon stand-out in clear disparity here to the comparative 3-sec. average minutely wind gust timeseries data from all three separate anemometers at MAREPAM Wellfleet on the evening of 11/11/21, each sensor introducing greater opportunity for aerodynamic turbulence and raw chance to produce unusual departures, none of which was observed to nearly the degree suggested by WxFlow's presumed-erroneous gust maxima.

False Spike Gust Reported 12/19/21 at WxFlow Wellfleet, MA

The following two graphs compare WxFlow Wellfleet 12/9/21 wind timeseries data to MAREPAM Wellfleet 3-sec. average max minutely timeseries gust data for 12/19/21:

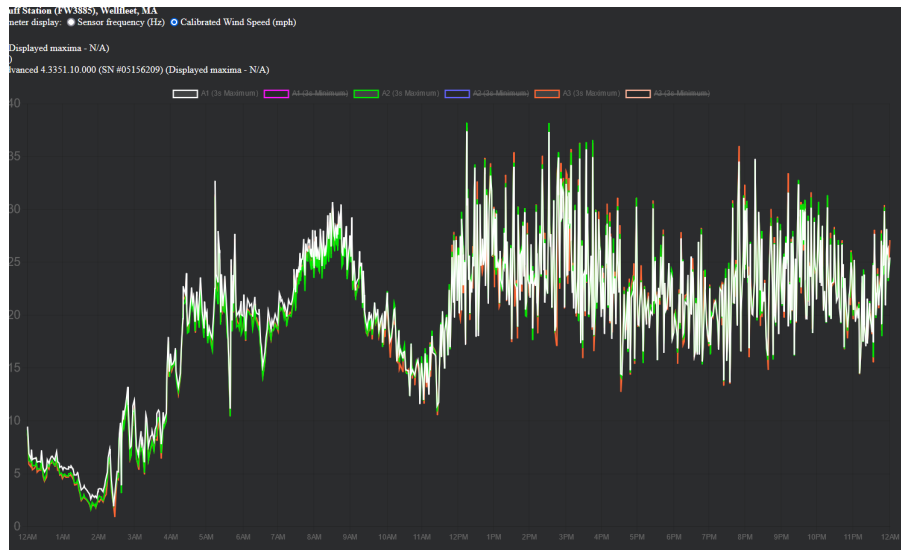
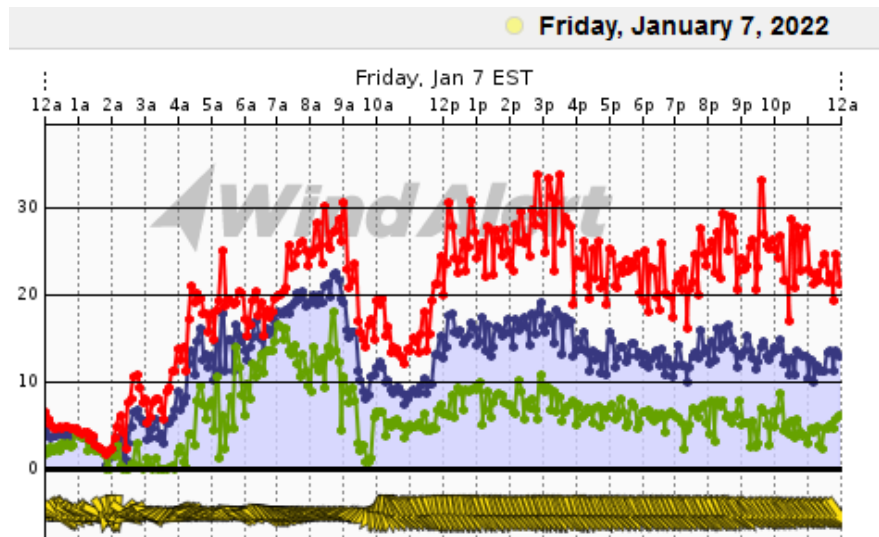


The highest pre-7am WxFlow wind gust in this dataset is strongly indicated as a False Spike Gust phenomenon, as the same exact synoptic wind trend appears in

both stations near identically, and yet the WxFlow timeseries dataset uniquely introduces a vastly disparate spike in wind gust at one single datapoint after 3am. This occurrence is unique across the many datapoints from the 2am lull to the 4am peak, all other ones of which obeyed gradual sample-to-sample deltas. The 2am-4am climb as represented in the corresponding MAREPAM 3-sec. average graph does not contain any gusts remotely comparable to the level of statistical deviation necessitated by the erroneous WxFlow value.

Noise Phenomenon Underlying False Spike Gusts Visible During Low Winds on 1/7/22 at WxFlow Wellfleet, MA

The following two graphs compare WxFlow Wellfleet 1/7/22 wind timeseries data to MAREPAM Wellfleet 3-sec. average max minutely timeseries gust data for 1/7/22:

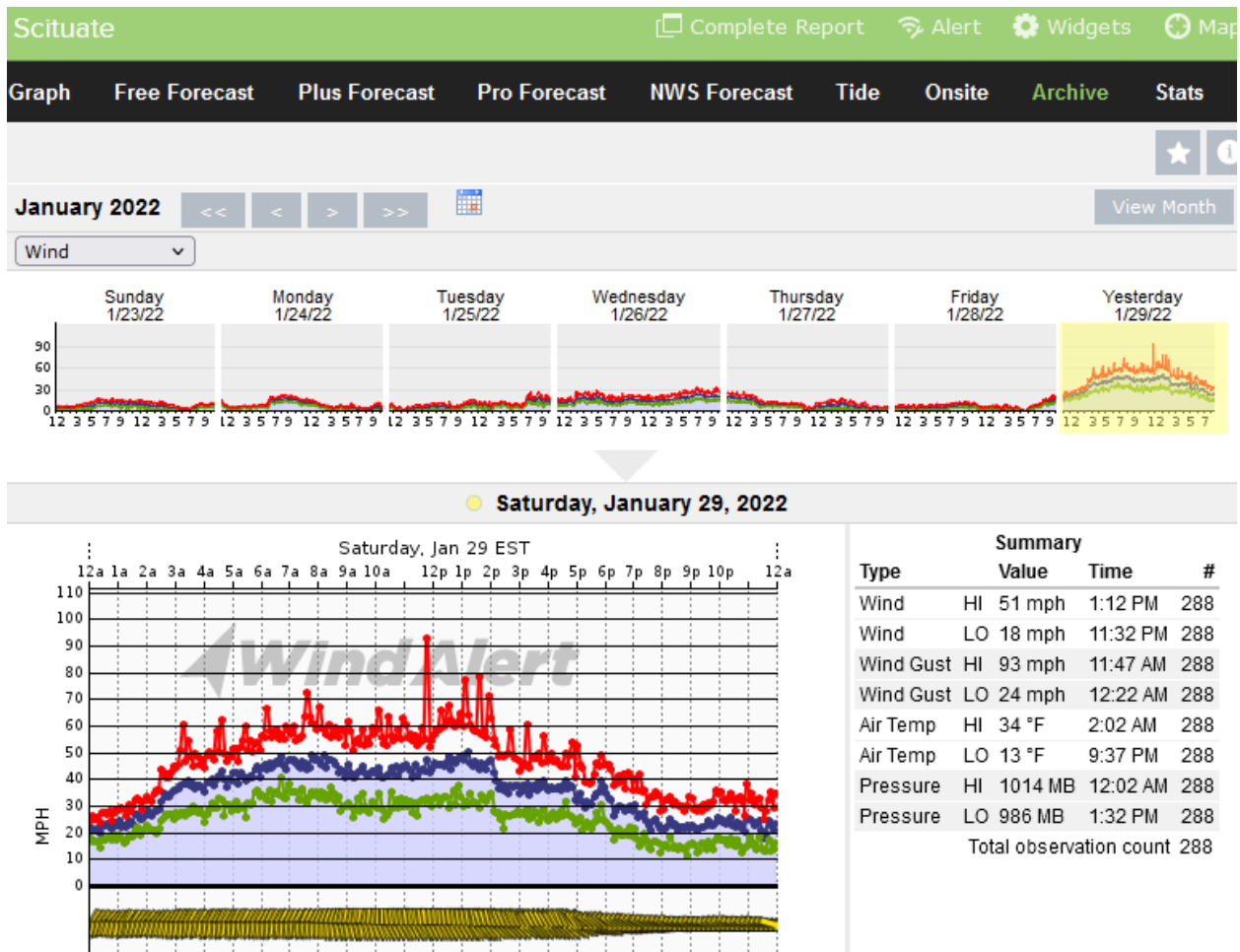


This unique low-wind speed comparison (where the False Spike Gust issue is less pronounced) involves a true, natural, minor gust spike at 5:15am to 32mph in the MAREPAM 3-sec. avg gust data surrounded by highly laminar wind until noon, when the wind rapidly increased in turbulence and remained turbulent the rest of the day.

The WxFlow dataset does not discriminate between any of these varying conditions of turbulence. Rather, a sort of “white noise” is uniformly cast across the 5-minute observations throughout the entire day. The comparative 1/7/22 WxFlow Wellfleet data appears to reveal a built-in, invalid, unnatural “randomness” or exogenous noise on the gust data which is not a result of natural wind speed, which becomes exacerbated only at high speeds but which easily “passes” visual inspection during lower wind days such as pictured. The WxFlow graph does not display variance between high-laminarity, low-turbulence conditions before 12pm and vice versa after 12pm, as was in fact the natural occurrence. Further, the one valid spike in wind speed around 5am is of imperceptible uniqueness in the over-noised WxFlow timeseries dataset.

False Spike Gusts Caused an Incorrect 93mph Wind Report on 1/29/22 at WxFlow Scituate, MA

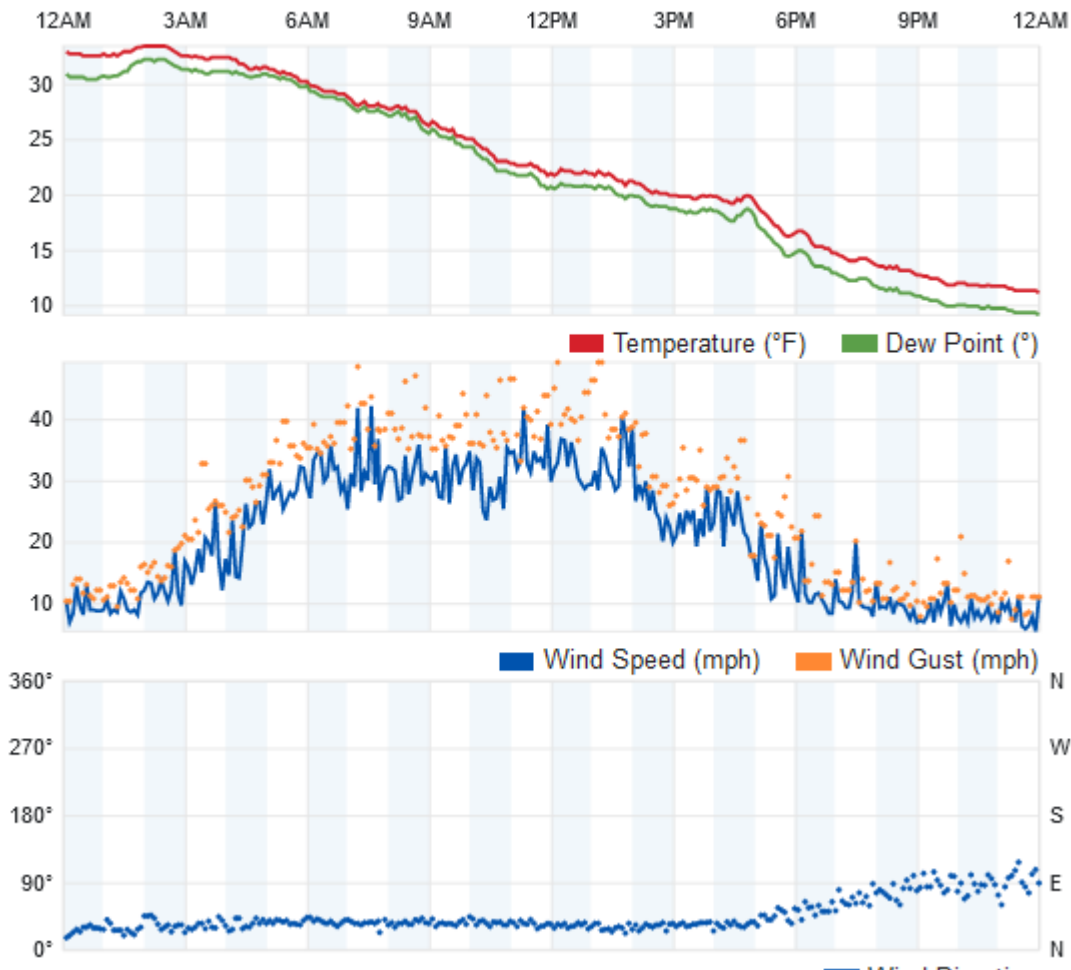
As claimed, the WxFlow’s False Spike Gust data corruption issue is not confined to WxFlow’s Wellfleet station but is widespread. A particularly salient instance is noted at WxFlow Scituate, MA in the 1/29/22 Nor’easter. The following figure indicates WxFlow Scituate wind history and tabular data from 1/29/22:



The unnatural, implausible False Spike Gust phenomenon is palpable here for similar reasons to those expounded above in the context of WxFlow's Wellfleet station. Note the 93mph 11:47am alleged gust fails to carry the support of even the most exiguous corresponding increase in sustained wind speed for that particular 5-minute observation period. In fact, it is not even occasioned by the daily maximum sustained wind at all, indicated rather as having transpired 1.5 hours later during an alleged gust only to ~78mph.

Readings from a nearby PWS (KMA SCITU74) – with less exposure and therefore with higher expected terrain-induced turbulence – indicate there were highly stable gust factors throughout the event:

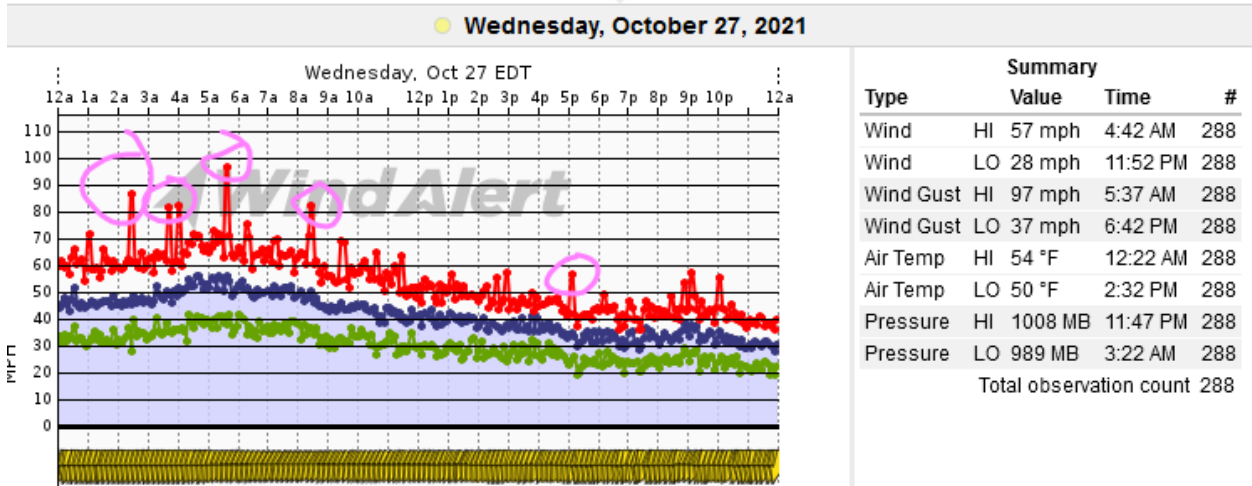
January 29, 2022



This reference station's top gust of approximately 49mph in fact reoccurred 3 separate times and is amply supported by neighboring secondary and tertiary gust maxima over 40mph and 45mph. Whereas, by comparison, the false 93mph Scituate, MA WxFlow report does not claim even one single neighboring secondary gust from the same day over ~79mph around ~1:45pm EST, and even this appears a likely False Spike Gust.

False Spike Gusts Caused an Incorrect 97mph Wind Report on 10/27/21 at WxFlow Scituate, MA

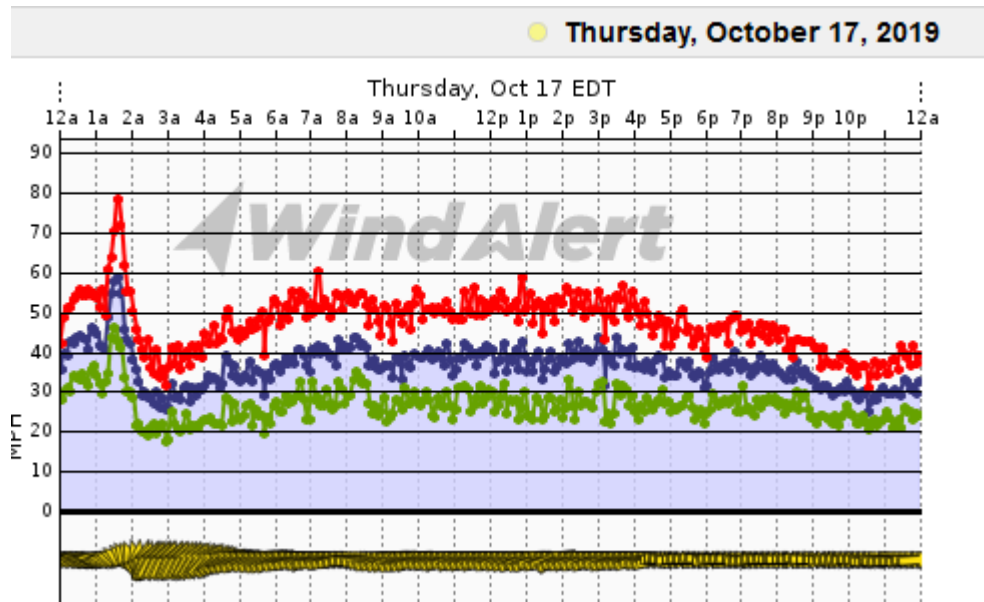
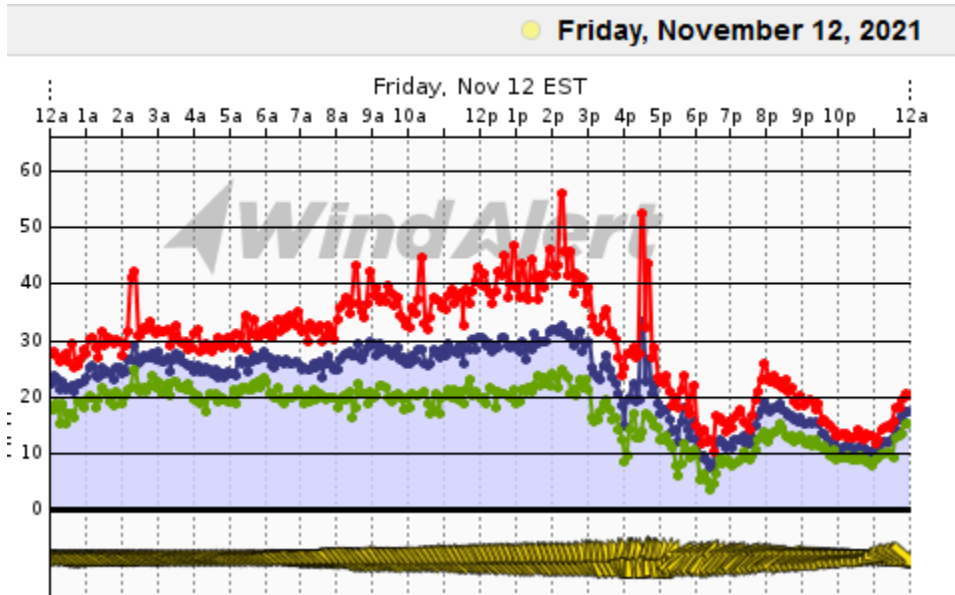
The following figure indicates WxFlow Scituate wind history and tabular data from 10/27/21:



In light of the foregoing, the 6 pink-circled alleged wind gust maxima are strongly suggested as spurious manifestations of the False Spike Gust phenomenon. By reference, MAREPAM XMRPM1 / Wellfleet, MA recorded only a maximum 3-sec. average of 90.9mph during this 10/27/21 event at 87ft ground elevation in exposed outer Cape Cod. Even absent the False Spike Gust phenomenon shown, it would strain credulity to assert the 4ft AGL Scituate, MA WxFlow weather station would record a 97mph 3-sec. average maximum wind gust when MAREPAM Wellfleet only recorded a 91mph 3-sec. average maximum at far greater elevation and exposure.

False Spike Gust Phenomenon Detected at WeatherFlow Woods Hole Passage Light Station in 2021

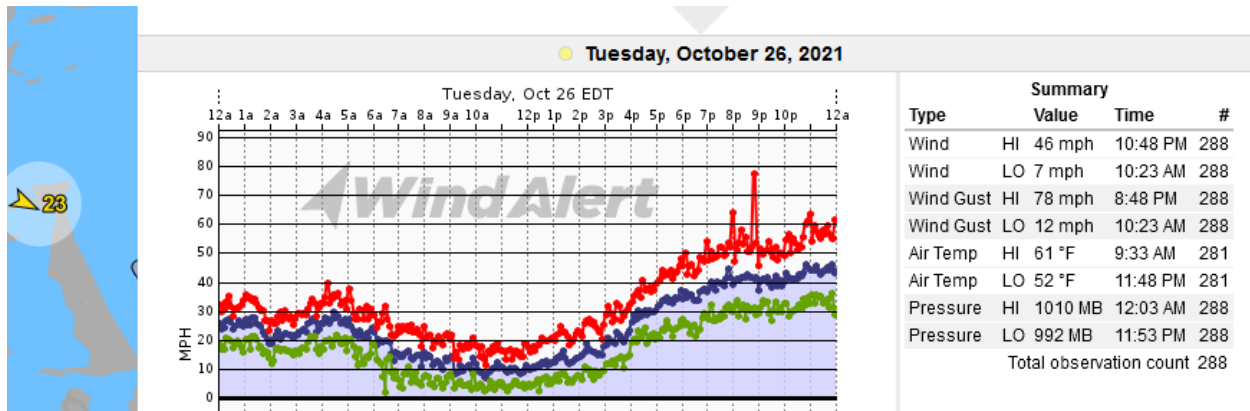
The following two graphs compare high-wind-event wind data during the control October 2019 event and 11/12/21 at Woods Hole Passage Light WxFlow station:



This comparison is instructive because it shows WxFlow data processing electronics/firmware correctly reporting a true, valid, natural wind spike phenomenon the early morning of 10/17/19, before the issue, in contrast to the chronic aberrant noise and False Spike Gust phenomena occurring in the modern day. Note the multiple supporting neighbor high wind observations surrounding the 10/17/19 maximum gust to 79mph. These characterize the progression of natural wind gust maxima but are absent in the timeseries data of modern manifestations of the False Spike Gust phenomena.

False Spike Gusts Caused an Incorrect 78mph Wind Report on 10/26/21 at Hull Yacht Club WxFlow / Hull, MA

The following figure indicates WxFlow Hull YC wind history and tabular data from 10/26/21:



The alleged 78mph gust at 8:48pm is suggested as a False Spike Gust occurrence, having not one single supporting supra-65mph secondary maximum in +/- >3 hours of occurrence.

Conclusion

Recent wind gust timeseries data from WeatherFlow, Inc. Professional weather stations appears affected by significant quality-control and data sampling issues. These seem to introduce random, occasionally harmonic noise on various data samples during high wind events. The magnitude of the postulated False Spike Gust phenomenon appears to scale with wind speed. The magnitude is perfectly misfortunate, insignificant enough to avoid previous widespread detection or skepticism, yet significant enough to impose an intolerable distortion upon the historical record of wind gust maxima from New England coastal storm events if not isolated.