

Severe wind event – Hamilton Parish, 6 April 2011

Background and operational impacts

On Wednesday 6 April 2011, a vigorous cold front approached the Bermuda area from the west, bringing the threat of heavy rain with thunderstorms, gales with gusts to storm force, low cloud ceilings and poor visibility. A Gale Warning and a Thunderstorm Advisory were posted during previous forecasts, and were valid for the morning period. The synoptic chart from 1200 UTC (9:00 AM local time) that day, displayed in Figure 1, indicates that the front was very close to the island, and that shower activity had already begun at LF Wade International Airport

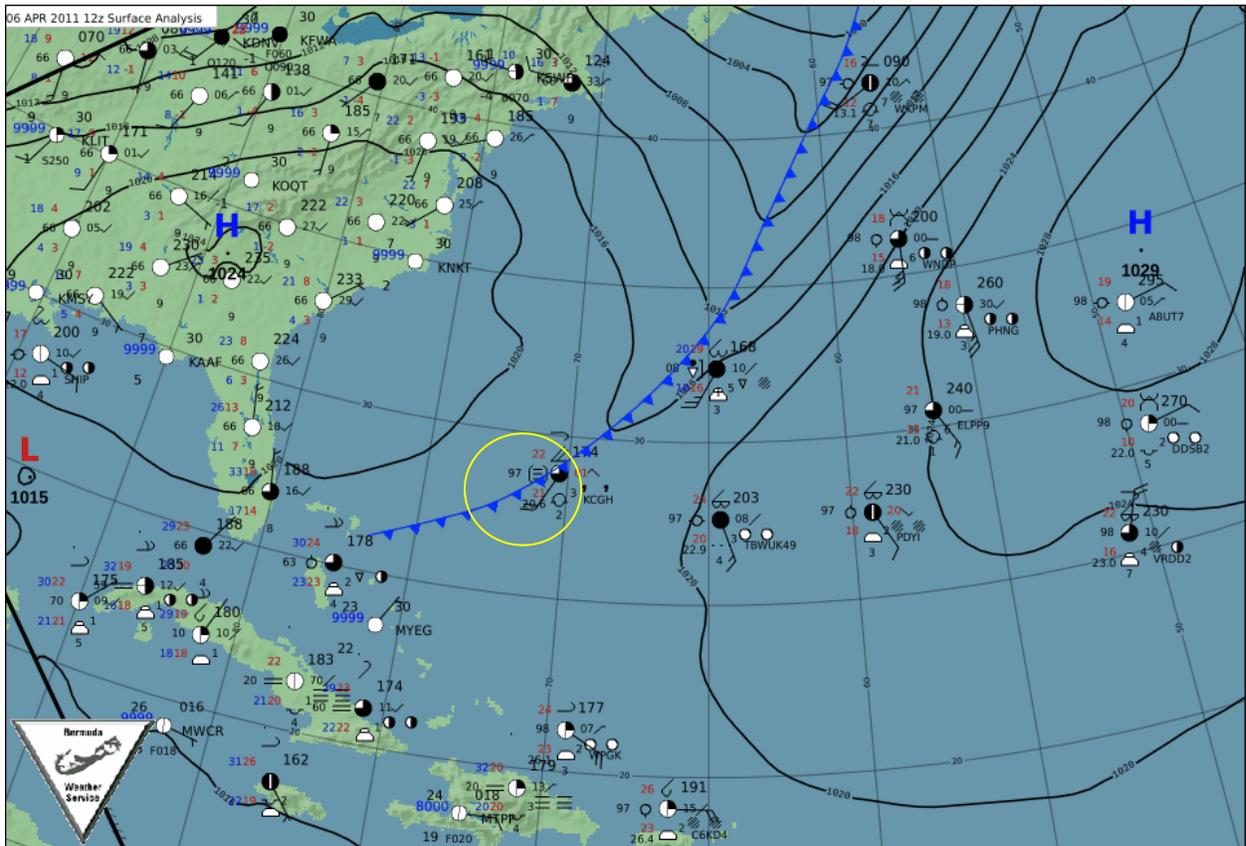


Figure 1: Local Synoptic Chart produced by the Bermuda Weather Service, valid at 12:00 UTC (9:00 AM Atlantic Daylight Time, ADT), Wednesday 6 April 2011. The observation at LF Wade International Airport, Bermuda is indicated by the yellow circle.

Radar imagery and data (Figure 2) indicated thunderstorm signatures, with various warnings indicating rotation, heavy rainfall and severe gusts. The first indications evident on radar of severe weather signatures in the Bermuda Marine Area were shortly before 9:00AM local time. The Duty forecaster, in consultation with the Director and Systems & Database Administrator, issued a Severe Weather Warning at approximately 9:15AM

(although through a technical oversight, it was mislabeled with the wrong time of 11:30AM; a correction was posted at 10:00AM, stating the correct issue time of 10:00AM). A Severe Weather Warning is issued when the potential for severe conditions have been identified on radar (usually associated with thunderstorm cells), or have been observed. Severe weather is defined as any of the following phenomena are likely to affect Bermuda or the local Marine area: Hail $\frac{3}{4}$ inch or more, Tornadoes, Wind gusts in excess of 50 knots associated with a Severe Thunderstorm, or Squalls >15 knots in excess of the mean speed .

Shortly before 10:00AM local time, evidence of rotation was displayed on a thunderstorms cell approaching the island from the southwest (see Fig.2d).

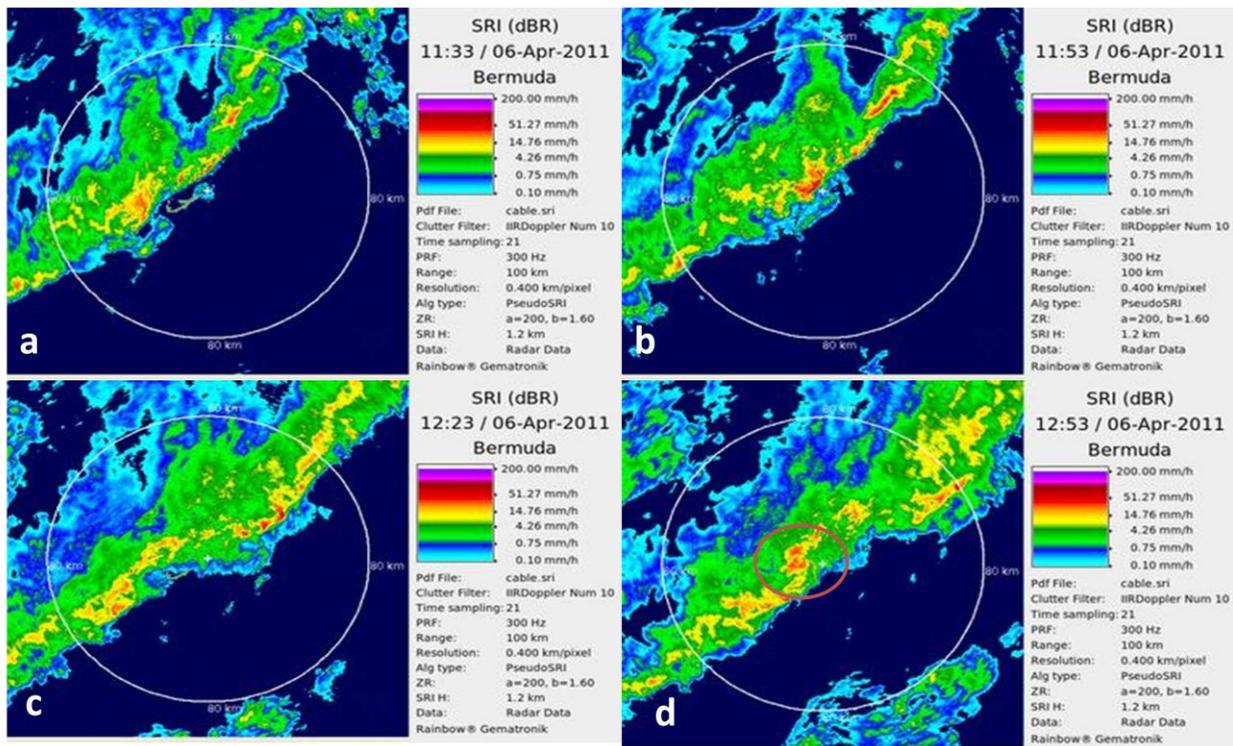


Figure 2: Surface Rainfall Intensity imagery product derived from Doppler Radar data. The red circle on panel ‘d’ indicates the cell just southwest of the island which spawned damaging winds. Times on the top left of each image are in UTC (3 hours ahead of local time, ADT).

After a series of potentially severe thunderstorm cells had passed the island and moved out of the Marine Area, the Severe Weather Warning was downgraded to a Severe Weather Watch concurrent with the 11:30am Public and Marine Forecasts, to cover the possibility of re-development of damaging conditions within Bermuda waters.

Wind data collected at 7 sites around the Bermuda is displayed in Figure 3 below:

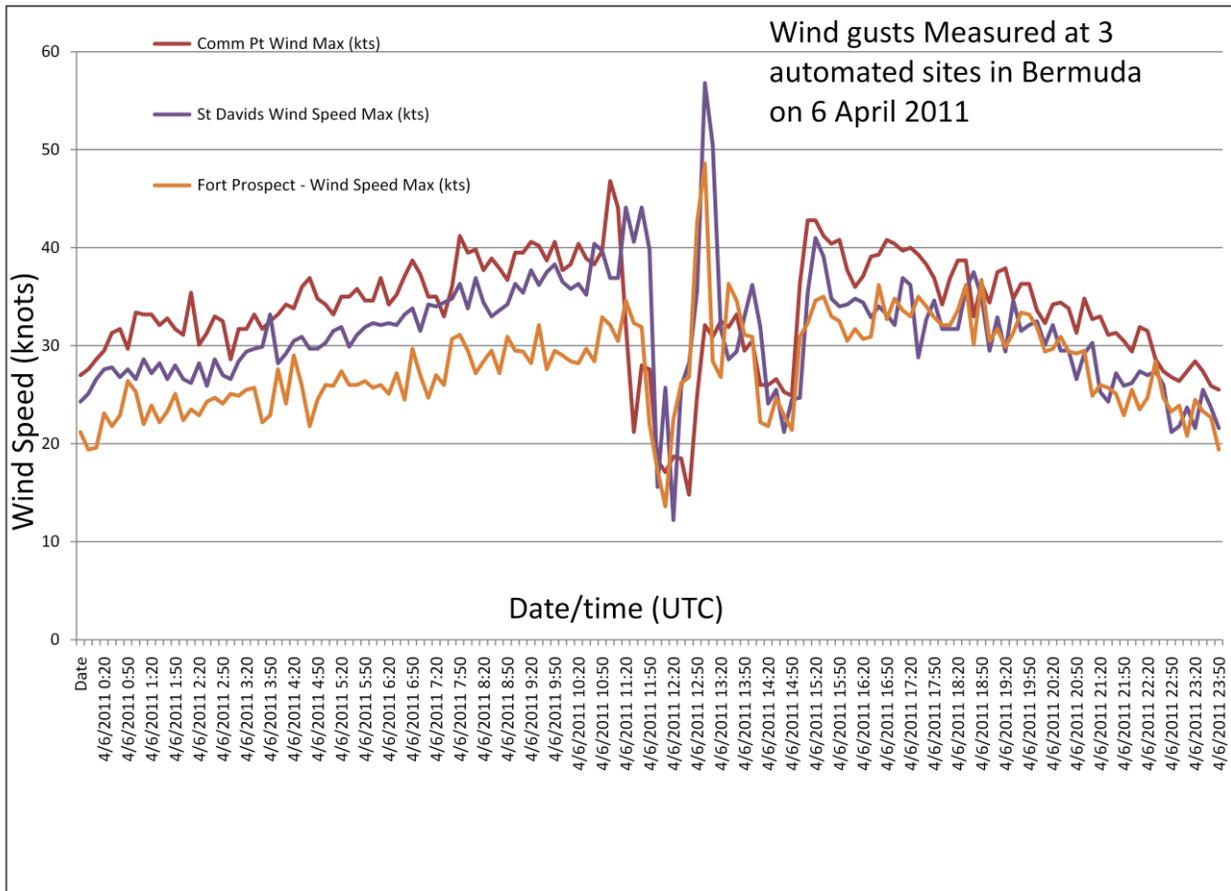


Figure 3: Wind gust data from 3 automated weather observing sites around the island – Commissioner’s Point Dockyard, Fort Prospect and St. David’s.

During the course of the afternoon, reports via the press and members of the public came in to BWS of damage which had been sustained as the result of a suspected tornado in the Radnor Road area of Hamilton Parish. Damage surveys were conducted late that afternoon and the following morning, in an effort to assess the scale and type of impact, with a view to ascertaining the nature of the phenomenon. The next section of this report focuses on the damage caused in Smith’s parish.

Damage Survey

This portion of the report is not intended to be a full damage assessment, nor is it intended to inform any decision making regarding insurance, construction or any action to be taken as a result of this specific event. The survey is by no means exhaustive, and is for the purposes of determining the type of phenomenon

experienced from the effects felt by residents and their properties. However, we hope that it will augment any material which may be for those purposes, and inform any decision-making process with regards to mitigation of similar future impacts.

Discussion with local residents, and a first-hand view of the scene, enhanced by photographs and witness accounts portrayed in the media resulted in the following map of damage and the path of damaging winds.

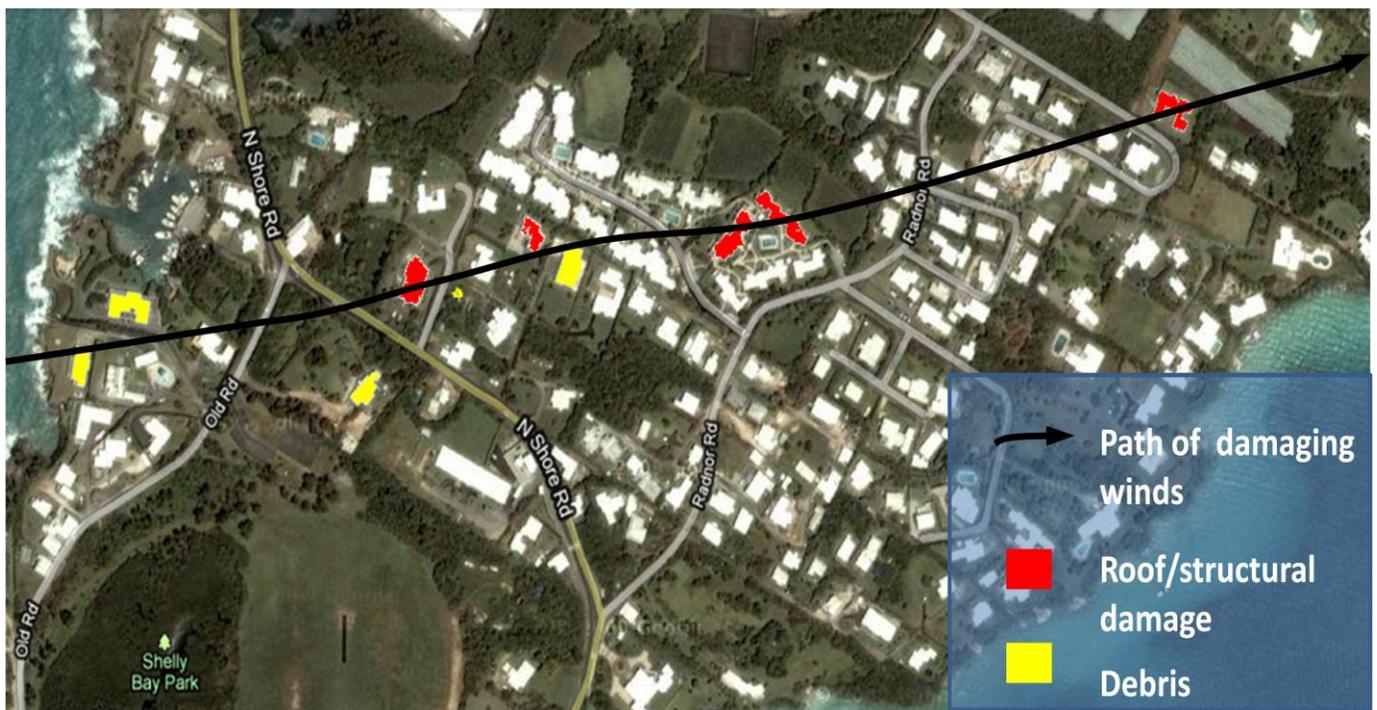


Figure 4: Estimated path of damaging winds, with reference to structural damage and debris-only sites.

It should be noted that the several properties in between those affected saw no damage at all. Often, reports of a ‘sudden change in pressure’ were given by residents. In addition, at least one eyewitness account referred to a rather a sudden increase of wind and debris being ‘whipped up’ – no reference to rotation or a funnel was made. Almost all the accounts refer to a loud noise, like a ‘freight train’ or a ‘plane coming in to land’. Some representative photos of damage and debris follow in Figure 5.



Figure 5: damage and debris in the Radnor Road area of Hamilton Parish.

It should be noted that in addition to these reports, there was an unconfirmed report of damage at one property on the north shore of Pembroke Parish, in which a west-facing window had been damaged, and the top hinge had been “ripped off the wall”.

Conclusions

The damage survey, and an examination of the available data have led us to the following conclusions:

A wide swath of damage was not evident through the area, but at least three individual properties sustained roof damage. The scale of the damage-causing phenomenon was sufficiently small that neighboring properties (within 10 metres in some cases) were seemingly unaffected. The damage to roofs was most likely cause by very sudden small-scale fluctuations in pressure, associated with the passage of a squall on the order of hurricane force. This conclusion is based upon the background flow, which was measured as gale force at various automated sites around the island, with gusts of 55 knots in some locations. If we are to assume that there was a significant difference in the very localized phenomenon and the background flow (reasonable, considering the damage was not widespread), then we are looking at gusts approaching, if not exceeding that of hurricane wind speed (64 knots or greater). It is of note that Bermuda recently experienced sustained hurricane force winds during Hurricane Igor, in September 2010, and similar damage was not recorded following that event.

The phenomenon moved on a trajectory from west-southwest towards the east-northeast, along the front itself. This is consistent with the overall pattern of movement of the frontal system through the Bermuda area, and the winds directions ahead of it – see Figure 6 schematic.

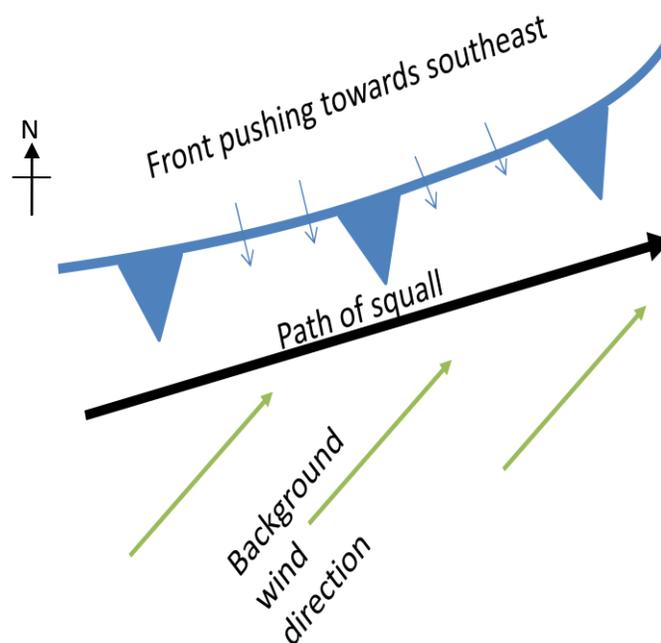


Figure 6: Schematic representation of squall path

The peak winds associated with the phenomenon only lasted on the order of 10 to 30 seconds at each impact site, so even if a tornado was evident, it was a) very weak and b) very small and c) short-lived.

Rainfall was reported both within, and after the event, generally inconsistent with a tornadic pattern, which is *usually* in the rain-free portion of a supercell thunderstorm.

No clearly-defined rotating supercell thunderstorm was evident on radar, nor was there a hook echo (both clear indicators of tornadic activity). The spin which was evident on the radar was not tight enough, and may have been a thunderstorm cell attempting to spin up, not quite attaining the rotation sufficient to spawn a tornado.

The small scale and individual nature of the damage indicates that the phenomenon was not a coherent structure at ground level, rather a feature which either moved in a vertical wave pattern (upwards then downwards along its path), or a shallow feature which was 'struggling' to develop, being disrupted by individual houses as it traversed the neighborhood. We have seen this pattern in recent years, most notably from an event in Sandys Parish in November 2005.

Our conclusion is that this was not a tornado, more of a very short-lived, shallow and narrow squall. However, it should be strongly noted that the classification of such events is only really an academic paper exercise, which may be of use for meteorological analysis– the really important aspect is that the squall caused damage, and similar types of events have caused damage in the past (and likely will again). The useful conclusion for us is that in Bermuda, you don't need to have a tornado to have damaging impacts. So, for our operational procedures, the issuing of Severe Weather Warnings is definitely warranted for similar events, even though they may not conform to what we meteorologists (by convention) call a tornado.

Acknowledgements

Credit for this work goes to Meteorologist Rob Giglio and Systems & Database Administrator Meteorologist Ian Currie for conducting the damage survey along with the Author. In addition, many thanks to the several residents named (and un-named) here, who took the time to talk to us even in the face of cleaning up their properties and fixing damage. In all instances, the residents were helpful and friendly – many thanks to Kelly and David Barbosa, Jimmy and Carole DeCouto, Penny Hill, Gerald Huntin, Jodi Rudo, Jucal Trott and Richard Zuill. Thanks to RCC Bermuda for their assistance.