**A Proposed Methodology for Estimating Wind Damage to Residential Slab-Only Claims Resulting from a Hurricane Impacting the Texas Coastline**

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MARINE
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Report Provided to The Texas Windstorm Insurance Association (TWIA)
Austin, Texas

This report reviews recommendations made by an Expert Panel assembled by the Texas Department of Insurance to advise the Texas Windstorm Insurance Association (TWIA) regarding the evaluation of tropical cyclone wind vs. flooding losses related to "slab" or "slab-only" claims. Such claims come from property owners who have entirely lost their homes, as the forces of tropical cyclones thoroughly destroy residential superstructures.

I am of the opinion that the motivation, approach and results of this study are sound, and that this document should be approved for publication after the following minor corrections are made. My review includes feedback on scientific principles, corrections made to the terminology related to storm surge and storm tide, several suggestions of how to improve the project, as well as the identification of syntax, grammatical and citation errors.

SUGGESTED CORRECTIONS/ IMPROVEMENTS:

3-2
Change "the Gulf Coast of the U.S." to "the U.S. Gulf Coast"

Change to "claim data itself has variability, especially if they are represented as the aggregate of the loss and do not represent component-level damage." (Data are plural)

4-4 and 4-5
Comment: This is a clear description of the various wind models and why the Panel concluded that an observational model would be best. Well done.

4-6
Change Sticknet to StickNet

4-7
This reviewer deployed a mobile anemometer in the path of Hurricane Gustav in Louisiana in 2008 and did field work during Hurricane Ike. After those experiences, I realized that mobile instruments need to be deployed ideally 18 or more hours before landfall (24 would be better), and given forecast errors, it is difficult to pinpoint the eyewall location at the time of deployment.

(Anecdotally, the outer bands of Gustav came through area near Houma, LA, around 7PM on Sunday night. These bands knocked down a massive oak tree into Hwy 90 between Houma and Morgan City. Our team was driving on Hwy 90 around 8PM and nearly crashed into the tree. We were driving down there around 11 hours before landfall. Also, during Hurricane Ike, the forerunner storm surge inundated many roads/ evacuation routes around 18 hours before landfall).

Therefore, it may not be possible to deploy mobile wind platforms at 3-5 mile increments within the eyewall region, because that region may not be known 24 hours before landfall.

Perhaps it would be better to form a specific plan to place mobile platforms at 5-mile intervals within 50 miles of the forecast landfall location at 24 hours before landfall, and 10-mile intervals outside that region. This would require approximately 20 mobile platforms in that 100-mile region (within 50 miles of projected landfall location). The remaining 20-40 platforms could be located > 50 miles from projected landfall location (forecast 24 hours before landfall), or in that second layer of platforms about 20 miles inland.

4-7
Excellent point about the preference for mobile, rather than fixed, wind platforms. That said, large surges capable of reducing buildings to slab-only sites will often destroy instruments like those set up in Figure 4-3.

While the mobile platforms are a good and necessary idea, another thought is to utilize fixed platforms that are already in place to elevate electrical equipment or other utilities. For example, cell phone towers and other utilities along the coast have elevated platforms on which anemometers and mobile tide gauges may be fixed. Other fixed infrastructure include small or medium bridges that are elevated above surge levels, but not so high to increase wind speeds much above surface winds.

USGS often fastens mobile tide gauges to bridges, overpasses, etc. before hurricane landfalls, so it may be possible to do something similar or even work with them.

Another option for data recording is a form of visual remote sensing from elevated structures like hotels and parking garages. Would it be possible to install cameras in such locations to take photos of housing clusters at regular intervals and wirelessly send these photos to a base station or a cell phone? If not, perhaps such devices could be fit with long-life battery packs and just store the pictures on the device. Even one picture every 15 minutes for the life of the storm could provide critical information.

Examples of fortified facilities near housing clusters in coastal Texas are:

1. Large, elevated school on the Bolivar Peninsula, near housing clusters
2. Several elevated hotels on the east end of Galveston Island that are adjacent to new subdivisions. These structures are outside the protective seawall. One camera in a room of the hotel could provide visual evidence for this entire neighborhood, which contains dozens of elevated homes.

Such visual data from elevated locations are not in danger of being washed away, as are mobile tide gauge or anemometer platforms. It may be advisable to the Panel to form a contract with trained storm observers/ storm chasers who have experience documenting such events and can take scientific observations. Such contracts should surely include disclaimers.

This video from Hurricane Ivan in Pensacola, Florida, shot by Mike Theiss, provides an example of this valuable work. Link: https://www.youtube.com/watch?v=o_uzqfhwc4k

At around 2:40 in the video, Mike uses a high-power spotlight to provide visual evidence of the height of storm surge, from a parking garage at night. A few select observations that capture the water height at specific times could clear up much confusion about damage inflicted by water vs. wind.

Such professionals who have done this type of work are:

1) Mike Theiss, creator of UltimateChase
2) Josh Morgerman, creator of iCyclone
3) Hal Needham, creator of SURGEDAT storm surge database, based in Galveston, TX.

5-1
Paragraph 2 states, "Storm surge only changes on relatively slow scales," and Paragraph 3 states, "Surge elevations and currents will change slowly over the course of the storm." These are absolute statements that are not always accurate. While storm surges are often characterized as a dome of water that moves much slower than a tsunami, in some cases tropical cyclone-generated surges have been recorded to move in very rapidly.

The storm surge from Super Typhoon Haiyan in the Philippines in November, 2013, was documented to move in much like a tsunami (Needham et al. 2015; Weber 2014).

While the physical geography of the Philippines often produces such rapid water-level rises, rapid rises have also been recorded in coastal Texas. Isaac Cline, Chief Meteorologist in Galveston at the time of the 1900 Hurricane, stated, "The water rose at a steady rate from 3 p.m. until about 7:30 p.m. when there was a sudden rise of about four feet in as many seconds," and, "…the sudden rise of 4 feet brought it above my waist before I could change my position." (Cline 1900).

This is clear evidence of a very rapid water level rise from a Texas storm surge.

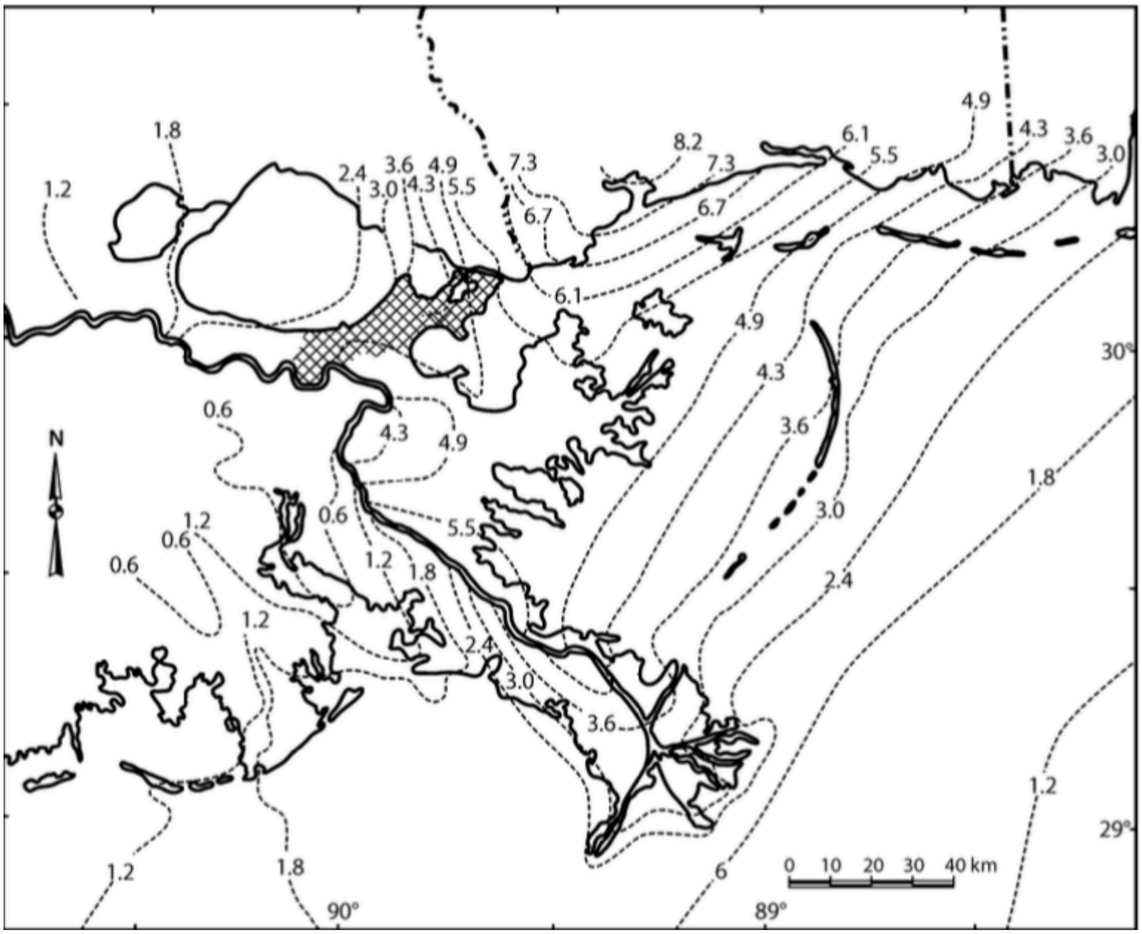
5-1 Last paragraph:
The last two sentences are inaccurate. Storm surge elevations do not include a tidal component, but rather they are the difference between observed water level and predicted (astronomical) water level. However, a storm tide is a total water elevation that contains both the predicted tide and storm surge. The last sentence should read, "The difference between the storm tide elevation and the ground elevation gives the water depth." (replace storm surge with storm tide).

5-2
Figure 5-1
Change "Surge elevation" to "Storm tide elevation"

5-2
Par 1: "Storm surge and astronomical tides also change relatively slowly in space with typical length scales of miles for any significant changes along a shoreline."

This is an absolute statement that is often incorrect, especially near the presence of flood control structures, bays, inlets or areas where the coastal aspect changes direction.

This is an extreme example, but Fig 4 in Needham and Keim (2011), which is adapted from Keim and Muller (2009) and came from the IPET (2006) report, depicts a change in water level of > 4 m over a distance of < 10 km. This difference is strongly forced by levees along the Mississippi River Delta. (see figure below)




However, areas of coastal Texas could also see great differences in water levels over a few miles, particularly near large bays, or areas with coastal flood protection, like at Galveston and Port Arthur (i.e. predicted surge at Galveston seawall vs. predicted surge 3 miles from end of seawall may be considerably different on the coast.)

5-3

The Panel may want to extend the domain to at least 23N latitude. The TX coast begins only ~65 miles N of latitude 25N.

6-1
Excellent argument for why to use both the model and observational approach.
Paragraph 2:
Change to, "…optimal when all available data are used to estimate damage…"

(data are plural)

6-3

Is it possible to add additional structural components to the list to improve the model over time? For example, fasteners, like nails, screws and steel strapping coils, are not mentioned, but recent attention has been given to structural improvements, like roofing screws.

In light of Fig 7-5 and Table 7-2, which show that structural components may matter as much or more than wind speed when considering physical failures, would there be a provision to improve the model by adding additional structural components over time?

[My question was mostly answered in the last sentence of page 7-19, when discussing the age of structures. Perhaps other attributes could be the roof slope and direction of longest roof slope.]

Bottom of page 7-9 top of 7-10
It appears as that 167 houses were sampled that experienced winds of 85-90 mph, but only 32 of these houses filed a claim. The text says that the other cases are assigned a damage of zero (135 cases). It is likely that some of these 135 cases did sustain damage, but no claim was filed. Does assigning the 135 cases as "zero" damage distort the damage module?

Pg 7-11 and 7-12

Fig 7-5 on page 7-11 depicts the variability of damage given wind conditions. This variability is also shown in Tables 7-2 (pg 7-12), and similar tables, which show that damage doesn't necessarily increase with higher wind speeds. I feel a sentence making this connection clearer would be valuable.

Example of what I'm discussing:

Relatively few (7.7%) of structures in the 115-120mph category were damaged, which is considerably less than those in 110-115, 100-105 and 95-100mph categories. Obviously, random sampling plays a role, but this table implies that different structural components impact housing damage as well.

Edits to Draft REFERENCES

Willoughby is listed in REFERENCES but not cited in text. The Willoughby Model is listed in text, and citation Willoughby et al. (2006) should be added.

Powell is listed four times in references, two of which as lead author. However, he is not mentioned in the text. Presumably, these references relate to his work with H-Wind Scientific, but citation will need to be cleaned up.

Reference formats should be consistent. Sometimes years are listed near front of citation, sometimes at the end of citation, and some references have no year provided. Reference #10 places a period after the year, Ref #4 provides no punctuation, Ref #8 provides a colon, and Ref #2 provides a comma. This will look more professional if it is all done in one style.

This should also be applied to text. For example, in section 6-3, references are cited as (FEMA 2012) and also (Dixon, 2013), with the Dixon reference containing a comma, but FEMA containing no punctuation.

The following sources are provided in the text but not in the references:

ASCE (2010) in text….ASCE/SEI Standard 7-10 in references, but no year provided
ASTM (2011)
AWC (2014) in text but not in references…it probably refers to AWC (2014a or 2014b)
IRC (2012)
NDS (2012)
NDS (2015)
Nowak and Collins (2000)
WFCM (2012)

REFERENCES from this review

Cline, I., 1900: West Indian Hurricane of September 1-12, 1900 (quote provided). *Monthly Weather Review*, **28**, No. 9. Link: http://www.aoml.noaa.gov/hrd/hurdat/mwr_pdf/1900.pdf.

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Keim, B.D., and R.A. Muller, 2009: *Hurricanes of the Gulf of Mexico*. Louisiana State University Press, 216 pp.

Needham, H.F., and B.D. Keim, 2011: Storm Surge: Physical Processes and an Impact Scale. Chapter 20 within publication *Recent Hurricane Research- Climate, Dynamics, and Societal Impacts, ISBN: 978-953-307-238-8.* Pages 385-406.

Needham, H.F., B.D. Keim, and D. Sathiaraj, 2015: A Review of Tropical Cyclone-Generated Storm Surges: Global Data Sources, Observations and Impacts. *Reviews of Geophysics*, **53**, 2, 545-591.

Weber, J., 2014: Interview on PBS documentary, *Killer Typhoon*. [Available on the Web at: http://www.pbs.org/wgbh/nova/earth/killer-typhoon.html.