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# Weather and Climate Extremes

journal homepage: [www.elsevier.com/locate/wace](http://www.elsevier.com/locate/wace)

## Hurricane names: A bunch of hot air?

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### ARTICLE INFO

#### Article history:

Received 7 July 2015

Received in revised form

10 November 2015

Accepted 22 November 2015

Available online 28 November 2015

#### Keywords:

Hurricanes

Data grubbing

Sexism

### ABSTRACT

It has been argued that female-named hurricanes are deadlier because people do not take them seriously. However, this conclusion is based on a questionable statistical analysis of a narrowly defined data set. The reported relationship is not robust in that it is not confirmed by a straightforward analysis of more inclusive data or different data.

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Jung, Shavitt, Viswanathan, and Hilbe (2014) argue that people do not take hurricanes with female names seriously and are consequently underprepared and more likely to be killed. The authors report that this “hazardous form of implicit sexism” is supported by their analysis of 92 hurricanes that hit the United States between 1950 and 2012.

Maley (2014) notes that average number of deaths were higher for male-named storms (14.5 versus 12.7) when there were fewer than 100 deaths, and that all of the reported deadliness of female-named storms comes from four storms with death tolls above 100, three of which occurred during years when all hurricanes had female names. Malter (2014) and Christensen and Christensen (2014) criticize the selective choice of explanatory variables and the fragility of the results.

A straightforward examination of the data suggests several additional reasons for skepticism. When it appears that a study's conclusions may be sensitive to the study's assumptions, there are two kinds of checks. One is to see if the conclusions are sensitive to other plausible assumptions. The second is to analyze a completely different set of data. The current paper reports that both ways of attempting to replicate the original results find that the conclusions are not robust.

### 1. Data

The National Hurricane Center (2015) classifies tropical cyclones based on the maximum sustained wind speed: tropical

depression (less than 39 mph), tropical storm (39–73 mph), hurricane (more than 73 mph), and major hurricane (more than 110 mph). Tropical storms and hurricanes are generally given names like Hurricane Sandy, but tropical depressions are not.

Jung et al. (2014) examine a narrowly defined dataset: U.S. fatalities from Atlantic hurricanes that made landfall in the United States. When a strong, surprising conclusion is drawn from restricted data, it can be instructive to see whether the conclusion is robust with respect to the myriad decisions used to restrict the data. Here, there are several issues:

(1) Why exclude tropical storms? In 1994 Tropical Storm Alberto made landfall near Destin, Florida, with maximum sustained winds of 65 mph and caused historic flooding in Alabama and Georgia that resulted in at least 30 deaths and caused \$1 billion in damages (in 1994 dollars). Alberto was classified as a tropical storm, rather than a hurricane, because its winds peaked at 65 mph, below the 73 mph threshold for hurricanes. During the years 2010–2014, eighteen Atlantic tropical storms caused a total of 235 deaths while twenty-two Atlantic hurricanes caused 614 deaths, nearly half of which were due to Hurricane Sandy (286 deaths). If there is implicit sexism in reaction to hurricane names, there should also be implicit sexism in response to tropical-storm names.

(2) Why exclude storms that do not make landfall? In 1991 Hurricane Bill moved along the East Coast of the United States producing heavy rainfall, large waves, and dangerous rip currents. Two people were killed, one in Florida and the other in Maine. Berg and Avila (2011) wrote that,

*Large swells, high surf, and rip currents generated by Bill caused two deaths in the United States. Although warnings about the dangerous waves had been posted along the coast, over 10 000 people gathered along the shore in Acadia National Park, Maine,*

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on 24 August to witness the event. One wave swept more than 20 people into the ocean; 11 people were sent to the hospital, and a 7-yr-old girl died. Elsewhere, a 54-yr-old swimmer died after he was washed ashore by large waves and found unconscious in New Smyrna Beach, Florida.

Some people did not take this hurricane seriously. Jung et al. (2014) note that hurricane fatalities may involve fishing boats, surfers, swimmers, and people washed into the sea by waves, and write that

*hurricanes sometimes move in and out of contact with land and also cause fatalities before making landfall (e.g., oil rig workers, boaters). Such deaths are appropriately part of the dataset as they reflect the preparedness issues being examined.*

However, Jung et al. (2014) only count offshore fatalities if the storm makes landfall. If there is implicit sexism in reaction to storms that make landfall, there should also be implicit sexism in response to storms that do not make landfall.

(3) Why exclude fatalities outside the United States? In 1980 Hurricane Allen had a sustained windspeed of 190 mph, the highest ever recorded for an Atlantic hurricane. It made landfall near Brownsville, Texas, on the U.S.–Mexico border. There were at least 269 deaths and close to \$1 billion in damages (1980 dollars); however, Jung et al. (2014) only counted two deaths from Hurricane Allen—two people who drowned in the Corpus Christi area. Jung et al. (2014) say that they counted both direct and indirect deaths but, in addition to the two Corpus Christi drownings, there were three fisherman who drowned after being swept off Galveston jetties, two Texas heart attack victims, thirteen deaths during an attempted helicopter evacuation of Louisiana offshore oil rigs, four drownings when a Louisiana offshore oil rig collapsed, and “several deaths in automobile accidents during the period of evacuation” (National Hurricane Center 1980). Thus Wikipedia (Hurricane Allen, 2015) counts “seven deaths in Texas and 17 in Louisiana (most resulting from the crash of a helicopter evacuating workers from an offshore platform).”

Even more serious is the omission of 245 fatalities in other countries. Many storm fatalities are in Mexico, the Caribbean, and Central America. The World Economic Forum's *Global Gender Gap Report* (2014), ranked 142 countries from first to worst based on economic, political, and social gender-based disparities. The U.S. was ranked 20 and Mexico was ranked 80. All Caribbean and Central American countries, except Nicaragua, were ranked lower than the United States. If this “hazardous form of implicit sexism” is true and these countries are generally more sexist than the United States, the disparity between fatalities for female-named and male-named storms should be even larger than in the United States.

Overall, if the implicit-sexism theory is true of U.S. fatalities from hurricanes that make landfall in the United States, it should also be true of fatalities from tropical storms, from storms that do not make landfall or make landfall in other countries, and of non-U.S. fatalities. I investigate whether this is so.

Another way to test the robustness of provocative results is to analyze fresh data. Jung et al. (2014) only consider Atlantic storms. I also analyze Pacific storms. For example, in 1983 Hurricane Tico made landfall in Mexico, where 135 people were killed (including 7 fishermen whose boats sank) and then moved north into the United States, killing a total of 7 people in Texas, Oklahoma, and Kansas. If there is sexism in responses to storms attacking North and Central America from the east, there should be similar sexism in storms attacking from the west.

## 2. Randomization

In 1950, 1951, and 1952, hurricanes and tropical storms were named using the military phonetic alphabet (Able, Baker, Charlie, ...). A switch was made to all female names in 1953. Many feminists decried this sexism, with Roxcy Bolton noting that, “Women are not disasters, destroying life and communities and leaving a lasting and devastating effect.” The switch to the current system of alternating male and female names was made in 1979 and the current system provides an implicit randomization in that the choice of a male or female name is made before anything is known about the specific storm being named.

The pre-1979, all-female data used by Jung et al. (2014) are problematic because the average number of deaths per hurricane was 29.1 during the all-female era and 16.2 afterward. Perhaps there were more fatalities in earlier years because hurricanes tended to be stronger (the average hurricane category was 2.26 during the all-female era and 1.96 afterward), the infrastructure was weaker, or there was less advance warning.

There is no concrete way to compare storm warnings before and after 1979, but there is anecdotal evidence of improvement. On September 20, 1938, the *Springfield Union* newspaper in Springfield, Massachusetts, printed this weather forecast for western Massachusetts: “Rain today and possibly tomorrow.” (Johnson, 2013). The Great Hurricane of 1938 hit the next day, killing 99 people in Massachusetts. In Springfield, the Connecticut River rose six-to-ten feet above flood level. Overall, nearly 700 people were killed and property damage was estimated at nearly \$5 billion in 2015 dollars (1938 New England hurricane, 2015). Seventy-five years later, the chief National Weather Service Meteorologist in Taunton, Massachusetts, observed that, “It is inconceivable for a hurricane to arrive unannounced like it did in 1938.” (Johnson, 2013)

The National Oceanic and Atmospheric Administration (2012) boasted that,

*NOAA's investment in ocean and atmospheric research, coupled with technological advancements, has led to a remarkable transformation in hurricane monitoring and forecasting. Emerging from these combined factors has come intricate computer modeling, a vast network of ground- and ocean-based sensors, satellites, and Hurricane Hunter aircraft.... Advances of the last half-century have brought tremendous improvements in hurricane forecasting and, despite a growing coastal population, have yielded a dramatic decline in hurricane-related fatalities.*

Even allowing for some self-promotion by the NOAA, it is clearly potentially misleading to treat the storm danger from 1950 through 1978 the same as in more recent years. It is more scientifically valid to analyze storms during the post-1978 period when male and female names were assigned randomly.

## 3. Methods

Tropical-cyclone fatality data are ill-suited for regression or correlation analysis because they consist of a large number of storms with very few fatalities and a small number of storms with a very large number of fatalities. Indeed, Jung et al. (2014) discarded the two most catastrophic hurricanes—Katrina (1833 deaths) and Audrey (416 deaths)—because, “Retaining the outliers leads to a poor model fit due to over-dispersion.”

In addition to discarding two outliers, Jung et al. (2014) tried to make the data more suitable for regression analysis by constructing a masculinity-femininity index (MFI) based on the responses of nine people who were asked to gauge the masculinity

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