Hurricanes

Hurricanes, Typhoons and Tropical Cyclones

Figure 1. An image of Hurricane Katrina taken from the Modis satellite at 1700 GMT on 28 August 2005.

The name Hurricane originates from the word ‘Hurakan’, a Mayan god, one of their creator gods, who it’s said blew his breath across the Chaotic water and brought forth dry land, later destroying the men of wood with a great storm and flood. It’s also said that a 17th-century Hurricane likely inspired Shakespeare's The Tempest and led to the British colonization of Bermuda.

The recent Category 5 Hurricanes Katrina and Rita that hit the Gulf coast of the US in August and September 2005 reminded the world how powerful and destructive they can be. Fatalities as a result of Katrina reached 1,836. This is less than Hurricane Okeechobee in 1928 that reportedly killed over 2,500 people in the US, although Katrina is undoubtedly the most costly (in terms of loss of life and an estimated $200 billion financial damage) natural disaster in US history.

The naming convention began in the 1940s originally with women’s names only. Since 1978, the United Nation’s World Meteorological Organization (WMO) has used a pre-determined list of names for each ocean basin of the world, that for obvious reasons does not use the letters Q, U, X, Y or Z. When a storm like Hurricane Katrina strikes, that causes loss of life and/or widespread damage, the country most affected by the storm may ask the WMO to ‘retire’ the name from the list as an act of respect – some fifty names have been retired since 1978 in the Atlantic basin alone.

So what makes a Hurricane?

To be precise it's actually a Tropical Cyclone. These are deep low pressure systems that occur in tropical or sub-tropical waters. They are tropical depressions at a sustained surface wind speed below 39 mph and become tropical storms when winds exceed this. When these winds exceed 73 mph, then they become severe tropical cyclones which, in the North Atlantic, we call Hurricanes (a name used generically hereafter).

Table 1: Regional terminology for Tropical Cyclones (after Newman, 1993)

Hurricane	the North Atlantic Ocean, the Northeast Pacific Ocean east of the dateline, or the South Pacific Ocean east of 160E
Typhoon	the Northwest Pacific Ocean west of the dateline
Severe Tropical Cyclone	the Southwest Pacific Ocean west of 160E or Southeast Indian Ocean east of 90E
Severe Cyclonic Storm	the North Indian Ocean
Tropical Cyclone	the North Indian Ocean

For Hurricanes to form there needs to be several favourable conditions, which include:

- the presence of warm ocean waters, that is temperatures at least as high as 26.5oC and through a sufficient depth of at least 50 m;
- an atmosphere which is humid at mid levels (around 5km) and that promotes thunderstorm activity;
- a minimum distance of at least 500 km from the equator to maintain the rotation and the existence of an organised pressure system near the surface;
- low values (less than about 23 mph) of vertical wind shear between the surface and the upper atmosphere, so as not to disrupt the organization of cyclone.

Of course, these conditions in themselves do not mean that a Hurricane will form, but they are necessary for development to occur.

The destructive power of Hurricanes is typically measured in Categories 1 to 5, from the Saffir - Simpson Hurricane Scale – a definition of which is provided at Appendix A.

What are the climate models telling us about how Hurricanes are changing?

Hurricane Katrina is the sixth most intense Hurricane in our observations history in the North Atlantic and was overtaken by Wilma and Rita – all occurring in 2005. Many people suggested that in the active Atlantic season in 2005 we were seeing the effects of climate change first hand.

Table 2. The most intense recorded Hurricanes in the North Atlantic as measured by central

pressure levels.

Rank	Hurricane	Year	Pressure (in millibars)
1	Wilma	2005	882 mb
2	Gilbert	1988	888 mb
3	Labor Day	1935	892 mb
4	Rita	2005	897 mb
5	Allen	1980	899 mb
6	Katrina	2005	902 mb

We know that under a changing climate sea surface temperatures will increase, which is favourable for the formation of more intense Hurricanes. But we also know that this is not the only condition needed to encourage Hurricane development. Simulations with the climate models show that other criteria, like low vertical wind shear, are not necessarily favourable in a warmed climate.

In fact, attributing the increase of events like Hurricanes to human-induced climate change is almost impossible with current climate models. The current global models are too course a resolution to resolve features like Hurricanes. Some studies have looked at embedding higher resolution regional climate models within the global predictions, but can only give broad indications of trends that have a large degree of uncertainty. What the climate models can do is to look at larger scale tropical storm systems as a surrogate for Hurricane development, but as yet these studies are inconclusive and an active area of research.

Drawing conclusions from time series of Hurricane data is fraught with difficulties. Methods of observing Hurricanes have changed over time. Before the 1950s observations of wind speed are only available over land or from ships. After that reconnaissance aircraft brought back additional measurements. Then from around 1980 we began to have reliable estimates of wind speeds from satellites.

What has remained relatively constant thought through time is the way in which pressure observations have been made, which can be related to Hurricane intensity.
