



## CME Hurricane Index: Scope and Definitions

### *Introduction*

CME Group (CME) offers a number of futures and options on futures to manage the risk posed by hurricanes to the US. The CME Hurricane Index™ (CHI™), originally developed by the ReAdvisory group of Carvill America, Inc. and acquired by CME in 2009, is the index upon which these exchange traded derivatives are based, and EQECAT, Inc. (EQECAT) serves as the official calculation agent to CME for the CHI. This document sets out the definition of the CHI, the scope of operations for EQECAT, and the definitions that EQECAT will employ in the calculation and delivery of the CHI to CME.

CME has applied for trademarks for both “CME Hurricane Index” and the abbreviation “CHI”.

### *The CME Hurricane Index*

#### **Introduction**

The CME Hurricane Index (CHI) is a numerical measure of the potential for damage from a hurricane. The current Saffir-Simpson Hurricane Scale (SSHS) classifies hurricanes in categories from 1 to 5. However, this measure has several issues which make it unsuitable for use as the basis for an exchange traded derivative. For example, meteorologists have had to quantify SSHS categories as either “strong” or “weak”. Katrina was a weak category 4 storm at landfall but this did not provide a real guide to the actual physical impact.

The CHI incorporates sustained wind speed and the radius of hurricane force winds. It is a continuous measurement, rather than a discrete scale, starting from zero and having no maximum value. Hurricane Wilma in 2005 was at one point in its life the strongest storm on record with a central pressure of 882mb. However, at its strongest, Hurricane Katrina had more potential for damage than Wilma, despite its lower wind speed, since Katrina was a far wider storm. The Saffir-Simpson scale would be unable to make this distinction.

#### **Formulation**

The CHI has a relatively simple formula:

$$CHI = \left(\frac{V}{V_0}\right)^3 + \frac{3}{2}\left(\frac{R}{R_0}\right)\left(\frac{V}{V_0}\right)^2$$



Where “R” is the radius of the extent of hurricane force winds from the center of the storm, “V” is the maximum sustained wind speed and the subscript “0” denotes reference values.

The first term in the CHI is a proxy for the potential for wind damage. The second term essentially measures the extent to which damaging winds extend.

### **Reference Values**

In the calculation of the CHI for CME, the following reference values will be used:

$V_o = 74$  statute miles per hour

$R_o = 60$  statute miles

Note that the reference value for the maximum sustained wind speed of 74mph coincides with the NOAA National Hurricane Center definition of the threshold defining when a tropical cyclone is declared a hurricane in the Atlantic and East Pacific basins. The reference value for the radius of hurricane force winds is an assumed generic value for storms in the Atlantic basin.

A storm with the same radius and velocity as the reference values would have a CHI value of 2.5. If V is less than 74 mph, then CHI is set equal to zero.

### **Data Source**

The data that EQECAT will use to calculate the CHI will be taken from the Public Advisories issued by NOAA's National Hurricane Center (NHC) and published on its website [www.nhc.noaa.gov](http://www.nhc.noaa.gov). Public Advisories are issued at least once every 6 hours for storms in the Atlantic basin, and list both the maximum sustained wind speed (the 10-meter, 1-minute sustained wind speed in statute miles per hour) and the radius of hurricane force winds (measured from the center of the storm in statute miles). Public Advisories round the values of maximum sustained wind speed to the nearest 5 mph and the radius of hurricane force winds to 5 miles.

The Public Advisories also contain timing and location information which EQECAT will use in determining when and where a storm makes landfall, enters a “box” or exits a “box”.

EQECAT will use the data contained in the Public Advisories on an “as-is” basis. EQECAT will not make any corrections or adjustments to the data in the Public Advisories in the calculation of the CHI or the determination of landfall.



## *CHI Data Delivery*

### **Settlement Data**

EQECAT will deliver to CME the value of the CHI for each storm based on the data contained in each Public Advisory issued by the NHC. The value of the CHI will be given in numerical form and rounded to the first decimal point, i.e. in the format XX.X.

For contracts based on landfall, the final settlement value for each named storm will be calculated using the data contained in the Public Advisory issued by the NHC immediately prior to the occurrence of landfall.

EQECAT will deliver to CME the location of landfall for each storm based on the data contained in the Public Advisory issued by the NHC and other information as appropriate. EQECAT will deliver the location of landfall in clear text where the location will be indicated as occurring between two points, i.e. in the format "landfall occurred between XXXX and YYYY". The points used to list the landfall location will be the breakpoints used by the NHC and listed on its website [www.nhc.noaa.gov/breakpoints.shtml](http://www.nhc.noaa.gov/breakpoints.shtml)

For contracts based on hurricane activity within a geographic area (i.e., "Cat-In-A-Box"), the final settlement value for each named storm will be the maximum CHI value for all Public Advisories issued while the storm is "in the box." For example, the Cat-In-A-Box (Galveston to Mobile) contracts use an area described by 95°30'0"W on the west, 87°30'0"W on the east, 27°30'0"N on the south, and the corresponding segment of the US coastline on the north. EQECAT will consider that the storm is "in the box" if the center of the storm as reported by the National Hurricane Center has coordinates within the described geographic area, and the location for final settlement will be reported as the latitude and longitude of the NHC Advisory generating the maximum CHI value within the box.

In the event a storm is classified as a hurricane either just at landfall or after making landfall, the landfall determination will be the same as below but the CHI settlement value will be the first non-zero CHI value at or after landfall.

Prior to landfall and final settlement, EQECAT will deliver to CME indicative values for the CHI, as described in the following paragraph.

### **Live Data**

For each storm, EQECAT will deliver a file of data which lists, among other data, the location of the storm, the values of the CHI, the time of measurement and the Public Advisory number upon which the CHI calculation was based, for each Public Advisory



released since the previous report. EQECAT will deliver this data to CME once per day, at or before 12:00 noon CT, for each storm in the Atlantic basin.

### **Missing Data**

Once a hurricane has formed, the NHC will list its maximum sustained windspeed as being some value in excess of 74mph. However, when a storm initially forms, it could be that the radius of hurricane force winds is ill-defined, in which case the NHC will not list a radius to hurricane force winds. In this situation, EQECAT will use best efforts to estimate the radius of hurricane force winds. In the event that no radius can be determined, the radius will be set to the value of the radius given in the first advisory before or after the missing data, depending on what data is available.

### **Landfall**

The intent of the CHI contract is to manage risk for storms making landfall along the mainland of the United States. To this end, storms crossing the Florida Keys are not considered to make landfall. That is, the Florida coast is considered continuous from the NHC breakpoint at Flamingo, FL, to Card Sound Bridge, FL, to Golden Beach, FL. The NHC breakpoints from Ocean Reef, FL, to Dry Tortugas inclusive (Ocean Reef, FL; Key Largo, FL; Craig Key, FL; Seven Mile Bridge, FL; Key West, FL; Dry Tortugas) are excluded from landfall considerations.

EQECAT will consider that a hurricane has made landfall based on notification in the NHC Public Advisories. Determining landfall is a rather subjective process given that a hurricane can have a very wide eye or, conversely, an ill-defined circulation. To that end, EQECAT will look for verbiage in the NHC Public Advisory which notes that the storm has made landfall or that the strongest winds (i.e. those in the eyewall) are coming onshore. In all cases, EQECAT will use the data from the NHC public advisories as well as other meteorological information to determine where and when landfall occurs. For the purposes of contracts traded on CME, EQECAT will be the final arbiter of where and when landfall has occurred for any hurricane.

Based on historical hurricanes, the eye wall may pass over the coastline but the center of the hurricane never actually crosses the coastline; instead, the hurricane glances or by-passes landfall. In this situation, EQECAT will report a landfall if the NHC reports that the strongest winds from the storm (i.e. the eyewall) are measured to have crossed onto land.

### **Multiple Landfalls**

For a hurricane that makes 2 or more landfalls in the same contract-specific location (e.g., Gulf Coast) within a 12 hour period, EQECAT will publish as the final settlement the CHI value based on the Public Advisory immediately prior to the first landfall.



For a hurricane that makes 2 or more landfalls in the same contract-specific location (e.g., Gulf Coast) which are in excess of 12 hours apart, EQECAT will publish separate final settlement values of the CHI based on the Public Advisory immediately prior to each distinct landfall.

Notice that the Cat-In-A-Box region is considered entirely separate from the US coast. This means that storms making multiple entries and exits (i.e., a storm that enters the box, leaves the box, and then subsequently re-enters the box) are subject to the 12 hour rule as detailed above. However, storms that enter the box before hitting the US coast are not subject to the 12 hour rule (i.e., a storm that enters the box and less than 12 hours later hits the US coast is considered to have caused an event inside the box and a landfall along the US coast).

### **Location**

As noted above, EQECAT will deliver the location of landfall in clear text where the location will be indicated as occurring between two points, i.e. in the format "landfall occurred between XXXX and YYYY". In the event that a hurricane was determined to have made landfall exactly on top of an NHC breakpoint, the landfall location will be indicated as occurring between the breakpoint on which the hurricane landed and the breakpoint immediately to the right of the landfall location. This rightward bias represents the likelihood that the most damaging winds from a hurricane are to the right of the center of the hurricane.



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