

## Teacher Guide

### Hurricanes and Global Climate Change

**Developed by:** David Burch

**Activity Focus:** The first part of the activity consists of a summary of basic hurricane facts. Students examine several potential influences on hurricane frequency and intensity, including El Niño and increased levels of CO<sub>2</sub> in the atmosphere. Students interpret data about the relationship between global climate change and hurricanes.

**Major Concepts:**

- Hurricanes are potentially the most costly, and perhaps deadly, natural disasters to strike the United States.
- Recent research in global climate change indicates a possible increase in hurricane frequency/intensity.

**Objectives:** After completing this activity, students will be able to:

- distinguish between the terms hurricane, typhoon, and cyclone
- interpret the Saffir-Simpson Hurricane Scale
- discuss possible connections between hurricane intensity and frequency in relation to global climate change

**Materials and Preparation:** You will need to prepare the following materials before conducting this activity.

- Copy the *Hurricanes and Global Climate Change* data interpretation and visualization activity (make 1 copy per student).
- Make a transparency or PowerPoint slide for each data set (appendix) for use in the class discussion. You may want to make color copies of the data sets for groups of students.

**Procedures:** Students may work individually to calculate their own carbon footprint and may work as a group to complete the remaining aspects of the activity.

1. Introduce the activity by reading the journal excerpt in class. Have students answer the “What I currently know and think” questions before starting the activity. You may want to discuss these as a class.
2. Organize students into small groups of 3-4 or have students work independently on completing the rest of the activity. If students are working in small groups, have them read and discuss each question as a group before recording a consensus response.

3. Discuss the activity as a class, asking students to share their responses to the questions.
4. Have students reflect on their ideas by re-answering the engage questions writing their responses to the “What I now know and think” questions and have them reflect on their own thinking by completing the “How my ideas and thinking have changed” question.
5. Collect student/group responses. Administer assessment item.

**Assessments:** The following assessments may be used as a pre/post activity assessment or as part of a module assessment.

- What types of danger do hurricanes pose?
- What does global climate change have on hurricane frequency and/or intensity?
- How are El Niño and La Niña related to hurricane activity?
- How does the Saffert-Simpson scale measure hurricanes?
- According to some scientific models, what changes in hurricane frequency and intensity may we expect in the future?

**Quiz:** The following quiz may be used as a post-activity assessment.

1. The greatest damage done by hurricanes is from  
A. high winds    B. low pressure    C. storm surge    D. sound
2. If ocean surface temperature increases, we may expect \_\_\_\_\_ hurricanes.  
A. less    B. more    C. no    D. the same number of
3. The Gulf of Mexico receives more hurricanes during  
A. El Niño    B. La Niña    C. Christmas vacation    D. Spring Break
4. Hurricane intensity is described by the  
A. Mohs Scale    B. Fujita Scale    C. Richter Scale    D. Saffert-Simpson Scale
5. Current computer models indicate that hurricane \_\_\_\_ may increase in the future.  
A. size    B. frequency    C. intensity    D. damage

## **Bibliography**

Number of Hurricanes and Major Hurricanes

<http://www.ncdc.noaa.gov/oa/climate/research/hurricane-climatology.html>

SAFFIR-SIMPSON HURRICANE SCALE

img.coxnewsweb.com/C/03/14/31/image\_1531143.jpg

<http://www.aoml.noaa.gov/hrd/tcfaq/D1.html>

Atlantic Hurricane Name List, 2007-2012

<http://www.nhc.noaa.gov/aboutnames.shtml>

1997-1998 El Nino Hurricane Season

[http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/mtr/hurr/enso.rxml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/hurr/enso.rxml)

United States Landfalling Hurricanes, 1901-1920, 1941-1960, 1981-1996

<http://www.ncdc.noaa.gov/oa/climate/severeweather/hurricanes.html#latest>

COMPARISON OF SIMULATED HURICANE INTENSITIES FOR PRESENT AND FUTURE (HIGH CO<sub>2</sub>) CONDITIONS

*“The Current Debate on the Linkage Between Global Warming and Hurricanes”*

J. Marshall Shepherd and Thomas Knutson, *Geography Compass* 1/1 (2007): 1–24

<http://www.blackwell->

[compass.com/subject/geography/article\\_view?article\\_id=geco\\_articles\\_bpl002](http://www.blackwell-compass.com/subject/geography/article_view?article_id=geco_articles_bpl002)

US Landfalling Tropical Cyclones by Intensity during Two 50-Year Periods

<http://www.marshall.org/pdf/materials/461.pdf>

*“Exploring the Potential Causes of Increased Storm Intensity”* Brenda Ekwurzel, Union of Concerned Scientists

[http://www.ucsusa.org/global\\_warming/science/hurricanes-and-climate-change.html](http://www.ucsusa.org/global_warming/science/hurricanes-and-climate-change.html)

Historical Hurricane Tracks, El Niño Years

Historical Hurricane Tracks, La Niña Years

<http://maps.csc.noaa.gov/hurricanes/viewer.html>

Intergovernmental Panel on Climate Change

<http://www.ipcc.ch/>

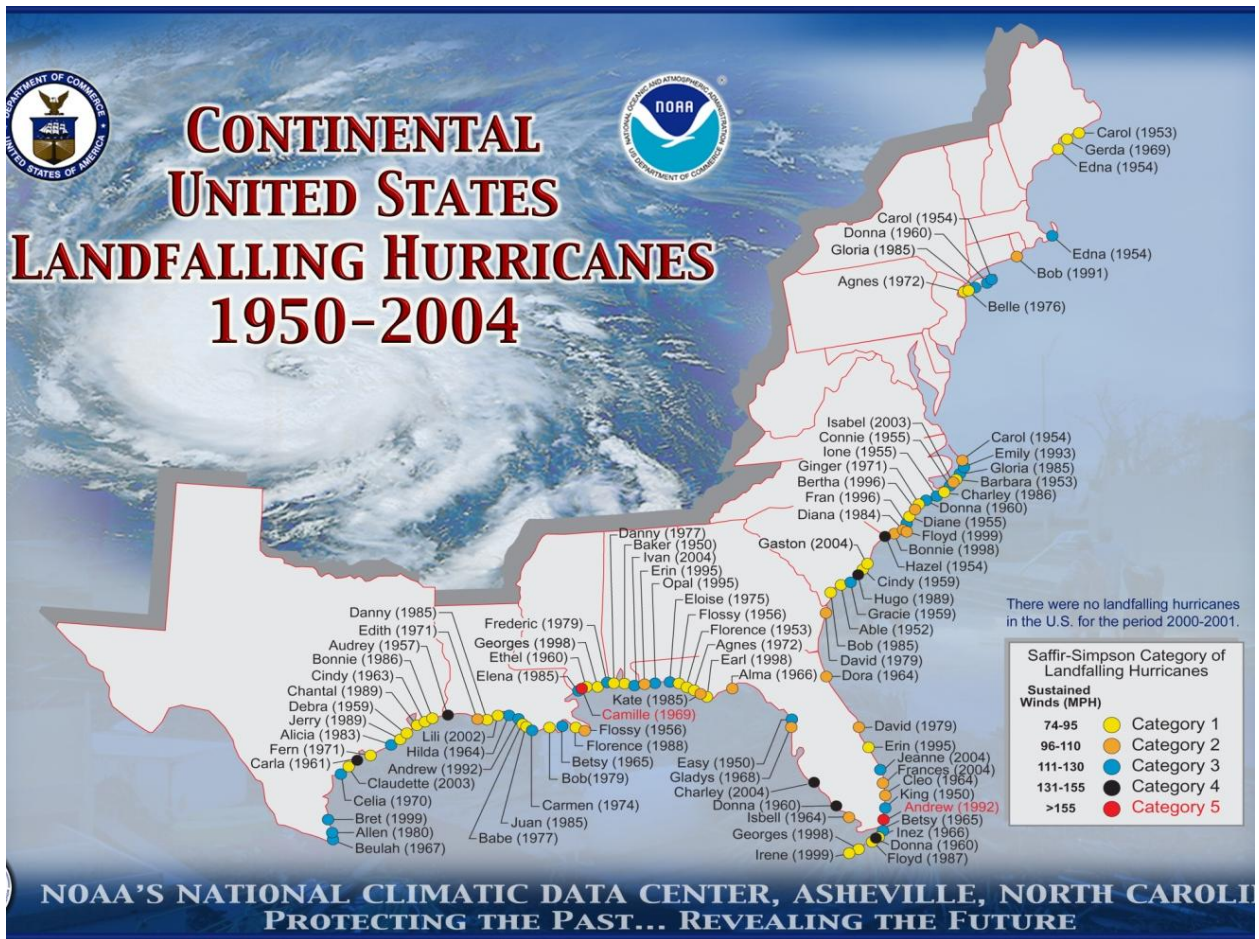
**Appendix:**



**SAFFIR-SIMPSON HURRICANE SCALE**

Source: NOAA

Saffir-Simpson Category	<a href="#">Maximum sustained wind speed</a>		
	mph	m/s	knots
1	74-95	33-42	64-82
2	96-110	43-49	83-95
3	111-130	50-58	96-113
4	131-155	59-69	114-135
5	156+	70+	136+



<http://lwf.ncdc.noaa.gov/img/climate/severeweather/hur5004.jpg>

### EL NIÑO HURRICANE SEASON COMPARED TO NORMAL HURRICANE SEASON

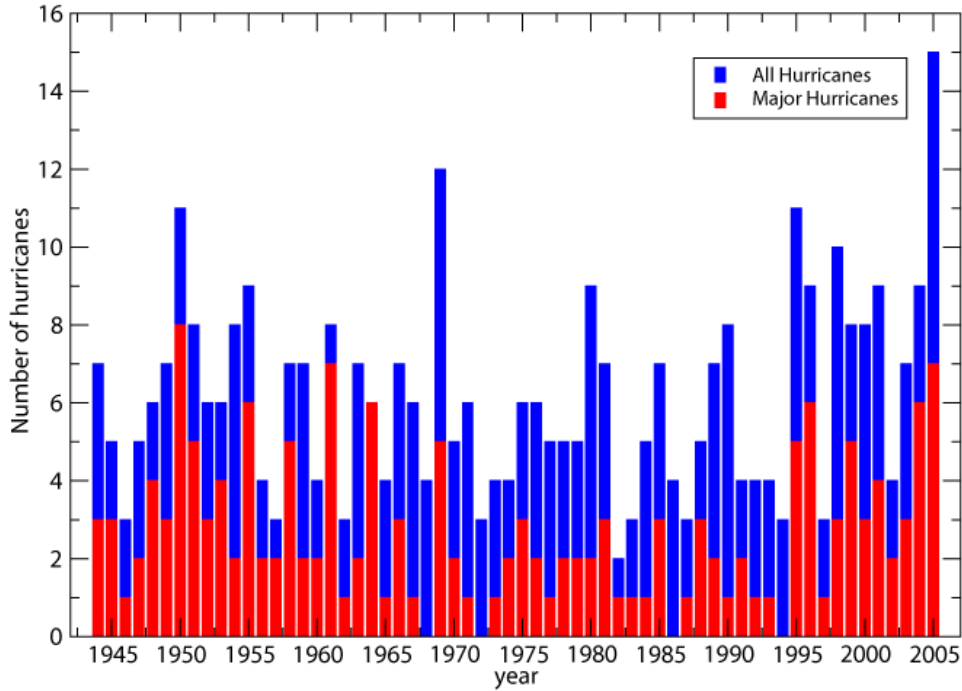
	Atlantic		Eastern Pacific	
	Average Hurricane Season	Average El Niño Hurricane Season	Average Hurricane Season	Average El Niño Hurricane Season
Named storms	9.4	7.1	16.7	17.6
Hurricanes	5.8	4.0	9.8	10.0
Intense Hurricanes	2.5	1.5	4.8	5.5

Source: NOAA

[http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/mtr/hurr/enso.rxml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/hurr/enso.rxml)

## Number of Hurricanes and Major Hurricanes (cat. 3-5)

Atlantic Basin, 1944-2005



<http://www.ncdc.noaa.gov/img/climate/research/hurricanes/fig1-atlantic-all-and-major.gif>

*US Landfalling tropical cyclones by intensity during two 50-year periods*

<b>YEARS</b>	<b>Named Storms</b>	<b>Hurricanes</b>	<b>Intense Hurricanes (Cat 3-4-5)</b>	<b>Global Temperature Increase</b>
1900-1949 (50 years)	189	101	39	+0.4°C
1956-2005 (50 years)	165	83	34	

<http://www.marshall.org/pdf/materials/461.pdf>

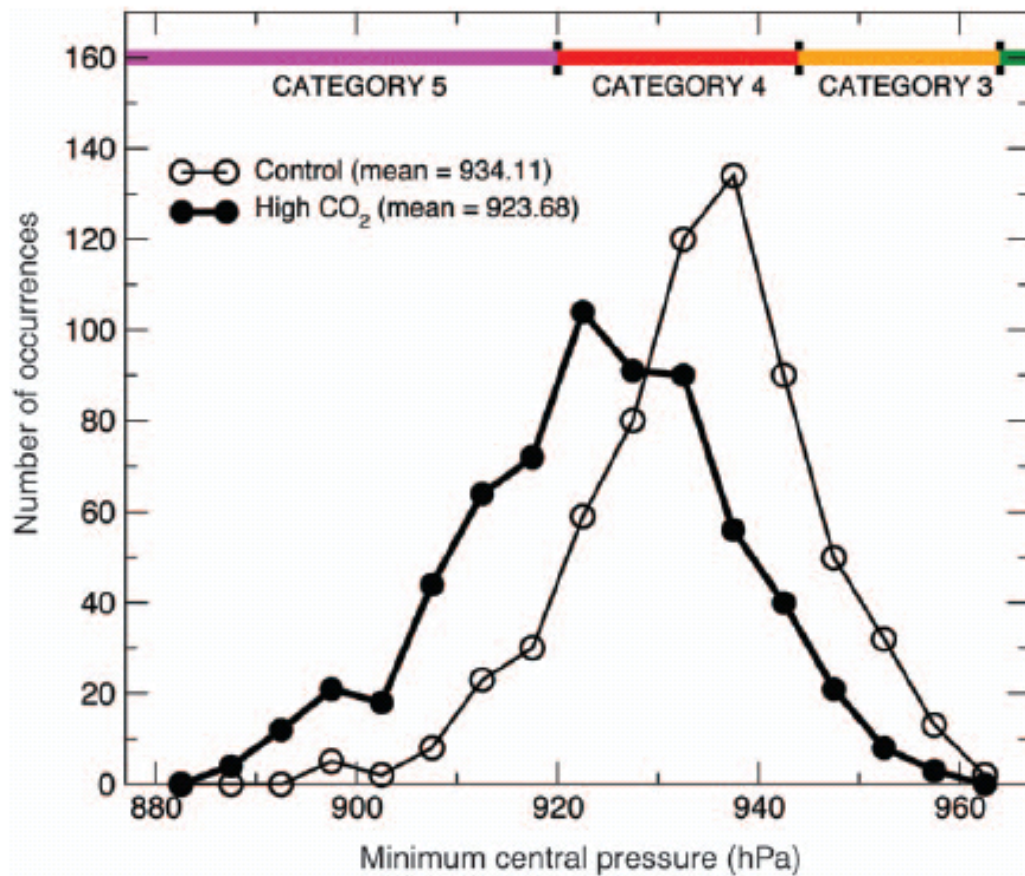
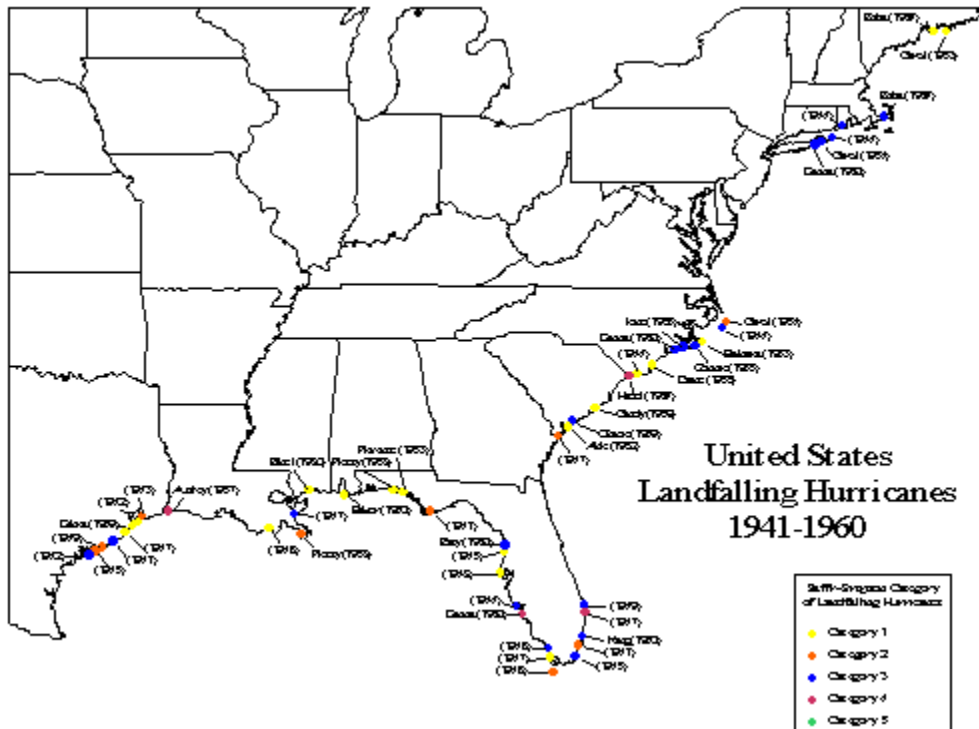
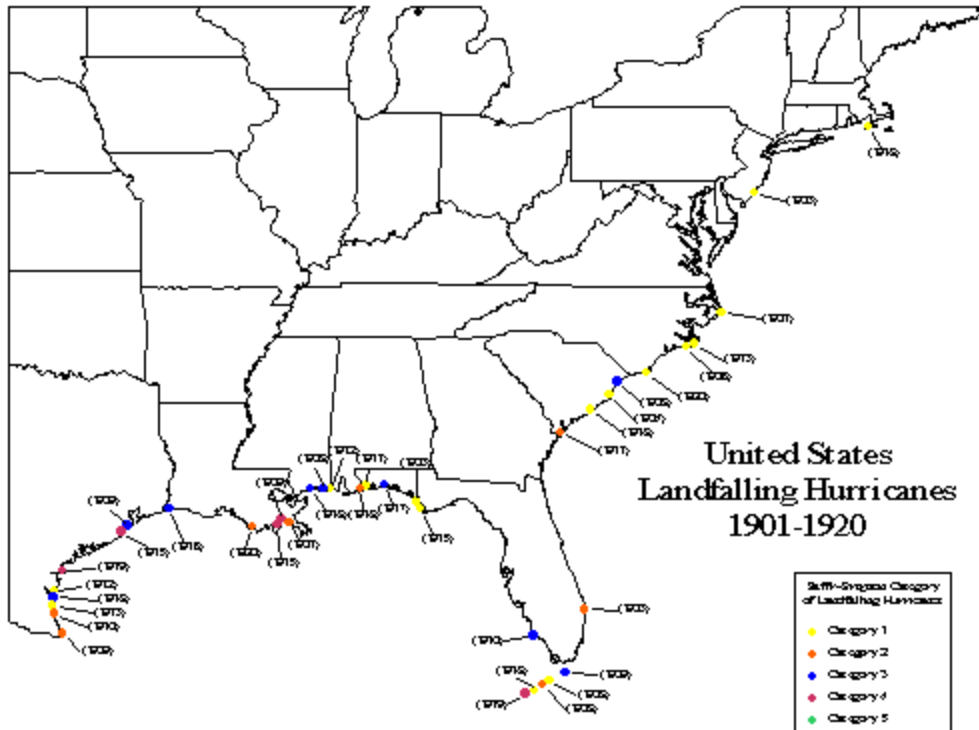
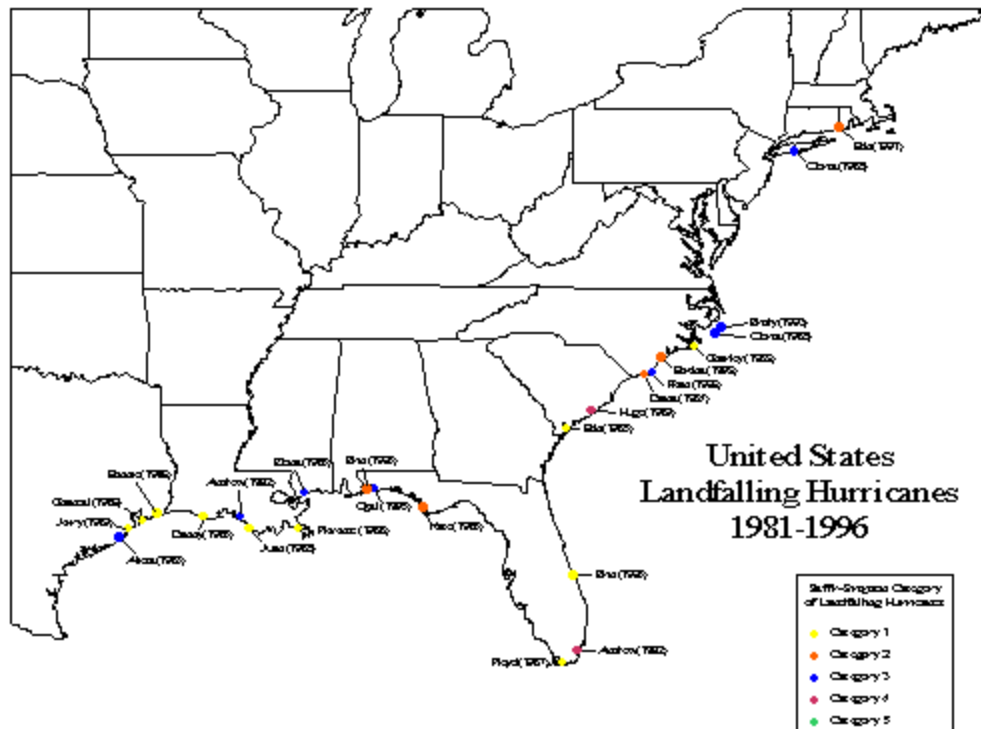


Fig. 2. Comparison of simulated hurricane intensities for present-day (thin line) and future (thick line) climate conditions assuming an 80-year buildup of atmospheric carbon dioxide at 1 percent per year compounded. The results are aggregated from sets of experiments using nine different global climate model projections and four different versions of a high-resolution hurricane prediction model (following Knutson and Tuleya 2004).

[http://www.blackwell-compass.com/subject/geography/article\\_view?article\\_id=geco\\_articles\\_bp1002](http://www.blackwell-compass.com/subject/geography/article_view?article_id=geco_articles_bp1002)





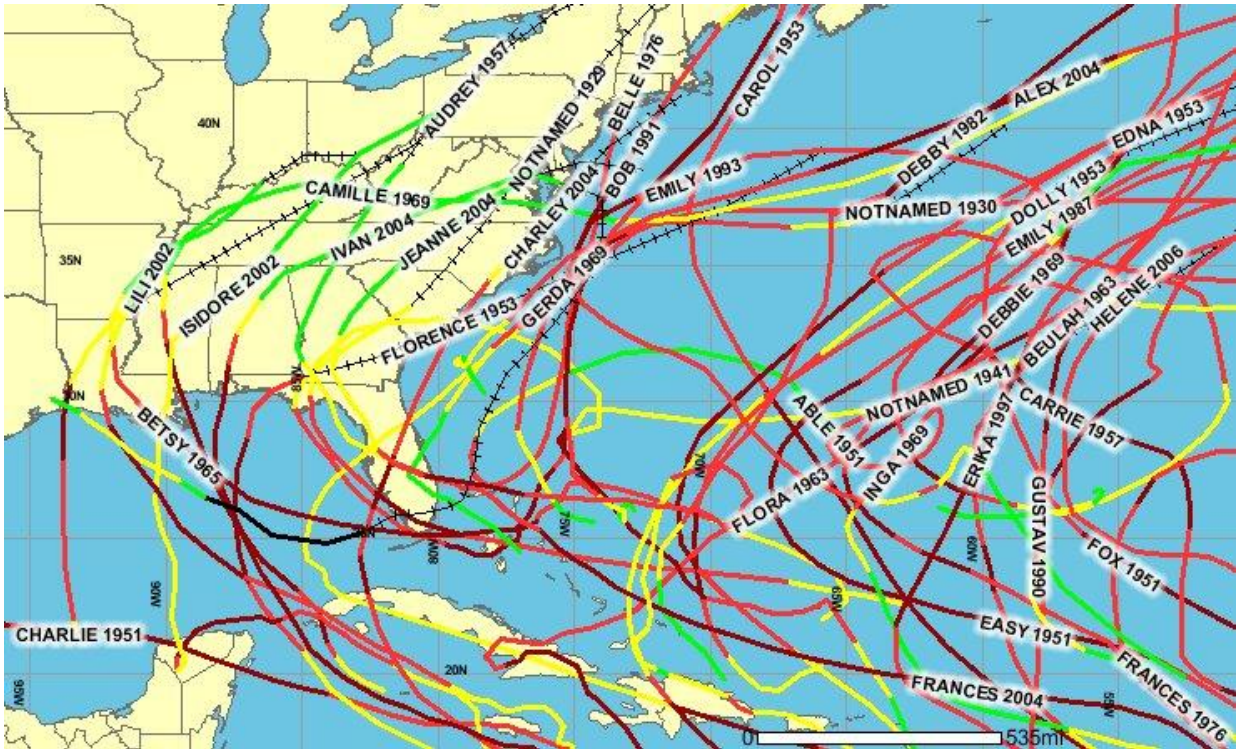


<http://www.ncdc.noaa.gov/oa/climate/severeweather/hurricanes.html#latest>

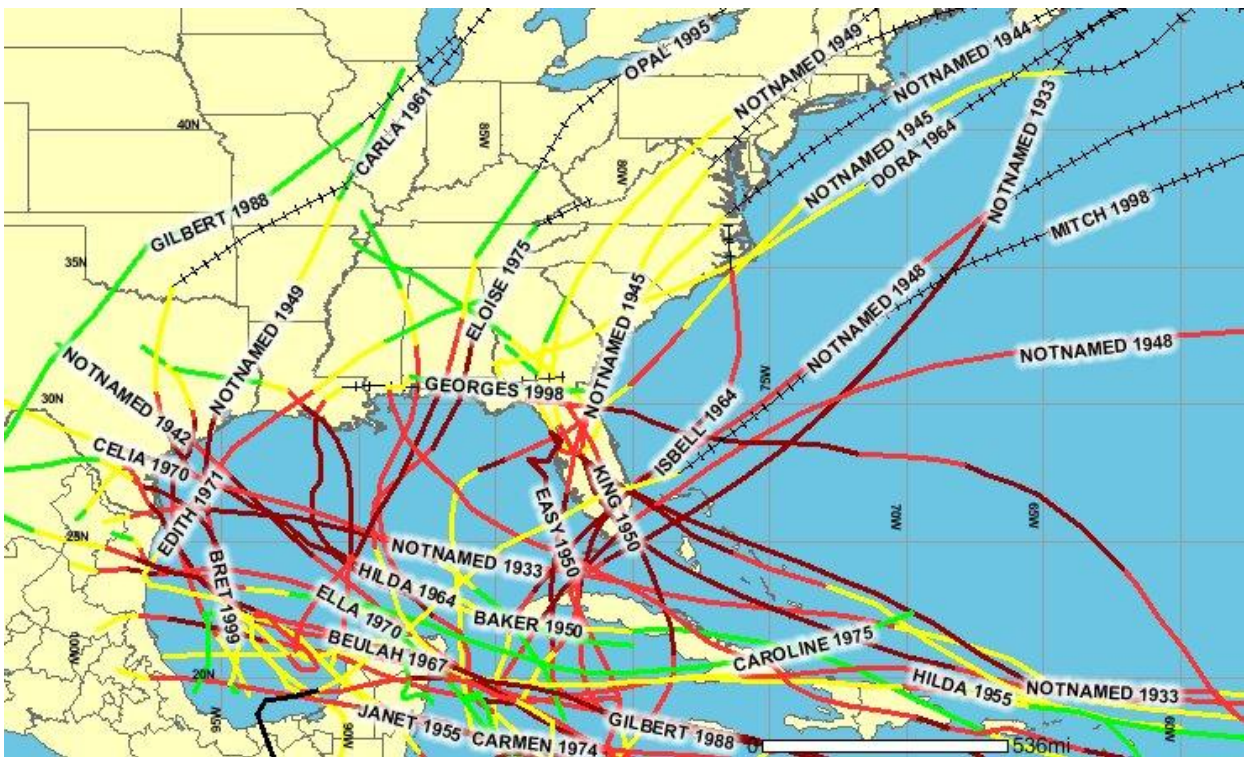
### Atlantic Hurricane Name List, 2007-2012

2007	2008	2009	2010	2011	2012
Andrea	Arthur	Ana	Alex	Arlene	Alberto
Barry	Bertha	Bill	Bonnie	Bret	Beryl
Chantal	Cristobal	Claudette	Colin	Cindy	Chris
Dean	Dolly	Danny	Danielle	Don	Debby
Erin	Edouard	Erika	Earl	Emily	Ernesto
Felix	Fay	Fred	Fiona	Franklin	Florence
Gabrielle	Gustav	Grace	Gaston	Gert	Gordon
Humberto	Hanna	Henri	Hermine	Harvey	Helene
Ingrid	Ike	Ida	Igor	Irene	Isaac
Jerry	Josephine	Joaquin	Julia	Jose	Joyce
Karen	Kyle	Kate	Karl	Katia	Kirk
Lorenzo	Laura	Larry	Lisa	Lee	Leslie
Melissa	Marco	Mindy	Matthew	Maria	Michael
Noel	Nana	Nicholas	Nicole	Nate	Nadine
Olga	Omar	Odette	Otto	Ophelia	Oscar
Pablo	Paloma	Peter	Paula	Philippe	Patty
Rebekah	Rene	Rose	Richard	Rina	Rafael
Sebastien	Sally	Sam	Shary	Sean	Sandy
Tanya	Teddy	Teresa	Tomas	Tammy	Tony
Van	Vicky	Victor	Virginie	Vince	Valerie
Wendy	Wilfred	Wanda	Walter	Whitney	William

<http://www.nhc.noaa.gov/aboutnames.shtml>



Historical Hurricane Tracks, El Niño Years



Historical Hurricane Tracks, La Niña Years (Source: NOAA)

<http://maps.csc.noaa.gov/hurricanes/viewer.html>