

Earth Science Regents

Hurricane Tracking Lab

Name _____

Period _____

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Companion Websites: <http://weather.unisys.com/hurricane/index.html>
<http://www.usacitylink.com/blake/tropical/>
<http://www.bedford.k12.ny.us/flhs/science/hurricane1.html>

INTRODUCTION:

Hurricanes begin as tropical depressions (low pressure systems) just north of the equator west of Africa. As energy laden warm, moist (mT) air rises up from the sea surface into the low, condensation releases heat and the low deepens. As air spirals in to "fill" the low, wind speeds around the low increase. Meteorologists often measure wind speed in *knots*, rather than miles per hour. A knot is 1 *nautical mile per hour*. Nautical miles are used at sea and are equal to 1 minute of latitude ($1/60^{\text{th}}$ of a degree). A nautical mile is a little longer than the 5280' *statute mile* we use on land, so 1 knot is a little faster than 1 mile per hour. When the wind speeds reach 35 knots, the low becomes a tropical storm, and at 64 knots, a hurricane. (For more info, look up the Saffir-Simpson Scale at one of the companion websites).

The location and path of a hurricane is important to mariners and aviators when it is over water, and to people living on islands and coastlines in the hurricane's path.

Planetary winds are important in steering a hurricane in its westward trip across the Atlantic tropics toward the Caribbean Sea, the Gulf of Mexico, and the east coast of the United States.

In this lab, you'll plot the path of the tropical depressions, storms, and hurricanes that occur during the current Atlantic hurricane season in an effort to learn where hurricanes get their energy, where they go, and why.

TERMS TO KNOW:

The following terms are important for you to understand before you begin this lab. Use your textbook, the reference tables, an atlas, and/or any other resources you need to write definitions of the following terms:

PLANETARY WINDS _____

PREVAILING WINDS _____

AIR MASS _____

The code letters describing air masses, and what they mean:

mT _____

mP _____

cT _____

cP _____

AIR PRESSURE _____

MILLIBARS (mb) _____

Greenwich Mean Time (GMT) or ZULU or UNIVERSAL TIME: _____

(See <http://www.bedford.k12.ny.us/flhs/science/labs/zulutime.html> for more info about timekeeping.)

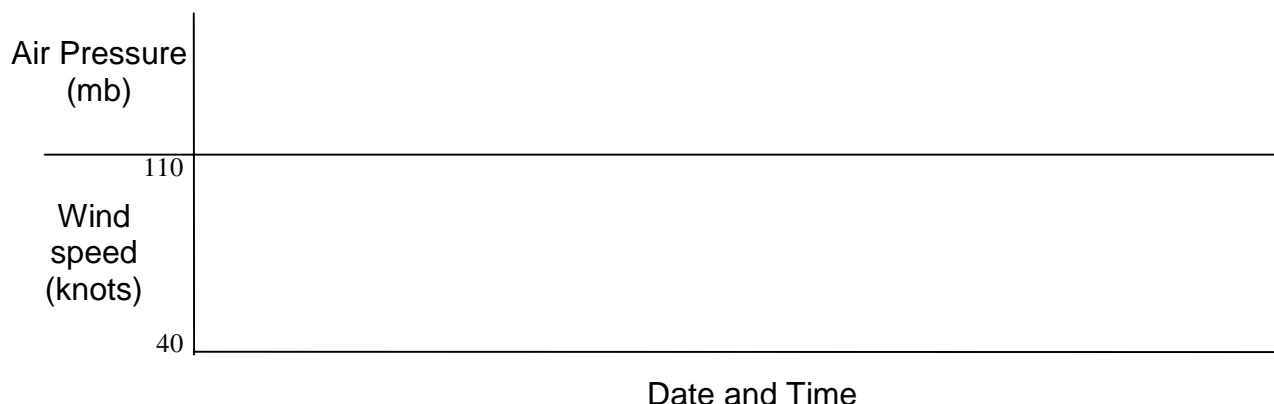
PROCEDURE

YOU'LL NEED:

- This lab
- Current hurricane data (get it at <http://www.bedford.k12.ny.us/flhs/science/tropicalseason.html> or one of the Companion Websites)
- 1998 Hurricane Bonnie data (see sites above)
- Blank Hurricane Tracking Charts
- Graph paper
- A sharp pencil

1. Using a pencil, plot the position of the first storm of the current tropical season on the accompanying map. It is not necessary to plot more than one point for each day, though the data tables list several. Next to each point, very lightly label the advisory number and the date.
2. Connect the plotted points with a smooth line that approximates the path of the center of the storm.
3. As the current Atlantic hurricane season progresses, do the same for all the named storms that occur. Get their daily positions at <http://www.bedford.k12.ny.us/flhs/science/tropicalseason.html> or <http://weather.unisys.com/hurricane/>
5. Answer/Do the following:

A. Using the data from hurricane BONNIE, a strong 1998 hurricane that hit the US, use graph paper or a spreadsheet to construct a line graph of wind speed and air pressure over time. You need not plot every point. Rather, start at Advisory 7A (on 8/21 at 12 Zulu) and plot each advisory nearest 0Z and 12Z thereafter (ie. Advisory 9a, 11A, 13A, 15A...). It would make sense to make a mark on the data table next to each point you plan to plot. Label the "DATE and TIME" on the X-axis (horizontal) of your graph. Label the bottom of the Y-axis "WIND SPEED", and the top of the Y-axis "AIR PRESSURE". See the example below:



B. Determine a reasonable scale on each axis to cover the values in the data table. For instance, the wind speeds range from 45 to 100 knots. Therefore your graph should probably start at 40 knots and go up to 110 knots, as shown above. Be sure to put a title on your graph.

C. Make a statement about the general relationship between wind speed and air pressure in the space below.

D. Notice the data recorded while BONNIE was over land. What happened to the wind speed during that time?

E. Read the introduction to this lab again, and explain *WHY* BONNIE'S winds slowed down while over land.

F. What happened to the wind speed during 8/28? _____ *WHY?* _____

G. Each tic on the mile scale (on the right middle of the map) represents 50 nautical miles and the whole scale is 250 nautical miles long. Determine the average speed (in knots) of the storm system (not the wind's speed in the storm) from 8/21/00Z to 8/26/00Z. *EXPLAIN* how you found that speed. (Speed or rate = distance/time)

SPEED = _____ How I figured it: _____

H. What was the average speed in knots of the storm system from 8/27/01Z to 8/29/00Z? _____

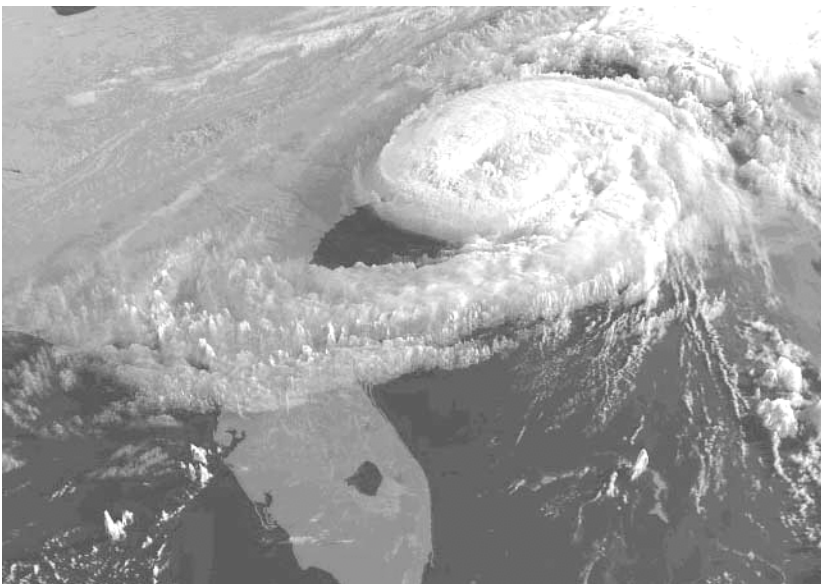
I. At approximately what latitude did BONNIE veer to the east? _____ Refer to your reference table chart of the planetary winds. Is BONNIE's change of direction compatible with the information on the chart? _____

J. Use your pencil to very lightly copy BONNIE's path onto the planetary wind diagram in your reference tables.

K. From what you can tell, is warm, moist, and stormy air associated with **high pressure** or **low pressure** air? (circle one)

L. Notice that Bonnie kept veering to the north (her right) as the northeasterly winds of the tropics drove her east across the Atlantic. This occurs due to an interesting effect of the Earth's rotation. Look up and describe the CORIOLIS EFFECT. _____

M. The image below shows Bonnie approaching the east coast of the US. Describe the motion of the air around the center of the storm as completely as you can.



WHAT TO HAND IN:

- These 3 pages
- 2 Maps
- 1 Graph

HURRICANE TRACKING CHART

WARNING: hurricanes are large powerful storm that can suddenly change direction! Check frequently on the storm's progress until all Warnings and Warnings for Your Area from the National Weather Service are cancelled!

HURRICANE WATCH:

- Hurricane may threaten the area within 24 hours
- Be prepared to evacuate (Call 1-800-354-3447)
- Call the National Weather Service

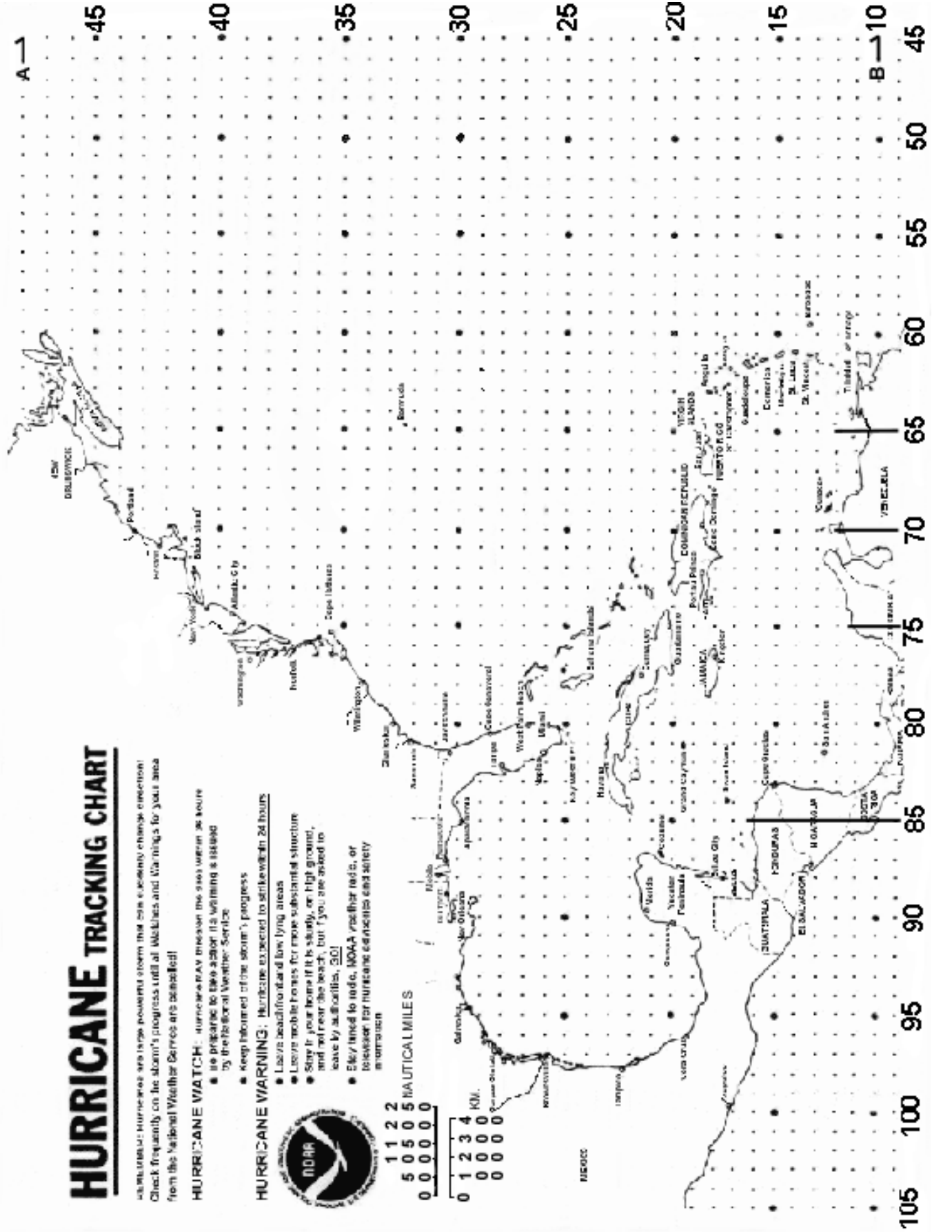
HURRICANE WARNING:

- Hurricane expected to strike within 24 hours
- Leave beach/forward low lying areas
- Leave mobile homes for more substantial structure
- Stay in your home if it is sturdy, or high ground, and not near the beach, but if you are asked to leave by authorities, GO!
- If/when linked to radio, NOAA weather radio, or television for hurricane forecasts and safety information



1 1 2 2
5 0 5 NAUTICAL MILES
0 0 0 0 0 0

0 1 2 3 4
0 0 0 0
0 0 0 0
0 0 0 0



Hurricane Bonnie

TRACKING CHART

CAUTION: Hurricanes are large powerful storms that can suddenly change direction. Check frequently on the storm's progress until all watches and warnings for your area from the National Weather Service are cancelled.

HURRICANE WATCH: Hurricane may threaten the area within 48 hours

- Be prepared to take action if a warning is issued by the National Weather Service
- Keep informed of the storm's progress

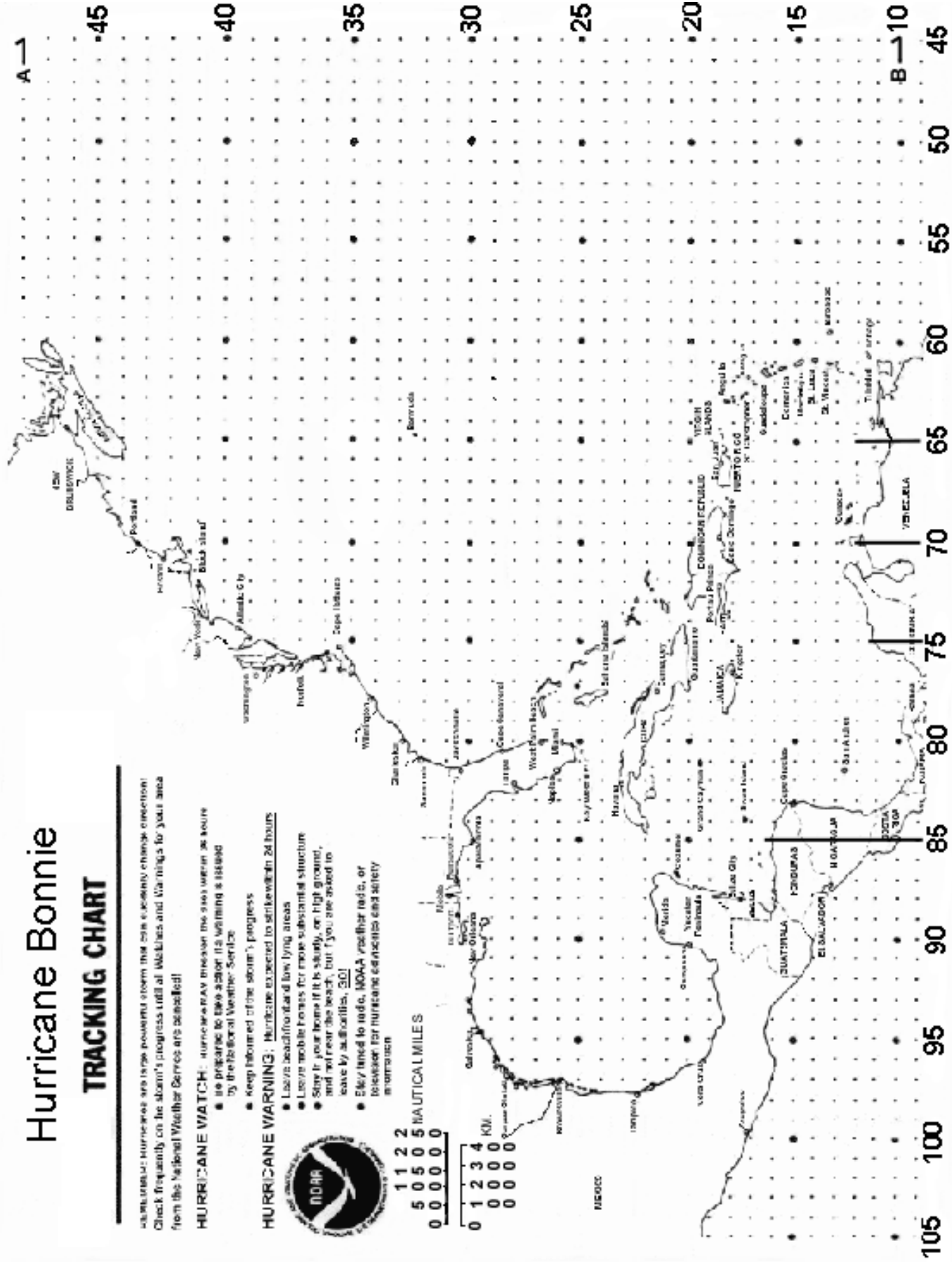
HURRICANE WARNING: Hurricane expected to strike within 24 hours

- Leave beachfront and low lying areas
- Leave mobile homes for more substantial structure
- Stay in your home if it is sturdy, on high ground, and not near the beach, but if you are asked to leave by authorities, GO!
- Stay tuned to radio, NOAA weather radio, or television for hurricane conditions and safety information



1 1 2 2
5 0 5 0 5 NAUTICAL MILES
0 0 0 0 0 0

0 1 2 3 4
0 0 0 0 0 KM.
0 0 0 0 0



Hurricane BONNIE Data

ADV	LAT	LON	TIME	WIND	PR	STAT	
1	16.00	-51.00	08/19/21Z	30	1005	TROPICAL	DEPRESSION
2	16.50	-52.40	08/20/03Z	30	1005	TROPICAL	DEPRESSION
2A	16.90	-53.20	08/20/06Z	30	1005	TROPICAL	DEPRESSION
3	16.80	-53.60	08/20/09Z	30	1005	TROPICAL	DEPRESSION
3A	17.50	-55.50	08/20/12Z	30	1005	TROPICAL	DEPRESSION
4	18.00	-58.00	08/20/15Z	30	1005	TROPICAL	DEPRESSION
4A	17.60	-59.60	08/20/18Z	30	1005	TROPICAL	DEPRESSION
5	17.90	-60.70	08/20/21Z	45	1004	TROPICAL	STORM
5A	18.60	-61.50	08/21/00Z	45	1004	TROPICAL	STORM
6	19.00	-62.30	08/21/03Z	45	1001	TROPICAL	STORM
6A	19.30	-63.30	08/21/06Z	45	1001	TROPICAL	STORM
7	19.90	-64.00	08/21/09Z	45	1001	TROPICAL	STORM
7A	20.20	-64.60	08/21/12Z	45	1001	TROPICAL	STORM
8	19.80	-65.40	08/21/15Z	55	999	TROPICAL	STORM
8A	20.30	-66.00	08/21/18Z	55	999	TROPICAL	STORM
9	20.60	-66.70	08/21/21Z	55	997	TROPICAL	STORM
9A	20.80	-67.50	08/22/00Z	55	988	TROPICAL	STORM
10	21.40	-68.00	08/22/03Z	60	991	TROPICAL	STORM
10A	21.80	-68.70	08/22/06Z	65	987	HURRICANE-1	
11	22.10	-69.40	08/22/09Z	65	987	HURRICANE-1	
11A	22.40	-70.00	08/22/12Z	70	980	HURRICANE-1	
12	22.70	-70.60	08/22/15Z	75	980	HURRICANE-1	
12A	23.00	-70.50	08/22/18Z	75	977	HURRICANE-1	
13	23.30	-71.00	08/22/21Z	80	977	HURRICANE-1	
13A	23.40	-71.20	08/23/00Z	85	973	HURRICANE-2	
14	23.60	-71.50	08/23/03Z	90	962	HURRICANE-2	
14A	23.70	-71.50	08/23/06Z	90	959	HURRICANE-2	
15	23.80	-71.70	08/23/09Z	90	959	HURRICANE-2	
15A	24.00	-71.70	08/23/12Z	90	959	HURRICANE-2	
16	24.20	-71.60	08/23/15Z	100	957	HURRICANE-3	
16A	24.60	-71.60	08/23/18Z	100	957	HURRICANE-3	
17	24.80	-71.80	08/23/21Z	100	955	HURRICANE-3	
17A	24.80	-71.80	08/24/00Z	100	958	HURRICANE-3	
18	25.10	-71.90	08/24/03Z	100	954	HURRICANE-3	
18A	25.00	-72.10	08/24/06Z	100	958	HURRICANE-3	
19	25.20	-72.20	08/24/09Z	100	963	HURRICANE-3	
19A	25.50	-72.50	08/24/12Z	100	963	HURRICANE-3	
20	25.60	-72.40	08/24/15Z	100	964	HURRICANE-3	
21	26.30	-72.90	08/24/21Z	100	963	HURRICANE-3	
22	27.20	-73.10	08/25/03Z	100	962	HURRICANE-3	
22A	27.60	-73.70	08/25/06Z	100	963	HURRICANE-3	
23	28.10	-74.00	08/25/09Z	100	963	HURRICANE-3	
24	28.80	-74.30	08/25/12Z	100	963	HURRICANE-3	
25	29.50	-75.20	08/25/15Z	100	964	HURRICANE-3	
26	30.00	-75.60	08/25/18Z	100	963	HURRICANE-3	
27	30.50	-76.20	08/25/21Z	100	963	HURRICANE-3	
27A	31.00	-76.50	08/26/00Z	100	958	HURRICANE-3	
28	31.60	-76.80	08/26/03Z	100	965	HURRICANE-3	
29	31.80	-77.30	08/26/06Z	100	965	HURRICANE-3	
30	32.40	-77.60	08/26/09Z	100	964	HURRICANE-3	
30A	32.70	-77.80	08/26/12Z	100	965	HURRICANE-3	
31	33.20	-77.80	08/26/15Z	100	966	HURRICANE-3	
31A	33.50	-77.90	08/26/17Z	100	966	HURRICANE-3	

31B	33.70	-78.00	08/26/19Z	100	963	HURRICANE-3
32	34.00	-78.00	08/26/21Z	100	963	HURRICANE-3
BONNIE Data (continurd)						
32A	34.10	-77.90	08/26/23Z	100	965	HURRICANE-3
32B	34.10	-77.80	08/27/01Z	90	965	HURRICANE-2
33	34.20	-77.70	08/27/03Z	85	967	HURRICANE-2
33A	34.40	-77.60	08/27/05Z	85	965	HURRICANE-2
33B	34.60	-77.50	08/27/07Z	85	970	HURRICANE-2
34	34.70	-77.50	08/27/09Z	75	970	HURRICANE-1
34A	34.90	-77.20	08/27/11Z	75	970	HURRICANE-1
34B	35.10	-77.00	08/27/13Z	65	975	HURRICANE-1
35	35.20	-76.80	08/27/15Z	55	978	TROPICAL STORM
35A	35.30	-76.60	08/27/17Z	55	980	TROPICAL STORM
35B	35.70	-76.10	08/27/19Z	55	981	TROPICAL STORM
36	35.80	-75.90	08/27/21Z	60	981	TROPICAL STORM
36A	35.90	-75.80	08/28/00Z	60	986	TROPICAL STORM
37	36.20	-75.50	08/28/03Z	65	985	HURRICANE-1
37A	36.10	-75.30	08/28/06Z	65	986	HURRICANE-1
38	36.50	-74.70	08/28/09Z	65	986	HURRICANE-1
38A	36.90	-74.50	08/28/12Z	65	990	HURRICANE-1
39	37.10	-74.10	08/28/15Z	65	992	HURRICANE-1
39A	37.30	-73.60	08/28/18Z	65	992	HURRICANE-1
40	37.70	-73.00	08/28/21Z	60	992	TROPICAL STORM
40A	37.80	-72.10	08/29/00Z	60	993	TROPICAL STORM
41	38.20	-71.20	08/29/03Z	60	993	TROPICAL STORM
42	39.30	-69.70	08/29/09Z	55	993	TROPICAL STORM
43	40.90	-67.10	08/29/15Z	50	994	TROPICAL STORM
44	42.30	-63.80	08/29/21Z	45	995	TROPICAL STORM
45	43.50	-59.60	08/30/03Z	50	989	TROPICAL STORM
46	44.80	-54.90	08/30/09Z	50	989	TROPICAL STORM
47	44.50	-51.50	08/30/15Z	45	990	EXTRATROPICAL