2014 Hurricane Briefing
Institute for Catastrophic Loss Reduction

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Canadian Hurricane Centre
Environment Canada
Contents

• Tropical Cyclones 101:  
  – Lifecycle, climatology and associated hazards

• Summary of the 2013 Hurricane Season

• What went wrong with last year’s forecast

• Outlook for the 2014 Hurricane Season

• Operational Response to Approaching Storms: Forecasting and Communications
What is a Tropical Cyclone?

- A relatively large and long-lasting low pressure system
- No fronts attached (unlike a winter storm)
- Forms over tropical or subtropical oceans
- Produces organized thunderstorm activity
- Has a closed surface wind circulation around a well-defined center

- Classified by maximum sustained surface wind speed
  - Tropical depression: < 63 km/h
  - Tropical storm: 63 - 117 km/h
  - Hurricane: 118 km/h or greater
    - Major hurricane: 178 km/h or greater

- Often storms will transform into a system that looks more like a winter storm
Why do they form?

- Tropical Cyclones form due to a build-up of heat energy in the ocean
- Tropical cyclones regulate the planet’s temperature
Typical life cycle of a hurricane
Questions #1
Tropical Cyclone Hazards

Inland Tropical Cyclone Fatalities since 1950

- Flood (rain): 63%
- Automobile: 19%
- Drownings (coastal waves): 8%
- Post-storm: 4%
- Rescue workers: 2%
- Misc: 3%
- Structural failures: 1%

Includes 82 fatalities in Hazel in 1954
Tropical Cyclone Hazards

Inland Tropical Cyclone Fatalities since 1950 (without Hazel)

- Automobile: 46%
- Drownings (coastal waves): 19%
- Flood (rain): 10%
- Post-storm: 11%
- Rescue workers: 5%
- Misc: 7%
- Structural failures: 2%
Tropical Cyclone Hazards

Rainfall

• As a hurricane the distribution of rainfall is almost the same on either side of the actual track

• As the storm approaches Canada it becomes post-tropical meaning it takes on the structure of a winter-type storm

• Rain on the right side begins to erode leaving the heaviest rain on the left side of the track

• Rainfall rates can reach 20-50 mm per hour
Tropical Cyclone Hazards

Extreme rainfall examples

- Hazel in 1954 (213 mm)
- Beth in 1971 (296 mm)
- Bertha in 1990 (194 mm)
- Harvey in 1999 (302 mm)
- Gabrielle in 2001 (175 mm)
- Hanna in 2008 (145 mm)
- Igor in 2010 (232 mm)
Tropical Cyclone Hazards

Wind

- Winds on both sides of a hurricane are very similar
- The difference in wind speed from right to left increases as the speed of the storm increases
- The maximum wind speed may not be as strong but the contrast between the left and right sides is higher
- Wind covers a larger area as the storm becomes post-tropical
Tropical Cyclone Hazards

Damaging wind examples

- Edna in 1954 (161 km/h)
- Ginny in 1963 (178 km/h)
- Gerda in 1969 (175 km/h)
- Juan in 2003 (176 km/h)
- Noel in 2007 (139 km/h)
- Igor in 2010 (172 km/h)
Tropical Cyclone Hazards

Storm Surge

- Abnormal rise in water generated by a storm, over and above the astronomical tide
- Caused primarily by force of wind blowing across water surface
- Contribution by low pressure within center of storm is minimal

Some Factors Affecting Storm Surge:
- Wind speed
- Direction of the storm
- Size of the storm
- Coastal bathymetry
Tropical Cyclone Hazards

Damaging Waves

- On occasion a particular phenomenon can give rise to extreme wave heights
- Meteorologists at the (CHC) have investigated the problem of waves that are “trapped” within a weather system
- Waves move in harmony with a storm, allowing waves to build to enormous heights
- This threat is most significant along the Atlantic coast
- Large waves and ponding surf can also be a threat in the Gulf of St Lawrence
Questions #2
Tropical Cyclone Climatology

Number of North Atlantic Basin Tropical Cyclones per 100 Years

- Depressions + Storms + Hurricanes + Major Hurricanes
- Storms + Hurricanes + Major Hurricanes
- Hurricanes + Major Hurricanes
- Major Hurricanes

Tropical Cyclone distribution by month
On average, 1 or 2 storms directly affect Canadian land regions each year. Another 2 or 3 typically threaten our offshore waters.
Hurricane Season 2013 in Review

Summary:
14 Named Storms
2 Hurricanes
0 Major hurricanes
Storms affecting Canadian territory in 2013

Post-Tropical Storm Andrea
- Heavy rainfall over parts of the Maritime Provinces
- Over 100 mm of rain in some areas but little or no flooding
- Gusty wind caused scattered power outages

Post-Tropical Storm Gabrielle
- Mostly a rainfall event with as much as 75 mm
What happened last year?

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<th>National Oceanic and Atmospheric Administration (US)</th>
<th>Named Storms</th>
<th>Hurricanes Category 1 to 5</th>
<th>Major Hurricanes Category 3-5</th>
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<td>Actual Storms</td>
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- Fewest number of hurricanes since 1982
- First time there were no major hurricanes since 1994
- First time there were no storms stronger than category 1 since 1968
What happened last year?

Increased wind shear
Cooler, drier air & Cooler water
Stronger circulation developed
Large-scale subsidence

Clockwise atmospheric circulation became stronger than expected
2014 Hurricane Season Outlook
# 2014 Hurricane Season Outlook

<table>
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Global Sea Surface Temperatures

Cooler water temperatures over the Atlantic means fewer storms.

Warming sea surface temperatures indicate El Nino conditions which suppresses hurricane activity in the Atlantic.
Latest Atlantic Sea Surface Temperature Pattern

Water temperatures are cooler than normal in the main storm formation region of the tropical Atlantic Ocean.
# List of Atlantic Storm Names

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<td>Whitney</td>
<td>William</td>
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2014 Hurricane Season Outlook

Consider the following forecast:

100% Guarantee that there will be 8 named storms this hurricane season

What would be your initial reaction?
Consider the 1963 hurricane season:

- A total of 8 storms
- 5 storms entered the CHC response zone
- 4 of those storms were hurricanes
- Landfalling category 2 hurricane - Ginny
2014 Hurricane Season Outlook

Consider the 1963 hurricane season:

- Transformed to a powerful post-tropical storm
- 176 km/h maximum sustained winds
- Buildings damaged and coastal infrastructure submerged
- Widespread power and communications outages
Watch Widens For Hurricane

MIAMI, Fla. (AP) — A hurricane watch was extended northward from Daytona Beach, Fla., to Myrtle Beach, S.C., today as Hurricane Ginny drifted slowly up the Atlantic. The storm was centered about 165 miles east-northeast of Daytona Beach and moving toward the northwest at five miles an hour. Peak winds of 75 m.p.h. barely qualified the storm as a hurricane.

At the season's seventh tropical storm plowed northward, gale warnings were extended to Savannah, Ga., and lowered south of Daytona Beach. Little possibility remained that the hurricane would move inland over Florida. But the state's northeast coast was still in danger.

A slight change in direction toward the coast could bring a rapid increase in winds, forecasters cautioned. But forecasters Gordon Dunn said no important damage was expected even if the storm reached the coast.

Some beach heavy swells will menace the offshore. Please go ashore at your own risk.

BOATS BEARING
Sixty shrimp boats from Galveston, Texas, were waiting off the coast for work. The owners were in a dilemma. They had to sail across the hurricane to work or wait out the storm.

HALIFAX — (AP) — Reports of damage began to mount Tuesday night as Hurricane Ginny moved across the Maritimes on a course toward western Newfoundland.

Many small buildings were knocked over by winds that hit 100 m.p.h. or higher. Dozens of small vessels broke their moorings and were piled up on shore and at least one freighter met the same fate.

The winds from Hurricane Ginny were powerful enough to turn the windmills at Nova Scotia's windmills at Yarmouth. Telephone lines were down in many coastal areas.

At least one ship and several yachts and fishing vessels broke their moorings and were driven ashore by high waves. In neighboring Dartmouth, the 68-ton tugboat Southern Star VI, which was moored in the harbor, was washed ashore.

Leaves Rain, Snow In N.E.

HALIFAX — (AP) — The Maritime Office said Monday night Hurricane Ginny appeared to be heading for the Maritimes. Wind and heavy snow are expected to hit the area later today.

BOSTON — Hurricane Ginny, still a threat, raged over Nova Scotia and Prince Edward Island late Tuesday, leaving behind welcome heavy rains in parched New England.

Greenwood, N.S., measured winds exceeding 100 m.p.h. per hour and St. Johns, N.B., had gusts up to 92 m.p.h.

Although winds at the storm's center measured about 100 m.p.h. in gusts, Ginny's travel over land and cold water caused it to lose tropical characteristics and the Weather Bureau said it is now a true hurricane.

Moving To Northeast

At last report the center of the storm was over the western portion of Prince Edward Island after having crossed Nova Scotia near Yarmouth. It was moving rapidly to the northeast, with gusts extending 150 miles from the center in its western semicircle and 350 miles in the eastern semicircle.

The advisory said the storm would continue to move in a northeasterly direction at about 35 miles an hour during the next 12 hours, then take a more easterly course. The Weather Bureau warned that Ginny would continue to carry high winds for at least 12 to 24 hours.

Higher Tides

Tides were expected to remain one to two feet above normal along the Maine coast southward to New Jersey for at least 12 hours and owners of small craft were advised to remain in port.

Afternoon tides were about one to two feet above normal along the Maine coast southward to New Jersey, except two to four feet on the bay side of Cape Cod. High seas and breakers were expected to hit New England.

Heavy rain ended over southeastern New England but moderate to heavy snows fell in central and northern Maine. Eight inches had fallen at Greenville, Maine, since morning. Rain was the heaviest along the coast. Nantucket Island measured slightly more than 2.5 inches.

The coastal half of New England picked up from one to two inches of much needed rain.

While awaiting its next move, weathermen put a 175-mile stretch of Florida coastline from Cape Canaveral to Fort Lauderdale under a hurricane watch. Fort Lauderdale is just a few miles north of Miami.

Heavy seas kicked up by Ginny's 75 mile an hour winds.

Ginny Stalls, Threatens 'Yo-Yo' Route

MIAMI (UPI) — Wrong-way hurricane Ginny stalled again Wednesday off the Florida coast and showed signs of swinging into an erratic loop that would send it shooting back to the north like a yo-yo.

While awaiting its next move, weathermen put a 175-mile stretch of Florida coastline from Cape Canaveral to Fort Lauderdale under a hurricane watch. Fort Lauderdale is just a few miles north of Miami.

Heavy seas kicked up by Ginny's 75 mile an hour winds.
Other examples of note

Years with low number of storms but with damaging ones or near-misses:

- 1954 saw 8 named storms – one was Hazel (massive flooding in Ontario) and the other was Edna (damaging wind in the Maritimes)
- 1964 saw 9 storm – 6 entered the Canadian with 2 landfalls at almost the identical location
- 1991 saw 7 named storms during that El Nino year – one was hurricane Bob and the other was the so-called “Perfect-Storm”
- 1996 saw 13 named storms – one was a landfalling hurricane in the Maritimes (Hortense)
- 2002 saw 12 named storms during that El Nino season - one was a landfalling hurricane in the Maritimes (Gustav)
- 2009 saw 11 named storms – 2 entered the response zone but one was hurricane Bill which came to within about 40 km of making landfall with 140 km and 20+ m waves
Hurricane Readiness and Operational Response to Hurricanes
Pre-Season Hurricane Readiness

• Good opportunity to review emergency plans

• Public education and training

• Hurricane seasonal briefing for emergency managers

• Cover the basics of tropical cyclones and how they affect Canada, review of previous year and outlook for the current year. Also review of the established operational practices used during actual storms

• Decision to execute many of the steps in an emergency plan will be based on weather information
Monitoring Tropical Activity

- A good tool to check overall tropical activity is the Tropical Weather Outlook issued by the NHC in Miami

http://www.nhc.noaa.gov/gtwo_atl.shtml
Storm Watch - 120 hours

- Tropical Weather Outlook (NHC) still a good place to start

- CHC will issue preliminary bulletins once or twice per day beyond 72 hours prior to the storm entering the response zone

- All tracks will be displayed on the CHC hurricane track map
  - Red tracks are NHC-issued tracks

CHC Website
www.hurricanes.ca
Storm Watch - 72 hours

- CHC will typically begin to issue regularly scheduled information bulletins every 6 hours about 72 hours prior to the storm entering the response zone.

- Issue times are 3 and 9 am and pm
  - Summary information on initial position, intensity, motion
  - Public impacts and warnings broken down by hazard (wind, rainfall, surge/waves)
  - Marine impacts and warning

- All tracks will be displayed on the CHC hurricane track map
  - Blue tracks are CHC-issued tracks
  - Red tracks are NHC-issued tracks

CHC Website
www.hurricanes.ca
### Forecast/Business Cycle at the CHC

<table>
<thead>
<tr>
<th>Time (HR:MM) (Atlantic time)</th>
<th>Event or Task</th>
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</table>
| 9:00 am                     | • Issue CHC Hurricane Information Statement, Technical Bulletin and the forecast track map  
                              | • Update any Tropical Warnings                                               |
| 09:15 am                    | • Emergency Management Briefings (if necessary)                              |
| 10:00 am                    | • Federal GOC Briefing (if necessary)                                        |
| 11:00 am                    | • Internal coordination call                                                  |
| 12:00 pm                    | • Transmit intermediate bulletin (if necessary)                              
                              | • Prepare material for media briefing                                       
                              | • Review NHC updated advisory                                                
                              | • Review new model guidance                                                  |
| 1:00 pm                     | • Media technical media briefing                                             |
| 2:00 pm                     | • Blackout period for the media                                              
                              | • Intermediate consultation with emergency managers                          |
| 3:00 pm                     | • New cycle begins                                                           |
Storm Watch - 36 hours

Watches and Warnings

- Once the storm is close enough and forecast confidence is higher, watches and warnings are issued in addition to the information bulletins.

Tropical Storm: winds 70 km/h to 118 km/h

Hurricane: winds 119 km/h or more

A Watch: wind conditions possible within 36 hours

A Warning: wind conditions expected within 24 hours

Note: It is recommended that all storm preparation activities be complete prior to the arrival of Tropical Storm Force winds.
Operational Response to Hurricanes

Hurricane Position Forecast Errors

**Avg. Position Error**
- 72 hrs – 212 km
- 48 hrs – 144 km
- 24 hrs – 96 km

Track error has diminished by about 13% from 2013
Common Misconception – Track Forecast

- Represents the probable track of the center of the tropical cyclone

- Track error cone is formed by connecting circles centered on each forecast point (at 12, 24, 36 h, etc.)

- Size of the circles are determined so that the actual storm position at a certain time will be within the corresponding circle 67% of the time
Operational Response to Hurricanes

Today’s cone superimposed on the cone used in 2003 for hurricane Juan

Tropical Storm Juan
September 26, 2003
5 AM EDT Friday

Advisory 4
Current Center Location 31.5 N 61.9 W
Max Sustained Wind 65 mph
Current Movement 9 mph
Use caution when interpreting model track forecasts!

- About 35 different track models
- Some of these models will provide more than one possibility
- Some models simply do not apply under certain situations
- Some of the best models are not used in these plots
Operational Response to Hurricanes

New Experimental Tools

- Threat areas for rainfall and wind (and possibly other parameters) can be produced time permitting and made available to emergency managers.
- Product will be internal for 2014 but will look at making it widely available in the future.
Operational Response to Hurricanes

New and Upcoming Tools

• Shape files are produced by the Canadian Hurricane Centre to be ingested into GIS applications
• Can also be viewed using Google Earth
Operational Response to Hurricanes

Social Media

• Using Twitter more this year to point to updates in the hurricane status
• Experimenting with YouTube to post short updates on active storms approaching Canada
Tides during hurricane season

• As we are near the peak of the 19-year tidal cycle we are seeing record tides
• Record level tides occurred in early January and February of this year
• Those records will be broken once again in August
Tides during hurricane season

Photo: Randy Mosher
Tides during hurricane season

Photo: Randy Mosher
Tides during hurricane season

Should a storm surge producing hurricane approach during high tide this summer and fall the impacts could be more significant than they would normally be.

Peak High Tide Dates this Season

- August 12\textsuperscript{th}
- September 10\textsuperscript{th}
- October 9\textsuperscript{th}
- November 7\textsuperscript{th}
....it only takes one storm! Are you prepared?