Environment and Climate Change Canada | Environnement et Changement climatique Canada

Canada

2017 Hurricane Briefing

Institute for Catastrophic Loss Reduction

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Warning Preparedness Meteorologist
Canadian Hurricane Centre

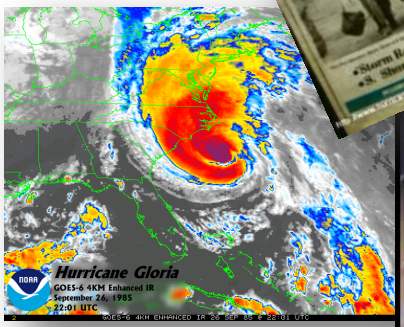
Contents

- 30 years of hurricanes in Canada
- Tropical Cyclones and their Associated Hazards
- Review of the 2016 Hurricane Season
  - A look at last year's storms and the lessons learned from them
- Outlook for the 2017 Hurricane Season
- Hurricane decision making tools

30 Years of Hurricanes in Canada

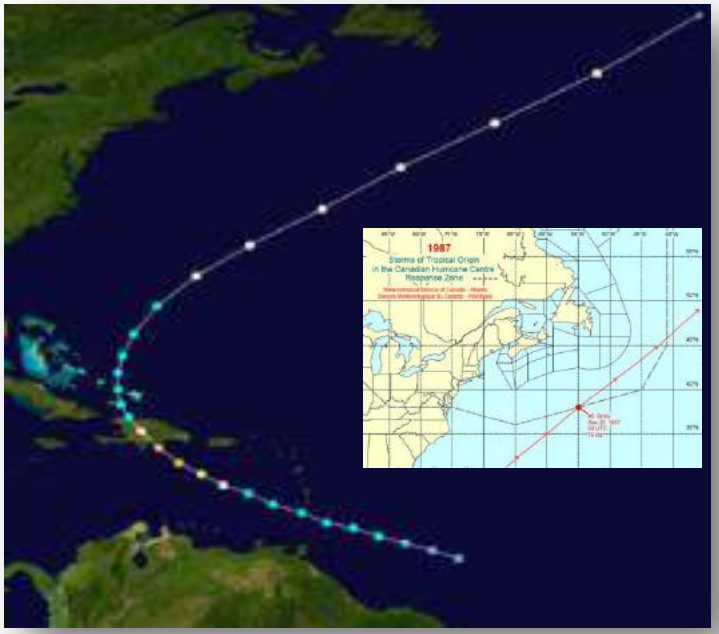
Why Does Canada have a Hurricane Centre?

- Back in 1985 a hurricane named Gloria tracked up the east coast of the U.S.
- Media coverage was intense and some U.S. media mentioning the likelihood of significant impacts in eastern Canada
- The behavior of tropical cyclones as they approach northern latitudes was not well understood at the time
- Damage was minimal over Canada



Canadian Hurricane Centre

- After about 2 years of planning, the Canadian Hurricane Centre was established in 1987 (August 31st)
- First official bulletin issued by the CHC was for hurricane Emily at 9 pm Friday September 25th 1987
- Only 3 forecast positions

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FXCN5 CWHX 252330
CANADIAN HURRICANE PROGNOSTIC MESSAGE ISSUED BY
ENVIRONMENT CANADA AT 0830 PM ADT FRIDAY 25 SEPTEMBER 1987.

THE NEXT MESSAGE WILL BE ISSUED BY 0230 AM ADT.

1. HURRICANE EMILY LOCATED NEAR 37.0N 57.0W AT 22Z 25 SEPT. NO
ESTIMATE OF LOWEST PRES AT THIS TIME BUT 18Z ESTIMATE WAS 973MB.
MAX SUSTAINED WINDS NEAR 80 KTS. HURRICANE EMILY MOVING NE 40 KTS.

2. EMILY EXPECTED TO CONTINUE PRESENT TRACK AND SPEED FOR NEXT 24 TO
48 HRS WITH SLO WEAKENING AS IT MOVS OVR COLDER WATER TONIGHT AND
SATURDAY AND WILL LIKELY BECOME EXTRA TROPICAL ON SUNDAY.
FCST POSNS.
26 SEPT 06Z 39.5N 51.5W
26 SEPT 18Z 43.0N 42.0W
27 SEPT 18Z 48.0N 24.0W

3. GALES ARE EXPECTED WITHIN 150 NM OF EMILY AND STORM FORCE
WITHIN 75 NM AND HURRICANE FORCE CLOSE TO THE CENTRE. MAX SUSTAINED
WNDS SHUD DMNSH TO NR 75 KTS BY 18Z 26 SEPT.

4. THE GALES AND HEAVY PCPN ARE EXPECTED TO AFFECT THE SOUTHEASTERN
NEWFOUNDLAND MARINE AREAS BY SAT.
END RWH
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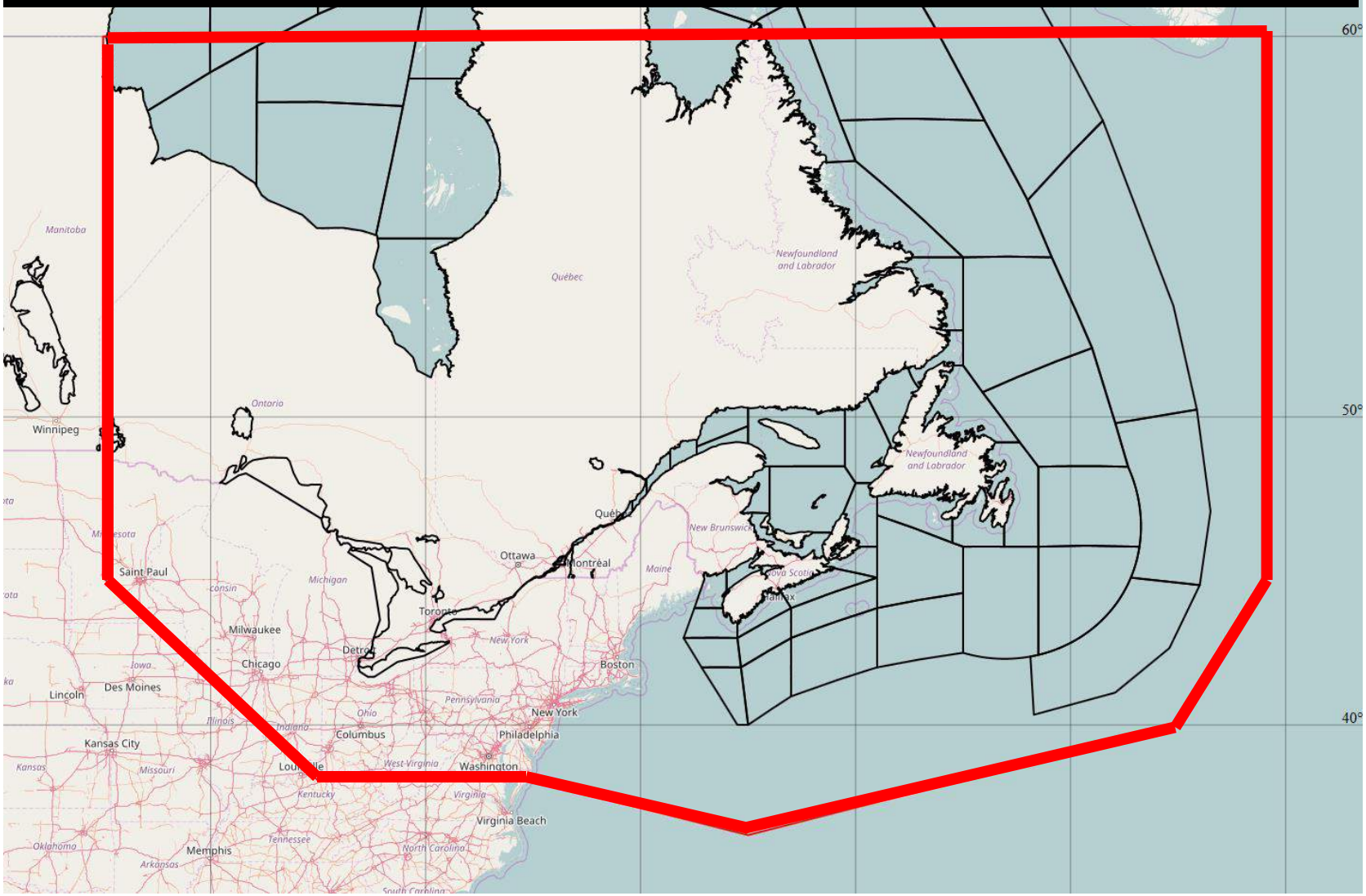
Canadian Hurricane Centre Response Zone

Since 1987 the CHC has sent 2445 bulletins and 116 storms have entered the Response Zone



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Canada

Then and Now

1987

- Tropical Cyclone Forecasts extended out to 72 hours
- Canada did not have a seat on the International World Meteorological Organization's Regional Area IV Tropical Committee
- The CHC did not have a special website for tropical cyclones
- No tropical-type watches or warnings
- Canada had never requested a tropical cyclone name be retired
- Typical forecast track error for 72 hours was 550 km

Today

- Current track forecasts extend out to 120 hours
- Canada is now a key member and significant contributor to this committee
- The CHC now has a dedicated website for tropical cyclone information (est. 1998)
- CHC now has the ability to issue tropical-type watches and warning
- Two tropical cyclone names have been retired at Canada's request: Juan and Igor
- Track error for 72 hour is now 198 km

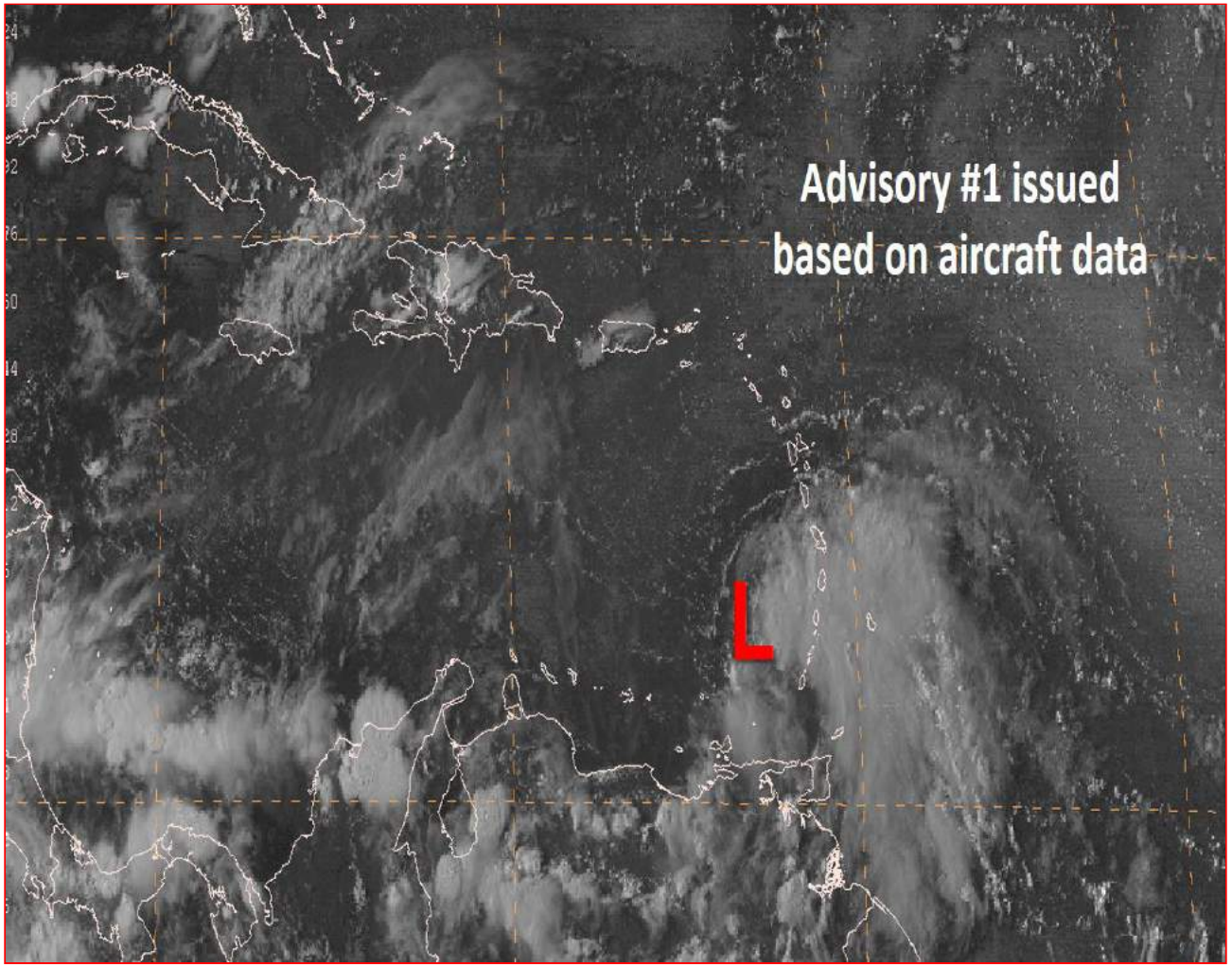
Tropical Cyclones

Tropical Cyclone

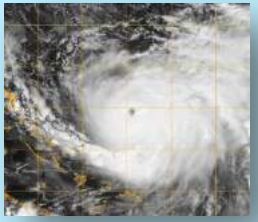
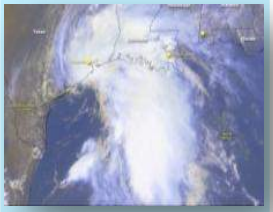
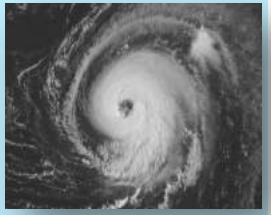
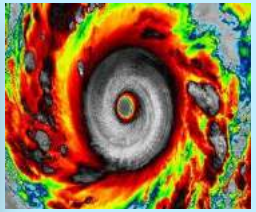
- Tropical cyclone is a relatively large and long-lasting low pressure systems that form over warm tropical water
- Tropical cyclones must have a closed surface wind circulation around a well-defined center
- They are classified by maximum sustained surface wind speed

Tropical Cyclones

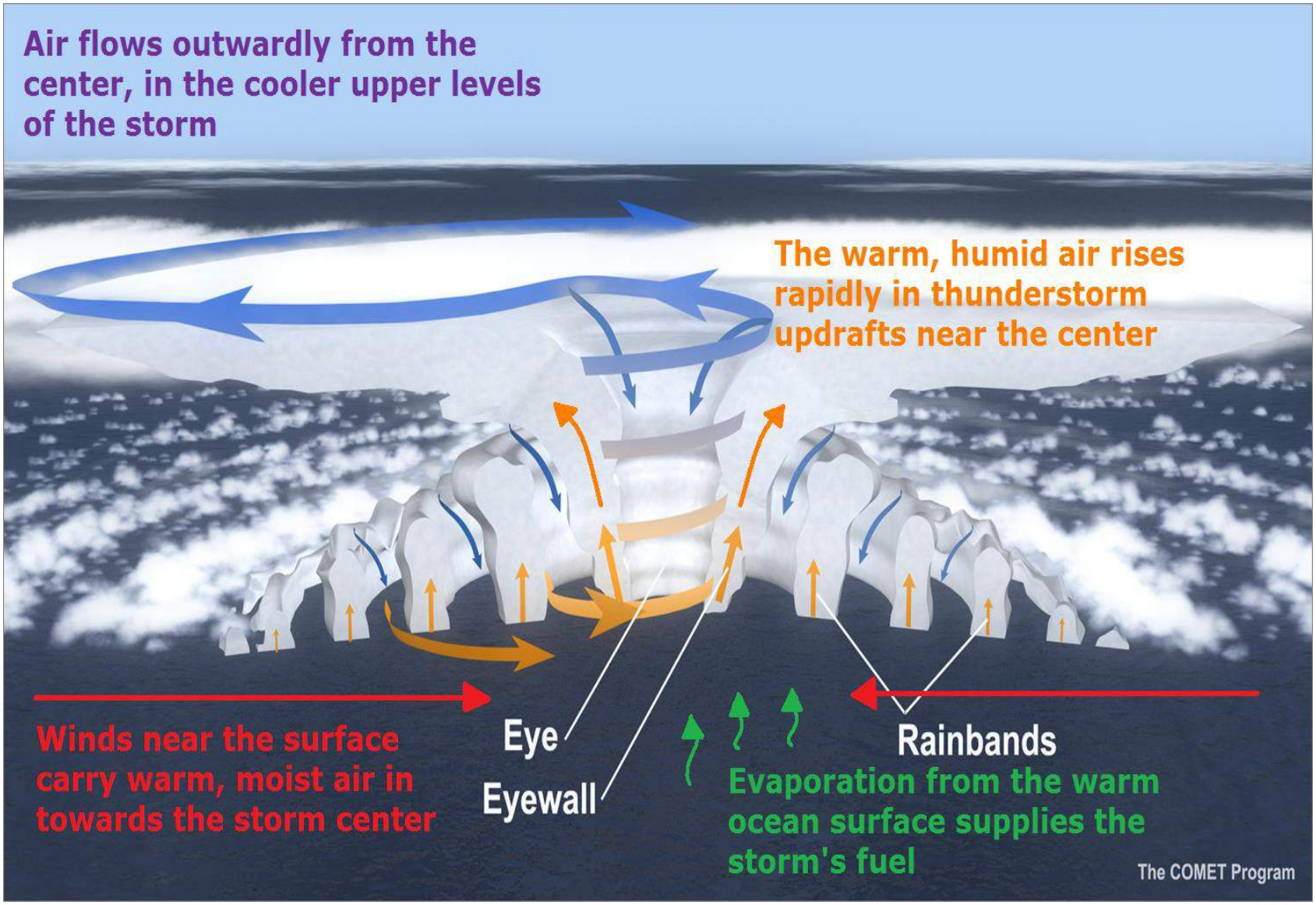
Aircraft data showed that it did and this was TS Ernesto in 2006



Tropical Cyclone Classification

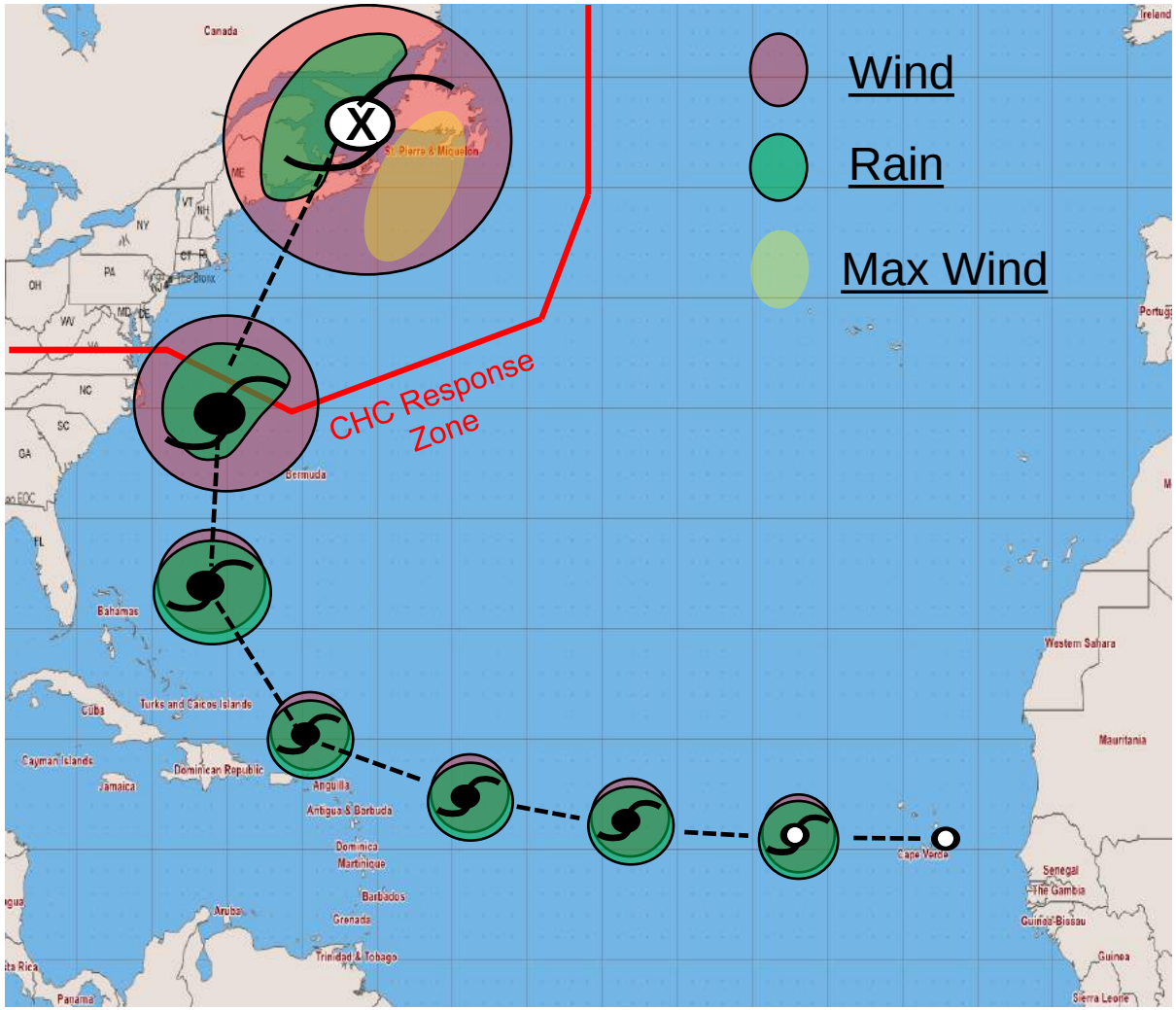
	Hurricane		Major Hurricane		
Tropical Storm	**Category 1**	**Category 2**	**Category 3**	**Category 4**	**Category 5**
Wind > 63 km/h	**Wind > 118 km/h**	**Wind > 154 km/h**	**Wind > 178 km/h**	**Wind > 211 km/h**	**Wind > 251 km/h**
 Debby (2012)	 Hermine (2016)	 Juan (2003)	 Joaquin (2015)	 Floyd (1999)	 Isabel (2003)
 Allison (2001)	 Isaac (2012)	 Arthur (2014)	 Gaston (2016)	 Rita (2005)	 Patricia (2015)

Tropical Cyclones – Nature's Heat Engine



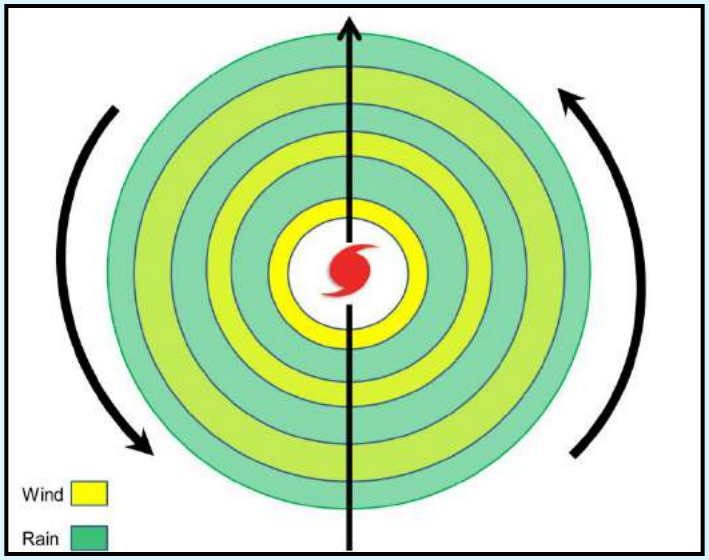
Tropical Cyclone Lifecycle

- Hurricanes are typically symmetric
- As hurricanes approach northern latitudes they speed up and get bigger
- This process is called extra-tropical transition
- End result is what we call a post-tropical storm with heavy rain on the left of the track and wind on the right



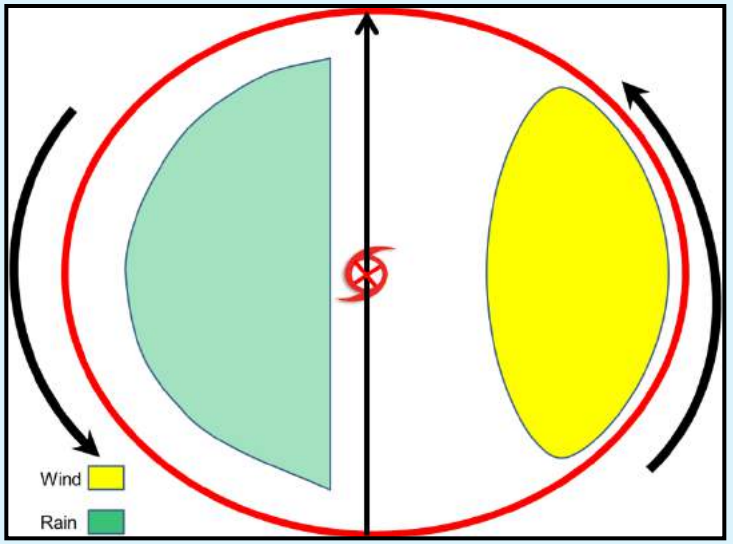
Tropical vs. Post-Tropical

Tropical



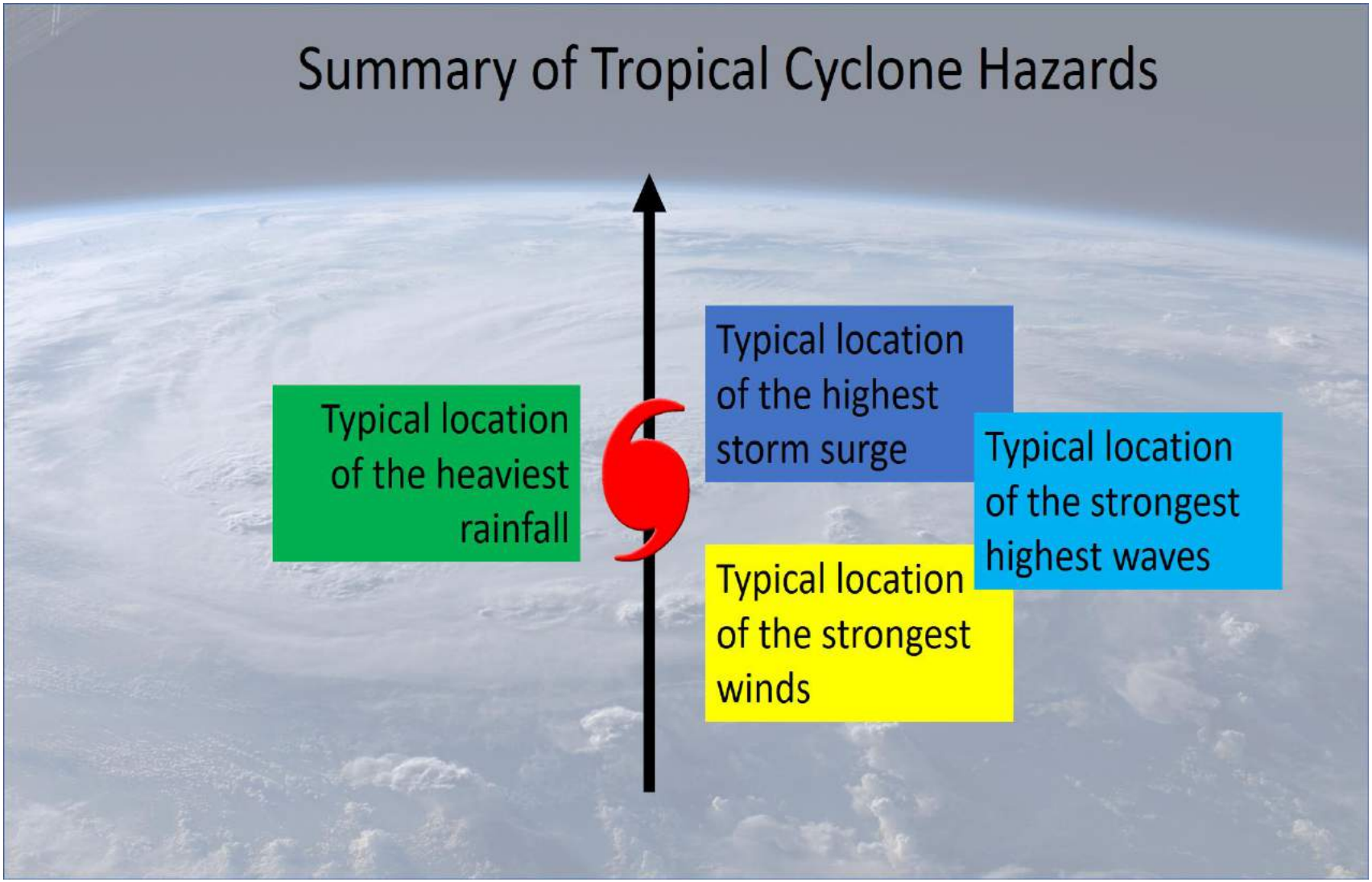
- Stronger winds for a series of concentric bands around the centre of the storm
- Strongest winds are found in the band closest to the centre – this is called the eyewall
- Rain is heavy and fairly symmetric around the centre of the storm

Post-Tropical

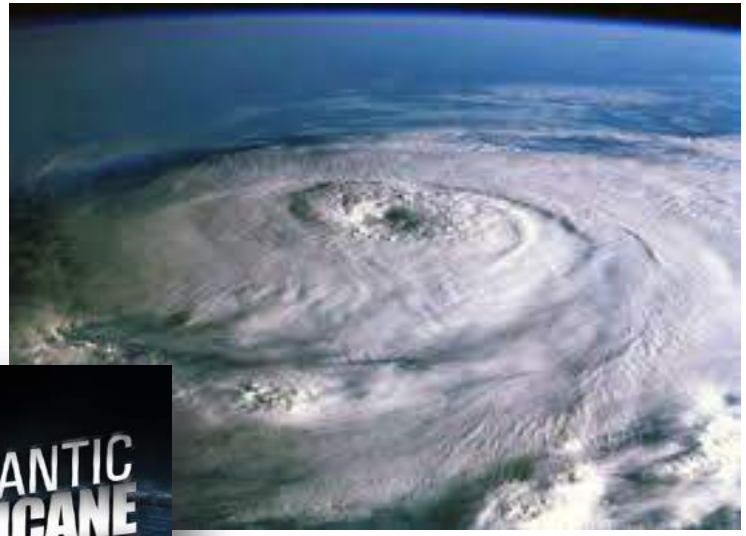


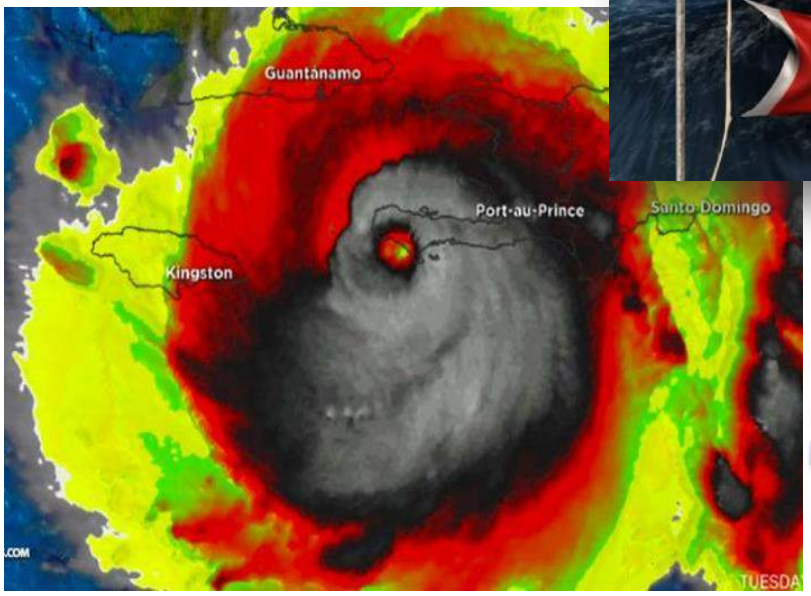
- Size of the storm increases
- Strongest winds usually found on the right side of the storm's track and some distance away from the centre
- Heaviest rain usually found on the left side of the storm's track

Tropical Cyclone Hazards



Hurricane Season 2016 in Review





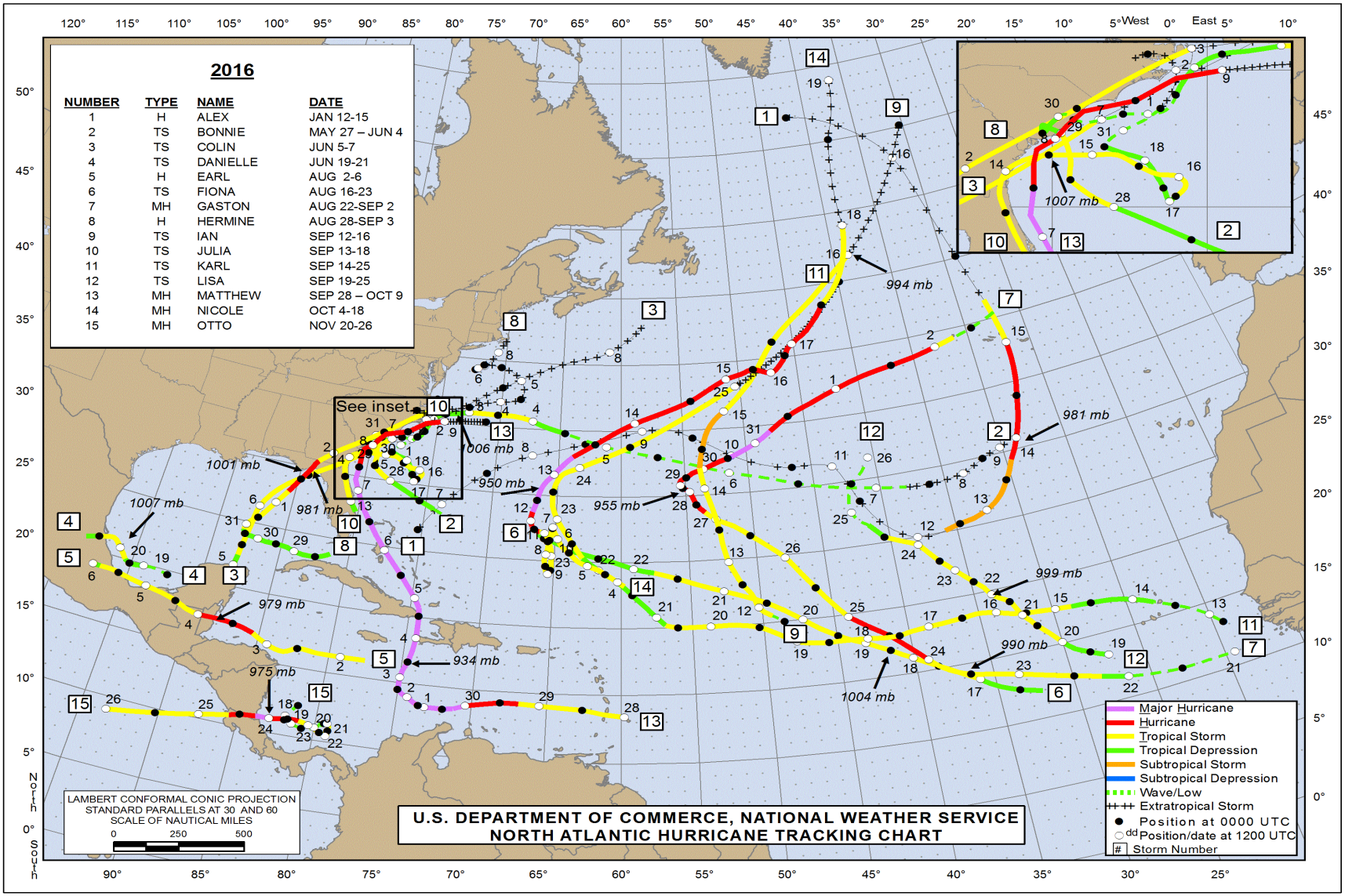
Canadian Hurricane Centre

Canadian Hurricane Centre

What happened last year?

	Named Storms	Hurricanes Category 1 to 5	Major Hurricanes Category 3-5
National Oceanic and Atmospheric Administration (US)	**10-16**	**4-8**	**1-4**
Actual Number of Storms	**15**	**7**	**4**

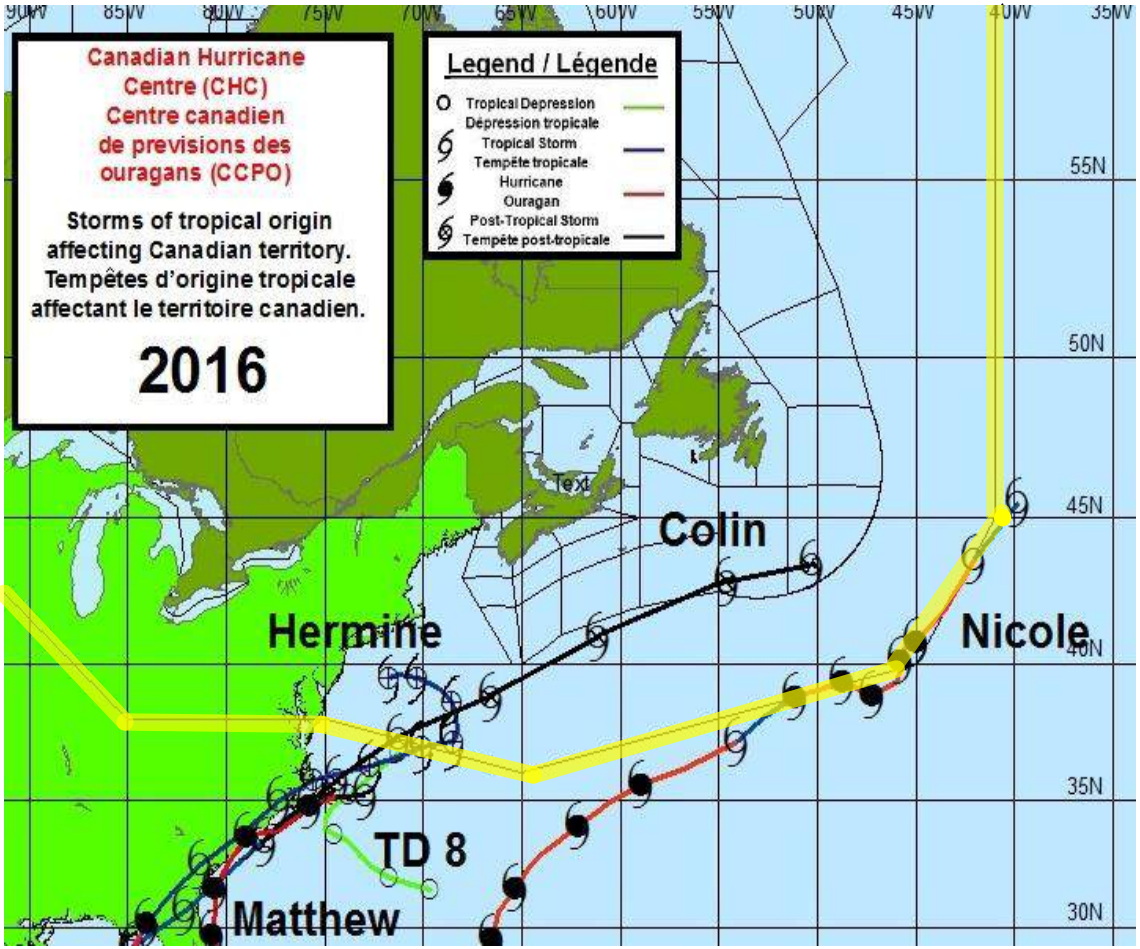
2016 Hurricane Season in Review



2016 Hurricane Season Review

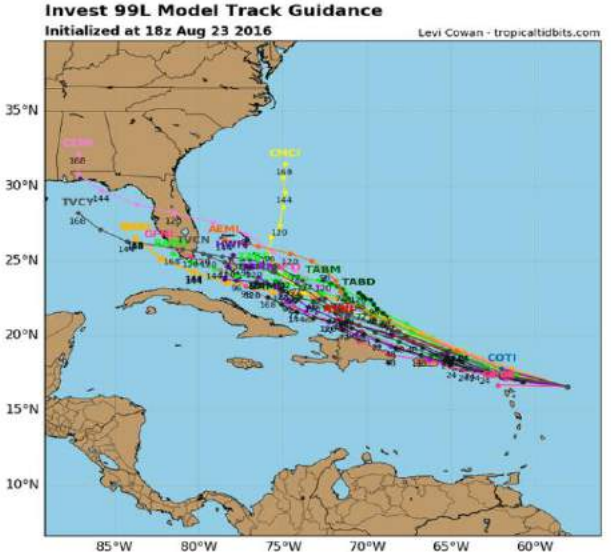
2016 season activity:

- **3 named storms entered CHC response zone**



2016 Season in Review – Hermine

- Started off as Invest 99L
- Predicted to become a Tropical cyclone over the mid or western Atlantic
- Finally became tropical cyclone on August 28th
- Initially not expected to become a hurricane
- 24 hours before landfall the forecast intensity increased and Hurricane Warnings were posted
- Florida got its first landfalling hurricane in 11 years



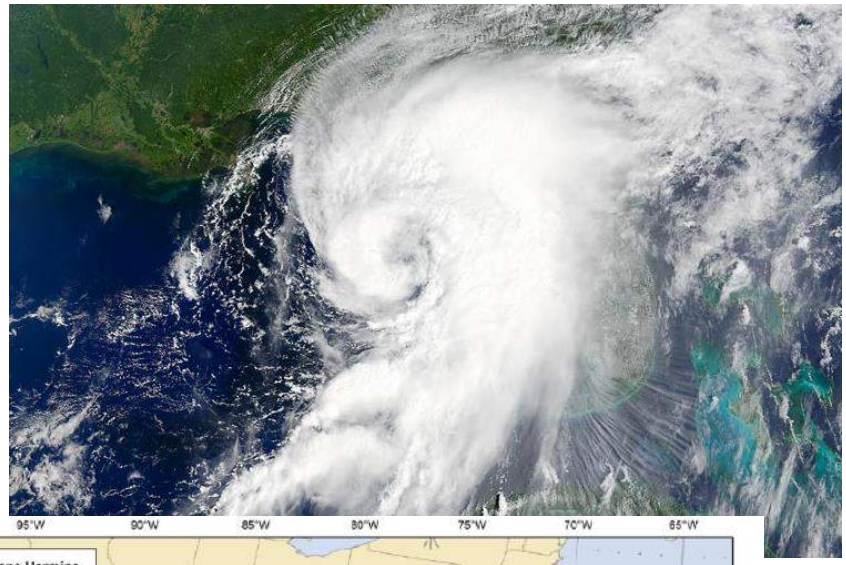
2016 Season in Review – Hermine

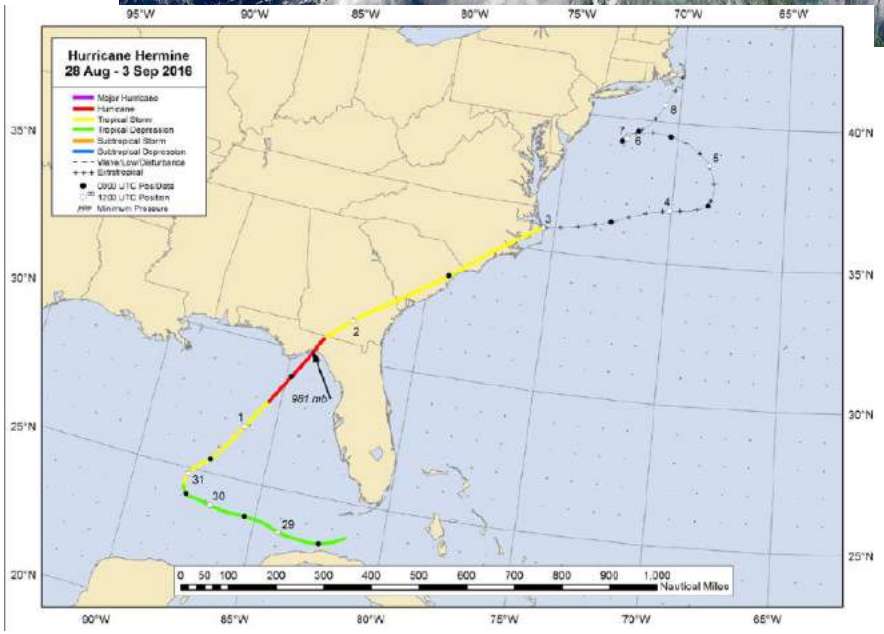
- Hermine was a category 1 when it made landfall along the sparsely populated Big Bend coast of Florida

- Hermine moved across Georgia, South Carolina, and North Carolina as a tropical storm and then meandered off the mid-Atlantic coast as an extratropical low for a few days

- Storm actually regained hurricane strength as a post-tropical storm over the Atlantic before weakening

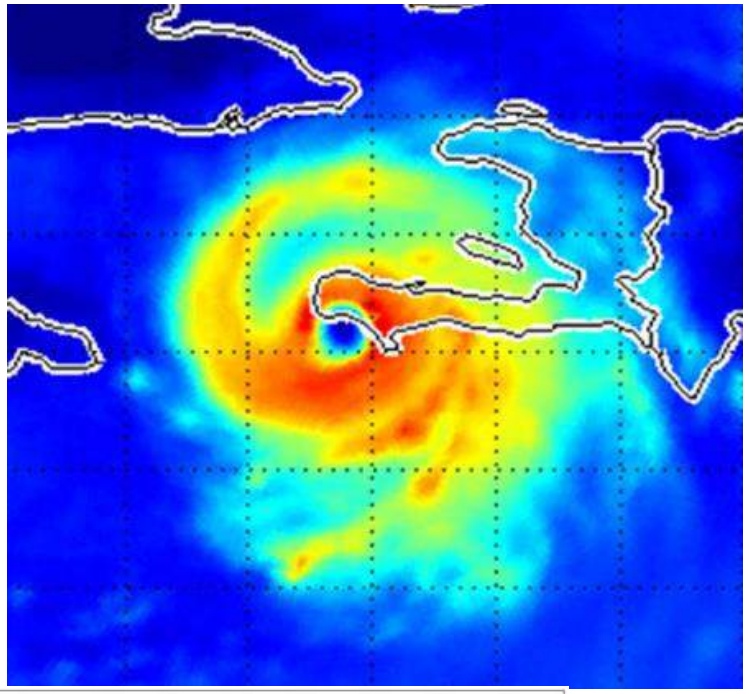
- One direct death and about $550 M in damages





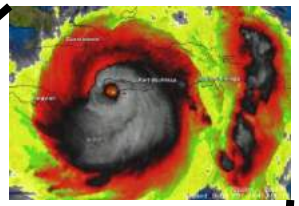
2016 Season in Review – Matthew

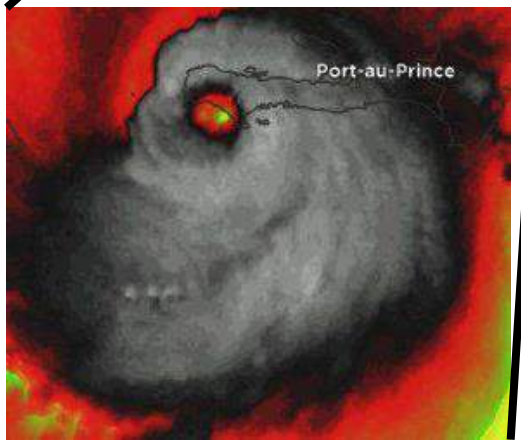
- Matthew was a category 5 hurricane that later made landfall as a major hurricane in Haiti, Cuba and the Bahamas. A 4th landfall occurred in South Carolina as a category 1
- Peak winds 145 knots (269 km/h)
- Surge also caused problems – peak surge in the U.S was 2.1m
- Rainfall was a the biggest hazard with this storm
- “Matthew” was retired from the list of hurricane names



2016 Season in Review – Matthew

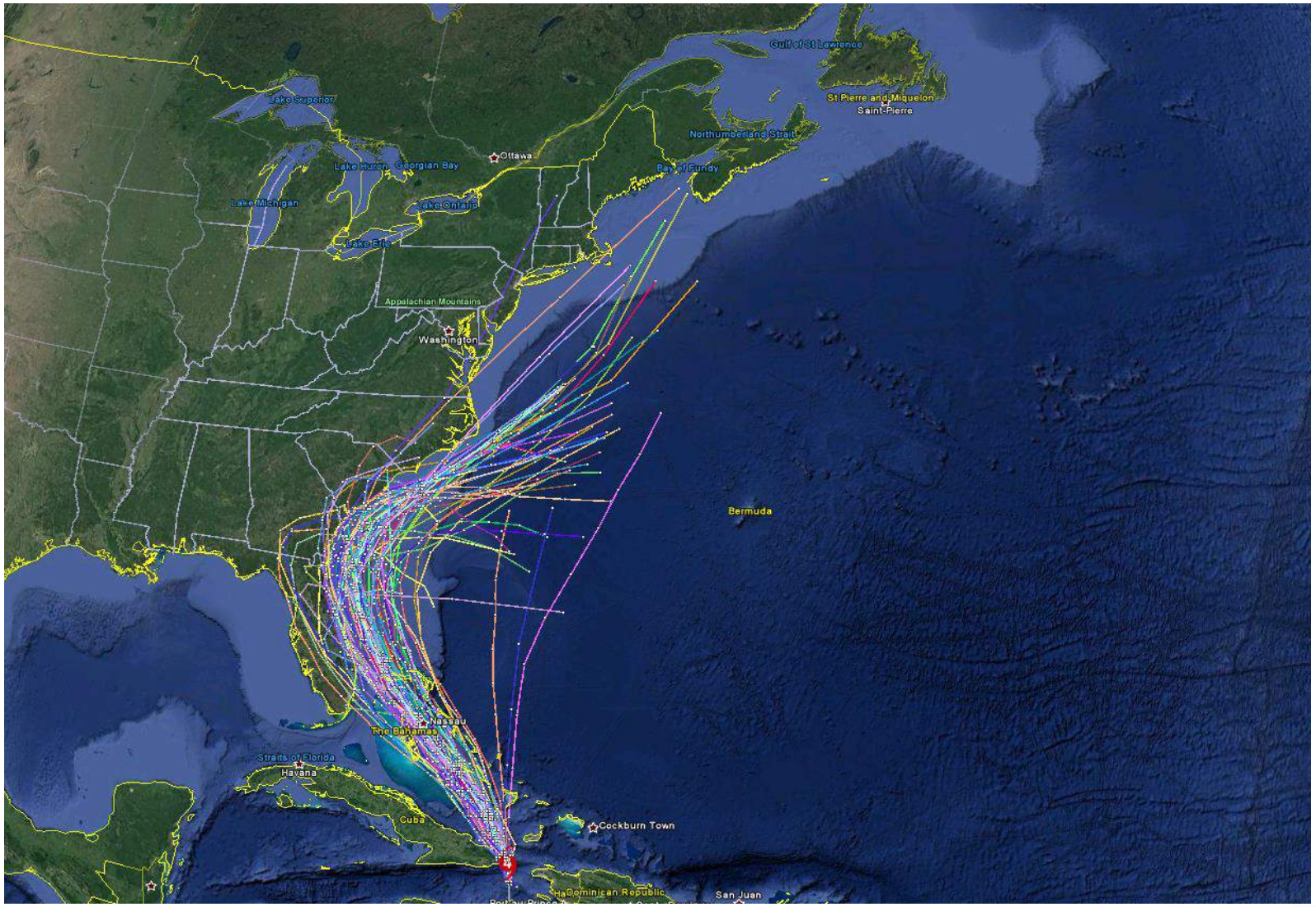
- Rainfall:
  - Haiti: 604.5 mm
  - Cuba: 661.4 mm
  - Dominican Republic: 506 mm
  - U.S.: 481 mm
- Total of 585 direct deaths - more than 500 deaths in Haiti alone making Matthew the deadliest Atlantic hurricane since Hurricane Stan in 2005
- 3 million evacuations from coastal U.S.
- $8-12 B in damage in the U.S.
- 24 fatalities in NC
  - 23 flood related
  - 19 caused by driving or walking into flood waters
- Moisture from Matthew also contributed to devastating floods in Canada





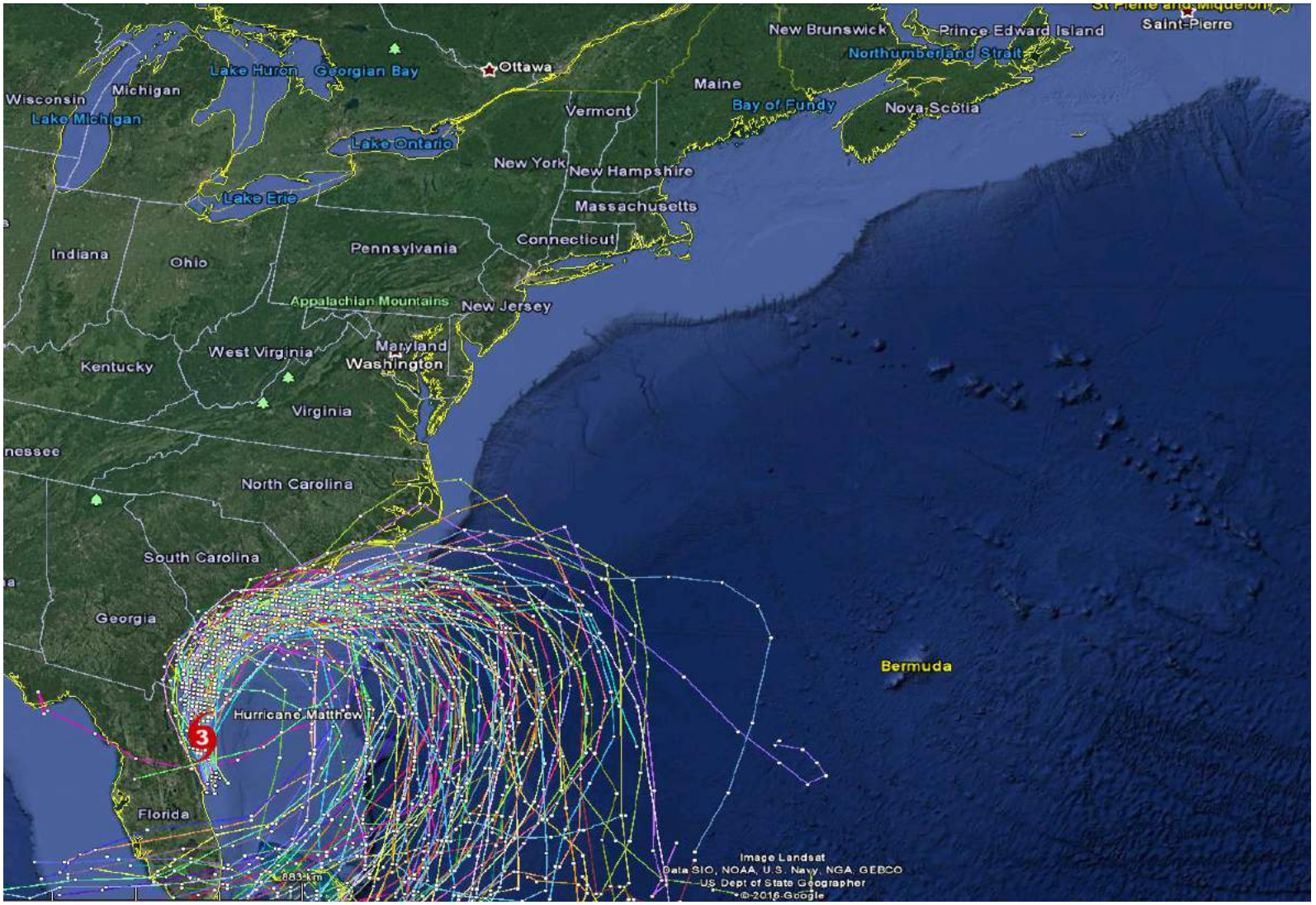
2016 Season in Review – Matthew

Model Track for Matthew on Wednesday October 5th



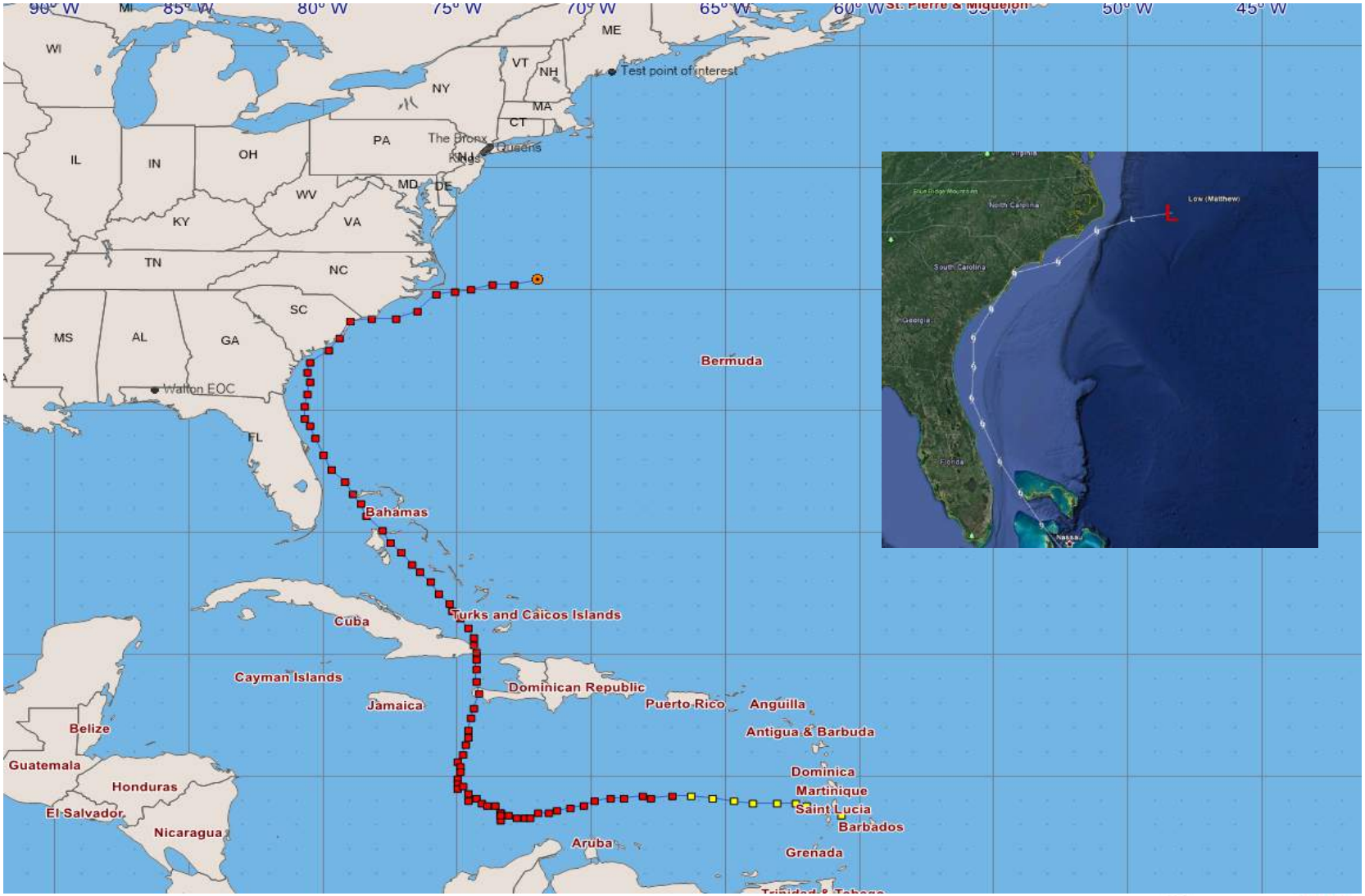
2016 Season in Review – Matthew

Model Track for Matthew on Friday October 7th



2016 Season in Review – Matthew

Actual Matthew Track



2016 Season in Review – Matthew

Separate Low Centre Formation

3 am Monday
October 10th

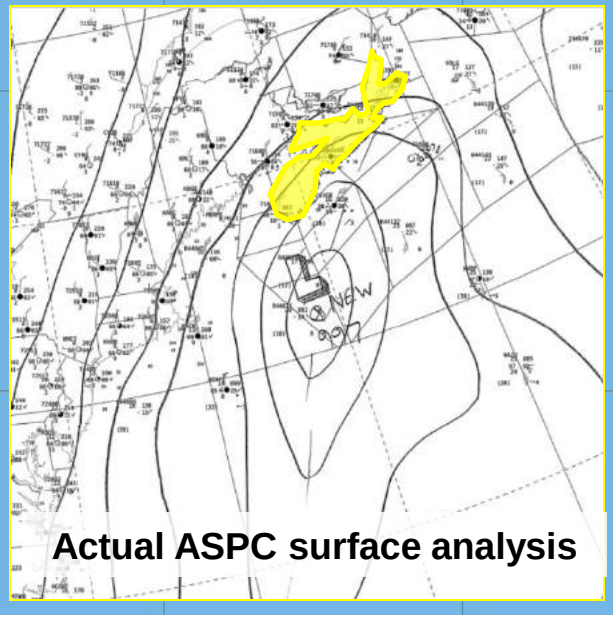
St. Pierre & Miquelon

ME
VT
NH
Test point of interest
NY
MA
CT
RI
PA
The Bronx
Queens
Kings
NJ
MD
DE
WV
VA
NC
Bermuda

L
X

New, independent low centre develops south of Nova Scotia

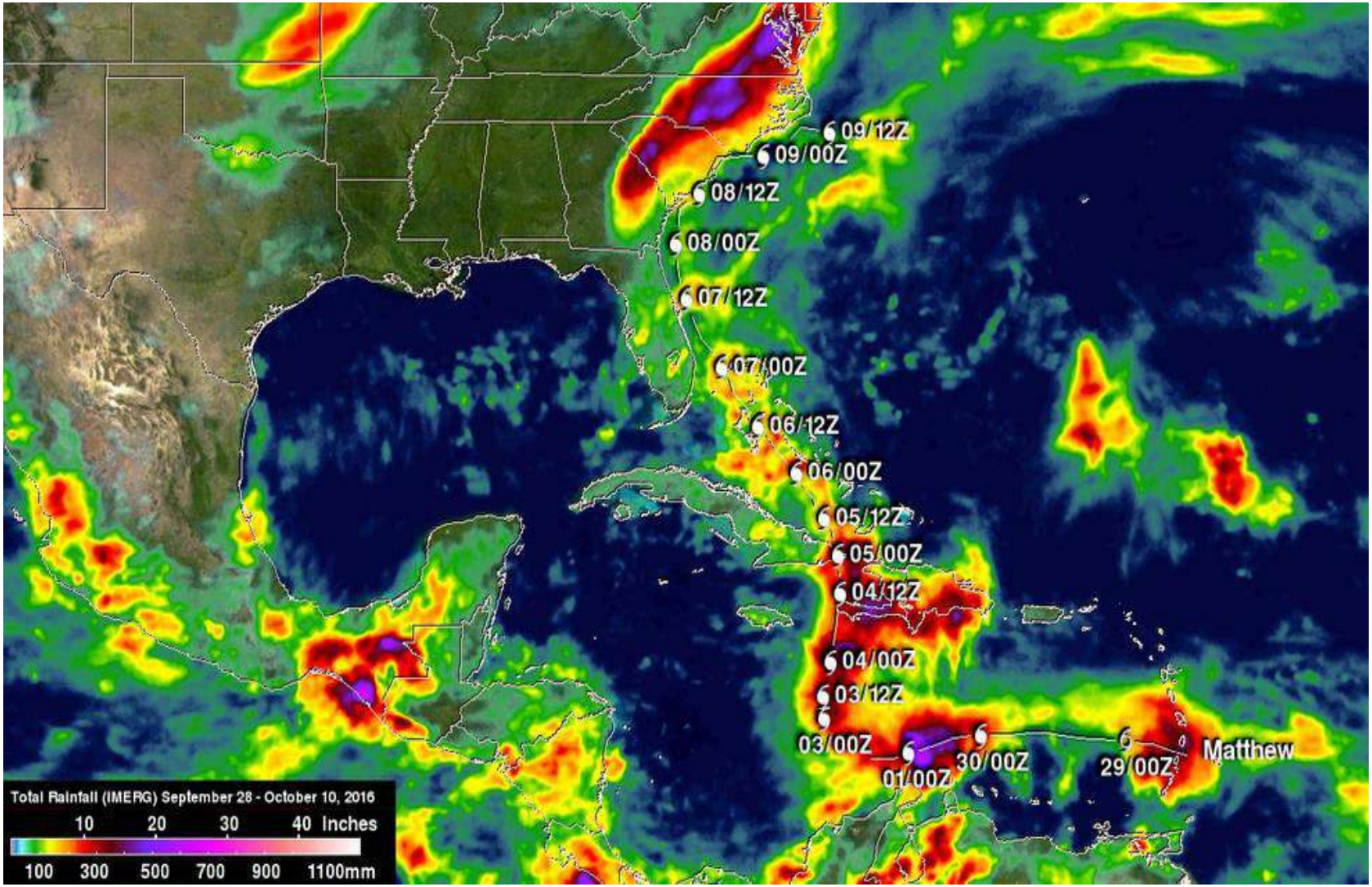
Matthew dissipates off the coast of Carolina



Actual ASPC surface analysis

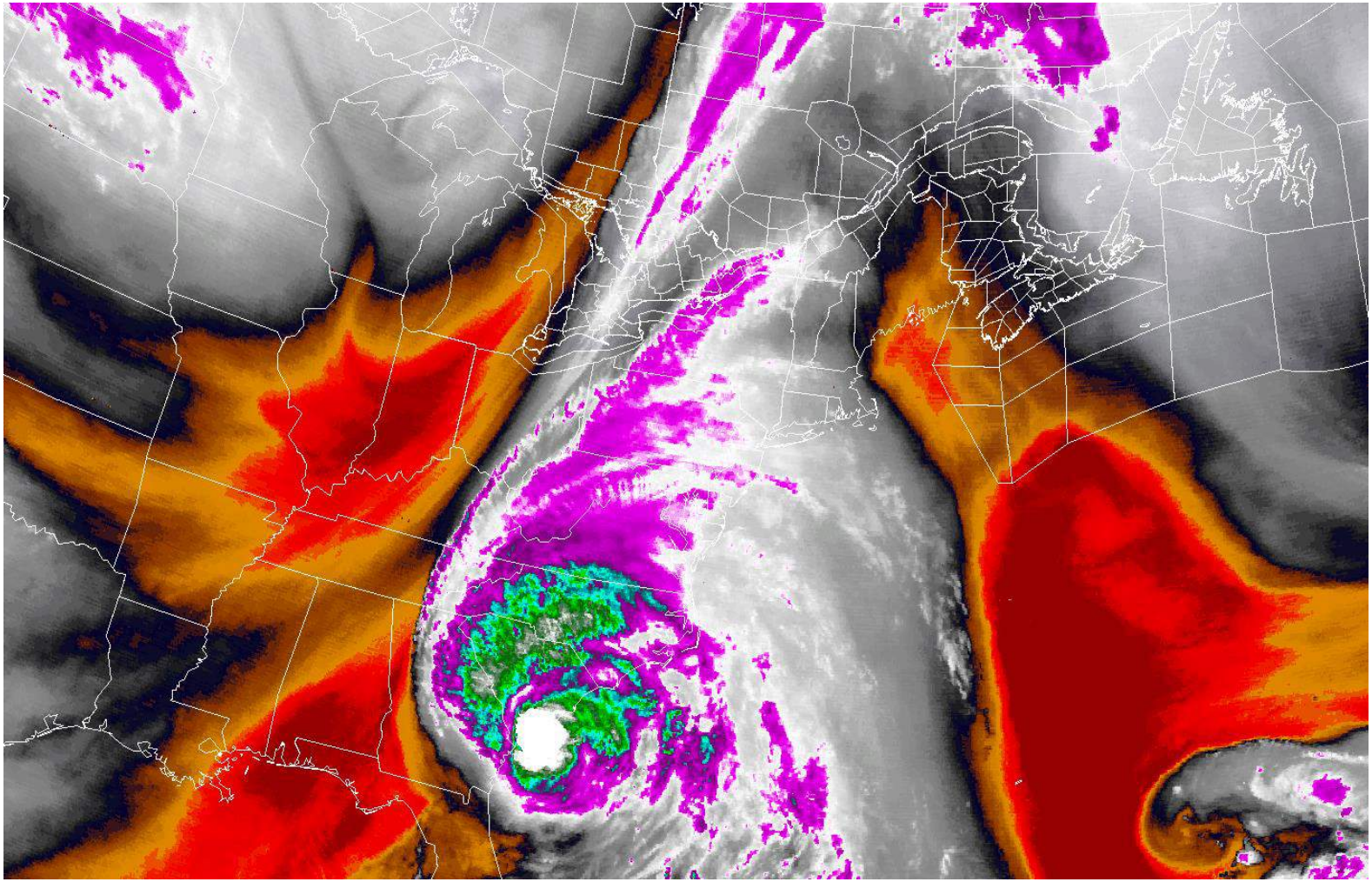
2016 Season in Review – Matthew

Satellite-Based Rainfall Estimates

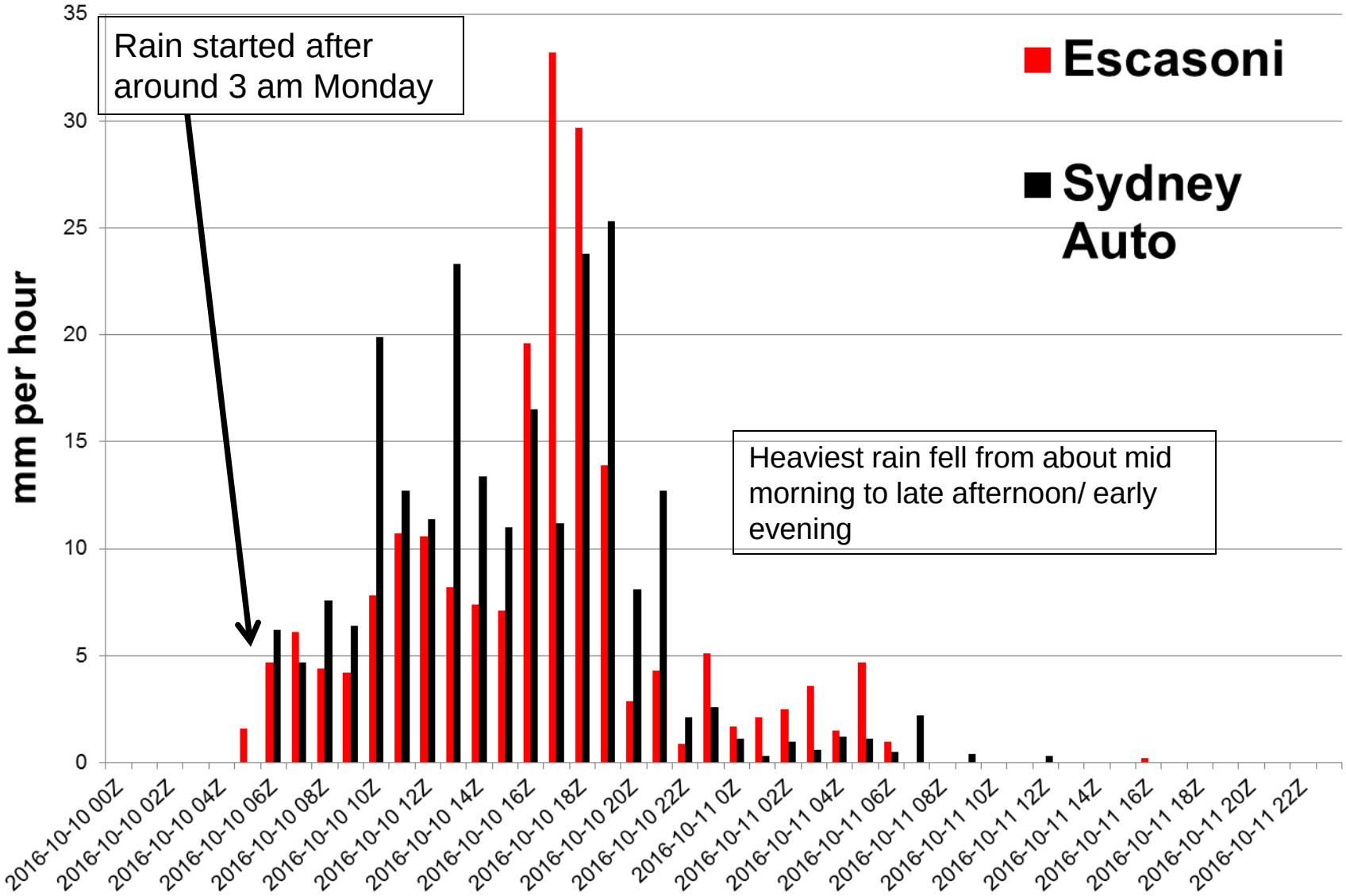


2016 Season in Review – Matthew

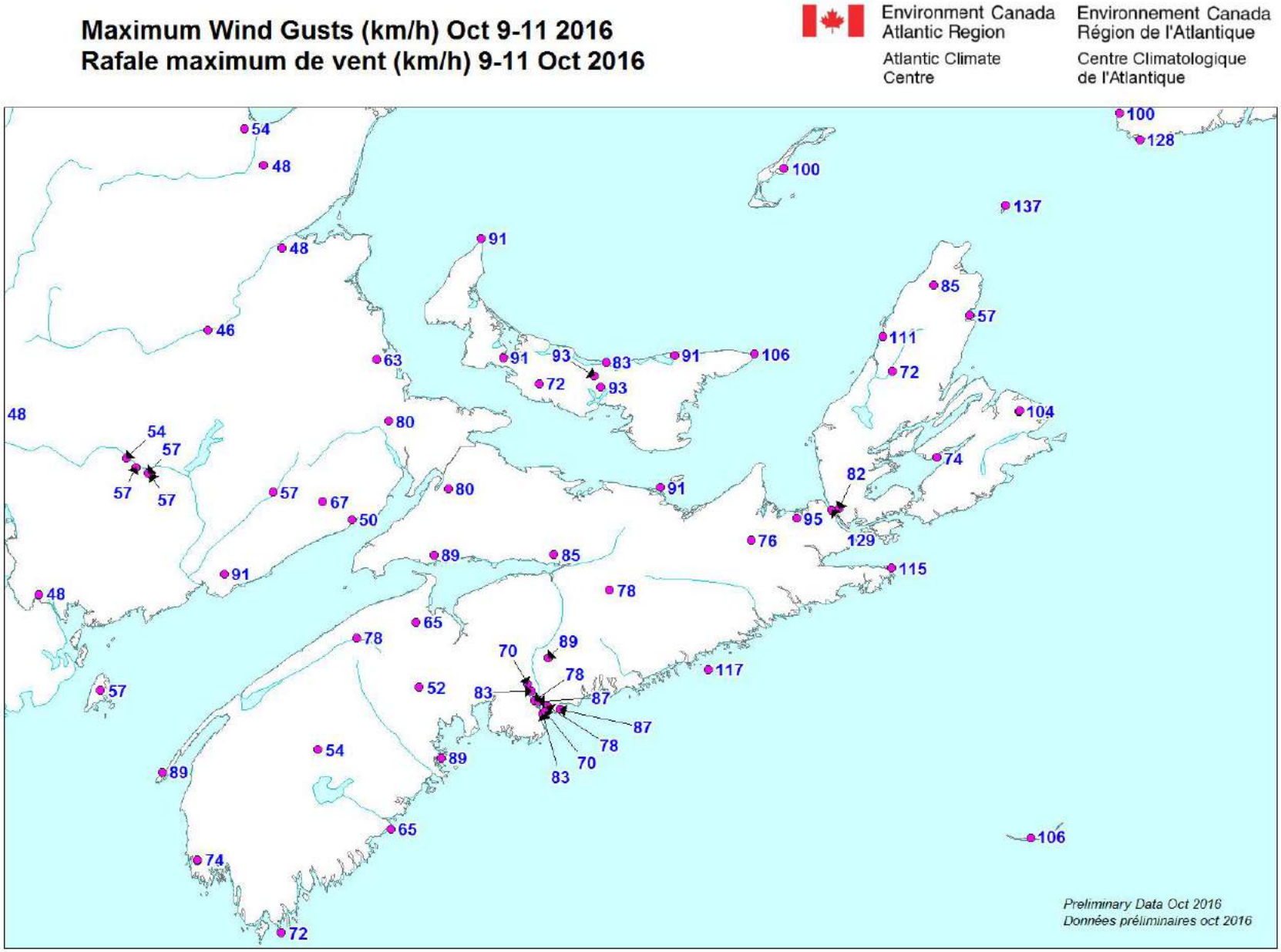
Satellite-Radar Composite



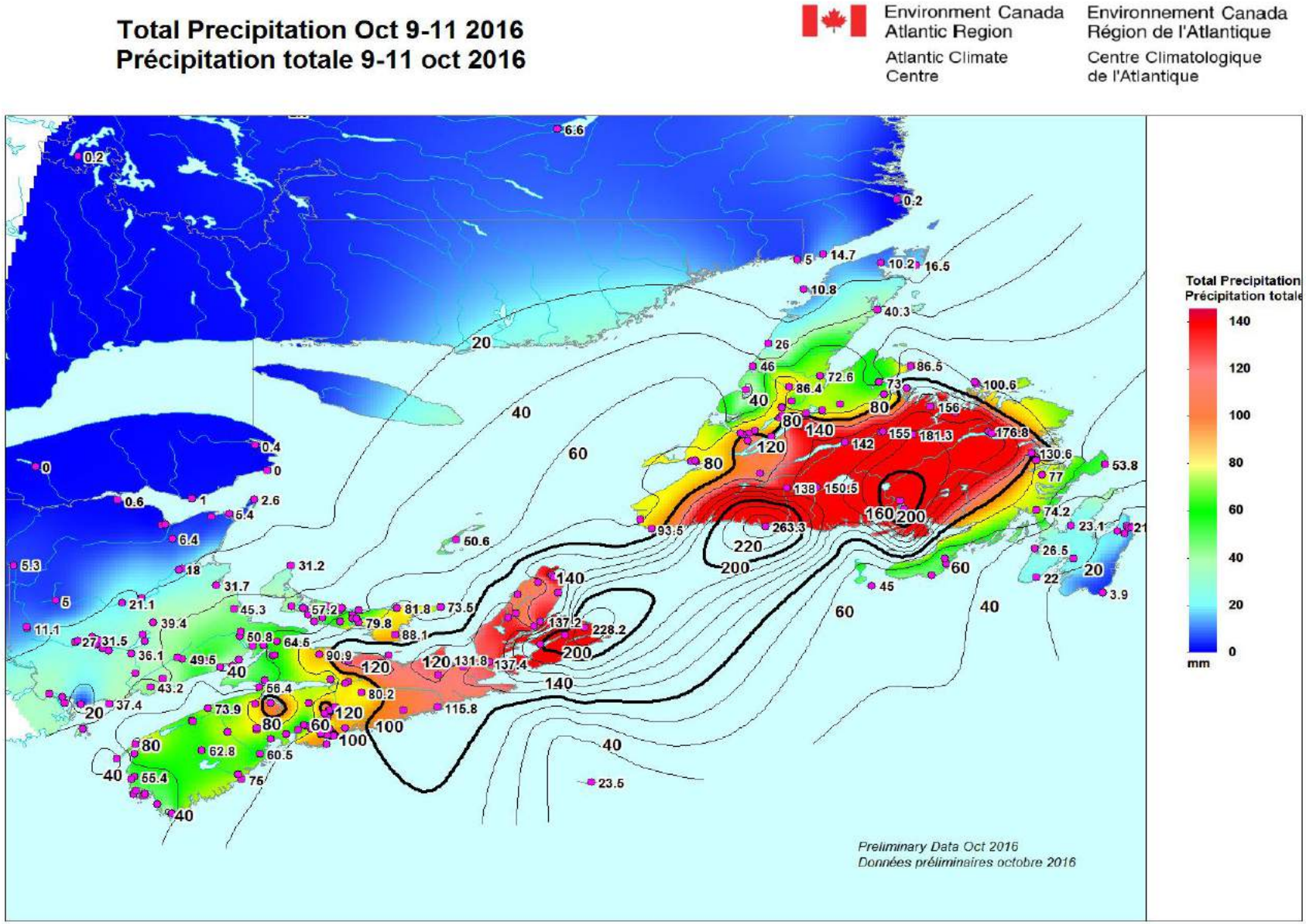
2016 Season in Review – Matthew



2016 Season in Review – Matthew

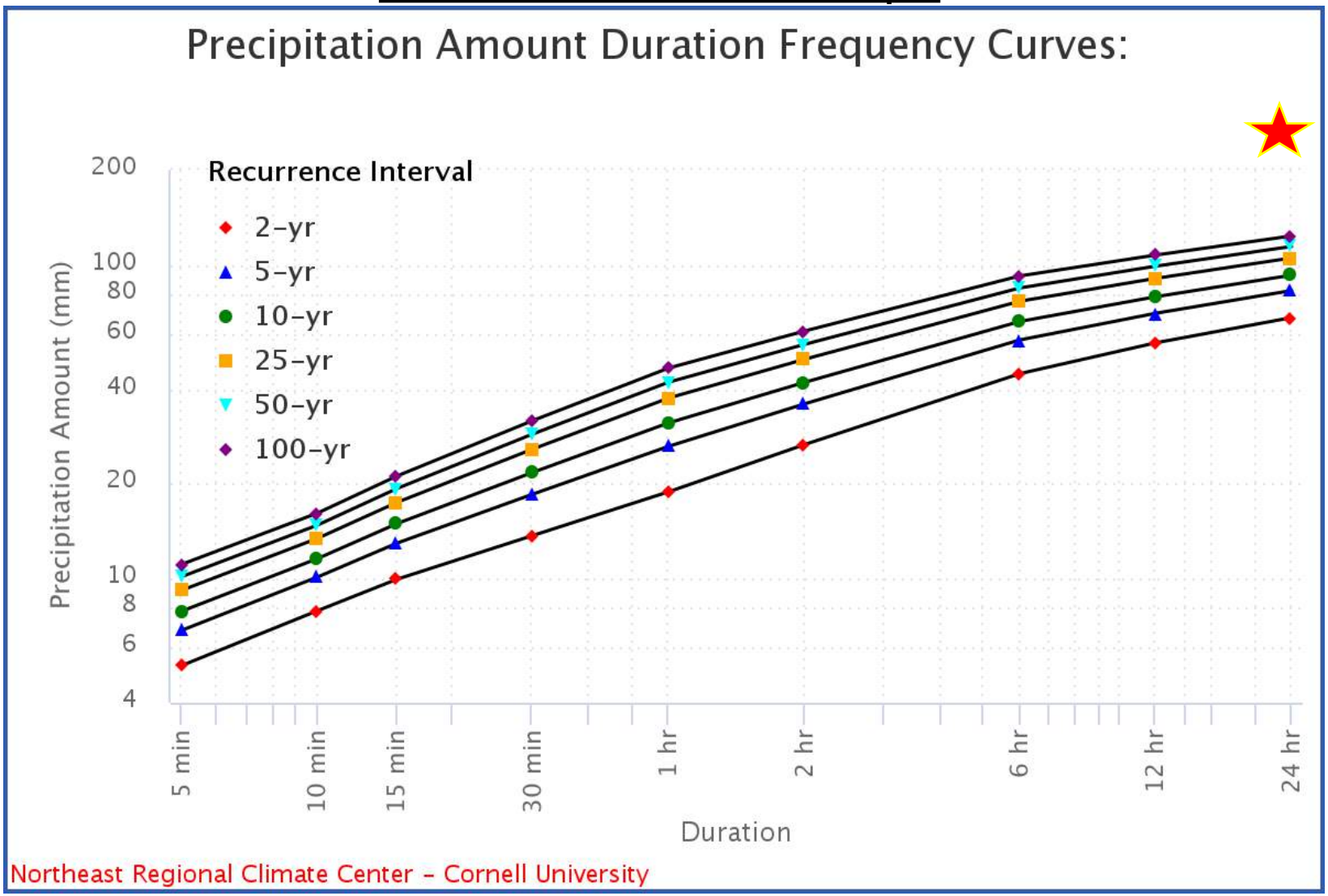


2016 Season in Review – Matthew



2016 Season in Review – Matthew

How does this stack up?



2016 Season in Review – Matthew

Photo: NS EMO

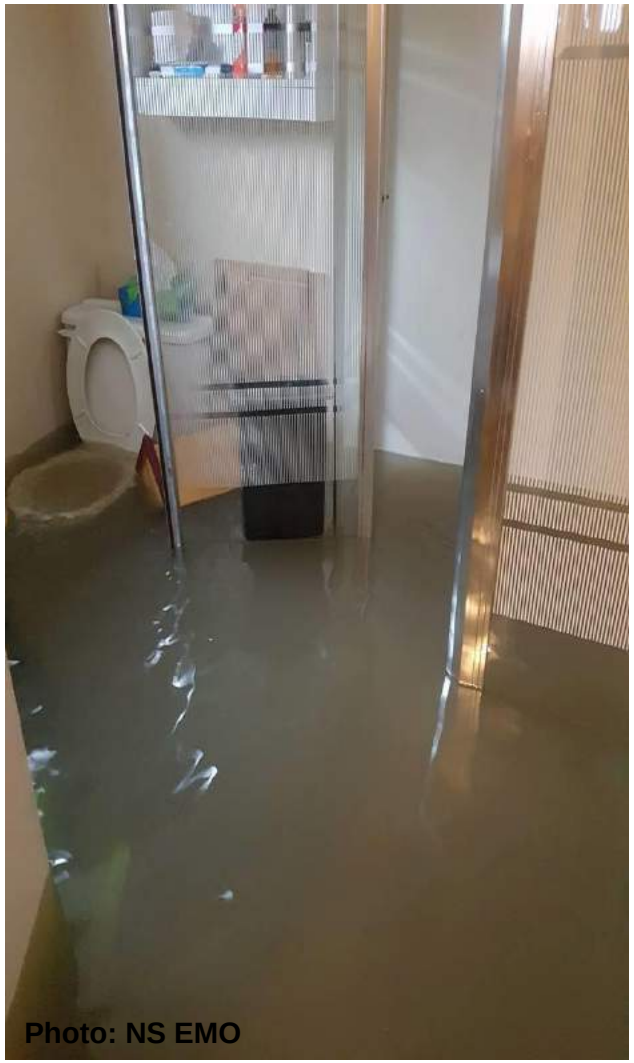
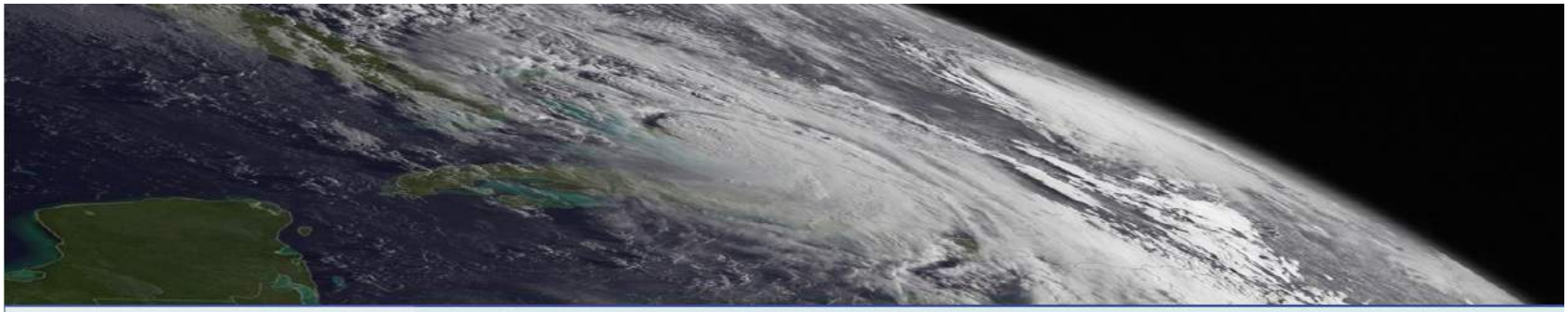


Photo: NS EMO

Photo: NS EMO

2016 Season in Review – Matthew

Photo: NS EMO



Canadian Hurricane Centre

Hurricane Season Outlook 2017

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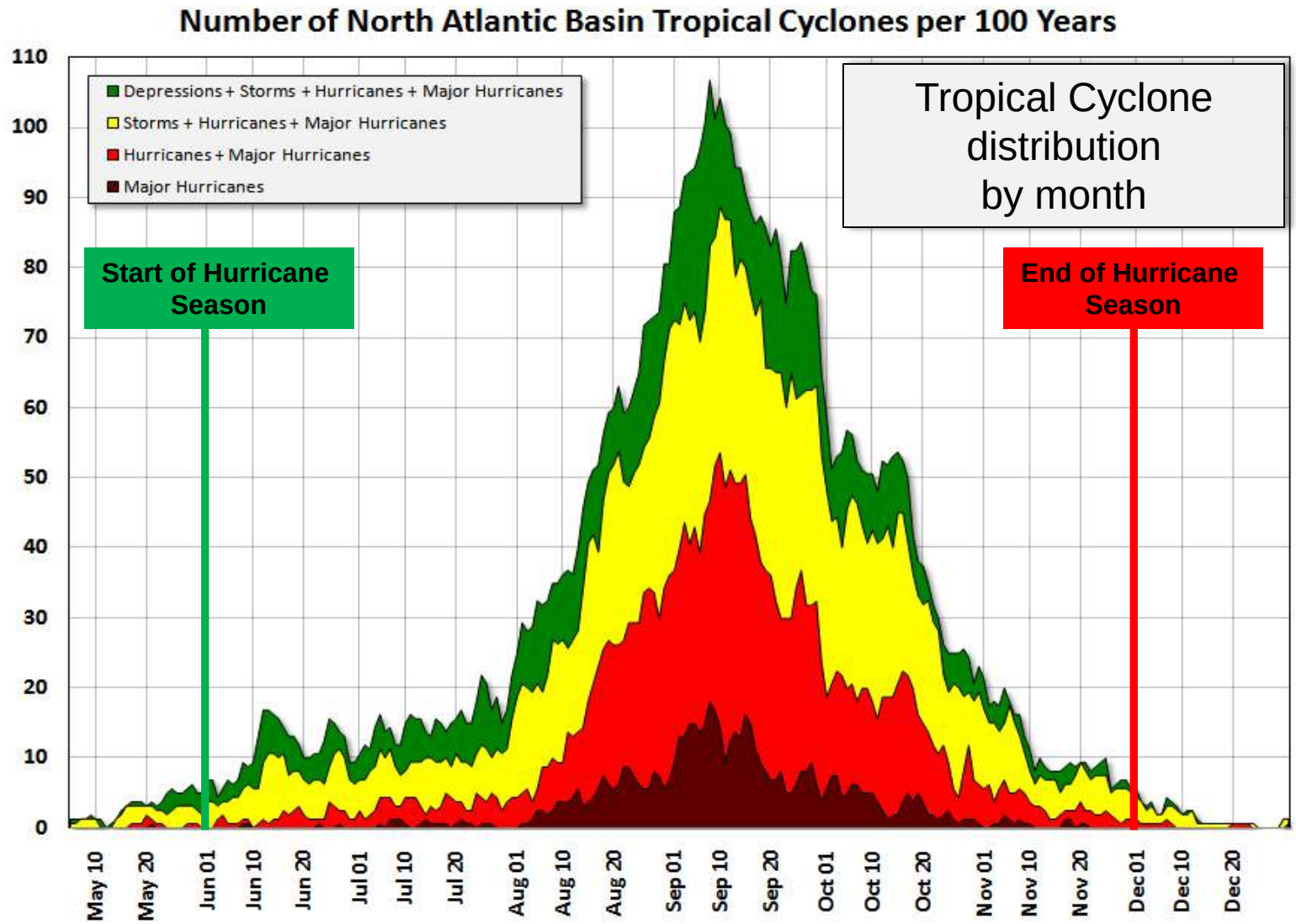
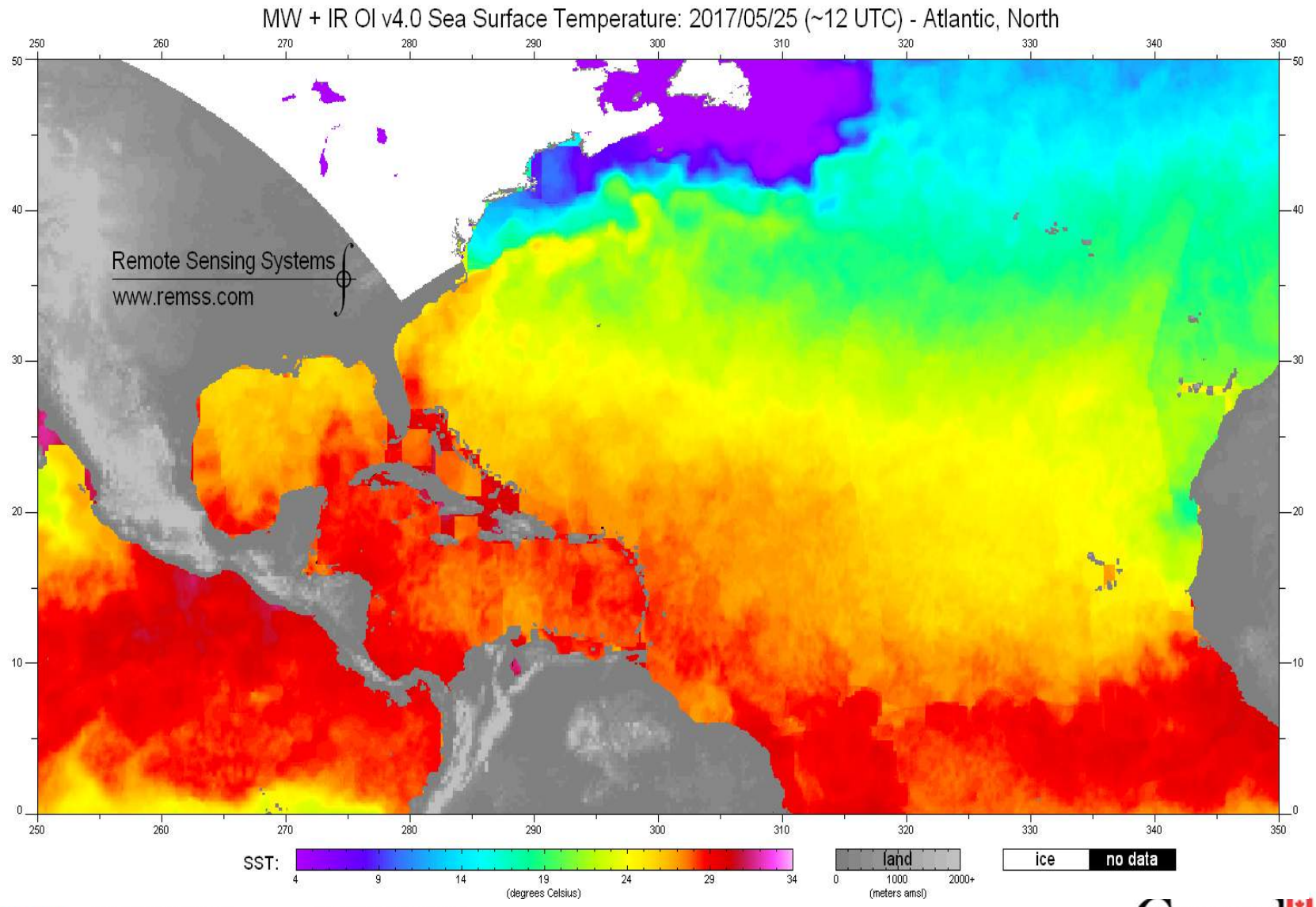
Tropical Cyclone Climatology



Current Water Temperature



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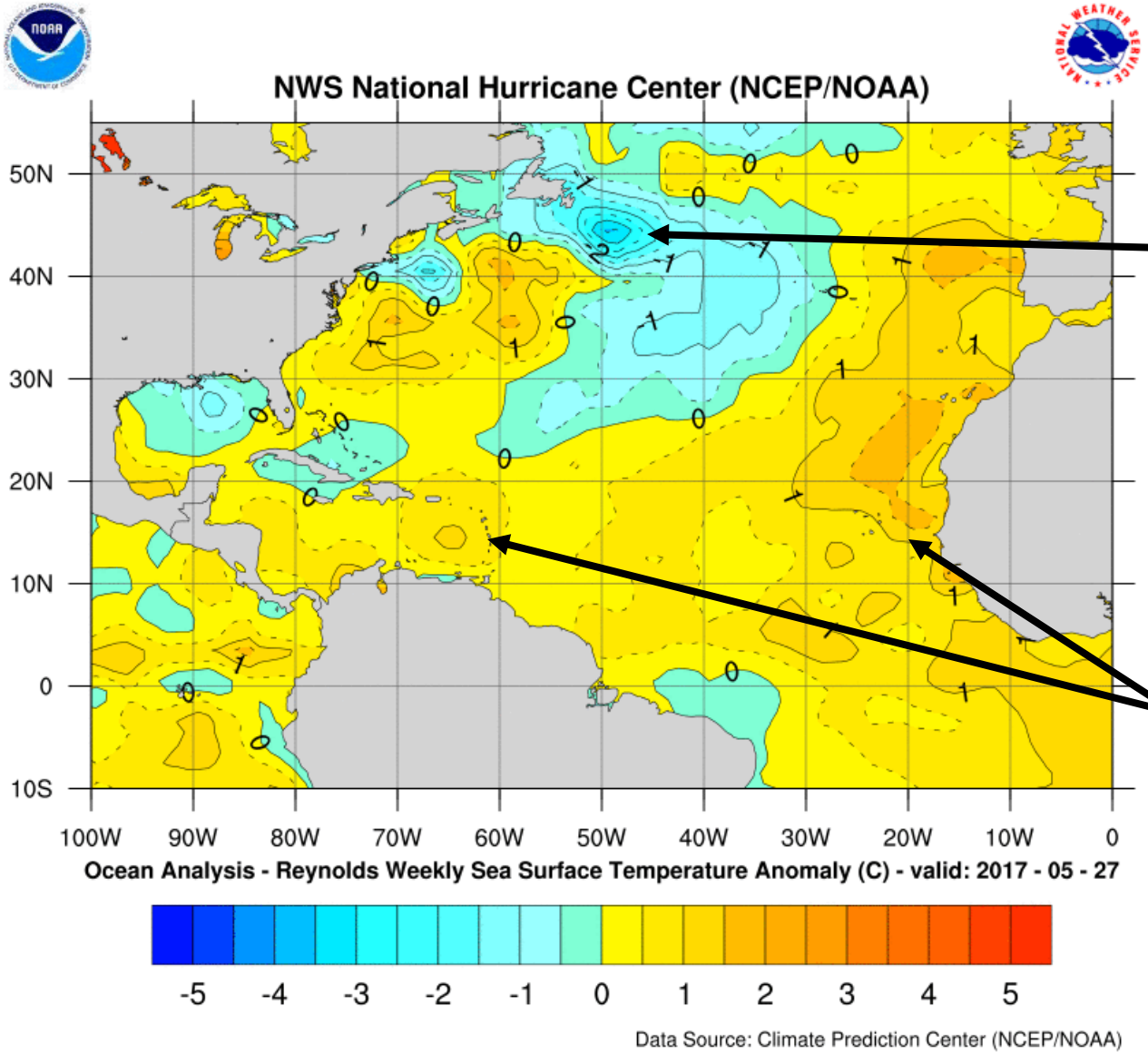
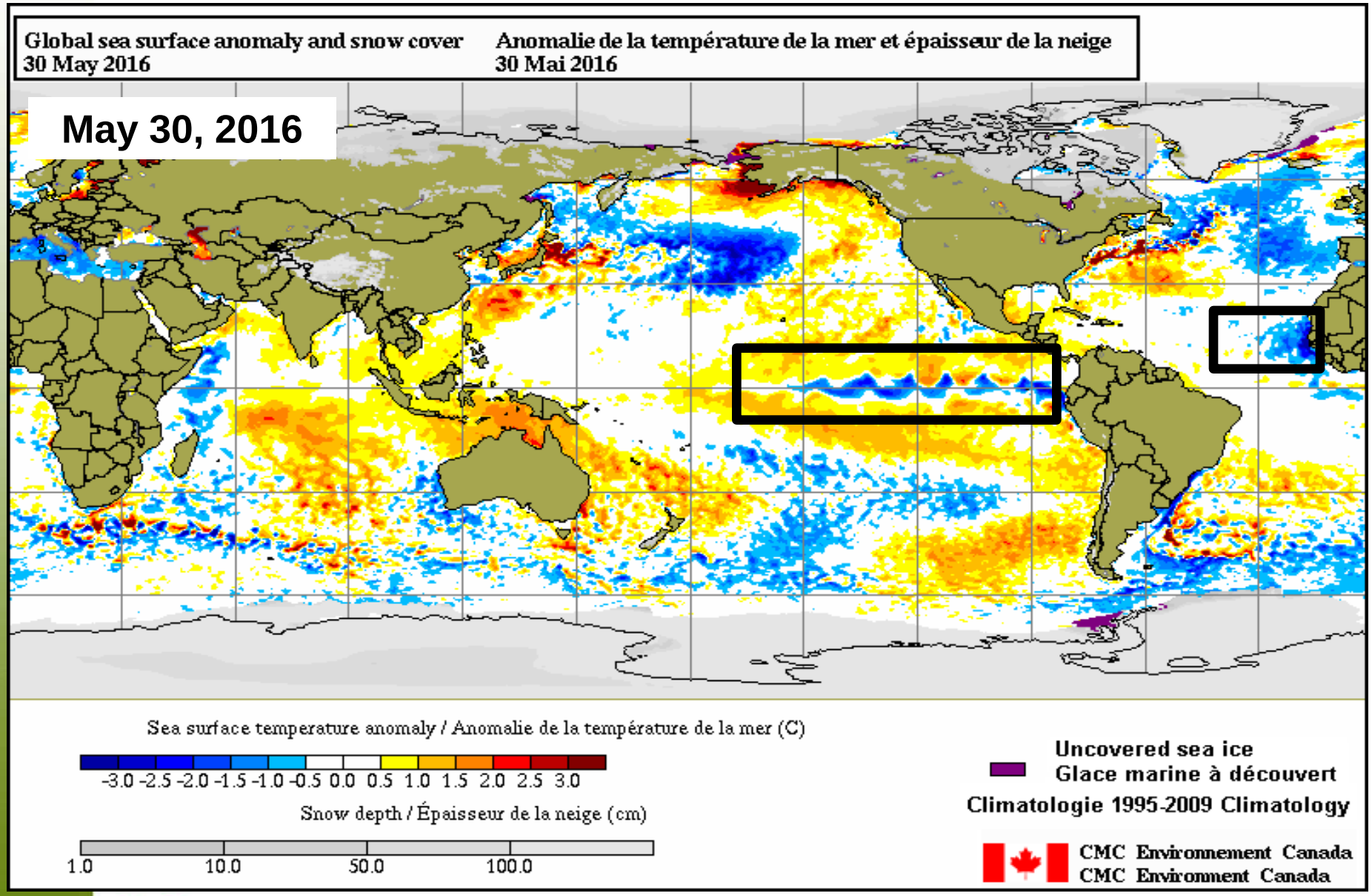
Latest Atlantic Sea Surface Temperature Pattern



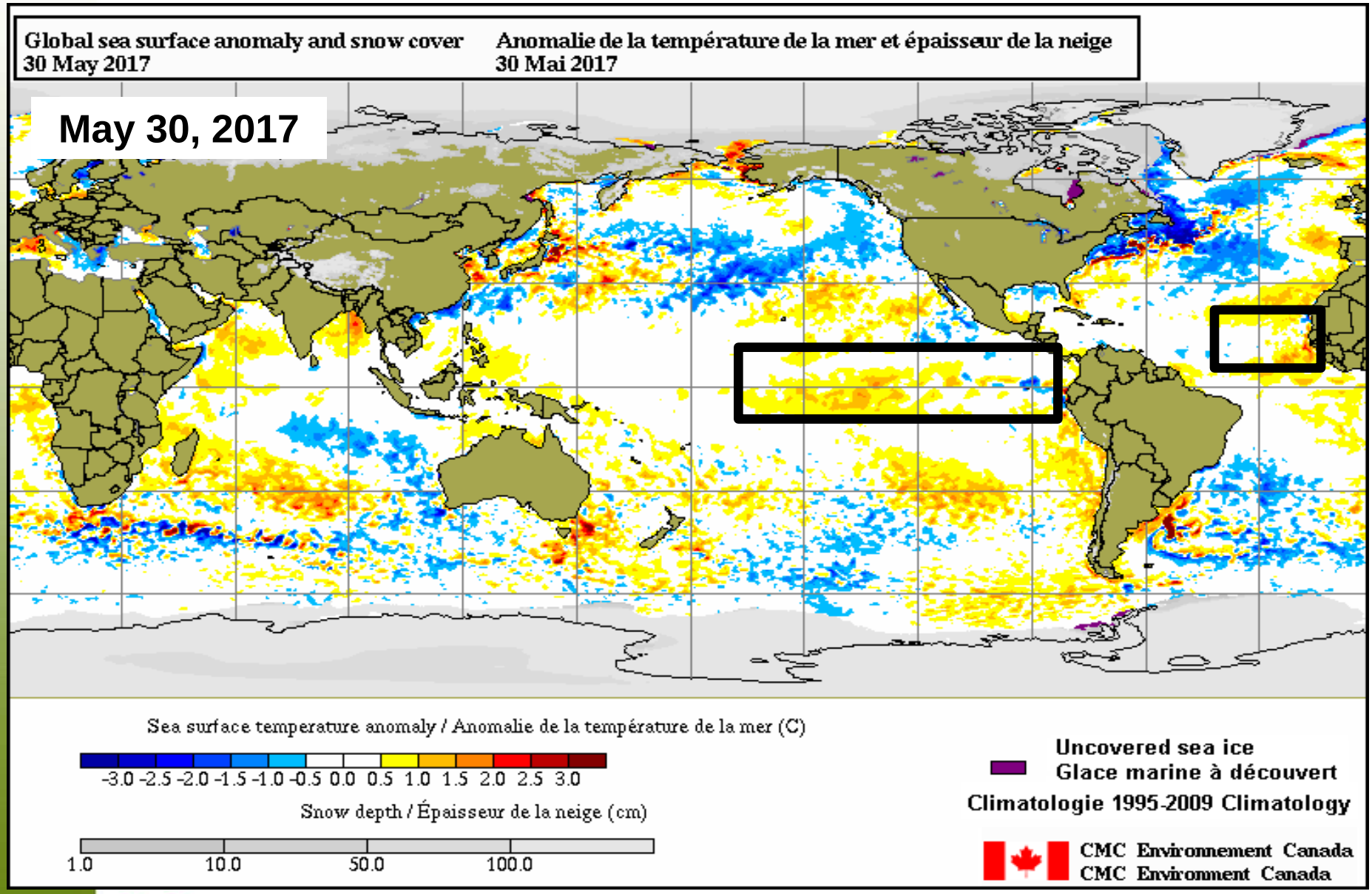
Water temperatures are cooler than normal

Water temperatures are warmer than normal

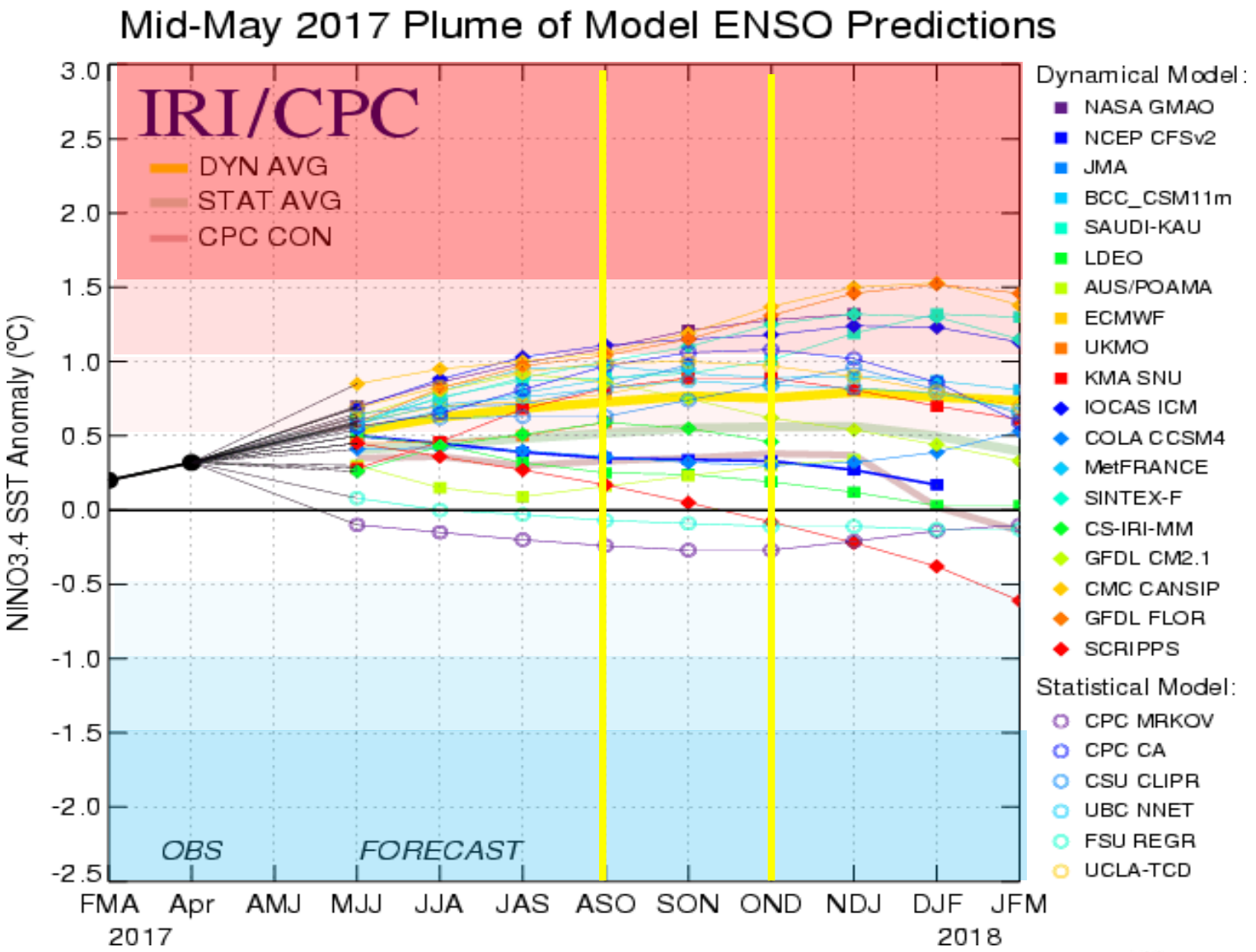
Factors Affecting Hurricane Season



Factors Affecting Hurricane Season



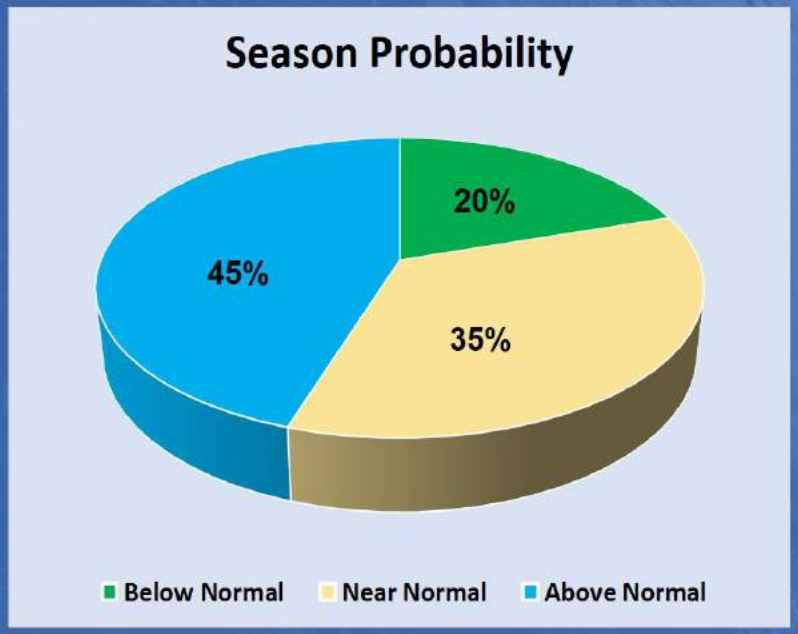
El Niño forecast through hurricane season



2017 Hurricane Season Outlook

2017 NOAA Hurricane Season Outlook

Canadian Hurricane Centre

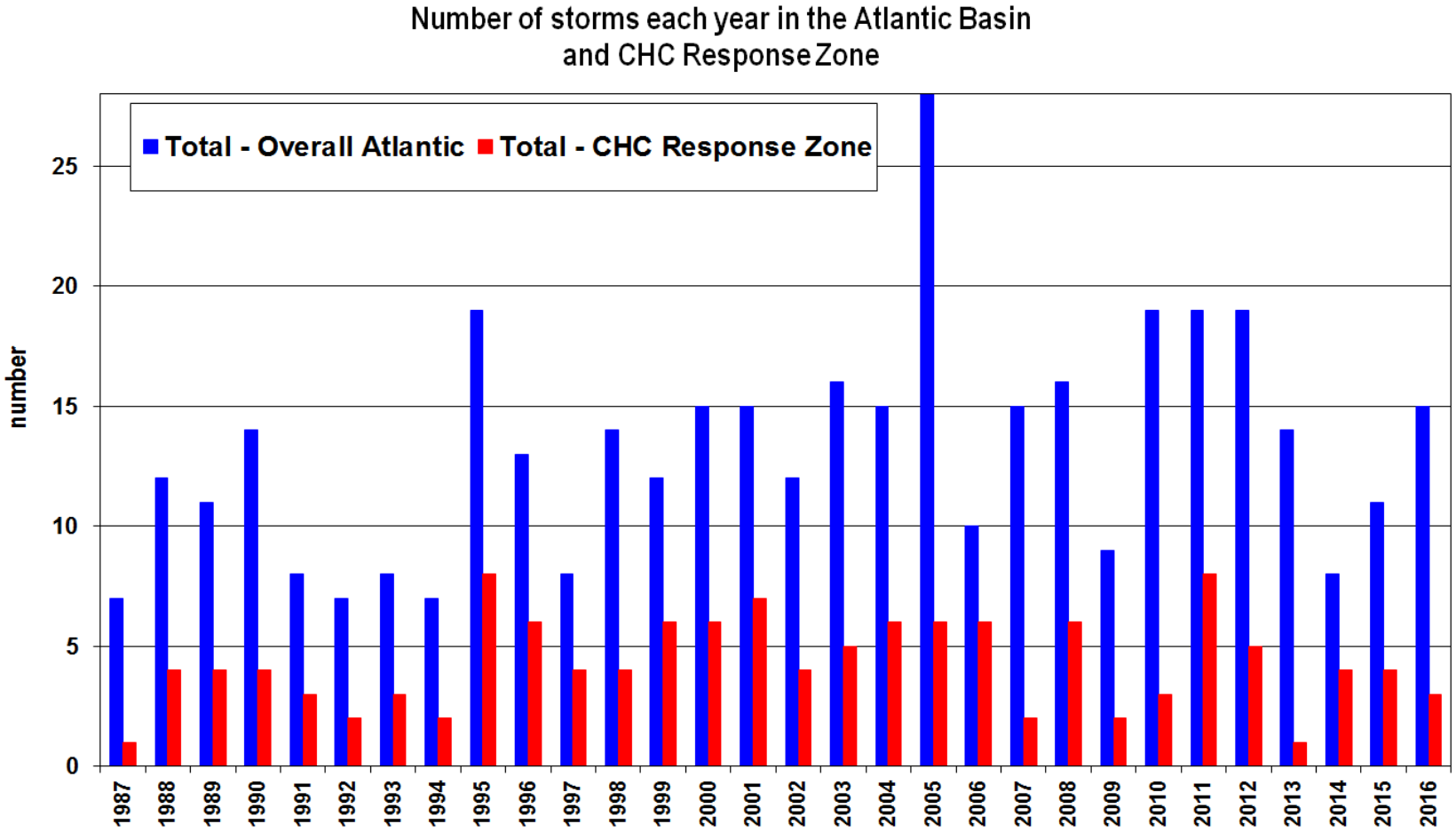


11-17 Named Storms
(Average 12)

5-9 Hurricanes
(Average 6)

2-4 Major Hurricanes
(Average 2)

Entire Atlantic vs. CHC Response Zone



Based on the 30 year average, about **35-40%** of the named storm that for in the Atlantic enter the CHC Response Zone

List of Atlantic Storm Names

2017

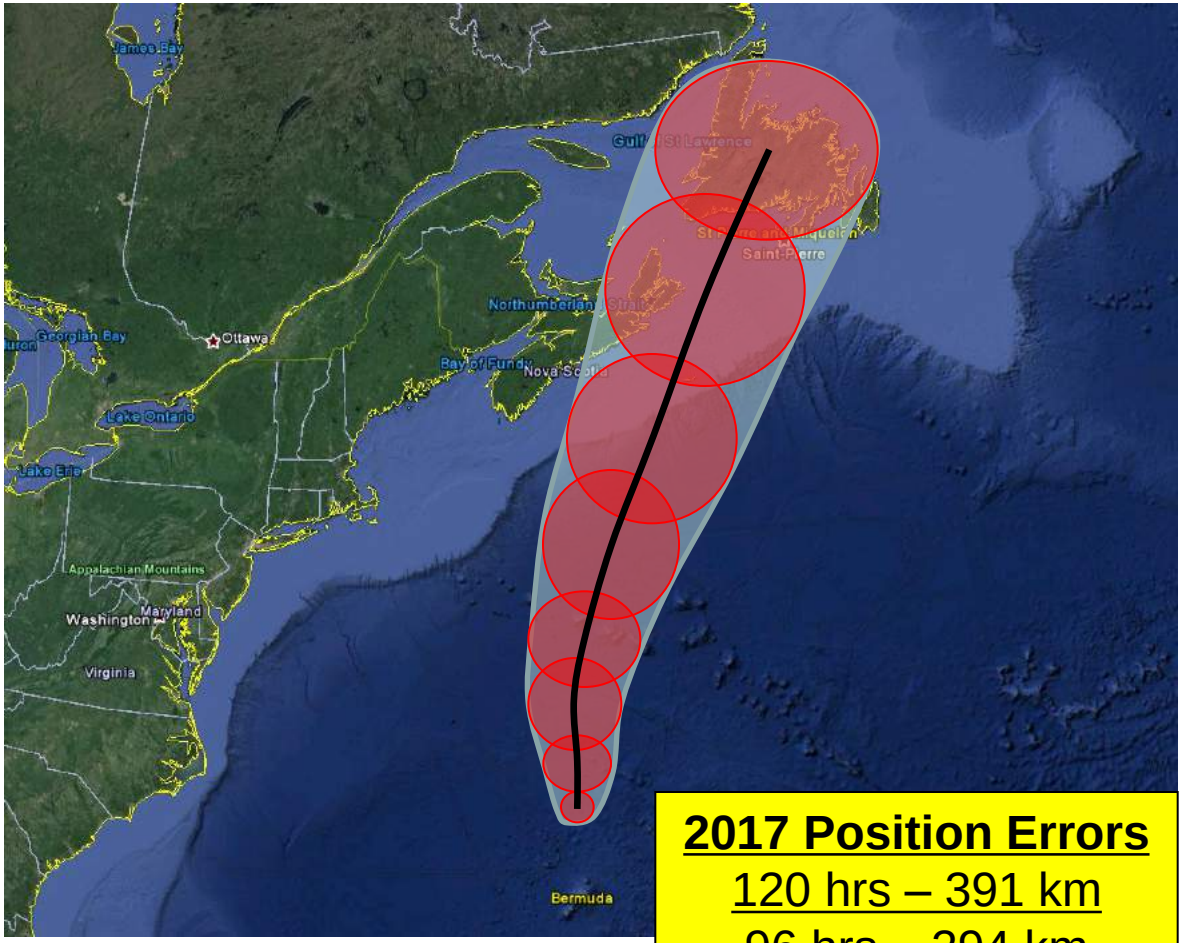
Arlene	Gert	Maria	Tammy
Bret	Harvey	Nate	Vince
Cindy	Irma	Ophelia	Whitney
Don	Jose	Philippe	
Emily	Katia	Rina	
Franklin	Lee	Sean	

Canadian Hurricane Centre

Hurricane Readiness and Operational Response to Hurricanes

Forecast Uncertainty – Track Error

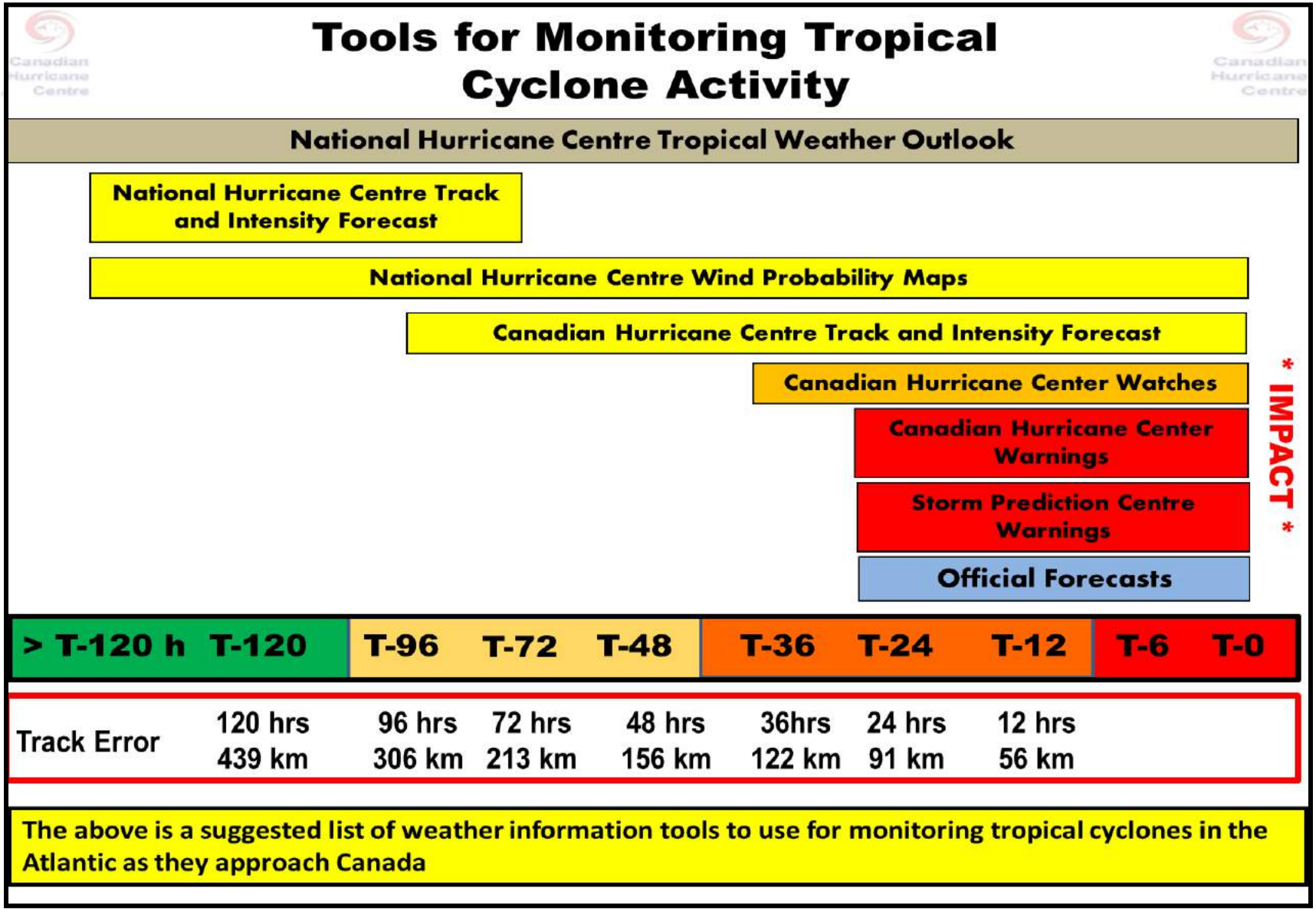
- Cone of uncertainty is constructed by superimposing position error at each forecast time
- You must assume that the centre of the storm will track ANYWHERE within that cone
- There is also a 33% chance the storm could track outside the cone
- Keep in mind that impacts could extend well outside the cone



2017 Position Errors

120 hrs – 391 km
96 hrs – 294 km
72 hrs – 198 km
48 hrs – 144 km
24 hrs – 83 km

Hurricane Weather Products



Hurricane Weather Products

Monitoring for storm development – Graphical Tropical Weather Outlook (U.S. NHC, Miami):
http://www.nhc.noaa.gov/gtwo.php?basin=atlc&fdays=5

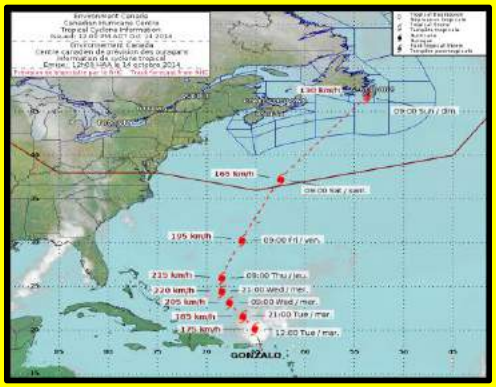
Categories	Probability of formation
Low	< 40%
Medium	40-60%
High	>60%

Details on storms that are not an imminent threat to Canada (U.S. NHC, Miami):
http://www.nhc.noaa.gov

Hurricane Weather Products

CHC Tropical Cyclone Track Map for all current storms (CHC, Dartmouth, NS):
http://weather.gc.ca/hurricane/track_e.html

CHC General Information Statement on storms possibly threatening Canada (CHC, Dartmouth, NS):
http://weather.gc.ca/hurricane/statements_e.html



WOCN31 CWHX 060545
TROPICAL CYCLONE INFORMATION STATEMENT ISSUED BY THE CANADIAN HURRICANE CENTRE OF ENVIRONMENT CANADA AT 12:15 AM ADT THURSDAY 6 JUNE 2013.

TROPICAL CYCLONE INFORMATION STATEMENT FOR:
-NEW- ATLANTIC PROVINCES.

FOR TROPICAL STORM ANDREA.

THE NEXT STATEMENT WILL BE ISSUED BY 3:00 PM ADT.

NEWLY-FORMED TROPICAL STORM ANDREA WEST OF FLORIDA EXPECTED TO TRANSFORM INTO WET LOW PRESSURE SYSTEM AFFECTING ATLANTIC CANADA THIS WEEKEND.

--DISCUSSION--
THE NATIONAL HURRICANE CENTER (NHC) IN MIAMI FLORIDA HAS DECLARED AN AREA OF HEAVY RAINFALL AND GUSTY WINDS WEST OF FLORIDA AS TROPICAL STORM ANDREA - THE FIRST NAMED STORM OF THE 2013 HURRICANE SEASON. THIS STORM IS NOT EXPECTED TO ATTAIN SIGNIFICANT WIND INTENSITY, BUT WILL LIKELY TRANSFORM INTO A WET LOW PRESSURE SYSTEM AS IT TRACKS TOWARD THE MARITIME PROVINCES THIS WEEKEND.

THE CANADIAN HURRICANE CENTRE WILL MAINTAIN A GENERAL WATCH OF THE LOW PRESSURE SYSTEM AND ITS ASSOCIATED RAINFALL WITH UPDATES AS NECESSARY. WE WILL ISSUE ANOTHER BULLETIN THURSDAY AFTERNOON TO UPDATE EXPECTED RELATED WEATHER FOR EASTERN CANADA AND SIMPLY CARRY THE NHC FORECAST TRACK ON OUR WEBSITE AT WWW.WEATHER.GC.CA/HURRICANE/TRACK_E.HTML (ALL LOWERCASE). IF DEEMED NECESSARY TO ACTIVATE THE FORECAST DESK 24/7, A SPECIFIC TRACK WITH ADDITIONAL DETAILS WILL BE ISSUED ON THE WEBSITE AND WILL APPEAR BLUE ON THE MAP.

END/FOGARTY/BORGEL

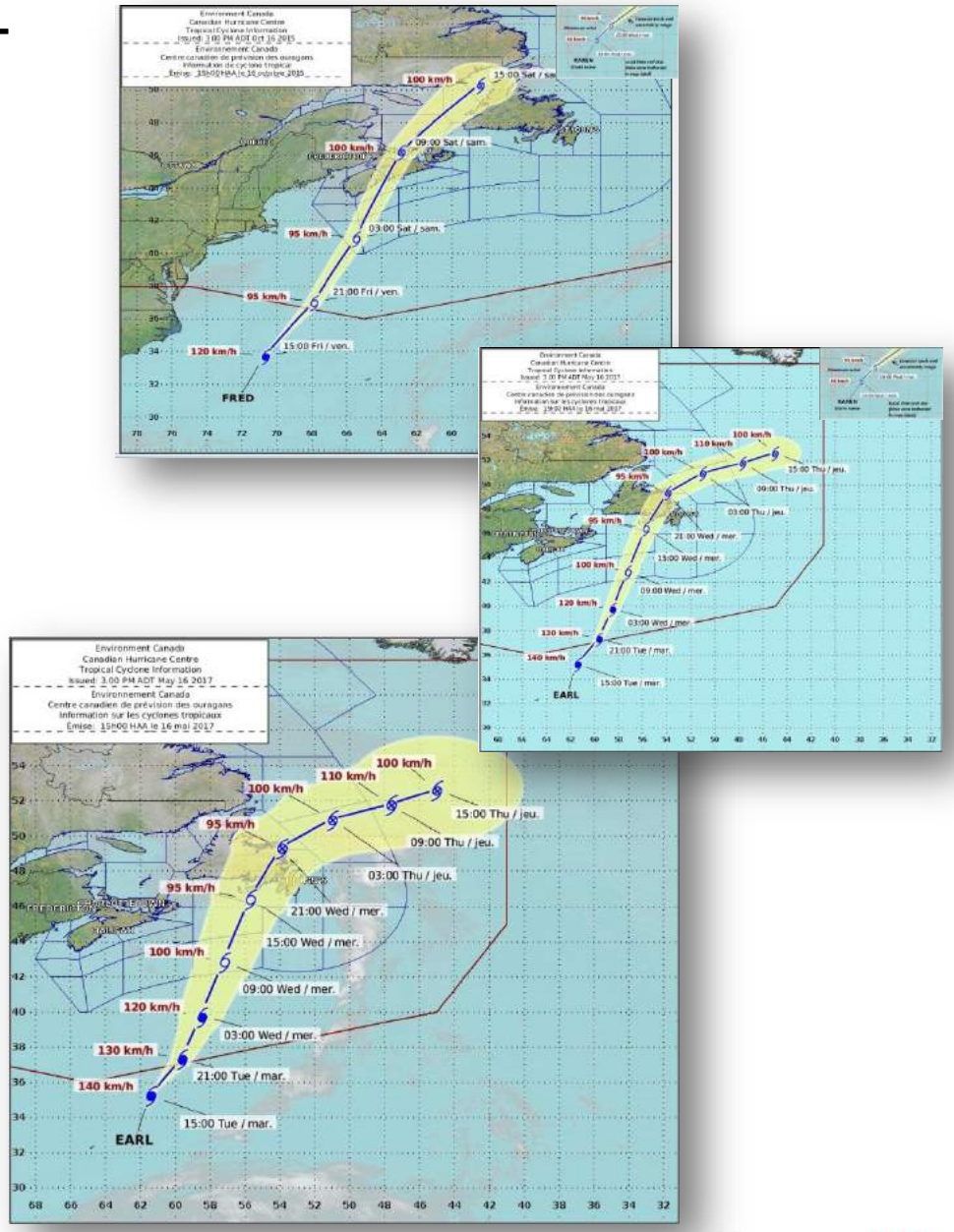
Hurricane Weather Products

Link to EC Geomet page – KML files for hurricane layers on Google Earth
http://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=C0D9B3D8-1

New Products for 2017

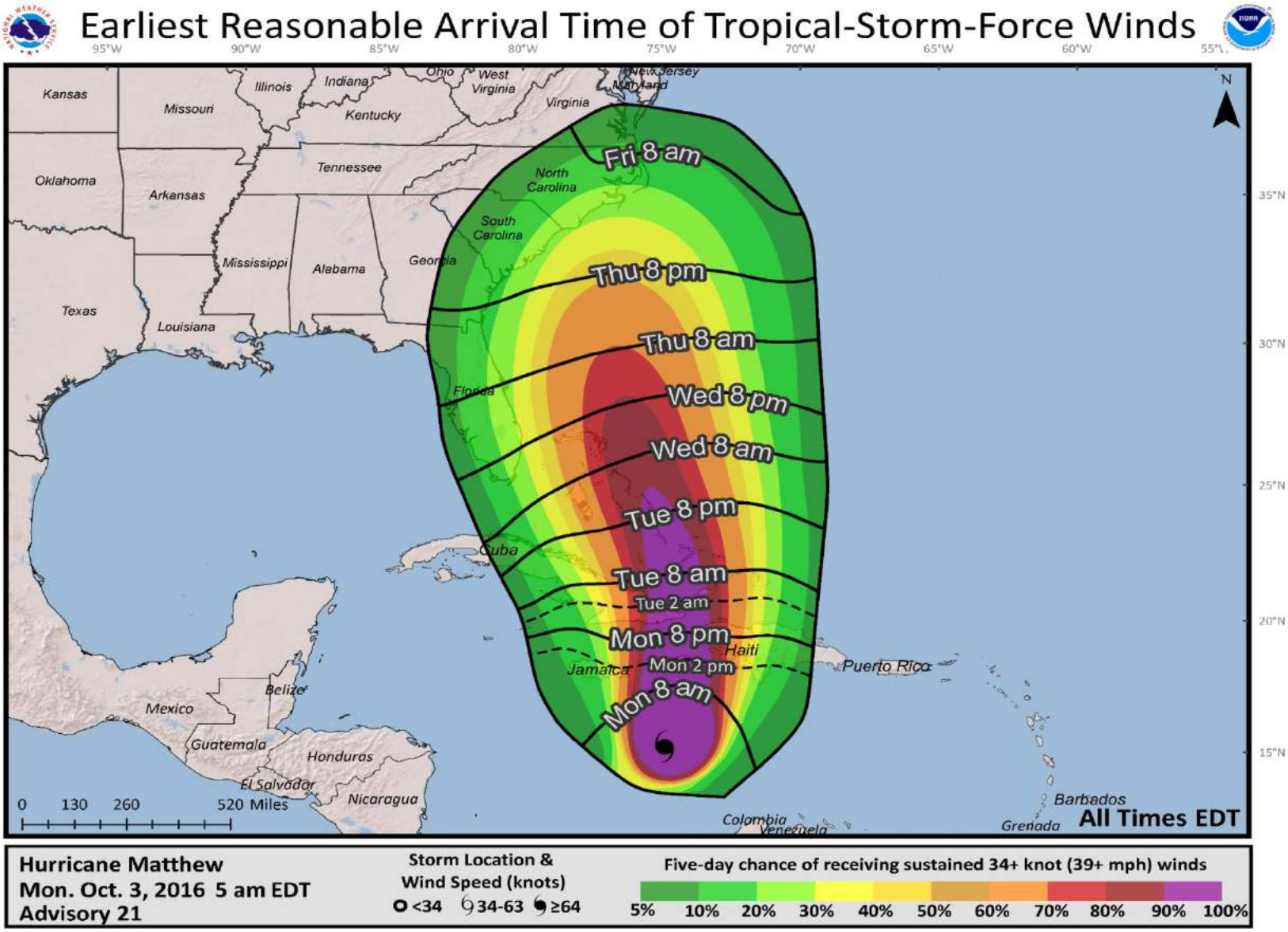
Introduction of a CHC Cone of Uncertainty

- CHC will be introducing a dynamic cone of uncertainty in 2017
- Expected to be a dynamic cone meaning it will be adjusted based on uncertainty with specific storms
- Implementation expected in July 2017



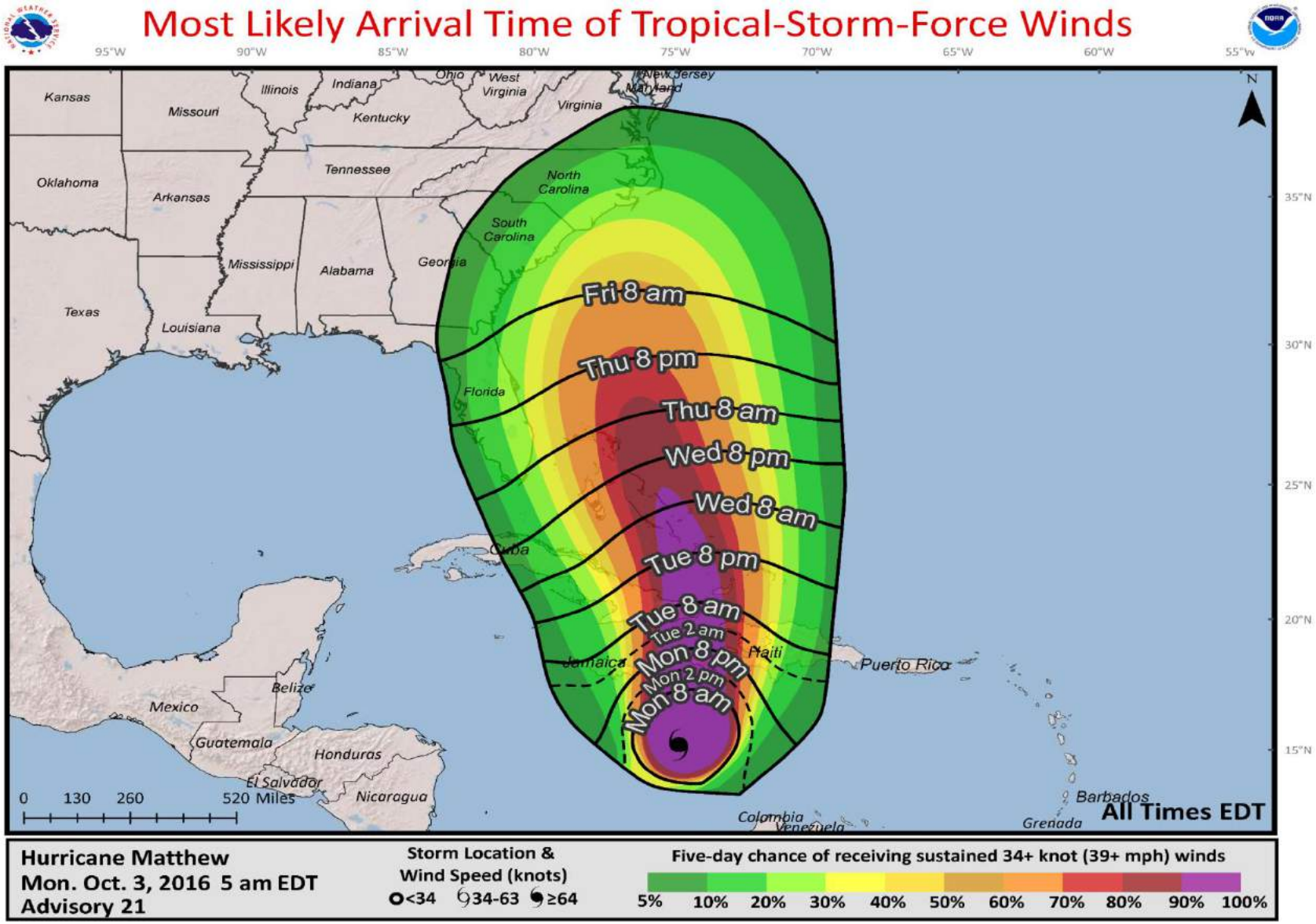
New Products for 2017

Wind timing Graphic



New Products for 2017

Wind timing Graphic



Update on Partnership/Outreach Opportunities

2017 Hurricane Awareness Tour (HAT):

- The 2017 Hurricane Awareness Tour kicked off in Gander, NL on Sunday
- U.S.A.F WC-130 and NOAA G-IV were present
- Weather cooperated and turnout was high

….it only takes <u>one</u> storm to make it a bad year!