Hurricane Briefing 2010

Institute for Catastrophic Loss Reduction

Canadian Hurricane Centre

Extreme wave heights at Peggy's Cove, NS during Hurricane Bill, August 23rd, 2009
Photo: From webcam screen capture

Friday
June 18th, 2010

Mersey Point Causeway
Damage from Hurricane Bill
August 23rd, 2009

Bob Robichaud
Meteorologist

2010 Hurricane Season Briefing

Canadian Hurricane Centre

Summary

- Tropical Cyclone Basics
- History of the Canadian Hurricane
- Closer look at Extratropical Transition
- Review of 2009 Hurricane Season and the Challenges of Communicating uncertain risk
- Predictions for the current 2010 Season

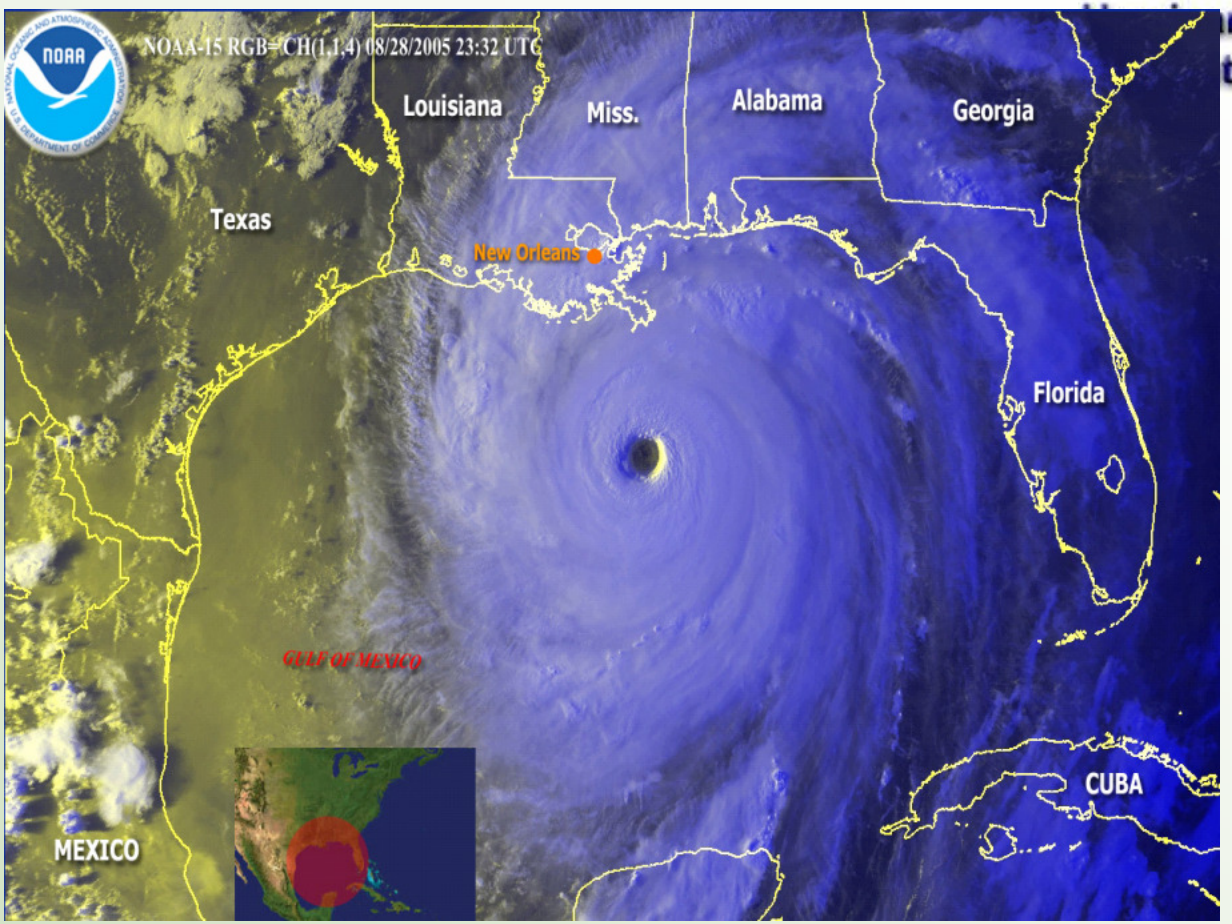
What is a Hurricane?

Canadian Hurricane Centre

Hurricanes

A "**hurricane**" is a regionally specific name for a strong "tropical cyclone".

A tropical cyclone is a generic term for a non-frontal low-pressure system over tropical or sub-tropical waters with organized thunderstorm activity and definite surface wind circulation.

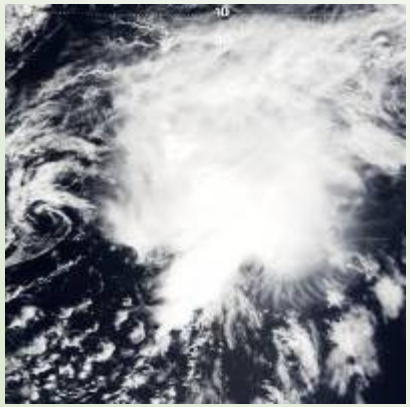


STAGES OF DEVELOPMENT

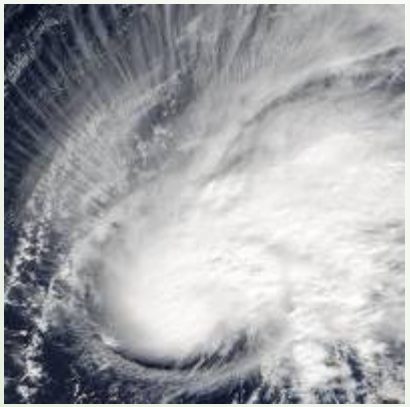
Canadian Hurricane Centre

Tropical Disturbance
Wind < 37 km/h (23 mph)

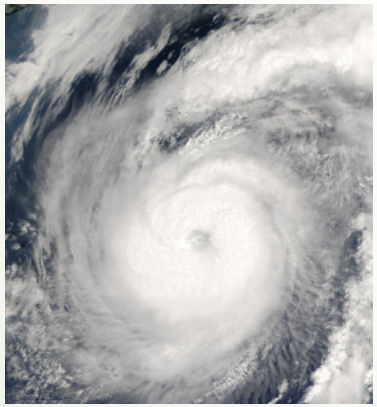
Tropical Depression
Wind 37+ km/h (23 mph)



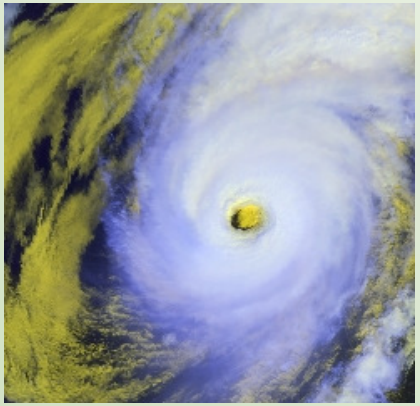
Tropical Storm
Wind 63+ km/h (39 mph)



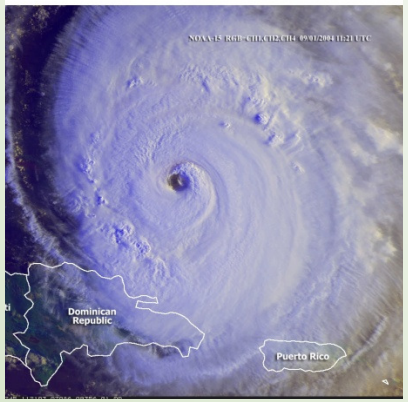
Hurricane – Cat. 1
Wind 119+ km/h (74 mph)



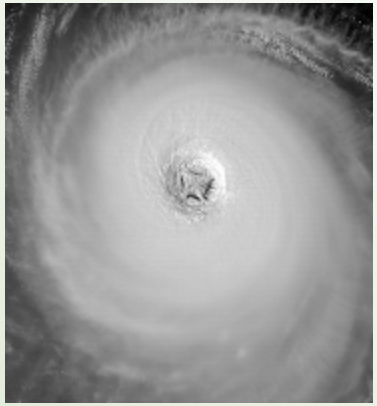
Wind 154+ km/h (96 mph)
Hurricane – Cat. 2



Wind 178+ km/h (111 mph)
Hurricane – Cat. 3



Wind 211+ km/h (131 mph)
Hurricane – Cat. 4

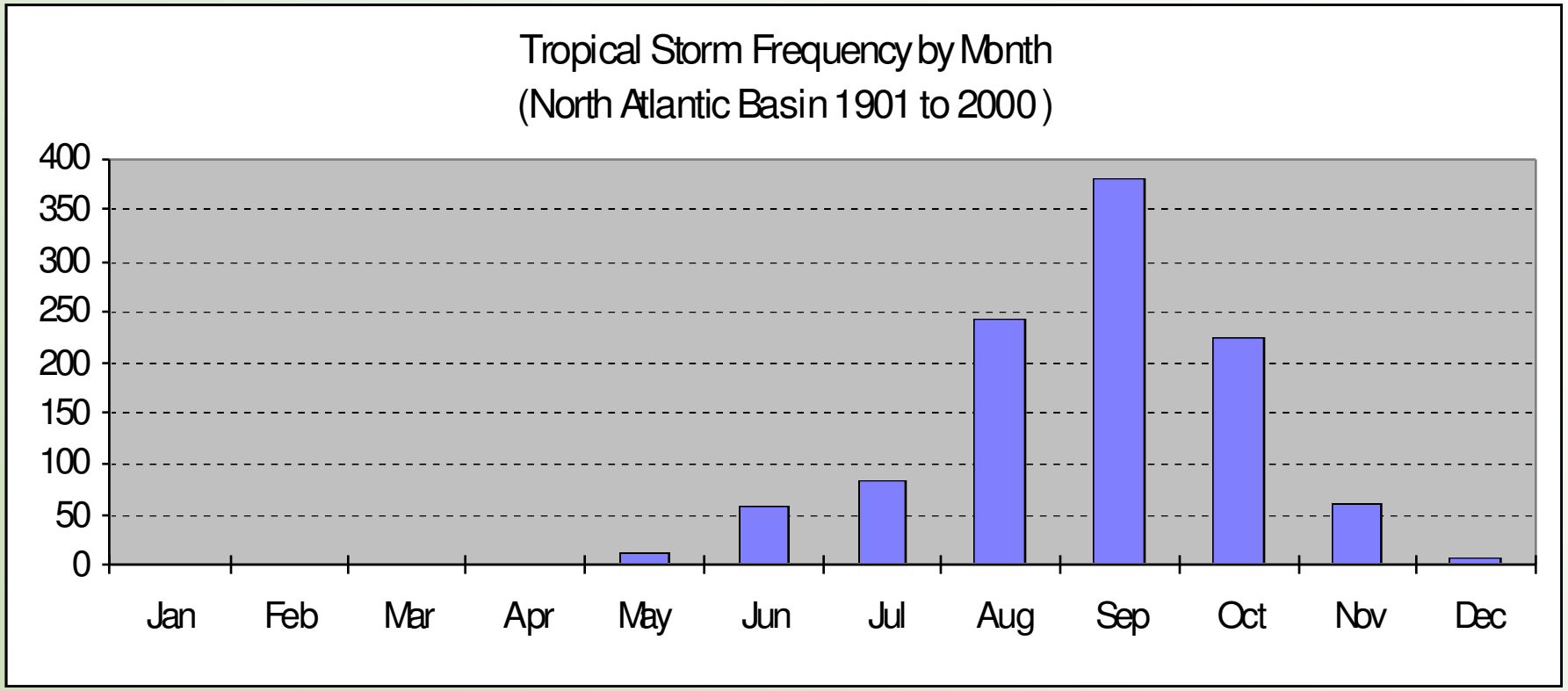


Wind > 251 km/h (156 mph)
Hurricane – Cat. 5

Atlantic Hurricane Season

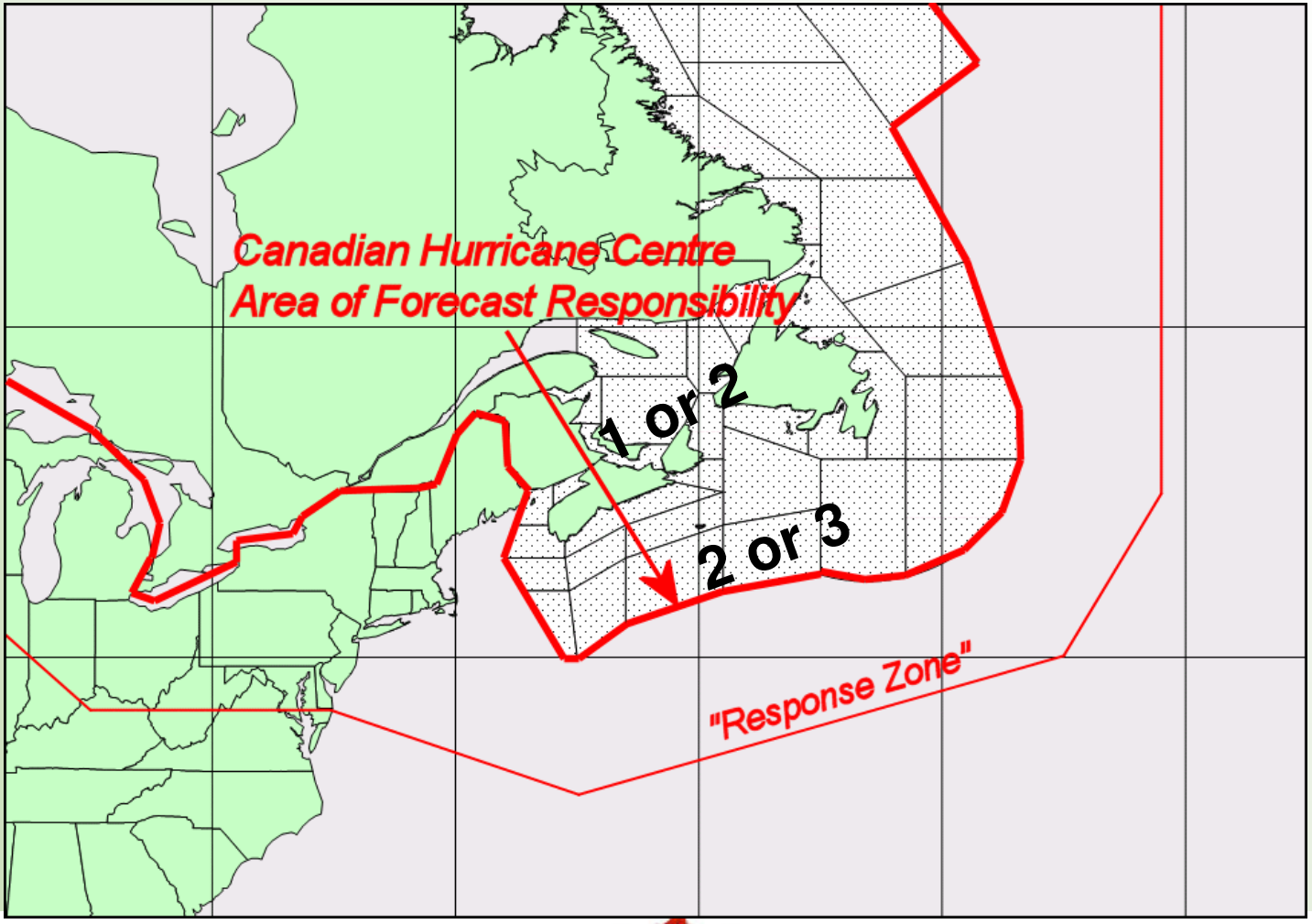
June 1 to November 30

Canadian Hurricane Centre



Canadian Hurricane Centre

On average, one or two storms directly affect Canadian land regions each year, with another 2 or 3 typically threatening our offshore waters

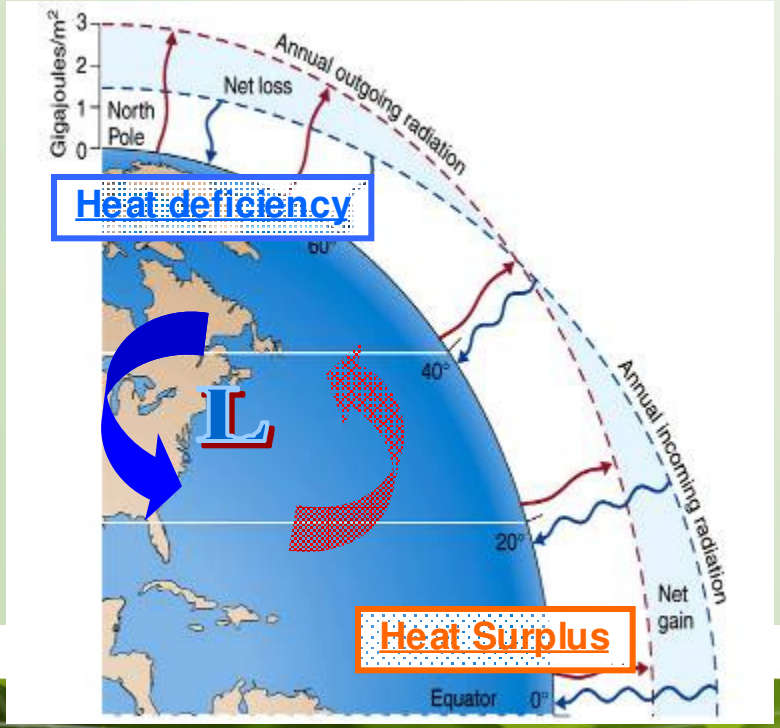


How are hurricanes different from a “regular” storm?

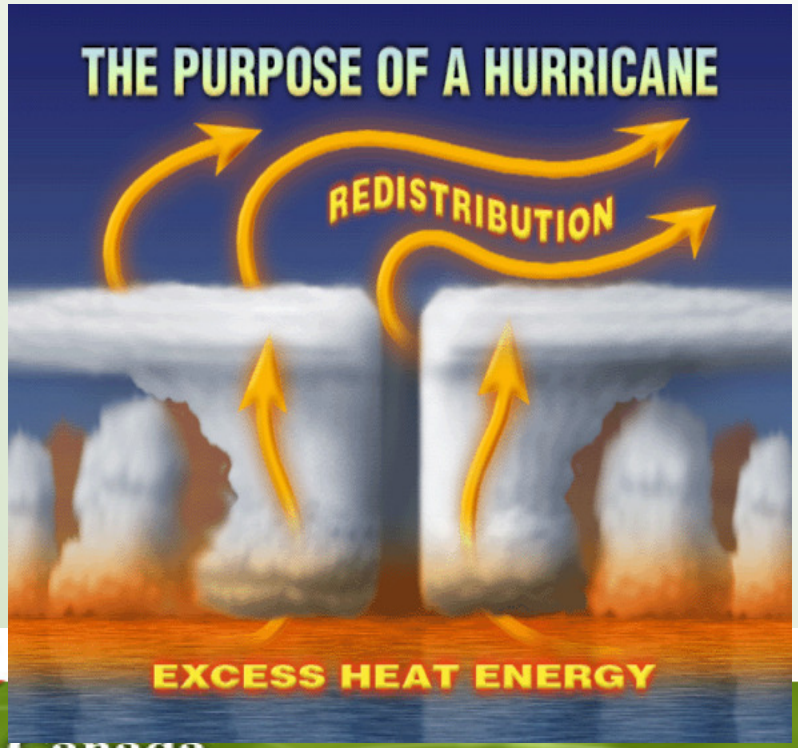
Canadian Hurricane Centre

- Both types of storms develop because of some imbalance in energy
- Different imbalances will result in different storm structures

Extratropical (ie regular storm)



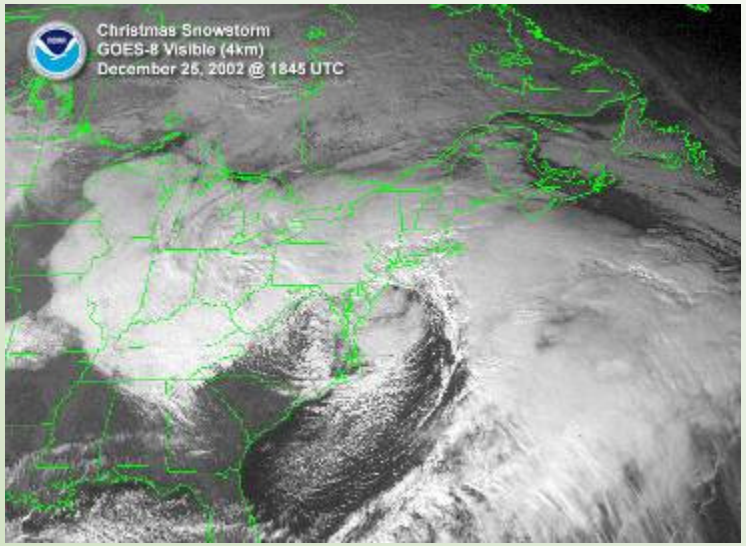
Tropical (AKA Hurricane)



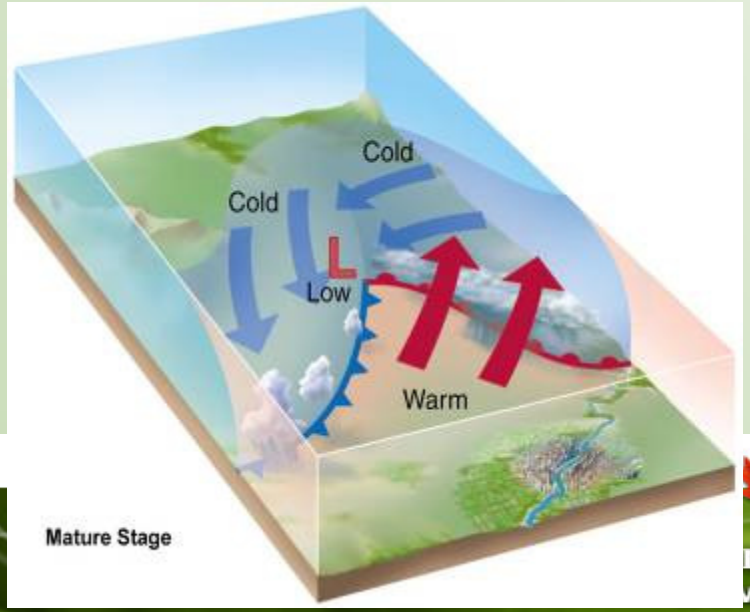
How are hurricanes different from a “regular” storm?

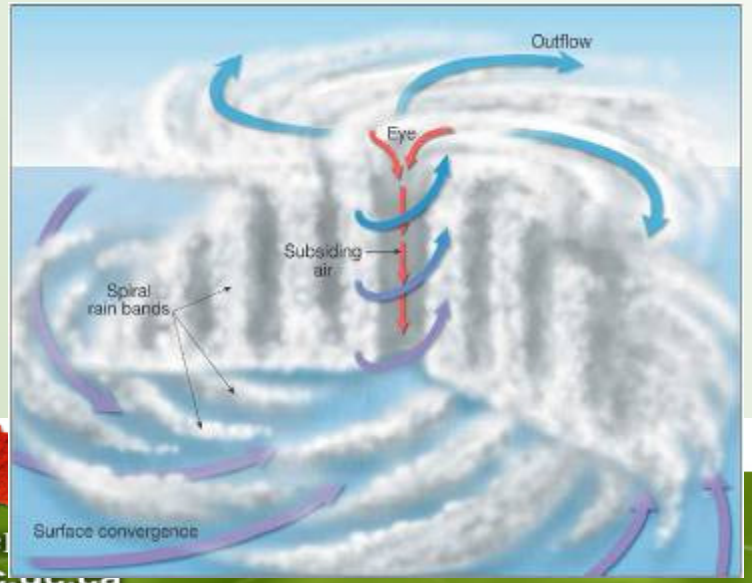
Canadian Hurricane Centre

Extratropical (AKA Frontal)



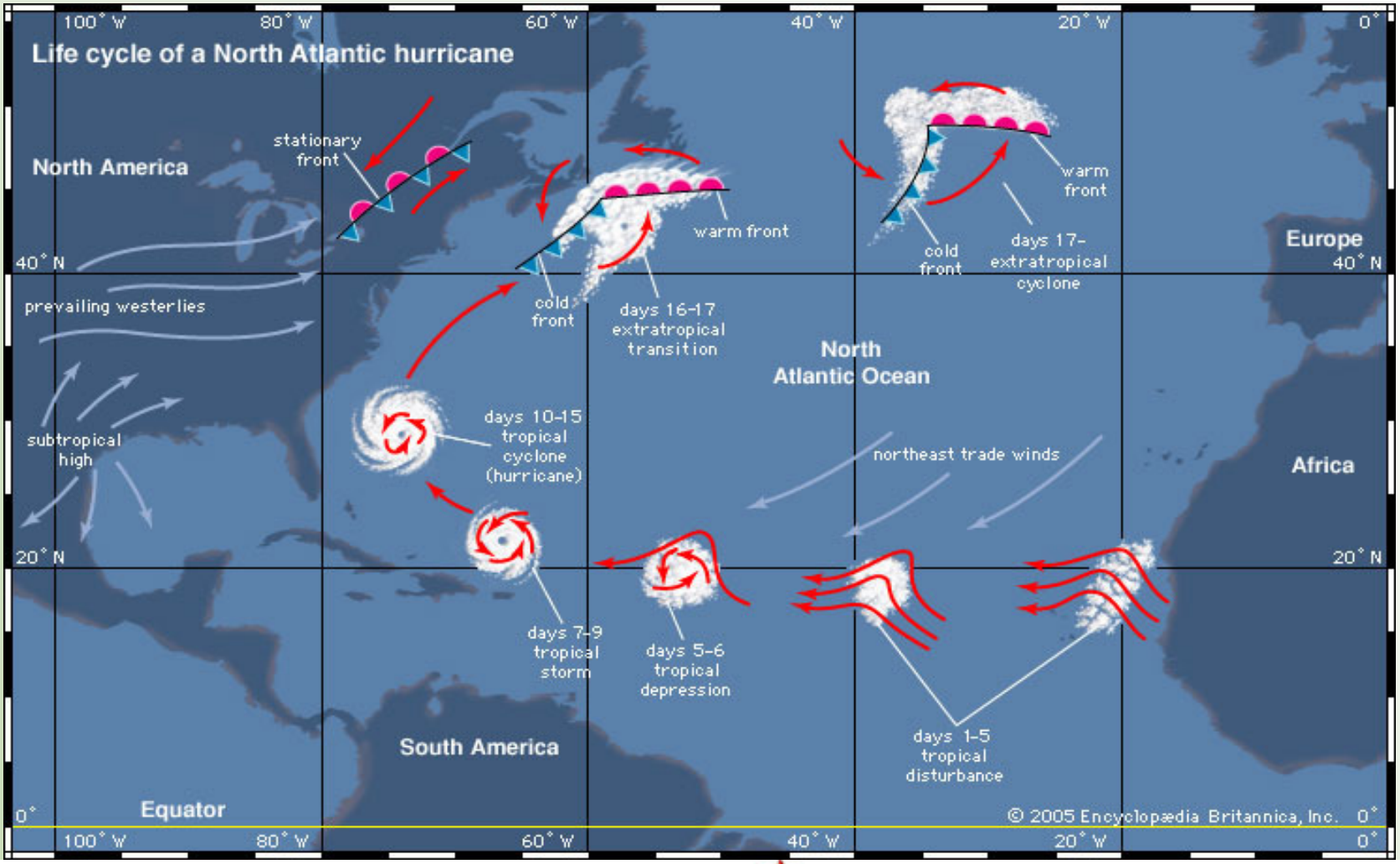
Tropical (AKA Hurricane)





Life Cycle of a Hurricane

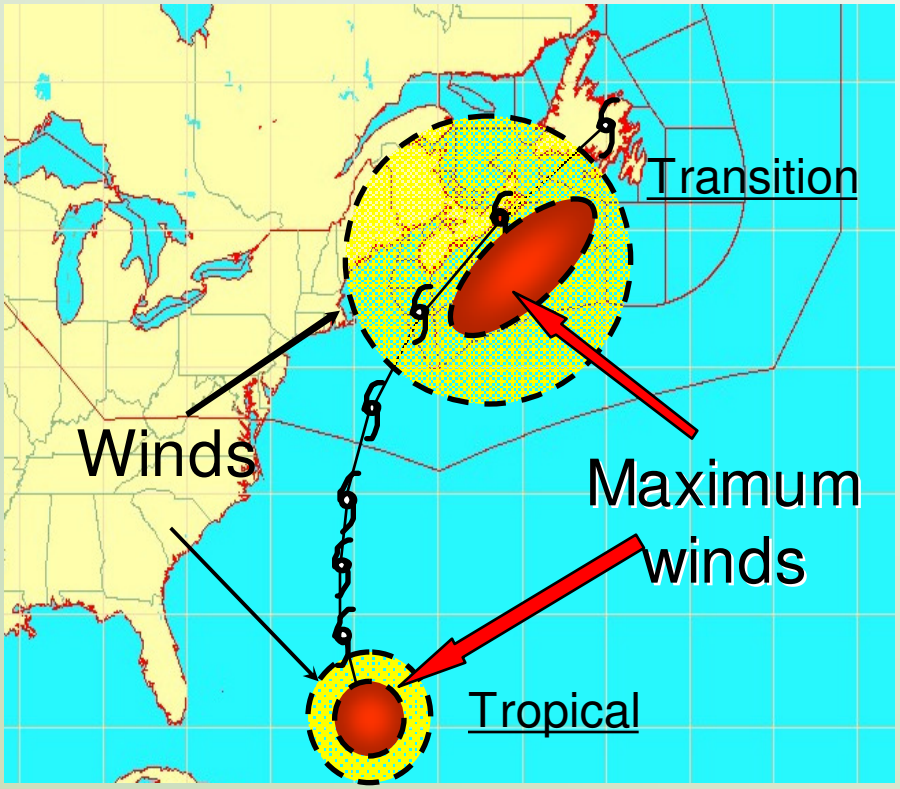
Canadian Hurricane Centre



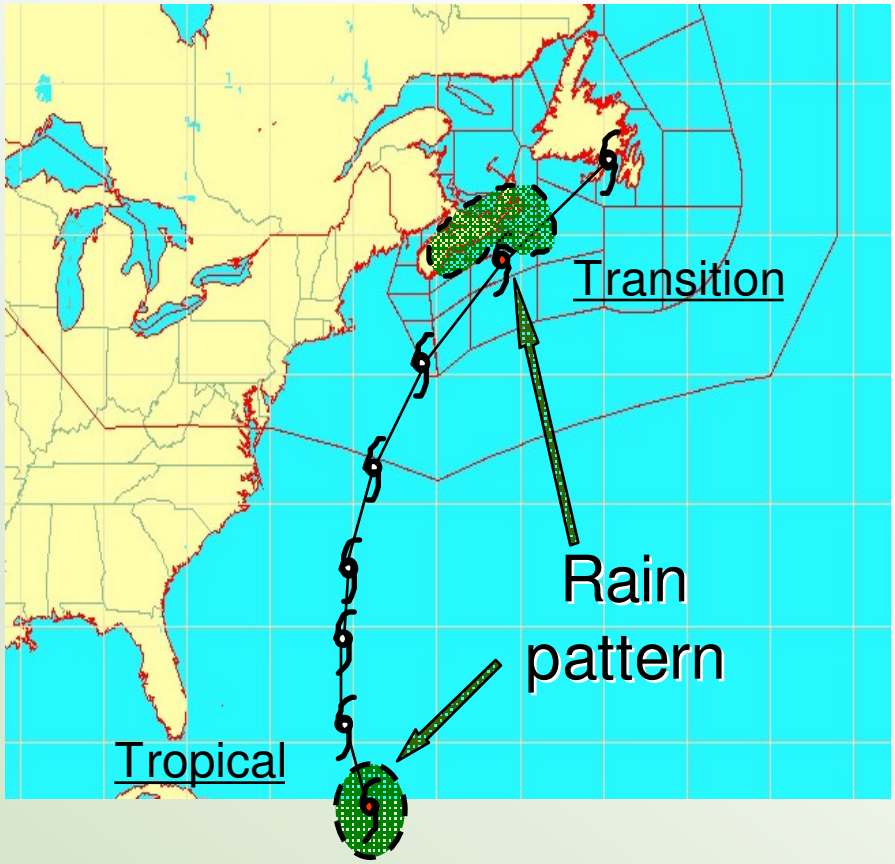
Canada's Problem:
Extratropical Transition - When a tropical storm becomes a Post-Tropical Storm

Canadian Hurricane Centre

Wind Pattern



Rain Pattern



“Storm of the Century” - 1985

Canadian Hurricane Centre

IN THE NATION

Hurricane Gloria raging off East Coast

Associated Press

MIAMI — Hurricane Gloria, one of the most powerful storms ever recorded in the open Atlantic, spared the Bahamas and headed for the East Coast Wednesday as it spun across the sea with 150 mph winds.

Officials in coastal states began taking precautions, and campers were evacuated from one coastal island. A hurricane watch was posted for North Carolina's vulnerable barrier islands and parts of Virginia and South Carolina.

"Some place along the East Coast of the United States is going to be threatened by this storm, and very quickly," if the storm's path doesn't change, said Neil Frank, director of the National Hurricane Center in nearby Coral Gables.

Frank said that even if Gloria's winds weaken before landfall, which could come by Friday at a site yet uncertain, it might attain such a fast forward speed that it could be just as dangerous because there would be less time to evacuate.

At 6 p.m. EDT, Gloria's eye was near latitude 27.5 north, longitude 73.5 west, or about 550 miles south-southeast of Cape Hatteras, N.C. It was moving northwest at 15 mph and was expected to turn northward and increase its forward speed.

Gloria did not make an expected turn, increasing the threat to the Carolinas, the weather service said.

A hurricane watch was posted from Edisto Beach, just south of Charleston, S.C., to Cape Henry, Va., including North Carolina's Outer Banks. A campground on Ocracoke Island, a short ferry ride from Cape Hatteras, was evacuated Wednesday morning, and residents of Ocracoke and Portsmouth islands were asked to leave.

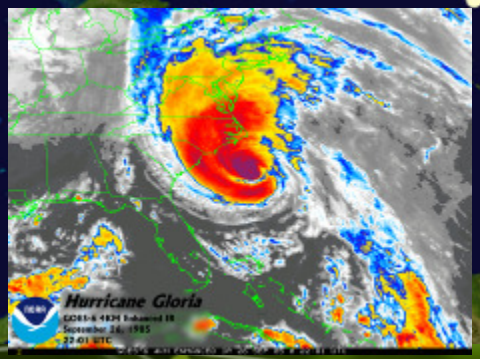
Even with the storm so far away, tides at Cape Hatteras were about a foot above normal.

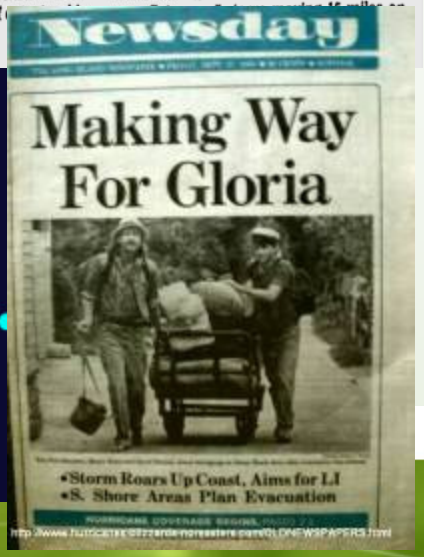
Gloria was classified as a "borderline" Category 5 storm on a scale that rates hurricane strength from 1 to 5, said Hal Gerrish, a forecaster at the hurricane center. A Category 5 hurricane is capable of [illegible] damage.

A Category 4 storm has winds between 131 mph and 155 mph, and storms with higher winds are classified Category 5. However, Gerrish said Gloria was classified Category 5 because its low central barometric pressure, which pulls in the wind, fluctuated above and below 27.17 inches, the threshold for that category.

Only two hurricanes of that strength have ever been known to hit the United States.

Frank cautioned that hurricanes often pick up forward speed as they move northward over colder water and that Gloria "could weaken to a Category 3 but cause as much damage moving 50 to 60 miles an hour




Newsday

Making Way For Gloria

•Storm Roars Up Coast, Aims for LI
•S. Shore Areas Plan Evacuation

Environment Canada
www.ec.gc.ca

In Canada: Gloria was relatively low damage…
……but definitely high impact!

Canadian Hurricane Centre

Canadian Hurricane Centre

- Planning began 1985
- Began operations in 1987
- Specially trained forecasters
- New Certification program
  - Junior CHC forecasters
  - CHC Forecasters
  - Senior CHC forecasters
- Several landmark and damaging storms since 1987

Hurricane Forecaster Training Miami

Why the concern in Canada?

Canadian Hurricane Centre

Intense Rainfalls

PT Harvey ’99, PT-Gabrielle ’01, Frances ’04, Chantal ’07, Cristobal & Hanna ‘08

Winds of hurricane force in Summer/Fall

Hortense ’96 > 120 km/h, Gustav ’02 >120km/h, Juan ’03 > 150 km/h, Florence ’06 >130 km/h, Noel ’07 > 140 km/h

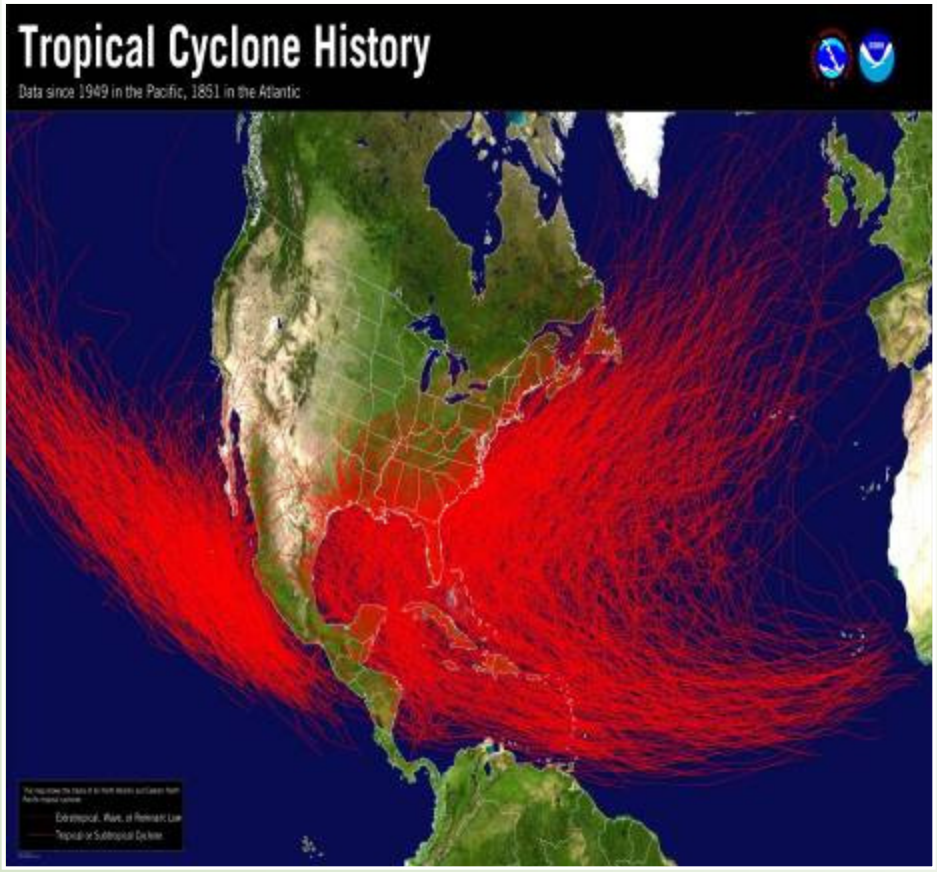
Extreme Wave Heights

Oct. ’91~30m, Luis ’95~30m, Danielle ’98~27m, Noel ’07~26m

Damaging Storm surges

Unnamed ’00 ~1.6m,

Juan ’03 ~2.0 m

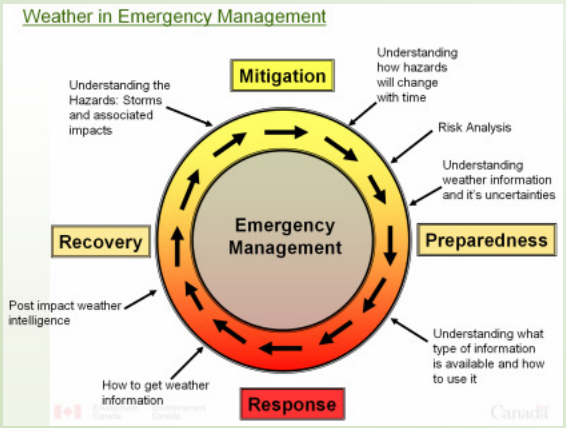


Our partners in Emergency Management..

Canadian Hurricane Centre

Canadian Hurricane Centre

- Very close working relationship with emergency management officials
- Through Warning Preparedness Meteorologist program we train and exercise on a regular basis
- Seasonal prep briefings
- Regular briefings during events
- Relocation the Joint emergency Operations Centre



…and our partners in the media

Canadian Hurricane Centre

Canadian Hurricane Centre

- Dedicated media room with direct plug-in facilities
- Seasonal forecast briefings
- Media workshops
- Special media technical briefings during actual events

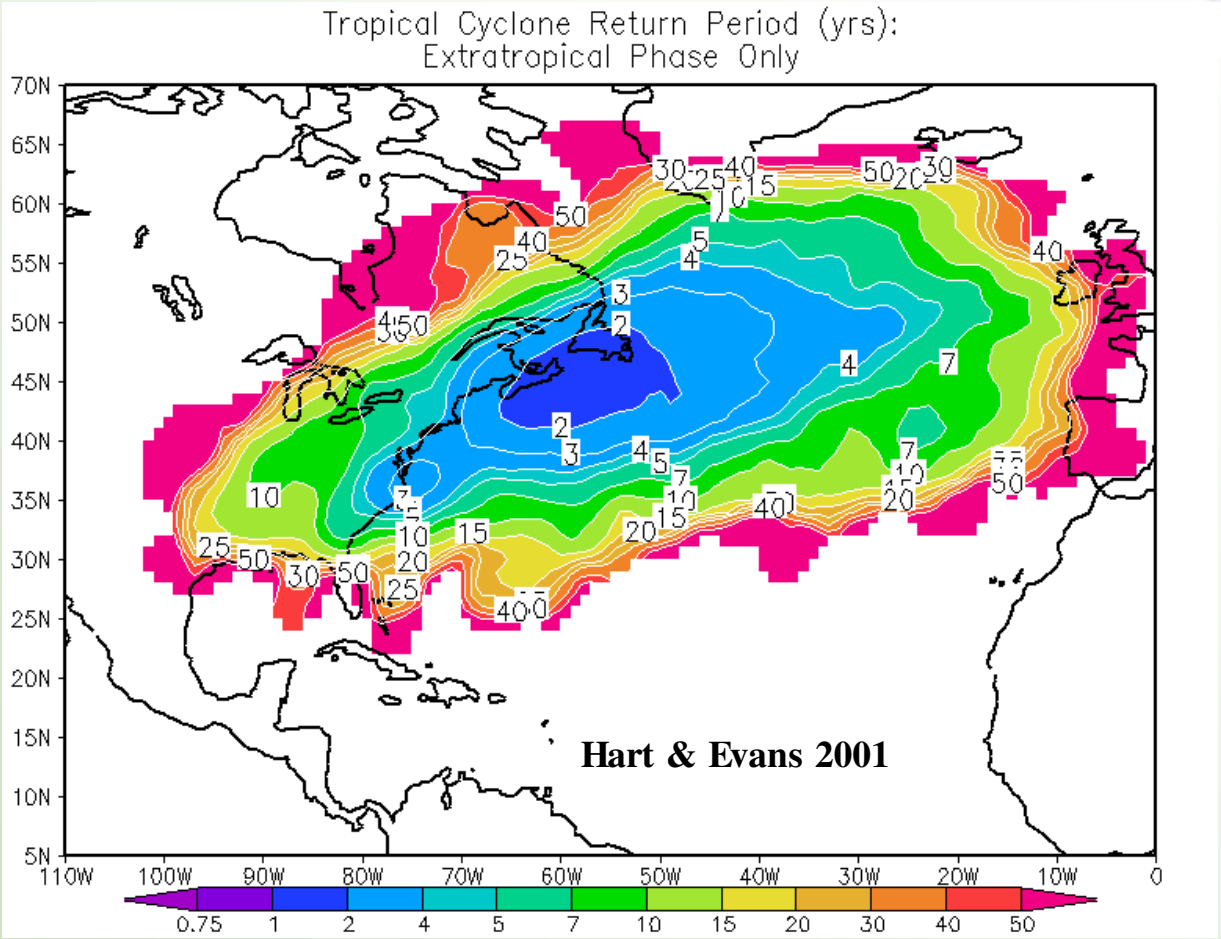
Media Technical Briefings

Extratropical Transition: A closer look

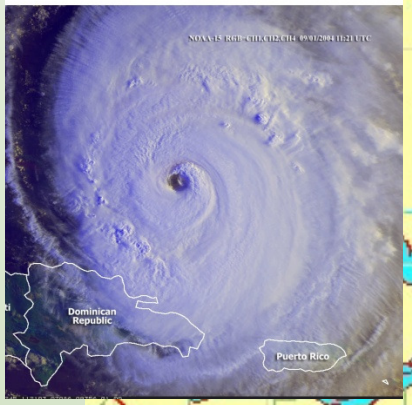
Canadian Hurricane Centre

Why this is important for Canada???

Because it's more likely to happen here!!



Extratropical Transition: Canada's Problem

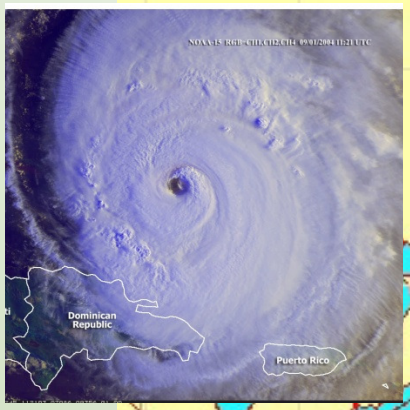


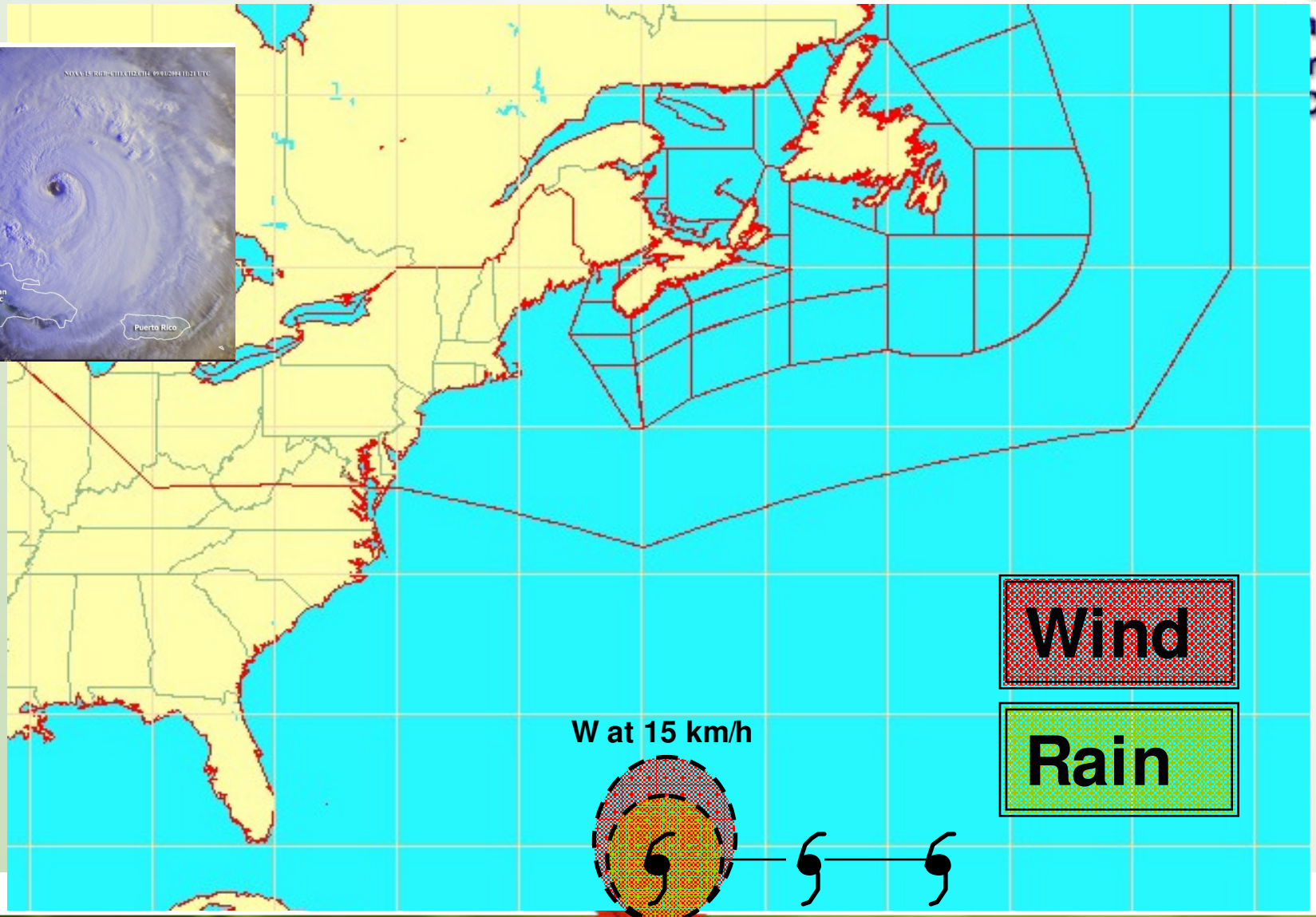
Wind

Rain

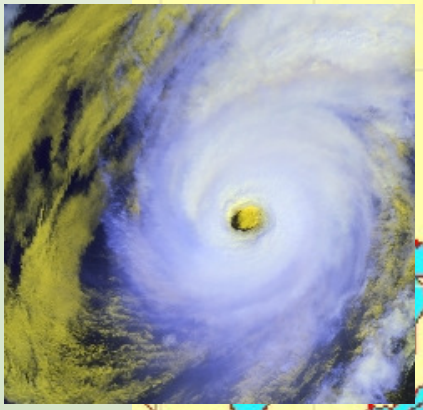
W at 15 km/h

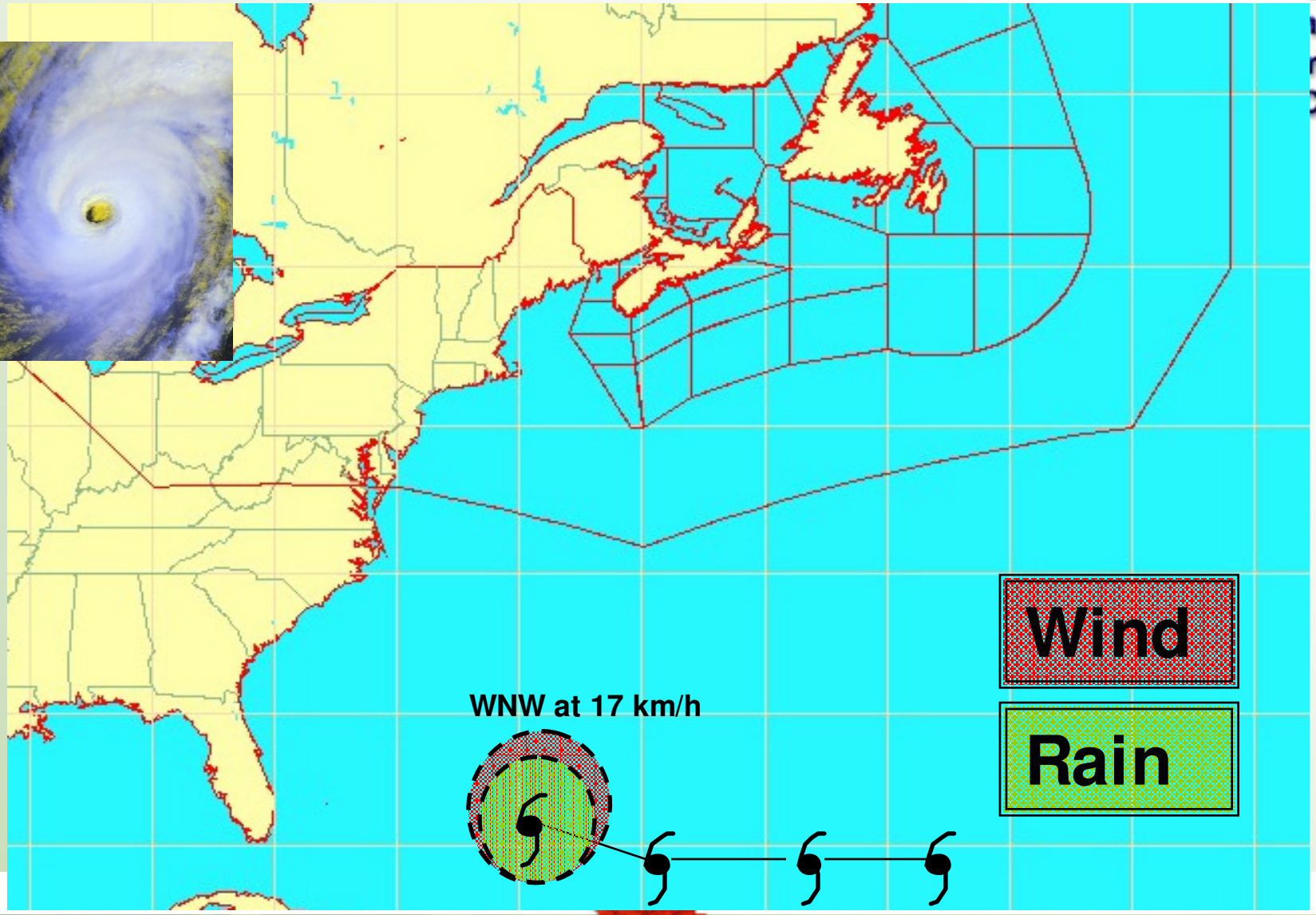
Extratropical Transition: Canada's Problem



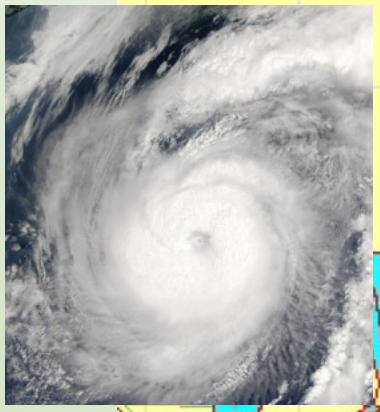


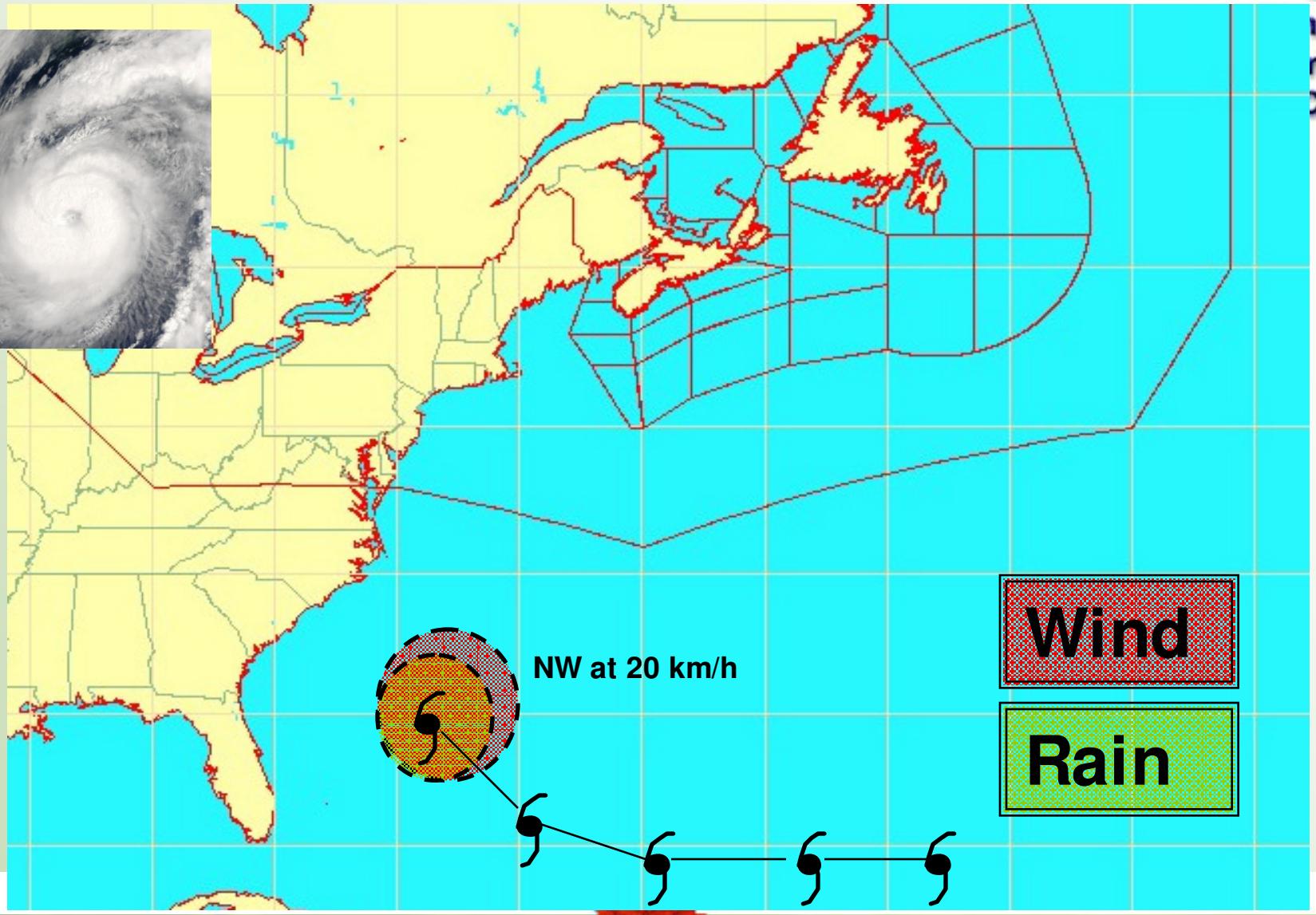
Extratropical Transition: Canada's Problem



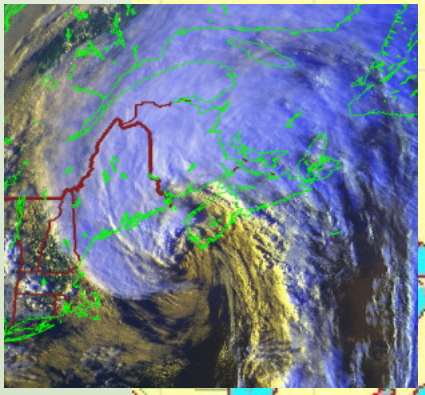


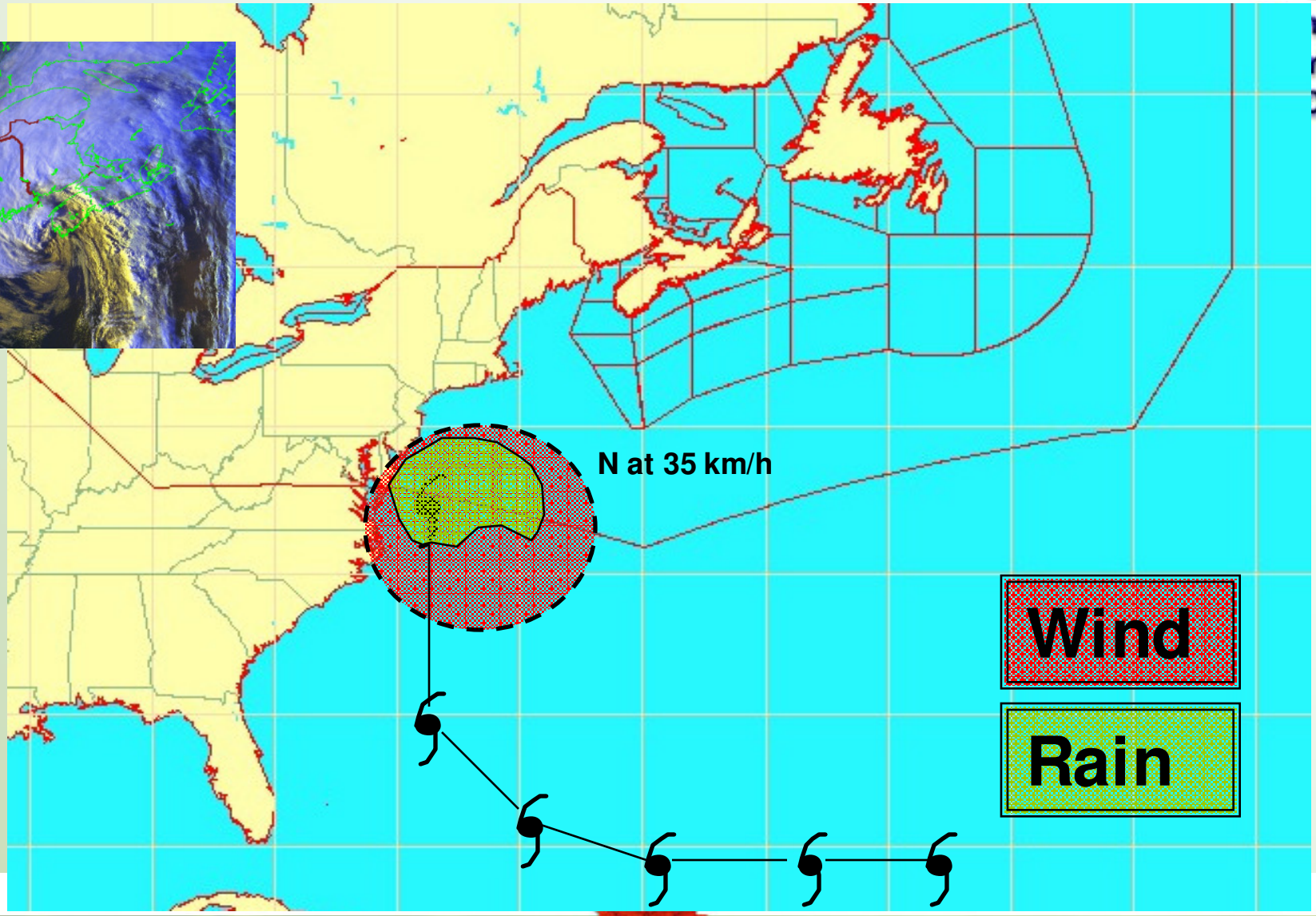
Extratropical Transition: Canada's Problem



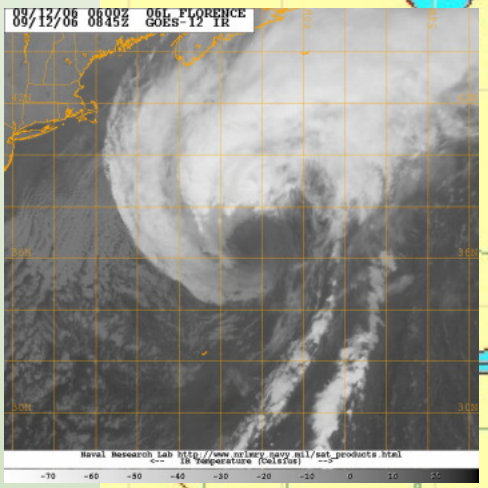


Extratropical Transition: Canada's Problem





Extratropical Transition: Canada's Problem

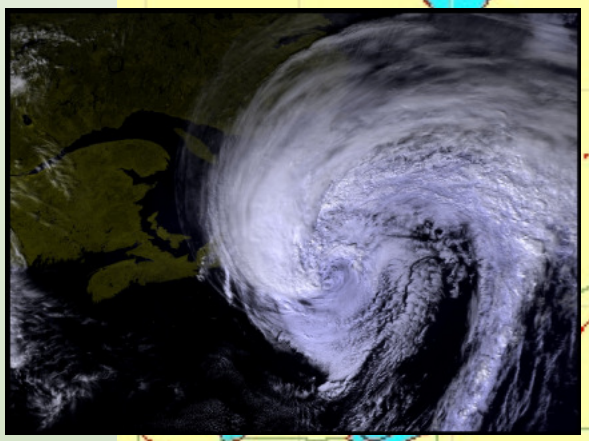


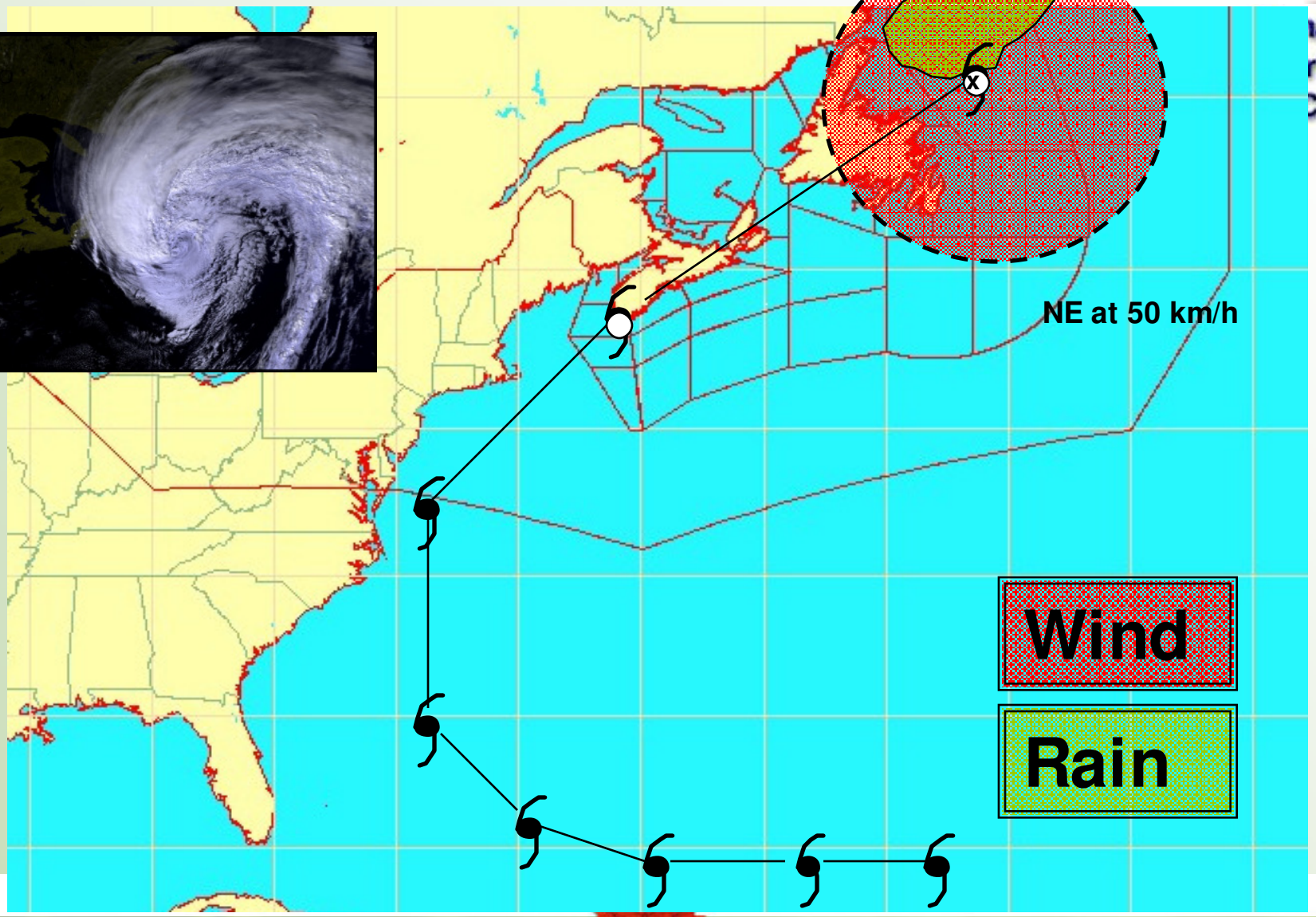
NE at 45 km/h

Wind

Rain

ET Transition: Canada's Problem





Extratropical Transition: Canada's Problem

Canadian Hurricane Centre

What weather hazards accompany these storms?

Tropical Stage

- Damaging winds on both sides
- Heavy rain/flash flooding on both sides
- Storm surge/flooding
- Large waves/pounding surf
- Tornadoes

Transitioning Stage

- Damaging winds mostly on the right of track but depends on stage of transition
- Heavy rain/flash flooding mostly ahead of and to left of the track but it depends on the stage of transition
- Storm surge
- Potential for very large waves

Post-Tropical Stage

- Possible damaging winds to right of track
- Heavy rain/flash flooding to left of track
- Storm surge more likely near and to right of track
- VERY large waves

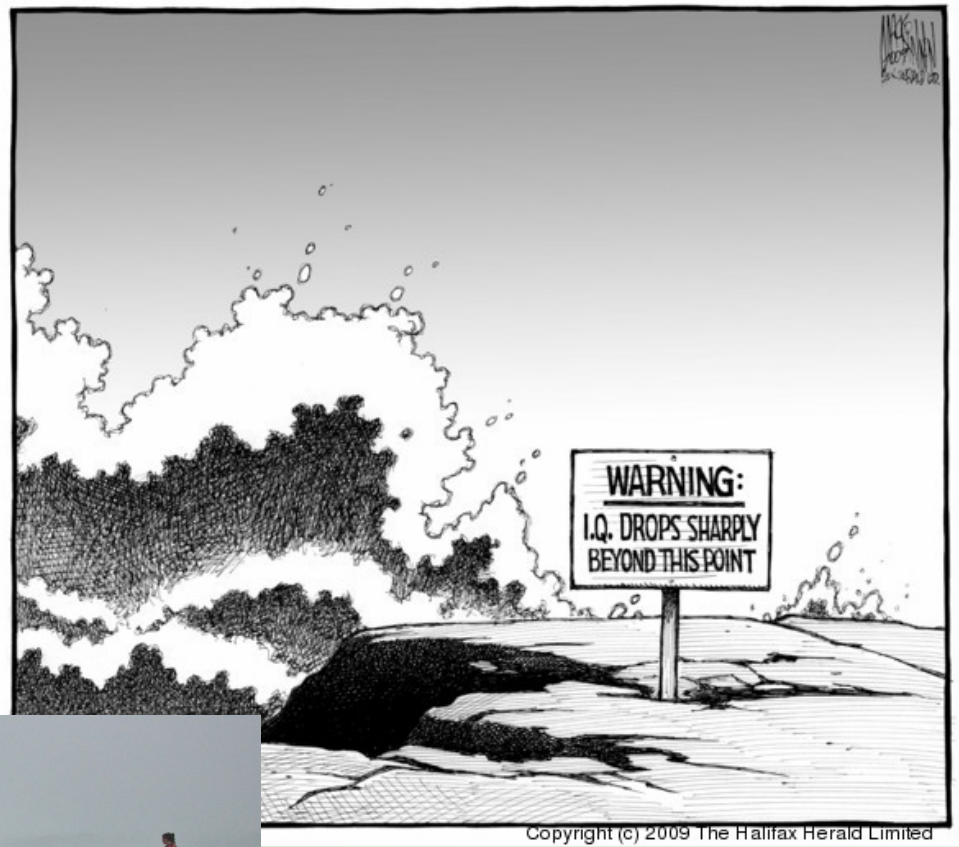
Extratropical Transition: Canada's Problem

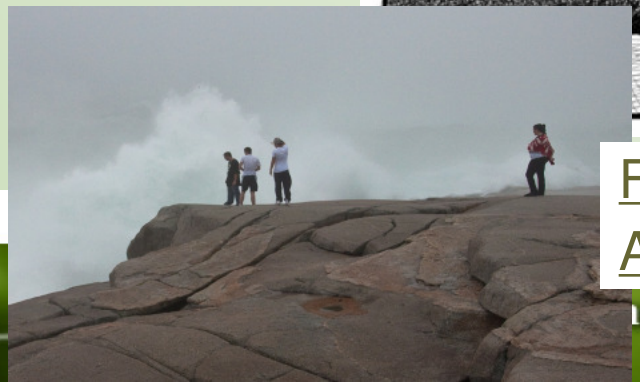
Trapped Fetch Wave – How BIG can these waves get?

Canadian Hurricane Centre

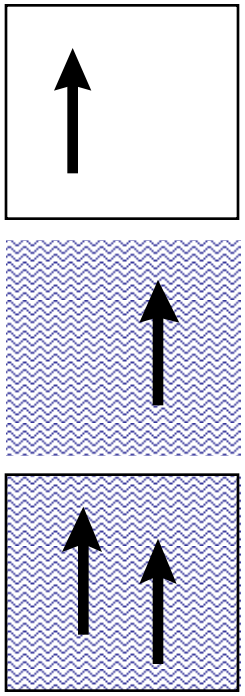
Trapped Fetch Wave

- 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





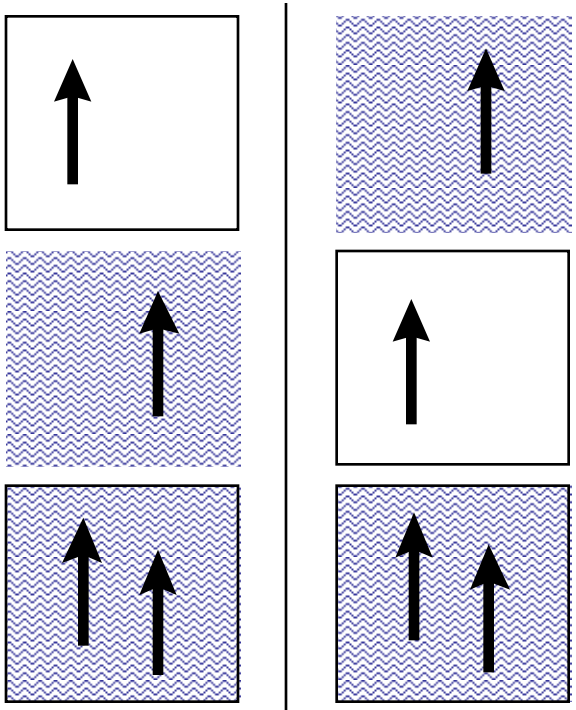
From Halifax Chronicle Herald, August 2009



A

Fetch moving much faster than waves

Mid-latitude systems



A

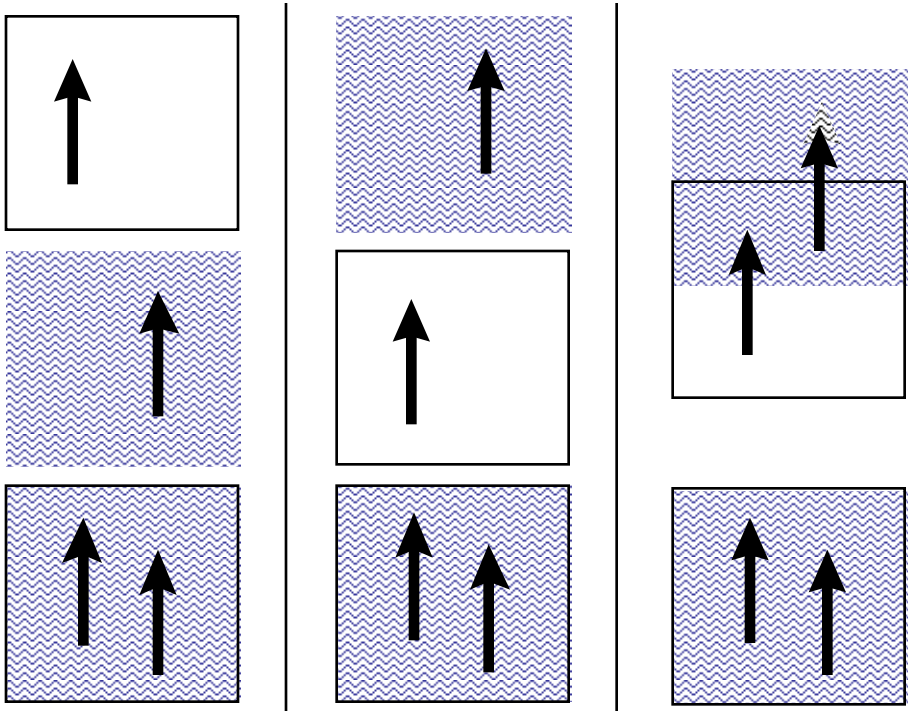
Fetch moving much faster than waves

Mid-latitude systems

B

Waves moving much faster than fetch

Tropical storms in the tropics



A

Fetch moving much faster than waves

Mid-latitude systems

B

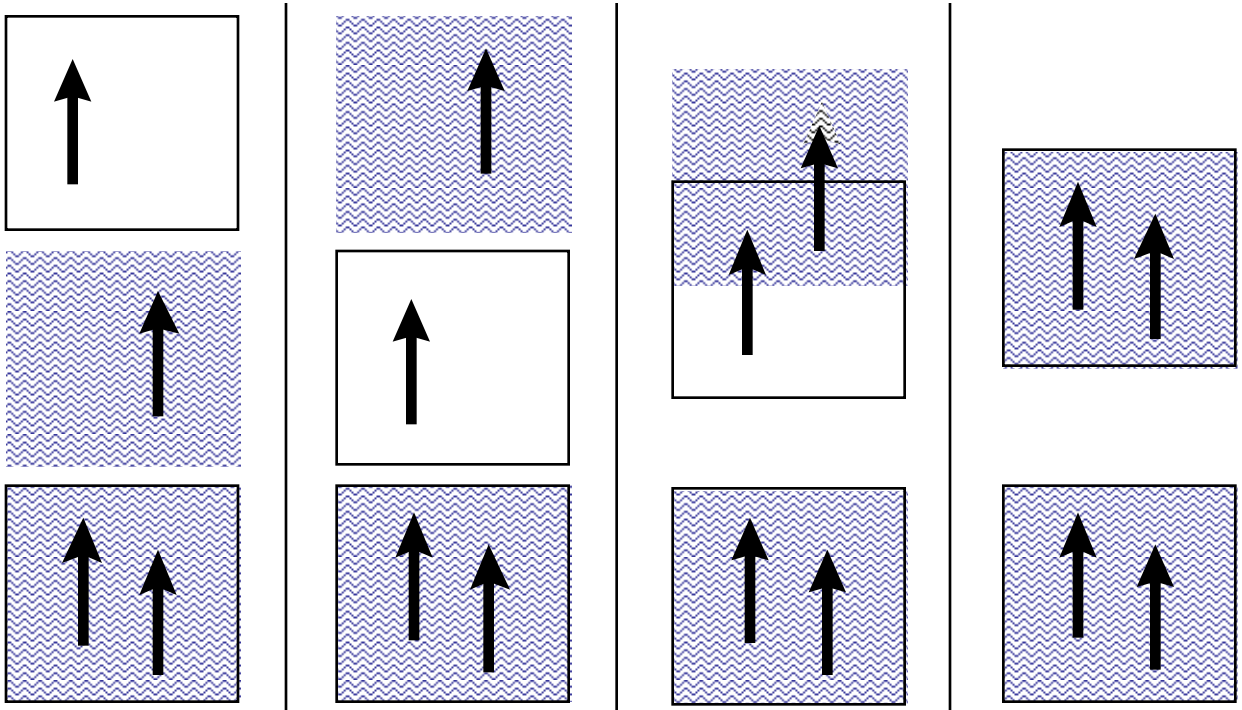
Waves moving much faster than fetch

Tropical storms in the tropics

C

Some waves in harmony with fetch

Strong wind systems in mid-latitudes



A

Fetch moving much faster than waves

Mid-latitude systems

B

Waves moving much faster than fetch

Tropical storms in the tropics

C

Some waves in harmony with fetch

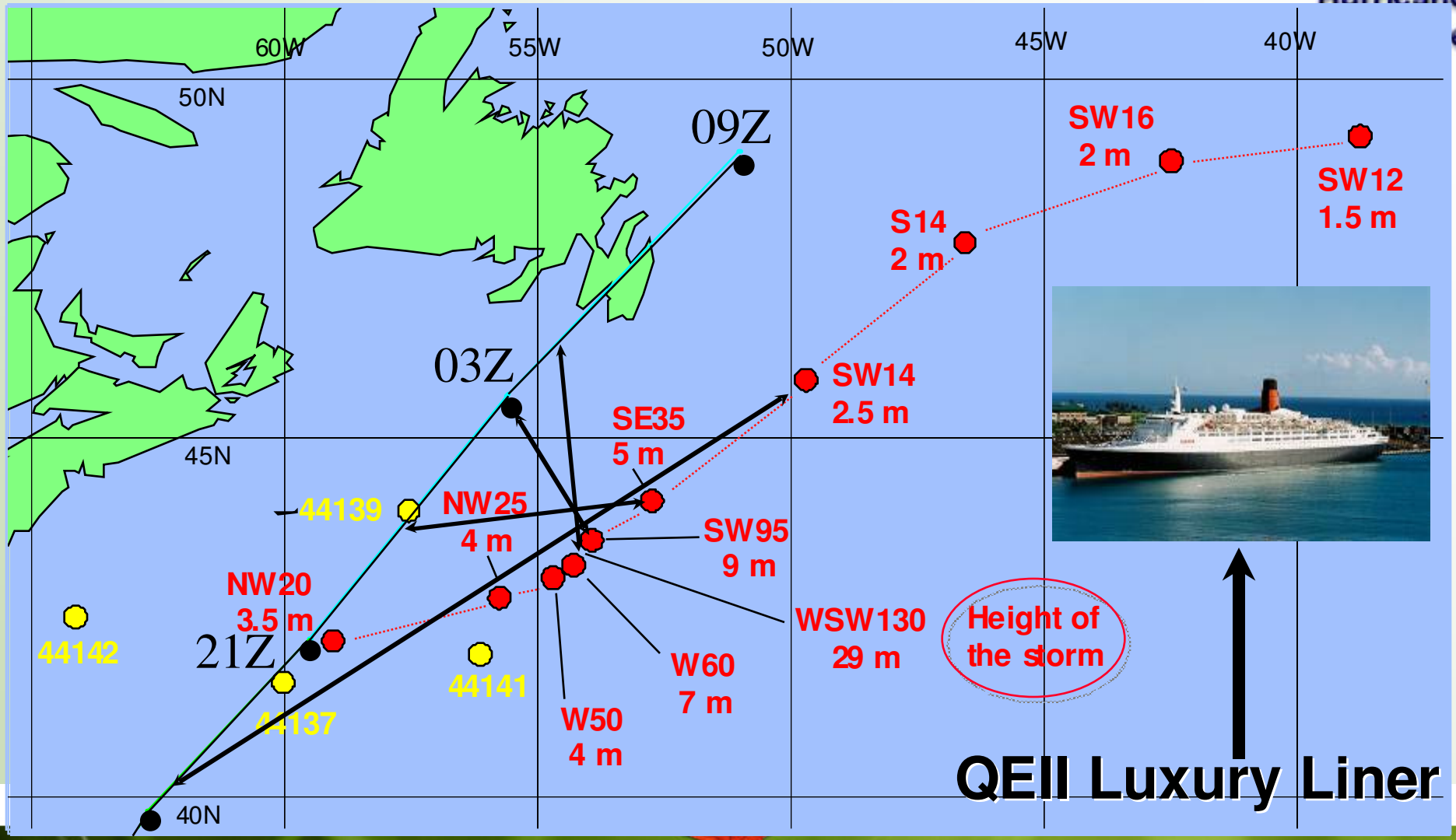
Strong wind systems in mid-latitudes

D

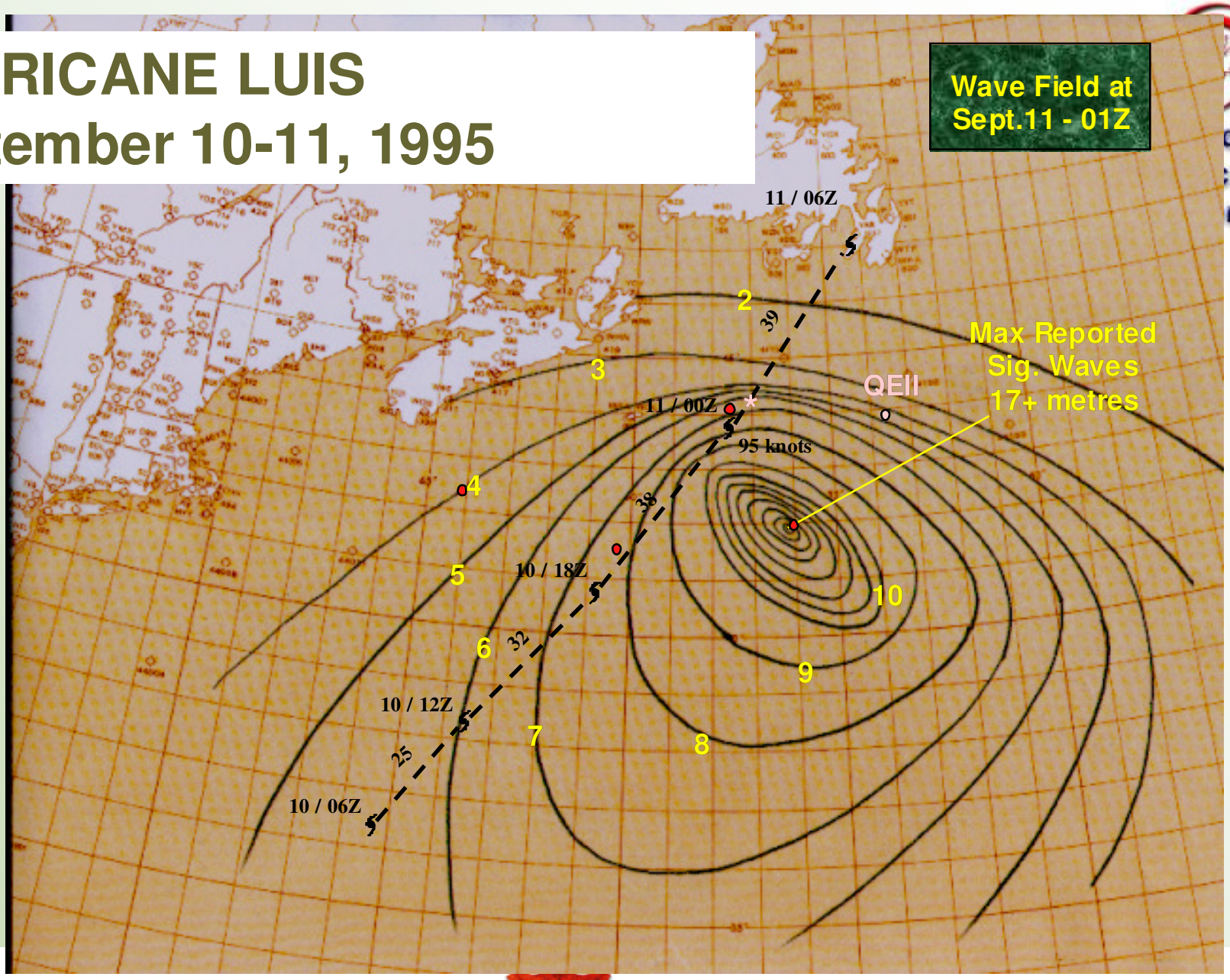
Perfect Waves-Storm Resonance

The ***REAL*** "Perfect Storms"

How big can waves get?



HURRICANE LUIS
September 10-11, 1995

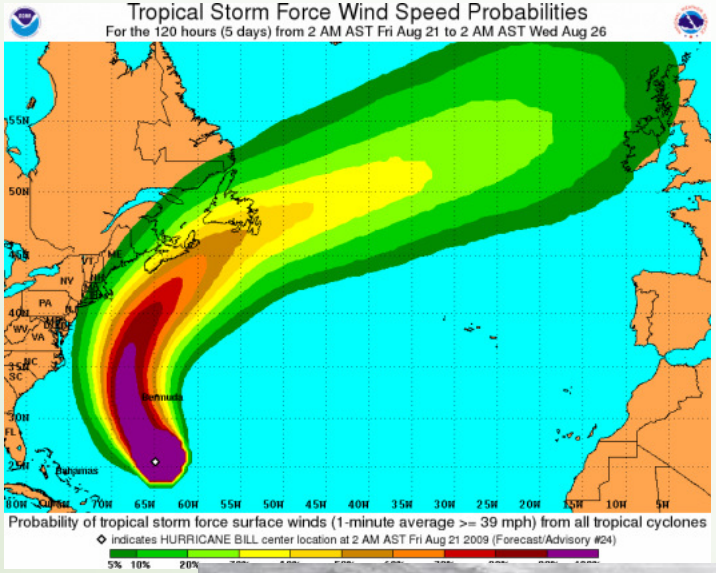


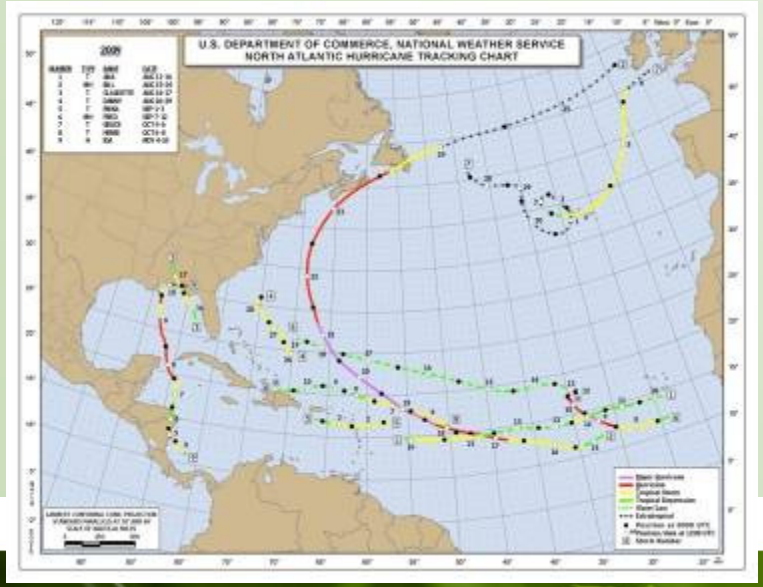
Hurricane Season 2009 in Review

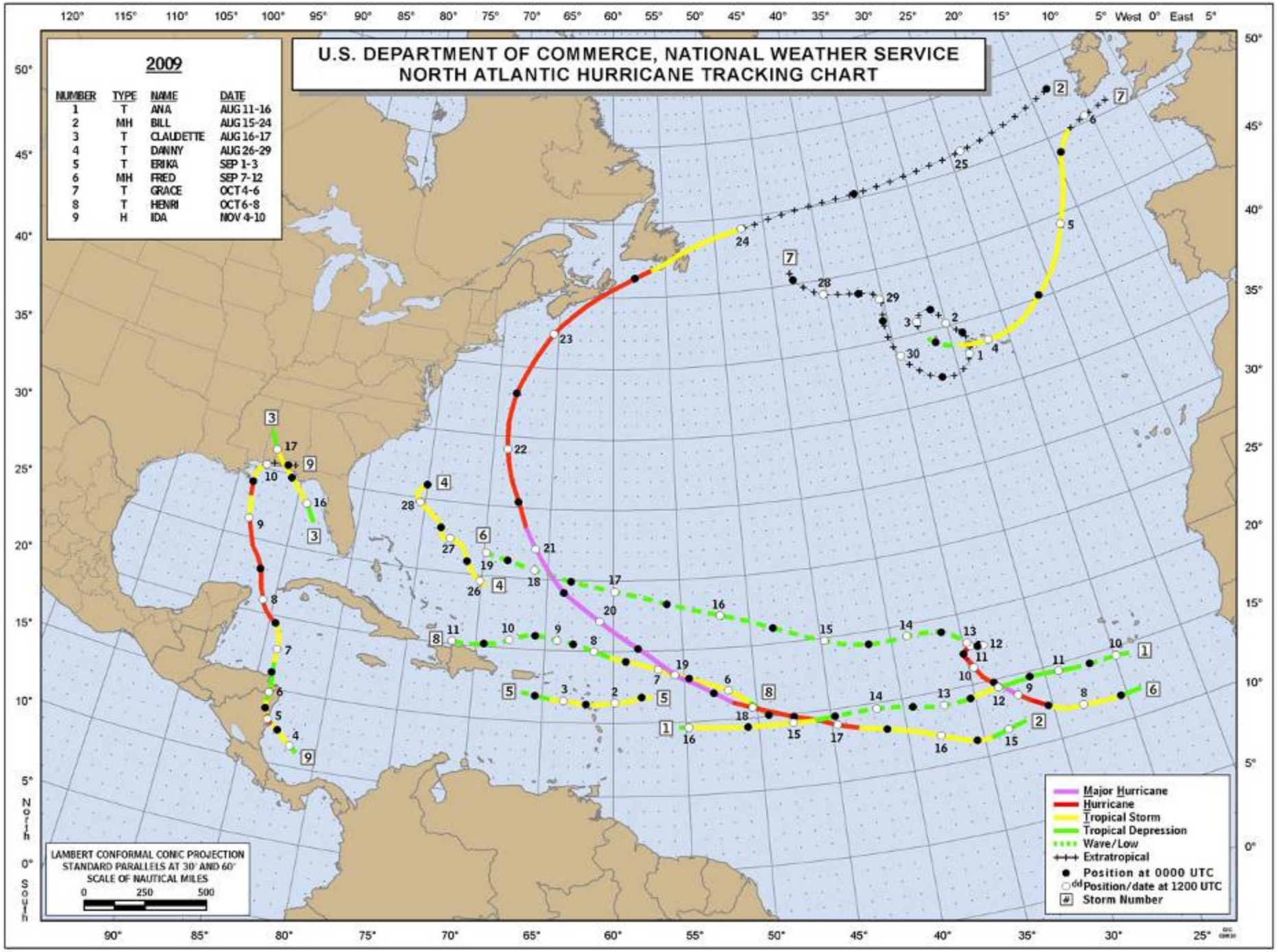
Canadian Hurricane Centre

Summary:

- *9 Named Storms*
- *3 Hurricanes*
- *2 Major hurricanes*

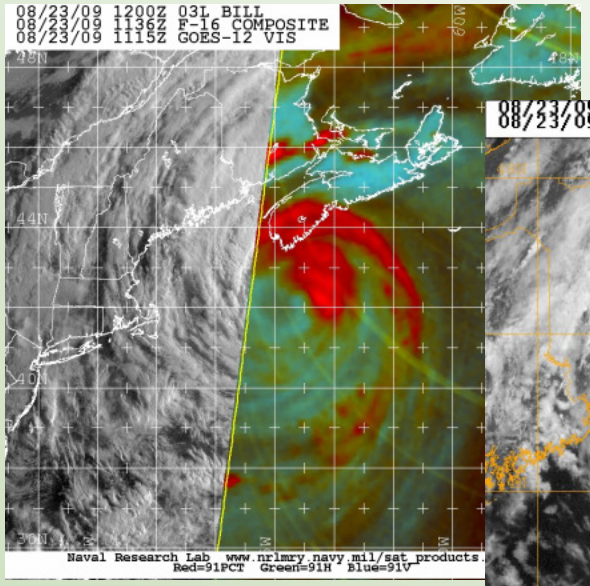


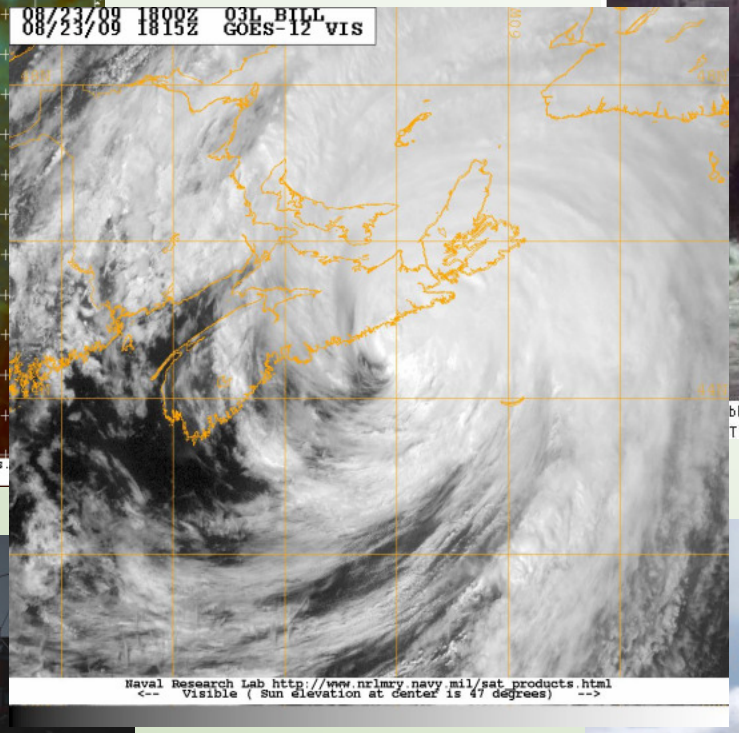



U.S. DEPARTMENT OF COMMERCE, NATIONAL WEATHER SERVICE
NORTH ATLANTIC HURRICANE TRACKING CHART
2009
NUMBER TYPE NAME DATE
1 T ANA AUG 11-16
2 MH BILL AUG 15-24
3 T CLAUDETTE AUG 16-17
4 T DANNY AUG 26-29
5 T ERIKA SEP 1-3
6 MH FRED SEP 7-12
7 T GRACE OCT 4-6
8 T HENRI OCT 6-8
9 H IDA NOV 4-10
Major Hurricane
Hurricane
Tropical Storm
Tropical Depression
Wave/Low
Extratropical
Position at 0000 UTC
Position/date at 1200 UTC
Storm Number
LAMBERT CONFORMAL CONIC PROJECTION
STANDARD PARALLELS AT 30° AND 60°
SCALE OF NAUTICAL MILES
0 250 500

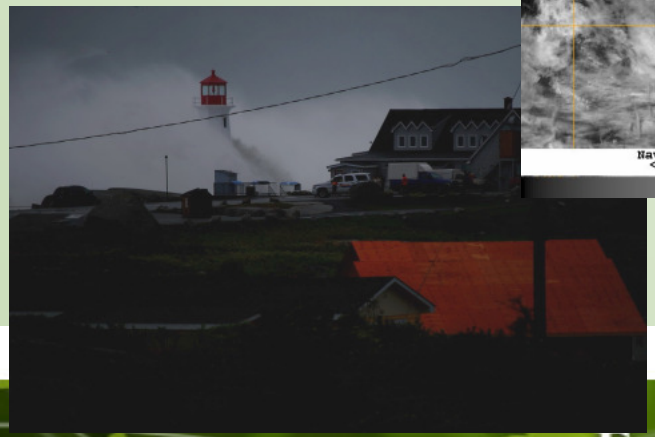
The challenge of communicating uncertain risk

Canadian Hurricane Centre





blocks the way as waves slam into Cow Bay Road in Cow Bay, N.S., Sunday
The Canadian Press/Tim Krochak)

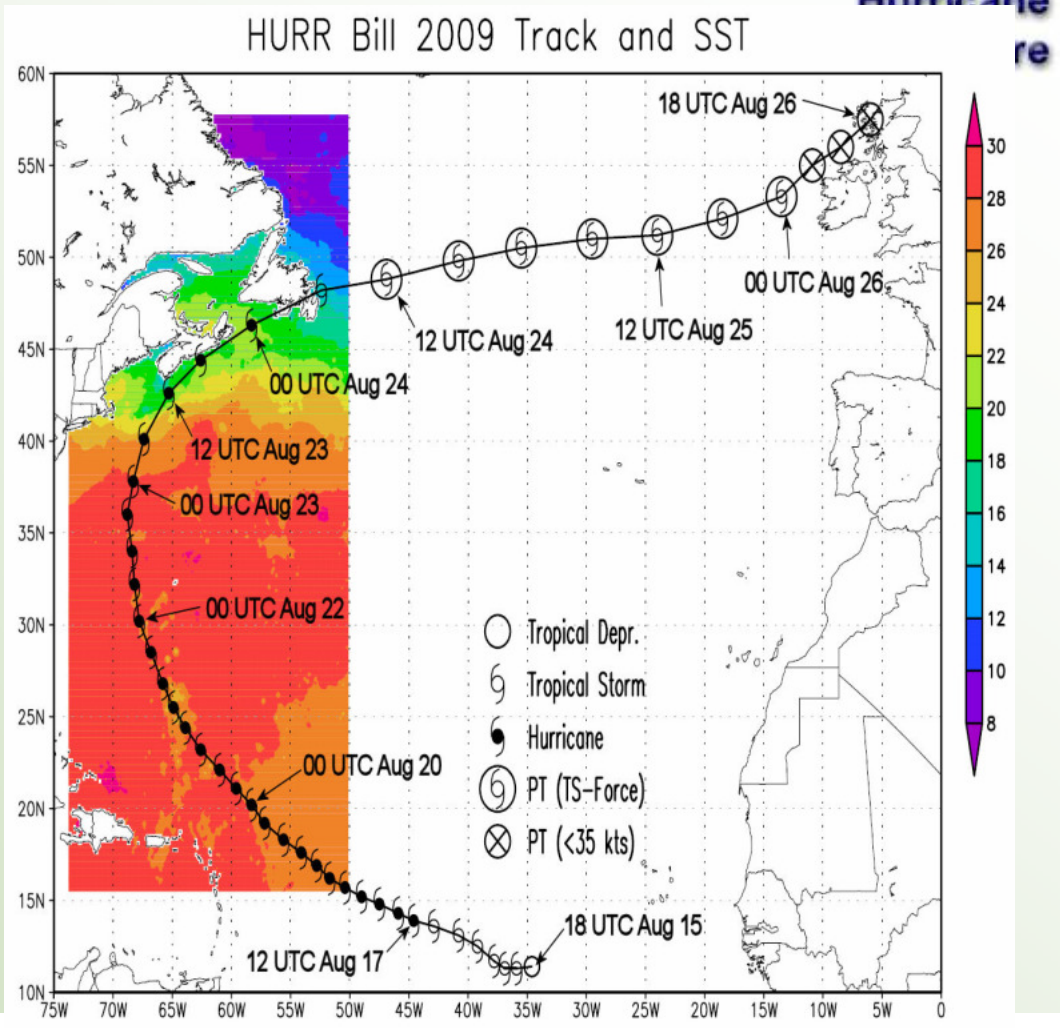


Hurricane Bill Post Storm Analysis

Canadian Hurricane Centre

Overview

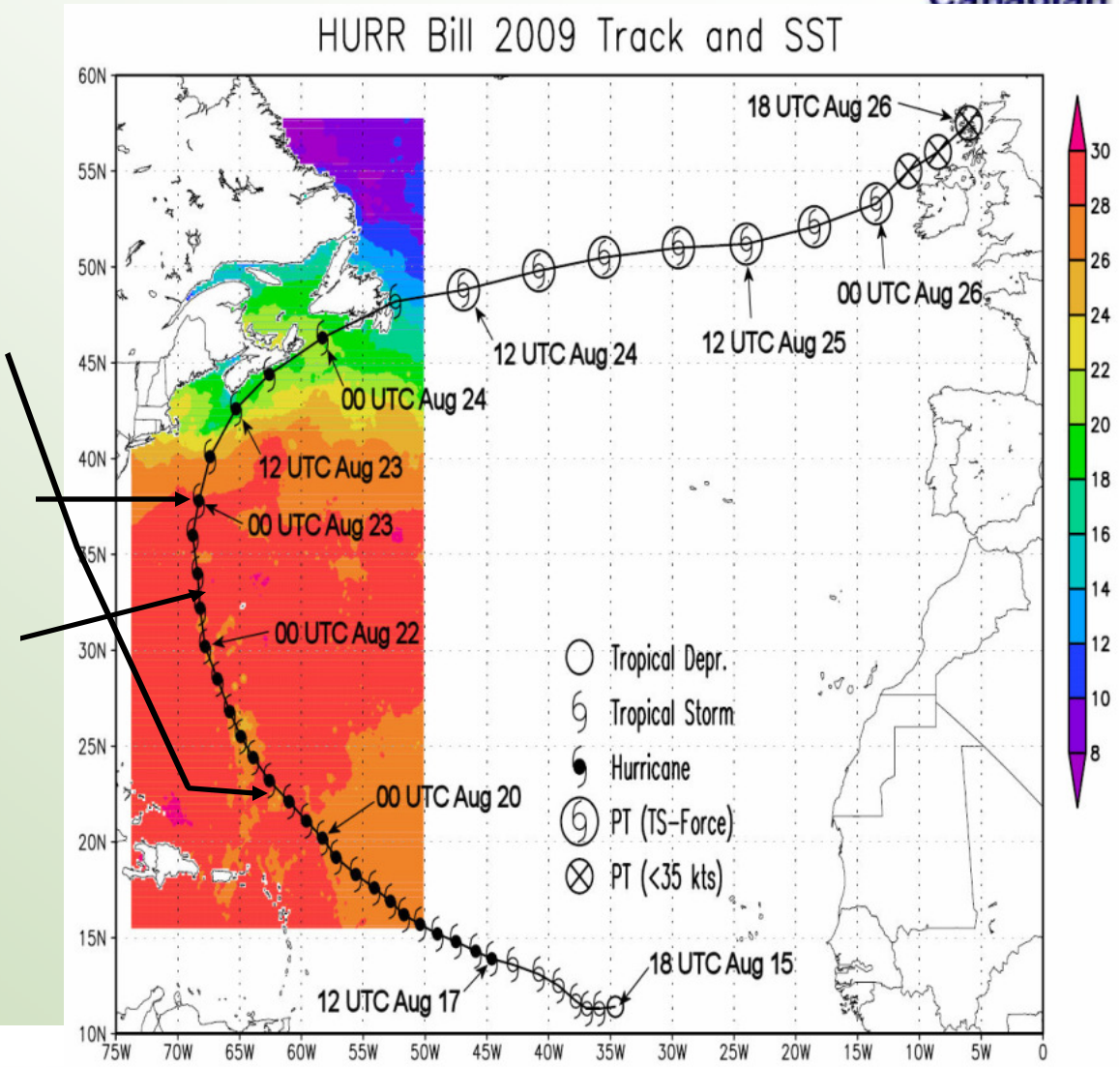
- Bill became a tropical storm on August 15th, 2009
- Upgraded to first hurricane of the season hurricane on August 17th , 2009
- Continued strengthening to reach Cat 4 with winds 213 km/h on August 19th, 2009
- Bill tracked just south of Nova Scotia as a strong Cat 1 hurricane on August 23rd, 2009
- Bill continued to track through NL then across the Atlantic as a Post-Tropical storm



Hurricane Bill Post Storm Analysis

CHC Operations

- Canadian Hurricane Centre (CHC) began issuing hurricane bulletins every 6 hours on Thursday August 20th at 9:00 am ADT
- CHC increased frequency to every 3 hours on August 22nd at 9:00 pm ADT
- First first public warnings for Nova Scotia were issued at 5:00 am ADT on Saturday
- Hurricane watches and Tropical Storm warnings were issued along the Nova Scotia coast and through south eastern Newfoundland.

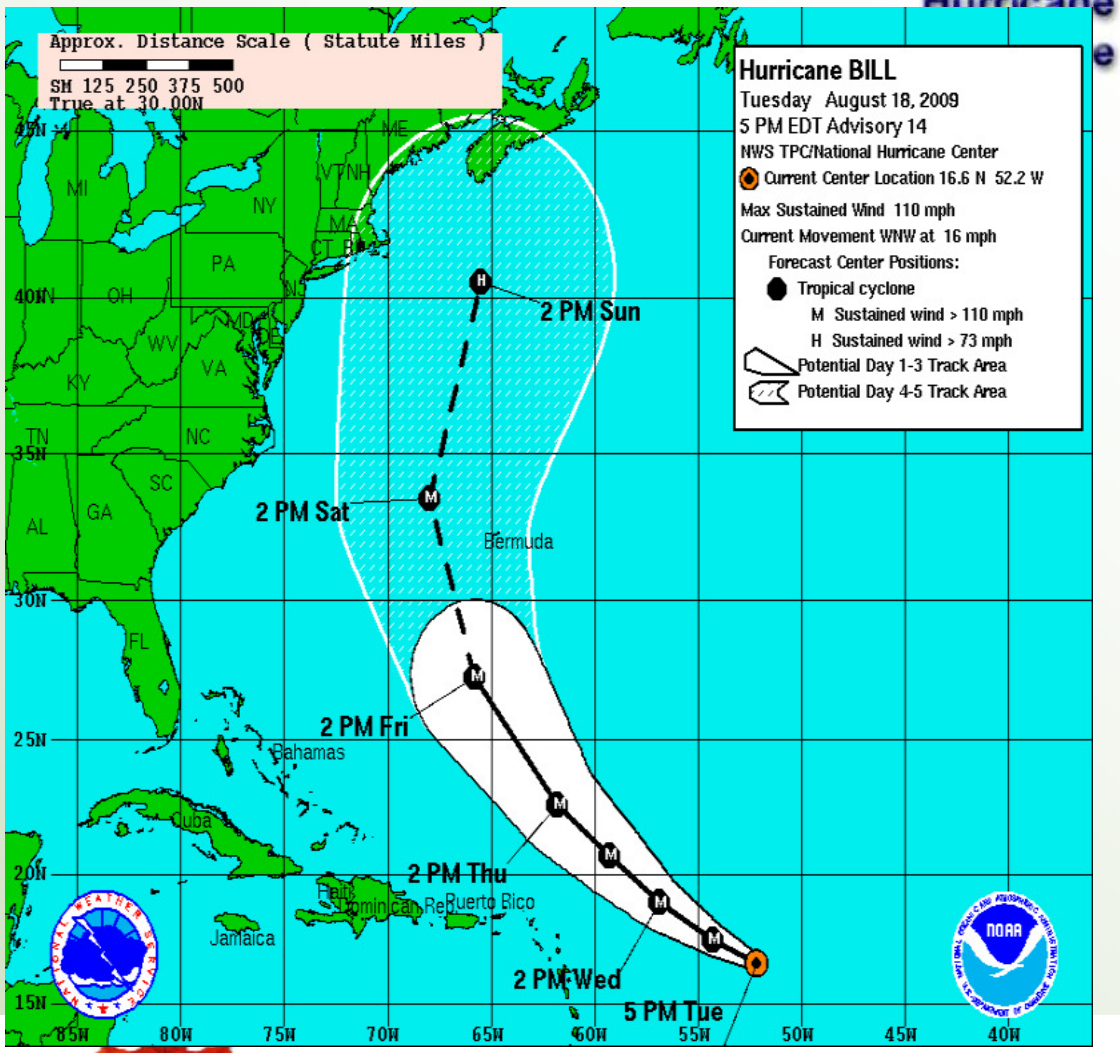


Hurricane Bill Post Storm Analysis

Canadian Hurricane Centre

What was expected

- 5 days out NHC in Miami first had the cone of error entering the Maritimes
- Expected arrival time was late Sunday at strong Category 1 strength

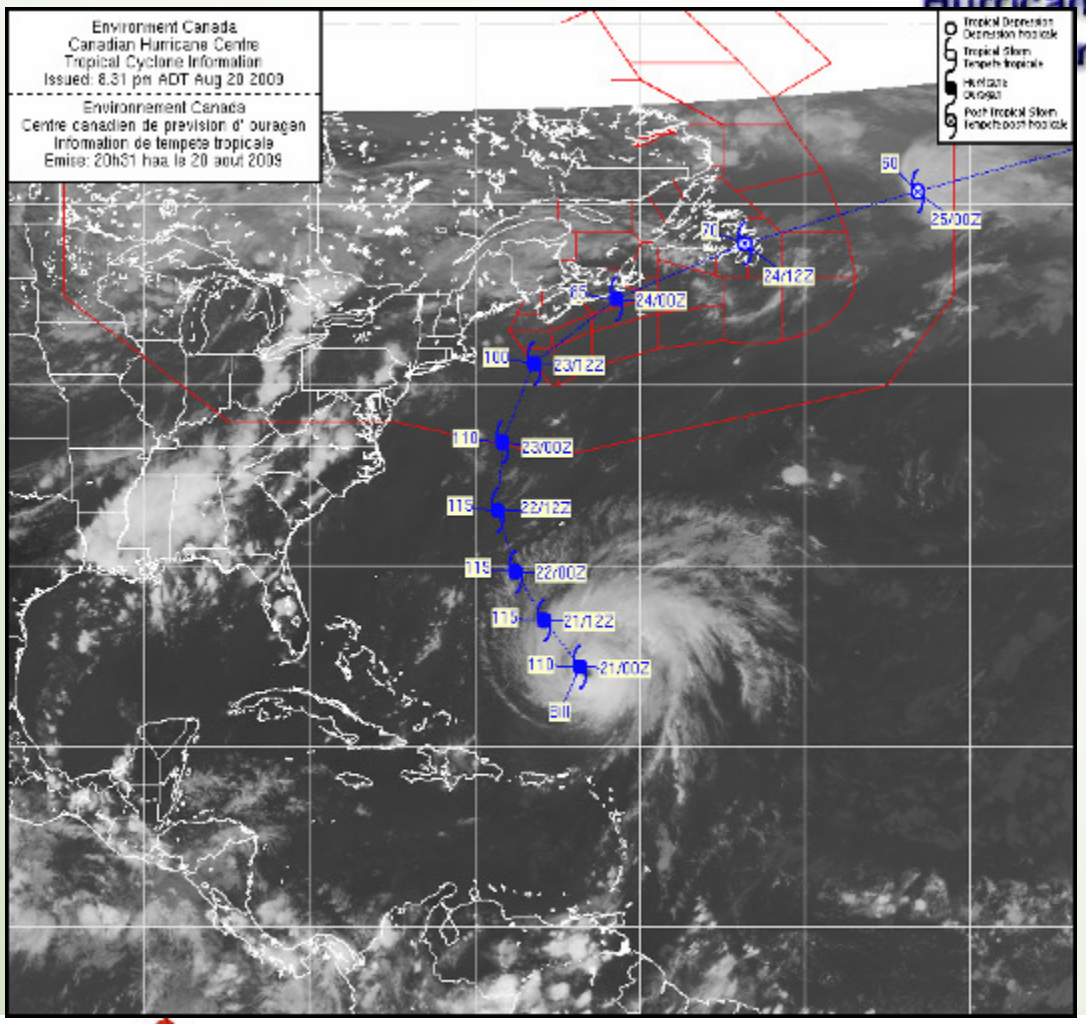


Hurricane Bill Post Storm Analysis

Canadian Hurricane Centre

What was expected

- About 3 days before expected impact CHC issues first bulletin on the storm
- Expected a strong Category 1 hurricane to track south of Nova Scotia on Sunday the 23rd
- Also expect the storm would be close to beginning extratropical transition
- Too early at that stage to be more specific on weather conditions

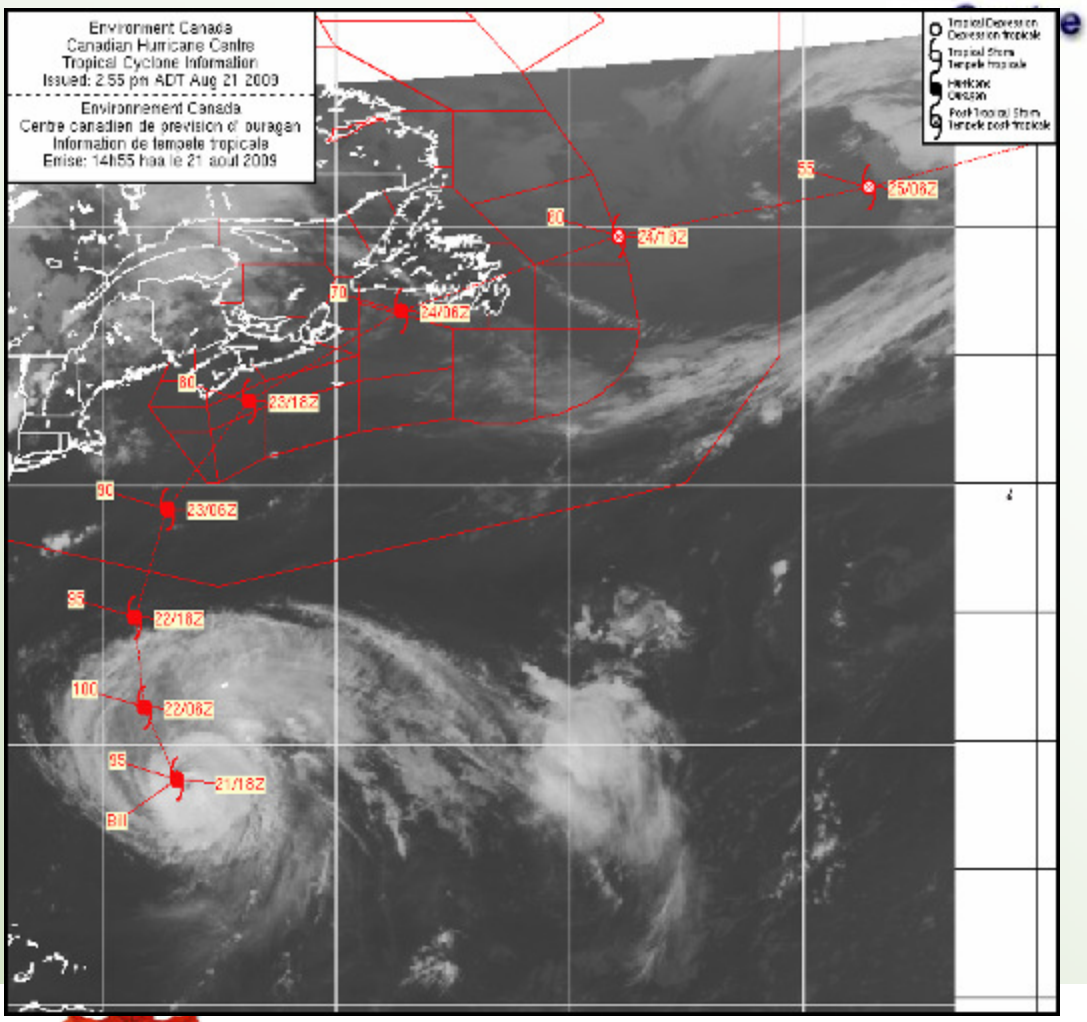


Hurricane Bill Post Storm Analysis

Canadian Hurricane Centre

What was expected

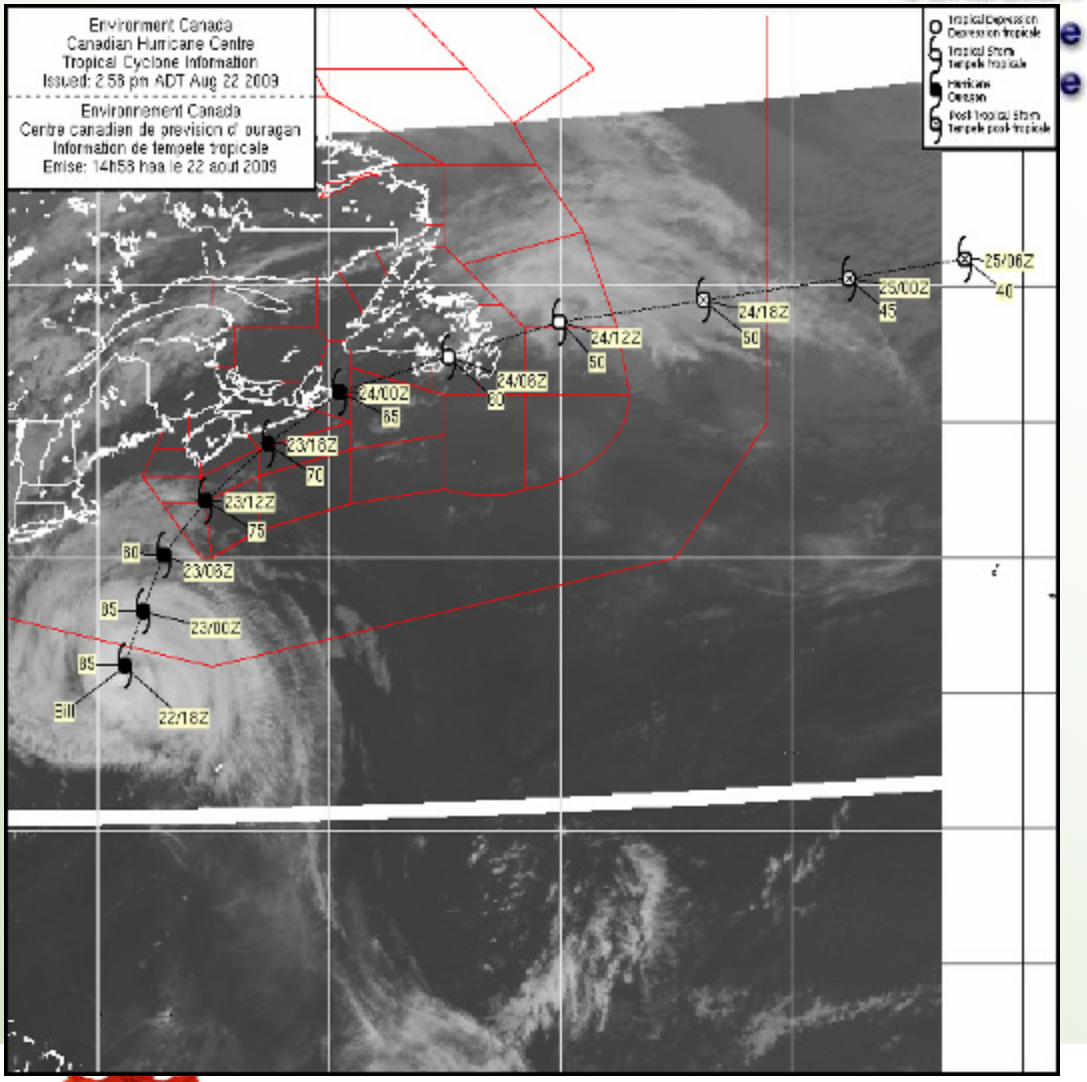
- 48 hours CHC consistent with previous forecasts and NHC forecast
- Expected a Category 1 hurricane to track just south of Nova Scotia on August 23rd
- Began talking about specific conditions for Nova Scotia:
  - "WINDS POSSIBLY EXCEEDING 90 KM/H"
  - "RAINFALL AMOUNTS OF UP TO 100 TO 150 MM"
  - "SIGNIFICANT WAVES HEIGHTS OF UP TO 12 METRES"



Hurricane Bill Post Storm Analysis

What was expected

- 24 hours before expected impact – still little change in the forecast track and intensity
- Solid Category 1 hurricane to track south of Nova Scotia on Sunday August 23rd
- Rainfall warnings (50 mm in 24 hours) were issued for eastern NS and Cape Breton by 5 am Saturday
- Hurricane Watch was issued for eastern NS and Cape Breton by mid morning on Saturday
- 4 PM Tropical Storm Warning issued for eastern NS and CB with Hurricane Watch still in effect



Hurricane Bill Post Storm Analysis

Canadian Hurricane Centre

What was expected – 24 hours before the event

• "TROPICAL STORM WARNINGS ARE IN EFFECT FOR PARTS OF NOVA SCOTIA WITH WIND SPEEDS OF 65 KM/H WITH GUSTS TO 90"

• "HURRICANE WATCHES ARE CONTINUED FOR EASTERN MAINLAND NOVA SCOTIA AND SOUTHERN CAPE BRETON WITH POTENTIAL WIND SPEEDS OF 120 KM/H WITH GUSTS TO 140"

• "A COMBINATION OF STORM SURGE AND HEAVY SURF ALONG THE ATLANTIC COAST OF NOVA SCOTIA IS EXPECTED. WAVES COULD REACH 8 METRES IN SOME LOCATIONS. THESE CONDITIONS MAY LEAD TO SHORELINE EROSION AND DAMAGE TO DOCKS AS WELL AS GENERATE DANGEROUS RIP CURRENTS AT LOCAL BEACHES. IT IS WORTHY TO NOTE THAT SPRING TIDES ARE OCCURING OVER THE WEEKEND..INCREASING THE THREAT OF COASTAL FLOODING.

Hurricane Bill Post Storm Analysis

Canadian Hurricane Centre

Summary of what was expected – "The Big Picture"

- Category 1 Hurricane tracking northeastward and paralleling the Atlantic Coast of Nova Scotia
- Rainfall of 50 to 100 mm (with local pockets up to 150 mm possible)
- Winds on the left side of the track to be in the 50-70 km/h range with gusts in excess of 90 km/h
- Winds on the right side of the track to be as high as 120 km/h with higher gusts possible
- Large, dangerous surf all along the Atlantic Coast of Nova Scotia


Amherst Daily News
AMHERST, N.S. WWW.AMHERSTDAILY.COM FRIDAY, AUGUST 21, 2009

Banfield wins
Amherst Open
Page 17

YOU SAID IT
"Going digital means we can finally get out to the rest of the world. Sadly not many people know we exist."
Mike McCoag of the Nova Scotia Highlanders Regimental Museum – Page 3

SYNOPSIS
Afghan election day slow
Voters in Kandahar province appeared wary of casting ballots in nationwide elections Thursday following weeks of Taliban intimidation. Officials said 26 Afghans were killed in 15 provinces. The instability dampened voter turnout but authorities said the election was not derailed. Canada's top commander in Afghanistan said the insurgent campaign to disrupt the vote was an "utter failure." Election officials in Kandahar, where Canadian troops have been battling the insurgency since 2006, said the trickle of voters seen at polling centres early in the day increased as it became clear that the worst of the Taliban threats had not borne out.
World, Page 9

QUICK WEATHER
TODAY Scattered showers High 29 Low 18
TOMORROW Variable High 27 Low 21
See detailed weather on Page 6
For up-to-the-minute weather, visit www.amherstdaily.com

Hit or miss?
Either way experts are warning Maritimers to be ready as Hurricane Bill heads this way for possible Sunday strike – see STORM, Pages 2 & 6

Other media coverage……

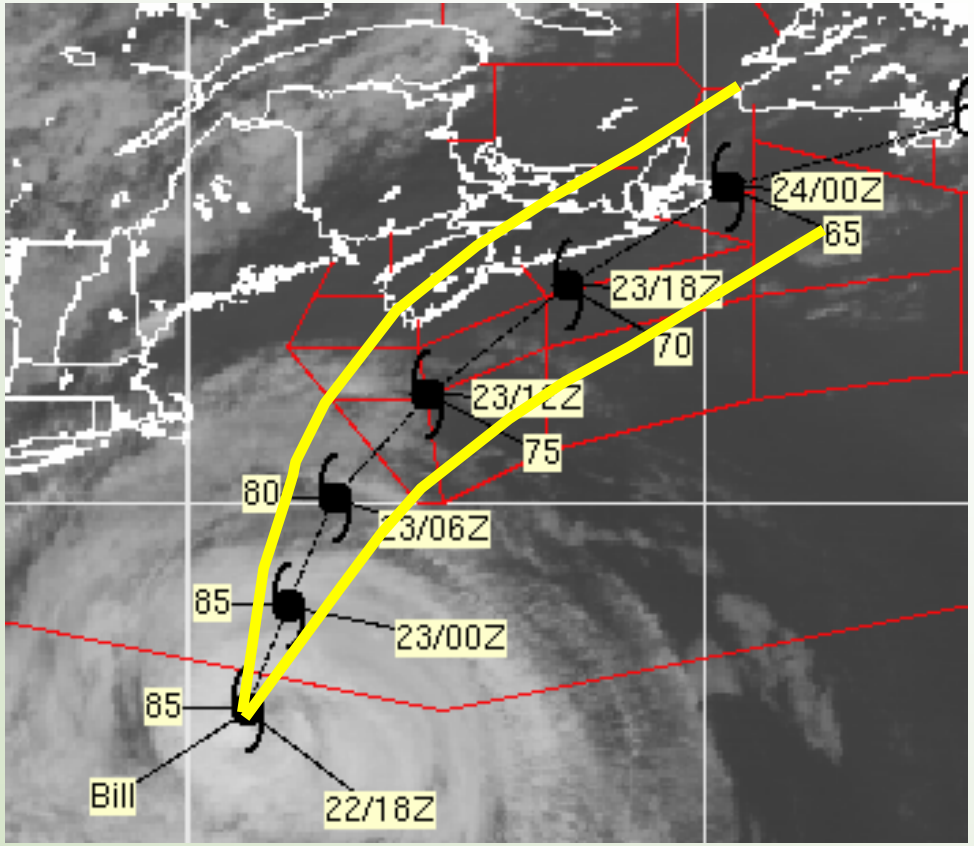
Canadian Hurricane Centre

- 3 days prior to event one national television channel showed track going through Bay of Fundy
- Some forecasts talked about 180 km/hr winds impacting NS
- On-air meteorologist stating the storm would as bad as hurricane Juan

Hurricane Bill Post Storm Analysis

Canadian Hurricane Centre

What should have people been preparing for?



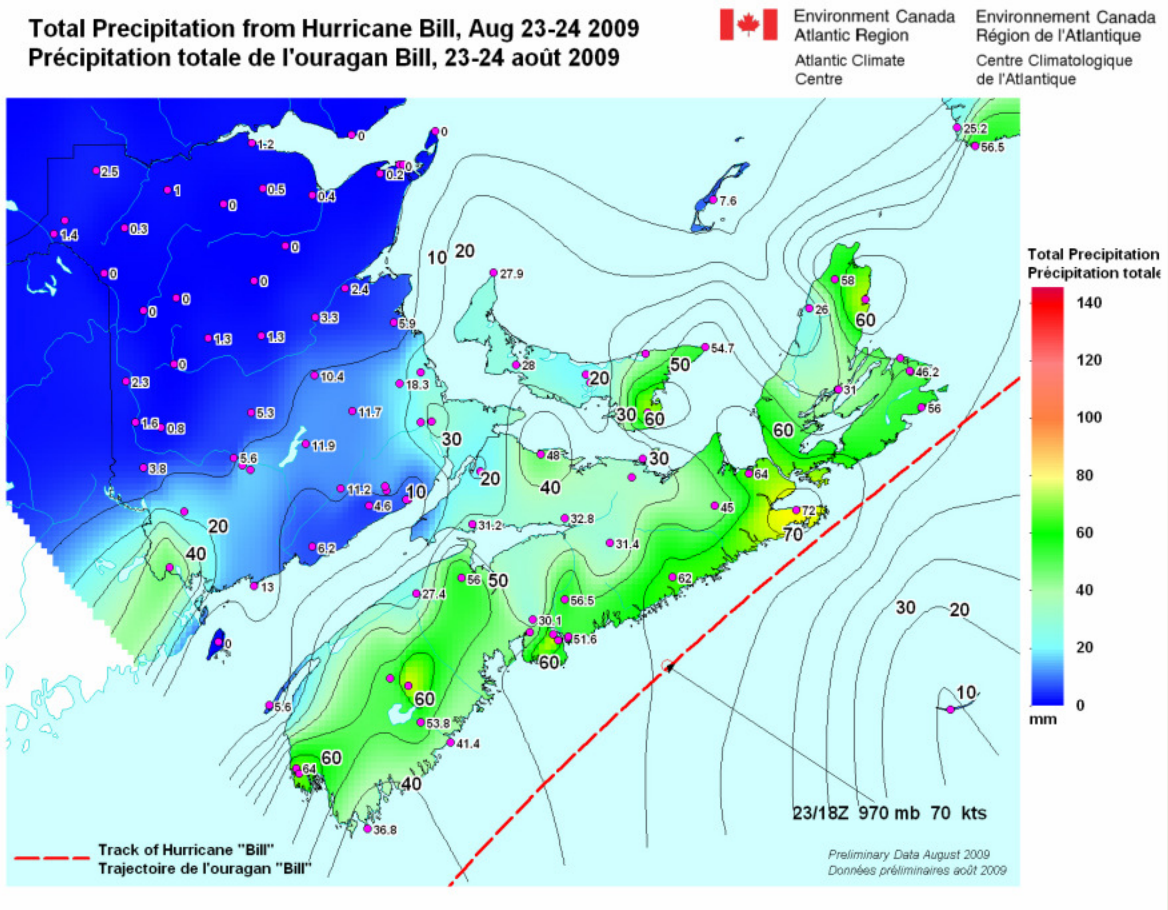
Hurricane Bill Post Storm Analysis

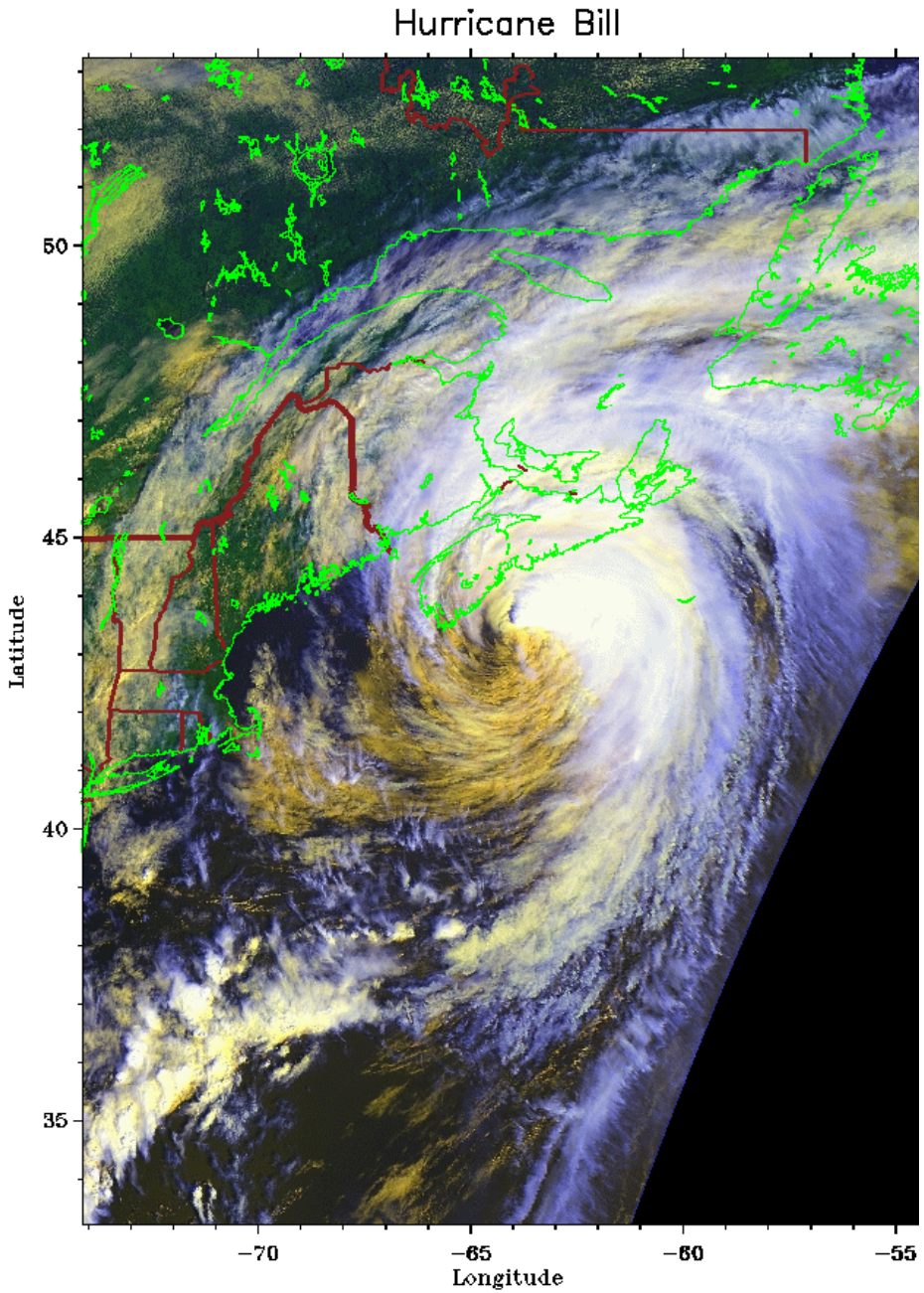
What Actually happened:

Canadian Hurricane Centre

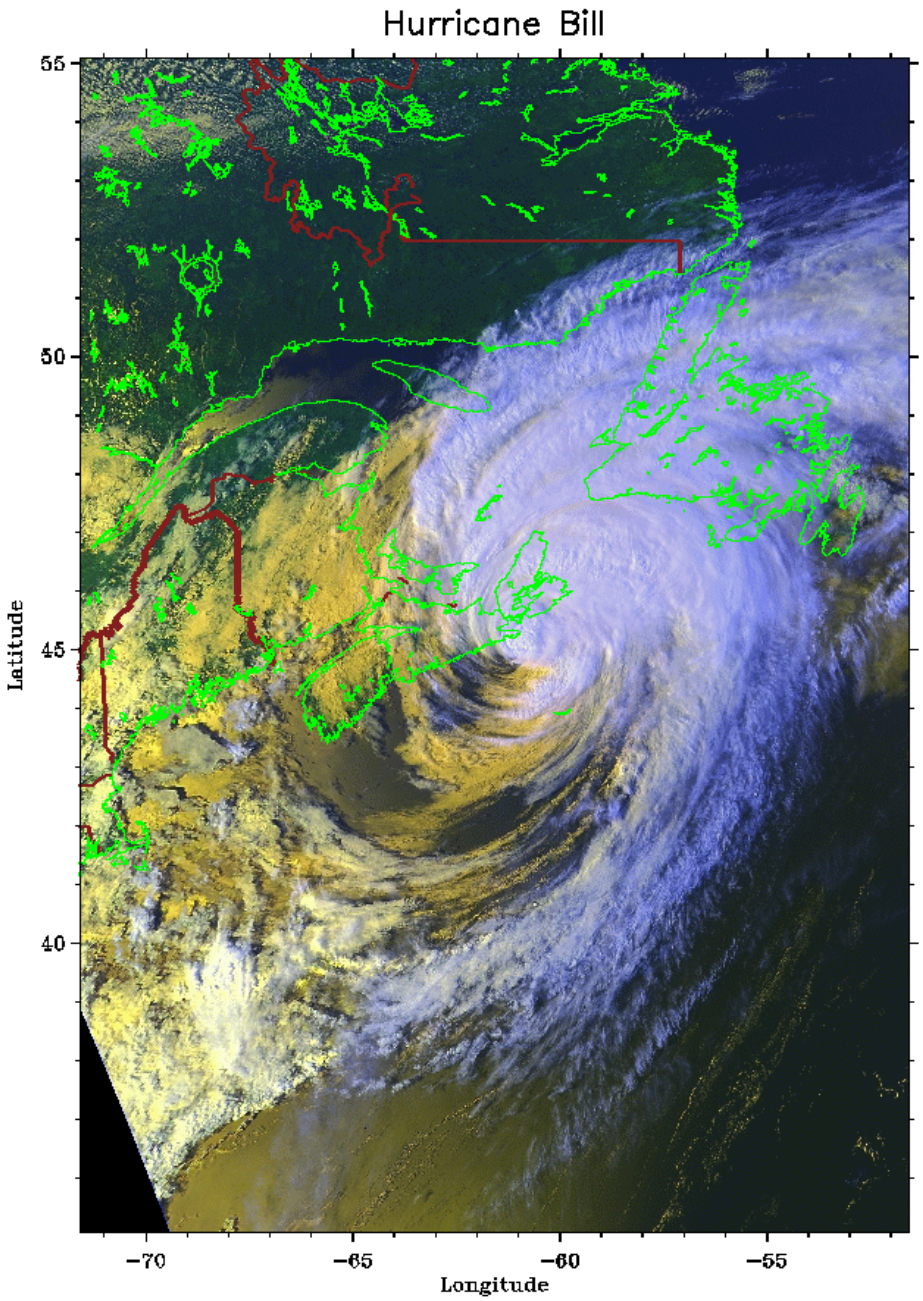
Rainfall

- Generally 50 mm to 70 mm
- No pockets of above 100 mm measured on land





AVHRR 3 Channel Color Composite
NOAA−17 AVHRR 2009 Aug 23 14:43 UT
Daytime: R=C1 G=C2 B=−C4



AVHRR 3 Channel Color Composite
NOAA−15 AVHRR 2009 Aug 23 19:50 UT
Daytime: R=C1 G=C2 B=−C4

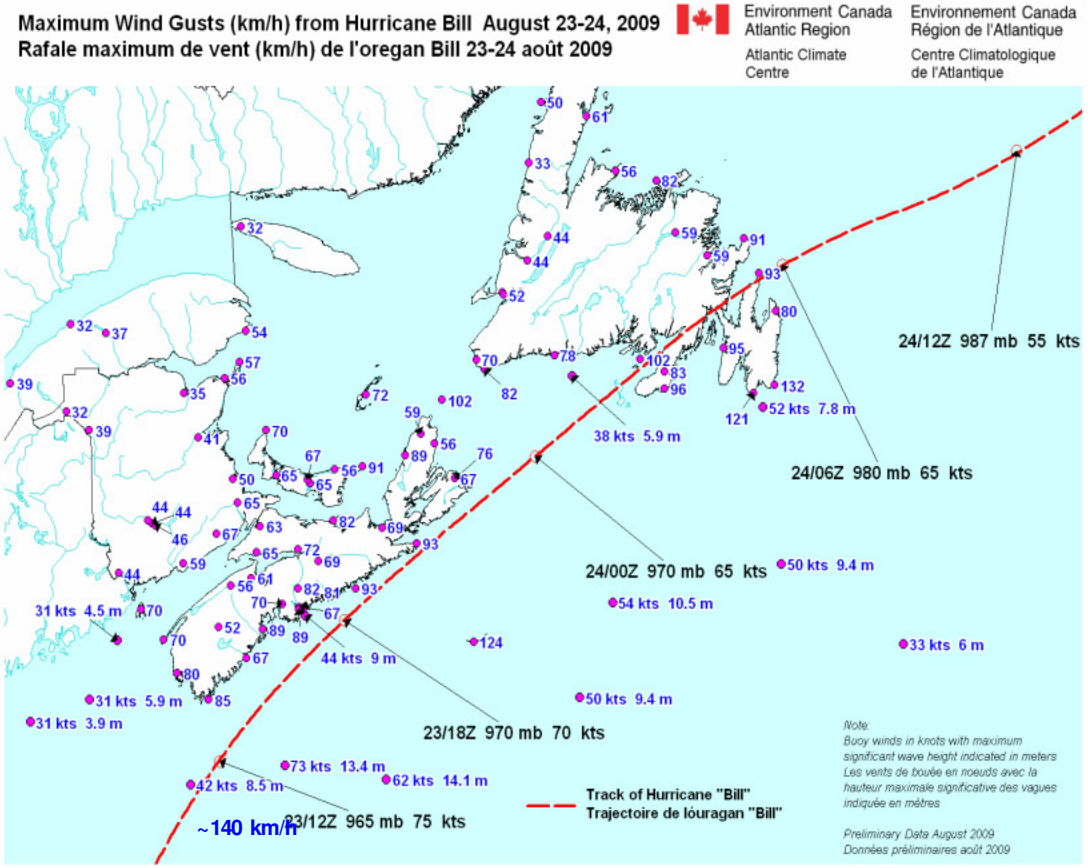
Hurricane Bill Post Storm Analysis

What Actually happened:

Canadian Hurricane Centre

Winds

- Peak wind gusts exceeded 90 km/h all along the Eastern Shore
- Slightly less over Cape Breton
- Gusts in the 70-80 km/h range in northern NS
- Duration of the strongest winds mitigated damage (30-90 minutes)

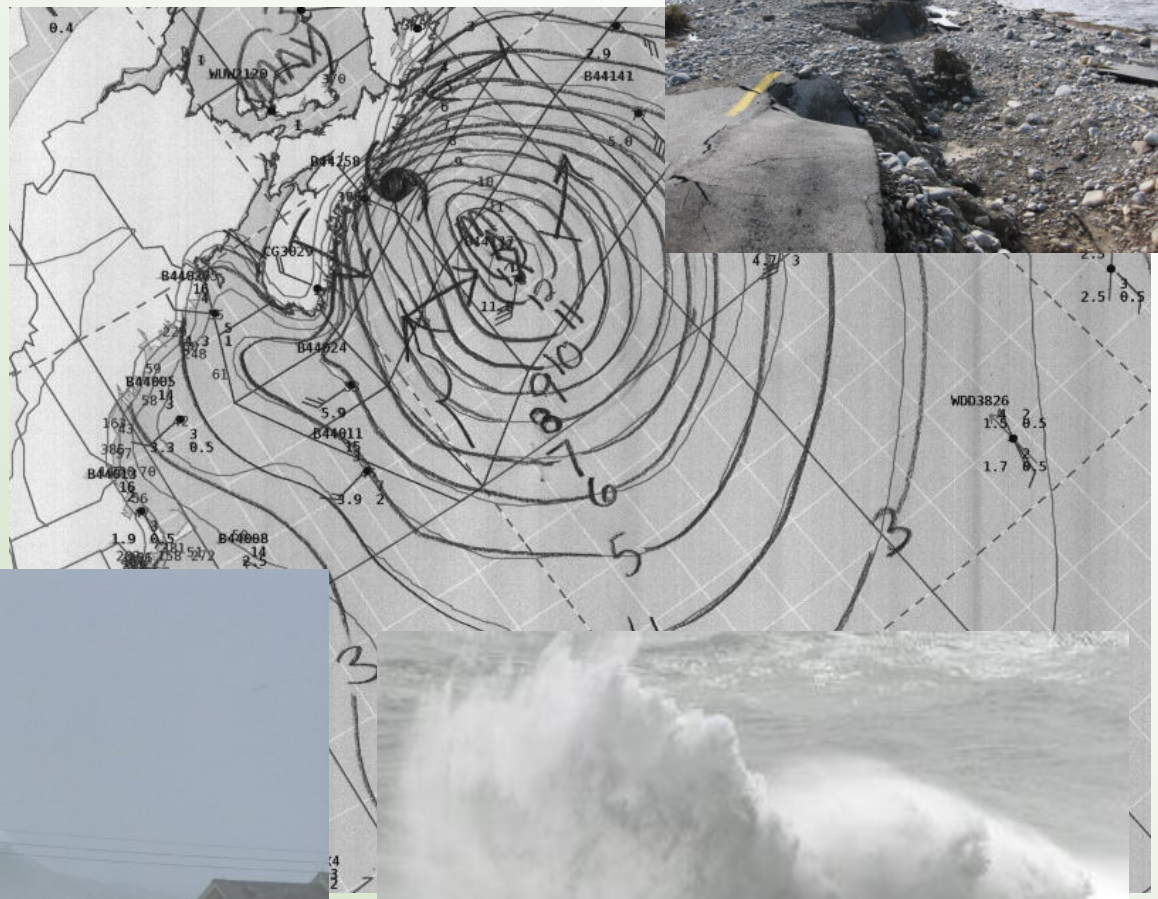


Hurricane Bill Post Storm Analysis

What Actually happened:

Waves

- Maximum sig waves of 14 m +
- Peak wave height of 24.5 m (75 feet)
- Peak wave of 14 m at mouth of Halifax Harbour

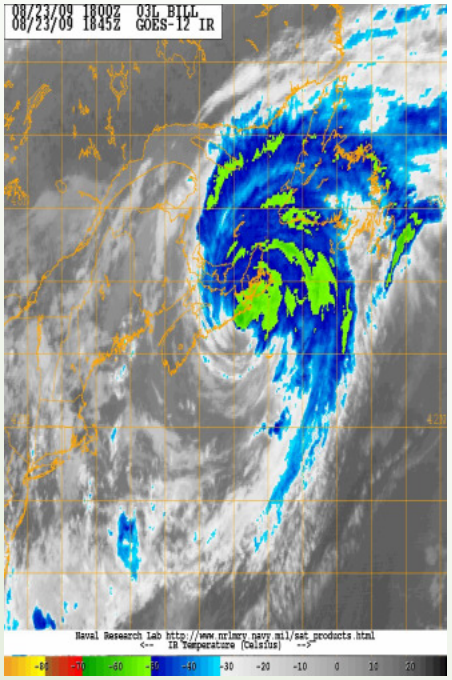


Hurricane Bill Post Storm Analysis

Conclusions

Canadian Hurricane Centre

- Most of damage-causing weather parameters (wind, rain, waves and storm surge) observed with hurricane Bill fell within the forecast values
- Duration of strongest winds was short and likely mitigated the damage
- Timing of ET Transition played a role in rainfall amounts and observed wind speeds
- Media attention may have contributed to a heightened awareness (although in many ways perhaps not a bad thing)
- Track was extremely well forecast – beyond the science's current capabilities even
- Had the storm made landfall, impacts would have likely been worse than expected



Canadian Hurricane Centre

"Now that Hurricane Bill has come and gone without loss of life or serious injury some are now criticizing weather forecasters and the news media for crying wolf on Bill."

Local News anchor, Halifax

Leading into an interview with NS Minister responsible for Emergency Management

Tropical Storm Danny Post Storm Analysis

Canadian Hurricane Centre

Overview

- Discussed rainfall in 50-100 mm range over 48 hours prior to onset
- Winds up to 90 km/h
- Wind and rainfall warnings

What happened?

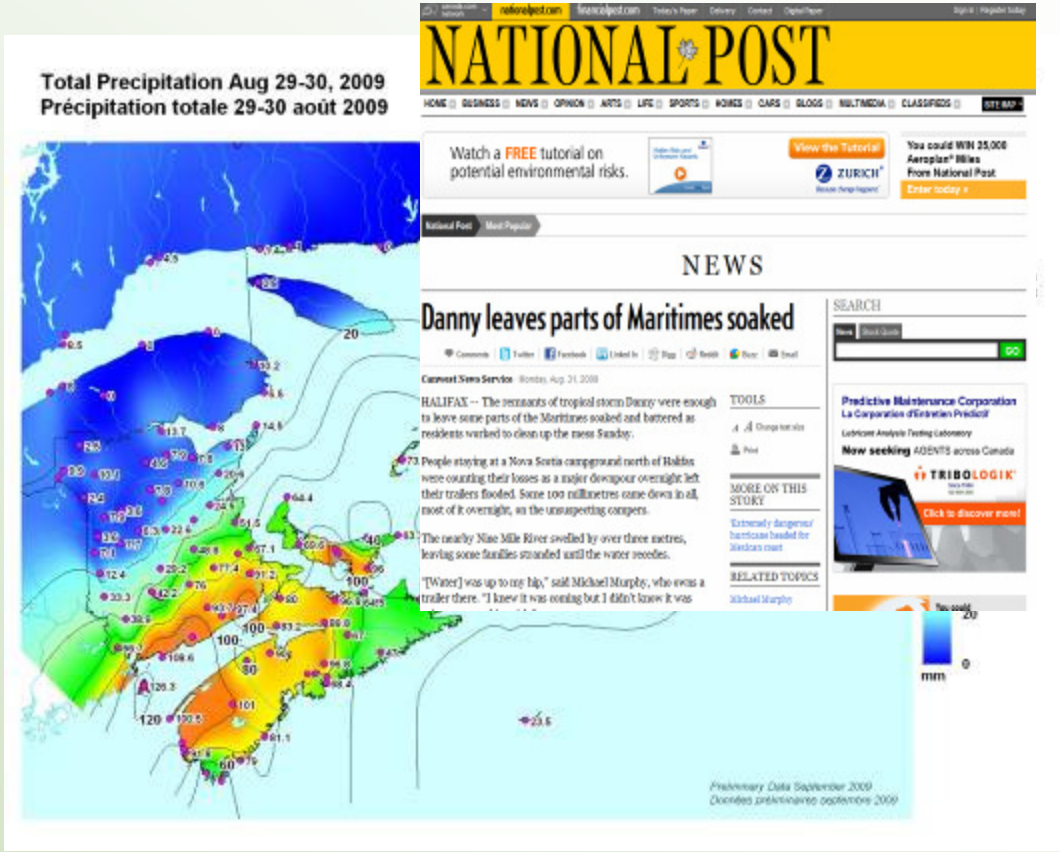
- Very heavy rain from New England to southern Maritimes
- Over 120 mm in Grand Manan
- Flooding in several locations

Media quotes after event

"We were not prepared for this"

"Nobody saw this coming!"

"I knew it was coming but I didn't know it was going to come this quick."



The challenge of communicating uncertain risk

Canadian Hurricane Centre

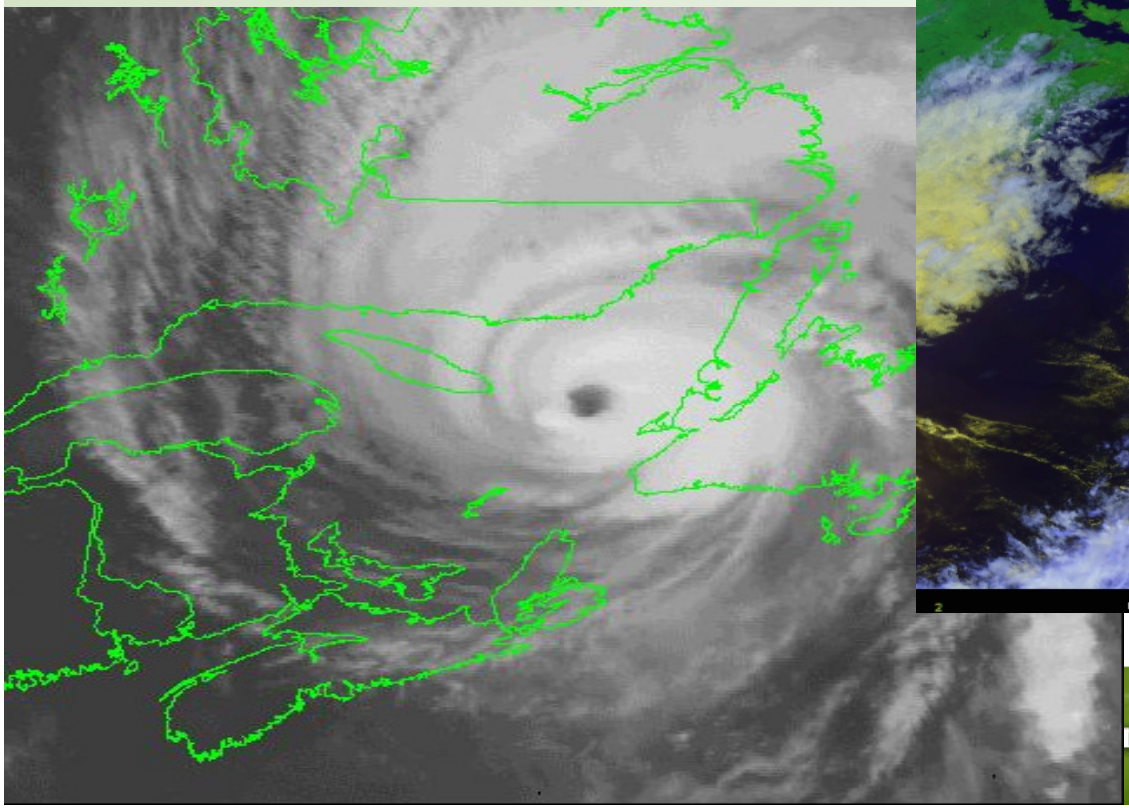
Summary

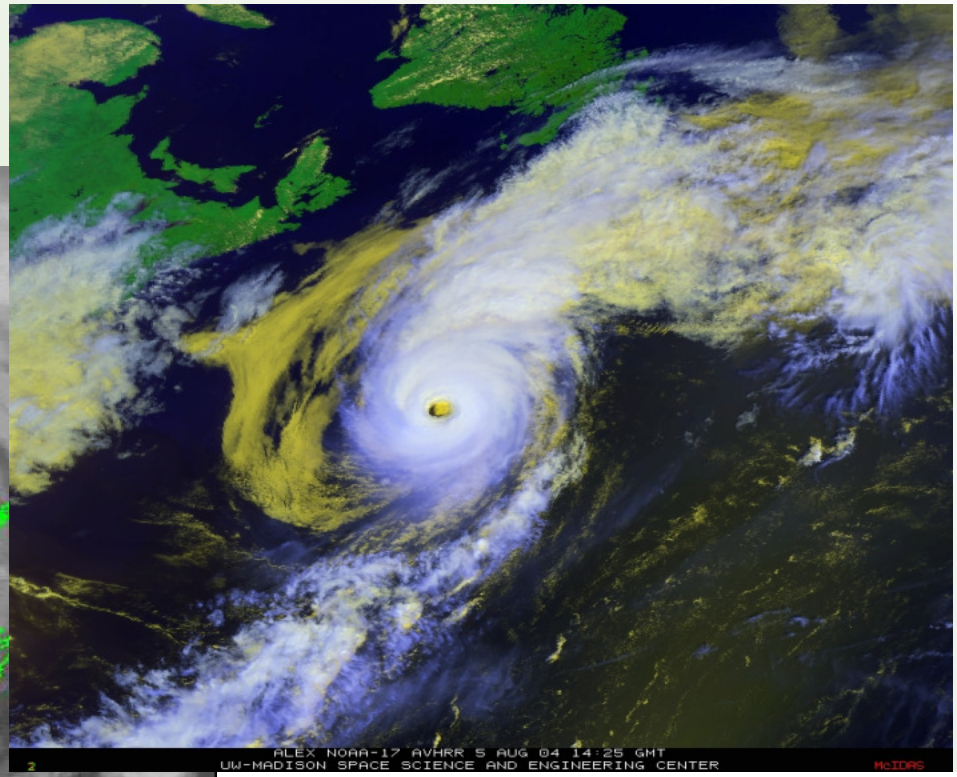
- Communicating uncertainties involving risk is very complex
- Numerous factors can affect what people hear and understand
- Complexity is heightened when conflicting messages exist
- Coordinated approach helps, unified message – “authorities have their act together”
- Hurricane Roadmap Project
  http://www.hurrnet.com/

An RCMP vehicle blocks the way as waves slam into Cow Bay Road in Cow Bay, N.S., Sunday August 23, 2009. (The Canadian Press/Tim Krochak)

2010 Seasonal Hurricane Forecast

Canadian Hurricane Centre





nada

2010 Atlantic Hurricane Season Forecast

Canadian Hurricane Centre

	Named Storms	Hurricanes Category 1 to 5	Major Hurricanes Category 3-5
National Oceanic and Atmospheric Administration (US)	14-23	8-14	3-7
2000-2009 Average	15	7 or 8	3 or 4
1951-2000 Average	10	6	2 or 3

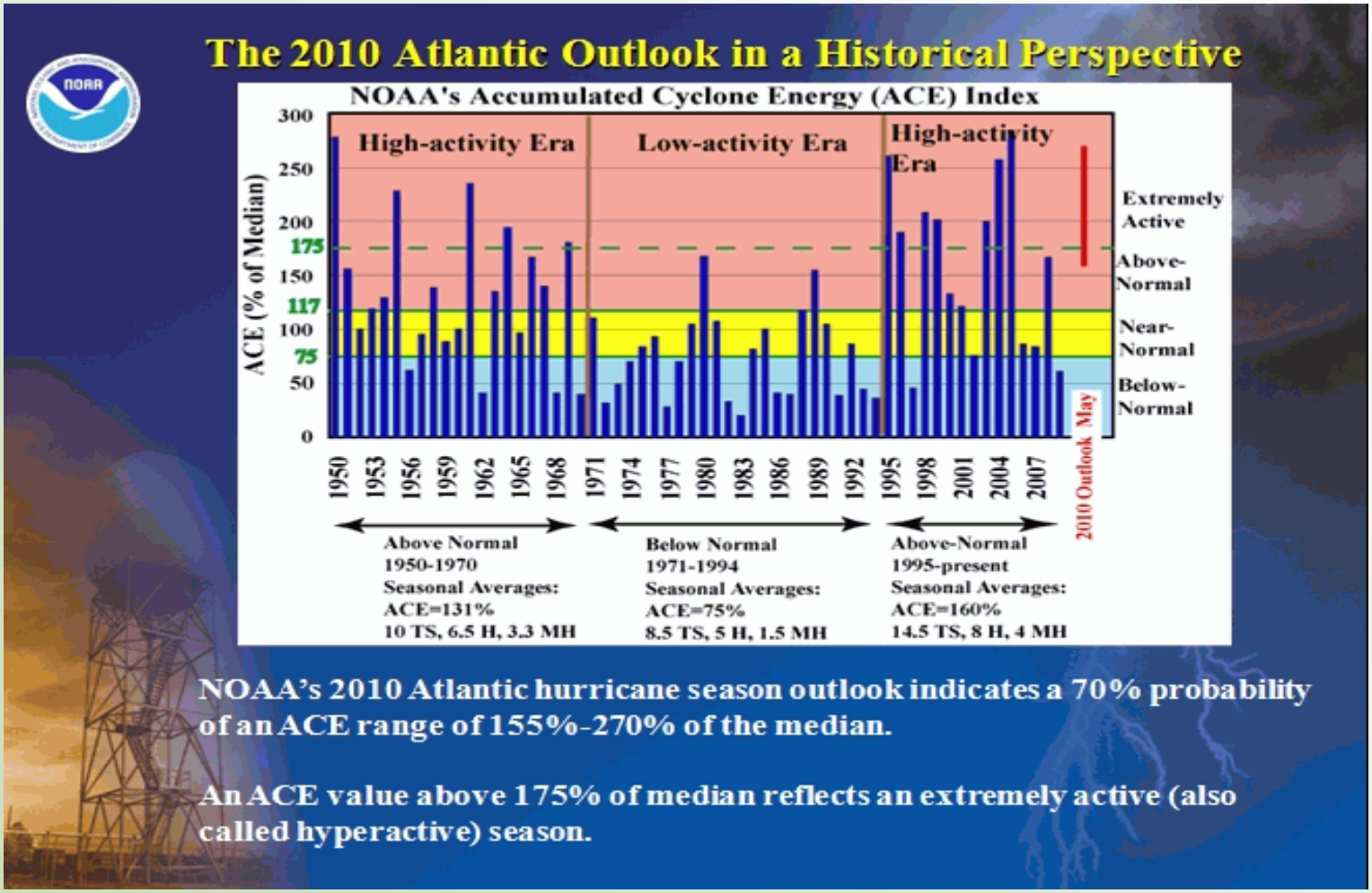
2010 Atlantic Hurricane Season Forecast

Canadian Hurricane Centre

Why is the season expected to be active?

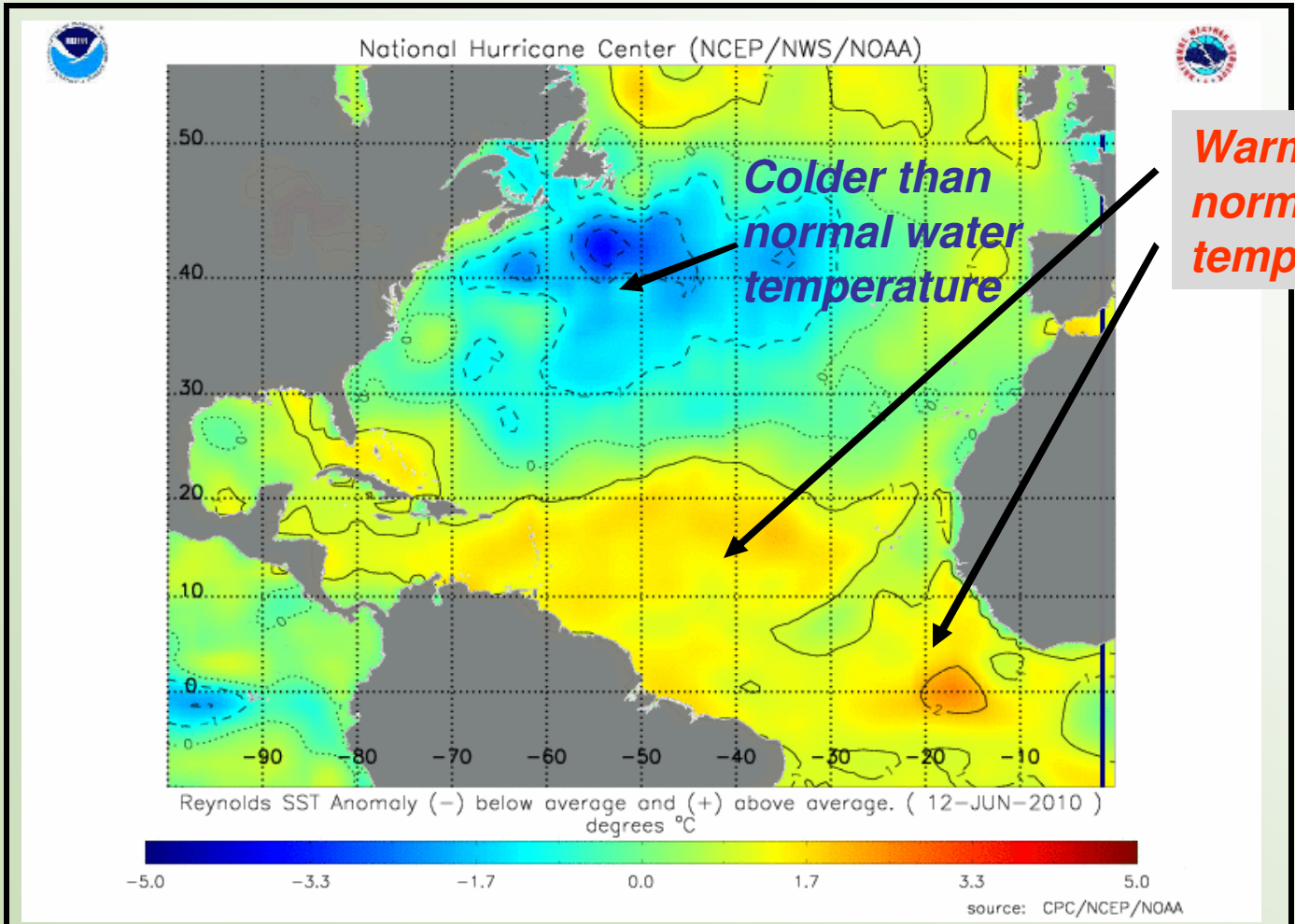
1. Continued active period in multi-decadal cycle

Canadian Hurricane Centre



2. Warmer water temperatures in tropics

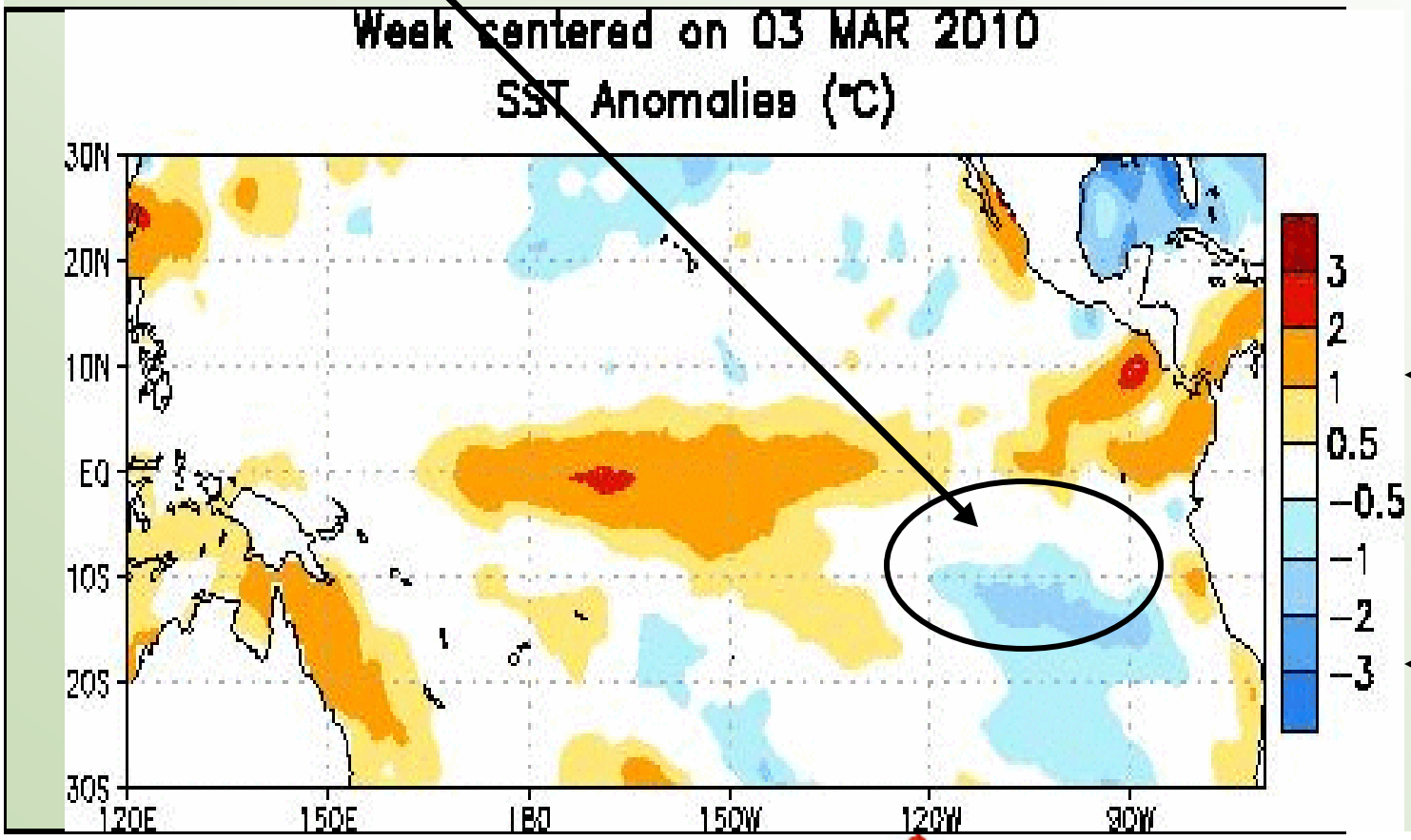
Canadian Hurricane Centre



if this pattern persists into the summer, there will be an increased chance of storm development

3. Water temperatures in the East Pacific Ocean near equator (El Nino or La Nina)

Canadian Hurricane Centre



Above normal water temp

Below normal water temp

Atlantic Storm Names Lists

2009	2010	2011	2012	2013	2014
Ana	Alex	Arlene	Alberto	Andrea	Arthur
Bill	Bonnie	Bret	Beryl	Barry	Bertha
Claudette	Colin	Cindy	Chris	Chantal	Cristobal
Danny	Danielle	Don	Debby	Dorian	Dolly
Erika	Earl	Emily	Ernesto	Erin	Edouard
Fred	Fiona	Franklin	Florence	Fernand	Fay
Grace	Gaston	Gert	Gordon	Gabrielle	Gonzalo
Henri	Hermine	Harvey	Helene	Humberto	Hanna
Ida	Igor	Irene	Isaac	Ingrid	Isaias
Joaquin	Julia	Jose	Joyce	Jerry	Josephine
Kate	Karl	Katia	Kirk	Karen	Kyle
Larry	Lisa	Lee	Leslie	Lorenzo	Laura
Mindy	Matthew	Maria	Michael	Melissa	Marco
Nicholas	Nicole	Nate	Nadine	Nestor	Nana
Odette	Otto	Ophelia	Oscar	Olga	Omar
Peter	Paula	Philippe	Patty	Pablo	Paulette
Rose	Richard	Rina	Rafael	Rebekah	Rene
Sam	Shary	Sean	Sandy	Sebastien	Sally
Teresa	Tomas	Tammy	Tony	Tanya	Teddy
Victor	Virginie	Vince	Valerie	Van	Vicky
Wanda	Walter	Whitney	William	Wendy	Wilfred

Canadian Hurricane Centre

....it only takes one storm!
Are you prepared?

Canadian Hurricane Centre

Questions?