



FINAL

Hurricane Season Outlook 2015

Submitted to:

**Water Resources Management Division
Department of Environment and Conservation**

4th Floor, West Block, Confederation Building
PO Box 8700, St. John's, NL A1B 4J6

Submitted by:

**Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited**

133 Crosbie Road
PO Box 13216
St. John's, NL A1B 4A5

17 June 2015

Amec Foster Wheeler Project #: TA1512741



IMPORTANT NOTICE

This report was prepared exclusively for Water Resources Management Division Department of Environment and Conservation by Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler). The quality of information, conclusions and estimates contained herein is consistent with the level of effort involved in Amec Foster Wheeler's services and based on: i) information available at the time of preparation, ii) data supplied by outside sources and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used by Water Resources Management Division Department of Environment and Conservation only, subject to the terms and conditions of its contract with Amec Foster Wheeler. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

TABLE OF CONTENTS

1.0 ANTICIPATED 2015 ATLANTIC HURRICANE SEASON.....4
2.0 HISTORICAL PERSPECTIVE OF THE HURRICANE SEASONS5
3.0 AVERAGE NEWFOUNDLAND AND LABRADOR HURRICANE SEASON7
4.0 ANTICIPATED 2015 NEWFOUNDLAND AND LABRADOR HURRICANE SEASON.....8
5.0 CLOSURE10

LIST OF TABLES

Table 2-1: 2009 Season5
Table 2-2: 2002 Season5
Table 2-3: 1994 Season5
Table 2-4: 1991 Season6
Table 2-5: 1986 Season6

LIST OF FIGURES

Figure 3-1 NCEP/NCAR Reanalysis8

1.0 ANTICIPATED 2015 ATLANTIC HURRICANE SEASON

The National Hurricane Center's 2015 Atlantic Hurricane Season Outlook favours a below-normal Hurricane Season with a 70% likelihood of: 6-11 Named Storms; 3-6 Hurricanes; and 0-2 Major Hurricanes, defined as those reaching Category 3 or greater with winds of or exceeding 178 km/h. These estimates pertain to the formation of such tropical systems over the Atlantic Ocean and do not imply subsequent track or landfall. Track and landfall predictions depend on the concurrent state of the atmosphere and cannot be assessed reliably more than 7-10 days in advance.

There are two key factors that will largely impact this year's Atlantic Hurricane Season:

- Moderate El Niño is expected to strengthen through the hurricane season.

The increase in sea-surface temperatures (SSTs) over the central and eastern equatorial regions of the Pacific Ocean (i.e., the El Niño) has a large signal globally on temperature, rainfall, pressure patterns and winds. During El Niño, strong upper-level winds and increased wind shear (the change of wind speed or direction with height) becomes a feature over the Gulf of Mexico, Caribbean Sea and the western Atlantic due to an increased sub-tropical jetstream that develops. With strong westerly winds aloft over the aforementioned regions, conditions become unfavourable for tropical storm development as it increases the amount of sinking motion and increases the stability of the atmosphere. Generally, tropical storms need weak winds in order to promote the rising motion necessary for development.

- Sea-surface temperatures in the Main Development Region (MDR) of the Tropical Atlantic Ocean this year are expected to remain near to below average.

Warm waters above 27° C are needed to keep the atmosphere unstable above a developing tropical system to sustain development. Should SSTs remain near to below average, "fuel" for sustaining tropical system growth will generally be limited. Conversely, above average SSTs would likely be a factor for an above-average season of tropical storms.

We are presently considered to be in the warm phase of the Atlantic Multidecadal Oscillation (AMO), which is a 20-40 year phase change from below to above-average SSTs across most of the Atlantic between the equator and Greenland that generally results in above-average tropical cyclone activity. However, there are variations within phases. SSTs in the MDR have been near to below average for the past two years, which may be an indication that we are entering the cool phase of the AMO and the active era of the Atlantic basin storm activity that began in 1995 may be coming to an end. Moreover, the current 12-month running average values of the AMO index are at their lowest since 1994.

2.0 HISTORICAL PERSPECTIVE OF THE HURRICANE SEASONS

Over the past several decades preceding this year, five Hurricane Seasons— 2009, 2002, 1994, 1991 and 1986— featured moderate El Niños. Such years could serve as an analog to other years of strengthening El Niño, such as this year. Presented below is an overview of those seasons’ storms that impacted Newfoundland and Labrador.

Table 2-1: 2009 Season

2009	9 Named Storms (6 Tropical Storms, 1 Hurricane and 2 Major Hurricanes)
Hurricane Bill	Hurricane Bill passed 20 km southeast of Cape Canso, N.S. in the afternoon of August 23 rd as a category 1 storm. Shortly after midnight Bill was downgraded to a tropical storm before crossing the Burin Peninsula and the northwest section of the Avalon Peninsula. Roughly 70 mm of rain was reported in Gander and Winterland. Winds of 131 km/h were reported at Cape Race.

Additional Information on the 2009 Hurricane Season:

<http://ec.gc.ca/ouragans-hurricanes/default.asp?lang=en&n=5BB17B61-1>

Table 2-2: 2002 Season

2002	12 Named Storms (8 Tropical Storms, 2 Hurricanes and 2 Major Hurricanes)
Hurricane Gustav	Hurricane Gustav made landfall along the southern coast of Cape Breton, N.S. at 1:30 a.m. ADT on September 12 th . The storm was downgraded to a post-tropical cyclone as it departed Nova Scotia. It then entered Newfoundland just east of Port Aux Basques near Rose Blanche-Harbour le Cou at 6:30 a.m. NDT.
Tropical Storm Arthur	Tropical Storm Arthur entered the Laurentian Fan and Southwestern Grand Banks on July 16 th and tracked over the Avalon Peninsula on July 17 th as a post-tropical cyclone. Wind speeds reached just over 80 km/h over the Avalon Peninsula and rainfall was not significant.

Additional Information on the 2002 Hurricane Season:

<http://ec.gc.ca/ouragans-hurricanes/default.asp?lang=en&n=24204F99-1>

Table 2-3: 1994 Season

1994	7 Named Storms (4 Tropical Storms and 3 Hurricanes)
Hurricane Chris	Hurricane Chris never made landfall, however it did quickly track 230 km southeast of Cape Race N.L. as a tropical storm in the evening on August 23 rd .

Additional Information on the 1994 Hurricane Season:

<http://ec.gc.ca/ouragans-hurricanes/default.asp?lang=en&n=6C787628-1>

Table 2-4: 1991 Season

1991	8 Named Storms (4 Tropical Storms and 4 Hurricanes)
Hurricane Bob	Hurricane Bob was a category 2 hurricane as it tracked along the Eastern Seaboard on August 16 th . Bob then tracked northeastward up through Maine, New Brunswick and finally over Newfoundland's Northern Peninsula as a tropical storm. There was no significant weather reported in Newfoundland. However, along the Eastern Seaboard, \$1.5 billion in damage, power outages to 2.1 million homes, and 18 deaths including 2 in Nova Scotia was reported.

Additional Information on the 1991 Hurricane Season:

<http://ec.gc.ca/ouragans-hurricanes/default.asp?lang=en&n=9D24F0EE-1>

Table 2-5: 1986 Season

1986	6 Named Storms (2 Tropical Storms and 4 Hurricanes)
N/A	No storms entered Canadian territory.

Additional Information on the 1986 Hurricane Season:

<http://ec.gc.ca/ouragans-hurricanes/default.asp?lang=en&n=D25A2B0A-1>

3.0 AVERAGE NEWFOUNDLAND AND LABRADOR HURRICANE SEASON

Based on climate records over the past thirty years (1983-2014), 44 tropical/post-tropical cyclones in the Atlantic Ocean have made landfall in or have passed within 100 km of Newfoundland and Labrador. This represents 11% of all tropical/post-tropical cyclones that have formed in the Atlantic Ocean for this period. Since the average number of total named storms is 12, 11% amounts to about 1.3 tropical/post-tropical cyclones impacting NL per year.

Of all NL tropical/post-tropical cyclones over the past thirty years, two happened in June, eight in July, seven in August, nineteen in September and eight in October. The most favourable time of year is thus early-mid September, corresponding to the warmest SSTs over the Atlantic Ocean.

For Labrador, hurricane activity is limited by the fact that a hurricane must traverse land or cross over cold ocean water to reach Labrador. As hurricanes move north and pass over the colder waters of the Labrador Current, it dramatically decreases the energy available to fuel the storm. In addition, hurricanes have typically lost strength by the time they reach Labrador because they have made landfall by that point, cutting off the source of warm, moist air that was encouraging storm development.

4.0 ANTICIPATED 2015 NEWFOUNDLAND AND LABRADOR HURRICANE SEASON

While the broad pattern described in Section 1 favors fewer tropical systems forming in the Atlantic, there are factors that point towards at least a few systems impacting Newfoundland and Labrador either as weak tropical storms or as transitioning tropical storms which can make quite an impact:

- Examining SST anomalies over the 5 analog years described in Section 2 highlights the 2009 and 2002 season as having a similar temperature regime with cool anomalies over the MDR in the tropical Atlantic and warm anomalies off the mid-western Atlantic coastal waters. Last season (2014) had similar SST anomalies across the Atlantic Ocean as analog years 2009 and 2002 and was in a weak El Niño phase that was expected to strengthen through the hurricane season. In 2014, storms that developed over the Atlantic either developed and intensified over the western Atlantic or developed over the tropical Atlantic and remained weak until tracking over and intensifying over the western Atlantic.

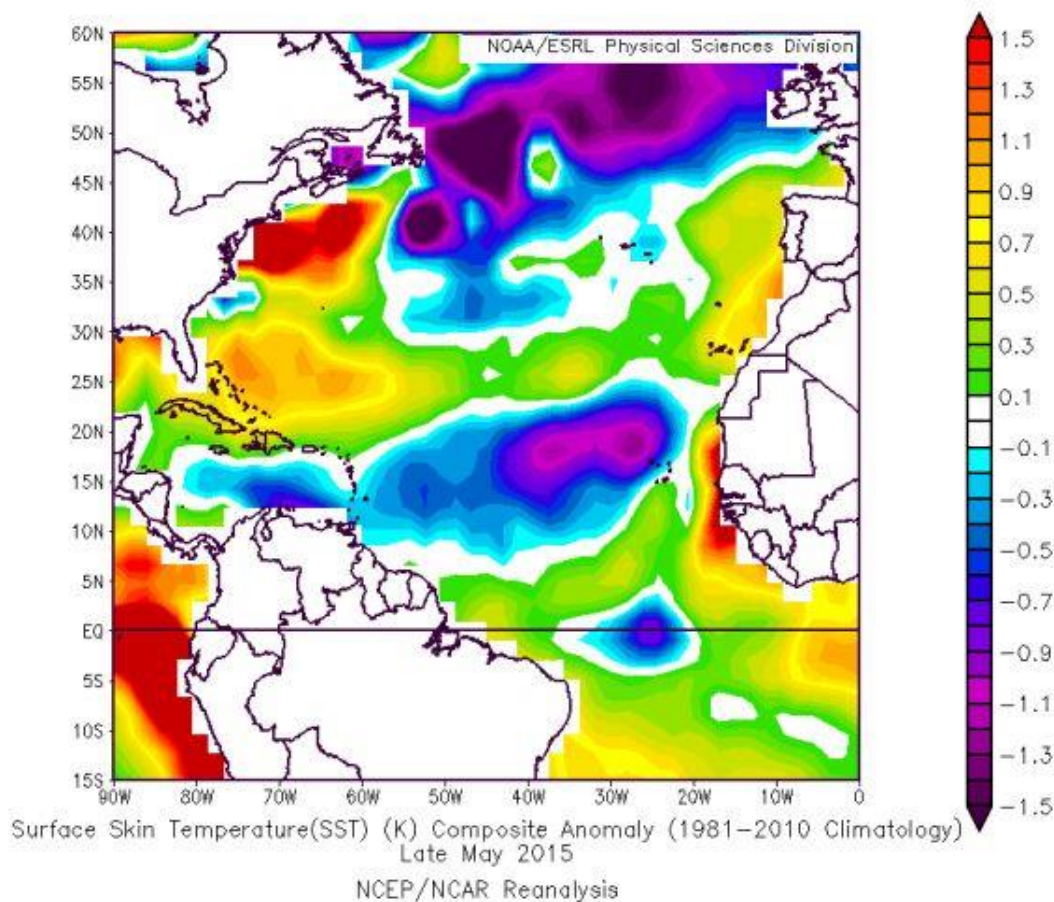


Figure 4-1 NCEP/NCAR Reanalysis

- The aforementioned warm anomalies over the western Atlantic waters in combination with the establishing wind shear to the south due to the expected strengthening of El Niño should favour tropical cyclone development or intensification north of the Caribbean Sea and east of the southeastern U.S. this year, similar to 2014. Such cyclones tend to track towards the northeast and impact NL, however, due to their limited track (time and distance) over warmer water and due to the colder-than-normal waters near Newfoundland the past two years, they may not be able to sustain favourable growth and may weaken before making landfall.
- A caveat with this suppressed growth scenario is that a strong mid-latitude feature not related to the storm could interact with it and cause unexpected intensification. However, such interactions are highly unpredictable ahead of time and can only be discussed reliably no more than a week ahead of such an event. This so-called Extratropical Transition, is relatively common in Atlantic Canada and is not well studied but is known to occasionally cause make tropical cyclones deepen dramatically.
- This season started early, with Tropical Storm Ana developing early this May north of the Bahamas, then weakening as it tracked inland over South and North Carolina. It is important to note that this early storm is not an indicator of this year's overall storm season strength. Ana developed over the mid-western Atlantic where SSTs were warmer than average, however the main contributor for Ana's development was the storm's proximity to a mid-latitude feature (frontal boundary related to a trough in the jet stream). This type of development is not associated with peak season storms, which typically develop off the west coast of Africa and have limited interaction with frontal boundaries and jet streams.

In view of the above, we can expect 1-2 tropical/extratropical cyclones to affect Newfoundland and Labrador this season. Due to the aforementioned factors limiting growth, those cyclones are not expected to exceed tropical storm strength (63-118 km/h). However, although the overall limiting environmental conditions are expected to suppress the total number of storms this season, the 1-2 cyclones that could impact NL may still produce heavy rainfall and cause significant damage. Hurricane Andrew (category 5) in 1992 is good reminder that destructive storms are still possible in below-normal seasons such as 1992 where there were only 7 named storms.

5.0 CLOSURE

We trust that this report meets your needs. Please do not hesitate to contact the undersigned if you have any questions or comments regarding the hurricane season outlook.

Yours sincerely,

**Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited**

Prepared by:



Kevin Roberts
Meteorologist

Reviewed by:



Elizabeth Loder
Meteorologist