WEATHER FORECAST SERVICES FOR 2014-2015 FLOOD ALERT AND FLOOD FORECASTING SERVICES

FOR THE GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

ISSUED FOR 2014-2015

HURRICANE FORECAST 2014

Submitted to:

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July 9, 2014

1. ANTICIPATED 2014 ATLANTIC HURRICANE SEASON

It is of note that the National Hurricane Center's 2014 Atlantic Hurricane Season Outlook favours a near-normal to below-normal Hurricane Season with a 70% probability of: 8-13 Named Storms; 3-6 Hurricanes; and 1-2 Major Hurricanes, defined as those reaching Category 3 or greater with winds of or exceeding 178 km/h. These figures pertain to the formation of such 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 a few key factors that will largely impact this year's Atlantic Hurricane Season:

- The development of El Niño this summer:
    - 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) become a feature over the Gulf of Mexico as well as the western Atlantic due to an increased sub-tropical jetstream that develops. With strong westerly winds aloft over the aforementioned regions, conditions become inhibitive for tropical storm development as proper outflow of a developing tropical system is inhibited. Normally, tropical storms need this outflow in order to sustain their circulation.
- Sea-surface temperatures in the Main Development Region (MDR) of the Atlantic Ocean this year are expected to remain near average 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 slightly below average, "fuel" for sustaining tropical system growth will be limited. Conversely, above average SSTs would likely be a factor for an above-average season of tropical storms.
- While we are presently in the warm phase of the Atlantic Multidecadal Oscillation (AMO), a 20-40 year phase change between below and above-average SSTs across most of the Atlantic between the equator and Greenland, which usually translates to above tropical cyclone activity, there are variations within phases. Given recent observations of near-average to below-average SSTs in the MDR, there are questions regarding how the AMO will affect this season, most notably, whether the Atlantic warms up to present a more conducive environment for tropical storm development.

2. HISTORICAL PERSPECTIVE OF THE HURRICANE SEASONS

Over the decade preceding this year, three Hurricane Seasons, 2002, 2004 and 2006 featured developing El Niños out of El Niño Southern Oscillation (ENSO) neutral conditions the previous winter as has been the case this year. Such years could serve as an analog to other years of developing El Niño, such as the current year. Presented below is an overview of those seasons' storms that impacted Newfoundland.

2002
Hurricane Gustav
Hurricane Gustav made landfall along the southern coast of Cape Breton, N.S. at 1:30 a.m. ADT on September 12th. The storm was downgraded to a post-tropical cyclone as it exited Nova Scotia. It then entered Newfoundland just east of Port Aux Basques near Rose Blanche-Harbour le Cou at 6:30 a.m. NDT.

Additional Information on Gustav
http://www.nhc.noaa.gov/2002gustav.shtml

Tropical Storm Arthur
Tropical Storm Arthur entered the Laurentian Fan and Southwestern Grand Banks on July 16th and tracked over the Avalon Peninsula on July 17th as a post-tropical cyclone.
Additional Information on the 2002 Hurricane Season
http://ec.gc.ca/ouragans-hurricanes/default.asp?lang=En&n=24204F99-0E00-49F7-BC1E&pedisable=true

2004
Tropical Storm Gaston
Tropical Storm Gaston passed south of Sable Island and Newfoundland on September 1st as subtropical storm. While there was no impact to Newfoundland, Sable Island reported 72mm of rain in four hours.
Additional Information on the 2004 Hurricane Season
http://ec.gc.ca/ouragans-hurricanes/default.asp?lang=en&n=B99742F3-1

2006
Hurricane Florence
Hurricane Florence had transitioned into an extratropical storm by the time it entered Canadian waters on September 12th. Peak wind gusts of 163 km/h were reported at Sagona Island, NL. Southeastern Newfoundland generally reported 30-50mm of rain.

Tropical Storm Isaac
Tropical Storm Isaac passed 45 km southeast of Cape Race on October 2nd. The storm produced peak winds of 96 km/h over Newfoundland and 26mm of rain over the southeastern Avalon Peninsula.

Tropical Storm Alberto
Tropical Storm Alberto passed over eastern Newfoundland June 16th as a strengthening extratropical storm.
Additional Information on the 2006 Hurricane Season
http://ec.gc.ca/ouragans-hurricanes/default.asp?lang=en&n=F5513F34-1

3. AVERAGE NEWFOUNDLAND HURRICANE SEASON

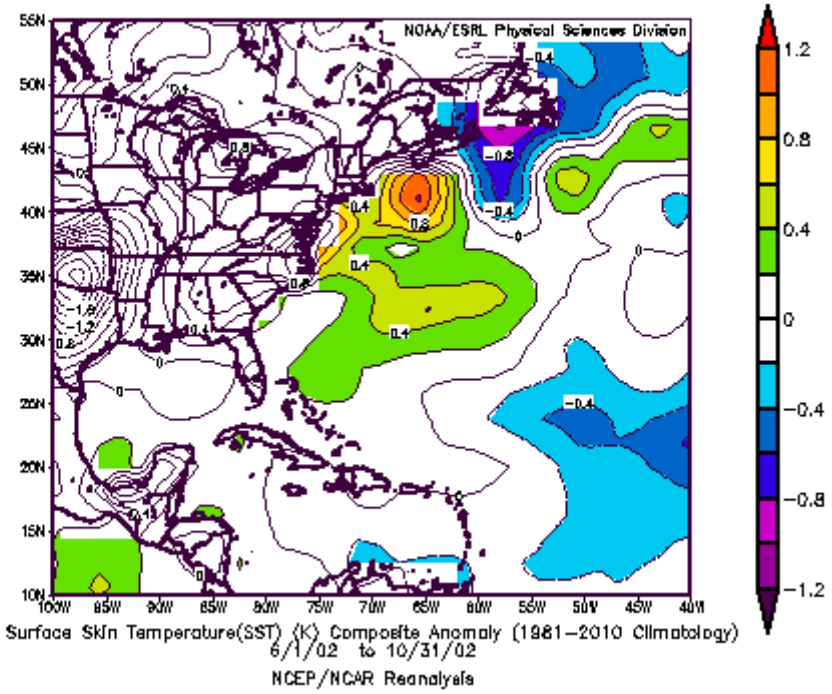
Based on climate records over the past thirty years (1983-2013), 42 tropical/post-tropical cyclones in the Atlantic Ocean have made landfall in or have passed within 100 km of Newfoundland. This represents 10% of all tropical/post-tropical cyclones that have formed in the Atlantic Ocean for this period. Since the average number of total named storms is 12, 10% amounts to about 1.2 tropical/post-tropical cyclones in Newfoundland per year.

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

4. ANTICIPATED 2014 NEWFOUNDLAND 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 either as weak tropical storms or as transitioning tropical storms which can make quite an impact.

- Examining SST anomalies over the three climatologically similar years described in Section 2, highlights the 2002 season as having a similar temperature regime with warm anomalies off the mid-Atlantic coastal waters and cool anomalies surrounding Newfoundland, concentrated over the southern Grand Banks.



- The aforementioned warm anomalies off the mid-Atlantic coastal waters in combination with the establishing wind shear to the south due to the expected building of El Niño should favour tropical cyclone formation north of the Caribbean Sea and east of the southeastern U.S. this year, similar to 2002. Such cyclones tend to track towards the northeast and impact Newfoundland, however, due to their limited track over water and due to the colder-than-normal waters near Newfoundland this year, they may not be able to sustain favourable growth.
- *In view of the above, we can expect 1-3 tropical/extratropical cyclones to affect Newfoundland this season. Due to the aforementioned factors limiting growth, those cyclones are not expected to exceed tropical storm strength (63-118 km/h), however, they may still produce heavy rainfall.*
- A caveat with this suppressed growth scenario is that a potent passing 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.
- Newfoundland has already seen one post-tropical cyclone (Arthur) make landfall this season, on July 6th. In the analog year of 2002 discussed above, (a different) post-tropical cyclone Arthur made landfall on July 16th, followed by Hurricane Gustav on September 11th.