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**Seasonal Summary**  
**For the Great Lakes**  
**Winter 2009-2010**



**Produced by the North American Ice Service**  
**May 2010**

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## **TABLE OF CONTENT**

<b>General Overview of the 2009-2010 Season.....</b>	<b>3</b>
<b>Lake Superior.....</b>	<b>5</b>
<b>Lake Michigan.....</b>	<b>6</b>
<b>Lake Huron.....</b>	<b>8</b>
<b>Lake Erie.....</b>	<b>9</b>
<b>Lake Ontario.....</b>	<b>10</b>

## **TABLE OF FIGURES**

<b>Figure 1: Weekly ice coverage – all lakes.....</b>	<b>11</b>
<b>Figure 2: Total accumulated ice coverage (TAC) - all lakes.....</b>	<b>12</b>
<b>Figure 3: Weekly ice coverage - Lake Superior.....</b>	<b>12</b>
<b>Figure 4: Total accumulated ice coverage (TAC) - Lake Superior.....</b>	<b>13</b>
<b>Figure 5: Weekly ice coverage - Lake Michigan.....</b>	<b>13</b>
<b>Figure 6: Total accumulated ice coverage (TAC) - Lake Michigan.....</b>	<b>14</b>
<b>Figure 7: Weekly ice coverage - Lake Huron.....</b>	<b>14</b>
<b>Figure 8: Total accumulated ice coverage (TAC) - Lake Huron.....</b>	<b>15</b>
<b>Figure 9: Weekly ice coverage - Lake Erie.....</b>	<b>15</b>
<b>Figure 10: Total accumulated ice coverage (TAC) - Lake Erie.....</b>	<b>16</b>
<b>Figure 11: Weekly ice coverage - Lake Ontario.....</b>	<b>16</b>
<b>Figure 12: Total accumulated ice coverage (TAC) - Lake Ontario.....</b>	<b>17</b>
<b>Figure 13: Temperature anomaly – December 2009 to March 2010.....</b>	<b>17</b>
<b>Figure 14: Temperature anomaly – December 2009.....</b>	<b>18</b>
<b>Figure 15: Temperature anomaly - January 2010.....</b>	<b>18</b>
<b>Figure 16: Temperature anomaly - February 2010.....</b>	<b>19</b>
<b>Figure 17: Temperature anomaly - March 2010.....</b>	<b>19</b>
<b>Figure 18: Comparison, first week of March 2009 and 2010 – Lake Superior.....</b>	<b>20</b>
<b>Figure 19: Ice Bridge - southern Lake Huron.....</b>	<b>20</b>

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## **General Overview of the 2009-2010 Season**

Observed temperatures for the month of November were generally above normal over the Great Lakes area. In the first half of December temperatures cooled to near normal except below normal in Lake Superior. In the second half of the month a strong temperature gradient was observed across the Great Lakes: above normal temperatures were reported in the western lakes cooling to below normal in the eastern end of the Great Lakes area. Freeze-up in the Great Lakes generally followed a near normal pattern except in Lake Superior where the ice developed at a much slower pace. Temperatures remained close to normal in the first half of January but climbed to above normal in the second half of the month. As a result, in January, the ice developed at a slower pace than normal over most of the lakes. The exception was in Lake Erie where a period of cold temperatures and relatively calm winds towards the end of the month allowed the ice to develop rapidly and the ice cover to surpass its normal value. The first half of February was characterized by near normal temperatures over all of the Great Lakes area. The peak of the ice season was reached in the second week of February which is a week earlier than normal. Just after mid-February the break-up started as temperatures climbed to above normal. The month of March was exceptionally mild in many areas of the lakes and this, combined with the fact that the ice was in generally thinner than normal, allowed break-up to proceed at a much faster pace than normal. Clearing in all of the lakes ice were in general two to three weeks earlier than normal.

Ice conditions in the Great Lakes were in general much easier than what we would normally expect. The total accumulated ice cover (TAC) over the entire ice season for most of the lakes was close to 50% less than normal. The exception was in Lake Erie where the TAC was relatively close to the normal. The ice cover in the second half of March in Lake Huron, including Georgian Bay and the North Channel, was the lowest in the Canadian Ice Service (CIS) ice records which date back to the winter of 1972-73. In fact break-up in Lake Huron occurred at a record pace. The ice cover in Lake Superior near the end of March was also the lowest ever recorded. While ice conditions in general were much easier than normal, a problematic situation developed in southern Lake Huron towards mid-February. A period of north-westerly winds packed medium and thick lake ice in the southern end of Lake Huron. An ice bridge formed (figure 19) near the entrance to the Sarnia River which persisted for a few weeks and caused some difficulties to the shipping community.

Figures 1, 3, 5, 7, 9 and 11 illustrate the weekly evolution of the ice coverage over the entire ice season for all the lakes and each individual lake. Figures 2, 4, 6, 8, 10 and 12 show the total accumulated ice coverage (TAC) over the entire season also for all the lakes and each individual lake. Figures 13 to 17 illustrate the temperature pattern for the entire ice season and for individual month.

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Weekly or daily ice analyses for the Great Lakes can be found at the two following URL's:

<http://www.ice.ec.gc.ca/App/WsvPageDsp.cfm?ID=1&Lang=eng>

<http://www.natice.noaa.gov/>

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## **Lake Superior**

Above to well above normal temperatures were reported in Lake Superior in the last two weeks of November. As a result no ice was observed in the lake at the end of the month. The first week of December was close to normal in terms of temperatures but a cold outbreak in the second week contributed to the formation of thin lake ice in Black and Nipigon Bays and new lake ice in some of the sheltered bays along the southwest coast of the lake. While the third week of December was slightly colder than normal, above to well above normal temperatures in the last week of the month prevented significant ice development. At the end of December the ice conditions were a few days to a week behind normal.

Near normal temperatures in the first half of January allowed the ice to develop in Thunder Bay as well as along the south coast of Lake Superior. However, very mild temperatures in the third week of the month melted most of the ice that had just developed. Ice did reform along the northern and southern coasts of the lake in the last week of January as temperatures dropped to near seasonal values. However ice conditions at the end of January were two to three weeks behind normal. Of note was the fact that at this time Whitefish Bay was still predominantly open water. Normally the bay is ice covered in the second week of January.

Temperatures in the first half of February were in general slightly above normal, which was just warm enough to prevent significant ice formation. Some ice did develop during the period but ice conditions were still about 3 weeks behind normal in most locations at mid-February. The only noticeable change that was observed in the first half of February was in Whitefish Bay which became entirely ice covered. Above normal temperatures continued into the second half of February and again not much in terms of ice development was observed. New lake ice did spread in most of the western half of the lake in the third week of February but melted a few days later. Except for ice in bays, including Whitefish Bay, and along sections of the southern and northern coasts Lake Superior was for the most part open water or ice free at the end of February. Figure 18 shows a comparison of ice conditions in the first week of March 2009 and 2010.

Mild temperatures were again recorded in the first half of March resulting in a gradual decrease in the ice cover in this period. Almost all of the mobile ice that was present in the lake in the first week of March had melted by the middle of the month. Despite mild temperatures Whitefish Bay became consolidated just before mid-March. The ice cover in Lake Superior, near mid-March, was the second lowest in CIS ice records (1987 was the lowest) Temperatures did

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temperate somewhat in the second half of March but remained above normal. Thunder Bay fractured shortly after mid-March and was mostly open water at the end of the month. The exception was an area of consolidated ice which persisted in the northeast end of the bay. Whitefish Bay did not remain consolidated for long as it fractured in the third week of March and, with the help of mild temperatures, was in open water at the end of the month. At the end of March the only ice remaining was consolidated ice in the northeast end of Thunder Bay and in most of Black and Nipigon Bays. The ice cover at the end of March, in Lake Superior, was the lowest in CIS ice records. The northeast end of Thunder Bay and Black Bay cleared in the second week of April and Nipigon Bay a week later. The clearing in Lake Superior was about three weeks early.

## **Lake Michigan**

Leading into the ice season, milder than normal air temperatures for this time of year was experienced in and around Lake Michigan during the second half of November; however near normal temperatures returned to the area by early December. Two weeks into the month, the first signs of ice development were seen across northern portions of Bays de Noc, southern portions of Green Bay, and within southern portions of Grand Traverse Bay. Conditions ripe for ice growth and development continued into mid December as new lake ice now impacted the majority of southern Green Bay, just south of Sturgeon Bay, all of Bays de Noc, along with areas along the northern shore west of the Straits of Mackinac. Near normal temperatures continued across all of Lake Michigan for the second half of December allowing for further ice development. By the end of 2009, near normal ice conditions were evident across the entire lake. Both Bays de Noc and extreme southern portions of Green Bay were now consolidated with thin lake ice.

Ice concentration and thickness values increased at a rapid pace during the first two weeks of January during which near normal temperature impacted the region. Green Bay became completely ice covered and the majority of the northeast portion of the Lake from Beaver Island north-eastward was now experiencing ice cover. Many areas along the western and southern shoreline also experienced high concentration levels of lake ice during this two week time span. A band of thicker ice developed and was evident along the shoreline between Michigan City and Chicago at this time. Prior to mid-January, a combination of sporadic above normal temperatures and persistent westerly winds affected the Lake. The resulting effects included significant shifting in the ice along the western coastline into warmer, interior sections of the lake leading to melt and deterioration of the ice pack. These winds also caused the ice in the western section of Green Bay to shift into the eastern section of the bay. Despite significant ice growth during the first two weeks of the month, ice conditions

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around mid-January were below normal especially within the northeast section of the Lake.

Temperatures recorded during the second half of January averaged above normal especially for the northern half of the lake. During this period ice coverage across the lake fell well below normal for this time of year. By the end of the month, ice covered the western approaches to the Straits of Mackinac and all of Green Bay; however conditions in both locations were well below average values. At this time a band of thin and new lake ice was reported along the southern and western shoreline extending from Michigan City to Milwaukee.

Temperatures across Lake Michigan during the first half of February remained relatively close to normal and even slightly below normal for areas across the southern half of the Lake. The slightly cooler than normal temperatures experienced throughout the southern portions of the Lake resulted in above ice concentration levels along most coastal regions. The band of thin and new lake ice between Michigan City and Chicago had now grown to medium and thin lake ice at this time. Green Bay was experiencing full ice coverage across the entire area, however thinner ice thicknesses and a mobile ice pack were evident which indicated less severity in ice conditions when compared to the mean for that particular time of year. Despite near normal temperatures, the northeast quadrant of Lake Michigan also was below normal in ice concentration levels. Far from the mean, the Straits of Mackinac had not consolidated at this time nor was there any ice within Grand Traverse Bay. Although higher than normal ice concentrations were observed within the southern half of the Lake, the overall ice coverage across the entire lake at mid-February indicated below normal values. In the later half of the month, temperatures climbed to above normal across the northern portion of the Lake while the southern half experienced yet again, slightly cooler than normal conditions. With shifting in the winds most of the ice along the eastern and western shores was able to move into warmer waters accelerating the melting process melt during this period. By the end of the month the southern half of the lake only contained a small band of medium and thin lake ice evident between Michigan City and Chicago. The northern half of the lake continued to see well below normal ice conditions contributing significantly to the total accumulated ice coverage dropping below 50% of its normal value by months end.

In the first half of March well above normal temperatures impacted the entire area especially in the northern half of the Lake. During the first week of March, ice started to melt and break up proceeded in a rather quick fashion. By mid month all but a small area of ice along the southern shore just west of the Straits of Mackinac remained. Green Bay remained consolidated south of Chambers Island; however the melt out of the Bay had started and was evident within the waters just north of Chambers Island within interior sections of the Bay.

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A deteriorating band of medium and thin lake ice still remained along the southern shore between Michigan City and Chicago.

The mild temperatures continued into the second half of the month leading to continual rapid ice melt across the entire lake. By the end of March all ice, except some remaining thick lake ice within extreme northern coastal areas of Bays de Noc and Sturgeon Bay, had melted leaving open water conditions across the entire Lake. The lake experienced open water and ice free conditions almost a half month earlier than normal. Ice records indicate the 2009-2010 total accumulated ice coverage was the lowest recorded ice coverage the lake has seen since the 2005-2006 winter.

## **Lake Huron**

Mild temperatures in the second half of November were followed by near normal temperatures in the first two weeks of December. At mid-December ice was found in St Mary's River, in Saginaw Bay as well as in sheltered bays along the northeast coast of Georgian Bay which is a near normal situation. Near normal temperatures in the second half of December allowed the ice to develop at a near normal pace and ice conditions at the end of 2009 was very close to normal.

Despite near to slightly colder than normal temperatures little ice development was observed in Lake Huron in the first half of January. As a result ice condition were a week to 10 days behind normal and the ice cover was about half of what we would normally expect at mid-January. Temperature climbed to above normal in the second half of January. Little ice development was observed in this two week period except for a band of ice which developed along the northeast coast of Georgian Bay. The ice cover at the end of January in Lake Huron remained at about 50% of its normal value.

Temperatures in the first half of February remained relatively close to normal which allowed the ice to develop and expand, so much so, that the ice cover at mid-February was approaching its normal value. However the ice thickness was a lot less than normal as a good portion of the ice cover was composed of new and thin lake ice. Temperatures climbed back to above normal values in the second half of February and as a result most of the new and thin lake ice, that formed in the first half of the month, melted. In fact the ice cover diminished by about 50% in the second half of February (figure 7). The ice cover, at the end of February, was the fourth lowest in CIS ice records. Of note was the central section of the North Channel which, at the end of February, was still mobile. Normally the central section of the Channel becomes consolidated just after mid-January. Unusual ice conditions developed in southern Lake Huron in the second half of February. Persistent north-westerly winds packed the ice along the southern shore of Lake Huron and an ice bridge developed near the



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entrance to the Sarnia River (figure 19). This bridge persisted for a few weeks and caused some problems to navigation.

The first half of March was particularly mild especially in the northern half of the lake and break-up occurred at a rapid pace. Most of the mobile ice melted in the first half of March. The only exception was an area of thick lake ice, which was still present, at mid-March, in the southern end of the lake and in the entrance to Sarnia River. At that time Georgian Bay was mainly open water and the ice was still mobile in the central section of the North Channel. Both events are not common. As above normal temperatures prevailed in the second half of March break-up continued at a rapid pace. Little ice remained in Lake Huron at the end of March. At that time ice was only observed in bays along the northeast coast of Georgian Bay and at both extremities of the North Channel. In fact the ice cover in Lake Huron, at the end of March, was the lowest in CIS ice records. The rest of the ice melted in the first few days in April. The total area ice coverage (TAC) was the forth lowest on record (figure 8).

## **Lake Erie**

Above normal temperatures in the second half of November were followed by near normal temperatures in the first half of December. At mid-December ice was found in eastern Lake St Clair and in coastal areas in the Western Basin which is a normal situation. More ice formed in the following week but a brief episode of mild temperatures and strong winds just after Christmas Day destroyed most of the ice. At the end of December less ice than normal was found in Lake St Clair and in the Western Basin. At this time Lake Erie was mainly ice free which is a normal situation.

The first half of January was generally colder than normal except for a return to milder than normal temperatures a few days before mid-Month. This allowed for moderate to rapid ice development in the first week of January. The ice cover at the end of the first week of January was greater than normal. A week later however the ice cover was back to below normal as mild temperatures melted a good portion of the newly formed ice. Lake St Clair and the Western Basin did however remain ice covered. Mild temperatures in the third week of January prevented significant ice development. The last five days of January were relatively cold and as a result the ice spread in most of Lake Erie by the end of month. At this time the ice cover was above normal but the ice thicknesses were less than normal.

Temperatures remained relatively close to normal in the first half of February and as a consequence Lake Erie remained almost entirely ice covered. While the ice cover remained above normal, the thicknesses in general were less than normal in Lake Erie, in Lake St Clair as well as in the Western Basin. In the

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last two weeks of February temperatures remained close to normal but the normal increase in average temperatures prevented significant ice development. The peak of the ice season in Lake Erie was reached just before mid-February which is a near normal. Due to prevailing west to northwest winds for most of the second half of February the ice drifted towards the south coast of the lake so that at the end of the month the southern half of the lake was covered with compacted medium lake ice. At this time open water was observed in the northern half of the lake as well as the northern section of the Western Basin. Temperatures were relatively close to normal in the first week of March but much above normal in the second week. Little change in the ice cover was observed in the first week of March. The natural increase in average temperatures combined with much above normal temperatures in the second week of the month resulted in a dramatic drop in the ice cover. At mid-March a narrow band of medium lake ice was present along the south coast of the lake. At this time the Western Basin and Lake St Clair were mostly open water except for an area of thick lake ice in the southern end of Lake St Clair. The rest of the ice in Lake St Clair and along the southern coast of Lake Erie gradually melted during the second half of March. The total accumulated ice coverage (TAC) in Lake Erie was just below normal (figure 10).

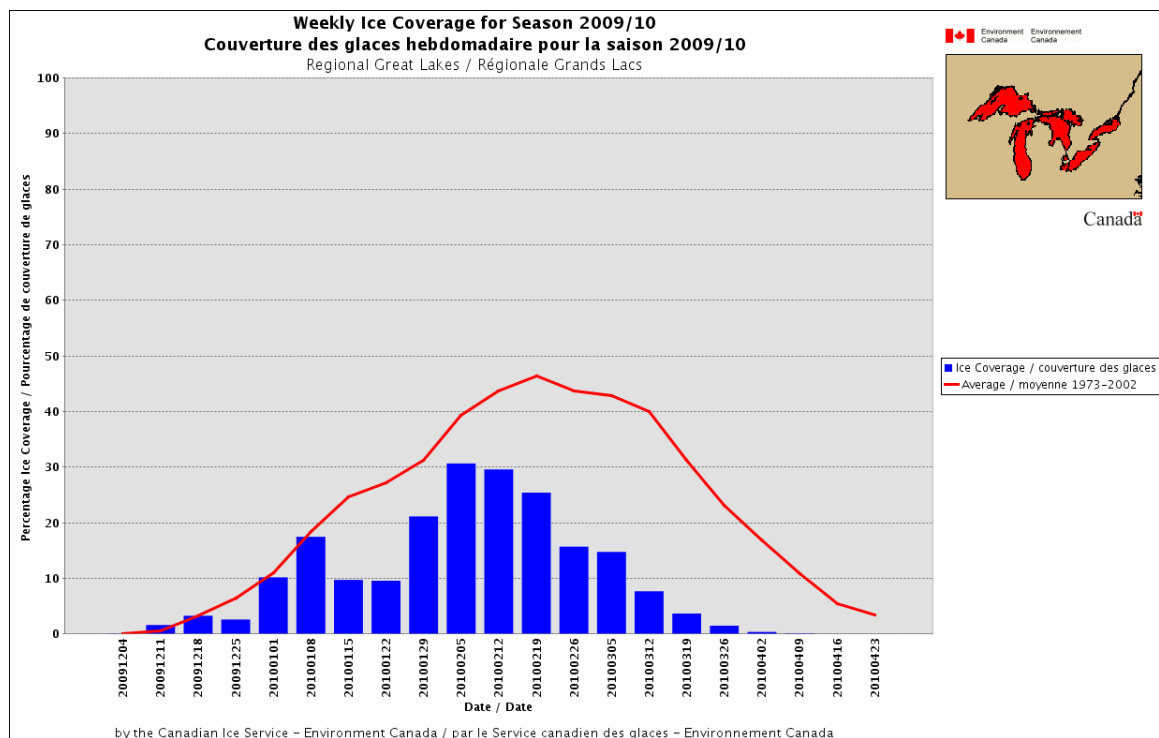
## **Lake Ontario**

The second half of November and the first half of December were both above normal in terms of temperatures in Lake Ontario area. At mid-December Lake Ontario was essentially ice free. At that time the only area where ice was reported was in Bay of Quinte. Colder than normal temperatures in the second half of December allowed the formation of ice in bays along the northeast coast of the lake as well as in the western section of the Seaway. Otherwise ice free was the norm in Lake Ontario at the end of 2009.

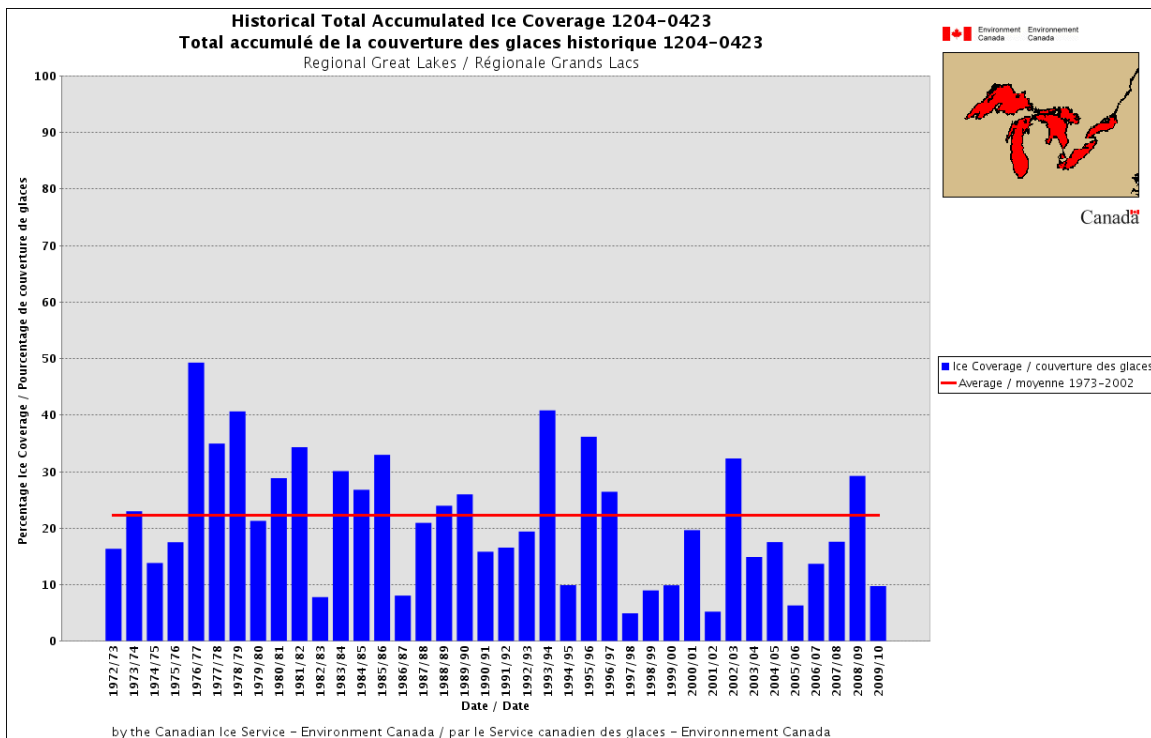
Near normal temperatures did allow more ice to form along the northeast coast of Lake Ontario in the first half of January and ice conditions there remained close to normal. Bay of Quinte became consolidated early in the month. Mild temperatures and strong south to southwest winds in the third week of January destroyed much of the coastal ice in the northeast end of Lake Ontario. Ice did reform there late in the month as temperatures dropped to below normal values.

Temperatures remained in general close to normal in the first half of February. More ice did form in the northeast end of Lake Ontario but the rest of the lake, at mid-February, was ice free except open water along the coast. Most of the mobile ice in the northeast section of the lake melted in the second half of February as temperatures climbed to well above normal values. The temperature trend that established itself in the second half of February continued into the first

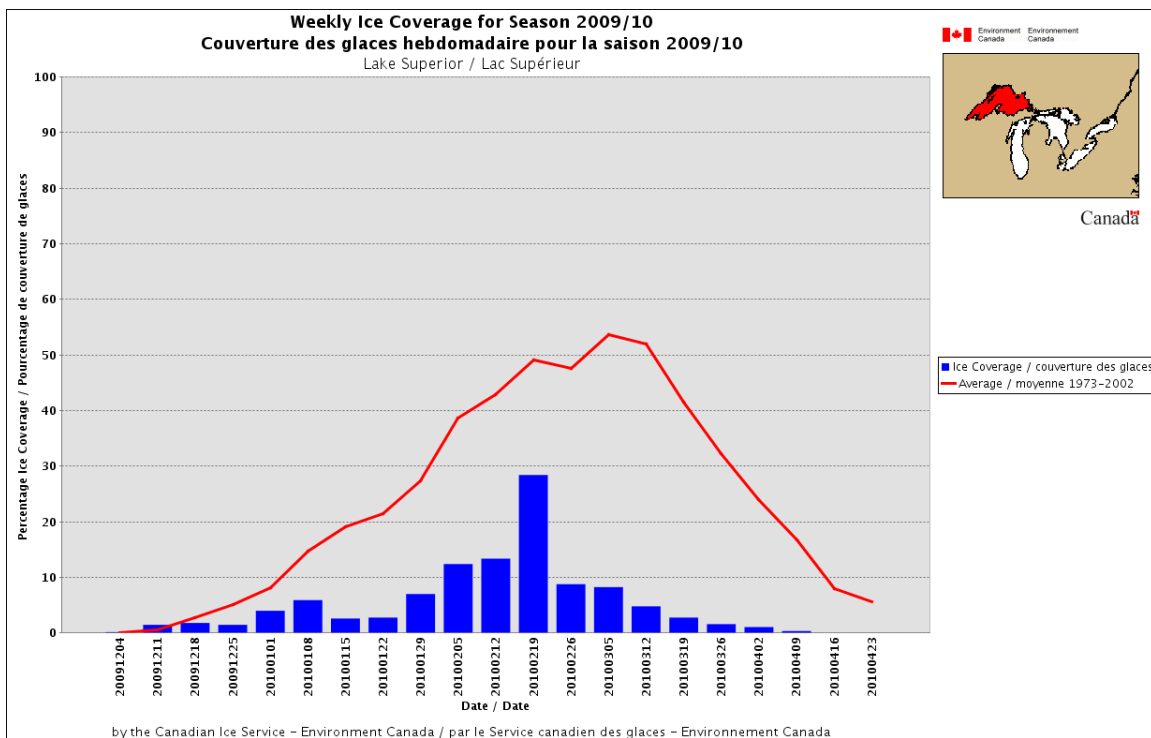
half of March. As a result the mobile ice in the northeast section of the lake melted in the first few days of March. The western section of the St Lawrence River fractured in the first week of March and melted in the second week. Bay of Quinte fractured and melted in the third week of March. Clearing in the northeast section of Lake Ontario was two to three weeks early.



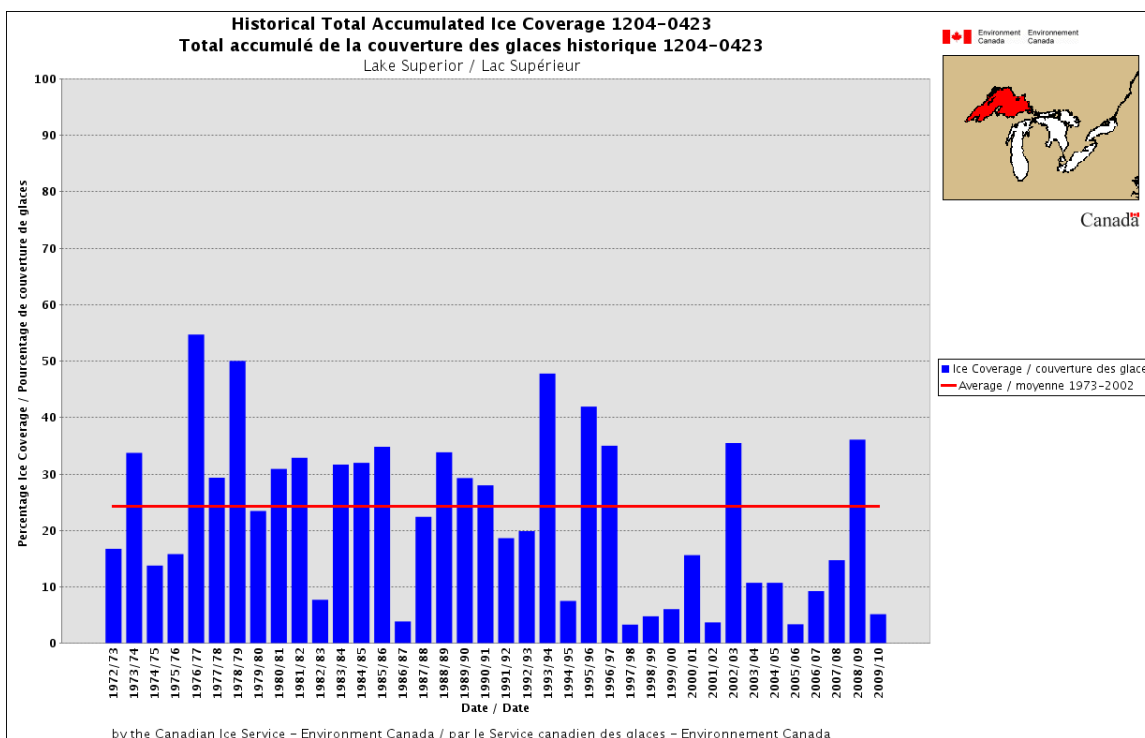
**Figure 1: Weekly ice coverage – all lakes**



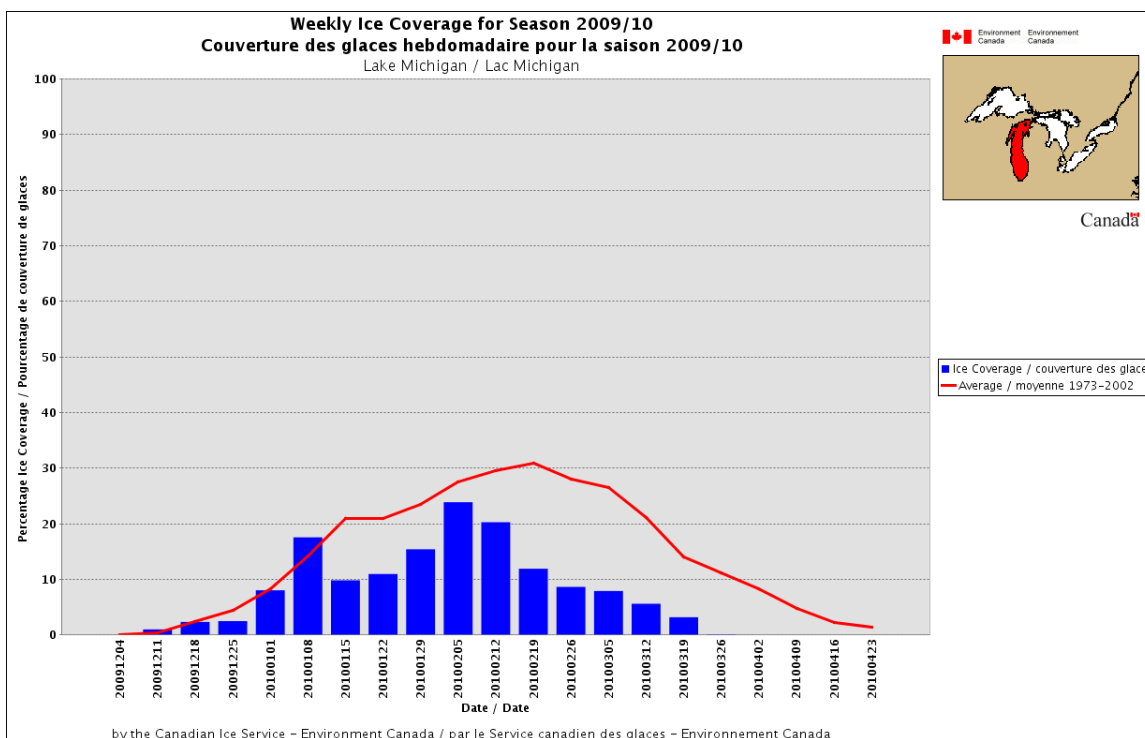
**Figure 2: Total accumulated ice coverage (TAC) - all lakes**



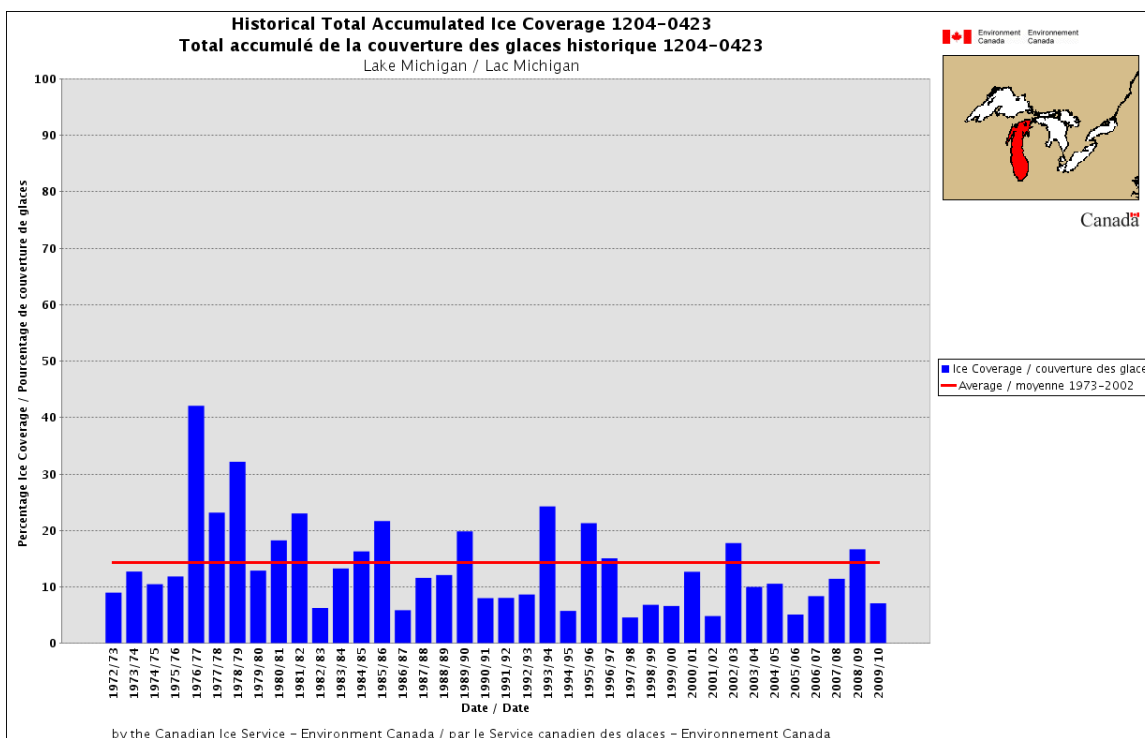
**Figure 3: Weekly ice coverage - Lake Superior**



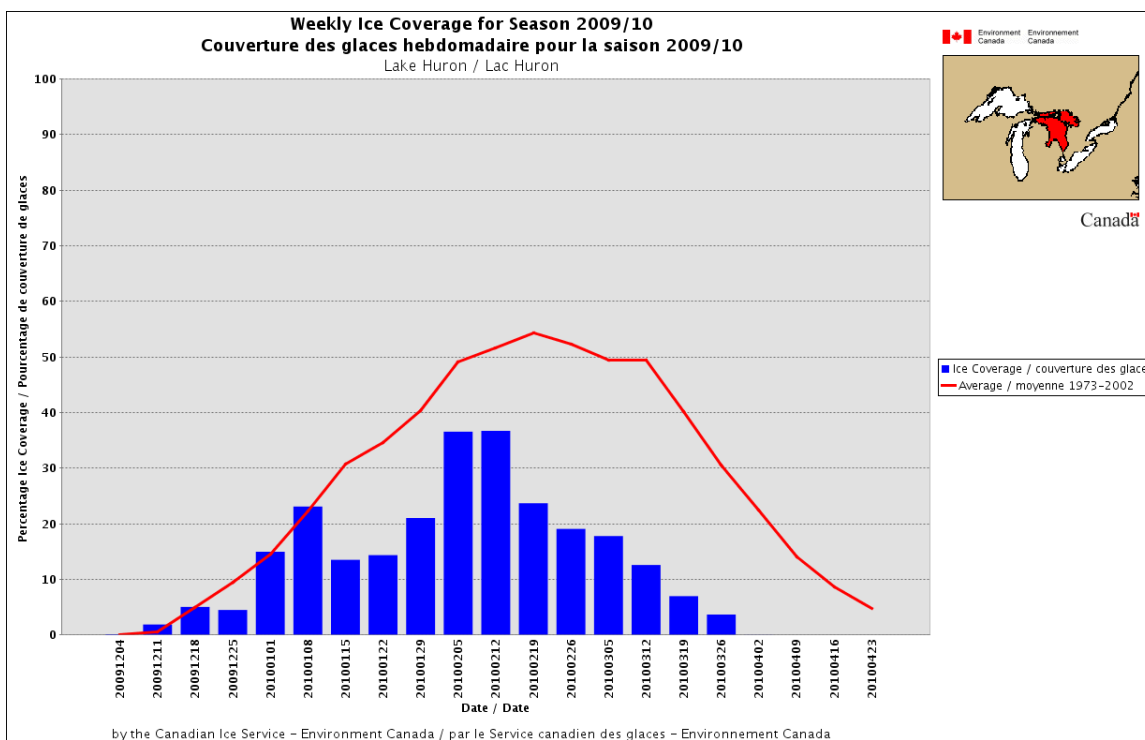
**Figure 4: Total accumulated ice coverage (TAC) - Lake Superior**



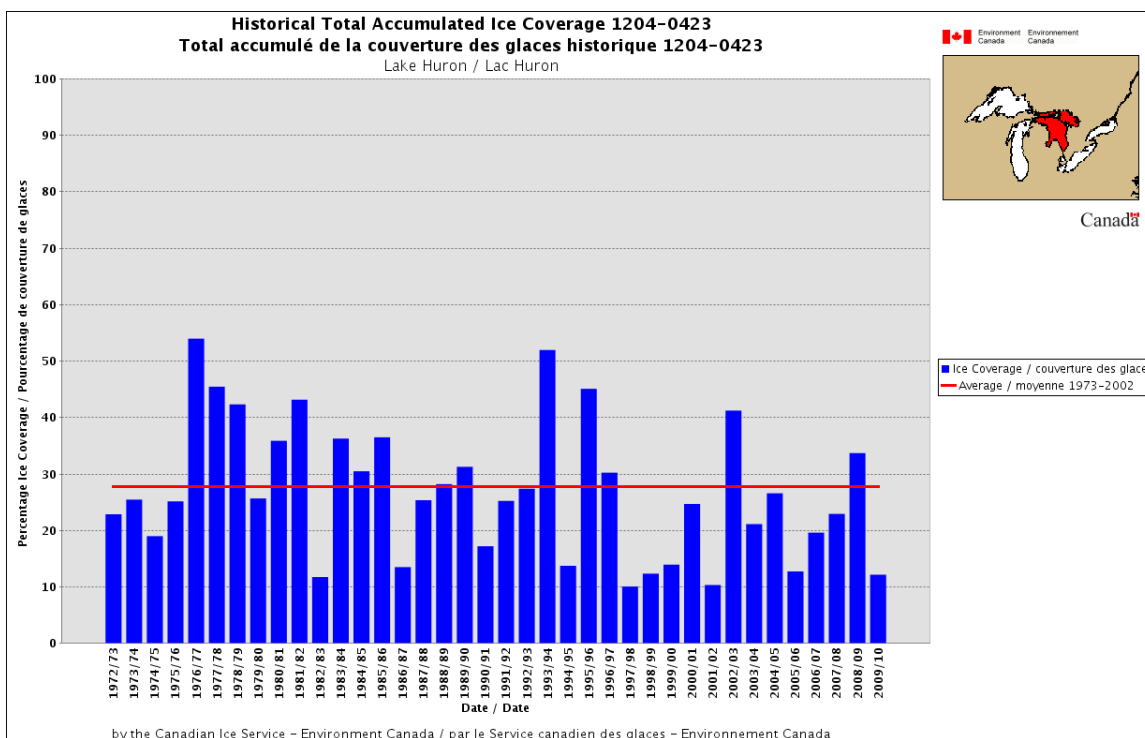
**Figure 5: Weekly ice coverage - Lake Michigan**



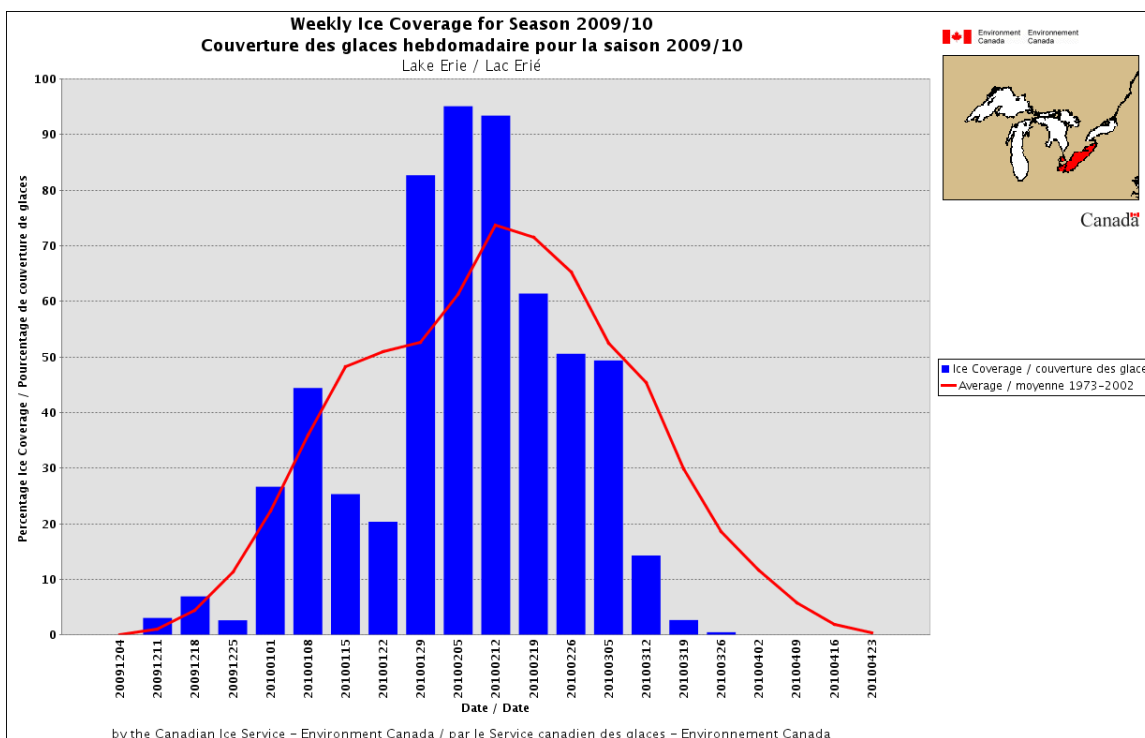
**Figure 6: Total accumulated ice coverage (TAC) - Lake Michigan**



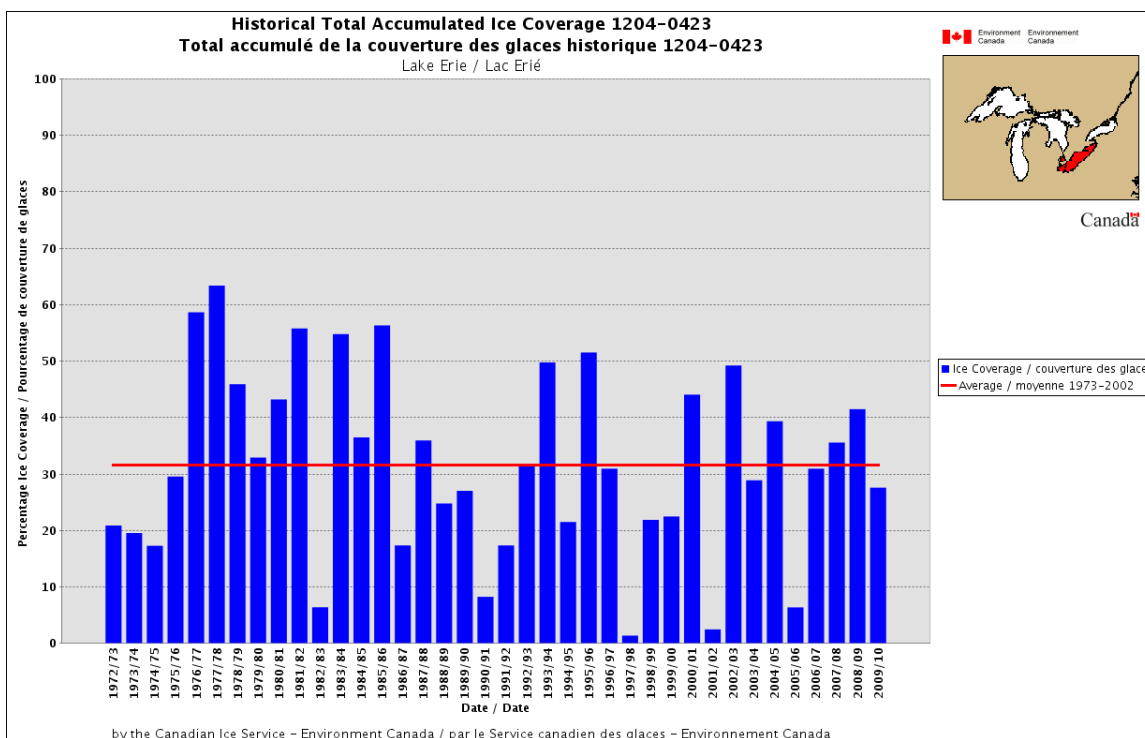
**Figure 7: Weekly ice coverage - Lake Huron**



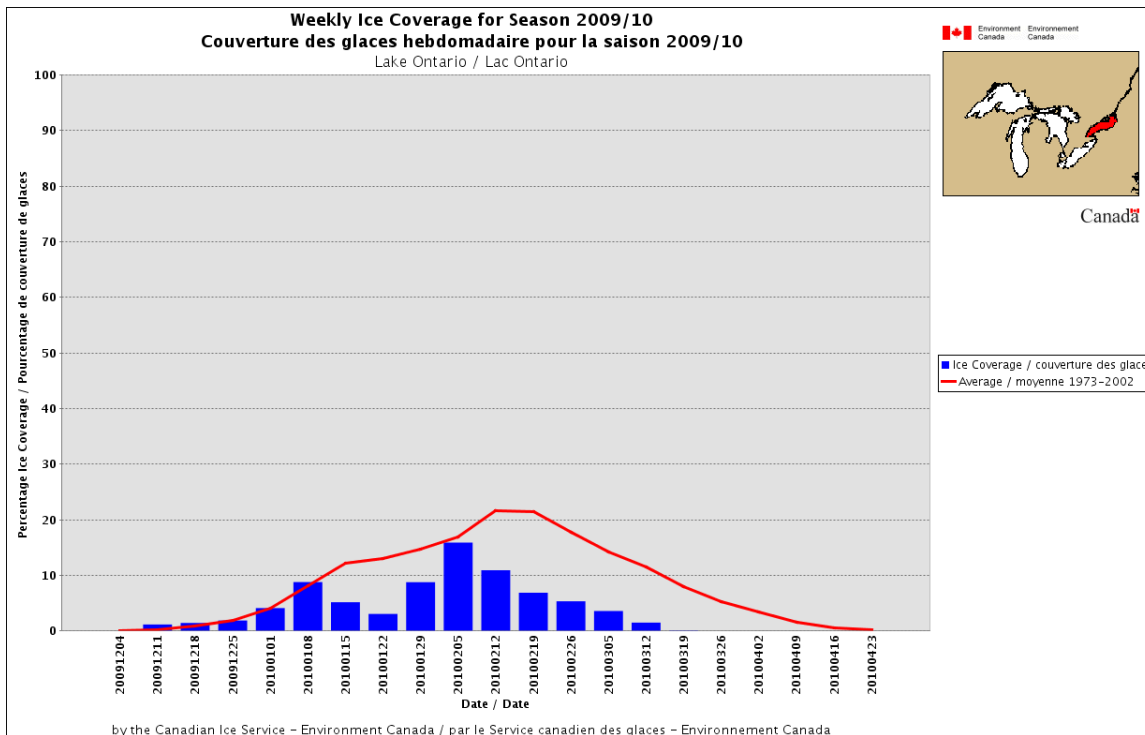
**Figure 8: Total accumulated ice coverage (TAC) - Lake Huron**



**Figure 9: Weekly ice coverage - Lake Erie**

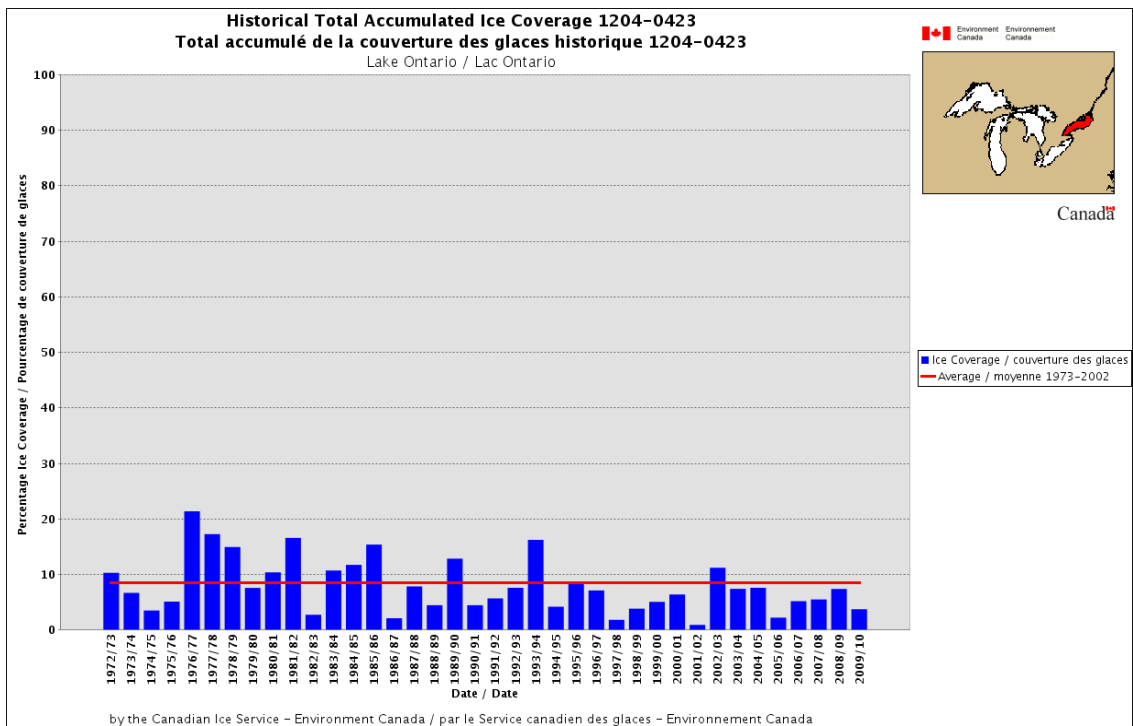


**Figure 10: Total accumulated ice coverage (TAC) - Lake Erie**

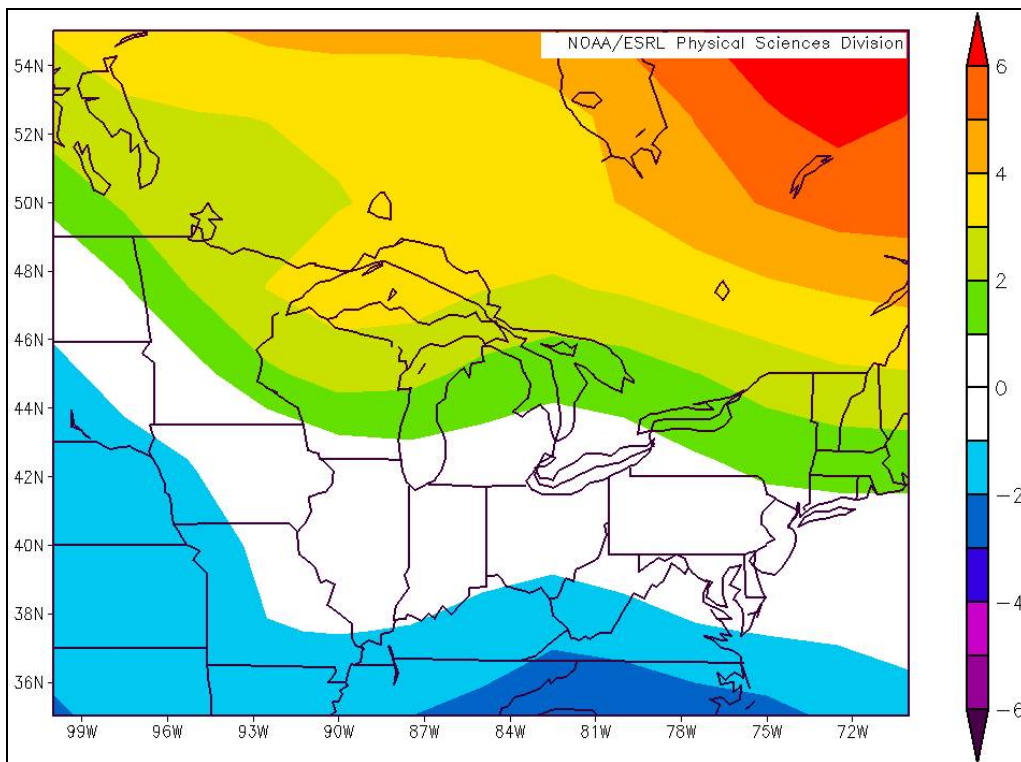


**Figure 11: Weekly ice coverage - Lake Ontario**

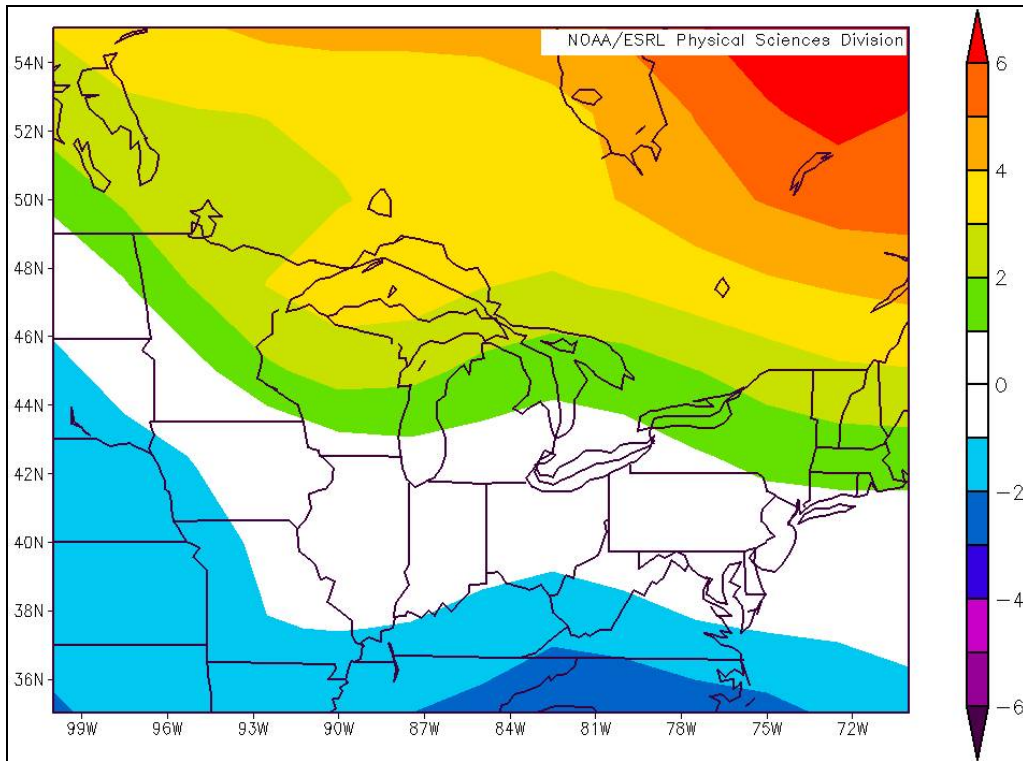




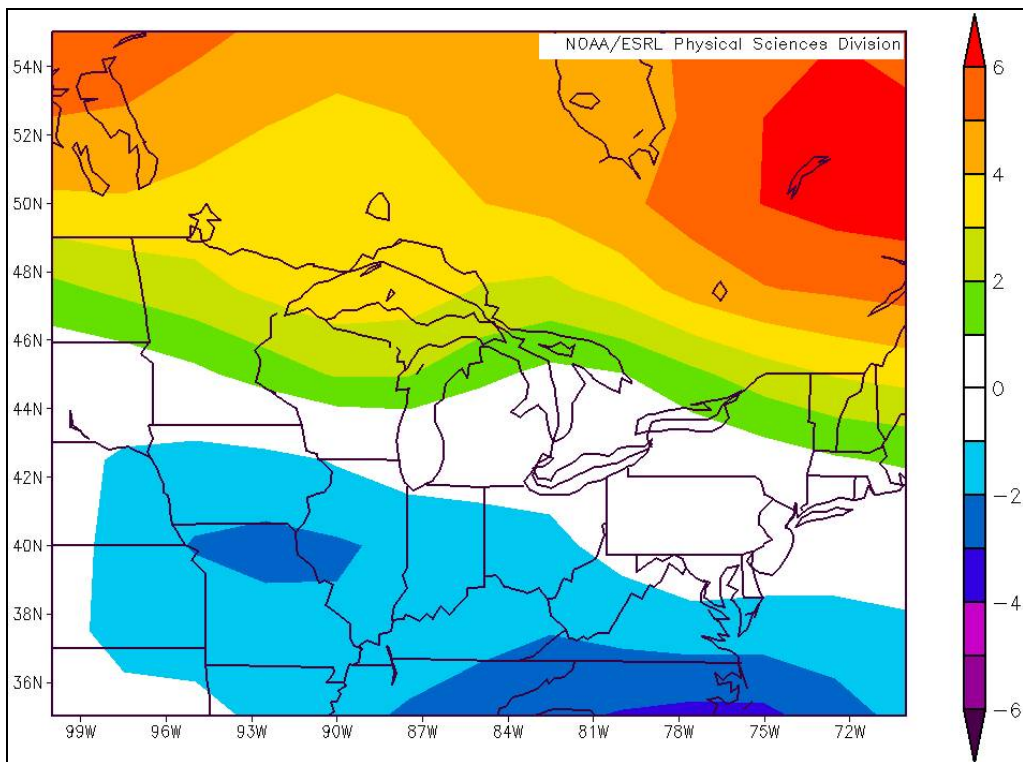
**Figure 12: Total accumulated ice coverage (TAC) - Lake Ontario**



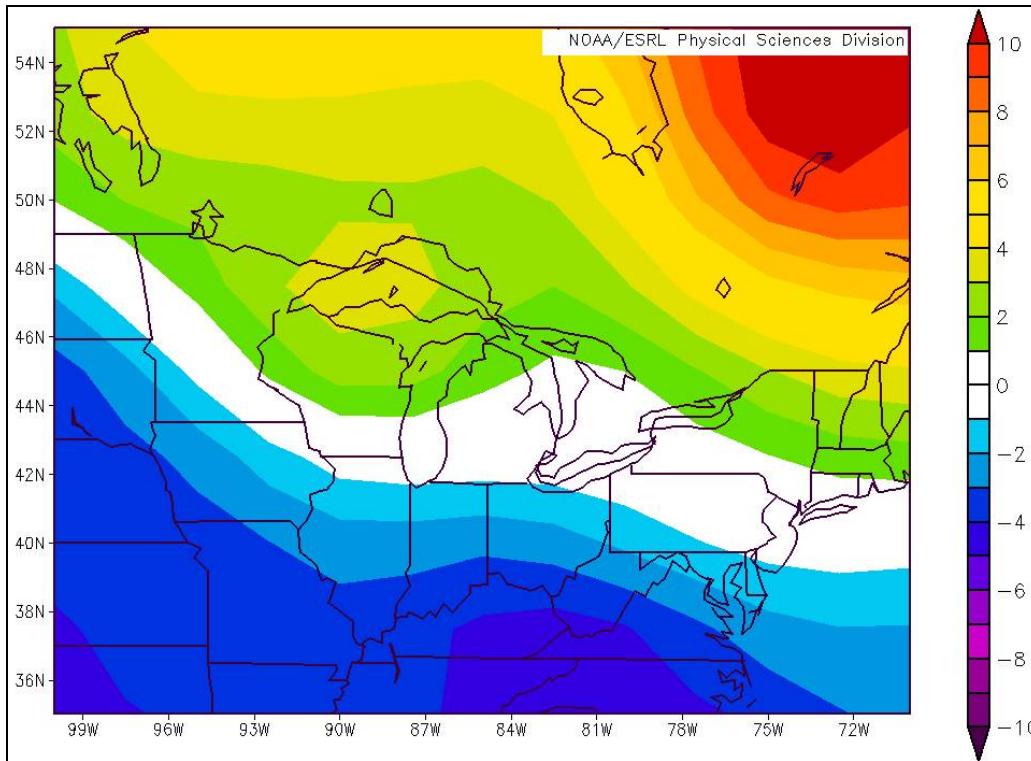
**Figure 13: Temperature anomaly – December 2009 to March 2010**



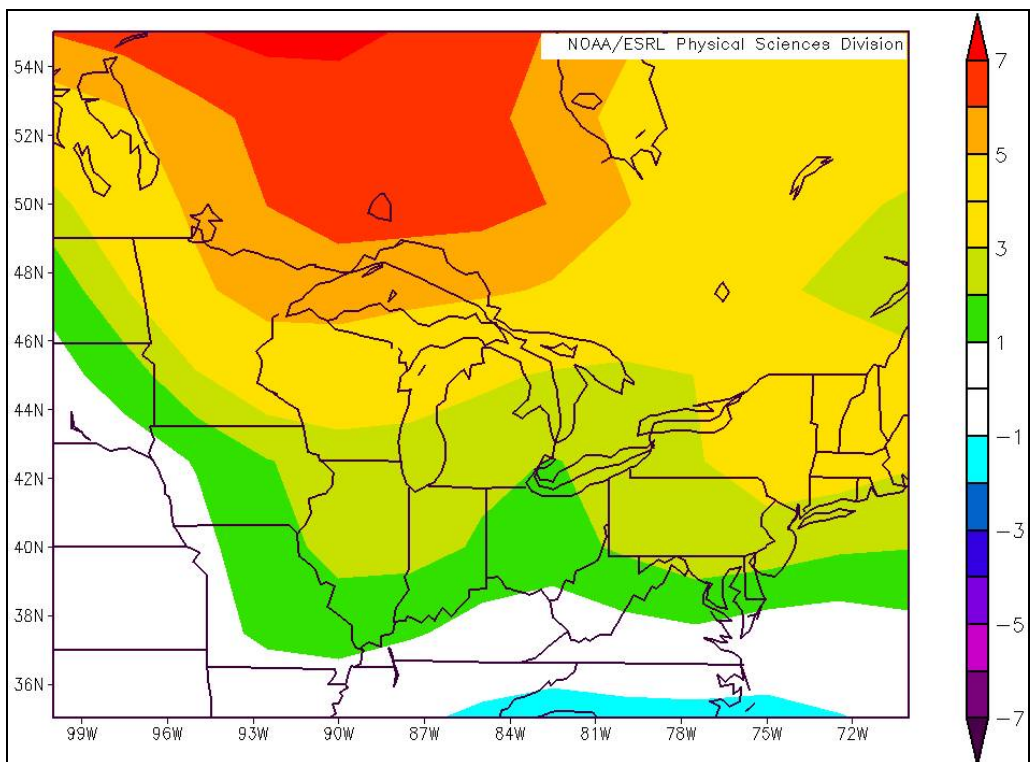
**Figure 14: Temperature anomaly – December 2009**



**Figure 15: Temperature anomaly - January 2010**



**Figure 16: Temperature anomaly - February 2010**



**Figure 17: Temperature anomaly - March 2010**





Figure 18: Comparison, first week of March 2009 and 2010 – Lake Superior

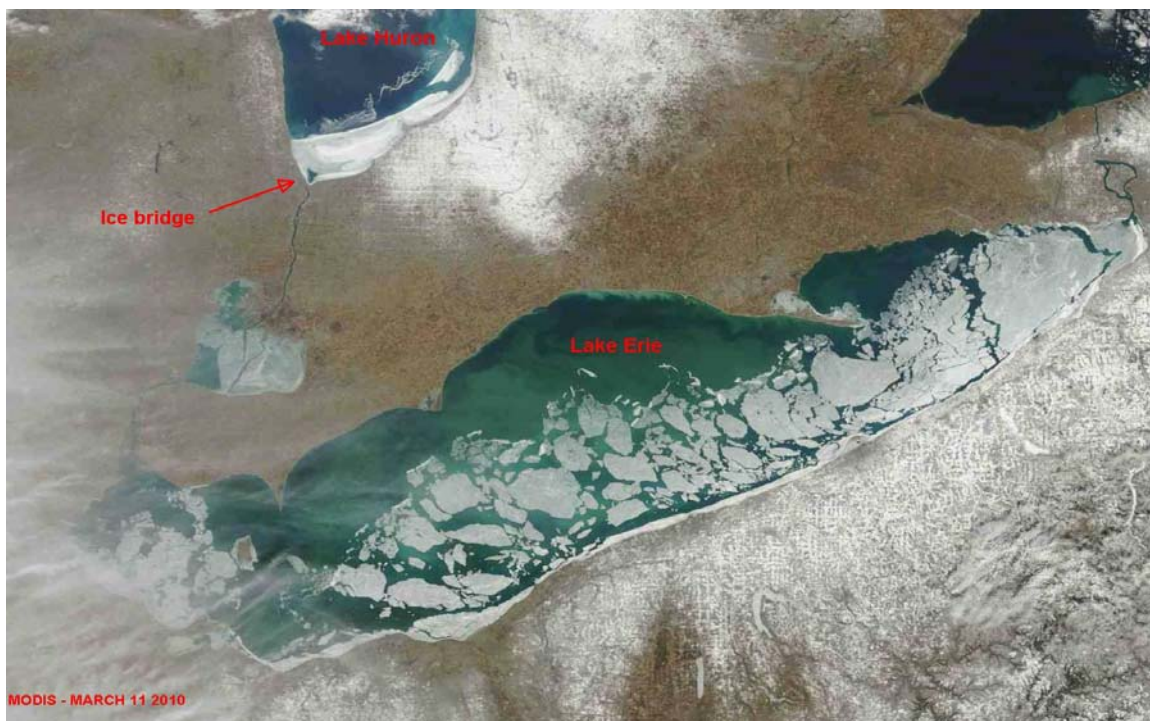


Figure 19: Ice Bridge - southern Lake Huron