

Seasonal Summary
For the Great Lakes
Winter 2010-2011



Produced by the North American Ice Service
June 2011

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General Overview of the 2010-2011 Season

Observed temperatures for the month of November were above normal over the Great Lakes. Temperatures cooled to below normal with the arrival of December and freeze-up in the Great Lakes happened faster than normal. The second half of December and the first part of January were much milder than normal over Lake Superior while Lake Erie remained colder than normal during that period. Much colder air moved over the Great Lakes in the second half of January but the cold weather was less severe over Lake Superior. As a result freeze-up was followed by normal to more severe than normal ice conditions except for Lake Superior. The ice coverage peaked at the end of January with December and January as a whole colder than normal for the eastern lakes and southern Lake Michigan. This was a month earlier than normal.

Generally, from early February to the end of March, temperatures ranged from above normal over Lake Superior to below normal over the eastern lakes. During that period, an intrusion of warm air over the Great Lakes around mid-February helped reduce the ice coverage to below normal values. Ice redeveloped after that but ice cover on the Great Lakes generally remained below normal for the rest of the season. Another significant cold outbreak occurred at the end of March; this was too late in the season to have a big impact on the overall ice coverage on the Great Lakes.

General ice conditions on the Great Lakes for the season, as expressed with the total accumulated ice cover (TAC), were normal. As described earlier, there was quite a variation from lake to lake. Ice cover on Lake Superior was below normal for the season, while ice conditions on Lake Michigan, Lake Huron and Lake Ontario were near normal. Ice conditions on Lake Erie were more severe than normal.

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.

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

<http://www.ec.gc.ca/glaces-ice/>

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

Lake Superior

Temperatures were well above normal in Lake Superior in the first half of November and closer to normal in the second half of the month. As a result ice formation was delayed somewhat and there was less ice than normal in Black Bay at the end of the month (Black Bay is the only area where there usually is significant ice at the end of November).

Cold outbreaks with the arrival of December resulted in slightly above average ice cover over Lake Superior by mid-month, with more ice than normal in Black Bay, Nipigon Bay and Chequamegon Bay. Black Bay and Nipigon Bay consolidated near mid-month, a few days to a week faster than normal.

Mild temperatures were reported in the second half of December and in the first half of January. Overall, ice cover was a little below normal at the end of December and into mid-January; ice was slow to develop in Thunder Bay and was developing a little faster than normal west of the Keweenaw Peninsula. Chequamegon Bay consolidated early in the last week of December, at a near normal pace.

Temperatures dove again below normal in the second half of January and by the end of the month the overall ice coverage returned to normal, with less ice than normal in the northern portion of the lake and a little more than normal along most of the southern shores. Thunder Bay consolidated a little before mid-month, and ice around the Apostle Islands consolidated a little after mid-month, at a close to normal pace.

The first three weeks of February were generally above normal and ice formation over Lake Superior was significantly delayed during that period. Additionally, there was less fast ice than normal in Thunder Bay and around the Apostle Islands. The eastern portion of Whitefish Bay consolidated in the third week of the month but fast ice extent in Whitefish Bay was lower than normal. Ice coverage on Lake Superior remained significantly below normal for the rest of the winter.

Colder temperatures occurred in late February and early March and by mid-March more ice than normal was found over portions of the south shore, but total ice cover over the lake remained well below normal.

In the last week of March, colder than normal temperatures occurred over most of Lake Superior and that was reflected in rapid and extensive new lake ice formation across the lake on March 31st. This new ice lasted about one day. Break-up of the ice in eastern Whitefish Bay and into St. Mary's river happened

at the end of March, a few days earlier than normal. An early April storm and above normal temperatures in the first half of April destroyed most of the ice on Lake Superior. Cold outbreaks in the second half of April and in early May delayed break-up of the ice in Nipigon and Black Bay. Clearing in Whitefish Bay occurred at the end of April, a near normal pace. Normal to higher than normal temperatures in the second week of May resulted in Black and Nipigon Bays clearing, a near normal pace.

Of note; fast ice extent in Whitefish Bay remained well below normal during the winter. Most of Whitefish Bay usually becomes consolidated around the end of the 3rd week of February. It never consolidated completely this year. Less fast ice than usual developed in Thunder Bay; a large opening was present east of Pie Island for most of the winter.

Lake Michigan

Above normal temperatures were reported over Lake Michigan in November. Cold outbreaks following the arrival of December resulted in ice developing a week faster than normal in Green Bay and in the Bays de Noc. A brief influx of milder air in late December, which was felt mostly in the north of the lake, did not slow down ice formation; by the end of December more ice than normal was reported in Green Bay, the Bays de Noc, in the approaches to the Straits of Mackinac, in the strait itself and along the south-western shore of Lake Michigan. The lower third of Green Bay and the Bays de Noc became consolidated early in the last week of the month. Ice formation was about a week ahead of normal in the northern half of the lake and a month ahead of normal in the south.

From early January to the first week of February, temperatures were below normal in the southern half of the lake and near normal in the northern half. The lower two thirds of Green Bay became consolidated near the end of the first week of February. Fast ice formation in Green Bay was one to two weeks faster than normal and it was about a week faster than normal in the Straits of Mackinac. Additionally, fast ice extent in the Straits of Mackinac was above normal. Little Traverse Bay became consolidated early in the second week of February, a week later than normal.

In the period from the beginning of December to the first week of February, overall ice cover on Lake Michigan remained above normal. Ice extent off the southern shores of the lake were unusual; ice formed unusually early and extended unusually far off the shores; this type of ice conditions were seen in only 15 percent or less of the years in CIS ice climatology (which span 30 years from 1981 to 2010).

A period of stormy weather and milder temperatures beginning in the second week of February destroyed some of the ice and resulted in a below normal ice cover on Lake Michigan; most of the ice present along portions of the south shore since the beginning of the winter was destroyed. It also caused the fast ice in the Straits of Mackinac to fracture early in the third week of February, which is quite unusual. Near normal temperatures and ice formation followed until the first week of March but the overall ice cover on the lake remained below normal. Ice in the Straits of Mackinac consolidated again during that period but the extent of the fast ice remained smaller than earlier in the winter. Another influx of warm air in the second and third week of March resulted in more ice destruction and below normal ice coverage on the lake. Break-up of the ice in Green Bay and the Straits of Mackinac occurred around the end of the third week of March which is a week earlier than normal.

The Straits of Mackinac cleared in the first week of April and break-up in the Bays de Noc occurred at that time. This was about a week earlier than normal. Break-up in Little Traverse Bay occurred in the second week of April; a week later than normal. Green Bay and Little Traverse Bay were clear of ice near mid-month, which is near normal. By then Lake Michigan was open water to ice free.

Lake Huron

Temperatures over Lake Huron were near normal in the first half of November and above normal in the second half of the month. Cold outbreaks with the arrival of December caused new lake ice development in St. Mary's river, in the North Channel and in Saginaw Bay. The presence of ice in the North Channel and far off the coast in Saginaw Bay was unusual for that time of the year. It has happened this early only in 15 percent or less of the years in CIS ice climatology.

Ice continued to grow at a rapid pace and fast ice in Saginaw Bay, along the coast in north-eastern Georgian Bay, in the North Channel and in St. Mary's river started forming in the third week of December, one to two weeks faster than normal. Also in the third week of December, ice developed along the southern shores of Lake Huron which was unusually early. Milder temperatures were reported around the end of December but cold air outbreaks occurring from the first week of December to the first week of February caused higher than normal ice cover on Lake Huron throughout that period. Ice in Saginaw Bay became consolidated in the second week of January, about two weeks early. Ice in the North Channel consolidated in the third week of January; which was one week early.

The ice coverage on Lake Huron remained consistently above normal from early December to the first week of February.

A brief period of milder, stormy weather in the second week of February reduced the ice cover to below normal values but temperatures soon returned to near normal and ice cover on Lake Huron was near normal in the third week of February.

Stormy weather reduced the ice coverage to below normal over Lake Huron around mid-March and also moved the pack ice from eastern Georgian Bay to western Georgian Bay, where it remained until Georgian Bay cleared of ice. This meant lighter ice conditions in eastern Georgian Bay and heavier conditions in western Georgian Bay from mid-March until ice melt; this is the opposite of the normal pattern, with heavier ice conditions in the eastern portion of the bay. A cold snap in the last week of March brought ice coverage on the lake back to above normal values for that time of the year, but the seasonal ice coverage peak was passed and milder spring temperatures were bringing the decline of overall ice coverage over Lake Huron.

Break-up in Saginaw Bay occurred in the last week of March, which was about two weeks later than normal. St. Mary's river break-up started in early April at a near normal pace. Break-up of the North Channel fast ice and break-up of the consolidated ice in eastern Georgian Bay started in the second week of April, also at a near normal pace. Clearing of the ice in Saginaw Bay and along the south shore of Lake Huron occurred in the second week of April, a week late. Clearing of the ice east of the Straits of Mackinac also happened in the second week of April, at a normal pace. Clearing of the ice in St. Mary's river, in the North Channel and in eastern Georgian Bay occurred at the end of April and that was also near normal.

Lake Erie

Temperatures over Lake Erie were near normal in the first half of November and above normal in the second half of the month. Cold air spread over Lake Erie in early December; the month of December turned out to be abnormally cold. Ice started forming in Sandusky Bay, in Long Point Bay and along the eastern shore of Lake St. Clair in the second week of December; that was one to two weeks early. In the third week of December Lake St. Clair became ice covered. Also at that time, the Western Basin also became ice covered and ice extended eastward from the Western Basin to almost 82W. Narrow bands of ice started forming along the south shore of the lake and along the north shore west of Long Point. Also in the third week of December, ice in Sandusky Bay became consolidated and fast ice started forming in Long Point Bay, both events about three weeks earlier than normal. Ice developing along the south and north shores and spreading east of the Western Basin this early in the

season is quite unusual and is seen in 15 percent or less of the years since 1972.

Milder temperatures were reported for a brief period in late December and early January; the ice coverage on Lake Erie in early January returned to near normal; it had been above normal during the second half of December. Cold temperatures prevailed over Lake Erie from early January to mid-February. During that time, ice coverage on Lake Erie was above normal.

Most of Lake St. Clair became consolidated early in the second week of January; this was unusual. Usually, fast ice appears about two weeks later and often ice on the lake does not consolidate completely.

Most of Lake Erie, except for an open water area around Long Point, became ice covered in the third week of January. The lake became completely ice covered at the end of January. Ice in the approaches to Buffalo consolidated at around that time. The Western Basin also became consolidated for a brief period at the end of January. That it would consolidate completely is an unusual event. The extent of the fast ice near Buffalo was surprisingly large. Fast ice extent near Buffalo became closer to normal less than a week later.

Milder temperatures and stormy weather occurred around mid-February. Winds pushed the ice off the western end of Lake Erie and reduced the ice coverage to near normal values.

On the whole temperatures from the last week of February to mid-March were slightly below normal and ice coverage over Lake Erie remained above normal. However spring was approaching and temperatures were on the rise; ice extent on Lake Erie was decreasing with each passing storm. Wide leads opened along the shores of Lake Erie at the end of the first week of March and fast ice in Lake St. Clair started breaking up. Break-up in Sandusky Bay also happened at that time, a few days earlier than normal.

Temperatures rose to above normal right after mid-March. A cold snap hit Lake Erie in the last week of the month. By the end of the third week of March the Western Basin was almost clear of ice and the western third of Lake Erie was open water. Break-up started near Buffalo at that time. Clearing of the ice on Lake Erie and break-up of the ice near Buffalo were occurring a few days to a week later than normal. Fast ice had broken up completely in Lake St. Clair but a lot of ice was still present. The Western Basin finally cleared in the last week of the month.

April temperatures were above normal. Lake St. Clair cleared in late March- early April, one to two weeks later than normal. Ice near Buffalo melted in the last week of April, about two weeks later than normal.

Lake Ontario

Normal temperatures prevailed over Lake Ontario in the first half of November. The second half of the month was above normal. Temperatures turned colder in December and some new lake ice started forming in the Bay of Quinte and in the Seaway near Kingston in the first week of the month. This was about two weeks early. Ice in the Bay of Quinte consolidated in the third week of December, about a week early.

Above normal temperatures were reported at the end of December and in the first week of January. Still, new lake ice was present briefly along the south-western shore of the lake, a rare occurrence.

Temperatures fell to below normal in the second week of January and ice started developing rapidly in the Seaway east of Kingston. Very cold temperatures were recorded just after mid-month and ice in the western portion of the Seaway consolidated, about a week faster than normal. At that time, new and thin lake ice was observed from near Trenton to the eastern shores of Lake Ontario, and all along the southern shore. Cold temperatures prevailed over Lake Ontario until the end of January and ice coverage on the lake remained well above normal until then.

Temperatures were generally near normal after that, before turning decidedly warmer in the second week of March; from then on the ice cover on Lake Ontario was below normal. Break-up of the ice on the western portion of the Seaway and in Bay of Quinte occurred in the third week of March, about a week earlier than normal. Clearing of the ice in the north-eastern portion of Lake Ontario, in the western portion of the Seaway and in Bay of Quinte occurred in the first week of April. This was near normal for the Seaway and a few days earlier than normal for the Bay of Quinte and the shallow bays of north-eastern Lake Ontario.

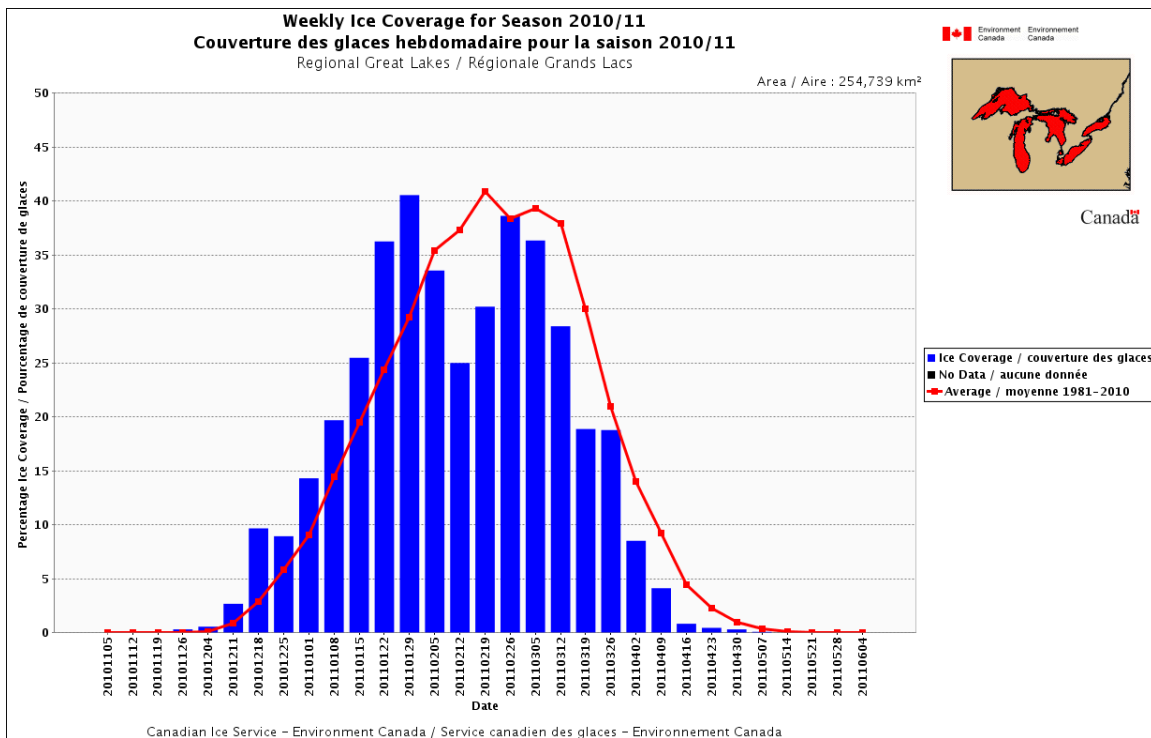


Figure 1: Weekly ice coverage – all lakes

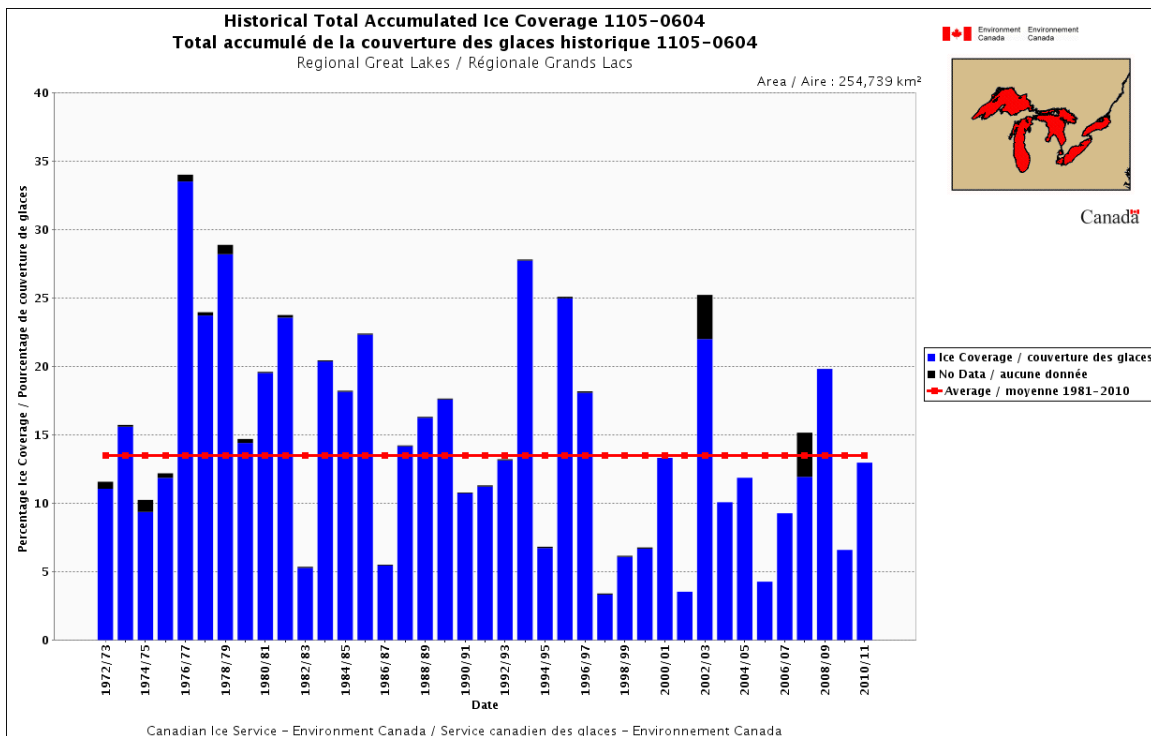


Figure 2: Total accumulated ice coverage (TAC) - all lakes

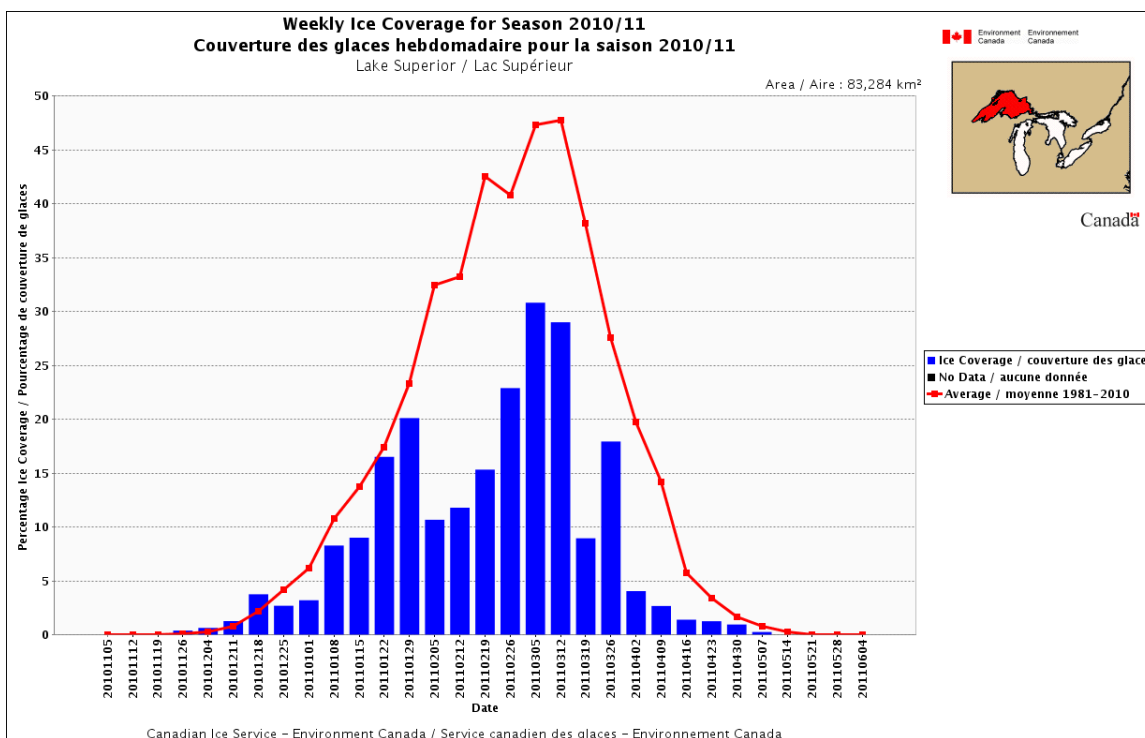


Figure 3: Weekly ice coverage - Lake Superior

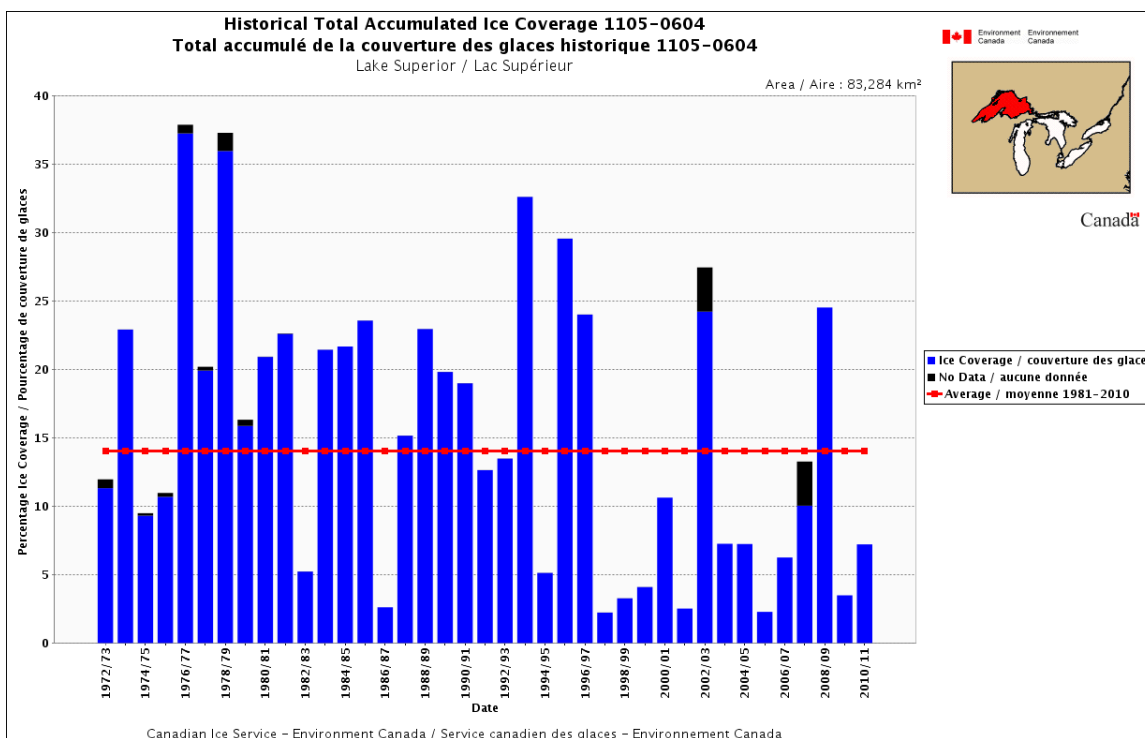


Figure 4: Total accumulated ice coverage (TAC) - Lake Superior

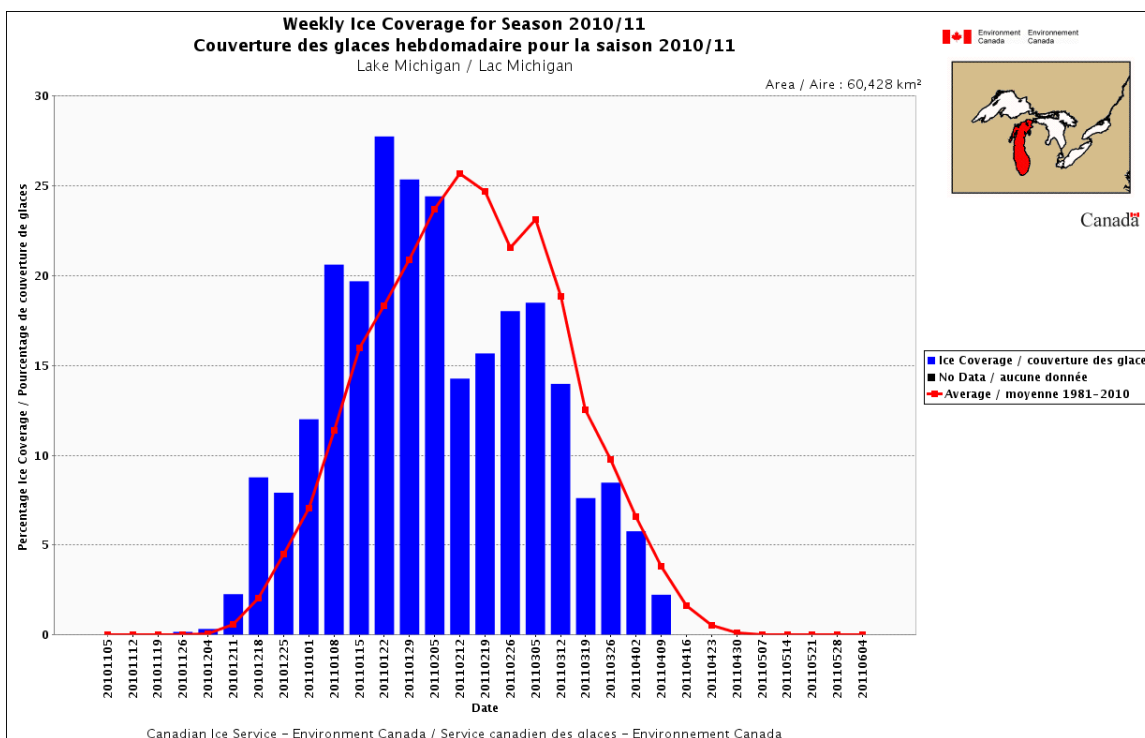


Figure 5: Weekly ice coverage - Lake Michigan

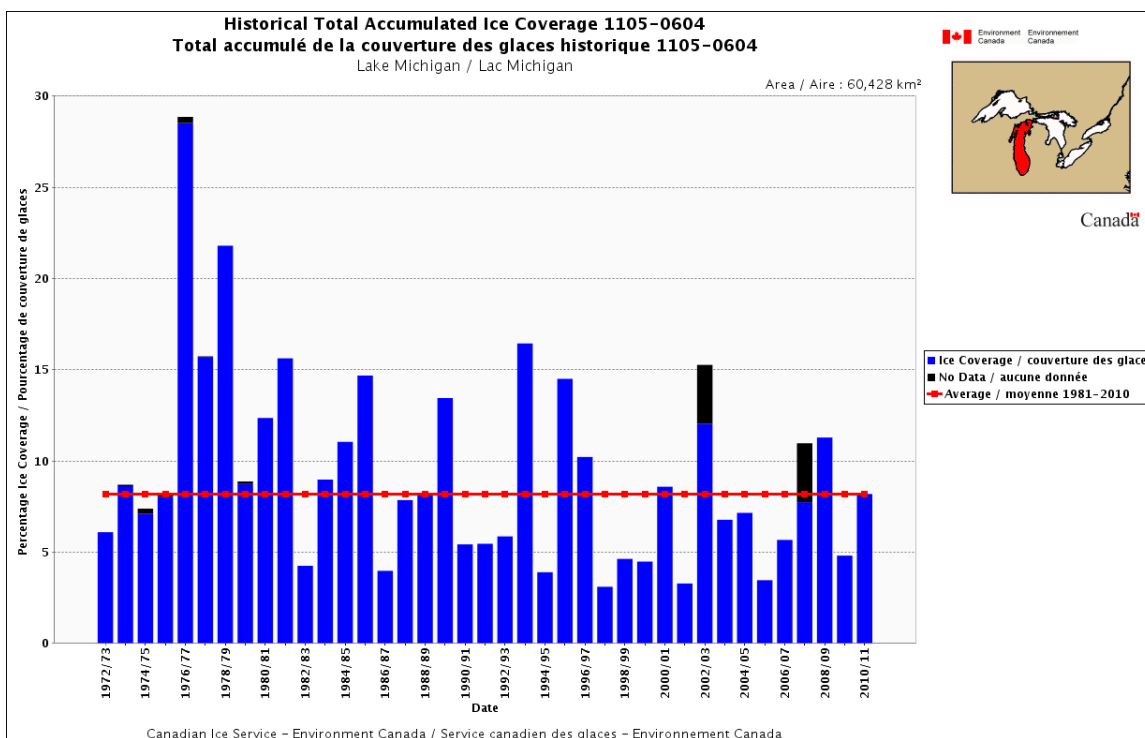


Figure 6: Total accumulated ice coverage (TAC) - Lake Michigan

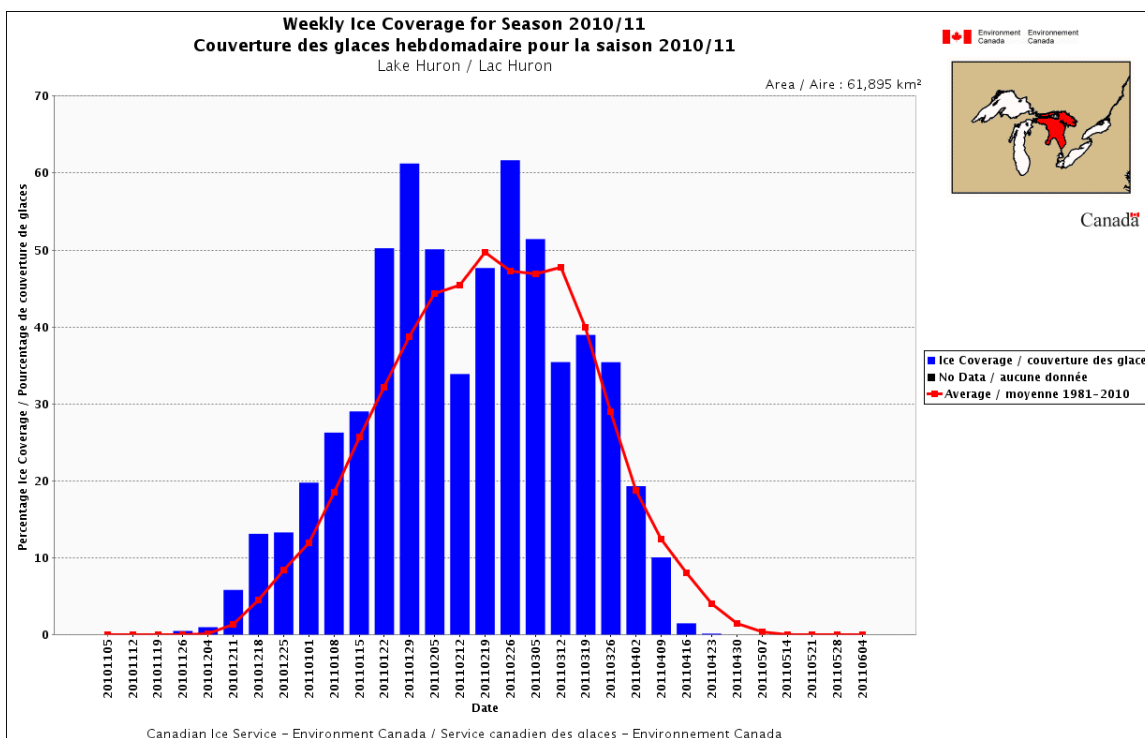


Figure 7: Weekly ice coverage - Lake Huron

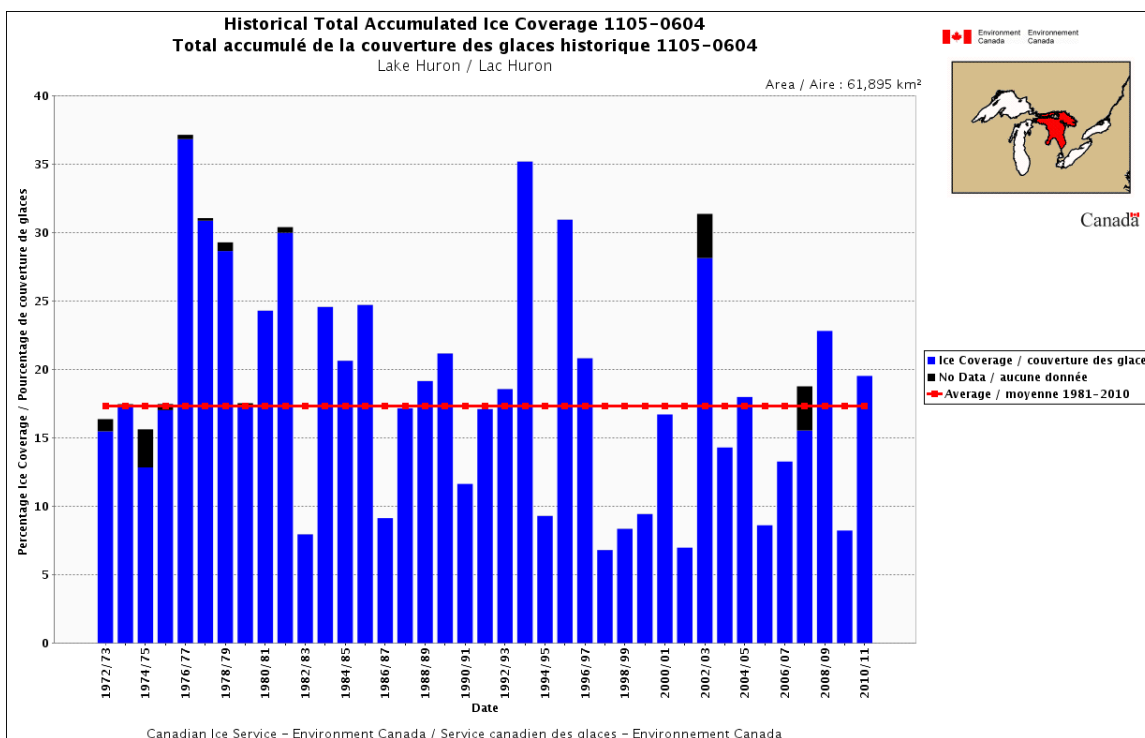


Figure 8: Total accumulated ice coverage (TAC) - Lake Huron

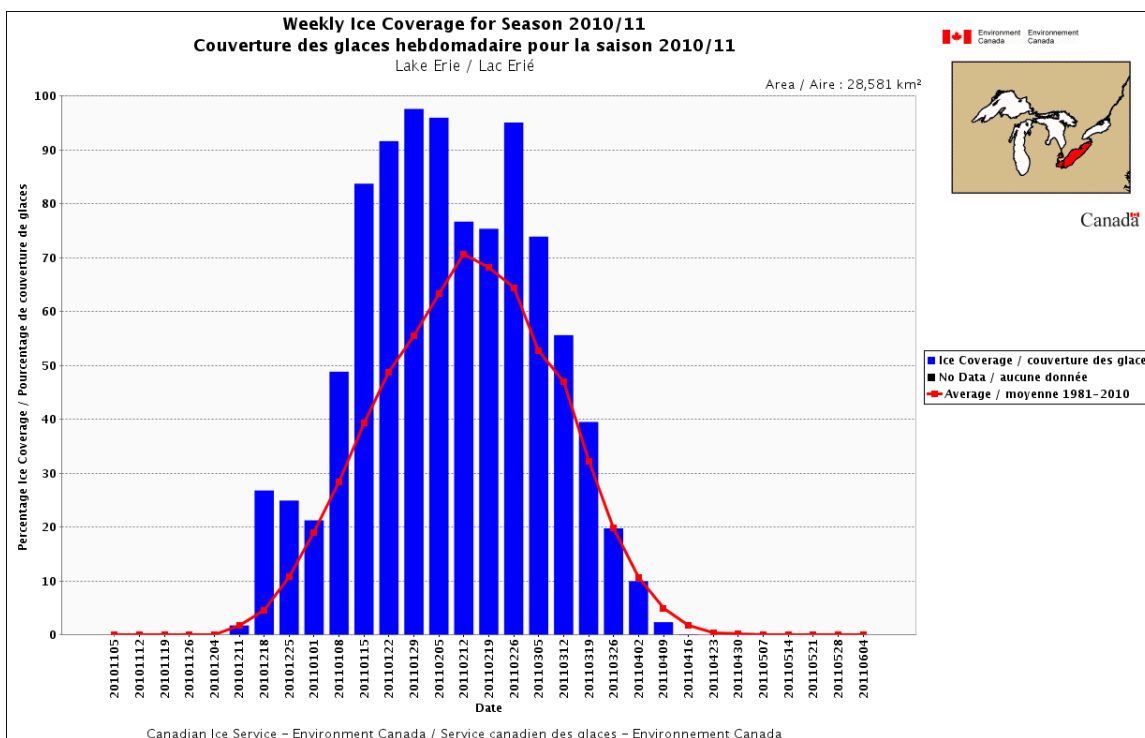


Figure 9: Weekly ice coverage - Lake Erie

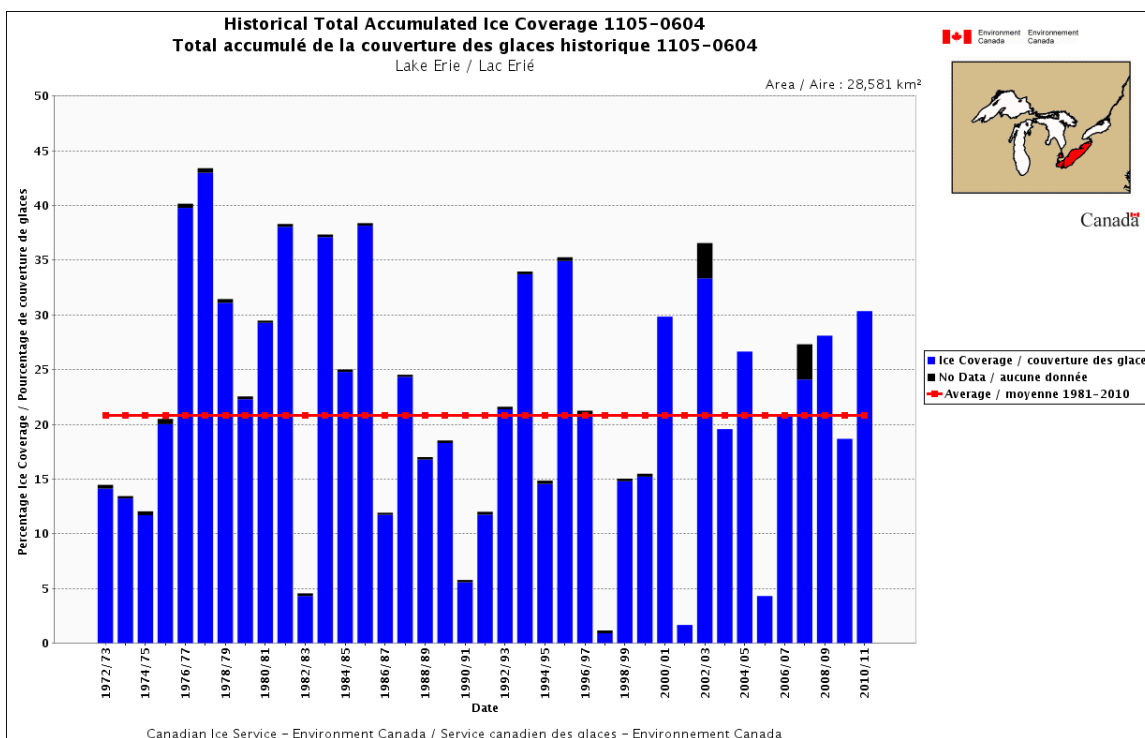


Figure 10: Total accumulated ice coverage (TAC) - Lake Erie

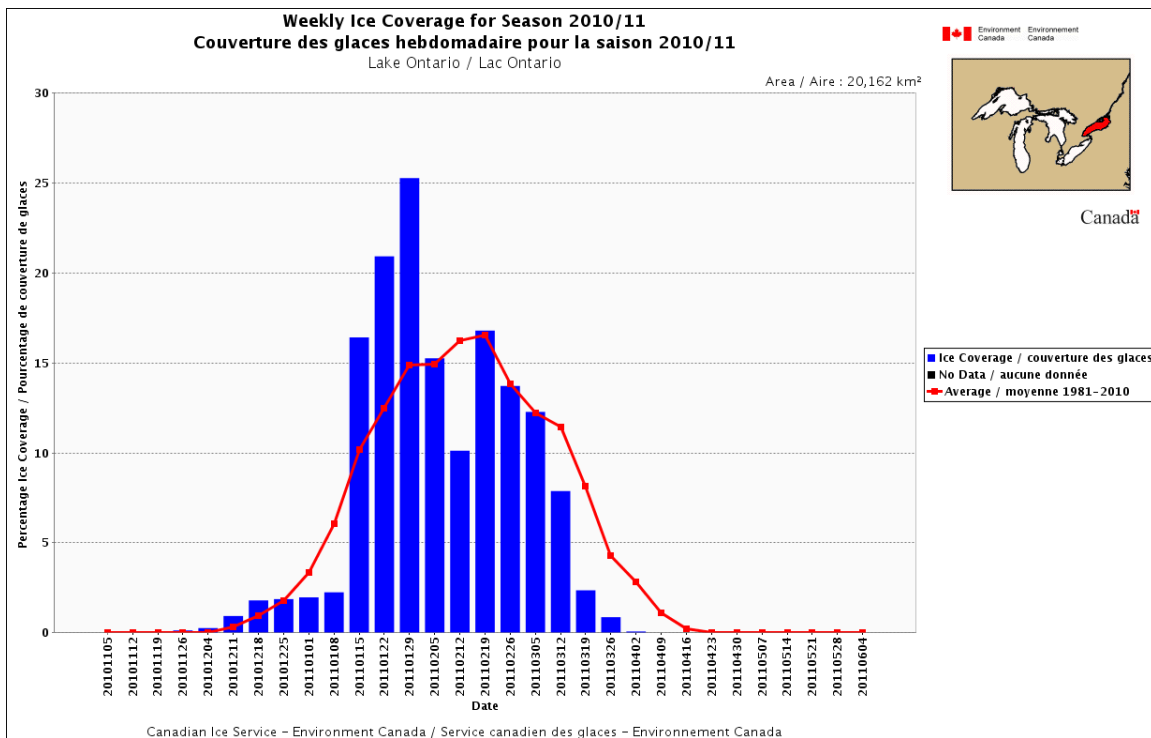


Figure 11: Weekly ice coverage - Lake Ontario

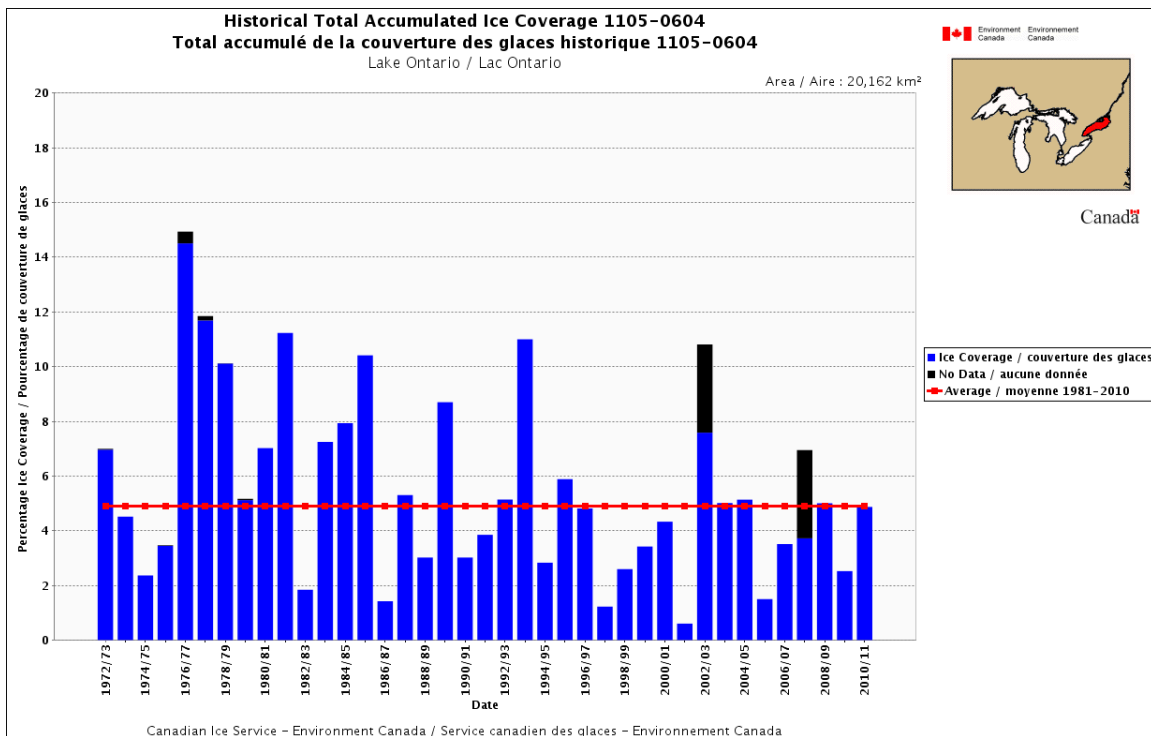


Figure 12: Total accumulated ice coverage (TAC) - Lake Ontario

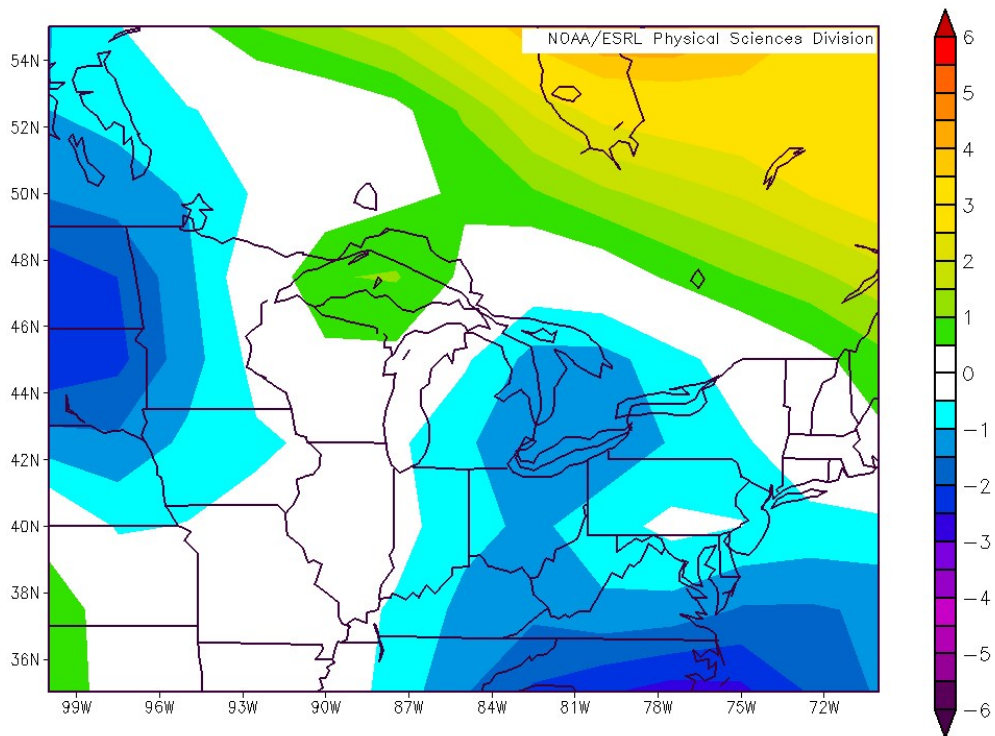


Figure 13: temperature anomaly – December 2010 to March 2011

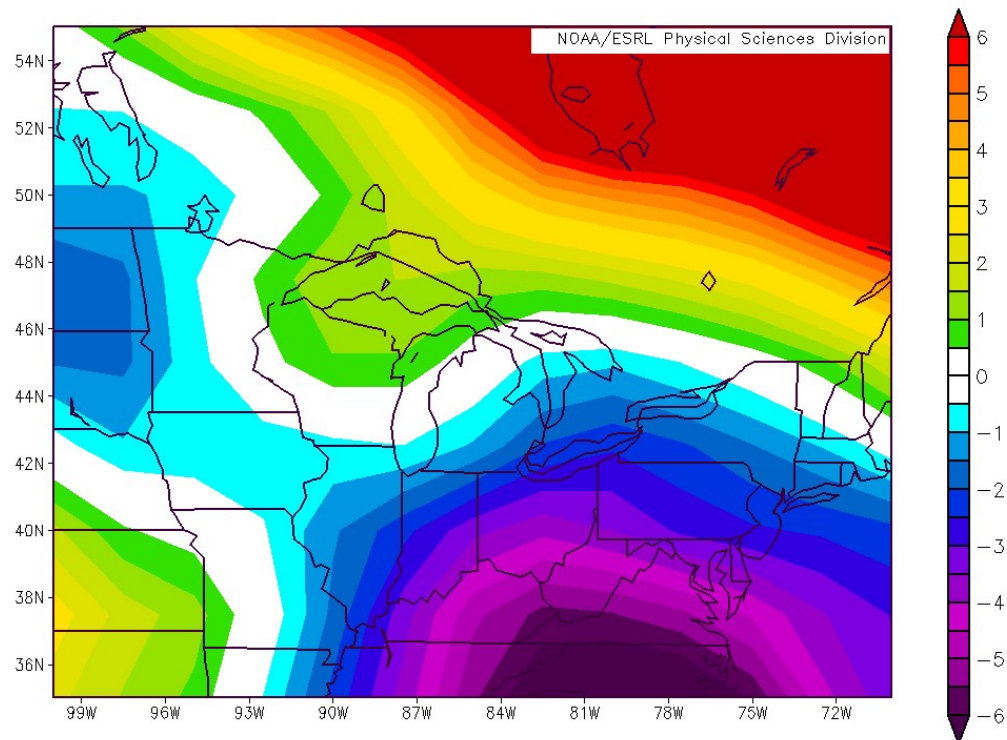


Figure 14: temperature anomaly – December 2010

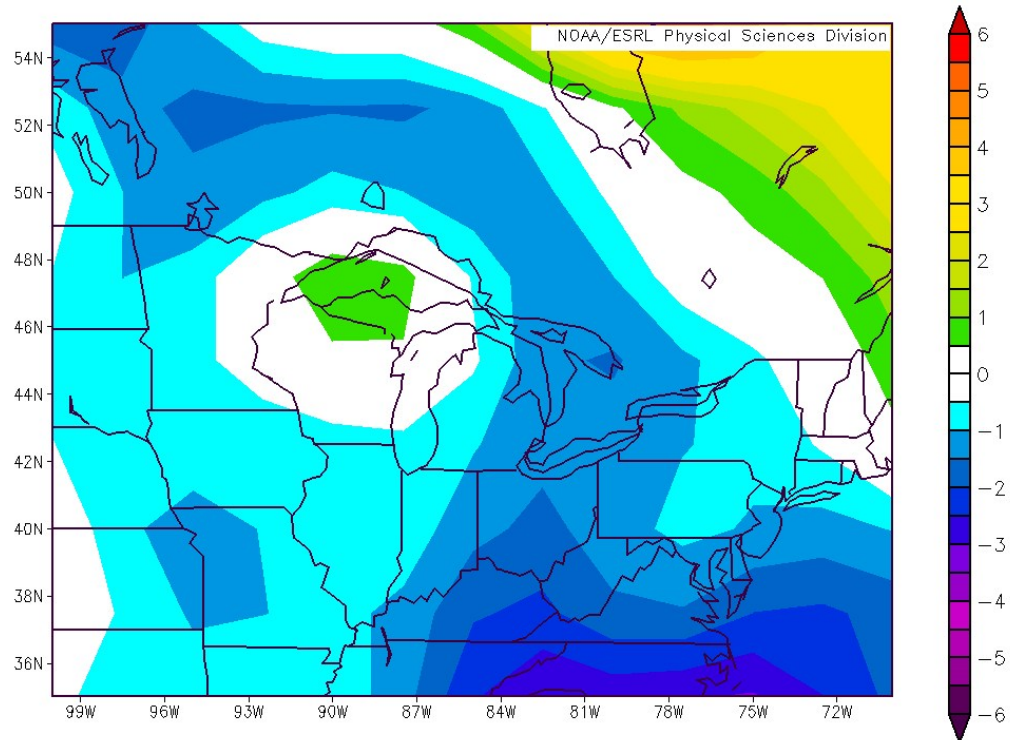


Figure 15: temperature anomaly - January 2011

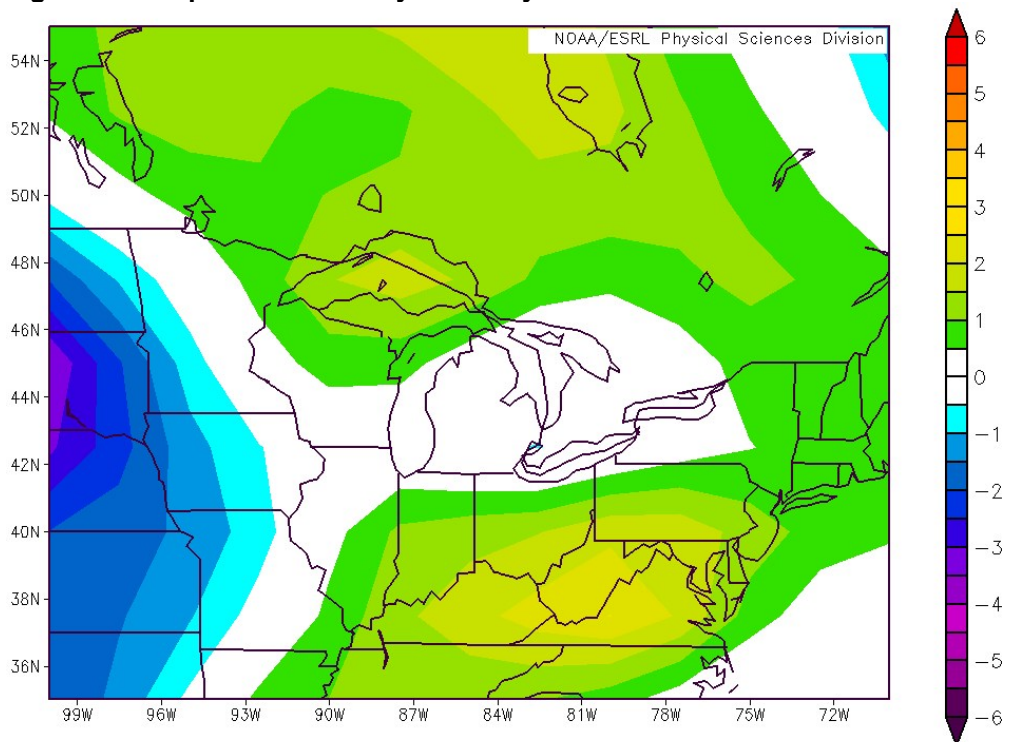


Figure 16: temperature anomaly - February 2011

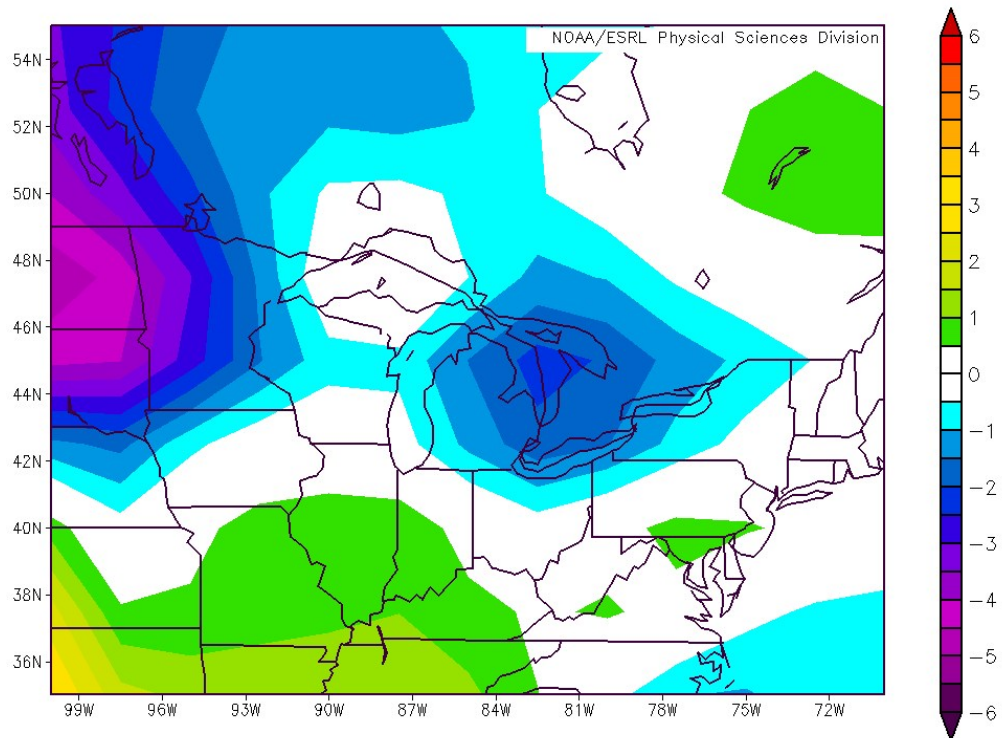


Figure 17: temperature anomaly - March 2011