The Front

NOAA's National Weather Service — February 2017

Aviation Weather News You Can Use

By Mike Graf, Meteorologist, NWS Aviation and Space Weather Services Branch

New TAF Board Offers Quick Visual Airport Status

In November 2016, the NWS Aviation Weather Center's (AWC) Impacts Terminal Aerodrome Forecast (TAF) Board or (ITB) transitioned from experimental to operational status. For those who don't like to interpret a TAF, the ITB offers a visual time-series display highlighting significant forecasted weather in the U.S. National Airspace System (NAS).

The TAF Board enables the aviation community to quickly ascertain specific impacts at key U.S. airports. The impacts catalog is a database designed to reflect weather conditions that could impair arrivals or departures and result in airport closures based on criteria specific to each airport. Each box in the hourly forecasts from the TAF is color coded to reflect the level of impact:

- White: No impact
- Yellow: Slight impact
- Orange: Moderate impact
- Red: High impact

Check out the examples and a general overview to get the most from this product or go to the main site to give it a try.

New TAF and METAR Groups

On December 8, 2016, the Federal Aviation Administration (FAA) began distributing five new groups of TAFs and METARs to meet a new international requirement. All U.S. METARs used by international carriers now must contain the remarks section of the METAR. Before this change, the METAR with remark is not sent out internationally. The change was made as a result of a National Transportation Safety Board recommendation to more closely align with the international standard set forth by the International Civil Aviation Organization (ICAO). The new collectives can be found under the following WMO IDs and are available for international distribution.

- SAUS21 KWBC SPUS21 KWBC FTUS21 KWBC
- SAUS22 KWBC SPUS22 KWBC FTUS22 KWBC
- SAUS23 KWBC SPUS23 KWBC FTUS23 KWBC
- SAUS24 KWBC SPUS24 KWBC FTUS24 KWBC
- SAUS25 KWBC SPUS25 KWBC FTUS25 KWBC

Inside

When's the Next *Front?*

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The Front

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Mission Statement

To enhance aviation safety by increasing the pilot's knowledge of weather systems and processes and National Weather Service products and services.

This change will be transparent to WAFC Internet File Service (WIFS) users, although users of WIFS will no longer be able to retrieve METAR without remarks effective January 30, 2017.

Five New U.S. TAFs Added in 2016

The FAA added the following five TAFs in 2016:

- Santa Monica, CA: KSMO
- San Bernardino, CA: KSBD
- Camarillo, CA: KCMA
- Driggs-Reed Memorial, ID: KDIJ
- Ennis-Big Sky, MT: KEKS

Online Pilot Report Form Now Operational

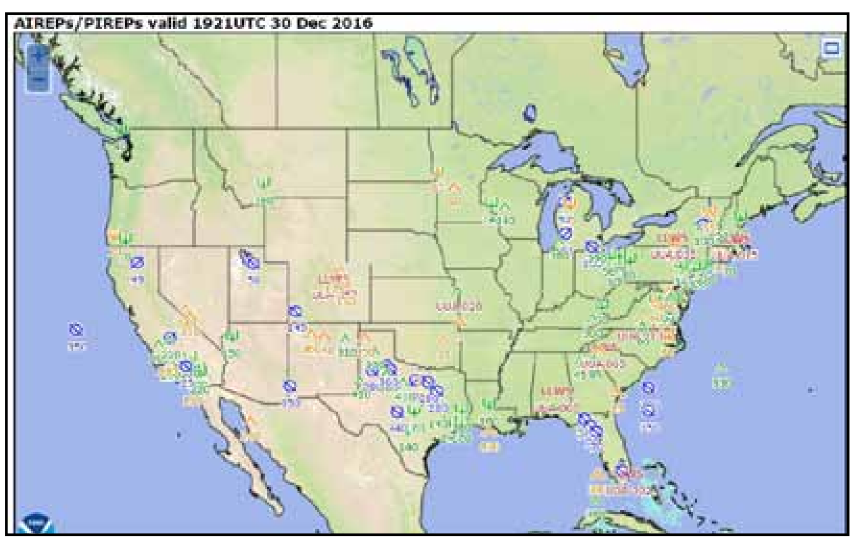
As of last September 2016, the Online Pilot Report (PIREP) Submission Form issued by the NWS Aviation Weather Center (AWC) changed from experimental to operational status. Pilots, operators and dispatchers can now submit PIREPs electronically, making these reports available sooner for flight plan preparation, situational awareness and operational decision making. In addition, PIREPs are integrated into the NWS forecast production process to help improve the accuracy of the forecasts such as AIRMET and SIGMET.

You must register to use the new online PIREP submission form. Anyone who meets one of the criteria below, can get an account:

- Pilot's license
- Email address with .gov or .mil
- Group ID number for airlines

You can obtain your pilot license information from the FAA public registry.

To start the registration process, go to the AWC PIREP Online Submission Form. PIREPs submitted via the website will be automatically formatted, distributed and displayed graphically at http://www.AviationWeather.gov**.** See example below.



PIREPs that have been formatted and posted online.

Impacts of the Great Lakes on Aviation Weather

By [Rick Mamrosh](), Meteorologist, NWS Green Bay, WI

The Great Lakes have a huge impact on flying weather in the United States. What's nice about the bigger and somewhat predictable local effects is how easily you can see them occurring with satellite and other observational tools. As we go through this discussion, think about how these examples may exemplify what happens in your own flight experiences. Knowing the mechanics behind the reasons it may be IFR or VFR around bodies of water will provide you another tool for your weather toolkit, always a good thing.

So why do the Great Lakes have a considerable impact on aviation weather? The Great Lakes serve as a giant "heat sink" or "heat source" depending on the season. The Great Lakes can also provide moisture for the formation of clouds and precipitation. The reduced friction of the water surface can produce acceleration of the wind field and locally strong winds. The terrain around the lakes can cause convergence and divergence and hinder or assist in cloud and precipitation formation. Lakes Michigan and Ontario are deep and far enough south that they seldom freeze over. Lake Erie usually freezes over (**Figure 1**). With few exceptions, a frozen lake has much less influence on the weather.

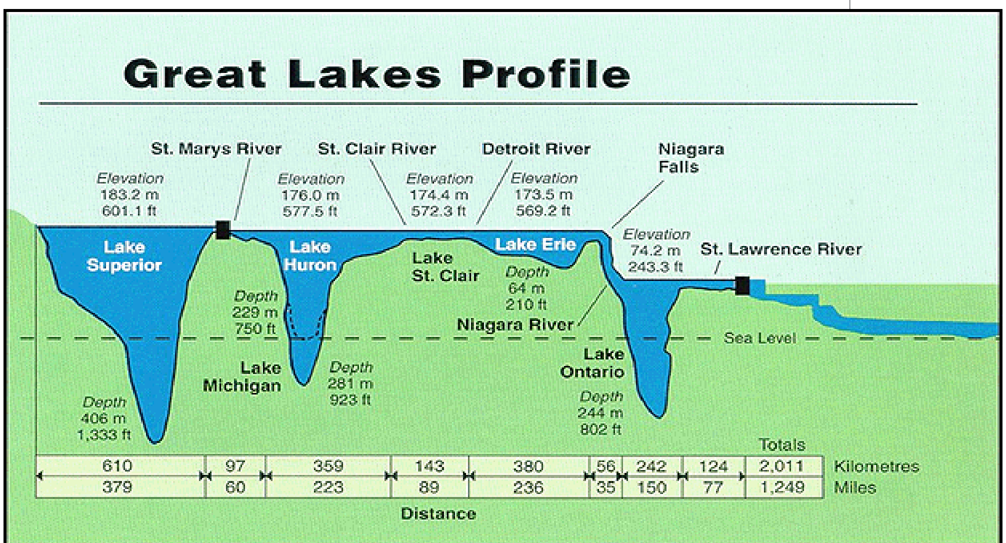


Figure 1: Freezing on the Great Lakes

Figure 2: *Typical ice cover in mid-winter. Lake Erie is frozen, but there is little ice on Michigan and Ontario.*

Figure 3: *Greater than average ice depicted during the winter of 2008-2009.*

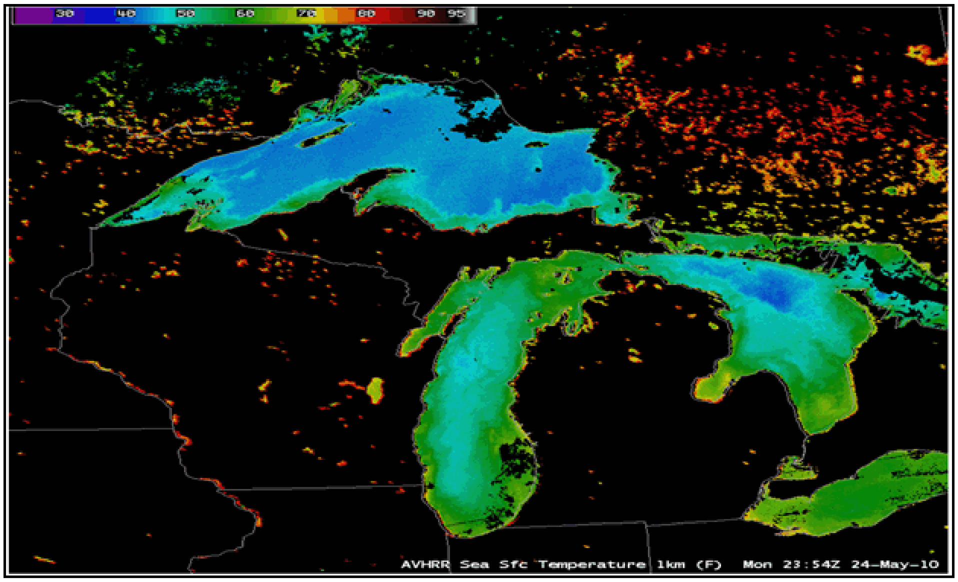


Figure 4. *Water temperature varies greatly from Great Lake to Great Lake and even within the same lake. In this figure, it varies from 42 to 65 degrees.*

Lake temperature affects the following:

- Lake-Effect snow and rain
- Production of low clouds and fog
- Acceleration or deceleration of wind
- Stabilizing effects

Lake Effect Snow and Rain

Lake-effect precipitation forms when cold air moves over warmer lake waters. As the warm lake water heats the bottom layer of air, moisture evaporates from the lake into the air. Since warm air is lighter and less dense than cold air, it rises and begins to cool and condense to form clouds and often precipitation.

Figure 5 makes lake effect weather look simpler than it is. Significant lake effect snow or rain is highly dependent on the temperature differential between the lake and air aloft—the greater the difference, the greater instability. Also wind direction and resultant fetch across the lake are key factors. For example the longer the cold air is over the warm lake, the greater the moisture increase in the original air mass as it crosses the lake.

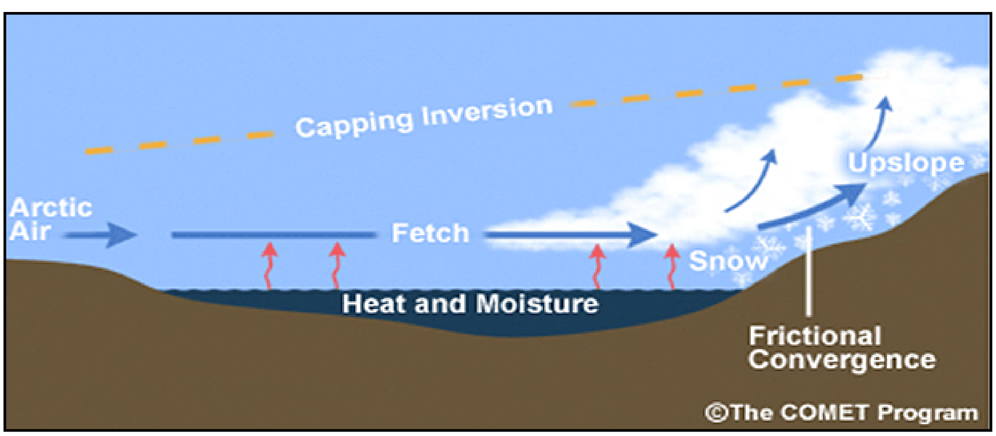


Figure 5: Quick look at lake effect weather

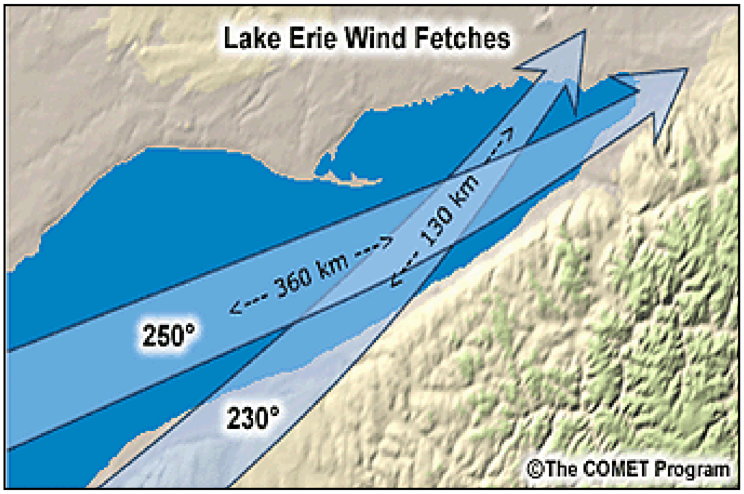


Figure 6: *Lake Erie wind fetches*

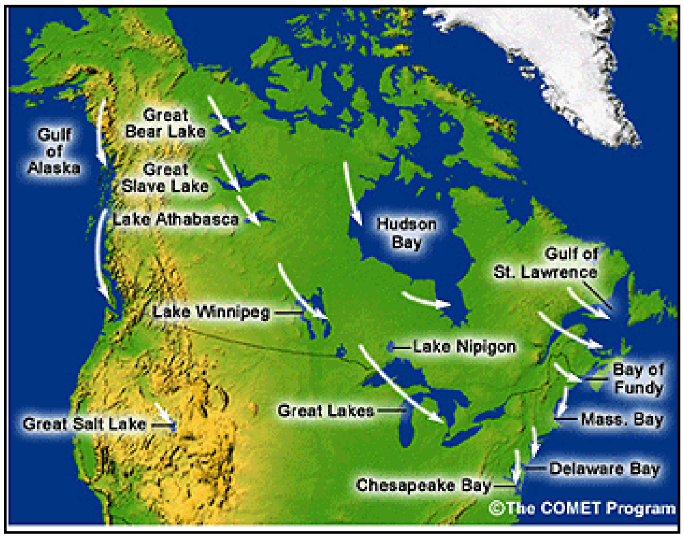


Figure 7: *Places where lake or ocean effect snow and rain occur*

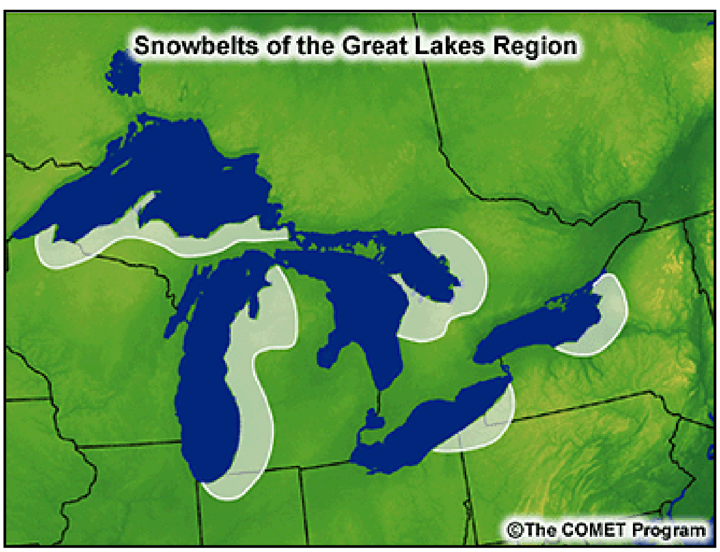


Figure 8: *Typical snow belt regions of the Great Lakes. Lake effect snow occurs downwind of the lakes, which means that the snow usually occurs southeast of the lakes, assuming a cold northwest wind.* ***It can happen with any wind direction.***

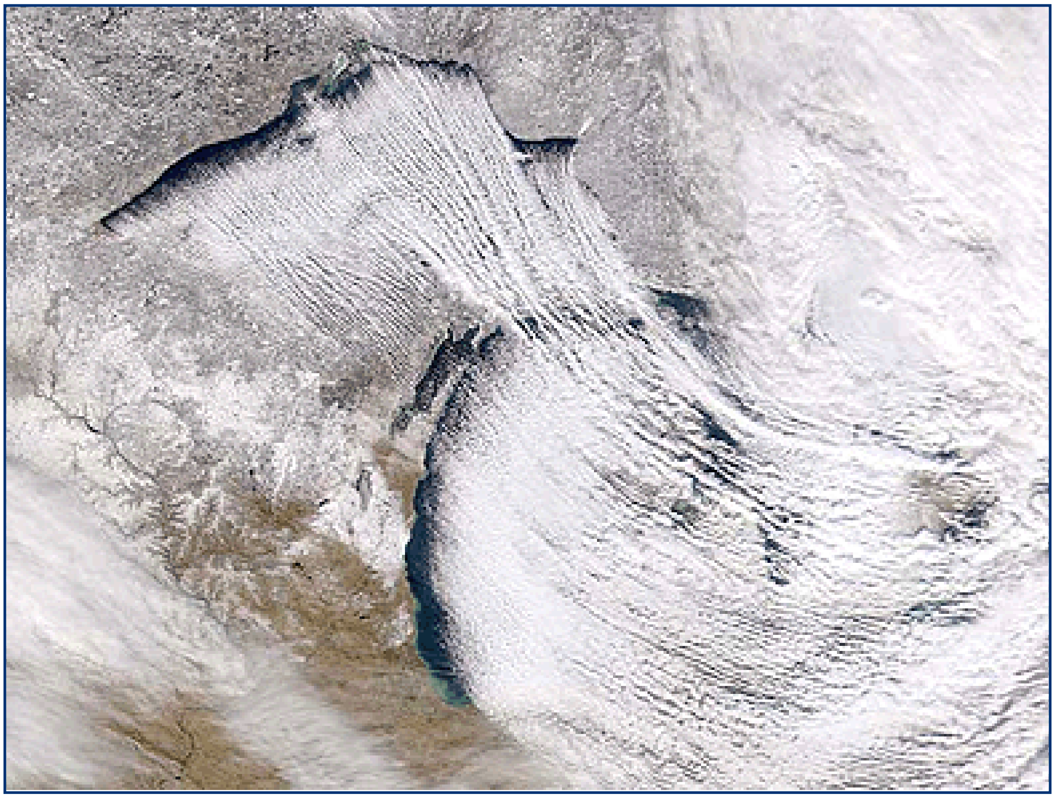


Figure 9: *Northwest winds producing multiple bands of lake effect in Michigan and Wisconsin*

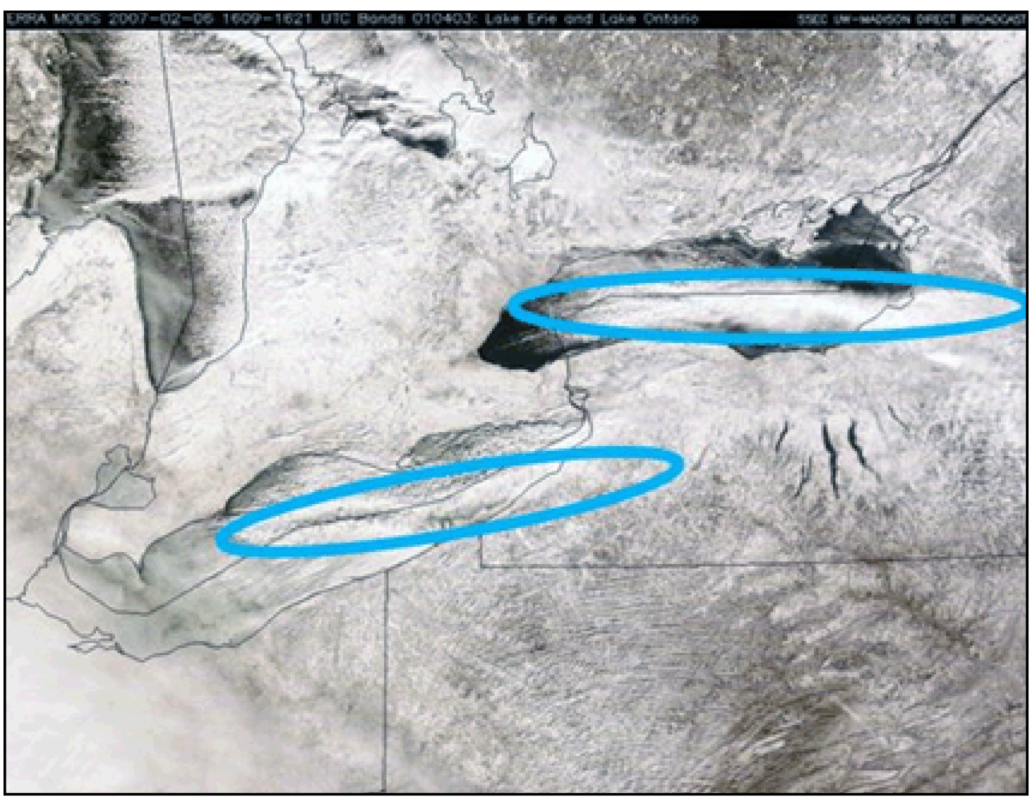


Figure 10: *West winds producing intense single band of lake effect snow over Upstate New York*

Lake Effect Snow—Satellite View

Figure 11 shows two, intense (2"-4" per hour) single lake-effect snow bands over the eastern portions of Lakes Erie and Ontario. Unless your origin or destination is Buffalo or Oswego, NY, the bands probably would have little impact on flight to surrounding areas, such as Albany, Toronto or even Syracuse; in other words, a big impact for relatively small areas.

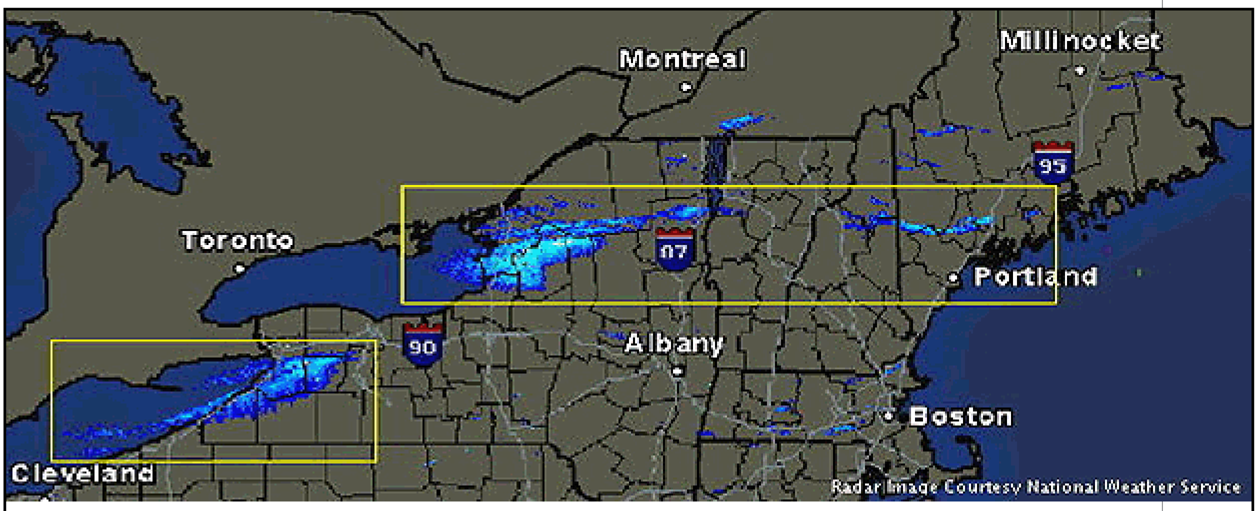


Figure 11: *Two, intense (2"-4" per hour) single lake-effect snow bands*

Figure 12 shows multiple bands of lake effect snow downwind of all the Great Lakes. Places like Rochester, NY; Cleveland, OH; Erie, PA; South Bend, IN; and Traverse City and Marquette, MI, will have conditions varying from flurries to moderate snow for hours to days. This situation creates a moderate impact over a large area.

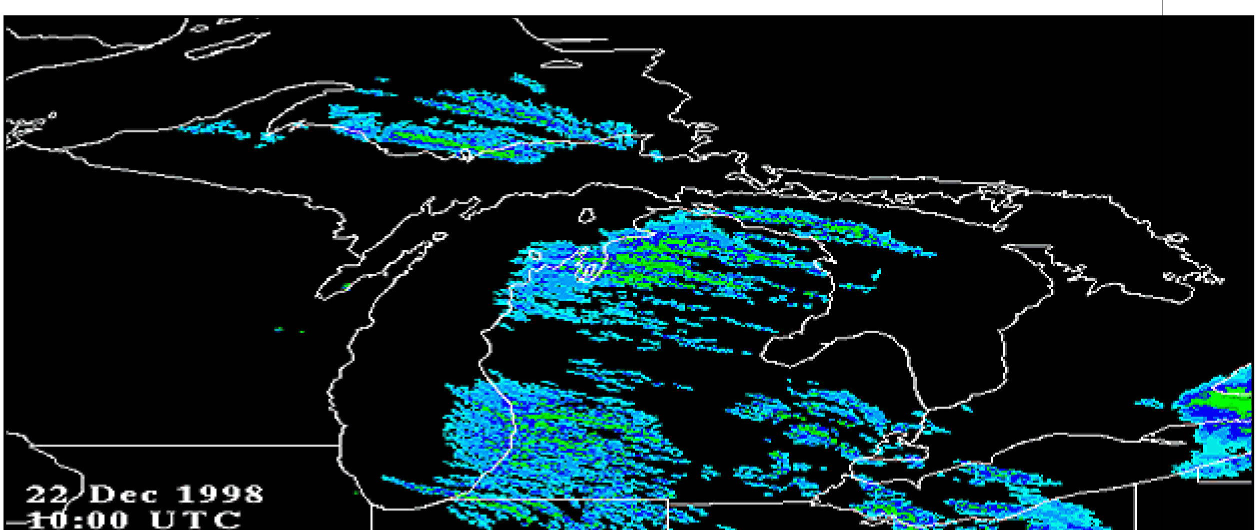


Figure 12: *Multiple bands of lake effect snow*

Figure 13 shows multiple bands of lake-effect snow over western Lower Michigan. You could expect anything from snow flurries to moderate snow in these bands.

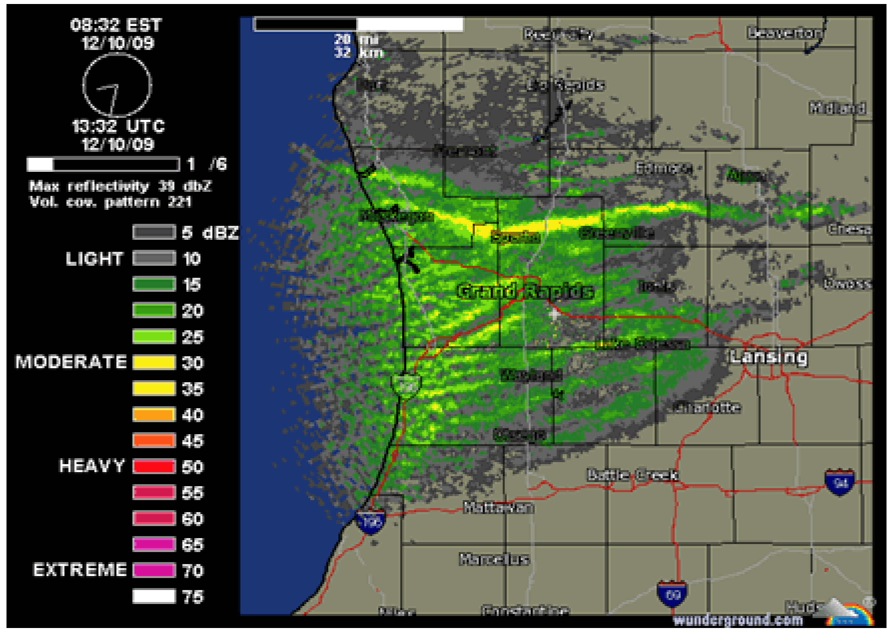


Figure 13: *Multiple bands of lake-effect snow*

Figure 14 shows single band of lake-effect snow in Upstate New York. Moderate to heavy snow is likely in this snow band.

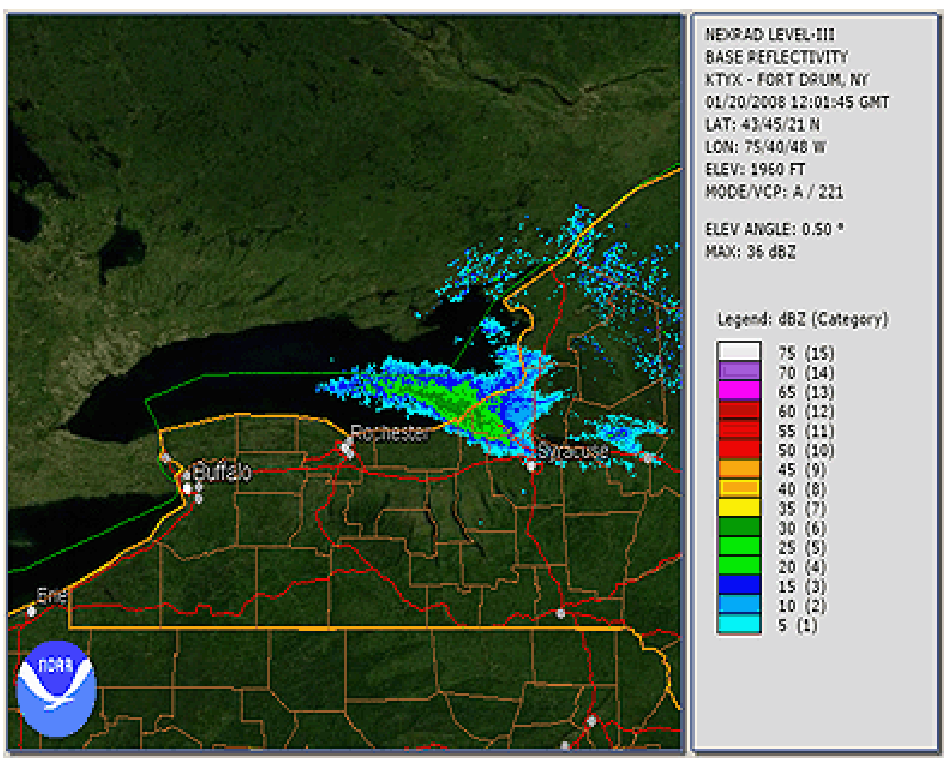


Figure 14: *Single band of lake-effect snow in Upstate New York.*

Intense, single bands of precipitation potentially are the most hazardous because they usually produce near zero visibility. Very low ceilings in the center of the band often have strong surface winds (20 to 40 knots) converging into the band from either side, which can produce significant turbulence in and just above the cloud tops. These bands often last for many hours or days, so you may need to fly over the top, FL160 or more.

Multiple bands have less intense snow but still pose hazards because they may produce visibilities down to ½ mile or less, often accompanied by gusty surface winds of 15 to 25 knots. Higher gusts persisting for many hours to several days may cover large areas, making circumnavigation difficult. Tops usually range from 4000 to 8000 ft AGL, so they can sometimes be flown over even by light aircraft.

Low Clouds/Fog

The Great Lakes Region experiences considerable low clouds and fog, especially in the winter months. Some fog is produced by the lakes and some due to other factors. The region has many river valleys and flat plains that can produce local ground fog on clear nights with light winds. Warm air flowing over the cool lakes can sometimes result in low clouds and fog

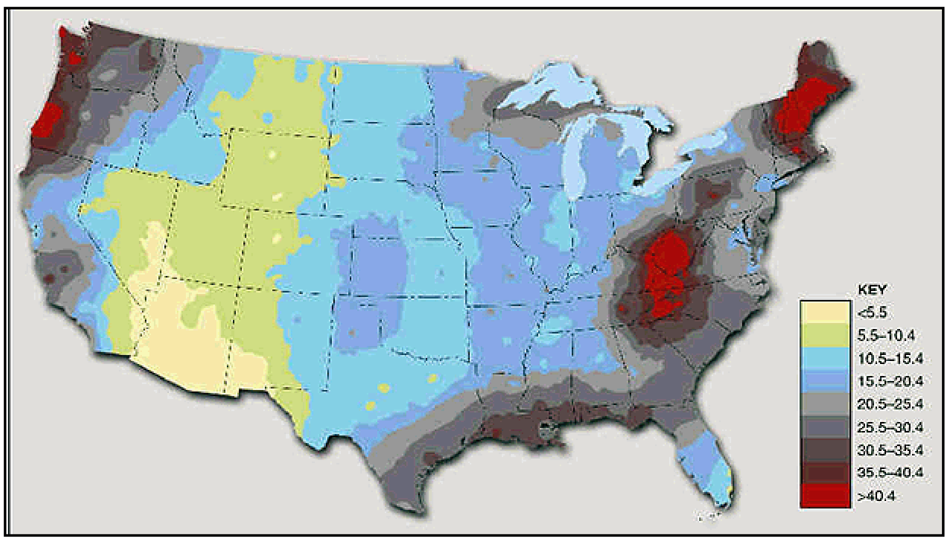


Figure 15: *Number of days with dense fog: visibility less than ¼ mile*

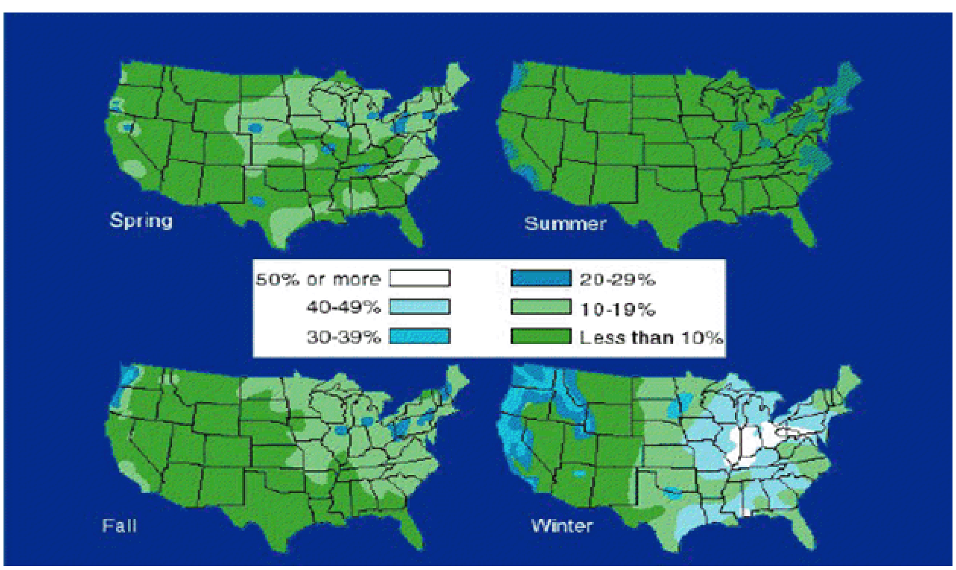


Figure 16: *Probability of Instrument Meteorological Conditions*

covering larger areas in late winter and spring. Warm, moist air flowing north from the Gulf of Mexico can produce extensive areas of low clouds, drizzle and fog when flowing across cold or snow covered ground.

Local Ground Fog—River Valleys

Ground fog often forms in river valleys on clear, calm nights when cool air sinks into the valleys. This sinking air causes condensation and results in low stratus clouds or fog. River valley fog usually dissipates shortly after sunrise, unless there are considerable clouds above the fog layer. Fog in deep river valleys can last most of the day. Area forecasts issued by the AWC may mention river valley fog but will not have specific information. Terminal Forecasts from NWS local forecast office, if available, will have more specifics.

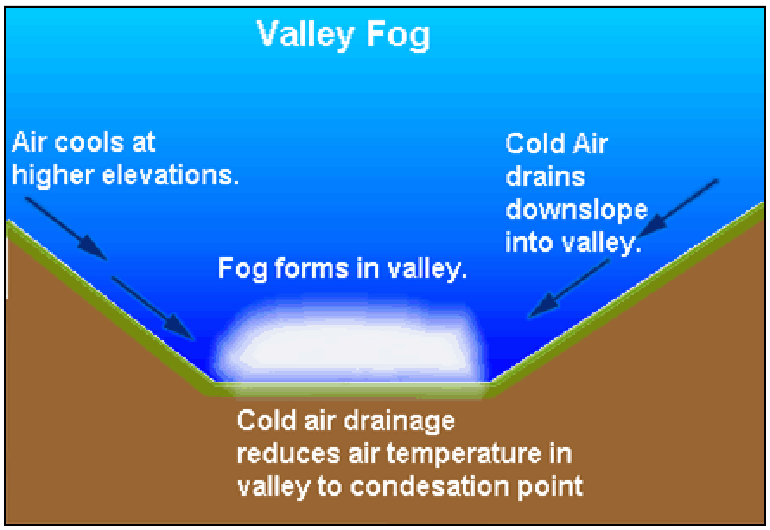


Figure 17: *Simple explanation of valley fog*

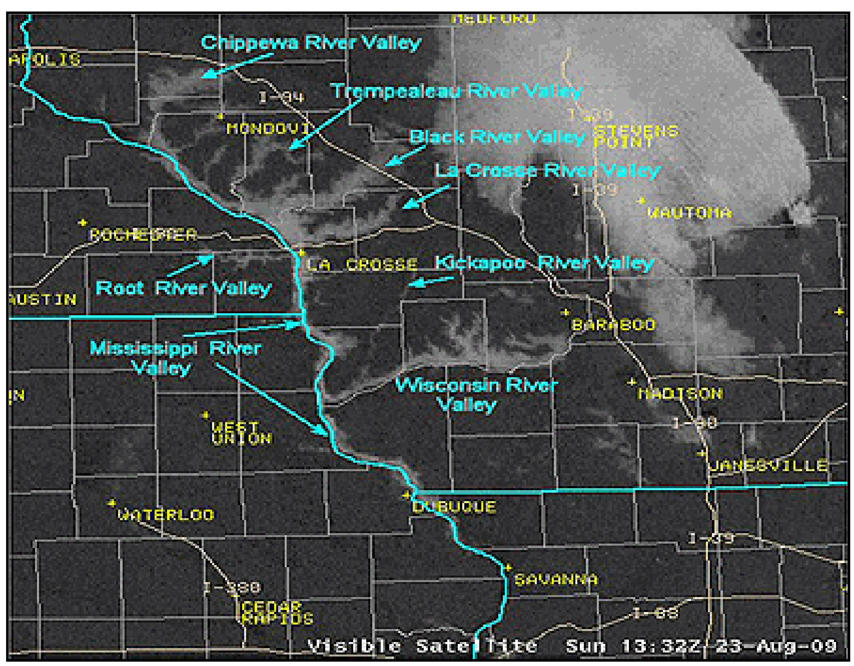


Figure 18: *Visible satellite image showing Valley Fog*

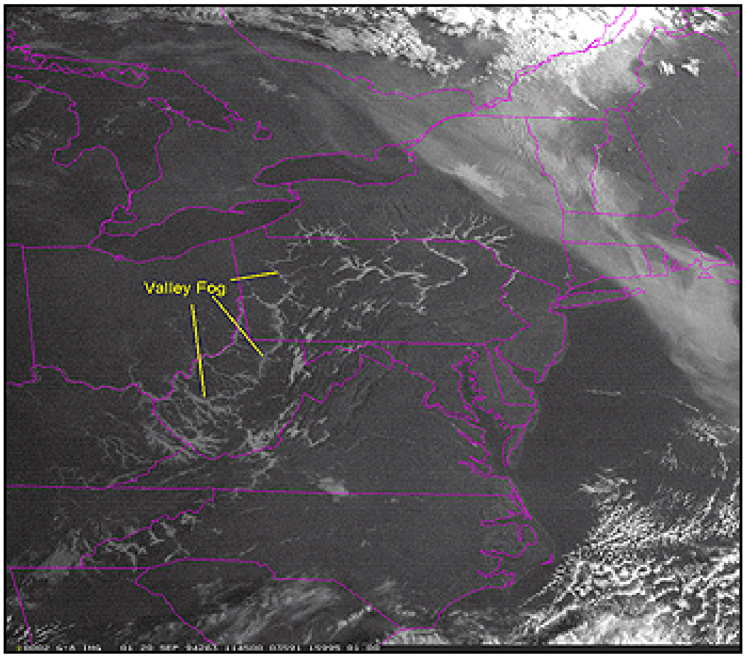


Figure 19: *Fog such as this can produce ceilings and visibilities below the airport published minimum in the valleys, but this type of fog is typically short lived.*

Advection Fog—Warm Air Over Cool Lakes

Advection fog is the result of condensation caused by the movement of warm, moist air over a colder surface, in this case the cold waters of the Great Lakes. The fog could stay over the lake or drift inland depending on wind direction.

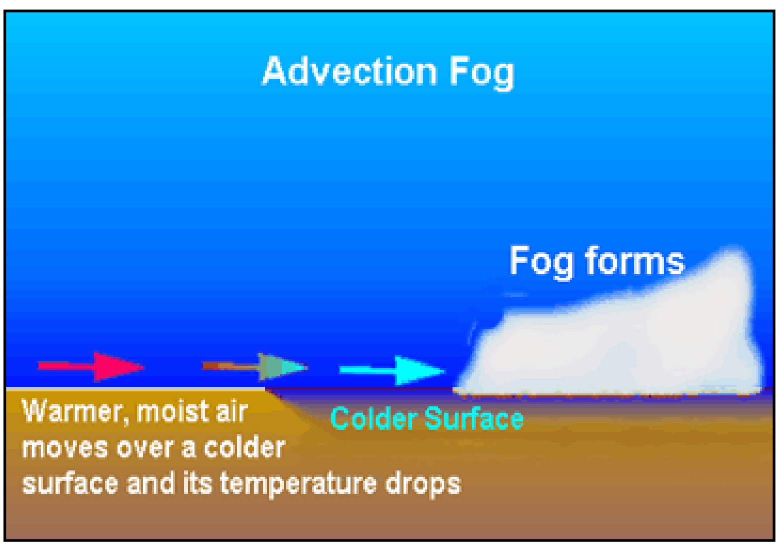


Figure 20: *Simple explanation of advection fog*

While NWS can usually forecast that fog will occur, it is difficult for meteorologists to accurately time the formation and dissipation of this fog. This fog will often extend inland during the nighttime hours, but recede back towards the water during the day due to mixing during the daytime.

This fog is usually shallow—typically anywhere from a few hundred to a thousand feet deep. If you encounter such fog, climb!

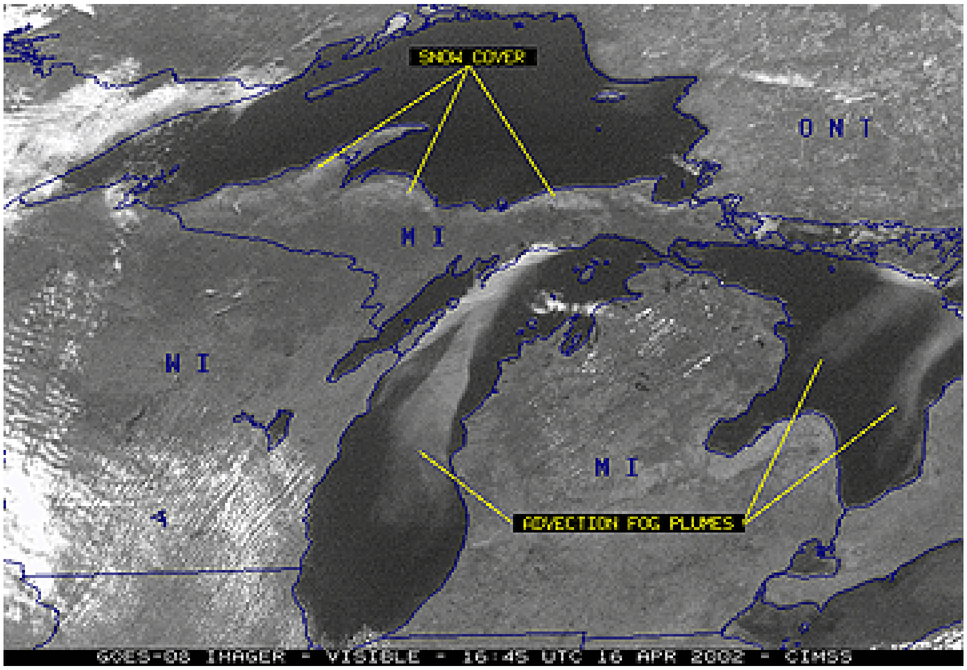


Figure 21: *Satellite picture showing advection fog over lakes*

Figure 22 shows radar picking up the stratus and fog, the byproduct of warm, moist air flowing across the cold waters of Lake Michigan. Notice the surface air dewpoints in the 50s and 60s with water temperatures in the upper 30s. Dewpoints on a typical surface plot like the one in this figure are in the lower left. Temperatures are in the upper left, sea level pressure is upper right and the wind direction is from the west generally in this example. Also notice how all the fog, plotted as horizontal dashes between the temperature and dewpoint are downwind of the lake. Hence the term advection.

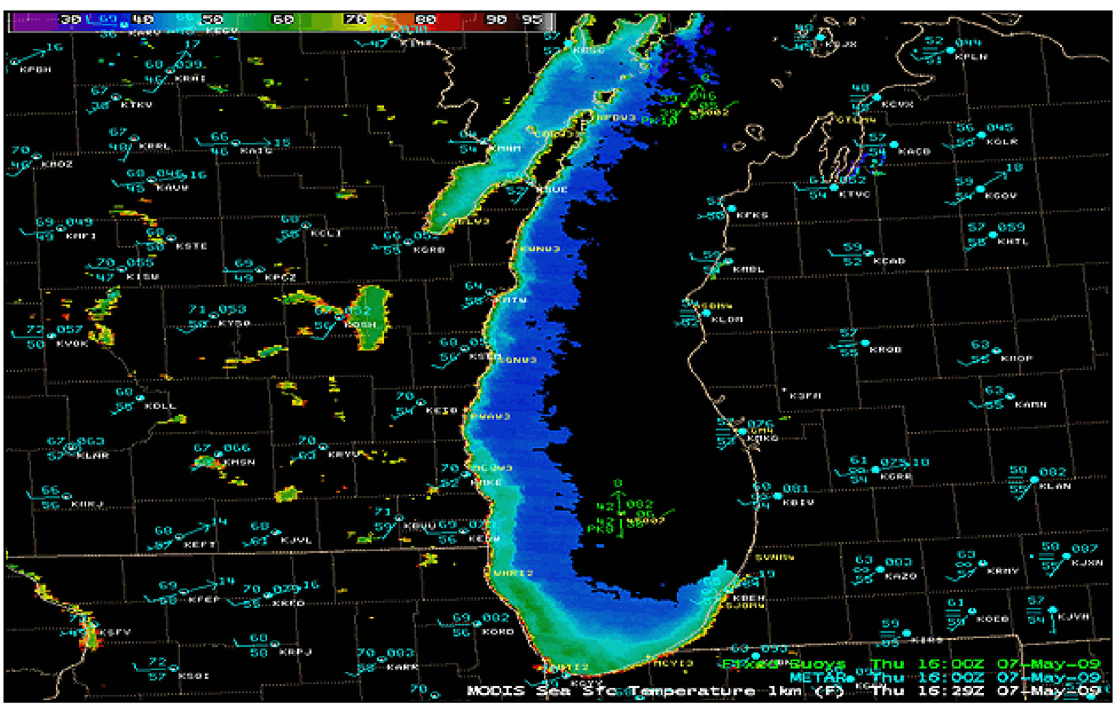


Figure 22: *Radar showing advection fog*

Advection Fog—Warm Air Over Snow Cover

This type of advection fog is the result of condensation caused by the movement of warm, moist air over snow covered ground. This advection fog can occur locally or cover large areas and last as long as several days. This fog can reduce ceilings and visibilities to near zero. **Figures 23-24** show advection fog over snow covered ground.

Figure 23: *Fog forming over snow covered fields*

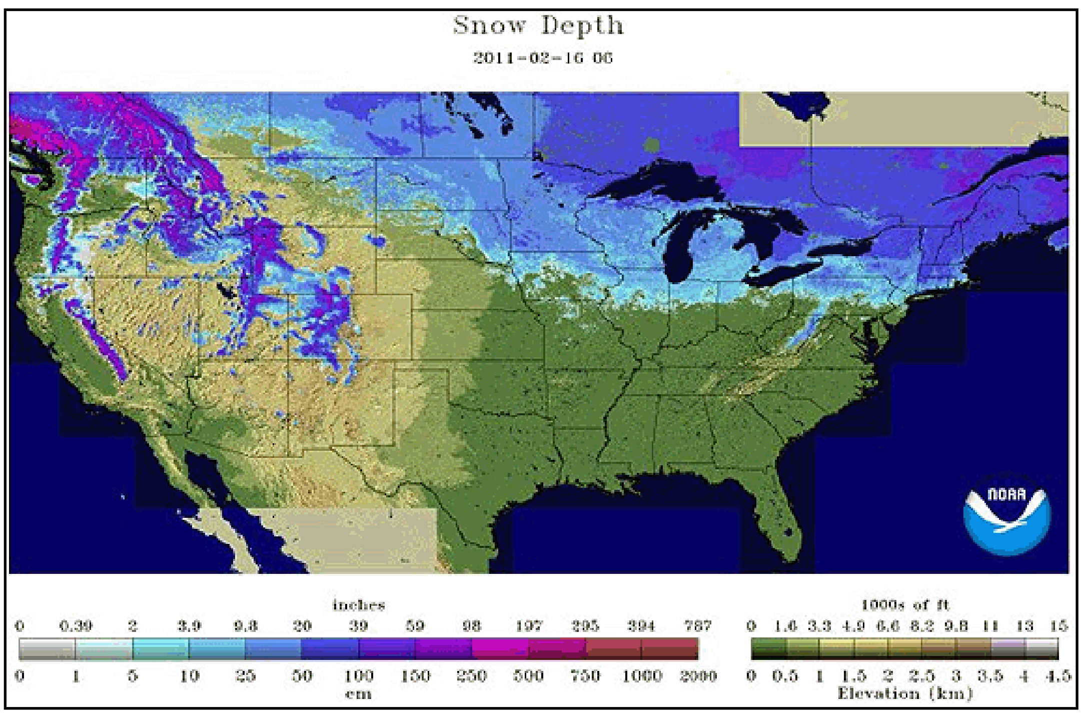


Figure 24: *Fog example for a large area: Snow (medium blue) covered the ground over all of the Great Lakes region on February 16, 2011.*

The surface map that evening showed southerly flow across the region that would bring much warmer and relatively moist air into the area. Warm air with dewpoints in the 30s, 40s and 50s going over the snow cover would force the surface temperature down closer to the dewpoint, which can produce fog and stratus.

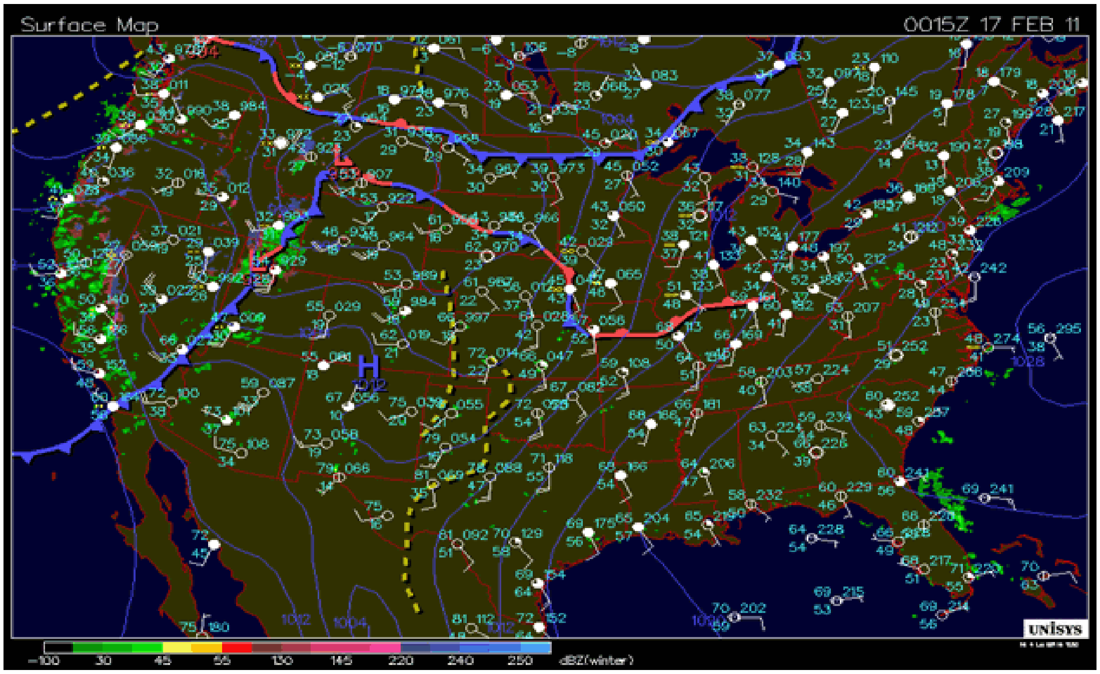


Figure 25: Surface weather map

Below is an excerpt from a forecast discussion from the NWS Green Bay, WI:

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE GREEN BAY WI
152 PM CST WED FEB 16 2011

.SHORT TERM... MAIN FCST CONCERN TO BE EXTENT OF DENSE FOG
TNGT THRU AT LEAST THU MORNING AS WARM/MOIST AIR CONTS
TO OVERSPREAD THE RGN.

.AVIATION...VFR CONDITIONS TO LINGER INTO THE EARLY
EVENING HRS...HOWEVER EXPECT VSBYS TO STEADILY LWR
DURING THE LATE EVENING AND EVENTUALLY BECOME LIFR
AROUND MIDNGT AS DENSE FOG DEVELOPS OVR A LARGE
PART OF WI. DENSE FOG WL PERSIST THRU AT LEAST THU
MORNING BEFORE SOME MIXING ALLOWS VSBYS TO CLIMB
TOWARD MVFR CONDITIONS LTR IN THE AFTERNOON.
KGRB 161724Z 1618/1718 21007KT 5SM HZ BKN200
FM170200 16005KT 4SM BR SCT005 OVC040

TEMPO 1703/1707 1SM -RA BR OVC005
FM170700 15006KT 1SM BR OVC004
TEMPO 1707/1711 1/4SM -DZ FG VV001
FM171100 17007KT 1/2SM -DZ FG OVC001
FM171600 19010KT 1SM BR OVC005

This TAF says the visibility will lower to 1 mile at times between 03z and 07z and the ceiling to occasionally lower to 500 feet. By 11z, the visibility is forecast to be a half mile with a ceiling of 100 feet. This level is below the airport minimum.

What actually happened:

METAR KGRB 170053Z 15004KT 4SM BR CLR 02/00
METAR KGRB 170253Z 19008KT 2SM BR BKN003 BKN007 02/02
METAR KGRB 170553Z AUTO 00000KT 1/2SM FG OVC003 02/02
METAR KGRB 170753Z AUTO 13004KT 1 1/4SM -RA BR BKN004 02/02
METAR KGRB 170953Z AUTO 16006KT 1 1/4SM BR OVC007 03/03
METAR KGRB 171253Z 19010KT 1 1/4SM BR OVC002 06/05
METAR KGRB 171353Z 19007KT 1/4SM FG OVC002 06/06
METAR KGRB 171653Z 17005KT 1/8SM FG VV001 05/05
METAR KGRB 171953Z 18009KT 1/4SM FG OVC001 06/06
METAR KGRB 172053Z AUTO 19009KT 1SM BR OVC006 06/06

The lower ceilings and visibilities did arrive around 03z as was forecast the day before, but the ceilings and visibilities did not rise at 16z as forecasted.

While NWS is very good at forecasting the occurrence of these low clouds and fog, it if often difficult for us to forecast the timing and duration. The ceilings and visibilities will sometimes briefly improve when winds increase or a rain shower occurs. This type of fog will often accompany a mid-winter thaw, or in the early spring when there is still snow on the ground and warm air from the Gulf of Mexico begins to move northward.

Effects of Wind in the Great Lakes

The Great Lakes can cause acceleration or deceleration of wind over and near the lakes. This is caused by temperature differential, frictional effects or both.

Frictional Effects

Everything else being equal, winds will be stronger over water surfaces due to reduced friction. This effect decreases with height and is insignificant after a few hundred feet, so it is usually of little consequence except for shoreline airports.

Temperature Differential

Unstable winds, air colder than water, over and near the lakes will be stronger than those inland. This effect occurs from the water to thousands of feet. Stable wind, air warmer than water, will be weaker over the water than inland, but the effect will lessen with height and usually disappear after several hundreds of feet.

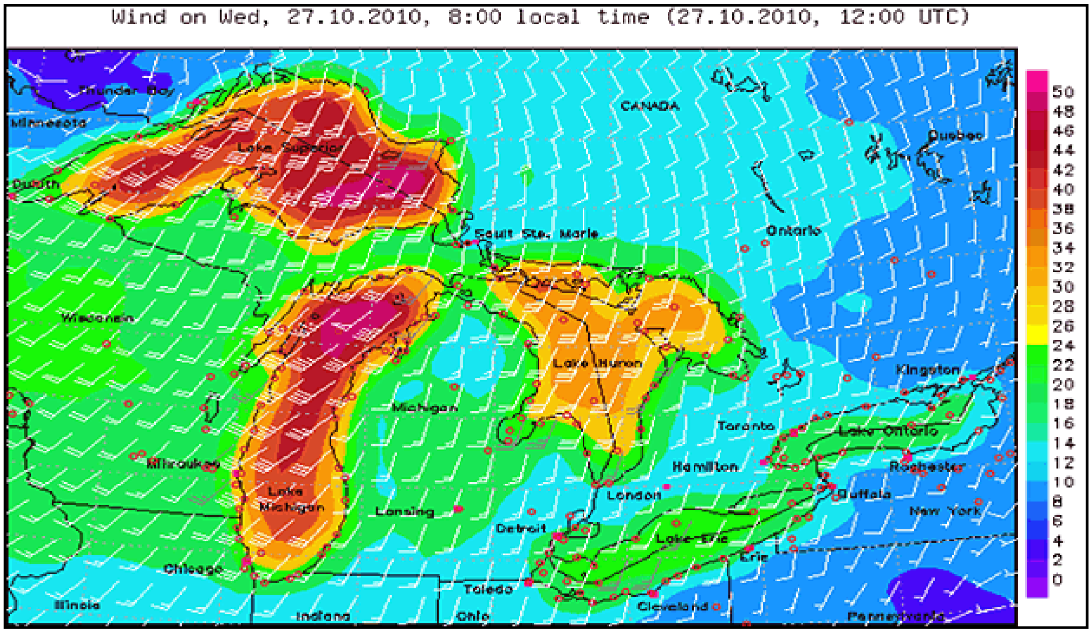


Figure 25: *Example of how reduced friction over the lakes and an unstable atmosphere can combine to produce much stronger winds over the Great Lakes.*

During the spring and summer when the lakes are cooler than the air, low level winds over and near the lakes are usually lighter than well inland. In the fall and winter, when the lakes are warmer than the air, low level winds over and near the lakes are usually stronger than well inland. The effects of the lakes on the wind are usually most significant in the fall and winter.

Great Lakes Stabilizing Effects on the Weather

So far we have only seen how the Great Lakes can produce low clouds, fog and lake-effect snow. But the lakes also can produce good flying weather, at least over limited areas.

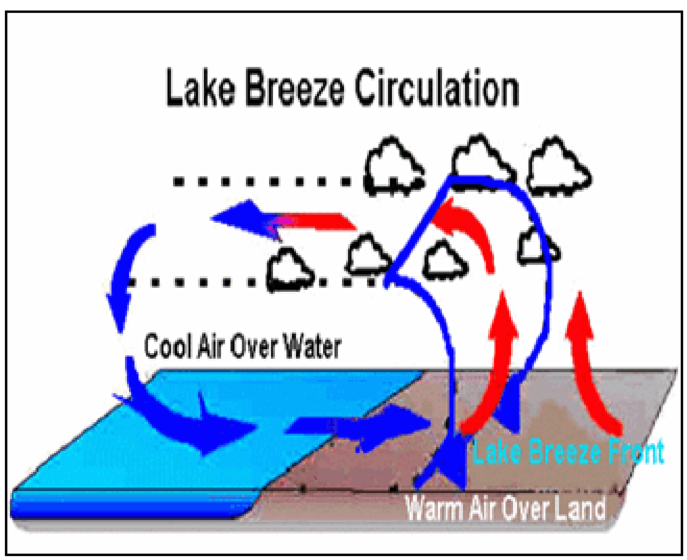


Figure 26: *The lake cools the air and it moves inland.*

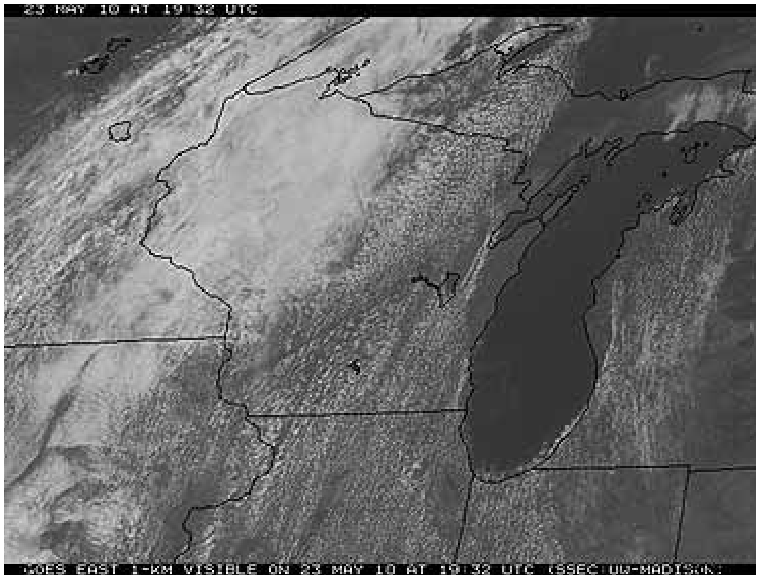


__Figure 27:__ Clear over Lake Michigan. Fly MKE to GRB in the clear.

Figure 28 shows a satellite picture of the eastern Great Lakes on April 20, 1999. The lakes were still cold, which prevented afternoon clouds from forming over and around them. You could fly from TOL to BUF in clear, smooth air.

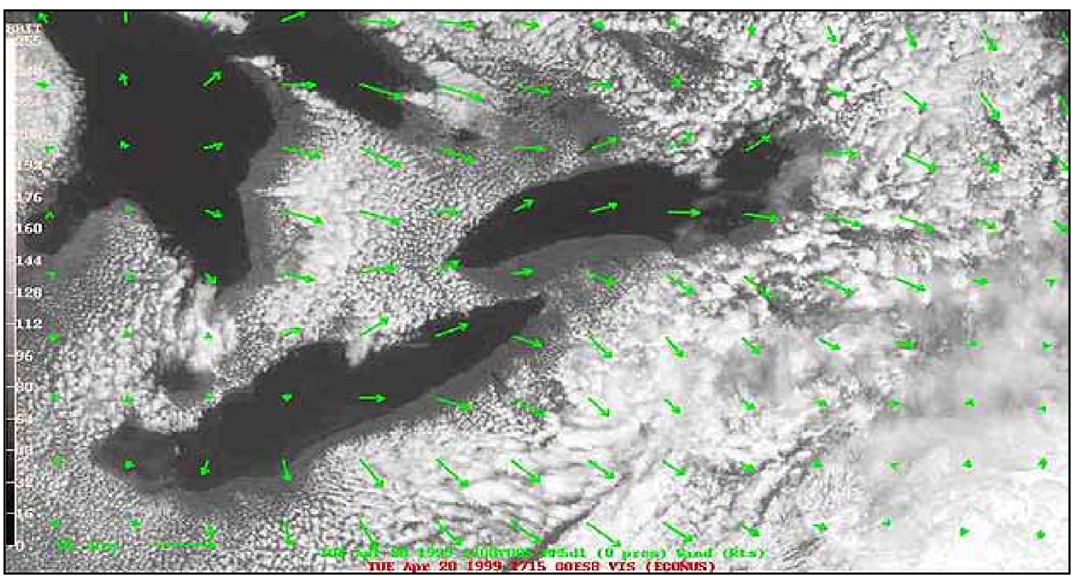


__Figure 28:__ Satellite view of eastern Great Lakes.

Summary—Great Lakes Weather

The Great Lakes regularly influence the weather in the region. Fall and winter bring frequent low clouds and local lake-effect snow and rain. Winds also are usually stronger near the lakes. In spring and summer, the lakes typically have a stabilizing influence with less cloudiness and wind near the lakes. Warm, moist air from the south can sometimes produce low clouds and fog while the lakes are still cool.

While the Great Lakes can influence the weather in any season, winter probably causes more disruption to flight than summer. Understanding the effects of the Great Lakes can help you plan a safer and more efficient flight.