Chapter 5

Airport Climatology

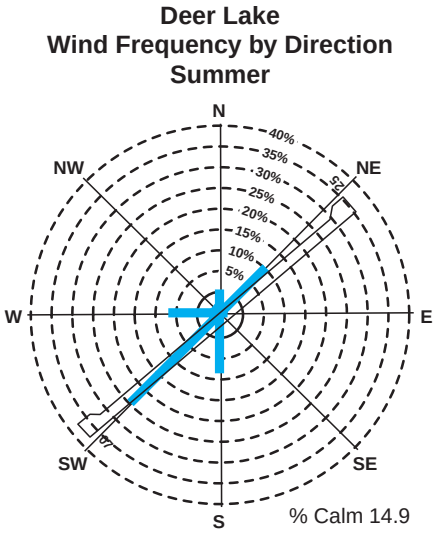
(a) Deer Lake

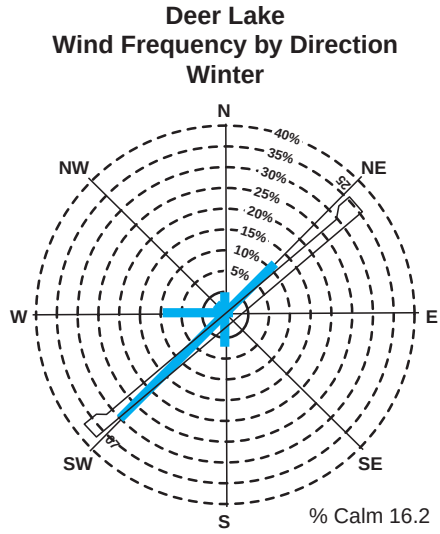
Deer Lake Airport is located in the Humber River Valley just northeast of Deer Lake. The 1500 to 2300 foot hills on either side of the northeast-southwest oriented valley play an important role in the wind direction at the airport throughout the year, as is evident from the wind rose diagrams. Stronger winds are channelled in either a southwest or northeast direction while winds from other directions are usually lighter.

Almost any wind from the western quadrant will be channelled in the valley and result in a southwesterly wind at the airport. During the summer the winds are generally lighter and somewhat more variable than in the winter. This is due to the air cooling in the valley on summer nights, often causing an inversion to develop and winds to become very light or even calm.

Although the general circulation shifts to a more westerly direction in the winter, the winds at the airport are still predominantly from the southwest due to channelling in the valley. There is also a slight increase in the incidence of northeast winds in the wintertime because of the increased frequency and intensity of low pressure systems affecting the island.

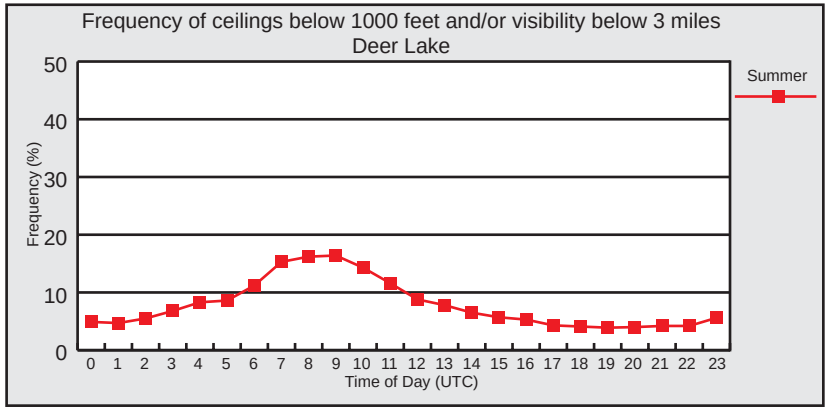
When the general flow crosses the hills at or near right angles, surface winds tend to be light at the airport due to the sheltering effect of the hills. This accounts for the very low incidences of east to southeast or northwest winds at Deer Lake. Northwest winds are usually more unstable than southeast winds and, as a result, will usually be more noticeable at the airport. It is also important to note that significant windshear occurs in these situations.

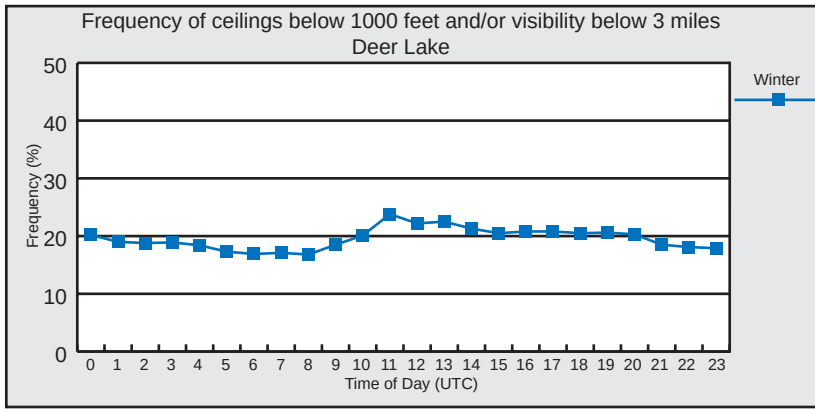




The best flying weather at Deer Lake occurs in the summer when prolonged periods of IFR conditions are infrequent. One fairly common occurrence, nevertheless, is for fog or low stratus to develop near sunrise. This is usually brief, however, since the fog or low stratus burns off within a few hours.

This phenomenon will occur during the winter yet will tend to be persistent during this time of the year. Fog or freezing fog develops early in the morning and will lift to form a stratus deck, rather than burn off completely. Winter storms will also reduce visibility to IFR conditions in snow, although the inversion mentioned previously tends to preclude strong winds from reaching the surface and causing blowing snow. Freezing rain is also more prevalent in Deer Lake due to this inversion.





(b) Halifax

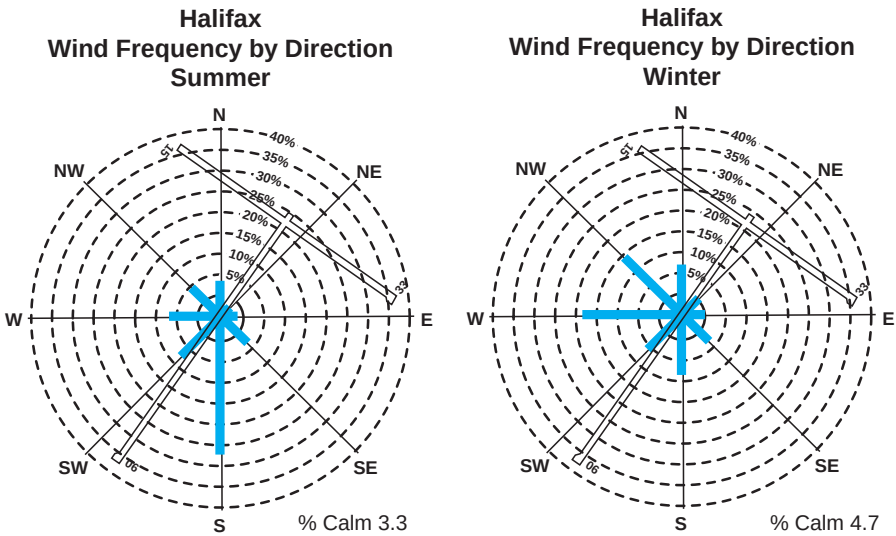
Halifax International Airport is located on an east-northeast to west-southwest running ridge 15 miles from the city of Halifax. The terrain in the vicinity of the airport is characterized by rolling hills with an overall slope towards the Atlantic Ocean, located approximately 16 miles to the south. There is also a gentle slope towards Cobequid Bay 26 miles to the north.

The wind direction at the airport largely depends on the season. Winter winds will blow predominantly from the west or northwest and tend to be stronger than during any other season. This is due to the higher intensity of weather systems that affect this region during this time of year.

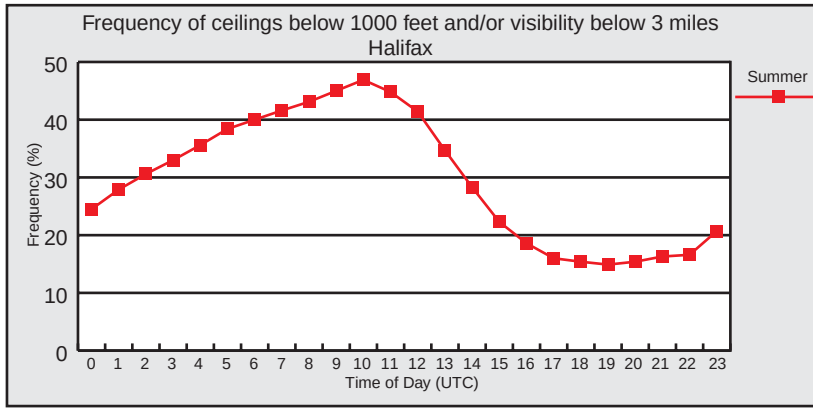
During the summer, the prevailing wind undergoes a drastic shift to the south. These southerly winds occur with a frequency more than double that of winds from

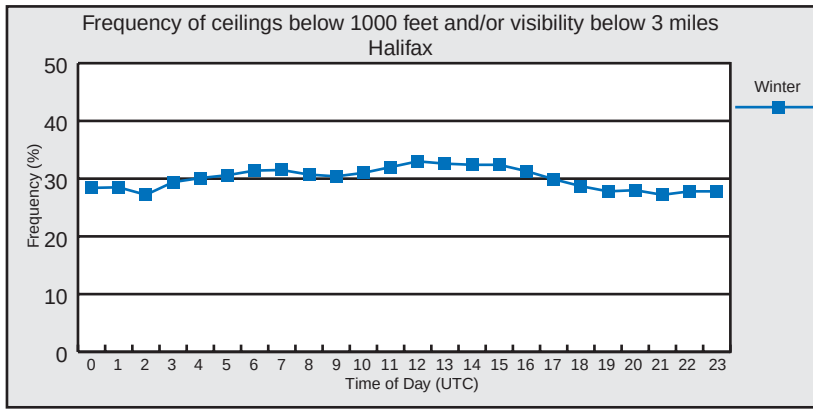
any other direction. This is mainly due to the strengthening of the Bermuda High over the Atlantic Ocean that causes a southerly shift in the large-scale wind patterns.

The effects of the Atlantic Ocean on the aviation climatology of Halifax are indisputable. Like Torbay Airport in St John's, Halifax is well known for its frequent fog. Although fog can and does occur at any time of the year, the spring and summer months are by far the worst. As the prevailing winds shift to a more southerly direction in the spring, they bring with them warm, moist air from the south that is then cooled from below, causing fog to develop. The prevailing southerlies push the fog inland resulting in higher frequencies of IFR weather at the airport. It is evident from the spring and summer graphs of IFR conditions that the fog usually burns off during the daytime but moves in again during the evening hours. This is an extremely common occurrence here during summer as IFR conditions are reported almost 50% of the time during the nighttime hours. Although other types of fog occur at Halifax, this advection fog is what is experienced in this area most frequently.



By the fall, water temperatures over the ocean are such that fog becomes less of a problem for airport operations. In the winter, IFR conditions develop due to a number of other weather situations including snow, fog and low cloud which remains fairly constant throughout all hours of the day.





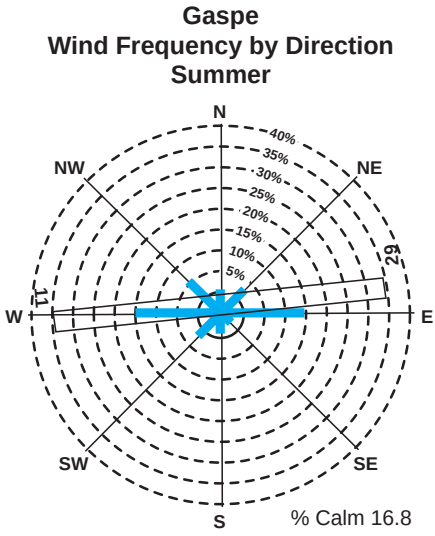
(c) Gaspe

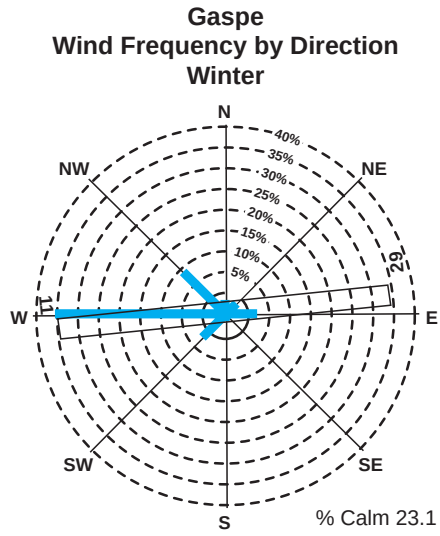
The Gaspe Airport is located 3.5 miles west of the town of Gaspe on the eastern tip of the Gaspe Peninsula. York River and the St. Jean River both flow eastward and

are located to the north and south of the airport respectively. The terrain surrounding the airport generally rises in every direction except towards Baie de Gaspe to the east. This rise is fairly abrupt and reaches the 2000 foot level within about 5 miles.

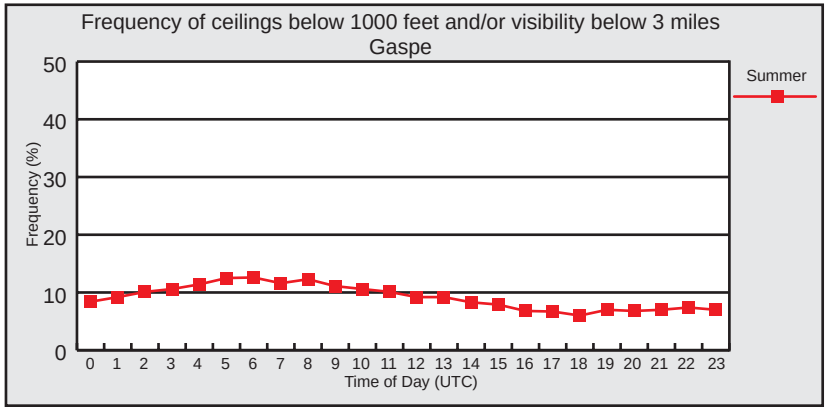
The wind patterns at Gaspe are closely related to the topography around the airport. Although the general circulation in the winter is from the northwest, the valley channels these winds resulting in a predominant westerly flow at the airport. Drainage winds also contribute to the westerlies which blow 42% of the time during the winter.

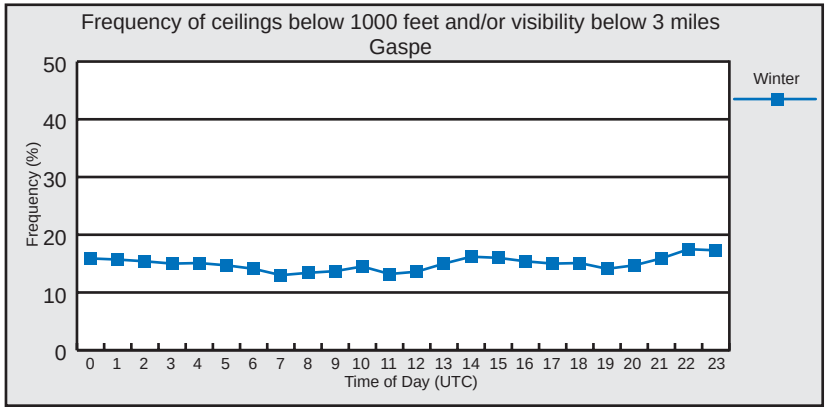
Although the predominant winds are from the west in the summer time as well, they blow from this direction only half as frequently as they do during the winter. This can be attributed to the frequent easterly sea breeze circulation during these warmer months.





Flying weather at Gaspe is actually quite good. While the highest frequency of IFR conditions occurs in April, the summer months experience the largest diurnal variation as fog or low stratus at night usually burns off during the day. Most of the IFR weather in the winter is caused by reduced visibility in snow. Blowing snow is less of a factor here due to the sheltering effect of the valley.


Frequency of ceilings below 1000 feet and/or visibility below 3 miles
Gaspe
Summer
Frequency (%)
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time of Day (UTC)


Frequency of ceilings below 1000 feet and/or visibility below 3 miles
Gaspe
Winter
Frequency (%)
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time of Day (UTC)

(d) Goose Bay

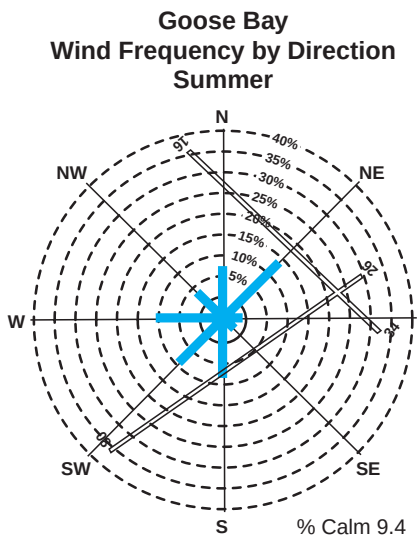

3000 FT
2000 FT
1500 FT
1000 FT
600 FT
300 FT
0 SEA LEVEL
GOOSE BAY

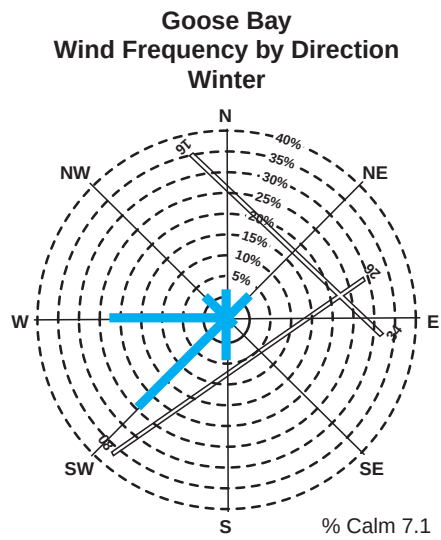
Goose Bay Airport is located on a plateau surrounded by the Goose River to the north, the eastward flowing Churchill River to the south and Goose Bay to the northeast. Beyond the lower terrain that almost surrounds the airport, hills and mountains in the 1,500 to 2,500 foot range will result in downslope conditions in all directions, except to the northeast. The winds at Goose Bay tend to be channelled by the northeast-southwest oriented Hamilton Inlet, the Mealy Mountains and the Hamilton River Valley.

Winds during the winter months are predominantly (almost 60% of the time) from the west or southwest. Southeast winds here are quite rare due to the sheltering effect of the Mealy Mountains and the fact that, due to channelling, east or southeast gradients will result in a northeast wind at the airport. Northwest winds are as frequent as northeast winds in the winter, but the nature of these winds are quite different. Northwest winds are generally stronger than northeast winds and have a tendency to be gustier during the winter months.

As the transition from winter to summer begins, the storms take on a more northerly track and more prolonged periods of northeast winds develop at Goose Bay.

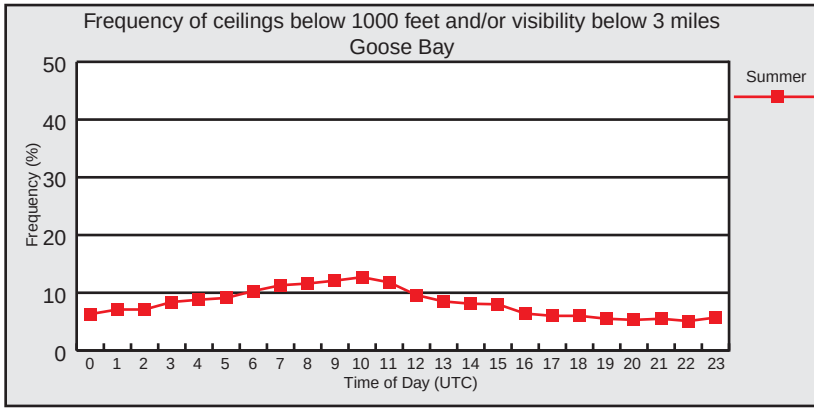
Summertime winds here, although still predominantly from the west or southwest, are noticeably more variable than in the winter. The fact that northeast winds are steadier in the winter does not hold true for the rest of the year. Winds can be gusty from any direction in the summer because of the destabilizing effect of daytime heating. Warm summer days, consequently, tend to be quite windy but the winds usually diminish by mid evening.

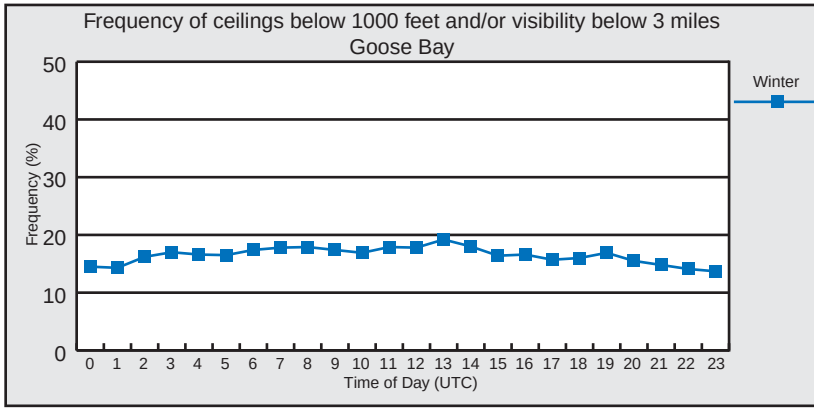




Goose Bay experiences IFR weather an average of 15 to 20 percent of the time during the winter season. Most of these cases are caused by reduced visibility in snow and blowing snow. Since the start and stop times of this type of precipitation are independent of the time of day, there is remarkably very little diurnal variation in IFR weather in the winter. During spring, the IFR conditions can be a combination of both snow/blowing snow and fog related to northeast winds. Ceilings and visibility usually improve somewhat under foggy conditions and, thus, a more pronounced diurnal variation is evident here.

In the summer the IFR conditions are mostly caused by low ceilings rather than low visibility. Since the airport lies on a plateau, radiational cooling will cause colder air to drain into the valleys during summer nights. This hampers the formation of radiation fog at the airport. When ceilings are IFR at night, daytime heating usually produces an improvement until sunset.

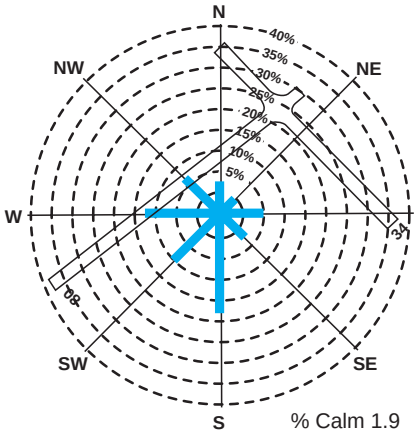




(e) Iles-de-la-Madeleine

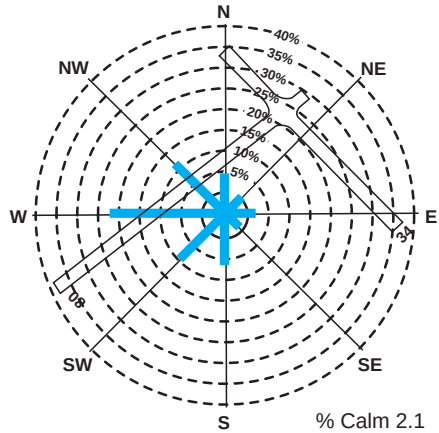
The Iles-de-la-Madeleine, or Magdalen Islands, are located in the middle of the Gulf of St. Lawrence, isolated from the mainland. The Iles-de-la-Madeleine Airport is located on Ile du Havre-aux-Maisons, 1.7 miles northeast of the village of Cap-aux-Meules (Grindstone), near the centre of the island complex. Terrain immediately surrounding the airport is flat to the northeast but experiences a rise to the south. The Buttes Pelees reach a height of 362 feet to the south, with the highest the peak of 543 feet located 7 miles to the southwest.

Iles-de-la-Madeleine
Wind Frequency by Direction
Summer



% Calm 1.9

Iles-de-la-Madeleine
Wind Frequency by Direction
Winter

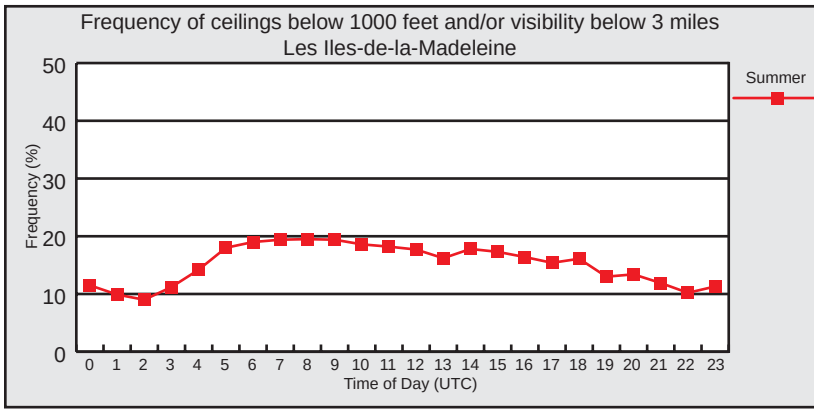


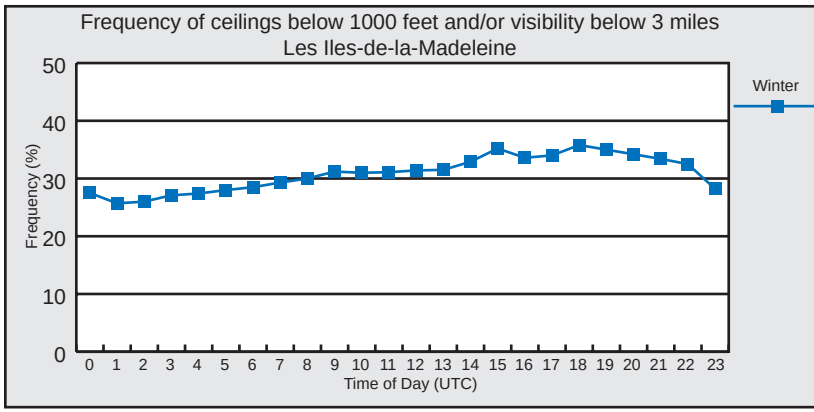
% Calm 2.1

Les Iles-de-la-Madeleine are well known for being quite windy. In the winter, winds here blow predominantly from the west with speeds approximately 50% higher than in the summer. Winds during the winter also tend to be quite gusty due to the relative instability and the surrounding terrain.

The prevailing wind in the summer exhibits a shift to the south, which is directly attributed to the circulation around the stronger high pressure system far to the southeast.

Although the terrain around the airport is conducive to turbulence, it has little affect on the prevailing wind directions throughout the year.

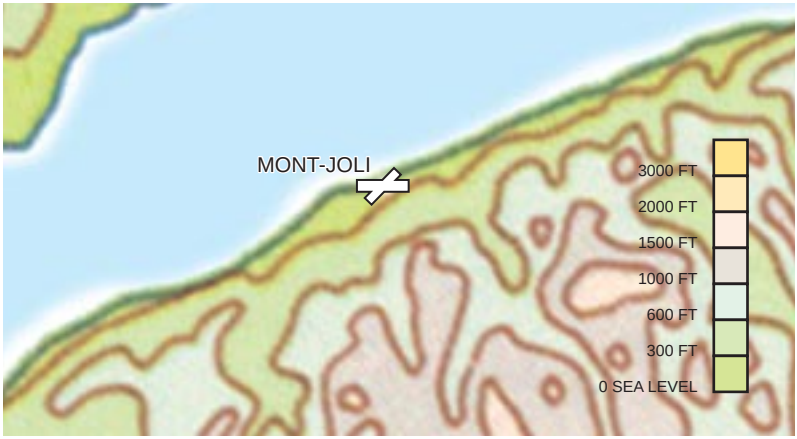




IFR weather at the airport is quite common here especially in the winter and spring seasons. Most of the bad flying weather during the winter season can be attributed to snow and blowing snow. Snow associated with low pressure systems, as well as snow squall activity, frequently reduces visibility to below IFR thresholds. In the spring, on the other hand, fog and low stratus are the culprits. Sea fog will form over the gulf as warmer, moist air starts to move up from the south and is cooled from

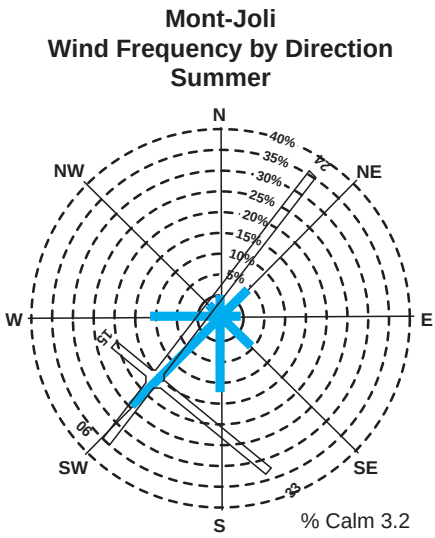
below by the cold water. It is usually necessary for an area of rain to saturate the lower levels for widespread fog to form in the gulf. Once formed, however, the fog will remain here until drier air is ushered in from the west. Any diurnal improvements at the Iles-de-la-Madeleine Airport will be in the form of fog lifting to low stratus. Although fog also happens in the summer, it tends to occur less frequently, reaching a minimum in the fall.

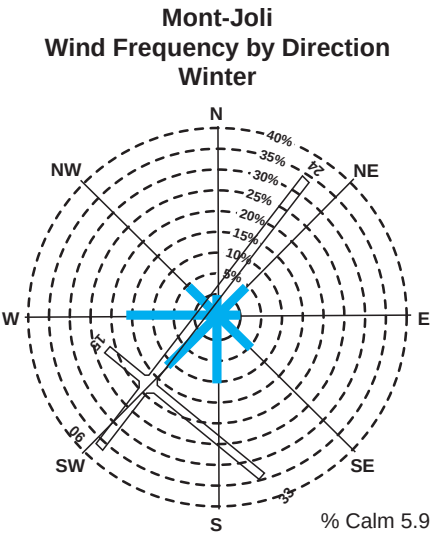
(f) Mont-Joli



The airport at Mont-Joli is located 1.5 miles north of the town at an elevation of 172 feet. Located just one mile north of the airport, the southwest-northeast oriented St. Lawrence River is about 23 miles wide at this point along the coast and plays an important role in the climatology at the airport. The northward flowing Mitts River is a much smaller river located 3 miles to the east. The airport is built on a plateau with surrounding terrain being rolling in nature and rising more abruptly further to the south and southeast.

At Mont-Joli, the winter winds are predominantly out of the west or southwest. A secondary, albeit smaller, peak in wind direction occurs with northeasterlies, especially during the late winter. These preferred wind directions are a direct result of channelling in the St. Lawrence River Valley.

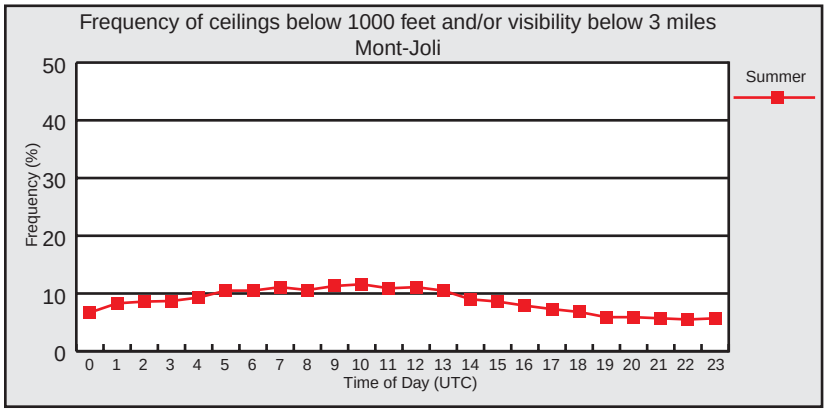


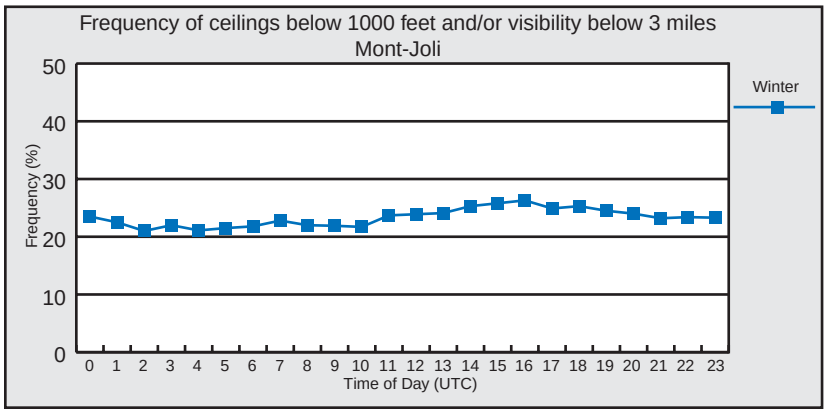


The summer time winds take on a similar pattern to those seen in the winter but tend to be lighter. The two main wind axes are southwest and northeast although the southwesterlies in the summer are almost twice as frequent as they are in the winter. This is due to the change in the general circulation pattern in the summer which shifts towards the south or southwest.

The prevailing wind at Mont-Joli gives rise to excellent flying weather. By far the best season is during the fall when IFR conditions occur only about 10% of the time. Snowstorms cause most of this IFR weather in the winter, although visibility can briefly drop below IFR limits in snow showers when cold, onshore northwesterlies develop. Winter is generally the season that IFR weather is most frequent.

Springtime weather is generally better than winter weather, however, low ceilings tend to be more frequent during this time of the year. Summer time brings even more good flying weather with occasional early morning fog or low stratus generally burning off quite quickly. Thunderstorms often develop over the mountains to the south and southwest and then move over the airport. Mont-Joli experiences an average of 11 days with thunderstorm activity each year, with July being the most active.

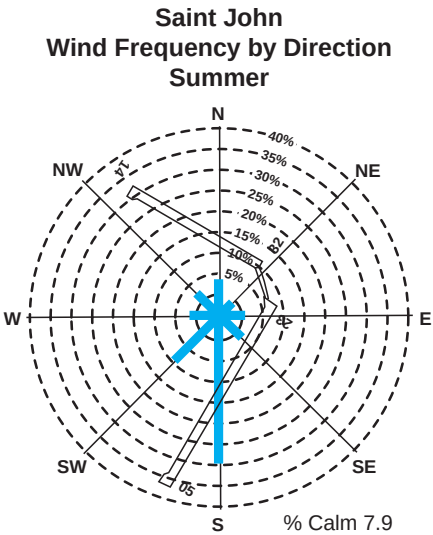


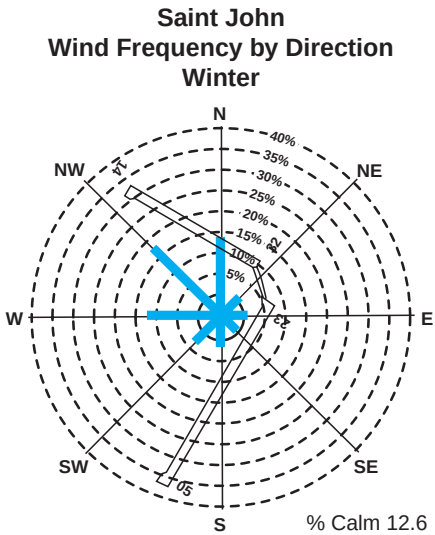


(g) Saint John

The Saint John Airport is located 8 miles east-northeast of the city, at an elevation of 357 feet. The immediate area around the airport is characterized by rolling hills in the 500 to 1,000 foot range with the highest hills located to the northeast. Several

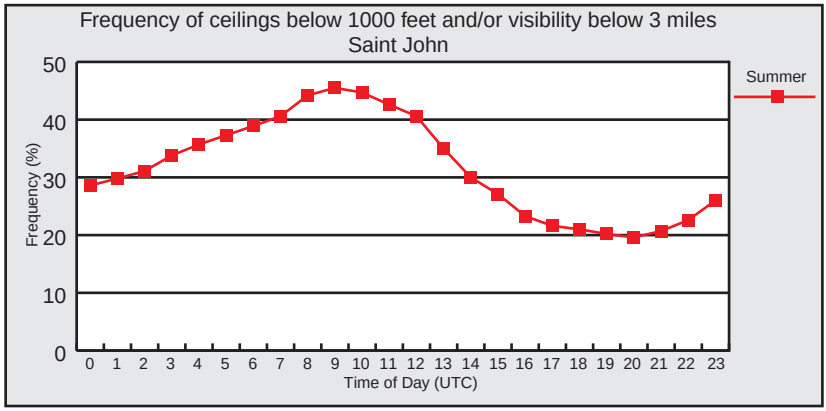
bodies of water surround the airport: Loch Lomond Reservoir to the north; Kennebecasis Bay and the Saint River to the west; and, last but not least, the Bay of Fundy to the south. The Bay of Fundy has the biggest impact on the climatology at Saint John.

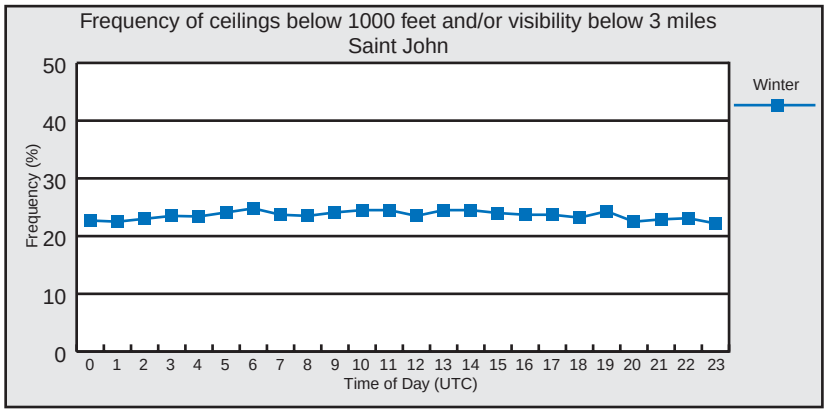




As with other areas in the Maritimes, the larger scale pressure patterns in the winter are such that the prevailing winds in the winter are from the northwest; the summer, however, is another matter. The general circulation during the summer is from the southwest, yet these winds tend to back somewhat due to friction over the land. Sea breezes are also frequent here in the spring and summer. Both effects result in a prevailing southerly wind at the airport.

The IFR graph for the winter season shows a uniform occurrence of IFR weather at Saint John. The prevailing northwesterly winds experienced in the winter are, for the most part, very dry, resulting in clear weather. A secondary maximum of IFR conditions occurs with north to northeast winds but is limited to the winter months and can be attributed to snowstorm situations. The occurrences of IFR weather in these situations are mostly due to transiting low pressure systems and are not dependent on the time of day.



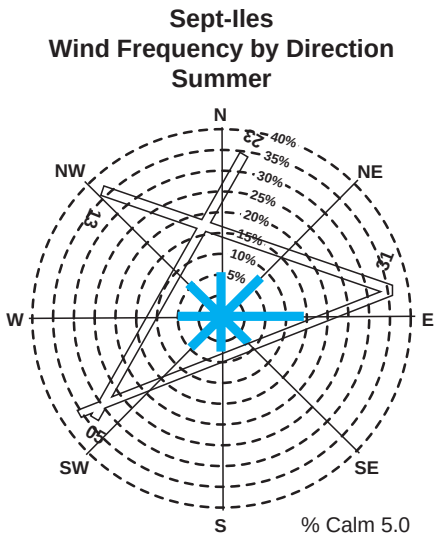


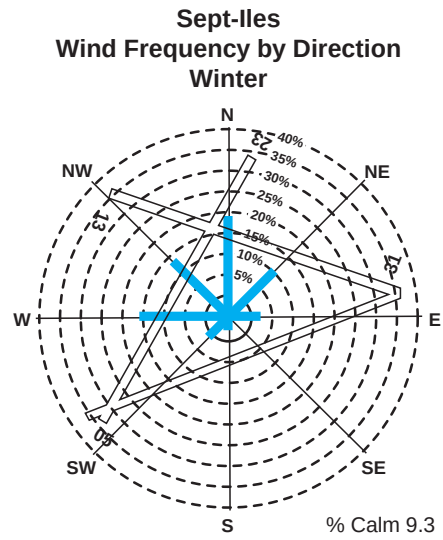
The most frequent constraints to flight operations occur during the late spring and summer when stable inversions are formed by warm, moist air flowing over the cold Bay of Fundy. Fog usually forms under this inversion and, given Saint John Airport's elevation, significant orographic lift and onshore winds keep the airport shrouded in fog.

(h) Sept-Iles

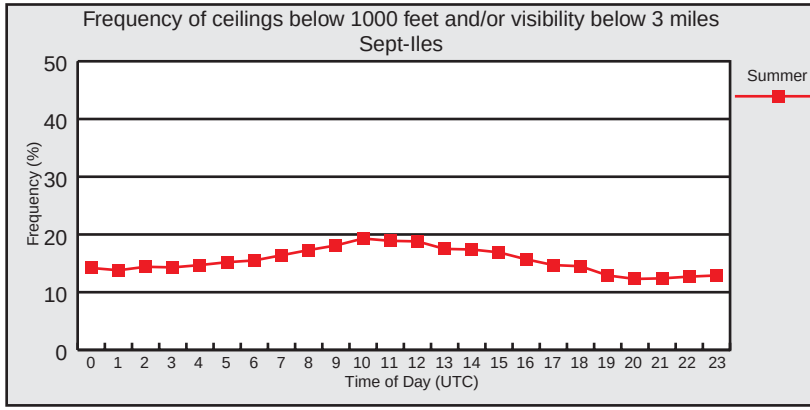
The airport at Sept-Iles is located on the North Shore of the St. Lawrence River, 4.5 miles east of the town. Several bays are located south of the airport along the St. Lawrence. Baie-de-la-Boule is located just a half mile to the south and Baie-des-Sept-Iles lies 5 miles to the west. The latter is protected by seven islands, which give the town its name. For the most part, the terrain around the airport is flat with several marshy areas. The topography rises more abruptly to the 1,500 to 2,000 foot range 10 to 15 miles to the north.

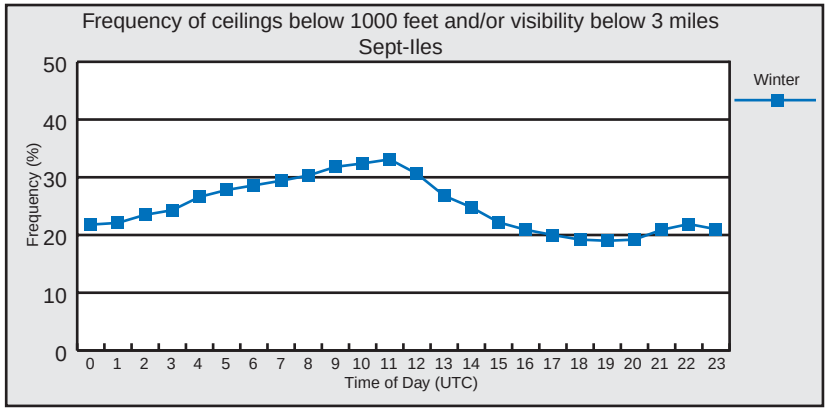
The winds at Sept-Iles show a definite seasonal dependency. During the winter months, the winds are predominantly from the north but are also frequently from the west and northwest. During the summer, the winds are generally lighter and much more evenly partitioned. Winds blow from most directions about 10% of the time, yet winds from the east occur 18% of the time. This is due to the larger scale channelling of the general circulation winds in the Jacques-Cartier Strait between the North Shore and Anticosti Island.





On average, Sept-Iles experiences almost an equivalent amount of IFR weather in the winter and in the spring. More of a daytime improvement is apparent, however, during the colder months. As the prevailing wind begins to shift towards the east in the springtime, the incidences of fog also increase. By summer, fog remains somewhat of a problem but mostly restricts operations early in the morning and evening. The fall months of the year bring with them some of the best flying weather for this location.





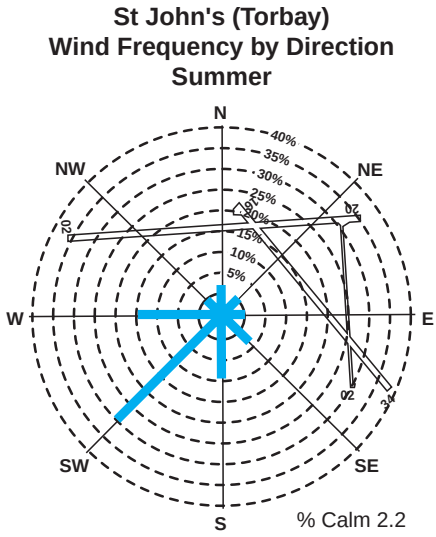
(i) St. John's (Torbay) Airport

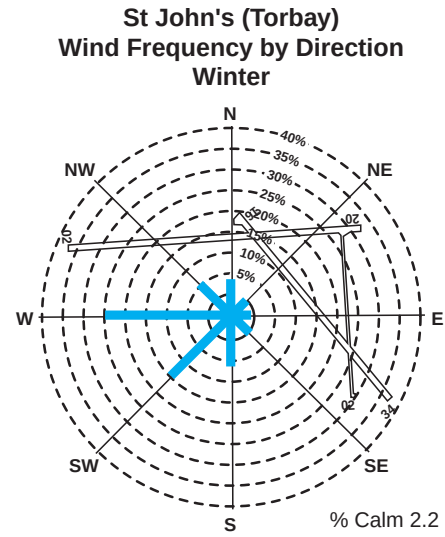
St. John's Airport is located in the northeast corner of the Avalon Peninsula and is in close proximity to water in almost every direction. The elevation of the Airport is about 450 feet and the terrain slopes steadily downward towards Torbay, reaching sea level. To the east, cliffs rise to over 500 feet at the ocean edge. Marshland, at an elevation of 200 or 300 feet, lies beyond these cliffs.

The winds at St. John's are, for the most part, determined by large-scale weather systems. The prevailing wind direction is from the western quadrant but does vary slightly from season to season. Winds during the winter are predominantly from the west, whereas summer winds exhibit a shift to a more southwesterly direction due to

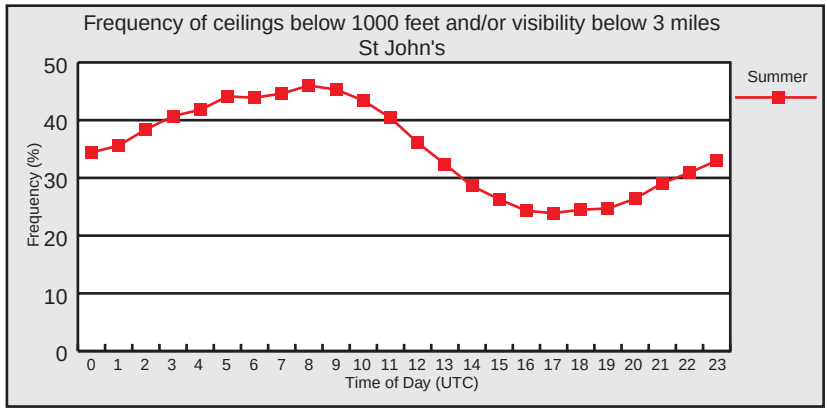
the strengthening of the Bermuda High over the Atlantic Ocean. The stronger winds generally occur in the winter and are always associated with storms moving northeastward near Newfoundland. Gusts of up to 35 knots occur frequently at St. John's and often persist for prolonged periods of time. Winds with gusts to 35 knots or more occur most frequently from the southwest. Very strong winds with gusts to 60 knots or more occur mostly with very deep, low pressure systems that pass to the west of the Avalon Peninsula. Calm winds, on the other hand, only occur about 2% of the time.

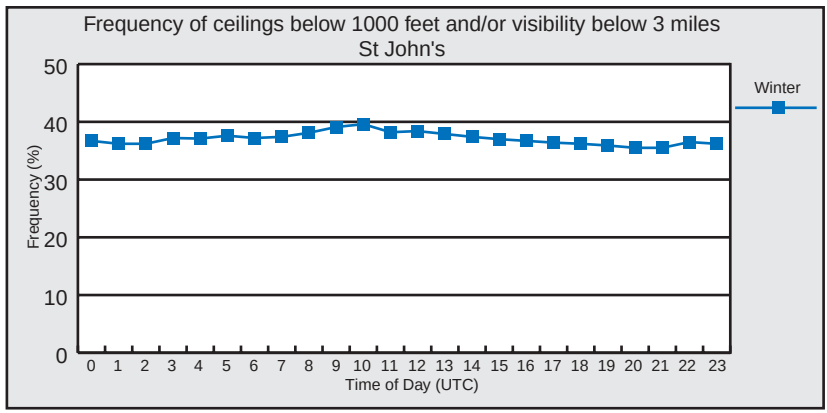
Although sea breeze activity does occur at St. John's, its overall effect on the prevailing wind direction is small. Even if the water temperatures are favourable for the development of sea breezes, the prevailing wind speed and direction are often such that any sea breeze formation will be suppressed. When they do develop, sea breezes at St. John's tend to be between 120 and 150 degrees or between 40 and 60 degrees.





St. John's Airport has a reputation for being one of the foggiest airports in Canada. The worst cases by far occur during the spring. Low ceilings and visibility are extremely common when winds are from the northeast to southeast. This is due to the upslope nature of the terrain and the air's prolonged exposure to the ocean when winds are from these directions. As seen from the winter diagram, when IFR conditions are present, there is very little diurnal variation. In the summer time, sea fog may move inland at night, however, it often burns off during the day accounting for the more pronounced improvement after about 1000 UTC on the summer diagram.



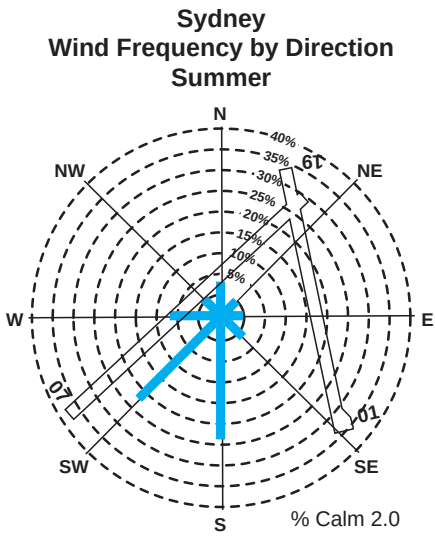


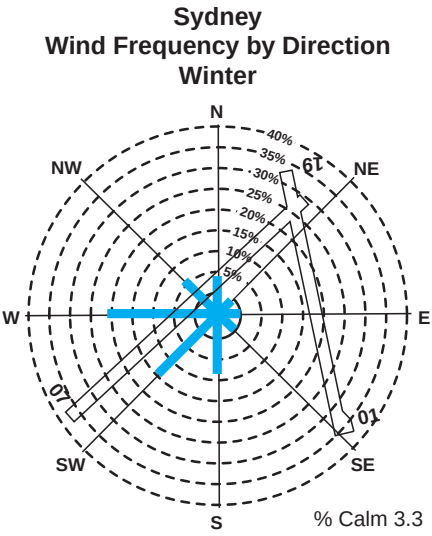
The fall is more stable at St. John's in that IFR conditions are generally less frequent during this time than during all other seasons. Although very low conditions sometimes exist in mild flow, particularly if fog blankets the water south of the Avalon Peninsula, operational ceilings usually exist in the winter especially when winds are from the western quadrant. IFR conditions in this season are often due to snow and blowing now and can be quite variable. A particular hazard to aviation that develops frequently at St. John's is freezing precipitation, which occurs an average of 175 hours each year.

(j) Sydney

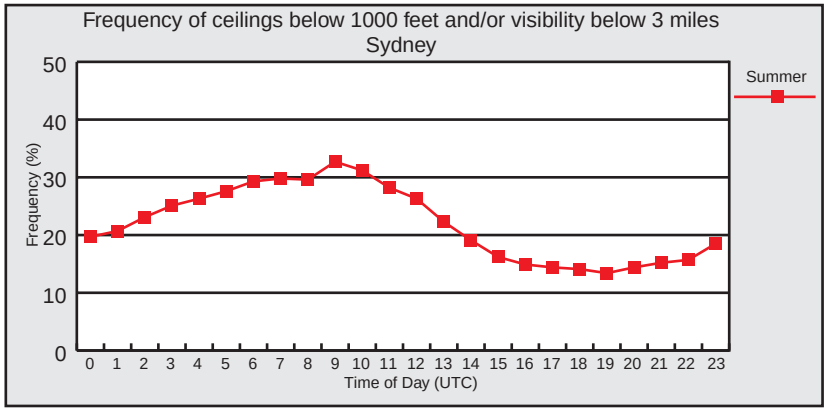
Sydney Airport is located 5 miles east-northeast of the city of Sydney. The terrain within about 10 miles of the airport is mostly composed of undulating hills, several small lakes and some marshland. Hills in the 500 foot range lie beyond this area to the west and southwest. The airport is in fairly close proximity to water in all directions except to the southwest.

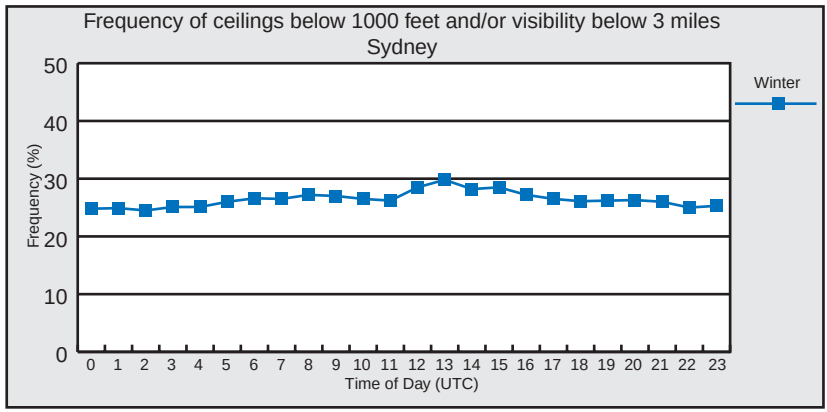
The summer winds at Sydney Airport are predominantly from the south or southwest. Other wind directions are much less frequent and are mostly associated with low pressure systems transiting through the area.





In the winter, the prevailing winds shift to a more westerly direction due to the southward shift in storm tracks. As winter storms cross the Maritimes, the winds at Sydney will often have an easterly component until the low passes to the east of the airport. At this time, the winds will shift to westerly or northwesterly and can then persist for days until the approach of the next pressure system. This is a common scenario during the winter and accounts for the corresponding westerly shift in prevailing wind direction.



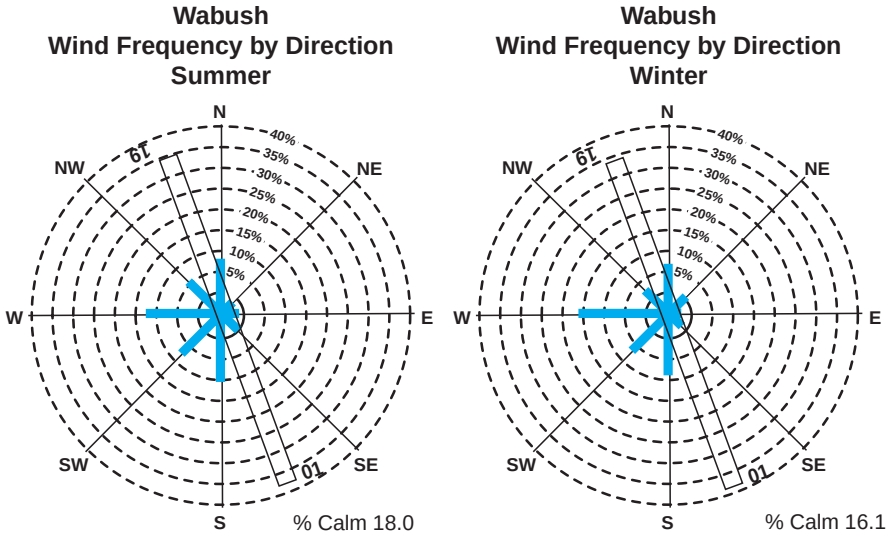


The effect of the ocean is quite apparent for all four seasons when looking at the IFR condition charts. The spring has the highest frequency of IFR weather at Sydney due to the change in pressure patterns from winter to summer. Blocking patterns are much more prevalent during the spring and cause prolonged periods of east or north-east winds, compared to other seasons. These winds are onshore at Sydney and result in low stratus cloud and reduced visibility in fog. In the spring, this occurs an average of 10 days each month. Although the hills to the southwest of the airport tend to block off the fog that forms over the ocean in the summer, low stratus sometimes spills over the hills causing brief IFR ceilings. Freezing precipitation is also fairly common at the airport occurring most frequently in mid to late winter.

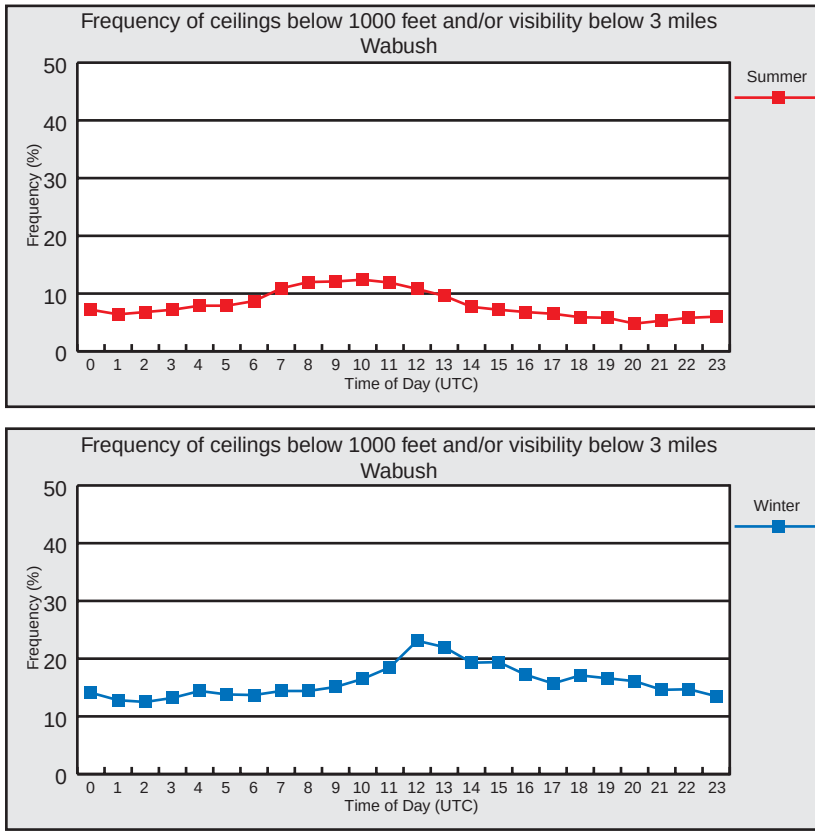
(k) Wabush

The airport at Wabush is located one mile northeast of the town and just south of Wabush Lake. Hills to the west and northwest of the airport will result in subsidence when the winds are from a general westerly direction.

Prevailing winds at Wabush are mostly influenced by the larger scale pressure patterns found over Atlantic Canada. In the winter, winds clearly blow more frequently from the west and southwest than from any other direction. Secondary peaks in wind frequency occur from the north and south due to the orientation of the valley. This part of Labrador is also subject to extremely cold temperatures during the winter. This causes substantial low-level inversions and results in very light winds at the surface. Calm winds are reported at Wabush airport almost 20% of the time during the winter months.



During the summer months, the winds are more variable but still blow from a predominantly westerly direction. The secondary, northerly and southerly peaks in wind frequency are apparent in the summer as well. Calm winds are also relatively frequent in the summer but occur mostly in the early morning hours. Summer time winds usually become fairly gusty by the afternoon.



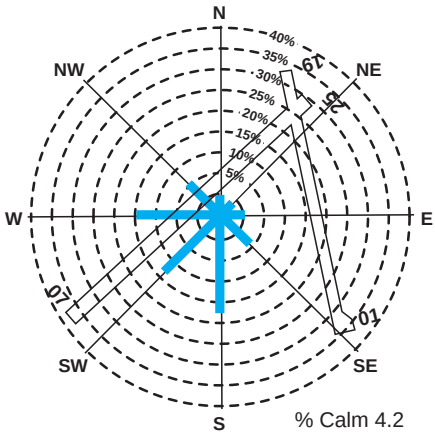
The combination of prevailing downslope winds throughout the year, and the fact that the Wabush airport is quite far from the ocean, results in generally good ceilings and visibility. Fog can develop at the airport during any season but is most common in the late summer and fall. The best flying weather at Wabush is in the summer with IFR conditions occurring quite infrequently. Most of the IFR conditions during this time of year are due to low ceilings, which usually improve during the daytime even in the worst of situations. The fall and spring months, on the other hand, usually bring the worst weather. Winds are often northeasterly during this time of year and happen to be upslope at Wabush.

(l) Yarmouth

Yarmouth Airport is located just east of the town of Yarmouth and lies no farther than 4 miles from the Atlantic Ocean from the west to the south. The terrain in the vicinity of the airport is mostly composed of flat and gently rolling hills.

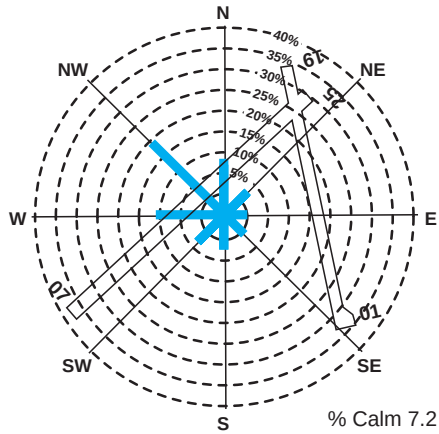
The average wind at Yarmouth is strongest in the winter and blows anywhere between the westerly and northerly directions almost two thirds of the time. The most prevalent wind is from the northwest. As a low pressure system deepens and tracks over the Maritimes, winds increase out of the east ahead of the low and then shift to northwesterly in its wake. These northwesterlies often persist for a few days following the passage of a low, resulting in a high occurrence of winds from this direction.

Yarmouth
Wind Frequency by Direction
Summer



% Calm 4.2

Yarmouth
Wind Frequency by Direction
Winter

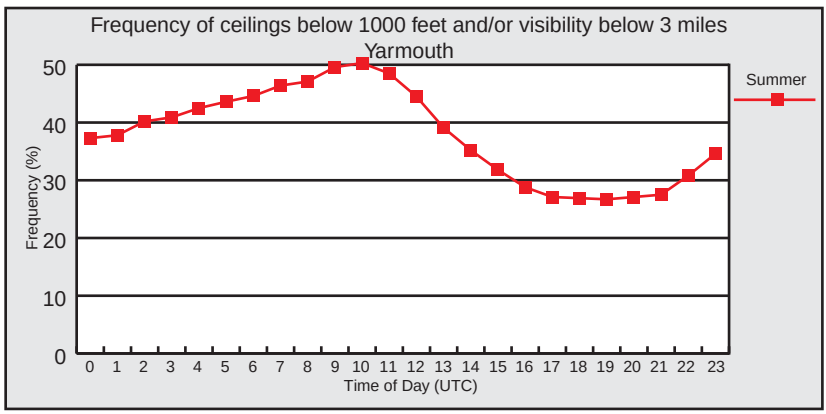


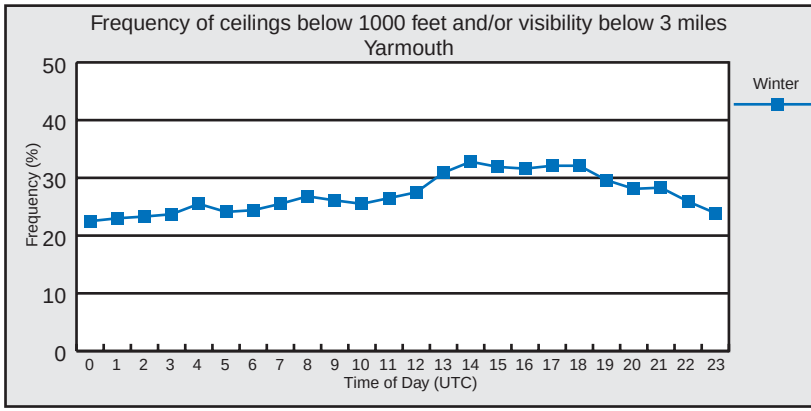
% Calm 7.2

Two main forces drive the winds during the summer. The larger scale wind pattern is such that the general flow will be from the south. Sea breezes from a southerly to a westerly direction are also common here in the summer time.

When flying weather at Yarmouth is restricted it is usually either due to fog, low clouds or snow. Fog occurs here an average of 120 days out of the year, second only to Halifax and St. John's. Like Halifax, the major problem here is advection fog during the spring and summer. There is usually some diurnal improvement in the daytime but it is less pronounced due to the airport's height and proximity to the water. As the prevailing wind begins to shift back to a more northwesterly direction in the fall, the weather becomes more conducive to flying.

By winter, snow becomes the major restriction to visibility. Although precipitation associated with winter storms usually starts off as snow, it often changes over to rain at Yarmouth. The real problem with snow here occurs once the storm has passed and very cold air is ushered in from the west or northwest. The snow squall activity that results is usually worse in the daytime and can give extended periods of IFR ceilings and visibility at the airport.




Frequency of ceilings below 1000 feet and/or visibility below 3 miles
Yarmouth
Winter
Frequency (%)
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time of Day (UTC)

Glossary of Weather Terms

anabatic wind - a local wind which blows up a slope heated by sunshine.

advection - the horizontal transportation of air or atmospheric properties.

air density - the mass density of air expressed as weight per unit volume.

air mass - an extensive body of air with uniform conditions of moisture and temperature in the horizontal.

albedo – the ratio of the amount of solar radiation reflected by a body to the amount incident on it, commonly expressed as a percentage.

anticyclone - an area of high atmospheric pressure which has a closed circulation that is anticyclonic (clockwise) in the Northern Hemisphere.

blizzard - a winter storm with winds exceeding 40 km/h, with visibility reduced by falling or blowing snow to less than one kilometre, with high windchill values and lasting for at least three hours. All regional definitions contain the same wind speed and visibility criteria but differ in the required duration and temperature criterion.

cat's paw – a cat paw-like, ripple signature on water given by strong downdrafts or outflow winds. A good indication of turbulence and wind shear.

ceiling - either (a) the height above the surface of the base of the lowest layer of clouds or obscuring phenomena (i.e. smoke) that hides more than half of the sky; (b) the vertical visibility into an obstruction to vision (i.e. fog).

chinook - a warm dry wind blowing down the slopes of the Rocky Mountains and over the adjacent plains.

clear air turbulence (CAT) - turbulence in the free atmosphere not related to convective activity. It can occur in cloud and is caused by wind shear.

clear icing - the formation of a layer or mass of ice which is relatively transparent because of its homogeneous structure and smaller number and size of air spaces; synonymous with glaze.

climate - the statistical collection of long-term (usually decades) weather conditions at a point; may be expressed in a variety of ways.

cold front - the leading edge of an advancing cold air mass.

convection - atmospheric motions that are predominately vertical, resulting in the vertical transport and mixing of atmospheric properties.

convergence - a condition that exists when the distribution of winds in a given area is such that there is a net horizontal inflow of air into the area; the effect is to create lift.

cumuliform - a term descriptive of all convective clouds exhibiting vertical development.

cyclone - an area of low atmospheric pressure which has a circulation that is cyclonic (counterclockwise) in the Northern Hemisphere.

deepening - a decrease in the central pressure of a pressure system; usually applied to a low. Indicates a development of the low.

deformation zone - an area in the atmosphere where winds converge along one axis and diverge along another. Where the winds converge, the air is forced upward and it is in these areas where deformation zones (or axes of deformation as they are sometimes referred to) can produce clouds and precipitation.

disturbance - applied loosely: (a) any small-sized low pressure system; (b) an area where the weather, wind, and air pressure show signs of cyclonic development; (c) any deviation in flow or pressure that is associated with a disturbed state in the weather; and (d) any individual circulatory system within the primary circulation of the atmosphere.

divergence - a condition that exists when the distribution of winds in a given area is such that there is a net horizontal outflow of air from the area.

downdraft - a small scale downward current of air; observed on the lee side of large objects that restrict the smooth flow of air or in or near precipitation areas associated with cumuliform clouds.

downburst - an exceptionally strong downdraft beneath a thunderstorm usually accompanied by a deluge of precipitation.

filling - an increase in the central pressure of a pressure system; applied to a low.

Föhn wind (foehn wind)- a warm dry wind on the lee side of a mountain range, whose temperature is increased as the wind descends down the slope. It is created when air flows downhill from a high elevation, raising the temperature by adiabatic compression.

front - a surface, interface or transition zone of discontinuity between two adjacent air masses of different densities.

Fujita Scale – a scale used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure (see Table 1).

F-Scale Number	Intensity Phrase	Wind Speed (kts)	Type of Damage Done
F0	**Weak** Tornado	35-62	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	**Moderate** Tornado	63-97	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	**Strong** Tornado	98-136	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	**Severe** Tornado	137-179	Roof and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted
F4	**Devastating** Tornado	180-226	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large-object missiles generated.
F5	**Incredible** Tornado	227-285	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-inforced concrete structures badly damaged.

funnel cloud - a tornado cloud or vortex cloud extending downward from the parent cloud but not reaching the ground.

gust - a sudden, rapid and brief increase in wind speed. In Canada, gusts are reported when the highest peak speed is at least 5 knots higher than the average wind and the highest peak speed is at least 15 knots.

gust front - the leading edge of the downdraft outflow ahead of a thunderstorm.

high - an area of high barometric pressure; a high pressure system.

hurricane – an intense tropical weather system with a well defined circulation and maximum sustained winds of 64 knots or higher. In the western Pacific, hurricanes are called "typhoons," and similar storms in the Indian Ocean are called "cyclones" (see Table 2 for hurricane intensitites).

Table 2 - Saffir-Simpson Hurricane Scale

Category #	Sustained Winds (kts)	Damage
1	64-82	Minimal
2	83-95	Moderate
3	96-113	Extensive
4	114-135	Extreme
5	>155	Catastrophic

icing - any deposit of ice forming on an object.

instability - a state of the atmosphere where the vertical distribution of temperature is such that a parcel displaced from its initial position will continue to ascend.

inversion - an increase of temperature with height - a reversal of the normal decrease of temperature with height.

isothermal layer - equal or constant temperature with height.

jet stream - a quasi-horizontal stream of wind concentrated within a narrow band; generally located just below the tropopause.

katabatic wind - downslope gravitational flow of colder, denser air beneath the warmer, lighter air. Also known as "drainage wind" or "mountain breeze". Strength can vary from gentle to extremely violent winds.

knot - a unit of speed equal to one nautical mile per hour.

lapse rate - the rate of change of an atmospheric variable (usually temperature) with height.

lee wave - any stationary wave disturbance caused by a barrier in a fluid flow; also called mountain wave or standing wave.

lightning - any and all forms of visible electrical discharge produced by a thunderstorm.

low - an area of low barometric pressure; a low pressure system.

meridional flow – airflow in the direction of the geographic meridians, i.e. south-north or north-south flow.

meteorology - the science of the atmosphere.

mixed icing - the formation of a white or milky and opaque layer of ice that demonstrates an appearance that is a composite of rime and clear icing.

occluded front - a front that is no longer in contact with the surface.

orographic - of, pertaining to, or caused by forced uplift of air over high ground.

outflow - a condition where air is flowing from the interior land area through mountain passes, valleys and inlets onto the coastal areas; used most commonly in winter when cold Arctic air spreads onto the coastal area and adjoining sea.

overrunning - a condition when warm air overtakes or is lifted by colder denser air.

parcel - a small volume of air, small enough to contain uniform distribution of meteorological properties, and large enough to remain relatively self-contained and respond to all meteorological processes.

plow wind - usually associated with the spreading out of a downburst from a thunderstorm; a strong, straight-line wind in advance of a thunderstorm that often results in severe damage.

precipitation - any and all forms of water particles, whether liquid or solid, that fall from the atmosphere and reach the surface.

quasi-stationary front - a front that is stationary or nearly so; commonly called stationary front.

ridge - an elongated area of relatively high atmospheric pressure; also called ridge line.

rime icing - the formation of a white or milky and opaque granular deposit of ice formed by the rapid freezing of supercooled water droplets.

saturation - the condition in the atmosphere where actual water vapour present is the maximum possible at the existing temperature.

shower - precipitation from cumuliform cloud; characterized by suddenness of beginning and ending, by rapid changes in intensity, and usually by rapid changes in the appearance of the sky.

squall - essentially gusts of longer duration. In Canada, a squall is reported when the wind increases by at least 15 knots over the average speed for a duration of at least 2 minutes and the wind reaches a speed of at least 20 knots.

squall line - a non-frontal line or narrow band of active thunderstorms.

stability - a state of the atmosphere where the vertical distribution of temperature is such that a parcel will resist displacement from its initial position.

stratiform - term descriptive of clouds of extensive horizontal development; flat, lacking definition.

stratosphere - the atmospheric layer above the tropopause; characterized by slight increase in temperature from base to top, very stable, low moisture content and absence of cloud.

subsidence - the downward motion of air over a large area resulting in dynamic heating.

supercooled water - liquid water at temperatures below freezing.

thunderstorm - a local storm invariably produced by a cumulonimbus cloud, and always accompanied by lightning and thunder.

tornado - a violently rotating column of air, shaped from a cumulonimbus cloud, and nearly always observed as "funnel-shaped;" other names are cyclone and twister.

tropopause - the transition zone between the troposphere and the stratosphere; characterized by an abrupt change in lapse rate.

troposphere - the portion of the earth's atmosphere from the surface to the tropopause; characterized by decreasing temperature with height and appreciable water vapour. Often referred to as the weather layer.

trough - an elongated area of relatively low atmospheric pressure; also called trough line.

trowal - a trough of warm air aloft; related to occluded front.

turbulence - any irregular or disturbed flow in the atmosphere.

updraft - a localized upward current of air.

upper front - any frontal zone which is not manifested at the surface.

virga - water or ice particles falling from a cloud, usually in wisps or streaks, and evaporating completely before reaching the ground.

warm front - the trailing edge of retreating cold air.

weather - the instantaneous conditions or short term changes of atmospheric conditions at a point; as opposed to climate.

wind - air in motion relative to the earth's surface; normally horizontal motion.

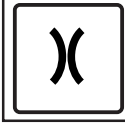
wind direction - the direction from which the wind is blowing.

wind speed - rate of wind movement expressed as distance per unit time.

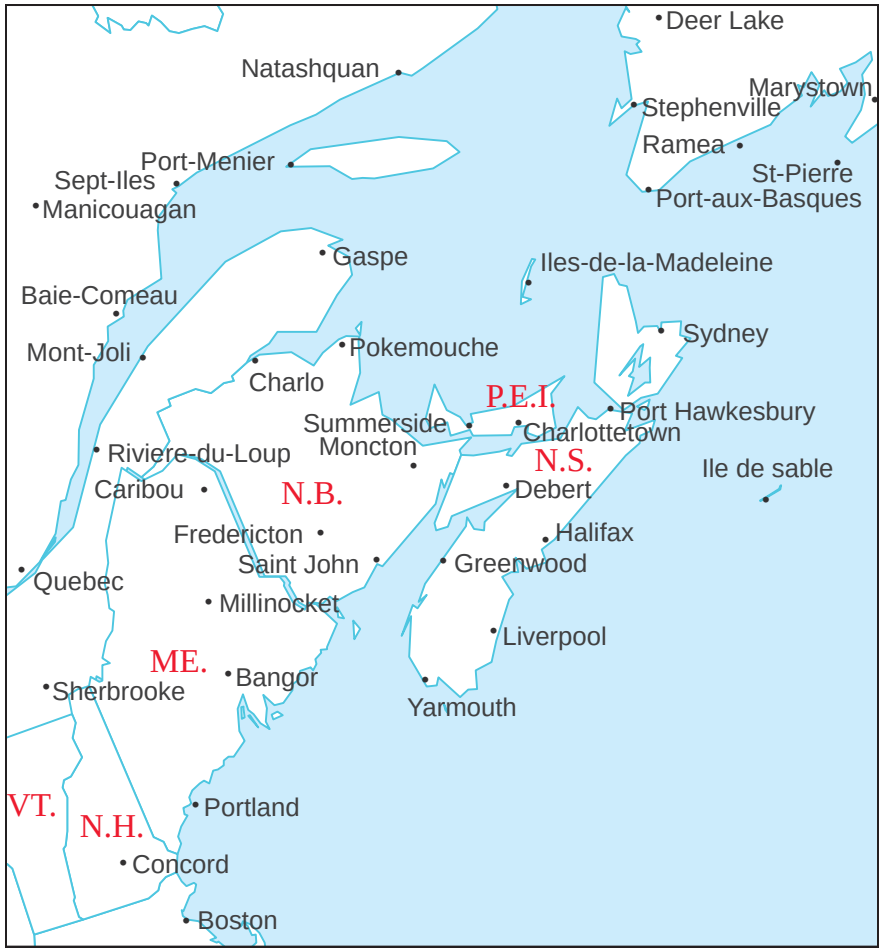
wind shear - the rate of change of wind direction and/or speed per unit distance; conventionally expressed as vertical and horizontal wind shear.

zonal wind - a west wind; conventionally used to describe large-scale flow that is neither cyclonic or anticyclonic; also called zonal flow.

Table 3: Symbols Used in this Manual

	**Fog Symbol (3 horizontal lines)** This standard symbol for fog indicates areas where fog is frequently observed.
	**Cloud areas and cloud edges** Scalloped lines show areas where low cloud (preventing VFR flying) is known to occur frequently. In many cases, this hazard may not be detected at any nearby airports.
	**Icing symbol (2 vertical lines through a half circle)** This standard symbol for icing indicate areas where significant icing is relatively common.
	**Choppy water symbol (symbol with two wavelike points)** For float plane operation, this symbol is used to denote areas where winds and significant waves can make landings and takeoffs dangerous or impossible.
	**Turbulence symbol** This standard symbol for turbulence is also used to indicate areas known for significant windshear, as well as potentially hazardous downdrafts.
	**Strong wind symbol (straight arrow)** This arrow is used to show areas prone to very strong winds and also indicates the typical direction of these winds. Where these winds encounter changing topography (hills, valley bends, coastlines, islands), turbulence, although not always indicated, can be expected.
	**Funnelling / Channelling symbol (narrowing arrow)** This symbol is similar to the strong wind symbol except that the winds are constricted or channeled by topography. In this case, winds in the narrow portion could be very strong while surrounding locations receive much lighter winds.
	**Snow symbol (asterisk)** This standard symbol for snow shows areas prone to very heavy snowfall.
	**Thunderstorm symbol (half circle with anvil top)** This standard symbol for cumulonimbus (CB) cloud is used to denote areas prone to thunderstorm activity.
	**Mill symbol (smokestack)** This symbol shows areas where major industrial activity can impact on aviation weather. The industrial activity usually results in more frequent low cloud and fog.
	**Mountain pass symbol (side-by-side arcs)** This symbol is used on aviation charts to indicate mountain passes, the highest point along a route. Although not a weather phenomenon, many passes are shown as they are often prone to hazardous aviation weather.

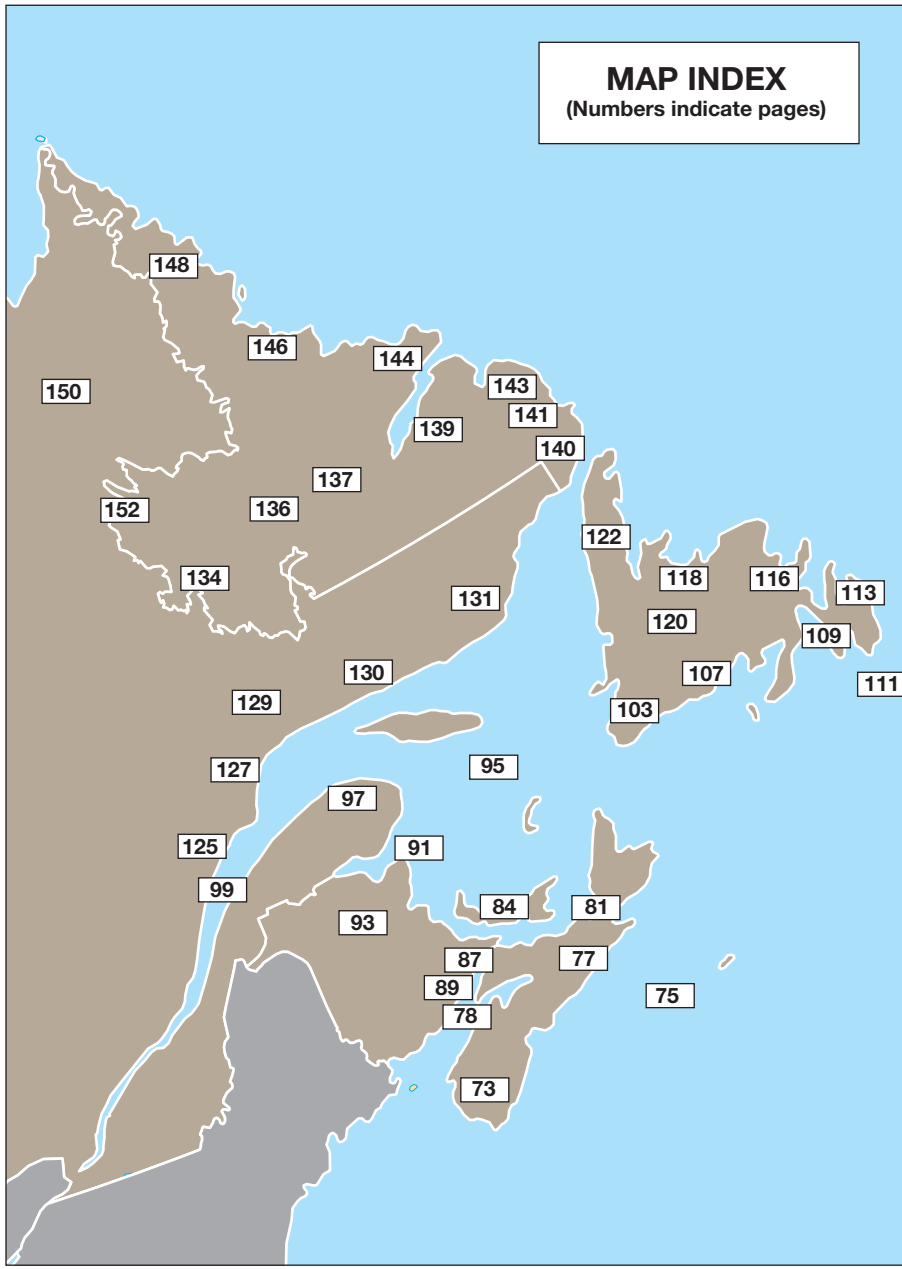
Appendix



The Maritimes and Gaspe Peninsula

Newfoundland

The North Shore of Quebec and Labrador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