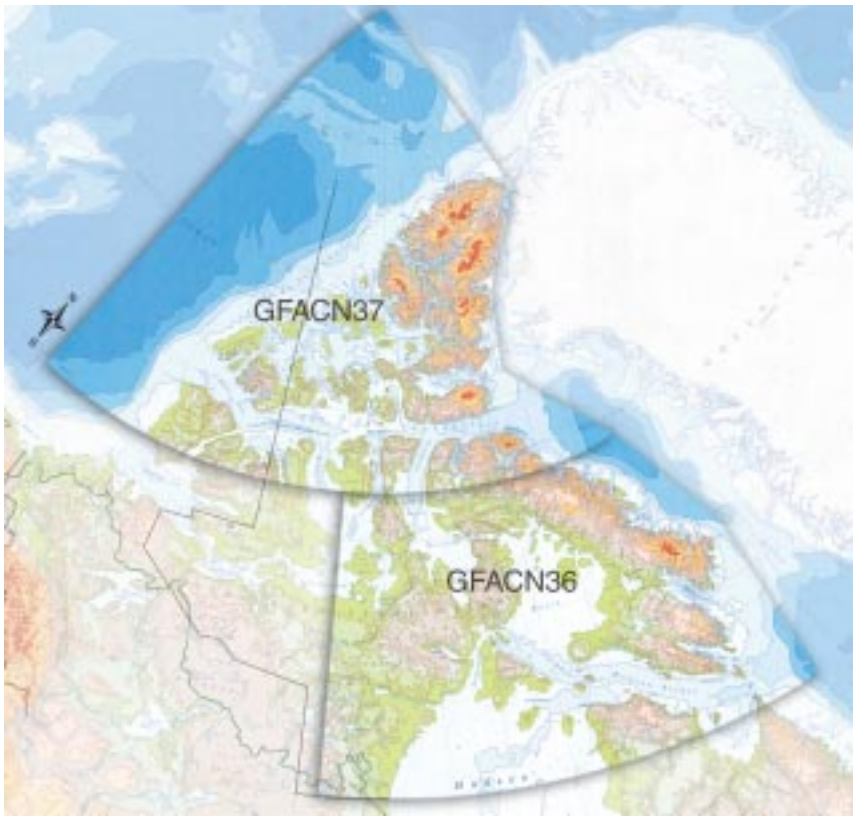
Chapter 4

Seasonal Weather and Local Effects

Introduction



Map 4-1 - GFACN36 and GFACN37 domains

This chapter is devoted to local weather hazards and weather effects observed in the GFACN36 and GFACN37 domains. After discussions with weather forecasters, FSS personnel, pilots, dispatchers, scientists, wildlife rangers, park rangers and local residents, the most common and verifiable hazards are listed. Most weather hazards are described in symbols on the many maps along with a brief textual description located beneath it. In other cases, the weather phenomena are better described in words. Table 3 provides a legend for the various symbols used throughout the local weather sections.

The chapter first presents a general overview of the weather across the GFACN36 and 37 domains and then the weather section by section.

Weather of the GFACN36 and GFACN37 domains

Major controlling features - The major controlling features of the weather across the GFACN36 and 37 domains are the state of the ocean/sea and topography. The ocean/sea can be ice covered, in a stage of melt, or ice free. Topography ranges from rugged mountains covering, for example, Ellesmere and Axel Heiberg Islands southwards through eastern Baffin Island to the flat terrain west of Hudson Bay.

Mean pressure patterns and flow favour northwesterly flow - Mean pressure patterns year round generally feature low pressure from the Labrador Sea northward through Davis Strait into Baffin Bay. A ridge of high pressure routinely resides from the Arctic Basin southeastward to the Mackenzie/Great Bear Lake/Great Slave Lake areas. The prevailing flow between the trough and the ridge is north to northwest. There is however often a secondary weak low-pressure area present over Foxe Basin with a narrow surface ridge running along the mountain spine of Baffin Island from west of Pond Inlet to west of Cape Dyer.

This flow often produces very strong north to northwest winds around the eastern headlands of Baffin Island (e.g. Cape Dyer) with slightly weaker winds along the coast northwest of Cape Dyer and northward to the southeast coast of Ellesmere Island. Some locations favour light winds in the predominant northwest flow due mainly to sheltering from mountains. Grise Fiord, Pond Inlet, Pangnirtung are such locations. At places such as Iqaluit, terrain favors northwesterly flows.

Strong northwest winds are a matter of routine - winter particularly - for an area from the Arctic Basin southeast across the central arctic islands and the barrens west of Hudson Bay.

Storms - Throughout the GFACN36 and 37 domains, storms in fall, and to a lesser degree in spring, bring strong winds that favour east and southeast with the approach of the storm and northwest in the wake of the storm. These same storms can bring significant dumps of snow.

Seasonal Comments

Winter

Ice fog, ice crystals, bands of low cloud - The seas of the GFACN36 and 37 domains are generally frozen over and act largely as a relatively smooth land surface, although often slightly warmer than surrounding land as heat transfers through the ice from underlying liquid water. Open leads in the ice are still found, most commonly in the moving polar ice pack and in the shear zone between it and the fast ice amongst the islands of the archipelago. Polynyas are also found in preferred locations providing local moisture sources; more extensive moisture can often be seen downwind of the large polynya in northern Baffin Bay/Kane Basin (the North Water). Leads

commonly develop in the pack ice during strong wind events, especially downwind of coastlines. These can create local ice fog and ice crystals or even bands of low cloud.

Ice fog - Cold temperatures (-40°C) can lead to ice fog around habitations/aircraft operations, but the ice fog is usually not persistent at most locations across the GFACN36 and 37 domains.

Snow - Visibility limiting - and at times sky obscuring - snowfall can occur 12 months of the year.

Strong winds and blowing snow - The main winter weather problem is strong winds and the associated low visibility in blowing snow. This happens most commonly when there is a strong high-pressure system extending from the Arctic Basin southeastward to the Mackenzie/Great Bear/Great Slave Lake areas concurrent with a deep low/trough from Baffin Bay to Davis Strait. The band of strong winds and blowing snow routinely occurs in a swath along an axis from Isachsen to Rea Point to Cambridge Bay to Baker Lake and southeastward. Blowing snow is less frequent through mountainous sections further east but becomes locally frequent on the east and south coasts of Baffin Island and along the northern Quebec Coast. Less common but not rare, storm tracks can produce strong winds and blizzards in normally protected locations such as Pangnirtung and Pond Inlet.

Calm winds - In winter, due to strong temperature inversions, some of the communities which experience increased frequency of strong winds, winter versus summer, also experience a significant increase in the percentage of calm winds. At Iqaluit, for example, calm winds go from almost 11 percent in summer to approximately 24 percent in winter while winds of 20 knots or greater increase from nearly 4 percent in summer to 10 percent in winter. At Resolute, the percentage of calm winds goes from 3 percent in summer to just under 10 percent in winter while the percentage of strong winds increases from just over 11 percent to just under 16 percent. At Baker Lake, the percent of calm winds summer and winter is close to 10 percent while the percent of strong winds increases sharply from near 5 percent in summer to 22 percent in winter.

Low level wind shear and turbulence - Moderate to severe mechanical turbulence is common over the rough terrain in strong wind situations. Significant low-level wind shear may be present particularly when surface winds are light. Strong winter inversions help to create local erratic strong winds in some locations, with little significant pressure gradient. These can produce strong low-level wind shear and severe turbulence.

In winter, low-level turbulence can also occur over polynyas and other open water areas.

Spring

Good flying weather but wind, blowing snow, and blizzards persist - In the high arctic especially, spring is often the season of the best flying weather as ice is still frozen and daylight hours increase rapidly. However, wind, blowing snow, and blizzard events persist in most areas.

Heavier snowfalls, icing, freezing precipitation - In southern locations and spreading north, during spring, air mass contrasts increase with warmer/moister air being involved in storms. This brings generally heavier snowfalls, more significant icing and the possibility of freezing precipitation.

Ice melts - Across the Hudson Bay and Hudson Strait sections of the GFACN36 domain, ice may begin to break up/melt in late spring. Across the GFACN37 domain, polynyas tend to expand and leads and puddling starts on the ice.

Stratus and fog - Stratus and fog may increase in frequency with warmer air over cold snow and ice covered surfaces.

Freezing drizzle - Freezing drizzle typically occurs in May in the GFACN36 domain and in June in the GFACN37 domain. Surface air temperatures are usually in the zero to -8°C range during the freezing drizzle events.

Summer

Snow - Over higher terrain, visibility limiting and at times sky obscuring, snowfall can be significant. For example, Cape Dyer located on the Cumberland Peninsula and at an elevation of 1289 feet ASL, shows mean snowfall of 37 centimetres in June, 42 centimetres in July and 48 in August.

Ice melts - During the summer, sea ice melts and breaks up producing cool moist air at low levels over nearby areas. Large areas of low cloud and fog/mist trapped under inversions are widespread over sea and along coasts, and sometimes spreads well inland in persistent onshore flows. Interiors of larger islands and inland sections of fiords/ inlets usually have much better conditions than exposed coasts. Cumulus and some towering cumulus can develop over inland sections of larger islands.

Some thundershowers - Good flying weather dominates the mainland "interior" section of the GFACN36 domain during the summer. Convective cloud becomes more common, with some thundershower activity, southern sections particularly. With sufficient upper level support, thundershowers can persist over, and across, the cold surface of Hudson Bay to reach northern Quebec. Albeit rare, isolated thundershowers have been noted on the islands of the GFACN37 domain, Banks and Victoria Islands in particular.

Weak pressure systems and light winds - Generally, pressure systems through summer are weaker than their winter counterparts. Thus, winds in summer tend to be lighter than those of other seasons.

Fall

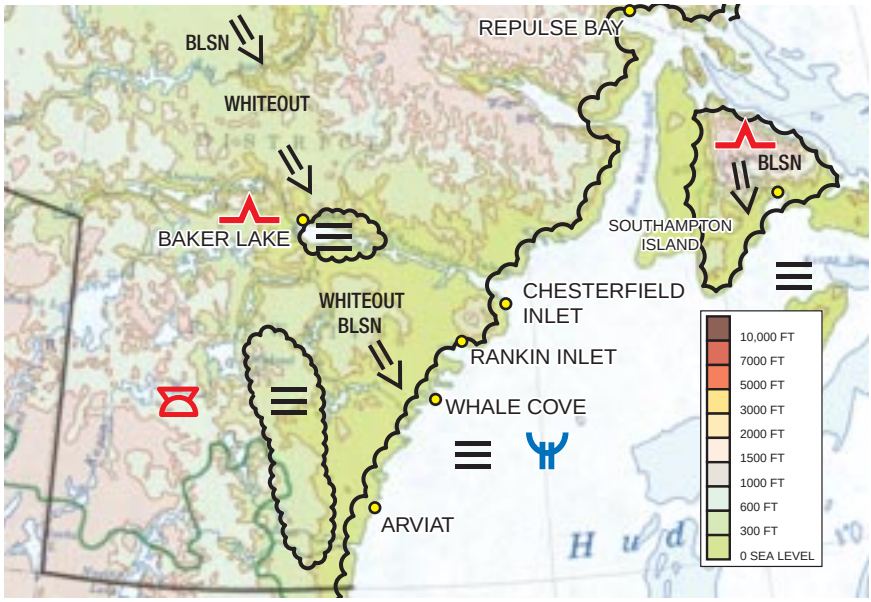
Stormy, heavy snowfalls, low level mixed icing - Stormy, heavy snowfalls, low-level mixed icing - Fall is the stormiest season in general. Air mass contrasts strengthen and open water extent is at its maximum facilitating strong development. Heavy snowfalls can occur with instability and ample moisture supply as cold air moves over open water. Low cloud over the seas is replaced by stratocumulus, cumulus, and towering cumulus with local freezing drizzle. The prime month for freezing drizzle is September across the GFACN37 domain and October across the GFACN36 domain. Surface air temperatures are typically in the zero to -10°C range during the freezing drizzle events. Low-level mixed icing becomes more common.

Strong winds then strong winds with blizzards - Stronger storms produce strong winds, but full blizzards do not usually occur until late fall when the ground becomes fully snow covered and temperatures colder. Low visibilities (blizzards) generally happen only when there is snow falling.

Weather area by area

Southwestern GFACN36

Arviat, Whale Cove, Rankin Inlet, Chesterfield Inlet, Baker Lake and Coral Harbour



Map 4 -2 - Southwestern section of GFACN 36 domain

The majority of the communities of this area lie on the Hudson Bay coast. Baker Lake lies on the shores of a large lake. Coral Harbour lies on Southampton Island. All of the communities are well beyond the tree line which barely extends into the GFACN36 domain from northern Manitoba. The land is relatively flat. The local weather is influenced by the moisture from Hudson Bay and a myriad of inland lakes during the open water period and from the predominant northwest flow over the area in the winter.

Weather by Season

Winter: blizzards - In the winter, strong northwest winds are common across the entire area bringing blowing snow and blizzard conditions. These conditions can last days. After such a strong wind event, an area of open water - albeit new ice is quick to form - develops between the departing mobile ice of Hudson Bay and the ice which is fast along the shore. Onshore flow from the open water brings 'sea smoke' or freezing fog onshore. Additionally, even after the winds have decreased following a blizzard event, visibility may take a few hours to improve as ice crystals suspended in the air take their time to fall out. The average number of blizzard events through

the frozen season (fall and winter into spring) ranges from 20.8 at Baker Lake to 16.9 at Rankin Inlet to 14.7 at Coral Harbour.

Spring: low cloud and fog - In the spring, with the breakup of the ice starting in May through July, the addition of moisture to the lowest levels of the atmosphere is substantial creating large areas of low cloud and fog. Easterly flows readily move this low cloud and fog inland. The "flavour" of the easterly winds is critical. For instance, Chesterfield Inlet is more exposed than Rankin Inlet and tends to have poor flying conditions more often than Rankin Inlet. Indeed, Rankin Inlet is situated far enough into the inlet that a northeast flow may help disperse the low cloud as it moves over the land for some distance before reaching Rankin Inlet. Patchy freezing drizzle may be encountered in a low cloud deck. At times in the early spring, low cloud can redevelop inland when the flow is upslope. The aviation community cites such cloud developing inland from Arviat through Whale Cove.

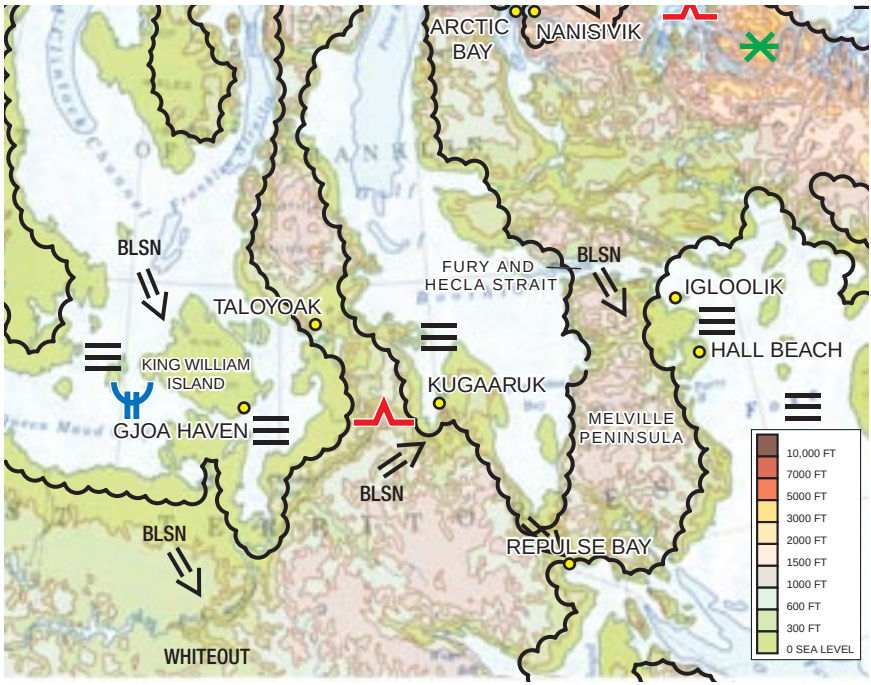
Summer: thundershowers - Conditions slowly improve into the summer months as the ice melts and low cloud disperses more quickly in the morning. Over the mainland, convective cloud becomes more common and the chance of a thunderstorm increases, especially during July. Summer afternoons are the best time to fly along the coast. However, low-pressure systems are often deflected into the area from the south giving rain and fog events along the coast. The summer low-pressure systems tend to be weak in comparison with fall and spring lows.

Photo 4-1 - Rankin Inlet airstrip looking west on a sunny July day credit: Tim Gaines

Fall: storms - In the fall, low-pressure systems become more energetic as the air mass contrasts strengthen and open water is at its maximum. Well defined synoptic storms can inflict the region with rain and snow as well as freezing precipitation. Freezing drizzle is common with the cloud that flows off Hudson Bay. Mixed icing in the cloud can be significant. Winds strengthen and can be very gusty from the southeast ahead of the low and from the northwest behind it. In the late fall, blizzards return.

Northwestern GFACN36

Repulse Bay, Gjoa Haven, Taloyoak, Kugaaruk, Hall Beach, Igloolik



Map 4-3 - Northwestern section GFACN36 domain

Weather by Season

Winter: winds, blowing snow and blizzards - During the winter, local weather is often at the mercy of the strength of the northwest winds with respect to blowing snow. Even after winds have decreased after a blizzard event, visibility may take a few hours to improve as ice crystals suspended in the air take their time to fall out.

Spring: wet snow, freezing rain, freezing drizzle - During the spring, prior to break-up, flying weather tends to be good. Spring low-pressure systems can however be intense and can dump considerable wet snow. On occasion, these spring lows can bring a bout of freezing rain. May into early June is the period for freezing drizzle.

Late spring/summer: low cloud and fog - Very late spring and summer brings ice melt and breakup with open water areas developing. The addition of moisture to the lowest levels of the atmosphere over the open water can be substantial creating areas of low cloud and fog. Onshore flows readily move this low cloud and fog inland. Of the airport sites in this area, Gjoa Haven is the site most vulnerable to poor flying weather while Taloyoak tends to have more favourable flying weather.

Summer: good inland, cloud and fog over water - During the summer, inland areas of the mainland and the interior of islands tend to have good flying conditions. Convective cloud becomes more common. Thundershowers are rare. Over the sea, low cloud is common.

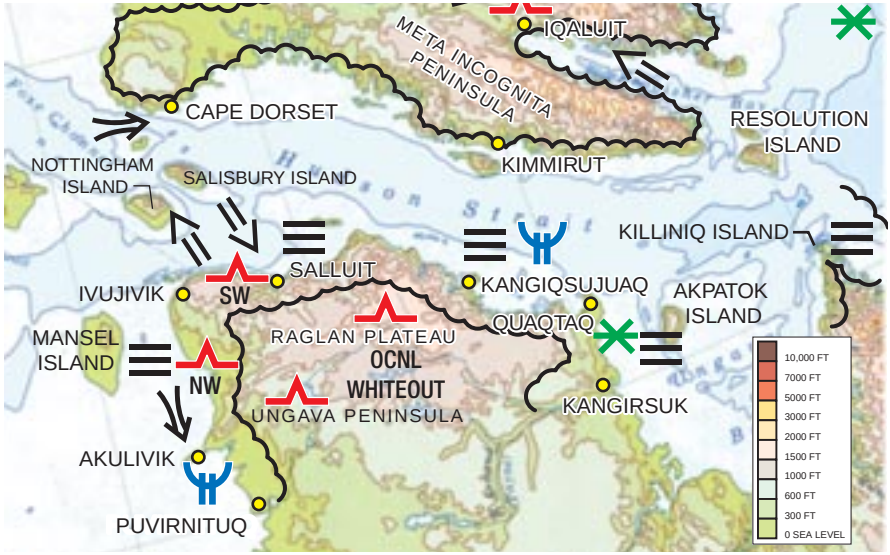
Fall: storms, freezing precipitation - In the fall, onshore flow from open water areas brings 'sea smoke' or freezing fog. Also, in the fall, low-pressure systems become more energetic as the air mass contrasts strengthen and open water is at its maximum. Well defined synoptic storms can inflict the region with rain and snow as well as freezing precipitation. Freezing drizzle is common with the cloud that flows off open water. October is typically the month when most freezing drizzle events occur. Mixed icing in the cloud can be significant. Winds strengthen and can be very gusty from the southeast ahead of the low and from the northwest behind it. In the late fall, blizzards make their return.

Local effects

Kugaaruk - The hills in the vicinity of Kugaaruk are capable of giving low-level mechanical turbulence in strong northwest wind regimes.

Northern Quebec (Nunavik) and extreme northern Labrador section of GFACN36

Puvirnituq, Akulkivik, Ivujivik, Salluit, Kangiqsujuaq, Quaqtaq and Kangirsuk



Map 4-4 - Northern Quebec (Nunavik) and extreme northern Labrador section of GFACN36 Domain

Weather conditions across northern Quebec and extreme northern Labrador section of GFACN36 are strongly influenced by the large saltwater bodies of Ungava Bay, Hudson Bay, Hudson Strait, and the Labrador Sea as well as mountains. Ungava Bay usually freezes over in late October or early November and remains covered until the pack ice goes in late July. Some years, Ungava Bay never freezes over completely and the ice can be all gone early July. Hudson Bay usually freezes much later, usually by the end of December, but never does so completely as the ice shifts continuously under the influence of the wind. Near the coastline, the ice usually melts in late June or early July with the rest of the ice not breaking up until later in the summer. In Hudson Strait, the water usually freezes by the end of November. The main ice pack usually goes away by mid-July leaving floes and small bergs that finally clear out of the strait by the end of July.

Weather by Season

Late winter/early spring: ice covered season

Once the ice pack is well established, flying conditions tend to become more favourable than at other times of the year in terms of ceiling and visibility. This is especially true for the months of February, March and April. Typically, during this time of year, a localized high-pressure system establishes itself over Ungava Bay giving clear skies and good visibility. The area is still exposed to synoptic-scale weather systems that move generally from west to east or from southwest to northeast. In such cases, weather conditions that hit the eastern shore of Hudson Bay usually reach Ungava Bay 24 hours later.

Whiteouts - Weather can rapidly change to whiteout conditions when visibilities fall drastically in ice crystals in the lowest levels of the atmosphere. Whiteouts are frequent north of the tree line, since there are few visual markers and the horizon is easily lost. Whiteout conditions are frequent across the Raglan Plateau, which is at 1,900 feet ASL. Whiteout conditions become generalized as soon as the land is covered by low cloud.

Turbulence - Due to usually stronger winds at this time of the year, and "winter" inversions, turbulence becomes more frequent over - and in the lee of - mountainous terrain. The Raglan Plateau, wave clouds are frequently observed at altitudes of 6,000 to 7,000 feet ASL, indicating the presence of severe lee wave turbulence. Pilots cite that lee wave cloud and turbulence can be found on the northeast side of the Raglan Plateau when the flow aloft is from the southwest and on the southeast side of the Raglan Plateau when the flow aloft is from the northwest. Moderate to severe mechanical turbulence is common with northwesterly winds of 30 knots or more developing after the passage of a cold front. It is also frequent throughout the Ungava Peninsula when the upper winds at 3,000 feet are 30 knots or more. The strong winds also routinely give reduced visibility and at times blizzard conditions in blowing snow.

Icing - Icing can be an issue as most flights are short "hops" between neighbouring communities and tend to be conducted at altitudes of less than 3,000 feet AGL. Significant amounts of ice can then accumulate over aircraft surfaces during such hops. Fog, producing significant icing and very low ceilings and visibilities, forms over any open water and drifts inland, pushed by the wind during colder months. Ice fog also tends to form over villages, when winds are light, due to the moisture contained in the exhaust of building heating systems.

Late spring and early summer: warm air arrives, ice melts

Low cloud and fog - The arrival of warmer air over ice-covered or snow-covered surfaces generally results in the formation of thick fog or low cloud. As a result, low ceilings, poor visibility, and light to moderate rime or mixed icing are common. Conditions improve once the snow melts and the pack ice moves away. The top of the fog layer may reach 500 feet AGL. The fog generally stays over water during the day but the fog can move inland as the ground and air temperatures warm up generating a sea breeze.

Mid to late summer: ice-free season

Fog - Fog is the dominant poor weather giver once the ice is completely gone. The water, although warming, remains much cooler than the air over it. The resultant advection fog routinely gives zero to near zero ceilings and visibilities to areas along the coast. Trapped under an inversion, this fog is reluctant to lift, regardless of how strong the sun. The months of July and August are generally the worst "fog" months.

Rain and thunderstorms - Rain is generally observed with the passage of a weather system. Thunderstorms are rarely observed over northern Quebec. When observed, they are usually associated with an upper trough crossing Hudson Bay from the west. The thundershowers are usually embedded in the general cloud mass associated with the upper trough.

Lee wave turbulence - Strong southerly winds (20-30 knots) are often observed during the summer months as weather systems approach from the west. Lee wave turbulence and lenticular clouds are frequently observed over the Ungava Peninsula, especially over the Raglan Plateau.

Fall transition from mid-September to mid-November

Freezing drizzle and icing - Fog becomes less dominant as the land cools down. However, status ceilings persist and freezing drizzle can result. Freezing drizzle tends to form in onshore/upslope flow off the sea. Icing is common over water and along the coast line. Conditions improve inland.

November to mid winter

Snow squalls, turbulence, icing, and katabatic winds - During the coldest months, prior to freeze-up, snow squalls can develop over Hudson Bay, Hudson Strait, and Ungava Bay and push inland. Severe turbulence and icing, along with whiteout conditions, are usually encountered in these squalls. Strong turbulence can be expected when the wind runs crosswise to the fiord. It will be smoother when a strong, but steady and stable, wind is coming down the fiord. Additionally, strong katabatic winds, which have reached 80 knots on occasions, sometimes develop in various fiords at night.

Depth of winter

Violent winds, turbulence, blizzards - In the depth of winter, violent winds from the southeast, in excess of 50 knots, are observed when an intense low-pressure system moves from Hudson Bay to northern Baffin Island. After the passage of a cold front, northwesterly winds of 50 to 60 knots are often observed, mostly at night. Such winds usually generate significant mechanical turbulence along the coast, especially in Kangiqsujuaq and Salluit, due to the high elevation of their respective runways. These strong winds also give blizzard conditions.

Extreme northern Labrador/extreme northeastern Quebec

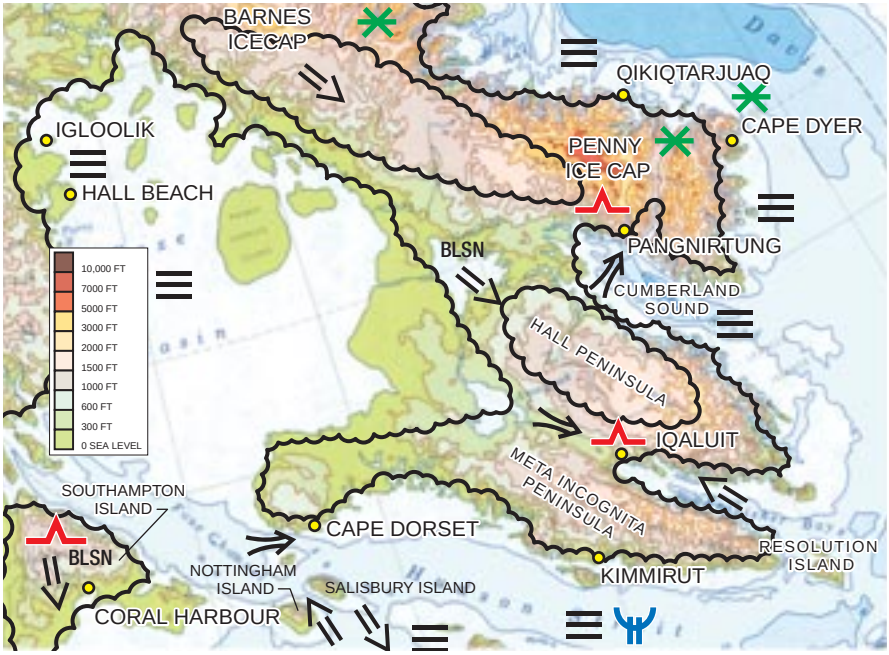
Turbulence, updrafts, and downdrafts - The area commonly experiences very strong wind regimes and resultant turbulence over rugged terrain. Numerous mountains and fiord-like valleys cause an array of local effects such as funneling, channeling and cornering. Severe updrafts and downdrafts are also encountered in the deep valleys and fiords.

Low cloud, poor visibilities, and freezing fog - Across the area, including Killiniq Island, southeast to northeast winds will generally give low ceilings and poor visibility conditions. These conditions will often penetrate deep into the valleys and fiords, depending on the wind. The lowest conditions generally occur in the spring and summer. Freezing drizzle in onshore flow can be a problem particularly in the spring and fall.

Icebergs - Numerous icebergs protrude out of the water creating a "terrain" hazard. The more icebergs and the more ice cover across an area, the greater the occurrence of fog and low cloud.

Southern and southeastern Baffin Island section of GFACN36

Cape Dorset, Kimmirut, Iqaluit, Pangnirtung, and Qikiqtarjuaq



Map 4-5 - Southern and southeastern Baffin Island section of GFACN36 domain

The terrain of the area goes from mountainous with glaciers and ice caps on the Cumberland Peninsula to the seasonally ice covered waters of Foxe Basin, Hudson Strait and Davis Strait. Terrain and its orientation can for example direct the winds or shield a site from onshore flow. Iqaluit lies in a bay/valley combination that runs northwest to southeast with the higher terrain of the Hall Peninsula to the northeast and the Meta Incognita Peninsula to the southwest. One would expect northwest and southeast winds to prevail at Iqaluit and they do. Kimmirut has lots of terrain in the immediate area as well as terrain upstream in all directions except for the southeast quadrant. The terrain shelters the Kimmirut runway from much of the low cloud and fog that exists over Hudson Strait. That same terrain also produces low level mechanical turbulence when it is windy. Similarly, there is considerable terrain in the immediate area of Qikiqtarjuaq that can shelter the community from intrusions of low cloud and fog off the water. Pangnirtung resides in Pangnirtung Fiord which is oriented northeast to southwest off Cumberland Sound and is surrounded by mountains. Cumberland Sound runs northwest to southeast. This combination makes for a complex wind regime at Pangnirtung which at ground level favours light winds but can blow strong from the west-southwest or east-northeast.

Weather by Season

Winter - Winter is the season for snow and blowing snow albeit the heaviest snowfalls occur spring and fall along with blowing snow events. Snow is also a feature of summer weather over the higher terrain of the Cumberland Peninsula. Blowing snow, snow, and fog make the winter period the poorest season with respect to flying weather at Iqaluit. On average, through the frozen period that starts in the fall and extends through the winter into the spring, Iqaluit will experience 5.9 blizzard events while Cape Dorset will experience 3.5 such events. Often the blowing snow events occur when there are clear skies above the surface-based layer of blowing snow. Although the surrounding water is frozen, occasionally open leads will develop courtesy of winds and tides. Patchy fog and stratus from the open water areas can advect over the terminals depending on flow.

Spring - Spring is the start of the melting season and with more moisture available fog and stratus can develop. Freezing drizzle occurs on occasion particularly with cloud that originated over open water. With the longer days and rising temperatures, diurnal effects become more apparent, giving poor flying conditions during the overnight and morning hours. Snow and blowing snow linger.

Summer - Summer brings favourable flying conditions on land while over the open water of Foxe Basin, Hudson Strait and Davis Strait, there is routinely low cloud and patchy fog. Summer shows as having the most favourable flying weather of the seasons for Cape Dorset, Iqaluit and Pangnirtung. At higher elevations, summer can still be winter with snow and even blowing snow. Indeed, at the old Cape Dyer site, (about 1,300 feet ASL) average monthly summer snowfall ranges from 37 centimetres in June to close to 48 centimetres in August.

Average snowfall in centimetres by month (Montreal included for comparison)

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Cape Dorset	24.6	21.0	23.2	33.3	30.3	8.1	0.3	1.1	13.5	41.6	51.6	39.7
Iqaluit	24.0	22.7	23.6	28.5	23.2	8.8	0.2	0.5	13.9	34.8	34.5	24.5
Cape Dyer	66.1	53.0	34.8	41.1	51.4	37.0	41.7	47.9	68.2	92.2	68.8	55.5
Montreal	49.6	43.8	35.0	12.4	0.3	0	0	0	0	2.0	22.6	48.5

Table 4-1 - Average snowfall in centimetres by month (Montreal included for comparison)

Fall - Fall brings a return to more frequent low cloud as available moisture clashes with colder air. Fall snowfalls are routinely the heaviest snowfalls of the year along with periods of freezing drizzle. For the Baffin Coast bordering Davis Strait, a combination of weather systems and upslope flow make for significant snowfalls. Snow streamers off open water can give heavier squalls with visibility approaching zero.

Local Effects

Cape Dorset - The location of Cape Dorset on Cape Dorset Island and the surrounding terrain causes a funnelling effect, giving strong and gusty winds from the west. Being close to Hudson Strait, fog and stratus will readily move over the terminal.

Kimmirut - Winds from the southeast can funnel up through Glasgow Bay into the town and terminal giving gusty winds from that direction. Severe turbulence is common with winds from any direction due to the surrounding terrain, but especially with an easterly flow over the higher terrain of the Meta Incognita Penisula. Being so close to Glasgow Bay and Hudson Strait, fog and stratus can advect into Kimmirut.

Iqaluit - Moderate to severe turbulence and low-level wind shear can occur with an easterly flow. During the ice-free season, low tide at Iqaluit can expose about 1/4 mile of sea floor. When the low tide occurs during the day, heating over the exposed dark sea floor of Frobisher Bay can produce updrafts. These updrafts can give turbulence with a southeast approach to the runway.

Pangnirtung

The runway at Pangnirtung is located in Pangnirtung Fiord, which is narrow and has mountains on either side. Despite what seems to be a sheltered location, flight operations into this airport are affected by the direction and strength of the wind. Wind funnelling from the southwest into the fiord can be hazardous as pilots have to fly into the fiord with the wind and then make a 180-degree turn to turn into the wind to land at the terminal. Long approaches from the east are not recommended due to the terrain. Winds of greater than 12 knots can prevent an airplane from landing at Pangnirtung. Occasionally a storm will track from northern Labrador to southwestern Baffin Island, as far north as Cumberland Sound. These storms can produce very gusty east to east-northeasterly winds that can reach damaging strengths. Indeed a resident of Pangirtung cites that a house was blown off its blocks, even though it was tied down during a storm of this type. A southeasterly flow over the peninsula can give severe turbulence and/or low-level wind shear. In summer, during the open water season and when it's sunny, afternoon sea breezes blowing along Pangnirtung Fiord (westerly winds at about 15 knots) are common.

Higher terrain including Cape Dyer

The higher terrain of the Cumberland Peninsula makes the peninsula vulnerable to snow 12 months of the year and the snow can be heavy reducing visibility to 1/2 mile or less and giving ceilings which are 500 feet or less. The combination of cloud and precipitation readily obscures higher terrain.

Seasonal charts of ceiling below 1000 feet and/or visibility less than 3 miles for the

old Cape Dyer site suggest that spring has the poorest flying weather. Indeed, the charts show the weather meeting these poor conditions about 40 percent of the time by night lowering to 30 percent of the time by day. Values for the other seasons range from 25 to 30 percent by night to 20 percent by day.

Qikiqtarjuaq

Qikiqtarjuaq, located on Broughton Island, is somewhat protected by higher terrain of the island and the presence of Baffin Island to the west. That being said, fog and low cloud do, on occasion, find their way onto the airport. Surrounding hills impact on the winds. Surface winds are rarely strong. However, at times, moderate to severe turbulence and/or low-level wind shear can occur.

Northern Baffin Island section of GFACN36 and GFACN37

Clyde River, Pond Inlet, Nanisivik and Arctic Bay

Map 4-6 - Northern Baffin Island section of GFACN36 and 37 domains

The terrain of the area goes from mountainous with glaciers and ice caps to seasonally ice covered waters. With the exception of Nanisivik, the airports in the area are along the coasts of a bay, fiord or inlet and have other large bodies of water nearby. Nanisivik lies on an exposed plateau of about 2,000 feet ASL.

Weather by Season

Winter - Winter season for this area is the most stable and brings relatively good weather. Although the surrounding water is frozen, occasionally patchy fog and low cloud can move from open leads of eastern Lancaster Sound or Baffin Bay to the communities. Strong winds can give blowing snow/blizzards to exposed terrain.

Spring - Spring is the start of the melting season, and with more moisture available fog and low cloud develop. With the longer days, and rising temperatures diurnal effects become more apparent, with the poorest flying conditions developing overnight and lingering into morning.

Summer - Inland, summer is a time of favourable flying weather. However, over the waterways it is a time of warm air over cold water surfaces, a recipe for low cloud and areas of fog. Coastal communities such as Clyde River are vulnerable to intrusions of low cloud and/or fog. Summer has the poorest flying weather at Clyde River, especially during the overnight period. At Nanisivik, fall and summer are a toss up with respect to having the poorest flying weather.

Fall - Fall brings a return to more frequent fog and low cloud conditions as available moisture clashes with colder air. Before freeze-up, snow streamers develop over Davis Strait with heavier squalls giving at times near zero visibility. Storms consistently track from south to north across Davis Strait to Baffin Bay. These storms routinely cause strong northwesterly winds along the east coast of Baffin Island including at Clyde River.

Local effects

Clyde River - The terrain to the north through northeast and east of Clyde River is flat giving a ready path for fog and low cloud to get to the community. Strong northwesterly winds develop as a low pressure system moves northward through Davis Strait and a ridge of high pressure develops west of Clyde along eastern Baffin Island. Higher terrain to the northwest channels the wind along the coast into Clyde River. The winds usually ease once the low-pressure system has moved to the northeast quadrant from Clyde River. During the "frozen season", the strong gusty northwest winds give blowing snow and at times blizzards. On average Clyde gets 10.7 blizzard events a year. This type of wind can also occur with a trough of low pressure oriented northwest to southeast across Baffin Bay and Davis Strait. Severe low-level turbulence and wind shear especially around Black Bluff, about 3 miles south of the terminal, accompany the strong, gusty northwest surface winds.

Pond Inlet - Pond Inlet has much better flying weather and a lighter wind regime than Clyde River and Nanisivik. Strong westerly winds can, on rare occasions, be expected. Stratus from Baffin Bay can advect into Pond Inlet with an easterly flow. Moderate turbulence can occur with a northerly flow over Bylot Island.

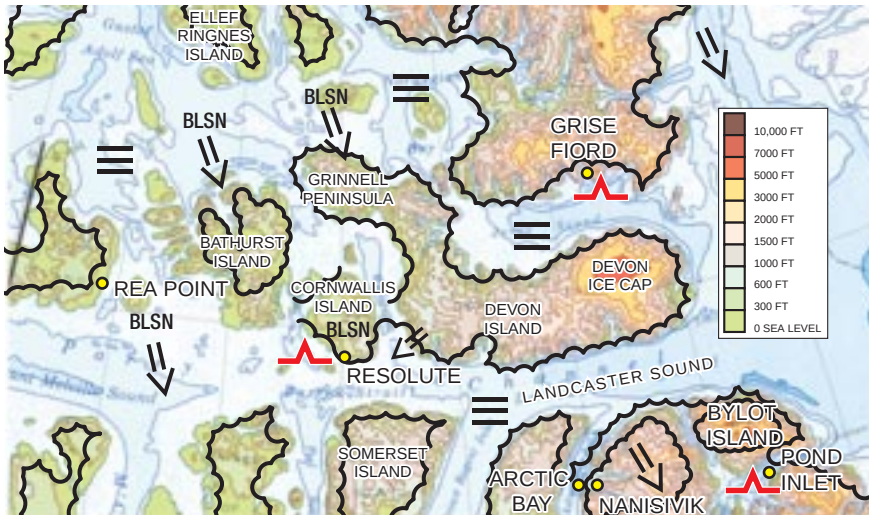
Nanisivik - Because of its elevation (about 2,000 feet ASL), and the flatness /openness of the plateau on which it resides, Nanisivik airport is exposed to the weather and has a lot of poor flying weather throughout the year. Storms that track from the south-southwest give Nanisivik strong southeasterly winds and low ceilings along with poor visibility. Blizzards are common during the fall and early winter. What is

low cloud to the community of Arctic Bay (located at sea level) becomes fog for the Nanisivik airport. With its higher elevation, the weather at Nanisivik shows a diurnal trend with fog being common during the morning hours.

Arctic Bay - The community of Arctic Bay and to a lesser degree, the Arctic Bay airstrip are sheltered from much of the wind and weather that Nanisivik experiences.

Southeastern section of GFACN37

Resolute, Rea Point, and Grise Fiord



Map 4-7 - Southeastern section of GFACN37 domain

The terrain of the area varies from mountainous with glaciers over southern Ellesmere Island to an ice cap eastern Devon Island to seasonally ice covered waters, to the open waters of the North Water and other polynyas.

Weather by Season

Persistent snow cover in excess of 2 centimetres across this section ranges from about 260 to 280 days per year bridging fall, winter, and spring. At Resolute, only the months of June, July and August have mean daily maximum temperatures above zero and of these months, only July also has an above zero mean daily minimum. Ice melt begins in June with the maximum amount of open water occurring in mid September. Summer is the time of 24 hours of daylight (Resolute is at 74°43'N and Grise Fiord is at 76°25'N) while winter is the time of 24-hour darkness.

Frozen season

The frozen season begins in September as new ice forms in coastal areas and skims

over the surface of open water areas. The frozen season ends in June. Once the open water areas are ice covered, the abundant source of moisture for low cloud and fog is cut off. Before this happens, a combination of weather systems and open water contribute to make September followed by October the snowiest months. The snow routinely gives obscured ceilings by snow and restricted visibility.

The frozen season is also the blowing snow and blizzard season. The entire western portion of this section is vulnerable to strong northwest winds and blowing snow and is part of the blizzard alley that extends southeast from the Arctic Basin across the central Canadian arctic islands and into the GFACN36 domain (barrens west of Hudson Bay). Resolute Bay experiences on average 12.6 blizzard events during the frozen season. Just as September is the month showing the most snow, September is also the most likely month for freezing drizzle or freezing rain.

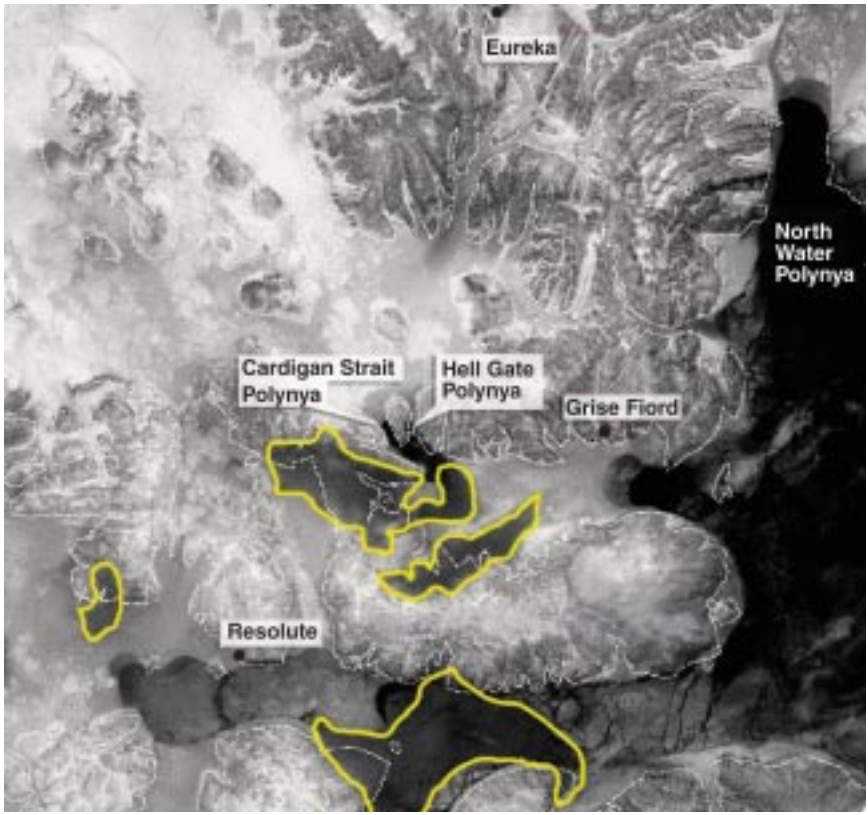


Photo 4-2 - Infrared Satellite photo 26 February 2001 showing low cloud (areas circled with yellow line) that originated over, or still resides over, open water (darkest areas are areas of open water, thin ice, or low cloud)

The winter months December, January and February are a time of strong inversions with the visibility often restricted in ice crystals below that layer. Open water leads,

polynyas, moisture associated with heating systems and aircraft exhaust can at times trigger ice fog below the inversion. An approaching upper trough can trigger a layer of ice crystals that extends up to 18,000 feet or more. Under such conditions light snow can fall from skies that have no discernible cloud. This "fluffy" snow readily becomes blowing snow. This ice crystal haze clears with the passage of the upper trough.

The spring months of March, April and May reside in the frozen season. Statistically, they are the months of most favourable flying weather. These months are also the months that the area of 24-hour daylight pushes south and bring about a thinning snow cover. Warmer and moister air masses that have, except for rare occasions, lingered well south, now move into the area. At Resolute for example, average snowfall values go from about 4 centimetres in January and February to values near 6 centimetres in March to near 10 centimetres in May.

Unfrozen season

At Resolute, the months of June, July and August have mean daily maximum temperatures above zero degrees Celsius of these months only July has an above zero mean daily minimum. During the unfrozen season, low cloud and fog are the routine across ice-covered waterways and open water areas. Onshore flows readily bring these conditions inland. During summer, Resolute and Rea Point are vulnerable to onshore flow that moves the cloud easily across low terrain. Summer frequency of ceilings below 1000 feet and/or visibility below 3 miles at both Resolute and Rea Point show values close to 40 percent for the overnight and morning periods. These values drop to near 30 percent during the afternoon and evening. Grise Fiord, with high terrain across the entire north quadrant which blocks intrusions of cloud and fog from those directions, has better unfrozen season/summer flying weather than either Rea Point or Resolute. Summer frequencies of ceilings below 1000 feet and/or visibilities below 3 miles at Grise Fiord peak at about 25 percent which is 15 percent lower than at Resolute or Rea Point.

Local Effects

Resolute and Vicinity - Winter has more stable weather than any other season as cold arctic air pervades over the area. There are small polynyas to the north of Cornwallis Island and with a northerly flow fog and low cloud can make it across the island to Resolute. With a strong northwesterly flow, there can be blowing snow and depending on the amount of snow upstream and the strength of the winds, the blowing snow can constitute a blizzard. Spring brings warmer temperatures and the start of the melting season. As open water develops, fog and stratus can be a problem as it moves into Resolute from the west and southeast particularly. Northwest winds transport low cloud into Resolute, as do the winds from the west and southwest. When the fog and stratus starts to roll in during the late spring, the locals remark that "summer is here." With stagnant weather patterns, the low cloud and fog can persist

for days. On occasion, strengthening winds can disperse the fog, but when winds subside, the fog returns. Thunderstorms do occur in Resolute and over the islands such as Prince of Wales Island but this is rare. Local residents have commented that they have heard thunder more frequently over the last few years. Fall brings the return of darkness, colder temperature and more stable weather. As the waterways begins to freeze the chance of fog and stratus developing becomes less.

When air temperatures are below freezing and water upwind is open, freezing drizzle or freezing fog can occur at Resolute. With freezing fog, rime or glaze forms on cold surfaces. Depending on the moisture content of the air, hoarfrost can also develop on cold surfaces with freezing fog. Winds at Resolute can be strong from most directions even when weather charts depict a weak flow. Occasionally observed winds of 15 to 20 knots can abruptly find a few more knots of speed resulting in blizzard conditions. There is often little change in the pressure pattern to tip one off that this is about to happen. In winter, with a pressure pattern that favours north through northeast winds, pumping winds do occur at Resolute. Thus long periods of strong northeasterly winds can, at times, become light and back to the west or northwest, then return to northeasterly. At Resolute, winds from the northeast flowing over the ridge can give severe turbulence and/or low-level wind shear.

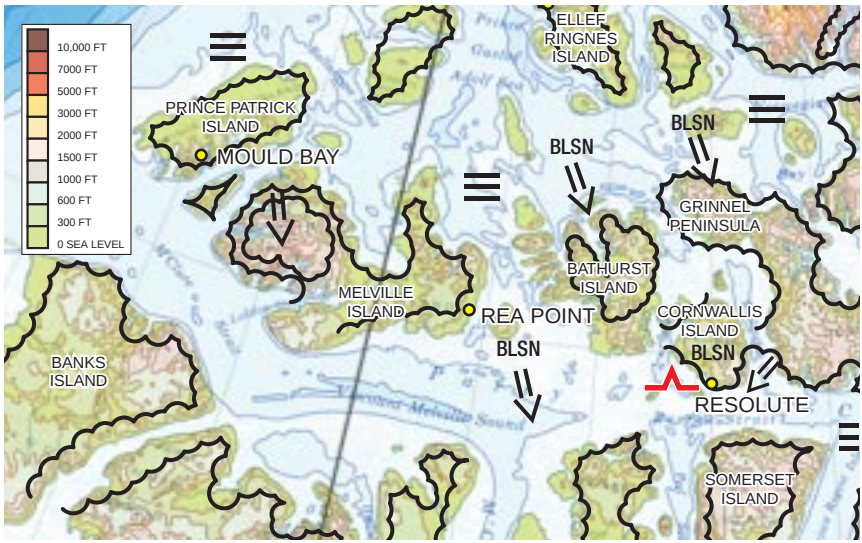
Southern Ellesmere Island - Cold dry arctic air dominates during the winter. However, through the winter the North Water Polynya is a source of moisture for low cloud and fog that can invade the many fiords bordering the open water. Downstream of the North Water Polynya, one can also expect to encounter snowflurries. During the spring with melting occurring and warmer temperatures, fog and stratus will develop over the water and move inland depending on the flow. Upslope flow can produce shelf clouds over higher terrain and also moderate turbulence. In the summer, the weather on land favours scattered cloud. Disturbances however, bring cloud and precipitation on occasion. At higher elevations, the precipitation will be snow. The fall brings a return to colder temperatures and until the water freezes completely, fog and stratus are a problem.

Grise Fiord - The airport is located at the bottom of a valley between two plateaus that rise over 2,000 feet ASL. Pilots cite that with surface winds of only 10 knots, moderate to severe turbulence and low-level wind shear can be expected making landing very difficult. Pilots also noted that they look to see if the local winds are increasing or decreasing. If winds are increasing they do not fly into Grise Fiord. If the winds are decreasing, they will. That said, the wind regime at Grise Fiord is a challenge. Onsite weather observers have cited that they have observed winds over the nearby water of Jones Sound being different from those at the airport which in turn were different from those at the other end of runway. Wind speed and wind direction measurements can fluctuate wildly.

Being adjacent to Jones Sound, the airport is vulnerable to low cloud and fog moving in with a southeasterly wind.

Southwestern section of GFACN37

Mould Bay, Rea Point



Map 4-8 - Southwestern section of GFACN37 domain

The terrain of the area varies from the high terrain of western Melville Island, northern Banks Island, and northern Victoria Island to the generally ice covered waters between islands and the Arctic Basin.

Persistent snow cover in excess of 2 centimetres across this section ranges from about 260 to 280 days per year bridging fall, winter, and spring. At Mould Bay, only the months of June, July and August have mean daily maximum temperatures above zero and of these months, only July also has an above zero mean daily minimum. Ice melt begins in May with puddling on the ice making landing on ice treacherous June through July and August.

Photo 4-3 - Puddled ice, 10 June 1976, at 73°N 130°W during the installation of an automatic weather station about 80 n. miles west of Banks Island. Per the pilots, June is not a good time to land fixed wing aircraft on the ice of the Arctic Basin!

credit: Robert Grauman

Climatologically, the amount of open water that develops across this area is limited. There are, however, years such as 1998 when the area of open water is considerable. Summer is the time of 24 hours of daylight while winter is the time of 24-hour darkness.

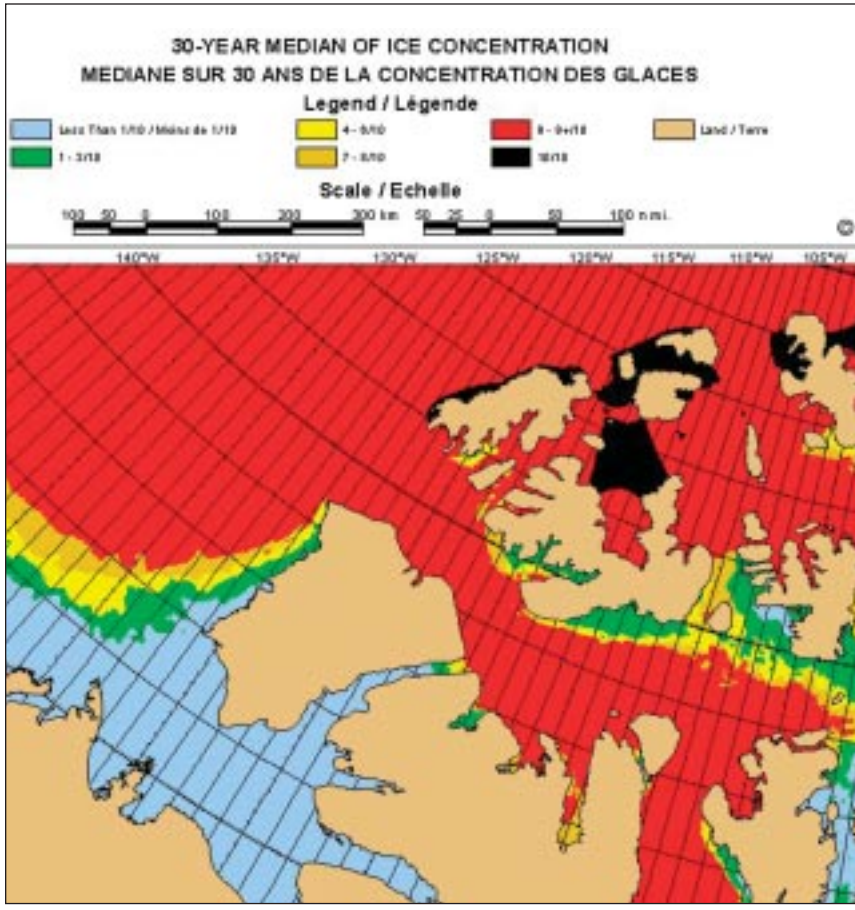


Fig. 4-1 - Median ice conditions for 3 September, 1971 to 2000 data

credit: Canadian Ice Service

Weather by Season

Frozen season

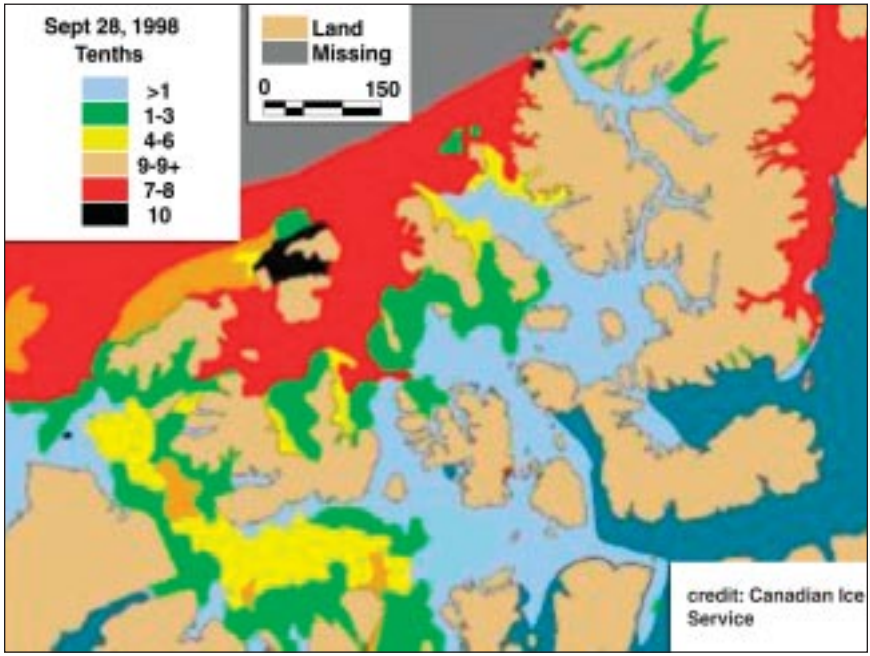


Fig. 4-2 - Ice conditions 28 September 1998

The frozen season begins in September as new ice forms in coastal areas and skims over the surface of open water areas. Before this happens, a combination of weather systems and open water contribute to make September followed by October the snowiest months. The snow routinely gives obscured ceilings and restricted visibilities. The frozen season ends in June. Once the open water areas are ice covered, the abundant source of moisture for low cloud and fog is cut off. That said, low cloud can, on occasion, track hundreds of miles and find its way from, for example, the open waters of the North Atlantic, across the ice north of Greenland and wrap back to the south and east to make its way into the Canadian arctic islands.

The frozen season is also the blowing snow and blizzard season. The entire eastern portion of this section is vulnerable to strong northwest winds and blowing snow and is part of the blizzard alley that extends southeast from the Arctic Basin across the central Canadian arctic islands and into the GFACN36 domain (barrens west of Hudson Bay). Rea Point resides in the blizzard alley while Mould Bay is routinely just west of the alley. The southern Banks Island section of GFACN37 is vulnerable to blizzards with southeast winds as well as with northwest winds. Late August and September are the most likely months for freezing drizzle or freezing rain.

The winter months December, January and February are a time of strong inversions

with visibility restricting ice crystals occurring below that layer. Moisture from open water leads, polynyas, heating systems and aircraft exhaust can at times trigger ice fog below the inversion. An approaching upper trough can trigger a layer of ice crystals that extends to 18,000 feet or more while the upper troughs passage will do away with the ice crystal haze. Light snow can fall from skies that have no discernible cloud. This "fluffy" snow readily becomes blowing snow.

The spring months of March, April and May reside in the frozen season. Statistically, these months have the most favorable flying weather. For the area west of blizzard alley including Banks Island, western Victoria Island and Prince Patrick Island, winter flying weather is equally favorable but it is dark! March, April and May are the months that the area of 24-hour daylight pushes south. Warmer and moister air masses that have, except for rare occasions, lingered well south now get to the area. At Mould Bay for example, average snow fall values go from about 4 centimetres in January to values near 7 centimetres in April to near 9 centimetres in May.

Unfrozen season

At Mould Bay, the months of June, July and August have mean daily maximum temperatures above 0° C. July and August have an above zero mean daily minimum. June is the month of rapid snowmelt and sublimation. Month-end snow cover at Mould Bay, for example, decreases from about 22 centimetres end of May to about 2 centimetres by the end of June. July is the month that favours snow-free ground.

During the unfrozen season, low cloud and fog are the routine across the Arctic Basin and the ice-covered or open water areas between islands. Onshore flows readily bring these conditions inland.

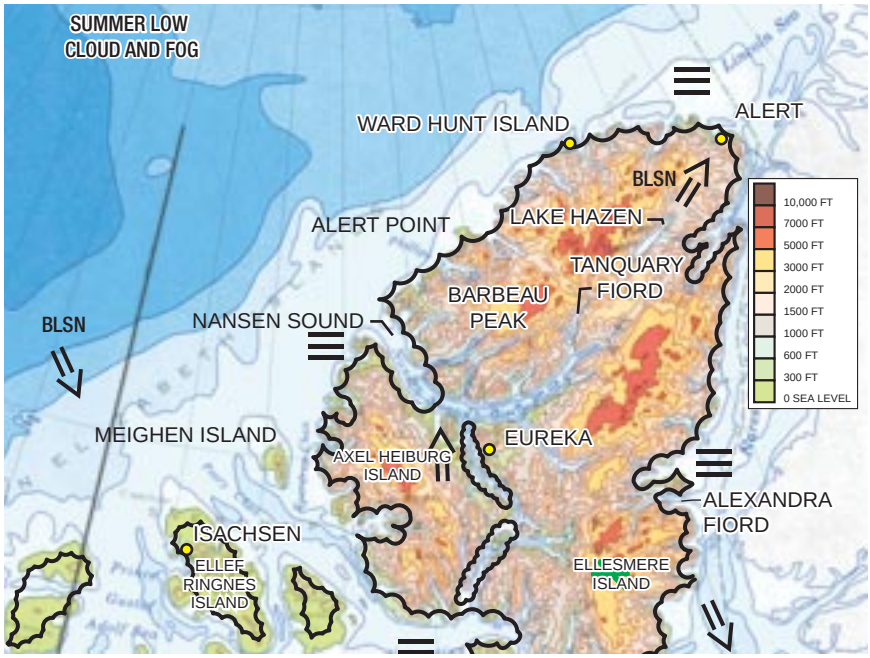
Local Effects

Northern Banks Island/Aulavik National Park

Late June is spring with weather systems bringing precipitation that is an almost equal mix of rain and snow. July is summer with rain about 2 1/2 times more likely than snow. August has the most precipitation and it is almost equally split between rain and snow. During summer, with onshore flow, low cloud and at times fog readily find their way from McClure Strait into northern Banks Island including Aulavik Park. The cloud and fog are at times accompanied by drizzle. Also in summer, albeit rare, thundershowers can occur inland.

Northern section of the GFACN37

Eureka, Alert, Ward Hunt Island, and Isachsen



Map 4-9 - Northern section of GFACN37 domain

The terrain of the area varies from the highest mountain in North America east of the Rockies (Barbeau Peak at 8,583 feet ASL) to the corridor of low lands through the central arctic islands to the generally ice covered waters between islands and across the Arctic Basin.

Persistent snow cover in excess of 2 centimetres across this section ranges from about 280 to more than 300 days per year bridging fall, winter, and spring and catching portions of summer. At Alert, only the months of June, July and August have

mean daily maximum temperatures above 0°C and of these months, only July also has an above-zero mean daily minimum.

The amount of open water that develops across this area is limited. There can however be years such as 1998 when the amount of open water is significantly greater.

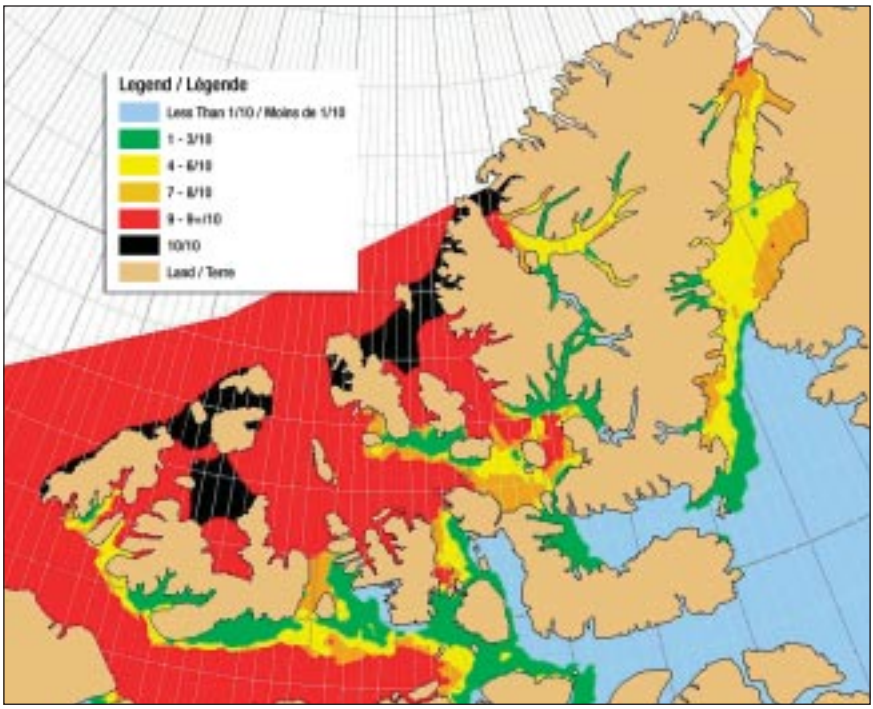


Fig 4-3 - Median ice conditons for September, 1971 to 2000 credit: Canadian Ice Service

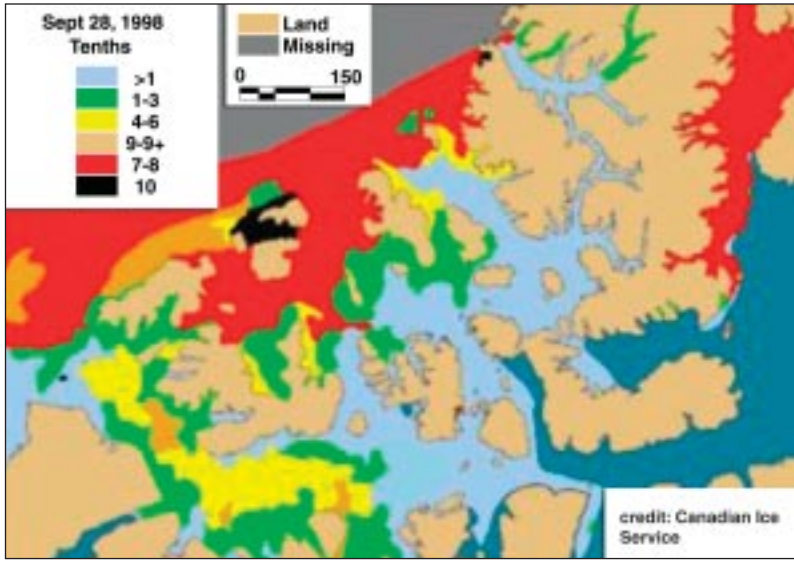


Fig. 4-4 - Ice conditions 28 September 1998 credit: Canadian Ice Service

Summer is the time of 24 hours of daylight (Alert is at 82°30'N and Eureka is at 79°59'N) while winter is the time of 24-hour darkness.

Photo 4-4 - Ellesmere Island near Tanquary Fiord, summer credit: Claude Labine

Photo 4-5 - Alexandra Fiord, Ellesmere Island, summer credit: Claude Labine

Weather by Season

Frozen season

The frozen season begins early September as new ice forms in coastal areas and skims over the surface of open water areas. Before this happens, a combination of weather systems and open water contribute to make September the snowiest month. The snow routinely gives obscured ceilings and restricted visibilities. The frozen season ends in June. Once the open water areas are ice covered, the abundant source of moisture for low cloud and fog is cut off. The Lincoln Sea to the north of Alert and the waterway between Ellesmere Island and Greenland can be slow to freeze over providing a moisture source through the fall into winter. Low cloud can, on occasion, track hundreds of miles and find its way from, for example, the open waters of the North Atlantic, across the ice north of Greenland and wrap back to the southeast to make its way into the Canadian arctic islands. Nansen Sound is a ready path for low cloud to make its way from the northwest into arctic islands. The low terrain west of Axel Heiburg Island (blizzard alley) is another ready pathway for low cloud to stream into the arctic islands from the northwest.

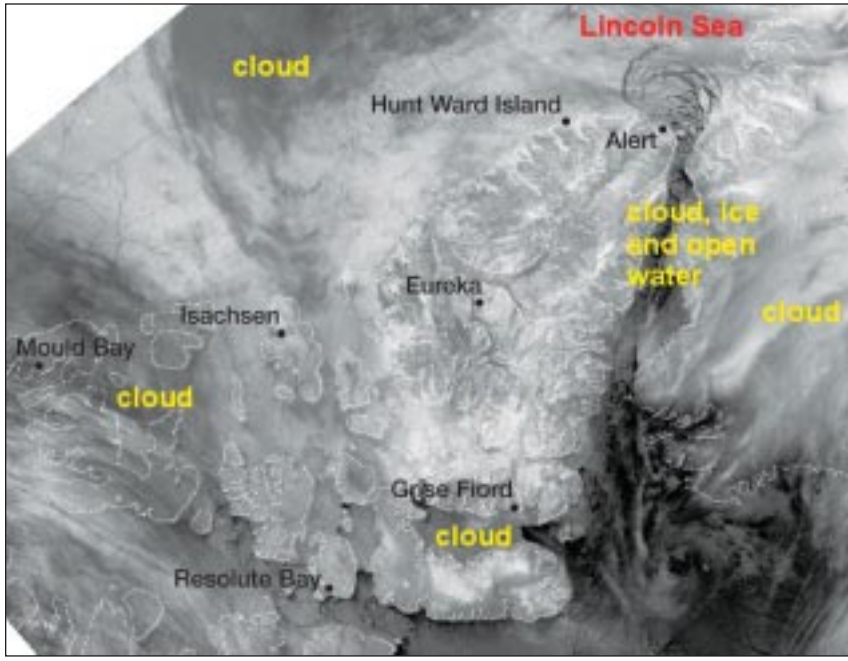


Photo 4-6 - Infrared satellite photo, 21 November 2001: cloud, ice and open water

The frozen season is also the blowing snow and blizzard season. If there is going to be freezing drizzle at Eureka, it is most likely to occur in June. For Alert, if there is going to be freezing drizzle, September is the most probable month.

The winter months December, January and February are a time of strong inversions with ice crystals restricting the visibility below that layer. Moisture from open water, polynyas, heating systems and aircraft exhaust can at times trigger ice fog below the inversion. An approaching upper trough can trigger a layer of ice crystals that extends to 18,000 feet or more while the upper troughs passage will do away with the ice crystal haze. Light snow can fall from skies that have no discernible cloud. This "fluffy" snow readily becomes blowing snow. Winter is the most favourable of the seasons with respect to flying weather for such locations as Alert and Isachen albeit both these sites are vulnerable to blowing snow and it is dark!

The spring months of March, April and May reside in the frozen season. Spring and summer are the best seasons for flying weather-wise at sites such as Eureka. Warmer and moister air masses that have, except for rare occasions, lingered well south now get to the area. At Alert, for example, average snowfall values go from about 8 centimetres in January to values near 14 centimetres in May. Monthly snowfall amounts through the summer range from 12 to 18 centimetres. Snowfall at Alert peaks in September at 32 centimetres. Eureka on average gets about 1/3 as much snow. Rain shows up in May and lingers to September.

Photo 4-7 - Agassiz Ice Cap, Ellesmere Island: Twin Otter and snow frosted instrument, spring

credit: M. Waskiewicz (both photos)

Unfrozen season

During the unfrozen season, low cloud and fog are the routine across the Arctic Basin and the ice-covered or open-water area between islands. Onshore flows readily bring these conditions inland.

Local Effects

Ellesmere Island - Ellesmere Island is the 6th largest island in the world and sports a lot of high terrain. Moderate to severe clear air turbulence can develop over Ellesmere Island when the flow aloft is strong. Similarly, there can be lee wave turbulence. With the approach of an upper disturbance from the west cloud and precipitation can envelop the entire island. The waterway between Ellesmere Island and Greenland routinely experiences strong northerly winds. It is these winds and associated currents that sustain the North Water polynya.

Eureka - Eureka is sheltered from most cloud being to the lee of mountains. As a result the ceiling is rarely low. With weather systems approaching from the west however, ceilings can drop quickly, particularly when the precipitation that the system brings is snow. The passage of the upper troughs usually brings precipitation to an end and promotes rapid thinning of the cloud. The approach of disturbances from the west generates strong southerly winds at Eureka and just as the passage of the disturbance brings clearing, it can also put an abrupt end to the strong winds.

Photo 4-8 - Low cloud and fog hugging the hills above Eureka, August 2001 credit: Brian Kahler

Photo 4-9 - Russian ice breaker Khlebnikov off Eureka, August 2001 credit: Brian Kahler

Alert - Weather systems approaching from the west can trigger strong southwest winds at Alert and, when there is loose dry snow on the ground, blowing snow is quick to lower visibility. Low cloud and fog are routine when there are onshore winds (northerly winds) off the open water areas of the Lincoln Sea. The low cloud can be accompanied by freezing drizzle. With strong wind regimes, surrounding terrain to the west and southeast can give occasional light to moderate turbulence.

Lake Hazen - Located about 2/3 the way from Eureka to Alert, lies Lake Hazen, the largest lake north of the Arctic Circle at about 50 miles by 3 miles. The lake usually melts only partially open. However, since 1994, has been observed to thaw completely open at times. During summer, when the rest of Ellsemere Island is shrouded in cloud, Lake Hazen, like Eureka can be wide open. Winds at Lake Hazen favour southwesterly which is the general orientation of the relatively lower terrain between the mountains of northern Ellesmere Island and the Agassiz Ice Cap. Lake Hazen remains open in the fall for a while after the air temperature has dropped below freezing so that localized heavier cloud results.

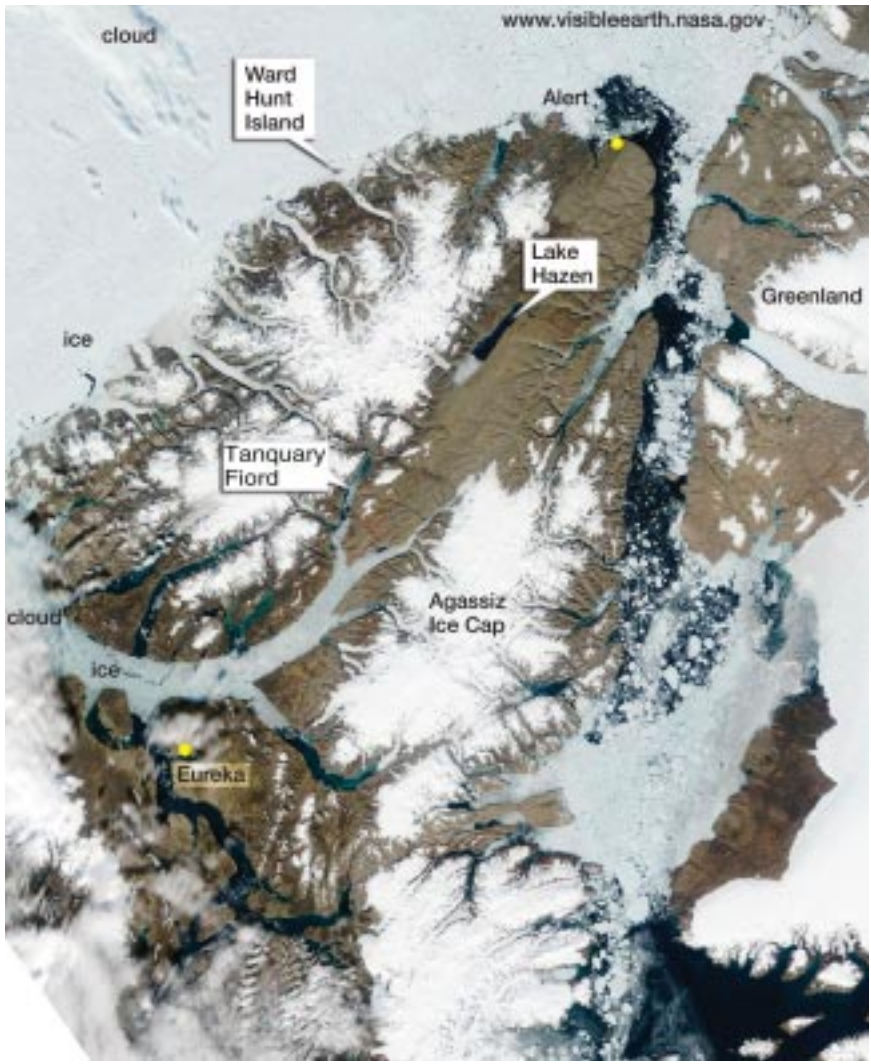


Photo 4-10 - Visible satellite photo, 2 August 2002. credit: NASA
A large portion of Lake Hazen is open

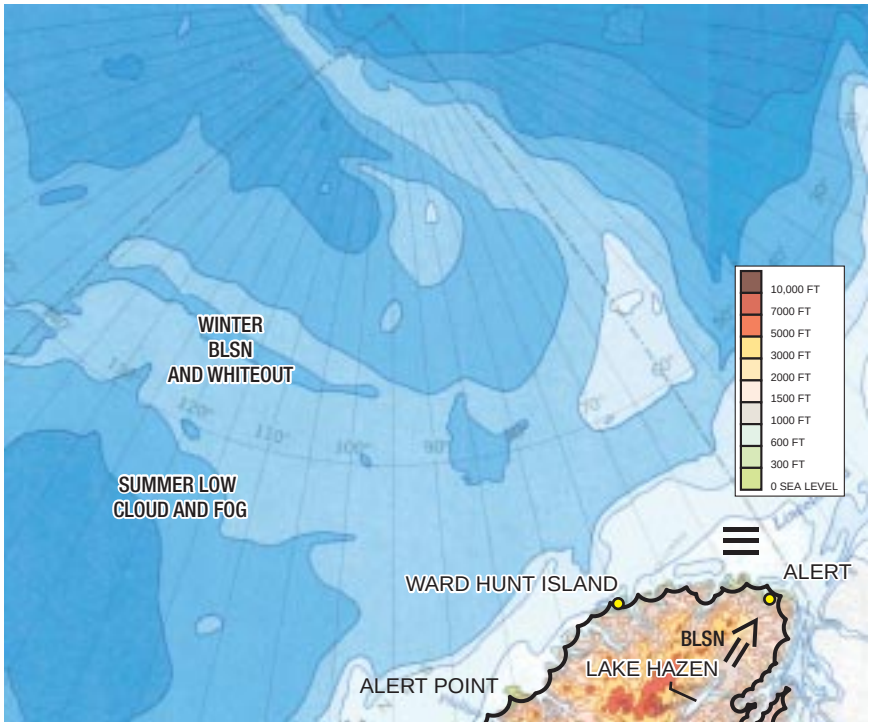
Tanquary Fiord - Barring strong weather systems, the prevailing wind direction in summer is southwest as a sea breeze routinely kicks in. During the winter, drainage northeasterly winds prevail. The Russian ice breaker/cruise ship Kaptain Khlebnikov and from time to time Canadian icebreakers go to the head of Tanquary Fiord.

Per Canada Flight Supplement, "The short, gravel strip near the head of the fiord is not maintained. Runway strength and condition are subject to seasonal and/or climatic variations."

Photo 4-11 - Head of Tanquary Fiord (a part of Quttinirpaaq (Ellesmere) National Park), 1 June 1998 credit: David Schmidt

Meighen Island - The elevation of Meighen Island is just above sea level yet the island sports a permanent glacier. The ice cap on Meighen Island forms the highest terrain on the island peaking at about 870 feet ASL. Whiteout on the ice cap can occur year-round. The island, like other islands bordering the Arctic Basin, is vulnerable to intrusions of low cloud and fog especially during the summer. In summer, cloud/fog from the Arctic Basin is enhanced as it is lifted orographically up the ice cap of Meighen Island that is at 0°C with a melting surface. The cloud/fog sometimes burns off/dissipates by the time it reaches the southern part of the island (south of the ice cap). The cloud streaming off the Arctic Basin onto the waterways between the arctic islands routinely has bases from 500 to 800 feet AGL and tops from 1,500 to 2,000 feet.

Arctic Basin Section of GFACN37 Domain



Map 4-10 - Northern Ellesmere to the pole

Ice covered but openings

The "terrain" of the area is that of a constantly changing ice surface of varied thickness, surface roughness and snow cover. Pilots cite that only a very small percentage of the ice cover on the basin is suitable for landing. Ice sheets slide under each other (rafting) or ice sheets bump into each other to create ridges both below and above the surface (ridging). Ridging across the battleground between the arctic pack ice and the ice that is permanently anchored to northern Ellesmere Island can reach heights of tens of metres. Ice sheets routinely obstruct each other's fit into the jigsaw puzzle of ice cover such that cracks and areas of open water develop (leads) and close, at times suddenly. New ice forms. Snow covered ice dominates fall through winter to mid spring. Wind continually redistributes the snow via drifting and blowing snow. Snowdrifts develop. Melting and sublimation of the snow cover and then the ice begins mid spring. The ratio of open water to ice increases and the ice thickness decreases into September. A return to below freezing temperatures brings a return of ice growth both coverage and thickness-wise.

Landings on ice including flights to the pole routinely occur March through April and May and occasionally into very early June. During this period, there is 24 hours

of daylight, air temperatures are still below freezing, and the ice is at its maximum thickness. Many of these flights use Ward Hunt Island as a staging point.

Photo 4-12 - Twin Otter on ice the Arctic Basin, March 1996, for installation of automatic temperature and surface air pressure station credit: Don Tolhurst and Mark Pyper and Twin Otter C-GNDO, pilots Doug McLeod and Blake Reid

The terrain moves

The ice of the Arctic Basin is always on the move. Statistically, the ice that is at the North Pole at any given time will have moved on to the North Atlantic in one year.

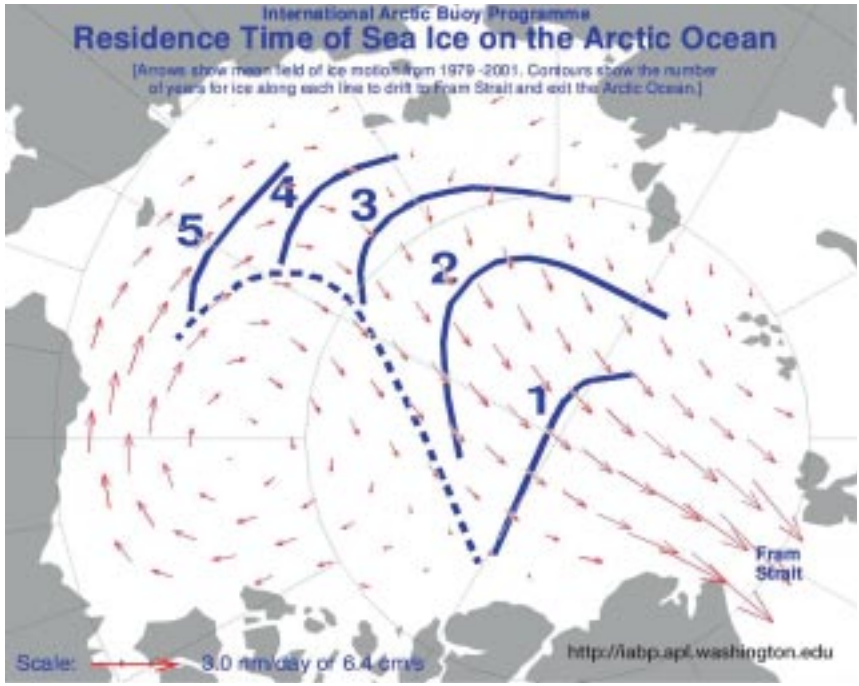


Fig. 4-5 - Resident time of sea ice on the Arctic Ocean

credit: International Arctic Buoy Programme

Flying weather

Winter - Winter is the season of 24-hour darkness where areas of low cloud combine at times with higher level cloud from weather systems, and drifting and blowing snow. The average cloud cover is about 50 percent. Monthly mean daily temperatures range from -31°C to -33°C.

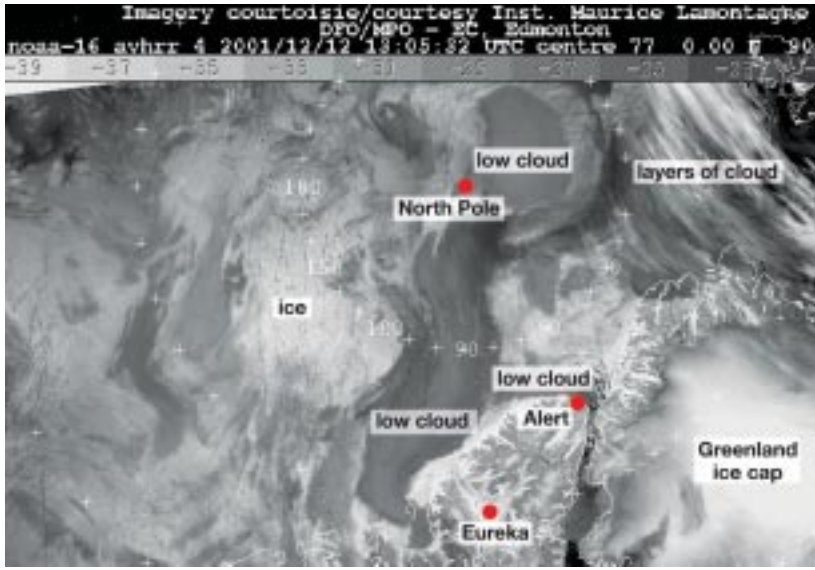


Photo 4-13 - Infrared satellite photo 12 December 2001. showing areas of low cloud just off northern Ellesmere Island and across the Arctic Basin intruding into the Canadian arctic islands.

Spring - Spring is the season of 24 hour sunlight but temperatures that are still below freezing. Sublimation and melt starts to occur putting moisture into the air. The average cloud cover increases from about 50 percent in April to about 80 percent in May. Monthly mean daily temperatures climb from -24°C in April to -11°C in May.

Summer - Summer is the season that temperatures get above 0°C but not by much above zero. The snow cover melts, the ice thins and open water areas that develop between floes stay open. The influx of moisture over the ice and cold water surface leads to a blanket of cloud and fog over the Arctic Basin. The average cloud cover through the summer months is 90 percent. Excluding weather systems with their layers of mid-and upper-level cloud, the cloud over the basin is routinely based at 500 to 800 feet and topped at 1,500 to 2,000 feet ASL. Monthly mean daily temperatures hover just below or near 0°C (-1.8°C June, near 0°C July, and -1.4°C August).

Fall - Fall is the season where open water leads between floes freeze over almost as quickly as they form and the cloud coverage over the basin diminishes. Average cloud cover decreases from 90 percent in September to 50 percent in November. On infrared satellite images, one is once again able to see the "cracks" between floes via the heat that is leaking from them and areas of low cloud show up dark grey or black as long as there is no higher cloud. Monthly mean daily temperatures drop from -8°C in September to -20°C in November and then to -27°C in December.