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Climatic Regions of the Canadian Arctic Islands

J.B. MAXWELL[1]

ABSTRACT. As a result of a comprehensive assessment of the climate of the Canadian Arctic Islands and adjacent waters, five climatic regions were identified. The regional boundaries were delineated by an analysis of the influence of the major climatic controls while further regional subdivisions were arrived at through consideration of the fields of the standard observed meteorological elements. Short discussions of the climatic characteristics of each sub-region are given and tables outlining values of selected climatic elements are presented. A brief discussion of climatic change across the entire area is included.

Key words: Canadian Arctic Islands, climate, climatic change, meteorology

RÉSUMÉ: Suite à une évaluation détailée du climat des îles Arctiques canadiennes et des eaux adjacentes, cinq régions climatiques ont été identifiées. Les bornes régionale ont été tracés au moyen de l'analyse de l'influence des principaux contrôles climatiques, et les subdivisions régionales ont été déterminées par l'étude des champs des éléments météorologiques standards ayant été observés. De courtes discussions des caractèristiques climatiques de chaque sous-réion sont présentées, ainsi que des tableaux signalant les valeurs de certains des éléments climatiques. Une courte discussion du changement climatique dans toute la région paraît aussi.

Traduit par Maurice Guibord, Le Centre Français, The University of Calgary.

INTRODUCTION

The vast area of land and water that makes up the Canadian Arctic has long been popularly regarded as a region of fairly uniform climatic conditions — a "polar desert" with little diversity and strikingly harsh weather throughout the year. This perception has been particularly true for the Canadian Arctic Islands and adjacent waters. General climatologies of the Canadian Arctic completed during the past 10 to 15 years (Thompson, 1965; Dept. of Transport, 1970) have recognized the areal and seasonal variations that exist, but have not attempted a systematic climatic subdivision of the region. Recently, however, detailed analyses of meteorological data for a climatology of the Canadian Arctic Islands and adjacent waters (Maxwell, 1980) suggested that such an approach was now both possible and desirable, in view of the high degree of interest of both developmental and environmental groups in the arctic areas.

DATA BASE

Following the introduction of the Joint Arctic Weather Station (JAWS) network in the High Arctic in the late 1940s and the development of the Distant Early Warning (DEW) stations in the mid 1950s, the Atmospheric Environment Service (AES) weather-observing network in the Canadian Arctic had developed to the point where, by the early 1970s, a reasonable record of surface and upper-air weather observations was available for study. These data formed the basis for the recent climatology already mentioned, and hence for this paper. In addition, auxiliary observing networks of such elements as snow cover and radiation were utilized. Specifically, data mainly from the period 1953-1972 (but up to 1976 in some instances) were used in this study. Figure 1 shows the network of principal observing stations.

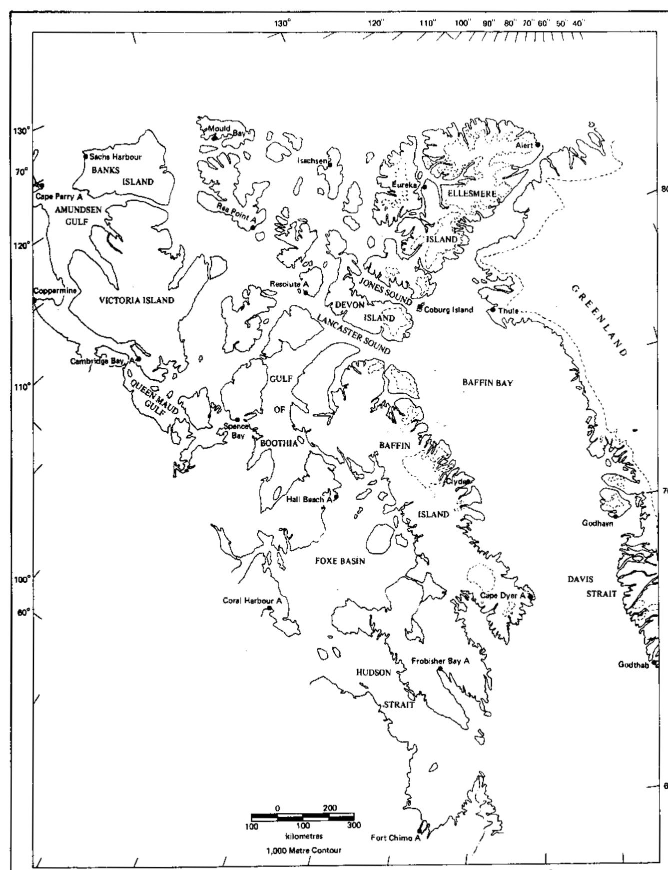

FIG. 1. The Canadian Arctic Islands region showing the principal observing stations and indicating the topography of the various islands (areas above and below the 1000-m contour).

An important limitation of these data is the fact that the vast majority of the observing sites are located on the coasts of the various arctic islands. Long-term inland and offshore observational programs are relatively few. To overcome this deficiency somewhat, short-term data from

[1]Arctic Meteorology Section, Canadian Climate Centre, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, Canada M3H 5T4

AES inland observing sites and those collected by scientific parties or resource exploration groups located on the islands' interiors were utilized wherever possible. For the offshore areas, ship observations (archived for North American waters by the United States) were obtained and collectively analyzed for each waterway in the Arctic Islands area. These marine observations, however, were available only for the months July through October and were relatively few in number in comparison with the coastal stations. As a typical example, there were fewer than 2000 observations available from the whole of Lancaster Sound for the entire 20-year period 1953-1972; this may be compared with the hourly observing program of a standard AES surface station which would accumulate almost 9000 observations in only one year.

Due to this imbalance of data coverage, weather conditions over the inland and offshore areas often had to be either empirically or subjectively assessed in relation to conditions at the coastal stations in order to produce areal maps of many of the standard meteorological elements. Temperature and precipitation, which are important in developing a regional breakdown of climate, are good examples of fields so treated.

Important to this particular study was the sizable volume of literature dealing with the Arctic. This comprised a wide range of approaches including regional, island, and site-specific climatologies; single climatic element studies; analyses of single storms and the development of synoptic climatologies; and assessments of climatic variation and change. A broad, but by no means complete, selection of the literature available and used as background to the regional analysis presented in this paper is shown in Table 1. Many of the studies cited are based on AES data.

METHOD OF CLIMATIC SUBDIVISION

The usefulness of the major climatic classification systems (for example: Koppen and Geiger, 1930-40; Thornthwaite, 1948; Flohn, 1969) is rather limited in the arctic areas, for such schemes generally divide the entire Arctic into only one or two regions. This is not sufficiently detailed to recognize the many important climatic differences that impact on human activities there.

In this study, the approach chosen was one which involved first subdividing the Canadian Arctic Islands into regions on the basis of a subjective assessment of the relative effects (outlined below) of the major climatic controls and then further sectioning the resulting regions on the basis of major local variations. It was felt that this was the only realistic way to approach the problem considering the serious lack of uniformity in the data coverage.

For the detailed examination of the various weather element analyses that served as the basis for this climatic subdivision, the reader should refer to Maxwell (1980); however, a brief outline is given here. For the initial regional breakdown, the major climatic controls used were cyclonic activity, the sea ice-water regime, broad-scale physiographic features, and net radiation.

(1) *Cyclonic activity* (Figs. 2 and 3). The percentage frequencies of occurrence of low pressure centres within 400 000-km^2 areas along with the primary cyclonic trajectories are shown for both January and July. These figures represent amalgamations of the results of Berry *et al.* (1953), Klein (1957), Prostjkova (1968), and McKay *et al.* (1969). The ever-present trajectory extending north through Davis Strait and Baffin Bay is to be noted. This is an offshoot from the major trajectory which skirts southern Greenland on its route from the eastern seaboard towards the Iceland area.

(2) *Sea ice-water regime* (Figs. 4 and 5). For mid-winter, the typical nature of the sea-ice cover is shown, indicating both ice type and ice motion. Ice coverage on this map is virtually complete except for eastern Davis Strait. This may be contrasted with the extent of the clearing that can occur by mid-August in a "good" year (one of above-average degree of clearing).

(3) *Broad-scale physiographic features*. An appreciation of this climatic control can be gained from the topographic contours included on Figure 1. The dominance of higher

TABLE 1. Selected references dealing with Canadian Arctic climate

Arctic Climatology, Environment — General	Regional, Island, & Specific Site Climatologies	Analysis of Specific Climatic Elements	Synoptic Studies, Synoptic Climatology	Sea Ice, Oceanography	Climatic Variation, Change in the Arctic
Barry & Hare (1974)	Alt (1975)	Berry & Lawford (1977)	Alt (1978)	Arctic Institute North America (1968)	Bradley (1973a, b)
Brown (1972)	Barry (1964)	Bilello (1966, 1973)	Barry (1974)	Bushell (1959)	Bradley & England (1978)
Dept. Energy, Mines, Resources (1970)	Barry & Fogarasi (1968)	Catchpole & Moodie (1971)	Barry, Bradley & Jacobs (1975)	Collin & Dunbar (1964)	Crane (1978)
Dept. Transport (1944, 1970)	Berry *et al.* (1975)	Dept. Environment (1976)	Berry *et al.* (1953)	Dept. Environment (1970)	Dunbar (1976)
Dunbar & Greenaway (1956)	Burns (1973, 1974)	Fraser (1959)	Cogley & McCann (1976)	Dept. Transport (1964-69)	Jacobs & Newell (1979)
Hare (1968, 1969)	Duck *et al.* (1977)	Fraser (1964)	Fogarasi (1972)	Fletcher *et al.* (1973)	Kellogg (1975)
Hare & Hay (1971)	Hare & Montgomery (1944)	Hagglund & Thompson (1964)	Jacobs *et al.* (1974)	Gade *et al.* (1974)	Lamb (1980)
Hastings (1971)	Henry (1947)	Henderson (1967)	Keegan (1958)	Hibler *et al.* (1974)	Thomas (1975)
Orvig (1970)	Holmgren (1971)	Huschke (1969)	Klein (1957)	Leahey (1967)	Vowinckel & Orvig (1967)
Rae (1951)	Jackson (1959, 1960)	Jackson (1961)	LeDrew (1976)	Markham (1975, 1977)	Walsh & Johnson (1979)
Thompson (1965)	Lotz and Sagar (1960)	Longley (1960, 1972)	Prostjkova (1968)	Morgan (1970)	
Vowinckel & Orvig (1963)	Maxwell *et al.* (1980)	MacKay & Arnold (1965)	Reed & Kunkel (1960)	United States Navy (1958)	
Weller & Bowling (1975)	Müller & Roskin-Sharlin (1967)	Thomas (1960)	Scholefield (1978)	Walker (1975, 1977)	
Wilson (1967, 1969)	Müller *et al.* (1976)	Thomas & Thompson (1962)			
Wilson (1973)	Savdie & Berry (1976)	Thomas & Titus (1958)			
	Treshnikov & Voskresenkiy (1977)	Thompson (1963)			
		Vowinckel (1962)			

Abstracted from Maxwell (1980)

terrain in the Eastern Arctic in contrast with the mainly low-lying islands in the Western Arctic is particularly to be noted.

(4) *Net radiation* (Fig. 6). The field of annual net radiation received across the Canadian Arctic Islands has been provisionally analyzed using data collected during the period 1970-1976. The interesting feature of this map is the high values that have been recorded at the three stations on the northwestern islands. Although this may be due to disturbed instrument sites, a tentative contour (dashed) has been analyzed in this area due to similar anomalies in other climatic elements that also exist (e.g. high frequencies of fog, and low ceilings and visibility). There are undoubtedly other localized occurrences of relatively high annual net radiation in the Arctic Islands area. Courtin and Labine (1977), for example, reporting on a continuing program to study the microclimate of Truelove Lowland on the northern coast of Devon Island, indicated a measured value for annual net radiation of 17.8 kly, similar in magnitude to those values indicated in the northwestern islands.

The secondary subdivision of the resulting regions considered such major local variations as local topography, aviation weather, maritime influences, temperature, precipitation, snow cover and wind.

MAJOR REGIONS IDENTIFIED

The application of the major climatic controls listed above resulted in five climatic regions being identified within the Canadian Arctic Islands. These are shown in Figure 7. Delineation of the boundaries of these regions was, of necessity, somewhat arbitrary and is therefore subject to future alteration. It must be realized that the climatic boundaries arrived at represent average positions which may show some year-to-year variations. The assertions regarding climatic conditions that occur in the following discussions of each of the regions (and the subregions later) are based on data analyses found in Maxwell (1980) unless otherwise indicated.

The first two regions — the Northwestern (I) and the South-Central (II) — are of a kind in terms of cyclonic activity and relief. Anticyclonic activity is a maximum over these areas as far as the Canadian Arctic Islands are concerned. The eastern boundary of the two areas has been selected on the basis that it represents the furthest westward extent of the major cyclonic activity that feeds into the Davis Strait-Baffin Bay-Baffin Island area from the south and southwest. Generally, this boundary runs north-south from western Axel Heiberg Island through Somerset Island to the Gulf of Boothia, then east through Fury and Hecla Strait, and finally south through western

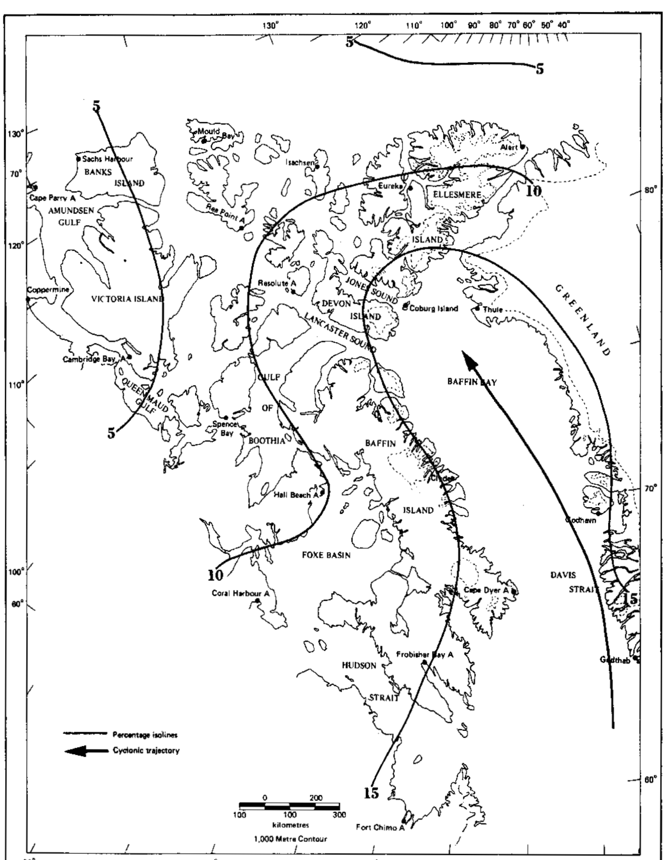

FIG. 2. The percentage frequency of occurrence of low pressure centres within 400 000-km² areas and the primary cyclonic trajectory during January.

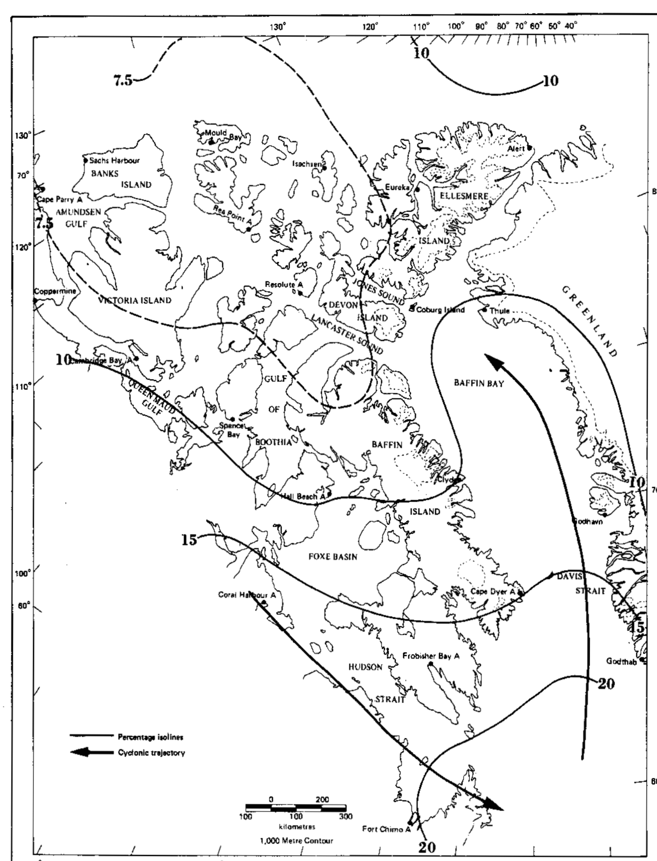

FIG. 3. The percentage frequency of occurrence of low pressure centres within 400 000-km² areas and the primary cyclonic trajectories during July.

Foxe Basin. In the west, the increased cyclonic activity in the Beaufort-Mackenzie area and its influence over Amundsen Gulf and the adjacent coasts defines the boundary there. Unlike the Eastern Arctic, there are no major relief features in either of the two regions.

The central boundary between regions I and II is not well-defined as there is a gradual transition between the two rather than an abrupt change. Region II possesses many of the characteristics of the continental regime of the adjacent mainland. The Northwestern region, on the other hand, is more closely related to the Arctic Ocean in terms of climatic characteristics. For example, except for localized conditions mainly along the northwestern islands, annual net radiation is uniformly low in the northwest. Sea-ice conditions there are dominated by multi-year ice.

Region III, the Western region, includes the eastern Beaufort Sea and Amundsen Gulf, but only the coastal areas of adjacent Banks and Victoria Islands and the mainland. The distinguishing feature of this region is the alternation of cyclonic and anticyclonic activity that is found in the Arctic Islands only here. Other regions are all markedly anticyclonic or markedly cyclonic in character. In addition, increasing amounts of annual net radiation characterize the area when compared to regions I and II.

The most interesting climatic area from the standpoint of diversity of weather is the Eastern region (IV). This is the largest of the five regions and stretches from Quebec in the south to Smith Sound in the north. Its chief distinguishing feature is the high degree of cyclonic activity that influences most of the region. The waters within it are mainly characterized by first-year ice which develops each winter. In a good year, this ice will completely disappear by mid-September, but in heavy-ice years, the pack ice along the east coast of Baffin Island can persist through the summer and into the following winter. Except for the "North Water", Baffin Bay experiences an annual net radiation total comparable to the Northwestern region, but there is a gradual increase over Baffin Island southward to Hudson Strait. (North Water net radiation totals are somewhat higher than for the adjacent areas of northern Baffin Bay.) Probably the most striking feature of the region is the mountainous terrain that exists in many areas. This plays an important role in the precipitation totals so that the highest amounts recorded in the Canadian Arctic Islands are found here.

The remaining area, the Northern region (V), includes Axel Heiberg Island and most of Ellesmere Island except for the southeastern portion which falls within region IV. This fifth region is mostly characterized by rugged mountainous terrain, a fact which alone serves to separate it

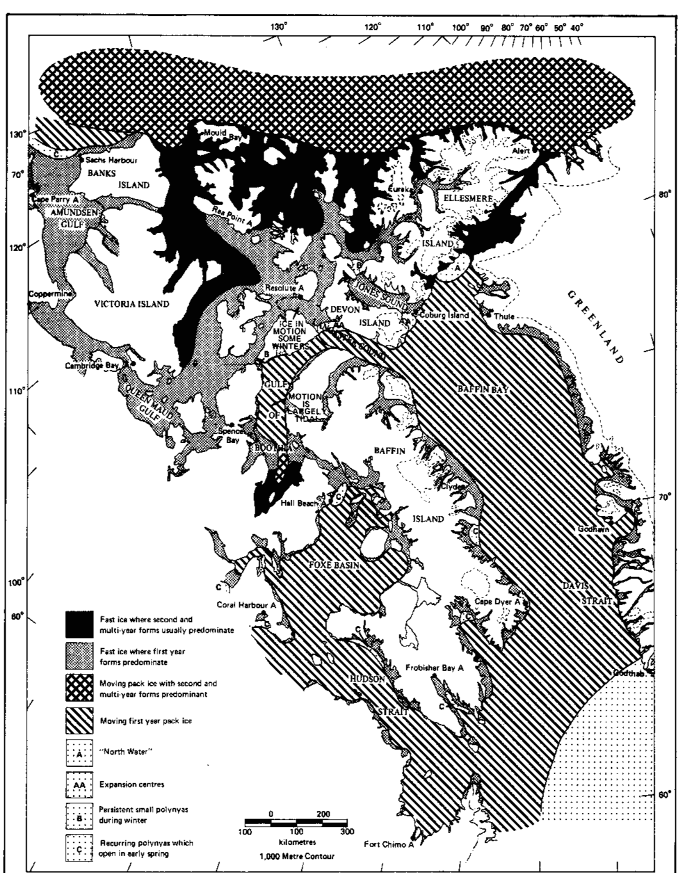

FIG. 4. The mid-winter nature of the sea-ice cover, indicating both ice type and ice motion.

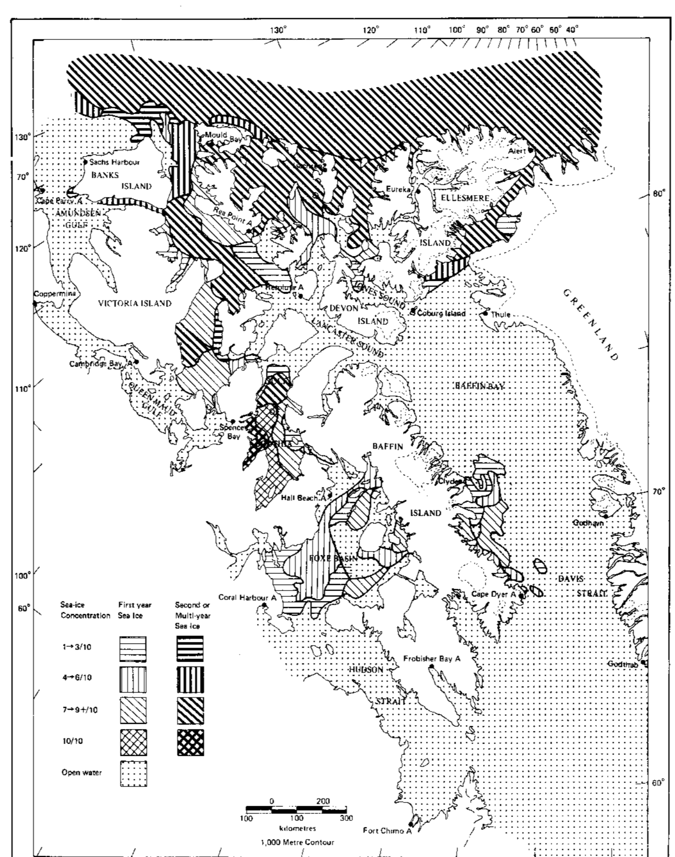

FIG. 5. The extent of sea-ice clearing by mid-August in a "good" year.

from the Northwestern region (I). The area could almost be described as a transition zone between the latter and the Eastern region. The chief basis for its southern boundary is the reduced influence of cyclonic systems originating in Davis Strait and Baffin Bay.

REGIONAL SUBDIVISIONS

Each of the five climatic regions discussed above has been subdivided as mentioned previously. These sub-regions are outlined in the following paragraphs with short narratives covering the highlights of each area and are accompanied by tables giving selected climatic data.

Region I: The Northwestern (Table 2)

Sub-region Ia: Western Parry Channel

Other than in a strip extending along the islands adjacent to the Arctic Ocean, weather conditions over the islands north and northeast of western Parry Channel, along the northern coasts of Banks and Victoria Islands, and south into M'Clintock Channel are fairly uniform. To a great extent, they represent slightly modified Arctic Ocean climatic conditions. The greater portion of the area is composed of the numerous channels that surround the many small islands — channels that are dominated by multi-year sea ice both in summer and winter. The annual net radiation received in the area is in the 5-10 kly range as compared to values of less than 5 kly over the Arctic Ocean.

The persistent sea-ice cover reduces the maritime effect to the extent that the mean annual temperature range is still very high (38-40°C), second only to the ranges experienced near the mainland to the south and in the lowlands of the Northern region (V).In this area surface-based temperature inversions are very prevalent in winter months, occurring some 75-80% of the time.

Sub-region Ib: Northwestern Island Fringe

The feature that distinguishes this area, which extends along the northwestern islands from M'Clure Strait to Lincoln Sea, from the preceding sub-region is the generally poor flying conditions that exist here. In summer, the Arctic Ocean pack-ice cover is not complete and is extensively puddled. The resulting moisture source maintains a constant layer of stratus and stratocumulus. These cloud and fog features are frequently advected over the islands and waterways of this sub-region. With the exception of stations near the eastern entrance to Hudson Strait, Isachsen in sub-region Ib has the highest frequency of occurrence of below-VFR flying conditions at recording stations in the Canadian Arctic Islands. Even greater frequencies of poor flying weather would be expected over Brock, Meighen and Borden Islands and over the exposed western portions of Prince Patrick Island. Commenting on

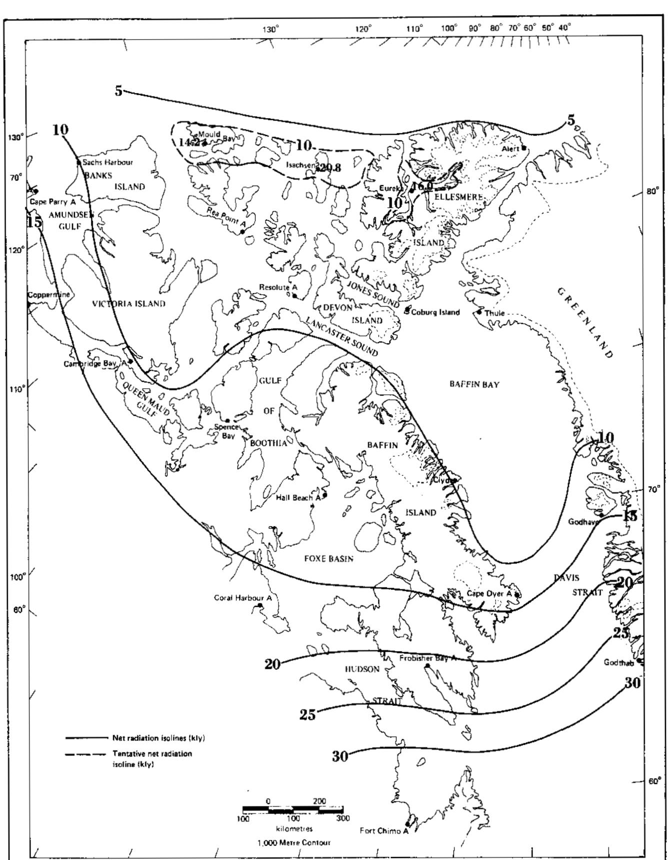

FIG. 6. Annual net radiation received at the earth's surface.

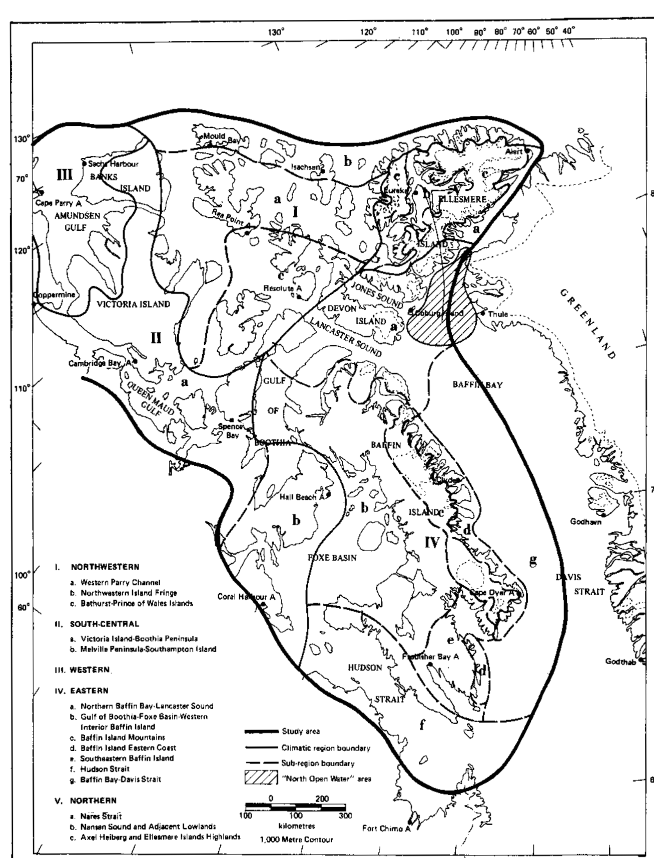

FIG. 7. The climatic regions of the Canadian Arctic Islands.

weather conditions at the latter two, Stefansson (in Rae, 1951) noted that in summer, winds from open water to the west bring almost continuous fog over western portions of the islands. MacKay and Arnold (1965) documented much more severe ceiling and visibility conditions at Meighen Island, where the ice cap station was located at 240 m elevation, than at Isachsen. In winter, variable open leads along the Polar Continental Shelf (where moving Arctic Basin ice impinges on land-fast ice) are important influences for steam and ice fog occurrences throughout the area.

Sub-region Ic: Bathurst - Prince of Wales Islands

This area includes the stations of Rea Point and Resolute and the islands adjacent to central Parry Channel in the vicinity of 105°W longitude. Sea-ice conditions here are a mixture of multi-year and first-year types with the degree of summer clearing variable from year to year. As a result, shipping conditions are generally less harsh than in the other areas of the Northwestern region.

In many respects, climatic conditions are similar to the Western Parry Channel sub-region, but modification of mean temperature values is evident in both summer and winter. As in the two other sub-regions, blizzard conditions can be common. Percentage frequencies of occurrences in January are in the 10-15% range, depending on the location.

Region II: The South-Central (Table 3)
Sub-region IIa: Victoria Island - Boothia Peninsula

As the name suggests, this sub-region is mainly composed of those two areas of land; however, it contains also the adjacent waters of Coronation and Queen Maud gulfs and other land areas including King William and northern Banks islands. The climatic characteristics of this sub-region are very similar to those of the nearby mainland. Two factors are important in producing this result: one is the fairly massive size of the land areas and their proximity; the other is the fact that the inter-island waterways are generally narrow and shallow.

Rivers flowing northward into Coronation and Queen Maud gulfs cause some clearing of the solid winter ice cover along the mainland coast in July, but often heavy concentrations of ice still persist in northern Coronation Gulf in late August. Ice cover is even more persistent in eastern and northern areas of Queen Maud Gulf. Freeze-up begins again in late September and is complete by November.

These ice patterns lead to one distinction that should be made in this sub-region and that is the summer climate. Queen Maud and Coronation gulfs have a reputation for high frequencies of low cloud and fog during July and August when sea ice is still present. This regime is reflected in the July mean daily temperature at the small island stations in the area such as Jenny Lind and Hat

TABLE 2. Region I: The Northwestern

Sub-Region	Temperature: Mean Annual Range	Temperature: Mean Daily Temperature (°C)	Temperature: Winter	Surface-Based Temperature Inversion Frequency	Percentage Frequency of Occurrence of Winds ≥ 40 km/h	January Percentage Frequency of Blizzard Occurrence	Annual Precipitation	Percentage Frequency of Occurrence of Fog or Ice Fog	Percentage Frequency of Occurrence of IFR Conditions
a: Western Parry Channel	38 to 40°C	January: -35 to -33 from north to south	Begin: Aug. 20-25 from west to east	Dec.—Feb.: 80%	January: 15-20	5-10	100-125 mm from west to east	Dec.—Feb.: 10	Dec.—Feb.: 20
		July: 5 to 3 from south to north	End: June 10-15 from south to north	June—Aug.: 20-40% from northwest to southwest	July: 5-10		35-40% falls as liquid precipitation	July—Aug.: 15-20	June—Aug.: 25-30
b: Northwestern Island Fringe	38 to 40°C	January: -35 to -33 from north to south	Begin: Aug. 20	Dec.—Feb.: 80%	January: Isachsen-17 Mould Bay-10	Isachsen-12, Mould Bay-5	Less than 100 mm	Dec.—Feb.: Isachsen-14, Mould Bay-13	Dec.—Feb.: Isachsen-25, Mould Bay-17
		July: 3	End: June 10 to June 25 from south to north	June—Aug.: near 20%	July: Isachsen-6 Mould Bay-4		30-35% falls as liquid precipitation	June—Aug.: Isachsen-24, Mould Bay-16	June—Aug.: Isachsen-33, Mould Bay-25
c: Bathurst-Prince of Wales Islands	37 to 39°C	January: near -33 or slightly below	Begin: Aug. 25	Dec.—Feb.: 80%	January: Rea Point (short-term station) -16, Resolute-18	Rea Point-15, Resolute-6	125-150 mm from west to east	Dec.—Feb.: Rea Point-6, Resolute-10	Dec.—Feb.: Rea Point-21, Resolute-19
		July: 5 to 3 from south to north	End: June 15	June—Aug.: 30-40% from north to south	July: Rea Point-3, Resolute-10		35-40% falls as liquid precipitation	June-Aug.: Rea Point-13, Resolute-17	June-Aug.: Rea Point-28, Resolute-28

Notes for Tables 2-6:

1. Winter is defined here as that period of the year during which the mean daily temperature remains below 0°C.
2. Surface-based air temperature inversion frequency is here based on 1100 (nominally 1200) GMT data.
3. In the strong wind and succeeding columns, either station or areal values are given for the times of year specified.
4. A blizzard condition is said to exist if the following four weather elements occur simultaneously: snow or blowing snow, winds 40 km/h or greater, visibility 0.8 km or less, and temperature below -12°C.
5. For fog or ice fog, a visibility of 10 km or less is the defined criterion.
6. Instrument flight rules (IFR) are in force with ceiling below 300 m or visibility less than 4.8 km.

islands. The summer temperatures of 6°C and 5°C at these locations respectively are some 3-4°C cooler than the inland areas of the sub-region.

The degree of continentality of the sub-region may be judged from the mean annual temperature range whose values lie in the 42-45°C range. Only in the Eureka area of Ellesmere Island are such large ranges encountered in the rest of the Canadian Arctic Islands. Indeed, the largest mean annual temperature at a long-term recording station is found in this sub-region at Shepherd Bay (44.7°C), which is located just south of Boothia Peninsula.

The dominance of anticyclonic conditions is indicated by the very low precipitation amounts in the southern Victoria Island-King William Island area. Mean annual totals are less than 100 mm at some locations there and thus are second only to the Eureka lowland area in that regard.

Sub-region IIb: Melville Peninsula - Southampton Island

Although there are many similarities between this sub-region and the preceding, it is basically a transition zone between continental and maritime conditions. When one considers the area's proximity to such large water bodies as Foxe Basin, Hudson Strait and Hudson Bay, it may even be surprising that the differences from the sub-region to the west are not greater.

Fairly high concentrations of multi-year ice persist in the Committee Bay area during most summers. This, together with a prevailing onshore air flow from the bay onto the rugged, coastal terrain of western Melville Peninsula, is reflected in the high July frequencies of low cloud, fog and IFR conditions at Mackar Inlet (elevation 430 m). Sea ice persists near the centre of Foxe Basin during the summer, but with large open areas near shore, it does not affect the weather along the eastern side of Melville Peninsula as greatly.

With prevailing winds from the northwest quadrant during most of the year resulting in a subsiding flow from the continental land mass upstream, the climate of Southampton Island is typically continental, except for a short period in July and August when maritime influences are evident along the eastern coastlines.

This sub-region is an area which cyclonic activity begins to be increasingly significant in the local climate. One example involves lows which stagnate and fill in the vicinity of Foxe Basin. This is particularly reflected in the higher percentage of autumn cloudiness that occurs in the sub-region compared to the area to the west.

As would be expected, the mean annual temperature range is somewhat lower than to the west, lying in the 36-39°C range. Precipitation is generally higher with mean annual totals increasing from 200 to 300 mm from north to south.

TABLE 3. Region II: The South-Central

Sub-Region	Temperature			Surface-Based Temperature Inversion Frequency	Percentage Frequency of Occurrence of Winds ≥ 40 km/h	January Percentage Frequency of Blizzard Occurrence	Annual Precipitation	Percentage Frequency of Occurrence of Fog or Ice Fog	Percentage Frequency of Occurrence of IFR Conditions
	Mean Annual Range	Mean Daily Temperature (°C)	Winter						
a: Victoria Island-Boothia Peninsula	42 to 45°C	January: -33 to -35 from west to east	Begin: Aug. 25 in west to September 15 in east	Dec.—Feb.: 70-80% from east to west	January: Cambridge Bay-10, Gladman Point-7, Pelly Bay-20	Cambridge Bay-7, Gladman Point-5, Pelly Bay-6	150 mm in west to 100 mm in centre to 200 mm in east	Dec.—Feb.: Cambridge Bay-16, Gladman Point-10	Dec.—Feb.: Cambridge Bay-21, Gladman Point-18, Pelly Bay-26
		July: +8 to +10 over land, +8 to +5 over water	End: June 5-15 from west to east	June—Aug.: 40-50% from west to east	July: Cambridge Bay-5, Gladman Point-3, Pelly Bay-2		50-60% falls as liquid precipitation except lesser over northern Banks Is.	June—Aug.: Cambridge Bay-7, Gladman Point-12	June—Aug.: Cambridge Bay-15, Gladman Point-18, Pelly Bay-24
b: Melville Peninsula-Southampton Island	36 to 39°C	January: -33 to -30 from west to east	Begin: Sept. 5-20 from north to south	Dec.—Feb.: 80%	January: Coral Harbour-9, Hall Beach-9, Mackar Inlet-6	Coral Harbour-5, Hall Beach-5, Mackar Inlet-2	200 to 300 mm from north to south	Dec.—Feb.: Coral Harbour-5, Hall Beach-14, Mackar Inlet-17	Dec.—Feb.: Coral Harbour-16, Hall Beach-23, Mackar Inlet-13
		July: +5 to +8 from north to south	End: June 10-15 from south to north	June—Aug.: 30-50% from south to north	July: Coral Harbour-5, Hall Beach-2, Mackar Inlet-2		40-50% falls as liquid precipitation	June—Aug.: Coral Harbour-7, Hall Beach-11, Mackar Inlet-27	June—Aug.: Coral Harbour-12, Hall Beach-15, Mackar Inlet-26

TABLE 4. Region III. The Western

Sub-Region	Temperature			Surface-Based Temperature Inversion Frequency	Percentage Frequency of Occurrence of Winds ≥ 40 km/h	January Percentage Frequency of Blizzard Occurrence	Annual Precipitation	Percentage Frequency of Occurrence of Fog or Ice Fog	Percentage Frequency of Occurrence of IFR Conditions
	Mean Annual Range	Mean Daily Temperature (°C)	Winter						
No sub-regions	36°C	January: -28 to -30 from west to east	Begin: Aug. 30 to Sept. 5 from north to south	Dec.—Feb.: 75%	January: Cape Parry-8, Clinton Point-18, Sachs Harbour-5	Cape Parry-4, Clinton Point-9, Sachs Harbour-3	125 to 175 mm from northwest to southeast	Dec.—Feb.: Cape Parry-8, Clinton Point-3, Sachs Harbour-4	Dec.—Feb.: Cape Parry-16, Clinton Point-15, Sachs Harbour-11
		July: +5 to +8 from north to south	End: May 25	June—Aug.: 40-50% from north to south	July: Cape Parry-2, Clinton Point-6, Sachs Harbour-3		45-55% falls as liquid precipitation	June—Aug.: Cape Parry-20, Clinton Point-15, Sachs Harbour-17	June—Aug.: Cape Parry-28, Clinton Point-16, Sachs Harbour-26

Region III: The Western (Table 4)

This region is a fairly small one, reasonably uniform in its climatic controls, and has not been subdivided.

The degree of variety in the weather of this region is considerably greater than in Regions I and II. Maritime air masses moving into the Mackenzie Valley and southern Beaufort Sea from the west and affecting this region are the main influences. The more moderate conditions which this suggests are reflected in the mean annual temperature range which is near 36°C. The annual precipitation amount and the degree of cloudiness in the autumn are both higher than in the Victoria Island-Boothia Peninsula area although they do not compare with the high values in the Eastern Arctic.

It is in this area that the sea ice on the coastal shipping route along the Canadian mainland first deteriorates. South of the arctic pack ice, the cover is generally first-year ice which often clears completely by the end of the summer. The shallow water levels and the relatively warm summer conditions (for the Canadian Arctic Islands, at any rate) are important factors in this clearing.

Region IV: The Eastern (Table 5)
Sub-region IVa: Northern Baffin Bay - Lancaster Sound

The northern portion of this sub-region is characterized by mountainous, partly-glacierized terrain which is surrounded by water that is mainly subject to first-year ice. An important phenomenon of the area is the North Water (see Fig. 7) of Baffin Bay where open water or thin ice conditions prevail right through the winter. (It is from this feature that some of the first deterioration of sea ice develops in the Eastern Arctic in spring. This then spreads southward and westward into Jones and Lancaster sounds.) Lancaster Sound is also mainly influenced by first-year sea ice which clears in the summer; however, occasional intrusions of multi-year floes and icebergs can pose problems for shipping. The land areas along its southern edge are plateau-like in nature and, with the exception of Bylot Island, are generally unglaciated. The north Baffin Bay-Lancaster Sound sub-region is the most northerly sector of the Arctic Islands which is affected at all frequently by cyclonic activity originating in the Davis Strait route. Many of the systems stagnate and die here. Precipitation along the exposed coasts of Ellesmere, Coburg, and Devon Islands is heavy with respect to most other Arctic Islands areas (> 300 mm annually), partly due to the storm activity and the abrupt lift of the onshore winds up the rugged coastal slopes, but also because of the presence of the North Water. The north Baffin and Bylot islands coasts receive appreciable amounts of precipitation in autumn while Lancaster Sound is open and the prevailing winds have a northerly component. By winter this moisture source is cut off, although Bylot Island likely continues to be affected to some extent by the presence of the North Water.

The sub-region climate possesses a certain maritime character which, although not as marked as the more southerly and easterly Baffin Island coasts, is certainly more so than the rest of the Canadian Arctic Islands at the same latitude. This is related to the maritime nature of the air masses that invade the area, the presence of open water or thin ice throughout the year in the north, and the tide-torn moving ice of Lancaster Sound in the winter. The mean temperature range lies in the 33-36°C range generally, but may be as low as 22°C over the North Water.

Extension of this sub-region to include Prince Regent Inlet has been made because the width of that inlet and the adjacent topography suggest that influences over Lancaster Sound could easily penetrate it. Sea ice conditions, both in type and movement, are also similar to those experienced in Lancaster Sound.

Sub-region IVb: Gulf of Boothia - Foxe Basin - Western Interior Baffin Island

With the exception of the coastal and water areas where fog and low cloud are common occurrences during the summer, this sub-region may be classed as a generally fair-weather area. Foxe Basin presents a mostly ice- and snow-covered surface to the prevailing northwesterly flow of cold arctic air for more than seven months of the year. During the remaining period, maritime effects are greatest in August and September when the extent of open water in the basin exceeds that of ice, but the influence seldom reaches far inland.

In the east the area is protected by the mountainous backbone of Baffin Island; in the north there is a certain degree of protection, but the terrain is composed more of gentle hills and plateau-like features. This topography effectively separates the area from most of the cyclonic activity moving through the Davis Strait-Baffin Bay corridor. In the south, however, occasionally storms in the Hudson Bay area will affect the sub-region, particularly in their mature stages when there apparently is a tendency for them to move into Foxe Basin where they stagnate and fill. The resulting annual precipitation totals decrease from 300 mm to 200 mm from central Baffin Island and its western coast with amounts less than 200 mm over Foxe Basin and Gulf of Boothia. Arctic Bay and Pond Inlet in the northeast receive less than 150 mm due to their sheltered locations.

One of the most interesting features of this sub-region is the high percentage of surface-based temperature inversions that occur in the southern Foxe Basin during the winter. The phenomenon extends to the Southampton Island area of the South-Central region (II) and over the western end of Hudson Strait. Percentages are in excess of 80%, values that are matched in the Canadian Arctic Islands only in the Eureka and northwestern islands areas.

Sub-region IVc: Baffin Island Mountains

The area of mountainous terrain on Baffin Island extending from near Pond Inlet in the north to the Cumberland Peninsula in the south is generally 1000-1600 m ASL with some areas in excess of 2300 m. In the south and east, the edge of the mountains is well-defined, but in the west it becomes plateau-like and hilly.

An interesting aspect of the climate here is the fact that the elevation of the land enables it to escape some of the extreme low temperatures that occur in lowland areas due to the intense surface-based inversions. The result is an area with mean annual temperature range (<33°C) less than the Foxe Basin interior area (35-37°C), but not as low as on the eastern Baffin coast (29-30°C) where the marine influence is very strong. This is also partially due to the fact that in summer the higher altitudes result in cooler temperatures than the surrounding lower areas.

One of the characteristics of this sub-region (and in fact all similar mountainous areas) is the variety of local conditions than can occur due to such factors as ponding of cold air and air drainage and local wind effects resulting in air mixing or *foehn* influences. Locally mild conditions may be due to the latter whereas large-scale warming is related to synoptic-scale influences. In this sub-region, the active cyclonic track to the east is an important influence in that regard.

This cyclonic activity combined with the proximity of a source of moist air, the temperature regime, and the local relief provide the prerequisites for glacial development and a number of glacierized areas are found in the sub-region, chief among them being the Barnes and Penny ice caps. Precipitation throughout the sub-region is generally above 300 mm annually with higher totals on the exposed eastern slopes.

Sub-region IVd: Baffin Island Eastern Coast

The thin eastern strip of Baffin Island which forms this sub-region features a complex series of fiords, each with its own peculiarities. Along southeastern coasts, fiord walls rise abruptly to more than 1000 m. In the north, the fiords penetrate up to 100 km into the mountains, but coastal slopes are not as sheer.

Other than along Hudson Strait, this is the coastal area in the Canadian Arctic Islands where marine influences are greatest. This is reflected in the mean annual temperature range which varies from 30°C in the north to 26°C in the south. In winter, mean temperatures are not nearly as low as in regions at similar latitudes to the west due to the presence of milder air associated with cyclonic systems, the numerous water inlets along the coast, and the occasional warming due to milder air moving down the mountains. In summer, the southward-moving Baffin cold current and the heavy concentrations of sea ice which persist until late in the summer season have a marked chilling effect along the coast. In this regard, it is interesting to note that the final sea ice to melt along the Baffin Island east coast is usually in the vicinity of Home Bay to the north of Broughton Island.

Cloudiness amounts, particularly in southern sections, are high, maintained in winter by vigorous cyclonic activity combined with the abrupt lift provided to an onshore airflow by the coastal cliffs. In summer, the latter, together with the persistent maritime influence of cold seas, results in a high incidence of fog and low clouds. In this regime, annual precipitation averages 400 mm, increasing to 600 mm or more on exposed southern coastal slopes. With somewhat less cyclonic activity in northern sections of the sub-region, annual precipitation averages about 200 mm there.

Winds in the sub-region are usually quite strong at unsheltered locations as low-pressure areas move up the Davis Strait in winter. The high speeds are often maintained over periods exceeding one or two days.

Sub-region IVe: Southeastern Baffin Island

This sub-region has posed some problems as to whether it should really be a separate area. It does not, however, appear to fit into any of the adjacent sub-regions. In comparison with the Interior Baffin Island sub-region (IVb), it experiences a significantly higher degree of cyclonic activity, particularly in terms of active systems. Its mean annual temperature range is 5 to 6°C higher than along the Baffin east and south coasts and the terrain is not as rugged or high as the mountainous area of northern and central Baffin Island. Finally, the climate of the sub-region is also significantly different from that of the Hudson Strait area, where ice and moderating maritime influences are so strong.

The area is composed of Cumberland Sound and Frobisher Bay and most of the adjacent lands. From both of these large water bodies, valleys trend northwestward through hilly terrain to lowlands on the western side of the island. Prevailing winds down the valleys give somewhat better aviation weather conditions to Frobisher Bay and Pangnirtung, the two stations in the sub-region for which observations are available, than one would expect elsewhere in the area. As both are located near the heads of large inlets, the marine influence is evident in the summer and autumn. Residual summer sea ice is not usually present, with clearing of the inlets being complete by mid-July on the average. This is in contrast to the coastal areas directly to the north where sea ice can linger throughout the summer, resulting in relatively cooler temperatures.

Precipitation amounts range from 300-400 mm annually in lowland areas to in excess of 500 mm at the higher elevations. Winter conditions are not as mild as in the Hudson Strait area or the coastal sub-region to the east, but temperatures rise relatively early and rapidly in the spring. In summer, interior temperatures are influenced by cooler air from over the surrounding water, but not as markedly as on the coasts to the west and south of the sub-region.

Sub-region IVf: Hudson Strait

The Hudson Strait area lies at the most southerly latitude of any portion of the Canadian Arctic Islands and the extreme deficit of solar radiation in winter is not quite so significant here as it is further north. In the western and central parts of the strait, there are ice and moderating marine influences imposed both in summer and winter to about the same extent as along the Baffin Island east coast. The typical characteristics of increased fog and

TABLE 5. Region IV: The Eastern

Sub-Region	Temperature			Surface-Based Temperature Inversion Frequency	Percentage Frequency of Occurrence of Winds ≥ 40 km/h	January Percentage Frequency of Blizzard Occurrence	Annual Precipitation	Percentage Frequency of Occurrence of Fog or Ice Fog	Percentage Frequency of Occurrence of IFR Conditions
	Mean Annual Range	Mean Daily Temperature (°C)	Winter						
a: Northern Baffin Bay-Lancaster Sound	33 to 36°C generally; as low as 23°C over "North Open Water"	January: -20 to -33 from northeast to southwest	Begin: Aug. 30 to Sept. 5	Dec.—Feb.: 75% except much lower over "North Open Water"	January: Coburg Island (short-term record) -8	Coburg Island-5	150-200 mm over water surfaces, up to 300 mm on exposed slopes of Ellesmere and Devon Islands	Dec.—Feb.: Coburg Island -4, marine areas 5-20	Dec.—Feb.: Coburg Island-18, marine areas 20-25
		July: +3 to +5	End: June 15	June—Aug.: 30%	July: Coburg Island-7, "North Open Water"-10		40-50% falls as liquid precipitation 20% at elevation above 400 m	June—Aug.: Coburg Island-13, marine areas 15-30	June—Aug.: Coburg Island-24, marine areas 25-30
b. Gulf of Boothia-Foxe Basin-Western Interior Baffin Island	35 to 37°C	January: -32 to -28 from northwest to southeast	Begin: Sept. 5-15 from northwest to southeast	Dec.—Feb.: 80%	January: Dewar Lakes-13, Longstaff Bluff-3	Dewar Lakes-7, Longstaff Bluff-3	175-250 mm from northwest to southeast	Dec.—Feb.: Arctic Bay-16, Dewar Lakes-9, Longstaff Bluff-9	Dec.—Feb.: Arctic Bay-6, Dewar Lakes-15, Longstaff Bluff-14
		July: +5 to +8 from northwest to southeast	End: June 10-15 from southeast to northwest	June—Aug.: 50-40% from northwest to southeast	July: Dewar Lakes-9, Longstaff Bluff-3		40-50% falls as liquid precipitation	June—Aug.: Arctic Bay-4, Dewar Lakes-16, Longstaff Bluff-17	June—Aug.: Arctic Bay-3, Dewar Lakes-17, Longstaff Bluff-18
c: Baffin Island Mountains	33°C	January: -28 to -23 from northwest to southeast	Begin: Sept. 5	Dec.—Feb.: 70%	Jan.: 15-20	5-10	Generally more than 300 mm; 500-600 mm locally on Cumberland Peninsula	Dec.—Feb.: 20-25	Dec.—Feb.: 20-25
		July: +5 to slightly below	End: June 15-20	June—Aug.: 40-20% from north to south	July: 10		20-25% falls as liquid precipitation	June—Aug.: 25-30	June—Aug.: 20-25
d: Baffin Island Eastern Coast	30 to 26°C from north to south	Jan.: -25 to -20 from north to south	Begin: Sept. 10-25 from north to south	Dec.—Feb.: 60%	Jan.: Brevoort Island-23, Broughton Island-6, Cape Dyer-14, Clyde-3	Brevoort Island-8, Broughton Island-3, Cape Dyer-4, Clyde-3	200 mm in north to 600 mm locally in Cape Dyer area to 400 mm in south	Dec.—Feb.: Brevoort Island-20, Cape Dyer-12, Clyde-4	Dec.—Feb.: Brevoort Island-29, Cape Dyer-19, Clyde-12
		July: +5	End: June 15	June—Aug.: 30-20% from north to south	July: Brevoort Island-9, Broughton Island-1, Cape Dyer-3, Clyde-1		15-25% in north and 35-45% in south (except lesser at high elevations) falls as liquid precipitation	June—Aug.: Brevoort Island-42, Cape Dyer-32, Clyde-12	June—Aug.: Brevoort Island-42, Cape Dyer-18, Clyde-16
e: Southeastern Baffin Island	33 to 34°C	January: -25	Begin: Sept. 20-25	Dec.—Feb.: 70%	Jan.: Frobisher Bay-10	Frobisher Bay-2	Generally 400 mm except 500 mm at higher elevations north and south of Frobisher Bay	Dec.—Feb.: Frobisher Bay-5	Dec.—Feb.: Frobisher Bay-14, Pangnirtung-13
		July: +5 in north to +8 in centre to +5 in south	End: June 10 over lowland, June 15 over highland	June—Aug.: 20%	July: Frobisher Bay-3		40-45% falls as liquid precipitation, 20% at elevations above 400 m	June—Aug.: Frobisher Bay-10	June—Aug.: Frobisher Bay-10, Pangnirtung-10
f: Hudson Strait	30°C in west to 22°C in east at Resolution Island	Jan.: -25 to -20 from west to east	Begin: Sept. 30	Dec.—Feb.: 80-50% from west to east	Jan.: Nottingham Island-8, Resolution Island — Cape Warwick-48	Nottingham Island-3, Cape Warwick-7	275-300 mm from west to east	Dec.—Feb.: Nottingham Island-2, Cape Warwick-38	Dec.—Feb.: Nottingham Island-15, Cape Warwick-37
		July: +5 to +8 in west, less than +5 in east	End: June 5	June—Aug.: 30-10% from west to east	July: Nottingham Island-2, Cape Warwick-26		45-55% falls as liquid precipitation on coasts	June—Aug.: Nottingham Island-9, Cape Warwick-45	June—Aug.: Nottingham Island-14, Cape Warwick-43
g: Baffin Bay-Davis Strait	25 to 30°C	January: -20 to -28 from south to north	Begin: Sept. 10-30 from north to south	Dec.—Feb.: 60%	Jan.: 15-20	5	Less than 200 mm in north to between 300 and 400 mm in south	Dec.—Feb.: 5-10	Dec.—Feb.: 20-25
		July: between +3 and +5	End: June 5-10	June—Aug.: 20%	July: 10-15			June—Aug.: 15-20	June—Aug.: 30-35

cloud occurrence and more moderate temperature conditions are present. At the eastern end, however, the proximity to open water in both summer and winter results in the most pronounced marine influence of any area of the Canadian Arctic Islands. Resolution Island, located there, has a mean annual temperature range of only 22°C. In winter, Resolution Island's coldest months are the warmest of any of the regions while the July mean temperature is almost the lowest of anywhere in the Arctic Islands, even though it is for the southernmost point. The presence of ice in the Hudson Strait waters being flushed from the west and the cold water current down the eastern Baffin Island coast are important factors in this regard. The combination of these factors and the presence of warm moist air due to cyclonic activity results in fog formation reaching its maximum occurrence here.

Sub-region IVg: Baffin Bay - Davis Strait

This is the only climatic sub-region in the Canadian Arctic Islands that is entirely a marine area. It includes all the Canadian waters off the east coast of Baffin Island from the North Water in the north to east of Frobisher Bay in the south. The area is composed of water of both Atlantic and Arctic influence and is characterized by first-year ice for most of the year. During the summer season, the sea ice cover gradually shrinks from both the north and south so that the Home Bay area experiences sea ice the longest, usually well into August. The cold southward-flowing Baffinland current is the dominant surface water motion of the sub-region. Many icebergs calved from the glaciers of Greenland and Ellesmere Island are carried along in this flow and the water to the east of Clyde is an important staging area for them.

The sub-region is the closest one to the mean cyclone trajectory over the eastern half of Davis Strait, and as a result storm activity in the area is frequent. Injections of relatively milder air because of this and the presence of the water itself keep winter mean temperatures in the -20 to -25°C range, similar to those experienced over Hudson Strait and thus warmer than all other areas of the Arctic Islands. In summer, the cold water and floating ice floes keep mean temperatures below 5°C. The resulting mean annual temperature is around 25 to 30°C, fairly similar to sub-region IVd.

Region V: The Northern (Table 6)
Sub-region Va: Nares Strait

This sub-region includes Kane and Hall basins, their connecting channels and the adjacent Ellesmere Island coastal lands. The latter are marked by fiords, but not to the same extent as Baffin Island. The waterways are dominated by a mixture of first- and multi-year sea ice and summer clearing is inhibited by the ice plug that forms in narrow Smith Sound to the south.

Although most of the storm systems in the Eastern Arctic stagnate in northern Baffin Bay, the few that continue northward between Ellesmere Island and Greenland are enough to make this area different from the rest of region V. This activity is mainly responsible for the sea ice in Nares Strait consolidating later than most of the other narrow Arctic Islands channels, usually not until February or March (Dunbar, 1971).

The mean annual temperature range is near 38°C, fairly high, but still significantly lower than the 43°C at Eureka in the interior. Precipitation is less than 200 mm annually, but again this differs from both the higher elevations of Axel Heiberg and Ellesmere islands whose exposed slopes receive in excess of 200 mm, and the interior lowlands which experience less than 100 mm in places.

Along relatively narrow, steep-sided Nares Strait, it appears that downslope winds off either the Greenland or Ellesmere highlands may be frequent and turbulent in winter and often accompanied by low visibilities in blowing snow. In the summer and fall, the influences of varying coverages of sea ice-open water lead to high frequencies of fog and low cloud over the channels and along the coastlines. The same influences probably result in localized fog and low cloud patches during the early winter sea ice consolidation period.

Sub-region Vb: Nansen Sound and Adjacent Lowlands

Nansen Sound and the adjacent interior lowlands, principally of Ellesmere Island, are almost completely surrounded by mountains and the resulting rainshadow effect is indicated by the area's receiving the least mean annual precipitation in Canada. Protected from cyclonic activity along the Baffin Bay storm track by the mountainous barrier of Ellesmere Island and from the occasional cyclonic centre moving northward from the western Parry Channel by similarly mountainous Axel Heiberg Island, this essentially continental area has few outside synoptic influences.

The sub-region experiences the greatest mean annual temperature range in the Arctic Islands, 43°C at Eureka. Although not so indicated on Figure 7 due to scale limitations, Lake Hazen and vicinity belong in this sub-region. During 1957-58 when temperatures were recorded continuously for one year at Lake Hazen, the mean annual range was 50°C compared to Eureka's 49°C for the same period. The implication here that some of the interior lowland locations are more continental than Eureka seems reasonable when one considers that in summer the effect of nearby Eureka Sound probably keeps Eureka's temperature down somewhat.

Insofar as aviation weather is concerned conditions are generally favourable. For example, IFR conditions at Eureka occur only 6% and 2% of the time during December-to-February and June-to-August respectively.

In comparison with Resolute, some 500 km further south in region I, spring breakup of streams near Eureka is several days earlier. This has been attributed to the lesser cloud cover at Eureka and the higher net radiation (mean annual value > 10 kly) there (Walker and Lake, 1973). A further interesting feature of the area is the 80-85% frequency of surface-based inversion occurrence during the winter.

Sub-region Vc: Axel Heiberg and Ellesmere Islands Highlands

This remaining area of region V is dominated by mountainous terrain with extensive glacierization. To some extent, these characteristics result in a climatic regime somewhat similar to the mountainous sub-region of Baffin Island. These similarities include the effects of lowering the mean annual temperature range relative to the adjacent lowlands because of the higher percentage frequency of surface-based temperature inversions over the latter. Greater precipitation amounts on the exposed slopes also occur. At the higher latitudes of this sub-region, though, the precipitation amounts (200 mm annually) are not as impressive as on Baffin Island owing to the difference in the frequency of cyclonic activity. Similarly, mean cloudiness is not quite as high, particularly in winter.

RECENT REGIONAL VARIATIONS IN CLIMATE

The usefulness of the climate information presented in this paper depends on how representative the data base is for future years. Observing stations with reasonably long periods of record in each of the five climatic regions were examined for any evident trends. Surface air temperature was chosen as the element for analysis. Annual and decadal values of annual mean daily temperature were determined and are shown in Figures 8 and 9.

The Northwestern region (I), represented by Resolute, Mould Bay and Isachsen, indicates a gradual temperature decrease from the early 1950s into the 1970s followed by a levelling out or even a slight increase (as suggested by Resolute and Mould Bay). The South-Central region (II) is characterized by a gradual temperature decrease from the late 1940s to the early 1960s followed by a slight increase as indicated by Cambridge Bay. This increase also shows up at Coral Harbour, but is delayed until the early 1970s. In the Western region (III), data for Cape Parry and Sachs Harbour are in good agreement as to year-to-year variations, but no conclusive trends are evident over the period of record. For the Eastern region (IV), Nottingham Island in the south indicates temperatures rising to a peak in the early to mid-1950s and beginning to decline thereafter. These trends are closely paralleled by available data from Cape Hopes Advance. Further north, temperature has declined since the mid 1950s at Frobisher Bay, but the data from Clyde do not show such a distinct trend. In the Northern region (V), Alert and Eureka both show a marked temperature decrease from the early 1950s through the 1970s.

An examination of the year-to-year annual mean temperatures since 1950 at the 11 stations representing the five climatic regions was made to determine the warmest and coldest years across the Arctic Islands as a whole. (Cape Hopes Advance and Nottingham Island were not considered here as their observing programs ceased in 1970-71.) By combining the annual data at the two or three stations in each region, an average annual mean temperature was determined for each year for each region. The three warmest and three coldest years were selected for each region from these. These are shown in Table 7 along with corresponding information for each station in the regions.

As far as the warmest years are concerned, no one year was uniformly warm across the entire Arctic Islands. The

TABLE 6. Region V: The Northern

Sub-Region	Temperature: Mean Annual Range	Temperature: Mean Daily Temperature (°C)	Temperature: Winter	Surface-Based Temperature Inversion Frequency	Percentage Frequency of Occurrence of Winds ≥ 40 km/h	January Percentage Frequency of Blizzard Occurrence	Annual Precipitation	Percentage Frequency of Occurrence of Fog or Ice Fog	Percentage Frequency of Occurrence of IFR Conditions
a: Nares Strait	38°C	Jan: -35 to -28 from north to south	Begin: Aug. 20-25 from north to south	Dec.—Feb.: 70-80% from south to north	Jan.: Alert-8	Alert-3	175-150 mm from south to north	Dec.—Feb.: Alert-4	Dec.—Feb.: Alert-12
		July: slightly above 3	End: June 15-20 from south of north	June—Aug.: 20-30%	July: Alert-11		In north, 10-15% falls as liquid precipitation; 40-50% in south	June—Aug.: Alert-18	June—Aug.: Alert-25
b: Nansen Sound & Adjacent Lowlands	43°C and greater	Jan.: near -35 or slightly below	Begin: Aug. 25	Dec.—Feb.: 80%	Jan.: Eureka-4	Eureka-2	Less than 100 mm, slightly higher in south	Dec.—Feb.: Eureka-2	Dec.—Feb.: Eureka-6
		July: above +5 in Eureka area, elsewhere +3 to +5	End: June 10-15	June—Aug.: 30-40%	July: Eureka-2		35-40% falls as liquid precipitation	June—Aug.: Eureka-1	June—Aug.: Eureka-2
c: Axel Heiberg and Ellesmere Islands Highlands	35°C	Jan.: -28 to -32	Begin: Aug. 20-25	Dec.—Feb.: 70%	Jan.: 5-10	2-4	Slightly above 200 mm	Dec.—Feb.: 5-10	Dec.—Feb.: 15-20
		July: 0 to +3 except less than 0 in northern Ellesmere	End: June 15-20	June—Aug.: 20-30%	July: 5-10		20-30% falls as liquid precipitation	June—Aug.: 15-20	June—Aug.: 15-20

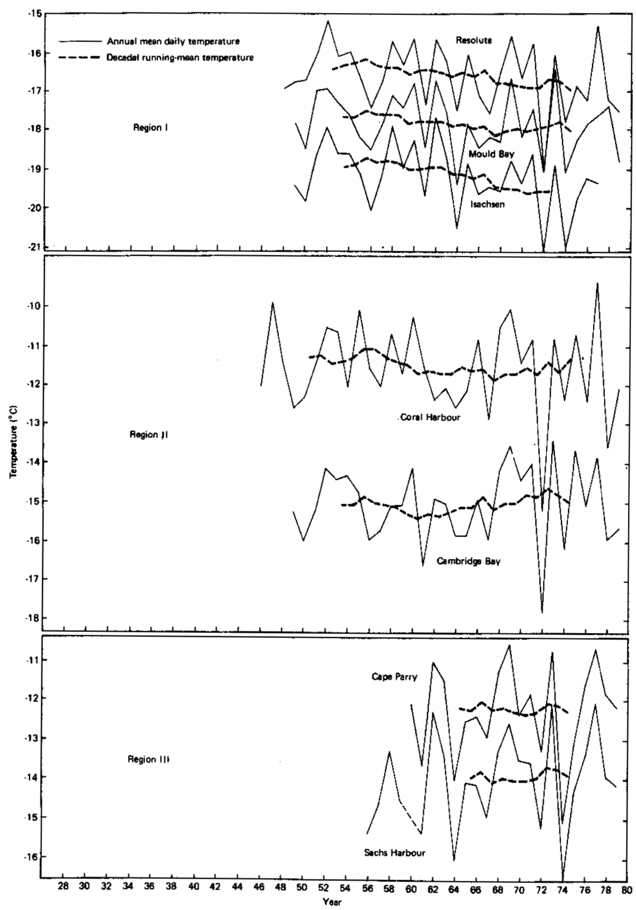

FIG. 8. Annual mean daily temperature variation in regions I, II and III.

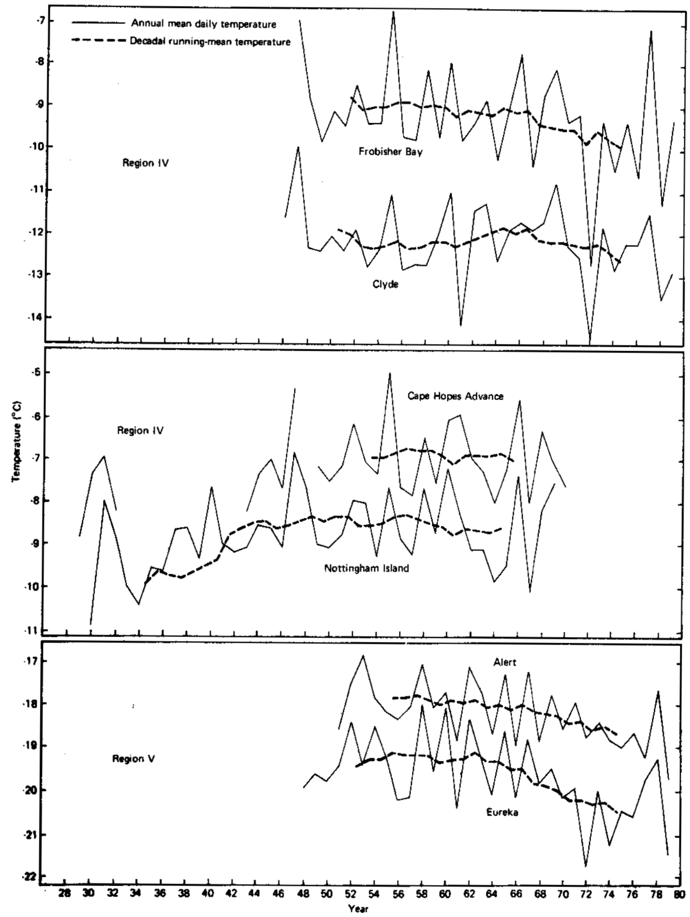

FIG. 9. Annual mean daily temperature variation in regions IV and V.

TABLE 7. Warmest and coldest years in the climatic regions on the basis of annual mean daily temperature

Region	Station	Warmest Years at Stations 1st	2nd	3rd	Warmest Years on Regional Basis 1st	2nd	3rd	Coldest Years at Stations 1st	2nd	3rd	Coldest Years on Regional Basis 1st	2nd	3rd
I	Isachsen	1962	1958	1952	1962, 1952		1969	1972	1974	1964	1972	1974	1964
	Mould Bay	1973	1969	1962				1964	1974	1972			
	Resolute	1952	1977	1969				1972	1974	1967			
II	Cambridge Bay	1973	1969	1975	1977	1969	1973	1972	1961	1974	1972	1978	1967
	Coral Harbour	1977	1969	1955				1972	1978	1967			
III	Cape Parry	1969	1977	1973	1977	1973	1969	1974	1964	1961	1974	1964	1961
	Sachs Harbour	1977	1973	1969				1974	1964	1956			
IV	Clyde	1969	1960	1955	1955	1877	1960	1972	1961	1978	1972	1978	1961
	Frobisher Bay	1955	1977	1966				1972	1978	1976			
V	Alert	1953	1958	1962	1958	1962	1960	1979	1977	1975	1979	1972	1974
	Eureka	1958	1960	1962				1972	1979	1974			

year 1977 was warm from east to west south of the Parry Channel, but not to the north, and 1962 showed the opposite pattern. For the coldest years, 1972 was almost uniformly cold across the entire Arctic Islands. The exception was in region III, adjacent to the Beaufort Sea. 1974 was cold north of the Parry Channel and in the west also, but not sufficiently so in the Eastern and South-Central regions to be ranked in the three coldest years of those regions.

It is interesting to note that, of the eight different regional warmest years, five were before 1963. Of the seven different regional coldest years, only one was before 1963. This fits with the work of Bradley (1973) and Bradley and England (1978) which pointed out marked summer temperature decreases after about 1963/1964 in the Eastern and Northern Arctic. A comparison of mean maximum July temperatures (a common index of glacial ablation season conditions) for 1948-1963 and 1964-1976 for the 11 representative stations of the five climatic regions (Table 8) showed decreases up to 1.6, 1.9 and 1.4°C for the period after 1963 in regions I, IV and V (Northwestern, Eastern, and Northern) respectively and increases under

TABLE 8. Comparison of July mean maximum temperature at 11 stations between 1948-1963 and 1964-1976

Region	Station	July Mean Maximum Temperature (°C)		
		1948-1963	1964-1976	Change
I	Isachsen	6.1	4.7	-1.4
	Mould Bay	6.4	6.2	-0.2
	Resolute	7.5	5.9	-1.6
II	Cambridge Bay	12.0	12.1	+0.1
	Coral Harbour	13.3	13.5	+0.2
III	Cape Parry (1957)*	8.6	9.1	+0.5
	Sachs Harbour (1956)	9.1	9.1	0.0
IV	Clyde	9.2	7.3	-1.9
	Frobisher Bay	12.1	11.2	-0.9
V	Alert (1950)	7.3	5.9	-1.4
	Eureka	8.9	7.8	-1.1

* Indicates a station where data collection did not begin until after 1948.

0.6°C in regions II and III (South-Central and Western).

It would appear from the various above results that a measurable cooling in the climate has been in progress in the Northern and Eastern Arctic since at least the early 1960s. This cooling is not generally reflected in the Central and Western Arctic south of Parry Channel.

SUMMARY

The pattern of regional climate in the Canadian Arctic Islands outlined here is an attempt to come to grips with the diversity of climatic conditions that characterizes the area. As pointed out, the bias in the network of observations towards coastal locations is a major problem for such a regional delineation. It is felt, however, that the results arrived at provide a useful background for those involved in weather-sensitive activities in the Arctic Islands.

The regional boundaries should, however, be treated cautiously in view of the subjectivity involved in their choice. Obviously, a denser observing network with sites representative of inland and marine areas as well as coastal ones would provide an improved data base over a long period of time to define the regional boundaries more accurately. In the meantime, much can still be gained through the study of many existing short-term observational data collection programs which support environmental and industrial activities in the north. It is hoped that the climatic regions suggested in this study will serve as a basis for discussion in the scientific community and provide greater recognition of the distinct regional climatic variation within the Canadian Arctic.

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