REPORT GD-2

ISSN 0149-1776

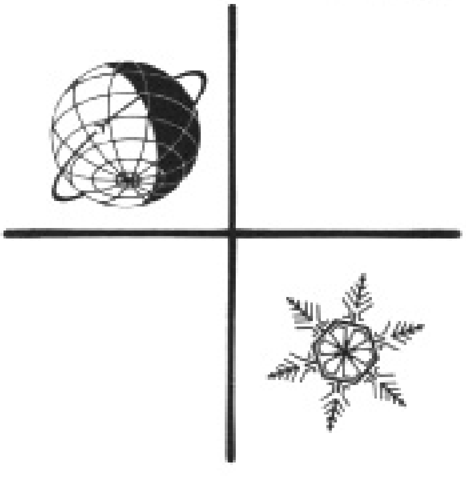
GLACIOLOGICAL DATA

this issue:

ARCTIC SEA ICE

Part 1

World Data Center A
for
Glaciology
Snow and Ice



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National Academy of Sciences
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World Data Center A
Coordination Office
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C., U.S.A., 20418
[Telephone: (202) 389-6478]

Glaciology [*Snow and Ice*]:

World Data Center A: Glaciology
[Snow and Ice]
Inst. of Arctic & Alpine Research
University of Colorado
Boulder, Colorado, U.S.A. 80309
[Telephone: (303) 492-5171]

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GLACIOLOGICAL
DATA

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Published by:
WORLD DATA CENTER A FOR GLACIOLOGY
[SNOW AND ICE]
Institute of Arctic and Alpine Research
University of Colorado
Boulder, Colorado 80309 U.S.A

Operated for:
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
Environmental Data Service
Boulder, Colorado 80302 U.S.A.

Glaciological Data, which supercedes Glaciological Notes, is published three to four times per year by the World Data Center A: Glaciology [Snow and Ice]. It is distributed without charge to interested individuals and institutions. Copies of most of the back issues of Glaciological Notes are available without charge upon request.

Direct all communications to:

Marilyn J. Shartran, Editor
Glaciological Data
World Data Center A: Glaciology [Snow and Ice]
Institute of Arctic and Alpine Research
University of Colorado
Boulder, Colorado 80309 U.S.A.

DESCRIPTION OF DATA CENTERS

WDC-A, Glaciology is one of three international data centers serving the field of glaciology under the guidance of the International Council of Scientific Unions Panel on World Data Centres. It is part of the World Data Center System created by the scientific community in order to promote worldwide exchange and dissemination of geophysical information and data. WDC-A endeavors to be promptly responsive to inquiries of the scientific community and to provide data and bibliographic services in exchange for copies of publications or data by the participating scientists.

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World Data Center A
INSTAAR
University of Colorado
Boulder, Colorado, U.S.A. 80309

World Data Center B
Molodezhnaya 3
Moscow 117 296, USSR

World Data Center C
Scott Polar Research Institute
Lensfield Road
Cambridge, CB2 1ER, England

Permanent Service on the Fluctuations of Glaciers
Section on Hydrology and Glaciology
Research Institute on Hydraulics and Soil Mechanics
Federal Institute of Technology
Voltastrasse 24
8044 Zürich, Switzerland

The World Data Centers follow the guidelines established by the International Council of Scientific Unions Third Consolidated Guide to International Data Exchange through the World Data Centres, 1973. The following description from the Guide details the form of the data accepted by the WDCs.

General. WDCs are prepared to accept raw, analyzed, or published data, including photographs. It is suggested that researchers submitting data to the WDCs do so in a form which will be intelligible to other users. Researchers should be aware that the WDCs are prepared to organize and store data which may be too detailed or bulky for inclusion in published works. It is understood that such data which are submitted to the WDCs will be made available according to guidelines set down by the ICSU Panel on WDCs in the Guide to International Data Exchange. Such material will be available to researchers as copies from the WDC at cost, or if it is not practical to copy the material, it can be consulted at the WDC. In all cases the person receiving the data will be expected to respect the usual rights, including acknowledgment, of the original investigator.

Fluctuations of Glaciers. The Permanent Service will be responsible for receiving data on the fluctuations of glaciers and will also receive such data as are generated by the International Hydrological Decade Project on Variations of Existing Glaciers. The types of data which should be sent to the Permanent Service are detailed in UNESCO/IASH (1969) Variations of Existing Glaciers: A Guide to International Practices for Their Measurement. These data should be sent through national correspondents in time to be included in the regular reports of the Permanent Service every 4 years (1964-68, 1968-72, etc.).

Projects of the International Hydrological Decade. In addition to the above, the International Hydrological Decade, 1965-74, sponsors an Inventory of Seasonal and Perennial Snow and Ice Masses, as well as a project on the Combined Heat, Ice and Water Balances at Selected Glacier Basins. Until such time as technical secretariats are established for these projects, data should be channeled through the World Data Centers.

In order that the WDCs may serve as information centers, researchers and institutions are requested:

To send WDCs reprints of all published papers and public reports which contain glaciological data or data analysis; one copy should be sent to each WDC or, alternatively, three copies to one WDC for distribution to the other WDCs.

To notify WDCs of changes in operations involving international glaciological projects, including termination of previously existing stations or major experiments, commencement of new experiments, and important changes in mode of operation.

FOREWORD

The extensive literature on arctic sea ice, even narrowly delimited, has necessitated issuing Glaciological Data number 2 in two parts, and has considerably delayed its publication. We hope the resulting compilation will prove to be a useful guide to data sources.

Our next issue will not be built around a selected bibliography, but will contain the results of our user survey on Glaciological Data and other services, and also of a survey conducted by Dr. R. Vivian on glaciological field stations. It is planned that Glaciological Data number 4 will deal with snow cover.

The interpretation of the term "glaciology" appears to be a continuing problem for many users of the Center. Several individuals have suggested that "snow and ice" would be more informative of the scope of our activities, particularly in an international and interdisciplinary context. Also, our formal scientific link to the International Council of Scientific Unions (ICSU) is via the International Commission on Snow and Ice (ICSI), of the International Association of Hydrological Sciences. To clarify the mission of the Center, we are therefore adding "Snow and Ice" parenthetically to the designation of the Center.

Roger G. Barry
Director
World Data Center A for Glaciology [Snow and Ice]

PREFACE

The contributions in this issue are intended to provide information on data problems and data availability on arctic sea ice. Drs. W.F. Weeks and W.J. Stringer discuss problems associated with sea ice terminology. Descriptions of data acquisition and analysis centers are presented by Dr. N. Untersteiner (Arctic Ice Dynamics Joint Experiment); Dr. E.P. McClain (U.S. National Environmental Satellite Service); E.A. O'Lenic (U.S. Navy); and W.J. Sowden (Canadian Ice Forecasting Central). Dr. J.E. Walsh describes a data set on Northern Hemisphere sea ice extent. We would like to express our appreciation to all these contributors.

We hope that the material will provide useful perspectives on data collection and analysis. Comments or suggestions regarding these types of contributions in the various snow and ice disciplines are always welcome.

We would also like to thank P. Harvill, G. Manzanares, F. Brown, J. Futo, A. Brennan, and J. Rogers for the many hours spent in the compilation and organization of the bibliography.

Contributions from those who have donated material to the Data Center in recent months are gratefully acknowledged.

Marilyn J. Shartran
Editor

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Sea Ice Conditions in the Arctic

W.F. Weeks
Cold Regions Research and Engineering Laboratory
Hanover, New Hampshire, U.S.A.

This part of the original report describes in general terms the types of ice found in the Arctic, the terminology used to describe it, the main factors controlling the physical property variations of the ice, and the seasonal variations in ice conditions.

Terminology and Classification

Much of the sea ice terminology originated with the whaling industry which flourished around Greenland from the 17th century and spread to the North American Arctic in the 19th century. Whalers operating in the ice devised terms to describe what they saw, and these terms gradually found their way into the reports of the British Navy, which often used whalers as ice masters. There the terms became accepted and standardized to some degree. Eventually the terminology came to be used by national groups engaged in ice reconnaissance, and recently it has been standardized on an international basis by the World Meteorological Organization (1970).

This report uses the WMO terminology as much as possible. However, because it was developed primarily for ice reconnaissance, it is necessary to modify and supplement it in a discussion focused on applied problems. A complete list of definitions of ice terms used here is given in appendix I. Where possible, we have shortened the WMO definitions. For a useful summary of the WMO terminology, the reader is referred to Dunbar (1969) or to the original standardization document, which is presented in a multilingual, illustrated glossary form (WMO, 1970). Other good illustrated ice glossaries have been prepared by the U.S. Navy Hydrographic Office (1952) and by Armstrong et al (1966).

A summary of terms commonly used to describe the genetic history of a specific piece of sea ice is shown in figure 1. The overall format of the chart was suggested by Wilson, Zumberge, and Marshall's (1954) classification of lake ice, and Transehe's (1928) and Hela's (1958) genetic classification of certain aspects of sea ice. A typical history for ice in the Arctic Ocean is traced with a heavy line. In addition, a summary of terms relating to development, concentration, floe size, and arrangement is given in table 1. Some of the development terms (dark and light nilas, grey and grey-white ice) describe rather arbitrary differences in ice thickness that do not correspond to any significant physical change in ice characteristics; others (shuga, grease ice, pancake ice) describe slight differences in the characteristics of the initial ice cover that are caused by changes in the atmospheric or oceanographic conditions during initial ice formation. As the ice thickens during a winter's growth, these slight variations in initial ice characteristics become unimportant. The most important distinction related to the age of the ice is between first-year ice that has not been through a summer's melt season and old ice which has. This is important because the flushing of fresh surface melt water through the ice cover during the summer causes significant changes in the physical properties of the ice. Another important distinction is between fast ice, which is attached solidly enough to the shore that its movement is small, and pack ice, which is not solidly attached to the shore and may experience daily movements as large as 20 km.

Formation and Structure of Sea Ice

A calm body of natural sea water with a salinity of 35‰ will begin to freeze when the water temperature reaches -1.8°C. For this to occur, the air temperature must be even lower. Ice begins to form at a few points where stable crystallization nuclei occur. A skim ice sheet forms with rapid lateral (as opposed to vertical) growth. The growth occurs by accretion to the underside of the sheet and to its lateral edges at a rate dependent on temperature. It is generally believed that the lower the air temperature, the smaller the grain size in the initial ice skim, but this has not yet been verified. In the initial skims of such ice sheets, most of the ice crystals have c-crystallographic axes that are vertical (normal to the plane of the ice sheet). This orientation is favored because the plate-like early-formed ice crystals tend to float in the most geometrically stable position (i.e., with their close-packed planes, which are the planes of most rapid ice growth, oriented parallel to the ice/water interface). Turbulence in the water during freezing favors abundant nucleation and increases the abrasive action between crystals. This results in the formation of a thick slushy layer of ice. When the slush congeals, the consequent ice cover is usually several centimeters thick, fine grained, equigranular, and with a random c-axis orientation.

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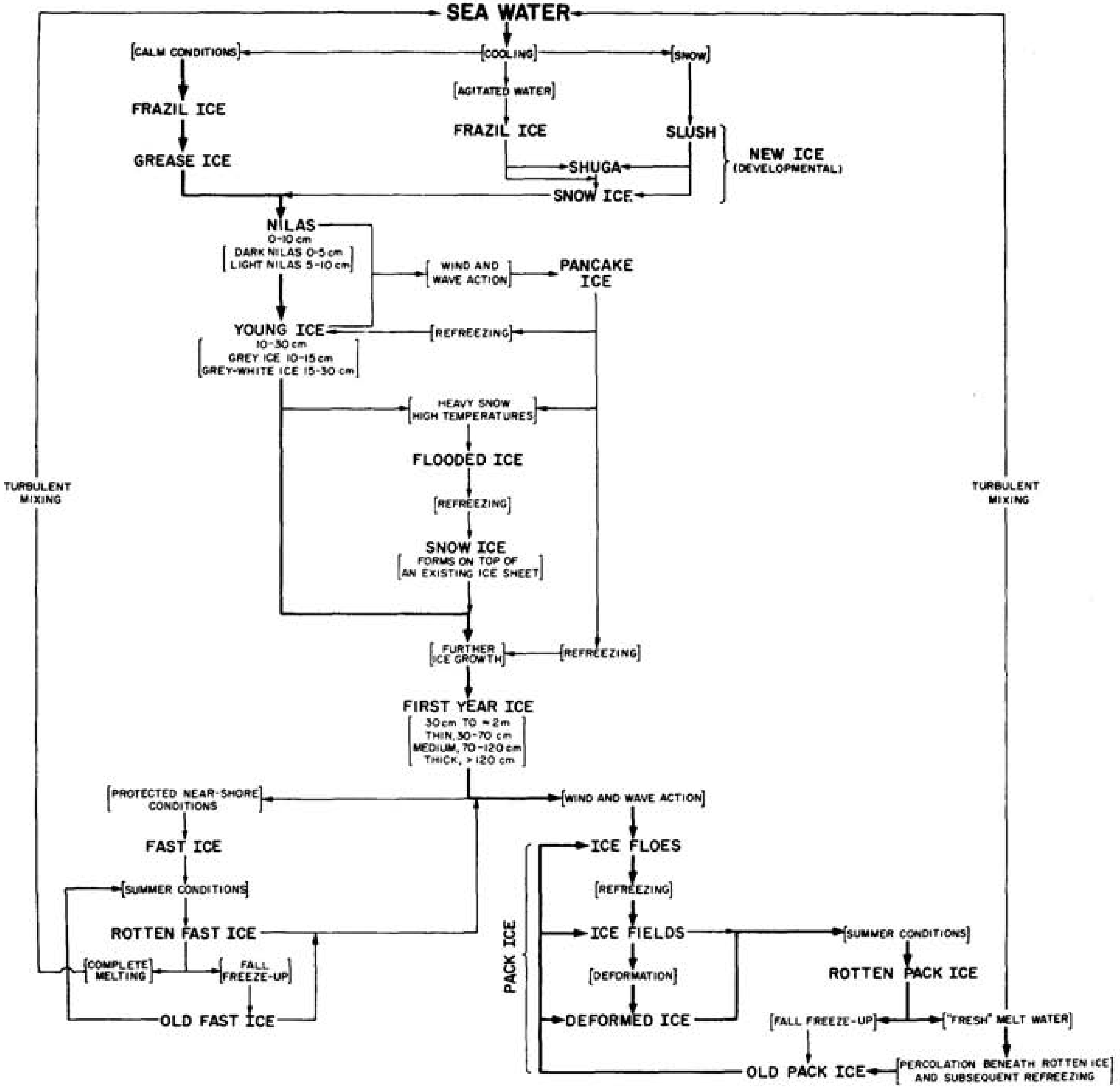

Figure 1. Sea ice terminology arranged in genetic sequence. (For detailed definitions see appendix 1.)

Once a continuous ice cover has formed, there is competitive growth among the differently oriented crystals that occur at the ice/water interface. The favored crystals have their c-axes oriented in the horizontal plane. This corresponds to orienting the crystallographic planes of most rapid growth parallel to the direction of heat flow. The c-axis horizontal orientation develops quite rapidly and is usually found by the time the ice sheet is 10-20 cm thick. The physical properties of the ice are highly dependent upon the orientation of the ice structure relative to the direction of loading. Once the c-axis horizontal orientation is well developed, the ice has the characteristics of the so-called columnar zone in metal ingots with a gradual increase in grain size downward as the distance from the initial ice/air/water interface increases. Most grain sizes determined for sea ice are small (in the range of a few centimeters or less). However, it has been speculated (Peyton, 1966; Campbell and Orange, 1974) that in thick first-year or multiyear ice, very large ice crystals occur that

Table 1. Terms related to arctic sea ice (Dunbar (1969)).

Development	Concentration	Floe Size	Arrangement
New ice frazil ice grease ice slush shuga	Compact (10/10)	Giant (> 10 km)	*Ice field* large (> 20 km) medium (15-20 km small (10-15 km)
Nilas dark (0-5 cm) light (5-10 cm) rind (to 5 cm)	Consolidated (10/10, frozen together)	Vast (2-10 km)	*Ice patch* (< 10 km)
Pancake ice	Very close (9-10/10)	Big (500-2000 m)	*Belt* (width 1-100 km)
Young ice grey (10-15 cm) grey-white (15-30 cm)	Close (7-8/10)	Medium (100-200 m)	*Tongue* (length to several km)
First-year ice thin (30-70 cm) medium (70-120 cm) thick (> 120 cm)	Open (4-6/10)	Small (20-100 m)	*Strip* (width 1 km or less)
Old ice second-year multiyear	Very open (1-3/10)	Ice cake (2-20 m)	
	Open water (< 1/10)	Small ice cake (< 2 m)	
	Ice free (no ice)	(Brash ice is accumulation of small ice cakes)	

have lateral dimensions of meters to even many tens of meters. If this proves to be true, it could introduce an interesting anisotropic effect into problems involving the mechanics of thick ice sheets.

As the ice crystals grow downward into the underlying sea water, the details of the temperature and composition at the ice/solution interface are such that each ice crystal develops a highly irregular dendritic interface. This interface is composed of a series of plates of pure ice that protrude downward into the sea water and are separated by layers of brine. The width of the plates (from the center of one brine layer to another) is called the plate spacing and is a function of the growth conditions. In the lowest 2.5 cm of the ice sheet, one platelet does not connect laterally with the next and the ice does not have an appreciable tensile strength. Once bridging occurs laterally between the plates, brine is physically entrapped within the ice, producing a series of elongated brine pockets. It is the arrays of brine pockets trapped within the sea ice between the ice plates that produce the characteristic sea ice substructure seen in horizontal thin sections. Each single ice crystal is composed of a "pocket" of plates, and each plate is partially separated by an array of brine pockets.

The strength of the ice is determined primarily by the amount of ice-to-ice connections between the plates. This is controlled by the volume of brine occurring within the ice, with the brine pockets reducing the areal percentage of ice-ice bonding between the individual platelets of each sea ice crystal. Therefore, it should be possible to express sea ice failure strengths in the form $\sigma_f = \sigma_0 (1 - \psi)$, where σ_0 is the basic strength of sea ice (i.e., the strength of an imaginary material that contains no brine but still possesses the sea ice substructure and fails as the result of the same mechanism which causes failure in natural sea ice), and ψ is the "plane porosity," or relative reduction in an area of the failure plane as the result of the presence of brine and air inclusions. The experimentally determined value of σ_0 is close to the failure strength of bubble-free lake ice. There are a variety of models that have been developed to relate ψ to the brine volume ν_b. A review of this subject can be found in Weeks and Assur (1967, 1969).

The exact functional form of the σ_f versus ν_b equation depends upon how the brine pockets change shape with changes in ν_b. Experimental observations show that the simplest relation (linear) results if σ_f is plotted against $(1 - \nu_b^{\frac{1}{2}})$. Many other sea ice properties can also be expressed as functions of ν_b, with the elastic modulus and dielectric constant proving to be proportional to $(1 - \nu_b)$ and $1/(1 - 3\nu_b)$ respectively. It would undoubtedly prove useful to develop a general theory for the variations in the properties of sea ice in terms of recent theoretical work that has been undertaken on property variations in multiphase media.

To determine the brine volume at any level in a sheet of sea ice, its temperature and salinity profiles must be known. Although the details of the chemistry of the brine in sea ice are rather complex, with different hydrated salts crystallizing out at low temperatures (Assur, 1958), for most purposes sea ice can be treated as a simple ice-brine system at temperatures above -22°C, and a simple linear relation is available for calculating brine volume given the ice temperatures and salinities (Frankenstein and Garner, 1967).

For most engineering purposes, estimating the temperature at any location in a sheet of sea ice is fairly easy if the meteorology and the properties of the snow cover on the ice are known. The difficulty is in estimating the salinity profile of the ice sheet. The limited observations that are available on salinity profiles show that young sea ice has a C-shaped profile with the highest salinities (12 to 15°/••) occurring in newly formed ice. As the ice thickens and ages, brine gradually drains down and out of the ice until at the end of a year's growth the ice has an average salinity of 4 to 5°/••. This decrease in salinity with ice thickness (age) is shown in figure 2 (Cox and Weeks, 1974), which presents field data obtained at several locations in the Arctic.

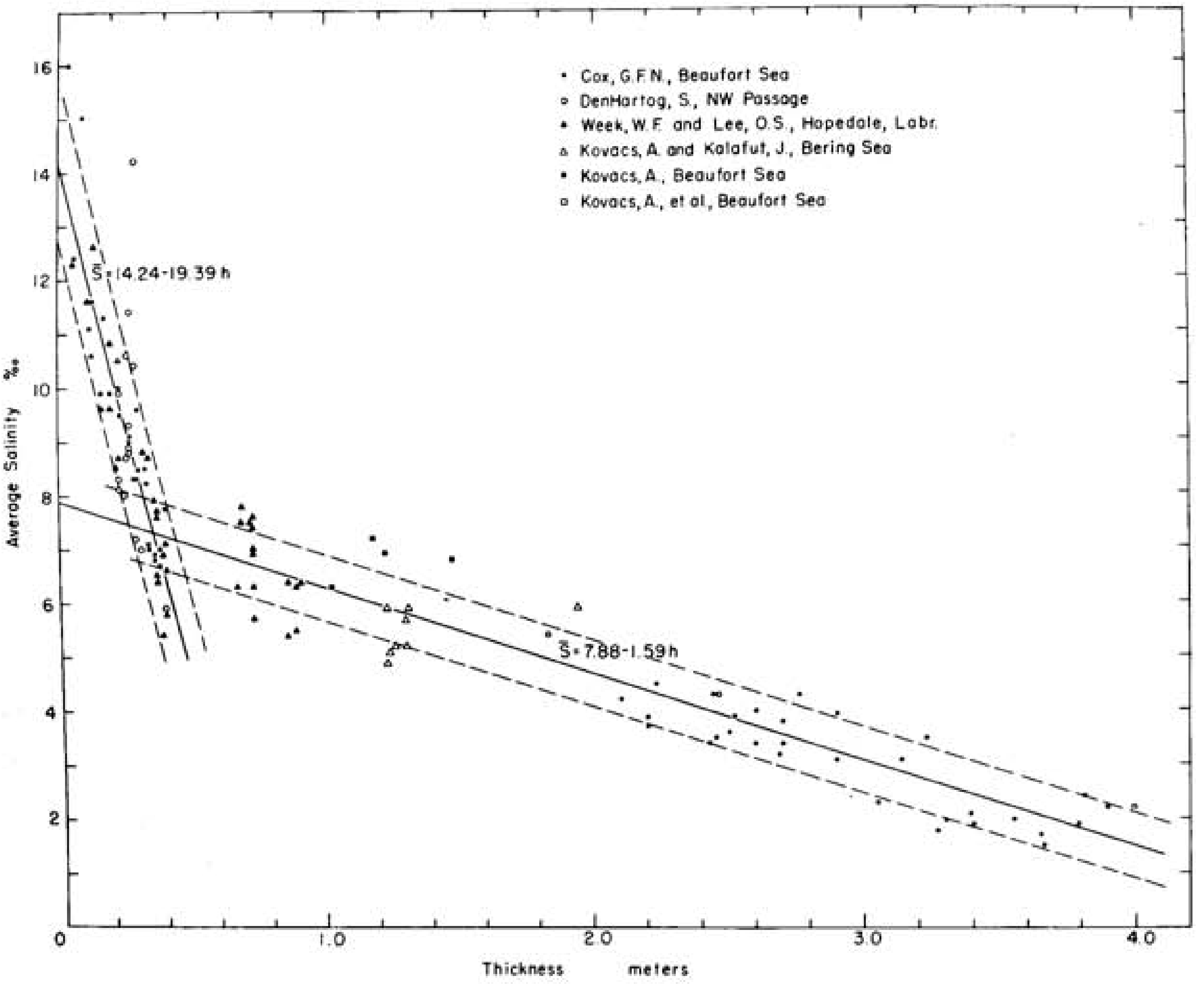

Figure 2. Average salinity of sea ice vs. ice thickness (Cox and Weeks, 1974).

The most striking change in a salinity profile occurs during the first summer's melt season when low salinity (0 to 1°/••) surface melt water percolates down through the ice sheet. This flushing process produces a salinity profile whose values start at about zero near the surface and increase with depth to 2 to 3°/•• near the bottom of the ice. This is the characteristic salinity profile for multiyear ice. Figure 3 shows a typical first-year ice salinity profile (100 cm), a profile at the start of the melt season (200 cm), and a multiyear ice profile (300 cm). The importance of the brine volume profile cannot be overemphasized; it is the principal parameter controlling the large variations in the strength of sea ice.

The differences in properties between first-year and multiyear ice are particularly illustrative in this regard. First-year ice is thin (0 to 2 m), being limited by the amount of ice growth possible during one winter. Multiyear ice is generally thicker (2 to 4 m), with the limiting thickness being specified by the ice thickness at which the winter's ice growth (on the bottom) equals the summer's ice melt (on the top). Therefore, the surface and average temperatures of the thicker multiyear ice are invariably lower during the winter. In addition, because of the extensive desalination process which occurs during the summer melt period, multiyear ice also has a very low salinity. This combination of low temperature and low salinity results in a very low brine volume, which produces a high strength. Some multiyear ice may also have recrystallized. Sea ice can therefore be classed by age: thinner, weaker first-year ice; and thicker, stronger multiyear ice.

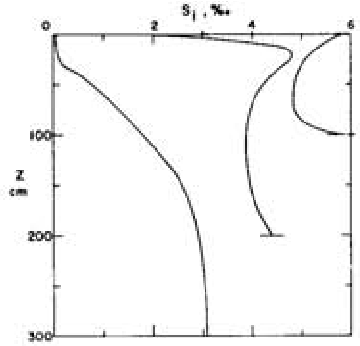

Figure 3. Representative salinity profiles for 100-cm thick first-year ice, 200-cm first-year ice at the start of the melt season, and multiyear ice (Weeks and Assur, 1967).

Other important aspects of the pack are produced primarily by the surface forces that are exerted on the ice by the atmosphere and the ocean. Cracks in sea ice are quite common and occur on several scales. When a long crack opens up, the resulting open water area is called a lead. The large leads in the Arctic Ocean occur in consistent patterns that presumably can be predicted by an adequate air-ice-ocean model. Leads offer lines of least resistance for ship travel through the pack, but their behavior is so highly dynamic that shipping-route planners would need near real-time information to take advantage of lead patterns.

During most of the year, a newly opened lead freezes within a few hours, and 30 cm of ice forms within 5 to 15 days depending upon the meteorological conditions. When divergence stops and the pack starts to converge, it it this thinner ice that is crushed and pushed into the ridges and rubble fields that characterize pack ice. Some of these ridges are immense accumulations of deformed ice; sails as high as 13 m and keels as deep as 47 m have been observed. These form obstacles which must be considered by anyone who designs operational structures for the polar oceans. Based on our current limited knowledge of ridging, first-year ridges are commonly poorly frozen together and are much less resistant to penetration than multiyear ridges, which are massive pieces of low-salinity ice. In fact, next to ice islands, which are pieces of thick shelf ice from the north coast of Ellesmere Island, multiyear pressure ridges are believed to be the greatest obstacle to ships or structures operating on the edge of the Arctic Ocean.

Distribution, Deformation, and Drift

The mean maximum and mean minimum limits of sea ice in the Northern Hemisphere are shown in figure 4. At its maximum extent, the Arctic sea ice covers 15.1×10^6 km^2. Most of this ice, and almost all of the heavy multiyear ice, is contained within the essentially land-locked Arctic Ocean and its marginal seas. The more southerly seas in the north, such as the Bering and Labrador Seas and Baffin and Hudson Bays, contain primarily first-year ice. The one exception to this general rule is the East Greenland Sea, which serves as the main exit for heavy old ice leaving the Arctic Ocean. Because of the land-locked nature of the Arctic Ocean, the seasonal variation of the ice extent in the Arctic is only 20% to 25% of the maximum. In contrast, the seasonal variation of the ice in the Southern Ocean, which can drift freely toward the equator, is estimated as 75% of the maximum. The total area covered by sea ice in both hemispheres (40.6×10^6 km^2) is more than 2.5 times the area covered by glacier ice, covering 7.8% of the earth's surface and 12.7% of the surface of the World Ocean. Clearly, sea ice is a geophysical entity of appreciable importance.

Much of what follows is based on visual assessments of the state of the ice cover compiled from ice reconnaissance flights and ship observations. Such observations are intended to provide an instantaneous series of quantitative assessments of complex topography in which the criteria for distinguishing between different ice types, ages, and degrees of deformation are, in many cases, both poorly established and difficult to apply. For instance, comparisons (Bushuev and Loshchilov, 1967) between visual observations and observations compiled later by careful study of aerial photographs show that there was a systematic tendency to overestimate the ice concentration by 14%, and the amount of pressure ridging, by 20%. Also, the error range in estimating the quantity of ice of different ages varied between 14% and 46%. Particular difficulty was encountered in estimating the area of old ice, which was consistently exaggerated by up to 40%, and in distinguishing between second-year and multiyear ice.

These problems should be kept in mind while reading the following. Nevertheless, as will be shown, the general trends documented by the ice observers are now being validated by more exact methods of remote sensing. However, data provided by remote sensing have not yet been collected over a sufficiently wide temporal and spatial scale to provide the general picture that is needed here.

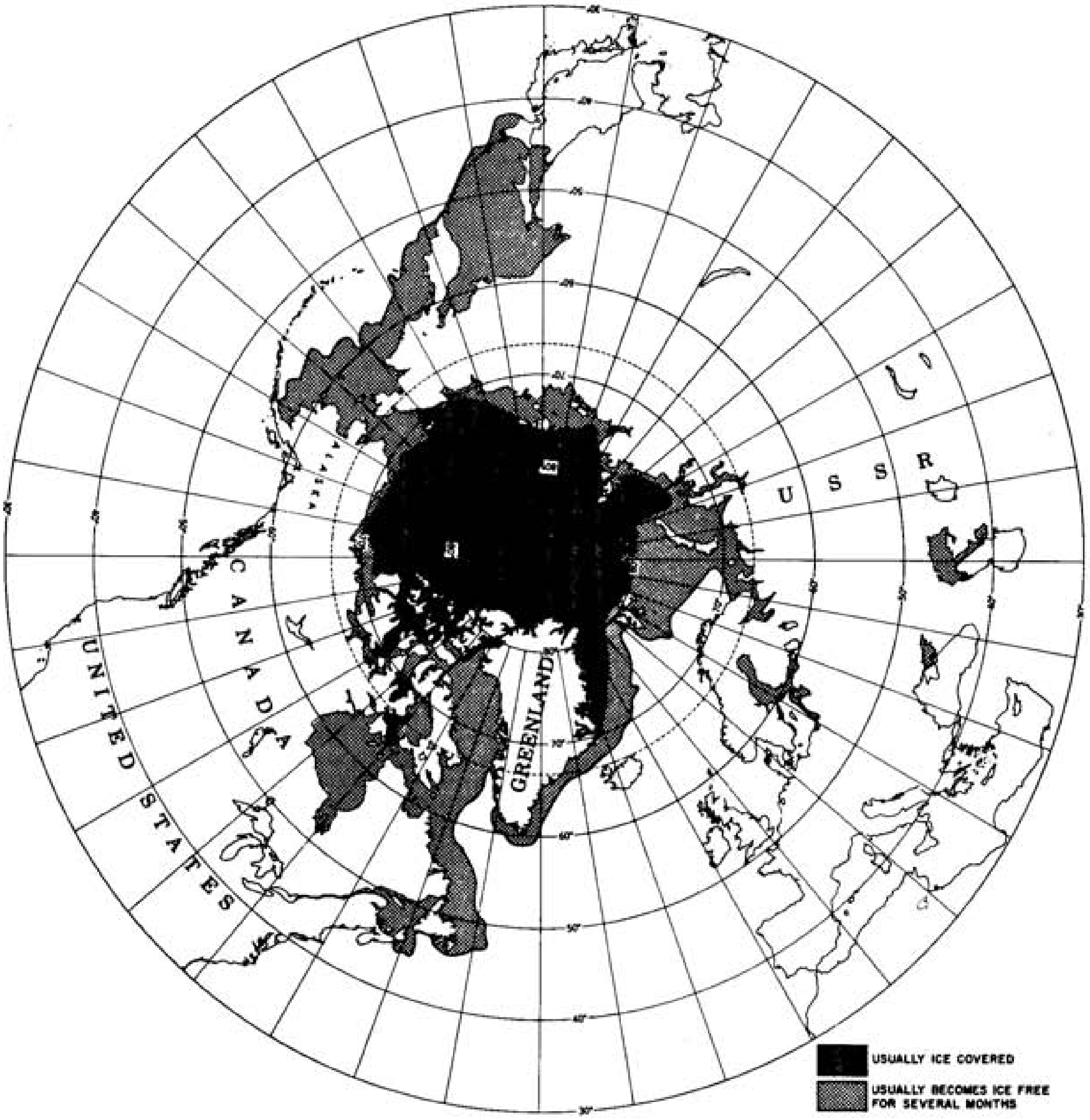

Figure 4. Mean maximum and mean minimum limits of sea ice in the Northern Hemisphere (Wittmann and Schule, 1966).

The Arctic Ocean

The most detailed compilation of information on sea ice conditions in the Arctic has been published by Wittman and Schule (1966). Their paper, a summary of information collected by the U.S. Navy "Birds Eye" ice reconnaissance flights, separates the Arctic Ocean into eight sectors. However, the data indicate that in a general way the Arctic Ocean can be separated into three main ice provinces (Wittmann, personal communication):

1. A Coastal Province, consisting of a zone of shorefast ice bordered by a flaw zone of disturbed ice, and in some locations, by a recurring flaw lead.

2. An Offshore Province, primarily composed of relatively unstable first-year ice with a thickness of 2 m or less which has usually experienced a considerable amount of deformation. In the spring, the distinction between the first two provinces vanishes with the breakup of the fast ice and the melting of the great majority of the first-year ice located near the coast.

3. A Central Arctic Basin Province, which is by far the largest province of the three, and is composed mostly of multiyear ice. The amount of deformation in this province is commonly thought to be less than in areas near the coast. The possibility of further subdividing the Central Arctic Basin Province into subprovinces related to the major ice drift features in the pack will be discussed later.

The Coastal Province. The width of the Coastal Province depends upon the configuration of the shoreline and the presence of islands or shoal areas off the coast. Fast ice usually starts to grow in late September or October and thickens gradually throughout the winter, reaching a maximum of slightly more than 2 m in April. Close to shore, the fast ice is usually relatively undeformed. However, as both the width of the fast ice zone and the general ice thickness increase, zones of deformed ice are incorporated into the fast ice. These zones consist of ridges and frozen leads that formed either in the pack or at the fast ice edge. Multiyear ice floes may also become part of the fast ice; in fact at present, there is no reason to believe that the mix of ice types present in the Coastal Province is significantly different from the ice types present in the Offshore Province.

Two types of ridges would be expected to be particularly frequent near the edge of the fast ice: the grounded ridge and the shear ridge. When large pressure ridges form in shallow water areas, their keels may extend until they reach bottom. Once it becomes grounded, the ridge does not sink lower in the water as additional ice is piled upon its upper surface. Therefore, although sail heights of less than 10 m are the general rule, very high sails can form; heights of 30 m have been reported north of Greenland and along the Canadian Archipelago by Sverdrup, Peary and Stefansson (Zukriegel, 1935). The shear ridges are produced by lateral motion between the fixed fast ice and the pack, and are usually quite long and straight. The Plaisted Expedition observed a large shear ridge north of Ellesmere Island that extended at least 75 km (Aufderheide and Pitzl, 1970).

The northern edge of the Coastal Province is commonly marked by the flaw lead at the fast ice/pack ice boundary. This lead opens and closes as the pack moves; it is several nautical miles wide at its maximum width in winter. For short periods open water may exist in the lead; but more often, because of the rapid ice formation during the winter, the lead will be covered with new ice. This new ice deforms readily if the pack moves, producing small pressure ridges and abundant finger rafting. When the flaw lead closes, the thin ice that has been formed is fractured and piled onto the sails of the grounded ridges and ice island fragments that many times serve as islands in helping to fix the location of the edge of the fast ice.

The Offshore Province. The Offshore Province contains a large amount of first-year ice in the winter, since it commonly has large ice-free areas in the summer. The width of the province is variable because the multiyear pack to the north may drift southward during the late summer to occupy much of the area that is normally ice free. North of the Alaskan coast, 200 km could be considered as a representative width for the province. The thickness of the first-year ice in the province will be equal to or less than the thickness of the undeformed fast ice located along the coast. Inasmuch as this relatively thin first-year ice lies between the thicker multiyear ice and a fixed boundary (the coast), it is characteristically highly deformed.

An impression of the variation in surface relief in parts of this province can be obtained from examining figure 5, which shows a laser profile of the upper ice surface taken on 17 April 1970 at roughly 60 nautical miles north of Prudhoe Bay. This very rough ice is predominantly first-year and contains ridges with sail heights between 4 and 5 m. A summary of representative winter and summer ice conditions for the Offshore Province based on the Birds Eye observations is given in table 2. According

Table 2. Ice conditions in the Offshore Province

			Season	
Source	Subject		Winter	Summer
BIRDS EYE	Concentration (areal, %)	average	99	78
		range	70-100	8-100
	Ice types (areal, %)	young	7	5
		winter	46	46
		multiyear	46	27
	Topography (areal, %)	large ridges and hummocks (>3 m high)	21	15
		small ridges and hummocks (<3 m high)	5	8
	Number of water openings	>30 m/100 nm	34	76
		<30 m/100 nm	134	73
Submarine	Topography (linear, %)	openings	2	9
		ice	98	91
		keels	12	7

to these figures, 26% of the province area is deformed in the winter. Similar results have been obtained from aerial photographic surveys and sonar profiles which occasionally have reported zones several hundred kilometers wide that were covered more than 50% with deformed ice.

Figure 6 shows the histograms of ridge heights as well as the number of ridges per nautical mile as observed by Birds Eye flights over the Chukchi and Beaufort Seas (Offshore Province) in the winter. These results show a positive skew and suggest that ridges greater than 4 m in height are rare. Figure 7, which presents maps of the intensity of ridging as again estimated by the Birds Eye flights for the winter and summer periods, clearly shows a broad band of intense ridging (30 to 40 ridges per nautical mile) running parallel to the coast of the Canadian Archipelago and northern Alaska during the winter. This band corresponds roughly to the Offshore Province. Limited information suggests that floes in the Offshore Province are appreciably smaller than ice farther north and that rubble fields and areas of brash ice are particularly common.

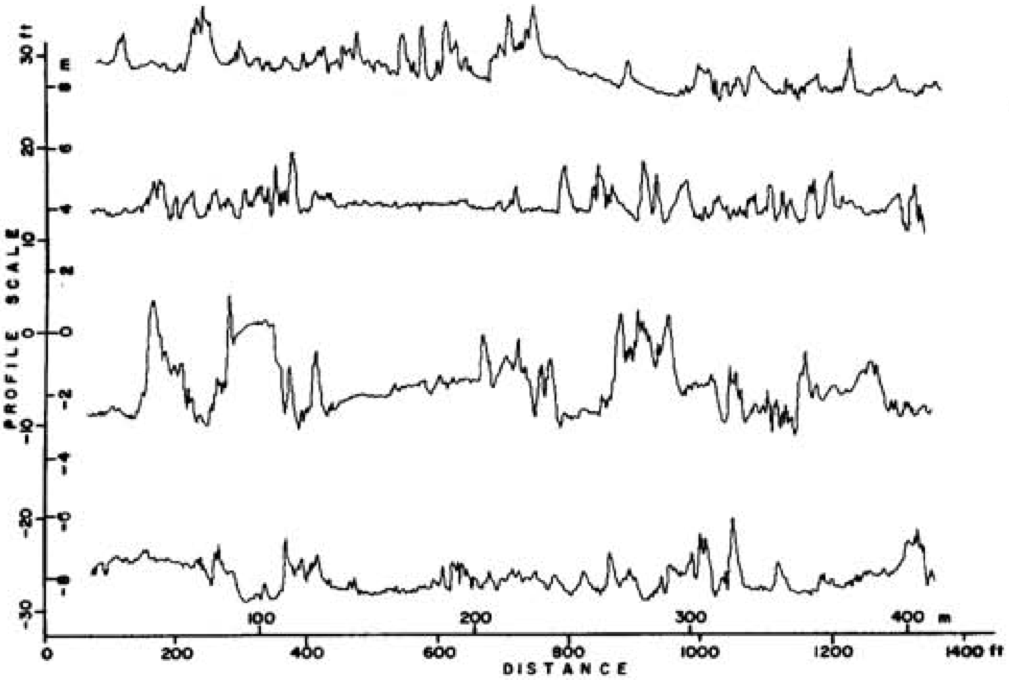

Figure 5. Laser profile of sea ice roughly 60 nautical miles north of Prudhoe Bay, Alaska. The profile runs consecutively from upper left to lower right. The zero locations of the profile are arbitrary.

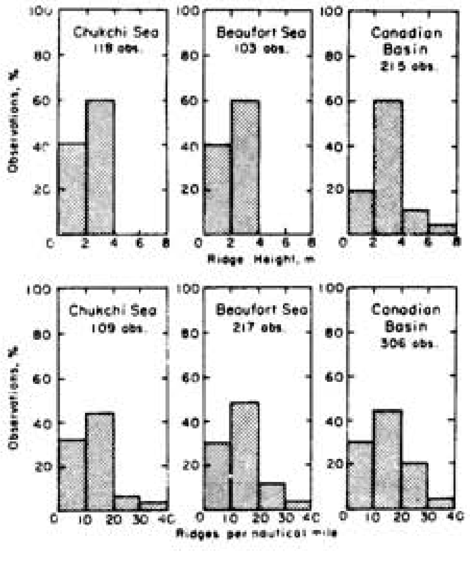

Figure 6. Winter frequency distributions of ridge heights and the number of ridges per nautical mile for the Chukchi and Beaufort Seas (Offshore Province) and the Canadian Basin (Central Arctic Basin Province).

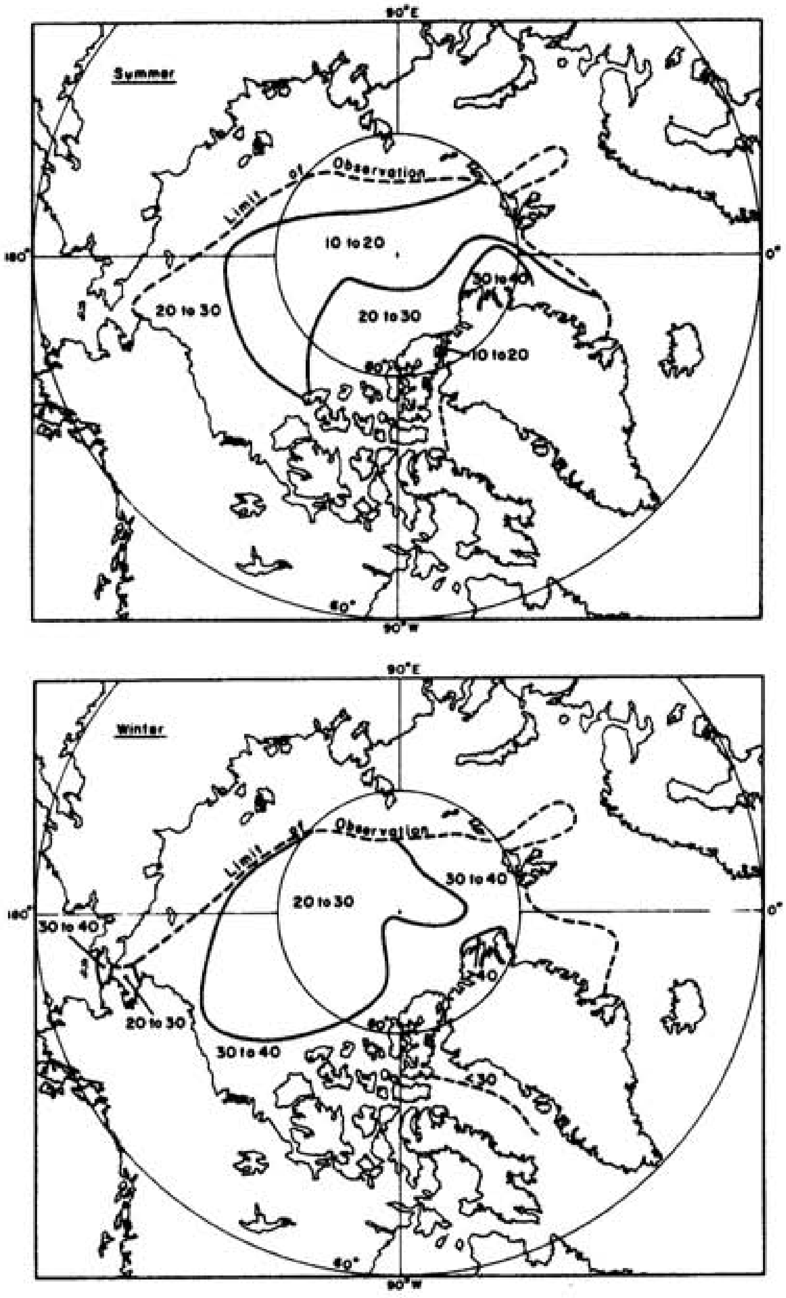

Figure 7. Maps of the number of ridges per nautical mile during the winter and during the summer. The dotted line indicates the areal extent of the data.

Summer ice conditions in this province are extremely variable. The location of the pack boundary ranges from nearshore to onshore to up to 200 nautical miles offshore. According to table 2, which summarizes observations in the ice-covered portions of the province, there is a sharp decrease in concentration associated with an increase in the number of water openings (i.e., the floe size decreases). There also appears to be an increase in the percentage of first-year ice and a decrease in the amount of multiyear ice. A slight decrease in ridge height, presumably due to melting and a marked decrease in the number of ridges per nautical mile, is also indicated. The latter may be caused by the melting and collapse of a number of ridges in the more highly deformed areas. During the peak of the melt season, a significant percentage of the surface of the drifting ice (up to roughly 60%) is covered with melt ponds, many of them deep and some completely perforating the ice cover.

The Central Arctic Basin Province. In the northern portion of the Offshore Province, there is a gradual increase in the amount of multiyear ice until old floes become the dominant aspect of the terrain. This marks the edge of the Central Arctic Basin Province, which covers the remainder of the

Arctic Ocean. Table 3 summarizes from Birds Eye data the ice conditions found in the province. The limited seasonal variation in the mean ice concentration and the large percentage of multiyear ice are notable features. The frequency distribution of ridge heights, as well as the number of ridges per nautical mile for the Canadian Basin (see Wittman and Schule, 1966), which is part of the Central Arctic Basin Province, is shown in figure 6. Again the histograms show a pronounced positive skew. Figure 7 suggests that during both the winter and summer the ridging intensity in the Central Arctic Basin Province is lower than in the Offshore Province. This general increase in ridging intensity is also suggested by the representative laser trace of multiyear ice from the Central Polar Basin (figure 8). Note the gentle undulating topography of the surface of the large old floes which are separated by distinct zones of ridging.

Table 3. Ice conditions in the Central Arctic Basin Province

			Season	
Source	Subject		Winter	Summer
BIRDS EYE	Concentration (areal, %)	average	99	92
		range	98-100	30-
	Ice types (areal, %)	young	1	4
		winter	17	27
		multiyear	81	61
	Topography (areal, %)	large ridges and hummocks (>3 m high)	21	23
		small ridges and hummocks (<3 m high)	4	4
	Number of water openings	>30 m/100 nm	23	39
		<30 m/100 nm	33	53
Submarine	Topography (linear, %)	openings	1	5
		ice	99	95
		keels	15	15

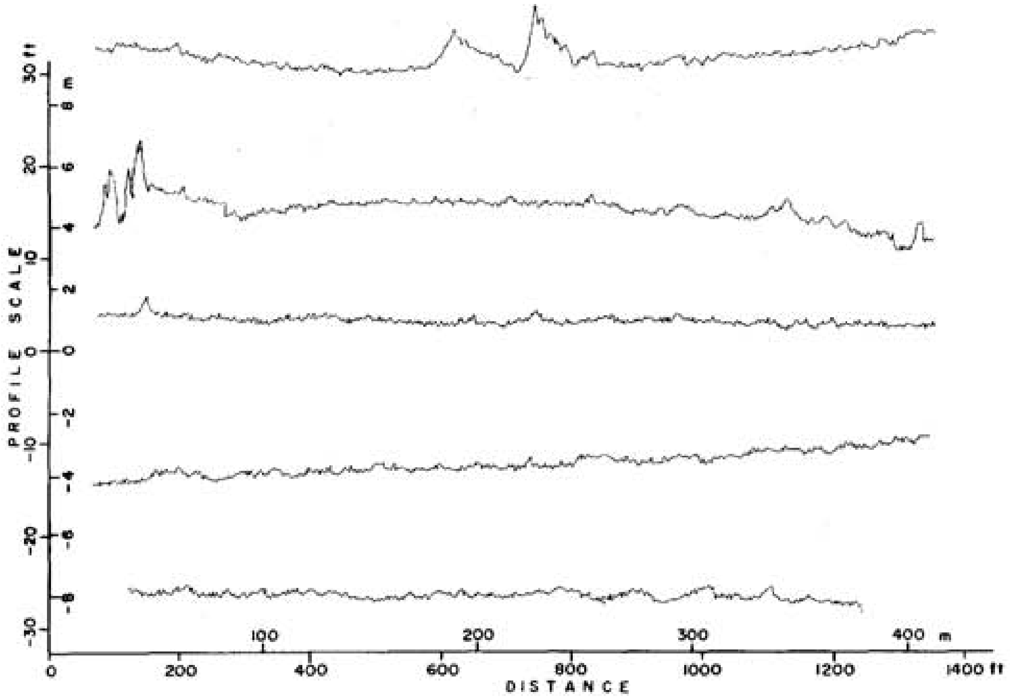

Figure 8. Laser profilometer trace of multiyear ice in the Central Polar Basin. The aircraft motion has not been removed. The profiles run consecutively from upper left to lower right. The zero locations of the profile scales are arbitrary.

Melt hummocks, which produce the characteristic surface of old floes and the striking difference between the topographies of multiyear and first-year ice, develop because of differential surface melting during the summer. Flat areas of smooth ice are formed between the mounds as the drainage channels refreeze. Pressure ridges, hummocks, and rubble fields, which are initially composed of angular ice blocks, are also rounded during the summer melt, producing large, smooth, rounded hummocks and ridges.

In the summer, melt ponds cover the surface of the ice in the Central Arctic Basin Province. Northward toward the Pole, the amount of surface melt presumably decreases, although this is not substantiated by field data. There is also a small (7%) decrease in the average amount of open water, and a drop in ridging intensity.

The general drift pattern of the ice in the Arctic Ocean has been gradually pieced together from studying the tracks of scientific stations situated on the sea ice, ice islands, and ships locked in the pack. Figure 9 is a generalization based on plots of such tracks. Two dominant drift features are evident, the most striking of which is the Transpolar Drift Stream stretching from the East Siberian Sea across the North Pole to the northeast of Greenland. The source of the ice in the Transpolar Drift Stream is the cold and relatively shallow water of the Siberian Continental Shelf which, because it is relatively ice free in the summer, serves as an area of rapid ice growth every fall. The ice that remains over the shelf in the summer is primarily concentrated into a series of local ice packs, such as the Aion and the Taimyr packs, which are associated with irregular coastlines or islands that impede ice drift (Dunbar and Wittmann, 1963). Because there is a general advection of ice northward from the Siberian coast, areas of thin, rapidly growing ice are common here even in winter. For an ice floe to make the transit from the Siberian Coast to the northeast of Greenland takes roughly five years (Koerner, 1970), about the time required for the floe to reach its maximum thickness of approximately 3 m (Yakovlev, 1962). During this time most of the ridges and hummocks in the stream still show slightly angular outlines.

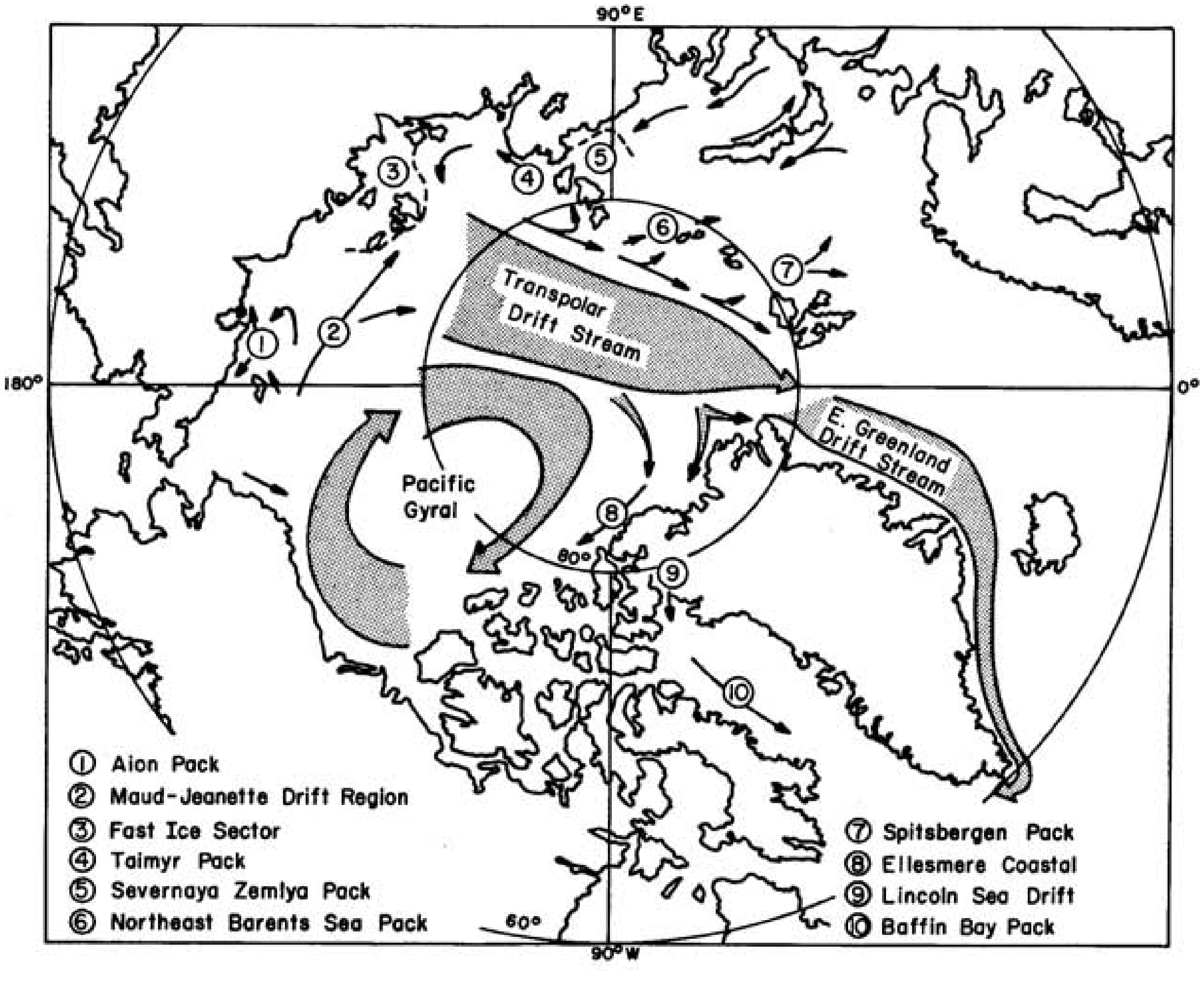

Figure 9. Major drift patterns of ice in the Arctic Ocean.

The other major drift feature, the Pacific Gyral, is a region of generally closed clockwise drift located between the Canadian Archipelago, the north coast of Alaska, and the North Pole. This region contains the oldest and heaviest ice present in the Arctic; floes can remain within the Gyre for more than 20 years. These old floes are covered with large, smooth, old hummocks that have gradually been rounded by many summers of ablation. The boundary between the Pacific Gyre and the Transpolar Drift Stream, although marked by the change in surface topography, seems to fluctuate from year to year. Floes drifting northward on the western edge of the Gyre may one year swing around the Gyre to once again enter the area of slow ice and drift north of Ellesmere Island and Greenland, while another time floes from essentially the same location will enter the Transpolar Drift Stream and exit from the Arctic Ocean via the East Greenland Drift Stream. This latter feature, combined with the flux of polar ice into the Barents Sea near Spitsbergen, accounts for the principal exit for ice from the Arctic Ocean.

A comparison of figure 9 with figure 7 shows another interesting feature of the Arctic pack. The most intense ridging in the Arctic Ocean occurs just off the coast of northeast Greenland, where the ice that splits away from the Transpolar Drift Stream to move westward to rejoin the Pacific Gyre is forced to turn the corner by the blocking effect of Greenland.

As might be expected, there are wide variations in the observed rates of ice drift in the Arctic Ocean. Mean annual net drift rates vary from 0.4 to 4.8 km per day, with the actual rates (including loops and other irregularities), as high as 2.2 to 7.4 km per day (Dunbar and Wittmann, 1963). Over shorter periods, monthly average values run as high as 10.7 km per day. When drift measurements are grouped according to area, there is a slight tendency for an increase in the net drift rates, as well as a decrease in the coefficients of meandering (length actually traveled/great circle distance) as one moves along the Transpolar Drift Stream toward the Greenland Sea. Both the lowest and the highest drift speeds within the Arctic Ocean are apparently found within the Pacific Gyre. In general, there appears to be a pronounced deceleration between the Pole and Ellesmere. From May 1954 to March 1957, T-3 covered a straight-line distance of only 440 km in this region, and, as of the time this was written, it was once again essentially motionless in the same general area after completing another trip around the Gyre. In the southern part of the Gyre, however, high drift speeds have been recorded, with the highest net rate being observed near the southern edge of the pack during the summer (the Karluk, 1913-1914, 7.0 km per day, according to Dunbar and Wittmann, (1963)).

The Marginal Arctic Seas

Inasmuch as the interests of AIDJEX have been primarily focused on the Arctic Ocean, the ice conditions in the marginal arctic seas will be described only briefly.

Because the Arctic Ocean is the main source for multiyear ice, the amount of multiyear ice found farther to the south is primarily related to the ease with which the ice of the polar pack can drift south and into the region in question. Therefore, as might be expected, there is quite a large amount of multiyear ice in both the northern Barents Sea and the Greenland Sea, which serve as the main exits for ice moving out of the Arctic Ocean. In the winter, the multiyear ice concentration is 58% in the Barents Sea and 23% in the Greenland Sea. Much less multiyear ice is found in such regions as Baffin Bay and Bering Sea which are separated from the Arctic Ocean by relatively narrow straits. The straits, because they tend to restrict flow, may contain very highly deformed ice. Figure 7 suggests that the intensity of ridging in the winter in the Barents and Greenland Seas and in Baffin Bay is similar to that found in the Offshore Province of the Arctic Ocean.

It is also known that the ice near the southern edges of these ice packs is extremely broken and the floe size is quite small, presumably a result of wave-inducing fracturing. Ketchum and Wittmann (1972) have shown that during March 1971, mean multiyear floe size at the edge of the East Greenland pack was roughly 4 m and that even at a distance of 50 km into the pack, the maximum floe size had increased only to 45 m. Although the fracturing process did not produce large ridges, the surface of the resulting ice was extremely rough.

Drift rates comparable to the highest values found in the Arctic Ocean appear to be quite typical for the marginal arctic seas. Net drift rates of 7.4 km per day are frequently recorded, and during storm periods may be as high as 37 to 44 km per day (≈ 1 knot). As in the Arctic Ocean, the high rates usually occur near the edge of the pack in regions where the ice concentration is low.

It should also be noted that because most ice reconnaissance flights over the marginal seas have been more concerned with helping shipping avoid the ice than with documenting ice features within the pack, there is abundant information available on the location of the ice edge as a function of season. A useful summary of this information is given by Smirnov (1970), and several recent papers relating to this subject occur in Karlsson (1972).

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Appendix I

Ice Terminology

Ice terminology used in this paper is given below. Definitions marked with an asterisk either are not included in or are modified significantly from the definitions given in WMO Sea-ice Nomenclature: Terminology, Codes and Illustrated Glossary, WMO/OMM/BMO no. 259, 147p., published in 1970 by the World Meteorological Organization. Underlined terms are defined elsewhere in the list.

ANCHOR ICE
Submerged ice attached or anchored to the bottom, irrespective of the nature of its formation.

BELT
A large feature of pack ice arrangement, longer than it is wide, and from 1 to 100 km in width (cf. strip).

BESET
Situation of a vessel surrounded by ice and unable to move.

BRASH ICE
Accumulation of floating ice made up of fragments not more than 2 m across (small ice cakes), the wreckage of other forms of ice.

BREAK UP*
A general expression applied to the formation of a large number of fractures through a compact ice cover, followed by a rapid diverging motion of the separate fragments.

BUCKLING*
The flexure of a floating ice sheet into a series of open folds as the result of the elastic instability of the sheet under lateral pressure. Buckling is usually observed only in thin ice.

BUMMOCK*
The underside of a hummock that projects down below the lower surface of the surrounding ice (comparable to a ridge keel).

CANDLING*
The separation of the elongate ice crystals in fresh and brackish-water ice into individual crystals (candles) as the result of differential melting along grain boundaries caused by the absorption of solar radiation.

COMPACTING
Pieces of floating ice are said to be compacting when they are subjected to a converging motion which increases ice concentration and compactness and/or produces stresses which may result in ice deformation.

COMPACTNESS*
The ratio of the area of the sea surface actually covered by ice to the total area of the sea surface under consideration. Therefore a compactness of 0 corresponds to ice free and a compactness of 1, to compact pack ice (cf. concentration).

CONCENTRATION
The ratio, in tenths, of the sea surface actually covered by ice to the total area of sea surface, both ice covered and ice free at a specific location or over a defined area (cf. ice cover). May be expressed in the following terms:

Compact pack ice -- concentration 10/10, no water visible.
Consolidated pack ice -- concentration 10/10, floes frozen together.
Very close pack ice -- concentration 9/10 to less than 10/10.
Close pack ice -- concentration 7/10 to 8/10, floes mostly in contact.
Open pack ice -- concentration 4/10 to 6/10, many leads and polynyas, floes generally not in contact.
Very open pack ice -- concentration 1/10 to 3/10.

CONVERGENCE*
Used to describe the condition when div $\vec{v}_i$ is negative (cf. divergence).

CONVERGING*
Ice fields and floes are said to be converging when they are subjected to a convergent motion that increases the concentration and compactness of the ice or increases the stresses in the ice.

CORE* (of a ridge or hummock)
The central portion of a ridge or hummock, usually below waterline, that because of pressure or the drainage and refreezing of low salinity melt water, has become frozen together into a strong, massive piece of ice.

CRACK
Any fracture which has not yet parted.

DEFORMED ICE
A general term for ice which has been squeezed together and in places forced upward (and downward). Forms of deformation include rafting, ridging, and hummocking.

DIVERGENCE*
Formally defined as div $v_i = \frac{\partial v_x}{\partial x} + \frac{\partial v_y}{\partial y}$ where $\vec{v}_i$ is the ice drift velocity. The divergence can be considered as the change in area per unit area at a given point. The word is also used to indicate a generally diverging motion in the ice.

DIVERGING
Ice fields or floes are said to be diverging when they are subjected to a divergent or dispersive motion, thus reducing the ice compactness and concentration, or relieving stresses in the ice (cf. converging).

DRAFT*
The distance, measured normal to the sea surface, between the lower surface of the ice and the water level.

FAST ICE*
Sea ice of any origin which remains fast (attached with little horizontal motion) along a coast or to some other fixed object.

FINGER RAFTING
Type of rafting whereby interlocking thrusts are formed, each floe thrusting "fingers" alternately over and under the other. Common in nilas and grey ice.

FIRST-YEAR ICE
Sea ice of not more than one winter's growth, developing from young ice; with a thickness of 30 cm to 3 m. May be subdiveded into thin first-year ice/white ice (30-70 cm), medium first-year ice (70-120 cm) and thick first-year ice (over 120 cm).

FLAW
A narrow separation zone between pack ice and fast ice, where the pieces of ice are in a chaotic state, that forms when pack ice shears under the effect of a strong wind or current along the fast ice boundary.

FLAW LEAD
A lead between pack ice and fast ice.

FLOE
Any relatively flat piece of sea ice 20 m or more across (cf. ice cake). Floes are subdivided according to horizontal extent:

Giant floe -- more than 10 km across.
Vast floe -- 2-10 km across.
Big floe -- 500-2000 m across.
Medium floe -- 100-500 m across.
Small floe -- 20-100 m across.

FLOEBERG
A massive piece of sea ice composed of a hummock, group of hummocks, or a rubble field, frozen together and separated from any surrounding ice. It may have a freeboard of up to 5 m.

FLOODED ICE
Sea ice which has been flooded by melt water or river water and is heavily loaded with water and wet snow.

FRACTURE
Any break or rupture through very close, compact, or consolidated pack ice (see concentration), fast ice, or a single floe resulting from deformation processes (cf. lead). Fractures may contain brash ice and be covered with nilas or young ice. The length may be a few meters or many kilometers.

FRACTURE ZONE

An area which has a great many fractures.

FRACTURING*

Process whereby the ice is permanently deformed and rupture occurs.

FRAZIL ICE

Fine spicules or plates of ice, suspended in water.

FREEBOARD*

The distance, measured normal to the sea surface, between the upper surface of the ice and the water level.

FROST SMOKE

Foglike clouds due to the contact of cold air with relatively warm water. Frost smoke can appear over openings in the ice or leeward of the ice edge and may persist while ice is forming.

GREASE ICE

A stage of freezing, later than that of frazil ice, in which the crystals have coagulated to form a soupy layer on the surface. Grease ice reflects little light, giving the sea a matte appearance.

GREY ICE

Young ice, 10-15 cm thick. Less elastic than nilas, it breaks on swell. Usually rafts under pressure.

GREY-WHITE ICE

Young ice, 15-30 cm thick. Under pressure, it is more likely to ridge than to raft.

GROUNDED ICE*

Floating ice (e.g., ridge, hummock, ice island) which is aground (stranded) in shoal water.

HUMMOCK

A hillock of broken ice which has been forced upward by pressure. May be fresh or weathered. The submerged volume of ice under the hummock, forced downward by pressure, is called a bummock.

HUMMOCK FIELD*

An area of sea ice that essentially has all been deformed into a series of hummocks (cf. rubble field).

HUMMOCKING

Process whereby sea ice is forced into hummocks.

ICEBERG

A massive piece of ice of greatly varying shape with a freeboard of more than 5 m, which has broken away from a glacier and may be afloat or aground.

ICE BOUNDARY

The demarcation at any time between fast ice and pack ice or between areas of pack ice of different concentration (cf. ice edge).

ICE CAKE

Any relatively flat piece of sea ice less than 20 m across (cf. floe). If less than 2 m across, it is a small ice cake.

ICE COVER

The ratio of an area of ice of any concentration to the total area of sea surface within some large geographic locale; this locale may be global, hemispheric, or prescribed by a specific oceanographic entity, such as Baffin Bay or Barents Sea.

ICE EDGE

The demarcation at any given time between the open sea and sea ice of any kind, whether fast or drifting.

ICE FIELD

Area of pack ice greater than 10 km across (cf. ice patch), consisting of floes of any size. Subdivided as follows:

Large ice field -- more than 20 km across.
Medium ice field -- 15-20 km across.
Small ice field -- 10-15 km across.

ICE FREE

No sea ice present. There may, however, be some icebergs present (see also open water).

ICE ISLAND

A large piece of floating ice with a freeboard of approximately 5 m, which has broken away from an arctic ice shelf. Ice islands usually have a thickness of 30-50 m, an area of from a few thousand square meters to several hundred square kilometers, a regularly undulating upper surface.

ICE LIMIT

Climatological term referring to the extreme minimum or extreme maximum extent of the ice edge in any given month or period, based on observations over a number of years.

ICE MASSIF

A concentration of sea ice (ice field) covering hundreds of square kilometers and found in the same region every summer.

ICE PATCH

An area of pack ice less than 10 km across (cf. ice field).

ICE RIND

A brittle shiny crust of ice formed on a quiet surface by direct freezing or from grease ice, usually in water of low salinity. Thickness to about 5 cm. Easily broken by wind or swell, commonly breaking in rectangular pieces (cf. nilas).

ICE SHEET*

A general expression for a laterally continuous, relatively undeformed piece of sea ice with lateral dimensions of 10 m or larger.

ICE SHELF

A floating ice sheet of considerable thickness, showing 2 to 50 m or more above sea level, attached to the coast. Usually of great horizontal extent and with a level or gently undulating surface. Nourished by annual snow accumulation and often by the seaward extension of land glaciers. Parts of it may be aground. The seaward edge is called an ice front.

KEEL*

The underside of a ridge that projects downward below the lower surface of the surrounding sea ice.

LEAD*

Any fracture or passage through sea ice that is generally too wide to jump across. A lead may contain open water (open lead) or be ice-covered (frozen lead).

LEVEL ICE

Sea ice which has been unaffected by deformation.

MELT HUMMOCK*

A round hillock-shaped raised portion of the surface of the ice cover that is caused by differential ablation during the summer melt period.

MELT POND*

An accumulation of meltwater on the surface of sea ice that, because of appreciable melting of the ice surface, exceeds 20 cm in depth, is embedded in the ice (has distinct banks of ice), and may reach several tens of meters in diameter (cf. puddles).

MULTIYEAR ICE

Old ice 3 m or more thick, which has survived at least two summers' melt. The hummocks are even smoother than in second-year ice, and the ice is almost salt-free. The color, where bare, is usually blue. The melt pattern consists of large interconnecting irregular puddles and melt ponds, and a well-developed drainage system.

NEW ICE

A general term for recently formed ice, which includes frazil ice, grease ice, slush, and shuga. These types of ice are composed of ice crystals which are only weakly frozen together (if at all) and have a definite form only while they are afloat.

NILAS

A thin elastic crust of ice up to 10 cm thick, with a matte surface. Bends easily under pressure, thrusting in a pattern of interlocking "fingers" (finger rafting). Dark nilas, up to 5 cm thick is very dark in color; light nilas, 5-10 cm thick, is rather lighter in color (cf. ice rind).

NIP

Ice is said to nip when it presses forcibly against a ship. A vessel so caught, although undamaged, is said to have been nipped.

OLD ICE

Sea ice which has survived at least one summer's melt. Most topographic features are smoother than on first-year ice. May be subdivided into second-year ice and multiyear ice.

OPEN WATER

A large area of freely navigable water in which sea ice is present in less than 1/10 concentration (see also ice free).

PACK ICE

Any accumulation of sea ice, other than fast ice, no matter what form it takes or how it is disposed (see also concentration.)

PANCAKE ICE

Predominantly circular pieces of ice from 30 cm to 3 m in diameter, and up to about 10 cm in thickness, with raised rims due to the pieces striking against one another. It may be formed on a slight swell from grease ice, shuga or slush, or as a result of the breaking up of ice rind, nilas, or, under severe conditions of swell or waves, grey ice. It also sometimes forms at some depth, at an interface between water bodies of different physical characteristics, and floats to the surface. It may rapidly cover wide areas of water.

POLYNYA

Any nonlinearly shaped opening enclosed in ice. Polynyas may contain brash ice or be covered with new ice, nilas, or young ice. If it is limited on one side by the coast, it is called shore polynya; if it is limited by fast ice, it is called a flaw polynya. If it is found in the same place every year, it is called a recurring polynya.

PRESSURE RIDGE

A general expression for any elongated (in plan view) ridgelike accumulation of broken ice caused by ice deformation (cf. P-ridge, S-ridge).

P-RIDGE*

A line or wall of broken ice that is formed when two adjacent floes move toward each other in a direction that is in general normal to the trace of the boundary between them. The surface expression of a P-ridge is commonly sinuous in plan view.

PUDDLE*

An accumulation of meltwater on the surface of sea ice. Puddles are usually only a few meters across and less than 20 cm deep. As puddles deepen as melting progresses, they become melt ponds.

RAFTING*

Process whereby one piece of ice overrides another; most obvious in new and young ice (cf. finger rafting) but common in ice of all thicknesses.

RIDGE

A line or wall of broken ice forced up by pressure. May be fresh or weathered.

RIDGING

The process whereby ice is deformed into ridges.

ROTTEN ICE

Sea ice which has become honeycombed and which is in an advanced state of disintegration.

RUBBLE FIELD*

An area of sea ice that has essentially all been deformed. Unlike hummock field, does not imply any specific form of the upper or lower surface of the deformed ice.

SAIL*

The upper portion of a ridge that projects above the upper surface of the surrounding sea ice.

SASTRUGI

Sharp, irregular, parallel ridges formed on a snow surface by wind erosion and deposition. On mobile floating ice, the ridges are parallel to the direction of the prevailing wind at the time they were formed.

SECOND-YEAR ICE

Old ice which has survived only one summer's melt. Because it is thicker and less dense than first-year ice, it stands higher in the water. In contrast to multiyear ice, second-year ice during the summer melt shows a regular pattern of numerous small puddles. Bare patches and puddles are usually greenish blue.

SHEARING

An area of pack ice that is subject to shear when the ice motion varies significantly in the direction normal to the motion, subjecting the ice to rotatory forces. These forces may result in phenomena similar to a flaw.

S-RIDGE*

A line or wall of broken ice that is formed when adjacent floes move parallel to the boundary that separates them. S-ridges commonly are quite straight in plan view. The sail of a S-ridge also usually has one vertical or near vertical side.

SHEAR ZONE

An area in which a large amount of shearing deformation has been concentrated.

SHORE LAND

A lead between pack ice and the shore or between pack ice and an ice shelf or a glacier.

SHUGA

An accumulation of spongy white ice lumps a few centimeters across, formed from grease ice or slush and sometimes from anchor ice rising to the surface.

SLUSH

Snow which is saturated and mixed with water on land or ice surfaces, or forms as a viscous mass floating in water after a heavy snowfall.

SNOW ICE*

The equigranular ice that is produced when slush freezes completely.

STRIP

Long narrow area of pack ice, about 1 km or less in width, usually composed of small fragments detached from the main mass of ice and run together under the influence of wind, swell, or current (cf. belt).

THAW HOLE*

Vertical hole in sea ice formed when a melt pond melts through to the underlying water.

WEATHERING

Processes of ablation and accumulation which gradually eliminate irregularities in an ice surface.

YOUNG ICE*

Ice in the transition stage between nilas and first-year ice, 10 to 30 cm in thickness. May be subdivided into grey ice and grey-white ice. The expression young ice is also commonly used in a more general way to indicate the complete range of ice thickness between 0 and 30 cm (as in "the formation and growth of young ice"). Usually these differences in meaning are clear from the context of the discussion.

Fast Ice Terminology

William J. Stringer
Geophysical Institute
University of Alaska
College, Alaska, U.S.A.

In all areas of science, terminologies have been developed to serve as shorthand descriptors of events, processes and structural features. Obviously, the greatest utility arises from the most precise terminologies. The biological classification system comes to mind as a very well-ordered terminology scheme. Sea ice terminology is most similar to the geomorphic terminology scheme, where descriptors name land forms in terms of their structure and appearance. However, while most geomorphic features are sufficiently permanent to allow particular examples to be cited as models which are available for scrutiny and discussion, this process is generally denied sea ice investigators. Furthermore, many sea ice descriptors have been proposed by persons having relatively site-specific and season-specific experience. The terms thus proposed may be inappropriately applied to other locations and seasons. This becomes particularly troublesome when persons from other disciplines wish to use sea ice nomenclature to relate ice conditions to other phenomena. The terminology they use may not be applicable to their geographical area of study and may presuppose ice conditions which really do not exist.

This problem appears to be greatest in the near-shore areas as a result of widely varying near-shore ice conditions and the large number of other disciplines requiring the use of sea ice nomenclature in those areas. The most frequently referred-to ice condition in the near-shore areas is fast ice (or landfast ice or shorefast ice). These words seem to imply a relatively simple concept: ice which is somehow fixed to or with respect to geographical features. Operationally, however, the question arises "how fixed?". From late winter through late spring, grounded ice ridges and other features along the Alaskan Beaufort coast are located out to the 20-m isobath and appear to serve as an anchoring mechanism for fast ice. Many investigators identify significant ridges near this isobath as the seaward limit of fast ice, because the ice is clearly less stable beyond the grounded ridges. On the other hand, for periods of up to six weeks, fixed ice can be attached to the seaward side of such grounded features and extend seaward several tens of kilometers. Many would deny that this is truly fast ice because it can be broken free with relative ease.

In the Canadian Beaufort, a sheet of ice has also been observed to extend to approximately the 20-m isobath (Cooper, 1974), but with the absence of grounded ridges for anchoring. Cooper, recognizing this distinction, used the term quasi-land fast to define such ice.

In the Canadian Arctic Islands, Jacobs et al (1975) discuss a sheet of land fast ice which extends seaward well beyond the 20-m isobath in which the presence or absence of grounded ridges is not significant. Furthermore, in some areas these ice sheets are semi-permanent, while the Beaufort fast ice recurs annually.

Along the Alaskan Chukchi coast a wide range of conditions exists, ranging from recurring polynyas adjacent to the coast north of Point Hope, to massive grounded ridge systems defining the seaward limit of fast ice off various seaward-extending land forms, to Cooper's quasi-land fast ice in the bights between these seaward-extending land forms (Stringer, 1977).

Off the Siberian coast, other conditions exist. Many ice features called stamukhi (Reimnitz et al, 1976) remain fixed in place throughout the melt season and act as anchor points for the next year's fast ice. This phenomenon also occurs occasionally along the Alaskan Beaufort coast. Reimnitz et al, have taken the seaward limit of the stamukhi zone to define the seaward limit of fast ice (figure 1).

For the past two years, I have been mapping near-shore ice conditions along the Alaskan coast as part of the Bureau of Land Management/National Oceanic and Atmospheric Administration's Environmental Assessment of the Continental Shelf. Being aware of the wide range of concepts associated with fast ice, I choose to use another term, contiguous ice, so that the reader of the maps will not jump to conclusions regarding the meaning of the term used. Contiguous ice has been defined as ice contiguous to shore and continuous in such a way that a person might walk to its edge. Hence, at times contiguous ice extends over one hundred km from shore in the Beaufort Sea region --- well beyond any grounded ridges. I have no particular attachment to the term contiguous ice and would rather use a term in common usage.

Weeks (1976) has proposed a sea ice nomenclature based on modifications of terms defined by the World Meterological Organization. Taken together, these terms define the boundary of fast ice in such a way that I have no objection to their standardization and would endorse their use.

The definition Weeks lists to describe fast ice is as follows:

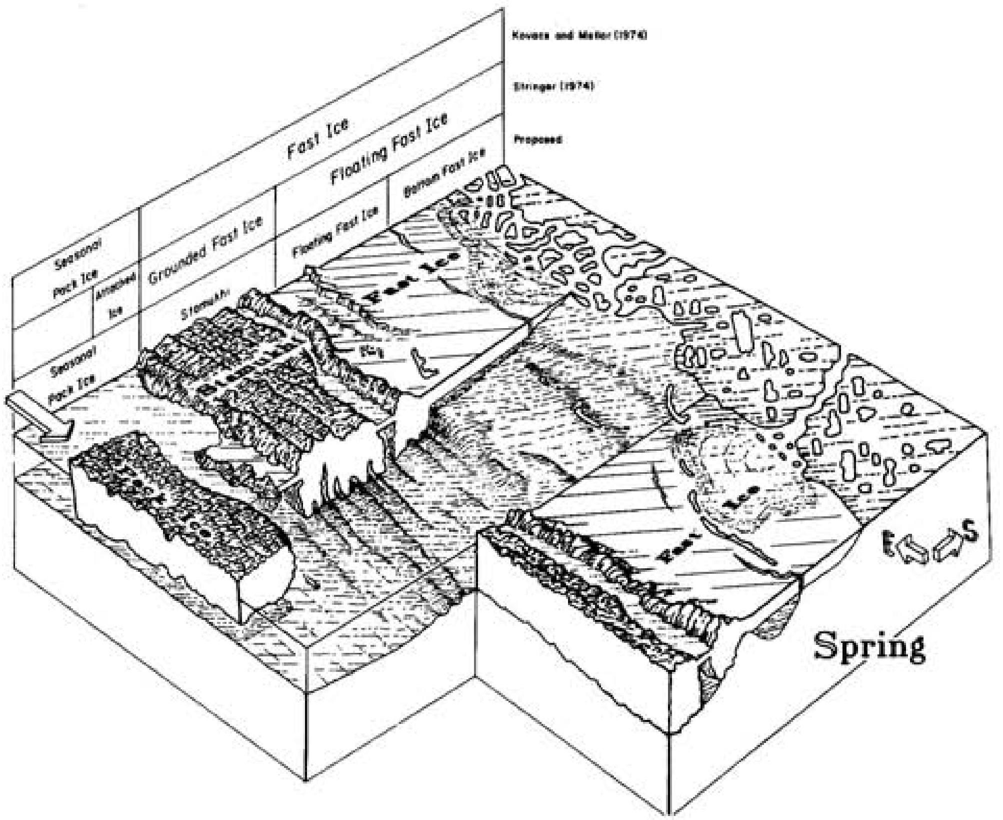

Figure 1. Seasonal development of ice zonation in relation to bottom morphology. Drawing by Tau Rho Alpha (Reimnitz et al, 1977).

<u>Fast ice</u>: sea ice of any origin which remains fast (attached with little horizontal motion) along a coast or to some other fixed object.

Even if Weeks' concept of <u>fast ice</u> were adopted, many ice features remain within the <u>fast ice zone</u> which several investigators would like to refer to by name. These include ice held firmly between the shore and grounded ridges; fast ice extending seaward from grounded ridges; ice which, although bottom-fast, does not touch shore; fast ice containing grounded multi-year fragments; and other ice conditions which are found within the near-shore area.

Reimnitz et al (1976), Kovacs and Mellor (1974), Barnes and Reimnitz (1974) and Stringer (1974) have all proposed nomenclature within the fast ice zone that could perhaps lead to adoption of a standardized nomenclature. However, it appears to me that a sufficient number of problems remain to require a collective effort on the part of current sea ice and other investigators to come to agreement concerning the terminology to be used.

It would be particularly useless to propose yet another set of descriptive terms here. I would like to propose that, with the growing industrial and governmental interest in processes and base line determinations in near-shore areas, a near-shore ice convention should be held to determine the state of knowledge of near-shore ice behavior. The convention should be organized so that an atmosphere of non-competitive cooperation exists, and a graphic nomenclature for near-shore ice terminology results.

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The Arctic Ice Dynamics Joint Experiment

Norbert Untersteiner
Arctic Ice Dynamics Joint Experiment
Seattle, Washington, U.S.A.

*1. DESCRIPTION

Introduction

The Arctic Ice Dynamics Joint Experiment (AIDJEX) was conceived in 1969 as a highly focused and task-oriented program of data acquisition and mathematical modeling, aimed at answering the following fundamental questions: (1) How is large-scale sea ice deformation on short-time scales related to the external stress fields? (2) What is the relationship, on long time and space scales, between ice thickness distribution and mechanical properties? (3) How can the external stresses be derived from a few fundamental and easily measured parameters? (4) What are the mechanisms of sea ice deformation?

A difficult aspect, common to all these questions, arises from the choice of scales on which observations and calculations are to be made. On a scale of meters, sea ice behaves like a brittle plastic material, forming cracks in bending and thermal contraction, rafting and ridging, shearing along planes, or parting to form open leads and exposing the sea surface to the atmosphere. These small-scale events are essentially tractable by the working methods of engineering mechanics and amenable to laboratory-type experimentation. In a large aggregate of "ice floes" (1000 km), a large number of such events produce a mechanical and thermodynamic behavior that is not quantitatively understood. The primary purpose of AIDJEX is to acquire data and design a predictive mathematical model that can be used for short-term forecasts of ice movement and pressure, and that lays the groundwork for building sea ice into global climate models.

Experiment design

Much of the early work of AIDJEX was devoted to the definition of an optimal program of data acquisition that would yield the necessary information on stress and strain, and could be executed within given budgetary limits. Required are, at a number of points, data on atmospheric pressure, wind stress, water stress, and accurate location. Certain two-dimensional data from satellite-borne and airborne sensors are needed to estimate ice thickness distributions and to test some of the modeling assumptions pertaining to the behavior of the ice as a continuum (figure 1). In addition, the array of observation points must be smaller than the typical atmospheric pressure system (so that inaccurate higher-order derivatives in the computational schemes can be avoided), and must be larger than the average distance between inhomogeneities in the ice (so that each computational element contains a large number of them and can be assigned average properties).

The program summarized in the table is expected to provide the essential data to both "drive" and test the numerical model.

In order to resolve ice strain to the necessary accuracy, the distance between points (manned camps and data buoys) has to be measured to ±0.1%. This required the development of a new type of ice-going data buoy, equipped with automatic navigation satellite receivers. Doppler counts from these receivers were transmitted by high-frequency radio link to the central camp and computer-processed there. Eight such buoys were in operation in 1975, observing an average of eight location fixes per day. Atmospheric pressure and temperature data were transmitted by the same link. As a back-up, 10 data buoys equipped with the less accurate Random Access Measuring System (RAMS) transmitted their data via Nimbus 6. All buoys had battery power supplies expected to last for one year or longer (unless the buoy falls victim to a pressure ridge or a polar bear).

Modeling

Previous attempts to model the large-scale dynamics of sea ice were summarized by Rothrock (1975). These attempts, which in their basic formulation go back to Fridtjof Nansen, have in common that they either consider external forces only, and neglect the stress transmitted through the ice, or approximate the latter by severely simplifying assumptions.

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* Part 1 is reprinted as excerpts from Untersteiner, Norbert, "Arctic Ocean," McGraw-Hill Yearbook of Science and Technology, 1975, p. 111-15.

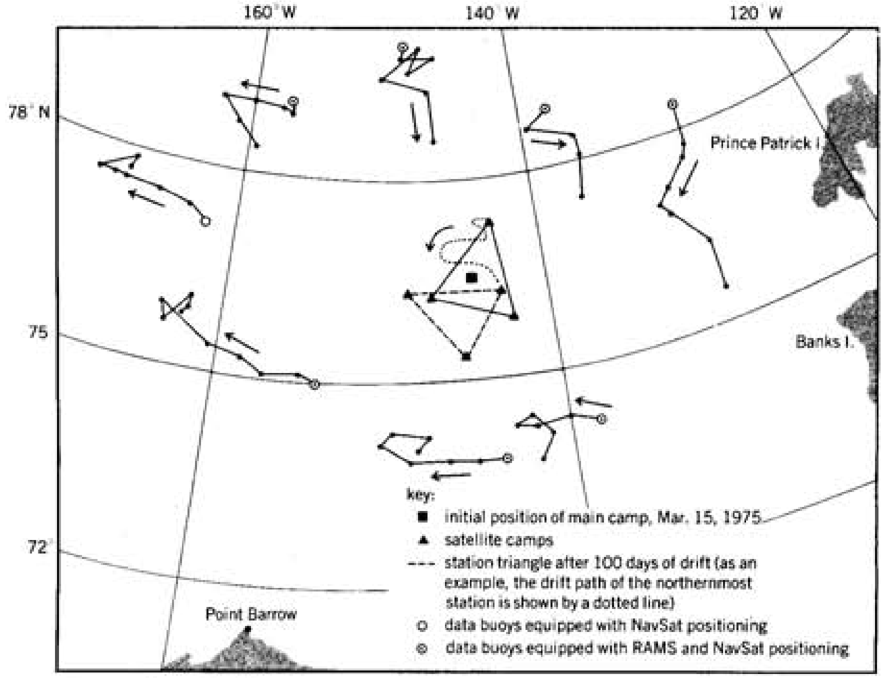

Figure 1. AIDJEX manned camp and buoy array in spring and early summer 1975 in the Beaufort Sea. The drift tracks of the buoys cover 40-90 days (depending on the date of deployment) and are plotted in 10-day increments.

AIDJEX observational program

Observation point	Experiment
Central station	Position, by Navy Navigation Satellite System (NavSat); root-mean-square error 50 m Atmospheric pressure (to ±0.1 mb, or 10 N/m^2) Wind vector Air temperature (at five levels on a 24-m mast) Solar and atmospheric net radiation Ocean current profile in the mixed layer (one roving current meter to 150-m depth, two fixed current meters at 2 and 30 m below the ice) Ocean temperature and salinity to 1000-m depth, by STD (salinity-temperature-depth)
Corner stations	Position, by NavSat, as above Atmospheric pressure (to ±0.2 mb) Wind vector, at 10 m Air temperature, at 2 and 10 m Ocean current profile in the mixed layer (as at central station) Ocean temperature and salinity (as above)
Data buoys	Positions, by NavSat (rms error 100 m) and by RAMS (expected rms error 5 km) Atmospheric pressure (±0.3 mb) Air temperature at 1 and 4 m
Remote sensing	Photographs, infrared and passive microwave images, laser and sonar profiles of ice topography, side-looking airborne radar (SLAR) images, LandSat images

The approach taken in formulating the AIDJEX model is that it must: (1) employ a constitutive law that combines a reasonable representation of small-scale phenomena (such as pressure ridging) with a plausible continuum behavior on the large scale; (2) satisfy the equations of motion (relating ice acceleration to all external and internal forces); (3) contain an explicit formulation of the conservation of mass (sources and sinks of ice computed by a thermodynamic submodel); and (4) state explicitly the conservation of mechanical energy (transformation of strain energy into potential energy, heat and surface energy).

Such a model has been formulated and tested successfully with data obtained from a pilot study performed in 1972. An important concept introduced in the model is the "ice thickness distribution." Since it is known that most pressure ridges are built up from thin ice, the fractional area covered by thin ice determines the compressive strength of a large assembly of "floes." If compression continues and more thin-ice area is converted to pressure ridges, a process comparable to strain hardening sets in. On a sufficiently large scale, the ice is assumed to always contain enough fractures so that it has no resistance to tension. In addition to the effect that deformation has on the ice thickness distribution, freezing and thawing (thermodynamic model) introduce changes which, in turn, affect the mechanical properties. The most important example of this effect is the rapid hardening by the formation of new ice during winter in open leads. Figure 2 shows in simplified form how the field data are processed to give suitable inputs for the model, which then computes all the necessary variables to predict strain and rotation in the field of grid points, as well as ice velocity, thickness distribution, and the state of stress in the ice. Data from the spring of the Main Experiment 1975 are being processed for use in the model.

Status of field work

With the experience gained in three pilot studies, especially one comprehensive three-station and buoy experiment in March and April 1972, the Main Experiment was deployed in March 1975. To establish a large camp on drifting sea ice, it is necessary to find a large, multiyear floe adjacent to a smooth frozen lead long enough (1300 m) and thick enough (1 m) to accommodate heavy cargo aircraft landings. Such a site was found in the target area centered at 76°N and 140°W, on March 12, 1975. Subsequently, about 900 metric tons of cargo were airlifted to this site. Three satellite camps were established on a circle of about 60-km radius, and 16 automatic data buoys were installed on a circle of about 300-km radius (see figure 1). By late April, the entire observational program as outlined in the table was in operation, and several missions by United States and Canadian remote-sensing aircraft had been flown (photography, passive microwave imagery, infrared imagery, SLAR, laser altimeter profiles). After Nimbus 6 was successfully launched on June 12, 1975, it was found that transmissions of 8 of the 10 RAMS buoys deployed earlier were being received by the satellite. Position, surface pressure, and air temperature were received via an hf radio link from eight NavSat buoys by a central computer at the main camp. At all manned camps, meteorological and oceanographic data were recorded, along with the navigation data, by a computer-operated magnetic tape recording system. Daily synoptic weather messages were transmitted for use by various national weather services. Data of all forms have been processed and stored by the AIDJEX Data Bank located at the University of Washington.

It should be noted that all structures placed on drifting pack ice are bound to be destroyed by the ice. Judicious placement can reduce but not eliminate this prospect. During summer, when the ice is bare and pockmarked by meltwater ponds, and fog and icing conditions are frequent, landings even by small aircraft are dangerous. During winter, darkness and cold hamper all outside activities. Therefore, an experiment that requires manned pack ice stations involves considerable risks, particularly one of irreparable equipment breakdown. The trend is clearly toward greater automation, use of expendable instrument packages, and remote sensing. AIDJEX may well be the last enterprise to use a number of long-term manned ice camps.

Participation

The prime supporting agency of AIDJEX was the National Science Foundation, Division of Polar Programs. The main source of logistical support was the Office of Naval Research-Naval Arctic Research Laboratory. Considerable contributions, both to operations and to the science program, were provided by the Canadian Polar Continental Shelf Project (Department of Energy, Mines, and Resources). The project headquarters was at the University of Washington, Seattle, providing science coordination and operations management. Other participating agencies and institutions were Columbia University, Oregon State University, McGill University, University of Alaska, Bedford Institute of Oceanography, NDAA, U.S. Geological Survey, U.S. Army Cold Regions Research and Engineering Laboratory, National Aeronautics and Space Administration, Environment Canada, and Canadian Geological Survey. The AIDJEX project was completed in 1977.

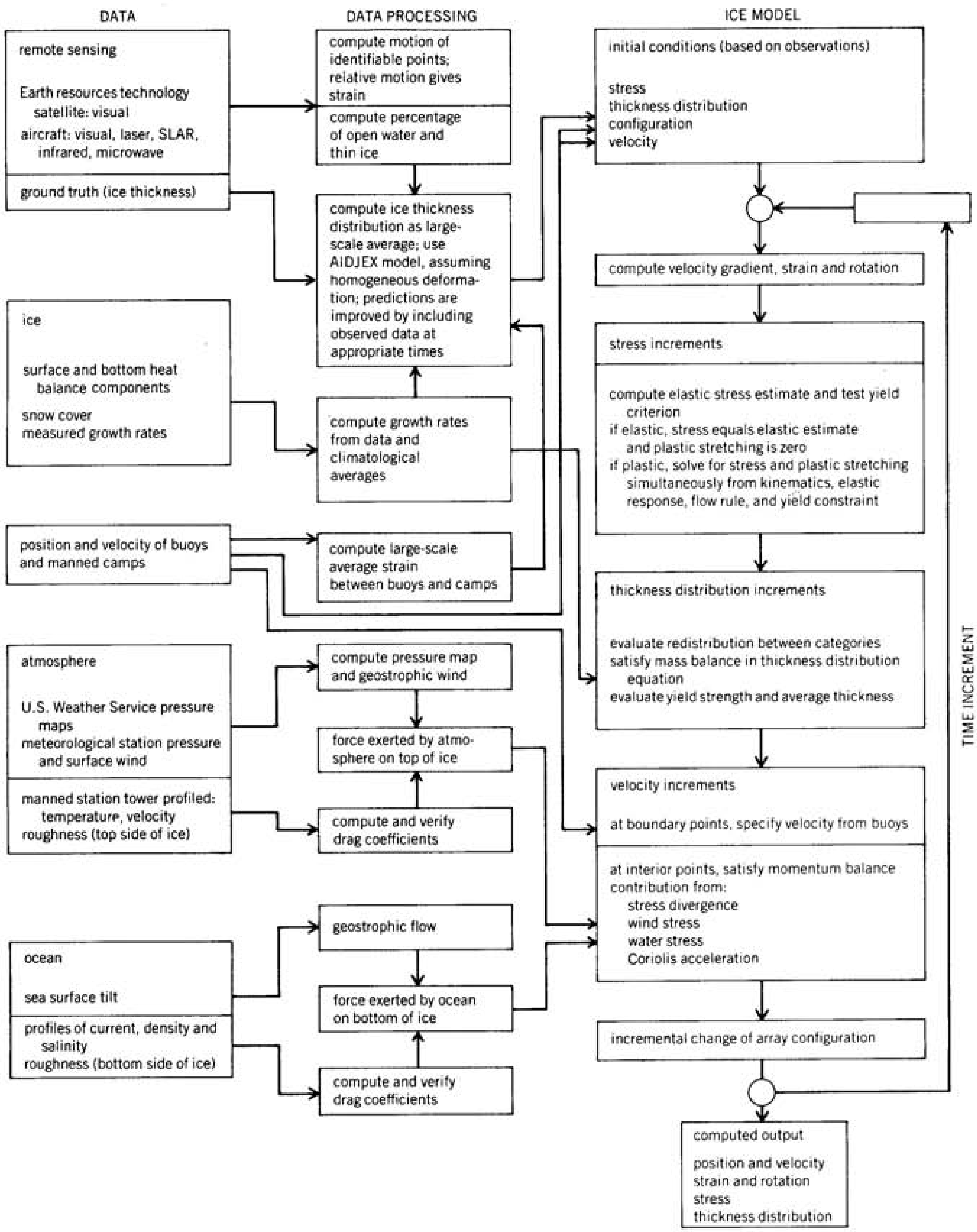

Figure 2. Structure of the AIDJEX sea ice model.

2. DATA AVAILABILITY

Introduction

The AIDJEX Data Bank is the primary repository for data acquired on the Beaufort Sea pack ice during the AIDJEX Field Test of 1972 and the AIDJEX Main Experiment of 1975-76. AIDJEX Bulletin, no. 19, March 1973, shows the data sets acquired during the first period. The purpose of this note is to outline the variety of data which has been validated and entered into the AIDJEX Data Bank from the second period. In addition to the source data, there are some postprocessed data sets and several supplementary supportive data sets supplied by outside sources.

These data are being used for the analysis of the air-ice-sea interactions and associated phenomena. Many articles published in the AIDJEX Bulletin relate to analyses of these data sets and some of the articles include a brief overview of the actual data.

Data in digital form are stored on magnetic tape and are housed at the Computer Center of the University of Washington. Duplicate copies of these tapes are held at the AIDJEX office for security. Non-digital data, such as remote sensing data in the form of satellite photographs and sample printouts of various data sets, are also housed at the AIDJEX office.

Any set of files or subfiles listed below may be obtained by writing to AIDJEX, noting the data files desired and the medium on which it should be produced. Digital data can be provided as a printout, as a set of keypunched cards, or on half-inch, seven-track magnetic tape. These would be accompanied by a narrative description of the file contents and the format of the data sets. The cost of these outputs will be approximately the cost of reproduction and mailing. Supplementary data such as satellite photos or weather maps are available for inspection at the AIDJEX office during business hours. Copies of these materials are best obtained from the original source.

All comments and inquiries concerning the AIDJEX Data Bank should be addressed to:

Murray J. Stateman, AIDJEX Data Manager
4059 Roosevelt Way N.E.
Seattle, WA 98105 U.S.A.

Data Files

File 1. Position of the Manned Camps and Buoys in Latitude and Longitude Versus Time.

Approximately 10 positions were calculated each day for each operating station using the Transit Navigational Satellite or the Nimbus 6 satellite. Data for the manned camps were taken from 10 April 1975 to 20 April 1976. Data for buoys at various locations in the Beaufort Sea were taken from April 1975 to November 1976. Note that the lifetime of most buoys is of the order of six months. These data characterize the motion of the pack ice in the Beaufort Sea for all seasons of the year.

Data are organized in a time series for each station with a separation marker at the end of each 20-day period.

File 2. Smoothed Position, Velocity, and Acceleration for the Manned Camps and Buoys in Cartesian Coordinates.

Data from file 1 above have been postprocessed using a Kalman filter technique. In one form, sorting on time, data from each operating buoy are arrayed together at each 3-hour interval. In another form, sorting on station, position, and velocity are given as a time series, separately for each station. A variance measure accompanies each element of data to characterize its error.

File 3. Source Data for RAMS Buoys Tracked by the Nimbus 6 Satellite.

These position data have been provided by the NASA Goddard Space Flight Center. After decoding and editing the Goddard tapes, these data have been incorporated into file 1 above. Data have been acquired since the start of the Nimbus 6 operation in June 1975. Several land-based RAMS packages are included in order to determine the temporal and spatial accuracy of the tracking system.

File 4. Rotation of the Manned Camp Ice Floes.

The orientation of the ice floes, to which the Navigational Satellite positioning system was aligned, was determined together with the camp position. Each camp azimuth, with respect to true north, has been smoothed for the period 10 April 1975 to 22 April 1976. Angular position and rate of rotation for all camps is given at 3-hour intervals in a time-sorted data file together with error estimates for each data.

File 5. Ice Thickness and Snow Depth.

Periodic measurements were made at various sites near the manned camps. Statistical evaluation of ice and snow conditions were made from frequent measurements around a given site. Data are not continuous. Tabulations of available data for the period 10 April 1975 to 29 June 1975 have been published in AIDJEX Bulletin, no. 32, June 1976. Data to April 1976 is available in a similar form.

File 6. Ice Surface Profile.

One profile was taken using a laser altimeter in the NASA 990 as it traveled a 72-km track between two manned camps. A data point is a height above a reference plane every 0.4 m along the track. The measurements were made on 24 April 1975.

File 7. LANDSAT (ERTS) 1 and 2 Satellite Images.

Satellite photos of the Beaufort Sea region have been obtained for qualitative and quantitative analysis from the EROS Data Center. About 1,500 photos taken when visibility and cloud cover permitted are on file, Each photo covers a square region 100 miles on a side. Time periods are the spring and fall seasons of 1972, 1973 and 1975.

File 8. NOAA-4 and NOAA-5 Satellete Images.

Photos of the Arctic from Greenland to the Bering Straits have been received daily from NESS since 2 January 1975. Two images cover the belt between 70° and 80° N latitude. That is, each photo covers a square area about 600 miles on a side. During the period from November through January only IR photos are available, while both IR and visible photos are taken during the rest of the year. These are source data for examining large-scale ice movements in the Arctic as well as large-scale weather patterns.

File 9. Surface Level Air Pressure - Derived Data.

From the combination of National Weather Service surface pressure maps and pressures measured at scattered points in the Beaufort Sea, two-dimensional pressure contours have been derived for every 3-hour interval. These contours are a sixth order polynomial in X and Y, with the grid coordinates overlaying the Beaufort Sea region. The grid is rectangular and each element is 75 miles on the side. The coefficients of the polynomial are the data of this file. They can be used to determine the surface pressure at any point in the area at any 3-hour interval by translating latitude and longitude of the point to the grid coordinates and employing the polynomial coefficients for the time desired.

To date the coefficients have been calculated for the period 11 April 1975 to 19 July 1975. This work will continue until all coefficients to 30 April 1976 are obtained.

File 10. Geostrophic Surface Winds - Derived.

From the derived pressure data of file 9 above, geostrophic wind speed and direction at grid points and at AIDJEX stations are obtained. There are two separate files with data given every 3 hours during the corresponding time period.

File 11. Pressure Charts - Source Data.

Surface and 850-mb pressure charts prepared by the National Meteorological Center for the Northern Hemisphere have been received for 0 and 12 hours GMT each day since April 1975. These analog charts are used in the derivation of the digitized data of files 9 and 10 above.

File 12. Surface Level Meteorological Data.

Weather stations were operated at each of the AIDJEX manned camps from April 1975 through April 1976. Hourly averages of observed wind speed and direction at 10 m height and air temperatures at 2 m and 9 m height above the surface have been prepared. Time series for each camp are available for the full operating time period of the AIDJEX Main Experiment. There are separation markers between each 20-day interval.

File 13. Atmospheric Inversion Levels.

Inversion heights in the atmosphere were continuously monitored by Acoustic Radar at the manned camp designated as the main camp. Analog records were digitized at hourly intervals for the periods 13 April to 1 October 1975 and 5 November 1975 to 18 April 1976. Up to seven distinct inversion heights are given when they exist simultaneously.

File 14. Ocean Currents - Combined Files for Manned Camps.

The manned camps on ice floes served as floating platforms from which ocean currents were measured continuously at depths of 2 and 30 m. These are currents measured relative to the motion of the ice. One-hour averages of ocean currents combined with 1-hour geostrophic winds and 3-hour smoothed ice velocity (files 10 and 2) at each manned camp, for the full operating period of the AIDJEX program are available in a single file.

These data are sorted by camp, by time with separation markers between 20-day intervals.

File 15. Ocean Currents Combined with Position - Measured from RAMS Buoys.

Two RAMS spar buoys were deployed offshore in the Beaufort Sea in November 1975. They contained sensors which measured ocean currents at depths of 2 and 30 m. A magnetic compass heading for the buoy and internal bearing of the current sensors are given with the current data at 3-hour intervals. These data have been combined with buoy position data to allow for absolute current determination. One buoy operated until 1 October 1976 while the other provided meaningful data only until 28 March 1976.

File 16. Oceanic Mixed Layer Characteristics.

The upper ocean mixed layer is defined in depth by the point(s) at which a rapid change in salinity occurs. This layer was measured for surface temperature, surface salinity and depth(s) twice daily at each manned camp. All available measurements (one per day) were published in tabular form in AIDJEX Bulletin, no. 32, June 1976.

File 17. Ocean Depth.

The depth of the ocean beneath the Main AIDJEX Camp track was measured during two time periods. Acoustic soundings were taken every hour from 25 May to 3 August 1975 and from 18 December 1975 to 25 April 1976. Round-trip time of sound travel is given together with interpreted depth.

File 18. Surface Pressure, Validated, Offshore RAMS Buoys.

Four RAMS Buoys deployed offshore in the Beaufort Sea measured surface pressure. These measurements have been corrected for scale and sensor drift and have been smoothed and interpolated to 3-hour readings.

Buoy 207 was operational from 18 March 1976 to 28 August 1976
Buoy 1015 was operational from 23 March 1976 to 30 September 1976
Buoy 1245 was operational from 4 November 1975 to 1 October 1976
Buoy 1416 was operational from 5 November 1975 to 28 March 1976

The data are sorted by buoy, by time and are merged with buoy position in latitude and longitude.

File 19. Surface Pressure, Validated - AIDJEX Camps and Selected Buoys.

Navigational Satellite systems at the four manned camps and at nine buoys had pressure sensors to make detailed measurements not specifically included in the surface pressure charts of file 11 above. After appropriate corrections and calibration, these validated measurements were incorporated in the derivation of area-wide geostrophic winds (file 10). These source data are available together with their geographic position at 3-hour intervals. Data are sorted by station. The manned camps were operational from April 1975 to April 1976. Some of the buoys (supplemented by nearby RAMS Buoys) continued to be operational as late as 6 December 1976.

File 20. Weather Observations - Manned Camps.

Handwritten weather notes were logged daily by the observers in the manned camps. Wind velocity, surface pressure, temperature, visibility and weather were noted. These data are backups for the digitized data in the respective files noted above.

File 21. Logbook Entries - Manned Camps.

Informal notes concerning any events, performance of equipment, changes or calibration of sensors, etc., were recorded by members of the scientific groups. These entries are backups to the data collection procedures performed during the main AIDJEX experiment.

Data Being Processed But Not Yet Available

The following data sets are in the process of validation and calibration. They will be added to the AIDJEX Data Bank files and made available to the scientific community together with the files noted above.

File 22. Pilot Balloon (PIBAL) - Wind Speed and Direction

PIBAL measurements using two tracking theodolites were made each day at each manned camp during the AIDJEX Main Experiment.

File 23. Ocean Current Profile.

A current meter was lowered to a depth of 194 m and raised at a steady rate to determine the stratification of the ocean layers. This measurement was made twice daily at each manned camp. The analog outputs will be digitized to show time, depth, speed and direction at uniform depth increments.

File 24. Salinity and Temperature Versus Depth at Manned Camps.

Standard STD measurements were made twice daily at each manned camp during the AIDJEX Main Experiment.

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Sea Ice Observations by NOAA's National Environmental Satellite Service

E. Paul McClain
National Oceanic and Atmospheric Administration
Washington, D.C., U.S.A.

Introduction

Sea ice has been receiving increasing attention in recent years because of its importance to weather and climate, and perhaps also because of its usefulness as an index of global climate. Maykut and Untersteiner (1971) have stated that the surface albedo and its variations, which are almost totally a function of the presence or absence of ice and the condition of the ice, are probably the most important regional factors affecting the heat and mass budgets of the Arctic Basin in summer. Sea ice is the major factor that controls the exchange of heat and moisture between ocean and atmosphere in polar regions in winter. The heat and moisture flux into the atmosphere from open water, i.e., areas such as leads and polynya, are at least an order of magnitude greater than from the surrounding ice.

The ice cover in the Arctic and Antarctic is variable seasonally as well as on shorter and longer time scales. In order to monitor the seasonal patterns of heat and moisture fluxes over the polar oceans, one should systematically observe the location and extent of pack ice, its concentration, its condition, and the extent and position of open leads and polynya. Such surveillance also serves as an aid to navigation in polar waters (Vasil'ev, 1968). Reconnaissance aircraft are being used by several nations for this purpose, but their operation is too expensive for coverage of more than limited areas on an infrequent basis. The vast areas involved, their general remoteness, and the need for repetitive coverage make operational environmental satellites a particularly cost-effective platform for comprehensive and frequent monitoring of sea ice.

Description of NOAA's ITOS System

The NOAA (National Oceanic and Atmospheric Administration) series of Improved TIROS Operational Satellites (ITOS), which began in 1970, are placed in circular, sun-synchronous, near-polar orbits above the earth at a nominal altitude of 1450 km (Schwalb, 1972). Data are collected from a swath on earth about 3300 mi wide, providing contiguous, twice daily coverage as the satellite completes approximately 12.5 circuits of its orbit (passes) during each 24 hours of the earth's rotation. The ITOS are equipped with a Scanning Radiometer (SR) designed primarily to provide daily global coverage and local direct readout data for general meteorological purposes. The global coverage capability is possible because the data from two to three complete orbital passes can be stored on board the satellite for subsequent transmission to Command and Data Acquisition (CDA) stations (one is located on the coast of Virginia and the other in central Alaska).

That portion of the earth in view of the satellite whenever the satellite is above the horizon of the receiving station, can be received on simple and relatively low-cost receivers by direct broadcast from the spacecraft (Automatic Picture Transmission Service). APT-SR service has been available worldwide for over 10 years, and there are presently over 700 known receiving stations in some 120 countries. Some characteristics of the SR are found in table 1.

Another line-scanning radiometer carried on the ITOS is the Very High Resolution Radiometer (VHRR). The data from the VHRR is collected and transmitted primarily by local direct broadcast, and their chief use has been nonmeteorological, mostly for oceanographic and hydrologic applications, both research and operational. On-board tape recorder capacity permits a maximum of only 10 minutes of stored VHRR data (which covers an area about 3000 km on a side) per pass to be acquired when the spacecraft is remote from a CDA station. Direct broadcast VHRR data can be acquired by anyone with suitable receiving equipment, but this equipment is much more elaborate and expensive than that needed to receive APT data. The VHRR is an analog data system similar in many ways to the SR, but the VHRR has substantially better ground resolution (see table 1), especially in the infrared.

The next generation of U.S. polar-orbiting, operational environment satellites has its first launch scheduled for spring of 1978. The NASA prototype of this series is called TIROS-N, but subsequent NOAA-funded satellites will be a continuation of the NOAA ITOS series (Ludwig, 1974). The major improvements that TIROS-N will bring include the replacement of the SR and the VHRR by the Advanced Very High Resolution Radiometer (AVHRR) and on-board digitization of data before transmission from the satellite. This conversion is accomplished by an on-board data processor, which also reduces the stored 1-km resolution data to 4-km resolution. Such data compression reduces data volume to the point where it is practical to provide meteorological and oceanographic coverage on a global basis. Full-resolution measurements will

Table 1. Satellite sensors and data characteristics with reference to sea ice applications

Sensor	Spacecraft	Nominal Spectral band (um)	Nominal Resolution at nadir (km)	Swath Width (km)	Repeat Coverage
SR (Scanning Radiometer)	NOAA-5, 6,... (operational)	0.5-0.7 or 0.5-0.9 10.5-12.5	3.5 8	3000	12 hr
VHRR (Very High Resolution Radiometer)	NOAA-5, 6,... (operational)	0.6-0.7 10.5-12.5	1	3000	12 hr
AVHRR (Advanced VHRR)	NOAA (TIROS-N) (Operational; first launch in 1978)	0.55-0.9 or 0.58-0.68 0.72-1.1 3.55-3.93 10.5-11.5 (11.5-12.5)	1-4	2800	12 hr
ESMR (Electrically Scanning Microwave Radiometer)	Nimbus 5 Nimbus 6	1.55 cm 0.8 cm	25 32	1200 1200	12 hr 12 hr
SMMR (Scanning Multifrequency Microwave Radiometer)	Nimbus-G SEASAT-A (1978 launch)	0.81 cm 0.81 cm	27 x 18 21 x 14	780 650	36 hr 36 hr
SAR (Synthetic Aperture Radar)	SEASAT-A	21.5 cm	25 m	100	36 hr
MSS (Multi-spectral Scanner System	LANDSAT 1, 2, C (late 1977 launch for C)	0.5-0.6 0.6-0.7 0.7-0.8 0.8-1.1	80 m	185	18-day
	LANDSAT-C only	10.5-12.5	250 m		
RBV (Return Beam Vidicon)	LANDSAT 1, 2,	0.475-0.575 0.580-0.680 0.690-0.830	80 m	185	18-day
	LANDSAT-C	0.55-0.72	40 m	185	18-day

still be available for direct readout service and for limited coverage via a stored-data mode. Conventional APT service also will continue. The AVHRR is to have four data channels: visible, reflected-infrared (IR), and two thermal-infrared (see table 1). Data from the two thermal-IR channels will be used for improved surface temperature computations at night. A five-channel version of the AVHRR is to be incorporated on a later satellite to enable highly accurate nighttime and daytime surface temperature determination. TIROS-N will also be equipped with a data platform location and data collection subsystem.

Sea Ice Applications of Polar Satellite Data

Visual band data from the SR. Employment of satellite vidicon photographs or radiometer line-sca images for detection and mapping of sea ice in the Arctic or Antarctic has emphasized photo-interpretation techniques to delineate the ice boundaries and features (McClain, 1974). One of the problems most encountered is the discrimination between ice, with or without a snow cover, and clouds, for all often have about the same reflectance in the visual range. By taking advantage of the conservative behavior of the ice fields compared with the often more rapidly changing cloud masses, careful study of the area of several successive days generally enables differentiation of ice-covered areas from just cloudy ones. It is helpful that ice often has characteristically different patterns, shapes, or texture than clouds. Furthermore, clouds can cross coastlines, cast shadows, or are partially transparent. The better the spatial resolution of the sensor, the more effectively photo-interpretation methods are employed.

Cloud filtering and suppression in visual satellite images can also be achieved by computer manipulation of the observed relative reflectances. One such method generates what are termed Composite Minimum Brightness (CMB) charts which retain and display only the lowest reflectances observed at each geographic grid element during the composing period. Lacking a means for internal calibration, McClain

(1973) developed a procedure for external calibration of the CMB values, and found characteristic brightness values corresponding to ice pack concentration, snow cover, and melting conditions. Wendler (1973) used a similar procedure to study ice movements in a small area of the Arctic Ocean off the shore of northern Alaska and to derive monthly mean albedo maps. A fairly complete set of Arctic and Antarctic CMB charts exists for the period 1967 to the present (a sample is shown in figure 1). The compositing period was five days for the pre-1975 CMB charts, but has been ten days since then.

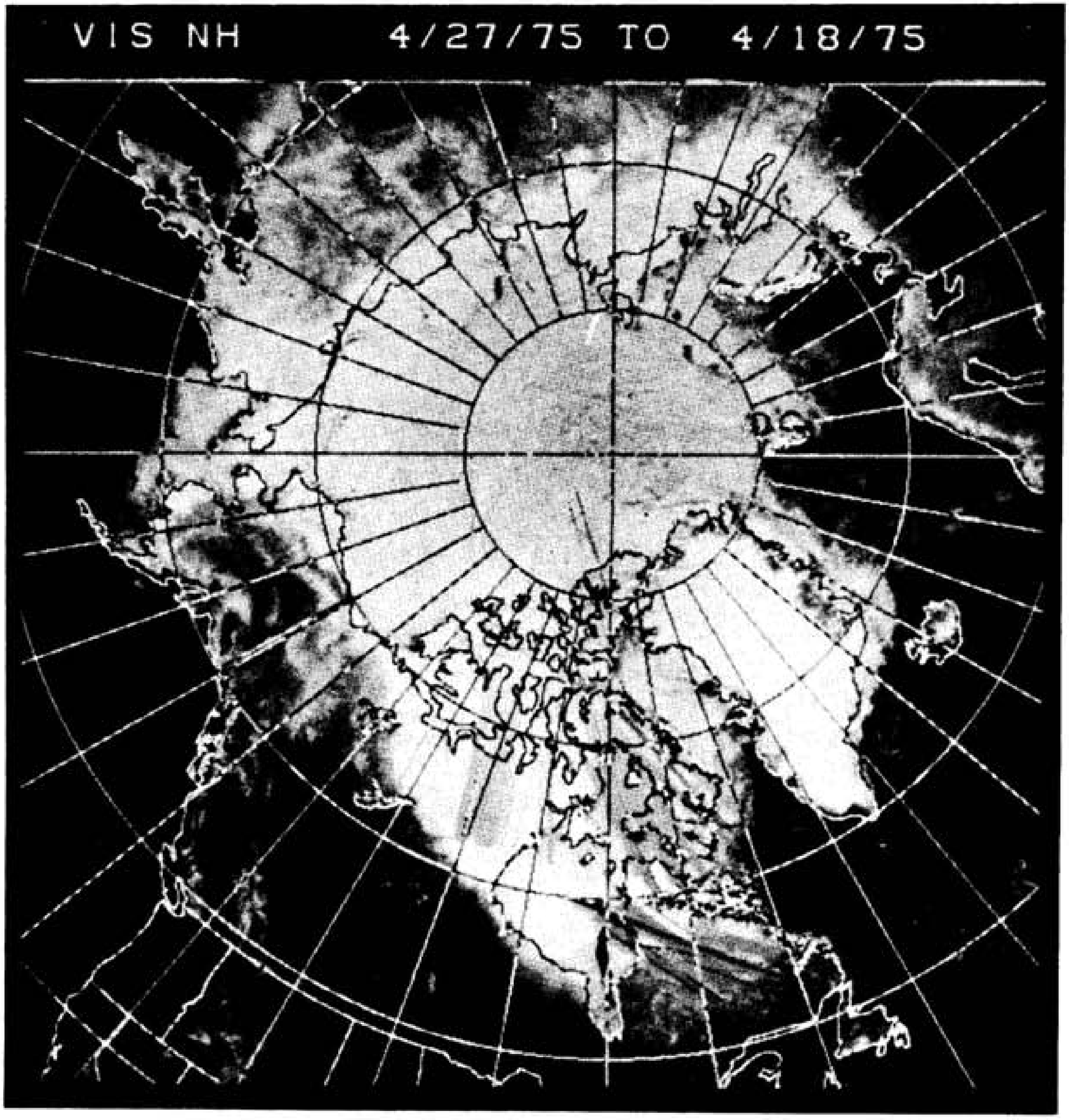

Figure 1. Ten-day Composite Minimum Brightness chart for the Arctic generated from NOAA satellite Scanning Radiometer data (visible band) by retaining only the lowest reflectance value measured at each location during the compositing period.

Thermal-infrared data from the SR. Thermal infrared (IR) imagery and measurements from the SR on the NOAA satellites provide a means of mapping gross ice boundaries during the long winter periods of polar darkness, although the 8-km resolution SR-IR imagery generally is inferior to the 3.5-km visual (SR-VIS) imagery that can be used during the remainder of the year. When visible and thermal IR can be used jointly, preliminary results indicate that additional ice information, such as ice concentration and possibly thickness, can be inferred. An analysis of a small sample of daytime and nighttime IR data indicated that diurnal variations are up to three times greater over pack concentration of 7/10 or more than they are over concentrations of 6/10 and less (Barnes et al, 1972).

When a thermal infrared image is processed for general meteorological purposes, it possesses little or no contrast because the 16 or so distinguishable gray tones have been spread over the entire meteorological temperature range of over 100°C. Infrared scenes of ice need to be "enhanced" to make them more useful in ice studies. This is accomplished after digitization of the original analog data tape by redisplaying the data so that the available gray tones are spread only over the temperature range of primary interest, generally less than 30°C, thus heightening scene contrasts.

Since 1975 a product analogous to the CMB chart has been generated from SR-IR data. This product, termed the Composite Maximum Temperature (CMT) chart, retains and displays only the highest radiative temperature observed at each geographic grid element during the compositing period (presently 10 days). The CMT chart (a sample is given in figure 2) provides for coverage of the winter half of the year not covered by the CMB chart.

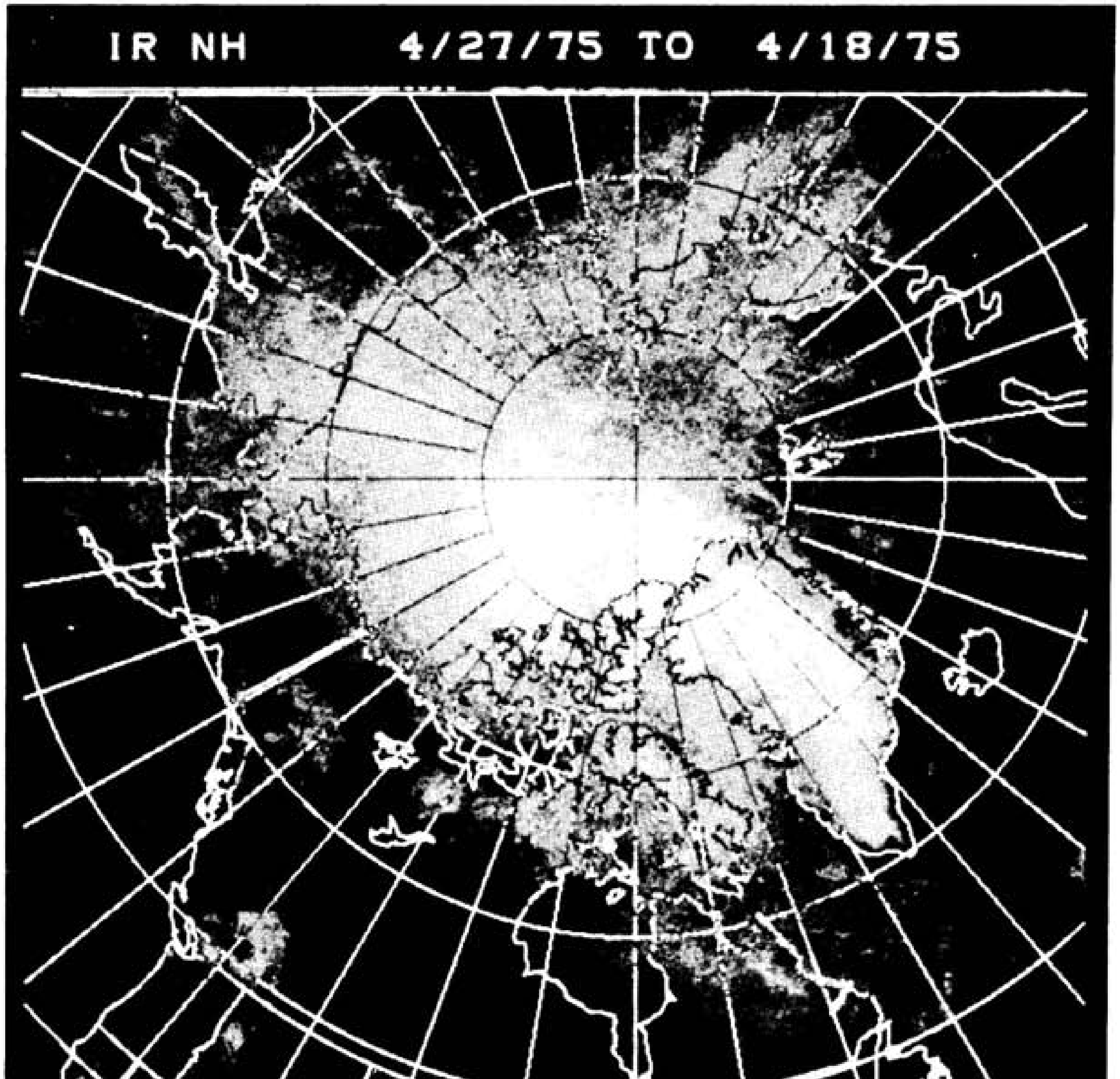

Figure 2. Ten-day Composite Maximum Temperature chart for the Arctic generated from NOAA satellite Scanning Radiometer data (thermal-infrared band) by retaining only the highest temperature value at each location during the compositing period. The gray-scale is such that above-freezing temperatures are displayed as black, and increasingly lower temperatures are shown in increasingly brighter tones.

Advanced ice applications with VHRR visible and infrared data. The relatively poor spatial resolution of the SR and earlier satellite data has limited the application of these satellite data to fairly coarse delineation of main pack ice boundaries and detection of large polynya. The VHRR visible and thermal infrared data available since 1973 represent a substantial gain in ice mapping capability from space. Cloud discrimination techniques are applied more effectively with the higher resolution images. Furthermore, details of floe, lead, and fracture patterns stand out clearly in the new data; improvement in ice information content is especially marked in the infrared imagery. Satellite imagery, particularly VHRR, has been used to study pack ice motions over periods of several days to weeks in the Antarctic (DeRycké, 1973) and in the Labrador ice stream (McClain, 1975), and to track large tabular icebergs in the Antarctic for periods up to ten years (Swithinbank et al, 1977). In addition to increasingly widespread use of VHRR data as images, statistical analyses of 32 x 32 arrays of VHRR-IR measurements over the Arctic Ocean in winter and early spring periods have been employed to discriminate multi-year ice, first-year ice, landfast ice, land, water, and clouds (LeSchack, 1975).

There is fairly complete VHRR coverage of the North American side of the Arctic Ocean from about Ellesmere Island westward over the Beaufort, Chukchi, Bering, and East Siberian Seas by direct readout to the Alaska CDA station (figure 3). Direct readout to the Virginia CDA station provides good coverage of the Hudson Bay and Labrador Coast areas. VHRR coverage elsewhere in the Arctic is irregular because it must be obtained using the stored data mode, and about the only areas for which very much imagery has been collected are Baffin Bay and the Greenland Sea (figure 4). Lower resolution SR data are almost always available for anywhere in the Arctic, but the IR images are not enhanced for ice scenes (Dismachek, 1977).

Operational applications of satellite data. Several operational sea ice products derived from photo interpretation of VHRR-VIS and VHRR-IR images are generated by NOAA and distributed by facsimile or mail (Dismachek, 1977). One is a composite weekly ice type and concentration chart covering the Bering, Chukchi, and Beaufort Seas bordering Alaska. The U.S. Navy has long used satellite imagery (SR and VHRR) in making arctic sea ice analyses and providing sea ice forecasts in support of Department of Defense operations (Potocsky, 1975). Great Britain's Meteorological Office also makes use of satellite information in their published ice charts for the Arctic.

Some Remarks on Current and Near-Future Research Satellites

The discussion above has been limited to ice observations from NOAA's operational environmental satellites. Among current research satellites, the two most recent of NASA's Nimbus series of polar-orbiting sun-synchronous satellites, Nimbus 5 and 6 (Sabatini, 1972), carry among their experimental sensors an Electrically Scanning Microwave Radiometer (ESMR). An important limitation on satellite sensing of sea ice at visible and infrared wavelengths is cloud cover, but microwave radiation between about 0.8 and 1.55 cm wavelengths is attenuated only slightly by clouds typical of polar regions (Zwally et al, 1977). Large microwave brightness temperature contrasts found at ice-water boundaries--due to emissivity rather than physical temperature differences--are observed readily through clouds, with first-year ice being somewhat more emissive than multi-year ice (Gloersen et al, 1973). Some of the Nimbus spacecraft also have been equipped to locate and collect data from free-drifting instrument platforms such as buoys emplaced in the pack ice (Martin, 1972). More details on the recent Nimbus spacecraft are given in table 1.

The 80-m resolution of the multispectral image data from the Return Beam Vidicon (RBV) and Multispectral Scanner Subsystem (MSS) on NASA's LANDSAT 1 and 2 (formerly called Earth Resources Technology-ERTS) has permitted the most detailed and precise interpretation and mapping of ice features ever possible from an earth satellite (Rango et al, 1973). The limited coverage afforded by the 185-km wide swath and the 9- or 18-day return cycle precludes virtually all operational use, especially when cloud obscuration and data processing delays are taken into account (U.S. National Aeronautics and Space Administration, 1976). LANDSAT data also can be used to delineate areas of melting pack ice because when an ice or snow surface becomes wet, its reflectivity diminishes sharply in the reflected infrared, but only slightly in the visible (Strong et al, 1971). Table 1 provides more information on LANDSAT's instrumentation.

As for the near future, the last in the Nimbus series, Nimbus-G, is scheduled for launch in mid-1978, and a new NASA research spacecraft dedicated to ocean observation, SEASAT-A (U.S. Department of Commerce, 1977), is planned for launch shortly thereafter (see table 1). Both will carry a Scanning Multi-frequency Microwave Radiometer (SMMR), one channel of which is designed, like the ESMR, for gathering ice information at about 25-km resolution. Also on SEASAT will be a Synthetic Aperture Radar (SAR) system. The SAR is designed to obtain images of extremely high spatial resolution, viz, 25 m, but the areal coverage will be severely constrained by the 100-km wide limited-length swath widths, SEASAT's orbit (maximum latitude of 72°), and data readout and processing restrictions. Finally, NASA's LANDSAT-C, slated for launch in late 1977, differs from the first two spacecraft in this series in that the RBV system is reduced to two television cameras operating in tandem to provide panchromatic images having a ground resolution of 40 m. Also, the MSS will be equipped with a fifth band, this one in the thermal infrared (see table 1). The LANDSATs are also equipped with data collection systems, but they cannot locate drifting instrument platforms.

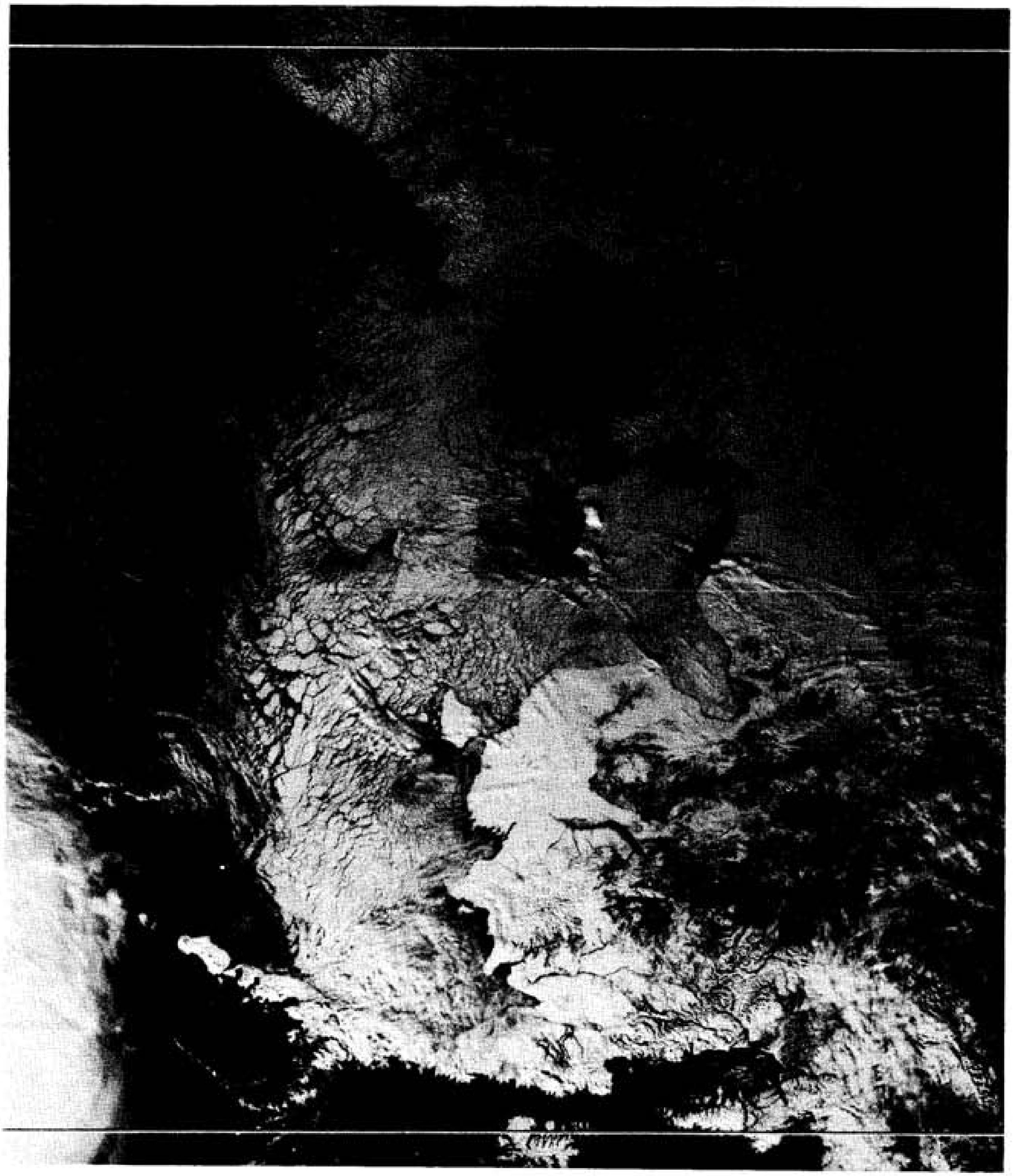

Figure 3. Visible-band image for the Bering Sea and adjacent areas generated from NOAA satellite Very High Resolution Radiometer data that was read out directly to a receiving station near Fairbanks, Alaska, on 25 March 1976.

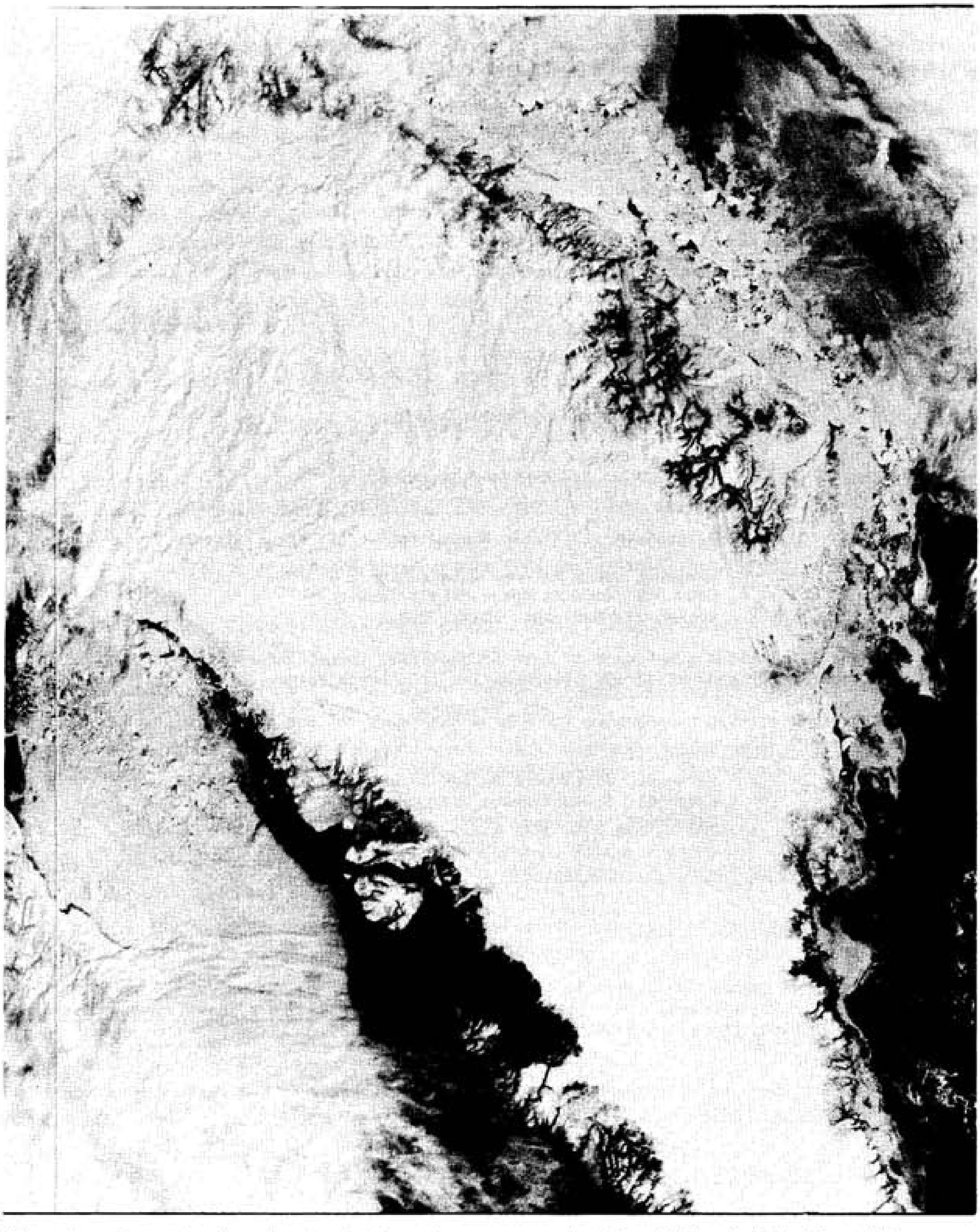

Figure 4. Image for Greenland and adjacent seas generated from NOAA satellite Very High Resolution Radiometer data (visible band) that was stored onboard the spacecraft and later read out to a receiving station on the Virginia coast on 16 May 1974.

Data Availability

Data from the NOAA series of operational environmental satellites and from SEASAT are available to all scientists from NOAA's Environmental Data Service (EDS) at the following address:

Satellite Data Services Branch, NCC
World Weather Building, Room 606
Washington, D.C. 20233 U.S.A.

The EDS operates under a user charge and service policy that requires the recovery of the cost of reproduction of satellite data products. Direct billing for these products is handled through the National Climatic Center (NCC).

LANDSAT data may be obtained from the Satellite Data Services address given above or from one of the following:

EROS Data Center
U.S. Geological Survey
Sioux Falls, South Dakota 57198 U.S.A.

Canada Centre for Remote Sensing
2464 Sheffield Road
Ottawa, Canada K1A 0Y7
Attention: LANDSAT User Service

Data requests from U.S. scientists for NASA's Nimbus spacecraft are available from:

National Space Science Data Center
Code 601, Goddard Space Flight Center
Greenbelt, Maryland 20771 U.S.A.

The NSSDC will furnish limited quantities of data to qualified investigators without charge. The NSSDC may establish a charge for production and dissemination if a large volume of data is requested.

All requests from foreign researchers for Nimbus data archived and available through NSSDC must be specifically addressed to:

Director, World Data Center A for Rockets and Satellites
Code 601, Goddard Space Flight Center
Greenbelt, Maryland 20771 U.S.A.

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Appendix I

Acronyms

APT - Automatic Picture Transmission

AVHRR - Advanced Very High Resolution Radiometer

CDA - Command and Data Acquisition

CMB - Composite Minimum Brightness

CMT - Composite Maximum Temperature

ESMR - Electrically Scanning Microwave Radiometer

IR - Infrared

ITOS - Improved TIROS Operational Satellites

MSS - Multispectral Scanner Subsystem

RBV - Return Beam Vidicon

SAR - Synthetic Aperture Radar

SMMR - Scanning Multi-frequency Microwave Radiometer

SR - Scanning Radiometer

VIS - Visual

VHRR - Very High Resolution Radiometer

U.S. Navy Global Ice Analysis and Forecasting

Edward A. O'Lenic
U.S. Navy Fleet Weather Facility
Suitland, Maryland, U.S.A.

Introduction

The initial efforts in sea ice analysis and forecasting at the Naval Oceanographic Office (NAVOCEANO) in 1951 grew out of the need for sea ice support to MSTS (Military Sea Transportation Service) ships supplying DEW (Defense Early Warning) Line construction, starting with Thule Air Base. During this first year of heavy ship traffic in Baffin Bay, ice-inflicted damages to ships totaled 16 million dollars. The Navy Aerial Ice Observer program materialized in 1954, emphasizing ice analysis from aerial reconnaissance. During 1954 alone, over 2800 hours of aerial ice reconnaissance were flown to support expanded DEW Line construction. During the early 1960's, NAVOCEANO conducted PROJECT BIRDSEYE, an expanded ice reconnaissance program. As satellite resolution improved and data became routinely available, satellite imagery became the major data source for sea ice analysis. By 1972, a combination of low-resolution all-weather microwave satellite imagery, and high resolution visual and IR imagery, gave the Fleet Weather Facility Ice Operations Department a truly global, all weather, year-round sea ice analysis capability.

Over 170 organizations now receive products and services (table 1) regularly from the Ice Operations Department. This includes civilian and foreign customers as approved by the Chief of Naval Operations. The recent formation of the Navy/NOAA Joint Ice Center is designed to enhance our ability to respond to these latter groups.

Table 1. Operational sea ice products and services

Southern Ice Limit Eastern Arctic
Southern Ice Limit Western Arctic
30-Day Outlook for Northern Hemisphere
Arctic Data Limit
15 and 30-Day Forecast for Antarctic
Antarctic Data Limit
Special Request
Tailored Ice Message
Aerial Ice Message
Ship and Shore Observations
Ice Vectors
Flight Request

Products and Services

Two types of products or services are available:

1. operational analysis, forecasts and outlooks prepared weekly, monthly, or yearly on a routine schedule; and

2. detailed analyses and forecasts prepared on request, or on opportunity.

Probably the most important operational products are the weekly analyses of sea ice conditions in the Eastern Arctic, the Western Arctic, and the Antarctic. These are colored in a "traffic light" color scheme, whereby light concentrations are colored green; intermediate concentrations, yellow; and heavy concentrations, red. The concentration is expressed numerically in eighths.

Regions of particular interest, such as the Ross Sea or the Beaufort Sea along Alaska's North Slope, may be analyzed in great detail when ships request close support and routing information. These services are transmitted to the user via Naval Message. Requests for detailed ship-routing information increased by over 33 percent from 1976 to 1977.

Thirty-day forecasts and seasonal outlooks provide estimates of ice edge position, port-opening dates, and ice thickness distribution based on freezing degree days.

Satellite Imagery

Early sea ice analysis from aerial reconnaissance, ship, and shore station reports, revealed that ice age and thickness can be accurately estimated from its color or gray tone. This knowledge paved the way for ice analysis from satellite photographs (McClain, 1973, 1974, 1975; Wendler, 1973; Swithinbank, 1970; Gerson, 1975). Imagery available routinely to the Fleet Weather Facility includes microwave imagery with 25-km resolution, NOAA-5 scanning radiometer imagery with 5- to 10-km resolution, and NOAA-5 very high resolution imagery, with 1- to 2-km resolution.

Antarctic Operations

The Antarctic northern ice limit charts (U.S. Fleet Weather Facility, 1976) provide an opportunity to observe seasonal variations in ice conditions (figure 1). The maximum winter and summer ice conditions illustrate that

1. a large percentage of the Antarctic winter ice pack is first year ice;

2. maximum northern ice limits occur in the Western Hemisphere during late August;

3. multiyear ice hazard is greatest in the Weddell Sea and from the Palmer Peninsula to the eastern Ross Sea; and

4. multiyear ice is minimal in the Eastern Hemisphere.

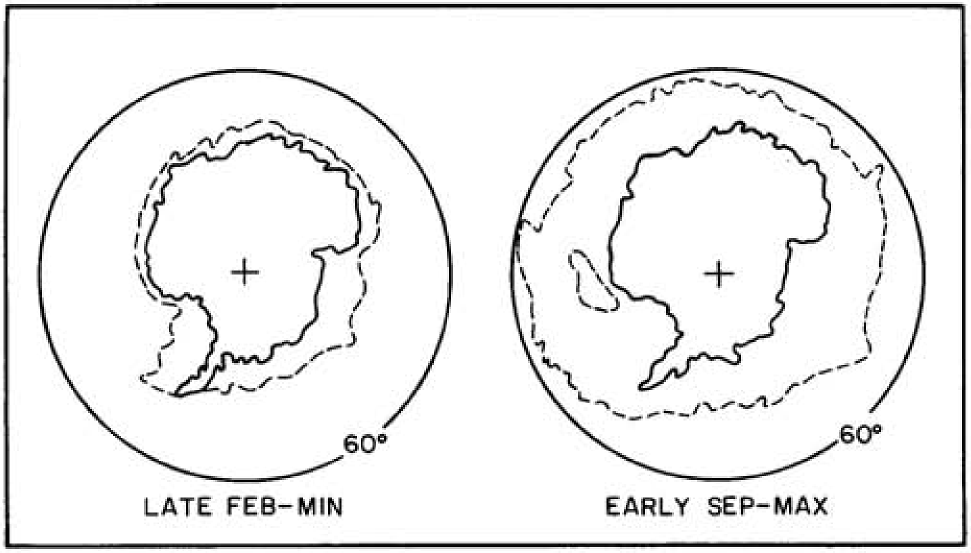

Figure 1. Seasonal variation in Antarctic ice pack (dashed lines depict the northern ice limit).

The small oval-shaped area in the winter ice pack is a region of lighter concentration, sometimes called the "south water", which appeared in three out of four years analyses (Wilheit, 1977). The weekly Antarctic analyses were also used to produce the schematic of the typical breakup pattern in the Ross Sea (figure 2). This was the breakup sequence forecast in the 1977 seasonal outlook for the Ross Sea and McMurdo Sound. Because the western Ross Sea is characterized by unrestricted northward ice drift, the pack covers a larger area, and the ice is relatively thin (generally less than 1 m) (Perchal, 1975). An open water lead forms along the Ross Ice Shelf and expands northward, while the northern pack edge recedes southward. These regions meet in mid to late January, the optimum time to safely transit to McMurdo.

Iceberg Location and Tracking

Icebergs and large ice floes are routinely observed in satellite imagery. Efforts at tracking such objects have been shown to be feasible (DeRycke, 1973; McClain, 1975).

In late 1967, a very large iceberg was observed off the Larsen Ice Shelf. The berg apparently calved from the ice shelf on the Princess Martha coast in early March 1967. This portion of the ice shelf is a rectangle approximately 45 by 85 km, and has an area, measured by planimeter, of approximately 3268 square kilometers. This is slightly smaller than the state of Rhode Island. During the years since 1967, the berg has traveled 18,000 miles, making slow progress through the Weddell Sea. The depth of the berg is estimated at 700 to 850 feet, with an additional 150 feet extending above the waterline. These

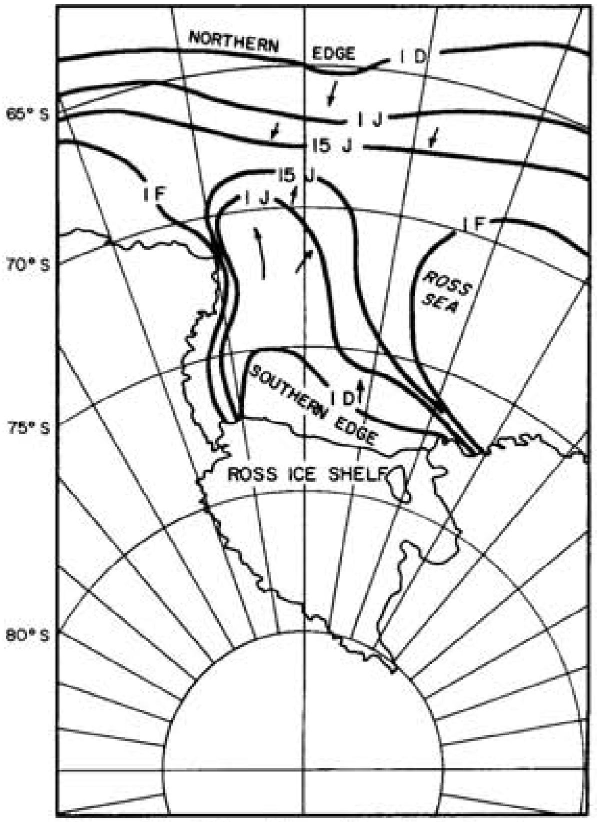

Figure 2. Schematic of typical breakup pattern in the Ross Sea during the summer operating season. D=December; J=January; F=February.

estimates are based on known depths near the Ronne Ice Shelf, where the berg grounded in early 1970 (Bryner, 1976). The approximate volume of the berg is $8.8x10^{11}$ m^3, which corresponds to about $8.9x10^{14}$ liters ($2.3x10^{14}$ gallons) of water.

Summary and Recommendations

Since 1972 the Fleet Weather Facility Ice Operations Department has produced global sea ice analyses and forecasts on a year-round basis. The data summarized in these analyses provide useful information for planning Antarctic operations. The products and some applications are:

1. detailed "tailored" analyses and forecasts for close support of ships in the polar pack;

2. routine weekly analyses which indicate the existing trends in ice growth or recession. These also serve as bases for long-range forecasts and climatological summaries;

3. 15- and 30-day forecasts, used to update seasonal forecasts; and

4. seasonal outlook in the Ross Sea, indicating the expected rates and patterns of breakup and the expected dates for safe transit to McMurdo or the Ross Ice Shelf.

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Canadian Government Ice Services

W.J. Sowden
Ice Climatology and Applications Division
Department of the Environment
Ottawa, Canada

Within the Canadian Government there are a number of organizations whose energies are, at least in part, involved with ice. Most of these energies, however, are oriented toward research or special projects. The mandate for providing ice services has been given to the Atmospheric Environment Service (AES) of the Department of Environment and to the Canadian Coast Guard which provides the icebreaker service. The Ice Branch of AES is the organization with the responsibility for providing the guidance to management for long-term planning, ice climatology, and a day-to-day ice reconnaissance and ice forecasting program.

To meet this responsibility, the Ice Branch, with its administrative headquarters near Toronto, Ontario, has three main divisions: Ice Reconnaissance, Ice Forecasting, and Ice Climatology and Applications. Personnel include professionals who specialize in the remote sensing and engineering problems arising from the specialized equipment operating under unique conditions.

The ICE RECONNAISSANCE DIVISION, collocated with the administrative headquarters near Toronto, consists of some 40 personnel and has the responsibility for training ice observers (a three-month course) and for staffing the ice reconnaissance aircraft and Canadian Coast Guard icebreakers. The division is also responsible for organizing the acquisition of all ice data which includes, in addition to the visual and remote sensing data from aircraft, the observations originating from ships, shore reporting stations, and ice thickness reporting stations.

The ICE FORECASTING DIVISION is located in Ottawa, Ontario, and is responsible for the analysis of all available ice data and the provision of forecasts and ice information for the current season.

The ICE CLIMATOLOGY AND APPLICATIONS DIVISION, the most recently created division, is located in Ottawa. Its responsibilities include archiving ice data and providing consultation on ice matters of a climatological and applications nature.

THE PROGRAM

During the period of late June to November, two Lockheed Electra aircraft, which are dedicated to ice reconnaissance, operate on contract in the Arctic. One is based at Inuvik, N.W.T.; the other, at Frobisher Bay, or, if the ice melts quickly in the Eastern Arctic, at Resolute Bay. From about mid-December to June (depending on the severity of the ice year), the aircraft are operated on the Canadian Eastern Seaboard from Gander, Newfoundland, covering the ice along the Labrador Coast. They are also operated east of Newfoundland, and from Summerside, Prince Edward Island, carrying out reconnaissance in the Gulf of St. Lawrence. Both aircraft are equipped with double Inertial Navigation Systems, double Omega Systems, ground mapping radar, special visual observing positions, laser profilometer, infrared line scanner, camera array, airborne radiation thermometer, radio facsimile transmitter and additional marine communications channels. In addition to these two aircraft, a third aircraft (traditionally a DC-3) is chartered and dedicated to ice reconnaissance on the Great Lakes. This aircraft is not as well equipped with remote sensors. The Electra aircraft carry an ice observer crew of five, whereas three ice observers perform the work on board the Great Lakes aircraft. The aircraft provide real time tactical support to ships, and on request provide facsimile transmissions of observed ice charts.

Ice observers are also aboard two helicopters and a DC-3, providing ice observations of the St. Lawrence Seaway and the St. Lawrence River. These aircraft are not dedicated to ice reconnaissance on a full-time basis. Ice observers are also assigned to eight to ten of the Canadian Coast Guard's icebreakers, thus giving on-the-spot ice observations.

Ice Forecasting Central collects ice and meteorological data by telecopier, facsimile and teletype.

At Ice Forecasting Central, real time NOAA VHRR and LANDSAT is received during the summertime Arctic operation, while during the wintertime southern operation, only the NOAA imagery is received in real time. This imagery is interpreted and used with the analysis of the incoming ice data to produce the current ice situation chart. When used with the current and prognostic meteorological charts, ice forecasts for 36 hours with an outlook for the following 24 hours is produced. In addition, every two weeks a 30-day forecast is produced, and at the beginning of each season a seasonal outlook is developed. The daily ice charts and forecast are distributed by facsimile and teletype transmission. A weekly ice chart, as well as the 30-day forecast, is distributed by mail.

The data bank for climatological purposes consists primarily of a series of weekly historical ice charts which date back to 1958. As the repository for ice data, the Ice Climatology and Applications Division is also responsible for the archiving of observed ice charts and ice-related meteorological parameters, and data observed and interpreted from side-looking airborne radar (SLAR), infrared thermal-mappers, laser profilometers, photography, and the NOAA and LANDSAT satellite imagery. Publications are listed in appendix I.

Demands for ice reconnaissance and ice information have increased markedly, including a requirement for year-round reconnaissance of the Canadian Arctic. In order to meet these demands, expansion of the present staff of approximately 60 professionals and technicians is planned, as well as conversion of some manual processes to automated methods, and the development of new techniques and procedures.

Appendix I

PUBLICATIONS

1. ICE SUMMARY AND ANALYSIS

This soft covered publication is produced yearly for three areas: the Canadian Eastern Seaboard, the Hudson Bay and Approaches, and the Canadian Arctic. They contain a series of periodic (mostly weekly) ice charts with an accompanying meteorological chart depicting ice conditions by type (age) and concentration. The present series covers the period 1964-1973. Approximate cost: $2.75/copy.

2. HISTORICAL ICE CHARTS

Weekly ice charts for the period since 1958 are produced for the same areas as the Ice Summary and Analysis publications, but contain more detail. Copies of these charts are available on microfilm ($10.00-$15.00 per roll) or on microfiche, or as paper copies ($1.00/chart).

3. OBSERVED ICE CHARTS

These charts contain ice observations from ships and aircraft for the various geographical areas. Cost and format are similar to the Historical Ice Charts. Actual ice observation charts are also available for the St. Lawrence River and the Great Lakes.

4. COMPOSITE ICE CHARTS

Like the Historical Ice Charts in cost and format, these charts are for the Great Lakes for the period 1973-1977.

5. ICE THICKNESS DATA FOR SELECTED CANADIAN STATIONS

Weekly ice thickness and snow depths are given for a number of stations throughout Canada including the Canadian Arctic. Published yearly.

6. FREEZE-UP AND BREAK-UP DATES OF WATER BODIES IN CANADA

Published approximately every five years, this publication contains data concerning ice formation/decay and maximum thickness for over 300 stations in Canada including the Arctic. Approximate cost: $1.50/copy.

REQUESTS FOR INFORMATION OR COPIES OF THESE PUBLICATIONS SHOULD BE DIRECTED TO:

CHIEF, ICE CLIMATOLOGY AND APPLICATIONS DIVISION
DEPARTMENT OF THE ENVIRONMENT
473 ALBERT STREET, ROOM 531
OTTAWA, ONTARIO K1A 0H3
CANADA

A Data Set on Northern Hemisphere Sea Ice Extent, 1953-76

John E. Walsh
Laboratory for Atmospheric Research
University of Illinois
Urbana, Illinois, U.S.A.

Introduction

Substantial year-to-year variations in the extent of sea ice have been observed in nearly every geographical sector of the Arctic. Winchester and Bates (1958) examine cases in which the September position of the ice edge north of Alaska differed by several hundred kilometers in successive years. Haupt and Kant (1976) and Volkov and Sleptsov-Shevlevich (1972) describe similar fluctuations in the North Atlantic and in the Soviet Arctic, respectively. These fluctuations can seriously affect the navigability of the peripheral arctic seas. Variations in the extent of arctic sea ice have also been claimed to be climatically significant (Budyko, 1972; Fletcher, 1965). These claims are based on the fact that the high albedo and the effective insulating properties of sea ice profoundly affect the surface energy budget of the high-latitude oceans. Unfortunately, the existing data on sea ice extent has been collected primarily on a regional basis. Before hemispheric-scale studies of observed sea ice fluctuations can be performed, a relatively uniform set of data must be available for all longitudes. This report describes the construction of such a data set.

The Grid and the Data Sources

The existing data on sea ice extent are being represented in the form of concentration grids. The grid, shown in figure 1, consists of approximately 1500 points separated by 60 n mi (1° latitude). The grid covers the Arctic Ocean and those portions of the peripheral seas where ice is observed during all or part of the year. The concentration values are in tenths of ice coverage at each point. The grids are being digitized so that the entire data set will be stored compactly on tape.

The grids are being constructed for the end of each month in the 1953-76 period. 1953 was chosen as the starting date because it represents the beginning of the data record for the North American Arctic. Grids will be constructed at bi-weekly intervals for several recent years in order to assess the loss of accuracy suffered when mid-month grids are simply interpolated from the surrounding monthly grids.

The ice data for the years 1972-75 have been obtained from the charts of the U.S. Fleet Weather Facility (1976a,b). These charts are available at one-week intervals for the entire Northern Hemisphere. For years prior to 1972, the hemispheric grids are synthesized from the regional data sets. The ice coverages for the Alaskan sector (Bering, Chukchi, Beaufort Seas) are obtained from the yearbooks of the U.S. Naval Oceanographic Office (NAVOCEANO) (1953-71). These yearbooks contain charts at intervals ranging from one week or less in summer to approximately one month in winter. The NAVOCEANO yearbooks also contain data for the eastern Canadian Arctic (Baffin Bay, Davis Strait, Hudson Strait) and the ocean area south of Greenland. Additional data for the Canadian Arctic have been compiled by the Canadian Department of Transport for the years 1964-69. The Canadian yearbooks contain ice maps for June-October at intervals of 1-3 weeks.

Hemispheric ice maps for the end of each month in the 1960-76 period have been obtained from the British Meteorological Office. For the years 1960-61, the charts in this set cover only the North Atlantic. Areas for which the data are considered unreliable are so indicated by the color-coding of the B.M.O. charts. The British data for the North Atlantic Ocean and the Norwegian Sea are being supplemented by the yearbooks of the Danish Meteorological Institute, particularly in the early years of the study period.

Some data for the Soviet Arctic (between long. 50°E. and 180°E.) are contained in the charts of the U.S. Fleet Weather Facility and the British Meteorological Office, but reliable data for the years prior to the late 1960's need to be provided by the Soviets.

Difficulties in the Data Processing

The major difficulties inherent in the construction of a uniform data set can be grouped into several categories:

a. Imprecise concentration classifications

Since ice conditions can vary considerably over relatively small areas, several ice-observing agencies have tended to group the ice concentrations into classes. The British Meteorological Office, for example, uses classifications such as "very open" (1/10-3/10), "open" (4/10-6/10), and "close or very

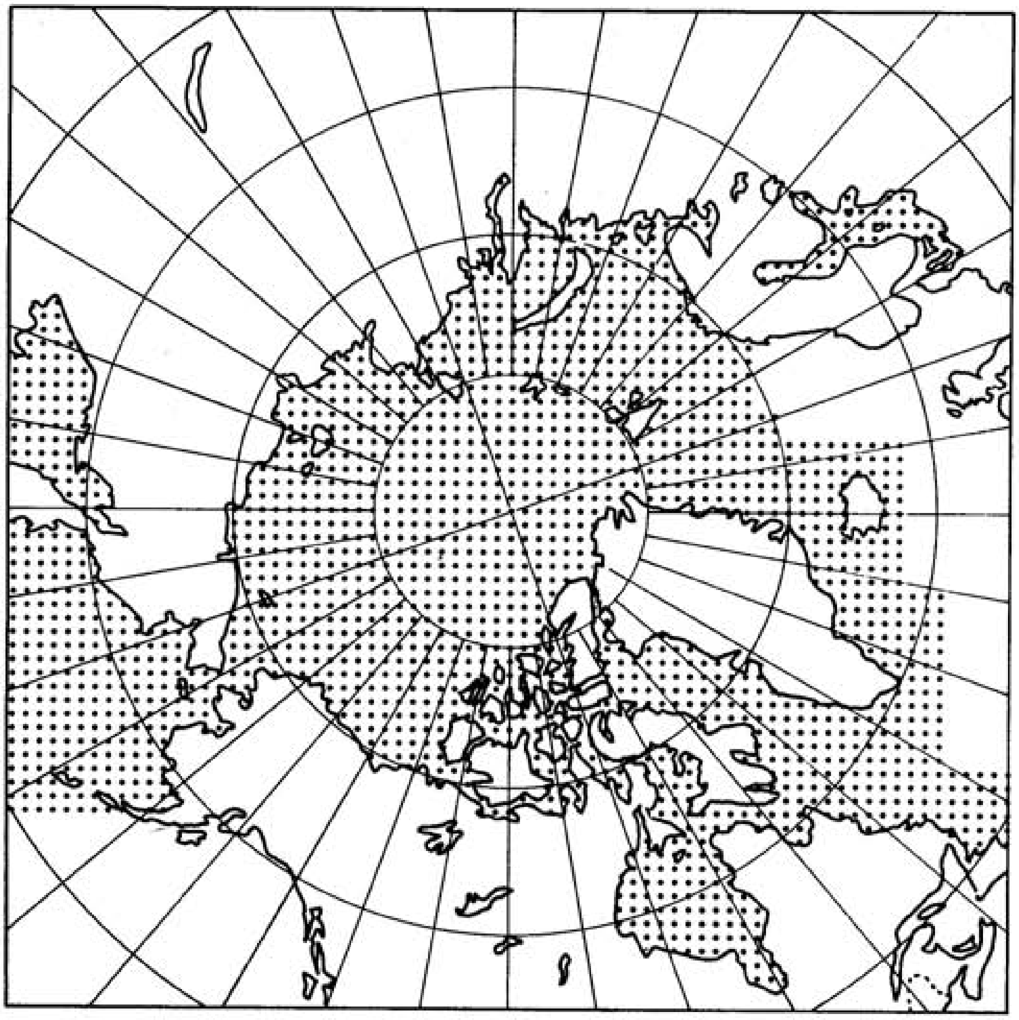

Figure 1. The ice concentration grid.

close" (7/10-9^{+}/10) pack ice. The Canadian and NAVOCEANO charts are based on similar classifications, although the latter two sources superimpose specific concentration values on their charts when the data permit such precision. In areas where only the concentration categories are indicated, the mean concentration of the category is chosen for the digitization in the present work. If the mean is between two integer values, the mean is rounded up to the next tenth.

b. Inconsistencies in overlapping data

When data from more than one source are available for the same region and the same date, there are occasional inconsistencies in the plotted concentration fields. A reliability ranking of the data sources, based on an admittedly subjective examination of the temporal continuity within each individual data set, has therefore been compiled. Priority is assigned, in order of decreasing reliability, to the Canadian, U.S., Danish and British sources. The relative reliability of the Soviet data will be assessed when the Soviet data is in hand.

c. Missing data

For a few months in the early part of the study period, there are no available data in some areas. In particular, there are no data for the Canadian Archipelago for several years in the 1950's. The winter data for the Alaskan sector are also quite sketchy in these early years, especially in those months when observations were limited by darkness. Several months of the North Atlantic data for the years 1955-58 have not been located. The strategy in these cases is to "tag" the digitized data to indicate a missing value. In addition to such a tag, the normal (monthly mean) concentration will be included at grid points for which the data are missing. Users of the data set can then choose either to omit these values entirely or to substitute the monthly normals.

d. Temporal interpolations

Because the data from the sources other than the British Meteorological Office do not always correspond to the final day of the month, the charts constructed in this study are often based on temporal interpolations. In most cases the interpolations are between charts that are 1-3 days to either side of the end of the month. However, since changes in ice conditions over a period of several days are generally too small to be resolved on a 60 n mi grid, the errors due to the temporal interpolations are felt to be of little consequence.

Potential Applications of the Data Set

The digitization should be complete by mid-1978 for all regions other than the Soviet sector. The digitized version of the completed data set will become part of the data collection at the National Center for Atmospheric Research, Boulder, Colorado. The data will be available to all interested investigators. Possible uses of the data include:

a. A determination of the statistical relationships between sea ice anomalies in different geographical regions.

b. The computation of regional and hemispheric trends in ice extent over the past 24 years.

c. A determination of normals and extremes of sea ice extent for use in atmospheric model studies of the high-latitude surface energy budget.

d. A quantification of the extended-range predictability of sea ice extent in terms of the corresponding meteorological fields.

Acknowledgements

The work described here is supported by the National Science Foundation, Division of Polar Programs, under grant no. DPP76-15352. Computing facility support is being provided by National Center for Atmospheric Research, which is sponsored by the National Science Foundation.

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U.S. Fleet Weather Facility (1976b) Western Arctic Sea Ice Analyses, 1972-75. Suitland, Maryland, U.S. Navy, 1976. 212p. NTIS: AD-A033 345.

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Winchester, J.W.; Bates, C.C. (1958) Meteorological conditions and the associated sea ice distribution in the Chukchi Sea during the summer of 1955. (In: Sutcliffe, R.E., ed. Polar Atmosphere Symposium, Part I: Meteorology Section. N.Y., Pergamon, 1958, p. 323-34.)

ARCTIC SEA ICE: A SELECTED BIBLIOGRAPHY, 1965-77

Because of the large body of literature on arctic sea ice, we found it necessary to limit the citations included in this bibliography by the date of publication (1965 to 1977), geographic area, and subject scope. Our definition of "arctic" for the purposes of this bibliography is illustrated by the shaded areas in figure 1. The following areas have been excluded unless they were included in more general studies: Bering Sea, Canadian Arctic Archipelago, Baffin Bay (including North Water), Davis Strait, Hudson Bay, Labrador Sea and the Gulf of St. Lawrence.

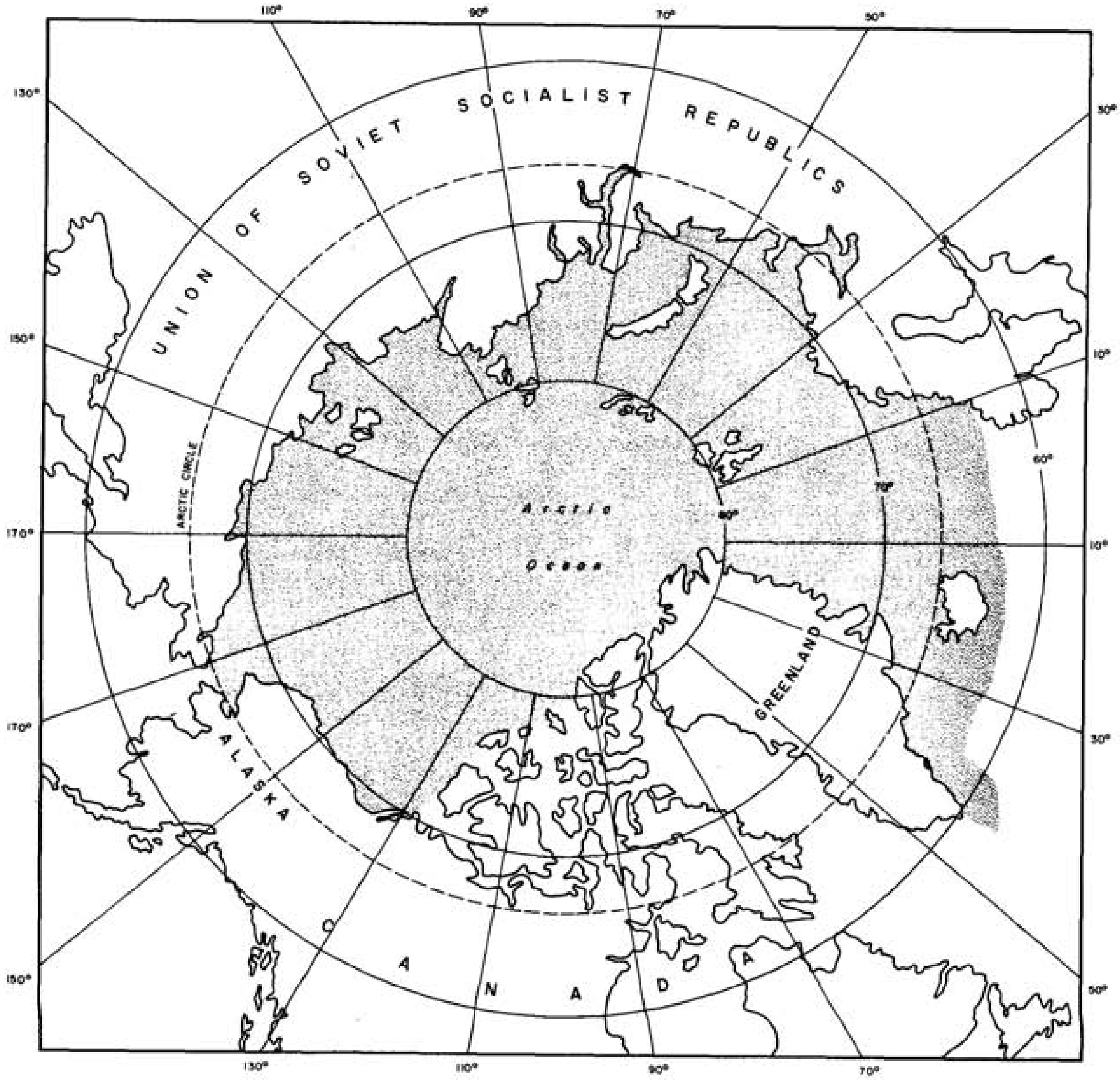

Figure 1. Shaded areas are included in the bibliography.

The citations have been divided into the ten sections described below:

A. GENERAL

Includes entire works on sea ice, terminology, bibliographies, conference proceedings, and textbooks which contain sections on sea ice.

B. MICROSCALE ICE CHARACTERISTICS

Salinity, electrical properties, dielectric permittivity, engineering aspects, ice chemistry, stress in ice, crystalline structure, ice structure, ice temperature, and some aspects of supercooling.

C. MASS BUDGETS

Mass and heat budgets of arctic ice cover, radiation budgets and albedo of ice types, and transmissivity of ice. Some articles on transfers at the air-water-ice interface are cross-referenced with Category H.

D. MESOSCALE AND MACROSCALE ICE CHARACTERISTICS

Ice surface and underside characteristics, including ridging, hummocking, surface forces, and associated ice dynamics; multiyear ice, ice islands; ice morphology; Ellesmere ice shelf.

E. ICE DRIFT

Ice drift, water drag, ice velocity, ice deformation, ocean circulation and tidal exchange, ice redistribution, air stress by winds, planetary boundary layer, and wind profiles related to ice drift, drifting stations and ice island stations.

F. FREEZEUP, ICE GROWTH, AND THICKNESS

Includes articles on the above and on the refreezing of leads (which are cross-indexed with Category G).

G. BREAKUP, LEADS, POLYNAS

Breakup of sea ice, leads, polynas; plus articles on ice decay and river outflow onto the sea ice cover.

H. THE ICE-OCEAN-ATMOSPHERE SYSTEM

Interrelationships in the ice-ocean-atmosphere system including climate-ice relationships, past climates and ice covers of the arctic. Includes many studies on ice distribution and limits, seasonal and longer term fluctuations of sea ice.

I. REMOTE SENSING

Data obtained from satellites, sonar and aircraft overflights, and ice measurements made by devices on the ice. Articles are cross-referenced with other categories if useful results are included.

J. ICE FORECASTING

Forecasting of freezeup, breakup, and other ice characteristics and limits.

Note: Modelling studies are listed in their appropriate category. References where modelling is discussed in general, with no specific research results, are placed in Category A.

Except where the citation deals mainly with one of the above subjects, the following topics have been excluded: icebergs; ice engineering; ice breakers; vehicles on ice; navigation, except where ice conditions are reported; organisms in ice; underwater sound; oil spills; action of ice on structures; ice as a geological agent; artificial growth of sea ice.

The decision to exclude particular geographic areas and subjects was made arbitrarily in order to limit the overall magnitude of the undertaking. We propose to include such topics in future bibliographies.

The bibliography has been compiled from several different sources, including the automated and manual indexing and abstracting services listed below. Many of the citations were found uniquely in one source, indicating the need for this more comprehensive literature survey.

Cold Regions Bibliography, 1965-77.

Meteorological and Geoastrophysical Abstracts, 1965-76.

Oceanic Abstracts, 1965-77.

NTIS (National Technical Information Service), 1965-77.

Polar Record, 1965-72.

Recent Polar Literature, 1973-77.

Catalog of the Scott Polar Research Institute Library, 1976; monthly accessions lists, 1977.

Journal of Glaciology ["Glaciological Literature"], 1965-77.

Arctic Bibliography, 1965-75.

Georef, 1967-July 77.

Bibliography of Geology, 1965-66.

Bibliography of Geology Exclusive of North America, 1965-66.

Scisearch (Science Citation Index), 1974-77.

Dissertation Abstracts, 1965-77.

Libcon (U.S. Library of Congress), 1968-77.

Monthly Catalog of U.S. Government Publications, 1965-77.

Books in Print, 1977.

Catalog of the Scripps Institution Library, 1970, 1973.

Miscellaneous bibliographies.

In the bibliography, we assume that the language of publication is English unless otherwise stated. Because we do not have all of the original material in hand, we cannot be certain of the completeness of each citation, although every effort possible has been made to ensure accuracy. Where keywords or phrases were provided by the sources, we have included them as guides to subject content. Since we realize that the maximum value of a bibliography lies in the availability of the original documents, we have marked each item owned by the World Data Center with an "*". Photocopies of any of these documents can be provided upon request at $0.10/page ($1.00 min.) to institutions and individuals. Lengthy publications are available on interlibrary loan to other libraries. Publications with an NTIS number are available in microfiche or photocopy form from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia, 22161, U.S.A. Prices vary according to length of the publication.

We urge you to acquire items not owned by the WDC through your regular library channels or from the publishing agency or author. However, if these methods are unsuccessful, please feel free to call or write the WDC for assistance.

If any individuals or institutions see their publications in this list without an "*", the WDC would gratefully appreciate receiving copies of the ones which are still available.

Since we plan to update the bibliography in the future, we greatly appreciate your notifying us of any errors or omissions.

Marilyn J. Shartran
Assistant Director
World Data Center A for Glaciology [Snow and Ice]

A. GENERAL

A-1
Aagaard, Knut; Coachman, L.K. (1973)
ARCTIC OCEANOGRAPHY. Oceans, v. 6(2), March/April 1973, p. 24-31. [review of the scientific and practical importance of research in arctic oceanography, of the methods used in such research and of some results of arctic oceanographic studies; oceanographic investigation methods involving the method of drifting ships, drifting ice stations or ice islands, aircraft surveys, observations from submarines, ice breakers, and automatic sensing and transmittal]

A-2
Aagaard, Knut (1975)
OCEANOGRAPHY OF THE ARCTIC SEAS. Reviews of Geophysics and Space Physics, v. 13(3), July 1975, p. 614-15. [U.S. research activities in the arctic seas briefly reviewed]

A-3 *
Abrahamson, Kurt V. (1966)
ARCTIC ENVIRONMENTAL CHANGES. Arctic Institute of North America. Research Paper no. 39, 1966. 79p. Maps, tables.

A-4
Adey, A.W. (1970)
SURVEY OF SEA-ICE-THICKNESS MEASURING TECHNIQUES. Canada. Dept. of Communications. Communications Research Centre. Report CRC-1214, 1970. 28p. NTIS: N71-14827. [ice formation, ocean surface, thickness]

A-5
ADRIFT ON ARCTIC SEAS. ESSA World, v. 4(4), Oct. 1969, p. 9-11. Map. [historical review of drift of floating ice island T-3 and outline of Weather Bureau program on T-3 since 1966]

A-6
Adrov, M.M. (1970)
K GIDROLOGII KANDALAKSHSKOI VPADINY (Hydrology of the Kandalaksha Deep). Poliarnyi Nauchno-Issledovatel'skii i Proektnyi Institut Morskogo Rybnogo Khoziaistva i Okeanografii. Trudy, v. 27, 1970, p. 101-213. 19 ref. In Russian. [ocean currents, sea ice distribution, ice formation, water transport, ice cover thickness]

A-7 *
AIDJEX BULLETIN, no. 1-37, Sept. 1970-Sept. 1977. Individual papers appear under author throughout this bibliography. Following is a list of the issues devoted to a single topic:

No. 1 (Sept. 1970). Status Report.
NTIS: AD-713 986.
No. 2 (Oct. 1970). Theoretical Discussions.
NTIS: PB-195 636.
No. 3 (Nov. 1970). Selected Soviet Research.
NTIS: PB-196 063.
No. 4 (Jan. 1971). Water Stress Studies.
NTIS: PB-220 357.
No. 5 (Feb. 1971). Remote Sensing and Ice Morphology.
No. 6 (March 1971). Ice Dynamics.
NTIS: PB-220 358.
No. 7 (April 1971). Arctic Data Buoy and Positioning Systems.
No. 8 (May 1971). 1971 Pilot Study Narratives.
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SCIENTIFIC OPERATIONS OF THE 1972 AIDJEX PILOT STUDY. AIDJEX Bulletin, no. 11, 1971, p. 25-30. [tabulated data on the 23 projects and their investigators, institutions and funding agencies]

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WORKING GROUP ON NUMERICAL MODELING AND ANALYSIS: THIRD WORKING SESSION HELD ON NOV. 13-14, 1970, AT THE UNIV. OF WASHINGTON. AIDJEX Bulletin, no. 5, 1971, p. 55-58. [air stress from pressure maps, time-dependent Ekman layer, ice acceleration, processing remote sensing data, interaction of ice strain and heat balance, mass balance equation, ice as a continuum or not, space and time scales on which strain measurements should be made, finding a constitutive law and interpretation of stress and strain data]

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NOMENKLATURA MORSKIKH L'DOV: USLOVNYE OBOZNACHENIIA DLIA LEDOVYKH KART (Sea ice nomenclature: Conventional terms used on ice maps). Leningrad, Gidrometeoizdat, 1974. 85p. Maps. In Russian and English. [over two hundred terms relating to ice are defined in Russian, their English equivalents given]

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Norina, A.M. (1968)
HYDROLOGICAL CHARACTERISTICS OF THE NORTHERN BARENTS SEA. U.S. Naval Oceanographic Office. Translation no. 373, 1968. 42p. 9 fig., 7 tables, 18 ref. NTIS: AD-669 876. (Translated from "Gidrokhimicheskaya kharakteristika severnoi chasti Barentseva morya," Gosudarstvenni Okeanograficheskii Institut. Trudy, v. 83, 1965, p. 243-271.) [seasonal variations, phytoplankton, nitrites, ice conditions]

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NEUE EISBEZEICHNUNGEN FÜR UNTERSEEBOOTFAHRTEN UNTER DEM EIS (New ice terminology for submarine trips under ice). Deutsche Hydrographische Zeitschrift, v. 17(5), April 1965, p. 236-37. Ref. In German with English and French summaries. [navigation underneath the ice cover offers problems of how to designate the subsurface ice formations from submariner's point of view]

A-199
OCEAN '74: IEEE INTERNATIONAL CONFERENCE ON ENGINEERING IN THE OCEAN ENVIRONMENT, RECORD, v. 1. Held 21-23 Aug. 1974, in Halifax, Nova Scotia. New York, Institute of Electrical and Electronic Engineers, Publication no. 74 CHO 873-0 OCC, 1975. 430p. Ref.

A-200
OCEANOGRAPHIC CRUISE USCGC NORTHWIND--CHUKCHI, EAST SIBERIAN AND LAPTEV SEAS, AUGUST-SEPTEMBER 1963. U.S. Coast Guard. Oceanographic Report no. 6, March 1965. 69p. [data, oceanography, ice meteorology, bathymetry, cruises]

A-201
OCEANOGRAPHIC DATA REPORT: D'IBERVILLE FIORD, ELLESMERE ISLAND, N.W.T.: MARCH TO APRIL 1974: AUGUST 1974. Canada. Marine Sciences Directorate. Pacific Region. Pacific Marine Science Report 75-1, Feb. 1975. 126p. [conductivity, oceanographic data, pressure variations, sea ice, sound velocity, temperature variations]

A-202
OCEANOGRAPHICAL OBSERVATIONS FROM DANISH LIGHT-VESSELS AND COASTAL STATIONS. Charlottenlund, Denmark, Danish Meteorological Institute, 1972. 151p. NTIS: N73-29386. In English and Danish. [data on surface temperatures of the North Atlantic in tabular form; salinity and current observations]

A-203
OCEANOGRAPHY. U.S. Defense Documentation Center. Report Bibliography Jan. 1969-April 1973, TAS-73-55, 1973. 405p. NTIS: AD-766 200. [selection of unclassified-unlimited distribution references]

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OCEANOGRAPHY. U.S. Defense Documentation Center. Report Bibliography Jan. 1963-June 1968, TAS-69-36-1, 1969. 645p. NTIS: AD-689 700 and AD-855 000. [two-volume bibliography includes references to marine life, ocean waves, tides, currents, properties of sea water and ice ocean-bottom topography and composition, equipment, and oceanographic vessels]

A-205
OCEANOGRAPHY/ACOUSTICS. Naval Ship Systems Command Technical News, v. 16(1), Jan. 1967, p. 42-43. 3 fig. [acoustics, sea ice, engineering sonar]

A-206
OFFSHORE TECHNOLOGY CONFERENCE, 5TH, PAPERS, v. 1. Held in Houston, Texas, 30 April-2 May 1973. 888p. Ref. [sea ice, engineering, meteorological factors, ice navigation]

A-207
Olenicoff, Sergei M. (1971)
THE SOVIET DARMS. Rand Corp. Paper P-4679, 1971. 20p. NTIS: AD-738 073. (Also in: AIDJEX Bulletin, no. 7, April 1971, p. 5-23.) [Soviet scientists have developed and deployed Drifting Automatic Radio-Meteorological Stations (DARMS) specially designed to operate and gather data in the pack-ice environment of the Arctic]

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Olenicoff, Sergei M. (1973)
THE SOVIET DARMS PROGRAM: TWENTY YEARS OF DEVELOPMENT, DEPLOYMENT, AND DATA. AIDJEX Bulletin, no. 22, 1973, p. 8-34. [describes Soviet work in Arctic Ocean since 1953 with DARMS]

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Olenicoff, Sergei M. (1968)
SOVIET DEVELOPMENT AND USE OF DRIFTING AUTOMATIC RADIOMETEOROLOGICAL STATIONS FOR ARCTIC RESEARCH. Rand Corp. Research Memorandum RM-5624-PR, May 1968. 74p. 21 fig., 6 tables, ref. NTIS: AD-669 802. [ice drift, instrumentation, meteorological measurement]

A-210 *
Olenicoff, Sergei M. (1975)
SOVIET LABORATORY FOR SEA ICE RESEARCH. Arctic Bulletin, v. 1(5), 1975, p. 208-17. 4 fig., ref. [low temperature research, artificial ice, lab techniques, ice models, ice breaking]

A-211 *
Ostenso, Ned A., ed. (1966)
PROBLEMS OF THE ARCTIC AND ANTARCTIC, no. 11. Montreal, Arctic Institute of North America, May 1966.

A-212
Paulson, Clayton A. (In press)
AIDJEX ATMOSPHERIC PROGRAM REVIEW. Presented at Symposium on Sea Ice Processes and Models, Seattle, Univ. of Washington, 6-9 Sept. 1977, sponsored by ICSI and AIDJEX.

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PERENNIAL ICE AND SNOW MASSES. UNESCO, Technical Papers in Hydrology, v. 1, 1970. 59p.

A-214
Peschanskii, I.S. (1968)
ICE SCIENCE AND TECHNOLOGY. CRREL Translation no. 117, 1968. 67p. NTIS: AD-715 026. (Translated from Ledovedeniye i Ledoteknika. Leningrad, Izdatel'stvo, revised ed., 1967, p. 134-379.) [proposed classification of the ice cover on the basis of its origin]

A-215 *
Peschanskii, I.S.; Iakovlev, G.N.; Petrov, I.G. et al (1970)
PROSPECTS AND RESULTS OF ICE RESEARCH. (In: Treshnikov, A.F., ed. Problems of the Arctic and Antarctic, v. 36-37. New Delhi, Amerind, 1970, p. 149-73. NTIS: TT72-52006.) (Translated from "Itogi i perspektivy ledoissledovatel'skikh rabot," Problemy Arktiki i Antarktiki, v. 36-37, 1970, p. 116-34.) [recent Soviet work in studying properties of floating ice]

A-216
Petrov, I.G. (1976)
IZUCHENIE L'DOV NA DREIFUISHCHIKH STANTSIIAKH (Studying ice from drift stations). Voprosy Geografii, v. 101, 1976, p. 70-86. 14 ref. In Russian. [drift stations, ocean currents, ice cover thickness, ice structure, ice composition, ice temperature, ice surface, ice air interface, heat transfer]

A-217 *
Pounder, Elton R.; Langleben, M.P. (1972)
MCGILL ICE PHYSICS GROUP ACTIVITIES. AIDJEX Bulletin, no. 14, 1972, p. 37.

A-218
Proskuriakov, B.V. (1965)
OSNOVNYE NAPRAVELENIIA NAUCHNYKH ISSLEDOVANII V SSSR V OBLASTI LEDOTERMIKI (Basic trends in ice research in the U.S.S.R.). Vsesoiuznyi Nauchno-Issledovatel'skii Institut Gidrotekhniki. Izvestiya, v. 78, 1965, p. 59-70. 44 ref. In Russian with English and French summaries. [ice thermal properties, ice jams, sea ice, ice pressure]

A-219
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THE SHIFTING WORLD OF ARCTIC SEA ICE. Science News, v. 100(5), July 1971, p. 80-81. [outlines aims of AIDJEX]

A-220
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ARCTIC BASIN RESEARCH. Naval Research Reviews, v. 19(10), 1966, p. 1-15. [oceanographic research since 1947; history of ice island drifts]

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ACROSS ARCTIC AMERICA, NARRATIVE OF THE FIFTH THULE EXPEDITION. Westport, Conn., Greenwood, 1968.

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Reed, John C.; Sater, J.E., ed. (1975)
THE COAST AND SHELF OF THE BEAUFORT SEA. Proceedings of a symposium held in San Francisco, 7-9 Jan. 1974. Arlington, Va., Arctic Institute of North America, 1975. 750p.

A-223
REPORT OF COMMITTEE A TO PLENARY ON ITEM 8: SEA ICE. (In: World Meteorological Organization. Commission for Maritime Meteorology, 5th Session. Held in Kingston, R.I., 1968. WMO, Unbound Papers, no. CMM-V/PINK 1, 1968. 14p. 3 ref.) [meteorological data, exploration, international cooperation]

A-225
Roots, E.F. (1976)
DATA AVAILABILITY FROM THE ARCTIC ICE DYNAMICS JOINT EXPERIMENT (AIDJEX). Canadian Geophysical Bulletin, v. 29, 1976, p. vii-xi. [describes what is available in the data bank and how it may be obtained]

A-226*
Sackinger, William M. (1977)
ARCTIC COASTAL RESEARCH ON SEA ICE AND OFFSHORE PERMAFROST. Arctic Bulletin, v. 2(10), 1977, p. 169-76. 35 ref. [ice mechanics]

A-227
Samoilenko, Vladimir (1966)
ENERGY FROM THE ARCTIC. Discovery, v. 25(6), June 1966, p. 17-20. 3 fig., map. [weather, energy, ice elimination, heat balance, theoretical]

A-228*
Santeford, Henry S.; Smith, J.L., comp. (1974)
ADVANCED CONCEPTS AND TECHNIQUES IN THE STUDY OF SNOW AND ICE RESOURCES: An Interdisciplinary Symposium Held at Monterey, Calif., 2-6 Dec. 1973. Washington, D.C., National Academy of Sciences, 1974. 789p. NTIS: AD-787 130. [information needs and distinguishing characteristics, information systems, radar techniques, remote sensing techniques, nuclear techniques, and miscellaneous techniques]

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Sater, J.E. (1969)
THE ARCTIC BASIN. Washington, D.C., Arctic Institute of North America, 1969. 337p.

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Sater, J.E., ed. (1968)
ARCTIC DRIFTING STATIONS: A Report on Activities Supported by the Office of Naval Research. Proceedings of a symposium held 12-15 April 1966 in Warrenton, Va. Washington, D.C., Arctic Institute of North America, 1968. 475p. [sea ice islands, drift stations, logistics, atmospheric physics]

A-231
Sater, J.E. (1974)
BEAUFORT SEA SYMPOSIUM REPORT. Coastal Research Notes, v. 4(2), 1974, p. 1-3.

A-232
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NAVAL SURFACE SHIP ARCTIC MISSIONS, V. 3: ENVIRONMENT OF THE ARCTIC OCEAN AND THE RIMLAND. Arctic Institute of North America. Technical Report TR-N3001, Appendix B, 1970. 326p. NTIS: AD-716 416. [sea ice, ocean currents, climatology, geology of Arctic Ocean and coastal areas]

A-233*
Schwarz, J. (In press)
NEW DEVELOPMENTS IN MODELING ICE PROBLEMS. Presented at International Conference on Port and Ocean Engineering under Arctic Conditions, 4th, Memorial Univ. of Newfoundland, 26-30 Sept. 1977.

A-234
SCIENTIFIC PLAN FOR THE PROPOSED NANSEN DRIFT STATION. Washington, D.C., National Academy of Sciences, 1976. 247p. [drift stations, sea ice, ice physics]

A-235
SEA ICE. (In: World Meteorological Organization. Commission for Maritime Meteorology, 5th Session. Held in Kingston, R.I., 1968. WMO, Unbound Papers, no. CMM-V/DOC. 7, 1968. 6p. 2 ref.

A-236
SEA ICE: REESTABLISHMENT OF THE WORKING GROUP ON SEA ICE. (In: World Meteorological Organization. Commission for Maritime Meteorology, 5th Session. Held in Kingston, R.I., 1968. WMO, Unbound Papers, CMM-V/DOC. 38, 1968. 5p. 7 ref.

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Sergin, S.Ia. (1974)
GEOFIZICHESKIE ISSLEDOVANIIA PLANETARNOI MODELI SISTEMY "LEDNIKI-OKEAN-ATMOSFERA." Vladivostok, 1974. 196p. In Russian with English summaries.

A-238
Shamont'ev, V.A.; Tsurikov, V.L. (1973)
PROBLEMY MORSKOGO LEDOVEDENIIA. KONFERENTSIIA V LENINGRADE (Problems in studying sea ice. Conference in Leningrad). Akademiya Nauk SSSR. Vestnik, no. 10, Oct. 1973, p. 108-110. In Russian. [arctic sea ice, ice forecasting, aerial reconnaissance, drifting, navigating chemistry, ice cover dynamics, operation of drift stations]

A-239
Shoemaker, B.H. (1976)
SHIPS OF ICE. U.S. Naval Institute. Proceedings, v. 102(2), Feb. 1976, p. 103-06. [pack ice, history, drift stations]

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Shpaikher, A.O. (1966)
LEDOVYY ATLAS KANADSKOY ARKTIKI (Ice atlas of the Canadian Arctic). Problemy Arktiki i Antarktiki, v. 23, 1966, p. 50-51. In Russian. [review of C.W.M. Swithinbank's atlas published in 1960]

A-241*
Shpaikher, A.O. (1973)
U.S. NAVAL ARCTIC RESEARCH LABORATORY IN ALASKA. (In: Treshnikov, A.F., ed. Problems of the Arctic and the Antarctic, v. 40. Jerusalem, Israel Program for Scientific Translations, 1973, p. 132-33. 3 ref. NTIS: TT72-50089.) (Translated from "Arkticheskaia Nauchno-Issledovatel'skaia laboratoriia VMF S.Sh.A. na Aliaske," Problemy Arktiki i Antarktiki, v. 40, 1972, p. 131-32. 3 ref.) [drift stations, oceanography, aerial reconnaissance]

A-242*
Slessers, Martin A. (1970)
LIST OF TRANSLATIONS. Washington, D.C., U.S. Naval Oceanographic Office, Supplement no. 1, 1970. 32p. NTIS: AD-714 912. [supplement to Naval Oceanographic Office's List of Translations from 1 July 1968 to 1 Nov. 1970]

A-243
Smith, Willard J. (1966)
INTERNATIONAL ICE PATROL. Sperryscope, v. 17(5), 1966, p. 1-4. 5 fig.

A-244
Smith, Willard J. (1968)
INTERNATIONAL ICE PATROL. Oceanology International, v. 3(4), June 1968, p. 37. 1 fig.

A-245
Staib, Bjørn O. (1966)
ARCTIC JOURNEY. Explorers Journal, v. 44(3), 1966, p. 188-99. [attempt to cross Arctic Ocean by dog sledge, which ended at Arlis II in 1964]

A-246
Stateman, Murray J. (In press)
AIDJEX DATA BANK. Presented at Symposium on Sea Ice Processes and Models, Seattle, Univ. of Washington, 6-9 Sept. 1977, sponsored by ICSI and AIDJEX.

A-247 *
Stateman, Murray J. (1977)
DATA AVAILABLE FROM AIDJEX AS OF 1 MAY 1977. AIDJEX Bulletin, no. 36, 1977, p. 203-10. [lists data files and explains how data may be obtained]

A-248 *
Stateman, Murray J. (1974)
ERTS-1 IMAGERY ACQUIRED BY THE AIDJEX BANK. AIDJEX Bulletin, no. 25, 1974, p. 29-48. 10 fig. [set of 628 photographs of Beaufort Sea, March-Sept. 1973; describes method of cataloging, indexing, displaying and analyzing these to study ice concentration and movement]

A-249 *
STATION POSITIONS, AZIMUTHS, WEATHER 1972 AIDJEX PILOT STUDY-PRELIMINARY DATA. AIDJEX Bulletin, no. 14, 1972, p. 63-69.

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Stewart, R.W. (1965)
RECOMMENDATIONS OF THE PANEL ON CURRENTS. (In: Oceanography from Space: Proceedings of Conference on the Feasibility of Conducting Oceanographic Explorations from Aircraft, Manned Orbital and Lunar Laboratories. Held at Woods Hole, Mass., 24-28 Aug. 1964, April 1965, p. 19-20.) [surface, sea level, mapping, communication, satellites]

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Storrs, A.H.G.; Pullen, T.C. (1970)
S.S. MANHATTAN IN ARCTIC WATERS. Canadian Geographical Journal, v. 80(5), 1970, p. 166-81. Map. [defines first-year and multiyear ice]

A-252 *
Stringer, J.R. (1976)
FEDERAL ARCTIC RESEARCH: FISCAL 1975 REPORT OF THE INTERAGENCY ARCTIC RESEARCH COORDINATING COMMITTEE. Arctic Bulletin, v. 2(8), 1976, p. 41-124.

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SYMPOSIUM ON BENEFICIAL MODIFICATIONS OF THE MARINE ENVIRONMENT, PROCEEDINGS. Washington, D.C., National Academy of Sciences, 1972. 116p. Ref.

A-254 *
SYMPOSIUM ON DRIFT ICE AND CLIMATE, REYKJAVIK 1969: LECTURES AND DISCUSSION. Jökull, v. 19, 1969. 160p. Graphs, maps, tables. [presents an abridged version, in English, of 21 of the 30 papers given at the symposium, 27 Jan.-17 Feb. 1969]

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SYMPOSIUM ON REMOTE SENSING IN THE POLAR REGIONS. Held at Easton, Md., 6-8 March 1968. Washington, D.C., Arctic Institute of North America, 1968. 70p. NTIS: AD-682 240. [symposium was designed to foster an exchange of ideas between the users and potential users of remote sensing, and instrumentation and interpretation specialists]

A-256
SYMPOSIUM ON SEA ICE PROCESSES AND MODELS. Held at Seattle, Univ. of Washington, 6-9 Sept. 1977, sponsored by International Commission on Snow and Ice (ICSI) and Arctic Ice Dynamics Joint Experiment (AIDJEX). In press.

A-257
Thomsen, H. (1972)
MARITIM METEOROLOGI OG FYSISK OCEANOGRAFI. (In: Denmark. Dansk Meteorologisk Institut. Meteorologisk Institut Gennem Hundrede År, 1872-1972. Kobenhavn, 1972, p. 165-98.) In Danish with English summary. [meteorological and oceanographical work in the North Atlantic since 1879, including ice observations in Greenland waters]

A-258 *
Thorndike, Alan S.; Cheung, J.Y. (1977)
AIDJEX MEASUREMENTS OF SEA ICE MOTION 11 APRIL TO 14 MAY 1976. AIDJEX Bulletin, no. 35, 1977. 149p.

A-259
Tolstikov, Evgeni (1968)
DRIFTING OVER THE ARCTIC. Geographical Magazine, v. 40(12), April 1968, p. 1058-63. 6 fig. [account of Soviet drifting stations in Arctic]

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Treshnikov, A.F.; Borisenkov, E.P.; Volkov, N.A. et al (1973)
THE AMERICAN "ARCTIC ICE DYNAMICS JOINT EXPERIMENT" PROJECT. (In: Treshnikov, A.F., ed. Problems of the Arctic and Antarctic, v. 38. New Delhi, Amerind, 1973, p. 9-18. 20 ref. NTIS: TT72-52007.) (Also in: AIDJEX Bulletin, no. 11, Nov. 1971, p. 11-22.) (Translated from "Ob amerikanskom proyekte "Ob" yedinennyy eksperiment po izucheniyu dinamiki arkticheskikh l'dov," Problemy Arktiki i Antarktiki, v. 38, 1971, p. 14-21.)

A-261
Treshnikov, A.F., ed. (1965)
DVENADTSAT' PODVIGOV (Twelve exploits). Leningrad, Izdatelstvo Gidrometeorologicheskoe, 1965. 321p. Ref. In Russian. [Soviet drifting station accounts from 1937]

A-262
Treshnikov, A.F. (1967)
IZUCHENIE SOVETSKOĬ ARKTIKI (Study of Soviet Arctic). (In: Fedorov, E.K., ed. Meteorologiia i Gidrologiia za 50 Let Sovetskoi Vlasti, Sbornik Statei. Leningrad, Gidrometeoizdat, 1967, p. 173-186. Photo.) In Russian. [history of Soviet research on the Arctic since 1918 in the fields of hydrography, meteorology, hydrology, and oceanography]

A-263 *
Treshnikov, A.F. (1966)
NAUCHNE ISSLEDOVANIIA V ARKTIKE I ANTARKTIKE V 1965 G. (Scientific investigations in the Arctic and Antarctic in 1965). Problemy Arktiki i Antarktiki, v. 24, 1966, p. 5-10. In Russian.

A-264
Treshnikov, A.F. (1972)
OCEANOLOGICAL INVESTIGATIONS IN THE ARCTIC AND ANTARCTIC DURING THE SOVIET REGIME. Oceanology, v. 11(5), May 1972, p. 684-89. (Translated from Okeanologiya, v. 11(5), 1972.)

A-265 *
Treshnikov, A.F., ed. (1970)
PROBLEMS OF THE ARCTIC AND ANTARCTIC, V. 29-32. Jerusalem, Israel Program for Scientific Translations, 1970. 536p. NTIS: TT70-50017. (Translated from Problemy Arktiki i Antarktiki, v. 29-32, 1968-69.) [arctic climate, sea ice, ice navigation, polar regions]

A-266 *
Treshnikov, A.F., ed. (1973)
PROBLEMS OF THE ARCTIC AND ANTARCTIC, V. 33-35. Jerusalem, Israel Program for Scientific Translations, 1973. 403p. NTIS: TT72-50006. (Translated from Problemy Arktiki i Antarktiki, v. 33-35, 1970.)

A-267 *
Treshnikov, A.F., ed. (1973)
PROBLEMS OF THE ARCTIC AND ANTARCTIC, V. 36-37. New Delhi, Amerind, 1973. 327p. Fig., tables, ref. NTIS: TT72-52006. (Translated from Problemy Arktiki i Antarktiki, v. 36-37, 1970.)

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Treshnikov, A.F., ed. (1973)
PROBLEMS OF THE ARCTIC AND ANTARCTIC, V. 38. New Delhi, Amerind, 1973. 187p. NTIS: TT72-52007. (Translated from Problemy Arktiki i Antarktiki, v. 38, 1971.) [climate, sea ice, meteorology]

A-269 *
Treshnikov, A.F., ed. (1973)
PROBLEMS OF THE ARCTIC AND ANTARCTIC, V. 40. Jerusalem, Israel Program for Scientific Translations, 1973. 447p. NTIS: TT72-50089. (Translated from Problemy Arktiki i Antarktiki, v. 40, 1972.)

A-270 *
Treshnikov, A.F., ed. (1975)
PROBLEMS OF THE ARCTIC AND ANTARCTIC, V. 41. New Delhi, Amerind, 1975. 152p. Fig., tables, ref. NTIS: TT74-52009. (Translated from Problemy Arktiki i Antarktiki, v. 41, 1973.)

A-271 *
Treshnikov, A.F., ed. (1976)
PROBLEMS OF THE ARCTIC AND ANTARCTIC, V. 42. New Delhi, Amerind, 1976. 138p. NTIS: TT75-52018 and PB-261 149T. (Translated from Problemy Arktiki i Antarktiki, v. 42, 1973.)

A-272
Treshnikov, A.F. (1976)
RECENT SOVIET RESEARCH IN THE ARCTIC. Alaska. Univ. Institute of Marine Science. Occasional Publication no. 4, 1976, p. 55-59. 1 ref. [ice breaking, meteorology]

A-273
Treshnikov, A.F. (1972)
SOVETSKIYE ISSLEDOVANIYA V ARKTIKE (Soviet investigations in the Arctic). Akademiya Nauk SSSR. Izvestiya. Seriya Geograficheskaya, no. 3, May/June 1972, p. 26-37. In Russian. [history of Soviet investigations in the Arctic, which began on July 2, 1918]

A-274
Treshnikov, A.F. (1965)
SOVIET RESEARCH IN THE ARCTIC. WMO Bulletin, v. 14(1), 1965, p. 15-18. [summary of meteorological and oceanographical work in recent years, including observations from drifting stations and studies of ice cover and ice movement]

A-275
Trowbridge, R. (1976)
THE ARCTIC ICE DYNAMICS JOINT EXPERIMENT (AIDJEX). Naval Research Reviews, v. 29(5), 1976, p. 8-17. [describes development and aims of experiment]

A-276
Tsurikov, V.L. (1966)
K VOPROSU O MEZHDUNARODNOY LEDOVOY NOMENKLATURE (On an international ice nomenclature). Okeanologiya, v. 6(2), 1966, p. 372-78. In Russian. [discussion of Canadian proposals to amend WMO sea ice nomenclature]

A-277
Tsurikov, V.L. (1971)
MORSKIYE L'DY (Sea ice). Itogi Nauki. Geofizika. Okeanologiya, no. 1, 1971, p. 89-107. 104 ref. In Russian. [methods of observation of sea ice, its seasonal distribution and its properties]

A-278
Tsurikov, V.L. (1969)
SCIENTIFIC CONFERENCE ON SEA ICE. Oceanology, v. 8(6), Sept. 1969, p. 859-62. (Translated from Okeanologiya, v. 8(6), 1968.)

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Uda, M., ed. (1971)
OCEAN WORLD: PROCEEDINGS OF THE ASSEMBLY. Joint Oceanographic Assembly, IAPSO, IABO, CMG, SCOR. Held 13-25 Sept. 1970, Tokyo, Japan. Tokyo, Japan Society for the Promotion of Science, Dec. 1971. 562p. [ice formation, pack ice]

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Underwood, Dorothy (1975)
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INTERNATIONAL ICE PATROL, 1966. Marine Observer, v. 37(216), April 1967, p. 71-74.

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Wells, R.D. (1966)
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A-317
Wilimovsky, N.J.; Wolfe, J.N., ed. (1966)
ENVIRONMENT OF THE CAPE THOMPSON REGION, ALASKA. U.S. Committee on Environmental Studies for Project Chariot. Oak Ridge, Tennessee, U.S. Atomic Energy Commission, Division of Technical Information, 1966. 1250p. [bioenvironment, engineering geology, patterned ground, drill core analysis, slope processes, frost heave, soil classification, sea ice, oceanography, radioactivity]

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Williams, G.P. (1972)
SUMMARY OF CURRENT RESEARCH ON SNOW AND ICE IN CANADA. Canada. National Research Council. Associate Committee on Geotechnical Research. Technical Memorandum no. 106, 1972. 30p.

A-319*
Wittmann, Walter I. (1972)
NAVOCEANO FIELD PARTICIPATION. AIDJEX Bulletin, no. 14, 1972, p. 22-23.

A-320
WMO ISNOMENKLATUR. DANSK UDGAVE (The WMO sea ice nomenclature. Danish edition). Dansk Meteorologisk Institut. Meddelelser, no. 22, 1969. 29p. NTIS: N71-22544. In Danish with English summary.

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REPORT OF THE FIRST SESSION OF THE WORKING GROUP ON SEA ICE OF THE COMMISSION FOR MARITIME METEOROLOGY. Geneva, World Meteorological Organization, 1967. 62p. [proposals for ice nomenclature, symbols, and codes, made at meeting, 18-23 Sept. 1967, Geneva]

A-322
World Meteorological Organization (1967)
WMO-SCAR-ICDM SYMPOSIUM ON POLAR METEOROLOGY. World Meteorological Organization, 1967.

A-323*
World Meteorological Organization (1970)
WMO SEA ICE NOMENCLATURE. World Meteorological Organization. Technical Publication no. 145, 1970. 152p.

A-324*
Yakovlev, G.N., ed. (1973)
STUDIES IN ICE PHYSICS AND ICE ENGINEERING, v. 300. Jerusalem, Israel Program for Scientific Translations, 1973. 192p. NTIS: TT72-50005. (Translated from Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 300, 1971.) [ice physics, ice navigation, ice reporting, ice forecasting, ice cover thickness, ice cover strength, snow cover effect]

A-325
Zavatti, Silvio (1966)
LA NOMENCLATURA ITALIANA PER I GHIACCI DI MARE. Il Polo, v. 12(1-4), Jan.-Dec. 1966, p. 1-5. In Italian, English and German.

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H-1, H-45, H-66, H-76, H-80, H-86, H-159

I-7, I-12, I-19, I-22, I-115, I-116, I-183, I-275, I-343, I-386.

B. MICROSCALE ICE CHARACTERISTICS

B-1 *
Addison, J.R. (1969)
ELECTRICAL PROPERTIES OF SALINE ICE. Journal of Applied Physics, v. 40(8), 1969, p. 3105-14. NTIS: AD-704 269. [study of complex dielectric permittivity of artificial sea ice as a function of frequency, temperature and salinity]

B-2
Addison, J.R. (1967)
ELECTRICAL PROPERTIES OF SALINE ICE. Montreal, McGill Univ., 1967. Ph.D. thesis.

B-3 *
Addison, J.R.; Pounder, Elton R. (1967)
THE ELECTRICAL PROPERTIES OF SALINE ICE. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967, p. 649-60. NTIS: AD-704 268.) [measurements of dielectric constant and resistivity of laboratory-grown saline ice from 20 Hz to 10 Khz and various salinities]

B-4
Addison, J.R. (1975)
ELECTRICAL PROPERTIES OF SALINE ICE AT 1 KHZ, DOWN TO -150 C. Journal of Applied Physics, v. 46, 1975, p. 513-22.

B-5
Addison, J.R. (1970)
ELECTRICAL RELAXATION IN SALINE ICE. Journal of Applied Physics, v. 41(1), 1970, p. 54-63. NTIS: AD-705 788. [frequency dispersion of dielectric coefficient used to determine spectrum of relaxation times which is interpreted in terms of properties of ice and brine]

B-6 *
Addison, J.R. (1977)
IMPURITY CONCENTRATIONS IN SEA ICE. Journal of Glaciology, v. 18(78), 1977, p. 117-27. 26 ref. In English with French and German summaries. [impurities, ice composition, ion density (concentration)]

B-7
Addison, J.R.; Stalinski, P.; Pounder, Elton R. (1974)
STUDIES ON THE ELECTRICAL PROPERTIES OF SALINE ICE: FINAL REPORT. Montreal, McGill Univ. Macdonald Physics Laboratory, Ice Research Project, 1974. 69p. 47 ref. NTIS: AD-780 463/6. [presents results of measurements of electrical properties at 1 Khz at temperatures down to -150°C and at UHF and microwave frequencies]

B-8
Afanas'ev, V.P. (1971)
DIMENSIONAL FACTOR AND ITS INFLUENCE UPON DETERMINATION OF THE COMPRESSIVE STRENGTH OF ICE. Hydrotechnical Construction, no. 11, 1971, p. 1046-49. 8 ref. (Translated from Gidrotekhnicheskoe Stroitel'stvo, Nov. 1970.) [compressive strength, tests, laboratory techniques]

B-9 *
Allan, A.J.; Bilham, R.G.; Goodman, D.J. (1975)
WIRE STRAINMETERS ON ICE. Nature, v. 255(5503), May 1975, p. 45-46. [creep processes, wire strainmeter, glaciers, ice forces, measuring instruments]

B-10 *
Aota, Masaaki; Tabata, Tadashi; Ishikawa, M. (1976)
HOKKYOKU-KEN KAIHYŌ CHŌSA, 2: ASSHUKU KYŌDO, ŌRYOKU KANWA NO SOKUTEĪ (Arctic sea ice research, Part 2: Measurement of compressive strength and relaxation of stress). Teion Kagaku, Series A, no. 34, 1976, p. 209-20. 6 ref. In Japanese with English summary. [ice cover strength, compressive strength, relaxation (mechanics), temperature effects]

B-11
Appel', I.L.; Gudkovich, Z.M.; Frolov, I.E. (1976)
O SILAKH SZHATIIA I VNUTRENNEGO SOPROTIVLENIIA V LEDIANOM POKROVE PRI NAZHIMNOM DREIFE (Compression strength and internal resistance in ice cover during pressure drift). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 320, 1976, p. 153-60. 12 ref. In Russian. [ice cover strength, compressive strength, ice deformation, drift, rheology]

B-12
ARCTIC BASIN. Washington, D.C., Arctic Institute of North America, revised edition, 1969. 337p. Ref. [ice physics, sea ice, permafrost distribution, permafrost structure, cold weather construction]

B-13
Arikainen, A.I. (1976)
SOLENOST' I TEPLOVOE SOSTOIANIE BERINGOVOMORSKIKH VOD KAK POKAZATELI STEPENI RAZVITIIA CHUKOTSKOI ZAPRIPAINOI PROGALINY V IIUNE (Salinity and thermal state of Bering Sea water as indicators of the extent of ice-free beaches in the Chukchi Sea in June). Problemy Arktiki i Antarktiki, v. 48, 1976, p. 64-69. 16 ref. In Russian. [polynyas, sea ice distribution, ice forecasting, water temperature, sea water, salinity]

B-14
Ashton, George D. (1974)
HYDRAULIC ROUGHNESS OF ICE COVERS. American Society of Civil Engineers. Proceedings. Journal of the Hydraulics Division, v. 100(HY2), Feb. 1974, p. 321-23. 2 ref. [ice water interface, heat transfer, ice bottom surface, ice structure, floating ice, ice friction]

B-15 *
Assur, Andrew (1967)
FLEXURAL AND OTHER PROPERTIES OF SEA ICE SHEETS. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, Part 1. Sapporo, Institute of Low Temperature Science, 1967, p. 557-67. 5 ref.) [outlines mathematical treatment of composite properties of sea ice to permit computer or nomogram methods of predicting properties to be developed]

B-16 *
Assur, Andrew (1972)
ICE ENGINEERING IN THE AMERICAN EXPERIENCE. (In: I.A.H.R. Symposium on Ice and Its Action on Hydraulic Structures, 2nd, Proceedings, v. 1. Held in Leningrad 26-29 Sept. 1972. Leningrad, International Assn. for Hydraulic Research, 1972, p. 81-82.) [brief outline of current studies on floating ice (fresh and sea)]

B-17 *
Assur, Andrew (1976)
SEA ICE ENGINEERING. (In: International Conference on Port and Ocean Engineering under Arctic Conditions, 3rd, Proceedings. Held 11-15 Aug. 1975, Fairbanks, Alaska. Institute of Marine Science, Univ. of Alaska, 1976, p. 231-34.) [vertical and horizontal forces, icebreaking ships, pressure ridges, ice erosion and scouring, icebergs, ice islands, modeling]

B-18
Beliakov, L.N. (1974)
GIDROMEKHANICHESKIYE OSOBENNOSTI PODLEDNOGO SLOYA (PO EKSPERIMENTAL'NYM DANNYM) (Hydromechanical features of the sub-ice layer (from experimental data)). Problemy Arktiki i Antarktiki, v. 43-44, 1974, p. 147-52. In Russian.

B-19
Belysheva, E.V. (1976)
SOLEVOY SOSTAV VOD V ARKTICHESKOM BASSEYNE I YEGO VLIYANIYE NA SOLENOST' MORSKOGO L'DA (Salt content of water in the Arctic Basin and its influence on salinity of sea ice). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 331, 1976, p. 157-65. 5 ref. In Russian. [ice salinity, ice formation, ion density (concentration)]

B-20 *
Bennington, Kenneth O. (1968)
CRYSTAL AND BRINE RELATIONSHIPS IN SEA ICE. (In: Sater, J.E., ed. Arctic Drifting Stations: A Report on Activities Supported by the Office of Naval Research. Proceedings of a symposium held 12-15 April 1966 in Warrenton, Va. Washington, D.C., Arctic Institute of North America, 1968, p. 181-87. 11 ref. NTIS: AD-685 573.) (Also Washington. Univ. Dept. of Atmospheric Sciences. Contribution no. 142 and its Technical Report no. 39, 1969.)

B-21 *
Bennington, Kenneth O. (1967)
DESALINATION FEATURES IN NATURAL SEA ICE. Journal of Glaciology, v. 6(48), 1967, p. 845-57. NTIS: AD-663 611. (Also Washington. Univ. Dept. of Atmospheric Sciences. Technical Report no. 30 and its Contribution no. 146, 1967.)

B-22 *
Berger, R.H.; Marshall, S.J.; Munis, R.H. et al (1975)
HOLOGRAPHIC TECHNIQUE FOR MEASUREMENTS OF STRAIN. CRREL Special Report no. 227, 1975. 325p. NTIS: AD-A011 247.

B-23
Bernard, R. (1965)
PENETRATION STUDIES OF ICE WITH APPLICATION TO ARCTIC AND SUBARCTIC WARFARE. Stanford Research Institute. Report, Nov. 1965. 41p. 9 ref. NTIS: AD-630 122. [floating ice, ice cover thickness, ice temperature]

B-24
Biewer, F.N.; Grinius, V.G.; Hammett, D.S. (1973)
ICE MODEL TESTING. (In: Offshore Technology Conference, 5th, Papers, v. 1. Held in Houston, Texas, 30 April-2 May 1973, p. I/757-62. 8 ref. OTC Paper no. 1812.) [ice models, sea ice, ice mechanics, ice elasticity]

B-25
Biggs, Albert W. (1975)
VOLUME SCATTERING FROM ICE AND WATER IN INHOMOGENEOUS TERRAIN. (In: AGARD Conference Proceedings, no. 144. Neuilly sur Seine, North Atlantic Treaty Organization, Advisory Group for Aerospace Research and Development, 1975, p. 16-1 to 16-13.)

B-26
Biggs, Albert W. (1970)
VOLUME SCATTERING FROM SEA ICE AND GLACIER SNOW. Kansas. Univ. Technical Report no. 137-2, 1970. 46p. NTIS: AD-A021 393. [physical properties of sea ice and dielectric properties of glacier snow described in terms of dielectric mixtures and the relaxation spectra of water at microwave frequencies]

B-27
Blinov, L.K. (1968)
SALT CONTENT OF SEAWATER AND ICE. U.S. Naval Oceanographic Office. Translation no. 370, 1968. 66p. (Also Marine Hydrochemistry. Hanover, N.H., CRREL, 1970. NTIS: AD-711 925.) (Translated from Gosudarstvennyi Okeanograficheskii Institut. Trudy, v. 83, 1965, p. 5-55.) [discusses the salt composition of ocean waters, salinity in sea ice in relation to processes of phase transitions; formation of ice from sea water as a complex solution]

B-28
Bogorodskii, V.V.; Smirnov, G.E.; Smirnov, S.A. (1975)
ACOUSTICAL PROPERTIES OF SEA ICE IN ULTRASONIC FREQUENCY RANGE. (In: Ocean '74: IEEE International Conference on Engineering in the Ocean Environment, Record, v. 1. Held 21-23 Aug. 1974, in Halifax, Nova Scotia. New York, Institute of Electrical and Electronic Engineers, 1975, p. 121-24. 5 ref.) [ice acoustics, sea ice, ultrasonic tests, elastic waves, absorption]

B-29
Bogorodskii, V.V.; Gavrilo, V.P.; Gusev, A.V. (1974)
AKUSTICHESKI EFFEKTY PRI TRENII L'DA (Acoustic effects of ice friction). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 324, 1974, p. 97-103. 12 ref. In Russian. [sea ice, drift, ice floes, ice friction, ice breakup, noise (sound), acoustic measuring instruments]

B-30
Bogorodskii, V.V.; Gusev, A.V. (1968)
AMBIENT NOISE UNDER ICE. REVIEW. Akusticheskii Zhurnal, v. 14(2), April-June 1968, p. 153-62. 9 fig., 16 ref. In Russian.

B-31 *
Bogorodskii, V.V.; Smirnov, G.E.; Smirnov, S.A. (1976)
ATTENUATION AND SCATTERING OF SOUND WAVES BY SEA ICE. CRREL Translation no. 539, Aug. 1976, p. 126-32. 4 ref. NTIS: AD-A030 818.

B-32
Bogorodskii, V.V.; Gusev, A.V. (1973)
ATTENUATION OF SOUND IN ICE IN THE FREQUENCY RANGE 200-1100 KHZ. Soviet Physics. Acoustics, v. 19(2), Sept.-Oct. 1973, p. 97-100. (Translated from Akusticheskii Zhurnal, 1973.)

B-33
Bogorodskii, V.V.; Tripol'nikov, V.P. (1974)
O KONTRASTE ELEKTROMAGNITNYKH KHARAKTERISTIK NA GRANITSE MORSKOY LED-VODA (Contrast of electromagnetic characteristics of the sea-ice-water boundary). Zhurnal Tekhnicheskoy Fiziki, v. 44(4), 1974, p. 835-38. In Russian. [observations on pack ice and one-year ice]

B-34
Bogorodskii, V.V.; Khokhlov, G.P. (1969)
ELEKTRICHESKIE KHARAKTERISTIKI DREIFUIUSHCHEGO ARKTICHESKOGO L'DA V DIAPAZONE CHASTOT 100 GTS-1 MGTS. (Electrical properties of drifting arctic ice in the frequency range of 100-1 MHz). Akademiya Nauk SSSR. Doklady. Seriya Matematika, Fizika, v. 189(1/6), 1969, p. 1230-32. Ref. In Russian.

B-35
Bogorodskii, V.V.; Tripol'nikov, V.P. (1973)
ELEKTORMAGNITNYYE KHARAKTERISTIKI MORSKOGO L'DA V DIAPAZONE 30-400 MGTS (Electromagnetic characteristics of sea ice in the 30-400 MHz range). Akademiya Nauk SSSR. Doklady. Seriya Matematika, Fizika, v. 213(1/3), 1973, p. 577-79. In Russian.

B-36
Bogorodskii, V.V.; Gaitskhoki, B.Ia.; Tripolnikov, V.I. (1973)
ELECTROMAGNETIC AND OPTIC CHARACTERISTICS OF SEA ICE. (In: Orvig, Svenn, ed. Energy Fluxes over Polar Surfaces. Proceedings of the IAMAP/IAPSO/SCAR/WMO symposium held in Moscow, 3-5 Aug. 1971. Geneva, World Meteorological Organization, 1973, p. 281-99.) [discusses remote methods of measuring thickness of drifting sea ice]

B-37*
Bogorodskii, V.V.; Koslov, A.I.; Tuchkov, L.T. (1976)
EMISSIVITY OF ICE, TERRESTRIAL, AND SEA SURFACES MODELED BY STRATIFIED HETEROGENEOUS STRUCTURES. CRREL Translation no. 539, Aug. 1976, p. 29-35. 14 ref. NTIS: AD-A030 818. (Translated from "Izluchatel'naia sposobnost' ledianykh, zemnykh i morskikh poverkhnostei, modeliruemykh sloisto-neodnorodnymi strukturami," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 326, 1975, p. 32-38.)

B-38
Bogorodskii, V.V.; Gavrilo, V.P. (1974)
FIZICHESKIE METODY ISSLEDOVANIIA NAPRIAZHENNOGO SOSTOIANIIA LEDIANOGO POKROVA (Physical methods of studying stresses in pack ice). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 316, 1974, p. 59-69. 26 ref. In Russian.

B-39
Bogorodskii, V.V.; Khokhlov, G.P. (1971)
INTERLAYER POLARIZATION IN ICE WITH NaCl INCLUSIONS. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 88-91. 5 ref. NTIS: TT70-50158. (Translated from "Mezhduslоinaia poliarizatsiia vo l'du soderzhaschem vkliuchenii a NaCl," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 103-07.)

B-40
Bogorodskii, V.V.; Khokhlov, G.P. (1974)
INTERPRETATSIIA EKSPERIMENTAL'NYKH DANNYKH PRI IZMERENII NEODNORODNYKH OBRAZTSOV MORSKOGO L'DA V SANTIMETROVOM DIAPAZONE (Experimental data interpretation in measuring inhomogeneous samples of sea ice in the microwave range). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 324, 1974, p. 28-32. In Russian.

B-41
Bogorodskii, V.V.; Galkin, E.I. (1966)
INVESTIGATION OF THE INTERNAL FRICTION OF ICE SLABS WITH A LAYER OF SNOW DURING FLEXURAL VIBRATIONS. Soviet Physics. Acoustics, v. 12(4), 1967, p. 360-63. (Translated from "Issledovaniye vnutrennego tremya plastin l'da so sloyem pri izgibnykh kolebaniyakh," Akusticheskii Zhurnal, v. 12(4), 1966, p. 411-15.) [investigations on slabs frozen in a tank of water in the laboratory]

B-42
Bogorodskii, V.V.; Khokhlov, G.P. (1974)
ISSLEDOVANIE ELEKTRICHESKIKH SVOISTV MORSKOGO L'DA SETCHATYMI KONDENSATORAMI (Grid capacitors for studying electrical properties of sea ice). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 324, 1974, p. 46-49. 6 ref. In Russian.

B-43
Bogorodskii, V.V.; Khokhlov, G.P. (1971)
MEASUREMENTS OF THE PERMITTIVITY AND CONDUCTIVITY OF SEA ICE WITHOUT CONTACT ELECTRODES. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 71-75. 4 ref. NTIS: TT70-50158. (Translated from "Analiz beskontaktnogo metoda izmereniia dielektricheskoi pronitsaemosti i provodimosti morskogo l'da," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 83-88.)

B-44
Bogorodskii, V.V.; Gavrilo, V.P.; Gusev, A.V. (1971)
NONLINEAR EFFECTS ACCOMPANYING ICE BREAKING IN A LIQUID. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 133-38. 6 ref. NTIS: TT70-50158. (Translated from "O nelineinykh effektakh pri razrushenii l'da v zhidkosti," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 159-65.)

B-45 *
Bogorodskii, V.V. (1976)
PHYSICAL METHODS OF STUDYING ICE AND SNOW. CRREL Translation no. 539, Aug. 1976. 248p. Ref. NTIS: AD-A030 818. (Translated from "Fizicheskie metody issledovaniia l'da i snega," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 326, 1975. 228p.) [proceedings of a scientific symposium which was held in Leningrad on 1-5 Oct. 1973]

B-46
Bogorodskii, V.V. (1971)
THE PHYSICS OF ICE. Jerusalem, Israel Program for Scientific Translations, 1971. 157p. NTIS: TT70-50158. (Translated from Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970.) [ice physics, glacier ice, sea ice, ice crystals]

B-47
Bogorodskii, V.V.; Smirnov, G.E.; Smirnov, S.A. (1975)
POGLOSHCHENIE I RASSEIANIE ZVUKOVYKH VOLN MORSKIM L'DOM (Absorption and scattering of acoustic waves in sea ice). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 326, 1975, p. 128-34. 4 ref. In Russian.

B-48 *
Bogorodskii, V.V.; Gavrilo, V.P.; Gusev, A.V. et al (1972)
STRESSED ICE COVER STATE DUE TO THERMAL WAVE AND RELATED UNDERWATER NOISE IN THE OCEAN. (In: I.A.H.R. Symposium on Ice and Its Action on Hydraulic Structures, 2nd, Proceedings, v. 2. Held in Leningrad 26-29 Sept. 1972. Leningrad, International Assn. for Hydraulic Research, 1972, p. 28-33.) [physical-statistical relationships of underwater noise, recorded under ice, with variations of air temperature and surface wind speeds; underwater noise being caused by thermal cracks]

B-49
Bogorodskii, V.V.; Khokhlov, G.P. (1971)
EFFECT OF SOME SALT COMPONENTS AND THEIR COMPOSITION ON THE ELECTRICAL PROPERTIES OF ICE. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 76-81. 3 ref. NTIS: TT70-50158. (Translated from "Vliianie nekotorykh solevykh komponent i ikh sostava na elektricheskie svoistva l'da," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 89-95.) [ice composition, ice physics, ice electrical properties]

B-50
Bondarev, E.A.; Kolmogorov, A.V. (1974)
DINAMIKA LEDIANYKH MASS (Ice dynamics). (In: Fizika L'da i Ledotekhnika (Ice physics and ice engineering). Yakutsk, 1974, p. 60-86. 17 ref.) In Russian. [ice structure, impurities, ice strength, polycrystalline ice, ice creep, ice mechanics, viscoelasticity, deformation, ultrasonic tests, models]

B-51
Bourkland, Martin T. (1968)
OCEANOGRAPHIC CRUISE SUMMARY, WESTERN GREENLAND SEA, AUG.-SEPT. 1965. U.S. Naval Oceanographic Office. Informal Report no. 10, March 1968. 18p. NTIS: AD-671 058.

B-52
Bradley, D.L.; Colvin, G.M. (1972)
ACOUSTIC MEASUREMENTS IN THE WEST GREENLAND SEA. U.S. Naval Ordnance Laboratory. Technical Report NOLTR-72-134, June 1972. 17p. NTIS: AD-746 839. [ice acoustics, underwater acoustics, acoustic measuring equipment]

B-53
Bradley, D.L.; Colvin, G.M. (1973)
LONG RANGE ACOUSTIC TRANSMISSION LOSS IN THE MARGINAL ICE ZONE OF ICELAND. U.S. Naval Ordnance Laboratory. Technical Report NOLTR-72-217, April 1973. 33p. NTIS: AD-763 662. [sound transmission, ice acoustics, acoustic measurement]

B-54
Bradley, D.L.; Colvin, G.M. (1972)
LONG RANGE ACOUSTIC TRANSMISSION LOSS IN THE NORTHERN DENMARK STRAIT. U.S. Naval Ordnance Laboratory. Technical Report NOLTR-72-178, 1972. 24p. NTIS: AD-754 394.

B-56
Brown, J.R.; Milne, A.R. (1967)
REVERBERATION UNDER ARCTIC SEA-ICE. Acoustical Society of America. Journal, v. 42(1), 1967, p. 78-82. Fig., 8 ref. [measurements of back-scattering strength and correlation with surface roughness]

B-57
Brown, J.R.; Brown, D.W. (1966)
REVERBERATION UNDER ARCTIC SEA-ICE. Acoustical Society of America. Journal, v. 40(2), 1966, p. 399-404. 8 fig., 7 ref. [strong dependence of under-ice back-scattering on surface roughness]

B-58 *
Buck, Beaumont M. (1965)
ICE DRILLING IN FLETCHER'S ICE ISLAND (T-3) WITH A PORTABLE MECHANICAL DRILL. Arctic, v. 18(1), 1965, p. 51-54. [operational details using Houston Model V-100 drill in "pressure mode"; temperature and chlorinity measurements on ice]

B-59
Byrd, Robert C. (1971)
DIELECTRIC PROPERTIES OF SEA ICE IN THE FREQUENCY RANGE FROM 26GHZ TO 40GHZ. (In: Alaska. Univ. Institute of Arctic Environmental Engineering. Report no. 7203, 1971. 88p. 15 ref. M.S. thesis. NTIS: AD-736 593.) [ice dielectrics, temperature effects, salinity, electromagnetic prospecting, radar echoes, ice surface, topographic features]

B-60
Campbell, Kerry J.; Orange, Arnold S. (1974)
ELECTRICAL ANISOTROPY OF SEA ICE IN THE HORIZONTAL PLANE. Journal of Geophysical Research, v. 79(33), Nov. 1974, p. 5059-63. 7 ref. [electrical properties of sea ice]

B-61
Chapman, R.P.; Scott, H.D. (1966)
BACKSCATTERING STRENGTHS OF SEA ICE. Acoustical Society of America. Journal, v. 39(6), 1966, p. 1191-93. 5 ref. [measurements for "point" sources of sound in sea-water scattered back from smooth young ice and heavily rafted winter ice]

B-62
Cherepanov, N.V. (1973)
CLASSIFICATION OF THE CRYSTALLINE STRUCTURE OF ARCTIC ICE. (In: Treshnikov, A.F., ed. Problems of the Arctic and Antarctic, v. 40. Jerusalem, Israel Program for Scientific Translations, 1973, p. 75-80. Map. NTIS: TT72-50089.) (Translated from "Sistemalizatsiya kristallicheskikh struktur l'dov v Arktiki," Problemy Arktiki i Antarktiki, v. 40, 1972, p. 78-83.)

B-63 *
Cherepanov, N.V. (1975)
MAIN RESULTS OF AN INVESTIGATION OF THE CRYSTAL STRUCTURE OF SEA ICE. (In: Treshnikov, A.F., ed. Problems of the Arctic and Antarctic, v. 41. New Delhi, Amerind, 1975, p. 55-68. 6 fig., ref. NTIS: TT74-52009.) (Translated from "Osnovnyye rezul'taty issledovaniya kristallicheskoy struktury morskikh l'dov," Problemy Arktiki i Antarktiki, v. 41, p. 43-54.)

B-64 *
Cherepanov, N.V. (1970)
ROLE OF THE THERMAL REGIME OF A WATER BODY IN THE FORMATION OF THE CRYSTAL STRUCTURE OF ICE. (In: Treshnikov, A.F., ed. Problems of the Arctic and Antarctic, v. 29-33. Jerusalem, Israel Program for Scientific Translations, 1970, p. 56-64. 6 ref. NTIS: TT70-50017.) (Translated from "Rol' termicheskogo rezhima vodoema v formirovanii kristallicheskoistruktury l'da," Problemy Arktiki i Antarktiki, v. 29, 1968, p. 55-63.)

B-65 *
Cherepanov, N.V. (1973)
SPATIAL ARRANGEMENT OF SEA ICE CRYSTAL STRUCTURE. (In: Treshnikov, A.F., ed. Problems of the Arctic and Antarctic, v. 38. New Delhi, Amerind, 1973, p. 176-81. 2 fig., 6 ref. NTIS: TT72-52007.) (Translated from "Prostranstvennaia uporiadochennost' kristallicheskoi struktury morskikh l'dov," Problemy Arktiki i Antarktiki, v. 38, 1971, p. 137-40.) [ice crystal structure, ice crystal optics, ice crystal size]

B-66
Cherepanov, N.V. (1966)
STRUCTURE OF SEA ICE OF GREAT THICKNESS. Canada. Defence Research Board. Directorate of Scientific Information Services. Translation, no. T-448-R, Jan. 1966. 7p. 4 fig., 5 ref. NTIS: AD-631 236. (Translated from "Skruktura morskikh l'dov bol'shoi tolshchiny," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 267, 1964, p. 13-18.) [thickness, ice island, sea ice structure]

B-67
Chikovskii, S.S. (1976)
O RASCHETE TEMPERATURY MORSKOGO L'DA NA STANDARTNYKH GORIZONTAKH NABLIUDENII (Calculation of sea ice temperature at standard depths of observation). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 331, 1976, p. 185-88. 4 ref. In Russian. [ice temperature, ice cover strength, thermal conductivity, ice salinity, air temperature, analysis (mathematics)]

B-68 *
Chikovskii, S.S. (1973)
SUPERCOOLING OF SEA WATER UNDER NATURAL AND LABORATORY CONDITIONS. (In: Yakovlev, G.N., ed. Studies in Ice Physics and Ice Engineering, v. 300. Jerusalem, Israel Program for Scientific Translations, 1973, p. 121-34. 35 ref. NTIS: TT72-50005.) (Translated from "O pereokhlazhdenii morskikh vod v prirodnykh i laboratornykh usloviiakh," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 300, 1971, p. 137-52.) [supercooled water, ice formation, ice growth, ocean currents, water temperature, ice water interface]

B-69
Chugui, I.V.; Legen'kov, A.P.; Eremin, N.N. (1975)
TEMPERATURE MEASUREMENTS FROM DRIFTING ICE ISLAND "NORTH POLE 19." Oceanology, v. 14(4), May 1975, p. 495-98. (Translated from Okeanologiya, v. 14(4), 1975.)

B-70
Coon, Max D.; Mohaghegh, Mohammed M. (1972)
PLASTIC ANALYSIS OF COULOMB PLATES AND ITS APPLICATION TO THE BEARING CAPACITY OF SEA ICE. Washington. Univ. Dept. of Atmospheric Sciences. Scientific Report no. 12, 1972. 159p. NTIS: AD-745 764. [bearing capacity of floating ice sheets was determined by application of analysis methods]

B-72 *
Cox, G.F.N.; Weeks, Wilford F. (1975)
BRINE DRAINAGE AND INITIAL SALT ENTRAPMENT IN SODIUM CHLORIDE ICE. CRREL Research Report no. 345, Dec. 1975. 85p. 33 fig., 8 tables, 41 ref. NTIS: AD-A021 765.

B-73
Cox, G.F.N. (1974)
BRINE DRAINAGE IN SODIUM CHLORIDE ICE. Hanover, N.H., Dartmouth College, 1974. Ph.D. thesis. Univ. Microfilm order no. 74-23090.

B-74 *
Cox, G.F.N.; Weeks, Wilford F. (1973)
SALINITY VARIATIONS IN SEA ICE. CRREL Research Report no. 310, 1973. 23p. Fig., ref. (Also in: Journal of Glaciology, v. 13(67), 1974, p. 109-20 and AIDJEX Bulletin, no. 19, 1973, p. 1-17.)

B-75
Cox, G.F.N. (1972)
VARIATION OF SALINITY IN THE MULTI-YEAR SEA ICE AT THE AIDJEX 1972 CAMP. Hanover, N.H., Dartmouth College, 1972. M.S. thesis.

B-76
Craig, H.; Hom, B. (1968)
RELATIONSHIPS OF DEUTERIUM, OXYGEN 18, AND CHLORINITY IN THE FORMATION OF SEA ICE. American Geophysical Union. Transactions, v. 49(1), March 1968, p. 216-17. [abstract only]

B-77
Croasdale, K.R. (1974)
CRUSHING STRENGTH OF ARCTIC ICE. (In: Reed, John C.; Sater, J.E., ed. The Coast and Shelf of the Beaufort Sea. Proceedings of a symposium held in San Francisco, 7-9 Jan. 1974. Arlington, Va., Arctic Institute of North America, 1974, p. 377-99.)

B-78 *
Croasdale, K.R. (In press)
ICE ENGINEERING FOR OFFSHORE PETROLEUM EXPLORATION IN CANADA. Presented at International Conference on Port and Ocean Engineering under Arctic Conditions, 4th, Proceedings, Memorial Univ. of Newfoundland, 26-30 Sept. 1977. 32p.

B-79 *
Croasdale, K.R. (1970)
THE NUTCRACKER ICE STRENGTH TESTER AND ITS OPERATION IN THE BEAUFORT SEA. (In: I.A.H.R. Symposium on Ice and Its Action on Hydraulic Structures, 1st, Proceedings. Held in Reykjavik, Iceland, 7-10 Sept. 1970. International Assn. for Hydraulic Research, 1970, Part 6.4. 10p.) In English with French summary.

B-80
Darby, D.A. et al (1974)
AIRBORNE DUST ON THE ARCTIC PACK ICE, ITS COMPOSITION AND FALLOUT RATE. Earth and Planetary Science Letters, v. 24(2), 1974, p. 166-72. 21 ref. [fall-out rates show marked decrease in atmospheric dust from area off Ellesmere Island to sampling stations north of Point Barrow, Alaska, 1,400 km west]

B-81
Davis, H.; Munis, R.H. (1973)
EFFECT OF SALINITY ON THE OPTICAL EXTINCTION OF SEA ICE AT 6328A. CRREL Research Report no. 308, July 1973. 17p. NTIS: AD-763 882.

B-82*
Davis, H.; Munis, R.H. (1976)
EFFECT OF SEA ICE SALINITY ON OPTICAL EXTINCTION AT WAVELENGTH 6328A. CRREL Translation no. 539, Aug. 1976, p. 63-68. 2 ref. NTIS: AD-A030 818. (Translated from "Vliianie solenosti morskogo l'da na opticheskuiu ekstinktsiiu s dlinoi volny 6328A," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 326, 1975, p. 66-70.)

B-83*
de Jong, J.J.A.; Stigter, C.; Steyn, B. (1976)
DESIGN AND BUILDING OF TEMPORARY ARTIFICIAL ISLANDS IN THE BEAUFORT SEA. (In: International Conference on Port and Ocean Engineering under Arctic Conditions, 3rd, Proceedings, v.2. Held 11-15 Aug. 1975, Fairbanks, Alaska. Institute of Marine Science, Univ. of Alaska, 1976, p. 753-89.)

B-84
DenHartog, S.L. (1971)
SS MANHATTAN TESTS: A REVIEW OF THE ICE PROGRAM. (In: International Conference on Port and Ocean Engineering under Arctic Conditions, 1st, Proceedings, v. 1. Held 23-30 Aug. 1971, in Norway. Trondheim, Technical Institute of Norway, 1971, p. 101-11. 2 ref.) [sea ice, tensile strength, ice breaking, ice temperature, ice salinity]

B-85 *
Dixit, Bharat; Pounder, Elton R. (1975)
SPECIFIC HEAT OF SALINE ICE. Journal of Glaciology, v. 14(71), 1975, p. 459-465. Ref. In English with French and German summaries.

B-86
Dorsey, N. Ernest (1968)
PROPERTIES OF ORDINARY WATER SUBSTANCE IN ALL ITS PHASES: WATER-VAPOR, WATER, AND ALL THE ICES. New York, Hafner Publishing Co., 1968. 696p. 13 fig., tables, ref. (American Chemical Society Monograph Series no. 81.)

B-87
Dykins, J.E. (1971)
ICE ENGINEERING--MATERIAL PROPERTIES OF SALINE ICE FOR A LIMITED RANGE OF CONDITIONS, FINAL REPORT, JULY 1969-MAY 1970. U.S. Naval Civil Engineering Laboratory. Technical Report, no. R-720, April 1971. 101p. NTIS: AD-887 840. [linear equation relating flexural strength (rupture modulus) with brine volume developed for temperature range -2C to -10C for normal seawater ice]

B-88
Dykins, J.E. (1966)
ICE ENGINEERING--TENSILE AND BENDING PROPERTIES OF SEA ICE GROWN IN A CONFINED SYSTEM. U.S. Naval Civil Engineering Laboratory. Technical Report no. R-415, Jan. 1966. 74p. 43 fig., 3 tables, 12 ref. NTIS: AD-626 585.

B-89
Dykins, J.E. (1970)
ICE ENGINEERING--TENSILE PROPERTIES OF SEA ICE GROWN IN A CONFINED SYSTEM. U.S. Naval Civil Engineering Laboratory. Technical Report no. R-689, July 1970. 60p. [laboratory study using axially loaded test specimens of artificially grown polycrystalline ice, frozen from natural sea water and distilled water diluted with natural sea water]

B-90*
Dykins, J.E. (1969)
TENSILE AND FLEXURE PROPERTIES OF SALINE ICE. (In: Riehl, N.; Bullemer, B. et al, ed. Proceedings of the International Symposium on Physics of Ice. Munich, Germany, Sept. 9-14, 1968. N.Y., Plenum, 1969, p. 251-270. 18 fig., 6 ref.)

B-91*
Dykins, J.E. (1967)
TENSILE PROPERTIES OF SEA ICE GROWN IN A CONFINED SYSTEM. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967, p. 523-37.) [test on laboratory-grown sea ice compared with natural sea ice; grain structure most important parameter]

B-92
Efimov, V.A. (1974)
K RASCHETU GLAVNYKH OSEI TENZORNYKH ELLIPSOV VNESHNIKH NAPRIAZHENII, DEISTVUIUSHCHIKH NA LEDIANOI POKROV (Calculating the principal axes of stress-tensor ellipses for pack ice). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 316, 1974, p. 52-58. 3 ref. In Russian.

B-93*
Eide, Lars Ingolf; Martin, Seelye (1975)
THE FORMATION OF BRINE DRAINAGE FEATURES IN YOUNG SEA ICE. Journal of Glaciology, v. 14(70), 1975, p. 137-154. 10 fig., ref. NTIS: AD-A011 190. [laboratory experiments on the growth of sea ice clearly show formation and development of brine drainage channels]

B-94
Evans, R.J. (1972)
CORRECTION TO "CRACKS IN PERENNIAL SEA ICE DUE TO THERMALLY INDUCED STRESS." Journal of Geophysical Research, v. 77(9), 1972, p. 1701.

B-95*
Evans, R.J. (1971)
CRACKS IN PERENNIAL SEA ICE DUE TO THERMALLY INDUCED STRESS. Journal of Geophysical Research, v. 76(33), 1971, p. 8153-55. NTIS: AD-737 452. [lowering of surface temperature below that of the water temperature underneath a floating sea-ice sheet often results in thermal cracking]

B-96 *
Evans, R.J.; Parmerter, R. (1976)
GRAVITATIONAL STRESSES IN FLOATING ICE SHEETS. AIDJEX Bulletin, no. 31, March 1976, p. 86-91. 4 fig., 3 ref.

B-97*
Evans, R.J. (1970)
NOTES ON A POSSIBLE CONSTITUTIVE LAW FOR ARCTIC SEA ICE. AIDJEX Bulletin, no. 2, 1970, p. 13-17. NTIS: AD-715 450. (Also in: Washington. Univ. Dept. of Atmospheric Sciences. Annual report no. 2, Dec. 1970, p. A15-A19.)

B-98*
Evans, R.J. (1975)
ON THE CONTINUUM APPROXIMATION FOR THE AIDJEX MODEL. AIDJEX Bulletin, no. 28, 1975, p. 99-117. 5 fig., ref. [drift, dynamic properties, mathematical models, viscous flow]

B-99
Evans, R.J.; Rothrock, D.A. (1975)
STRESS FIELDS IN PACK ICE. (In: Frankenstein, Guenther E., ed. International Symposium on Ice Problems, 3rd, Proceedings. Held 18-21 Aug. 1975, Hanover, N.H. International Assn. of Hydraulic Research, 1975, p. 527-39. 8 ref.)

B-100 *
Evans, R.J.; Untersteiner, Norbert (1971)
THERMAL CRACKS IN FLOATING ICE SHEETS. Journal of Geophysical Research, v. 76(3), 1971, p. 694-703. NTIS: AD-721 414. [quantitative aspects of thermal cracking from a strength of materials viewpoint]

B-101
EXPERIMENTAL INVESTIGATION OF ICE FLOE UNDER WAVE ACTION. Pasadena, Calif., National Engineering Science Co., Final Report, Jan. 1965. 35p. NTIS: AD-456 969. [thermal stresses, polyethylene plastics, brittleness, model tests, strain gauges, transducers, gravity]

B-102
Farrar, John; Hamilton, W.S. (1965)
NUCLEATION AND GROWTH OF ICE CRYSTALS. U.S. Dept. of the Interior. Research and Development Progress Report, no. 127, 1965. 51p. [ice growth in supercooled water measured as function of crystal orientation, temperature, flow, salt concentration and additives; mechanism of ice formation in sea water]

B-103
Fedotov, V.I. (1976)
STROYENIYE ODNOLETNEGO L'DA MORYA LAPTEVYKH V VESENNYY PERIOD (Structure of one-year-old first-year ice in the Laptev Sea in spring). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 331, 1976, p. 151-56. In Russian.

B-104
Feldman, H.R.; Garrison, G.R.; Pence, E.A.; Shah, S.R. (1973)
STUDIES IN THE MARGINAL ICE ZONE OF THE CHUKCHI SEA: ANALYSIS OF 1972 DATA. Washington. Univ. Applied Physics Laboratory. Report no. APL-UW-7309, July 1973. 157p. NTIS: AD-767 043. [ice floes, microstructure, sea ice, sound propagation, sound scattering, temperature profiles]

B-105
Feldman, H.R.; Garrison, G.R.; Pence, E.A. et al (1974)
STUDIES IN THE MARGINAL ICE ZONE OF THE CHUKCHI SEA: ANALYSIS OF 1972 DATA. Washington. Univ. Applied Physics Laboratory. Report no. APL-UW-7311, March 1974. 142p. NTIS: AD-779 856. [ice floes, oceanographic data, sound propagation, sound pulses, sound scattering, sound transmission, temperature profiles, thermoclines]

B-106
Fertuck, L.; Spyker, J.W.; Husband, W.H.W. (1972)
COMPUTING SALINITY PROFILES IN ICE. Canadian Journal of Physics, v. 50(3), 1972, p. 264-67. [equation obtained for calculating ice salinity for temperature gradients up to 1.3°C/cm]

B-107
Finke, Siegfried (1972)
UNTERSUCHUNGEN ZUM VERFORMUNGSVERHALTEN DES MEEREISES IM ECLIPSE SOUND (BAFFIN ISLAND) UND MESSUNGEN DES REIBUNGSKOEFFIZIENTEN STAHL-EIS (Investigation on the deformation behavior of sea ice in Eclipse Sound (Baffin Island) and measurements of the coefficient of friction of steel-ice). Polarforschung, Jahrg. 42, Bd. 7, Nr. 2, 1972, p. 75-81. In German. [observations on plastic behavior of sea ice, samples being subjected to various methods of deformation; describes measurement of friction parameter steel-ice, referring to drilling holes]

B-108
Finkel'shtein, M.I.; Glushnev, V.G.; Petrov, A.N. et al (1970)
ANISOTROPIC ATTENUATION OF RADIO WAVES IN SEA ICE. Akademiya Nauk SSSR. Izvestiya. Atmospheric and Oceanic Physics, v. 6(3), 1970, p. 175-76. 2 ref. (Translated from "Ob anizotropii zatukhaniya radiovoln v morskom l'du," Akademiya Nauk SSSR. Izvestiya. Fizika Atmosfery i Okeana, v. 6(3), March 1970, p. 311-13.)

B-109
Finkel'shtein, M.I.; Glushnev, V.G. (1973)
ELECTROPHYSICAL PROPERTIES OF SEA ICE MEASURED BY RADAR SOUNDING IN THE ONE-METER WAVE RANGE. Akademiya Nauk SSSR. Doklady. Earth Science Section, v. 203(1/6), 1973, p. 7-9. 3 ref. (Translated from "O nekotorykh elektrofizicheskikh kharakteristikakh morskogo l'da, izmerennykh putem radiolokatsionnogo zondirovaniia v metrovom diapazone voln," Akademiya Nauk SSSR. Doklady, v. 203(3), March 1972, p. 578-80.)

B-110
Finkel'shtein, M.I.; Kozlov, A.I.; Mendel'son, V.L. (1970)
MODELLING OF REFLECTION OF RADIO WAVES FROM SEA ICE. Radio Engineering and Electronic Physics, v. 15(11), 1970, p. 1999-2005. (Translated from "O modelirovanii otrazheniya radiovoln ot morskogo l'da," Radiotekhnika i Elektronika, v. 15(11), 1970, p. 2282-88.) [from a rigorous solution of the problem of reflection of a plane electromagnetic wave from sea ice, equivalent frequency characteristics are constructed for signals reflected from the upper and lower edges]

B-111
Finkel'shtein, M.I. (1970)
OPTIMUM FORM OF PULSES IN RADAR SOUNDING OF SEA ICE. Radio Engineering and Electronic Physics, v. 15(12), 1970, p. 2179-82. (Translated from "Ob optimal'noy forme impul'sov pri radiolokatsionnom zondirovanii morskogo l'da," Radiotekhnika i Elektronika, v. 15(12), 1970, p. 2468-72.) [presents optimum wave form for which the resolving characteristics of the signal are retained after reflection from the edges of the ice]

B-112 *
Finkel'shtein, M.I.; Glushnev, V.G.; Petrov, A.N. (1970)
ON THE ANISOTROPY OF THE RADIOWAVE ATTENUATION IN THE SEA ICE. SERIES ON THE PHYSICS OF THE ATMOSPHERE AND THE OCEAN. (In: Gudmandsen, P., ed. Proceedings of the International Meeting on Radioglaciology, Lyngby, May 1970. Lyngby, Technical Univ. of Denmark, Laboratory of Electromagnetic Theory, 1970, p. 159-65.)

B-113
Firouzabadi, A.H. (1968)
PROPAGATION OF RADIO WAVES OVER ICE WITH UNDERLYING SEA WATER. College Park, Maryland, Maryland Univ., 1968. 82p. Ph.D. thesis. Univ. Microfilms order no. 68-6524. [analyzes the problem theoretically by using Maxwell's field equations and satisfying the appropriate conditions imposed by the various boundaries]

B-114
Fletcher, Neville H. (1970)
CHEMICAL PHYSICS OF ICE. Cambridge, Cambridge Univ. Press, 1970. (Monographs on physics series.)

B-115
Foldvik, A.; Kvinge, T. (1974)
CONDITIONAL STABILITY OF SEA WATER AT THE FREEZING POINT. Deep-sea Research, v. 21(3), March 1974, p. 169-74. 6 ref. [sea water freezing, ice crystal formation, convection, water temperature, salinity; thermohaline convection mechanism based on the depression of the freezing point of sea water with increasing pressure discussed]

B-116
Foster, Theodore D. (1969)
EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER. Journal of Geophysical Research, v. 74(28), 1969, p. 6967-74. [laboratory study of convection below freezing layer of sea ice]

B-117
Foster, Theodore D. (1968)
HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER. Journal of Geophysical Research, v. 73(6), 1968, p. 1933-38. [onset of haline convection investigated, and applied to formation of sea ice]

B-118
Foster, Theodore D. (1972)
HALINE CONVECTION IN POLYNYAS AND LEADS. Journal of Physical Oceanography, v. 2, 1972, p. 462-69.

B-119 *
Frankenstein, Guenther E.; Garner, Robert (1970)
DYNAMIC YOUNG'S MODULUS AND FLEXURAL STRENGTH OF SEA ICE. CRREL Technical Report no. 222, May 1970. 19p. Ref. NTIS: AD-710 975.

B-120 *
Frankenstein, Guenther E.; Garner, Robert (1967)
EQUATIONS FOR DETERMINING THE BRINE VOLUME OF SEA ICE FROM -0.5 DEGREES TO -22.9 DEGREES C. Journal of Glaciology, v. 6(48), Oct. 1967, p. 943-44. 1 ref. In English with French and German summaries.

B-121
Frankenstein, Guenther E. (1970)
FLEXURAL STRENGTH OF SEA ICE AS DETERMINED FROM SALINITY AND TEMPERATURE PROFILES. Canada. National Research Council. Associate Committee on Geotechnical Research. Technical Memorandum no. 98, Nov. 1970, p. 66-73.

B-122 *
Frankenstein, Guenther E. (1969)
RING TENSILE STRENGTH STUDIES OF ICE. CRREL Technical Report no. 172, 1969. 36p. 8 ref. NTIS: AD-686 284.

B-123 *
Frederking, R. (1974)
DOWNDRAG LOADS DEVELOPED BY A FLOATING ICE COVER: FIELD EXPERIMENTS. Canadian Geotechnical Journal, v. 11(3), Aug. 1974, p. 339-47. 10 fig., 6 ref. [information obtained on dependence of pile displacement rate on applied stress for snow ice at temperature within 10°C of melting point]

B-124
Frederking, R. (1976)
MECHANICAL PROPERTIES OF ICE AND THEIR APPLICATION TO ARCTIC ICE PLATFORMS. (In: Ice Tech 75: Symposium on Icebreaking and Related Technologies. Held 9-11 April 1975 in Montreal, Canada. New York, Society of Naval Architects and Marine Engineers, 1976, p. K/1-K/18.)

B-125 *
Frolov, A.D.; Slesarenko, Iu.E. (1974)
CHARACTERISTICS OF ELASTICITY OF SEA ICE OF DIFFERENT COMPOSITIONS. (In: I.A.H.R. Symposium of Ice and Its Action on Hydraulic Structures, 2nd, Proceedings. Held in Leningrad, 26-29 Sept. 1972. Leningrad, International Assn. for Hydraulic Research, 1972, p. 88-90.) [application of ultrasonic pulse method]

B-126 *
Frolov, A.D. (1972)
VLIYANIYE FAZOVOGO SOSTAVA I STRUKTURY MORSKOGO L'DA NA EGO UPRUGIYE I DIELEKTRICHESKIYE SVOYSTVA (The influence of phase composition and sea ice structure upon its dielectric and strength properties). Akademiya Nauk SSSR. Institut Geografii. Materialy Glyatsiologicheskikh Issledovaniy. Khronika, Obsuzhdeniya, no. 19, 1972, p. 203-09. In Russian with English summary.

B-127 *
Fujino, Kazuo (1970)
DIELECTRIC PROPERTIES OF SEA ICE. Hanover, N.H., CRREL, 1970. 54p. NTIS: AD-877 403. (Translated from "Kaikyō no yūdenteki seishitsu ni kansuru kenkyū," Teion Kagaku, Series A, no. 25, 1967, p. 127-69.) [ice dielectrics, conductivity]

B-128 *
Fujino, Kazuo (1967)
ELECTRICAL PROPERTIES OF SEA ICE. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967, p. 633-48.) [measurements of permittivity and conductivity of sea ice 100 Hz-50 kHz from -5° to -70°C; relation with geometrical arrangement of brine cells]

B-129
Gaitskhoki, B.Ia.; Morozov, P.T.; Sovalkov, L.I. (1970)
ISSLEDOVANIE STROENIIA I SOSTAVA MORSKIKH L'DOV V ARKTICHESKOM BASSEINE (Investigation of the structure and composition of sea ice in the Arctic Basin). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 108-15. In Russian.

B-130 *
Gaitskhoki, B.Ia. (1976)
OPTICAL CHARACTERISTICS OF SOME VARIETIES OF NATURAL ICE. CRREL Translation no. 539, Aug. 1976, p. 69-72. 2 ref. NTIS: AD-A030 818. (Translated from "Opticheskie kharakteristiki nekotorykh raznovidnostei estestvennykh l'dov," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 326, 1975, p. 71-73.)

B-131
Gaitskhoki, B.Ia.; Spitsyn, V.A. (1971)
SOME RESULTS OF TEMPERATURE MEASUREMENT IN ICE ON THE DRIFTING STATIONS NP-13F. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 154-58. NTIS: TT70-50158. (Translated from "Nekotorye rezultaty izmereniia temperatury lda na dreifuiushchei stantsii Severnyi Polius-13F," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 129-32.)

B-132
Gaitskhoki, B.Ia. (1971)
SPECTRAL TRANSMISSION OF SNOW AND SOME ICE VARIETIES. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 44-47. 4 ref. NTIS: TT70-50158. (Translated from "Spektral'naia prozrachnost' snega i nekotorykh raznovidnostei l'da," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 50-54.)

B-133
Gaitskhoki, B.Ia.; Morozov, P.T.; Sovalkov, L.I. (1971)
STUDIES OF THE STRUCTURE AND COMPOSITION OF SEA ICE IN THE ARCTIC BASIN. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 92-97. 4 ref. NTIS: TT70-50158. (Translated from "Issledovanie stroeniia i sostava morskikh l'dov v Arkticheskom basseine," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 109-15.)

B-134
Gaitskhoki, B.Ia.; Tikhonov, Iu.P. (1974)
TERMOMETRICHESKAIA USTANOVKA DLIA IZMERENIIA TEMPERATORY LEDIANOGO POKROVA (Temperature measuring device for establishing ice cover temperatures). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 324, 1974, p. 193-96. 2 ref. In Russian.

B-135
Galkina, A.I.; Spitsyn, V.A. (1971)
MEASURING THE TEMPERATURE OF THE SURFACE OF WATER, SNOW, AND ICE WITH A RADIATION THERMOMETER. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 56-59. NTIS: TT70-50158. (Translated from "Izmerenie temperatury poverkhnosti vody, snega i l'da radiatsionnym termometrom," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 64-68.)

B-136
Ganton, J.H.; McMillin, D.J.; Milne, A.R. (1967)
AMBIENT NOISE UNDER SEA ICE AND FURTHER MEASUREMENTS OF WIND AND TEMPERATURE DEPENDENCE. Acoustical Society of America. Journal, v. 41(2), Feb. 1967, p. 525-28. Fig., 3 ref. [wind effects, under ice, air temperature, ambient noise]

B-137
Ganton, J.H.; Milne, A.R. (1965)
TEMPERATURE- AND WIND-DEPENDENT AMBIENT NOISE UNDER MIDWINTER PACK ICE. Acoustical Society of America. Journal, v. 38(3), 1965, p. 406-11. [measurement of noise reveals two sources, cracking due to thermal stresses and wind effects]

B-138
Garbaccio, Donald H. (1967)
CREEP OF FLOATING ICE SHEET, U. San Marino, Calif., Science Engineering Associates, April 1967. 52p. 8 fig., 14 ref. (Also U.S. Naval Civil Engineering Laboratory. Report no. CR-67.025, 1967. NTIS: AD-654 742.) [linear viscoelasticity, floating ice sheet, creeping plate behavior, nonlinear creep]

B-139
Garrison, G.R.; Pence, E.A.; Early, E.W. (1976)
ACOUSTIC STUDIES FROM AN ICE FLOE NEAR BARROW, ALASKA, IN APRIL 1974. Washington. Univ. Applied Physics Laboratory. Report no. APL-UW-7514, 1976. 139p. NTIS: AD-B014 157. [acoustic measurements, ice floes, low frequencies, magnesium sulfates, microstructure, sea ice transducers]

B-140
Garrison, G.R.; Francois, R.E.; Pence, E.A. (1975)
SOUND ABSORPTION MEASUREMENTS AT 10-60 KHZ IN NEAR-FREEZING SEA WATER. Acoustical Society of America. Journal, v. 58(3), Sept. 1975, p. 608-19. Ref. [sound propagation measurements at various frequencies between 10 and 60 kHz were made in April 1974 under the pack ice near Point Barrow, Alaska]

B-143
Gavrilo, V.P.; Gusev, A.V.; Poliakov, A.P. (1971)
ACOUSTIC RECORDING ON THE CRITICAL STATE OF STRESS IN ICE. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 139-45. 11 ref. NTIS: TT70-50158. (Translated from "O vozmozhnosti akusticheskoi registratsii kriticheskogo napriazhennogo sostoianiia ledianogo pokrova," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 166-73.) [acoustic wave generation, sea ice temperatures, sea ice breakup]

B-144
Gavrilo, V.P. (1974)
FRIKTSIONNYE KHARAKTERISTIKI MORSKOGO L'DA (Friction properties of sea ice). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 316, 1974, p. 107-12. 7 ref. In Russian. [pack ice, ice friction, pressure ridges, experimental data, drift stations]

B-145
Gavrilo, V.P.; Gaitskhoki, B.Ia. (1971)
STATISTICS OF AIR INCLUSIONS IN ICE. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 125-28. 2 ref. NTIS: TT70-50158. (Translated from "K voprosu o statistike vozdushnykh vkliuchenii vo l'du," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 149-53.)

B-146
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A SIMPLE FIELD MEASURE OF ICE STRENGTH. (In: Frankenstein, Guenther E., ed. International Symposium on Ice Problems, 3rd, Proceedings. Held 18-21 Aug. 1975, Hanover, N.H. International Assn. of Hydraulic Research, 1975, p. 589-600.) [penetration test for testing strength of floating ice]

B-147
Getman, James H.; Moffett, Mark B. (1973)
DEVELOPMENT OF A SEA-ICE THICKNESS GAGE. AN ATTEMPT TO USE SHEAR WAVES. U.S. Coast Guard. Report USCG-D-44-75. Kingston, Rhode Island Univ., 1973. 218p. NTIS: AD-A006 599. [experimental apparatus for the measurement of the thickness of sea ice by the use of a shear wave reflection technique]

B-148 *
Glen, John W. (1974)
PHYSICS OF ICE. CRREL Monograph II-C2a, April 1974. 81p.

B-149 *

Gold, Lorne W. (1972)

FAILURE PROCESS IN COLUMNAR-GRAINED ICE. *Canada. National Research Council. Division of Building Research. Technical Paper* 369, May 1972. 108p.

B-150

Gold, Lorne W. (1965)

THE INITIAL CREEP OF COLUMNAR-GRAINED ICE--PART 1: OBSERVED BEHAVIOR; PART 2: ANALYSIS. *Canadian Journal of Physics*, v. 43(8), 1965, p. 1414-34. Table.

B-151 *

Gollandtseva, A.N.; Glukhova, N.V. (1973)

A STUDY OF THE STRUCTURE OF SEA ICE. (*In*: Yakovlev, G.N., ed. *Studies in Ice Physics and Ice Engineering*, v. 300. Jerusalem, Israel Program for Scientific Translations, 1973, p. 177-80. 3 ref. NTIS: TT72-50005.) (Translated from "Issledovanie struktury morskogo l'da," *Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy*, v. 300, 1971, p. 205-09.)

B-152

Golovkov, M.P. (1972)

THE HYDROCHEMISTRY OF NATURAL ICE. Washington, D.C., Arctic Institute of North America, Jan. 1972. 13p. NTIS: AD-738 188. (Translated from "O gidrokhimii prirodnykh l'dov," *Gidrokhimicheskie Materialy*, v. 20, 1953, p. 46-48.) [need of further study of the diverse kinds of natural ice discussed]

B-153

Goodman, D.J. (1977)

SURFACE STRAIN RATE MEASUREMENTS ON SEA-ICE AND GLACIERS. *Geophysical Journal*, v. 49(1), 1977, p. 268.

B-154

Goodrich, L.E. (1975)

NUMERICAL MODEL FOR CALCULATING TEMPERATURE PROFILES IN AN ICE COVER. *Canada. National Research Council. Associate Committee on Geotechnical Research. Technical Memorandum* no. 114, Jan. 1975, p. 44-59. 5 ref. [ice temperature, profiles, mathematical models, floating ice, ice cover thickness, temperature variations]

B-155

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MAJOR ELEMENTARY HYDROLOGICAL PROCESSES IN THE ARCTIC SEAS. (*In*: Treshnikov, A.F., ed. *Problems of the Arctic and Antarctic*, v. 40. Jerusalem, Israel Program for Scientific Translations, 1973, p. 1-8. NTIS: TT72-50089.) (Translated from "Osnovnye elementarnye gidrologicheskie protsessy v arkticheskikh moriakh," *Problemy Arktiki i Antarktiki*, v. 40, 1972, p. 5-12.) [ice conditions, water temperature, sea water, salinity, ocean currents, sea level]

B-156 *

Gosink, T.A.; Pearson, J.G.; Kelley, John J. (1976)

GAS MOVEMENT THROUGH SEA ICE. *Nature*, v. 263(5572), 1976, p. 41-42. [letter; data indicate gas migration is important factor in ocean-atmosphere winter communication particularly when surface temperature is above -10°C]

B-157 *

Gow, Anthony J.; Sheehy, W. (1975)

EFFECT OF POROSITY ON THE HYDROSTATIC COMPRESSION OF ICE. *CRREL Special Report* no. 234, Oct. 1975.

B-158 *

Gow, Anthony J.; Williamson, T.C. (1972)

LINEAR COMPRESSIBILITY OF ICE. *Journal of Geophysical Research*, v. 77(32), 1972, p. 6348-52.

B-159

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THE OPTICAL PROPERTIES OF ICE AND SNOW IN THE ARCTIC BASIN. Submitted to the *Journal of Glaciology*.

B-160

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O MIKRORELʹEFE RIZHNEI POVERKHNOSTI MORSKIKH DREIFUIUSHCHIKH L'DOV (Microrelief of the bottom surface of drifting sea ice). *Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy*, v. 320, 1976, p. 208-13. 2 ref. In Russian. [microrelief, ice bottom surface, sea ice, seasonal variations, drift]

B-161

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SOME IMPORTANT FEATURES OF THE FORMATION OF WATER DENSITY ANOMALIES AND THEIR EFFECT ON ICE AND HYDROLOGICAL CONDITIONS IN THE ARCTIC BASIN AND MARGINAL SEAS. *Oceanology*, v. 5(2), 1966, p. 49-57. 11 ref. (Translated from *Okeanologiya*, v. 5(2), 1965.)

B-162

Gudmandsen, P. (1970)

ELECTROMAGNETIC STUDIES OF SEA ICE. *International Scientific Radio Union. Information Bulletin*, no. 177, 1970, p. 7-9. [further studies required on dielectric properties of sea ice, remote sensing of sea ice, and wave propagation in inhomogeneous anisotropic ice structures]

B-163 *

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RADIO ECHO SOUNDING OF POLAR ICE. Lyngby, *Technical Univ. of Denmark. Report* D-170, 1972. 27p.

B-164 *

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IMPACT PENETRATION OF ARCTIC SEA ICE. (*In*: I.A.H.R. *Symposium on Ice and Its Action on Hydraulic Structures, 1st, Proceedings*. Held in Reykjavik, Iceland, 7-10 Sept. 1970. International Assn. for Hydraulic Research, 1971, Paper 5.5. 8p.) [development of large-deformation theory techniques involving use of computer code]

B-165
Hanse, J.G.; Bunney, R.E. (1974)
A CALCULATION OF THE ACOUSTIC SHEAR WAVE ATTENUATION IN SEA ICE. *Washington. Univ. Applied Physics Laboratory. Report* APL-UW-7310, July 1974. 46p. NTIS: AD-786 707. [attenuation of an acoustic disturbance propagating in ice]

B-166
Harrison, J.D. (1965)
MEASUREMENT OF BRINE DROPLET MIGRATION IN ICE. *Journal of Applied Physics*, v. 36(12), 1965, p. 3811-15. [observations of velocity and changes of size and shape of droplets of NaCl, KF, and KI through ice from -6° to 0°C]

B-167
Harrison, J.D. (1965)
SOLUTE TRANSPIRATION PORES IN ICE. *Journal of Applied Physics*, v. 36(1), Jan. 1965, p. 326-27. 13 ref. [ice grown by progressive freezing of water samples containing various solutes at different concentration]

B-168 *
Hattersley-Smith, G. (1969)
OPERATION "HAZEN-TANQUARY" 1965-68. *Canada. Defence Research Board. Geophysics Section, Hazen 37, DREO Report* no. 580, 1969. 20p. [field studies outlined in northern Ellesmere Island, including glacier studies and sea ice physics]

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TENSILE STRENGTH OF ICE UNDER TRIAXIAL STRESSES. *CRREL Research Report* no. 312, Dec. 1973. 21p.

B-170
Heinrich, H. (1965)
ELASTISCHEN WELLEN IN EIS (Elastic waves in ice). *Zeitschrift für Geophysik*, v. 31(6), 1965, p. 293-99. In German. [measurements of propagation and dispersion of elastic waves in floating ice; influence of water on group velocity of flexural waves]

B-171
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INTERACTION THEORY FOR A FLOATING ELASTIC SHELF OF FINITE LENGTH WITH GRAVITY WAVES IN WATER OF FINITE DEPTH, INCLUDING A COMPARISON WITH EXPERIMENTAL DATA. Port Hueneme, Calif., U.S. Naval Civil Engineering Laboratory, 1966. 178p. [assessment of internal stress state in an ice floe due to wave action and degree to which such forces are major cause of breakup]

B-172
Henry, Charles J. (1968)
WAVE-ICE INTERACTION MODEL EXPERIMENTS. *Stevens Institute of Technology. Davidson Laboratory. Report* no. 1314, Dec. 1968. 52p. NTIS: AD-680 449. [measurements of amplitude and bottom pressure were made over a range of free-surface wave lengths incident upon simulated floes of varying solidity and size]

B-173 *
Hibler, William D., III; Weeks, Wilford F.; Ackley, S.F. et al (1972)
MESO-SCALE STRAIN MEASUREMENTS ON THE BEAUFORT SEA PACK ICE (AIDJEX 1971). *AIDJEX Bulletin*, no. 13, 1972, p. 35-76. (Also *in*: *Journal of Glaciology*, v. 12(65), 1973, p. 187-206.) (Translated into "Izmerenie srednemasshtabnoi deformatsii morskikh l'dov v more Boforta (Aidzheks-1971)," *Problemy Arktiki i Antarktiki*, v. 43-44, 1974, p. 119-38. In Russian.) [pack ice, ice deformation, drift, aerial reconnaissance, ice reporting, aerial photographs]

B-174 *
Hoekstra, Pieter; Capillino, Patrick (1971)
DIELECTRIC PROPERTIES OF SEA AND SODIUM CHLORIDE ICE AT UHF AND MICROWAVE FREQUENCIES. *Journal of Geophysical Research*, v. 76(20), 1971, p. 4922-31. Fig., 20 ref.

B-175 *
Hoekstra, Pieter (1970)
THE DIELECTRIC PROPERTIES OF SEA ICE AT UHF AND MICROWAVE FREQUENCIES. (*In*: Gudmandsen, P., ed. *Proceedings of the International Meeting on Radioglaciology, Lyngby, May, 1970*. Lyngby, Technical Univ. of Denmark, Laboratory of Electromagnetic Theory, 1970, p. 32-53.)

B-176 *
Hoekstra, Pieter; Osterkamp, T.E.; Weeks, Wilford F. (1965)
THE MIGRATION OF LIQUID INCLUSIONS IN SINGLE ICE CRYSTALS. *Journal of Geophysical Research*, v. 70(20), 1965, p. 5035-41. (Also *CRREL Research Report* no. 183, 1965. 8p.) [migration of brine pockets under influence of temperature gradient investigated; results help in understanding composition of sea ice]

B-177 *
Hoekstra, Pieter; Miller, R.D. (1965)
MOVEMENT OF WATER IN A FILM BETWEEN GLASS AND ICE. *CRREL Research Report* no. 153, May 1965. 8p. Fig., ref. [properties of the film between glass and ice]

B-178 *
Holdsworth, G.; Traetteberg, A. (1973)
THE DEFORMATION OF AN ARCTIC ICE ISLAND. (*In*: *International Conference on Port and Ocean Engineering under Arctic Conditions, 2nd, Proceedings*. Held 27-30 Aug. 1973, Reykjavik. Univ. of Iceland, 1974, p. 419-40. 14 fig., 1 table, 6 ref.)

B-179 *
Holdsworth, G. (1969)
FLEXURE OF A FLOATING ICE TONGUE. *Journal of Glaciology*, v. 8(54), Oct. 1969, p. 385-97. Fig., ref. In English with French and German summaries. [several analyses for the flexure of a floating polar ice tongue]

B-180
Hoskins, E.R.; Shapiro, Lewis H. (1976)
RESULTS OF PRELIMINARY FLAT JACK TESTS FOR DETERMINING THE ELASTIC AND CREEP PROPERTIES OF IN SITU SEA ICE. *EOS*, v. 57(3), 1976, p. 151. [abstract only; experimental studies, creep curves, elastic moduli, stress]

B-181
Huang, J.S. (1975)
EFFECT OF NATURAL CONVECTION ON ICE CRYSTAL GROWTH IN SALT SOLUTIONS. Syracuse, N.Y., Syracuse Univ., 1975. 118p. Ph.D. thesis. Univ. Microfilms order no. 76-18524. [ice crystal growth, solutions, convection, salt water]

B-182 *
Hunkins, Kenneth L. (1975)
GEOSTROPHIC DRAG COEFFICIENTS FOR RESISTANCE BETWEEN PACK ICE AND OCEAN. AIDJEX Bulletin, no. 28, 1975, p. 61-67. 3 fig., ref.

B-183
Hunkins, Kenneth L.; Bauer E.; Amos, Anthony F. (In press)
SALINITY AND TEMPERATURE MEASUREMENTS FROM THE AIDJEX MANNED ARRAY. Presented at Symposium on Sea Ice Processes and Models, Seattle, Univ. of Washington, 6-9 Sept. 1977, sponsored by ICSI and AIDJEX.

B-184
Hunkins, Kenneth L. (1965)
THE SEASONAL VARIATION IN THE SOUND-SCATTERING LAYER OBSERVED AT FLETCHERS ICE ISLAND T-3 WITH A 12-KC/S ECHO SOUNDER. Deep-Sea Research and Oceanographic Abstracts, v. 12(6), Dec. 1965, p. 879-81. 4 fig., 1 ref. (Also Columbia Univ. Lamont Geological Observatory. Contribution no. 847.)

B-185 *
Hutter, Kolumban (1975)
FLOATING SEA ICE PLATES AND THE SIGNIFICANCE OF THE DEPENDENCE OF THE POISSON RATIO ON BRINE CONTENT. Royal Society of London. Proceedings, no. 343, 1975, p. 85-108. 6 fig., 8 ref. In English with French and German summaries.

B-186 *
Hutter, Kolumban (1974)
ON THE SIGNIFICANCE OF POISSON'S RATIO FOR FLOATING SEA ICE. Zurich. Eidgenossische Technische Hochschule. Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie. Mitteilung no. 11, May 1974. 78p. 11 ref. In English with German and French summaries. [investigates influence of temperature profile in ice plates on plate characteristic coefficients for dynamical theory of flexible plates that accounts for such effects as variation of Poisson's ratio across plate thickness]

B-187 *
Hutter, Kolumban (1976)
THE SIGNIFICANCE OF THE SHEAR RIGIDITY AND OF THE POISSON RATIO FOR SEA ICE PLATES. (In: International Conference on Port and Ocean Engineering under Arctic Conditions, 3rd, Proceedings. Held 11-15 Aug. 1975, Fairbanks, Alaska. Institute of Marine Science, Univ. of Alaska, 1976, p. 247-68.)

B-188
Iakunin, A.E. (1974)
CALCULATION OF ICE-COVER BENDING ALLOWING FOR VISCOUS PROPERTIES OF ICE. CRREL Translation no. 425, Sept. 1974. 9p. NTIS: AD-A002 378. (Translated from "K voprosu ob izgibe ledianogo prokrova s uchetom viazkikh svoistv l'da," Novosibirsk. Institut Inzhenerov Zhelezhodorozhnogo Transporta. Trudy, v. 79, 1968, p. 72-82.) [linear viscoelastic deflections and stresses of floating ice sheet]

B-189
Ibchenko, V.O.; Kheisin, D.E. (1974)
OPREDELENIYE VNUTRENNIKH NAPRYAZHENIY V LEDYANOM POKROVE, VOZNIKAYUSHCHIKH PRI DREYFA L'DA (Measurement of internal strains in ice cover occurring during ice drift). Problemy Arktiki i Antarktiki, v. 43-44, 1974, p. 84-91. In Russian.

B-190
ICE IS SAFE ONLY IN A GLASS. Canadian Mining Journal, v. 95(1), 1974, p. 11. [table showing load-carrying capacity of floating ice of various thicknesses for loads ranging from one person on skis to 7-8 ton truck]

B-191
Iizuka, K.; Nguyen, V.K.; Ogura, H. (1971)
REVIEW OF THE ELECTRICAL PROPERTIES OF ICE AND HISS DOWN-LOOKING RADAR FOR MEASURING ICE THICKNESS. Canadian Aeronautics and Space Journal, v. 17(10), Dec. 1971, p. 429-30. [ice cover thickness, ice electrical properties, radar echoes, airborne radar, ice dielectrics, measuring instruments, holography]

B-192
Illich, H.A.; Davis, G.A.; Hill, W.L. (1974)
CRYSTAL FABRIC VARIATIONS IN ARCTIC SEA ICE. (In: Reed, John C.; Sater, J.E., ed. The Coast and Shelf of the Beaufort Sea. Proceedings of a symposium held in San Francisco, 7-9 Jan. 1974. Arlington, Va., Arctic Institute of North America, 1974, p. 205-19.) [results from examination of sea ice collected off southwest coast of Amund Ringnes]

B-193 *
Ishida, Tamotsu; Tabata, Tadashi; Suzuki, Y. et al. (1972)
PRELIMINARY TESTS OF STRESS AND STRAIN MEASUREMENT WITHIN ICE SHEET. (In: Karlsson, T., ed. Sea Ice: Proceedings of an International Conference. Held 10-13 May 1971, Reykjavik. National Research Council, 1972, p. 174-75.)

B-194
Ishida, Tamotsu (1966)
VIBRATIONS OF A SEA ICE SHEET ON THE OCCASION OF ITS BREAKING. Teion Kagaku, Series A, no. 24, 1966, p. 239-48. In Japanese with English summary.

B-195
Ivchenko, V.O.; Kheisin, D.E. (1974)
OPREDELENIYE VNUTRENNIKH NAPRYAZHENIY V LEDYANOM POKROVE, VOZNIKAYUSHCHIKH PRI DREYFE L'DA (Measurement of internal strains in ice cover occurring during ice drift). Problemy Arktiki i Antarktiki, v. 43-44, 1974, p. 84-91. In Russian.

B-196
Jellinek, H.G.G. (1972)
ICE INTERFACE. (In: Horne, R.A., ed. Water and Aqueous Solutions: Structure, Thermodynamics, and Transport Processes. N.Y., Wiley-Interscience, 1972, p. 65-107.)

B-197 *
Johnson, Philip R. (1976)
AN EARLY DESALINATION AND ICE STRUCTURES PROJECT USING NATURAL FREEZING. (In: International Conference on Port and Ocean Engineering under Arctic Conditions, 3rd, Proceedings. Held 11-15 Aug. 1975, Fairbanks, Alaska. Institute of Marine Science, Univ. of Alaska, 1976, p. 285-86.)

B-198 *
Johnson, Phillip R. (1972)
MODULUS OF ELASTICITY OF SEA ICE SHOWN BY DIRECT TENSION AND COMPRESSION TESTS OF SMALL SPECIMENS. (In: I.A.H.R. Symposium on Ice and Its Action on Hydraulic Structures, 2nd, Proceedings. Held in Leningrad 26-29 Sept. 1972. Leningrad, International Assn. for Hydraulic Research, 1972, p. 8-16.)

B-199
Kaleri, E.Iu.; Kluga, A.M.; Petrov, A.N. et al (1971)
ANISOTROPY OF RADIO-WAVE DELAY IN SEA ICE. Akademiya Nauk SSSR. Izvestiya. Atmospheric and Oceanic Physics, v. 7(10), Oct. 1971, p. 738. (Translated from "Ob anizotropii zapazdyvaniya radiovoln v morskom l'du," Akademiya Nauk SSSR. Izvestiya. Fizika Atmosfery i Okeana, v. 7(10), 1971, p. 115-16.)

B-200
Kamb, Barclay (1966)
EXPERIMENTAL RECRYSTALLIZATION OF ICE UNDER DEFORMATION. American Geophysical Union. Transactions, v. 47(1), 1966, p. 187-88. [abstract only]

B-201
Kapitkin, B.T. (1972)
ISSLEDOVANIYA DIELEKTRICHESKIKH SVOYSTV MORSKOGO L'DA V DIAPAZONE SVCh (Research into the dielectric properties of sea ice in the VHF spectrum). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 298, 1972, p. 116-20. In Russian.

B-202 *
Kaplar, C.W. (1966)
LABORATORY DETERMINATION OF THE DYNAMIC MODULI OF FROZEN SOILS AND OF ICE. (In: Permafrost International Conference, Lafayette, Ind., 1963, Proceedings. National Research Council. Publication no. 1287, 1966, p. 293-301.) (Also CRREL Research Report no. 163, 1969. 45p.)

B-203
Kashtelian, V.I.; Pozniak, I.I.; Ryvlin, A.Ia. (1968)
SOPROTIVLENIE L'DA DVIZHENIIU SUDNA (Ice resistance to the ship's movement). Leningrad, Izdatelstvo Sudostroenie, 1968. 238p. Tables, 110 ref. In Russian. [theoretical and experimental problems of a vessel's movement through loose pack, solid, and hummocky sea ice]

B-204 *
Kashtelian, V.I.; Ryvlin, A.Ia. (1966)
UCHET PRIRODNYKH KHARAKTERISTIK SPLOSHNOGO L'DA PRI OTSENKE EGO PROKHODIMOSTI LEDOKOLOM (Calculation of natural properties of close pack ice by appraisal of its penetrability by icebreakers). Problemy Arktiki i Antarktiki, v. 22, 1966, p. 75-80. In Russian. [icebreaker movement in Arctic Basin ice where transit is significantly affected by the ice thickness, degree of decay, hummocking, etc.]

B-205
Katona, Michael G.; Vaudrey, K.D. (1973)
ICE-ENGINEERING-SUMMARY OF ELASTIC PROPERTIES RESEARCH AND INTRODUCTION TO VISCOELASTIC AND NONLINEAR ANALYSIS OF SALINE ICE. U.S. Naval Civil Engineering Laboratory. Technical Report no. 797, Aug. 1973. 72p. NTIS: AD-768 279. [previous studies on elastic behavior with emphasis placed on plate analysis]

B-206
Katona, Michael G. (1974)
ICE ENGINEERING: VISCOELASTIC FINITE ELEMENT FORMULATION. U.S. Naval Civil Engineering Laboratory. Technical Report no. 803, Jan. 1974. 60p. NTIS: AD-774 482. [sea ice, viscoelasticity, loads (forces), stress strain relations, landing fields, boundary value problems, computerized simulation]

B-207
Katsaros, K.B. (1973)
SUPERCOOLING AT THE SURFACE OF AN ARCTIC LEAD. Journal of Physical Oceanography, v. 3(4), 1973, p. 482-86. [field observations verify the supposition that supercooling of the surface water on open leads acts as a source of water for observed sub-surface freezing]

B-208
Kennedy, R.J. (1968)
ON THE EXPANSION OF A FLOATING ICE SHEET WITH TEMPERATURE CHANGE. Canada. National Research Council. Associate Committee on Geotechnical Research. Technical Memorandum no. 92, March 1968, p. 185-87.

B-209 *
Kerr, Arnold D. (1975)
THE BEARING CAPACITY OF FLOATING ICE PLATES SUBJECTED TO STATIC OR QUASI-STATIC LOADS: A CRITICAL SURVEY. CRREL Research Report no. 333, March 1975. 43p. 28 fig., tables, 157 ref. NTIS: AD-A009 363.

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Kerr, Arnold D.; Palmer, W.T. (1970)
THE DEFORMATIONS AND STRESSES IN FLOATING ICE PLATES. New York. Univ. School of Engineering and Science. Dept. of Aeronautics and Astronautics. Report no. S-70-3, NYU-AA-70-17, 1970. 22p. [further mathematical development of Assur's work on flexural and other properties of sea ice sheets]

B-211 *
Kerr, Arnold D. (1966)
ON PLATES SEALING AND INCOMPRESSIBLE LIQUID. International Journal of Mechanical Sciences, v. 8(4), 1966, p. 295-304. (Also CRREL Research Report no. 260, 1968. 11p.) [mathematical study of problem of bearing capacity of ice floes on which melt water has partially refrozen]

B-212
Ketcham, W.M.; Hobbs, P.V. (1967)
THE PREFERRED ORIENTATION IN THE GROWTH OF ICE FROM THE MELT. Journal of Crystal Growth, v. 1, 1967, p. 263-70.

B-213
Kheisin, D.E. (1969)
DYNAMICS OF THE ICE COVER. U.S. Air Force Systems Command. Foreign Technology Division. Wright-Patterson Air Force Base. Translation no. FTD-HT-23-485-69, Sept. 1969. 252p. (Translated from Dinamika Ledyanogo Pokrova. Leningrad, Gidrometeorologicheskoye Izdatel'stvo, 1967.)

B-214 *
Kheisin, D.E. (1972)
EXCITATION OF COMPRESSIVE STRESSES IN ICE DURING THE HYDRODYNAMIC STAGE OF COMPACT ICE DRIFT. AIDJEX Bulletin, no. 16, Oct. 1972, p. 97-107. [external and internal forces affecting the drift of ice floes; time scales required to describe ice drift]

B-215
Kheisin, D.E.; Cherepanov, N.V. (1970)
IZMENENIYE STRUKTURY L'DA V ZONE UDARA TVERDOGO TELA O POVERKHNOST' LEDYANOGO POKROVA (Change of ice structure in a region where a solid object has struck the ice cover). Problemy Arktiki i Antarktiki, v. 34, 1970, p. 79-84. In Russian. [studies with floating ice, with possible application to shipping problems]

B-216
Kheisin, D.E. (1969)
ON THE PROPOGATION OF FLEXURAL GRAVITATIONAL WAVES ON AN ICE-COVERED SEA. Akademiya Nauk SSSR. Izvestiya. Atmospheric and Oceanic Physics, v. 5(12), Dec. 1969, p. 173. (Translated from "O rasprostranenii izgibno-gravitatsionnykh voln v more, pokrytom l'dom," Akademiya Nauk SSSR. Izvestiya. Fizika Atmosfery i Okeana, v. 5(12), Dec. 1969, p. 1334.)

B-217
Kheisin, D.E.; Ivchenko, V.O. (1976)
OPREDELENIE TANGENTSIAL'NYKH NAPRIAZHENII NA NIZHNEI POVERKHNOSTI L'DA PRI CHISTO VETROVOM DREIFE (Calculating tangential stress on the lower surface of ice during drift due entirely to wind). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 332, 1976, p. 51-59. 7 ref. In Russian. [drift, turbulence, ice mechanics, stresses, sea ice, analysis (mathematics), wind factors]

B-218*
Kheisin, D.E. (1971)
O VOZBUZHDENII USILII LEDOVOGO SZHATIIA NA GIDRODINAMICHESKOI STADII DREIFA SPLOCHENNYKH L'DOV (Activation of ice compaction stresses at the hydrodynamic stage of packed ice drift). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 303, 1971, p. 89-97. 11 ref. In Russian. [ice compression, drift, pack ice, stresses, analysis (mathematics), sea ice]

B-219
Kheisin, D.E.; Ivchenko, V.O. (1976)
PRESSURE DISTRIBUTION IN CONSOLIDATED ICE. Oceanology, v. 15(5), May 1976, p. 542-46. 8 ref. (Translated from Okeanologiya, v. 15(5), 1975.)

B-220*
Kheisin, D.E. (1971)
SOME UNSTEADY-STATE PROBLEMS IN ICE-COVER DYNAMICS. (In: Yakovlev, G.N., ed. Studies in Ice Physics and Ice Engineering, v. 300. Jerusalem, Israel Program for Scientific Translations, 1973, p. 69-78. 3 fig., 5 ref. NTIS: TT72-50005.)

B-221
Khokhlov, G.P. (1970)
RESULTS OF EXPERIMENTAL MEASUREMENTS OF THE ELECTRICAL PARAMETERS OF ARCTIC SEA ICE AT FREQUENCIES BETWEEN 100 HZ and 1MHZ. Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Transactions, v. 295, 1971, p. 64-70. NTIS: TT70-50158. (Translated from "Resul'taty eksperimental'nykh issledovanii elektricheskikh kharakteristik arkticheskogo morskogo l'da v diapazone chastot 100 Gts - 1 Mgts," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 295, 1970, p. 74-82.)

B-222
Kiselev, Iu.G. (1971)
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B-223
Kiviniemi, A. (1975)
MEASUREMENTS OF WAVE MOTION IN THE ICE SURFACE. Suomen Geodeettinen Laitos. Tiedonantoja, v. 75(4), 1975. 13p. 2 ref. [geodetic surveys, lake ice, gravimetric prospecting, water waves]

B-224 *
Kivisild, H.R. (1976)
ICE MECHANICS. (In: International Conference on Port and Ocean Engineering under Arctic Conditions, 3rd, Proceedings. Held 11-15 Aug. 1975, Fairbanks, Alaska. Institute of Marine Science, Univ. of Alaska, 1976, p. 287-313.)

B-225 *
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ORIENTATION FABRICS IN SEA ICE. (In: Sater, J.E., ed. Arctic Drifting Stations: A Report on Activities Supported by the Office of Naval Research. Proceedings of a symposium held 12-15 April 1966 in Warrenton, Va. Washington, D.C., Arctic Institute of North America, 1968, p. 217-224.)

B-226
Kohnen, Heinz (1976)
ON THE DC-RESISTIVITY OF SEA ICE. Zeitschrift für Gletscherkunde und Glazialgeologie, Bd. 11, Heft 2, 1976, p. 143-54. 12 ref.

B-227
KOLEBANIIA LEDIANOGO POKROVA, OBUSLOVLENNYE SVOBODNYMI VNUTRENNIMI GRAVITATSIONNYMI VOLNAMI (Ice cover oscillations caused by free internal gravity waves). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 316, 1974, p. 113-17. 5 ref. In Russian. [pack ice, oscillations, water waves, analysis (mathematics)]

B-228
Korunov, M.M. (1967)
AN APPROXIMATE METHOD FOR THE DETERMINATION OF THE BEARING CAPACITY OF AN ICE COVER. Sverdlovskii Nauchno-Issledovatel'skii Institut Lesnoi Promyshlennosti. Trudy, v. 3, 1967. In Russian.

B-229 *
Kovacs, Austin; Weeks, Wilford F. (1977)
DYNAMICS OF NEAR-SHORE ICE. (In: Environmental Assessment of the Alaskan Continental Shelf, v. 4. Boulder, Colo., Environmental Research Laboratories, 1977, p. 106-12.) [fast ice, ice mechanics, radar echoes, logistics]

B-230 *
Krouse, H. Roy (1974)
STABLE ISOTOPES IN THE STUDY OF SNOW AND ICE RESOURCES. (In: Santeford, Henry S.; Smith, J.L., comp. Advanced Concepts and Techniques in the Study of Snow and Ice Resources: An Interdisciplinary Symposium held at Monterey, Calif., 2-6 Dec. 1973. Washington, D.C., National Academy of Sciences, 1974, p. 651-60.) [reviews techniques and applications with reference to studies in the Arctic]

B-231
Kupetskii, V.N. (1967)
O LYUMINISTSENTSII MORSKIKH L'DOV (Luminescence of sea ice). Geograficheskoe Obshchestvo SSSR. Izvestiya, v. 99(1), 1967, p. 67-70. In Russian.

B-232
Kusunoki, Kou; Minoda, Takashi; Fujino, Kazuo et al (1966)
DESCRIPTION OF OCEANOGRAPHIC OBSERVATIONS AT DRIFT STATION ARLIS II IN 1964-1965. Washington, D.C., Arctic Institute of North America, Dec. 1966. 106p. NTIS: AD-652 616. [temperature, chlorinity (salinity), dissolved oxygen, silicate, phosphate, ice drift, subsurface ocean currents]

B-233*
Kusunoki, Kou (1966)
AN EXAMPLE OF CHLORINITY DISTRIBUTION IN PERENNIAL SEA ICE. Seppyo, v. 28(6), 1966, p. 161-62. In Japanese with English summary. [vertical distribution of salinity in ice core sample from ice island ARLIS 2]

B-234
Kuzenkova, P.O. (1972)
IZMENENIYE SOLENOSTI VODY PRI OBRAZOVANII L'DA V MELKOVODNYKH MORYAKH (Water salinity variation during ice formation in shallow seas). Meteorologiya i Gidrologiya, no. 5, May 1972, p. 75-79. In Russian. [empirical method for calculating the water salinity during the winter]

B-235
Lake, R.A.; Lewis, Edward L.; Walker, E.R. (1969)
BRINE DRAINAGE DURING SEA ICE GROWTH AND VERTICAL CIRCULATION IN THE UNDERLYING WATER. EOS, v. 50(2), 1969, p. 63. [abstract only]

B-236*
Lake, R.A.; Walker, E.R. (1973)
NOTES ON THE OCEANOGRAPHY OF D'IBERVILLE FIORD. Arctic, v. 26(3), Sept. 1973, p. 222-29. In English with French and Russian summaries. [sea ice, heat transfer, water temperature, salinity, ice cover effect]

B-237
Lake, R.A.; Lewis, Edward L. (1970)
SALT REJECTION BY SEA ICE DURING GROWTH. Journal of Geophysical Research, v. 75(3), 1970, p. 583-97. [salt rejection shown to take place by cyclic convective processes in small interstitial spaces in bottom centimeters of ice]

B-238*
Lane, J.W. (1975)
OPTICAL PROPERTIES OF SALT ICE. Journal of Glaciology, v. 15(73), 1975, p. 363-72. 6 fig., ref.

B-239
Langleben, M.P.; Pounder, Elton R. (1968)
ACOUSTIC ATTENUATION IN SEA ICE. McGill Univ. Macdonald Physics Lab. Ice Research Project. Report no. S-14, June 1968. 21p.
NTIS: AD 679 627.

B-240
Langleben, M.P.; Pounder, Elton R. (1970)
ACOUSTIC ATTENUATION IN SEA ICE: REFLECTION OF SOUND AT THE WATER-ICE INTERFACE. McGill Univ. MacDonald Physics Laboratory. Ice Research Project. Report no. S-16, May 1970. 36p.
NTIS: AD-707 059.

B-241*
Langleben, M.P. (1969)
ATTENTUATION OF SOUND IN SEA ICE, 10-500 KHZ. Journal of Glaciology, v. 8(54), Oct. 1969, p. 399-406. In English with French and German summaries.

B-242*
Langleben, M.P. (1969)
PHYSICS OF SEA ICE. (In: International Dictionary of Geophysics, 1969, p. 1-5.
NTIS: AD-698 722.) [growth and microstructure of sea ice, mechanical properties, ultimate strength, elastic properties, thermal properties, and electrical properties]

B-243*
Langleben, M.P. (1970)
REFLECTION OF SOUND AT THE WATER-SEA ICE INTERFACE. Journal of Geophysical Research, v. 75(27), 1970, p. 5243-46. 3 fig., 4 ref.

B-244*
Lavrov, V.V. (1971)
DEFORMATION AND STRENGTH OF ICE. Jerusalem, Israel Program for Scientific Translations, 1971. 164p. NTIS: TT70-50130. (Translated from Deformatsiya i Prochnost' L'da. Leningrad, Gidrometeorologicheskoye Izdatel'stvo, 1969.) [structure, behaviour of ice under load, mechanical properties, and shape]

B-245
Lavrov, V.V. (1965)
THE INFLUENCE OF ICE STRUCTURE UPON ITS STRENGTH. CRREL Translation no. 306, 1965.
NTIS: AD-737 823. (Translated from "Vliianie struktury l'da na ego prochnost'," Problemy Arktiki i Antarktiki, v. 20, 1965, p. 61-67.) [coarse-grained crystalline freshwater ice, polycrystalline freshwater ice, snow-ice, and sea ice of 1% salinity are investigated in compression and bending]

B-246
Lebedev, G.A.; Popov, I.K. (1975)
LOW FREQUENCY NOISE GENERATED IN SEA ICE BY BLOWING SNOW. (In: Ocean '74: IEEE International Conference on Engineering in the Ocean Environment, Halifax, Nova Scotia, Aug. 21-23, 1974, Record, v. 1. New York, Institute of Electrical and Electronic Engineers, 1975, p. 102-03. 5 ref.) [sea ice, ice acoustics, noise (sound), acoustic properties, blowing snow, snow acoustics, wind factors]

B-247
Legen'kov, A.P.; Chugui, I.V.; Basova, L.G. (1977)
DEFORMATSIYA LEDYANOGO OSTROVA DREYFUYUSHCHEY STANTSII "SEVERNYY POLYUS-19" (Deformation of the ice island of the drifting station SP-19). Problemy Arktiki i Antarktiki, v. 49, 1977, p. 118-20. In Russian.

B-248
Legen'kov, A.P. (1970)
K VOPROSU O POVEDENII PREDMETOV, PLAVAIUSHCHIKH NA POVERKHNOSTI VOLN (Behavior of objects floating on wave surfaces). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 293, 1970, p. 134-40. 2 ref. In Russian. [analysis (mathematics), ocean currents, drift]

B-249
Legen'kov, A.P. (1970)
ON THE THERMAL STRESSES AND STRAINS IN ICE FIELDS. Akademiya Nauk SSSR. Izvestiya. Atmospheric and Oceanic Physics, v. 6(8), 1970, p. 490-94. (Translated from "K voprosu o termicheskikh napryazheniyakh i deformatsiyakh ledyanykh poley," Akademiya Nauk SSSR. Izvestiya. Fizika Atmosfery i Okeana, v. 6(8), 1970, p. 832-39.) [simplified method of computing thermal stress and deformation of sea ice]

B-250
Legen'kov, A.P.; Uglev, V.D. (1970)
RESULTS OF MEASUREMENTS OF THE DEFORMATION OF A MULTIYEAR ICE-FLOE BY INVAR WIRES. Akademiya Nauk SSSR. Izvestiya. Atmospheric and Oceanic Physics, v. 6(5), 1970, p. 310-12. (Translated from "Rezul'taty izmereniya deformatsii mnogoletnego ledyanogo polya invarnymi provolokami," Akademiya Nauk SSSR. Izvestiya. Fizika Atmosfery i Okeana, v. 6(5), 1970, p. 537-40.)

B-251 *
Legen'kov, A.P.; Chugui, I.V. (1973)
RESULTS OF MORPHOMETRIC MEASUREMENTS OF THE ICE ISLAND OF THE SEVERNYI POLYUS-19 DRIFTING STATION. (In: Treshnikov, A.F., ed. Problems of the Arctic and Antarctic, v. 42. Jerusalem, Israel Program for Scientific Translation, 1973, p. 53-60.) (Translated from Problemy Arktiki i Antarktiki, v. 42, 1973, p. 44-48.)

B-252
Legen'kov, A.P.; Chugui, I.V.; Eremin, N.N. (1975)
RESULTS OF TEMPERATURE MEASUREMENTS ON THE DRIFTING ICE ISLAND NORTH POLE 19. (In: Ocean '74: IEEE International Conference on Engineering in the Ocean Environment, Halifax, Nova Scotia, Aug. 21-23, 1974, Record, v. 1. New York, Institute of Electrical and Electronic Engineers, 1975, p. 137-39. 2 ref.) (Also in: Okeanologiya, v. 14(4), 1974, p. 619-22. In Russian.) [ice temperature, temperature distribution, ice islands, drift stations, freezing points]

B-253
Legen'kov, A.P. (1974)
THERMAL STRESSES AND DEFORMATIONS OF THE DRIFTING ICE ISLAND STATION NORTH POLE 19. Oceanology, v. 13(6), Dec. 1974, p. 804-08. 5 ref. (Translated from "Termicheskiye naprazheniya i deformatsii ledyanogo ostrova deyfuyushchey stantsii Severnyy polyus-19," Okeanologiya, v. 13(6), 1973, p. 975-80.) [calculations based on ice temperature and salinity data]

B-254
Lerner, B.A.; Poliakova, T.V.; Popov, I.K. (1973)
HIGH FREQUENCY MICROSEISMIC OSCILLATIONS OF ICE COVER. Soviet-Bloc Research in Geophysics, Astronomy and Space, no. 310, Oct. 1973, p. 36-37. [abstract of Russian article, "Statistical characteristics of high-frequency microseismic oscillations of the ice cover in the Arctic Basin," Avtomatizatsiya Nauchnogo-Issledovaniya Morey i Okeanov. Simpozium, Chast' 1, 1972, p. 254-58]

B-255 *
Lewis, Edward L.; Lake, R.A. (1971)
SEA ICE AND SUPERCOOLED WATER. Journal of Geophysical Research, v. 76(24), 1971, p. 5836-41. [literature review and laboratory experiments suggest that existence of supercooled water below growing sea ice is temporary if it is there at all]

B-256
Lewis, Edward L.; Walker, E.R. (1970)
THE WATER STRUCTURE UNDER A GROWING SEA ICE SHEET. Journal of Geophysical Research, v. 75(33), 1970, p. 6836-45. [data illustrating seasonal changes in temperature and salinity profile beneath an annual sea ice cover]

B-257 *

Ling, Chi-Hai; Campbell, William J. (1976)

ANTISYMMETRIC STRESS FOR SEA ICE. AIDJEX Bulletin, no. 33, Sept. 1976, p. 77-84. 14 ref.

B-258 *

Little, Edward M.; Allen, M.B.; Wright, F.F. (1972)

FIELD MEASUREMENT OF LIGHT PENETRATION THROUGH SEA ICE. Arctic, v. 25(1), 1972, p. 28-33. Fig.

B-259 *

Lofgren, Gary; Weeks, Wilford F. (1969)

EFFECT OF GROWTH PARAMETERS ON SUBSTRUCTURE SPACING IN NaCl ICE CRYSTALS. CRREL Research Report no. 195, Jan. 1969. 20p. NTIS: AD-687 280. [effect of growth velocity and solute concentration on cellular substructure that develops in NaCl ice]

B-260

Luchininov, V.S. (1968)

ELECTRICAL CHARACTERISTICS OF ICE. Soviet Physics, Technical Physics, v. 13(3), 1968, p. 418-23. (Translated from "Elektricheskiye kharakteristiki l'da," Zhurnal Tekhnicheskoy Fiziki, v. 38(3), 1968, p. 565-72.) [study of electrical properties of sea ice as a function of frequency and temperature]

B-261*

Määttänen, M. (1976)

ON THE FLEXURAL STRENGTH OF BRACKISH WATER ICE BY IN SITU TESTS. (In: International Conference on Port and Ocean Engineering under Arctic Conditions, 3rd, Proceedings. Held 11-15 Aug. 1975, Fairbanks, Alaska. Institute of Marine Sciences, Univ. of Alaska, 1976, p. 349-59.)

B-262*

McNeill, Duncan; Hoekstra, Pieter (1971)

IN-SITU MEASUREMENTS ON THE CONDUCTIVITY AND SURFACE IMPEDANCE OF SEA-ICE AT VLF FREQUENCIES. Copenhagen. Polyteknisk Laereanstalt. Laboratoriet for Elektromagnetisk Feltteori. Report no. R105, Dec. 1971. 19p. 5 ref. (Also in: Radio Science, v. 8(1), Jan. 1973, p. 23-30.) [experimental program to measure in-situ values of the electrical conductivity and surface impedance of sea ice at VLF frequencies]

B-263

Mahrenholtz, O. (1966)

ZUR TRAGFÄHIGKEIT VON EISDECKEN (Load-bearing capacity of ice layers). Zeitschrift für Angewandte Mathematik und Mechanik, Bd. 46, Sonderheft, 1966, p. T170-73. In German. [computation of load-bearing capacity of ice layers]

B-264 *

Malmberg, Svend-Aage (1972)

ANNUAL AND SEASONAL HYDROGRAPHIC VARIATIONS IN THE EAST ICELANDIC CURRENT BETWEEN ICELAND AND JAN MAYEN. (In: Karlsson, T., ed. Sea Ice: Proceedings of an International Conference. Held 10-13 May 1971, Reykjavik. National Research Council, 1972, p. 42-54.) [discusses variations and relates to drift ice conditions in north Icelandic waters]

B-265

Malmberg, Svend-Aage (1969)

ASTAND SJAVAR MILLI ISLANDS OG JAN MAYEN I JUNI 1962 OG 1969 (Hydrographic conditions between Iceland and Jan Mayen in June 1962 and 1969). Aegir, v. 62(22), Dec. 1969, p. 404-08. 15 ref. In Icelandic with English summary. [sea ice, salinity, ice conditions, temperature effects, drift, fish migration]

B-266

Malmberg, Svend-Aage (1969)

ASTAND SJAVAR MILLI ISLANDS OG JAN MAYEN OG HAFÍS VID ISLAND (Temperature and salinity conditions between Iceland and Jan Mayen and relationship with pack ice occurrence in north Icelandic waters). Aegir, v. 62(22), 1969, p. 410-13. In Icelandic with English summary.

B-267*

Malmberg, Svend-Aage (1970)

HYDROGRAPHIC CHANGES IN THE WATERS BETWEEN ICELAND AND JAN MAYEN IN THE LAST DECADE. Jökull, v. 19, 1970, p. 30-43. [influence of salinity and temperature changes in East Icelandic current on drift ice conditions in Icelandic waters]

B-268*

Martin, Patrick; Thorndike, Alan S. (1972)

ACOUSTIC BOTTOM REFERENCING SYSTEM. AIDJEX Bulletin, no. 14, 1972, p. 59.

B-269 *

Martin, Seelye; Kauffman, Peter (1974)

THE EVOLUTION OF UNDER-ICE MELT PONDS, OR DOUBLE DIFFUSION AT THE FREEZING POINT. Journal of Fluid Mechanics, v. 64(3), 1974, p. 507-27. NTIS: AD-785 321. (Abstract in: EOS, v. 53(11), 1972, p. 1011.) [describes experimental and theoretical study modelling phenomenon observed in summer Arctic]

B-270

Martin, Seelye (1971)

AN EXPERIMENTAL STUDY OF SOME CONVECTIVE MODELS FOR NATURAL DESALINATION OF SEA ICE. Washington. Univ. Final Report, Oct. 1971. 8p. NTIS: AD-733 064. [growth of brine channels in sea ice; growth of stalactites under sea ice]

B-271

Martynova, V.A.; Spitsyn, V.A. (1974)

TEPLOVYE KONTRASTY ESTESTVENNOI VODNO-LEDOVOSNEZHNOI POVERKHNOSTI I VOZMOZHNOST' KOLICHESTVENNOI OTSENKI IKH PO DANNYM IZMERENII IK METODAMI (Thermal contrasts in a natural water-ice-snow surface and possibilities of their quantitative evaluation from infrared data). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 324, 1974, p. 148-50. 2 ref. In Russian.

B-272

Maser, K.R. (1971)

DETERMINATION OF THE STRENGTH OF AN ICE SHEET FROM SMALL SAMPLE DATA. (In: Offshore Technology Conference, 3rd, Preprints, v. 2. Held in Houston, Texas, 19-21 April 1971, p. 1187-94.) [ice sheets, plasticity, strength prediction, sea ice, grain size, load rates]

B-273
Masterson, D.M. (1974)
FLOATING ICE SHEETS. Northern Engineer, v. 6(3), Fall 1974, p. 11-18. 14 fig., ref.

B-274
Mayer, Walter G. (1974)
DETERMINATION OF TRANSVERSE-WAVE VELOCITY IN TRANSITION LAYER OF SEA ICE FROM REFLECTION OF WATER-BORNE SOUND. Journal of Geophysical Research, v. 79(6), 1974, p. 885-86. 7 ref.

B-275
Mayer, Walter G.; Diachok, O.I. (1973)
SCALE MODEL ULTRASONIC STUDY OF ARCTIC ICE. Georgetown Univ. Dept. of Physics. Technical Report, no. 1, Sept. 1973. 14p. NTIS: AD-766 485. [sea ice, ultrasonic properties, sound transmission, sea ice, reflection, model tests, interfaces]

B-276
Mayer, Walter G. (1975)
SCALE MODEL ULTRASONIC STUDY OF ARCTIC ICE. FINAL TECHNICAL REPORT 1 OCT. 1972-15 JAN. 1975. Georgetown Univ. Dept. of Physics. Final Report, 1975. NTIS: AD-A004 249. [scale-model study of sonic reflectivity, transmissivity and the partition of energy upon sonic incidence at the arctic ice cover]

B-277
Mayer, Walter G.; Behravesh, M.; Plona, T.J. (1974)
SONIC REFLECTIVITY FROM SEA-ICE/WATER INTERFACES. Georgetown Univ. Dept. of Physics. Technical Report no. 2, March 1974. 41p. NTIS: AD-775 655. [reflectivity curves calculated for sea-ice/water boundaries in which the densities and sonic velocities in the two media are changed in increments]

B-278 *
Maykut, Gary A.; Grenfell, T.C. (1975)
THE SPECTRAL DISTRIBUTION OF LIGHT BENEATH FIRST-YEAR SEA ICE IN THE ARCTIC OCEAN. Limnology and Oceanography, v. 20(4), July 1975, p. 554-63. 7 fig., ref. NTIS: AD-A017 413.

B-279
Mendel'son, V.L.; Kozlov, A.I.; Finkel'shtein, M.I. (1972)
INVESTIGATION OF SOME ELECTRODYNAMIC MODELS OF ICE (SHEETS USEFUL) IN RADAR-SOUNDING PROBLEMS. Akademiya Nauk SSSR. Izvestiya. Atmospheric and Oceanic Physics, v. 8(4), 1972, p. 225-29. (Translated from "Issledovaniye nekotorykh elektrodinamicheskikh modeley l'da v zadachakh radiolokatsionnogo zondirovaniya," Akademiya Nauk SSSR. Izvestiya. Fizika Atmosfery i Okeana, v. 8(4), 1972, p. 396-402.) [method developed for estimating intensities of signals reflected from upper and lower interfaces of floating ice sheets, assuming a variety of models]

B-280
Merino, M.P. (1974)
INTERNAL SHEAR STRENGTH OF FLOATING FRAGMENTED ICE COVERS. Iowa City, Univ. of Iowa, May 1974. 80p. 6 ref. M.S. thesis.

B-281
Metge, M.; Strilchuk, A.; Trofimenkoff, P. (1975)
ON RECORDING STRESSES IN ICE. (In: Frankenstein, Guenther E., ed. International Symposium on Ice Problems, 3rd, Proceedings. Held 18-21 Aug. 1975, Hanover, N.H. International Assn. of Hydraulic Research, 1975, p. 459-68. 7 ref.) In English with French summary. [ice mechanics, stresses, strains, temperature effects]

B-282 *
Michel, Bernard (1970)
ICE PRESSURE ON ENGINEERING STRUCTURES. CRREL Monograph III-B1b, 1970. 71p. Graphs, tables, 85 ref. [summarizes the existing knowledge on forces exerted by an expanding ice sheet, impact forces of ice on structures, and vertical forces exerted by ice on hydraulic structures, including mathematical computations]

B-283
Milne, A.R.; Ganton, J.H.; McMillin, D.J. (1967)
AMBIENT NOISE UNDER SEA ICE AND FURTHER MEASUREMENTS OF WIND AND TEMPERATURE DEPENDENCE. Acoustical Society of America. Journal, v. 41(2), 1967, p. 525-28. [letter; noise under shore-fast ice related to wind and temperature changes, that under moving ice is not so easily accounted for]

B-284
Milne, A.R. (1971)
PREDICTIONS OF TEMPERATURES IN SNOW-FREE SEA ICE WITH HOURLY CHANGES IN ATMOSPHERIC HEAT FLUXES. Canada. Defence Research Board. Defence Research Establishment Pacific. Report, no. 71-3, 1971. 30p. [calculations made of temperatures vs. time and depth in arctic ice with hourly atmospheric heat fluxes as input data for April 1968]

B-285
Milne, A.R.; Brown, J.R. (1967)
REVERBERATION UNDER ARCTIC SEA-ICE. Acoustical Society of America. Journal, v. 42(1), July 1967, p. 78-82. Fig., 6 ref.

B-286
Milne, A.R. (1967)
SOUND PROPAGATION AND AMBIENT NOISE UNDER SEA ICE. (In: Albers, V.M., ed. Underwater Acoustics, v. 2. N.Y., Plenum Press, 1967, p. 103-38.) [effects of characteristic of arctic seas and of ice cover]

B-287
Milne, A.R.; Ganton, J.H. (1965)
A STATISTICAL DESCRIPTION OF NOISE UNDER SHORE-FAST SEA ICE IN WINTER. Canada. Defence Research Board. Pacific Naval Laboratory. Report no. 65-1, Jan. 1965. 23p. Map, 6 ref.

B-288
Milne, A.R. (1966)
STATISTICAL DESCRIPTION OF NOISE UNDER SHORE-FAST SEA ICE IN WINTER. Acoustical Society of America. Journal, v. 39(6), 1966, p. 1174-82. [attempt to relate field measurements of noise to wind action and cracking origins]

B-289 *
Milne, A.R. (1972)
THERMAL TENSION CRACKING IN SEA ICE: A SOURCE OF UNDERICE NOISE. Journal of Geophysical Research, v. 77(12), 1972, p. 2177-92. Fig., 31 ref.

B-290
Milne, A.R. (1974)
WIND NOISE UNDER WINTER ICE FIELDS. Journal of Geophysical Research, v. 79(6), 1974, p. 803-09. 12 ref. [explains mechanism of noise production]

B-291
Mohaghegh, Mohammed M. (1973)
ANALYSIS OF THE FAILURE OF SEA ICE BEAMS. (In: Offshore Technology Conference, 5th, Papers, v. 1. Held in Houston, Texas, 30 April-2 May 1973, p. I/727-I/732. Paper no. OTC 1809. 12 ref.) [ice sheets, ice bearing capacity, ice plasticity, ice deformation, ice loads, strain measurement]

B-292 *
Mohaghegh, Mohammed M. (1973)
DETERMINING THE STRENGTH OF SEA ICE SHEETS. AIDJEX Bulletin, no. 18, 1973, p. 96-109. 4 fig., 15 ref. [describes method for determining axial and bending strength]

B-293
Mohaghegh, Mohammad M. (1972)
PLASTIC ANALYSIS OF COULOMB PLATES AND ITS APPLICATION TO THE BEARING CAPACITY OF SEA ICE. Seattle, Wash., Univ. of Washington, 1972. 144p. Ph.D. thesis. Univ. Microfilm order no. 72-28636.

B-294
Mohaghegh, Mohammad M. (1972)
STRENGTH OF SEA ICE SHEETS. EOS, v. 53(11), 1972, p. 1009. [abstract only]

B-295 *
Nazintsev, Iu.L. (1973)
ISOSTATIC PHENOMENA ON PACK-ICE FLOES. (In: Yakovlev, G.N., ed. Studies in Ice Physics and Ice Engineering, v. 300. Jerusalem, Israel Program for Scientific Translations, 1973, p. 87-94. 3 ref. NTIS: TT72-50005.) (Also CRREL Translation no. 394, Aug. 1973. 14p. NTIS: AD-798 828.) (Translated from "Izostaticheskie yavleniya na dreyfuyushchikh ledyanykh polyakh," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 300, 1971.) [sea ice, ice floes, isostasy, ice plasticity, ice elasticity, ice cover thickness, ice melting]

B-296
Nazintsev, Iu.L. (1974)
KOLICHESTVENNYYE SOOTNOSHENIYA V FAZOVOM SOSTAVE MORSKOGO L'DA (Quantitative relations in phase composition of sea ice). Problemy Arktiki i Antarktiki, v. 45, 1974, p. 62-67. In Russian. [ice physics, salinity and thermal properties]

B-297
Nazintsev, Iu.L.; Panov, V.V. (1975)
TEPLOFIZICHESKIE KHARAKTERISTIKI MORSKOGO L'DA (Thermal characteristics of sea ice). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 317, 1975, p. 172-82. 14 ref. In Russian.

B-298 *
Nelson, Richard D. (1976)
INTERNAL STRESS MEASUREMENTS IN ICE SHEETS USING EMBEDDED LOAD CELLS. (In: International Conference on Port and Ocean Engineering under Arctic Conditions, 3rd, Proceedings. Held 11-15 Aug. 1975, Fairbanks, Alaska. Institute of Marine Science, Univ. of Alaska, 1976, p. 361-73.)

B-299
Nelson, Richard D. (1974)
MEASUREMENTS OF TIDE- AND TEMPERATURE-GENERATED STRESSES IN SHOREFAST SEA ICE. (In: Reed, John C.; Sater, J.E., ed. The Coast and Shelf of the Beaufort Sea. Proceedings of a symposium held in San Francisco, 7-9 Jan. 1974. Arlington, Va., Arctic Institute of North America, 1974, p. 195-204.)

B-300
Nelson, Richard D.; Sackinger, William M. (1976)
STRESSES IN SEA ICE. (In: American Society of Mechanical Engineers Joint Petroleum Mechanical Engineering and Pressure Vessels and Piping Conference, Mexico City, 19-24 Sept. 1976.)

B-301
Nelson, Richard D.; Tauriainen, M.J.; Borghorst, J. (1972)
TECHNIQUES FOR MEASURING STRESS IN SEA ICE. Univ. of Alaska, Institute of Arctic Environmental Engineering, 1972.

B-302
Neshyba, Steve; Neal, Victor T. (1971)
TEMPERATURE AND CONDUCTIVITY MEASUREMENTS UNDER ICE ISLAND T-3. Journal of Geophysical Research, v. 76(33), Nov. 1971, p. 8107-20. [salinity variations, temperature profiles, ice islands, vertical profiles]

B-303 *
Nevel, Donald Eugene (1970)
CONCENTRATED LOADS ON PLATES. CRREL Research Report no. 265, March 1970. 8p. 11 ref. NTIS: AD-703 876. [analysis (mathematics), ice bearing capacity, elastic properties, loads (forces)]

B-304
Nevel, Donald Eugene (1976)
CREEP THEORY FOR A FLOATING ICE SHEET. Hanover, N.H., Dartmouth College, 1976. 110p. Ph.D. thesis. Univ. Microfilm order no. 76-23966. (Also CRREL Special Report no. 76-4, June 1976. 112p. NTIS: AD-A026 122.)

B-305
Nevel, Donald Eugene; Perham, Roscoe E.; Hogue, Gary B. (1972)
ICE FORCES ON VERTICAL PILES. Hanover, N.H., Cold Regions Research and Engineering Laboratory, 1972. 11p. NTIS: AD-750 358. [limiting force level; failure process in ice]

B-306 *
Nevel, Donald Eugene (1970)
MOVING LOADS ON A FLOATING ICE SHEET. CRREL Research Report no. 261, May 1970. 13p. 10 ref. NTIS: AD-707 923.

B-307 *
Nevel, Donald Eugene (1966)
TIME DEPENDENT DEFLECTION OF A FLOATING ICE SHEET. CRREL Research Report no. 196, July 1966. 16p. 7 fig., 12 ref. NTIS: AD-638 717.

B-308 *
Nevel, Donald Eugene (1970)
VIBRATION OF A FLOATING ICE SHEET. CRREL Research Report no. 281, Aug. 1970. 9p. NTIS: AD-712 995. (Also in: Canada. National Research Council. Associate Committee on Geotechnical Research. Technical Memorandum, no. 98, Nov. 1970, p. 57-65.) [develops solution for vibration of elastic plate floating on water]

B-309 *
Niedrauer, Terren M. (1977)
BRINE DRAINAGE AND CONVECTION IN YOUNG SEA ICE. Washington. Univ. Dept. of Atmospheric Sciences. Scientific Report no. 15, July 1977. 67p.

B-310
Nipcon, P.; Osterkamp, T.E.; Weller, Gunter E. (1971)
MEASUREMENTS OF LIGHT TRANSMISSION IN SHOREFAST ICE. (In: Science in Alaska: Alaska Science Conference, 22nd, Proceedings. Held 17-19 Aug. 1971, in College, Alaska, 1971, p. 122.) [abstract only; measurements made with photocells in core holes]

B-311
Novikov, Iu.R. (1973)
PRIBOR DLYA AVTOMATICHESKOGO OPREDELENIYA SPLOCHENNOSTI L'DA (An instrument for automatic determination of ice cohesion). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 307, 1973, p. 183-86. In Russian. [floating ice]

B-312
Numrich, S.K. (1974)
LOW-FREQUENCY SOUND PROPAGATION IN THE MARGINAL ICE ZONE OF THE GREENLAND SEA. Acoustical Society of America. Journal, v. 56(Suppl. S-50), Fall 1974. [abstract only; acoustic measurements, hydrophones, sound propagation, sound sources, sound transmission, towed instruments]

B-313 *
Nye, John F. (1976)
COORDINATE SYSTEM FOR THE TWO-DIMENSIONAL STRESS AND STRAIN-RATE AND ITS APPLICATION TO THE DEFORMATION OF SEA ICE. AIDJEX Bulletin, no. 33, Sept. 1976, p. 131-43. 2 ref.

B-314 *
Nye, John F. (1976)
DISCLINATIONS AND CATASTROPHES IN THE VECTOR AND TENSOR FIELDS OF SEA ICE. AIDJEX Bulletin, no. 33, Sept. 1976, p. 105-29. 7 ref. [pack ice, mathematical models, vector analysis, tensor analysis]

B-315 *
Nye, John F. (1975)
DISCONTINUITIES IN THE AIDJEX MODEL. AIDJEX Bulletin, no. 28, 1975, p. 119-26. Ref.

B-316 *
Nye, John F. (1973)
THE MEANING OF TWO-DIMENSIONAL STRAIN-RATE IN A FLOATING ICE COVER. AIDJEX Bulletin, no. 21, 1973, p. 9-17. [sets up definition of strain and then seeks how what is actually measured relates to defined quantity]

B-317 *
Nye, John F. (1973)
THE PHYSICAL MEANING OF TWO-DIMENSIONAL STRESSES IN A FLOATING ICE COVER. AIDJEX Bulletin, no. 21, 1973, p. 1-8. [discusses how to relate two-dimensional stresses in models to real three-dimensional ones]

B-318
Offenbacher, E.L.; Roselman, I.C. (1971)
HARDNESS ANISOTROPY OF SINGLE CRYSTALS OF ICE IH. Nature, Physical Science, v. 234(49), Dec. 1971, p. 112-13. [hardness of both basal and prismatic plane of ice has been measured between -5 and -12°C]

B-319 *
Ono, Nobuo (1976)
ARCTIC SEA ICE RESEARCH, PART III: MEASUREMENTS OF STATE OF THERMAL STRESS INDUCED IN SURFACE LAYER OF SEA ICE COVER. Teion Kagaku, Series A, no. 34, 1976, p. 221-26. 2 ref. In Japanese with English summary.

B-320
Ono, Nobuo (1965)
KAIHYŌ NO NETSU NO SEISHITSU NO KENKYŪ, I: USU I TŌHYŌ NO NETSU DENDŌRITSU NO SOKUTEI (Thermal properties of sea ice, I: Measurements of the thermal conductivity of young winter ice). Teion Kagaku, Series A, no. 23, 1965, p. 167-76. In Japanese with English summary.

B-321
Ono, Nobuo (1965)
KAIHYŌ NO NETSU NO SEISHITSU NO KENKYŪ, II: FUKINSHITSUNA HYŌSO NO K/CP NO ATAI O MOTOMERU (Thermal properties of sea ice, II: A method for determining the K/cp-value of a non-homogeneous ice sheet). Teion Kagaku, Series A, no. 23, 1965, p. 177-83. In Japanese with English summary.

B-322
Ono, Nobuo (1966)
KAIHYŌ NO NETSUTEKI SEISHITSU NO KENKYŪ, III: KAIHYŌ NO HINETSU NI TSUITE (Thermal properties of sea ice, III: On the specific heat of sea ice). Teion Kagaku, Series A, no. 24, 1966, p. 249-58. In Japanese with English summary. [two methods of calculating specific heat]

B-323 *
Ono, Nobuo (1967)
SPECIFIC HEAT AND HEAT OF FUSION OF SEA ICE. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967, p. 599-610. 8 ref. In English.) (Also "Udel'naia teploemkost' i teplota plavleniia morskogo l'da," Eksperimental'nye Issledovaniia Protsessov Teploobmena v Merzlykh Gornykh Prodakh (Experimental studies of heat transfer processes in frozen rocks). Moscow, Nauka, 1972, p. 52-60. In Russian.) [deduction of values on basis of thermal and phase equilibrium; laboratory tests to see whether such equilibrium is established, and with what time-lag]

B-324 *
Ono, Nobuo; Tanuma, Kunio (1973)
STRAIN MEASUREMENTS ON PACK-ICE FLOW WITH INFRARED DISTANCER. Teion Kagaku, Series A, no. 31, 1973, p. 221-29. 6 fig., 5 ref. In Japanese with English summary.

B-325
Ono, Nobuo (1975)
THERMAL PROPERTIES OF SEA ICE, PART 4: THERMAL CONSTANTS OF SEA ICE. CRREL Translation no. 467, Jan. 1975. 19p. NTIS: AD-B000 929. (Translated from Teion Kagaku, Series A, no. 26, 1968, p. 329-49.)

B-326
OPERATION TANQUARY ELLESMERE ISLAND, N.W.T. 1963-1966. Canada. Dept. of Energy, Mines and Resources. Canadian Oceanographic Data Centre. Data Record Series, no. 13, 1969. 152p. 28 ref. [meteorological data, salinity, statistical data, oceanography, traverses]

B-327
Ostoich, G. (1972)
THE THERMAL CONDUCTIVITY OF SALINE ICE. Montreal, Canada, McGill Univ., 1972. M.S. thesis.

B-328 *
Oura, Hirobumi, ed. (1967)
PHYSICS OF SNOW AND ICE: PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON LOW TEMPERATURE SCIENCE, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967. 711p. [papers presented at the meeting held in Sapporo, 14-19 Aug. 1966]

B-329
Outcalt, S.I. (1973)
SIMULATION OF THE DIURNAL SURFACE TEMPERATURE CONTRAST IN SEA ICE AND TUNDRA TERRAIN. Archiv fur Meteorologie, Geophysik und Bioklimatologie, Series B, v. 21(2-3), 1973, p. 147-56. 9 ref. In English with German summary. [environment simulation, climate, thermal analysis, temperature variations, tundra terrain, active layer thickness]

B-330
Paige, R.A.; Kennedy, R.A. (1967)
STRENGTH STUDIES OF SEA ICE: EFFECTS OF LOAD RATE ON RING TENSILE STRENGTH. U.S. Naval Civil Engineering Laboratory. Technical Report no. R-545, Oct. 1967. 28p. 13 fig., 1 table, 12 ref. NTIS: AD-659 298. [sea ice, load carrying capacity]

B-331
Panfilov, D.F. (1966)
ANALYSIS OF THE BEARING CAPACITY OF AN ICE COVER TAKING INTO CONSIDERATION ITS NONHOMOGENEITY WITH HEIGHT. Izvestiya Vuzov, Stroitel'stvo i Arkhitektura, no. 2, 1966. In Russian.

B-332
Panfilov, D.F. (1972)
APPROXIMATE FORMULAS FOR THE DETERMINATION OF THE CARRYING CAPACITY OF ICE. U.S. Army. Foreign Science and Technology Center, 1972. 12p. NTIS: AD-765 968. (Translated from "Priblizhennye formuly dlya opredeleniya nesushchei sposobnosti lda," Koordinatsionnykh Soveshchanii po Gidrotekhnike. Trudy, no. 10, 1964.) [rigorous calculation of the carrying capacity of ice based on the theory of elastic foundation]

B-333
Panfilov, D.F. (1970)
BENDING OF A FLOATING ICE STRIP SUBJECTED TO LOCAL LOADS NEAR THE EDGE. Izvestiya Vuzov, Stroitel'stvo i Arkhitektura, no. 1, 1970. In Russian.

B-334
Panfilov, D.F. (1966)
BENDING OF THE INFINITE ICE STRIP WHICH IS SUBJECTED TO A LOAD OF SHORT DURATION. Izvestiya Vuzov, Stroitel'stvo i Arkhitektura, no. 12, 1966. In Russian.

B-335
Panfilov, D.F. (1970)
CALCULATING ICE COVER STRENGTH. Izvestiya Vuzov, Stroitel'stvo i Arkhitektura, no. 6, 1970. In Russian.

B-336
Panfilov, D.F. (1970)
THE CHANGE OF THE BEARING CAPACITY OF AN ICE COVER DUE TO LOADS OF LONG DURATION. Izvestiya Vuzov, Stroitel'stvo i Arkhitektura, no. 3, 1970. In Russian.

B-337
Panfilov, D.F. (1965)
ON CREEP DEFORMATIONS OF ICE. Koordinacionnykh Soveshchenii po Gidrotekhnike. Trudy, v. 23. Moscow/Leningrad, Izdatelstvo Energia, 1965. In Russian.

B-338
Panin, G.N. (1967)
VLIYANIYE SOLENOSTI NA PROCHNOST' L'DA (Influence of salinity on ice strength). Moscow. Univ. Vestnik. Seriya 5: Geografiya, v. 22(5), 1967, p. 108-11. In Russian.

B-339
Paquette, R.G.; Bourke, R.H. (1976)
OCEANOGRAPHIC INVESTIGATION OF THE MARGINAL SEA-ICE ZONE OF THE CHUKCHI SEA, MIZPAC 1974. FINAL REPORT, 10 JUNE 1974-30 JUNE 1975. Monterey, Calif., U.S. Naval Postgraduate School, 1976. 129p. NTIS: AD-A025 854.

B-340
Paren, J.G.; Walker, J.C.F. (1971)
INFLUENCE OF LIMITED SOLUBILITY ON THE ELECTRICAL AND MECHANICAL PROPERTIES OF ICE. Nature, Physical Science, v. 230(12), March 1971, p. 77-79. Ref. [at low temperatures, the hydrated salts in polar ices have negligible dielectric loss]

B-341 *
Parmerter, R. (1974)
DIMENSIONLESS STRENGTH PARAMETERS FOR FLOATING ICE SHEETS. AIDJEX Bulletin, no. 23, 1974, p. 83-95. (Also in: International Conference on Port and Ocean Engineering under Arctic Conditions, 2nd, Proceedings. Held 27-30 Aug. 1973, Reykavik. Univ. of Iceland, 1974, p. 490-501.) [equations governing floating ice sheet subjected to vertical loading are studied in dimensionless form; more complex problems in which in-plane forces interact through vertical deformations to create additional leading as in rafting]

B-342
Pekhovich, A.I.; Zhidkikh, V.M.; Shatalina, I.N. et al (1975)
CONTROL OF THE THICKNESS AND STRENGTH OF THE ICE COVER. (In: Frankenstein, Guenther E., ed. International Symposium on Ice Problems, 3rd, Proceedings. Held 18-21 Aug. 1975, Hanover, N.H. International Assn. of Hydraulic Research, 1975, p. 487-98. 2 ref.) [ice growth, ice strength, ice cover thickness, heat transfer, temperature control]

B-343
Persidsky, M.D.; Richards, V. (1965)
NEW APPROACHES IN MEASURING THE LINEAR RATE OF ICE CRYSTALLIZATION IN WATER AND AQUEOUS SOLUTIONS. New York Academy of Sciences. Annals, v. 125(2), 1965, p. 677-88. Graphs, 17 ref. [design of an instrument for measuring the velocity of crystallization]

B-344 *
Peschanskii, I.S.; Chikovskii, S.S. (1973)
O FIZIKO-MEKHANICHESKIKH SVOYSTVAKH LEDYANOGO POKROVA MOREY KARSKOGO I LAPTEVYKH (On the mechanical properties of ice cover in the Kara and Laptev Seas). Akademiya Nauk SSSR. Institut Geografii. Materialy Glyatsiologicheskikh Issledovaniy. Khronika, Obsuzhdeniya, no. 21, 1973, p. 149-53. In Russian with English summary.

B-345 *
Peschanskii, I.S. (1973)
STATIC PRESSURE OF SEA ICE. (In: Yakovlev, G.N., ed. Studies of Ice Physics and Ice Engineering, v. 300. Jerusalem, Israel Program for Scientific Translations, 1973, p. 1-4. 2 fig. NTIS: TT72-50005.) (Also CRREL Translation no. 404, Aug. 1973. 8p. NTIS: AD-769 727.)

B-346 *
Petrov, I.G. (1971)
DIVISION OF THE ARCTIC MARINE ICE COVER INTO REGIONS ACCORDING TO ICE STRUCTURE. (In: Yakovlev, G.N., ed. Studies in Ice Physics and Ice Engineering, v. 300. Jerusalem, Israel Program for Scientific Translations, 1971, p. 33-45. 7 fig. NTIS: TT72-50005.)

B-347
Peyton, Harold R. (1968)
ICE AND MARINE STRUCTURES, PART 2: SEA ICE PROPERTIES. Ocean Industry, v. 3(9), 1968, p. 59-65. Graphs, 13 ref. [geometric model of the growth of ice indicating the entrapment of brine between platelets]

B-348 *
Peyton, Harold R. (1966)
SEA ICE STRENGTH. Alaska. Univ. Geophysical Institute. Final Report no. UAG R-182, Dec. 1966. 274p. Fig., 48 ref. NTIS: AD-653 883. (Also Fairbanks, Univ. of Alaska, 1967. 270p. Ph.D. thesis.) [ice failure, sea ice]

B-349 *
Peyton, Harold R. (1968)
SEA-ICE STRENGTH: EFFECTS OF LOAD RATES AND SALT REINFORCEMENT. (In: Sater, J.E., ed. Arctic Drifting Stations: A Report on Activities Supported by the Office of Naval Research. Proceedings of a symposium held 12-15 April 1966 in Warrenton, Va. Washington, D.C., Arctic Institute of North America, 1968, p. 197-216.)

B-350
PIER MEASURES ICE PRESSURES. Engineering News-Record, v. 179(24), Dec. 1967, p. 34. 2 fig. [ice pressure, ice load recorders]

B-351
Pounder, Elton R.; Langleben, M.P. (1968)
ACOUSTIC ATTENUATION IN SEA ICE. (In: I.A.S.H. Commission of Snow and Ice. Reports and Discussions. International Assn. of Scientific Hydrology, Publication no. 79, 1968, p. 161-69. NTIS: AD-690 437.) (Also McGill Univ. McDonald Physics Laboratory. Ice Research Project. Report S-14, June 1968. 18p. NTIS: AD-679 627.) [laboratory and field measurements in frequency range 10-500 kHz]

B-352
Pounder, Elton R.
HIGH FREQUENCY AUDIO ABSORPTION IN SEA ICE. U.S. Office of Naval Research Code 468, April 1966. Unpublished report.

B-353
Pounder, Elton R.; LeBlanc, A. (In press)
ICE WATER STRESS AT STATION SNOW BIRD, AIDJEX. Presented at Symposium on Sea Ice Processes and Models, Seattle, Univ. of Washington, 6-9 Sept. 1977, sponsored by ICSI and AIDJEX.

B-354 *
Pounder, Elton R. (1965)
PHYSICS OF ICE. Oxford, Pergamon Press, 1965. 151p. [mechanical, thermal, electrical properties and crystallography of pure and sea ice; formation and growth of an ice cover; ice drift and ice control]

B-355
Pounder, Elton R. (1969)
STRENGTH AND GROWTH RATES OF SEA ICE. (In: Ice Seminar. Held at Calgary, Alberta, in 1968. Canadian Institute of Mining and Metallurgy, Special Volume no. 10, 1969, p. 73-76. Graph, tables, 4 ref.)

B-356
Prentiss, David; Davis, Edward; Kutschale, Henry (1965)
NATURAL AND MAN-MADE ICE VIBRATIONS IN THE CENTRAL ARCTIC OCEAN IN THE FREQUENCY RANGE FROM 0.1 TO 100 CPS. Columbia Univ. Lamont Geological Observatory. Technical Report, no. 4, June 1965. 54p. 42 fig., 5 ref.

B-357 *
Pritchard, Robert S. (1974)
ELASTIC STRAIN IN THE AIDJEX SEA ICE MODEL. AIDJEX Bulletin, no. 27, 1974, p. 45-62. 4 fig., ref.

B-358 *
Pritchard, Robert S. (1976)
ESTIMATE OF THE STRENGTH OF ARCTIC PACK ICE. AIDJEX Bulletin, no. 34, Dec. 1976, p. 94-113. 3 ref. [pack ice, ice strength, ice models]

B-359
Proskuriakov, B.V.; Berdennikov, V.P. (1971)
METOD OPREDELENIIA NAPRIAZHENII LEDIANOGO POKROVA I OPYT EGO PRIMENENIIA (Method of determining stresses in ice cover and its application). Gosudarstvennyi Gidrologicheskii Institut. Trudy, v. 184, 1971, p. 3-22. 3 ref. In Russian.

B-360
Pruppacher, Hans R. (1967)
SOME RELATIONS BETWEEN THE STRUCTURE OF THE ICE-SOLUTION INTERFACE AND THE FREE GROWTH RATE OF ICE CRYSTALS IN SUPERCOOLED AQUEOUS SOLUTIONS. Journal of Colloid and Interface Science, v. 25(2), Oct. 1967, p. 285-94. Fig., ref. [experimental method devised to determine the rate at which ice crystals grow freely in supercooled water and in dilute aqueous solutions of various salts]

B-361 *
Ramseier, René O. (1972)
FORMATION OF PRIMARY ICE LAYERS. (In: I.A.H.R. Symposium on Ice and Its Action on Hydraulic Structures, 2nd, Proceedings. Held in Leningrad, 26-29 Sept. 1972. Leningrad, International Assn. of Hydraulic Research, 1972, Paper 3.1. 8p.) [reviews effects of water temperature and current on primary ice crystal formation]

B-362
Reeh, Niels (1970)
THERMAL STRESS IN A VISCO-ELASTIC PLATE IN SIMPLE EXTENSION. Denmark. Technical Univ. Danish Center for Applied Mathematics and Mechanics. Report no. 7, 1970. 19p. [analysis of temperature variations in plate, and analysis of internal stress caused by those variations, applied to natural ice covers]

B-363
Reismann, Herbert; Lee, Yu-Chang (1968)
DYNAMICS OF A FLOATING ICE SHEET. Journal of Hydronautics, v. 2(2), April 1968, p. 108-11. 7 fig., 1 table, 7 ref. [surface loading, plate theory, floating ice]

B-364
Rhoads, E.M. (1973)
ICE CROSSINGS. Northern Engineer, v. 5(1), 1973, p. 19-24. [techniques developed for improving upon the natural freezing process to increase the capacity and duration of ice crossings]

B-365 *
Richardson, Charles; Keller, E.E. (1966)
THE BRINE CONTENT OF SEA ICE MEASURED WITH A NUCLEAR MAGNETIC RESONANCE SPECTROMETER. Journal of Glaciology, v. 6(43), 1966, p. 89-100. 5 fig., 19 ref.

B-366 *
Richardson, Charles (1976)
PHASE RELATIONSHIPS IN SEA ICE AS A FUNCTION OF TEMPERATURE. Journal of Glaciology, v. 17(77), 1976, p. 507-19. 12 ref. In English with French and German summaries. [phase transformations, salt ice, brines, nuclear magnetic resonance, water temperature]

B-367
Riehl, N. et al (1969)
PHYSICS OF ICE. New York, Plenum Press, 1969.

B-368
Rose, G.D.; Masterson, D.M.; Friesen, C.E. (1975)
SOME MEASUREMENTS OF LATERALLY-LOADED ICE SHEETS. (In: Frankenstein, Guenther E., ed. International Symposium on Ice Problems, 3rd, Proceedings. Held 18-21 Aug. 1975, Hanover, N.H. International Assn. of Hydraulic Research, 1975, p. 555-66. 3 ref.) [ice deformation, ice strength, static loads, ice elasticity]

B-369 *
Ross, Bernard (1967)
PENETRATION AND FRACTURE OF SEA ICE DUE TO IMPACT LOADING. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967, p. 499-521. 13 ref.) [reports on studies to explore the possibility of air-dropping scientific instrumentation packages in remote ice-covered regions of the Arctic for oceanographic research]

B-370
Ross, Bernard; Hanagud, S. (1969)
PENETRATION STUDIES OF ICE WITH APPLICATION TO ARCTIC AND SUBARCTIC WARFARE. Stanford Research Institute. Report, Sept. 1969. 526p. 103 ref. NTIS: AD-861 771L.

B-371
Ross, Bernard (1967)
PENETRATION STUDIES OF ICE WITH APPLICATION TO ARCTIC AND SUBARCTIC WARFARE, PHASE II STUDY. Stanford Research Institute. Report NWRC-3072, May 1967. 168p. 33 ref. NTIS: AD-817 598L. [penetration tests, projectile penetration, impact tests, ice cover thickness, temperature factors, mathematical models, computer applications]

B-372
Ross, Bernard; Hanagud, S.; Sidhu, G. (1971)
PENETRATION STUDIES OF ICE WITH APPLICATION TO ARCTIC AND SUBARCTIC WARFARE, PHASE IV. Stanford Research Institute. Report, April 1971. 68p. 18 ref. NTIS: AD-736 633. [projectile penetration, impact tests, stress analysis, snow cover effect, ice structure, computer programs]

B-373
Ross, Bernard (1969)
PERFORATION OF THE ARCTIC SEA-ICE COVER BY PROJECTILE IMPACT. Journal of Hydronautics, v. 3(3), July 1969, p. 115-21. 5 fig., 2 tables, 18 ref. (Also abstract in: American Geographical Union. Transactions, v. 49(1), March 1968, p. 219.) [in situ measurements, penetration, ice cover, mechanical properties]

B-374 *
Ryvlin, A.Ia. (1976)
FIELD ANALYSIS OF PHYSICOMECHANICAL PROPERTIES OF ICE COVER. CRREL Translation no. 539, Aug. 1976, p. 204-09. NTIS: AD-A030 818. (Translated from "Naturnye issledovaniia fiziko-mekhanicheskikh svoistv ledianogo pokrova," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 326, 1975, p. 205-09.) [ice physics, ice strength, ice elasticity, ice navigation, ice breaking, ice bearing capacity]

B-375
Ryvlin, A.Ia. (1974)
METOD PROGNOZIROVANIYA PREDELA PROCHNOSTI LEDYANOGO POKROVA NA IZGIB (A method of forecasting ice cover bending strength). Problemy Arktiki i Antarktiki, v. 45, 1974, p. 79-86. In Russian.

B-376
Sackinger, William M.; Byrd, Robert C. (1973)
BACKSCATTER MILLIMETER WAVES FROM SNOW, ICE AND SEA ICE. Alaska. Univ. Institute of Arctic Environmental Engineering. Report 7207, 1973. 73p. NTIS: AD-758 071. [measurements of complex permittivity of sea ice as function of temperature and salinity for frequency range 26-40 GHz]

B-377
Sala, I.; Olkkonen, E. (1971)
ON THE VISCO-ELASTIC PROPERTIES OF ICE AND WOOD. Geophysica, v. 11(2), 1971, p. 249-60.

B-378
Savel'ev, B.A. (1972)
MANUAL FOR THE STUDY OF THE PROPERTIES OF ICE. Washington, D.C., Arctic Institute of North America, April 1972. 287p. NTIS: AD-741 870. (Translated from Rukovodstvo po Izuchenyu Svoistv Lda. Moscow, 1963.) [methods for studying the structure of ice and snow, salinity and brine in ice]

B-379
Savel'ev, B.A. (1973)
STRUCTURE, COMPOSITION AND PROPERTIES OF ICE COVER ON MARINE AND FRESH WATER BODIES. U.S. Army. Foreign Science and Technology Center. Technical Translation HT-23-50-72, April 1973. 553p. NTIS: AD-765 896. (Translated from Stroenie, Sostav i Svoistva Ledyanogo Pokrova Morskikh i Presnykh Vodoemov. Moscow, 1963. 541p.) [structural properties, thermal properties, chemical properties, porosity, salinity, hardness, thickness, melting, freezing]

B-380 *
Schwarz, J.; Weeks, Wilford F. (1977)
ENGINEERING PROPERTIES OF SEA ICE. (In: Environmental Assessment of the Alaskan Continental Shelf, v. 4. Boulder, Colo., Environmental Research Laboratories, 1977, p. 142-224. 109 ref.)

B-381
Schwarz, J. (1975)
ON THE FLEXURAL STRENGTH AND ELASTICITY OF SALINE ICE. (In: Frankenstein, Guenther E., ed. International Symposium on Ice Problems, 3rd, Proceedings. Held 18-21 Aug. 1975, Hanover, N.H. International Assn. of Hydraulic Research, 1975, p. 373-86. 6 ref.) [salt ice, brines, flexural strength, ice elasticity, ice temperature]

B-382 *
Schwarz, J.; Miloh, T. (1972)
ON THE TIME DEPENDENT TEMPERATURE VARIATION WITHIN ICE SHEETS. (In: I.A.H.R. Symposium on Ice and Its Action on Hydraulic Structures, 2nd, Proceedings. Held in Leningrad, 26-29 Sept. 1972. Leningrad, International Assn. for Hydraulic Research, 1972, p. 262-69. 10 ref.) In English with French summary. [ice sheets, ice temperature, ice thermal]

B-383 *
Seidensticker, R.G. (1966)
COMMENT ON PAPER BY P. HOEKSTRA, T.E. OSTERKAMP, AND W.F. WEEKS, "THE MIGRATION OF LIQUID INCLUSIONS IN SINGLE ICE CRYSTALS." Journal of Geophysical Research, v. 71(8), April 1966, p. 2180-81. 9 ref.

B-384
Serikov, M.I. (1975)
GRUZOPOD' 'YEMNOST' L'DA I OPREDELENIYE USULIY, RAZRUSHAYUSHCHIKH LEDYANOY POKROV (Load-carrying capacity of ice and determination of its breaking strength). Problemy Arktiki i Antarktiki, v. 46, 1975, p. 128-30. In Russian.

B-386
Shamont'ev, V.A. (1967)
O VLIYANII ZIMNIKH GIDROLOGICHESKIKH USLOVIY NA NEKOTORYYE ELEMENTY GIDROLOGICHESKOGO REZHIMA CHUKOTSKOGO MORYA V NAVIGATSIONNOM SEZONE (Influence of winter hydrological conditions on certain elements of the hydrological regime of the Chukchi Sea in the navigation season). Okeanologiya, v. 7(3), 1967, p. 450-56. In Russian. [effect on ice cover]

B-387 *
Shapiro, Lewis H.; Hoskins, E.R. (1976)
THE USE OF FLATJACKS FOR THE IN SITU DETERMINATION OF THE MECHANICAL PROPERTIES OF SEA ICE. (In: International Conference on Port and Ocean Engineering under Arctic Conditions, 3rd, Proceedings. Held 11-15 Aug. 1975, Fairbanks, Alaska. Institute of Marine Science, Univ. of Alaska, 1976, p. 417-25.)

B-388 *
Shaver, Ralph; Hunkins, Kenneth L. (1965)
GEOPHYSICAL STUDIES OF THE CHUKCHI CAP AREA OF THE ARCTIC OCEAN. American Geophysical Union. Transactions, v. 46(1), 1965, p. 70. [abstract only]

B-389
Shesteperov, I.A. (1970)
OBSERVATIONAL VERIFICATION OF TSURIKOV'S FORMULA. Oceanology, v. 9(4), March 1970, p. 502-04. (Translated from "Proverka formuly Tsurikova po resul'tatam nabliudenii," Okeanologiya, v. 9(4), July/Aug. 1969, p. 616-18.)

B-390
Shpaikher, A.O. (1976)
KOLICHESTVO PRESNOI VODY V MORSKIKH L'DAKH POLIARNYKH OBLASTEI ZEMNOGO SHARA (Amount of fresh water in polar sea ice). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 323, 1976, p. 168-77. 21 ref. In Russian. [ice composition, ice salinity]

B-391
Shpaikher, A.O. (1974)
ZAPASY PRESNOY VODY V MORSKIKH L'DAKH (Reserves of fresh water in sea ice). (In: Mirovoy Vodnyy Balans i Vodnyye Resursy Zemli. Leningrad, Gidrometeoizdat, 1974, p. 557-60.) In Russian.

B-392 *
Shvaishtein, Z.I. (1973)
EXPERIMENTAL STUDIES IN AN ICE-RESEARCH LABORATORY. (In: Yakovlev, G.N., ed. Studies in Ice Physics and Ice Engineering, v. 300. Jerusalem, Israel Program for Scientific Translations, 1973, p. 16-25. 3 ref. NTIS: TT72-50005.) (Translated from "Eksperimental'nye raboty v ledoissledovatel'skoi laboratorii," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 300, 1971, p. 21-31.) [ice cover strength, ice navigation, models]

B-393 *
Sinha, N.K. (1977)
TECHNIQUE FOR STUDYING STRUCTURE OF SEA ICE. Journal of Glaciology, v. 18(79), 1977, p. 315-23. [microtoming and replicating technique for examining microstructure optically and by scanning electron microscope]

B-394 *
Slesarenko, Iu.E.; Frolov, A.D. (1974)
COMPARISON OF ELASTICITY AND STRENGTH CHARACTERISTICS OF SALT-WATER ICE. (In: I.A.H.R. Symposium on Ice and Its Action on Hydraulic Structures, 2nd, Proceedings. Held in Leningrad, 26-29 Sept. 1972. Leningrad, International Assn. for Hydraulic Research, 1974, p. 85-87.) [fairly distinct correlation between elasticity and strength characteristics of NaCl ice confirms feasibility of indirect procedure for estimating strength by acoustic measurements]

B-395
Slesarenko, Iu.E.; Frolov, A.D. (1975)
KHARAKTERISTIKI UPRUGOSTI LEDIANYKH POKRYTII (Ice cover elasticity). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 317, 1975, p. 80-91. 16 ref. In Russian. [icing, ice elasticity, ice adhesion]

B-396
Slesarenko, Iu.E. (1973)
UL'TRAZVUKOVOI SPOSOB OPREDELENIIA FAZOVOGO SOSTAVA LEDIANYKH OBRAZOVANII IZ MORSKOI VODY I RASTVOROV (Ultrasonic techniques for determining phase composition of ice grown from sea water and solutions). (In: International Conference on Permafrost, 2nd, v. 4. Yakutsk, 1973, p. 215-18. 9 ref.) In Russian.

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ON THE POSSIBILITY OF CALCULATING THE STRENGTH LIMITS OF SEA ICE UNDER LOADS OF SHORT DURATION. Oceanology, v. 7(3), March 1968, p. 331-38. 5 fig., 2 tables, 18 ref. (Translated from "O vozmozhnosti rascheta predela prochnosti ledianogo pokrova pri kratkovremennykh nagruzkakh," Okeanologiya, v. 7(3), May/June 1967, p. 428-36.)

B-398 *
Smirnov, V.I. (1973)
POTENTIAL ICE RESISTIVITY ACCORDING TO DATA FROM AIRBORNE OR SHIPBOARD OBSERVATION. (In: Treshnikov, A.F., ed. Problems of the Arctic and Antarctic, v. 33-35. Jerusalem, Israel Program for Scientific Translations, 1973, p. 122-26. 1 fig., 6 ref. NTIS: TT72-50006.) (Translated from "O potentsial'noi soprotivliaemosti l'da po nabliudeniiam za ledianym pokrovom s borta samoleta ili sudna," Problemy Arktiki i Antarktiki, v. 33, 1970, p. 115-18.)

B-399 *
Smirnov, V.N. (1973)
DETERMINATION OF ELASTIC CHARACTERISTICS OF AN UNDISTURBED ICE COVER USING STATIC AND DYNAMIC METHODS. (In: Yakovlev, G.N., ed. Studies in Ice Physics and Ice Engineering, v. 300. Jerusalem, Israel Program for Scientific Translations, 1973, p. 46-49. 4 ref. NTIS: TT72-50005.) (Translated from "Opredelenie uprugikh kharakteristik nenarushennogo ledianogo pokrova dinamicheskim i staticheskim metodami," Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 300, 1971, p. 56-60.) [ice physics, ice temperature, ice elasticity, ice plasticity, ice deformation, analysis (mathematics)]

B-400
Smirnov, V.N. (1973)
ICE COVER OSCILLATIONS RESULTING FROM INTERNAL WAVES OF THE ICE OCEAN. Akademiya Nauk SSSR. Doklady. Earth Science Sections, v. 206(1-6), Nov. 1973, p. 16-18. 4 ref. (Translated from "Kolebaniia ledianogo pokrova, obuslovlennye vnutrennimi volnami ledovitogo okeana," Akademiya Nauk SSSR. Doklady, v. 206(5), 1972, p. 1106-08.)

B-401 *
Smirnov, V.N. (1966)
ISSLEDOVANIYE IZGIBNYKH KOLEBANIY DREYFUYUSHCHEGO LDA (Study of bending variations of drifting ice). Problemy Arktiki i Antarktiki, v. 23, 1966, p. 47-49. In Russian.

B-402
Smirnov, V.N. (1976)
NEKOTORYE VOPROSY NATURNOGO ISSLEDOVANIIA DEFORMATSII I NAPRIAZHENII V LEDIANOM POKROVE (In-situ investigations of deformation and stresses in an ice cover). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 331, 1976, p. 133-40. 8 ref. In Russian.

B-403 *
Smirnov, V.N. (1965)
TIPY UPRUGIKH VOLN V TONKOM LEDYANOM SLOYE (Types of elastic wave in a thin layer of ice). Problemy Arktiki i Antarktiki, v. 19, 1965, p. 64-65. In Russian.

B-404
Smirnov, V.N. (1976)
UPRUGIE IZGIBNYE VOLNY V LEDIANOM POKROVE (Flexural elastic waves in an ice cover). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 331, 1976, p. 117-23. 7 ref. In Russian. [ice cover thickness, ice physics, elastic waves, wave propagation, ice mechanics]

B-405 *
Solomon, Harold (1972)
NOTE ON THE NO-STRESS BOUNDARY CONDITION AT THE EDGE OF THE ICE PACK. Arctic, v. 25(1), 1972, p. 57-59. 7 ref. [boundary value problems, ice pressure, stress analysis]

B-406
Spetzler, H.A.W. (1970)
EFFECT OF TEMPERATURE AND PARTIAL MELTING ON VELOCITY AND ATTENUATION IN A SIMPLE BINARY SYSTEM. Pasadena, Calif. Institute of Technology, 1970. Ph.D. thesis. [study of NaCl-ice system, acoustic wave propagation]

B-407
Spetzler, H.A.W.; Anderson, Duwayne M. (1968)
THE EFFECT OF TEMPERATURE AND PARTIAL MELTING ON VELOCITY AND ATTENUATION IN A SIMPLE BINARY SYSTEM. Journal of Geophysical Research, v. 73(18), 1968, p. 6051-60. [study of propagation of sound waves through ice-salt mixtures with and without appreciable brine volumes]

B-408 *
Sprenger, Robert M. (1972)
CONTINUOUS OBSERVATIONS OF THE STRUCTURAL CHANGES IN DEFORMING POLYCRYSTALLINE ICE. Washington. Univ. Dept. of Atmospheric Sciences. Scientific Report no. 14, Nov. 1972. 69p. Fig., 25 ref.

B-409 *
Squire, V.A.; Allan, A.J. (In press)
PROPAGATION OF FLEXURAL GRAVITY WAVES IN SEA ICE. Presented at Symposium on Sea Ice Processes and Models, Seattle, Univ. of Washington, 6-9 Sept. 1977, sponsored by ICSI and AIDJEX. 10p.

B-410
Starheim, O.K.; Brooks, P.N. (1972)
A REVIEW OF ICE PENETRATION BY KINETIC ENERGY PENETRATORS. Quebec. Defence Research Establishment Valcartier. DREV Technical Memorandum TN-1979/72, 1972. 72p. NTIS: AD-913 075. [feasibility of placing a sonobuoy for arctic operation under the ice by means of a kinetic energy penetrator]

B-411 *
Stehle, Nancy S. (1967)
MIGRATION OF BUBBLES IN ICE UNDER A TEMPERATURE GRADIENT. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967, p. 219-32.) [investigation into physical mechanism governing behavior of bubbles in glaciers and of brine pocket migration in sea ice]

B-412
Stewart, Michael K. (1974)
HYDROGEN AND OXYGEN ISOTOPE FRACTIONATION DURING CRYSTALLIZATION OF MIRABILITE AND ICE. Geochimica and Cosmochimica Acta, v. 38(1), 1974, p. 167-72. [equilibrium fractionation factors between ice and 2.5 molal NaCl solution at -10°C; results are of use in assessing mirabilite as a climatic indicator]

B-413 *
Tabata, Tadashi; Kawamura, T.; Takizawa, T. (1976)
HOKKYOKUKEN KAIHYŌ CHŌSA, I: SHŌSHIRYŌ NO MAGE-KYŌDO NO SOKUTEI (Arctic sea ice research, 1: Measurements of flexural strength of small sea ice beams). Teion Kagaku, Series A, no. 34, 1976, p. 201-07. 13 ref. In Japanese with English summary.

B-414
Tabata, Tadashi; Fujino, Kazuo (1965)
KAIHYŌ NO RIKIGAKU NO SEISHITSU NO KENKYŪ, VIII. (Studies of the mechanical properties of sea ice, 8: Measurement of flexural strength in situ, 2). Teion Kagaku, Series A, no. 23, 1965, p. 157-66. In Japanese with English summary.

B-415
Tabata, Tadashi (1966)
KAIHYŌ NO RIKIGAKUTEKI SEISHITSU NO KENKYŪ, IX: GENJŌ NI IKERU MAGE KYODO NO SOKUTEI (Studies of the mechanical properties of sea ice, 9: Measurement of flexural strength in situ, 3). Teion Kagaku, Series A, no. 24, 1966, p. 259-68. In Japanese with English summary.

B-416 *
Tabata, Tadashi (1972)
MICROSCALE STRAIN EXPERIMENT. AIDJEX Bulletin, no. 14, 1972, p. 26-27.

B-417 *
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STUDIES OF THE MECHANICAL PROPERTIES OF SEA ICE, PART 10: THE FLEXURAL STRENGTH OF SMALL SEA ICE BEAMS. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967, p. 481-97.)

B-418 *
Tabata, Tadashi; Fujino, Kazuo; Aota, Masaaki (1967)
STUDIES OF THE MECHANICAL PROPERTIES OF SEA ICE, PART 11: THE FLEXURAL STRENGTH OF SEA ICE IN SITU. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967, p. 539-56.)

B-419
Tarbeev, Iu.V. (1965)
OPREDELENIE NAPRIAZHENII I PROCHNOSTI PRIPAIA PO IZGIBU, VYZVANNOMU KOLEBANIIAMI UROVNIA VODY (Determination of fast-ice stress and strength for bending caused by variations in the water level). Gosudarstvennyi Okeanograficheskii Institut. Trudy, no. 86, 1965, p. 124-43. 6 ref., tables, graphs. In Russian. [methods of determination, using experimental data obtained under natural conditions in an ice basin]

B-420
Tatinclaux, J.C.; Wu, C.Y. (1976)
LABORATORY STUDY OF THE FLEXURAL STRENGTH AND ELASTIC MODULUS OF FRESHWATER AND SALINE ICE. Iowa. Univ. Iowa Institute of Hydraulic Research. Report no. 190, June 1976. 137p. 9 ref.

B-421
Tauriainen, M.J. (1971)
SEA ICE TESTING: NEW TECHNIQUES AND EQUIPMENT FOR CANTILEVER BEAM TESTS. Alaska. Univ. Institute of Arctic Environmental Engineering. Bulletin no. 7101, July 1971. 13p. 9 ref.

B-422
Teuscher, L.H.; England, W.G.; Hauser, L.E. (1972)
THE CALCULATION OF THE TEMPERATURE DISTRIBUTION WITHIN A MELTING/FREEZING MATERIAL USING FINITE ELEMENT TECHNIQUES. EOS, v. 53(11), 1972, p. 1020. [abstract only]

B-423
Timokhov, L.A. (1974)
NAPRIAZHENIIA V SZHATOM LEDIANOM POKROVE (Stresses in compressed pack ice). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 316, 1974, p. 42-51. 5 ref. In Russian. [pack ice, ice floes, drift, ice pressure, stresses, analysis (mathematics), ice cover, rheology]

B-424 *
Tinawi, R.; Murat, J.R. (In press)
SEA ICE-TESTING IN FLEXURE. Presented at International Conference on Port and Ocean Engineering under Arctic Conditions, 4th, Memorial Univ. of Newfoundland, 26-30 Sept. 1977.

B-425
Traetteberg, A.; Gold, I.W.; Frederking, R. (1975)
STRAIN RATE AND TEMPERATURE DEPENDENCE OF YOUNG'S MODULUS OF ICE. (In: Frankenstein, Guenther E., ed. International Symposium on Ice Problems, 3rd, Proceedings. Held 18-21 Aug. 1975, Hanover, N.H. International Assn. of Hydraulic Research, 1975, p. 479-86. 4 ref.) [ice mechanics, strain tests, temperature effects, ice strength, relaxation (mechanics)]

B-426
Tripp, R.B. (1967)
PHYSICAL AND CHEMICAL DATA FROM FLETCHER'S ISLAND (T-3): BEAUFORT SEA AREA, JANUARY-MAY 1966. Washington. Univ. Dept. of Oceanography. Technical Report no. 187, 1967. 62p. 12 ref. NTIS: AD-670 471. [physical properties, ice islands, sea ice, sea water, chemical composition]

B-427
Tripp, R.B.; Kusunoki, Kou (1967)
PHYSICAL, CHEMICAL, AND CURRENT DATA FROM ARLIS II: EASTERN ARCTIC OCEAN, GREENLAND SEA, AND DENMARK STRAIT AREAS, FEBRUARY 1964-MAY 1965, VOLUME I. Washington. Univ. Dept. of Oceanography. Technical Report no. 185, March 1967. 341p. 15 ref. NTIS: AD-670 474. [ocean currents, ice islands, sea ice, sea water, chemical composition]

B-428 *
Tryde, P. (In press)
EFFECT ON STRENGTH OF SEA ICE FROM POSSIBLE OVERPRESSURE IN BRINE POCKETS AT DYNAMIC LOADING. Presented at International Conference on Port and Ocean Engineering under Arctic Conditions, 4th, Memorial Univ. of Newfoundland, 26-30 Sept. 1977.

B-429
Tsurikov, V.L. (1968)
CHANGES IN THE SALINITY OF SEA ICE DUE TO THE MIGRATION OF BRINE POCKETS. Oceanology, v. 7(5), July 1968, p. 694-702. 2 fig., 1 table, 16 ref. (Translated from "Ismeneniye solenosti morskogo l'da valedstviye migratsii yacheyek s rassolom," Okeanologiya, v. 7(5), 1967, p. 894-900.)

B-430
Tsurikov, V.L. (1976)
FORMATION OF SEA ICE POROSITY. Oceanology, v. 15(5), 1976, p. 547-50. 6 ref. (Translated from Okeanologiya, v. 15(5), 1975, p. 813-19.)

B-431 *
Tsurikov, V.L. (1966)
FORMATION OF THE IONIC COMPOSITION AND SALINITY OF SEA ICE. Oceanology, v. 5(3), 1966, p. 59-66. 4 fig., 2 tables, 23 ref. (Translated from "O formirovanii ionnogo sostava i solennosti morskogo l'da," Okeanologiya, v. 5(3), 1965, p. 463-72.)

B-432
Tsurikov, V.L. (1970)
FORMIROVANIYE I IZMENENIYE SOLENOSTI MORSKOGO L'DA (Formation and change of salinity in sea ice). (In: Bruevich, S.V., ed. Khimicheskiye Resursy Morey i Okeanov (Chemical resources of the seas and oceans). Moscow, Izdatel'stvo Nauka, 1970, p. 3-11.) In Russian.

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Tsurikov, V.L. (1974)
SALINITY OF FORMING ICE COVER AS A FUNCTION OF ITS ACCRETION RATE AND SALINITY OF THE WATER. CRREL Translation no. 422, Oct. 1974, p. 242-49.
NTIS: AD-A012 005.

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Tsurikov, V.L. (1974)
STATISTICS OF SALT COMPOSITION IN SEA ICE. Oceanology, v. 14(3), 1974, p. 360-68. (Translated from "Statisticheskiye kharakteristiki solevogo sostava morskogo l'da," Okeanologiya, v. 14(3), 1974, p. 439-47.)

B-435
Tsurikov, V.L.; Tsurikova, A.P. (1977)
STUDIES IN SEA ICE CHEMISTRY (STATE OF ART AND OBJECTIVES). Okeanologiya, v. 17(1), 1977, p. 55-64. 30 ref. In Russian.

B-436
Tsurikov, V.L. (1976)
ZHIDKAIA FAZA V MORSKIKH L'DAKH (Liquid phase in sea ice). Moscow, Nauka, 1976. 210p. 130 ref. In Russian with abridged English table of contents. [ice structure, unfrozen water content, ice composition, ice salinity, ice density, ice thermal properties, analysis (mathematics)]

B-437
Tsurikova, A.P.; Tsurikov, V.L. (1973)
BRINE CONTENT OF SEA ICE (STATEMENT OF THE PROBLEM). Oceanology, v. 12(5), May 1973, p. 663-72. (Translated from "O soderzhanii rassola v morskom l'du (sostoyaniye voprosa)," Okeanologiya, v. 12(5), Sept./Oct. 1972, p. 792-802.)

B-438
Tuchkov, L.T. et al (1968)
TEPLOVOE RADIOIZLUCHENIE LEDIANOGO POKROVA V SVCH-DIAPAZONE (Thermal radio emission from an ice cover in the ultra-high frequency range). Leningrad. Glavnaia Geofizicheskaia Observatoriia. Trudy, no. 222, 1968, p. 159-60. Ref. In Russian. [prospects noted for the use of the radiometric method of determining parameters of ice and snow covers]

B-439
Umano, S.; Kawasaki, S. (1971)
STUDIES ON SEA WATER REFRIGERATION CONCENTRATION, REPORT 13: STUDIES ON THE NUCLEATION AND THE GROWTH OF ICE CRYSTALS IN SEA WATER. U.S. Joint Publications Research Service. Translation no. 275, 1971. 37p. 15 ref. NTIS: AD-885 376L. [sea water freezing, ice crystal growth, ice crystal nucleation, supercooling, analysis (mathematics)]

B-440 *
Untersteiner, Norbert (1968)
NATURAL DESALINATION AND EQUILIBRIUM SALINITY PROFILE IN PERENNIAL SEA ICE. Journal of Geophysical Research, v. 73(4), 1968, p. 1251-57.
NTIS: AD-667 347. [discussion of mechanisms of brine migration]

B-441 *
Untersteiner, Norbert (1967)
NATURAL DESALINATION AND EQUILIBRIUM SALINITY PROFILE OF OLD SEA ICE. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967, p. 569-77. NTIS: AD-671 774.) [discussion of various possible mechanisms of salt migration in old sea ice]

B-442
Vant, Malcolm Roy (1976)
A COMBINED EMPIRICAL AND THEORETICAL STUDY OF THE DIELECTRIC PROPERTIES OF SEA ICE OVER THE FREQUENCY RANGE 100 MHZ TO 40 GHZ. Ontario, Canada, Carleton Univ., 1976. Ph.D. thesis.

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Vant, Malcolm Roy; Gray, R.B.; Ramseier, René O. et al (1974)
DIELECTRIC PROPERTIES OF FRESH AND SEA ICE AT 10 AND 35 GHZ. Journal of Applied Physics, v. 45(11), 1974, p. 4712-17. 28 ref.

B-444
Vasil'ev, S.S.; Luchininov, V.S. (1968)
ELEKTRICHESKIYE KHARAKTERISTIKI L'DA (Electrical characteristics of ice). Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut. Trudy, v. 284, 1968, p. 115-19. In Russian. [dielectric penetration of fresh-water and salt-water ice]

B-445 *
Vaudrey, K.D. (In press)
DETERMINATION OF MECHANICAL SEA ICE PROPERTIES BY LARGE-SCALE FIELD BEAM EXPERIMENTS. Presented at International Conference on Port and Ocean Engineering under Arctic Conditions, 4th, Memorial Univ. of Newfoundland, 26-30 Sept. 1977.

B-446
Vaudrey, K.D. (1973)
DEVELOPMENT OF SEA-ICE STRAIN TRANSDUCER. U.S. Naval Civil Engineering Laboratory. Technical Note, no. 1310, Nov. 1973. 29p.
NTIS: AD-773 066.

B-447 *
Vaudrey, K.D.; Katona, Michael G. (1976)
AN ELASTIC STRUCTURAL ANALYSIS OF FLOATING ICE SHEETS BY THE FINITE ELEMENT METHOD. (In: International Conference on Port and Ocean Engineering under Arctic Conditions, 3rd, Proceedings. Held 11-15 Aug. 1975, Fairbanks, Alaska. Institute of Marine Science, Univ. of Alaska, 1976, p. 439-53.)

B-448
Vaudrey, K.D. (1975)
ICE ENGINEERING: ELASTIC PROPERTY STUDIES ON COMPRESSIVE AND FLEXURAL SEA ICE SPECIMENS. U.S. Naval Civil Engineering Laboratory. Technical Note, no. 1417, Dec. 1975. 19p. NTIS: AD-A019 028.

B-449 *
Wakahama, Gorow; Akitaya, Eizi; Tabata, Tadashi (1974)
OBSERVATIONS OF SNOW COVERS IN ARCTIC REGIONS. Teion Kagaku, Series A, no. 32, 1974, p. 175-84. In Japanese with English summary. [snow covers greatly influence temperature distributions in sea ice beneath the snow, and also the heat budget of the sea ice and the formation of ice at the bottom of the sea ice]

B-450 *
Wakatsuchi, M. (1974)
EXPERIMENTS ON THE GROWTH OF SEA ICE AND REJECTION OF BRINE. Teion Kagaku, Series A, no. 32, 1974, p. 195-205. 7 ref. In Japanese with English summary.

B-451 *
Walker, H.J. (1973)
SALINITY CHANGES IN THE COLVILLE RIVER DELTA, ALASKA, DURING BREAKUP. (In: International Symposia on the Role of Snow and Ice in Hydrology, Proceedings. Held in Banff, Canada, Sept. 1972. UNESCO-WMO-IAHS, 1973, p. 514-27.)

B-452
Walker, H.J. (1973)
SPRING DISCHARGE OF AN ARCTIC RIVER DETERMINED FROM SALINITY MEASUREMENTS BENEATH SEA ICE. Water Resources Research, v. 9(2), 1973, p. 474-80. [between 27 May and 15 June 1971, the discharge of the Colville River, Alaska, was $5.70 \times 10^9 m^3$, which is about 58% of the total for 1971]

B-453
Washington. Univ. Geophysics Program (1971)
FINAL REPORT. CONTRACT U00014-67-A-0103-0020, NR 307-325. Seattle, Wash., Univ. of Washington, 1971. 8p. [describes 1970-71 work on growth of brine channels in sea ice and growth of stalactites under sea ice, processes which bring about natural desalination]

B-454 *
Weeks, Wilford F.; Lofgren, Gary (1967)
THE EFFECTIVE SOLATE DISTRIBUTION COEFFICIENT DURING THE FREEZING OF NaCl SOLUTIONS. (In: Oura, Hirobumi, ed. Physics of Snow and Ice: Proceedings of the International Conference on Low Temperature Science, v. 1, part 1. Sapporo, Institute of Low Temperature Science, Hokkaido Univ., 1967, p. 579-97.) [variation of effective solute distribution coefficient as a function of growth velocity is in agreement with theoretical predictions]

B-455 *
Weeks, Wilford F.; Assur, Andrew (1969)
FRACTURE OF LAKE AND SEA ICE. CRREL Research Report no. 269, Sept. 1969. 77p. Fig., photos, table. NTIS: AD-697 750.

B-456 *
Weeks, Wilford F.; Cox, G.F.N. (1974)
LABORATORY PREPARATION OF ARTIFICIAL SEA AND SALT ICE. CRREL Special Report no. 206, 1974. 11p. 4 fig., ref. NTIS: AD-780 694.

B-457 *
Weeks, Wilford F.; Assur, Andrew (1968)
MECHANICAL PROPERTIES OF SEA ICE. Canada. National Research Council. Associate Committee on Geotechnical Research. Technical Memorandum, no. 92, 1968, p. 25-78. Graphs, tables, 200 ref. In English with French summary. (Also CRREL Monograph no. IIC3, 1967. 80p.) [reviews the literature with detailed discussion of published results that contain sufficient data on ice temperatures, salinities and densities to permit adequate analysis]

B-458 *
Weeks, Wilford F. (1972)
MESOSCALE STRAIN AND ICE MORPHOLOGY. AIDJEX Bulletin, no. 14, 1972, p. 24-25.

B-459
Weeks, Wilford F. (1967)
REVIEW OF THE PHYSICS OF ICE BY E.R. POUNDER. American Meteorological Society. Bulletin, v. 48(9), Sept. 1967, p. 735. [book review]

B-460
Weeks, Wilford F.; Cox, G.F.N. (1973)
SALINITY VARIATIONS IN SEA ICE. CRREL Research Report no. 310, Aug. 1973. 25p.

B-461 *
Weeks, Wilford F. (1976)
SEA ICE PROPERTIES AND GEOMETRY. AIDJEX Bulletin, no. 34, Dec. 1976, p. 137-71. Ref. [ice mechanics, ice physics, ice strength, ice cover thickness, pressure ridges]

B-462 *
Weeks, Wilford F.; Hibler, William D., III; Ackley, S.F. (1974)
SEA ICE: SCALES, PROBLEMS AND REQUIREMENTS. (In: Santeford, Henry S.; Smith, J.L., comp. Advanced Concepts and Techniques in the Study of Snow and Ice Resources: An interdisciplinary symposium held at Monterey, Calif. 2-6 Dec. 1973. Washington, D.C., National Academy of Sciences, 1974, p. 255-67.)

B-463
Weeks, Wilford F. (1968)
UNDERSTANDING THE VARIATIONS OF THE PHYSICAL PROPERTIES OF SEA ICE. (In: Symposium on Antarctic Oceanography, Papers. Held in Santiago, Chile, 13-16 Sept. 1966. Sponsored by ICSU, SCAR, SCOR, IAPO, IUBS, 1968, p. 173-90. 20 fig., 39 ref.) (Also CRREL Special Report no. 112, 1967. 18p. NTIS: AD-657 213.)

B-464
Wooster, W.S. et al (1969)
REDEFINITION OF SALINITY. Zeitschrift für Geophysik, v. 35(6), 1969, p. 611-13. [letter; new internationally agreed definition]

B-465
Wright, B.D. (1974)
INTERNAL STRESS IN A FLOATING COVER OF SEA ICE.
Montreal, Canada, McGill Univ., Marine Sciences
Center, 1974. M.S. thesis.

B-466 *
Yakovlev, G.N. (1973)
METHOD FOR PREDICTING STRENGTH CHARACTERISTICS OF
ICE COVER. (In: Yakovlev, G.N., ed. Studies in
Ice Physics and Ice Engineering, v. 300. Jerusalem,
Israel Program for Scientific Translations, 1973,
p. 5-15. 8 ref. NTIS: TT72-50005.)

B-467 *
Yakovlev, G.N., ed. (1973)
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