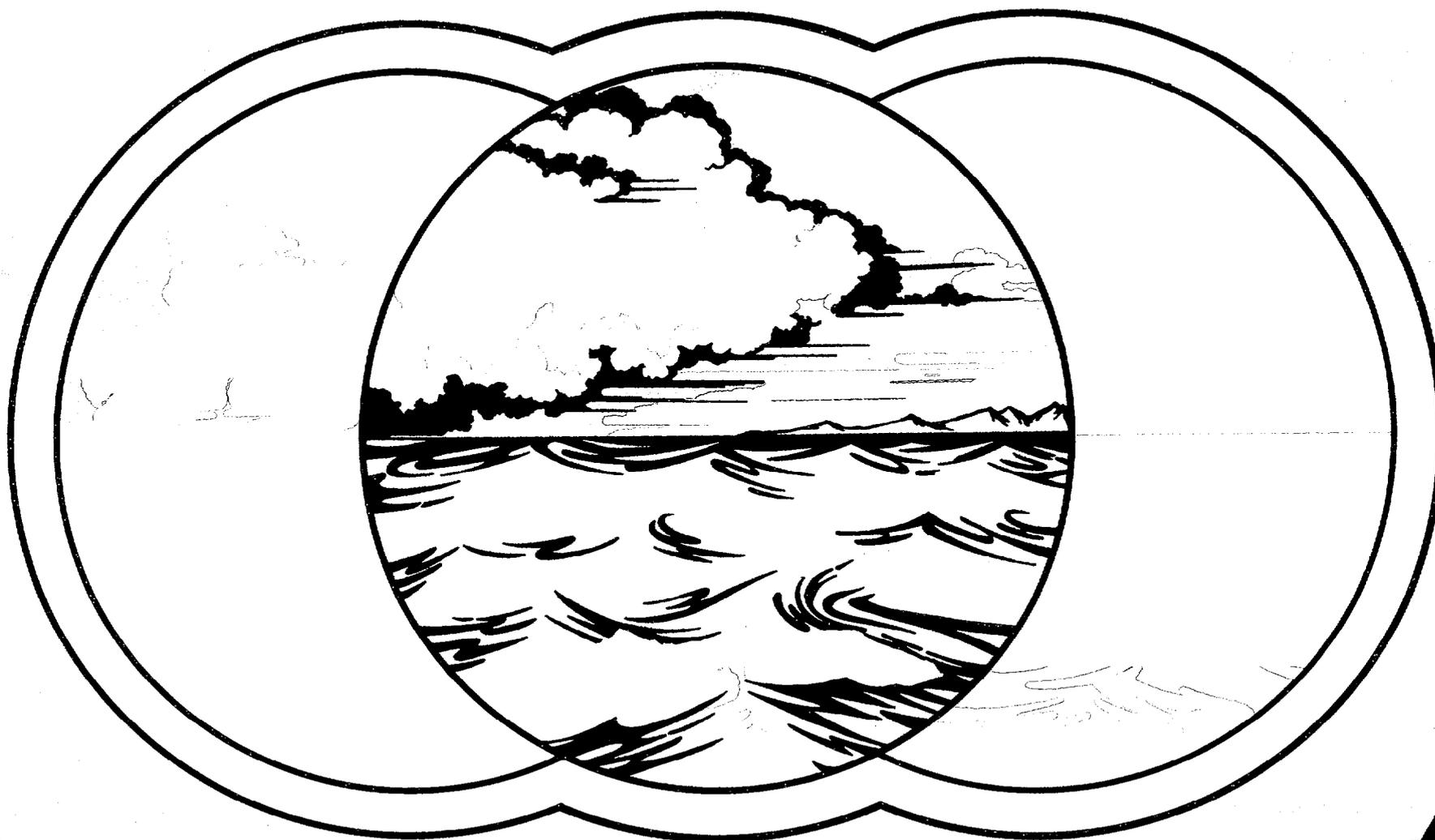
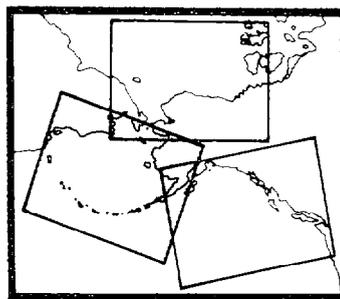


CLIMATIC ATLAS

OF THE OUTER CONTINENTAL SHELF WATERS AND COASTAL REGIONS OF ALASKA



VOLUME II BERING SEA





U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
ALASKA OUTER CONTINENTAL REGION
OCS STUDY, MMS 87.0012



U.S. DEPARTMENT OF DEFENSE
NAVAL OCEANOGRAPHY COMMAND DETACHMENT
ASHEVILLE, N.C.
NAVY S/N 0850.LP-014.8000



U.S. DEPARTMENT OF COMMERCE
NOAA, NATIONAL OCEAN SERVICE
OFFICE OF OCEANOGRAPHY AND MARINE ASSESSMENTS
OCEAN ASSESSMENT DIVISION, ALASKA OFFICE

RU-347

CLIMATIC ATLAS

OF THE OUTER CONTINENTAL SHELF WATERS AND COASTAL REGIONS OF ALASKA

VOLUME II BERING SEA

NCDC
WILLIAM A. BROWER, JR.
RONALD G. BALDWIN
CLAUDE N. WILLIAMS, JR.

AEIDC
JAMES L. WISE
LYNN D. LESLIE

NATIONAL CLIMATIC DATA CENTER • ASHEVILLE, NORTH CAROLINA
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ARCTIC ENVIRONMENTAL INFORMATION AND DATA CENTER, UNIVERSITY OF ALASKA • ANCHORAGE, ALASKA

1988

On the Authors

Arctic Environmental Information and Data Center

James L. Wise, M.S., is the Alaska State Climatologist in charge of the Climate Center at AEIDC. Mr. Wise joined the staff of AEIDC in 1975 after completing over 21 years of service as a weather officer in the **U.S.** Air Force. His writings and research include AEIDC project manager for work on this atlas and the earlier atlas published in 1977, a wind resource atlas for Alaska, the *Alaska Marine Ice Atlas*, and an oceanographic atlas for Bristol Bay. Applied projects include work on superstructure icing, storm surges, design wind, icing, and snow studies. He has also worked as a team member on numerous multidisciplinary applied research projects with other AEIDC staff and the Geophysical Institute, University of Alaska, Fairbanks.

Lynn D. Leslie, an oceanographer with the University of Alaska's Climate Center, works with marine and climatological data. She has developed numerous models and computer programs to analyze arctic climate variables and summarize long-term trends. Her work includes environmental assessment for several Pacific, Gulf of Alaska, and Beaufort Sea coastal regions; the compilation of long-term means and extremes at 470 cooperative climate stations in Alaska; design wind and snow load evaluations for numerous Alaska sites; and statistical and empirical analysis of superstructure icing rates in Alaskan waters. Her background research has focused on air-sea interaction in both tropical and arctic regimes with emphasis on engineering and design criteria in coastal communities.

National Climatic Data Center

William A. Brower, Jr., a meteorologist with the National Climatic Data Center's Applied Climatology Branch, works primarily in marine climatology. He served as task manager during the production of this three-volume Alaska atlas and the earlier atlas published in 1977. His contributions include environmental assessment reports for selected marine and coastal regions of the U.S. Pacific and Atlantic Oceans, Gulf of Mexico, Caribbean Sea, and Persian Gulf and Gulf of Oman; and a comprehensive climatic atlas of New York Bight. He has also served as data manager in production of major historical files for such programs as NOAA's and FGGE's U.S. Mobile Ship Data Programs, FGGE's II-c Surface-Based Precipitation and Snow Data Program, and DOE's U.S. Historical Climatology Network Program. His research includes a comparison of energy exchanges at the tropical sea-air interface based on data collected by a buoy and a ship.

Ronald G. Baldwin, a computer programmer/analyst with the National Climatic Data Center's Applied Climatology Branch, works primarily with computer-generated graphic presentations of meteorological and statistical data. He developed and produced the graphics for Sets 1-23 in section 2 of this atlas. He has made substantial contributions to the U.S. Navy Hindcast Spectral Ocean Wave Model (SOWM) Climatic Atlases for the North Atlantic and North Pacific, climatic summaries for NDBC data buoys, wind and wave summaries for selected U.S. Coast Guard operating areas, U.S. Navy climatic studies series, Defense Mapping Agency Pilot Charts,

Climate Impact Perception and Adjustment Experiment (CLIMPAX), U.S. Department of Commerce Recreational Day Summaries, and numerous other special studies such as climate change in North America as related to increasing concentrations of CO₂. Among his previous assignments were tours of duty as a National Weather Service specialist at Cordova, Cold Bay, and Annette, Alaska.

Claude N. Williams, Jr., a computer systems analyst with the National Climatic Data Center's Applied Climatology Branch, creates comprehensive data systems for meteorological data. He developed the quality control, data summarization, and preliminary contour mapping for the marine data in this atlas. His major contributions have been in a Tri-Service Upper Air Climatology Program, the DOE's U.S. Historical Climatology Network Program, and several marine atlases for the U.S. Navy. His background includes research and analysis in fields such as propeller design, ocean currents, remote sensing, and radio astronomy.

Table of Contents

| | |
|--|---------------|
| Figure Index-Section I | iv |
| Page Index—Section II | ..v |
| Acknowledgements | .vi |
| Abstract..... | v i |
| Introduction | ..v i |
| | |
| Section I: Selected Topics in Marine and Coastal Climatology <i>by James L. Wise and Lynn D. Leslie</i> | |
| Currents | I-5 |
| Sea Ice | ..I-9 |
| Tides | I-15 |
| Storm Surges. | I-19 |
| Superstructure Icing. | I-21 |
| Sensible Climate-Means and Extremes. | I-23 |
| Hypothermia | I-25 |
| Wind Chill. | I-27 |
| | |
| Section II: Marine and Coastal Climatic Atlas | |
| <i>by William A. Brower, Jr., Ronald G. Baldwin,</i> | |
| <i>and Claude N. Williams, Jr.</i> | |
| | |
| References..... | II-517 |

Figure Index

Section I: Selected Topics in Marine and Coastal Climatology

Figures

| | | |
|----|---|------|
| 1 | MMS Lease Sale Areas | I-1 |
| 2 | Place Names Map | I-2 |
| 3 | Bathymetry..... | I-3 |
| 4 | Bering Sea Currents-Summer | I-6 |
| 5 | Bering Sea Currents-Winter | I-7 |
| 6 | Recurring Polynyas | I-9 |
| 7 | Sea Ice Zones and Types..... | I-10 |
| 8 | January Southern Ice Limit for 1975-79 | I-10 |
| 9 | Seasonal Fast Ice Boundary-Norton Sound—Feb/Mar | I-11 |
| 10 | Seasonal Fast Ice Boundary-Norton Sound-Apr/May | I-12 |
| 11 | Seasonal Fast Ice Boundary-Norton Sound—May/Jun | I-12 |
| 12 | Seasonal Fast Ice Boundary-Southeast Bering—Feb/Mar | I-13 |
| 13 | Seasonal Fast Ice Boundary-Southeast Bering-Apr/May | I-14 |
| 14 | Seasonal Fast Ice Boundary-Southeast Bering—May/Jun | I-14 |
| 15 | Major Tide Components | I-15 |
| 16 | Tide Data..... | I-16 |
| 17 | Tide Type and Corange | I-17 |
| 18 | Storm Tracks with Storm Surge Floods | I-19 |
| 19 | Superstructure Icing Rate Nomogram | I-21 |
| 20 | Reported Occurrences of Superstructure Icing on Ships | I-22 |
| 21 | Climatic Means and Extremes | I-23 |
| 22 | Equivalent Wind Chill Temperatures | I-27 |

Section II: Marine and Coastal Climatic Atlas

| | | |
|----|----------------------------|------|
| 23 | Duration of Daylight | II-3 |
|----|----------------------------|------|

Acknowledgments

The maps, graphs, and tables in the second section are the result of efforts by many people at NOAA's National Climatic Data Center (NCDC) in Asheville, North Carolina. Special acknowledgment is given to the following named meteorologists of NCDC's **Climatological Analysis Division**: Phala L. Franks, for performing the voluminous computer processing and editing of data; Michael J. Changery and Joe D. Elms, for their editorial evaluation of the isopleth analyses **and graphics products**; Richard W. Knight, for production of the cyclone track and sea ice statistics; Thomas R. Karl, for production of the wind and wave persistence statistics; and M. Lawrence Nicodemus, for production of the annual maximum wind and wave statistics. Appreciation is also extended to NCDC's meteorological technicians Charles W. Thomason, Jr. (for assisting in the isopleth analyses), and Elaine H. Mason (for assisting in the edit of the film graphics); and to NCDC's print shop technicians Claude A. Cochran and Berry K. Coleman for filming the numerous graphics and analyses maps.

The observations processed for most of the U.S. coastal stations were collected by the National Weather Service (NOAA), the Federal Aviation Administration, and the U.S. Navy, and routinely sent to NCDC for digitizing and archiving. The digital data for the U.S. Air Force (USAF) and Russian stations were provided by the USAF's Environmental Technical Applications Center in Asheville. The digital data for the Canadian coastal stations were purchased from the Canadian Climate Centre in Downsview, Ontario. Data summaries were made possible through programs designed at NCDC and funded primarily by the Commander, U.S. Naval Oceanography Command, in support of U.S. Navy's continuing marine climatology requirements, and by Department of Interior's Minerals Management Service in support of this atlas production.

The extremes data in the first section were updated through 1984 from a published *Alaska Climate Summaries* done by AEIDC in another project, published Canadian normals 1951-1980, and data supplied by Drs. Howard Critchfield and Kelly Redman, state climatologists for Washington and Oregon. Joseph C. LaBelle, glaciologist and geomorphologist at AEIDC assisted in the preparation of Cook Inlet ice and

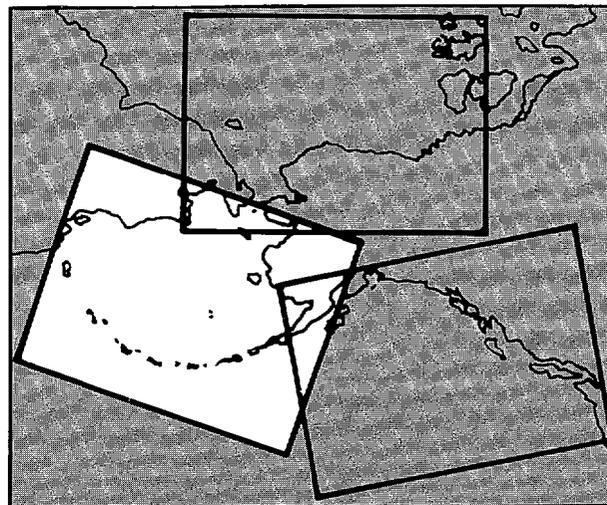
calving glacier ice in Volume I. Thanks also to Denise Cote for editing section I of all volumes and Laura J. Larson who was graphics project leader for the atlas and scheduled work on maps, charts, and text for all 3 volumes.

This revision was funded (under AEIDC contract #NE-EF3100-7-00240 with NOAA) in part by the Minerals Management Service, Department of the Interior, through an interagency agreement with the National Oceanic and Atmospheric Administration, Department of Commerce, as part of the Alaska Outer Continental Shelf Environmental Assessment Program. Additional funding was provided by the Naval Oceanographic Command Detachment, Asheville, North Carolina.

Abstract

This project updates the knowledge of climatological conditions presented in the 1977 publication of this three-volume atlas. Such environmental information for the three Alaskan marine and near-coastal areas is important for resource development of the outer continental shelf-The Gulf of Alaska (Volume I), the Bering Sea (Volume II), and The Chukchi and Beaufort Seas (Volume III) as shown on the map below.

The maps, graphs, and tables in the atlas present a detailed climatic profile of the marine and coastal regions of Alaska. Statistics give the means, extremes, and percent frequency of occurrence of threshold values for these elements: wind, visibility, present weather, sea level pressure, air and sea surface temperature, clouds, waves, and such supplemental information as storm surges, tides, sea ice, cyclone tracks, surface currents, bathymetry, detailed weather, and aviation weather. Data came from



4.5 million surface marine observations and 8.5 million observations for 66 coastal and island stations within the area 40°-84°N and 110°W-160°E, and provide the best possible climatological picture of the outer continental shelf waters and coastal regions of Alaska.

Introduction

The nature of man's offshore activities depends to a large extent on weather conditions. Knowledge of these conditions can help insure efficient and safe operations. Extreme weather conditions that may be encountered in a given location largely determine the design, construction, and operation of permanent platforms and structures in the ocean as well as onshore support activities. This atlas is useful to those engaged in shipping, national defense, fishing, and applied research where a knowledge of coastal and offshore climate is essential. Weather information also aids in assessing the onshore impact of offshore activities.

This atlas is the result of a joint effort by the Arctic Environmental Information and Data Center (AEIDC), University of Alaska and the National Climatic Data Center/National Oceanic Atmospheric Administration (NCDC/NOAA) to present descriptive climatology and data analyses of surface marine and atmospheric parameters for those waters and coastal regions of the Alaskan outer continental shelf important to resource development. It is designed to serve as a climatological reference in the assessment of potential impact by oil and gas exploration and development and of leasing and operating regulations and monitoring programs that will permit resource development and insure environmental protection.

The evaluation is in the form of a climatic atlas for each of three marine and coastal areas: The Gulf of Alaska (Volume I), The Bering Sea (Volume II), and The Chukchi and Beaufort Seas (Volume III).

The first section in each volume contains information on such hazards as storm surges, superstructure icing, hypothermia, and wind chill; extremes data on winds, temperature, and precipitation; and planning information on surface currents, bathymetry, sea ice, and tides. The second section presents a detailed climatic profile in the form of isopleth analyses, graphs, and tables.