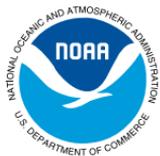




U. S. Department of Commerce • National Oceanic and Atmospheric Administration

National Ocean Service • Office of Response and Restoration

National Environmental Satellite, Data, and Information Service • National Ice Center



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For additional information contact:

NOAA Hazardous Materials Response Division

7600 Sand Point Way N.E.

Seattle, WA 98115

<http://response.restoration.noaa.gov>

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This Observers' Guide to Sea Ice was prepared by Dr. Orson P. Smith, University of Alaska Anchorage, School of Engineering for the National Oceanic and Atmospheric Administration. It is a product of the Cook Inlet and Prince William Sound Navigation Safety and Efficiency project. To order additional copies of this document, fax your request to 206-526-4442 or email [library@hazmat.noaa.gov](mailto:library@hazmat.noaa.gov).

# OBSERVERS' GUIDE TO SEA ICE

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## Introduction

This booklet is intended for use by volunteers to report aerial, shipboard, or shoreline observations of ice conditions at sea to authorities such as the National Weather Service, National Ice Center, U.S. Coast Guard, pilots associations, port authorities, or other maritime interests. Emphasis here is on conditions of concern to mariners with regard to safe passage of ships. Scientific observers may wish to note additional details following guidance of the World Meteorological Organization.

Sea ice consists of frozen sea water. River (freshwater) ice is often indistinguishable when mixed with sea ice, especially with snow cover. Glacier ice, broken away from a tidewater glacier, is usually more irregular than river ice or frozen sea water. Tidal estuaries may also have thick, irregular pieces of sediment-laden *beach ice* or *stamukhas*, which have been grounded on tidelands, repeatedly submerged, and floated free by spring tides.

Sea ice is observed in terms of three basic parameters: *concentration*, *stage* of development, and *form*. Concentration refers to the fraction of the sea surface covered by ice, reported in tenths by international convention. Stage of development refers to age and structural characteristics of the ice that may be inferred from specific visible features and knowledge of regional conditions prior to the observation. Stage may be more directly observed from shipboard when ice breaking reveals the prevailing thickness of the ice. Stage classification does not apply to glacier ice. Form refers to the horizontal shape and dimensions of pieces of ice. The form of glacier ice is also reported in terms of *freeboard*, or maximum height above the sea surface.

Observers should report sea ice conditions with reference to the date, time, and geographical position of the observation and the particular perspective, or *field of view*. The field of view from an airplane is much different from the field of view from the bridge of a ship or from the shoreline. A reporting form for sea ice and a separate form for glacier ice are provided to aid observers in noting this essential information.

---

## U.S. Sea Ice Reporting Agencies

### **National Weather Service**

Alaska Region, Forecast Office

6930 Sand Lake Road

Anchorage, Alaska 99502-1845

Ice Desk: 907/266-5113

Marine Desk (24 hours): 907/266-5106

Fax: 907/266-5188

Web page: <http://www.alaska.net/~nwsar/>

### **National Ice Center**

Federal Office Building #4, Room 2301

4251 Suitland Road

Washington, D.C. 20395

Telephone: 301/457-5303

Fax: 301/457-5305

email: [liaison@natice.noaa.gov](mailto:liaison@natice.noaa.gov)

Web page: <http://www.natice.noaa.gov>

## Completing an Observation Report

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1. Use a dry-erase marker to fill out either the sea ice or the glacier ice observation report form, or to make a permanent record on a copy of the form.
2. Note the date, time, and time zone of the observation, *e.g.*, "Alaska Standard," "Alaska Daylight Savings (summer) Time," or "Greenwich Mean Time" (GMT).
3. Note the latitude and longitude of the observation by reference to a chart or GPS positioning system. GPS systems also give accurate time of day.
4. Describe your position in words, as you would over the radio or telephone, noting the water body and nearby charted geographical features, *e.g.*, "central Cook Inlet, 3 nautical miles east of Middle Ground Shoal."
5. Describe your perspective in terms of altitude above the water, the compass direction toward which you are looking, and the most recognizable geographical features directly in view, *e.g.*, "10 meters (30 ft) above the water (bridge-level), looking west toward the center of Trading Bay."
6. Circle the choices of concentration that apply to the conditions you observe, noting the average and the range of concentrations in view.
7. Sea ice: Circle the stages of development you judge to be in view. Direct knowledge of recent local weather and prior nearby ice observations, as well as the appearance of the ice, may be applied to judge stage of development.
8. Use the length, or beam, of the ship or recognizable objects in view (like ships, docks, or oil platforms) to estimate the size of ice pieces observed and note the prevailing form and the range of ice forms visible.
9. Glacier ice: Note the form in terms of estimated maximum freeboard and waterline length. Also note the above-water shape.
10. Note any other observed features that might help mariners following you across the water body or that would help ice reporters match your observation with others.
11. Transmit your report as soon as possible to the National Weather Service, National Ice Center, or other marine service organization.

# Sea Ice Observation Report Form

---

Date:

Time:

Time zone:

Latitude:

Longitude:

Description of position:

---

Altitude of observer:

---

Looking toward (compass bearing):

---

Charted landmarks in view:

---

Concentration: (see pages 7-10)	0	1	2	3	4	5	6	7	8	9	10
Stage of Development: (see pages 11-15)	New			Ni	YN-G	YN-GW	FL	FM	FT	Old	
Form: (see pages 16-22)	New		Brash		Belts		Strips		Pancakes		
Cakes	Small floes		Medium floes		Big floes		Vast floes		Giant floes		

Other description:

---

# Glacier Ice Observation Report Form

---

Date: \_\_\_\_\_ Time: \_\_\_\_\_ Time zone: \_\_\_\_\_

Latitude: \_\_\_\_\_ Longitude: \_\_\_\_\_

Description of position: \_\_\_\_\_

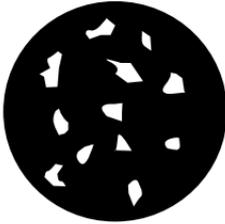
Altitude of observer: \_\_\_\_\_

Looking toward (compass bearing): \_\_\_\_\_

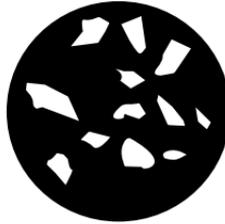
Charted landmarks in view: \_\_\_\_\_

Concentration: (see page 7)	0	1	2	3	4	5	6	7	8	9	10
Glacier ice forms: (see pages 23-27)	Growlers			Bergy bits			Small berg				
	Medium berg			Large berg			Very large berg				
Above-water shape: (see page 23)	Blocky			Tabular			Domed				
Pinnacled	Drydocked			Wedged			Non-tabular				

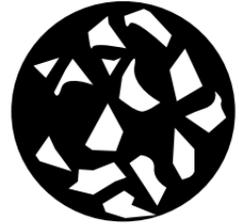
Other description: \_\_\_\_\_



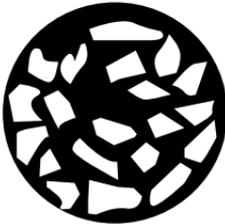
*less than 1 tenth "open water"*



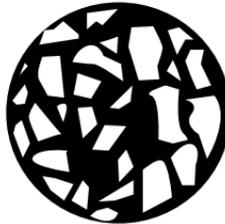
*2 - 3 tenths "very open drift"*



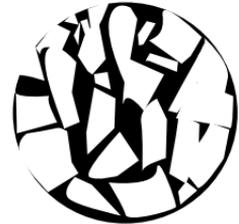
*4 tenths "open drift"*



*5 tenths "open drift"*



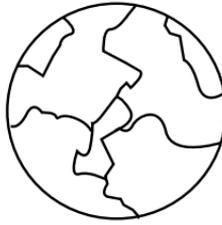
*6 tenths "open drift"*



*7 - 8 tenths "close pack"*



*9 tenths "very close pack"*



*10 tenths "compact"*

## Concentration

---



1 - 2 tenths "very open drift"



3 - 4 tenths "open to very open drift"



5 - 6 tenths "open drift"



7 - 8 tenths "close pack"

## Concentration

---



9 tenths "very close pack"



10 tenths "compact"

### **New (N):**

Ice of the following initial stages of ice formation

**Frazil:** Separate fine needles or plates suspended in the water

**Grease:** A thin, soapy-looking surface layer of coagulated frazil ice

**Slush:** Snow mixed with water in a viscous surface layer

**Shuga:** An accumulation of spongy white lumps

### **Nilas (Ni):**

A thin, elastic crust of ice, less than 10 cm (4 in) thick, easily bending on waves, often with a striped or chevron appearance.

### **Young (YN):**

Ice 10 - 30 cm (4 - 12 in) thick of the following sub-stages

**Gray (G):** Young ice 10 - 15 cm (4 - 6 in) thick, less elastic than nilas, that breaks on swell and rafts (one layer over another) under pressure

**Gray-white (GW):** Young ice 15 - 30 cm (6 - 12 in) thick, that buckles to form ridges on its edges from pressure or collisions

### **First-year thin (FL):**

Sea ice that, in uniform level areas without ridges or other deformations, is 30 - 70 cm (12 - 27 in) thick

### **First-year medium (FM):**

Sea ice 70 - 120 cm (27 - 48 in) thick

### **First-year thick (FT):**

Sea ice over 1.2 m (4 ft) thick

### **Old or multi-year (MY):**

Sea ice 3 m (10 feet) or more thick that has survived at least one melting season, characterized by undulating, weathered ridges and a well-defined melt water drainage pattern

## Stages of Development

---



**New Ice**

**Frazil:** Fine needles or plates suspended in the water

**Grease:** A soapy-looking surface layer of coagulated frazil ice



**New Ice**

**Slush:** Snow mixed with water

**Shuga:** An accumulation of spongy white lumps



**Nilas (Ni)** A thin, elastic crust of ice, less than 10 cm (4 in) thick, easily bending on waves, often with a striped or chevron appearance



**Young (YN)** Level ice 10 - 30 cm (4 - 12 in) thick, of the following sub-stages:

**Gray (G):** Young ice 10 - 15 cm (4 - 6 in) thick, less elastic than nilas, that breaks on swell and rafts under pressure

**Gray-white (GW):** Young ice 15 - 30 cm (6 - 12 in) thick, which buckles to form ridges on its edges from pressure or collisions

## Stages of Development

---



**First-year thin (FL)** Sea ice 30 - 70 cm (12 - 27 in) thick



**First-year medium (FM)** Sea ice 70 - 120 cm (27 - 48 in) thick



**First-year thick (FT)** Sea ice over 1.2 m (4 ft) thick (Photo provided by Jerry Galt)



**Old or Multi-year** Sea ice 3 m (10 feet) thick that has survived at least one melting season, characterized by undulating, weathered ridges and a well-defined melt water drainage pattern

## Sea Ice Forms

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**New:** small, thin, newly formed, dinner plate-sized pieces

**Brash:** Broken pieces less than 2 m (6 ft) across

**Pancake:** Rounded floes 30 cm - 3 m (1 - 10 ft) across with ridged rims

**Ice Cake:** Level piece 3 - 20 m (6 - 65 ft) across

**Small Floe:** Level piece 20 - 100 m (65 - 328 ft) across

**Medium Floe:** Level, continuous piece 100 - 500 m (328 - 1640 ft) across

**Big Floe:** Level, continuous piece 500 m - 2 km (1/3 - 1 mi) across

**Vast Floe:** Level, continuous piece 2 - 10 km (1 - 6 mi) across

**Giant Floe:** Level, continuous piece greater than 10 km (6 mi) across

**Belt:** A linear accumulation of sea ice from 1 km to over 100 km (0.6 - 60 mi) wide

**Strip:** A linear accumulation of sea ice less than 1 km (0.6 mi) wide

**Beach Ice or Stamukhas:** Irregular, sediment-laden blocks that are grounded on tidelands, repeatedly submerged, and floated free by spring tides

**Fast Ice:** Ice formed and remaining attached to shore

### Useful Size-Reference Objects

Brash: less than 2 m (6 ft) across

6 ft



Growler: less than 5 m (16 ft)

16 ft

Pancake: 30 cm - 3 m (1 - 10 ft)



Bergy Bit: 5 - 15 m (17 - 50 ft)

32 ft

Ice Cake: 3 - 20 m (6 - 65 ft) across



Small Berg: 15 - 60 m (50 - 200 ft)

200 ft

Small Floe: 20 - 100 m (65 - 328 ft)



Medium Berg: 61 - 122 m (201 - 400 ft)

300 ft

Large Berg: 123 - 213 m (401 - 670 ft)



Medium Floe:

100 - 500 m (328 - 1640 ft)

Very Large Berg:

greater than 213 m (670 ft)

Big Floe:

500 m - 2 km (1/3 - 1 mi)

710 ft

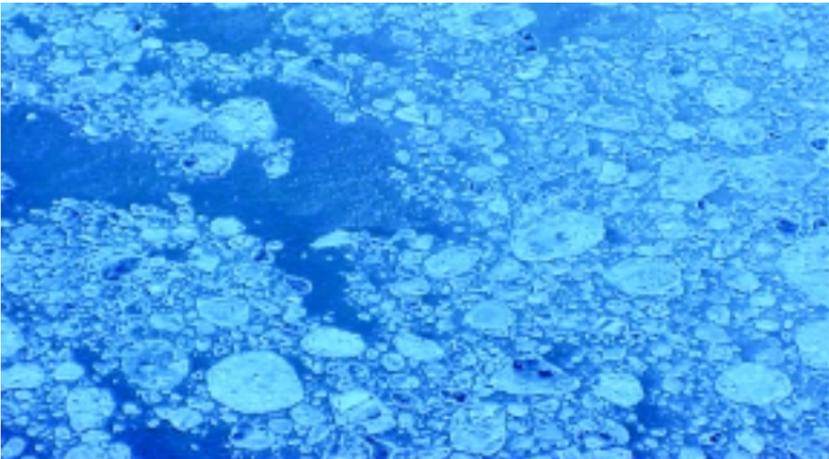


## Sea Ice Forms

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**Brash:** Broken piece less than 2 m (6 ft) across (Homer, Alaska)



**Pancake Ice:** Circular floes 30 cm - 3 m (1 - 6 feet) across and up to 10 cm (4 inches) thick with raised rims



**Ice Cake:** Relatively level piece less than 20 m (65 ft) across (altitude 500 feet, Cook Inlet, Alaska)



**Small Floe:** Continuous level piece 20 - 100 m (65 - 328 ft) across (altitude 500 ft, Anchorage, Alaska)

## Sea Ice Forms

---



**Medium Floe:** Continuous flat piece 100 - 500 m (328 - 1640 ft) across (altitude 800 ft, Cook Inlet, Alaska)



**Big Floe:** Continuous flat piece 500 m - 2 km (1/3 - 1 mi) across (altitude 500 - 600 ft, Arctic Ocean)



**Belt:** A linear accumulation of sea ice from 1 km to over 100 km (0.6 - 60 mi) wide



**Strip:** A linear accumulation of sea ice less than 1 km (0.6 mi) wide (altitude 800 ft, Cook Inlet, Alaska)

## Sea Ice Forms

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**Beach Ice, or Stamukhas:** Thick, irregular, sediment-laden *pieces*, which have been grounded on tidelands, repeatedly submerged, and floated free by spring tides (grounded beach ice, Cook Inlet, Alaska)



**Fast Ice:** Ice formed and remaining attached to shore (upper Cook Inlet, Alaska)

---

Form	Freeboard (height above water)	Length
Growler	less than 1 m (3 ft)	less than 5 m (16 ft)
Bergy Bit	1 - 5 m (3 - 16 ft)	5 - 15 m (17 - 50 ft)
Small Berg	5 - 15 m (17 - 50 ft)	15 - 60 m (50 - 200 ft)
Medium Berg	16 - 45 m (51 - 150 ft)	61 - 122 m (201 - 400 ft)
Large Berg	46 - 75 m (151 - 240 ft)	123 - 213 m (401 - 670 ft)
Very Large Berg:	greater than 75 m (240 ft)	greater than 213 m (670 ft)

---

**Blocky:** generally straight-sided polygonal shape

**Tabular:** flat top with near-vertical sides

**Domed:** rounded appearance above the waterline

**Non-tabular or irregular:** no regular geometric shape apparent

**Wedged:** triangular wedge shape

**Pinnaced:** one or more prominent central spires

**Drydocked:** melted out in center to form a U-shaped slot

**Black Ice:** Dark, sediment-laden ice from glacier medial moraines or associated frozen glacier surface ponds of turbid runoff water

## Glacier Ice Forms

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**Growler:** Glacier fragment less than 1 m (3 ft) freeboard and less than 5 m (16 ft) across (Prince William Sound, Alaska)



*Bergy bit (irregular)*



*Black ice bergy bit (blocky)*

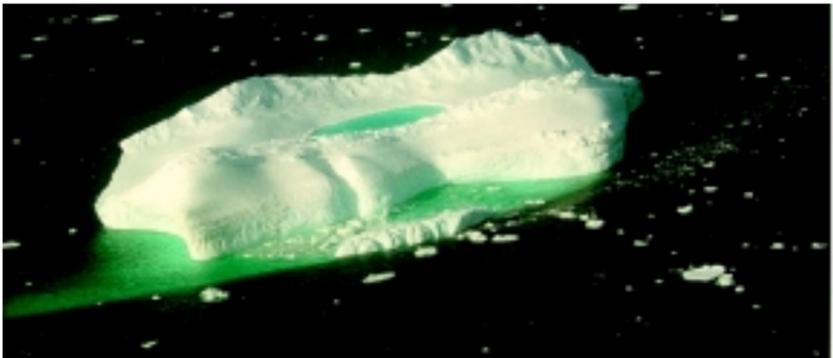
**Bergy Bit:** Glacier fragment 1 - 5 m (3 - 16 ft) freeboard or 5 - 15 m (16 - 50 ft) across (Prince William Sound, Alaska, photo provided by Stan Stephens)

## Glacier Ice Forms

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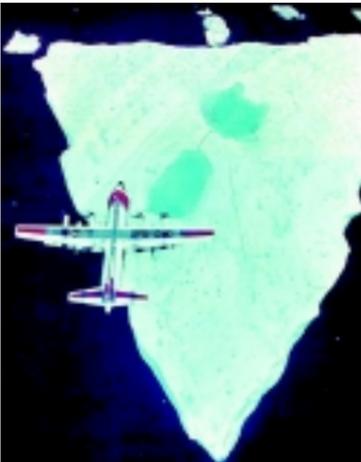
**Small Berg:** Glacier fragment 5 - 15 m (16 - 50 ft) freeboard or 15 - 60 m (50 - 200 ft) across (Prince William Sound, Alaska)



**Medium Berg:** Glacier fragment 16 - 45 m (51 - 150 ft) freeboard or 61 - 122 m (201 - 400 ft) across (North Atlantic, photo provided by USCG International Ice Patrol)



**Large Berg:** Glacier fragment 46 - 75 m (151 - 240 ft) freeboard or 123 - 213 m (401 - 670 ft) across  
(Photo provided by Jerry Galt)



**Very Large Berg:** Glacier fragment over 75 m (240 ft) freeboard or over 213 m (670 ft) across  
(Antarctica, photo provided by USCG International Ice Patrol)

# U.S. Department of Commerce

National Oceanic and Atmospheric Administration • National Ocean Service



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