

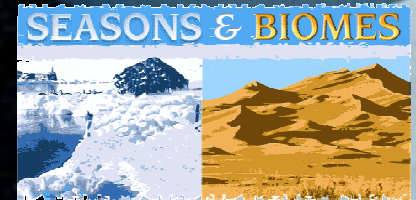
GLOBE Freshwater Ice Phenology Protocols

Kim Morris, Martin Jeffries and Elena Sparrow

University of Alaska Fairbanks



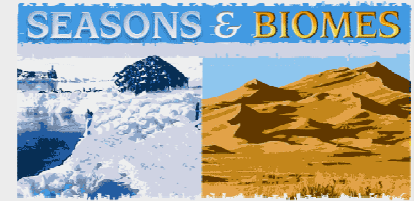
***Global Learning
and Observations
to Benefit the
Environment
(GLOBE)***



Prepared by Kim Morris and Martin Jeffries, UAF



Freshwater Ice Phenology



The **phenology** of an ice cover is the freeze-up date, break-up date and ice cover duration.

Freeze-up (FU) defines the period between initial ice formation and the establishment of a complete ice cover. The FU date is the day that the pond is completely ice covered.

Break-up (BU) defines the period between the onset of snow melt and the complete disappearance of the ice. The BU date is the day when the lake is completely ice free.

Taken together freeze-up and break-up denote the endpoints of the **ice cover duration**.



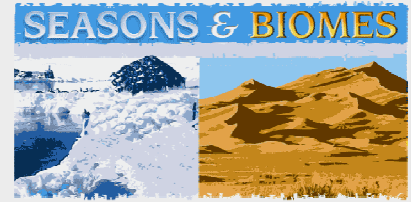
Border ice formation – begins freeze-up



Moat formation- begins break-up



Freshwater Ice Phenology Protocols, I



Purpose

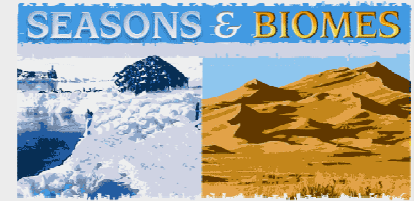
To monitor the freeze-up and break-up processes on a selected pond/lake or large creek/river to determine the duration of the annual ice cover.

Overview

Students will select an easily accessible pond/lake or large creek/river close to their school that is *known to develop an ice cover* in the winter and observe and document its freeze-up and break-up.



Freshwater Ice Phenology Protocols, II



Time

Selection and preparation of site (not including times to and from the site):
up to several hours.

Daily visits (not including times to and from the site): *about 15-20 minutes.*

Frequency

Observations will be made daily at the same time of day \pm 1 hour during the freeze-up and break-up processes (beginning to end). The recommended time of day is solar noon as this is the time of the maximum of sunlight even as the length of the day decreases.

Material and Tools

GPS (for site set-up)

GPS Datasheet (for site set-up)

Survey stakes/tape or other markers to identify the photo sites and viewing points

Digital camera

Computer and internet connection

Ice type identification glossary (provided)

Ice Phenology Datasheets (provided)

Preparation

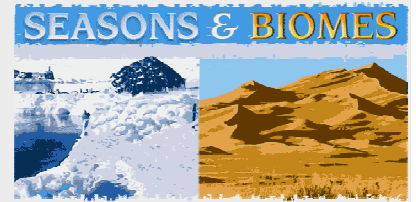
Select and mark the observation site.

Familiarize students with the ice types in the Ice Glossary



Break-up at 31.6 Mile Pond, AK in 2005

17 days documented. Break-up may have been as long as 20 days.



22 April



1 May



2 May



3 May



4 May



5 May



6 May



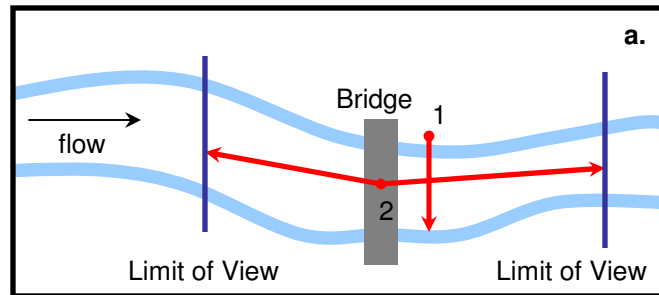
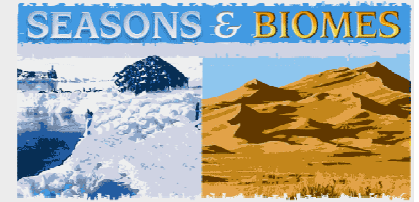
7 May



8 May



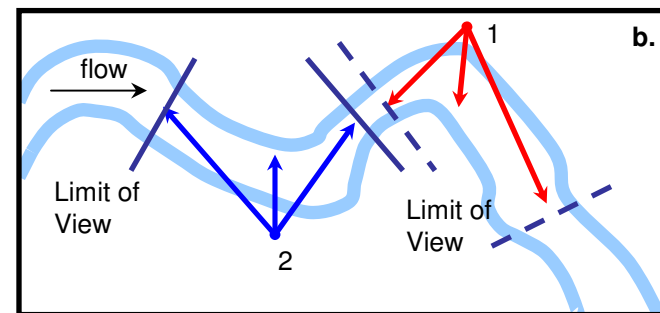
River Site Selection



QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

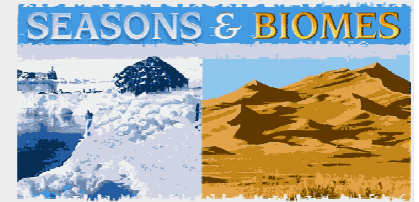
The point of access on a large creek/river may have a view of a long stretch of the water to either side (upstream and downstream or to the left and right) as well as easy access to an “across” view. An outer limit of the view to be documented should be chosen and marked.

In some cases, a viewing point must be chosen that allows a good view of a substantial but limited portion of the river.





River Ice Protocol



- 1) Take the set of digital photographs (upstream, downstream, across);
- 2) Complete the datasheet (estimating the % of the channel width that is covered by border ice; description of changes in the border ice (fractures, flooding, movement); description of other ice present; and completing the “Environmental Conditions” observations.
- 3) Submit the data (photographs and datasheet).



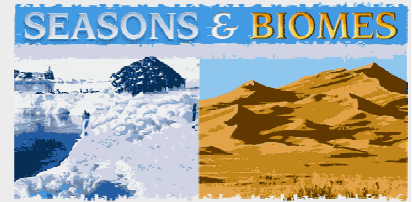
Note: There are separate datasheets for river freeze-up and break-up.





Daily River Ice Observations Datasheet

Freeze-up



LOCATION: [Text entered here.](#)
DATE: [Text entered here.](#)
TIME: [Text entered here.](#)

GENERAL FU ICE OBSERVATIONS

Upstream %
Borderl ice extent [Text](#)
Border ice change
 Fractured
 Flooding
 Movement
Downstream %
Borderl ice extent [Text](#)
Border ice change
 Fractured
 Flooding
 Movement
Across stream
Channel ice type
 Frazil
 Pancakes, small
 Pancakes, large
 Frost smoke Y/N

ENVIRONMENTAL OBSERVATIONS

Select (X) one from each category:

Sky: 5%
 (can substitute cloud few (5-25%)
 protocol here) scattered (26-50%)
 broken (51-90%)
 overcast (>90%)

Wind: calm
 light wind
 windy

Precipitation: none
 snow flurries
 snowing
 drizzle
 rain
 freezing rain

Snow on bank/shore: none
 new
 stable/no change
 wind redistributed
 melting/wet

Snow on ice: none (bare, cold)
 new - patchy
 new - continuous
 stable/no change
 wind redistributed
 melting/wet
 none (bare - warm)

Ice surface: smooth
 (may choose more than 1) rough
 blocky/broken/jumbled
 wet/flooded
 bare (melting)
 ice jam

Additional Comments: [Text entered here.](#)

OTHER COMMENTS

[Text entered here.](#)

DAILY PHOTOGRAPHS OF THE RIVER ICE FREEZE UP CONDITIONS

1) Across water body photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)

2) Upstream water body photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)

3) Downstream water body photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)

4) Additional photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)

5) Additional photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)

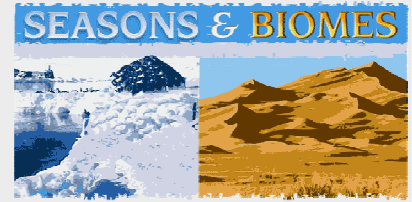
6) Additional photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)



Daily River Ice Observations Datasheet, Freeze-up SHAGELUK, ALASKA



LOCATION: Shageluk
 DATE: 3-Nov-07
 TIME: 1000

GENERAL FU ICE OBSERVATIONS

Upstream %
 Border ice extent 0

Border ice change
 Fractured
 Flooding
 Movement

Downstream %
 Border ice extent

Border ice change
 Fractured
 Flooding
 Movement

Across stream
 Channel ice type
 Frazil
 Pancakes, small
 Pancakes, large
 Frost smoke y

ENVIRONMENTAL OBSERVATIONS

Select (X) one from each category:

Sky: 5% (can substitute cloud protocol here)
 few (5-25%)
 scattered (26-50%)
 broken (51-90%)
 overcast (>90%)

Wind: calm
 light wind
 windy

Precipitation: none
 snow flurries
 snowing
 drizzle
 rain
 freezing rain

Snow on bank/shore: none
 new
 stable/no change
 wind redistributed
 melting/wet

Snow on ice: none (bare, cold)
 new - patchy
 new - continuous
 stable/no change
 wind redistributed
 melting/wet
 none (bare - warm)

Ice surface: smooth
 rough
 (may choose more than 1) blocky/broken/jumbled
 wet/flooded
 bare (melting)
 ice jam

Additional Comments: Starting to look like freezeup!

OTHER COMMENTS

Text entered here.

DAILY PHOTOGRAPHS OF THE RIVER ICE FREEZE UP CONDITIONS

1) Across water body photo:

 Comments: Nice!

2) Upstream water body photo:

 Comments: Making progress!

3) Downstream water body photo:

 Comments: Lovely!

4) Additional photo:

 Comments: Across the river

5) Additional photo:

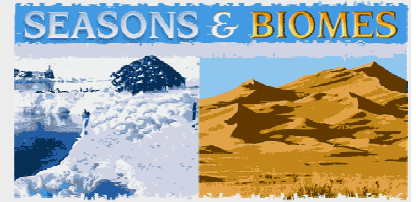
 Comments: Not exactly the same upriver shot, but almost.

6) Additional photo:

 Comments: Down river by the bank



Daily River Ice Observations Datasheet Break-up



LOCATION: [Text entered here.](#)
 DATE: [Text entered here.](#)
 TIME: [Text entered here.](#)

GENERAL BU OBSERVATIONS

Ice present [Y/N](#)

Static ice

Upstream [Y/N](#)

Ice fractured [Y/N](#)

Water on ice [Y/N](#)

Holes in ice [Y/N](#)

Channel through ice [Y/N](#)

Downstream [Y/N](#)

Ice fractured [Y/N](#)

Water on ice [Y/N](#)

Holes in ice [Y/N](#)

Channel through ice [Y/N](#)

Moving ice

Upstream [Y/N](#)

Downstream [Y/N](#)

ENVIRONMENTAL OBSERVATIONS

Select (X) one from each category:

Sky: clear (0-5%)
 (can substitute cloud few (5-25%)
 protocol here) scattered (26-50%)
 broken (51-90%)
 overcast (>90%)

Wind: calm
 light wind
 windy

Precipitation: none
 snow flurries
 snowing
 drizzle
 rain
 freezing rain

Ice surface: smooth
 rough
 blocky/broken/jumbled
 melt ponds
 ice jam

Additional Comments: [Text entered here.](#)

OTHER COMMENTS

[Text entered here.](#)

DAILY PHOTOGRAPHS OF THE RIVER ICE BREAK UP CONDITIONS

1) Across water body photo:
 Comments: [Text entered here.](#)

2) Upstream water body photo:
 Comments: [Text entered here.](#)

3) Downstream water body photo:
 Comments: [Text entered here.](#)

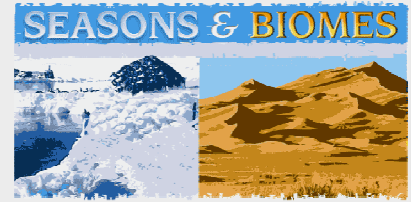
4) Additional photo:
 Comments: [Text entered here.](#)

5) Additional photo:
 Comments: [Text entered here.](#)

6) Additional photo:
 Comments: [Text entered here.](#)



Daily River Ice Observations Datasheet, Break-up SHAGELUK, ALASKA



LOCATION: Shageluk
 DATE: 28-Apr-07
 TIME: 1500

GENERAL BU ICE OBSERVATIONS

Ice present	Y
Static ice	
Upstream	Y
Ice fractured	Y
Water on ice	Y
Holes in ice	Y
Channel through ice	Y
Downstream	
Ice fractured	Y
Water on ice	Y
Holes in ice	Y
Channel through ice	Y
Moving ice	
Upstream	Y
Downstream	Y

OTHER COMMENTS

Text entered here.


ENVIRONMENTAL OBSERVATIONS

Select (X) one from each category:

Sky: (can substitute cloud protocol here)	clear	(0-5%)	<input type="checkbox"/>
	few	(5-25%)	<input type="checkbox"/>
	scattered	(26-50%)	<input type="checkbox"/>
	broken	(51-90%)	<input type="checkbox"/>
	overcast	(>90%)	<input checked="" type="checkbox"/>
Wind:	calm		<input checked="" type="checkbox"/>
	light wind		<input type="checkbox"/>
	windy		<input type="checkbox"/>
Precipitation:	none		<input type="checkbox"/>
	snow flurries		<input type="checkbox"/>
	snowing		<input checked="" type="checkbox"/>
	drizzle		<input type="checkbox"/>
	rain		<input type="checkbox"/>
Ice surface: (may choose more than 1)	smooth		<input type="checkbox"/>
	rough		<input checked="" type="checkbox"/>
	blocky/broken/jumbled		<input checked="" type="checkbox"/>
	melt ponds		<input type="checkbox"/>
Additional Comments:	ice jam		<input checked="" type="checkbox"/>
	Ice jam down river Ice moving here and there on the river, around bends.		


DAILY PHOTOGRAPHS OF THE RIVER ICE BREAK UP CONDITIONS

1) Across water body photo:




Comments:
Broken up ice

2) Upstream water body photo:



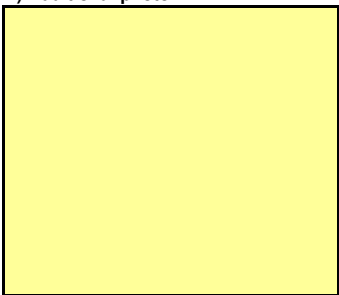
Comments:
Open around the bend.

3) Downstream water body photo:



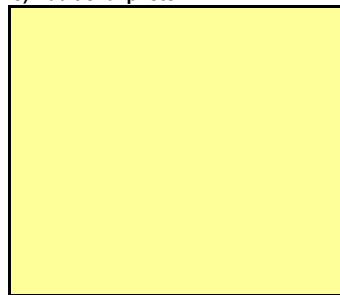
Comments:
Open around the bend

4) Additional photo:



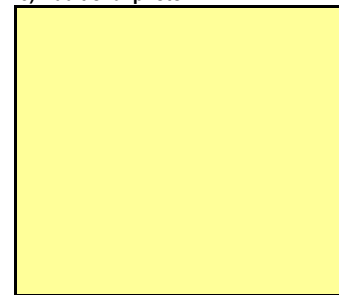
Comments:

5) Additional photo:



Comments:

6) Additional photo:

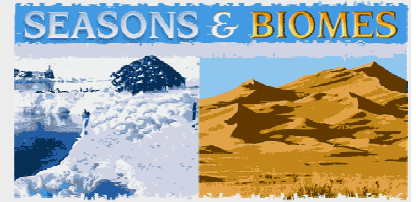


Comments:



Daily Lake Ice Observations

Freeze-up and Break-up



LOCATION: [Text entered here.](#)
 DATE: [Text entered here.](#)
 TIME: [Text entered here.](#)

GENERAL ICE OBSERVATIONS

Total ice cover %
 Ice Cover Change

Fractured
 Flooding
 Movement

Frost smoke Y/N

OTHER COMMENTS

[Text entered here.](#)

ENVIRONMENTAL OBSERVATIONS

Select (X) one from each category:

Sky: (can substitute cloud protocol here)

clear	(0-5%)	<input type="checkbox"/>
few	(5-25%)	<input type="checkbox"/>
scattered	(26-50%)	<input type="checkbox"/>
broken	(51-90%)	<input type="checkbox"/>
overcast	(>90%)	<input type="checkbox"/>

Wind:

calm	<input type="checkbox"/>
light wind	<input type="checkbox"/>
windy	<input type="checkbox"/>

Precipitation:

none	<input type="checkbox"/>
snow flurries	<input type="checkbox"/>
snowing	<input type="checkbox"/>
drizzle	<input type="checkbox"/>
rain	<input type="checkbox"/>
freezing raining	<input type="checkbox"/>

Snow on bank/shore:

none	<input type="checkbox"/>
new	<input type="checkbox"/>
stable/no change	<input type="checkbox"/>
wind redistributed	<input type="checkbox"/>
melting/wet	<input type="checkbox"/>

Snow on ice:

none (bare, cold)	<input type="checkbox"/>
new - patchy	<input type="checkbox"/>
new - continuous	<input type="checkbox"/>
stable/no change	<input type="checkbox"/>
wind redistributed	<input type="checkbox"/>
melting/wet	<input type="checkbox"/>
none (bare - warm)	<input type="checkbox"/>

Ice surface: (may choose more than 1)

smooth	<input type="checkbox"/>
rough	<input type="checkbox"/>
blocky/broken/jumbled	<input type="checkbox"/>
wet/flooded	<input type="checkbox"/>
bare (melting)	<input type="checkbox"/>
ice jam	<input type="checkbox"/>

Additional Comments: [Text entered here.](#)

DAILY PHOTOGRAPHS OF THE LAKE ICE CONDITIONS

1) View 1 photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)

2) View 2 photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)

3) View 3 photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)

4) Additional photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)

5) Additional photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)

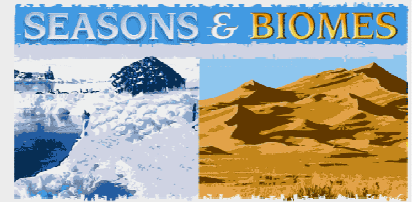
6) Additional photo:

DIGITAL IMAGE (jpg)

Comments: [Text entered here.](#)



Daily Lake Ice Observations Freeze-up and Break-up 33.5 MILE POND, Poker Flat Research Range, AK



LOCATION: 33.5 Mile Pond, PFRR, AK
 DATE: 1-May-05
 TIME: 15:00

GENERAL ICE OBSERVATIONS

Total ice cover %

Ice Cover Change

Fractured	<input checked="" type="checkbox"/>
Flooding	<input type="checkbox"/>
Movement	<input checked="" type="checkbox"/>

Frost smoke N

OTHER COMMENTS

Mosquitos are out.
Saw one of the beavers.

ENVIRONMENTAL OBSERVATIONS

Select (X) one from each category:

(can substitute cloud protocol here)

Sky: clear (0-5%)
 few (5-25%)
 scattered (26-50%)
 broken (51-90%)
 overcast (>90%)

Wind: calm
 light wind
 windy

Precipitation: none
 snow flurries
 snowing
 drizzle
 rain
 freezing raining


Snow on bank/shore: none
 new
 stable/no change
 wind redistributed
 melting/wet


Snow on ice: none (bare, cold)
 new - patchy
 new - continuous
 stable/no change
 wind redistributed
 melting/wet
 none (bare - warm)

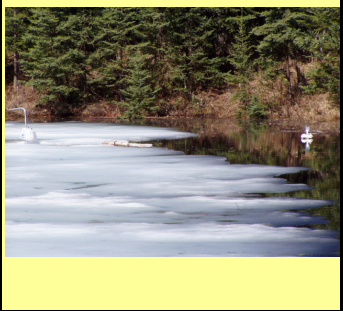
Ice surface: smooth
 rough
 blocky/broken/jumbled
 wet/flooded
 bare (melting)
 ice jam


Additional Comments: Ice cover inaccessible.

DAILY PHOTOGRAPHS OF THE LAKE ICE CONDITIONS

1) View 1 photo: 
 Comments: Large fractures have formed in the ice cover and large ice blocks are free-floating.

2) View 2 photo: 
 Comments: Standing water on some relic paths on the ice cover as the snow ice melts.

3) View 3 photo: 
 Comments: Moat has formed at the far end of the pond.

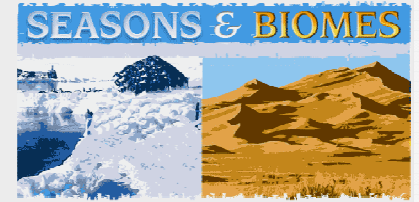
4) Additional photo: 
 Comments: Met. station tripod and temp. probes still in place.

5) Additional photo: DIGITAL IMAGE (jpg)
 Comments: Text entered here.

6) Additional photo: DIGITAL IMAGE (jpg)
 Comments: Text entered here.



Site Seasonal Summary Datasheet



LOCATION: [Text entered here.](#)

ICE PHENOLOGY

Rough schematic of your photo sampling scenario:

DIGITAL IMAGES (jpg)
(show the standard views of the site and describe the image naming conventions.)

This information only has to be submitted once (except in the event of a change in sampling strategy or site).

Basic description of the site:

[Text entered here.](#)



Latitude, Longitude, Altitude
Area, Mean length/width
Mean depth, etc.

Ice Phenology Milestones:

FREEZE-UP

Date of first overnight air temperature below freezing: [Text entered here.](#)
Date of mean daily air temperature below freezing: [Text entered here.](#)
Date of first maximum daily air temperature below freezing: [Text entered here.](#)
Date of first snow: [Text entered here.](#)

Date of first appearance of ice: [Text entered here.](#)
Date of 100% ice cover: [Text entered here.](#)

BREAK-UP

Date of first daytime air temperature above freezing: [Text entered here.](#)
Date of mean daily air temperature above freezing: [Text entered here.](#)
Date of first minimum daily air temperature above freezing: [Text entered here.](#)

Date of complete disappearance of snow on ice: [Text entered here.](#)
Date of 0% ice cover: [Text entered here.](#)

Thumbnail gallery of freeze-up images (1 per day) - linked to daily observations.

Thumbnail gallery of break-up images (1 per day) - linked to daily observations.

This form is filled out during the course of the ice growth and decay season.

← The first part of this form is completed as part of the site set up.

← This information is derived from the *GPS protocol* found in the GLOBE Teacher's Guide.

← This portion of the form is completed during the freeze-up period.

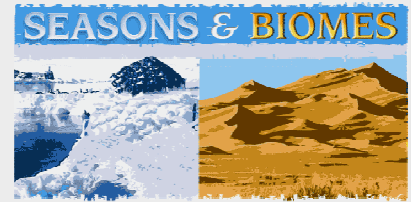
← This portion of the form is completed during the break-up period.

← This portion is filled in during the freeze-up season.

← This portion is filled in during the break-up season.



Environmental Factors Influencing Freshwater Ice Phenology



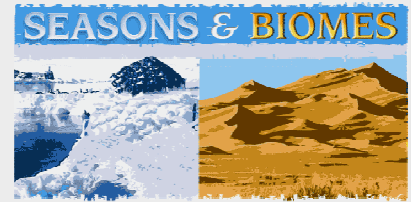
The freshwater ice growth and decay model CLiMO uses the meteorological variables *air temperature, precipitation, cloud cover, wind speed and relative humidity* as forcing variables.

It has been shown that *air temperature and precipitation* are the primary factors determining the ice growth and decay history.

***Cloud cover* takes on a prominent role during the spring break-up.**



Complementary GLOBE Protocols, I

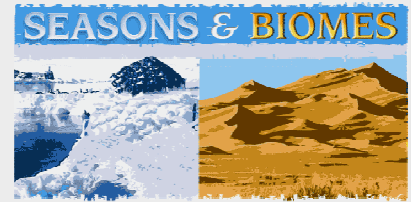


In order for the students to fully appreciate the relationships between the ice conditions and the forcing environmental conditions, we suggest the following GLOBE protocols:

- 1) Cloud protocols, Atmosphere;**
- 2) Temperature protocols, Atmosphere
maximum, minimum and current air
temperature protocol,
OR digital multi-day max/min/current air and soil
temperatures protocol
OR Automated soil and air temperature monitoring
protocol; and**
- 3) Solid Precipitation protocol, Atmosphere -
(measuring snow depth only - Precipitation
Protocols/Solid Precipitation Protocol).**



Complementary GLOBE Protocols, II

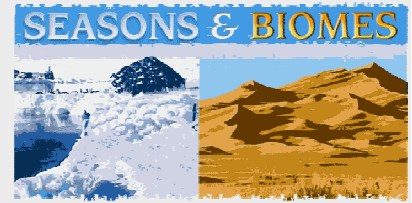


In order for the students to obtain an integrated understanding of the fall-winter and winter-spring seasonal transitions, we suggest the following GLOBE protocols:

- 1) *Snow and soil surface temperature protocol* (based on the Surface Temperature Protocol), *Atmosphere*;**
- 2) *Budburst, Green-Up and Green-Down protocols*, *Earth* (lake/river side vegetation); and**
- 3) *Arctic bird migration monitoring protocol*, *Earth* (focusing on water fowl).**



Find Out More on the World Wide Web



Seasons and Biomes

A biome is a large geographic area of distinctive plant and animal groups that are adapted specifically for a particular environment. Biome type is determined by the climate and geography of a region. Through the GLOBE Seasons and Biomes project, students and teachers will have the opportunity to use GLOBE resources and support to conduct scientific inquiries in their local environments and biomes.

This project will contribute critically needed science measurements to validate satellite data used in research on regional climate change, prevention and management of diseases, and understanding of the water and carbon cycles. By monitoring the seasons in your biome, you will learn how interactions within the Earth system affect your local environment and how it in turn affects regional and global environments.

Find out more about the Seasons and Biomes Project:
[Project summary](#) (PDF)
[Frequently Asked Questions](#)
[Descriptions of Land Biomes](#)
[International Polar Year \(IPY\)](#)

Activities

8 Nov 2006 - 15 Feb 2007: [Seasons and Biomes Questionnaire](#)
March 2007: Pole to Pole video conference and follow-up web chats

As additional Seasons and Biomes activities are planned, information about them will be added to this page.

<http://www.globe.gov/fsl/html/templ.cgi?seasons&lang=en&nav=1>

GLOBE Teacher's Guide

[View Teacher's Guide Table of Contents](#)

Browse the Teachers Guide via the Table of Contents. Each chapter and the individual protocols, learning activities, data sheets and field guides are available in PDF format for online viewing, printing, or downloading.

[Search By Concept and Grade Level](#)

Do you have a specific educational concept you are trying to teach? Now you can search for protocols and learning activities by educational concept and grade level.

[1997 Guía de Educadores GLOBE](#)

La Guía de Educadores (Spanish Teacher's Guide) online está basada en una copia del programa original GLOBE 1997.

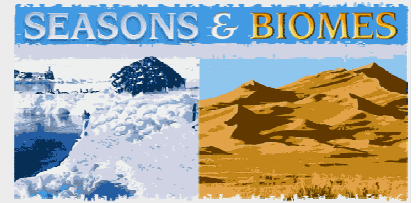
to view content.

Search Teacher's Guide for:

<http://www.globe.gov/tctg/globetg.jsp?rg=n&lang=en>



Contact Us



To find out more about the Freshwater Ice Phenology Protocols contact:

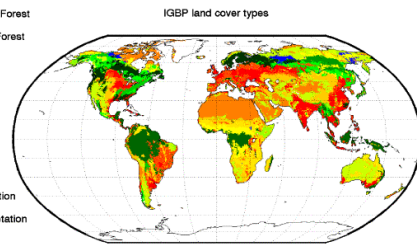
Kim Morris

(kim.morris@gi.alaska.edu)



Biome Representation Of Land Cover

- Evergreen Needleleaf Forest
- Evergreen Broadleaf Forest
- Deciduous Needleleaf Forest
- Deciduous Broadleaf Forest
- Mixed Forest
- Closed Shrubland
- Open Shrubland
- Woody Savanna
- Savanna
- Grassland
- Barren/Sparse Vegetation
- Cropland/Natural Vegetation
- Cropland
- Urban and Built-up
- Snow and Ice
- Permanent Wetland



- Biomes determine:
- Plant physiology (e.g., V_{max})
 - Leaf and stem optical properties
 - Roughness length
 - Leaf and stem area index



To find out more about Seasons and Biomes contact:

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