User's Guide

Introduction

Welcome to the Location File for Stefansson Sound, Alaska! Stefansson Sound is a region of the Beaufort Sea located off the North Slope of Alaska, adjacent to Alaska's Arctic National Wildlife Refuge (ANWR). This Location File incorporates a small region to the west of Prudhoe Bay, extending as far east as western Camden Bay. It also includes a small portion of the ANWR, located east of the Canning River.

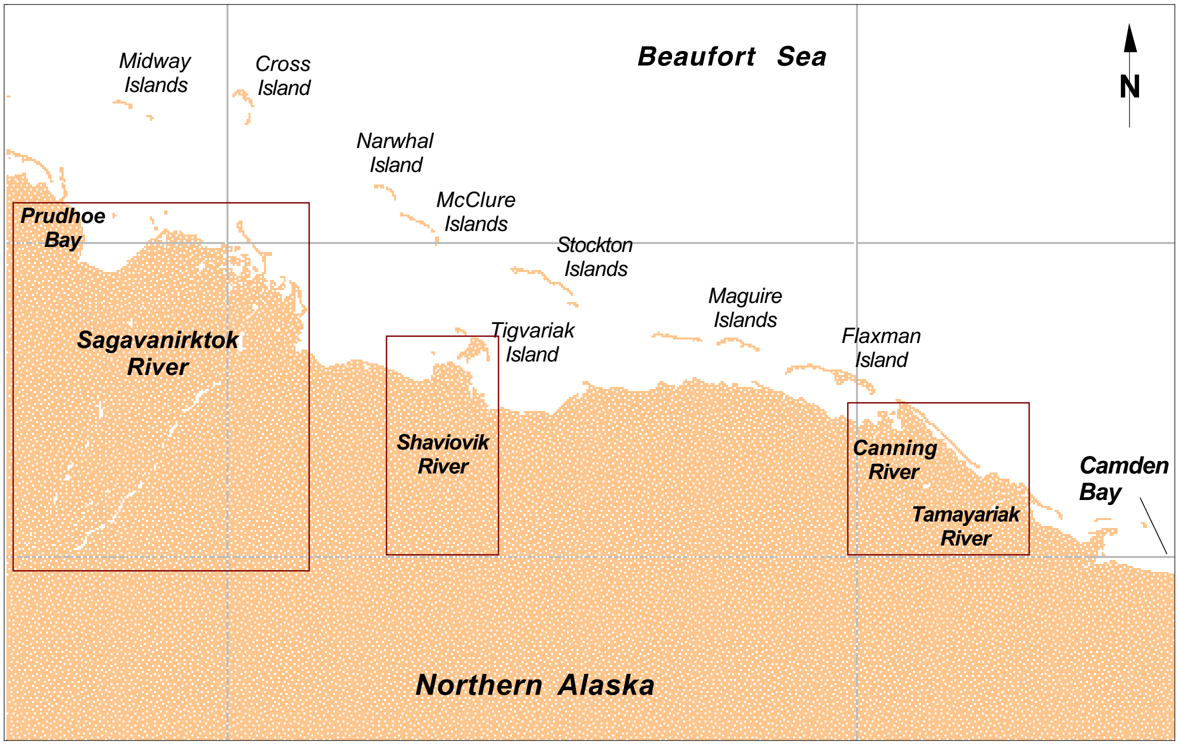
Stefansson Sound is part of Alaska's beautiful and fragile tundra. Tundra is a flat, treeless plain that supports shrubby or matlike vegetation, such as low shrubs, sedges, grasses, mosses, and lichens. In Alaska, the North Slope tundra extends north from the foothills of the Brooks Range to the Arctic Ocean, and west from the Canadian border to the Chukchi Sea.

The Stefansson Sound coastline is irregular, containing many small bays, lagoons, spits, beaches, and barrier islands. Extensive mud flats often occur in the deltas of the rivers. Some of the larger rivers discharging into the Beaufort Sea form depositional deltas that extend several kilometers from the shore. Most of the coastline is low lying, with only small bluffs less than 10 foot (3 meters) high. Some areas of the coast are directly exposed to the open ocean, and other sections are protected by chains of barrier islands that are composed of sand and gravel. (Committee 2003)

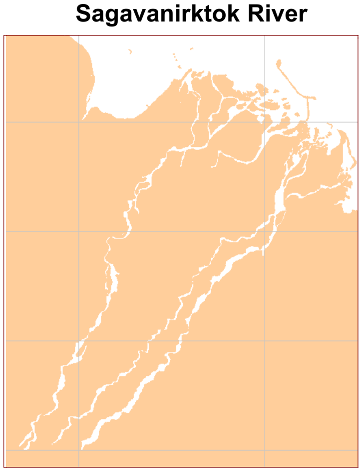
The Beaufort Sea is covered with ice for about 9 months each year. By mid-July, the Beaufort is usually ice-free from the shore to the edge of the pack ice, which by late summer, retreats from 10 km to 100 km (6 to 60 miles) offshore (Committee 2003). This Location File should only be used during these ice-free times.

Rivers in this area tend to be fast-flowing and braided, with extensive delta systems. The river systems support a diversity of plant and animal life, and can serve as corridors for migrating mammals and birds (Committee 2003). The rivers simulated in this Location File include the Sagavanirktok ("Sag"), Canning, Shaviovik, and Tamayariak Rivers, which are shown on the map on the following page. The longest of the rivers, the Sag, begins on the north slope of the Brooks Range and flows about 180 miles (290 km) north-northwest across a broad, open floodplain to the Beaufort Sea near Prudhoe Bay. The other major river, the Canning, forms the western boundary of the ANWR. This river begins at a glacier in the Franklin Mountains and flows 125 miles (201 km) north to Camden Bay. The Shaviovik and Tamayariak Rivers are smaller rivers, draining smaller watersheds than the two larger rivers.

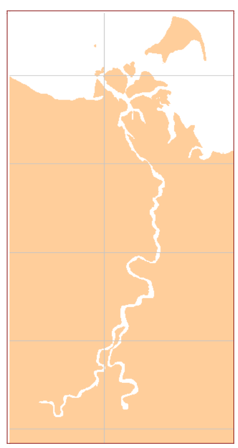
Significant oil development occurs on the North Slope; hence, the Stefansson Sound Location File is the third in a series for this area. The companion Location File to Stefansson Sound is the Harrison and Gwydry Bay Location File. If you are unable to start a spill as far west as you would like in this Location File, use the Harrison and Gwydry Bay Location File, as the spillable areas for the two Location Files do not overlap.



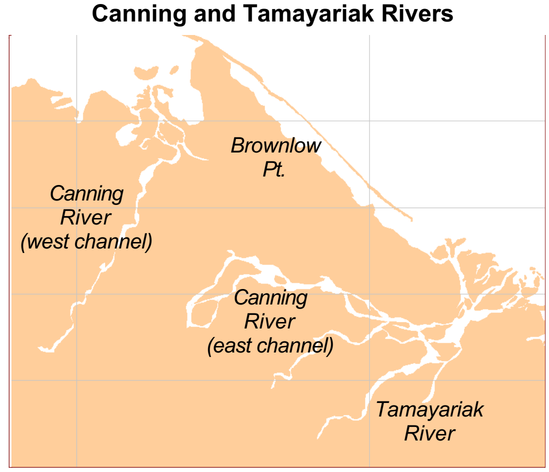
Sagavanirktok River



Shaviovik River



Canning and Tamayariak Rivers



Map insets are at varying scales.

NOAA has created Location Files for different U.S. coastal regions to help you use the General NOAA Oil Modeling Environment, GNOME. In addition, on a case-by-case basis, NOAA develops international Location Files when working with specific partners. Each Location File contains information about local oceanographic conditions that GNOME uses to model oil spills in the area covered by that Location File. Each Location File also contains references (both print publications and Internet sites) to help you learn more about the location you are simulating.

As you work with the Location File for Stefansson Sound, GNOME will prompt you to:

1. Choose the model settings (start date and time, and run duration).
2. Set the flow speeds for the coastal rivers.
3. Input the wind conditions.

GNOME will guide you through each of these choices. Each window has a button that leads you to helpful information and the general Help topic list. Click the Help button anytime you need help setting up the model. For example, in the window, Setting River Flow Speeds, you need to enter the surface current speed near the mouths of four rivers that flow into Stefansson Sound. To learn how to obtain flow speeds for these rivers, click the button, “Finding River Flow Data”, or check the “Finding River Flow Data” Help topic. Similarly, when you need to input the wind conditions in GNOME, you can click the “Finding Wind Data” button to see a list of web sites that publish wind data for this region.

More information about GNOME and Location Files is available at http://response.restoration.noaa.gov/software/gnome/gnome.html.

Technical Documentation

Background

The Stefansson Sound Location File simulates open water conditions (generally occurring mid-July through mid-September) in the coastal area between Prudhoe Bay and the Arctic National Wildlife Refuge (ANWR). The Location File includes detailed circulation between the numerous barrier islands of this region; however, other than the field work done for the Harrison and Gwydyr Bays Location File, we lack data for calibration of the currents.

Also in this Location File, four North Slope rivers are simulated. Unfortunately, east of Prudhoe Bay, few bathymetric surveys of the river channels have been conducted, and very little information exists on flow rates at the mouths of the rivers. With so little data available to build the hydrodynamics of the four river channels, we could not set the range of values and user-inputs well for any of the rivers. (The Sag River has the most data; however, the data are not as good as we would like, because the gauge is very far upstream.) Other complications in simulating these rivers are that the river flow rates can change very quickly, and the physical terrain of these braided rivers includes extensive mud flats, spits, and barrier islands. Consequently, we used our best professional judgment to depict the rivers.

A result of the limitations in simulating the rivers is that more information is needed from the user in order to set the river flows within a reasonable margin of error. In this Location File, the user needs to set a flow velocity near (generally < 1 nm) the mouth of each river. The user can either (1) make an estimate by throwing an orange into the river channel and tracking it with a GPS, pacing off the distance traveled, or by using some other estimation method; or (2) guess a range of values and see what happens in the model. The current speeds of the rivers can be measured using many different units. To help the user with conversions of the various units, we’ve provided two conversion tables in Appendix A.

In general, the higher the river flow, the harder it is for oil to move up into the river. Wind can partly overcome the river flow to move oil, but the complicated geometry of these river mouths (e.g., braided rivers with deltas and many barrier islands) means the wind would have to change direction in just the right combination of speeds and directions in order to move the oil through these complicated channels.

Circulation

The coastal circulation in the Beaufort Sea is driven by the wind and is constrained along the shoreline in either direction. Summer winds are primarily from the east to northeast, and secondarily from the west to northwest. Winds with an easterly component drive coastal circulation toward the west and offshore, while winds with a westerly component drive the coastal currents toward the east and onshore (Aagaard 1979, Barnes and Reimnitz 1974, Cannon and Hachmeister 1987, Hachmeister et al. 1987, Hale et al. 1989, Savoie and Wilson 1986). Changes in wind direction are generally reflected in the coastal circulation within a few hours (Savoie and Wilson 1986).

Wind-driven Ekman transport can alter the across-shelf surface pressure gradient. Upwelling situations tend to increase the water column stratification, while downwelling situations tend to make the water column more homogeneous (Hale et al. 1989). When the wind relaxes or reverses, the forcing sustaining this pressure gradient is released and water tends to move on- or off-shore (Savoie and Wilson 1986). Large river discharges, such as from the Mackenzie River in Canada, also create a surface plume with significant offshore velocities that move the fresher surface water offshore, creating an estuary-like circulation with colder, more saline water moving to the surface in response (Hale et al. 1989). These effects are not simulated in this Location File.

Current Patterns

This Location File has six current patterns: two components of the wind-driven currents in the lagoon systems; and four rivers systems: the Sagavanirktok (Sag), Shaviovik, Canning, and Tamayariak Rivers. All were created with the NOAA Current Analysis for Trajectory Simulations (CATS) hydrodynamic model.

Wind-Driven Currents

Wind-driven currents were simulated in the NOAA Current Analysis for Trajectory Simulation (CATS) hydrodynamic model, using the Wind-Driven Analysis Currents model. The model was used with linear physics so that the wind-driven currents could be related to the wind time series data entered by the user. Both northerly and easterly winds were simulated in the CATS model, so the wind direction that the user enters is decomposed into those two components. The current velocity is then related to the wind stress calculated from the user's wind time series. The wind-driven circulation patterns in this Location File were scaled to match the western boundary circulation in the Harrison and Gwydyr Bay Location File. The scaling in the Harrison and Gwydyr Bays Location File was created from fieldwork conducted during August, 2001.

River Flows

All the river flows are simulated with user interaction in this Location File. Unfortunately, very little information is available on riverbed bathymetry and flow rates in this region of the Arctic. The Sag River does have a river gauge, with forecasts made at the river's mouth in the Beaufort Sea; however, these forecasts are not available online. In order to create a useful planning tool in this Location File, we have estimated river circulation patterns and likely river flow rates, based on other rivers in the U.S. We have included simple methods for measuring river currents in the River Flows Help Topic. If measurements of surface currents are unavailable, we recommend that the user choose high and low values for the river flow, and run the model with these values to evaluate the difference.

References

You can get more information about Stefansson Sound from these publications and web sites.

Oceanography

Aagaard, K. 1984. The Beaufort Undercurrent. In: The Alaskan Beaufort Sea: Ecosystems and Environments. P.W. Barnes, D.M. Schell, and E. Reimnitz (eds). Orlando: Academic Press. pp 47-71.

Aagaard, K. 1979. Current Measurements in Possible Dispersal Regions of the Beaufort Sea. U.S. Dept. Commerce, NOAA, OCSEAP, Environ. Assess. Alaskan Continental Shelf, Annual Report 7: 208-232.

Barnes, P.W. and E. Reimnitz. 1974. Sedimentary processes on Arctic Shelves off the northern coast of Alaska. Pp. 439-476 in The Coast and Shelf of the Beaufort Sea, J.C. Reed and J.E. Sater, eds. Arctic Institute of North America, Arlington, VA.

Cannon, T. and L. Hachmeister. 1987. Integration and Assessment. Part I, Chapter 2 in 1985 Final Report for the Endicott Environmental Monitoring Program. Prepared by Envirosphere Company for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska.

1988 Endicott Environmental Monitoring Program Final Report: Oceanography. 1992. Prepared by Science Applications International Corporation for U.S. Army Corps of Engineers, Alaska District.

Environmental Protection Agency (EPA), Region 10. 1988. Causeways in the Alaskan Beaufort Sea. Technical Report 910/9-88-218. Anchorage: Alaska Operations Office. 25 pp.

Hachmeister, L.E., K.S. Short, K.B. Winnick, G.C. Schrader, and J.W. Johannessen. 1987. Oceanographic Monitoring. Part III, Chapter 3 in 1985 Final Report for the Endicott Environmental Monitoring Program. Prepared by Envirosphere Company for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska. 162 pp. + appendices.

Hale, D.A., M.J. Hameedi, L.E. Hachmeister, and W.J. Stringer. 1989. Effects of the West Dock Causeway on Nearshore Oceanographic Processes in the Vicinity of Prudhoe Bay, Alaska. Technical Report. Anchorage: NOAA, Ocean Assessments Division. 50 pp.

Hanzlick, D., C. Schrader, and L. Hachmeister. 1988. Ice Breakup/Freezeup. Part III, Chapter 1 in 1987 Draft Report for the Endicott Environmental Monitoring Program. Prepared by Envirosphere Company for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska. 49 pp. + appendices.

Hummer, P.G. 1988. Meteorology. Part II, Chapter 1 in 1987 Draft Report for the Endicott Environmental Monitoring Program. Prepared by Envirosphere Company for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska.

Savoie, M.A. and D.E. Wilson. 1986. Physical Processes Monitoring Program - 1984, final report. In: Prudhoe Bay Waterflood Environmental Monitoring Program - 1984. Prepared by Kinnetic Laboratories, Inc. for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska. 195 pp + appendices.

Schrader, G.C. and L.E. Hachmeister. 1987. Ice Breakup/Freezeup Monitoring. Part III, Chapter 1 in 1986 Draft Report for the Endicott Environmental Monitoring Program. Prepared by Envirosphere Company for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska. 49 pp.

Short, K.S., G.C. Schrader, L.E. Hachmeister, and C.J. Van Zee. 1988a. Oceanographer. Part II, Chapter 3 in 1986 Draft Report for the Endicott Environmental Monitoring Program. Prepared by Envirosphere Company for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska. 276 pp. + appendices.

Short, K.S., C.D. Janzen, C.J. Van Zee, and D.J. Hanzlick. 1988b. Oceanography. Part II, Chapter 3 in 1987 Draft Report of the Endicott Environmental Monitoring Program. Prepared by Envirosphere Company for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska. 171 pp. + appendices.

St. Martin, J.W. 1987. Arctic Drifting Buoy Data: 1979-1985. Technical Report CG-D-10-87. Prepared by U.S. Coast Guard, Research and Development Center, Avery Point, Groton, CT for Department of Transportation, U.S. Coast Guard, Office of Research and Development, Washington, D.C.

Stringer, W.J. 1987. Ice Breakup/Freezeup. Part III, Chapter 1 in 1985 Final Report for the Endicott Environmental Monitoring Program. Prepared by Envirosphere Company for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska.

Hydrography

Hydrocon Engineering (Continental) Ltd. 1982. Point Thomson Development Hydrologic Studies. Prepared for Exxon Company, USA, Production Department, Western Division. Calgary, AB: Hydrocon Engineering (Continental) Ltd. 93 pp. + appendices.

Dames & Moore. 1983. Data Report: Point Thomson Development, Alaska, 1983 Hydrology Program. Prepared for Exxon Company, USA, Production Department, Western Division. Golden, CO: Dames & Moore. 58 pp. + appendices.

Committee on Cumulative Environmental Effects of Oil and Gas Activities on Alaska’s North Slope. 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. Washington, D.C.: The National Academies Press. 160 pp. + appendices.

Wind and Weather

National Weather Service Forecast Office (NWSFO), Fairbanks, Alaska
http://pafg.arh.noaa.gov/zonefcst.php?zone=203
A zone forecast for Zone 203, Central Beaufort Sea Coast (including Nuiqsut, Prudhoe Bay, Alpine, Deadhorse, Kuparuk).

http://pafg.arh.noaa.gov/zonefcst.php?zone=204
A zone forecast for Zone 204, Eastern Beaufort Sea Coast (including Kaktovik, Flaxman Island).
Both pages include links to other forecasts, satellite pictures, weather history, and related information.

Interactive Weather Information Network--National Weather Service (NWS)
http://iwin.nws.noaa.gov/iwin/iwdspg1.html
To obtain weather reports and forecasts for this region, click AK on the U.S. map, then click Deadhorse or Barrow on the Alaska map.

NOAA/NOS Center for Operational Oceanographic Products and Services (CO-OPS)
http://co-ops.nos.noaa.gov/data_options.shtml?stn=9497645+Prudhoe+Bay,+AK
Retrieve environmental data recently collected at National Ocean Service data collection platforms and stored in the CO-OPS databases. Click the link "Weather/Ocean Data" to view the form you can use to retrieve data. Follow these steps to view current wind observations for station 9497645, Prudhoe Bay, AK:

1. Check that "9497645 Prudhoe Bay, AK" is shown in the Station box.
2. Choose "C1 - Wind Speed, Dir, Gusts" from the Sensor menu.
3. Enter beginning and ending dates for the data you'd like to view.
4. Select a date/time format from the Output Format menu, then select a Time Zone (UTC [coordinated universal time; formerly known as Greenwich Mean Time] or LST [Local Standard Time]).
5. Click the "View Data" button to see the data in tabular form, or click the "View Plot" button to see the data in graphical form. Wind speed is provided in meters per second (m/s) and wind direction in degrees true.

Oil Spill Response

NOAA Hazardous Materials Response Division (HAZMAT)
http://response.restoration.noaa.gov
Tools and information for emergency responders and planners, and others concerned about the effects of oil and hazardous chemicals in our waters and along our coasts.

Appendix A

The following table provides rough equivalents for these units that may be used to express current speed:

- knots
- meters/second (m/s)
- centimeters/second (cm/s)
- yards/minute (yd/min)
- yards/30 seconds (yd/30s)
- miles/hour (mph)

knots	m/s	cm/s	yd/min	yd/30s	mph
0.5	0.26	25.72	16.88	8.44	0.58
1.0	0.51	51.44	33.76	16.88	1.15
1.5	0.77	77.17	50.63	25.32	1.73
2.0	1.03	102.89	67.51	33.76	2.30
2.5	1.29	128.61	84.39	42.20	2.88
3.0	1.54	154.33	101.27	50.63	3.45
4.0	2.06	205.78	135.02	67.51	4.60
5.0	2.57	257.22	168.78	84.39	5.75

The following table contains conversion factors for the units of measure listed above.

To convert units, choose a unit from the left column, then read across the line to convert it to knots, meters/second (m/s), centimeters/second (cm/s), yards/minute (yd/min), yards/30 seconds (yd/30s), or miles/hour (mph). For example, to convert 1 knot to meters/second, you would multiply it by 0.514444. To convert it to centimeters/second, multiply it by 51.444393. To convert 1 knot to yards/minute, multiply it by 33.756197, and so on.

	knots	m/s	cm/s	yd/min	yd/30s	mph
knots	--	0.514444	51.444393	33.756197	16.8780985	1.150779
m/s	1.943844	--	100.00	65.616798	32.808399	2.236936
cm/s	0.019438	0.01	--	0.656168	0.328084	0.022369
yd/min	0.029624	0.01524	1.524	--	0.5	0.034091
yd/30s	0.014812	0.00762	0.762	2.00	--	.0170455
mph	0.868976	0.44704	44.704	29.333333	14.6666665	--