

Examples

Try out these examples to learn the basics of modeling oil spills in Stefansson Sound, a region of the Beaufort Sea located off the North Slope of Alaska. In these examples, you will see how different winds, pollutants, and river flows can affect the trajectories of oil slicks. In addition, you'll see how model and observation limitations can be overcome by considering both the "Best Guess" and the "Minimum Regret" (Uncertainty) solutions. This knowledge will help you in designing your own GNOME model runs.

The following conditions hold for each of the examples:

Wind: Constant at 0 knot, unless otherwise specified.

Spill size: As specified in each example.

Pollutant type: Non-weathering, unless specified.

Model duration: 2 days, unless specified.

Uncertainty: Not included, unless specified.

Use GNOME's Standard Mode and the Stefansson Sound Location File to answer the following questions. Be sure to carefully read and enter all the information in each problem.

1. Winds can have a significant effect on a spill because they influence the currents and move the oil on the surface of the water. To compare the effects of different winds, simulate a spill that occurs on July 1, 2004, at 9:00 a.m. (0900), and continues to spill for about 6 hours. You should observe the spill effects after 2 days. Your scenario should first include 20-knot winds from the east, then 20-knot winds from the west. The Sag, Shaviotvik, Canning, and Canning-Tamariak Rivers rivers flows should be moderately high: 50, 20, 50, and 50 cm/s, respectively. Set a spill of 1000 gallons of medium crude between the Maguire Islands and the mainland, at approximately 70° 12.07'N, 146° 24.16'W.

"Zoom in" to the spill area and describe how the trajectory changes with the wind conditions? How do the beach impacts differ?

Hints: To easily set a spill at a particular location, simply click *anywhere* on the water area of the map. In the Spill Information window that opens, you can then enter the exact latitude and longitude of the spill. (This method is much easier than moving your mouse around the map and watching its location in the lower left corner of the window!)

To model a point source spill that continues for several hours, you will need to enter the ending time in the Spill Information window. To do this, click the box labeled "Different end release time" and enter the ending time (1500 on July 1, 2004).

Note: You will need to use the spill settings from the east wind spill in later examples. Before moving on, save your settings as a Location File Save (LFS) by choosing Save from the GNOME File menu.

Answer: When the spill occurs with the east wind, the oil travels west, beaching heavily on Tigvariak Island and the delta of the Shaviovik River; the eastern section of the Sagavanirktok (Sag) River delta; and Point Brower. Some oil travels as far west as the Endicott Satellite Drilling Island (SDI). In comparison, when the spill occurs with the west wind, the oil moves to the east (and off the map). In this scenario, the most affected shorelines are on Mary Sachs Island and Flaxman Island.

2. Different types of pollutants weather differently. In this example, you'll re-run the east wind spill (your Location File Save from the previous example), and compare the spill effects of the medium crude spill with those of a kerosene spill. Try to predict how the spills will differ in their behavior, and at the end of your 48-hour prediction, write in the table below the mass balance that GNOME calculates for each product.

	Medium Crude (gallons)	Kerosene/Jet Fuel (gallons)
Released	1,000	1,000
Floating		
Beached		
Evaporated and Dispersed		
Off map		

Hints: To view the mass balance for each scenario, click the right-pointing triangle next to the spill description ("Medium Crude: 1000 gallons") under **Spills** in the Summary List (the left section of the Map Window). Then click the right pointing triangle next to "Spot Mass Balance" to view the mass balance for the "Best Guess" trajectory.

Answer: Heavier oils remain in the environment longer than lighter, refined products. You can see that after 48 hours, much more diesel (about 85% of the spill) has evaporated and dispersed than medium crude (about 34%). (Your numbers may differ slightly.) As a result, shoreline impacts are more severe in the medium crude oil spill.

	Medium Crude (gallons)	Kerosene/Jet Fuel (gallons)
Released	1,000	1,000
Floating	62	9
Beached	596	140
Evaporated and Dispersed	342	851
Off map	0	0

3. Forecasts of environmental parameters are inherently uncertain. For example, wind and weather forecasts can be "off" in their speed, direction, or timing. GNOME supports a "Minimum Regret" solution in addition to the "Best Guess" solution that you have been running. The "Minimum Regret" solution takes into account our uncertainty in wind, horizontal mixing, and currents.

Rerun the east wind scenario from Example 1, but this time, run GNOME with the "Minimum Regret" solution turned on.

"Zoom in" to the spill area and briefly discuss the difference between the "Best Guess" (black) and "Minimum Regret" (red) trajectories. Why do you think this type of information would be useful?

Hint: To include the Minimum Regret (Uncertainty) solution, click the box labeled "Include the Minimum Regret solution" under **Model Settings** in the Summary List.

Answer: The "Minimum Regret" solution shows where the spill could go if the currents, winds, or other model inputs were set differently. In this case, the "Minimum Regret" solution shows that the spill effects could be more severe in the regions depicted by the "Best Guess" scenario, and the spill could be more far-reaching, traveling to more areas of Mikkelson Bay, Foggy Island Bay, Point Brower, and the Endicott drilling complex.

Responders use both the "Best Guess" and "Minimum Regret" trajectories to make decisions about how they will allocate response resources. A highly valued environmental resource (e.g. an endangered species) may be important enough to protect, even if it has a low probability of being oiled.

4. In this example, you will simulate a spill that occurs in the delta of the Sag River on July 1, 2004 at 9:00 a.m. (0900), and continues for about 9 hours (until 1800). You should observe the spill effects for 1 day. Your scenario should first include a very slow (5 cm/s) current speed on the Sag River, then a faster flow (100 cm/s, or 1 m/s). In your scenario, include a series of winds that will "push" the oil upriver. Set the 100-barrel "non-weathering" spill in the Sag delta at approximately 70° 17.34'N, 147° 52.31'W.

"Zoom in" to the spill area and note the effects of the different river flows on the spill trajectory and beach impacts.

Hints: To make the changes for this scenario, double-click the name of your Location File ("Stefansson Sound") in the Summary List. The Location File Welcome window will appear with all the settings you have chosen. You only have to enter information that you are changing, so in the Model Settings window, change the run duration to 1 day. In the Setting River Flow Speeds window, change all the river

flows to slow (5 cm/s). In the Choosing Wind Type window, choose wind that is variable over time.

To enter winds that will drive the oil upriver, you could try a wind series such as this, or make up your own winds:

Date	Time	Knots	Direction
07/01/2004	0900	10	N
07/01/2004	1000	10	NNE
07/01/2004	1100	10	NE
07/01/2004	1200	10	ENE
07/01/2004	1300	10	NE
07/01/2004	1400	10	NNE
07/01/2004	1500	10	N
07/01/2004	1600	10	NNW
07/01/2004	1700	10	N
07/01/2004	1800	10	NNE
07/01/2004	1900	10	NE
07/01/2004	2000	10	ENE

To enter the winds in the Variable Winds window, first click "Delete All" to clear any winds from your previous work. Next, because the wind observations are 1 hour apart, enter an auto-increment time of 1 hour. To enter a wind, click within the blue Wind Target on the point that represents the wind speed and direction you want to enter (for example, the intersection of the N axis and the 10-knot circle). If necessary, you can hold down your mouse button and drag to adjust the wind speed and direction to the combination you want.

Finally, to change the details of the spill, double-click the spill description ("Kerosene / Jet Fuels: 1000 gallons") in the Summary List. In the Spill Information window, make the appropriate changes to the spill details.

Answer: When the Sag is flowing more slowly, the winds can carry the oil further upriver, oiling the mud flats, lagoons, and river islands. When the river is flowing at 1 m/s, the current carries the oil almost completely out of the river mouth, oiling the Endicott SDI to the west, and Point Brower, the area of Foggy Island, and the western shorelines of Foggy Island Bay to the east.