Examples

Try out these examples to learn the basics of modeling oil spills in Harrison and Gwydyr Bays, Alaska. The coastal circulation of the North Slope is primarily controlled by winds, both within the lagoon system and slightly farther offshore. In these examples, you will see how different winds, river flow rates, and spill products 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:

Date: August 17, 2001.
Model and Spill Start Time: 1200.
Model duration: 1 day, unless specified in a particular example.
Uncertainty: Not included, unless specified.
River Flow Rates: Both rates low, unless otherwise specified.
Wind: As specified in each example.
Pollutant type: As specified.
Spill size: 1000 gallons, unless specified.
Spill Location: As specified.

Use GNOME's Standard Mode and the Harrison and Gwydyr Bays Location File to answer the following questions:

1. Winds play an important part in the circulation of the coastal North Slope. To compare the effects of different winds, you will simulate a spill that occurs on August 17, 2001, at approximately 1200. Your scenario should include wind of 6 meters/sec first from 75 degrees true, then wind of the same speed from the NW. Set your spill volume at 1000 gallons of medium crude. The spill location is north of the Return Islands (70° 27'N, 148° 41'W).

How do the beach impacts differ in with the different wind conditions? How does the trajectory change?

> **Hints:** To easily set a spill at a particular location, simply click *anywhere* in 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 change the wind conditions, double-click **Wind** in the Summary List, then change the wind speed and direction in the Constant or Variable Wind window.

Note: You will need to use the spill settings from this example in Example 2 below. Before moving on, save your settings as a Location File Save (LFS) by choosing **Save** from the GNOME **File** menu.

Answer: The wind causes the oil in each scenario to beach quickly and extensively. With the wind from 75 degrees true, the oil travels to the northwest, impacting the Jones Islands and shorelines as far west as Milne Pt. With the NW wind, the oil travels southwest into Prudhoe Bay, with oiling occurring on the Return Islands and the West Dock Causeway.

2. Different types of pollutants weather differently. Now you will compare the effects of different types of pollutants. Using your saved files, re-run the scenarios from Example 1, but this time change the pollutant type to a light product, such as gasoline.

How does the "weathering" of the pollutants affect the spill impacts?

Hints: To quickly change the pollutant type, double-click the spill description ("Medium Crude: 1000 gallons") under **Spills** in the Summary List (the left section of the Map Window). In the Spill Information window, choose "gasoline" from the Pollutant pull-down menu.

Answer: Heavier oils remain in the environment longer than lighter, refined products. Beach impacts from the crude oil spill are much more extensive than for the gasoline spill in both wind scenarios. (To view the mass balance for a scenario, click the right-pointing triangle next to the spill description, "Gasoline: 1000 gallons", under **Spills** in the Summary List. Then click the right-pointing triangle next to "Splot Mass Balance" to view the mass balance for the "Best Guess" trajectory. You should see that about 98% of the gasoline evaporated and dispersed in each of these scenarios.)

3. In the next scenario, you will see how the Kuparuk River flow influences the large-scale circulation during normal summer conditions. You can set up the new scenario in either of two ways: (1) You can make the changes shown below in the appropriate sections of the Summary List; or (2) You can close your file (choose Close from the GNOME File menu), then double-click **Location File** in the Summary List. Choose the Harrison and Gwydyr Bays Location File and enter these conditions in the Location File dialog boxes:

- Wind is zero.
- Colville River flow set as "low".
- Pollutant type is "non-weathering".
- Spill location is a point east of Gwydyr Bay, between the Return Islands and the mainland (70° 25'N, 148° 42'W).

Next, try running the scenario with each of these Kuparuk River flow rates:

(a) low - 700 cfs

(b) mean - 2250 cfs

(c) high - 3800 cfs

Note: After setting up GNOME for the low Kuparuk River flow scenario, save your work as a Location File Save (LFS). You will use those settings in Example 4 below.

How does the trajectory change with the different river conditions?

Answer: The oil spreads farther, particularly to the east, with higher river flows. The higher the river flow rate, the more the outflow will keep oil out of the river delta.

4. Forecasts of environmental parameters are inherently uncertain. For example, wind and weather forecasts can be "off" in the speed, direction, or timing of the winds. 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. Using your saved file from Example 3 (a), add the Minimum Regret (Uncertainty) solution to your settings to see where else the spill might go.

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?

Hints: 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 more extensive impacts in all directions. In addition, it shows that there could be oil contact in the river delta, outside the Return Islands, and east of Gwydyr Bay. Responders use the "minimum regret" trajectory to make decisions about how they will allocate response resources. Sometimes 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.

5. The Colville River also influences the large-scale circulation of this region. To compare the effects of different river flow rates, simulate a spill that occurs on August 17, 2001 at 1200. Set the model duration to 2 days, and don't include the Minimum Regret solution. The wind is constant during this time at 20 knots from the east. For now, set both the Colville and Kuparuk River flow rates to "Low". The pollutant released is 1000 barrels of medium crude, spilled at the mouth of the Colville River (70° 28'N, 150° 9'W). It continues to spill for the next 24 hours.

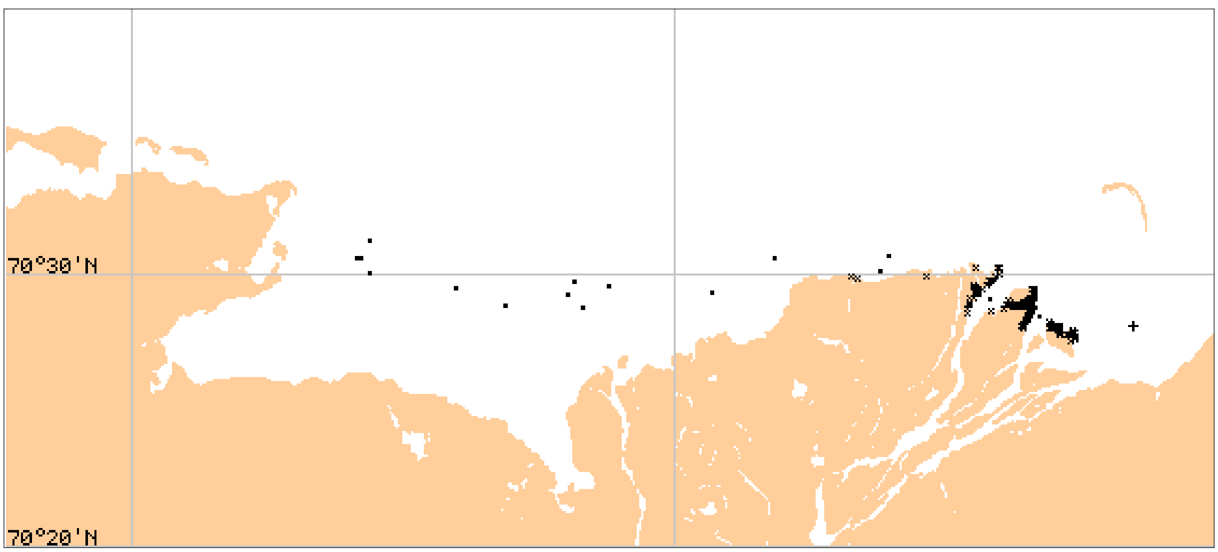
After you've run the low river flow conditions, re-run the simulation with a medium (10,000 cfs), and then high (20,000 cfs), flow rate for the Colville River only.

What effect(s) do the Colville River flow changes have on the trajectory and shoreline impacts of this spill?

Hint: To model a continuous release, in the **Spill Information** window, click the box labeled "Different end release time", and enter August 18th as the end release time.

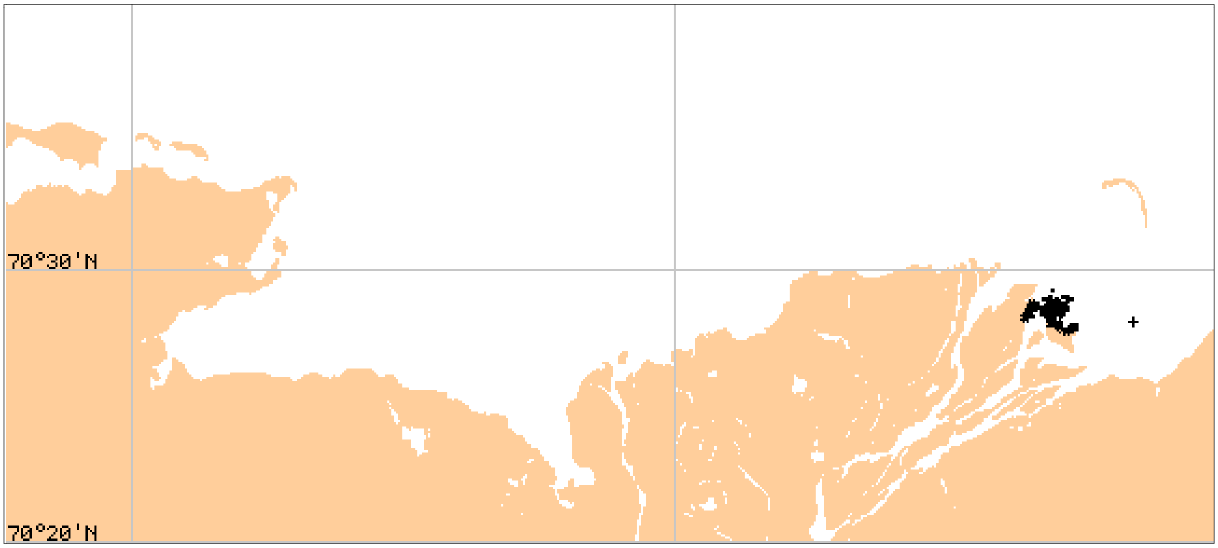
Answer: Higher river flows keep the oil offshore longer so that response equipment, like skimmers and boom, can be mobilized.

In the low flow condition (shown below), the "Best Guess" or Forecast trajectory shows that after 2 days, heavy oiling has occurred in the Colville River delta, and the wind has driven the oil eastward into Harrison Bay.



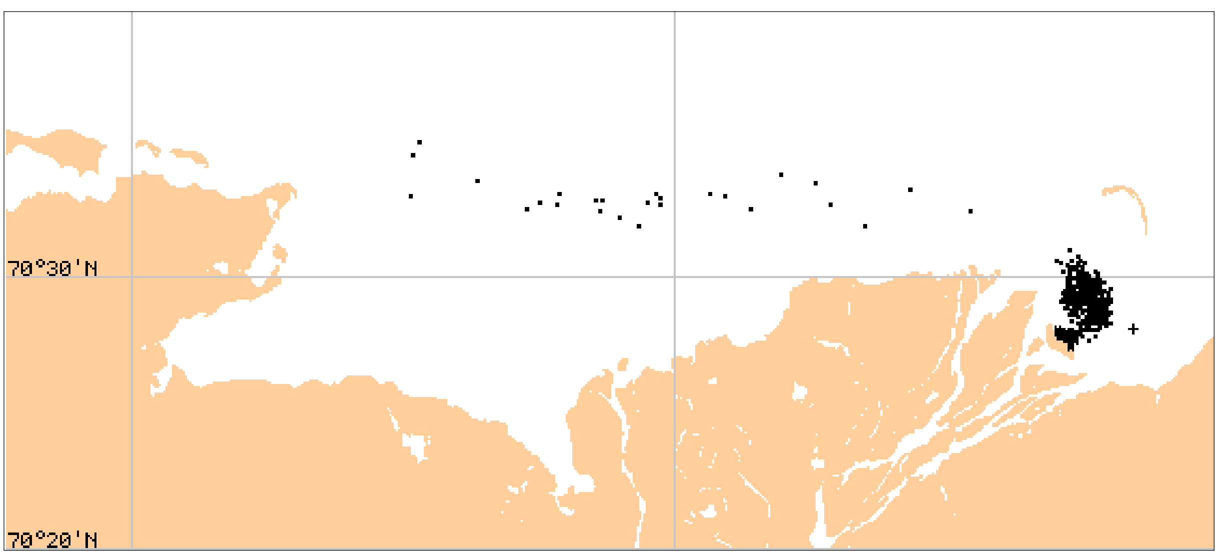
Low river flow condition

In the medium flow condition, the extent of beaching in the delta is not as severe. In this case, the fresh water from the higher river flow is pushing the oil out of the inlet, and the wind is pushing the oil into the inlet. The oil remains offshore until the oil spreads far enough to find a place where the river outflow is less, then the wind pushes it onshore in a limited area.



Medium river flow condition

In the high flow condition, most of the oil is pushed offshore by the higher river flow, where it is affected by the wind and coastal circulation. While this gives responders time to deploy equipment, it also means that the oil can travel a greater distance, possibly causing shoreline impacts to be more widespread.



High river flow condition