Examples

Try out these examples to learn the basics of modeling oil spills in Prince William Sound, Alaska. Explore how wind can move an oil spill in a direction different from the currents, and 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.

Note that the Location File for Prince William Sound includes an area larger than most of the Location Files, so the model may run rather slowly. If you don't want to wait for the model to run, you can review the results when it is finished by slowly dragging the carat under the Run Bar to see the hourly trajectory pictures, or you can create a movie of the results to view as needed.

Two sets of example problems are provided. Use GNOME's Standard Mode and the Prince William Sound Location File to complete them.

Example Set I

The following conditions hold for these examples:
Date: February 24, 1999
Model and Spill Start Time: 12:00 noon (1200)
Run duration: 2 days
Uncertainty: Not included, unless specified in a particular example.
Wind: No wind, unless specified in a particular example.
Pollutant type: Non-weathering, unless specified.

Initial Report:
A crude oil spill of 1,000 barrels is reported to have occurred at 1200 February 24, 1999, located at 60° 25.44' N, 146° 49.62' W. Winds at this time are from the NW at 15 knots and are forecast to remain the same for the next 48 hours.

1. What is the difference in beach impacts between the "Best Guess" and Uncertainty model runs for 2 days?

> **Hint:** To set a spill at a particular location, double-click the Spill Tool. In the Spill Information window that opens, you can enter the exact location of the spill.
>
> **Answer:** The "Best Guess" trajectory shows primarily the northwestern part of Hinchinbrook Island with oiling. The Uncertainty results show potential oiling of Montague Island and increased oiling of Hinchinbrook Island.

2. If this spill were gasoline in the same amount, what would your trajectory show?

Hint: To quickly change the pollutant type, double-click "Medium Crude: 1000 barrels" under "Spills" in the left section of the Map Window (the Summary List). In the Spill Information window that opens, choose gasoline from the Pollutant menu.

Procedure: Turn off the "Minimum Regret" (Uncertainty) solution (find the appropriate box under "Model Settings" in the Summary List) to make the model run faster. Run a "Best Guess" gasoline spill, then examine the Mass Balance by clicking the carat to the left of the spill, "Gasoline: 1000 barrels," in the Summary List.

Answer: By the end of two days, almost all of the gasoline has evaporated and dispersed (less than 5 splots are left). (For the crude oil spill, only about a third of the spill had evaporated and dispersed in two days.) Much less shoreline is oiled because the gasoline isn't around long enough to travel very far.

3. If the wind shifts to 15 knots from the north at 11:00 pm (2300) on the first day (Feb. 24), how will your trajectory change? (Change the pollutant type back to "medium crude.")

Procedure: Be sure to choose Variable Winds in the "Choosing Wind Type" section. (If you have chosen a constant wind, you can change it to variable winds by double-clicking the name of your Location File, "Prince William Sound," in the Summary List. The Location File Welcome window will appear with all the settings you had previously chosen. You only have to enter information that you are changing, so in the "Choosing Wind Type" window, choose "Variable" from the pull-down menu.)

Answer: Now the beach impacts of the "Best Guess" trajectory affect both Hinchinbrook and Montague Islands. In problem 1, the "Best Guess" trajectory impacted only Hinchinbrook Island, while the Uncertainty trajectory showed that Montague Island could possibly be affected as well. In this problem, you can see how a small shift in the wind has a dramatic effect on the spill's trajectory.

Example Set II

This set of examples is designed to show you differences in the circulation patterns within Prince William Sound and how they affect oil trajectories. You will also explore how wind and different oil types affect spill trajectories and see how modeling the uncertainty in wind, currents and other model inputs leads to a more complete picture of potential oil impacts.

The following conditions hold for this example set:
Date: November 10, 1999
Model and Spill Start Time: 9:00 AM (0900)
Run duration: 1 day
Uncertainty: Not included, unless specified in a particular example.
Wind: No wind, unless specified in a particular example.
Pollutant type: Non-weathering, unless specified.

1. Two spills, each 1000 bbl of Fuel Oil #6, have occurred in Prince William Sound at the following locations:

Spill #1: the north-central portion of the sound at 60° 40' N, 147° 0' W
Spill #2: between Green Island and Knight Island at 60° 20' N, 147° 32' W

How do the trajectories of these spills differ after 24 hours? What is the mass balance of each spill?

Hint: To quickly set the spill location, double-click the Spill Tool. In the Spill Information window that opens, you can enter the exact location of the spill.

Mass Balance	Spill #1 (bbl)	Spill #2 (bbl)
Floating		
Beached		
Evaporated and Dispersed		

Answer: The currents within the central sound are much weaker than in the western passages, so the northern spill spreads out more uniformly with some net movement to the north. The more southern spill spreads out in the direction of the current and travels much further. The mass balances for your trajectories should be similar to these results:

Mass Balance	Spill #1 (bbl)	Spill #2 (bbl)
Floating	837	777
Beached	0	52
Evaporated and Dispersed	163	171

2. Rerun the above spills with the following change: Add a 15-knot wind from the east.

How does the wind affect the trajectories? Note the changes in the mass balances.

Hint: To add the wind condition to your model, double-click "Wind" in the left section of the Map Window (the Summary List). Enter the speed and direction of the wind in the Constant Wind window that opens.

Mass Balance	Spill #1 (bbl)	Spill #2 (bbl)
Floating		
Beached		
Evaporated and Dispersed		

Answer: The wind makes the spills move in an easterly direction. Both spills have significantly more beach impacts with the wind blowing the oil onshore.

Mass Balance	Spill #1 (bbl)	Spill #2 (bbl)
Floating	599	117
Beached	238	712
Evaporated and Dispersed	163	171

3. Rerun the same spills with the following addition: Turn on the Minimum Regret (Uncertainty) solution (red splots).

How does this information change your forecast for potential beach impact areas?

Hint: To quickly turn on the Minimum Regret solution, click the box labeled "Include the Minimum Regret solution" in the Summary List.

Answer: Spill #1 could impact more beaches on Naked Island and other islands in the vicinity. Spill #2 shows impacts on more beaches of Knight Island, and now Evans Island and Latouche Island show some oiling and/or significant threat of oiling.

4. Rerun the same spills once more with the following change: Make both spills gasoline spills (keep the wind from the east at 15 knots).

Note the trajectories and the mass balances.

Hint: To change the pollutant type of a spill, double-click its description under "Spills" in the Summary List. (In this case, your two spills are described as "Fuel Oil #6: 1000 barrels.") In the Spill Information window that opens, choose gasoline from the Pollutant menu.

Mass Balance	**Spill #1 (bbl)**	**Spill #2 (bbl)**
Floating		
Beached		
Evaporated and Dispersed		

Answer: Lighter products evaporate more quickly than heavier products. These gasoline spills have few beach impacts because the product is evaporating so quickly.

Mass Balance	**Spill #1 (bbl)**	**Spill #2 (bbl)**
Floating	15	19
Beached	0	3
Evaporated and Dispersed	985	978