Examples

Try out these examples to learn the basics of modeling oil spills in the lower Mississippi River. In these examples, you will see how different river flow, winds, and pollutants, 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.

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

1. Let's begin by simulating a spill that occurs on May 3, 2005, at 9:00 a.m. (0900), and continues to spill for about 6 hours. You should observe the spill effects throughout 24 hours. To compare the effects of different river flow rates, run the model three times, setting the Mississippi River stage height first to 5, then 10, and then 15 feet. Set a spill of 1000 gallons of medium crude in the center of the river channel, at approximately 29° 38.5'N, 89° 56.8'W. Name the spill "Example 1."

"Zoom in" to the spill area and describe how the trajectory changes with the different river flow conditions.

> **Hints:** (1) 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!)
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> (2) 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 May 3, 2005 is 6 hours later than our spill start time of 0900).
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> (3) To make the stage height changes for this scenario, double-click "River stage height: 5 feet" under **Location File** in the Summary List, to the left of the map. 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 Setting River Flow window, change the stage height value to 10, then 15 for the next run.
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> **Note:** Let's use the spill settings from your last model run (stage height set to 15 feet) for 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 lowest river flow (stage height of 5 feet), the oil travels from the release point downriver, past Sixtymile Pt. When the stage height is 10 feet, the oil travels as far as Venice, and when the stage height is 15 feet, it moves into the three main passes of the bird's-foot delta: Southwest Pass, South Pass, and Main Pass.

2. Winds can have a significant effect on a spill because they influence the currents and move the oil on the surface of the water. Particularly in a narrow river channel, the wind has large effects on where the oil beaches. To compare the effects of different winds, add to your last scenario a 5-knot wind from the east, then a 5-knot wind from the west.

Describe how the trajectory changes with the wind conditions. How do the shoreline impacts differ?

Hint: To change the wind conditions in GNOME, double-click **Wind** in the Summary List, then enter the wind speed and direction in the Constant Wind window.

Answer: Even a very light wind dramatically changes the oil's trajectory! When the spill occurs with the 5-knot east wind, the oil travels downriver past Sixtymile Pt., beaching along the river's right descending bank. With the west wind, the oil moves a similar distance; however, in this scenario, the most affected shorelines of those of the left descending bank (http://www.uscgboating.org/safety/aton/rivers_marking_system.htm).

3. Different types of pollutants weather differently. In this example, you'll re-run the 15-foot stage height spill, and compare the spill effects of the medium crude spill with those of a kerosene spill. Try to predict how the spill will differ in its behavior, and at the end of your 24-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: (1) To view the mass balance for each scenario, click the right-pointing triangle next to the spill name ("Example 1: Medium Crude: 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.

(2) To change the pollutant type, double-click the spill name ("Example 1: Medium Crude: 1000 gallons") in the Summary List. In the Spill Information window, change the Pollutant to "kerosene / jet fuels".

Answer: Heavier oils remain in the environment longer than lighter, refined products. You can see that after 24 hours, about 69% of the kerosene has evaporated and dispersed, compared to about 21% of the medium crude. (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	216	106
Beached	576	208
Evaporated and Dispersed	208	686
Off map	0	0

4. 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 15-foot stage height scenario from Example 1, but first make these changes: (1) Change the model run duration to 8 hours, and (2) 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?

Hints: (1) To change the duration, double-click "Duration: 24 hours" under **Model Settings** in the Summary List. In the Model Settings window, change the Model Run Duration to 8 hours.

(2) 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 effects could be more far-reaching, traveling around Sixtymile Pt.

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.