Examples

Try out these examples to learn the basics of modeling oil spills in the St. Johns River in northeast Florida. In these examples, you will see how different tides, winds, 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: October 8, 2002.
Model and Spill Start Time: As specified in each example.
Model duration: 1 day.
Uncertainty: Not included, unless specified.
Wind: None, unless specified.
Pollutant type: Non-weathering, unless specified.
Spill size: 1000 barrels.
Spill Location: As specified.

Use GNOME's Standard Mode and the St. Johns River Location File to answer the following questions. Be sure to carefully read and enter all the information in each problem. Don't include the Uncertainty solution unless you are asked to.

1. Tides play an important part in the circulation of the St. Johns River region. In this example, you will examine the effects of tides by simulating a spill at two different times in the tidal cycle.

Create a spill at the mouth of the river (30° 24.05'N, 81° 24.28'W) that starts just before an ebb tide on October 8, 2002 at 1:00 p.m. (1300) (**spill 1a**). The spill releases 1000 barrels of pollutant into the river (use a non-weathering pollutant to best visualize the trajectory). Using the hint provided below, run this trajectory.

Next, change the spill start time to be just before a flood tide on the same day, at 8:00 p.m. (2000) (**spill 1b**). Use the hint provided for spill 1b.

How do the beach impacts differ with the different tide conditions? How does the trajectory change? If the spill exits the river, note the time that it started to exit.

> **1a Hint:** 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!)

1b Hint: When you change the start time of the spill, you will want to change both the *spill* start time and the *model* start time. To do this, double-click the description of the spill ("Non-Weathering: 1000 barrels") under **Spills** in the Summary List (the left section of the Map Window). In the Spill Information window, change the Release Start Time to October 8, 2002 at 2002. GNOME will then prompt you to change the model start time to match the spill start time. Click "Change". Because GNOME is set up to adjust the *model* start time to the *spill* start time, you should always change the spill start time first.

Note: You will need to use the spill settings from spill 1b 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 two spills take very different trajectories! Most of Spill 1a (the ebb tide spill) exits the river immediately (around 2 p.m.) and is carried north under the influence of the water currents and turbulence. Spill 1b (the flood tide spill) is swept upriver, all the way to the Drummond Point area, and extensively oils the shorelines of the lower reaches of the river.

2. Wind can have a significant effect on a spill because it both moves the oil along the water's surface and drives currents. Rerun the previous flood tide scenario (spill 1b), adding a 20-knot (constant or variable) wind in each of the cardinal directions (N, S, E, W).

How do the spills' trajectories and shoreline impacts change from the scenario without any wind?

Hint: 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.

Answer: Some of these winds dramatically change the oil's trajectory and others have minimal effect. In the scenario with no wind, the oil moved upriver under the influence of the tides. With the addition of a north wind, the spill quickly beaches on the southern shore of the river mouth. In the "south wind" scenario, the spill beaches quickly on the northern shore. The east wind blows basically in the direction of the flood current; however, it causes more oil to beach, so less oil is transported upriver. In the "west wind" scenario, the wind almost overpowers the currents in the first few hours of the spill, then the tide overtakes the wind. The oil doesn't travel as far upriver, and at the end of 24 hours, the area impacted by the spill is less extensive than without any wind.

3. 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.

(a) Using the saved flood tide scenario from example 1 (spill 1b), change the location of the spill to 30° 24.08'N, 81° 36.29'W. Run GNOME first without the "Minimum Regret" (Uncertainty) solution, then run it again with the "Minimum Regret" solution included.

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 spill location, double-click the spill description ("Non-Weathering: 1000 barrels") under **Spills** in the Summary List. In the Spill Information window, change the Latitude and Longitude to those of the new spill location. (2) To include the Minimum Regret (Uncertainty) solution, click the box labeled "Include the Minimum Regret solution" under **Model Settings** in the Summary List.
>
> **Note:** You will need to use the spill settings from this example in Example 4 below. Before moving on, save your settings as a Location File Save (LFS).
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> **Answer:** The Minimum Regret solution shows more extensive impacts in all directions. 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.

(b) Next, try adding a 10-knot (or greater) wind, from any direction, to the "Minimum Regret" scenario.

What do you learn about the trajectory?

> **Answer:** The wind causes much more extensive beaching of the oil. The "Minimum Regret" spill particles (red) show that oil contact on shoreline could involve a slightly larger area.

4. Different types of pollutants weather differently. In the previous examples, you were using an imaginary type of oil ("non-weathering") that did not change with time. Now you will run a spill with two different types of products to see how evaporation and dispersion change the oil impacts. Using your saved file from

Example 3, first change the pollutant type to a light product, such as gasoline, and run the scenario (without the "Minimum Regret" solution). Next, change the pollutant type to a heavy product, such as medium crude.

Compare the shoreline impacts and review the Mass Balance to see how the "weathering" of the pollutants affects the spill impacts.

	Gasoline (barrels)	**Medium Crude (barrels)**
Released	1,000	1,000
Floating		
Beached		
Evaporated and Dispersed		
Off map		

Hints: (1) To quickly change the pollutant type, double-click the spill description ("Non-Weathering: 1000 barrels") under **Spills** in the Summary List. In the Spill Information window, choose "gasoline" from the Pollutant pull-down menu. (2) To view the mass balance for a scenario, click the right-pointing triangle next to the spill description, "Gasoline: 1000 barrels", 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.

Answer: Heavier oils remain in the environment longer than lighter, refined products. (Your mass balance numbers may differ slightly from those shown below.)

	Gasoline (barrels)	**Medium Crude (barrels)**
Released	1,000	1,000
Floating	3	98
Beached	18	681
Evaporated and Dispersed	979	221
Off map	0	0

After 24 hours, beach impacts from the medium crude spill are much more extensive than for the gasoline spill. With the medium crude spill, about 68% of the spill beached on river shorelines, with about 10% of the spill still in the water. With the gasoline spill, beaching was negligible, and less than 1% of the spill was still floating. Most of the gasoline (about 98%) had evaporated or dispersed.

If you'd like, try running either of these spill scenarios over again with some wind, and see how the beach impacts change.