Examples

Try out these examples to learn the basics of modeling oil spills in Columbia River Estuary. Explore how the changing river flow alters the estuary's tidal currents and the trajectory of an oil slick, how wind can move an oil slick in a different direction from the currents, and how model and observation limitations can be overcome by considering both the "Best Guess" and the "Minimum Regret" solutions. This knowledge will help you in designing your own GNOME scenarios.

The following conditions hold for each of the examples:
Date: December 6, 1998
Model and Spill Start Time: 4:00 p.m. (1600)
Run duration: 1 day
Wind: No wind, unless specified in a particular example.
Pollutant type: Non-weathering.

Use GNOME's Standard Mode and the Columbia River Estuary Location File to answer the following questions:

1. To see the effects of river flow on the tidal currents, use each of the three given Columbia River flow rates in the Location File with a wind speed of zero (0). Set a nonweathering spill of any amount at 46° 14.087' N, 123° 42.708' W (an interesting portion of the deeper channel).

How long does it take for some of the leading "best guess" (black) splots to leave the estuary?

Hint: To find the time elapsed, stop the model using the Pause button, and then subtract the time shown on the run bar from the start time.

Answer: The order from fastest to slowest is

High	7 hours
Medium	15 hours
Low	18 hours

As you watch the slick move during each model run, the movement of the slick up-river during the flood tide will increase as the Columbia River flow decreases. When the river flow is low, the tides move the oil back and forth as the oil is moving out of the estuary. Under high river flow conditions, flood tides only slow the river flow, and there is no current reversal or reversal in the oil's direction of travel. This is because the river flow is greater than the tidal flood currents during a longer time period of the tidal flood cycle.

2. Rerun the fastest and slowest scenarios above with the addition of a 10-knot wind from the north.

What happens to the spill?

> **Answer:** Even light winds can dramatically change the trajectory of a spill. In both the fastest and the slowest cases, a 10-knot wind from the north will cause most of the oil to beach on the southern shore of the estuary before leaving the estuary. This beaching happens because the wind both moves the oil directly (by pushing it) and generates surface waves that move the oil.

3. GNOME chooses between two different methods for estimating total river flow at Astoria, depending on the value you enter for the flow rates at Bonneville Dam and for the Willamette River. If both your values are small enough, the low flow method is used; otherwise, the high flow method is used (check the Technical Documentation section of the Columbia River Estuary **User's Guide** to learn more). To see the difference, set a spill at 46° 12.02' N, 123° 51.65' W. Run the spill using 200 kcfs for the Bonneville Dam flow rate and 90 kcfs for the Willamette River at Portland flow. Rerun the spill with 210 kcfs for the Bonneville Dam flow rate and 100 kcfs for the Willamette River at Portland flow, respectively.

Can you see a difference in how fast the spill moves down river?

> **Answer:** Yes, when you increase river flow, you should be able to see a difference in how the oil moves, because a high river flow rate overwhelms the tidal currents. When the river flow is low, the tides move the oil back and forth as the oil is moving out of the estuary. Under high river flow conditions, flood tides only slow the river flow, and there is no current reversal or reversal in the oil's direction of travel. The first scenario (200 and 90 kcfs) leads to a total transport of 352 kcfs at Astoria. The second scenario (210 and 100 kcfs) leads to a substantially higher total transport of 506 kcfs. The large difference in oil movement that you saw when you ran the two scenarios shows that GNOME may not accurately model oil movement in the Columbia River Estuary near transitions between high and low flow conditions.

4.(a) Suppose there is a bird rookery on the southeastern portion of Puget Island (the large island near the eastern boundary of the map); the rookery extends from 46° 09.03'N, 123° 22.2' W to 46° 09.19' N, 123° 20.58' W. An oil spill occurs across the entire river at the right (eastern) edge of the map from a sunken boat. The river flow is low (125 kcfs) and you are concerned about immediate (within a few hours) impacts to the rookery.

Remember that the wind can be an important influence on oil trajectories. Experiment by changing the wind speed and direction to find the wind conditions that would keep all of the oil away from the rookery for the first hour of the spill.

From what direction must the wind blow to keep the rookery oil-free for the first hour? What is the minimum wind speed that would keep the rookery oil-free for that time?

Hint: Try zooming in to the area before you start. Select the Zoom In tool and use it to outline the new desired map area.

Hint: To set a line spill, click and drag the Spill Tool from the starting point to the end point of your spill.

(b) Suppose that you were responding to this spill, and the wind forecast was the same as your answer to part (a). **Would you anticipate any oil reaching the bird rookery?**

Hint: Try including the "Minimum Regret" solution to see if it makes a difference in the results.

Answers:
(a) A wind of 20 knots from the north should keep all splots off the bird rookery area.
(b) Though the "Best Guess" splots will probably not hit the bird rookery, the "Minimum Regret" splots will indicate more impacts to the rookery, showing you how important it is to consider the uncertainty solution when you want to understand the full range of possibilities. This is because forecasts are not likely to be perfect, and the "Minimum Regret" splots take into account how forecasts most commonly err. For more information, refer to the Uncertainty and "Minimum Regret" GNOME Help topics.