User's Guide

Welcome to the Location File for the Columbia River Estuary, located along the boundary between the states of Washington and Oregon in the U.S. Pacific Northwest.

NOAA created Location Files for different U.S. coastal regions to help you use the General NOAA Oil Modeling Environment, GNOME. Each Location File contains information about local oceanographic conditions that GNOME uses to model oil spills in the area covered by that Location File. Each Location File also contains references (both print publications and Internet sites) to help you learn more about the location you are simulating.

As you work with the Location File for the Columbia River, GNOME will prompt you to:

1. Set the Columbia River flow rate.
2. Choose the model settings (start date and time, and run duration).
3. Input the wind conditions.

The total flow of the Columbia River is primarily controlled by the amount of water flowing over the Bonneville Dam and down the Willamette River. When you are prompted to set the Columbia River flow rate, you can either (1) choose a High, Medium, or Low flow rate, or (2) enter measured flow rates of the Columbia River over Bonneville Dam and of the Willamette River measured at Portland, Oregon (check the "Finding Flow Data" Help topic to learn how to obtain these flow rates).

Similarly, GNOME will guide you through choosing the model settings and entering the wind conditions. Click the Help button anytime you need help setting up the model. Check the “Finding Wind Data” Help topic to see a list of web sites that publish wind data for this region.

More information about GNOME and Location Files is available at http://response.restoration.noaa.gov/software/gnome/gnome.html .

Technical Documentation

Background

The Columbia River Estuary is the second largest river in the United States and the largest river to flow into the eastern North Pacific. The drainage area is 660,480 km^2, covering much of the U.S. Pacific Northwest and southwestern Canada (Simenstad et al., 1990). The Columbia River Estuary Location File covers the section of the Columbia River from the Pacific Ocean to approximately River Mile 47. For a history of how humans have altered the geomorphology and flow of the Columbia River, see Sherwood et al., 1990.

Current Patterns

The Columbia River Estuary Location File contains two current patterns. One is scaled to the tidal predictions at Tongue Point, Oregon (46° 13.15' N, 123° 46.00' W). The other represents the river flow minus the mean river flow in the tidal predictions and is scaled according to the river flow rate(s) entered by the user. Since the tidal record contains a mean current of 0.2 m/s, the scaleable river flow represents the difference between the user transport and the transport in the tidal predictions. Both current patterns were created with the NOAA Current Analysis for Trajectory Simulation (CATS) hydrodynamic application.

River Flow Estimation

(a) Formulas Used

The Columbia River Estuary Location File uses the total river transport at Astoria to scale the river flow. To allow you to enter your own river flow values, the Columbia River Location File includes a modification of Jay's (1984) formula for calculating Columbia River flow at Astoria. The user enters values for river flow of the Columbia River at the Bonneville Dam and the Willamette River at Portland. Jay's (1984) formula for volume transport at Astoria can be written:

If Bonneville Dam flow < 200 kcfs AND Willamette River flow < 90 kcfs,
then Astoria flow (t) = 4.139 kcfs + 1.003 (Bonneville Dam flow (t) kcfs) +
1.632 (Willamette River at Portland (t-6) kcfs)

If Bonneville Dam flow > 200 kcfs OR Willamette River flow > 90 kcfs,
then Astoria flow (t) = 103 kcfs + 1.084 (Bonneville Dam flow (t) kcfs) + 1.757 (Willamette River at Portland (t-6) kcfs)

Since this function is undefined if both the Bonneville Dam and Willamette Rivers are at the decision flows (200 kcfs and 90 kcfs, respectively), the Columbia River Estuary Location File uses the lower-flow formula at the decision points. The use of this formula at the decision points results in a lower river flow and the oil moving down the river more slowly (more conservative estimate).

(b) Limitations on the Formulas

Jay's formula does not explicitly take into account the differing seasonal inputs from the eastern and coastal portions of the Columbia River watershed. The Cascade Range effectively divides the watershed into the smaller coastal portion (8%) and the much larger eastern portion (92%). The smaller coastal sub-basin contributes 24% of the total Columbia River flow, due to orographically-generated rains on the western Cascade slopes and the mild wet winters, during which water is not stored for summer release. The Willamette, Lewis, and Cowlitz Rivers of the coastal areas have their peak flows during the winter months, while the eastern portion of the watershed contributes highest flows during the snow melting season (April to July). The overall Columbia River transport is highest during the spring snow melting season and lowest during autumn (Simenstad et al., 1990).

(c) Time-Correcting River Flow Data

If you choose to enter river flow values for the Columbia River at Bonneville Dam and the Willamette River at Portland, enter the observed river flows at these two locations six (6) hours earlier than your model start time. This is the approximate length of time the transport signal takes to travel to the estuary.

(d) Scaling Current Patterns from User Entered Data

The Columbia River Estuary Location File scales all current patterns relative to the currents at Tongue Point, Oregon. To calculate the scale for the river current pattern (V_{scale}, m/s) from the Location File's estimate of the river transport at Astoria ($VolumeTransport$, m^3/s) calculated in section (a), the following formula is used:

$$V_{scale} = \frac{VolumeTransport}{CrossSectionalArea} - V_{tidal},$$

where V_{tidal} is the mean flow in the tidal record at Tongue Point (approximately 0.2 m/s), and $CrossSectionalArea$ (m^3) is the river's cross sectional area at Tongue Point.

References

You can get more information about the Columbia River Estuary from these publications and web sites.

Oceanographic

Giese, B.S. and D.A. Jay (1989). Modelling Tidal Energetics of the Columbia River Estuary. Estuarine, Coastal and Shelf Science 29: 549-571.

Jay, David (1984). Final Report on the Circulation Work Unit of the Columbia River Estuary Data Development Program: Circulatory Processes in the Columbia River Estuary. Geophysics Program, University of Washington, Seattle, WA. 169 pp. plus appendices.

Oregon Graduate Institute CORIE
    http://www.ccalmr.ogi/CORIE
Offers near-real time oceanographic (ADCP, CTD) and meteorological (wind) observations of the lower Columbia River.

Sherwood, C.R., D.A. Jay, R.B. Harvey, P. Hamilton, and C.A. Simenstad. Historical changes in the Columbia River Estuary. In: Small, L.F., ed. Columbia River: Estuarine System. Volume 25. Progress in Oceanography. New York: Pergamon Press; 1990: 299-352.

Simenstad, C.A., L.F. Small, C.D. McIntire, D.A. Jay, and C. Sherwood. Columbia River Estuary studies: An introduction to the estuary, a brief history and prior studies. In: Small, L.F., ed. Columbia River: Estuarine System. Volume 25. Progress in Oceanography. New York: Pergamon Press; 1990: 1-13.

US Army Corps of Engineers – North Pacific Region Water Management Division
    http://www.nwd-wc.usace.army.mil/report.htm
Supports Water Control Data for the Columbia River Basin. Select the Lower Columbia to view flow data for control points at Bonneville Dam (BON) and other locations.

US Geological Survey
    http://waterdata.usgs.gov/nwis-w/OR
Daily and historical data for Oregon rivers. Some useful station numbers are the Willamette River at Salem (station #14191000) and at Portland (station #14211720)

Wind and Weather

Oregon Graduate Institute CORIE
http://www.ccalmr.ogi/CORIE
Offers near-real time oceanographic (ADCP, CTD) and meteorological (wind) observations of the lower Columbia River.

National Weather Service (NWS) Interactive Weather Information Network
http://iwin.nws.noaa.gov/iwin/or/or.html
Current conditions for Portland and Astoria, Oregon.

NOAA NWS
http://www.nws.noaa.gov
Current weather observations, forecasts, and warnings for the entire U.S.

Oil Spill Response

NOAA Hazardous Materials Response Division (HAZMAT)
http://response.restoration.noaa.gov
Tools and information for emergency responders and planners, and others concerned about the effects of oil and hazardous chemicals in our waters and along our coasts.