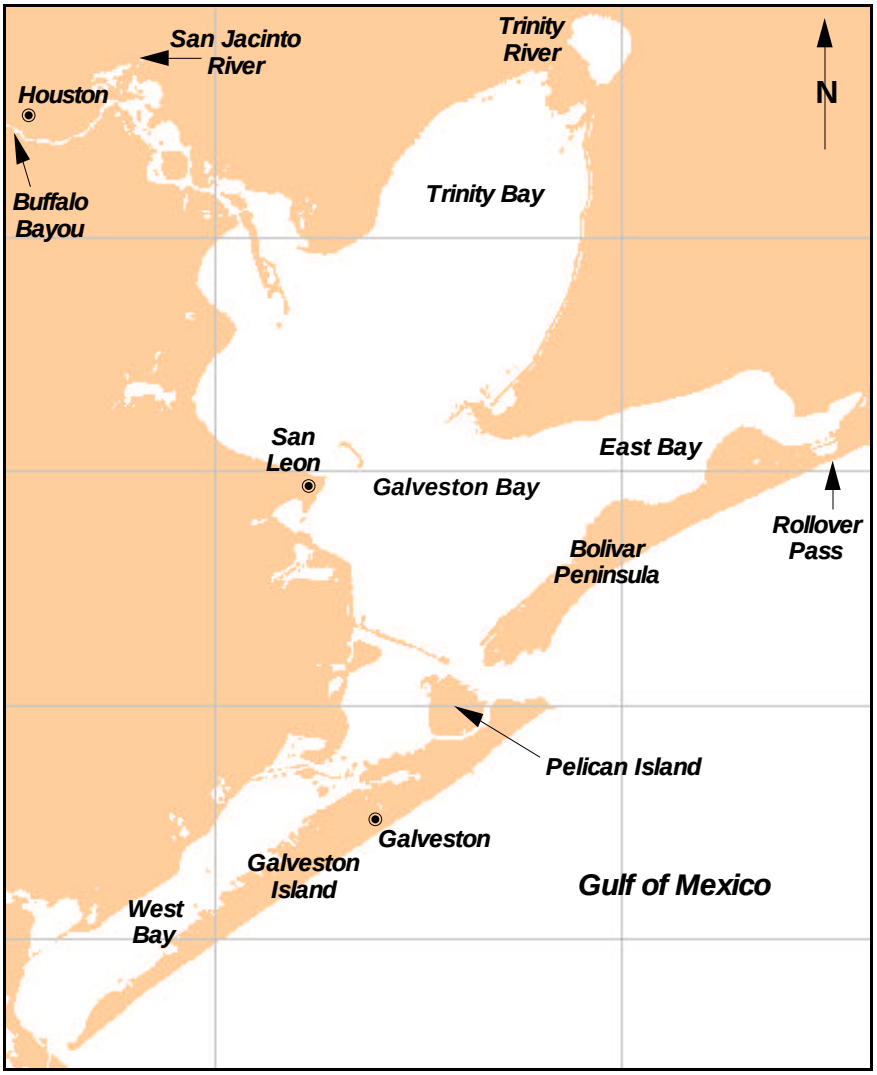
User's Guide

Welcome to the Location File for Galveston Bay, an inlet of the Gulf of Mexico, on the southeastern shore of Texas, U.S.A. Galveston Bay's 600 square miles of surface area is commonly divided into four major sub-bays: Galveston Bay, Trinity Bay, West Bay and East Bay. Galveston Bay receives freshwater from three main tributaries (the Trinity and San Jacinto rivers and Buffalo Bayou), and receives saltwater from the Gulf of Mexico.



NOAA has created Location Files for different U.S. coastal regions to help you use the General NOAA Oil Modeling Environment, GNOME. In addition, on a case-by-case basis, NOAA develops international Location Files when working with specific partners. 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 Galveston Bay, GNOME will prompt you to:

1. Choose the model settings (start date and time, and run duration).
2. Input the flow rates for the three main tributaries of the bay: the Trinity River, the San Jacinto River, and Buffalo Bayou.
3. Input information about the currents offshore.
4. Input the wind conditions.

GNOME guides you through choosing the model settings and entering the other conditions. Click the "Help" button if you need help setting up the model. Similarly, click the buttons labeled "Finding River Flow Data," "Finding Offshore Data," and "Finding Wind Data" to get help finding the data you need to input into GNOME.

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

Technical Documentation

Background

Galveston Bay is broad and very shallow (typically only 6 -12 feet deep), except for dredged channels. Winds and tides dominate the circulation in the bay; however, extremes in atmospheric low pressure (such as those associated with a hurricane) can significantly raise sea level, causing extensive flooding and currents that can overcome the tides.

Current Patterns

The Location File for Galveston Bay contains six current patterns. All current patterns were created with the NOAA Current Analysis for Trajectory Simulations (CATS) hydrodynamic model.

1. Tidal Flow

Tides dominate the circulation within Galveston Bay and are represented in the Location File with a current pattern driven by the tide station at Bolivar Roads, 0.5 miles north of Ft. Point (28° 20.80'N, 94° 46.10'W).

2. River Flows

During high runoff periods, river input is also important in driving the Galveston Bay circulation. Three main tributaries of the bay are simulated in this Location File: the Trinity River, the San Jacinto River, and Buffalo Bayou. The Trinity River is simulated as a single current pattern, while the San Jacinto River and Buffalo Bayou inputs are combined into one current pattern. Each of the river flow rates is calculated from the transport rates or stage heights that the GNOME user enters. Stage height is converted to flow rate through rating curves provided by the U.S. Geological Survey (USGS). Formulae for the conversions are detailed below. All flow calculation results are calculated in cubic feet/second (cfs) and all stage height data are assumed to be in feet.

(a) Trinity River

A 9th order polynomial fit to the rating curve yielded the following equation relating Trinity River flow rate, $flow_{Tr}$, to stage height near Liberty, Texas (station 08067000), Tr.

$$\begin{aligned} flow_{Tr} = (&-3.237200497277822*10^{-4} Tr^9 + 5.730374402263*10^{-2} Tr^8 \\ &-4.39356026997217* Tr^7 + 1.903947923307952*10^{2} Tr^6 \\ &-5.091414135633288*10^{3} Tr^5 + 8.570693130551324*10^{4} Tr^4 \\ &-8.785856324310122*10^{5} Tr^3 + 4.860075540379636*10^{6} Tr^2 \\ &-9.059453584957751*10^{6} Tr - 1.746415386161943*10^{7}) \end{aligned}$$

The calculated flow rate is used to scale the Trinity River current pattern.

(b) San Jacinto River and Buffalo Bayou

A 7th order polynomial fit to the rating curve yielded the following equation relating San Jacinto River flow rate, $flow_{SJ}$, to stage height near Sheldon, Texas (station 08072050), SJ.

$$\begin{aligned} flow_{SJ} = (&-8.962534216177780*10^{-4} SJ^7 + 8.090710430776*10^{-2} SJ^6 \\ &-2.87704742826949* SJ^5 + 52.01494119132756* SJ^4 - 497.7695044340068* SJ^3 \\ &+2598.874761983057* SJ^2 - 2873.610938411168* SJ + 2078.345299841351) \end{aligned}$$

A 7th order polynomial fit to the rating curve yielded the following equation relating Buffalo Bayou flow rate, $flow_{BB}$, to stage height at Houston, Texas (station 08074000), BB.

$$\begin{aligned} flow_{BB} = 10^2(&-1.67309*10^{-9} BB^7 + 2.1083008*10^{-7} BB^6 - 1.113042545*10^{-5} BB^5 \\ &+3.5192710537*10^{-4} BB^4 - 8.35199297309*10^{-3} BB^3 + 0.19852883938503* BB^2 \\ &+0.59674875618414* BB - 2.70649020121096) \end{aligned}$$

The flow rates for the San Jacinto River and Buffalo Bayou are combined and then converted to a scaling coefficient.

3. Wind Driven Currents (2 current patterns)

Wind driven currents are simulated by a linear combination of two current patterns scaled by the wind stress. One pattern was calculated with a NW wind and the other with a NE wind.

4. P.H. Robinson Power Plant Circulation

The small circulation driven by the P.H. Robinson power plant flow-through circulation at San Leon is simulated by a current pattern in the Location File. Flow data were provided by Reliant Energy, which operates the P.H. Robinson facility. Permitted flow from the plant is 75.7 m^3/s. For 1998 and 1999, the maximum flow was 74.6 m^3/s, with an average flow of 57.4 m^3/s. The average flow rate (57.4 m^3/s) was used to scale the current pattern.

5. Offshore Circulation

An offshore circulation pattern was derived assuming a barotropic setup. The offshore circulation pattern is scaled by the alongshore (55° True) component of the offshore velocity entered by the GNOME user.

References

You can get more information about Galveston Bay from these publications and web sites.

Oceanographic

Chuang, W.-S. and W. J. Wiseman. 1983. Coastal Sea Level Response to Frontal Passages on the Louisiana-Texas Shelf. *JGR 88 (C4):* 2625-2620.

Texas Department of Water Resources. 1981. Trinity-San Jacinto Estuary: A Study of the Influence of Freshwater Inflows. LP-113. Austin: Texas Department of Water Resources.

Texas Department of Water Resources. 1982. Trinity-San Jacinto Estuary: An Analysis of Bay Segment Boundaries, Physical Characteristics, and Nutrient Processes. LP-86. Austin: Texas Department of Water Resources. 77 pp.

U.S. Department of Commerce. 1988. *Galveston Bay: Issues, Resources, Status, and Management.* Proceedings of a NOAA Estuary-of-the-Month Seminar held March 14, 1988, Washington, D.C., 114 pp.

Wang, K.-H. 1994. Characterization of Circulation and Salinity Change in Galveston Bay. *Journal of Engineering Mechanics 120(3):* 557-579.

Ward, G. H. 1993. Galveston Bay Hydrography and Transport Model Validation. Technical Memorandum 93-1. Austin: Center for Research in Water Resources, Bureau of Engineering Research, College of Engineering, The University of Texas at Austin. 86 pp.

Weather and Online Information

NOAA National Weather Service Internet Weather Source
http://weather.noaa.gov/
A summary of current conditions, weather forecasts, and wind data from local airports over the previous 24 hours.

The Weather Underground, Inc.
http://www.wunderground.com/US/TX/Galveston.html
Weather conditions and forecasts for Galveston, TX.

Marineweather.com
http://www.marineweather.com/
Marine forecast for Galveston Bay.

General Information

Hydrodynamic & Oil Spill Modeling: Galveston Bay
http://hyper20.twdb.state.tx.us/anigalveston.html
An animated computer model of currents in Galveston Bay provided by the Texas Water Development Board and the Texas General Land Office.

Galveston Bay Bibliography (the Bay Bib)
http://bayinfo.tamug.tamu.edu/gbb.htm
A bibliography of more than 6000 Galveston Bay references, including published and unpublished reports, books, videos, photographs, charts and maps, computer files, journal articles, press releases, manuscripts, etc. The Bay Bib is a component of Galveston Bay Information Network at Texas A&M University at Galveston.

The State of the Bay: A Characterization of the Galveston Bay Ecosystem
http://chico.rice.edu/armadillo/Galveston/
A comprehensive overview of Galveston Bay, published with permission of the Galveston Bay National Estuary Program.

The Galveston Bay Estuary Program
http://gbep.tamug.tamu.edu/gbepix.html
A program of the Texas Natural Resource Conservation Commission, the Galveston Bay Estuary Program is a continuation of the National Estuary

Program (NEP) established for Galveston Bay in 1989. This site describes the program, its projects and activities, the state of the bay, etc.

Dredge-and-Fill Activities in Galveston Bay
http://www.ce.utexas.edu/centers/crwr/watermarks/summer94/articlefive.html
A brief *Watermarks* article about man's effects on Galveston Bay basin morphology. *Watermarks* is a newsletter of the Center for Research in Water Resources (CRWR) at The University of Texas at Austin.

Galveston Bay Characterization
http://twri.tamu.edu/twripubs/WtrResrc/v21n4/text-6.html
An article from the Texas Water Resources Institute newsletter, *Texas Water Resources*. Discusses water inflow and pollution issues in Galveston Bay.

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.

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