The Houston-Galveston ship channel is the second largest port by tonnage in the U.S. and is used by over 350 vessels daily. These vessels are piloted along the channel by ship pilots who rely on available atmospheric and oceanic information. Hydrodynamic predictions from the National Oceanographic and Atmospheric Administration’s (NOAA) PORTS models are available online in the NetCDF format. Although this file format is familiar to coastal researchers, few methods exist to bring these predictions to a broader base of users, and none that leverage the capabilities of mobile platforms, such as georeferencing. This project’s goal is to use mobile technologies to make these predictions easily accessible to the Houston-Galveston ship pilots.

The project’s architecture is based on a combination of existing and emerging technologies: it is a cross-platform mobile navigation application for the Houston-Galveston ship channel. The application combines hydrodynamic predictions and user input to provide predictions of transit time as well as current and water level predictions at the time of the vessel passage.

The application is packaged as a web page, allowing it to be platform independent. This makes it accessible through any web browser with WebKit based browsers being the most compatible. To visualize the channel, the path was selected in ArcGIS and exported with directions and distances between each point using a Python script. This data is combined with the filtered model output on the server and sent to the user’s device. The device then runs the ship model and calculates the predictions required to visualize the results which are drawn as markers on Google Maps using the canvas element, a part of the upcoming HTML5 web standard. These components are wrapped in a Sencha Touch interface, giving a native look and feel. Through HTML5, the application is also able to access the geolocation capabilities of the device to accordingly update the ship’s position on the map.

The app is developed to provide hydrodynamic predictions in a simple and intuitive format for pilots and boaters navigating the Houston-Galveston ship channel. The application combines hydrodynamic predictions and user input to provide prediction of transit time as well as current and water level predictions at the time of the vessel passage.

At the core of the application is the ship transit model, which combines hydrodynamic model output and user input to predict a ship transit time between selected locations (presently only for the length of the Houston-Galveston ship channel). Specifically the algorithm combines ship velocities and current forecasts at the predicted time of ship passage with the distance between grid points along the ship channel. In the present version of the application, the ship’s velocity is provided by the pilot or captain, the fluid velocities at each point are provided by the hydrodynamic model, and the distances are precalculated. The information is combined as follows to compute transit time:

\[\Delta t = \sum_{i=0}^{n-1} \frac{\Delta s_i}{v_{\text{ship}} + v_{\text{fluid}}(t)}\]

For each segment the distance between grid points is divided by the ship’s velocity relative to land to obtain each incremental travel time. The ship’s velocity relative to land is calculated by adding the ship’s velocity to the effect of the predicted current along the ship’s direction.

To find the predicted fluid velocity between two points, the endpoint velocities are averaged and the current is assumed to be constant between the two locations.

**References**

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NOAA Environmental Cooperative Science Center, Grant #: NA06OAR4810164  
James Davis, Information Technology Research Manager, Conrad Blucher Institute  
Sergei Reid, Research Assistant, Conrad Blucher Institute

**Acknowledgments**

NOAA's hydrodynamic model results are available to the public via an OPeNDAP server. Two types of output files are available: one for novcasts and one for forecasts. The novcast files contain hourly predictions for up to five hours and are updated hourly. For this project NetCDF files are downloaded from the OPeNDAP server hourly for the 72 MB novcast files and every six hours for the 92 MB forecast files. Once the data is downloaded, the data is processed and filtered on a TAMUCC server and formatted to be sent to the user’s devices. To minimize latency, only the relevant arrays of filtered and processed model output are sent and all calculations pertaining to visualization and the ship transit are performed on the mobile devices.