

A regional ocean forecast-hindcast system for the Texas-Louisiana shelf contributing to rapid oil spill responses and oceanographic research

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Objectives

A regional ocean forecast-hindcast system has been developed. The primary objectives of the system are to provide:

- robust ocean current prediction for rapid oil spill responses
- long-term spatio-temporal data (24 years) to conduct oceanographic research.

Introduction

Numerical ocean models are a useful tool to replicate ocean states on a computer. Although more and more observation data become available, their spatial and temporal coverage has still been limited. Ocean models provide spatio-temporal data which can be used to supplement lack of the coverage. Here we present how a numerical model can help contribute to a real-world problem and oceanographic research.

Numerical Model

- Based on Regional Ocean Modeling System
- 600m-3700m spatial resolution (671 x 191 grids)
- 30 vertical layers
- Realistic forcing to replicate key oceanographic processes
- Optimized for MPI on HPC clusters

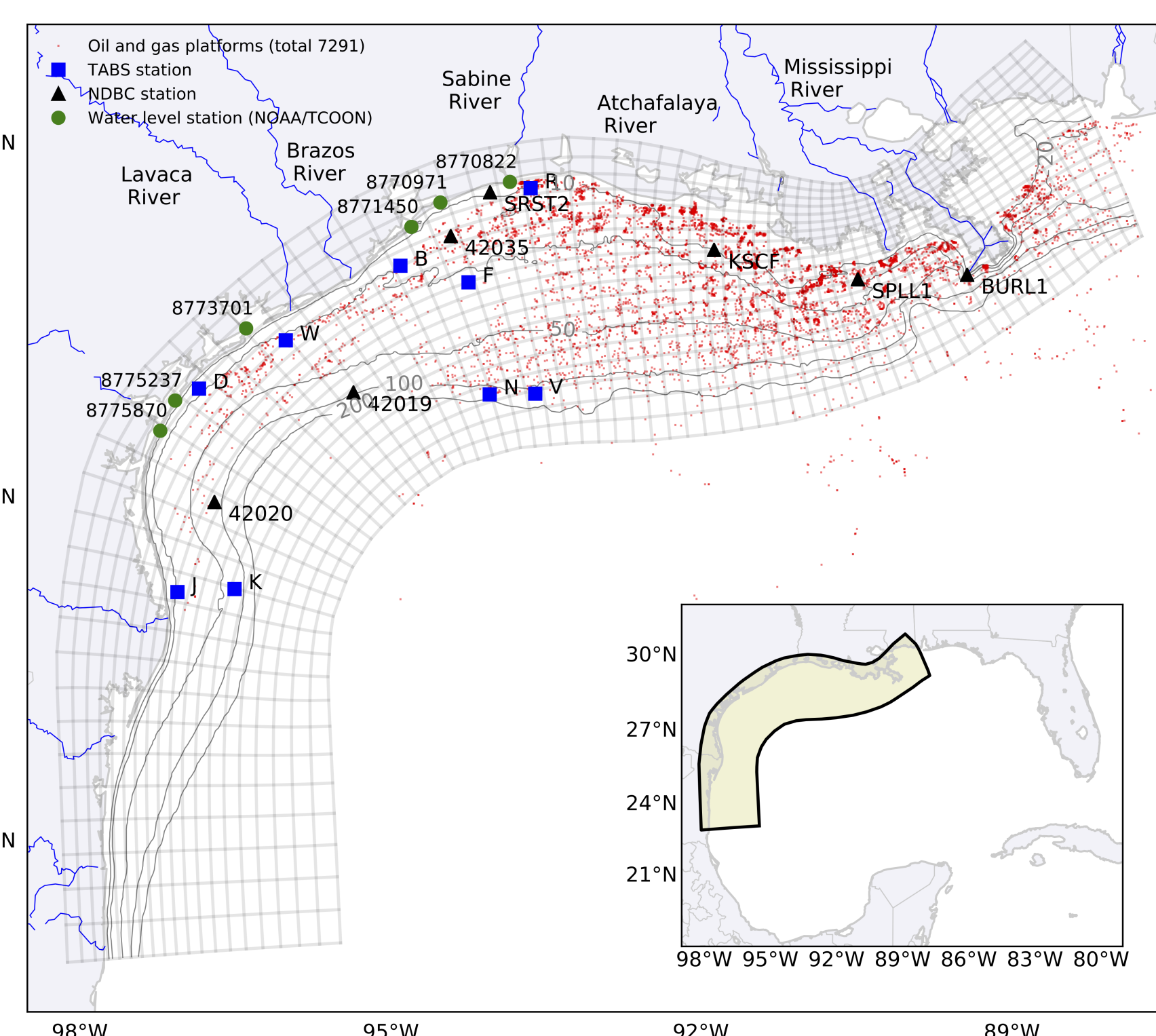


Figure 1: Model domain (Texas-Louisiana shelf)

Regional Ocean Forecast System

- Two regions: the Gulf of Mexico (GoM) and Texas-Louisiana shelf (TXLA)
- A series of Python and Shell scripts optimized for multiple processors
- Implemented on HPC clusters: Ada (primary), Terra (backup), and an in-house WS (Copano)
- Daily nowcast (1 day) and forecast (7 days for TXLA and 3 days for GoM)

Table 1: A list of ocean forecasts currently being implemented

Region	Ensemble	Clusters	CPUs	Wall time
Texas-Louisiana	No	Ada/Terra	120	0.1-0.4hr (nowcast), 0.5-2 hr (forecast)
Texas-Louisiana	Yes (11)	Ada	120	0.5-2 hr (forecast) for each ensemble
Gulf of Mexico	No	Copano	1	<1 hr (nowcast/forecast)

Data Distribution

All forecast data are publicly available through:

THREDDS server:

<http://barataria.tamu.edu:8080/thredds/catalog.html>

Interactive website:

<http://pong.tamu.edu/tabswebsite/>

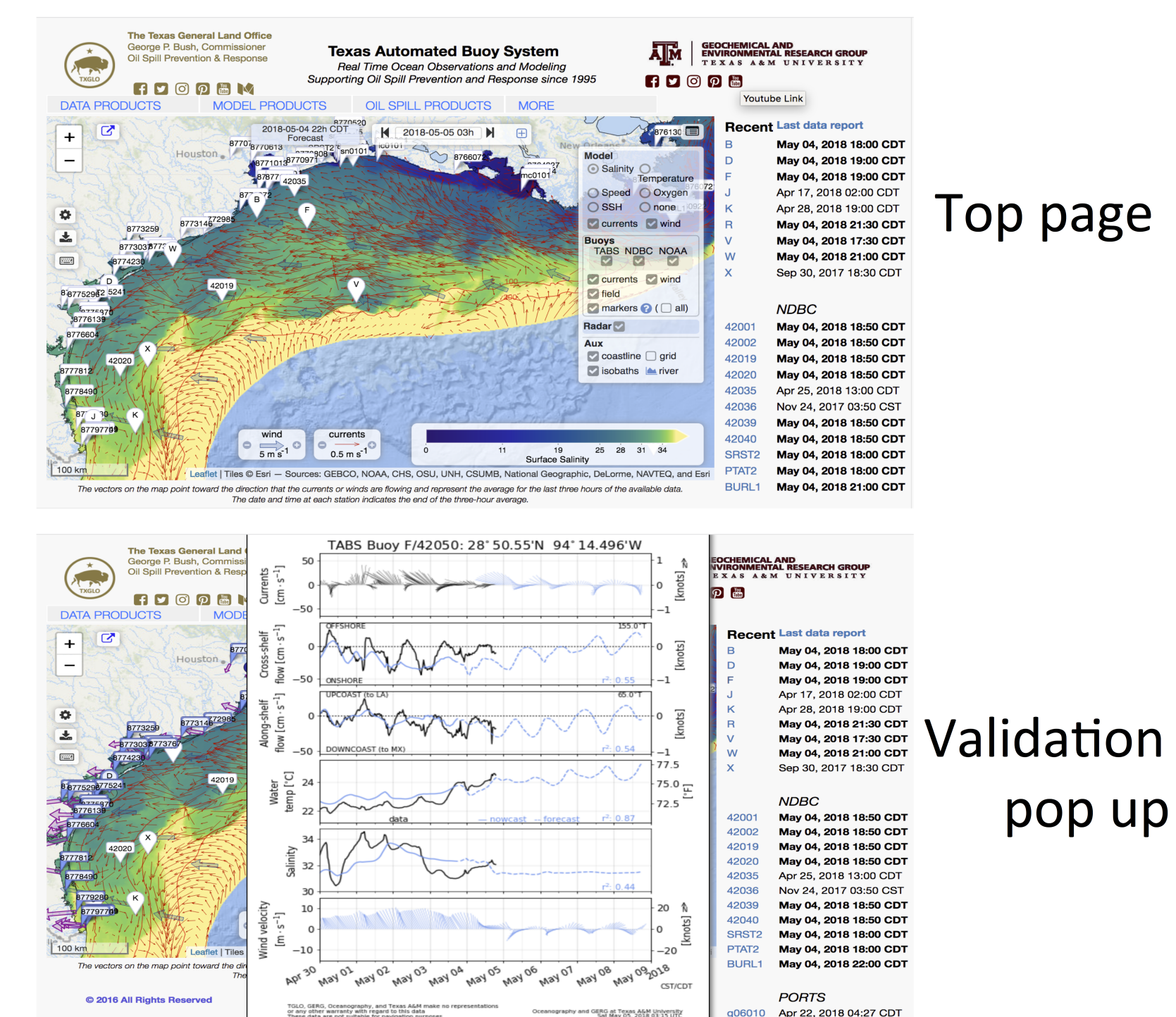


Figure 2: TABS-TGLO website (prototype)

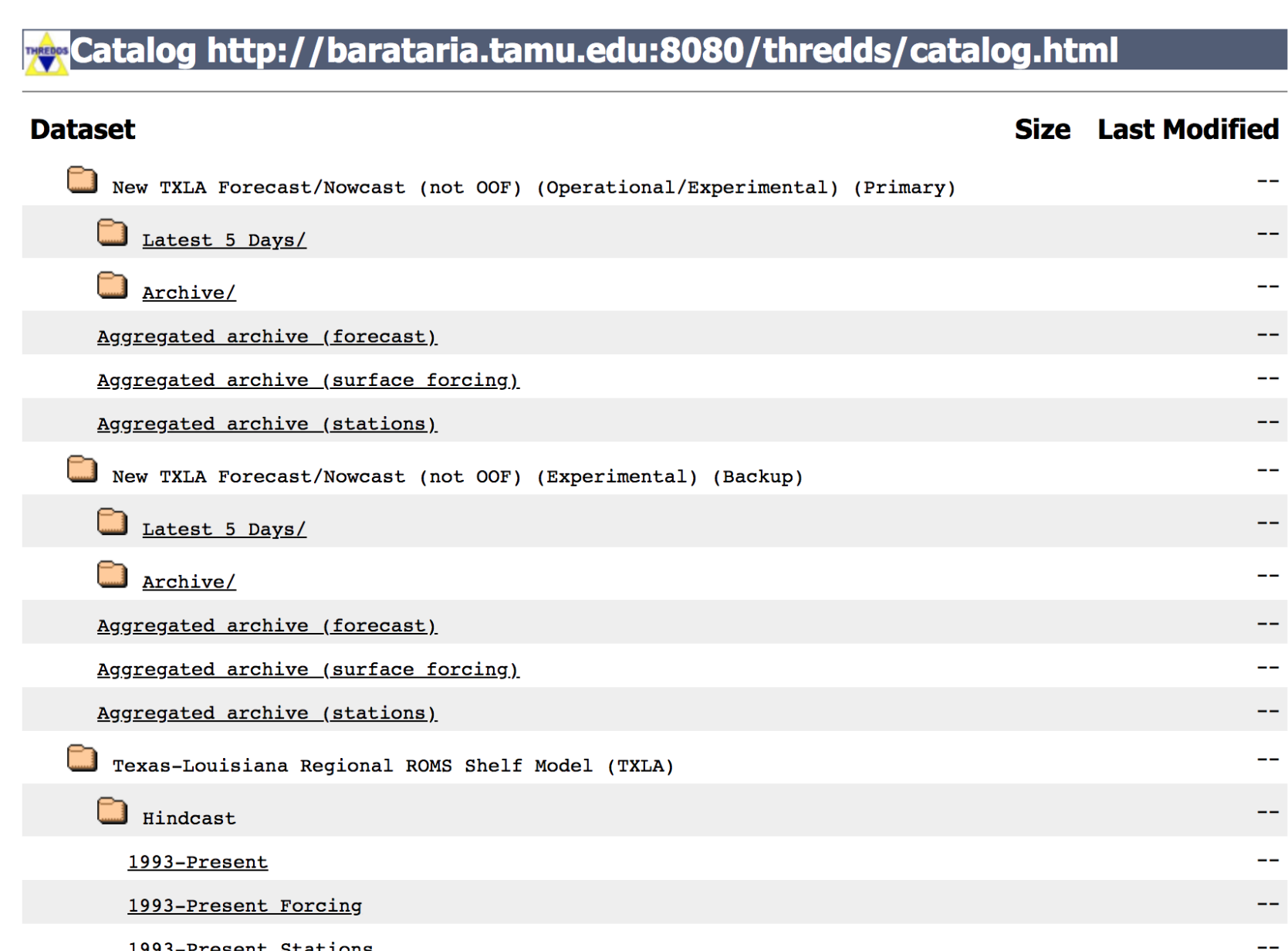


Figure 3: THREDDS server

Oil Spill Tracking

The oil spill model is based on GNOME (General NOAA Operational Modeling Environment). We provide gridded current and wind forecasts in format compatible to GNOME. A hypothetical oil spill scenario is presented (Fig.5)

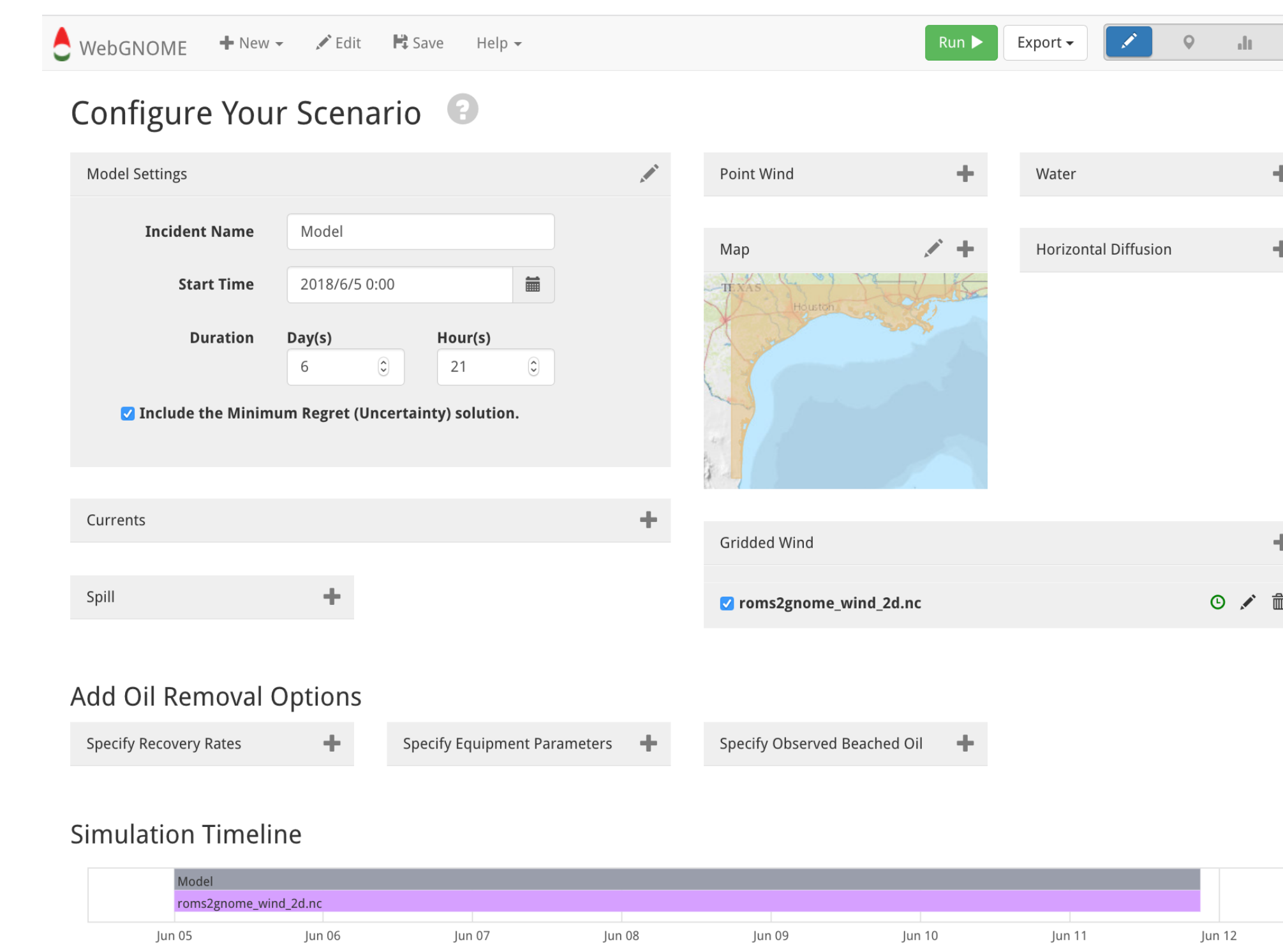


Figure 4: WebGNOME (<https://gnome.orr.noaa.gov/>)

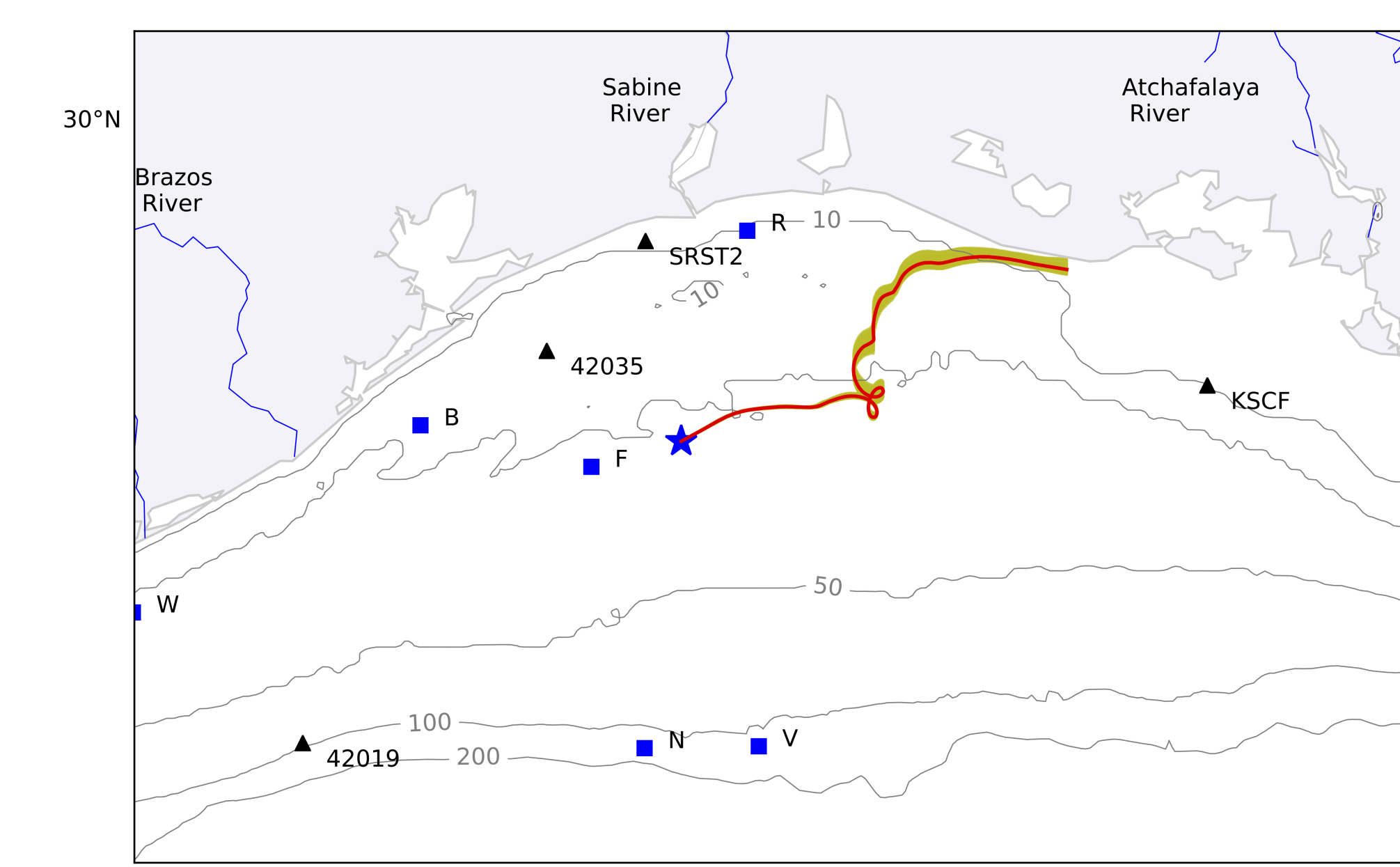


Figure 5: A hypothetical oil spill projection (7 days)

Research Examples

The hindcast model outputs have been used to study:

- Bio-physical interactions: Hypoxia [1] and Harmful Algae Bloom (HAB) [2]
- Freshwater transport and budget [3]
- Buoyancy-driven currents [4]
- Sediment transport [5]

to name a few

Remarks

Our numerical ocean model predicts ocean currents for upcoming days. The forecast data are used to run an oil spill model by the state government agency and thus, have been an integral part of the state rapid oil spill response efforts. Moreover, the ocean model provides long-term spatio-temporal data, which have been used to improve our understanding of the ocean.

Acknowledgements

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