



# Assessment of the Western Gulf of Mexico Harmful Algal Bloom Operational Forecast System: Analysis of Forecasts & Utilization over the First Two Operational Years, 2010-2012



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## INTRODUCTION

Blooms of the toxic dinoflagellate, *Karenia brevis*, occur nearly every year in coastal regions of the Gulf of Mexico (GOMX) causing impacts on public health, ecosystems, and regional economies. Following the successful transition of the eastern GOMX forecast system for harmful algal blooms (HABs) from research to operations along the Gulf coast of Florida in 2004, NOAA expanded its GOMX HAB Operational Forecast System (HAB-OFS) to include the coast of Texas (western Gulf of Mexico) in 2010. NOAA's GOMX HAB-OFS issues weekly bulletins that serve as decision support tools for coastal resource managers, federal and state agencies, and academic institutions. The Texas bulletins include three forecast components: bloom transport direction, transport distance and the daily potential for respiratory irritation along the coast. In order to continually improve the HAB-OFS, forecast skill and bulletin utilization are evaluated regularly. This analysis details the assessment of bulletin utilization and forecast skill for the first two years of operational status along the Texas coastline, encompassing 106 total bulletins issued for the western GOMX from October 2010 through April 2012. While there was no bloom along the Texas coastline during the first year of operations, 44 bulletins were issued during the 2011 Texas red tide, one of the longest lasting and largest blooms on record in Texas, covering the coastline and inshore bays and waterways from South Padre Island to the Galveston region. Results highlighted special challenges in the assessment of each forecast component and will be applied to improve HAB forecasting, product operations, and assessment for the western GOMX HAB-OFS.

## METHODS

### Bulletin Forecasts

- Bulletin forecasts consisted of three components: **Transport Direction**, **Transport Distance**, and **Respiratory Impacts** produced by the bloom. See [Table 1](#).

### Assessment

- Forecasts were evaluated for accuracy and usability each week based on the following post-bulletin data:
  - Bulletin Utilization:** Media or public health reports, sampling response, written/ telephone responses or inquiries, etc.
  - Transport Direction and Distance:** Satellite imagery and/or *in situ* sample data, Texas General Land Office/Texas Automated Buoy System ROMS Current Model data and GNOME particle trajectory model results.
  - Respiratory Impacts:** Observational data recorded and disseminated by state agencies, research institutions, and volunteer programs.
- Assessment data was then grouped by bloom year (BY), e.g. May 1, YYYY to April 30, YYYY.

### Statistical Analysis<sup>1,2</sup>

- Assessability:** % of bulletin forecast components and utilization with sufficiently available evidence for evaluation.
- Forecast Accuracy:** % of correct forecasts out of the total # of assessable forecasts.
- Relative Forecast Accuracy- Heidke Skill Score:** Proportion of correct forecasts relative to the # of correct forecasts that could be made by random chance.
- Bulletin Utilization:** % of bulletins confirmed utilized.

Table 1. Texas bulletin forecast component definitions.

FORECAST COMPONENT	DEFINITION	CATEGORIES	FORECAST BASIS
Transport Direction	Direction bloom is likely to migrate	<ul style="list-style-type: none"> <li>North</li> <li>South</li> <li>No Change</li> </ul>	<ul style="list-style-type: none"> <li>Local ocean currents, TGLO/TABS ROMS Current Model</li> </ul>
Transport Distance	Distance bloom is likely to migrate	<ul style="list-style-type: none"> <li>Rounded to nearest 10km</li> </ul>	<ul style="list-style-type: none"> <li>GNOME particle trajectory model</li> </ul>
Impacts	Potential respiratory irritation caused by the bloom (forecast by region)	<ul style="list-style-type: none"> <li>Very low</li> <li>Low</li> <li>Moderate</li> <li>High</li> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>Forecasted wind strength and direction</li> <li><i>K. brevis</i> concentration</li> <li>Bloom proximity</li> </ul>

## Acknowledgements

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## RESULTS

### RELATIVE FORECAST ACCURACY (FORECAST SKILL)

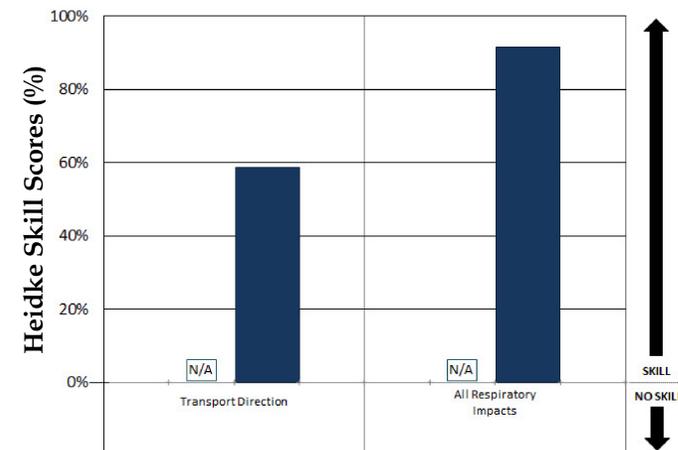


Figure 1. Heidke Skill Scores (of assessable) for transport & impact forecasts.

### FORECAST ACCURACY (% CORRECT)

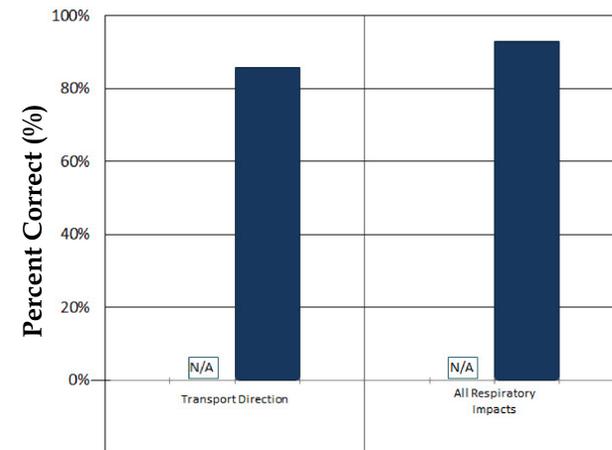


Figure 2. Percent correct (of assessable) for transport & impact forecasts.

### NUMBER OF ASSESSABLE FORECASTS



Figure 3. Number of assessable vs. unassessable forecasts.

## BULLETIN UTILIZATION

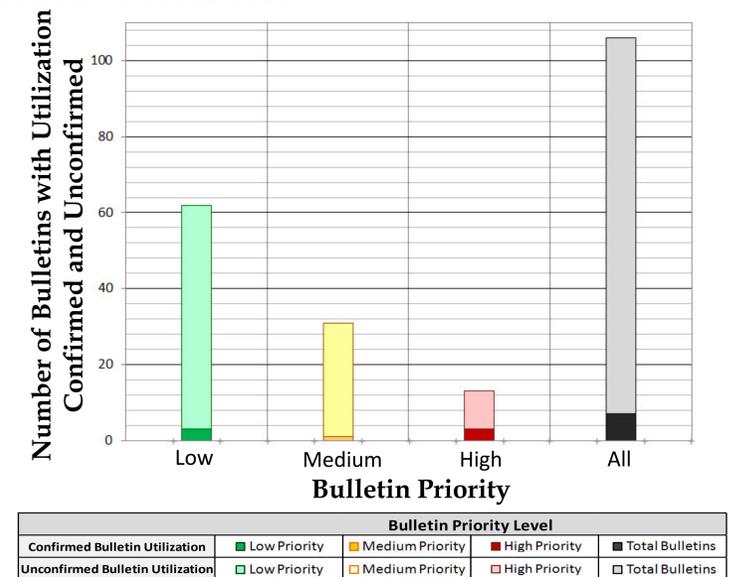


Figure 4. Number of confirmed vs. unconfirmed bulletins, by priority level (low, medium, high, all), for BY10-12.

## CONCLUSIONS

**Bulletin components are forecasted with high accuracy and skill.**

- Respiratory impact forecasts had the **highest accuracy and skill** (>90%).
- Transport forecasts also had a **high amount of skill** (>50%), but are the most difficult forecasts to assess. This will be addressed in the future.

**More information is often needed to assess bulletin forecasts.**

**Transport forecasts are the most difficult to confirm.**

- <15% of all transport forecasts were assessable. Resuspended chlorophyll visible in the ocean color imagery along the Texas coastline makes it difficult to assess transport forecasts, which can be verified only using satellite imagery. While algorithms are already in place to remove much of the resuspension visible in western GOMX imagery, refinement of algorithms to remove more resuspension is necessary to better track feature and bloom initiation and transport.<sup>3</sup> Cloudy imagery during the bloom timeframe also limited analysis and assessment.
- <10% of all respiratory impact forecasts were assessable. Working with partners to address more systematic reporting of respiratory impacts and the use of social media for on-the-ground impact reports will help to confirm forecasts.

**New methods to confirm bulletin utilization should be explored.**

- <10% of all bulletins were confirmed utilized.
- Procedures to verify bulletin utilization via social media outlets should be explored. This, along with partner feedback, will help increase bulletin utilization confirmation.

**Comparison of FL and TX forecasts over all operational active bloom years from BY04-12 reveals, on average:**

- There were less assessable forecasts of all types in TX than FL.
- Transport forecast accuracy (% correct, of assessable) was similar (~85%) for TX and FL.
- Impact forecast accuracy and skill was greater in TX than the average scores for FL; however, TX had only one bloom during the assessment period and fewer assessable impact forecasts than FL on average.

## References

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