



Assessment of the Gulf of Mexico Harmful Algal Bloom Operational Forecast System: An Analysis of Transport and Respiratory Irritation, 2010-2015



Analise Keeney¹, Karen Kavanaugh¹, Ed Davis¹, Katherine Derner²

¹ NOAA, National Ocean Service, Center for Operational Oceanographic Products and Services (CO-OPS), Silver Spring, MD 20910, USA; ² NOAA, National Ocean Service, CO-OPS, 672 Independence Parkway, Chesapeake, VA 23320, USA

Introduction

Since 2004, NOAA has maintained the Gulf of Mexico Harmful Algal Bloom Operational Forecast System (HAB-OFS) to issue weekly bulletins that aid in early identification of *Karenia brevis* and assist in response efforts. Forecast quality and bulletin utilization are evaluated regularly based on user feedback and observations. The HAB-OFS has issued 200+ bulletins for Florida since 2012, and Texas since 2010 with greater than 90% product utilization. Forecasts of transport direction and respiratory irritation are issued for both Florida and Texas, with the latter being the highest performing. "High" level forecasts issued for Florida and Texas performed well with greater than 60% and 90% improvement over chance, respectively. The performance of "high" respiratory irritation forecasts is important for protecting human health because the general public may experience noticeable discomfort at that level. Data gaps result in areas where forecasts cannot be adequately confirmed. All results have been compared to assessments from previous operational years (2004 to 2012) and are being used as guidance to improve future forecasting protocols for the HAB-OFS program.

Objective

Comparison of the performance of the Florida and Texas HAB-OFS products issued from 2010-2015 based on their common components: bloom detection and forecasts of transport direction and respiratory irritation (See Table 1).

Table 1. Definition of bulletin forecasts presented in this comparison.

Forecast Component	Definition	Categories	Forecast Basis
Transport Direction	Direction bloom is likely to migrate	<ul style="list-style-type: none"> North South No Change 	<ul style="list-style-type: none"> Local ocean currents, TGLO/TABS ROMS Current Model GNOME particle trajectory model.
Respiratory Irritation	Potential level caused by the bloom (forecast by region)	<ul style="list-style-type: none"> Very low Low Moderate High None 	<ul style="list-style-type: none"> Forecasted wind strength and direction <i>K. brevis</i> concentration Bloom Proximity

Methods

Assessments for May 1, 2010 to April 30, 2015

- Grouped by bloom year (BY), e.g. May 1, YYYY to April 30, YYYY.
- Forecasts were assessed based on the following observations:
 - Transport: Satellite imagery; *in situ* sampling; and, in Texas, the General NOAA Operational Modeling Environment (GNOME) particle trajectory tool.
 - Respiratory Irritation: Level of respiratory irritation as reported by state agencies, lifeguards, research institutions, and the public.
- When no observations were available, the forecast was assessed as "unconfirmed."

Statistical Analysis

- Assessability - % of forecasts with sufficient evidence to be adequately evaluated.
- Relative Forecast Accuracy - *Heidke Skill Score* - Proportion of correct forecasts relative to the # of correct forecasts which could be made by random chance.

Conclusions

Blooms typically affected Florida for a longer duration than Texas, and therefore, more Florida bulletins were issued.

- Florida: 343 bulletins issued.
 - The most occurring in BY 2012-2013.
 - The least in BY 2014-2015.
- Texas: 274 bulletins issued.
 - The most occurring in BY 2011-2012.
 - The least in BY 2014-2015.

Improvements to bloom detection are needed for both Florida and Texas.

- Water samples remain vital for ground-truthing remote sensing data.
- Florida: Bloom detection capabilities were strong from 2004-2009, but loss of SeaWiFS imagery led to a decline.
- Texas: Limited routine sampling (see Figure 1), especially along the coast, made validating satellite imagery difficult. Resuspension along the Texas coast presents an additional challenge.
- Next steps:
 - Ensemble satellite imagery transitioned to operations in Florida bulletins on 9/8/15, refining *K. brevis* bloom detection. Similar revisions to the Texas imagery will be evaluated.
 - Satellite imagery may further improve with the introduction of Visible Infrared Imaging Radiometer Suite (VIIRS).

More information is often needed to assess forecasts, especially in Texas.

- Data gaps exist in both Florida and Texas, especially during smaller, patchy blooms which may cause fewer impacts.
- Texas: Observational data was only available for the severe bloom during BY2011-2012.

Forecast skill was high for most forecasts issued for Florida and Texas; performance increased with bloom severity.

Transport Direction

- Limited samples and satellite imagery made assessment of transport direction difficult, especially in Texas.
- When forecasts were assessable, performance was at least 40% greater than chance in both Florida and Texas
- Next steps: Investigate the use of the CO-OPS Northern GOMX Operational Forecast System model to enable higher resolution predictions of bloom movement and provide forecasts for Galveston Bay.

Respiratory Irritation

- "Moderate" to "high" levels of respiratory irritation forecasts had the highest accuracy, reliability, and skill.
- Florida: Forecast performance was variable, but better in the most severe bloom years (BY2011-2013).
- Next steps: Evaluate and integrate methods to cost-effectively measure the concentration of *brevetoxin*.

Confirmed product utilization increased for both Florida and Texas, especially from BY2012-2015 due to social media.

- Florida: Confirmed product utilization increased from a range of 66.3-83.9% during BY2008-2012 to greater than 93.8% in BY2012-2014 and 100% in BY2014-2015.
- Texas: Utilization was most likely under reported, but increased from 3% in BY2010-2011 to 92.7% in BY2014-2015.
- A portion of the increases seen in both regions were due to the HAB-OFS Facebook Page launched in fall 2012.

References

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MAP OF THE DENSITY OF KARENIA BREVIS SAMPLES COLLECTED IN GULF OF MEXICO, 2010-2015

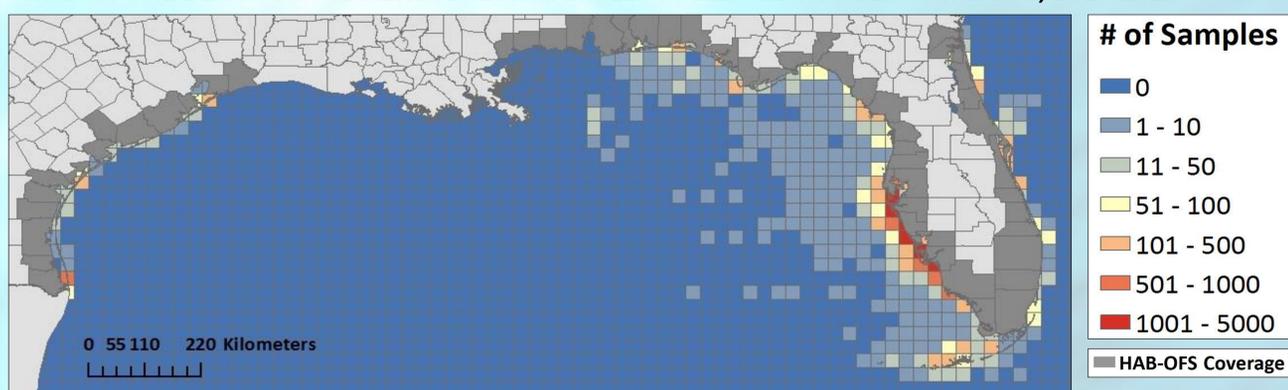


Figure 1. Water samples collected by state partners to monitor concentrations of *Karenia brevis* in the Gulf Of Mexico are the foundation for HAB-OFS forecasts and assessment. The maximum number of samples was 3,845 collected alongshore southwest Florida.

NUMBER OF ASSESSABLE FORECASTS, 2010-2015

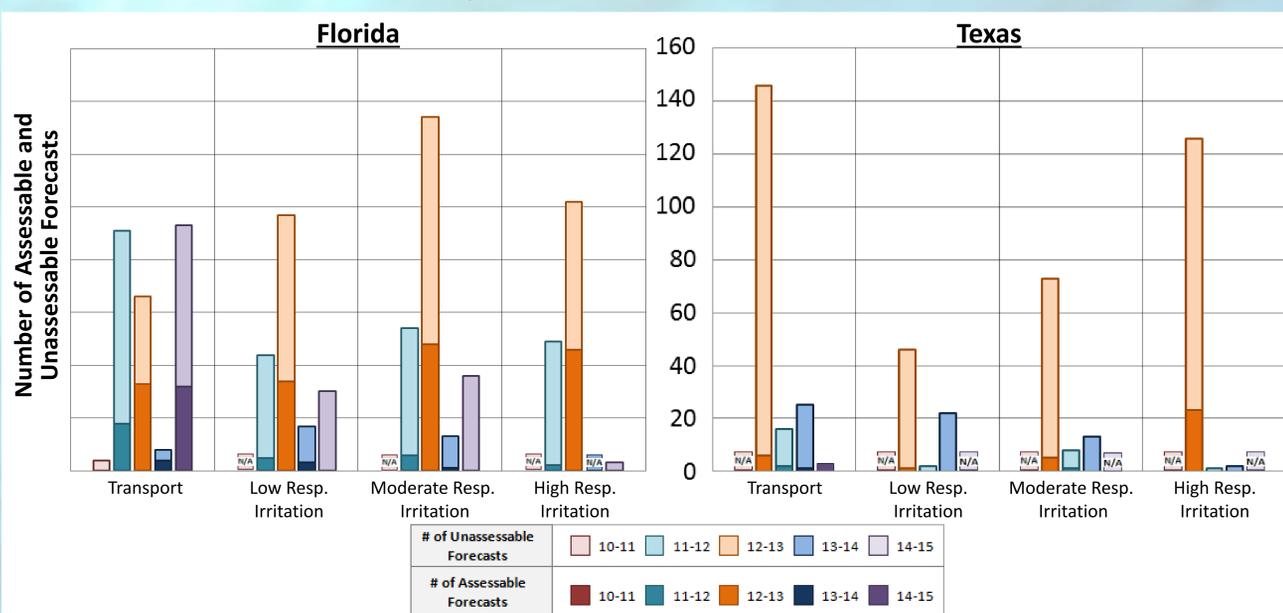


Figure 2. Graphs comparing the number of assessable vs. unassessable transport direction and respiratory irritation forecasts made in Florida (left) and Texas (right).

RELATIVE FORECAST ACCURACY (HEIDKE SKILL SCORES), 2010-2015

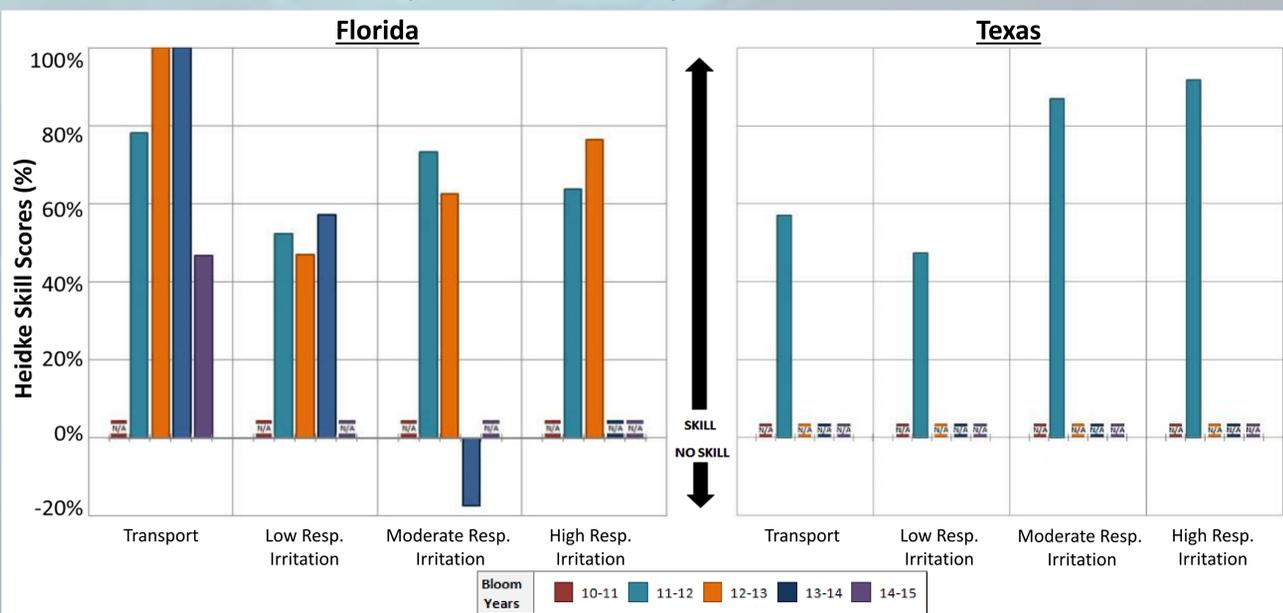


Figure 3. Heidke Skill Scores (of assessable) for transport direction and respiratory irritation forecasts made in Florida (left) and Texas (right).

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