

Origins and mechanisms of *Karenia brevis* bloom formation along the Texas Coast

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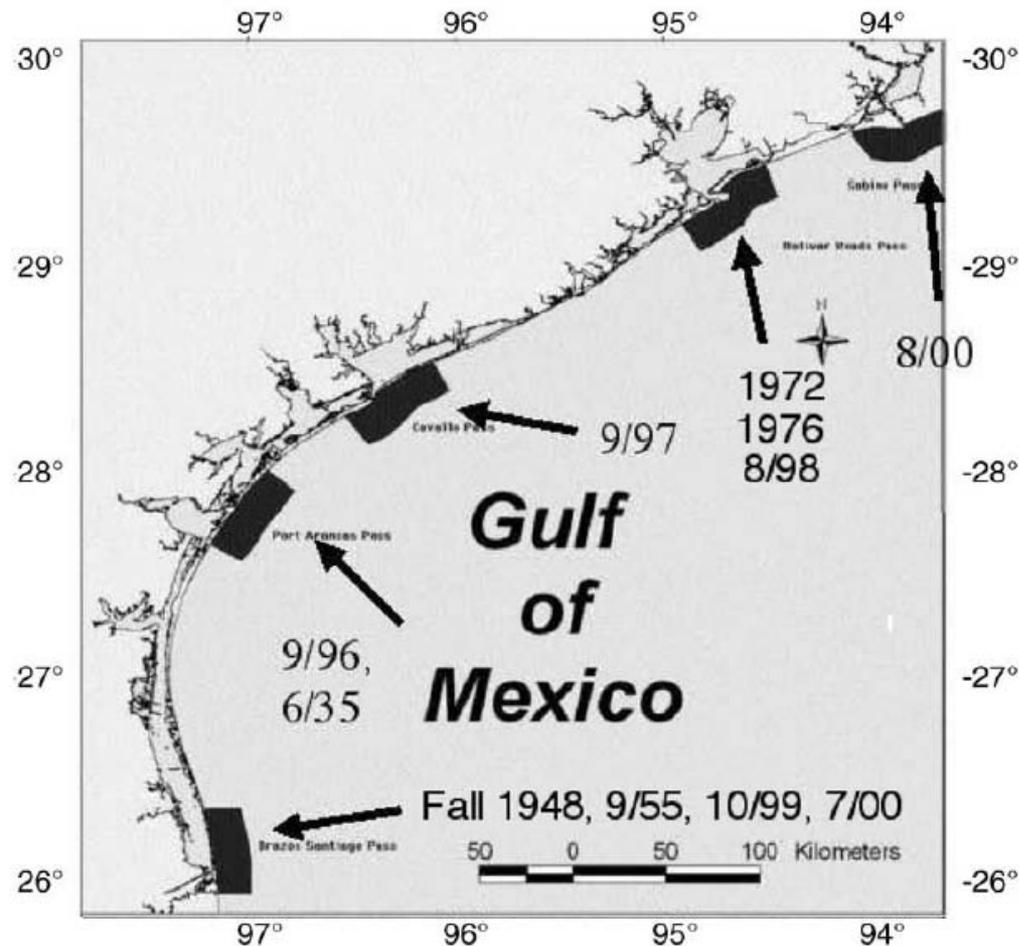
Michelle Tomlinson, Richard Stumpf, Timothy Wynne
NOAA, Center for Coastal Monitoring and Assessment

Objectives

- Determine the effects that downwelling winds play on concentrating cells along the coast
- Identify known blooms through in situ data and satellite imagery, and advect these blooms backward to determine origin.
- Develop a Downwelling Index to provide an indicator which favors bloom development
- Create a rule-based likelihood of *K. brevis* occurrence at the coast, using operational models
- Implement the rule as part of the demonstration Texas forecast system. Bulletin distributed throughout Texas coastal management community.

The problem: Unlike Florida, Texas does not have annual blooms of *Karenia*

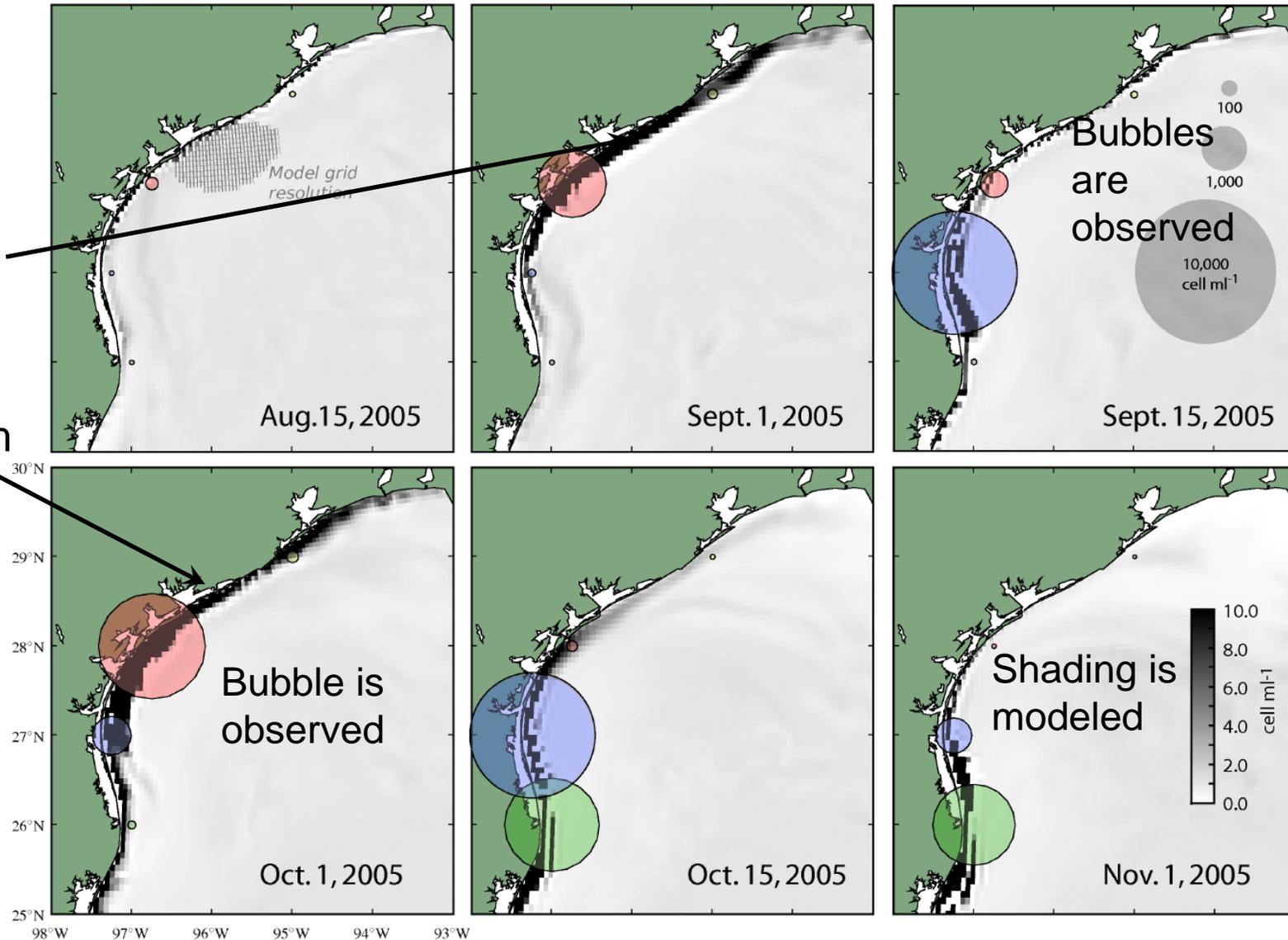
H.A. Magaña et al. / Harmful Algae 2 (2003) 163–171



Karenia “red tides” follow strong downwelling

(Hetland and Campbell, 2007)

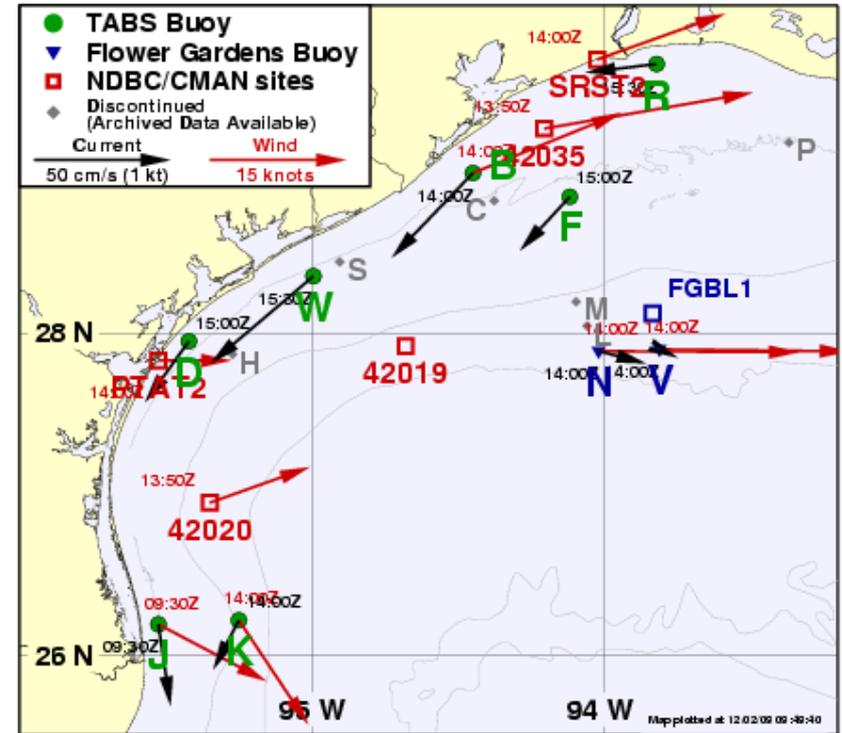
Increased concentration at the coast predicted from downwelling



Present day capabilities

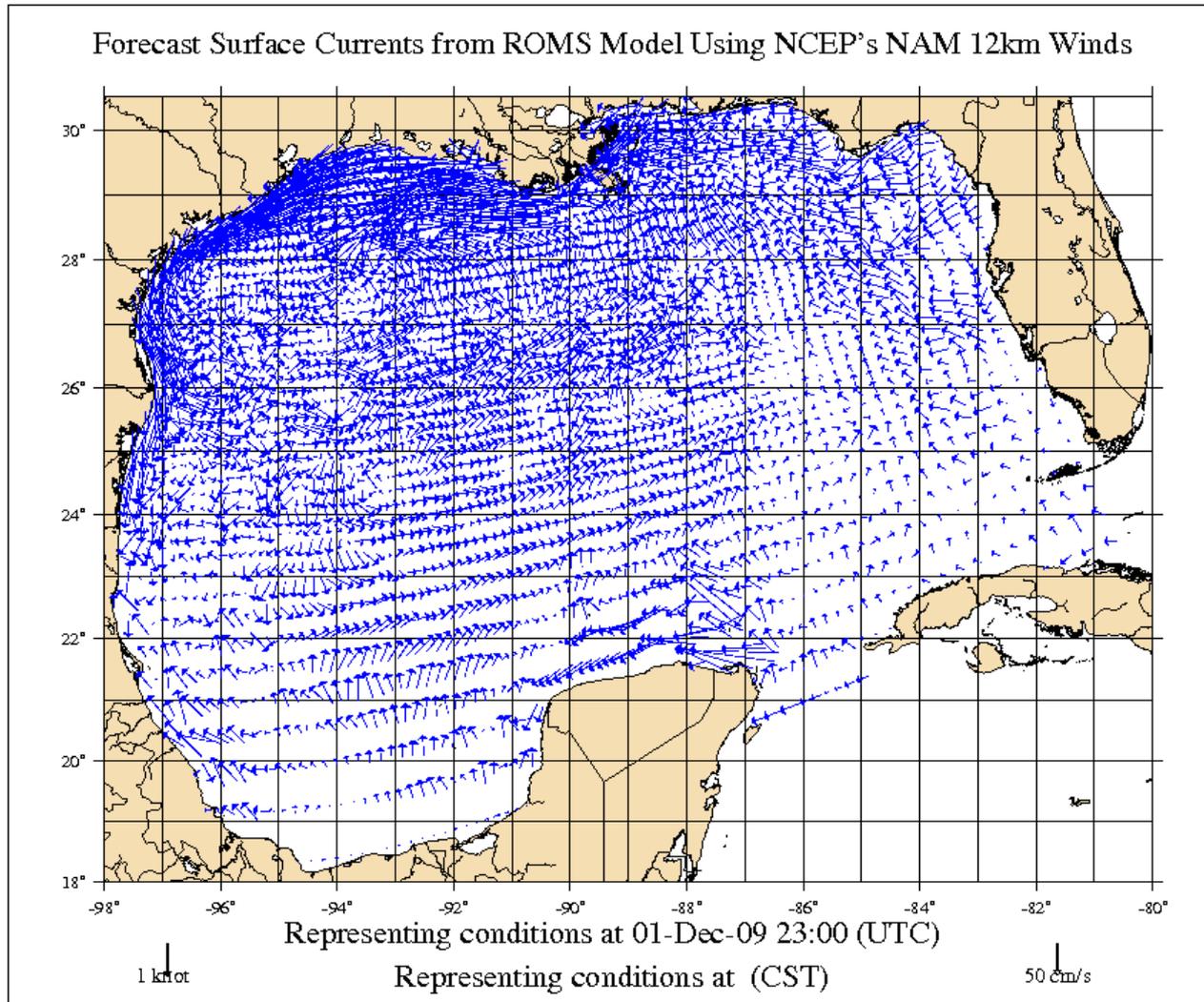
- Texas Automated Buoy System (TABs) and associated operational modeling supported by Texas General Land Office (TGLO)
- Used for oil spill trajectory prediction
- Uses forecast winds to drive currents
- LIMITATIONS: Does not include buoyancy effects from rivers and surface heating.
- Demonstration monitoring/forecast system for Texas supported by NOAA.

TABS buoys operated by TAMU for the Texas General Land Office (TGLO)

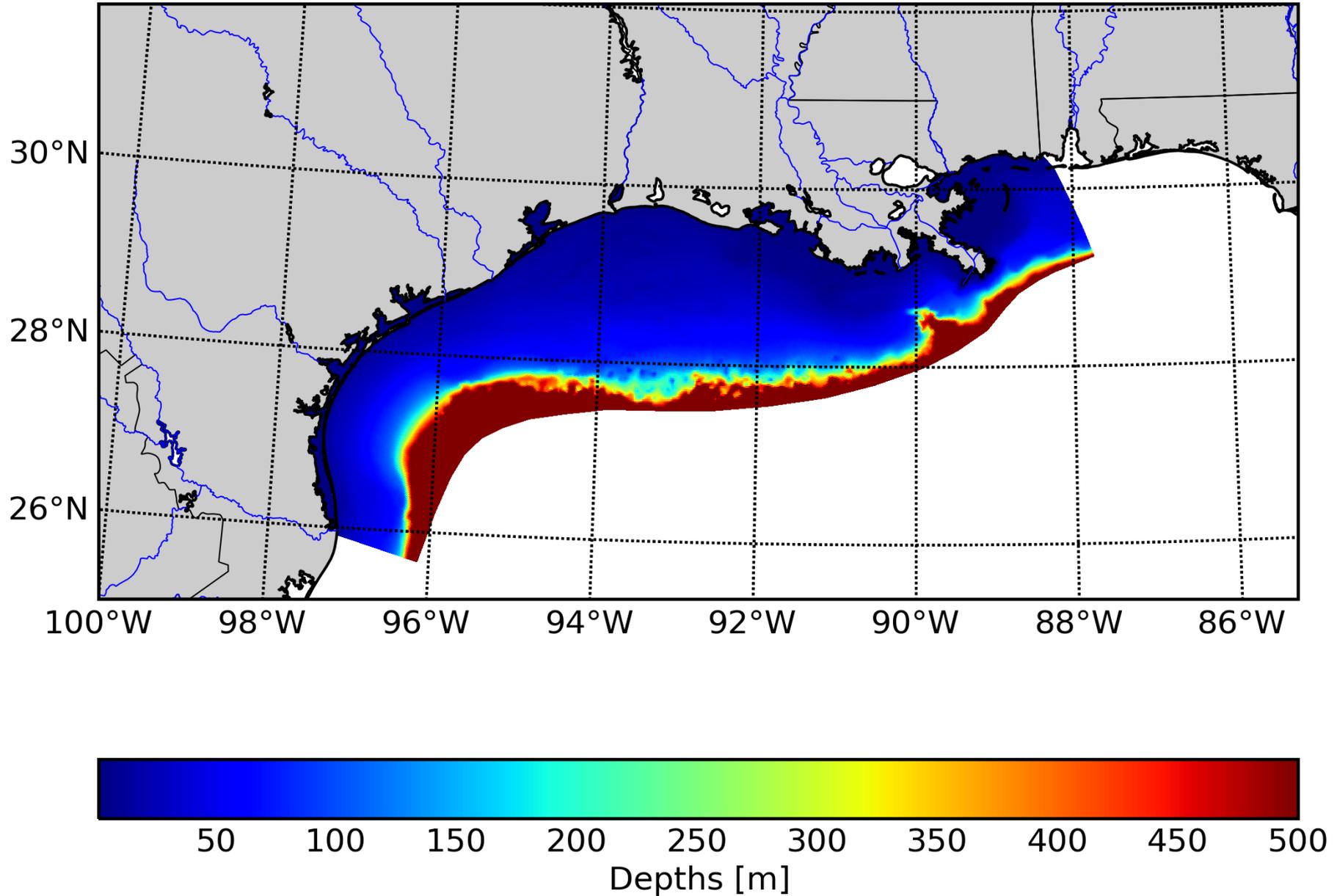


Surface current information is relayed back to shore in real time.

TABS model uses forecast winds from the National Center for Environmental Prediction (NCEP) to drive currents.



New grid domain and bathymetry



New grid characteristics

- Domain covers entire Louisiana and Texas continental shelves
- Includes all major rivers
- Approximately 1-2 km horizontal resolution
- Forced with NCEP North American Regional Reanalysis (NARR) hindcast
- Atmos. forcing includes winds, heat fluxes and fresh water fluxes.
- Will be forced with NCEP predictions for forecasts, as present day TABS model.

Demonstration Forecast for Texas since 2006



Gulf of Mexico Harmful Algal Bloom Bulletin

16 October 2006

NOAA Ocean Service

NOAA Satellites and Information Service

Last bulletin:

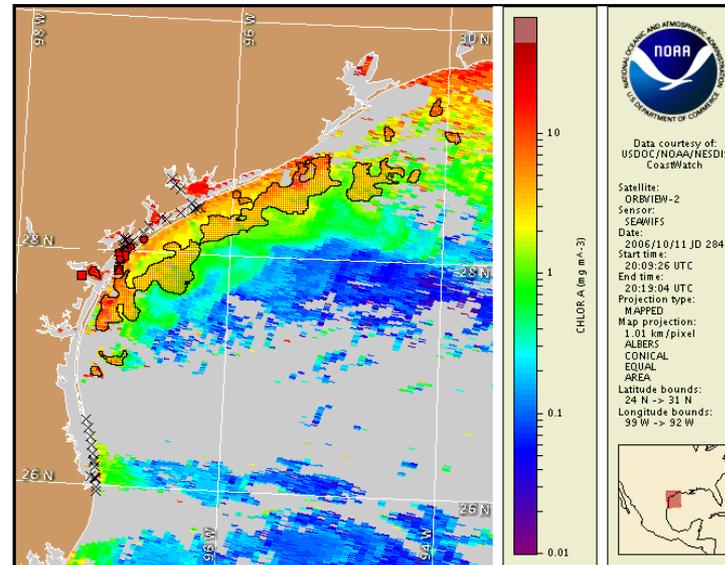
Conditions Report

As of Friday, a harmful algal bloom persisted from Nueces to Aransas County. Assuming persistence of the bloom, strong south winds may lead to patchy moderate to high impacts along coast. Dead fish have been reported on Padre Island over the weekend. Dead fish smell, while unpleasant, does not produce the same respiratory irritation as red tide.

Analysis

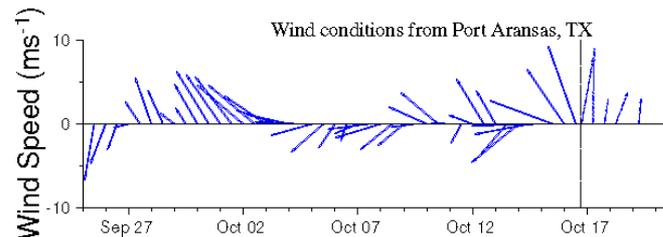
No clear satellite imagery has been available since last Wednesday. Please note that the imagery in this bulletin is from Wednesday, October 11. As of October 12, the bloom extended from Aransas to Nueces County. Southward transport of 50 km possible since Friday. Southward transport likely through Thursday. Any additional fish kills are likely to make landfall. As of Friday, red tide, (*Karenia brevis*) persisted near downtown Corpus Christi. Bloom was visible along North Beach and the Corpus Christi ship channel. The bloom also continued along the Gulf side of Padre Island and in Redfish Bay. Dead fish were observed in Pelican Cove area of Aransas Pass which were likely blown in from Hampton Channel area. Plans to sample have been hindered by bad weather along Texas coast.

Jewett, Lopez



Satellite chlorophyll image with possible HAB areas shown by red polygon(s). Cell concentration sampling data from October 6-13 shown as red squares (high), red triangles (medium), red diamonds (low b), red circles (low a), orange circles (very low b), yellow circles (very low a), green circles (present), and black "X" (not present). Cell concentration categories and corresponding cell count values from Florida Fish and Wildlife Research Institute. For a key to the cell concentration descriptions, visit the FWRI web site:

<http://research.myfwc.com>



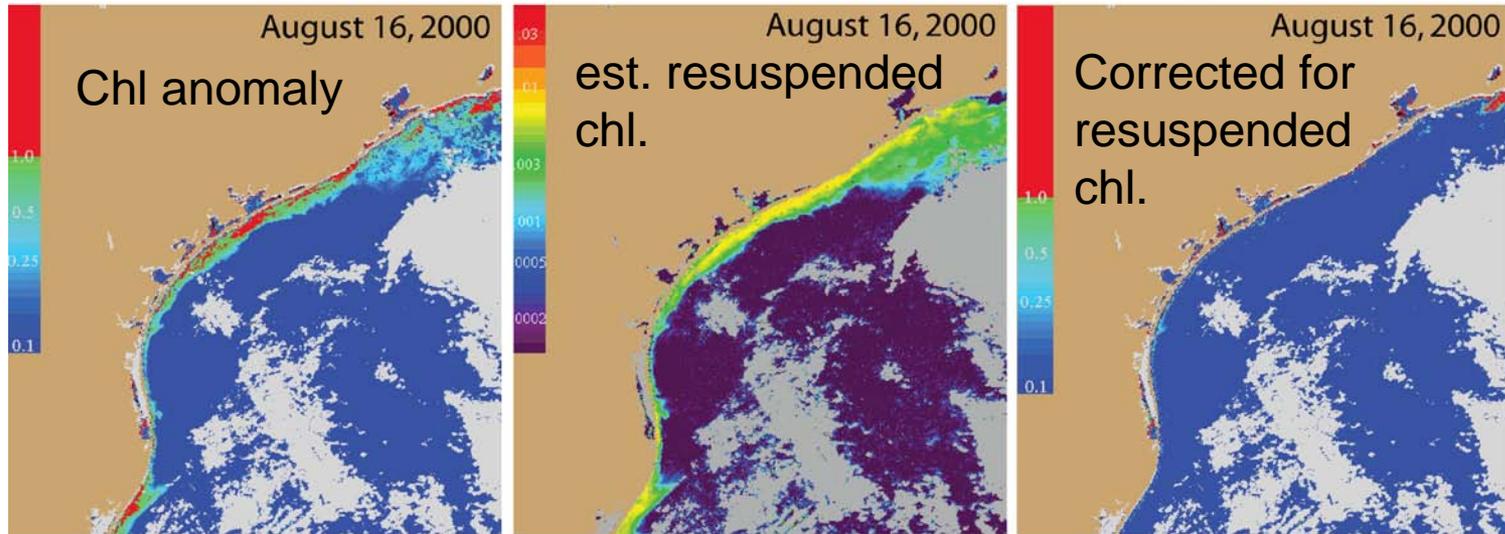
Wind speed and direction are averaged over 12 hours from buoy measurements. Length of line indicates speed; angle indicates direction. Red indicates that the wind direction favors upwelling near the coast. Values to the left of the dotted vertical line are measured values; values to the right are forecasts.

Strong winds from the south today (20 to 25 knots). Winds will diminish (10-15 knots) and shift to south-west tomorrow then to southeast on Wednesday.

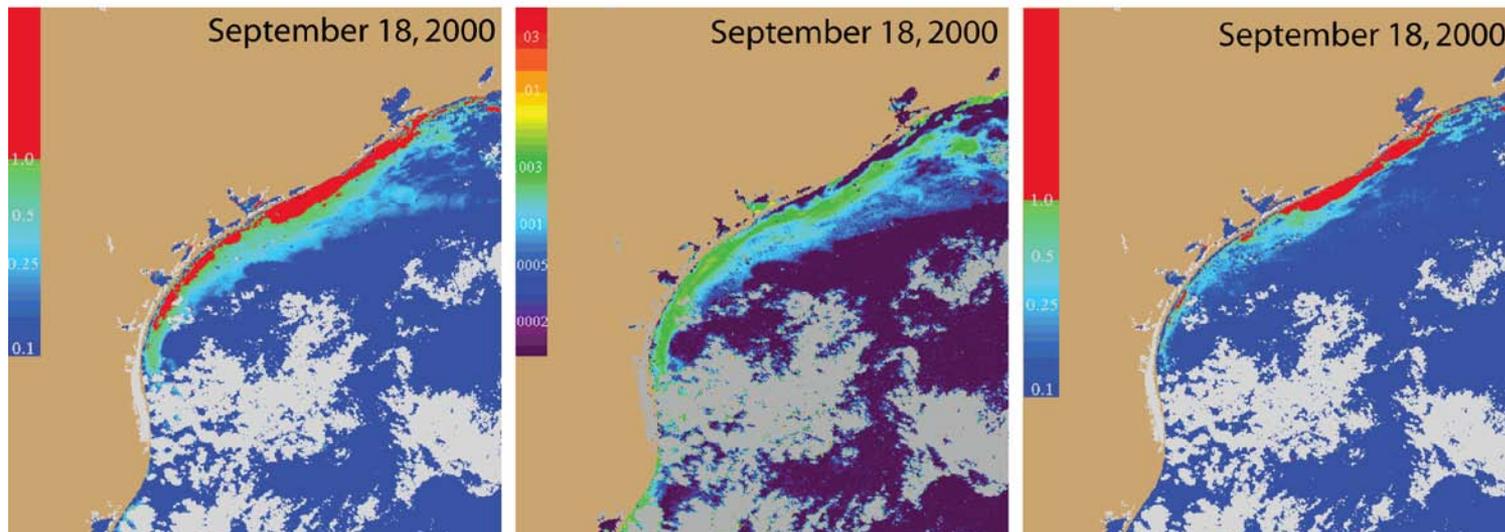
Please note the following restrictions on all SeaWiFS imagery derived from CoastWatch.

1. Data are restricted to civil marine applications only; i.e. federal, state, and local government use/distribution is permitted.
2. Image products may be published in newspapers. Any other publishing arrangements must receive GeoEye approval via the CoastWatch Program.

SeaWiFS Detection Algorithm



Wynne et al., 2007, chl anomaly corrected for resuspension;
Also application of ensemble (Tomlinson et al., 2009) when resuspension is absent



Plans

- Develop a high resolution, limited area model that contains buoyancy effects from rivers and atmospheric forcing.
- Develop tools to track tracers (i.e. Harmful Algal Blooms) both forward and backward in time.
- Identify potential sources of Harmful Algal Bloom populations (e.g., offshore vs. upcoast).
- Compare Harmful Algal Bloom trajectories with satellite observations of blooms.
- Develop a metric to predict the likelihood of harmful algal bloom occurrence based on environmental conditions (e.g., wind history).

Schedule year 1

- Run TABS model from 1990 – Present
- Collect all available satellite imagery and cell counts
- Collect ancillary data sets (temp, ppt, etc)
- Assess Skill of TABS hindcasts
- Correlate observed blooms with modeled currents and wind fields.
- Develop a rule-based model determining the likelihood of *K. brevis*.
- Year 2, evaluate and refine model

Evaluate with 2009 bloom

- First reported Sep 21, 2009
- Intensified through October

(Oct 27 photo courtesy of Texas Parks and Wildlife Dept.)

