DYNAMIC POSITIONING CONFERENCE
September 28-30, 2004
ENVIRONMENT

METOCEAN PHENOMENA IN THE GULF OF MEXICO AND THEIR IMPACT ON DP OPERATIONS

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Presentation Overview

Gulf of Mexico Meteorology
- Hurricanes, Winter Storms and Squalls

Gulf of Mexico Oceanography
- The Loop Current & associated eddies
- Submerged jets
- Hurricane-induced currents

Mitigation
- Data requirements
- Measurements & Monitoring

Questions
Hurricanes dominate extreme wind and wave conditions

Operational criteria derived from hindcast models

Good accuracy but need to be updated to account for recent events (e.g. Lili, 2002)
Gulf of Mexico Hurricane Climatology

Homegrown
• Form in the Gulf of Mexico, Bay of Campeche and NW Caribbean
• Short lead time for GOM interests
• Anytime from June to November

Migratory
• Form in the Caribbean and Atlantic Ocean
• Long lead time for GOM interests
• Mainly July through early October

Bret - August 1999
Andrew - August 1992
Formation Locations - July

July 1 - 31
1886 - 2000
Tropical Storm Formation Locations
Formation Locations - August

August 1 - 31
1886 - 2000
Tropical Storm Formation Locations
Formation Locations - October

October 1 - 31
1886 - 2000
Tropical Storm Formation Locations
Formation Locations - November

November 1 - 30
1886 - 2000
Tropical Storm Formation Locations
• Rare event in GOM
• Difficulty in obtaining data
• Currently use API guidelines
• Most severe effects may be after center passage due to post-storm inertial currents
Gulf of Mexico Winter Storms

Superstorm
12-13 March 1993

- Sustained winds ~45kts
- Gusts > 55kts
- Sig. wave heights ~9m
- Satellite image on 12-Mar-1993
Offshore Squalls

- Rapid changes in wind speed & direction
- Torrential rain
- Waterspouts

Bright-white cloudiness indicates intense squall

26 April 2004
Circles indicates where line is “bowing-out” - zone of strongest winds

Offshore Squalls - Bow Echo

17 February 1999 - High Island blocks
• No seasonality
• Sporadic pulsing
• Top ~1000m
• Eddies
Indirect effects of the Loop Current:

- Eddies - surface down to <1000m
- Submerged currents
- Intensified lower water column and near-bed currents
Eddy Characteristics

Eddy centers and typical tracks

After Vukovich et al. 1985: MMS Physical Oceanography of the Gulf of Mexico, Visual No 7
Loop Current and Eddy Sargassum
April--August 2003

UNCLASSIFIED: 1/16° Global NLOM
SSH/CURRENT ANALYSIS: 20030610

NAVAL OCEANOGRAPHIC OFFICE
Approved for public release. Distribution unlimited.
Submerged Currents Characteristics

- Sub-surface phenomenon
- Rarely observed/poorly understood
- Speeds >3 knots
- Durations vary
- May be related to cold-core eddies
- Currently under investigation by JIPs

![Normal and Submerged Current Profiles](image)
Near-Bed Intensified Current Characteristics

- Affect lowest 1000m, speeds approaching 2kts
- Strongest at bed
- Sigsbee Escarpment
- Associated with Loop Current and eddies
- Affect ROV operations
Mitigation - Current Data Requirements

- Full water column
- Long duration (>1 year) for extremes and operational
- Site specific measurements
- Joint Industry Projects
- Long-term monitoring
- Quality control & interpolation
- Numerical models
Current Monitoring and Eddy Surveys

- RigADCP
- Satellite measurements
- Drifters
- Towed ADCP
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Continuous Monitoring Data

- Cause and effect
- Assess performance
- Longer-term “real” data and understanding
3-D hindcast model data for criteria derivation
### Current Criteria Reliability - A Word of Caution

**Task:** extrapolate available data to 100-year return period

<table>
<thead>
<tr>
<th>Winds &amp; Waves</th>
<th>High Currents</th>
</tr>
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<tbody>
<tr>
<td>• 90+ year verified hurricane hindcast</td>
<td>• ~15 years parametric eddy data</td>
</tr>
<tr>
<td>• &gt; 25 years buoy data</td>
<td>• Few years measurements</td>
</tr>
<tr>
<td>• &gt; 50 years operating experience in</td>
<td>• ~10 years drilling experience</td>
</tr>
<tr>
<td>hurricane region</td>
<td>in high current region</td>
</tr>
<tr>
<td></td>
<td>• Little production experience</td>
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*From John Vermersch*

Still a fair amount of uncertainty …
Conclusions

- Intermittent metocean features
- Rapid changes associated with these features is important
- Mitigation is achieved primarily through monitoring, analysis of data and numerical models
- Forecasting of ocean currents
Thank You

Any Questions