

RP 2MET: An API Recommended Practice for Metocean

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January 28, 2014

DRAFT 1

Derivation of Metocean Design and Operating Conditions

API RECOMMENDED PRACTICE 2MET
FIRST EDITION, XXX 200X

This draft is for committee balloting purposes only.



Presentation Overview

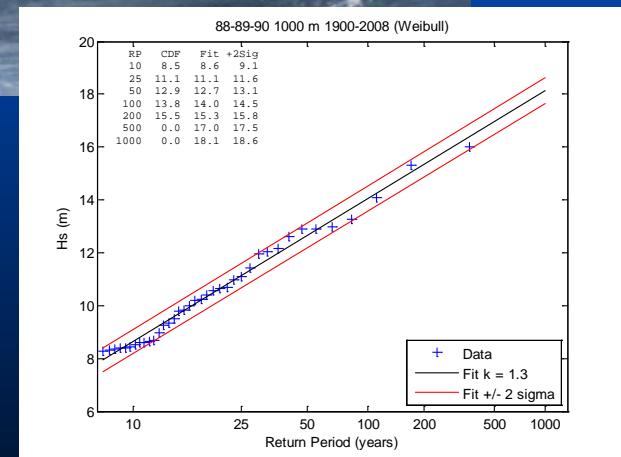
- Purpose of 2MET
- Evolution of new document
- Layout and contents
 - Core document
 - Informative annexes
 - Gulf annex and guidance



Ike near Gulf Coast, ISS

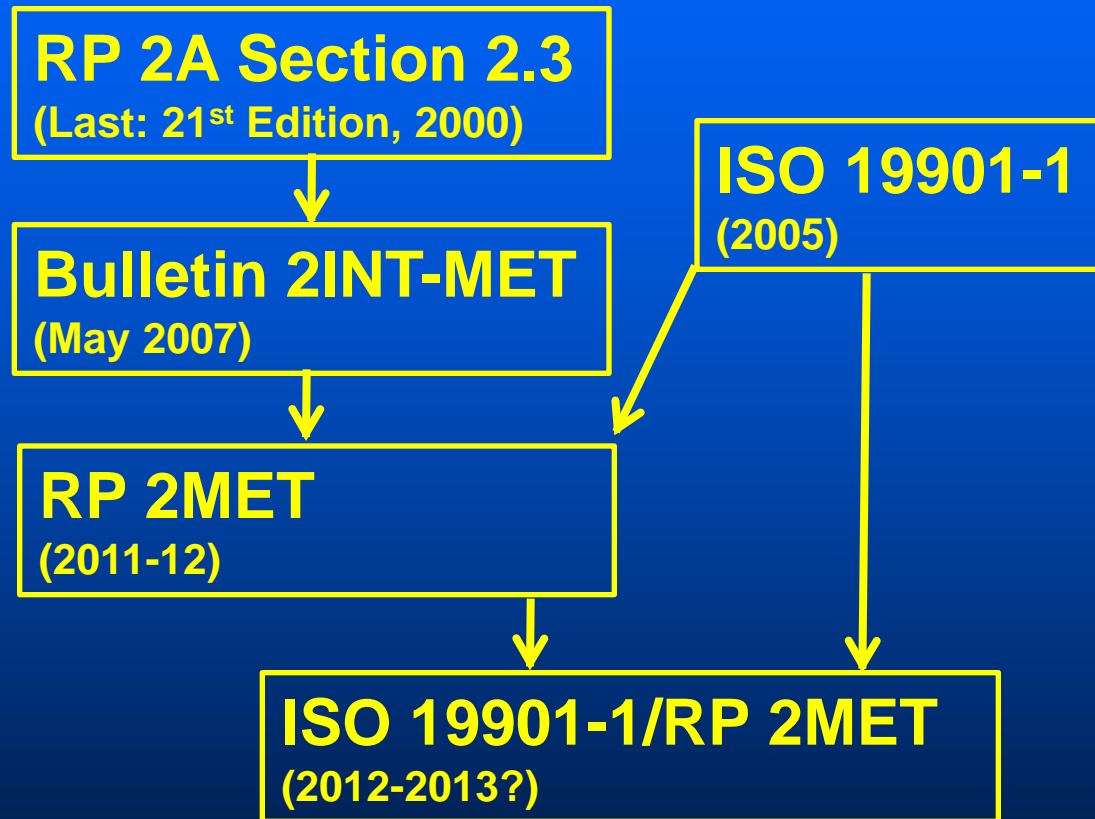
RP 2MET Purpose

- General requirements for developing metocean criteria
 - Determining conditions
 - Translating conditions into design parameters
- Clarify terms/definitions
- General guidance on regional phenomena
- Common metocean reference for all other RPs
 - Indicative criteria, use may be allowed without metocean study for some 2A/2SIM/2SK applications



Evolution of RP 2MET

- 2A: indicative Gulf shelf criteria since 1970's; little metocean guidance
- 19901-1 first industry guidance document
- 2-INT-MET: hurricane guidance, revised 2A indicatives post IKR
- 2MET: home for all RP metocean, aligned with 19901-1



Changes from 2A, 2-INT-MET to 2MET

- General metocean study guidelines
- Wave/current interaction from 2A, estimating extreme waves and crests
- Wave spectra/spreading
- More Gulf study guidance, indicatives:
 - Winter storms
 - Loop/eddy
 - TRWs



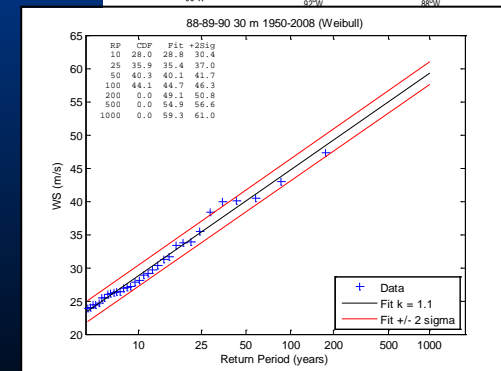
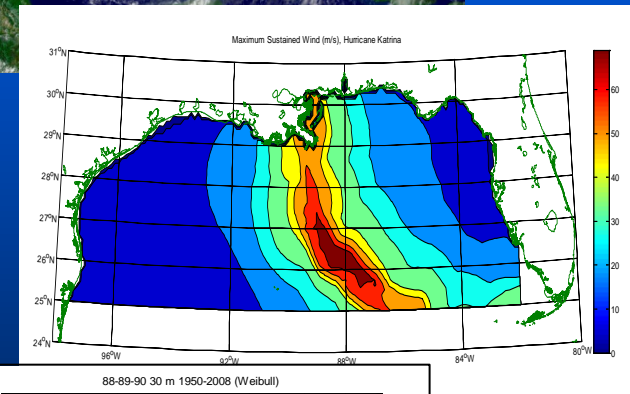
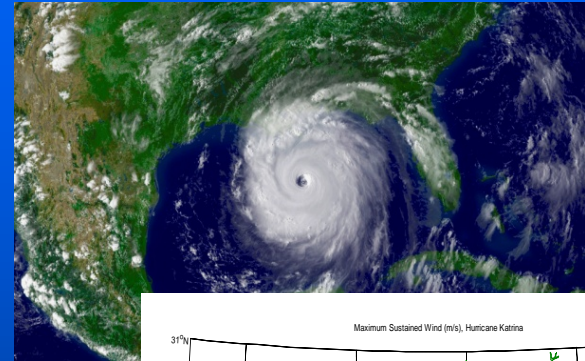
RP 2MET Contents

Table 1: Organization of RP 2MET

RP 2MET Section (ISO 19901-1)	API RP 2A Section / 2INT-MET
1. Scope	
2. Normative References	
3. Terms and Definitions	
4. Symbols and Abbreviations	
5. Determining the Relevant Metocean Parameters	1.3.1 General Metocean Considerations
6. Water Depth, Tides and Storm Surges	1.3.4 Tides
7. Wind	1.3.2 Winds
8. Waves	1.3.3 Waves, local wave crest from 2INT-MET
9. Currents	1.3.5 Currents
10. Other Environmental Factors	1.3.6 Ice
Annex A: Additional Information and Guidance	
A.1. Scope	
A.2. Normative References	
A.3. Terms and Definitions	
A.4. Symbols and Abbreviations	
A.5. Determining the Relevant Metocean Parameters	
A.6. Water Depth, Tides and Storm Surges	
A.7. Wind	2.3.2 Wind
A.8. Waves	2.3.1 Waves, local wave crest from 2INT-MET
A.9. Currents	2.3.3 Currents
A.10. Other Environmental Factors	
Annex B: Discussion of Wave Frequency Spectra	
B.1. The Pierson-Moskowitz Spectrum	
B.2. The JONSWAP Spectrum	
B.3. Comparison of the P-M and JONSWAP Spectra	
B.4. Ochi-Hubble Spectra	
Annex C: Regional Information	
C.1. Introduction	
C.2. Northwest Europe	
C.3. West Coast of Africa	
C.4. US Gulf of Mexico	2.3.4c, 2.3.4d, 17.6.2a GOM Conditions, hurricane site-specific guidance and indicative conditions from 2INT-MET
C.5. US Coast of California	2.3.4e, 2.3.4f, 17.6.2b Other US Waters
C.6. Other US Waters	2.3.4e, 2.3.4f
C.7. East Coast of Canada	
Bibliography	

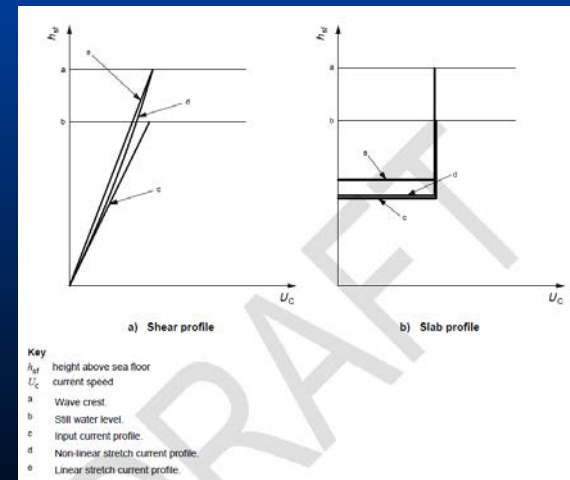
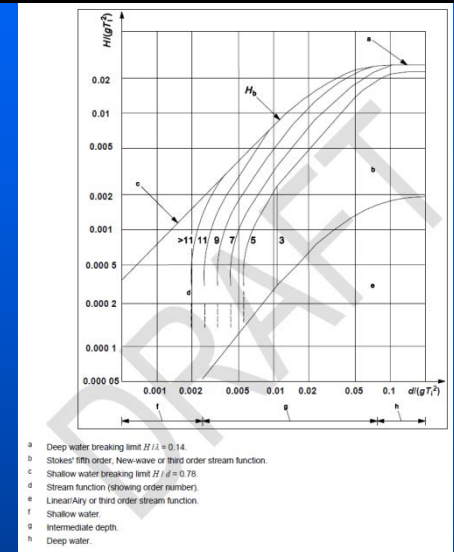
RP 2MET Core Document – Key Sections

- Sections 3/4: Terms and definitions, symbols
- Section 5: Guidance on determining parameters
- Sections 6-10: General guidance/requirements on determining
 - Water level variations
 - Winds
 - Waves
 - Currents
 - Other metocean considerations



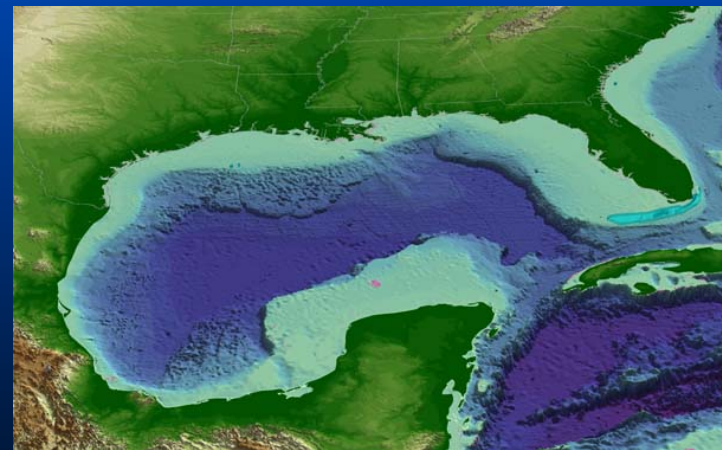
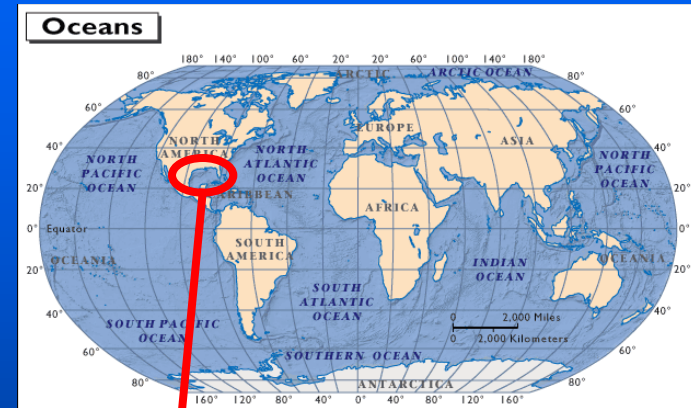
RP 2MET Core Document – Key Sections

- Appendix A: more guidance on core topics
 - Wind profile, averaging, spectra formulas
 - Wave periods, adjusting for current, estimating heights, spectra, spreading factors and crests
 - Current profile formulas
- Appendix B: wave spectra formulas



RP 2MET – Regional Annexes

- Appendix C: regional information for various parts of the world, of different detail/quality
- C.4: US Gulf of Mexico
 - Data sources available
 - Regional climatology
 - Water level, winds, waves, currents overview
 - C.4.9: indicative metocean parameters
 - C.4.10: guidance for Gulf metocean studies



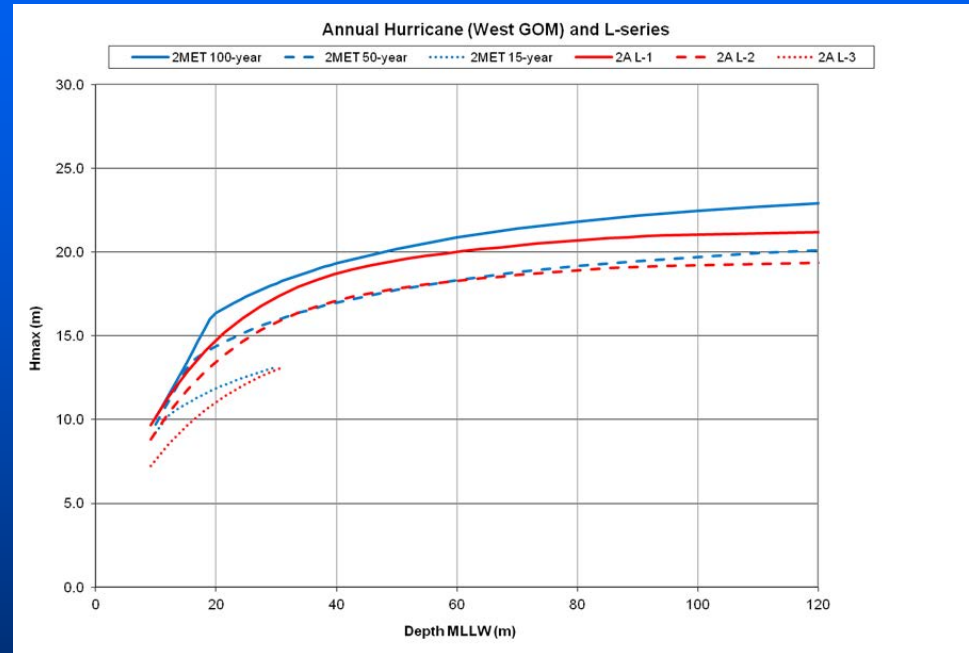
Current Contents of Annex C.4: Gulf

Table 2: RP 2MET Annex C.4: US Gulf of Mexico

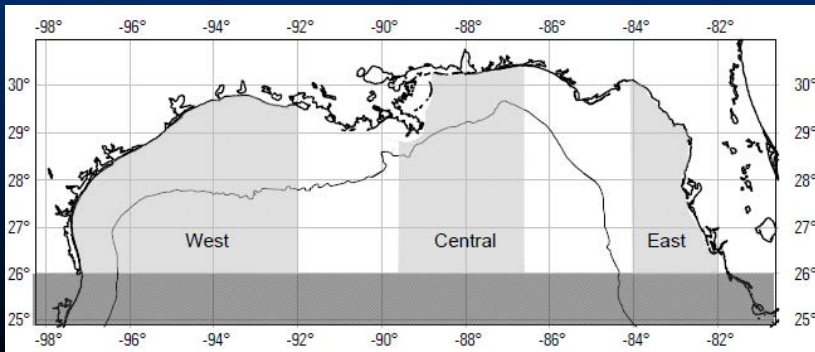
Annex C.4 Section	Modification from ISO 19901-1
C.4.1 Description of region	Updated with new references
C.4.2 Data sources	Updated with new references
C.4.3 Overview of regional climatology	Updated with new references
C.4.4 Water depths, tides and storm surges	Updated with new references
C.4.5 Winds	Updated with new references
C.4.6 Waves	Updated with new references
C.4.7 Currents	Updated with new references
C.4.8 Other environmental factors	Updated with new references
C.4.8.1 Air temperature and humidity	New, from RG1
C.4.8.2 Sea temperature	Updated with new references
C.4.8.3 Marine growth	Updated with new references
C.4.8.4 Visibility	New, from RG1
C.4.8.5 Precipitation	New, from RG1, replaces snow and ice section
C.4.9 Estimates of metocean parameters	
C.4.9.1 Extreme metocean parameters	Re-organization of extreme parameters, highlights different phenomena
C.4.9.1.1 Hurricanes	New section
C.4.9.1.1.1 Annual conditions	Updated with material from 2INT-MET, RG1
C.4.9.1.1.2 Sudden hurricane conditions	Updated with material from 2INT-MET, RG1, IADC study
C.4.9.1.1.3 Seasonal conditions	Updated with material from 2INT-MET supplement, RG1
C.4.9.1.2 Winter storms	New section, estimates from RG1
C.4.9.1.3 Loop and eddy currents	New section
C.4.9.1.3.1 Maximum surface current	New, estimates from CASE-supported study
C.4.9.1.3.2 Loop current and storms	New, from CASE-supported study
C.4.9.1.4 Topographic Rossby waves	New section, from CASE- and DeepStar-supported studies
C.4.9.1.5 Air and sea temperatures	Updated with new references
C.4.9.2 Long-term distributions of metocean parameters	Updated with new references
C.4.10 Guidelines for site-specific studies in the US GOM	New section
C.4.10.1 Hurricanes	Material from 2INT-MET, RG1, IADC study
C.4.10.1.1 Annual conditions	
C.4.10.1.2 Sudden hurricane conditions	
C.4.10.1.3 Seasonal hurricane conditions	
C.4.10.2 Winter storms	Material from RG1
C.4.10.3 Loop currents and eddies	Material from RG1
C.4.10.4 Topographic Rossby waves	Material from RG1

Hurricane Guidance

- Guidance:
 - Use 50-100 year data set, including through 2008
 - Pool/track shift
 - Use synthetic/deductive for long return periods
- Indicative:
 - Three areas for “annual” conditions
 - Central most severe

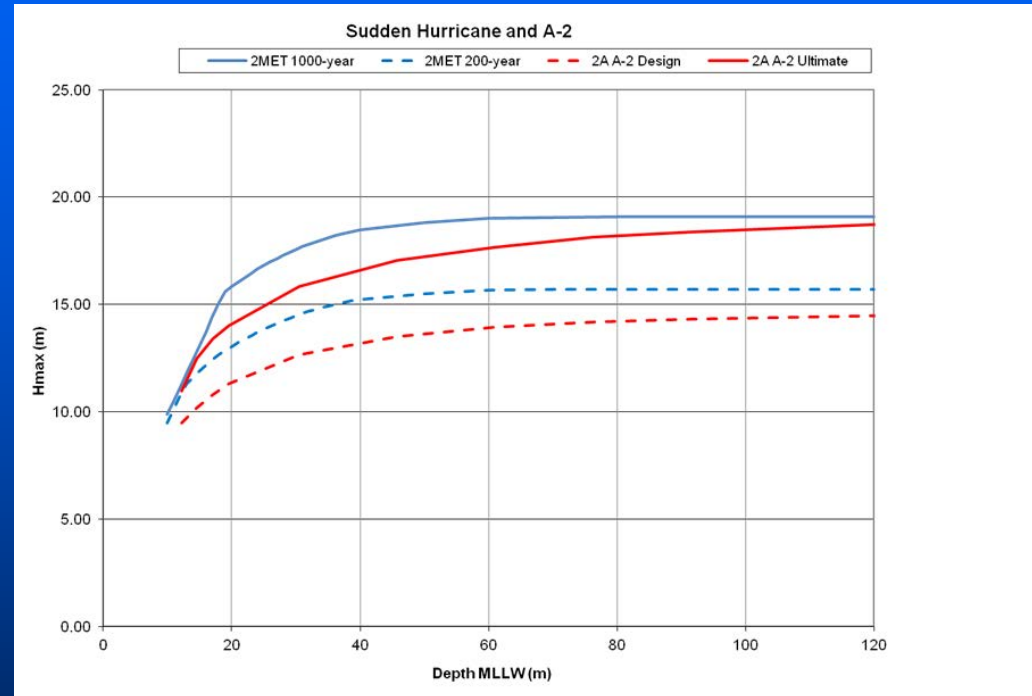


Comparing 2A, 2MET Indicative



“Sudden” Hurricane Guidance

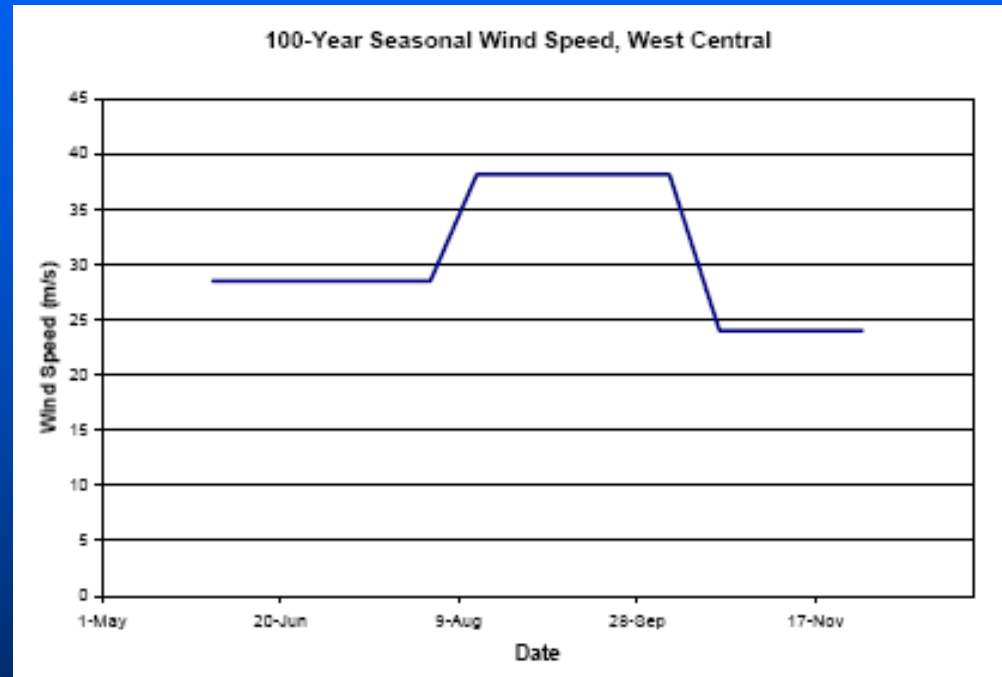
- Guidance:
 - Develop using “watch circle” approach, time of arrival of storm conditions appropriate to operation considered
- Indicative:
 - One set for GOM, representative of those storms bringing tropical storm-force winds to sites north of 28 N 24 hours after storm formation



Comparing 2A, 2MET Indicative

Seasonal Hurricane Guidance

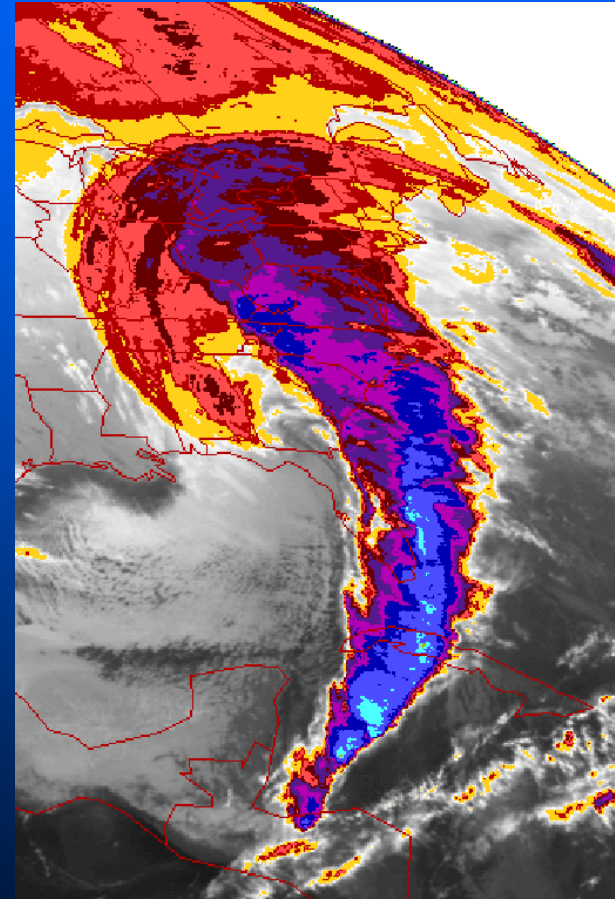
- Guidance:
 - Can evaluate hazard as pre- and post-peak periods
 - Should not base on single months
 - Consider other hazards (winter storm) outside of hurricane peak
- Indicative:
 - Two sets provided, West/Central and East, deepwater areas
 - Early (May-July) and Late (October-November) season periods



**Pre/Peak/Post 100-Year Ws,
West/Central GOM**

Winter Storm Guidance

- Guidance:
 - Important for operations, especially October-March
 - Use measurements (NDBC buoys), hindcasts as appropriate
 - Include 1980's
 - Highest observed ~ 9 m Hs
- Indicative:
 - One set of conditions for deepwater

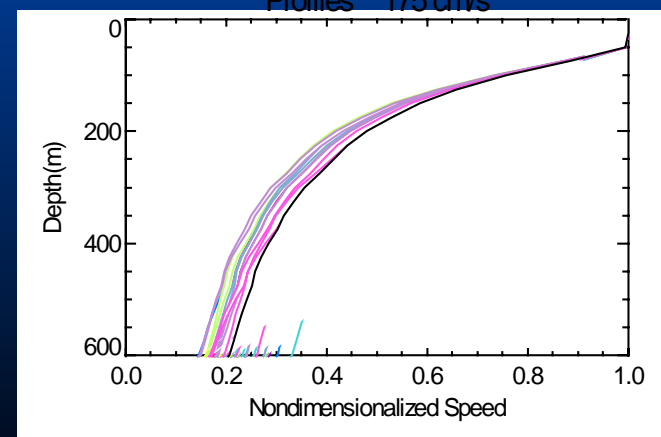
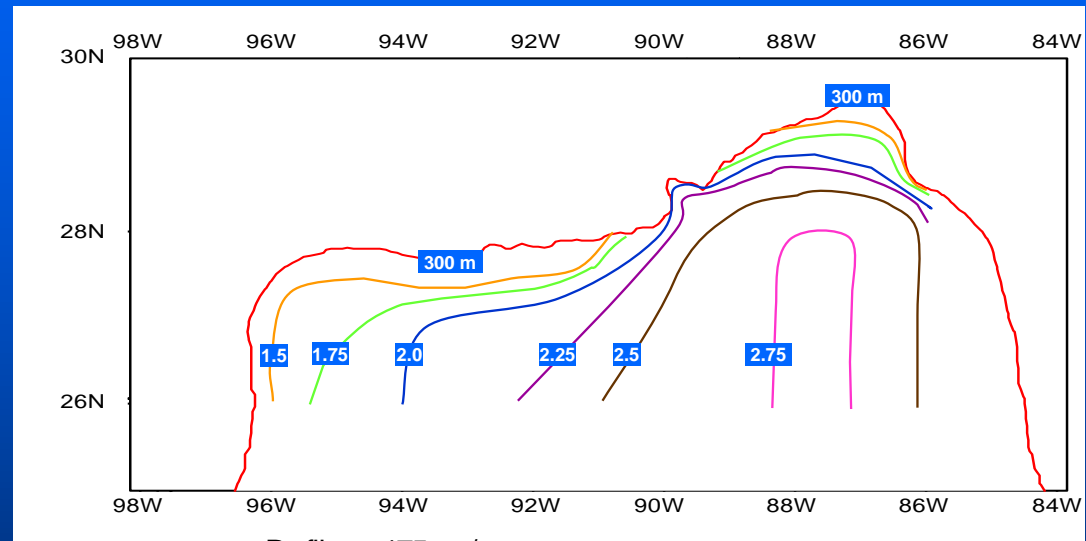


1993 Storm of the Century

Loop Current Guidance

- **Guidance:**
 - Govern mooring design for some facilities, and riser/tendon design
 - Use historical record through 2008, caution with pre-1985 years
 - Pool/site average
 - Consider joint Loop-hurricane occurrence

- **Indicative:**
 - Maximum surface current case
 - Provided for 10- and 100-year

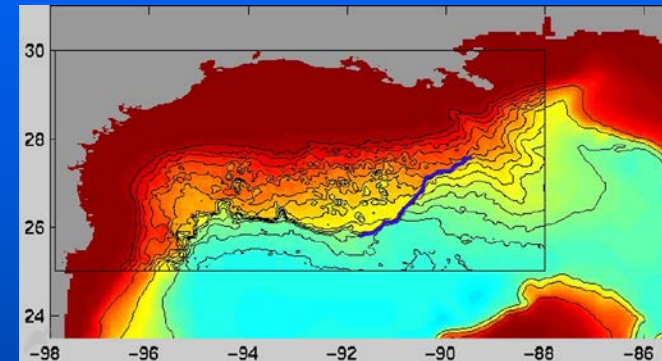


**Top: 100-Year
Loop/Eddy Surface
Speeds (m/sec)**

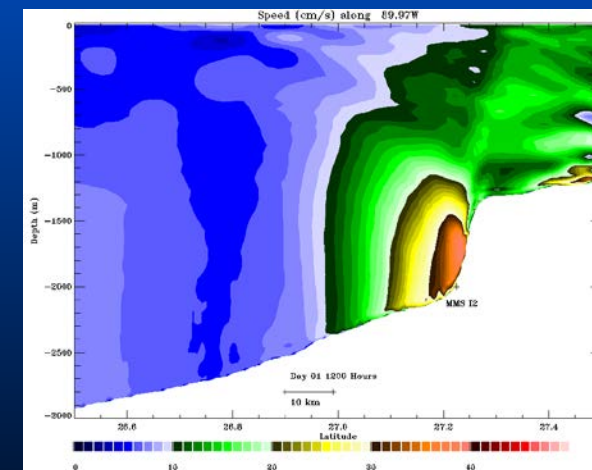
**Left: Normalized
current profile**

Topographic Rossby Wave Guidance

- Guidance:
 - TRW condition important for risers and drilling operations along Sigsbee Escarpment
 - Ability to model evolving, recommend 1-2 years of measurements at site
 - May be correlated to Loop proximity
- Indicative:
 - 10- and 100-year conditions provided



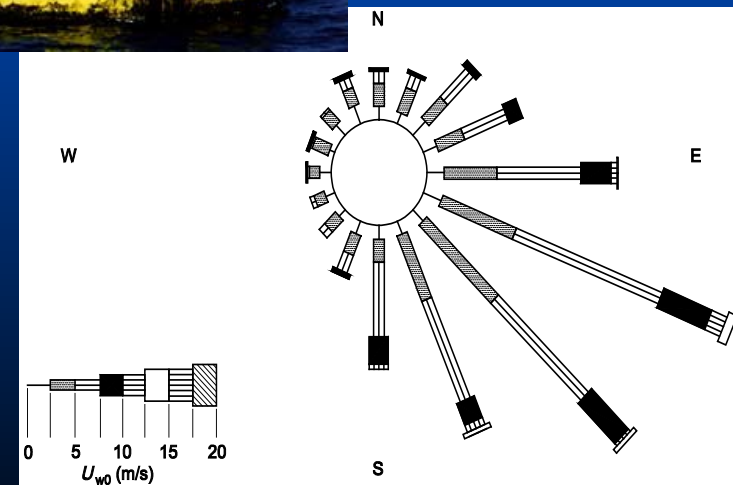
Sigsbee Escarpment Area



Modeled Currents Cross-Slope

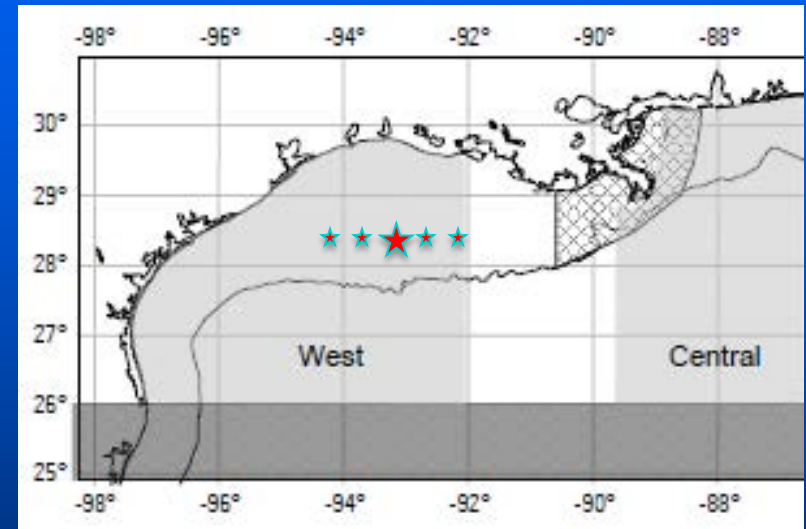
Operational

- Operational H_s-T_p
 - Data from NDBC 42001
 - Set does not represent extreme events
- Wind roses for June, December
 - From 42001
- Sea, air temperature ranges
 - From industry, NDBC measurements



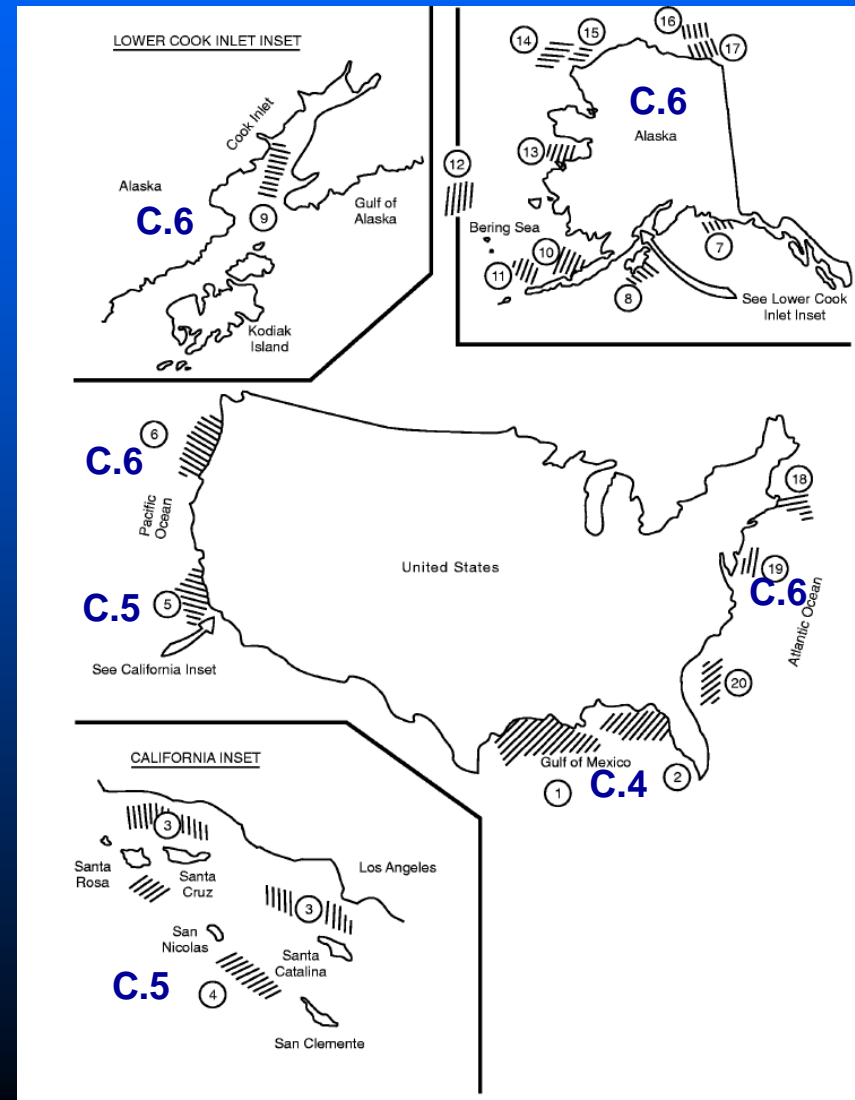
US Gulf Annex Summary

- Site-specific criteria is always preferred – annex values do not override a proper site-specific study
- Select Gulf annex values may be used with 2A and 2SIM for depths less than 120 m, as mapped from L- and A- to appropriate return periods
- May be used with 2SK for low consequence operations
- New values yield generally loads > older 2A, Section 17, and > new site-specific



Other US Waters

- California coast unchanged from ISO 19901-1 (C.5)
- Other US waters are “legacy” RP 2A (need update) – may not be used for design



RP 2MET Status

- Passed second ballot June 2013
- API preparing for publication 2014

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FIRST EDITION, XXX 200X

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- Doug Mitchell, XOM
- Dave Driver, BP
- Mike Vogel, Shell
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- API SC2 members
- Industry and regulatory reviewers
- MODU JIP
- CASE JIP
- DeepStar JIP



Thanks

- Any questions?



Hurricane Ike from ISS, 2008