An Overview of Different Methods for Assessing Historical Hurricane Frequency and Potential Risk for the Gulf of Mexico Coast

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Outline & Motivation

Background on the Standard Project Hurricane (SPH) Indices
 Central Pressure Index (CPI) and Peripheral Pressure (p_w)

Gulf Coast Hurricane Frequency Re-analysis
 – Generalized Extreme Value (GEV) analysis

Re-analysis of the Distance Marker Method
 ArcGIS mapping and analysis

Frequency analysis of Hurricane & Tropical Storm winds
 Over coastal and inland regions of the Gulf and East Coasts



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Background on Standard Project Hurricane (SPH) Indices

✓ SPH "model":

 1 of 2 approaches the Army Corps of Engineers (COE) uses to model tropical storm wind fields

Probable Maximum Hurricane (PMH) is a more conservative approach

 Original SPH indices were approved by COE in a design study for Lake Okeechobee, Florida

 U.S. Weather Bureau, March 1954

✓ National hurricane Research Project, Report #33 (Nov. 1959)

 After Hurricane Betsy in 1965 the Weather Bureau revised the wind field parameters, but did not change the other SPH indices

• U.S. Weather Bureau, Aug. 1965, Nov. 1965, and Feb. 1966



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National Hurricane Research Project Report #33

Guidance on the site-specific storm parameters
 SPH defined as "the most severe storm that is considered reasonably characteristic of a region"

 SPH indices were based on an analysis of past hurricanes of record:

 Hurricane characteristics were correlated with intensity, location, and circulation size criteria

Most recent SPH revisions:
 NWS Tech Report No. 23 (1979)
 NWS Tech Report No. 38 (1987)



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Return Period Analysis

Reanalysis of the Central Pressure Indices (CPIs)

 Along Gulf of Mexico Coast (Zones A, B, C)
 Central Pressure 1% Frequency of Occurrence
 1-in-100-year return periods of the CPI in each Zone
 Identify changes in CPI since last season assessed in 1979 Tech Report (data thru 1975)

Update of hurricane Peripheral Pressure (*p_w*)
 Determine changes in mean *p_w* since 1975
 Calculate each storm's peripheral pressure and pressure differential (ΔP)



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Original Zones and Mile Markers



Figure 11.



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Gulf Coast Zones



2005 Gulf Hurricanes



Annual Minimum Pressure in Zone B



HURDAT 1851-2005

All Observations Including Missing Pressures: 37,854 points

Observations w/ Pressures: 12,095 points





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HURDAT Pressure Counts 1900-2005







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Availability of Pressure Observations by Decade and Zone





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CPI Return Periods for Zone B: 90 N Mile Offshore Extent 50 & 100 N Mile Lateral Extensions





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CPI Return Periods for Zone B: 150 N Mile Offshore Extent 50 & 100 N Mile Lateral Extensions





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CPI Return Periods (150 N Mi offshore) Texas & Western Gulf Coast







Western Gulf Coast (Zone C) Return Periods and 90% Confidence Intervals Satellite Era 40-year Period (1965-2005)



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Distance Marker Method - NWS #23

✓ Tabulated p_o for hurricanes from 1900-1975, by location of the lowest p_o .

 Supplemented by historical accounts of seven hurricanes occurring prior to 1900

The p_o data was grouped within overlapping coastal zones:

- 200, 400, 500, and 800 N miles
- Lowest three, five, seven, and ten p_o of record within each zone length were averaged

- Coastal lengths overlapped by 50, 100, and 200 N miles



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CPI vs. Distance-marker in NWS #23



Figure 2.1 .-- Plot showing the adopted SPH p ..



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(kPa)

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150 N Mile Gulf Coast CPIs (1900-2005)



90 N Mile Gulf Coast CPIs (1900-2005)



CPI for Various Coastal Bins 90 and 150 Nautical Mile Offshore Extent

	Western Gulf Coast			Central Gulf Coast			Eastern Gulf Coast		
At Anna Anna Anna Anna Anna Anna Anna An		0-500			450-950			900-1400	
90 nm	CONTRACTOR .	930			928			949	
150 nm		929		* ***	922			947	
	K				Tent fait	The December of the			
	0-200	150-350	300-500	450-650	600-800	750-950	900-1100	1050-1250	1200-1400
90 nm	939	960	943	939	935	945	974	970	953
150 nm	936	955	942	937	932	941	973	975	951

Results by "Distance Marker" bins in millibars (mb)



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Hurricane Strike Frequency from NHC



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Hurricane Points 1926-2005





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Hurricane Frequency – Kernel Density (hurricanes/square degree)



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Hurricane Frequency – Based on Tracks (hurricanes/county)



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Hurricane Frequency – Buffered Tracks (hurricanes/county)





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Hurricane Frequency – Buffered Tracks (hurricanes/county)



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Tropical Storm Frequency – Buffered Tracks (tropical storms/county)



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Hurricane Frequency – Buffered Tracks (hurricanes/county)



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Summary

✓ Lower CPI return period:

Most reliable pressure data from the past 30-40 years

 Re-analysis of both methods (Frequency and Distance Marker) produced lower CPIs in all Gulf coast zones

Tropical Storm & Hurricane Frequency Analysis

 Vulnerability and risk don't end at shoreline counties!
 Inclusion of inland propagation shows a more realistic map of wind-related risk

Methodologies are reproducible in the future

 Climate Change requires more frequent updates of return period analyses (end of season, bi-annual, etc.)



Mahalo nui loa!



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