

# Performance of Third Generation Wave Models in Extreme Hurricanes

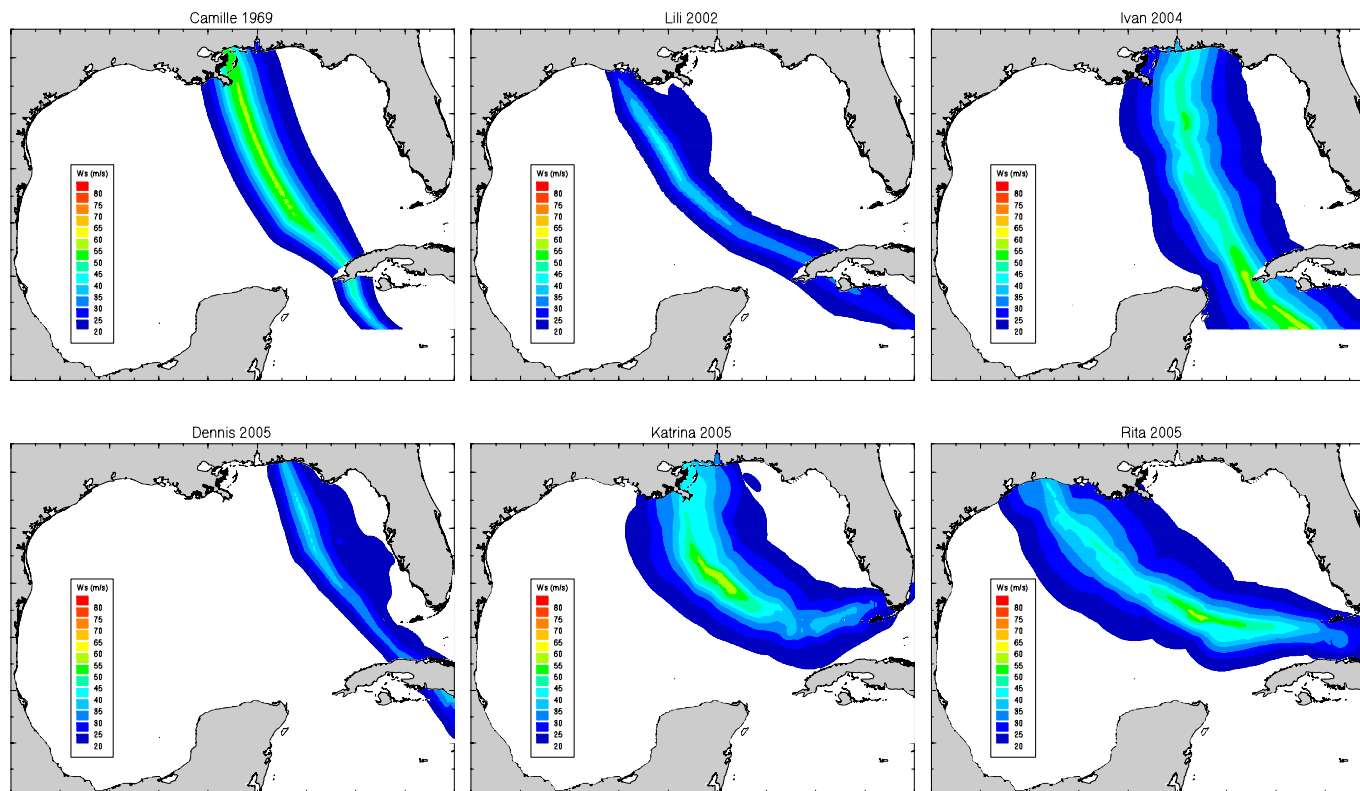
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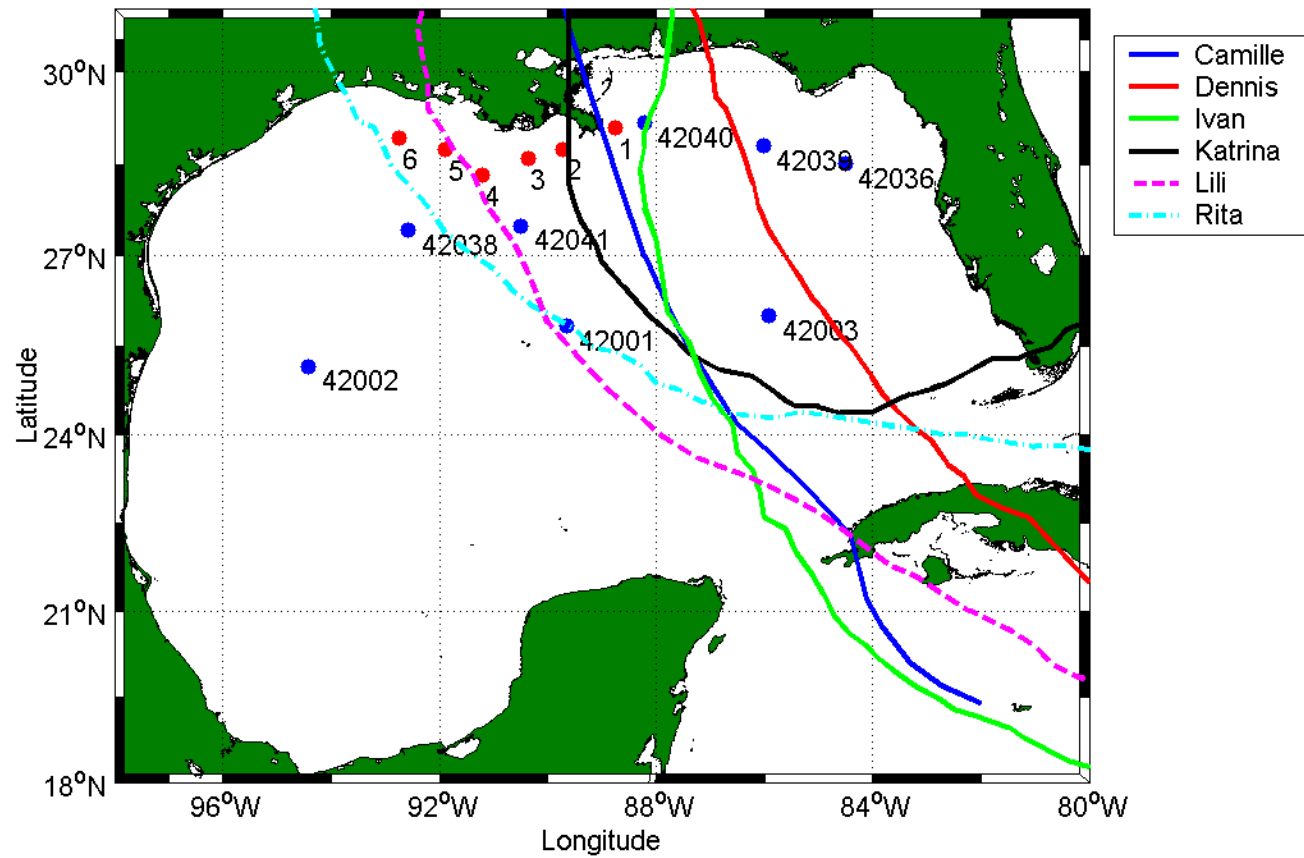
# THIS STUDY

- Apply “best” wind fields for:

•	SS#	Peak Winds (30-min)
• Camille (1969)	5	56 m/s
• Lili (2002)	4	48 m/s
• Ivan (2004)	5	58 m/s
• Dennis (2005)	3	41 m/s
• Katrina (2005)	5	57 m/s
• Rita (2005)	5	58 m/s

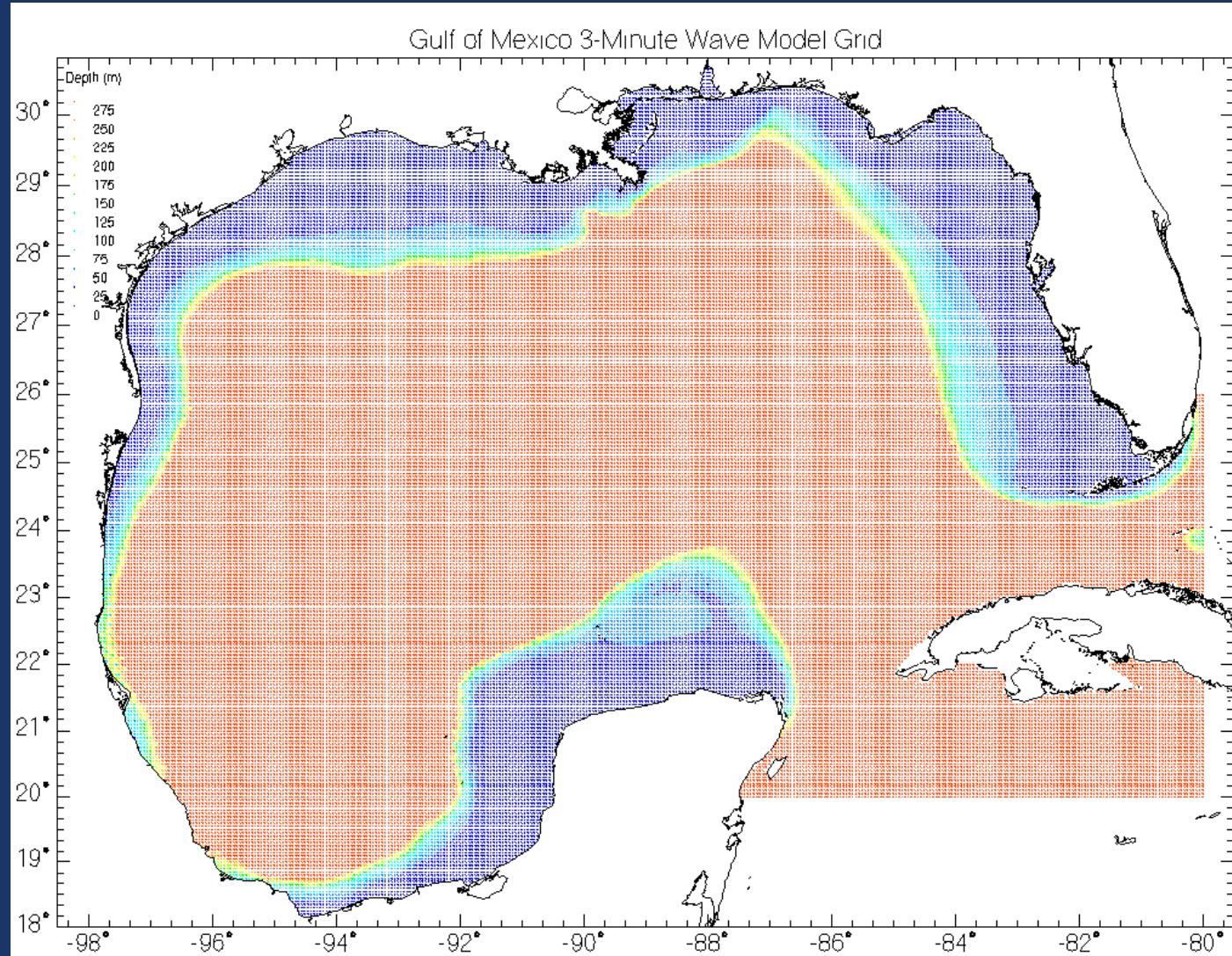


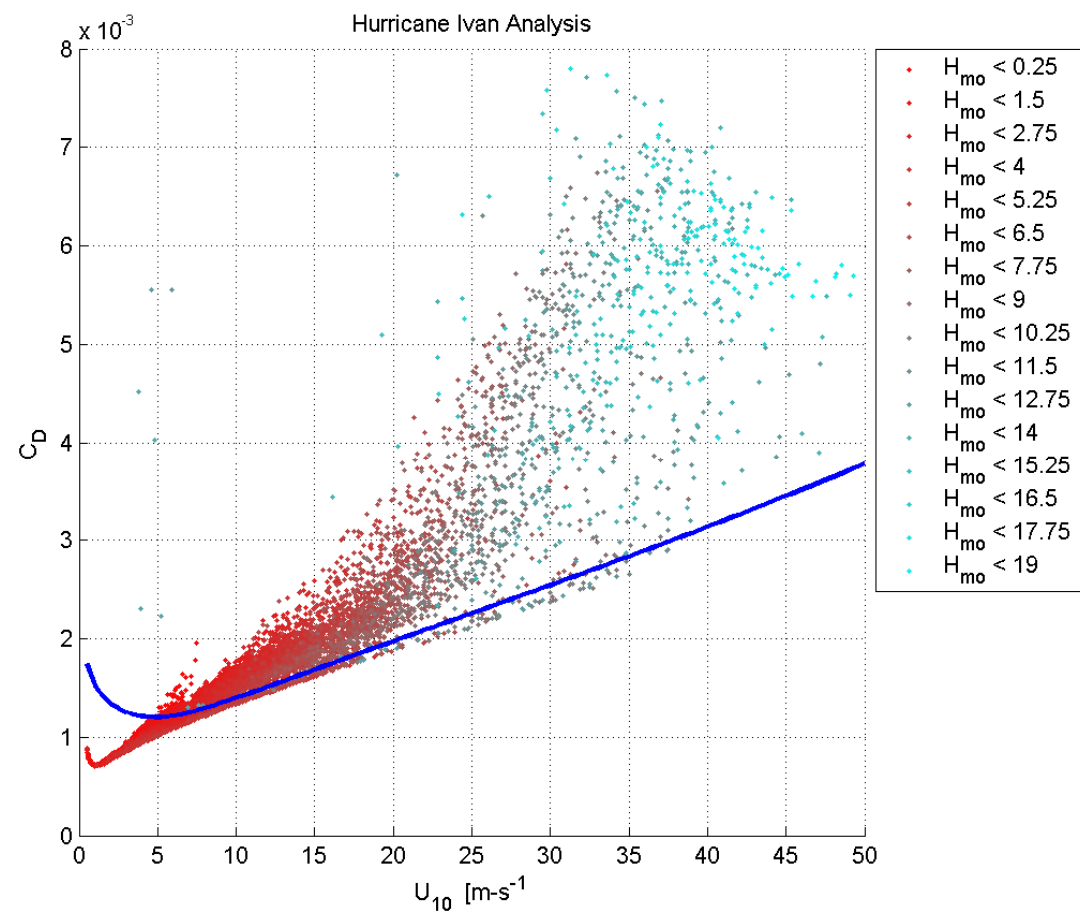
CD-CAP Hurricane Simulations and Measurement Sites



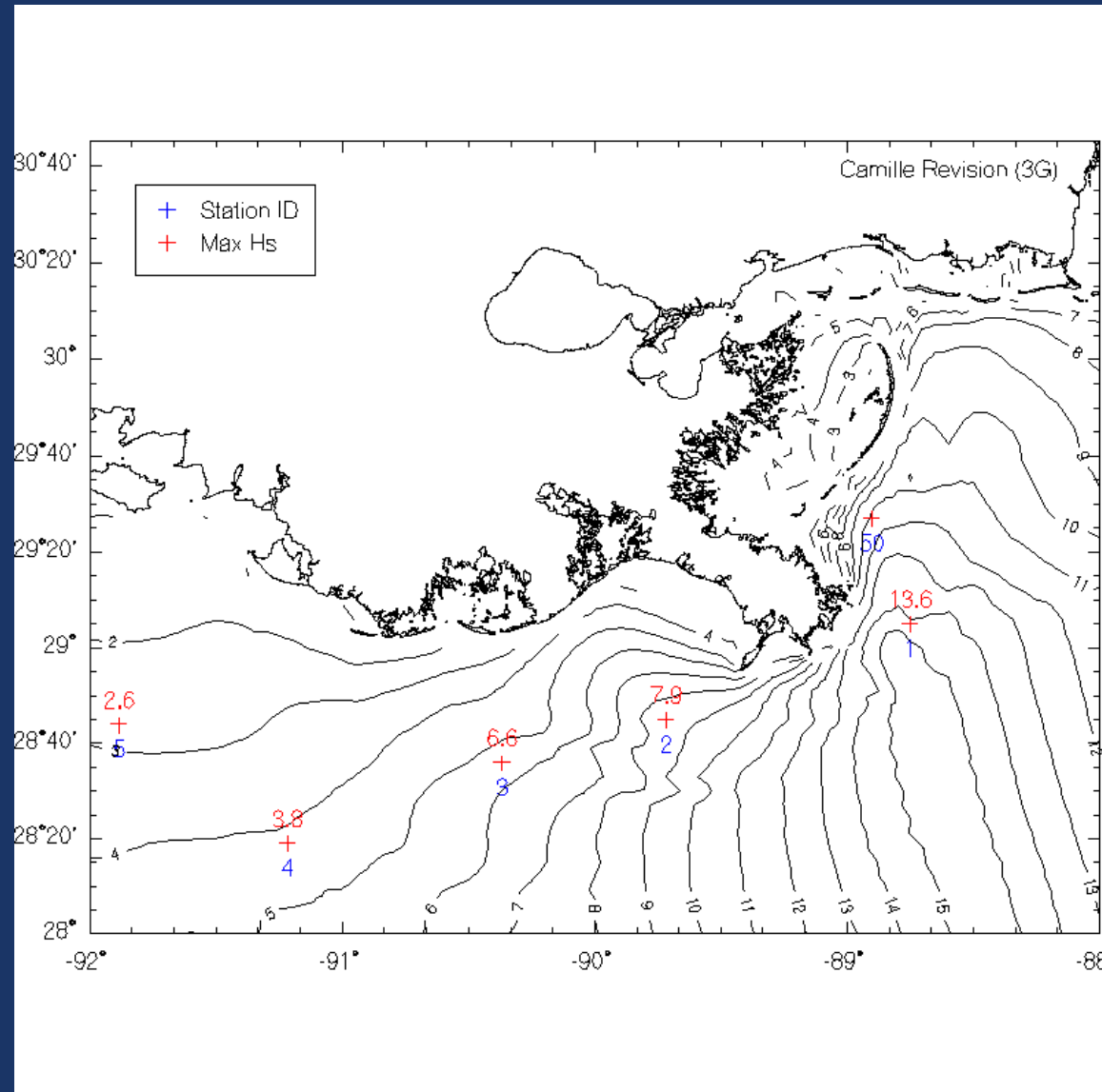
# 3G Wave Model Variants

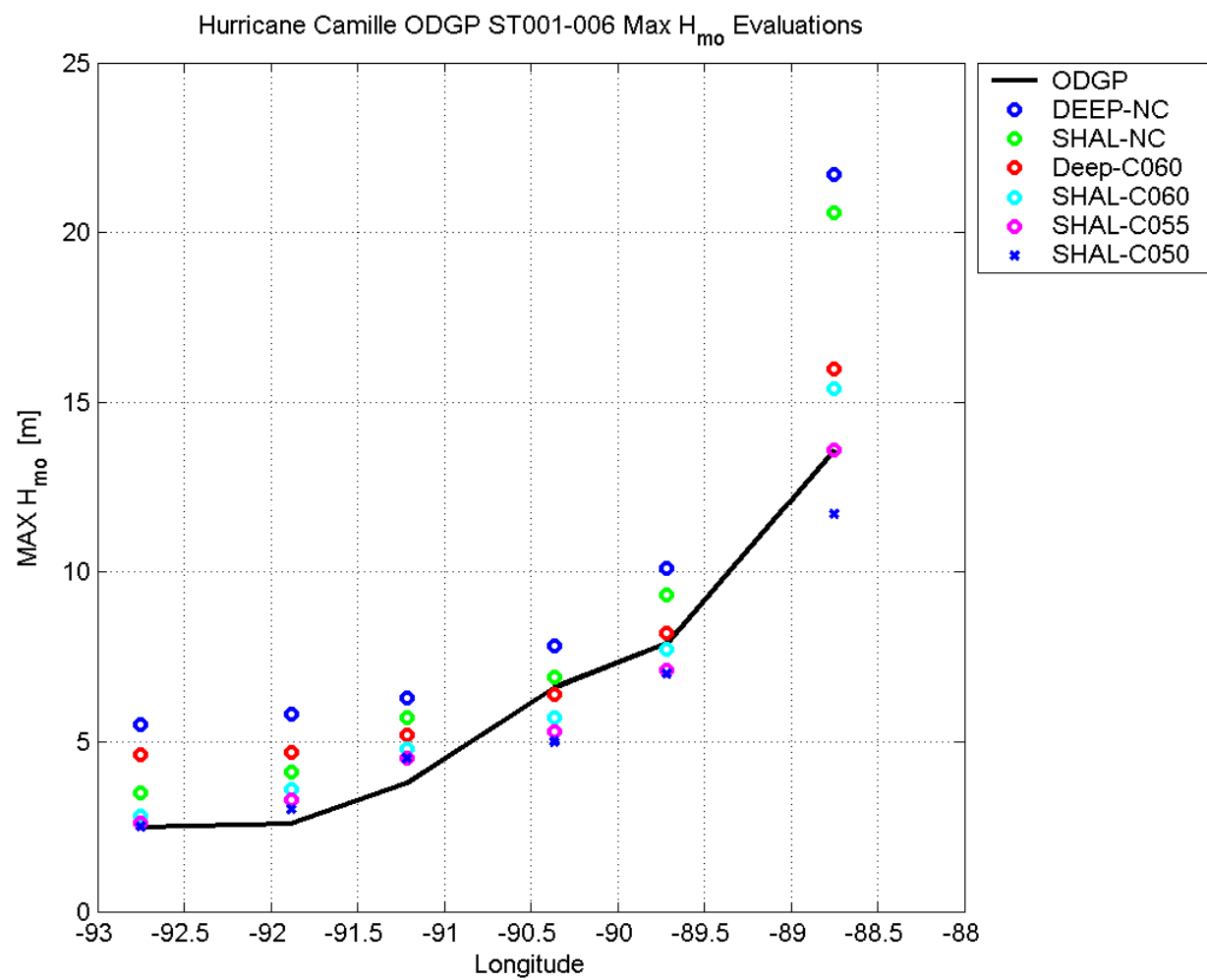
- WAM4.5 basically Janssen (1991) with code refinements
- WAM4.5CAP WAM4.5 except apply cap to  $U^*/U_{10}$  of .06
- OWI3G follows WAMD1 (1988) except:
  - Phillips resonance source term added
  - Second quartet of interactions in DIA
  - Source term balance tuning different
  - C10 Wu (1982) then asymptotic to  $2.2 \times 10^{-3}$  at 30 m/s
  - Model frozen since developed as CSOWM in 1994
  - see SWAMP (1985), Khandekar et al. (1994),
  - Forristall and Greenwood (2000) for public documentation



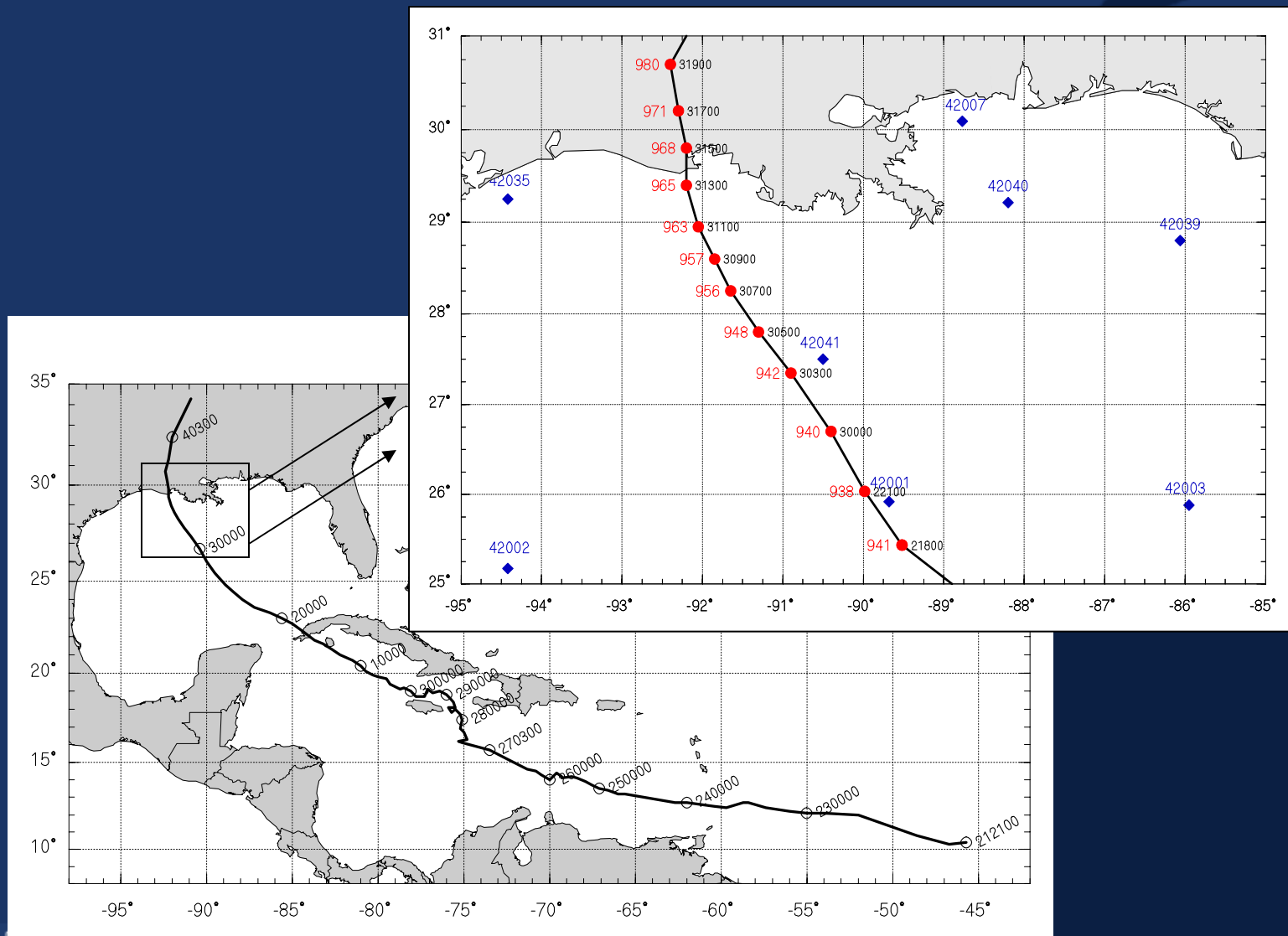


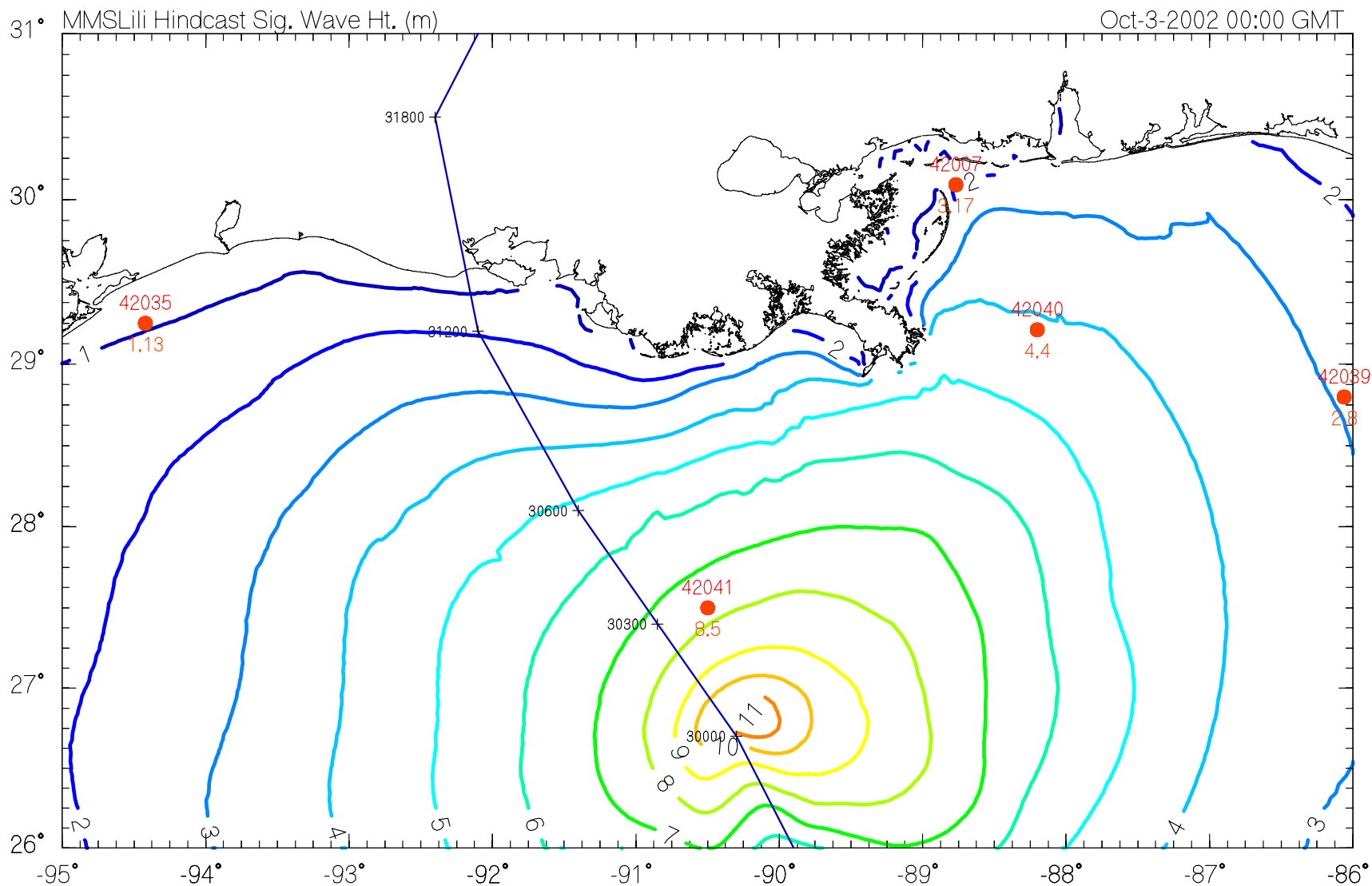
# Camille Reanalysis Waves vs ODGP Wave Data





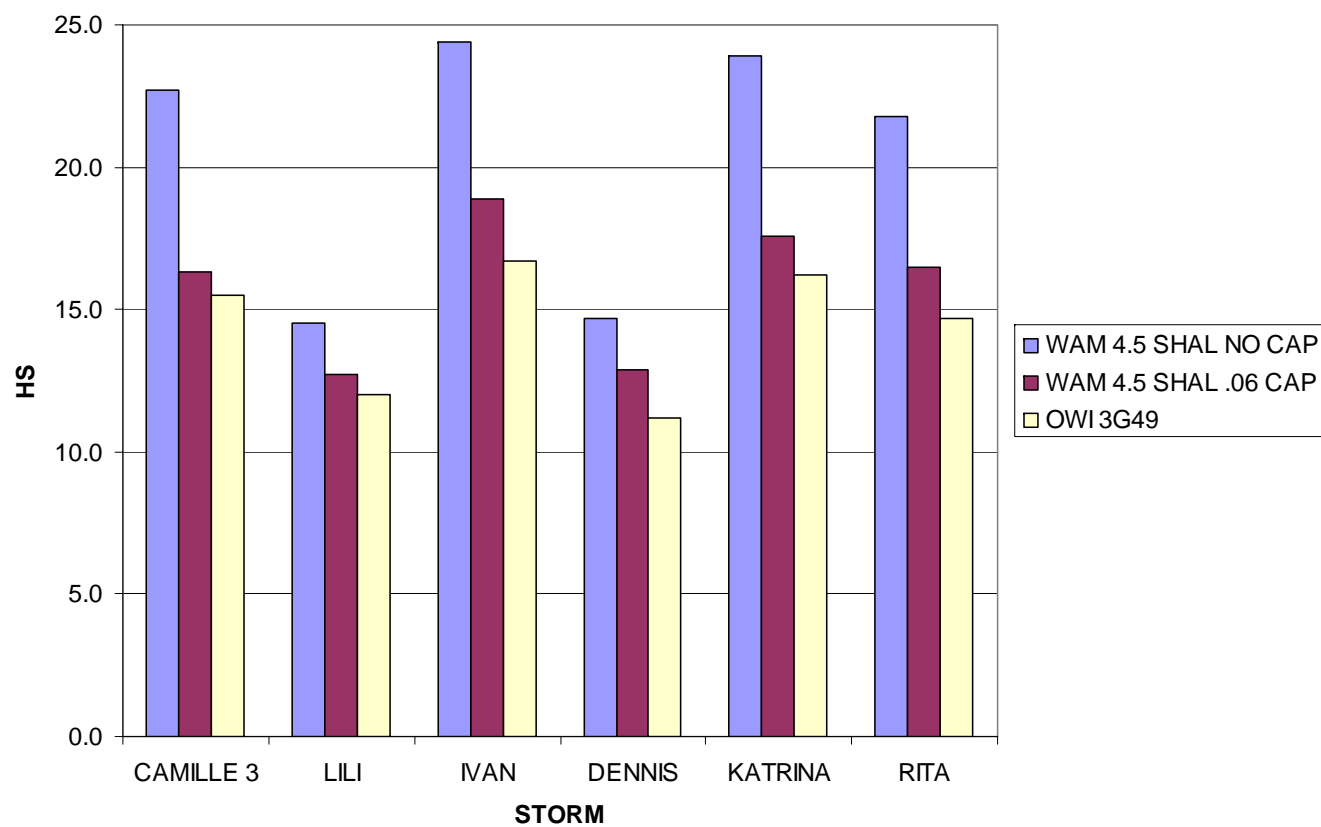
# Track of Lili

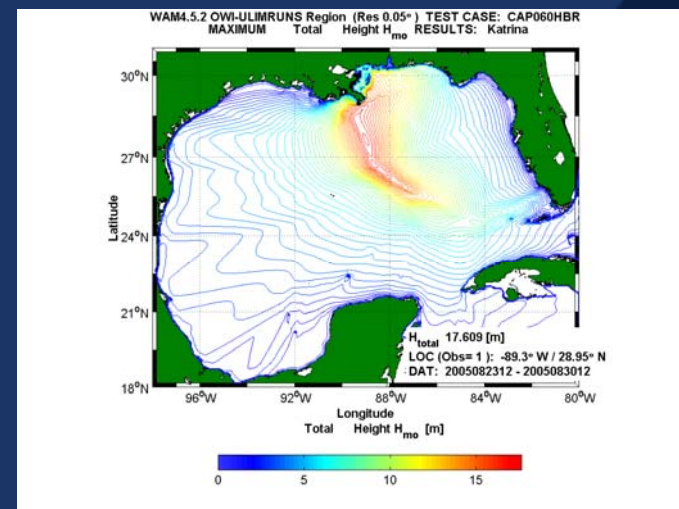
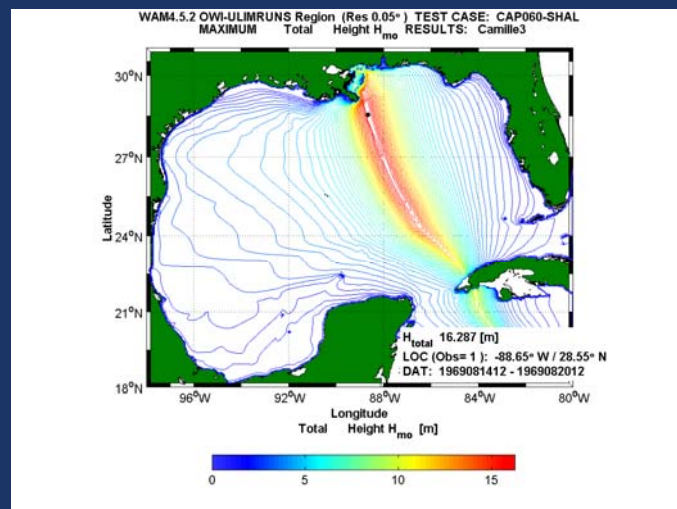
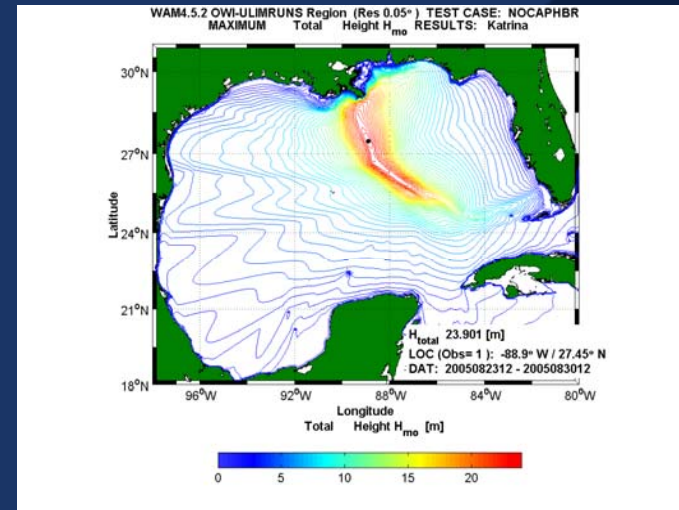
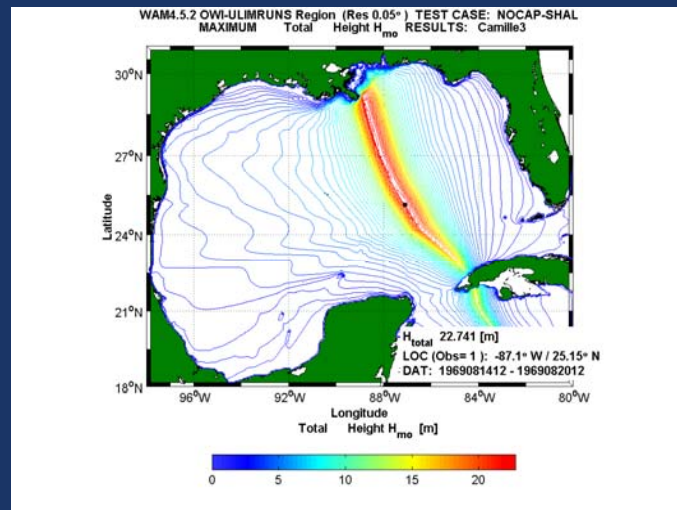


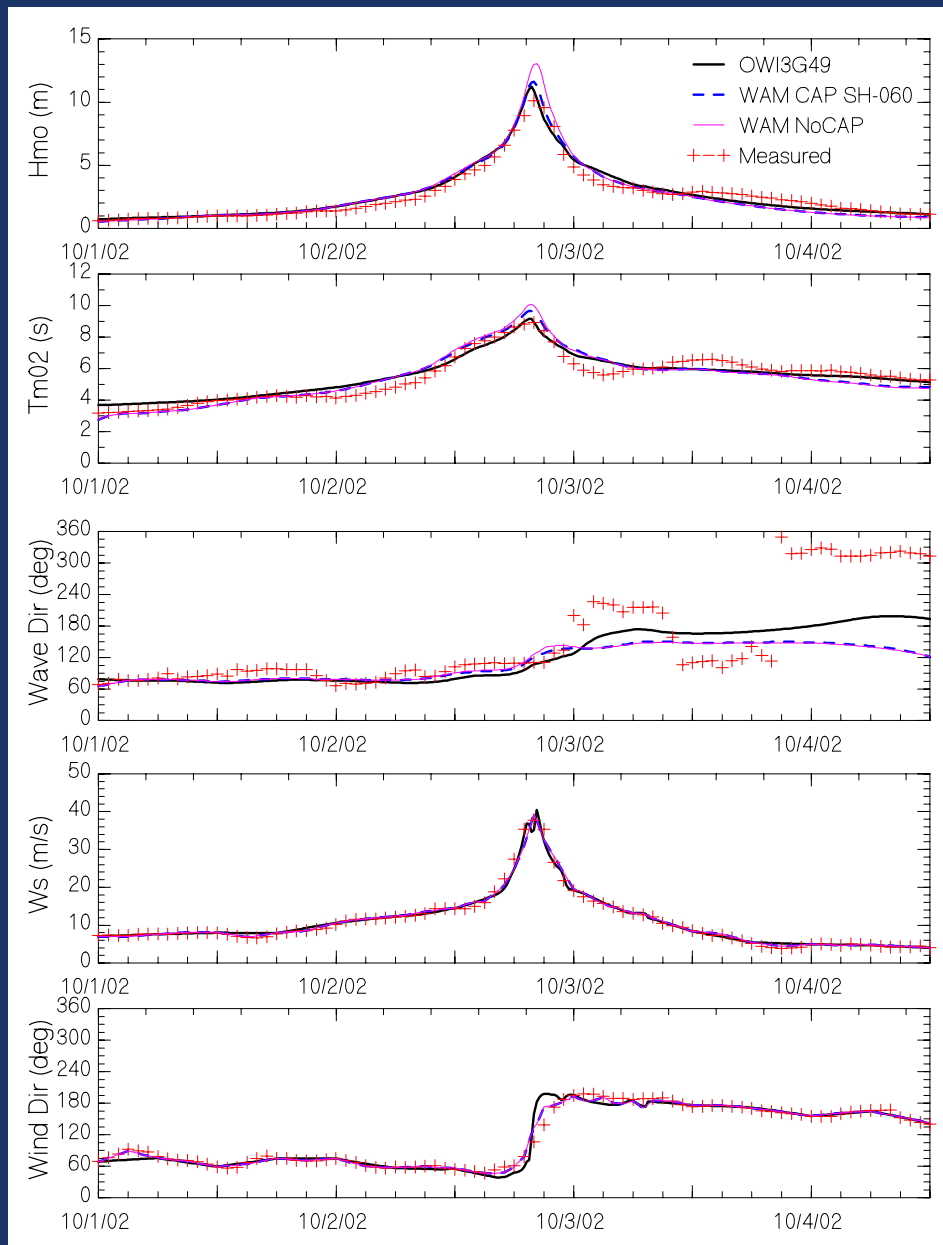


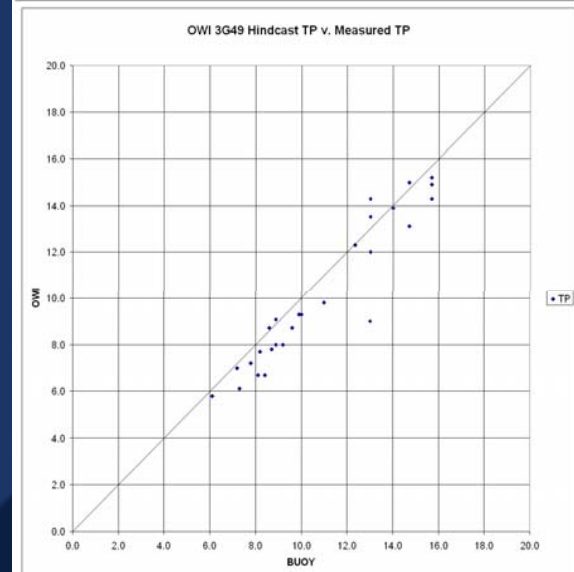
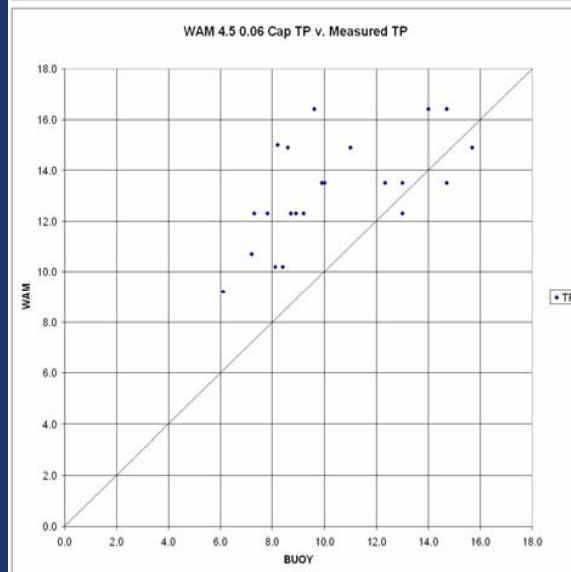
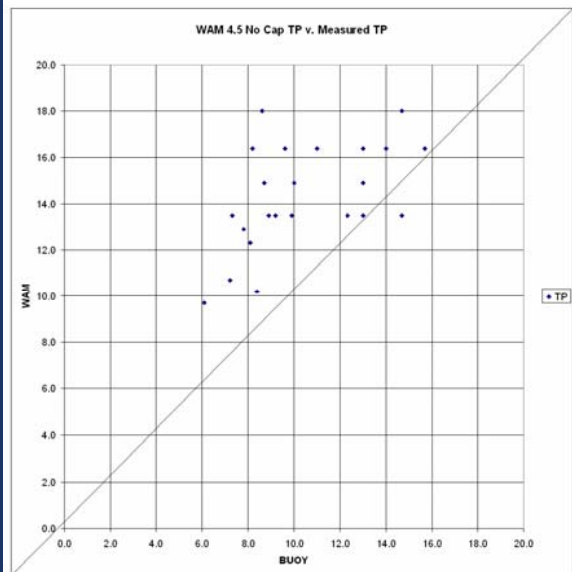
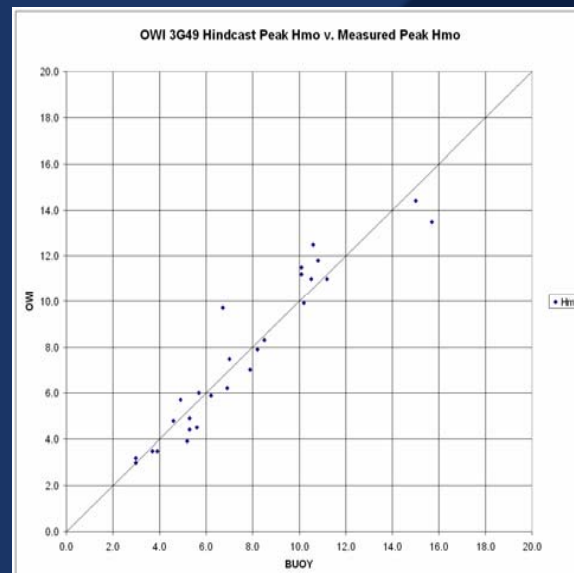
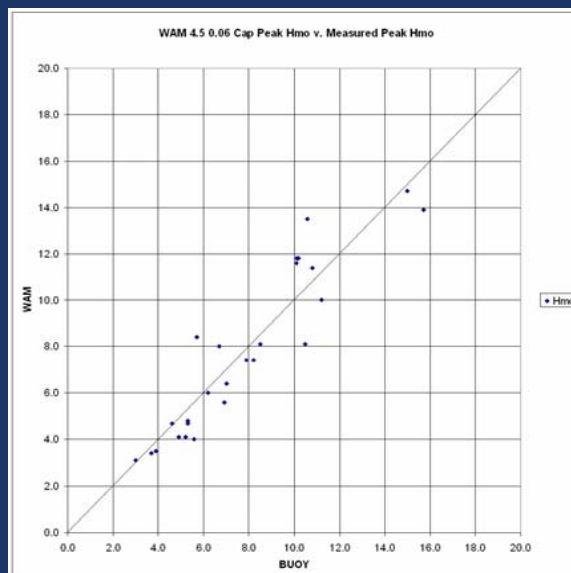
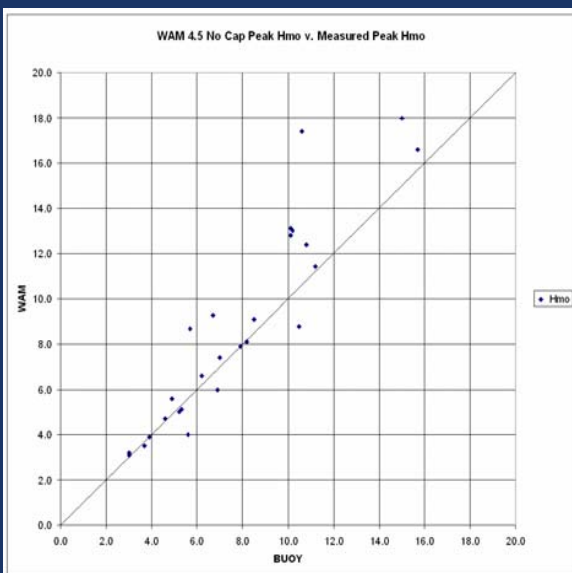
TYPE	STORM	Hmo	Lat	Lon
WAM 4.5 SHAL NO CAP	CAMILLE 3	22.7	25.15	-87.10
WAM 4.5 SHAL NO CAP	LILI	14.5	27.05	-90.40
WAM 4.5 SHAL NO CAP	IVAN	24.4	28.10	-87.80
WAM 4.5 SHAL NO CAP	DENNIS	14.7	28.60	-86.20
WAM 4.5 SHAL NO CAP	KATRINA	23.9	27.45	-89.90
WAM 4.5 SHAL NO CAP	RITA	21.8	27.75	-91.80
WAM 4.5 SHAL .06 CAP	CAMILLE 3	16.3	28.55	-88.65
WAM 4.5 SHAL .06 CAP	LILI	12.7	27.05	-90.40
WAM 4.5 SHAL .06 CAP	IVAN	18.9	28.20	-87.85
WAM 4.5 SHAL .06 CAP	DENNIS	12.9	28.55	-86.20
WAM 4.5 SHAL .06 CAP	KATRINA	17.6	28.95	-89.30
WAM 4.5 SHAL .06 CAP	RITA	16.5	27.75	-91.80
OWI 3G49	CAMILLE 3	15.5	27.90	-88.40
OWI 3G49	LILI	12.0	27.05	-90.40
OWI 3G49	IVAN	16.7	20.00	-83.25
OWI 3G49	DENNIS	11.2	27.00	-85.55
OWI 3G49	KATRINA	16.2	26.85	-88.80
OWI 3G49	RITA	14.7	24.55	-86.35

**HS Comparison of WAM 4.5 Shallow No Cap, WAM 4.5 Shallow 0.06 Cap,  
and OWI 3G49 Hindcast Model**









	<i>HS</i>				<b>TP</b>			
	BIAS	STD DEV.	SCATTER INDEX	CC	BIAS	STD DEV.	SCATTER INDEX	CC
WAM 4.5 Shallow No Cap	0.89	1.81	0.24	0.93	3.62	2.50	0.23	0.57
WAM 4.5 Shallow 0.06 Cap	-0.08	1.81	0.17	0.93	2.45	2.34	0.22	0.62
OWI 3G49	0.03	1.06	0.14	0.95	-0.72	0.96	0.09	0.95

# Conclusions

- Extrapolation of our present understanding of the physics to asymptotic limits represented by Cat. 5+ storms is to some extent a leap in the dark.
- WAM4+ variants positively biased in HS and TP in intense tropical cyclones
- An absolute wind speed cap on C10 is a simplification
- What is the effective roughness of the SBL over shoaling hurricane waves? Is there a cap as evident in deep water?
- Does the momentum flux from the SBL to ocean waves saturate, limiting ultimate response (more discussion later)
- We need measurements and a long term commitment to research on ocean response to extreme tropical cyclone forcing