ADDENDUM B

ADDITIONAL STORM TIDE ANALYSES FOR PINELLAS COUNTY

December 2000

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INTRODUCTION

Addendum B is a supplement to the Addendum which is attached to the original storm tide report for Pinellas County. This addendum presents the study results of Case 14 which uses the same surge model as in the original report except that the most southern 100 n. mi. segment is eliminated to reduce the number of sampled historical hurricanes from 26 to 12 for Pinellas County. This analysis is carried out in response to questions that a long surge model along the shoreline to obtain enough number of historical hurricanes to improve the probability distributions of hurricane parameters will unduly cause higher storm tide in Pinellas County because there were more historical hurricanes in this most southern 100 n. mi. of the original surge model. The following analysis in Case 14 will show the magnitude of changes in the storm tides in Pinellas County that occur due to this reduction in hurricane numbers.

CASE 14

Case 14 adopts the same surge model arrangement as the original surge model except that the most southern 100 n. mi. segment of the model is eliminated, making the surge model 200 n. mi long with half of its length to the north and half of its length to the south of the middle point of Pinellas County shoreline. This shortening of the surge model, as mentioned in the Introduction above, reduces the historical hurricane number from 26 to 12 (54% reduction). Table C14.1 lists the 12 historical hurricanes in the 200 n. mi. The probability distributions of the hurricane parameters for the12 hurricanes are shown in Figures c14.1 to c14.9. The Δp versus R plot in Figure c14.6 shows no clear indication of correlation due to lack of sufficient data points and thus the very mild Δp-R correlation box as depicted in the figure was used in this case.

Table C14.2 shows the analyses results.

TABLE C14.1
SUMMARY OF HISTORICAL HURRICANES AFFECTING PINELLAS COUNTY
FROM 1900 TO 1978

#	Date	Name	θ_N (degrees)	Y_F (n.mi.)	V_F (knots)	Δp (in.Hg)	R (n.mi.)	Type
1.	10/25/1921		235.0	10.0	10.0	-1.71	18.0	L
2.	09/18/1926		119.0	-90.0	12.0	-1.86	17.0	E
3.	09/17/1928		120.0	-10.0	12.0	-1.58	N/A	E
4.	09/28/1929		146.0	(43.0)	10.0	-1.22	N/A	A
5.	09/04/1933		120.0	-5.0	11.0	-1.40	29.0	E
6.	09/03/1935		156.0	(26.0)	9.0	-2.23	6.0	A
7.	10/19/1944		195.0	-50.0	13.0	-1.86	27.0	L
8.	06/24/1945		243.0	52.0	11.0	-0.97	N/A	L
9.	08/27/1949		130.0	-40.0	14.0	-1.60	23.0	E
10.	09/05/1950	Easy	230.0	60.0	3.0	-1.50	15.0	L
11.	06/04/1966	Alma	147.0	(36.0)	18.0	-1.15	23.0	A
12.	10/19/1968	Gladys	235.0	70.0	10.0	-1.01	21.0	L

Landfalling Hurricanes = 5; Alongshore Hurricanes = 3; Exiting Hurricanes = 4
Note: N/A = Not Available

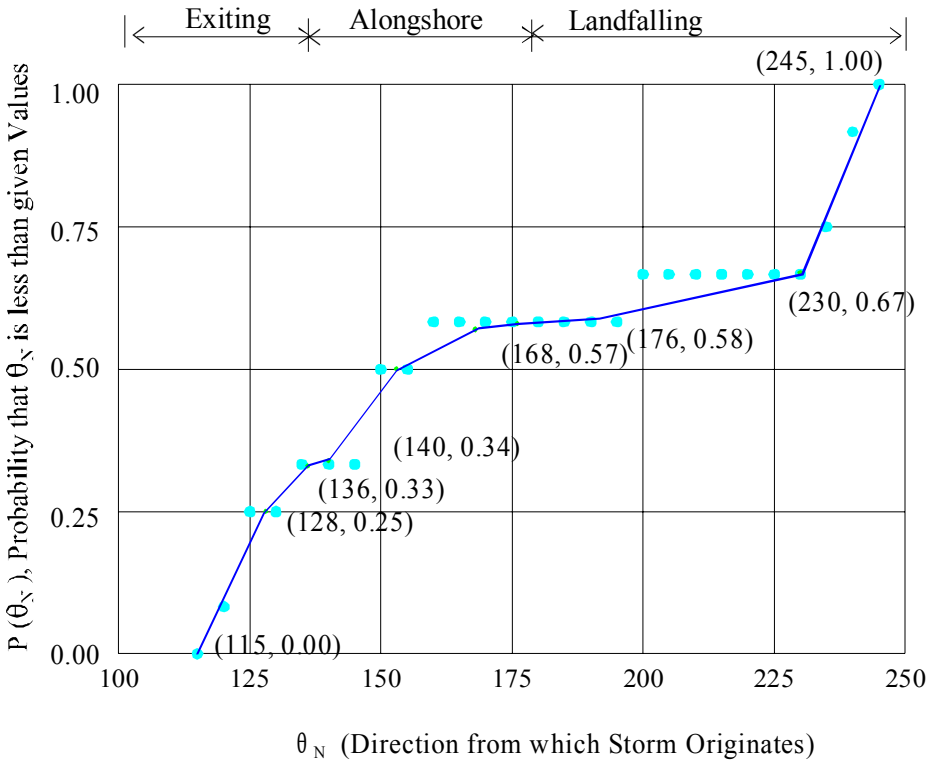

Figure c14.1 Cumulative Probability Distribution of Hurricane Track Direction, θ_N

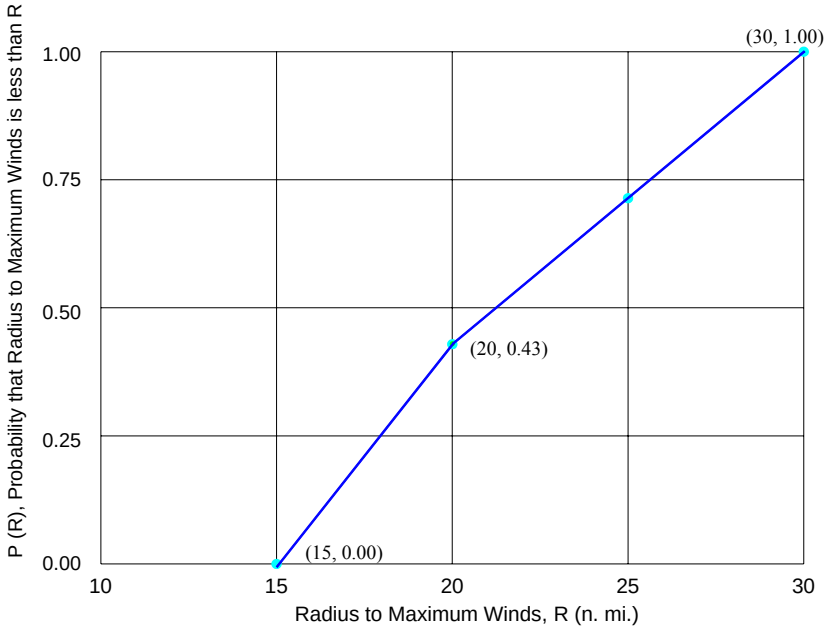

Figure c14.2 Cumulative Probability Distribution of Radius to Maximum Winds, R, for Landfalling and Exiting Hurricanes

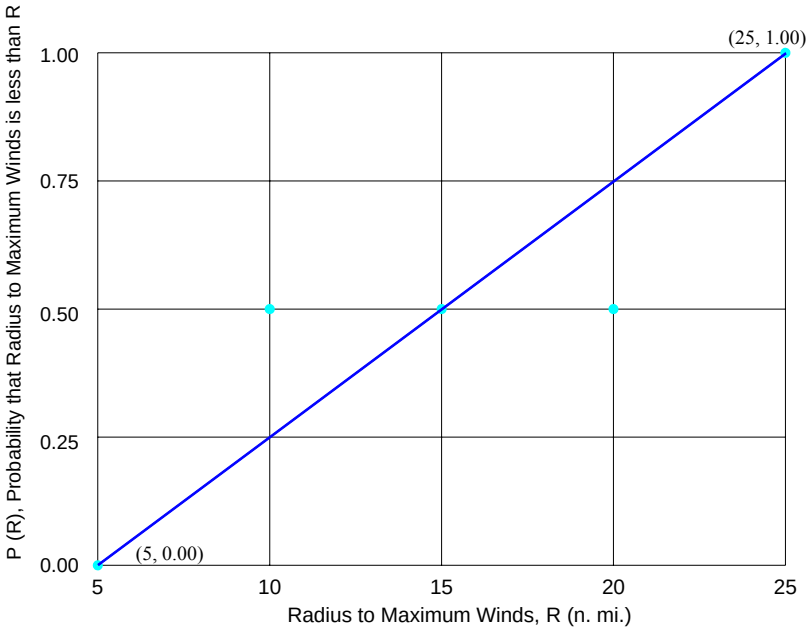

Figure c14.3 Cumulative Probability Distribution of Radius to Maximum Winds, R, for Alongshore Hurricane

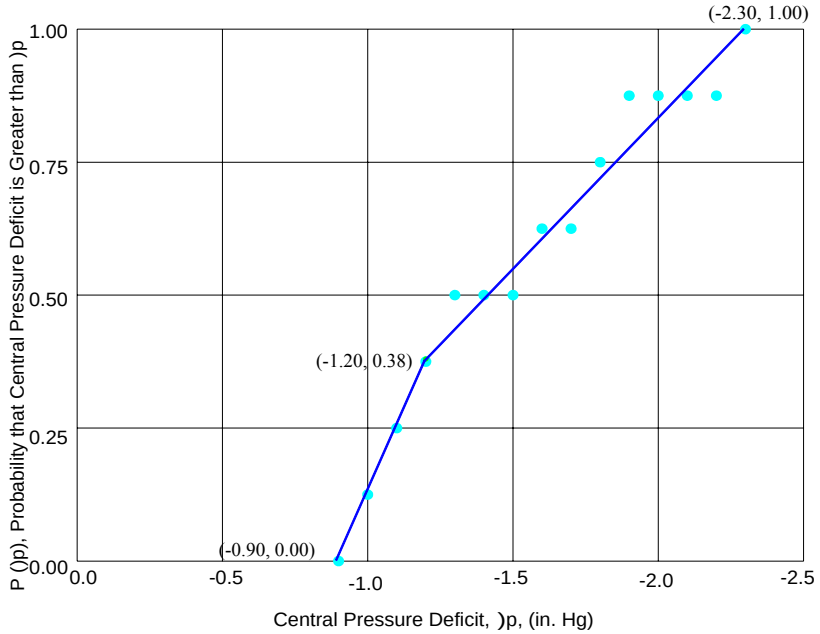

Figure c14.4 Cumulative Probability Distribution of Central Pressure, Deficit, Δp, for Landfalling and Alongshore Hurricanes

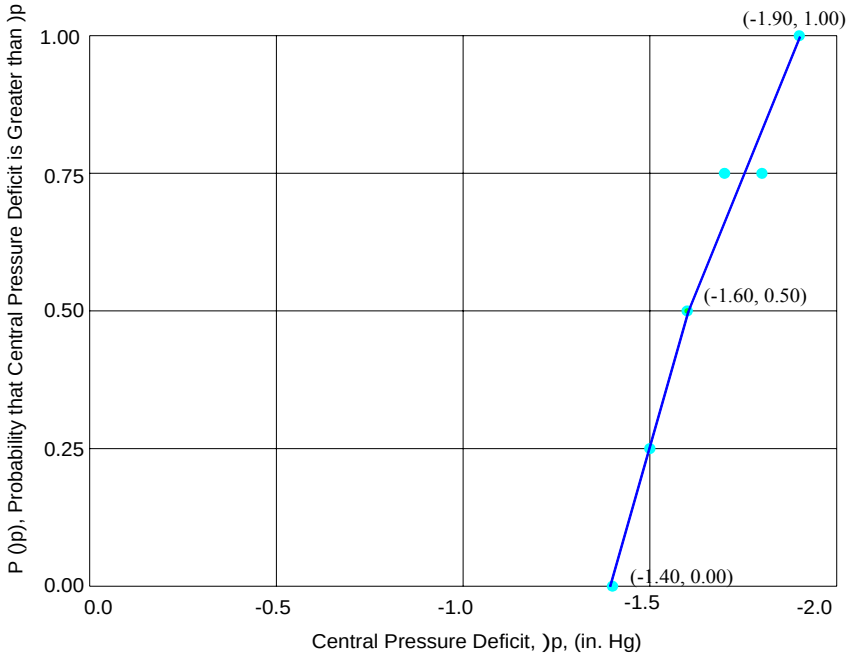

Figure c14.5 Cumulative Probability Distribution of Central Pressure Deficit, ∆p, for Exiting Hurricanes

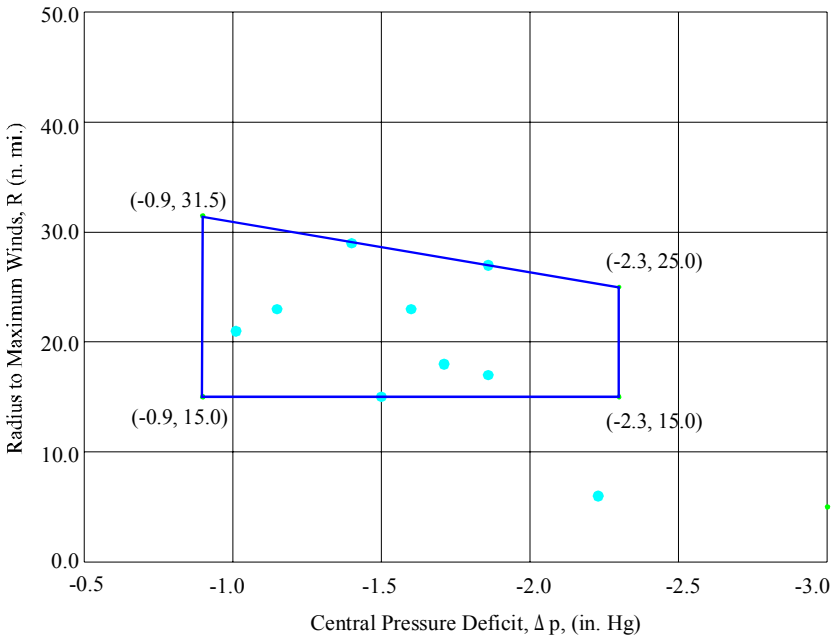

Figure c14.6 Historical Trend of Central Pressure Deficit, ▵p, and Radius to Maximum Winds, R, for Hurricanes

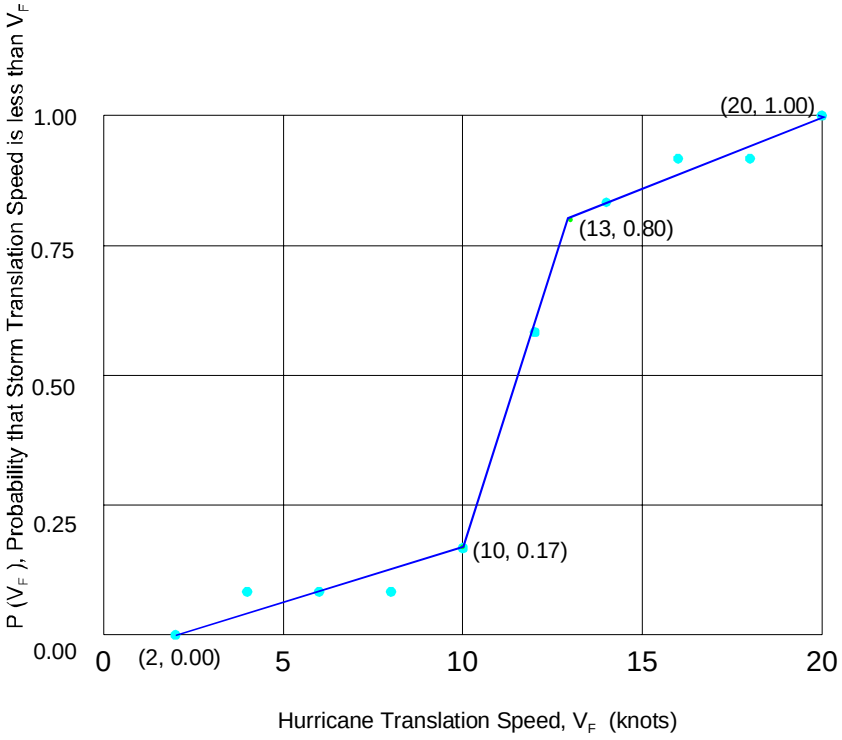

Figure c14.7 Cumulative Probability Distribution of Hurricane Translation Speed, V_F, for Landfalling, Alongshore and Exiting Hurricanes

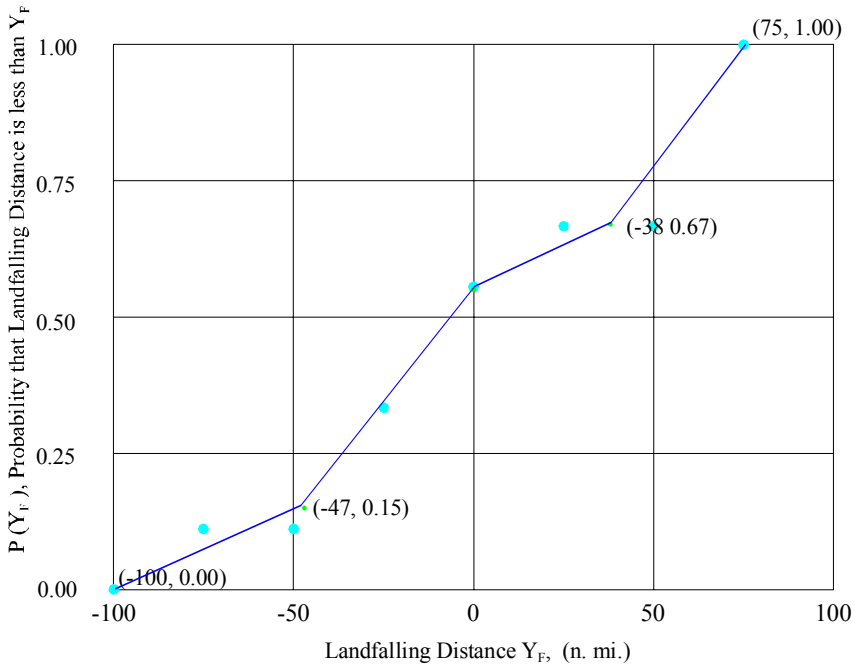

Figure c14.8 Cumulative Probability Distribution of Landfalling Distance, Y_F, for Landfalling and Exiting Hurricanes

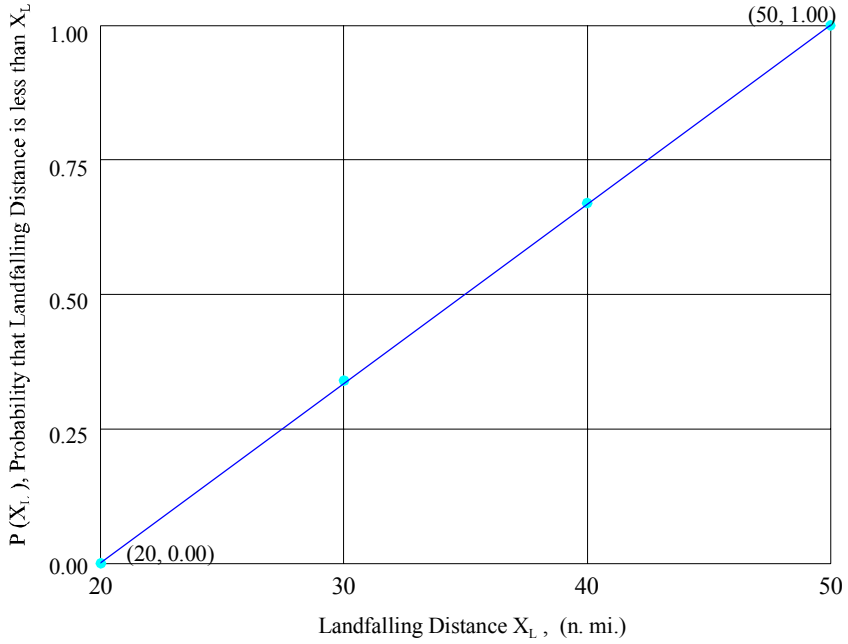

Figure c14.9 Cumulative Probability Distribution of Offshore Distance, X_L, for Alongshore Hurricanes

Table C14.2
Combined Total Storm Tide Values for Various Return Periods for Case 14

Return Period, TR (years)	Combined Total Storm Tide Level* above NGVD (ft.)						
	Profile 1	Profile 1a	Profile 2	Profile 2a	Profile 3	Profile 3a	Profile 4
500	14.8	13.5	13.6	14.4	14.6	14.3	13.8
200	13.0	11.7	11.7	12.6	12.8	13.0	12.0
100	11.1	10.2	10.1	11.0	11.2	11.1	10.3
50	9.1	8.3	8.4	9.4	9.7	9.5	8.3
20	6.3	5.8	5.9	7.4	7.8	7.5	6.2
10	3.1	3.2	3.2	4.3	4.8	4.6	3.8

CASE 15

This case is the same as Case 14 except that the Δp-R correlation as shown in Figure c14.6 was not used. Table C15.1 below shows the results of the analyses.

Table C15.1
Combined Total Storm Tide Values for Various Return Periods for Case 15

Return Period, TR (years)	Combined Total Storm Tide Level* above NGVD (ft.)						
	Profile 1	Profile 1a	Profile 2	Profile 2a	Profile 3	Profile 3a	Profile 4
500	15.5	14.0	14.0	14.9	15.2	14.8	14.1
200	13.3	12.0	12.1	12.8	13.1	13.1	12.2
100	11.4	10.4	10.3	11.1	11.5	11.3	10.5
50	9.1	8.4	8.5	9.4	9.7	9.4	8.4
20	5.9	5.7	6.0	7.1	7.5	7.2	6.2
10	2.7	3.0	2.9	3.7	4.1	4.1	3.3

SUMMARY AND CONCLUSION

The 100-year frequency storm tides as shown in Tables C14.2 and C15.1 were combined with Table A1 in Addendum A to form Table B1. The effects of reducing the surge model size from 300 n. mi. to 200 n. mi. did not affect the 100-year frequency storm tides with any significance for Pinellas County as shown in Case 1 and Case 14. The order of highest magnitude of change is ± 0.4 ft. at the northernmost and the southernmost transect lines.

Figure b1 shows the cumulative probability distributions of landfalling distance, Y_F, for Case 1 and Case 14. It clearly shows that the reduction of the 100 n. mi. of the southern hurricane prone area of the surge model changes the cumulative probability distribution considerably. With the model at 300 n. mi. wide, 658 hurricanes in 2,000 years were simulated to obtain the storm tide frequencies as shown in Case 1. There are 582 landfalling and exiting hurricane among the 658 hurricanes. Sixty-three percent (367 hurricanes) of the 582 hurricanes are landfalling or exiting beyond 100 n. mi. from the middle point of the Pinellas County shoreline. Eliminating the southern 100 n. mi. of hurricane prone area of the model reduces the sample size from 26 to 12 hurricanes. 304 hurricanes in 2,000 years are simulated with the 200 n. mi. wide model. Among the 304 hurricanes, 228 are landfalling and exiting hurricanes which are all landfalling or exiting at 100 n. mi. or less form the middle point of the Pinellas County shoreline. It is clear that the Y_F parameter plays the role of balancing the effect of model size, i.e. a larger model has more hurricanes, but most of them are landfalling or exiting far from the site of interest; a small model has less hurricanes, but they are all landfalling or exiting close to the site of interest. So these two conditions produce almost the same storm tide for a specific site. As stated in Case 7, extension of the model length to obtain more historical hurricanes does not unduly change the storm tide levels for a specific location, but improves the cumulative probability distributions of the hurricane parameters. One of the examples is the Δp-R correlation as shown in Figure b2. With only nine available data points (Three R parameters of the 12 hurricanes are unavailable.), it is difficult to see any Δp-R correlation. Another example is the limited range of radius to maximum winds, R, for landfalling and exiting hurricanes as shown in Figure b3. The range for R is from 5 to 40 n. mi. in Case 1 and only from 15 to 30 for Case 14. The third example is the central pressure deficit, Δp, for exiting hurricanes as shown in Figure b4. The range for Δp is from -1.0 to -2.5 in. (Hg.) in Case 1 and only from -1.4 to -1.9 in. (Hg.) for Case 14. These limited numbers of data points leave the cumulative probability distributions less than well defined and may have contributed to the minor storm tide elevation differences in Case 1 and Case 14.

Based on the results of the analyses, it is concluded that the surge model can predict the 100-year frequency storm tide elevations with good accuracy, even in greatly limited value ranges of historical hurricane parameters due to a shortening of the model length. But a small sample of historical hurricanes produces a set of cumulative probability distributions which are not well defined and thus may cause some minor changes in the simulation results.

Table B1
A SUMMARY OF 100-YEAR FREQUENCY STORM TIDE ANALYSES

Case	Profile							Hurricane/ Storm	R - ΔP Correlation
	1	1a	2	2a	3	3a	4		
1	11.5	10.2	10.0	11.2	11.5	11.2	9.9	26 hurricanes / 79 years	as original report
2	11.5	10.0	9.9	11.2	11.7	11.3	10.1	as Case 1	rectangular R - ▵p
3	12.1	10.7	10.6	11.8	12.0	11.7	10.5	as Case1	non
4	11.9	11.2	11.6	12.4	12.8	12.4	11.1	26 hurricanes + 30 storms / 79 years	extended R-▵p of Case 1 to: ▵p = −0.18", R = 44 n. mi.
5	11.9	11.2	11.6	12.6	12.9	12.5	11.2	as Case 4	rectangular R - ▵p
6	12.5	11.8	12.1	12.9	13.6	13.3	11.6	as Case 4	non
7	10.7	9.5	9.6	10.5	10.8	10.6	9.4	27 hurricanes / 100 years	as original report
8	10.8	9.5	9.5	10.7	10.9	10.7	9.5	as Case 7	rectangular R - ▵p
9	11.3	10.1	10.2	11.1	11.4	11.1	9.9	as Case 7	non
10	11.6	10.5	10.5	11.9	12.3	12.1	10.5	27 hurricanes + 37 storms / 100 years	extended R-▵p of Case 1 to: ▵p = −0.18", R = 44 n. mi.
11	11.7	10.3	10.6	11.8	12.2	12.1	10.4	as Case 10	rectangular R- ▵p
12	12.0	10.9	11.1	12.2	12.6	12.4	11.1	as Case 10	non
14	11.1	10.2	10.1	11.0	11.2	11.1	10.3	12 hurricanes / 79 years / 200 n.mi	new R- ▵p correlation
15	11.4	10.4	10.3	11.1	11.5	11.3	10.5	As Case 14.	non
AVE.	11.6	10.5	10.6	11.6	12.0	11.7	10.4		

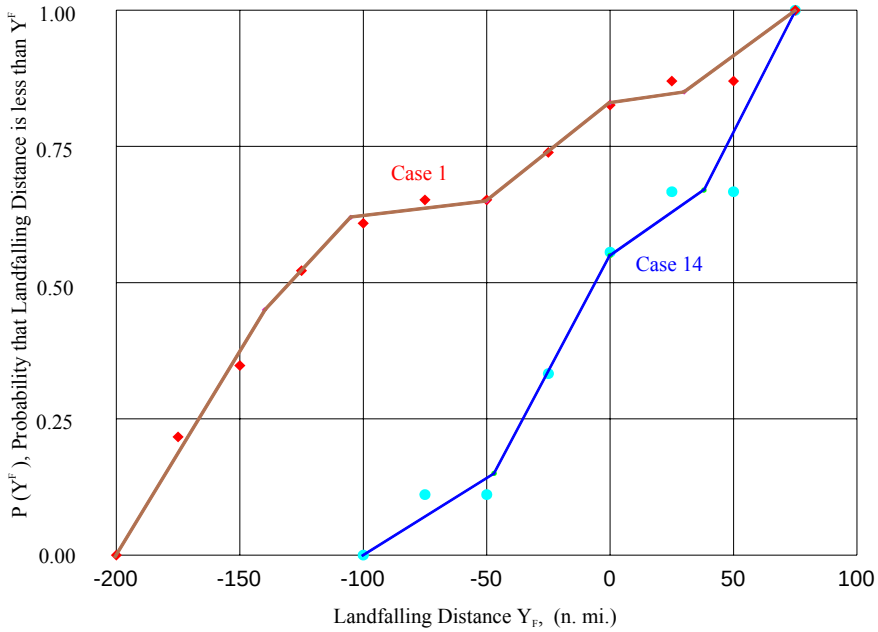

Figure b1 Comparison of Cumulative probability Distributions of Landfalling Distance, Y_F, for Landfalling and Exiting Hurricanes between Case 1 and Case 14

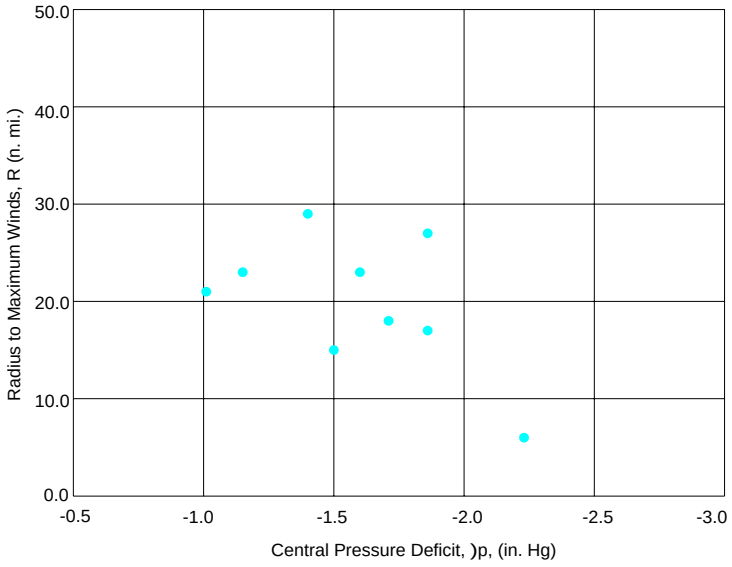

Figure b2 Historical Trend of Central pressure Deficit, ∆p, and Radius to Maximum Winds, R, for Hurricanes

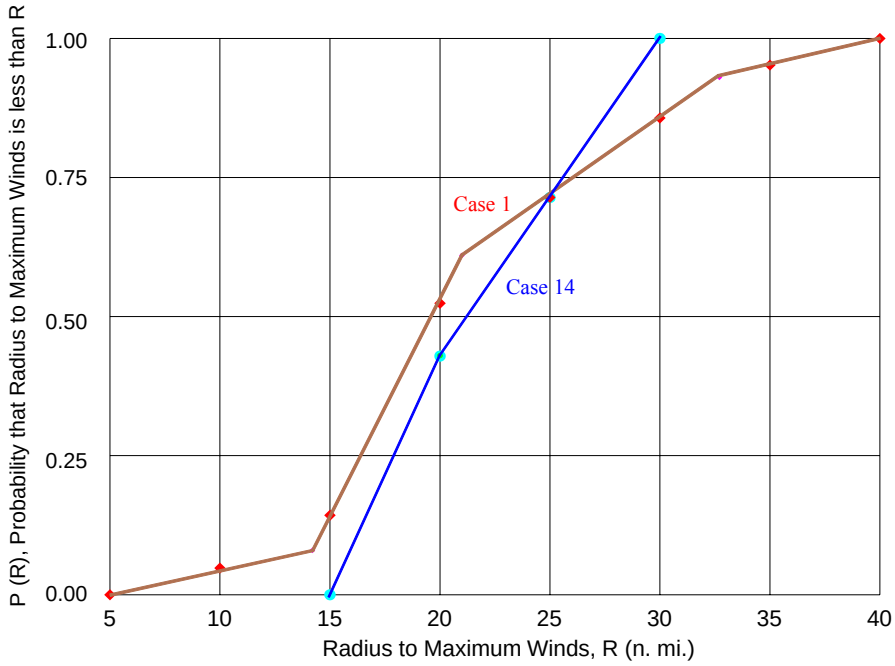

Figure b3 Comparison of Cumulative Probability Distributions of Radius to Maximum Winds, R, for Landfalling and Exiting Hurricanes between Case 1 and Case 14

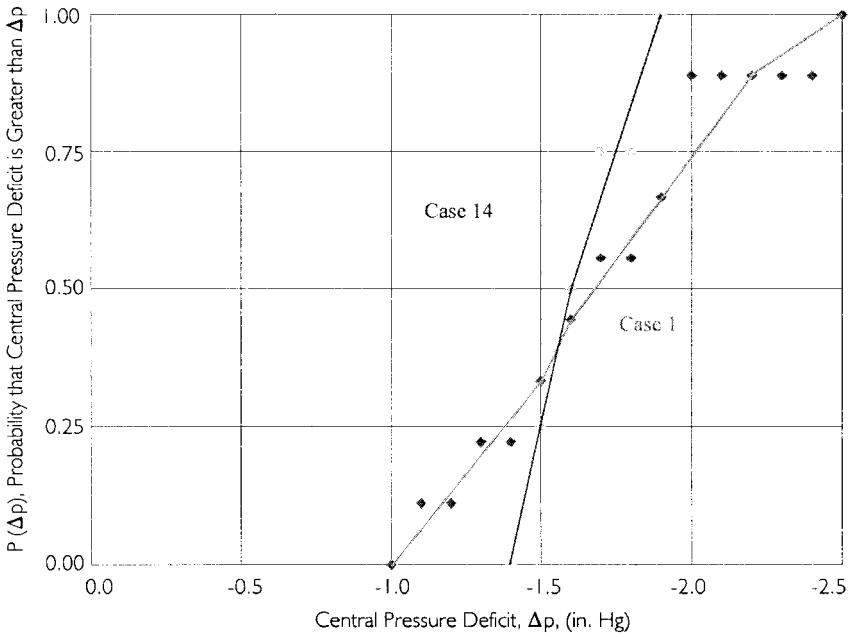

Figure b4 Comparison of Cumulative Probability Distributions of Central Pressure Deficit, Δp, for Exiting Hurricanes between Case 1 and Case 14