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A Note on the Radius of Maximum Wind for Hurricanes

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ABSTRACT

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Studies of wind waves in the shallow water require the input of deep water wave characteristics. Under hurricane conditions, a parameter called the radius of maximum wind, R, is needed for deep water wave generation. Although literature states that the typical value of R is either 40 or 50 km, it has not been quantified. This brief note is to provide the R values as a function of the Saffir/Simpson hurricane classification. On the basis of 59 hurricanes from 1893 through 1979 affecting the U.S. coastline as compiled by Simpson and Riehl, 90% fall between categories 2 and 4 having a composite mean R = 48 km with a standard deviation of only 3 km. Since only 8% and 2% sample remain for Categories 1 and 5, respectively, the statistical results are not recommended; however use of the generic formula to obtain R should be employed. The composite mean of 47 km for all hurricanes as compiled with central pressures between 909 and 993 mb is obtained, which quantifies the literature value.

ADDITIONAL INDEX WORDS: *Hurricanes, maximum winds, Saffir/Simpson, central pressure.*

Under hurricane conditions, a parameter called the radius of maximum wind, R, defined as the radial distance from the storm center to the region of maximum windspeed, has been used extensively in deep water wave studies (see U.S. ARMY CORPS OF ENGINEERS, 1984, pp. 3-81 to 3-84). SIMPSON and RIEHL (1981, pp. 98–99) describe R as a well-formed inner ring of maximum wind which encircles the eye at a variable distance averaging perhaps 50 km, while ANTHES (1982) states that the typical R = 40 km. More precisely, however, according to HARRIS (1958), R should be obtained through the following equations whenever pertinent data are available:

$$\frac{P - Po}{Pn - Po} = \mathrm{Exp}(-R/r) \quad (1)$$

or

$$R = r \ln\{(Pn - Po)/(P - Po)\} \quad (2)$$

where P is the pressure at a point located at a distance r from the storm center, Po is the central pressure, and Pn is the pressure at the outskirts of the storm.

The purpose of this brief report is to provide coastal scientists with a more precise value of R as a function of hurricane classification so that better deep water significant wave height and period can be estimated, since the real time value of R is not always readily available.

In order to do this, a comprehensive data set having both values of central pressure and R is employed (see SIMPSON and RIEHL, 1981, Table 36). A total of 59 hurricanes from 1893 through 1979 affecting U.S. coastlines has been compiled. This data set is further analyzed according to the Saffir/Simpson hurricane classification. The result is shown in Table 1. It can be seen that the mean R for hurricane Cate-

Table 1. *Results of mean and standard deviation for the radius of maximum wind as a function of Saffir/Simpson hurricane scale based on the data set provided in Simpson and Riehl (1981, Table 36).*

Hurricane Category	Central Pressure Po, mb	Mean R, km	Standard Deviation R, km	Number of Hurricanes
1	≥980*	34	13	5
2	965–979	46	22	15
3	945–964	51	26	27
4	920–944	48	40	11
5	<920**	19		1
Composite***	909–993	47	27	59

*Po between 986 and 993 mb
**Po = 909 mb
***All 59 hurricanes between 909 and 993 mb were taken into account regardless of their Po value

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gory 1 is 34 km, Categories 2, 3, and 4 are 46, 51 and 48 km, respectively, and Category 5 is 19 km. Therefore, since the variation of R value within Categories 2 through 4 is small and since 53 out of 59 cases or 90% of the hurricanes fall within these categories, the composite mean and standard deviation from these three values of 46, 51 and 48 for R, *i.e.*, (48 ± 3) km, may be used operationally for Categories 2 through 4. However, since the number of hurricanes incorporated in Category 1 is 5 and Category 5 is 1, their statistical mean is not recommended for use. Instead, the generic formula given in Eq. (2) should be applied. If the real time hurricane data such as P, Po, Pn, and r are not available and a quick estimate of R is needed, the composite mean for all R studied shown in the last row of Table 1 (47 km) may be used. This value is also in reasonable agreement with the statements made by SIMPSON and RIEHL (1981) and ANTHES (1982).

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