Journal of Coastal Research	16	2	494–495	Royal Palm Beach, Florida	Spring 2000

Discussion of: Hsu, S.A. and Yan, Z. 1998. A Note on the Radius of Maximum Wind for Hurricanes. *Journal of Coastal Research*, 14(2), 667–668.

Alexander M. Kerr

Osborn Memorial Laboratories
Yale University
New Haven CT 06520-8106 USA
alexander.kerr@yale.edu

Estimating aspects of the wave spectra of severe tropical cyclonic storms (hurricanes, typhoons and cyclones) has important coastal-engineering applications, as well as the potential to inform studies of marine ecology (KJERFVE *et al.*, 1986) and coral-reef geomorphology (BLANCHON, 1997). However, accuracy in reconstructing a hurricane-generated wave field via a widely used non-spectral model (BRETSCHNEIDER and TAMAYE, 1976; U.S. ARMY CORPS OF ENGINEERS, 1977) depends on an estimate of the radial surface-wind profile. In turn, the wind profile is defined by shape parameters often derived from a frequently unavailable observation: the distance from the storm's center to the zone of maximum winds, or radius of maximum winds R. Surprisingly, neither R nor other information from which to derive wind profiles is included in synoptic track archives.

In the absence of readily available information about R with which to hindcast hurricane waves, there exist few recommendations about how to proceed. The value of R varies widely between storms, as well as along each storm track, and is at most only weakly correlated with routinely reported observations (HOLLAND, 1980; SCHWERDT *et al.*, 1979). As a consequence, numerous authors (*e.g.*, SIMPSON and RIEHL, 1981; ANTHES, 1982; RUPP and LANDER, 1996) suggest using an average of recorded values, often given as between 40 and 50 km. Most recently, HSU and YAN (1998), provide a value of 48 km based on published measurements of R for Atlantic hurricanes of moderate intensity. In this note, I show that their derivation is unfortunately incorrect and that when corrected, their method still cannot, even in principle, provide a more useful estimate than those suggested by previous authors.

HSU and YAN (1998), employing data on 59 Gulf-coast and Atlantic hurricanes (Figure 1) published in SIMPSON and RIEHL (1981), first binned recorded values of R according to ranges of central pressures that define each of the five categories on the Saffir/Simpson scale of hurricane intensity. The advantage of this methodology is unclear. The Saffir/Simpson scale was developed to provide agencies a way of gauging anticipated preventive and response measures, as well as degree of structural damage (SIMPSON, 1974; SIMPSON and RIEHL, 1981); it provides no insight into hindcasting wind and waves.

Nevertheless, with the discretized data, the authors go on to find a relationship between central pressure and R. But as shown previously (HARRIS, 1958; HOLLAND, 1980; SIMPSON and Riehl, 1981), R depends on pressure gradients, not on central pressure. Using linear regressions and data on 122 hurricanes (Figure 1), SCHWERDT *et al.* (1979), sought potential associations between R and storm central pressure, as well as latitude, forward velocity and track direction. Together, these variables explained no more than 33% of the variation in observed R, with central pressure alone accounting for less than 8% (SCHWERDT *et al.*, 1979). The apparent relation that Hsu and Yan find between central pressure and R is undoubtedly due to the increased sampling error of their smaller data set.

Following their binning procedure, Hsu and Yan derive a mean and standard deviation for each category of hurricane intensity. Then, excluding categories 1 and 5 because of small sample size and to control for the perceived relation between pressure and R, the authors compute from the means of categories 2 through 4 an unweighted grand mean for R (their "composite mean"), as well as a standard error (their "standard deviation"). In addition to their misleading use of terms and failing to weight for sample size in each category, another important problem exists with their statistical approach. The distribution of their data is asymmetrical and skewed to the right (Figure 1). This results in their untransformed grand mean providing a biased estimate of the data given what they have set out to do. The ultimate goal of the estimation procedure is to find the value in a distribution (*i.e.*, the estimated R) that best approximates a randomly chosen but unknown member of the same distribution (the unknown R of a hindcasted storm). But since the data are right skewed, the few large R weight their estimate towards the less prob-

00002 received and accepted in revisions 7 January 2000.

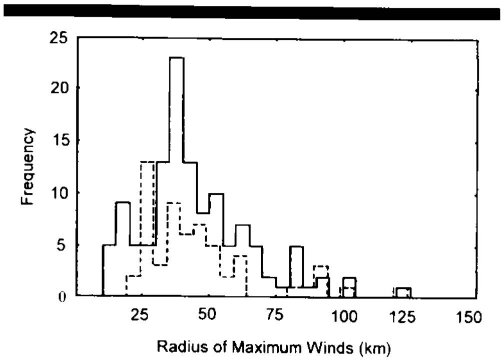

Figure 1. Frequency distributions of radius of maximum wind R (km) from Atlantic and Gulf-coast hurricanes. Data from SIMPSON and RIEHL (1981): dashed line, $n = 59$; and from SCHWERDT *et al.* (1979): solid line, $n = 122$. Data slightly offset for clarity.

able right tail of the distribution. In this situation, the appropriate measure is a geometric mean, which for Hsu and Yan's data is 41.25 km, rather less than their value of 48 km.

Finally, Hsu and Yan offer their estimate as a "more precise" estimate of R. However, increased precision of a poor estimator (mean R) is not needed. The estimate they derive cannot give "better [predictions of] deepwater significant wave height and period" than those suggested previously, since their method also cannot account for the considerable observed variation in R (Figure 1). I applaud Hsu and Yan for recognizing an important shortcoming of synoptic best-track archives as a tool for hindcasting wind and waves and share their desire to improve hindcasting procedures. However, greater accuracy (*contra* precision) in hindcasting waves can only come at the cost of obtaining more information about the shape of the radial wind profile of which R is only a maximum. To this end, there are efforts currently underway to develop a best-track database that incorporates just such additional information (C. Landsea, *personal communication*).

LITERATURE CITED

BLANCHON, P. 1997. Architectural variation in submerged shelf-edge reefs: the hurricane-control hypothesis. *Proceedings of the Eighth International Coral Reef Symposium*, 1, 547–554.

BRETSCHNEIDER, C.L. and TAMAYE, E.E. 1976. Hurricane wind and wave forecasting techniques. *James K.K. Look Laboratory Technical Report* (Department of Ocean Engineering, University of Hawaii and U. S. Department of Energy), 6, 1–29.

HARRIS, D.L. 1958. Meteorological aspects of storm surge generation. *Journal of the Hydraulics Division* (ASCE), 1859 (HY7), 1–25.

HOLLAND, G.R. 1980. An analytical model of wind and pressure profiles in hurricanes. *Monthly Weather Review*, 108, 1212–1218.

KJERFVE, B.; MAGILL, K.E., PORTER, J.W., and WOODLEY, J.D. 1986. Hindcasting of hurricane characteristics and observed storm damage on a fringing reef, Jamaica, West Indies. *Journal of Marine Research*, 44, 119–148.

RUPP, J.A. and LANDER, M.A. 1996. A technique for estimating recurrence intervals of tropical cyclone-related high winds in the tropics: results from Guam. *Journal of Applied Meteorology*, 35, 627–637.

SCHWERDT, R.W.; HO, F.P., and WATKINS, R.R. 1979. Meteorological criteria for standard project hurricane and probable maximum hurricane windfields, Gulf and east coasts of the United States. *NOAA Technical Report NWS* 23:1–315.

SIMPSON, R.H. 1974. The hurricane disaster potential scale. *Weatherwise* 27:169, 186.

SIMPSON, R.H. and RIEHL, H. 1981. *The Hurricane and Its Impact*. Louisiana State University Press, Baton Rouge Louisiana USA.

U.S. ARMY CORPS OF ENGINEERS. 1984. *Shore Protection Manual*. Vicksburg, Massachussetts.