Appendix E: HURASIM Model Description

HURASIM is a spatial simulation model of hurricane structure and circulation for reconstructing estimated windforce and vectors of past hurricanes. The HURASIM model generates a matrix of storm characteristics (i.e., quadrant, windspeed, and direction) within discrete spatial units and time intervals specified by the user for any specific storm or set of storms. HURASIM recreates the spatial structure of past hurricanes based on a tangential wind function, inflow angle offset, forward speed, and radius of maximum winds. Figure E.1 (below) shows the graphic user interface of the HURASIM model for a windfield reconstruction of Hurricane Katrina (2005) making landfall southeast of New Orleans, LA. Data input for the model includes tracking information of storm position, latitude and longitude, and maximum sustained wind speed every six hours or less. The model offers a suite of mathematical functions and parameter sets for the tangential wind profile taken from other hurricane studies (Harris, 1963; Bretschneiger and Tamaye, 1976; Neumann, 1987; Kjerfve et al., 1986; Boose et al., 1994). The user can specify the set of functions that provide more or less robust constructions of the range and extent of estimated winds.

Model output is user-specified for given geographic locations assigned by a given point or boundary area. Latitude and longitude for each study site location was supplied to the model to create a log of hurricane activity at 15-minute intervals for predicted winds above 30 mi/h for the period of record (1851-2003). The model estimates a suite of storm characteristics (i.e., quadrant, wind speed, and direction) within discrete spatial units and time intervals specified by the user for designated storms, years, and study site locations. Profiles of estimated wind conditions for a given site application are stored by year and storm. Time intervals of storm reposition and speed for this study were generated every 15 minutes. Minimum conditions of windspeed or distance can be set to parse the data output if warranted. In this study, windspeed estimates for any point or grid location were retained for further analysis if greater than 30 mi/h or tropical depression status.

HURASIM has been used extensively for field and modeling studies to relate biological response to hurricane forcing. HURASIM model output from Hurricane Andrew was correlated with field data to construct data tables of damage probabilities by site and species and to determine critical windspeeds and vectors of tree mortality and injury (Doyle et al., 1995a, 1995b). HURASIM also has been applied to reconstruct probable windfields of past hurricanes for remote field locations and correlated with tree-ring growth patterns and direction of leaning trees and downed logs (Doyle and Gorham, 1996). HURASIM also has been used to construct landscape templates of past hurricane activity that are linked with landscape simulation models of coastal habitat (Doyle and Girod, 1997).

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Figure E.1 Graphic user interface of the HURASIM model displaying storm track and windfield reconstruction of Hurricane Katrina (2005) at landfall south of New Orleans, LA. Grid cell color schemes represent different categories of storm strength and a directional line of wind direction.