

The Science and Policy of Natural Hazards

Problem Set 2

1. Consider an idealized, axisymmetric, steady hurricane at a latitude where the Coriolis parameter is f and suppose that the periphery of the hurricane (where the winds vanish) is at a distance r_o from the center. Suppose that air begins flowing inward at r_o and that by the time it reaches the radius of maximum winds, it has lost 75% of its initial angular momentum. Assume that the maximum wind speed is given by the thermodynamic bound V_{max} . Find the radius of maximum winds in terms of V_{max} , f , and r_o . What would happen if air tried to flow inward of the radius of maximum winds? On this basis, can you say something about the existence of hurricane eyes?
2. The Saffir-Simpson scale was devised largely by an engineer to help quantify the destructive potential of hurricane winds. The scale is given as follows:

Cat	Wind Speed (MPH)	Storm Surge (ft)
5	≥156 (≥250)	>18 (>5.5)
4	131–155 (210–249)	13–18 (4.0–5.5)
3	111–130 (178–209)	9–12 (2.7–3.7)
2	96–110 (154–177)	6–8 (1.8–2.4)
1	74–95 (119–153)	4–5 (1.2–1.5)

Studies show that the actual destruction caused by a hurricane tends to vary as

$$D \approx (V - 50)^3, \quad (1)$$

where V is the peak wind speed given in MPH. Now suppose that the frequency f of hurricanes were independent of wind speed. Plot $f \times D$ (the total destruction integrated across all the wind storms) integrated across each category as a function of the category. (For this purpose, you may assume that category 5 is bounded above by 200 MPH). Do this again for the more realistic case that f varies as V^{-1} . Now comment about the design of the Saffir-Simpson scale...could it be improved?

- 3.** Pick an historical U.S. hurricane that caused significant damage and/or loss of life and describe its meteorological history, including where it formed, how it moved, where it made landfall, and what kind of warnings may have been issued. Also describe the damage it caused as well as human casualties, if they occurred. If possible, suggest how policies then in place might have contributed to or mitigated the adverse effects of the storm.

MIT OpenCourseWare
<http://ocw.mit.edu>

12.103 Science and Policy of Natural Hazards
Spring 2010

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.