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HYPERCANES FOLLOWING THE GENESIS FLOOD

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KEYWORDS:

Hurricane, Hypercane, Mesoscale Meteorology Model, MM5, Florence, VIS5D, Flood, Gulf of Mexico, Yucatan Peninsula, New Orleans.

ABSTRACT

If the geologic processes of the Genesis Flood were as catastrophic as Biblical and scientific evidence suggests, the oceans would have been strongly heated by the release of magma from the mantle and the conversion of geologic work to heat. During and following the Flood, tremendous quantities of heat and water vapor would have been released into the atmosphere from the oceans. Local weather and global climate would have been dramatically altered for many years.

Kerry Emanuel of the Massachusetts Institute of Technology suggests that hurricanes would intensify beyond normally observed intensities today if they existed over unusually warm water for extended periods of time. He calls these hurricanes, which could have horizontal winds exceeding 300 mph, *hypercanes*. They can be simulated in numerical mesoscale meteorology models when the sea-surface temperature is increased to temperatures warmer than about 30°C.

This paper will explore the rate of development and intensity to which such hurricanes can reach when sea-surface temperatures are warmer than typically observed today. The amplification of Florence, a weak hurricane which formed in the Gulf of Mexico and moved northward toward New Orleans in 1988, is simulated by artificially setting the sea-surface temperature over a large area of the Gulf to 45°C, about 15°C warmer than the warmest waters in the tropics. The simulated *hypercane* immediately formed deep convection, dramatically increased its rate of rotation, quadrupled its vertical and horizontal winds, and increased its precipitation rate by a factor of about ten over that of the actual hurricane.

It will be shown that warmer sea-surface temperatures likely during and following the Genesis Flood for many years would have produced *hypercanes* with great destructive power which could have continued the devastation over continental areas. Extreme precipitation events on the tropical continents for several hundred years after the Flood may have eroded large areas of unconsolidated sediments. In mid-latitude, polar, and high mountainous regions *hypercanes* probably would have contributed significantly to the accumulation of snow and ice during the “ice age”.

It is recommended that simulations of hypercanes over the open ocean and for cooler sea-surface temperatures be conducted and the size to which they grow be identified. It is further recommended that the impact of heavy precipitation, winds, and storm surges be studied on the erosion of unconsolidated land masses near continental boundaries. Also, the contribution of hypercanes to the formation of ice sheets and glaciers during the ice age should be explored.

INTRODUCTION

Woodmorappe [15] introduced *hypercanes* to the creationist community when he suggested that they might be the cause of the 40-day rainfall of the global Flood. He concluded that if they actually formed during the early stages of the Flood at an appreciable frequency, *hypercanes* would have served as a very effective mechanism. Although I have little doubt that during the Genesis Flood *hypercanes* were formed, I suspect that the events were so catastrophic that even more violent processes like jets of supersonic steam were vented to space and the atmosphere as suggested by Baumgardner [2]. The problem during the Flood may not have been the lack of energetics to loft water into the atmosphere to explain the 40 days and nights of rain, but, rather, how so much energy could have been released from geologic processes without boiling the entire ocean off the planet.

My interest in this paper is not in exploring the violent processes during the Flood, but, rather, those near the end and following the Flood. The numerical models to which I have access would probably not perform well under the extreme conditions of the Flood. They are more suitable for conditions after the Flood, and even then, may numerically “blow up”, as actually happened for one of the simulations at the hottest temperature attempted.

Emanuel [7,8,9,10,11] of the Massachusetts Institute of Technology suggests that hurricanes would intensify beyond normally observed intensities today if they existed over unusually warm water for extended periods of time. He calls these hurricanes, which could have horizontal winds exceeding 300 miles per hour, *hypercanes*. They can be simulated in numerical mesoscale meteorology models when the sea-surface is increased to temperatures warmer than about 30°C.

In 1988 a weak hurricane named Florence entered the Gulf of Mexico and moved northward until it intersected the Louisiana Gulf Coast near New Orleans. The winds in this hurricane remained relatively constant in the Gulf at about 75 mph until it died upon making landfall. George Lai [14] of NASA Goddard Laboratories used this hurricane to conduct numerical simulations because of its weak intensity and uniform behavior. He made the data and pre-processing files used at NASA available to the Institute for Creation Research (ICR) which was then able to conduct additional numerical research.

Simulations were conducted with the Mesoscale Meteorology Model (MM5) on Hurricane Florence when it was near the Yucatan Peninsula and headed towards New Orleans. The only change to the boundary conditions made in the simulations was to vary the sea-surface temperature and extend its lifetime. The actual sea-surface temperature for Hurricane Florence was about 30°C. Simulations were conducted for a period of 33 hours and for five different sea-surface temperatures of 30°C, 35°C, 40°C, 45°C, and 50°C. Results for only 45°C will be reported here. A graduate student is working on her masters degree at ICR addressing this topic and will report on the effect of temperature on hypercane development.

When references are made to the historical data and to simulations of Hurricane Florence using observed sea-surface temperatures, the storm will be identified by the name, Hurricane Florence. When simulations are conducted for sea-surface temperatures warmer than or equal to 30°C, the storm will be identified by the name, Hypercane Florence. Hurricane Florence was a real hurricane and the simulation using observed sea-surface temperatures and wind fields, accurately duplicated its actual intensity and storm track. Hypercane Florence is hypothetical.

SIMULATION SOFTWARE AND INITIAL AND BOUNDARY CONDITIONS

MM5 is a widely-used numerical model for simulating mesoscale features like hurricanes. It was developed by Pennsylvania State University [1] and is operated and supported by the National Center for Atmospheric Research (NCAR) [3, 4, 5]. ICR acquired a distribution copy of MM5 from NCAR and adapted it to run on a PC with a LINUX operating system. A data display package available over the Internet called VIS5D [13] was used to visualize the results of the simulation. Four of the images of the simulation are shown in Figs. 1-4 for 00, 06, 12, and 18Z (Greenwich mean time). Only four images are shown here, but Hypercane Florence was modeled from 00Z on 10 September 1988 through 09Z on 11 September 1988. Hypercane Florence is shown as viewed from above and from the south. The ocean surface is shown in gray and the terrain from low to high elevation is shown in shades of gray from dark to light. Cloud water content is shown in white and rainwater in light gray.

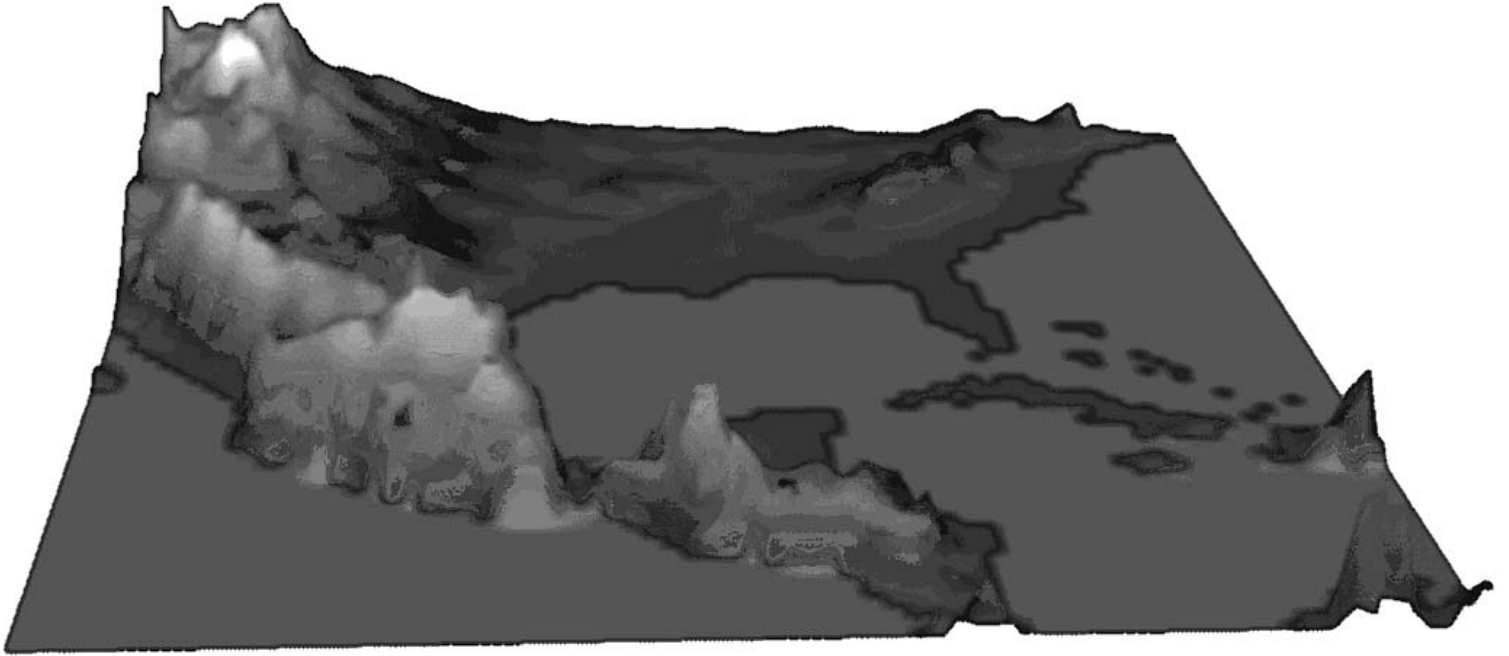


Figure 1. Perspective view of Hypercane Florence at 00Z on September 10, 1988 for a sea-surface temperature of 45°C . The cloud water content and precipitation water content did not exceed the display thresholds at this initial time.

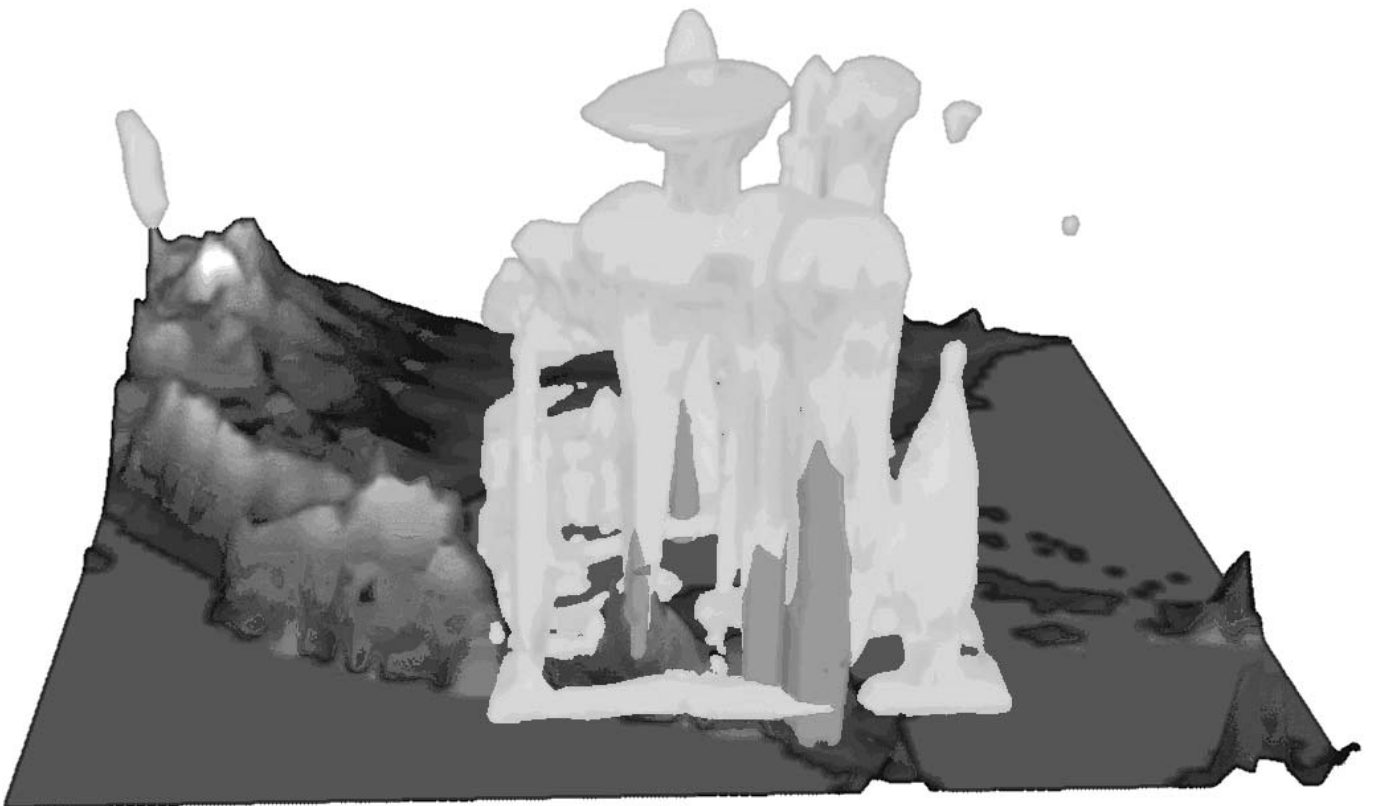


Figure 2. Perspective view of Hypercane Florence at 06Z on September 10, 1988 for a sea-surface temperature of 45°C . The white regions exceed the cloud water content threshold of 0.01 gm/m^3 and the light gray regions exceed the rain water content threshold of 0.5 gm/m^3 .

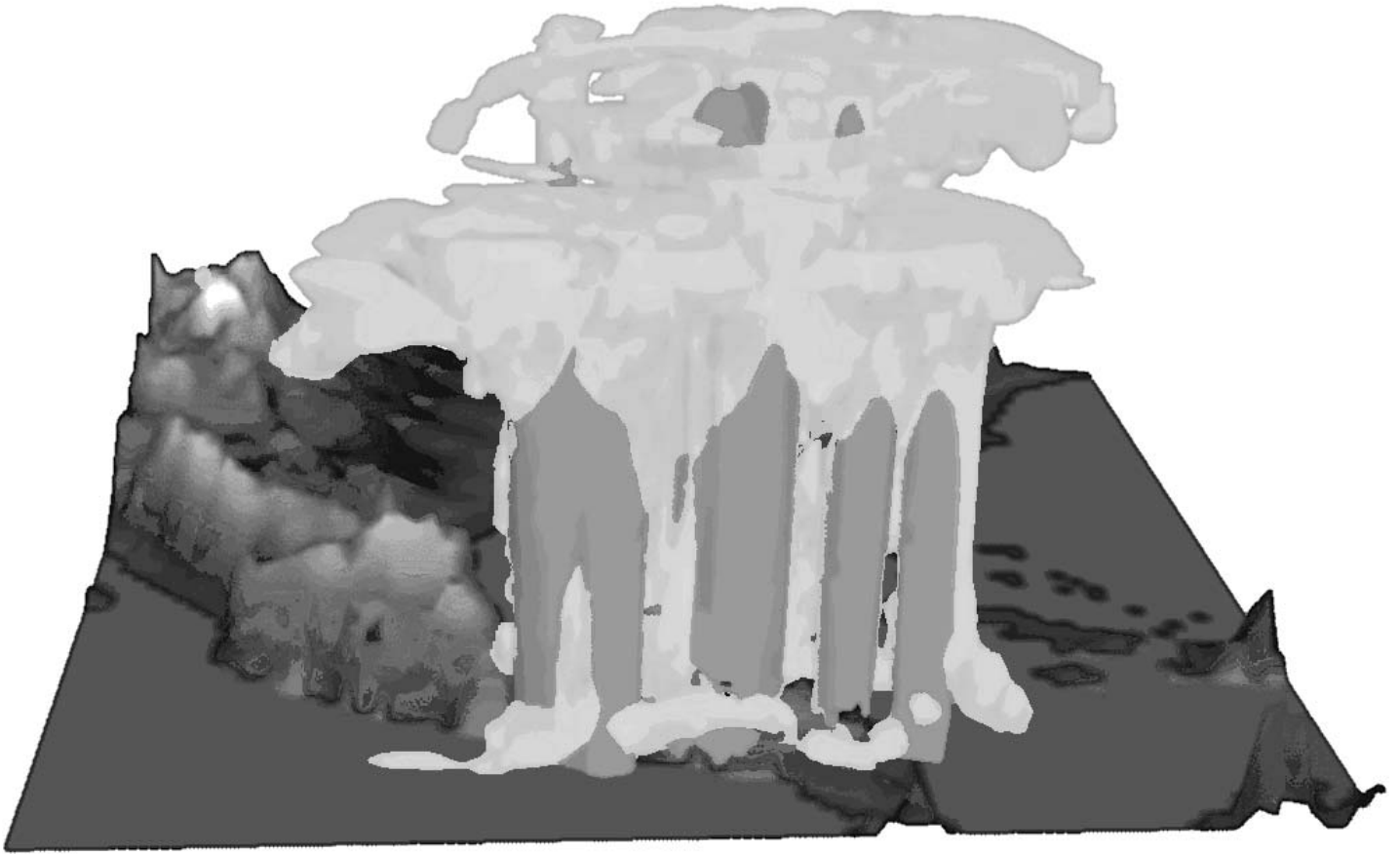


Figure 3. Perspective view of Hypercane Florence at 12Z on September 10, 1988 for a sea-surface temperature of 45°C . The white regions exceed the cloud water content threshold of 0.01 gm/m^3 and the light gray regions exceed the rain water content threshold of 0.5 gm/m^3 .

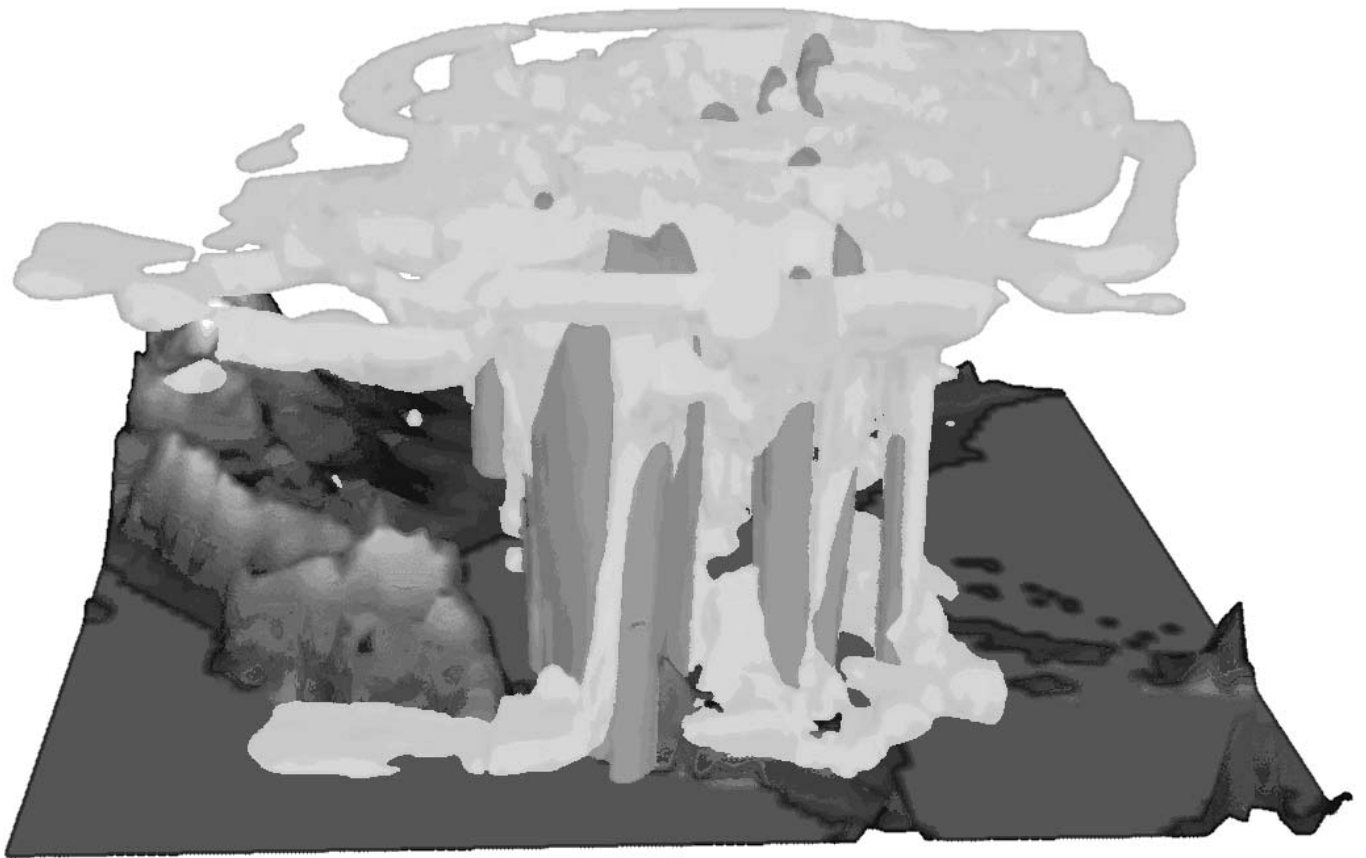


Figure 4. Perspective view of Hypercane Florence at 18Z on September 10, 1988 for a sea-surface temperature of 45°C . The white regions exceed the cloud water content threshold of 0.01 gm/m^3 and the light gray regions exceed the rain water content threshold of 0.5 gm/m^3 .

The sea-surface temperature for the region of the Gulf of Mexico between 10-40° latitude and between 80-95° west longitude was prescribed uniformly at 45°C. This area can be seen outlined in dashed lines in Fig. 5 and by the initial convection near the surface by the initial convection in Fig. 2. The area extends from near Corpus Christi, Texas to near Miami, Florida and from near Guatemala, Central America to near St. Louis, Missouri. It is over 1,000 kilometers wide near the center of the Gulf of Mexico and over 3,000 kilometers long north and south. The surface temperature of land was maintained at observed temperatures. Outside the box, the sea-surface temperature and land temperatures were held at the observed temperature distribution. The initial gradient of surface temperature between the land and sea at the coast was not smoothed or adjusted. Nor was the vertical temperature gradient adjusted between the sea surface and the lower layers of the model.

Both of these strong gradients would have initially produced a shock to the model because of thermodynamic instabilities. Strong land breezes did not appear to develop, but rapid initial convection was evident. However, convection driving Hypercane Florence was strong throughout the entire simulation, so the initial instabilities inside the simulation box didn't seem to be of lasting concern. The strongest response to artificial temperature gradients was at the boundaries of the enhanced box of sea-surface temperature. Wind vortices formed and invaded the box around the border and rapidly moved toward the center. By 00Z on September 11 the circulation of Hypercane Florence was strongly affected.

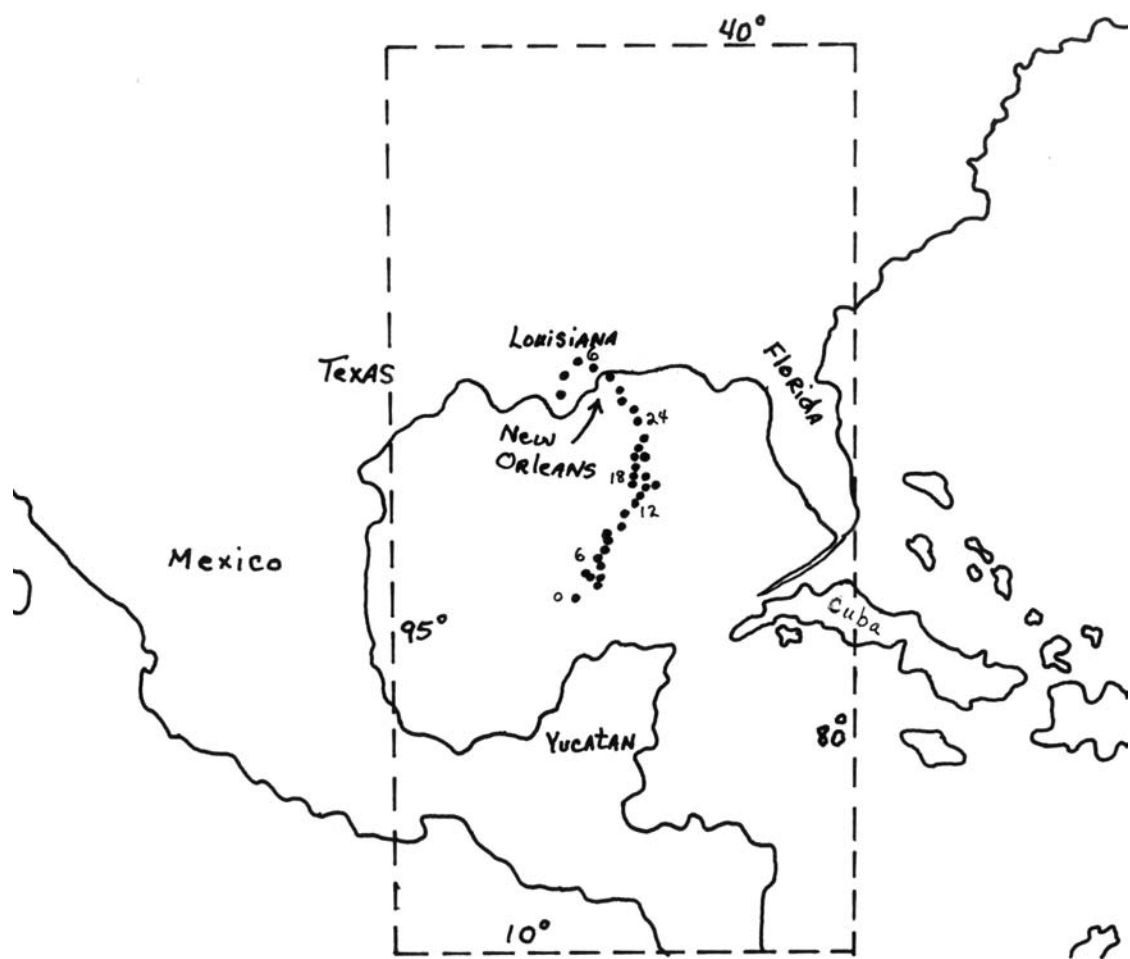


Figure 5. The center of Hypercane Florence's circulation as a function of time (Z) on September 10, 1988 as she moved across the Gulf of Mexico.

The model was started with Hurricane Florence in existence and the temperature and wind fields observed at 00Z on 10 September 1988. Preprocessed data used input from multiple sources including surface and upper air observations from the National Weather Surface in the Northern Hemisphere. These observations were supplemented by special rawinsondes or dropsondes (balloon borne or aircraft launched temperature, dew point, and wind measuring instruments) as available. The wind fields were updated every 12 hours through 00Z on 11 September 1988. The actual path of Hurricane Florence did *not* drive the simulation of Hypercane Florence. Although the simulated paths of Hypercane Florence differed somewhat from the actual path of Hurricane Florence depending upon sea-surface temperature and length of the simulation time steps, the difference was insignificant.

Cloud edges and tops are artificially bounded because of the effects of the computational box. The top of the box is at 50 kilometers and causes the top of the *hypercane* to be artificially flat. No cloud water or rain water was evident in the simulation initially because the threshold values were set at high values, above those actually present in Hurricane Florence. But by the sixth hour into the simulation at 06Z, the boundary of the heated region can be seen in the distribution of cloud water. Convective cells beginning a few hours after the simulation started and became organized into an accelerating vortex around the eye. The storm became a large *hypercane* by 18 hours into the simulation. By 24 hours the size of the boundaries adversely affected the simulation.

ANALYSES

Three sets of analyses were conducted on the simulation results of *Hypercane* Florence:

- (1) The location of Florence as a function of time.

Fig. 5 shows a plot of Florence's center of circulation as a function of time as it migrated across the Gulf of Mexico. The center was located by finding the eye where the winds were the weakest near the center of circular rotation. The standard error of its location was probably about 20 kilometers due to the grid size for displaying the wind fields. Florence moved north-northeast across the Gulf of Mexico from near the Yucatan Peninsula to just east of New Orleans at an average speed of less than 20 kilometers/hour from 00Z to 24Z on Wednesday, September 10, 1988. It then took a left turn and made landfall near Gulfport, Mississippi, curved around to the north, and hit New Orleans from the land side. During the 9 hours it was curving leftward around New Orleans its translational movement of the center of the storm almost doubled, but the rotation and cyclonic windspeed actually decelerated.

- (2) The rotation rate of Florence as a function of time.

One of the unique characteristics of a hurricane is its ability to organize the energy released by vertical convection into horizontal motions. As convection and vertical motions of a hurricane increase the rotation rate and horizontal motions increase. Figs. 6 and 7 show the horizontal wind fields at the 850-mb pressure level (about 5,000 feet above sea level) in the Gulf of Mexico at 06Z and 12Z. Not only was the circulation increasing in intensity but it was affecting a larger and larger area as Florence moved northward. The circulation was also becoming more complex. Initially the winds were almost circular around the eye, later it contained sharp wind shears associated with spiral rain bands which feed into the *eye wall*. The eye also became deformed into an elliptical shape.

One simple measure of the rotation rate of a fluid is *vorticity*, which is defined as follows:

$$\zeta = \partial v / \partial x - \partial u / \partial y \quad \text{Eq. 1}$$

where ζ is vorticity, u is the component of the wind in the eastward direction, and v is the component of the wind in the northward direction at a given point in a fluid. The partial derivatives measure the change in the components in the eastward (x) and northward (y) directions around a given location. Vorticity may be calculated at the center of a hurricane to estimate its average rotation rate. In this analysis the vorticity was calculated for a 200-kilometers radius outward from the center of Florence in the easterly and northerly directions. Fig. 8 shows the vorticity for Florence as a function of time.

It is clear that Florence's vorticity (measure of rotation rate) was rapidly increasing, and even accelerating, from 00Z to 24Z to a maximum value of about $150 \times 10^{-5} \text{ sec}^{-1}$. The typical vorticity for a hurricane, from a weak, category 1 hurricane to a strong, category 5 hurricane, is between 100 and $200 \times 10^{-5} \text{ sec}^{-1}$. However, the destructive power of a hurricane is only crudely estimated by the magnitude of the maximum winds alone. It is better estimated by the magnitude of the maximum winds and by the areal coverage of the maximum winds. In the case of *Hypercane* Florence not only did the maximum winds increase dramatically, but the vorticity and areal coverage of the maximum winds did as well, as can be seen in Figs. 6 and 7.

After 24Z the vorticity for *Hypercane* Florence began to decrease. This was due to the increased drag over land as Florence's winds were slowed by the roughness of the underlying terrain and the reduction in heat and water vapor feeding into the storm which energized it. Florence's vorticity increased by a factor of over four during its migration across the Gulf. If Florence had not run into the coastline near New Orleans and the sea-surface temperature had remained uniform at 45°C , its rotation and wind

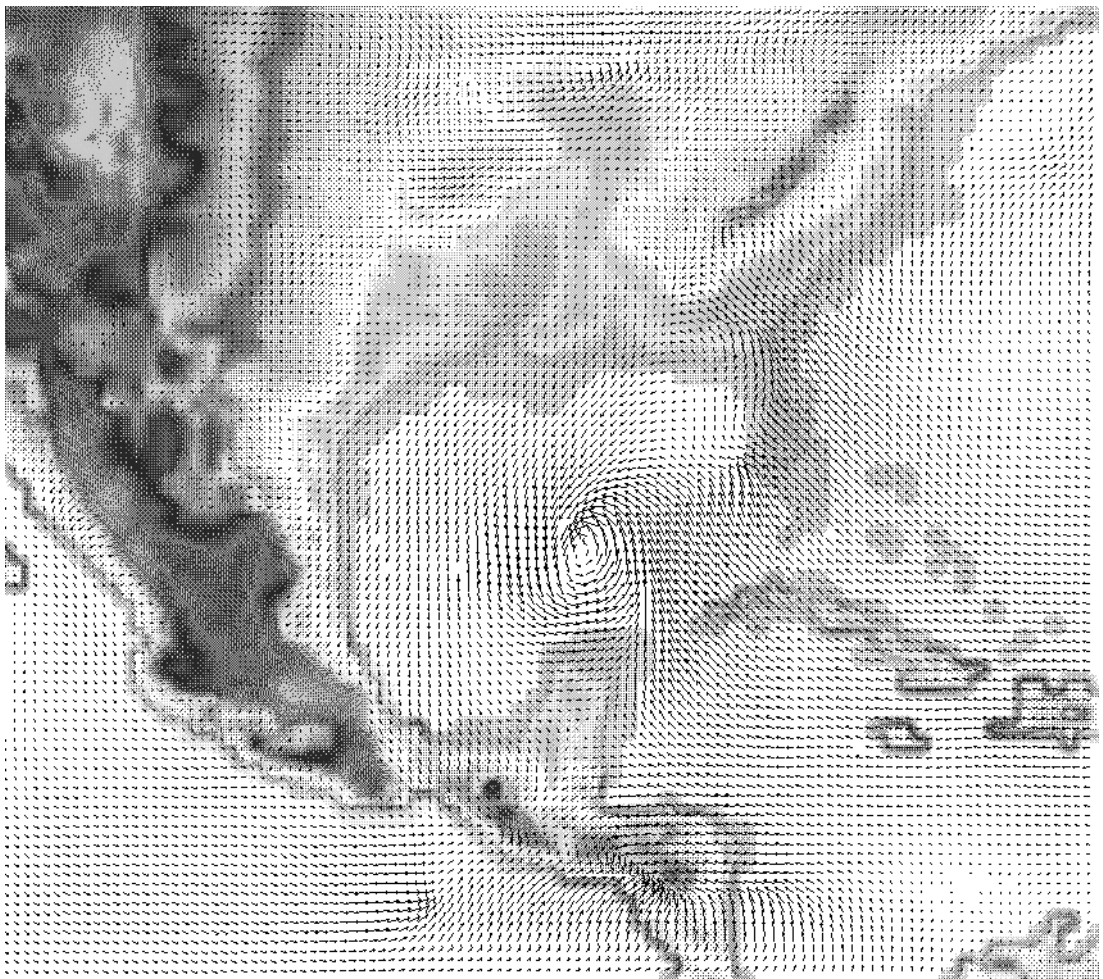


Figure 6. Horizontal wind field at 850 mb (5,000 feet asl) in the Gulf of Mexico at 06Z on September 10, 1988. A 1-mm wind arrow equals 5 m/s.

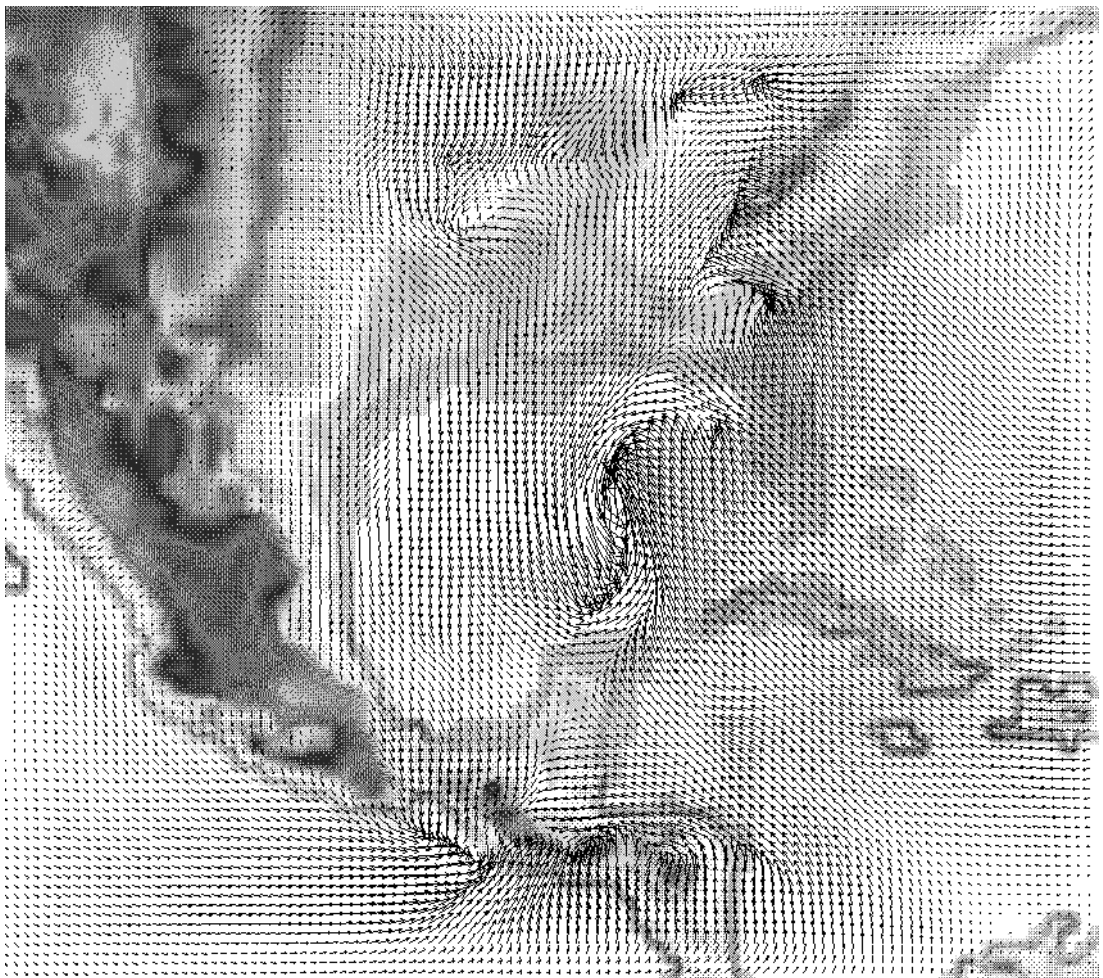


Figure 7. Horizontal wind field at 850 mb (5,000 feet asl) in the Gulf of Mexico at 12Z on September 10, 1988. A 1-mm wind arrow equals 5 m/s.

speeds would probably have continued to accelerate to a much higher level. Over open water Florence would probably have accelerated to much greater speeds until the surface friction counterbalanced the accelerating forces due to the energy source from the ocean. A crude estimate of the maximum wind speed would probably be at least twice (400 m/s) the highest wind speed obtained during this simulation (200 m/s), although this estimate is very uncertain.

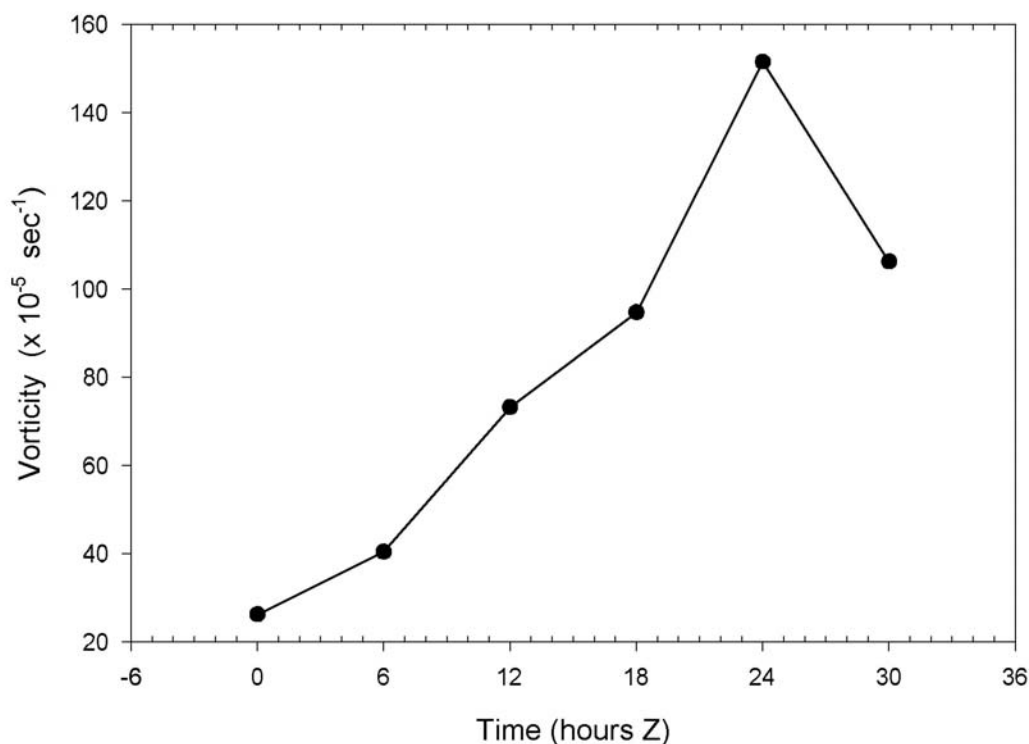


Figure 8. *Vorticity of Hypercane Florence vs. Time. Vorticity is a measure of the rotation rate of a fluid. Here vorticity is calculated from the wind field 200 kilometers radially from the center of the eye.*

(3) The size of the blow-off from Florence at upper levels as a function of time.

Hurricanes in the Northern Hemisphere are highly-organized heat engines which draw warm, moist air in a counterclockwise spiral inward near the surface, condense water vapor releasing heat and precipitation in spiral rain bands and the eye wall at mid levels in the atmosphere, and lift the residual ice crystals to high levels outward in a clockwise motion [6]. As this complex horizontal and vertical system ingests sensible and latent heat at the warm, sea-surface, it exhausts processed air, water vapor, and ice crystals into the cold upper atmosphere as the circulation moves horizontally in response to steering winds.

One of the measures of the growth of a hurricane is the size of the blow-off at high levels. In the simulated case of Florence an extremely large anvil developed which grew from a very small, circular area to cover the entire Gulf of Mexico and beyond. Fig. 9 shows a map of the boundary of the blowoff cloud from Florence as a function of time through 16 Z. After this time boundaries of the simulation became so pervasive that the display of the anvil was suspended. Fig. 10 shows a graph of the blowoff area versus time.

During the greatest growth in the anvil from about 10 to 15 Z it doubled in size about every 2-3 hours. The anvil eventually reached a size of over 10 million square kilometers covering the entire Gulf of Mexico, half of Mexico, part of the Carribean, and all of the southeastern U.S. It extended more to the northeast than in other directions because of the prevailing winds at high levels.

Such a large anvil not only demonstrates the magnitude of the coverage of such a *hypercane* but also illustrates the impact such systems can have on the radiation fluxes on the earth. Both short-wave and long-wave radiation balances would be strongly affected by the reflection and shielding of such large anvils.

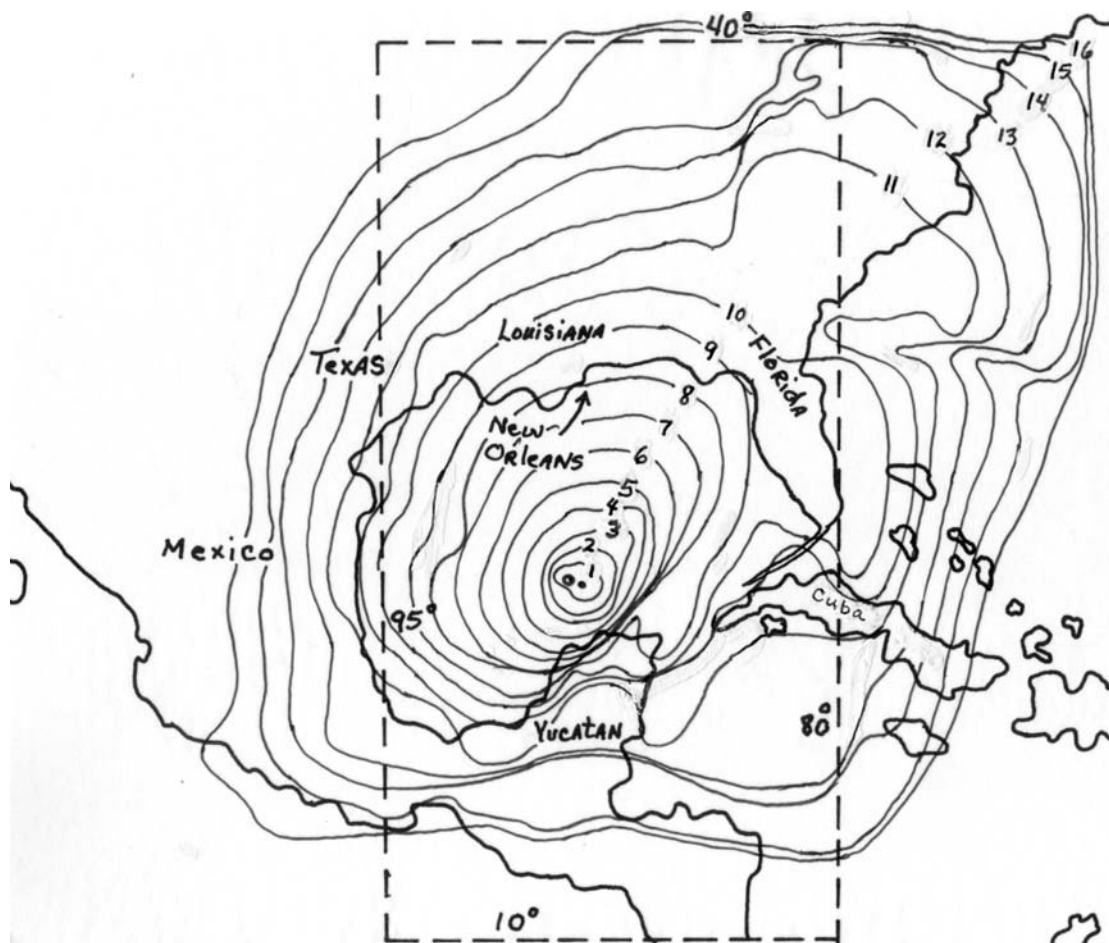


Figure 9. Boundary of the blowoff from Florence vs. time for a sea-surface temperature of 45°C. The boundary is shown at 1-hour increments.

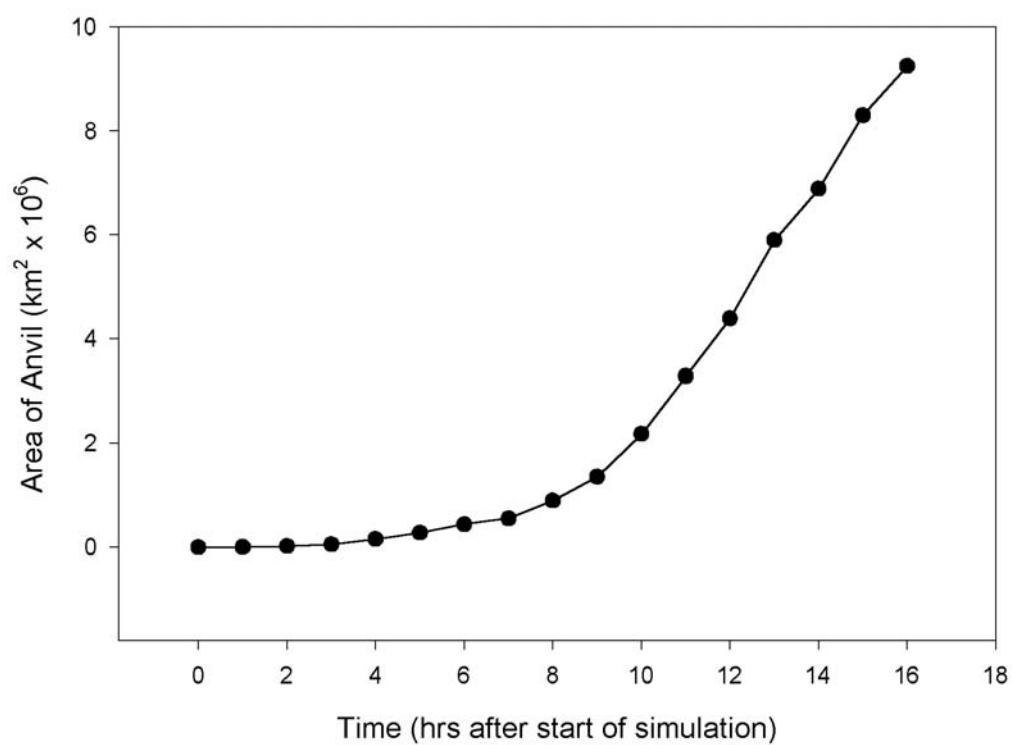


Figure 10. Area of blowoff from Hypercane Florence vs. time.

RESULTS AND CONCLUSIONS

In *Hypercane* Florence with a simulated sea-surface temperature of 45°C many variables increased dramatically compared to the actual values observed in Hurricane Florence. The horizontal wind speeds quadrupled to over 200 m/s, the vertical wind speeds increased to over 50 m/s, the vorticity increased by a factor of over four, the blowoff covered an extreme area over the Gulf of Mexico, and precipitation rates increased by a factor of ten over those observed in Hurricane Florence, to over 10 inches/hour. Warm sea-surface temperature can intensify hurricanes to *hypercane* categories in hours.

The size and intensity of such *hypercanes* would be devastating if they occurred today. They don't occur because the sea-surface temperature never reaches 45°C, rarely exceeding 30°C, which is the threshold for major hurricane development used by hurricane forecasters [6, p. 129]. The larger a hurricane and the higher the winds, the more devastating the hurricane becomes. Hurricane damage is generally proportional to the kinetic energy of the wind and the objects moved by the wind. Since kinetic energy is equal to $1/2mv^2$ the damage increases with the square of the wind.

For every doubling of wind speed, the damage is quadrupled. Most damage and loss of life from hurricanes is actually caused by the storm surge, a buildup in water depth as a hurricane sweeps water toward a coastline. The flooding of coastlines by surges 20-30 feet deep from typical hurricanes could be increased many times over by *hypercanes* which would be many times larger and more intense.

It seems likely that the presence of large regions of warm sea-surface temperature during and immediately following the Genesis Flood would have caused many *hypercanes* to have occurred over the oceans and to have made landfall on the eastern side of continents in the subtropics. These *hypercanes* would have probably been particularly frequent and intense above mid-ocean ridges where significant quantities of heat would have been released. When these *hypercanes* made landfall, they would have dumped massive quantities of rain on as-yet unconsolidated sediments and produced incredible amounts of erosion. Storm surges would be devastating to the coastal boundaries. The most likely location for *hypercane* landfall and such erosion would have been on the eastern edges of continents between about 10° and 40° latitude. Several heavily-eroded regions on the eastern side of continents could possibly be explained by this process. For example, the heavily-eroded Appalachian Mountains in the eastern U.S. and in Southeast Asia may have been rapidly eroded by hypercanes rather than by formation underwater over millions of years, as suggested by conventional explanations.

It has been suggested that once a "lava crust" has been formed on the mid-ocean ridges, heat flow from the magma to the water would decrease rapidly, preventing the formation of warm sea-surface temperatures and reducing the likelihood of *hypercanes*. The reduction of heat flow and the subsequent formation of *hypercanes* would have occurred at some point after the Flood. We obviously don't have the formation of *hypercanes* today, although there is some evidence for periodic releases of significant quantities of heat along the mid-ocean ridges, particularly in the southern Pacific. However, during the Flood and for some time following it, the extrusion of magma onto the ocean floor would have been so rapid that a "lava crust" would have been continually cracked and pushed aside as new magma was released. In fact, I anticipate that the opposite problem may have been likely. The amount of heat released from mountains of magma hundreds of miles wide, thousands of miles long, and thousands of feet high being extruded rapidly during the year of the Flood and for possibly hundreds of years thereafter, would have likely produced so much heating that I fear the oceans would have reached the boiling point at places and burst into steam geysers. The possibility of this catastrophic scenario has been suggested by Baumgardner [2] in these proceedings

It has also been suggested that hurricanes require large regions of warm water and weak atmospheric winds to form. Hot water over mid-ocean ridges may have been distributed in narrow bands and atmospheric winds would likely have been stronger than today, causing potential *hypercanes* to spend too little time over the warm water released by mid-ocean ridges. William Gray [12], the recognized expert on long-range hurricane prediction from Colorado State University, expressed a similar concern when such a scenario was described to him by this author.

These concerns are probably legitimate if bands of hot water from mid-ocean ridges are on the order of tens of kilometers wide and hurricanes are moving at speeds of 20 knots or more across them. However, if the bands are hundreds or thousands of kilometers wide, the residence time of a hurricane over the hot water could exceed the value of 24 hours, which was approximately the time for Florence to amplify from a weak hurricane to a full-fledged *hypercane*. For example, a hurricane moving at 10 knots

perpendicular to a band of hot water 500 kilometers wide would spend more than 24 hours over a pool of hot water. A *hypercane* would also amplify faster or slower depending on the temperature of the pool. Once the *hypercane* was formed it would tend to be long-lived over the open ocean as long as the water temperature didn't drop too low.

RECOMMENDATIONS

The results reported in this paper are due to a simulation of *Hypercane* Florence at only one value of sea-surface temperature. Although the intensification of Florence is dramatic, a sea-surface temperature of 45°C may be too extreme for a realistic simulation. Although it is likely that such temperatures existed over the mid-ocean ridges at least in limited areas during their emergence, it may be that regions of warm oceans large enough to spawn *hypercanes* only existed at cooler temperatures.

Simulations of hypercanes have been conducted at cooler temperatures, but they have not yet been reported. A graduate student at the Institute for Creation Research has almost completed her analyses at cooler temperatures and will report the effects of temperature variation. Assuming her results support and extend the basic conclusions of this paper, it is recommended that the next stage of this research should be to explore such *hypercanes* in the open ocean. Although *hypercanes* can intensify rapidly for high sea-surface temperatures such as found in this study, they may also develop at cooler sea-surface temperatures more slowly over longer periods of time if they develop far from continents where they have a longer time to develop before landfall. It is recommended that a moderate hurricane similar to Florence be identified which has been observed over the open ocean for up to a week and a long-period simulation be conducted with it for temperatures between 30 and 50°C. It would not only be important to see if *hypercanes* develop at cooler temperatures, but under what conditions they stop amplifying. In other words, is there an upper limit to the size to which *hypercanes* can grow?

Another topic of study which should be pursued is the impact of heavy precipitation and storm surges on the erosion of unconsolidated land masses near continental boundaries. For example, could some of the erosional features of southeastern Asia and western Africa be explained in terms of heavy precipitation from *hypercanes*? Also, of interest would be the contribution of *hypercanes* to the formation of ice sheets and glaciers during the *ice age* as they drifted northward from the tropics.

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REFERENCES

- [1] Anthes, R.A., and T.T. Warner, **Development of hydrodynamic models suitable for air pollution and other mesometeorological studies.** Monthly Weather Review, **106**, (1978) pp. 1045-1078.
- [2] Baumgardner, J.R., **Catastrophic Plate Tectonics: The Physics behind the Genesis Flood**, Proceedings of the Fifth International Conference on Creationism, Robert Walsh Editor, 2003, in press.
- [3] Dudhia, J., **Numerical study of convection observed during winter monsoon experiment using a mesoscale two-dimensional model.** Journal of the Atmospheric Sciences, **46**, (1989), pp. 3077-3107.
- [4] Dudhia, J., **A nonhydrostatic version of the Penn State/NCAR mesoscale model: Validation tests and simulation of an Atlantic cyclone and cold front.** Monthly Weather Review, **121**, (1993), pp. 1493-1513.

- [5] Dudhia, J., **A multi-layer soil temperature model for MM5.** Preprints, The Sixth PSU/NCAR Mesoscale Model Users' Workshop, 22-24 July 1996, Boulder, Colorado, pp. 49-50. Available from <http://www.mmm.ucar.edu/mm5/mm5v2/whatisnewinv2.html>.
- [6] Dunn, G.E., and B.I. Miller, Atlantic Hurricanes. Louisiana State University Press, (1964), 377 pp.
- [7] Emanuel, K.A., **The maximum intensity of hurricanes.** Journal of the Atmospheric Sciences **45** (1988a) pp. 1143-1155.
- [8] Emanuel, K.A., **Toward a general theory of hurricanes.** American Scientist **76** (1988b) 371-379.
- [9] Emanuel, K.A., **The finite-amplitude nature of tropical cyclogenesis.** Journal of the Atmospheric Sciences **46** (1989) pp. 3431-3456.
- [10] Emanuel, K.A., **Some aspects of hurricane inner-core dynamics and energetics.** Journal of the Atmospheric Sciences, **54** (1997) pp. 1014-1026.
- [11] Emanuel, K.A., K. Speer, R. Rotunno, R. Srivastava, and M. Molina, **Hypercanes: A possible link in global extinction scenarios.** Journal of Geophysical Research **100** (1995) pp. 13755-13765.
- [12] Gray, W., Personnel Communication, 1998.
- [13] Hibbard, B., J. Kellum, and B. Paul, **The VIS5D Project at the University of Wisconsin Science and Engineering Center**, 1999, Madison, WI, <http://www.ssec.wisc.edu/~billh/vis5d>.
- [14] Karyampudi, V.M., G. Lai, and J. Manobianco, **Impact of initial conditions, assimilation of satellite-derived rainfall rates and cumulus parameterization schemes on the development of Hurricane Florence (1988)**, 1995, in press.
- [15] Woodmorape, J., **Hypercanes as a cause of the 40-day global flood rainfall.** Proceedings of the fourth International Conference on Creationism, Robert E. Walsh Editor, 1998, Creation Science Fellowship, Pittsburgh, PA, pp. 645-658.