

Electric Theory of Tornado, Protection from Tornado

Alexander Bolonkin¹

¹ CUNY, USA

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Abstract

The author develops a new theory of tornado stability. He show that it is the high electric voltage between clouds and ground surface which produces the intensive electron/ion flow which creates the air stream which sucks off (pumping) air from the inside tornado channel and makes the tornado stable. If we want to destroy tornado stability we must decrease the electric intensity into the tornado channel. The simplest method is using conductive wire to connect the top funnel of tornado with ground. For this method, the top end of wire must have a large conductive area (air balloon or wing dirigible with conductive layer), the lower end of wire must have good contact with wet ground. The row from these conductive wires having step 150 ~ 200 m and altitude 200 ~ 300 m can protect villages, towns and important installations such as the nuclear electric station and military bases from tornados.

Index terms— tornado, stability of tornado, protection from tornado, hurricane, bolonkin.

1 Introduction a) Tornado

tornado is a violently rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. Tornadoes come in many shapes and sizes, but they are typically in the form of a visible condensation funnel, whose narrow end touches the earth and is often encircled by a cloud of debris and dust. Most tornadoes have wind speeds less than 110 miles per hour (177 km/h), are about 250 feet (76 m) across, and travel a few miles (several kilometers) before dissipating. The most extreme tornadoes can attain wind speeds of more than 300 miles per hour (483 km/h), stretch more than two miles (3.2 km) across, and stay on the ground for dozens of miles (more than 100 km).

Tornadoes have been observed on every continent except Antarctica. However, the vast majority of tornadoes occur in the Tornado Alley region of the United States, although they can occur nearly anywhere in North America. They also occasionally occur in southcentral and eastern Asia, northern and east-central South America, Southern Africa, northwestern and southeast Europe, western and southeastern Australia, and New Zealand. Tornadoes can be detected before Author: C&R, USA. e-mail: abolonkin@juno.com by recognizing patterns in velocity and reflectivity data, such as hook echoes or debris balls, as well as by the efforts of storm spotters In the United States, tornadoes are around 500 feet (150 m) across on average and travel on the ground for 5 miles (8.0 km).

Lighting conditions are a major factor in the appearance of a tornado. Night-time tornadoes are often illuminated by frequent lightning.

There is mounting evidence, including Doppler on Wheels mobile radar images and eyewitness accounts, that most tornadoes have a clear, calm center with extremely low pressure, akin to the eye of tropical cyclones.

Tornadoes emit on the electromagnetic spectrum, with sferics and E-field effects detected. There are observed correlations between tornadoes and patterns of lightning. Tornadic storms do not contain more lightning than other storms and some tornadic cells never produce lightning. More often than not, overall cloud-to-ground (CG) lightning activity decreases as a tornado reaches the surface and returns to the baseline level when the tornado lifts. In many cases, intense tornadoes and thunderstorms exhibit an increased and anomalous dominance of positive polarity CG discharges. Electromagnetic and lightning have little or nothing to do directly with what

45 drives tornadoes (tornadoes are basically a thermodynamic phenomenon), although there are likely connections
46 with the storm and environment affecting both phenomena.

47 In addition to winds, tornadoes also exhibit changes in atmospheric variables such as temperature, moisture,
48 and pressure. For example, on June 24, 2003 near Manchester, South Dakota, a probe measured a 100 mbar
49 (hPa) (2.95 inHg) pressure decrease. The pressure dropped gradually as the vortex approached then dropped
50 extremely rapidly to 850 mbar (hPa) (25.10 inHg) in the core of the violent tornado before rising rapidly as the
51 vortex moved away, resulting in a Vshape pressure trace. Temperature tends to decrease and moisture content
52 to increase in the immediate vicinity of a tornado.

53 2 b) Damage from Tornado

54 The tornadoes killed thousands, injured ten thousands peoples, damages ten billions USD dollars. Some data
55 about tornado disaster are below. The deadliest tornado in world history was the Daulatpur -Salturia Tornado in
56 Bangladesh on April 26, 1989, which killed approximately 1,300 people. Bangladesh has had at least 19 tornadoes
57 in its history kill more than 100 people, almost half of the total for the rest of the world (fig. ??).

58 3 Figure 1 : Typical Tornado

59 The United States gets about 1000 recorded tornadoes every year. From May 2 to 8, 1999, a large tornado
60 outbreak took place across much of the Central and parts of the Eastern United States. During this week-long
61 event, 152 tornadoes touched down, including one in Canada. The most dramatic events unfolded during the
62 afternoon of May 3 through the early morning hours of May 4 when more than half of these storms occurred.
63 Oklahoma experienced its largest tornado outbreak on record, with 70 confirmed. The most notable of these
64 was the F5 Bridge Creek-Moore tornado which devastated suburban communities to the southwest of Oklahoma
65 City. The tornado killed 36 people and injured 583 others; losses amounted to \$1 billion, making it the first
66 billion-dollar tornado in history. Overall, 50 people lost their lives during the outbreak and damage amounted
67 to \$1.4 billion.

68 4 c) Lighting

69 Cloud-Ground (CG) lightning can occur with both positive and negative polarity. The polarity refers to the
70 polarity of the charge in the region that originated the lightning leaders. An average bolt of negative lightning
71 carries an electric current of 30,000 amperes (30 kA), and transfers 15 coulombs of electric charge and 500
72 megajoules of energy. Typically, lightning at up to 100 million volts, large bolts of lightning can carry up to
73 120 kA and 350 coulombs. Positive lightning typically makes up less than 5% of all lightning strikes. . Plasma
74 temperatures in lightning can approach 28,000 kelvins and electron densities may exceed $10^{24} /m^3$. A bolt of
75 positive lightning may carry an electric current of 300 kA and the potential at the top of the cloud may exceed
76 a billion volts -about 10 times that of negative lightning (fig. 3) Year field. This electric field gradient continues
77 up into the atmosphere to a point where the voltage reaches its maximum, in the neighborhood of 300,000 volts.
78 This occurs at approximately 30-50 km above the Earth's surface. From that point in the atmosphere up to its
79 outer limit, nearly 1,000 km, the electric field gradient produced in the lower atmosphere either ceases or has
80 reversed.

81 A simple calculation gives the result that when such a collector is arranged for example on the ground, and
82 a second one is mounted vertically over it at a distance of 2000 meters and both are connected by a conducting
83 cable, there is a difference in potential in summer of about 2,000,000 volts and in winter even of 6,000,000 volts
84 and more.

85 5 e) Hurricane

86 A tropical cyclone (hurricane) is a rapidlyrotating storm system characterized by a low-pressure center, strong
87 winds, and a spiral arrangement of thunderstorms that produce heavy rain. Tropical cyclones typically form over
88 large bodies of relatively warm water. They derive their energy from the evaporation of water from the ocean
89 surface, which ultimately re-condenses into clouds and rain when moist air rises and cools to saturation.

90 At the center of a mature tropical cyclone, air sinks rather than rises. For a sufficiently strong storm, air may
91 sink over a layer deep enough to suppress cloud formation, thereby creating a clear "eye" (fig. 3). Weather in the
92 eye is normally calm and free of clouds, although the sea may be extremely violent. The eye is normally circular
93 in shape, and is typically 30-65 km (19-40 mi) in diameter, though eyes as small as 3 km (1.9 mi) and as large
94 as 370 km (230 mi) have been observed.

95 The cloudy outer edge of the eye is called the "eyewall"(fig. 6). The eyewall is where the greatest wind speeds
96 are found, air rises most rapidly, clouds reach to their highest altitude, and precipitation is the heaviest. The
97 heaviest wind damage occurs where a tropical cyclone's eyewall passes over land.

98 Scientists estimate that a tropical cyclone releases heat energy at the rate of 50 to 200 exajoules (1018 J) per
99 day, equivalent to about 1 PW (1015 watt). This rate of energy release is equivalent to 70 times the world energy
100 consumption of humans and 200 times the worldwide electrical generating capacity, or to exploding a 10-megaton
101 nuclear bomb every 20 minutes.

The most intense storm on record was Typhoon Tip in the northwestern Pacific Ocean in 1979, which reached a minimum pressure of 870 mbar (652. Electric Theory of Tornado Tornos (vortexes) killed, wounded, crippled thousands of people, destroyed, and damaged thousands of homes, made billions of dollars of losses. The theory of tornado has been researched for more than a hundred years. Only in the USA, the large state Agency NOAA, studied tornado and weather since 1807. We have an excellent mathematical theory of a vortex. However, we don't have a clear understanding of the nature and activity of tornados. The mathematical theory of the stability of the vortex requires the data of the outlet, influent the air. But researchers do not see the forces which pump or suck out the air from the internal core of tornado.

The author shows in this article that it is the electric intensity between clouds and ground (especially storm clouds and ground) which produces the electron (ion) strong vertical wind (flow) into tornado, which works as a pump inside tornado and makes the tornado stable.

Everyone can make this simple experiment in a kitchen sink or bathroom. If you fill the sink with a layer of water (2 -3 cm) and open the drain, the water, at some point, creates a stable vortex. Opening the drain is important element of system. If you close it, the vortex disappears.

In the atmosphere, air has friction and typically a vortex losses energy. The air flow (leak of air inside vortex) compensates for the loss of vortex energy and supports its rotation. The flow of electrons (ions) inside of tornado creates the electric current which produces the circular magnetic field which also helps the vortex and his stability.

The schemata of a tornado is shown in fig. 4. It is a vortex located between charged clouds and the ground. The vortex contains a wall which rotates with high speed. According to the Law of Angular Conservation the linear speed of rotation increases and air pressure is lowered when the tornado radius decreases.

According this author's theory (see computation in theoretical section) a strong electric intensity between an altitude layer (clouds) atmosphere and the ground produces a powerful electro (ion) flow inside of tornado along its axis. The air suck off from inside wall of tornado. When electrons reach the surface, they go into ground the ions are neutralized and air go out between low end of tornado and ground surface. If ground has negative charge (cloud has positive charge), the electric intensity works as pump sucked off the air flow into cloud.

6 Estimations and Computation

7 Theory of Vortex

The speed into a vortex wall may be estimated by equations (conservation of angular momentum): $V = r \omega$ (1) $p = p_0 - \frac{1}{2} \rho V^2$ (2)

8 Energy of Cloud

The vaporization energy of 1 km² is $E_{v1} = m \cdot \lambda$ (3) $E_{L1} = mgh$ (4)

The electric energy as condenser having area 1 km², distance 1 km and voltage 100 million volts the cloud has energy. $E_{e1} = 0.5 \cdot \frac{Q^2}{S \cdot h}$ (5) Example 1: For the rain gives 0.1 m water, the cloud of area 1 sq. km, located at altitude 1 km and charged up 100 million volts has energy:

1. Evaporation (condensation) energy is $E_{v1} = m \cdot \lambda = 10^8 \times 2.2 \cdot 10^6 = 2.2 \cdot 10^{14}$ J/km². 2. Lift energy is $E_{L1} = mgh = 10^8 \cdot 9.81 \cdot 1000 = 10^{12}$ J/km². 3. Electric energy $E_{e1} = 0.5 \cdot \frac{Q^2}{S \cdot h} = 0.5 \cdot \frac{8.85 \cdot 10^{-12} \cdot 10^6}{10^6} = 4.42 \cdot 10^7$ J/km².

For conventional cloud 10×10 km² the energy is in 100 times more. The clouds can has altitude 200 m and energy in 5 times more.

The electric energy is small in comparison with evaporation and lifting energy but one is used only for stabilization of tornado.

9 c) Electron (ion) Speed

The electron speed about the air flow, gas (air jet) may be computed by equation: $j_s = qn - bE + qD \cdot (-dn/dx)$ (6) $j_s = qn - bE$, $Q = qn$, $v = bE$, $j_s = Qv$ (7)

The negative charge mobility for normal pressure and temperature T = 20°C is:

In dry air $b = 1.9 \times 10^{-4}$ m²/sV, in humid air $b = 2.1 \times 10^{-4}$ m²/sV.a

If the air pressure is from 13 to 6×10⁶ where V₀ is speed on a vortex surface, m/s; V is speed into vortex wall, m/s; r₀ is radius of on a vortex surface, m; r is radius into the vortex wall, m. The pressure into the vortex wall is

Where p is pressure into the vortex wall, N/m²; p₀ is an atmospheric pressure, p₀ = 10⁵ N/m².

where E_{v1} is the vaporization energy of 1 km², J; m is water mass in 1 km² of cloud, kg; λ = 2.2·10⁶ is specific energy of vaporizing, J/kg. × The lift energy at altitude is where g = 9.81 m/s² is Earth gravity; h is altitude of cloud, m.

Where ε₀ = 8.85·10⁻¹² is electrostatic constant; S is area of condenser, m²; U is voltage, V; h is altitude, m.

Where j_s is density of electric currency about flow (jet), A/m²; q = 1.6×10⁻¹⁹ C is charge of single electron, C; n-is density of electrons (negative charges) in 1 m³; b is charge mobility of negative charges, m²/sV; E is electric intensity, V/m; D-is diffusion coefficient of charges; dn-/dx is gradient of charges. For our estimation we put

13 SUMMARY

160 $dn/dx = 0$. In this case where Q is density of the negative charge in 1 m^3 ; v is speed of the negative charges
161 about flow, m/s .

162 where p is air pressure. When air density decreases, the charge mobility increases. The mobility strength
163 depends upon the purity of gas.

164 For normal air density the electric intensity must be less than 3 MV ($E < 3\text{ MV}$). Otherwise the electric
165 breakdown may be.

166 If $v > 0$, the electrons (ions) accelerate the air ($E > 0$ the cloud spends energy (charge), works as ventilator).
167 If $v < 0$ ($E < 0$), the cloud works as suck pump (back ventilator). If $v = 0$ (electron speed about air flow equals
168 null), the electric resistance is zero.

169 Example 2 : Assume a voltage between a cloud and earth ground is $U = 100$ millions volt. Distance is $D =$
170 500 m . Then the average electric intensity is $E = U/D = 10^8 / 500 = 2 \cdot 10^5\text{ V/m}$. The average air speed inside
171 the tornado is $v = bE \cdot 2 \cdot 10^{-4} \times 2 \cdot 10^5 = 40\text{ m/s}$. In reality the speed may be same or more in less voltage
172 because the voltage (acceleration) is acting long time.

10 d) Magnetic Field

174 The electric current flowing along the tornado produces the circular magnetic field around tornado, which also
175 may influence in the tornado stability. This influence may be estimated by equations: $B = \mu_0 I / (2\pi r)$, $B = \mu_0 q v / (4\pi r^2)$
176 $m H B H p r i H m ? = = = ? \mu \mu \mu ? (10) ,) / (2 , / 2 ,) / (2 / 1 2 / 1 B m q T B U m q r \text{ or } B m q V$
177 $r e e e ? = ? ? ? ? ? ? ? = = (11)$

178 Where H is magnetic intensity A/m ; p is pressure, N/m^2 ; B is magnetic intensity in T ; q is charge of particles,
179 C ; v is speed charged particles. m/s ; r is moving speed of particles, m/s ; m is mass of charged particles, kg ; U
180 is energy of the charged particles in eV ; T is rotated period of the charged particles, sec . Motion of the charged
181 particles is perpendicular to magnetic lines.

182 IV.

11 Protection from Tornado

184 Using the offered theory the author offers a method of protection from tornado. If we temporarily can break
185 the stability of the tornado, we can destroy the tornado. To do this we must deprive the energy of the tornado
186 pump. It is possible, if the time, when the tornado pump cannot work, will be enough for its distraction. The
187 easiest way is a connection the tornado cloud (funnel) to ground. If we fence the important object (military base,
188 nuclear station, village, etc.) by row of small balloons (better wing dirigibles (fig. 5)) good connected by the
189 conductivity wire to ground, the electric current will flow directly to ground and will not pump the air from
190 tornado.

191 For good contact with cloud the entire surface of dirigible (air ballroom) must have the conductive layer and
192 the lower end of wire should be buried into a moist ground (fig. 5a). Distance between dirigibles is about 150
193 -200 m , altitude $200 - 250\text{ m}$. It is easy to build a small model to check up the theory and protection method.

194 V.

12 Note about Hurricane

196 The hurricane is gigantic vortex (fig. 6) typically having diameter 300 and more km . Photo of hurricane from
197 out space is shown in fig. 3. Into center the hurricane has a calm area having the diameter about $50 - 60\text{ km}$.
198 That area is named "Eye". "Eye" has "Eyewall" having the thickness about $40 - 50\text{ km}$.

199 At the center of a mature tropical cyclone, air sinks rather than rises. For a sufficiently strong storm, air may
200 sink over a layer deep enough to suppress cloud formation, thereby creating a clear "eye". Weather in the eye is
201 normally calm and free of clouds, although the sea may be extremely violent.

202 The cloudy outer edge of the eye is called the "eyewall". The eyewall is where the greatest wind speeds are
203 found, air rises most rapidly, clouds reach to their highest altitude, and precipitation is the heaviest. The heaviest
204 wind damage occurs where a tropical cyclone's eyewall passes over land.

13 Summary

206 The author proposes a new theory of the tornado stability. He shows: the high electric voltage between clouds
207 and ground surface produces the intensive electron/ion flow into tornado. That flow creates the air stream which
208 sucks off (pumping) air from the inside tornado channel and makes the tornado stability.

209 If we want to destroy the tornado stability we must decrease the electric intensity into the tornado channel.
210 The simplest method is connection by a conductive wire the funnel of tornado with ground.

211 For this the top end of wire must have a large conductive area (air ballroom or wing dirigible with conductive
212 layer), the lower end of wire must have the good contact with wet ground.

213 The row from these conductive wires having step $150 - 200\text{ m}$ and altitude $200 - 300\text{ m}$ allows protecting from
214 tornado the villages, towns and important objects as the nuclear electric station and military bases.

215 The research papers relating to this topic are presented in [1]- [17].



2

Figure 1: Figure 2 :



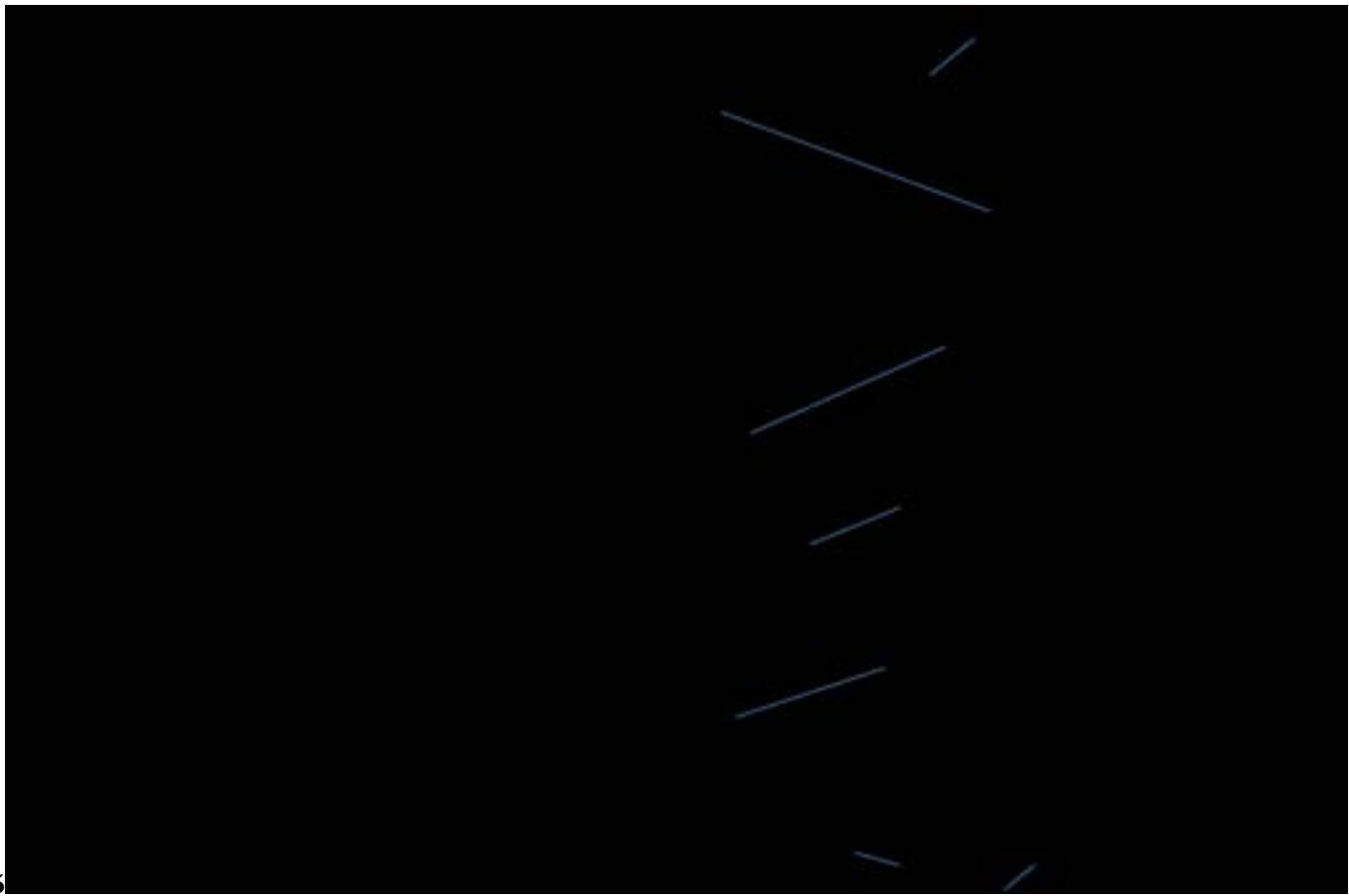
Figure 2:



Figure 3: Figure 3 :

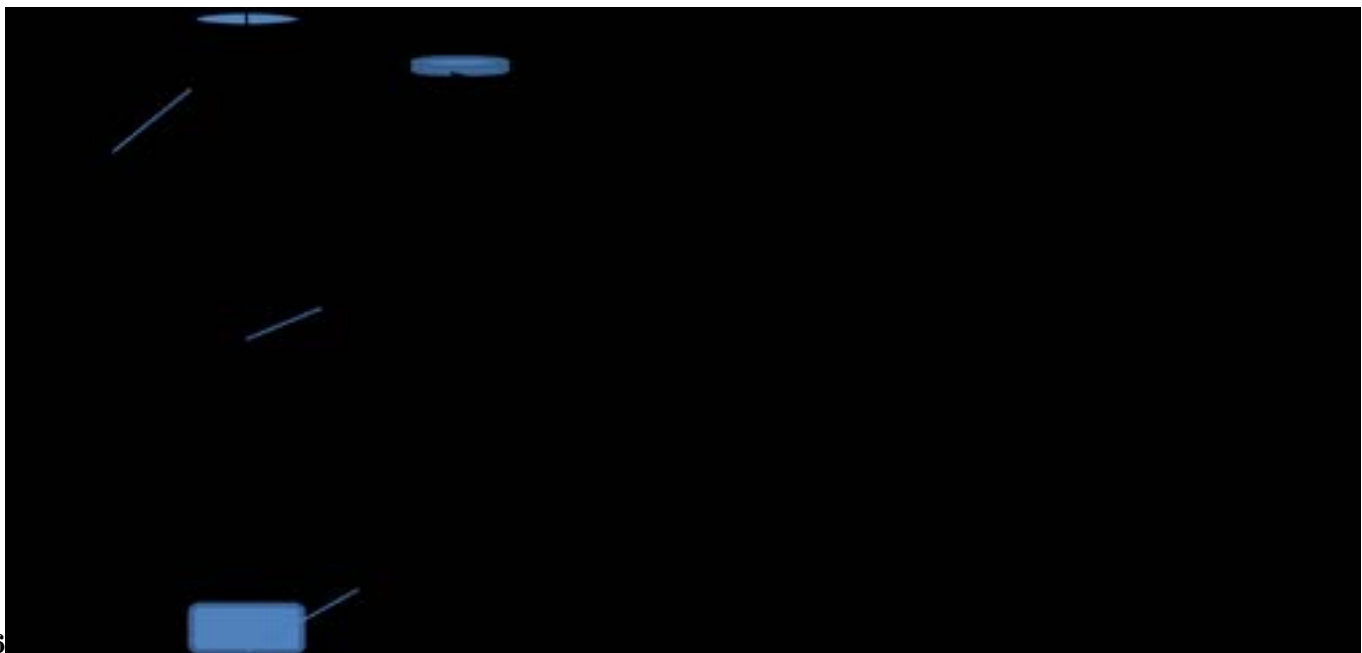


Figure 4: Figure 4 :



5

Figure 5: Figure 5 :



6

Figure 6: ElectricFigure 6 :

Tornado Disaster Statistics from 1980 -2008	
Number of events:	182
Number of people killed:	4,780
Average people killed per year:	165
Number of people affected:	12,710,204
Average number of people affected per year:	438,283
Economic Damage	\$31,510,661,000
Economic Damage per year	\$1,086,575,000
Issue : http://www.statisticbrain.com/tornado-statistics/	
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Figure 7:

216 VII. ¹

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