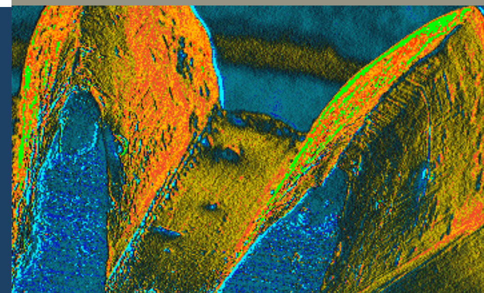
Cause and Effect:
High Summer Temperatures and Solar Activity



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July/August: The Summer of Records

The Triple Digits

- In San Berndadino, Ca., the mercury hit 113.
- The highest temperature recorded in Texas this July went into the record books at 117.
- Parts of Arizona suffered temperatures of 118 and 119 degrees.
- But Riverside, Ca. got hit worst of all at 120 degrees, breaking its prior record of 118 set in 1957.

High Temperature a Relative Concept

On the "who do you think you're kidding?" front, the Skagway-Hoonah-Angoon region in Alaska broke its 2005 high temperature record with a 2 degree increase- 65 degrees of not exactly hot, but record-setting temperature nonetheless.

Dog Days of August

With the dog days of August still upon us, there's not likely to be major relief in sight. In Arizona and Oklahoma, reports of highs like 118 and 111 are still coming in. The National Oceanographic and Atmospheric Administration (NOAA) is predicting higher than usual temperatures to continue in August for the southern portion of the United States.

Blame Summer Heat on Global Warming?

When summer's temperatures last reached record highs, Discovery News took a look at the influence of global warming on summer heat trends. Noting that both planetary record highs and flooding have been on the rise, the report concluded that global warming is influencing our record high temperatures, something that weather forecasters had resisted believing. Of course, just forty years ago the scientific wisdom was "Global Cooling".

Historical Highs

These historical high temperatures lend perspective to America's summer 2011 heat wave:

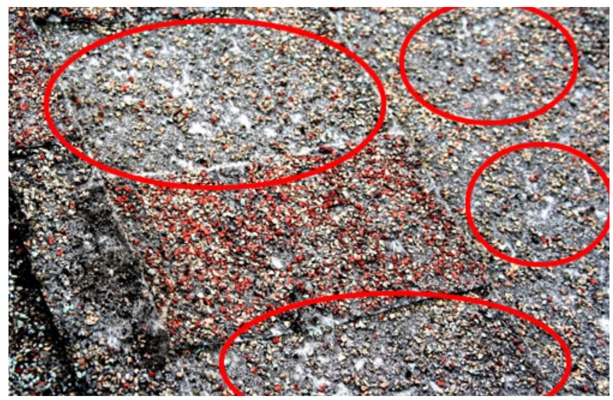
- Hottest place on earth: Iraq typically has the hottest temperatures on earth and has seen several 120 degree days this summer. At Tallil Airbase, the temperature soared to 127 degrees on July 18th.
- Hottest temperature in cold place: Antarctica experienced its record high in January 1974 when the mercury hit 54 degrees.
- Hottest temperature ever recorded: The temperature climbed to 136 degrees in Azizia, Libya in September 1922.
- Hottest temperature ever recorded in the United States: Greenland Ranch, Ca. missed laying claim to the world record for hottest temperature ever by two degrees. The heat there measured 134 degrees in July 1913.

Long Term Heat and The Effects

Air Conditioners

Reports are coming in about the shortages of start/run capacitors and even air conditioning units themselves. What is happening in these instances, the outside a/c units are working overtime to keep up with cooling. If a unit is not properly maintained it can be running longer and stop/starting more, putting a strain on capacitors and the whole unit itself. There are several ways to help prevent this, (1. Provide good air flow around outside unit (2. Keep the coils of the indoor and outdoor units clean (3. Change the indoor filter monthly (4. Operate cooling equipment wisely (5. Have the unit serviced on a regular bases. These five simple steps to help beat the heat.

Roofing



Extreme summer heat combined with poor attic ventilation can destroy composition shingles. Heat causes the asphalt layer of shingles to soften and detach from the shingle's fiberglass layer beneath the asphalt. The resulting blistering and then loss of the asphalt layer leaves the fiberglass layer exposed to UV radiation and weathering. Loss of the asphalt layer is also seen one to two years after hail impacts, but the two causes are easy to distinguish. Heat damage to shingles has a recognizable pattern, in which shingles higher up on the roof are the most damaged. Because hot air rises, the highest parts of the roof are heated most by the attic air. Shingles damaged by heat will have a large number of damaged areas near the top of the roof, with damage decreasing lower on the roof. Heat damage is likely to affect a large portion of each shingle, unlike hail, which may only result in several hits per square. Other factors being equal the amount of heat damage observed will be generally even on both sides of the roof for roofs facing east and west, but a south slope may show more heat damage than a north roof slope due to direct sun exposure.

In the above photographs, heat damage was caused by poor attic ventilation. While vent turbines are present on the roof, the main problem was the insufficient number of soffit vents. With few small soffit vents to allow air into the attic space, the turbines could not create a flow of air to cool the attic and roof. Insulation placed directly against the roof decking can have a similar effect on the shingles.

Home Foundations

"Bursting pipes caused by drought", that was a headline recently and it seemed odd initially because most of us know about pipes that burst from freezing. The same phenomenon that causes (usually large supply) pipes to bust is the ground shrinking and the soil contracting unevenly. The uneven shrinkage leads to stresses on the pipe that reveals themselves as broken water mains. This same soil interaction also occurs on a smaller scale with the soil under your residential or commercial foundation. There are two broad types of soil; clay and sand, the East Texas area has both kinds and they both have their own problems. Expansive clay soil is like a sponge. They swell when wet and shrink when dry. Variations in the moisture content produce a disproportionate degree of swelling and shrinkage of the soil, which can result in differential movement of the foundation.

If you see cracks that have opened up in your yard, you have some clay soil. Clay soil can be found most everywhere and it is not necessarily bad unless you have highly expansive clay soil.

Years ago, ordinary residential foundation design normally did not account for long term differential movement of the soil and no special design was incorporated into the foundation. A slab was poured usually with steel and minimal footing around the perimeter. Years later the slab would be cracked and shifting, frequently causing other issues such as cracked sheetrock walls and cracked brick veneer. Higher end construction would usually incur the expense of testing the soil to determine its properties, so that an appropriate foundation could be designed. Interior grade beams, post tension tendon cables and wider or deeper footings could be incorporated where required.

There is plenty of information about keeping the soil wet around your foundation but, too much moisture in clay soil can also lead to differential movement. So for those that have big gaping cracks in the soil near your foundation, water your lawn enough to close the cracks but don't keep the soil saturated.

The Heat and The Tire

Heat is your tire's worst enemy. The hotter a tire gets, the higher the risk of failure. Hot weather can impact tires much more severely than cold weather, because tires build pressure and overheat much more quickly, which may result in tire distress possibly even a blowout. Drivers are encouraged to be aware of how extreme temperatures affect their tires – especially during extended summer heat wave conditions. High-speed driving, excessive cornering, and frequent braking during periods of very high temperatures can cause the tire to heat up beyond their design ratings. Once this happens, a blowout may occur.

In summer heat conditions, as the pavement temperatures soar, it's important to regularly check air pressure. Make sure proper tire inflation to manufacturers' specifications is maintained, but only check pressure when tires are at ambient temperature. Maximum pressure recommendations are noted on the tires sidewall. Also, tire pressure information can be found in a vehicles owner manual or on a vehicle door placard. It's important to note that under-inflated tires increase the risk of tire blowouts.

Under-inflated tires run hotter than tires inflated properly to the manufacturer's recommendations, and in summer heat conditions tire temperatures can get high enough to cause serious damage to the tire. In addition, under-inflated tires will result in poor gas mileage.

Excessive heat can also cause badly worn or old tires to fail even while exercising safe and careful driving practices. Tire makers perform sophisticated heat tests. In one case, a tire reached 170 degrees after an hour of use, when the air temperature was just 73 degrees.

Not all rubber compounds are created equal either. Tires have separate ratings for temperature, tread wear, load capability, and speed. Temperature grades represent a tire's resistance to heat and its ability to dissipate heat when tested under controlled laboratory test conditions. The grades from highest to lowest are "A","B", and "C". The grade "C" corresponds to the minimum performance required by federal safety standard. Therefore, the "A" tire is the coolest running, and even though the "C" tire runs hotter it does not mean it is unsafe. The temperature grade is established for a tire that is properly inflated and not overloaded.

Brown Outs and Electrical Equipment

Brown outs are in effect a decrease in voltage coming into a residence or business. Home appliances and business equipment are designed to operate at specific voltages. If you decrease the voltage to an appliance or machine it will try to compensate by drawing more current (Amps). Current is what creates heat in a device. So as a appliance or machine attempts to draw more current it will create more heat possibly damaging the device. If an appliance is designed to operate on 600 watts of power at 120 volts, it will draw 6 amps of current. (P=I•E). If it needs 600 watts and the voltage drops to 100 volts, the current would need to rise to 6 amps. Repeat brown outs can damage appliances and equipment bringing on premature failures.

As we face record breaking temperatures this summer, it's important to remember that they aren't the only ones suffering from the heat. Electronics and heat don't mix, and the combination can be disastrous.

Many areas lost power or experienced brown outs during last week's heat wave. During that time, countless people flocked to their wireless devices to keep up to date on power repairs and entertain themselves. What they didn't realize was – the heat could be damaging their devices. Circuit systems within electronics work best at lower temperatures. Allowing systems to run for prolonged periods of time in high temperatures can decrease the longevity and reliability of devices. Most electronic equipment can only handle temperatures up to 120 degrees. Within the era of technology; cell phones and laptops have dramatically decreased in size. This causes a lot of systems to run with a higher heat density. Heat will degrade the battery of a device the most, and in some cases high temperatures can cause a battery to explode or cause a fire, but are rare in most cases. It's important to never leave a device in a hot car. A recent study found that cars left in 90 degree weather can get as hot as 133 degrees within an hour.

Solar Flares/Coronal Mass Ejections (CME): The Earth's Next Katrina?

<u>Solar Flares</u> are a sudden eruption of magnetic energy released on or near the surface of the sun, usually associated with sunspots and accompanied by bursts of electromagnetic radiation and particles. Ultraviolet and x-ray radiation from solar flares often induce electromagnetic disturbances in the earth's atmosphere.

<u>Coronal Mass Ejection (CME)</u>, a massive, bubble-shaped burst of plasma expanding outward from the Sun's corona, in which large amounts of superheated particles are emitted at nearly the speed of light.

The Sun's Glaring History

1847 - First recorded evidence of space weather effects on technology when currents were registered in telegraph wire.

1859 – Major failure of telegraph systems in New England and Europe coincide with a large solar flare called the "Carrington Event" after astronomer Richard Carrington witnessed the instigating solar flare.

1970s - Discovery of Coronal Mass Ejections (CMEs) and the recognition that these, rather than eruptive flares, are the cause of non-recurrent geomagnetic storms.

1989 - Early hours of March 13, a moderate intensity geomagnetic storm shut down the entire Hydro-Quebec electric transmission system leaving millions of people without service for nine hours or more. The North American Electric Reliability Council (NERC) attributed over 200 significant anomalies across the continent to this one storm.

2003 – A strong CME over Northern Europe caused transformer problems, system failure, and subsequent blackout in Sweden. One of the largest events recorded, but the CME was not directly aimed at the Earth.

Hot Weather and Solar Flares?

Here in Texas we've had a string of 40 days with temperatures over 100 F. The record, set in 1980, is 42 days. Not exactly something you aspire to. This string of hot days coupled with the August 9, 2011 report from the National Weather Service's Space Weather Prediction Center of a large solar flare has got people asking if these events are related.

The answer is that studies don't currently support a link between the hot weather and the solar flares. But that doesn't mean that the solar flares aren't significant. Take the recent August 9, 2011 event; on that day at about 3:05 AM Central time, a large solar flare was detected. While these flares occur all the time, they are not usually of any consequence. As in all cases, this flare produced magnetic waves, radiation, and a whole spectrum of radio signals. There are really two types of solar events that can affect us. The solar flare involves a release of electromagnetic radiation from the sun that is suddenly greater than its normal output. These flares produce a bright spot on the solar surface. The other type of event is a Coronal Mass Ejection (CME) which consists of streams of highly charged and rapidly moving particles. When these coronal mass ejections are pointed away from earth, they generally don't produce any effects. However, if they are directed toward earth, the resulting effects can be both spectacular and devastating. Although there are sunspot drawings from China dating to 800 BC, the invention and improvement of the telescope in the 17th century significantly increased the amounts of data collected about the sun. Between the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA), the tracking of sun activity has become as much a part of tracking the weather as watching the Doppler radar. The Solar and Heliospheric Observatory (SOHO) satellite tracks solar events and reports such information as the speed, type, and energy of ejected particles, the pressure of the solar wind, the spectral composition of the sun and its corona, and the magnitude and polarity of magnetic fluctuations. The Geostationary Operational Environmental Satellites (GOES) generally monitors the earth and reports weather patterns, storms, fires, and volcanic events, but it also monitors the x-ray emissions impacting the earth. Together, they provide a good set of data that can be used to correlate solar activity with the effects on the planet. Probably the most easily recognized result of these events is the effect called the aurora.

This is the effect produced when the charge particles ejected from the sun impact the earth's protective magnetic "shell". The effect is a fluctuating, multicolor display, usually only visible in the northern (aurora borealis) and southernmost (aurora australis) regions of earth. But the effects can be seen even closer to the equator if the flare is larger. Such was the case in 1859, when Royal Astronomical Society astronomer Richard Carrington was making observations of the sun and sketching sunspots. He noticed a sudden, bright white light visible at two locations on the sun's surface. The next day, aurora activity was recorded all over the earth and in places as far removed from the poles as Hawaii and the Bahamas. As spectacular and interesting as the display was, disastrous effects were also recorded: telegraph systems operators reported receiving electrical shocks and paper tapes set on fire. And this was in 1859, before the advent of cell phones, computer controlled electrical power grids, satellite communication,

and GPS. In June of 2010, the U.S. Department of Homeland Security (DHS) United States Fire Administration (USFA), through its Emergency Management and Response – Information Sharing and Analysis Center (EMR-ISAC) program, issued an informational message to the emergency services concerning solar storms . In their report, USFA indicated that the solar activity cycle, typically an eleven year cycle, was approaching a maximum that could result in the “perfect storm” of solar events occurring sometime in the spring or autumn of 2012.

The National Weather Service reports space weather effects in three categories: geomagnetic (G), solar radiation (S), and Radio Blackouts (R). The rating is scaled from 1 to 5, with 5 being the most devastating effect. For instance, the August 9, 2011 event had a radio blackout rating of R3 which is strong, with high frequency radio communications blacked out for at least one hour and low frequency navigational signals degraded for at least one hour. The highest rating for solar radiation, S5, would be a condition in which “satellites may be rendered useless” with loss of control and permanent damage.

The earth, fortunately, has several things that protect it from these solar events. One is the presence of an atmosphere that can shield us from the intense solar radiation. The magnetic field of the earth works to counter the fluctuations caused by magnetic fields produced when there is a solar flare. Though work is ongoing to determine the exact relationship between solar flares and sunspots, there is no doubt that the prediction of solar flare activity is critical to protecting sensitive electrical and electronic infrastructure on the earth. The potential for a catastrophic event related to solar flares is related to the intimate integration of technology into so much of our infrastructure. This integration exposes us to greater risk for a system-wide failure. Consider the magnetic storm that is produced when a flare exits the sun and expands out into space, eventually snapping off from the sun like chunk of “silly putty”. As this magnetic cloud moves toward the earth, at speeds reaching 8 million miles per hour, it eventually impacts our magnetic field. Even though most of the tremendous amount of energy in this cloud is directed around us by our magnetic field, a small amount is able to interact with power lines and transformers. The result is that power lines can be overloaded and cause circuits to open. Transformers can be overloaded and fail, potentially catastrophically. Fluctuations in the power grid as a result of multiple, simultaneous failures have the potential for producing overcurrent or heating on the power systems, some of which may result in a fire. Just such an event occurred in March 1989, when the power grid for the Province of Quebec was disrupted by a transformer that exploded as a result of the induce magnetic field from the storm. The resulting failures while trying to compensate left thousands without power for several hours. The outage disrupted communications and transportation and left thousands stuck with no lights, no elevators, and no traffic control.

Our Next Solar Cycle?

Today, we are even more dependent on our cell phones, many of which now operate in the frequencies above 1 GHz (1,000 megahertz) where electromagnetic activity from a solar flare is most likely to cause communication disruption. More importantly, it isn't just the inability to talk to someone on a cell phone; consider that many modern systems communicate through microwave services to coordinate activities like meeting electrical or water service demand. A solar flare could potentially disrupt this service and disable the system from delivering needed commodities. Although we on the planet are somewhat well protected, there are numerous satellites in orbit that do not have the atmosphere or magnetic field to protect them. We are currently on the increase for sunspots and for solar flares with the last peak of the cycle occurring in 2001. The latest estimate is that our next solar cycle will peak in 2012 or shortly after. So what should be done now to minimize the effects of such a catastrophic solar event? Individuals should always have preparedness in mind. The common wisdom has lately been self-sustaining for 72 hours, however many officials suggest 96 or even 120 hours.

Large facilities that want to be resilient to these events need to consider emergency power sources that are not dependent on the larger grid.

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