

# The Sun is Undergoing a State Change

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## Background

Each morning, I turn on my computer and check to see how the sun is doing. For the past several years I was normally greeted with the message "The sun is blank - no sunspots." We are at the verge of the next sunspot cycle, Solar Cycle 24. How intense will this cycle be? Why is this question important? Because there are "Danger Signposts" ahead!

Sunspots are dark spots that appear on the surface of the sun. They are the location of intense magnetic activity and they are the sites of very violent explosions that produce solar storms.

The sun goes through a cycle lasting approximately 11 years. It starts at a solar minimum when there are very few sunspots and builds to a solar maximum when hundreds of sunspots are present on the surface of the sun and then returns back to a solar quiet minimum. This cycle is called a solar cycle. We are currently in a solar minimum leading up to Solar Cycle 24, so named because it is the 24th consecutive cycle that astronomers have observed and listed. The first cycle began in March 1755.

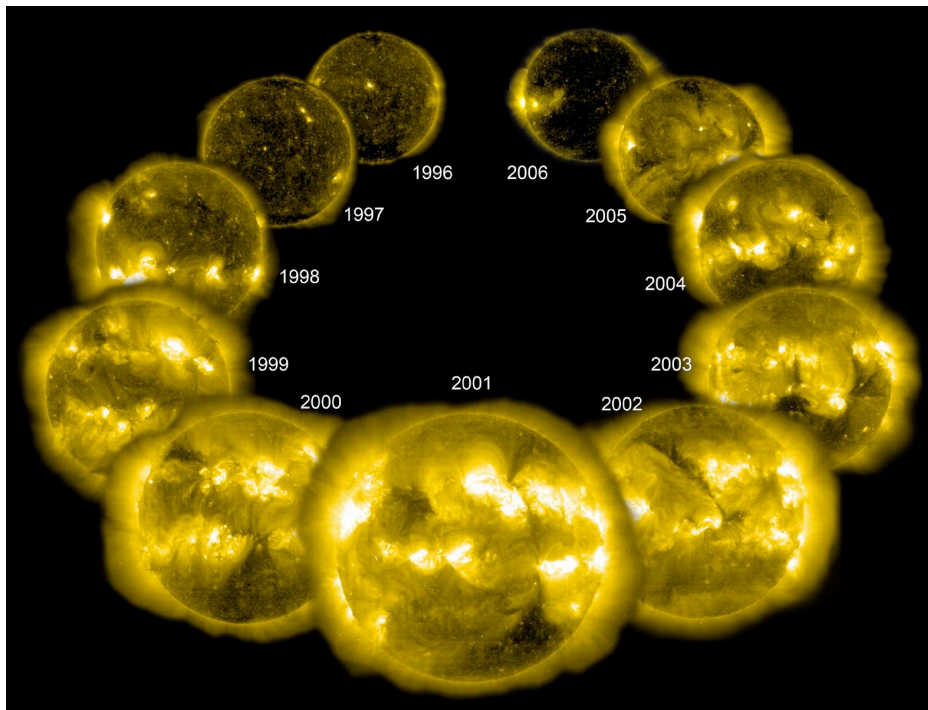


Figure 1. Image of Solar Cycle 23 from the Solar and Heliospheric Observatory (SOHO) by Steele Hill (NASA GSFC)

The sun exhibits great variability in the strength of each solar cycle. Some solar cycles produce a high number of sunspots. Other solar cycles produce low numbers. When a group of cycles occur together with high number of sunspots, this is referred to as a solar "Grand Maxima". When a group of cycles occur with minimal sunspots, this is referred to as a solar "Grand Minima". Usoskin details the reconstruction of solar activity during the Holocene period from 10,000 B.C. to the present.<sup>1</sup> Refer to Figure 2. The red areas on the graph denote energetic solar "Grand Maxima" states. The blue areas denote quiet solar "Grand Minima" states.

The reconstructions indicate that the overall level of solar activity since the middle of the 20<sup>th</sup> century stands amongst the highest of the past 10,000 years. This time period was a very strong "Grand Maxima". Typically

these grand maxima are short-lived lasting in the order of 50 years. The reconstruction also reveals “Grand Minima” epochs of suppressed activity, of varying durations have occurred repeatedly over that time span. A solar Grand Minima is defined as a period when the (smoothed) sunspot number is less than 15 during at least two consecutive decades. The sun spends about 17 percent of the time in a Grand Minima state. Examples of recent extremely quiet solar “Grand Minima” are the Maunder Minimum (about 1645-1715 A.D.) and Spörer Minimum (about 1420-1570 A.D.)

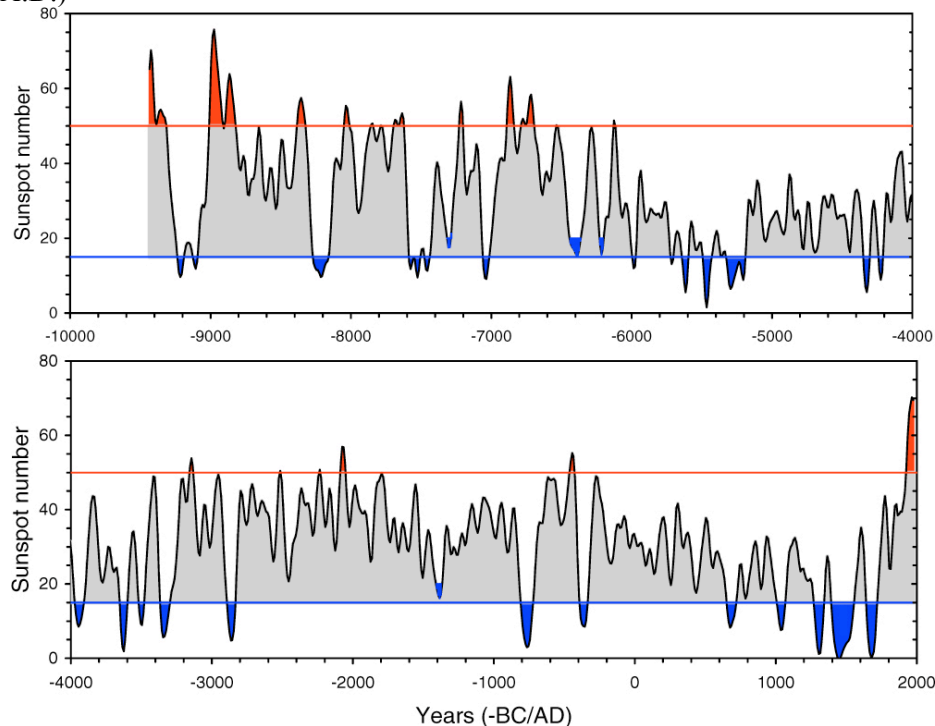


Figure 2. Sunspot activity throughout the Holocene. Blue and red areas denote grand minima and maxima, respectively. The entire series is spread out over two panels for better visibility.<sup>1</sup>

By monitoring the number of spotless days (days without sunspots) during a solar minimum, scientists can gain a sense of the intensity of the upcoming solar cycle. As of the end of December 2009, the cumulative number of spotless days in the transition into Solar Cycle 24 now stands at 771. The number of spotless days is beginning to taper off. There were only 10 spotless days in December.

The transitions into Solar Cycles (SC16-23), referred to as **recent solar cycles** (years 1923 to ~2008), averaged 362 cumulative spotless days. Those minimums ranged from 227 - 568 spotless days. Since the current transition now exceeds this range, it is fairly clear that the sun is undergoing a state change. The solar Grand Maxima state that has persisted during most of the 20th century is coming to an abrupt end. The **old solar cycles** (SC 10-15, years 1856 to 1923) averaged 797 spotless days, over twice that of the **recent solar cycles**. Those solar minimums ranged from 406 - 1028 spotless days.<sup>2</sup> If this solar minimum ends soon, as it appears to be doing, then the upcoming solar cycle may be similar to the **old solar cycles**.

The sun has gone magnetically quiet as it transitions to Solar Cycle 24. The Average Magnetic Planetary Index (Ap index) is a proxy measurement for the intensity of solar magnetic activity as it alters the geomagnetic field on Earth. It is commonly referred to as a measuring stick for solar magnetic activity. For 11 months, from November 2008 to September 2009, the Ap index had been hovering near rock bottom with reading of 4's and 5's. But in the last two months, October and November, the Ap monthly index broke through the glass floor and spawned the lowest value in the past 77 years with a reading of "3". And then in December, the AP Index even went quieter with a reading of "2" <sup>3</sup>

Our Milky Way galaxy is awash with high-energy galactic cosmic rays (GCRs). These are charged particles

(protons, ions) that originate from exploding stars (supernovas). Many of these particles are traveling near the speed of light. Because they are charged, their travel is strongly influenced by magnetic fields. Our sun produces a magnetic field that extends to the edges of our solar system. This field deflects many of the cosmic rays away from Earth. But when the sun goes quiet (minimal sunspots), this field collapses inward allowing cosmic rays to penetrate deeper into our solar system. Currently the sun's interplanetary magnetic field has fallen to around 4 nano-Tesla (nT) from a typical value of 6 to 8 nT. The solar wind pressure is down to a 50-year low. The heliospheric current sheet is flattening. In 2009, cosmic ray intensities have increased 19% beyond anything we've seen since satellite measurements began 50 years ago.<sup>4</sup>

If we slip into a quiet solar "Grand Minima" state, we can expect GCR flux rates to increase 200% to 300% above current levels.

## There are Two Paths Ahead; Each Marked with a “Danger” Signpost

We are now at a crossroad. Two paths lie before us. Both are marked with a signpost that reads “Danger”! Down one path lies the threat from massive solar storms. Down the other path lies several decades of crushing cold temperatures and global famine.

If either of these threats materializes, many nations will be hit blind-sighted. Both are related to the current state of the sun. The sun has been in a “Grand Maxima” for most of the past century. This has accounted for much of the natural warming the earth has experienced. But as evident in the high number of spotless days in this solar minimum, the sun is changing states. It might (1) level off and revert to the **old solar cycles** or (2) the sun might go even quieter magnetically slipping into a “Dalton Minimum” or a solar Grand Minima such as the “Maunder Minimum”. It is still a little early to predict which way it will swing.

## Solar Storm Threat

Most solar storms produce only minor disquieting effects on Earth. Typically one might expect short-term electrical power blackouts, short-lived communication outages, rerouting of aircraft, loss of a few satellites and a beautiful “aurora borealis” in the night’s sky from a large solar storm. But as the intensity of a solar storm increases like a wild beast, the storm can begin to develop the capacity to create a major disaster on Earth. The difference in solar storm intensity is like the difference between being hit with a tropical rainstorm and being devastated by a Category 5 hurricane. The solar storm of 1-2 September 1859, which began with a solar flare so strong that it was subsequently named the Carrington Flare, was such a beast.

A solar storm can consist of three major components: a solar flare, a solar proton event and a coronal mass ejection. A coronal mass ejection can interact with Earth’s magnetic field to produce a geomagnetic storm. Not all solar storms produce all three elements but the largest solar storms tend to.

Will the world face the threat from a massive solar storm in Solar Cycle 24? An increase in the number of cumulative spotless days during a solar minimum appears to correlate to a reduction in the number of sunspots over the entire solar cycle. The **old solar cycles** produced overall 38% fewer International Sunspot Numbers than the **recent solar cycles**. Since the **old solar cycles** produced fewer sunspots, one might draw the conclusion that we will be entering a period of reduced solar storms. But historical observations show this is not true. It is quite the opposite. The **old solar cycles** produced very intense solar storms. Massive solar storms in the **old solar cycles** occurred on 1-2 September 1859, 12 October 1859, 4 February 1872, 17-18 November 1882, 30 March 1894, 31 October 1903, 25 September 1909 and 13-16 May 1921. How can this be? This is because the **old solar cycles** produced massive sunspots. It was as if the magnetic field energy still existed and still had to be vented but during a shorter time interval, so the sunspots exploded in size and power.

The **old solar cycles** ranged from 406 - 1028 spotless days. That is a fairly wide range. As of the end of December 2009 the cumulative number of spotless days stands at 771. The number of spotless days is beginning to taper off. There were only 10 spotless days in December. It is likely that the final number for the solar minimum leading into Solar Cycle 24 will be in the 800's. This puts us uncomfortably close in spotless days to the two solar cycles that produced the most intense solar storms, Solar Cycles 10 and 13.

The solar minimum preceding Solar Cycle 10 produced 654 spotless days. The largest known solar storm in modern history occurred during Solar Cycle 10. On 1 September 1859, an extremely rare white-light flare occurred on the surface of the sun. This event was referred to as the Carrington flare. Minutes later a burst of high-energy protons struck earth. This Solar Proton Event (SPE) was the strongest observed in 450 years, producing an omnidirectional fluence of 18.8 billion solar protons (with energies greater than 30 million electron volts (MeV)) per square centimeter. Seventeen hours and forty minutes later the main mass of the Coronal Mass Ejection (CME) struck the earth like a large battering ram distorting the Earth's magnetic field, producing a massive geomagnetic storm. The intensity of this storm is estimated as magnetic intensity Disturbance Storm Time (Dst) of 1,760 nT (nano-Teslas). By way of comparison, the strongest geomagnetic storm since 1957 occurred on 13 March 1989 with a Dst of 589 nT.

The solar minimum preceding Solar Cycle 13 produced 736 spotless days. Five very large solar proton events (SPEs) occurred in Solar Cycle 13. These SPEs produced solar proton fluence of 2.3 billion, 7.7 billion, 11.1 billion, 8.0 billion and 3.1 billion respectively.<sup>5</sup> The (11.1 billion) SPE was the second strongest solar proton event detected in 450 years of ice core records. By way of comparison, the strongest SPE's during the past 5 solar cycles (1954 to ~2008) had a solar proton fluence of 8.0 billion for a November 1960 event and 5.0 billion for an August 1972 event.

If a solar storm of the magnitude of the Carrington flare were to occur today, the effect on our modern technologically dependent society would be grave. Of these, the greatest threat would lie in the loss of stable electrical power. The geomagnetic storm created as the coronal mass ejection collides with Earth's magnetic field can destroy many of the large custom Extra High Voltage (EHV) power transformers used in the United States and throughout the world. In 2007, I described the effects from a massive solar storm in Solar Storm Threat Analysis.<sup>6</sup> In 2008, the U.S. National Academy of Sciences took up the subject holding a public workshop to define the solar storm threat. Their independent findings (which mirrored mine) were published in a report titled Severe Space Weather Events - Understanding Societal and Economic Impacts.<sup>7</sup> In their findings, the bottom line was if a massive solar storm struck the United States today "it would result in large-scale blackouts affecting more than 130 million people and would expose more than 350 major transformers to the risk of permanent damage". Imagine the effect of a total power blackout for months/years on 100 million people in the U.S. along with many millions around the globe. The report then goes on to say, "Historically large storms have a potential to cause power grid blackouts and transformer damage of unprecedented proportions, long-term blackouts, and lengthy restoration times, and chronic shortages for multiple years are possible."

Imagine for a moment what modern life would be like without electricity. The transportation system would be thrown into gridlock. Electric trains and subway trains would stop dead in its tracks. Stoplights and railway signal light would no longer work. Gasoline stations would be unable to pump gasoline or diesel because the pumps run off of electricity. Businesses, schools and homes would go dark. Communication systems would either die or become severely constricted. Water in many homes would dry up after a few days because municipal water pumps are electric. Without water, the toilets would no longer flush. Some sewer systems would become inoperative spilling raw sewerage into rivers and lakes. Life without electricity for a few days is a major inconvenience. Life without electricity for months or years is a major disaster. Most EHV transformers are large, the size of a small house, and very unique. They are not off-the-shelf items. They are costly (around \$10 million each) and have a manufacture lead-time of a year or more for replacement. As a result, restoration would be slow and the massive blackout could extent through many months. This is the threat. Our technological world is vulnerable to a master reset.

## Quiet Sun Threat

There are some scientists that believe the sun, rather than leveling off into a new state in Solar Cycle 24, will continue to free fall throughout this solar cycle. Several scientists including David Hathaway (NASA)<sup>8</sup>, William Livingston & Matthew Penn (National Solar Observatory)<sup>9</sup>, Khabibullo Abdusamatov (Russian Academy of Science)<sup>10</sup>, Cornelis de Jager (The Netherlands) & S. Duhau (Argentina)<sup>11</sup> and Theodor Landscheidt (Germany)<sup>12</sup>, have forecasted that the sun may enter a period similar to the Dalton Minimum or a more severe “Grand Minima” (such as the Maunder Minimum or Spörer Minimum), a decade from now in Solar Cycle 25.

A few scientists including David C. Archibald (Australia)<sup>13</sup> and M. A. Clilverd (Britain)<sup>14</sup> have warned this might even begin in Solar Cycle 24. We are at the transition into Solar Cycle 24 and this cycle has already shown itself to be unusually quiet.

The sun is a major force controlling natural climate change on Earth. Our Milky Way galaxy is awash with cosmic rays. These are high-speed charged particles (protons, ions) that originate from exploding stars. Many of these particles are moving close to the speed of light. Because they are charged, their travel is strongly influenced by magnetic fields. Our sun produces a magnetic field that extends to the edges of our solar system. This field deflects many of the cosmic rays away from Earth. But when the sun goes quiet (minimal sunspots), this field collapses inward allowing cosmic rays to penetrate deeper into our solar system. As a result, far greater numbers collide with Earth and penetrate down into the lower atmosphere where they ionize small particles of moisture (humidity) forming them into water droplets that become clouds. Charged raindrops are ten to a hundred times more efficient in capturing aerosols than uncharged drops. Low clouds tend to be optically thick and are efficient at reflecting sunlight back into space. A large increase in Earth's cloud cover produces a global drop in temperature.

Galactic cosmic rays are a very effective amplifying mechanism for climate forcing because the energy needed to change cloudiness is small compared with the resulting changes in solar radiation received at the Earth's surface.

Earth's ocean cloud cover is strongly correlated with GCR flux modulated by solar cycle variations. Refer to Figure 3.

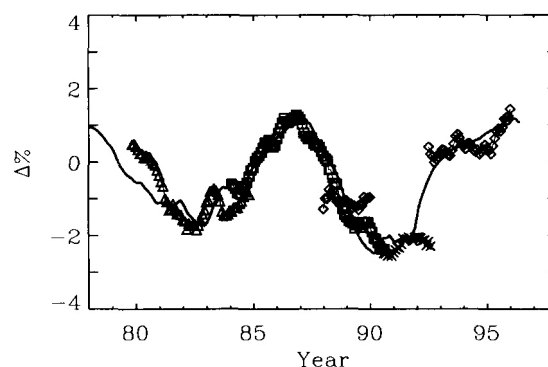


Figure 3. A strong correlation between Galactic Cosmic Rays (GCRs) and Earth's cloud cover over the oceans. This figure shows cosmic rays fluxes from Climax (thick curve) plotted against four satellite cloud data sets. Triangles are the Nimbus-7 satellite data, squares are the ISCCP-C2 data, diamonds are the DMSP data, and crosses are the ISCCP-D2 data.<sup>15</sup>

In 2006, the Danish National Space Center in Copenhagen conducted experimental studies of aerosol nucleation in air, containing trace amounts of ozone, sulfur dioxide and water vapor at concentrations representative of Earth's atmosphere over the oceans. Their experiments confirmed the causal mechanism by which cosmic rays facilitate the production of clouds in Earth's atmosphere.<sup>16</sup> Specifically the experiments showed that (1) stable cloud aerosol clusters were formed in the presence of ions, (2) the nucleation rate was proportional to the ion density, (3) the

characteristic time for producing stable clusters was very short (2 seconds or less).

This theory is not an abstract threat but rather a very real one grounded in historical observations. The last solar Grand Minima was the Maunder Minimum (1645-1715 AD). During the 30-year period from 1672-1699 AD, there were less than 50 sunspots detected, whereas during the past century over the same period between 40,000-50,000 sunspots normally would appear. The Maunder Minimum corresponded to the depths of the Little Ice Age. Before that was the Spörer Minimum (about 1420 to 1570 A.D.). That Grand Minima was also noted for bone-chilling cold temperatures and was referred to as a Little Ice Age.

The threat from a quiet sun is describe in the Solar Grand Minima Threat Analysis.<sup>17</sup> Historically past solar “Grand Minima’s” produced a global drop in world temperatures. Food production declined due to shortened growing seasons, unpredictable early frost, a dramatic increase of days with overcast skies and a resulting decline in the intensity of sunlight. With diminished food production, a string of famines occurred. Added cloud cover also produced greater rainfall, massive storms and floods. For example during the Spörer Minimum, approximately 400,000 people perished in the A.D. 1570 “All Saints Day storm” in northwestern Europe. And two catastrophic storms hit England and the Netherlands in A.D. 1421 and A.D. 1446, each storm killing 100,000. Flooding created swamplands that became mosquito breeding grounds and introduced tropical diseases such as malaria throughout Europe.<sup>18</sup> During the Little Ice Age, glaciers expanded rapidly in Greenland, Iceland, Scandinavia and North America. This caused vast tracts of land to become uninhabitable. The Arctic ice pack expanded into the far south. Several reports describe Eskimos landing their kayaks in Scotland. Finland’s population fell by one-third, Iceland’s by a half, the Viking colonies in Greenland were abandoned altogether, as were many Inuit communities.<sup>19</sup>

This threat is not a short-term threat but extends over several decades. Of the 27 “Grand Minima’s” that have occurred over the past 12,000 years: 30% lasted less than 50 years, 52% lasted between 50 and 100 years, and 18% lasted over 100 years. Of these, the longest was Spörer Minimum, which lasted approximately 150 years.

## Preparedness Planning

It would be unfair to discuss the threats from massive solar storm or from a solar “Grand Minima” event without providing some guidance in dealing with many of the after-effects. As a result, I have laid out civil defense planning to deal with each of these threats. The plans are in English (my native language) and freely available on the internet. The Solar Storm Disaster Preparedness Plan is available at <http://www.breadandbutter-science.com/SSDPP.pdf>. The Solar “Grand Minima” Preparedness Plan (i.e. Little Ice Age) Preparedness Plan is available at <http://www.breadandbutter-science.com/GMDPP.pdf>.

The goal of the **Solar Storm Disaster Preparedness Plan** is to alleviate some of the misery and hardship that may be encountered following a massive solar storm. The plan identifies both a reactive approach (immediate actions) and a proactive approach (long-term measures) that can be taken to minimize adverse effects from this threat. The plan provides practical advice primarily focused on survival basics: water, food, shelter and protecting human life.

The reactive approach discusses steps to be taken immediately to prepare for an imminent major solar storm and potential electrical blackout. The first section is similar a “to do” list. Stock-up on extra batteries, such as those used in flashlights and radios. Fill vehicles with gasoline/diesel. Pick up alternative fuel for cooking such as charcoal/propane and don’t forget the matches. For individuals on prescription medicine, obtain a 90-day or more supply. Visit the bank, withdraw some savings and have cash on-hand. Store tap water or buy bottled water. Obtain non-scented chlorine bleach for drinking water purification. Stock up on food, which does not require refrigeration or cooking. Make sure you have a manual can opener. Prepare intelligently for the morning commute. Avoid elevators. Don’t fly on airplanes. Coordinate preparations with friends and family. Make sure you have a portable radio. Fully charge all rechargeable batteries such as those found in cell phones. Disconnecting power from electronics. Fuel and check operation of automatic backup electrical generators. Individuals over 35 years of age should take an aspirin a day for the next week. Stock up on buckets, vitamins, and

toilet paper. Have activities ready for your spare time such as visit the library or bookstore and obtain books for reading. For those with pets, make sure you have adequate supplies of pet food. In winter in cold weather areas additional preparations are required. If you have an electric garage door opener in your home, know how to manual disengage it. Reduce power consumption from the electrical power grid.

The next section discusses issues after an electrical blackout has taken hold: determining the scope of disaster, communications that will still be operational after a blackout, controlling traffic jams, travel advice, the threat from accidental electrocution, emergency call centers, reducing electrical surge loads, loss of water, perishable food, loss of indoor electrical or gas ranges, fires and carbon monoxide poisoning, frozen water pipes, surviving climate extremes without electricity, inoperative toilets, tall buildings, neighborhood watches, critical computer infrastructure, national guards, riots, conservation and relocation.

The proactive section describes the preparation needed to survive a long-term electrical blackout lasting months/years. At the individual level this section discusses in depth: water storage, water treatment, long-term food storage, food preparation and cooking, lighting, sanitation, cold weather considerations, alternate electrical power, medical emergencies and security. At the governmental level, the plan discusses: service stations, traffic lights, emergency communications, old standard equipment, emergency system design, satellite hardening, spacecraft shielding, electrical grid design, backup grid assets, power restoration priority and the breakdown in banking and the financial system.

The **Solar Grand Minima Preparedness Plan** focuses on threats present in a Little Ice Age. Mankind has been down this road before and we will go down this road again and we will survive. The last time we faced the threat from a solar Grand Minima was over 300 years ago, and as a result it has almost been erased from our collective memory. A solar Grand Minima produces a time of great hardship, a time of significant natural global cooling, a time of great famine and starvation and a time of major epidemics.

In general, the way we survived this harsh cold weather in the past will be the way we will in the future - through adaptation. The plan researched the methods individuals use to survive the extreme cold weather in Fairbanks, Alaska; International Falls, Minnesota; and in Antarctica. It looked at the problems they faced and how they coped and adapted. This adaptation encompasses the clothes we wear, our transportation, the design of our homes and businesses, a greater understanding of cold weather health hazards and treatments. Little Ice Age conditions will strangle food production resulting in a series of famines. One section of the plan describes techniques individuals can apply in preparing long-term food storage. Massive ice storms and blizzards cause massive electrical outages. Many of the methods we currently use to heat our modern homes in the winter require electricity. Without electricity, homes in cold environments will slowly lose heat and become unlivable. Therefore, another focus in this plan is the need to have a back-up heat source that does not use electricity. At the governmental level, this plan discusses farming, energy, natural resources, plagues and excessive environmental regulations.

## Non-Threats

I find it interesting that many people fear imaginary threats while at the same time basically ignoring threats that are real and imminent. Two imaginary threats currently playing out on the world stage are the man-made global warming scare and the predicted cataclysmic world disaster linked to the end of the Mayan calendar in the year 2012.

In the **Man-Made Global Warming** scare, it is alleged that man-made industrial emissions of carbon dioxide are increasingly trapping heat, which would otherwise escape from our atmosphere, thus causing global warming. It is further believed that this increasing carbon dioxide level will reach a tipping point where the world will heat up to the point that life will no longer be sustainable on the planet.

The consensus among scientists in support of the man-made global warming theory has been grossly exaggerated.



For example, over 31,000 American scientists signed the following petition "There is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth."<sup>20</sup> This number of scientists is not a trivial number.

By taking this stance many scientists place their careers in jeopardy. This is because the global warming lobby is very powerful and vindictive. The scientists that signed this petition believe in the scientific principles of openness, falsifiability, replicability and independent review. When the integrity of science is at stake, they are willing to step forward and be counted.

The primary greenhouse gas in Earth's atmosphere is not carbon dioxide. Rather, it is water vapor. Water vapor is directly responsible for the Earth's present climate. Carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are only minor constituents in Earth's atmosphere and produce only very minimal effects on our climate.

Life on Earth is based on the carbon atom. Carbon dioxide is part of the fabric of life. Declaring carbon dioxide a pollutant is scientifically unsound. Without carbon dioxide; plants would quickly die. Even humans require some carbon dioxide to survive. Over the last 350 million years carbon dioxide levels have varied between 250 parts per million (ppm) and 2,500 ppm with an average level of around 1,500 ppm. This average level (1,500 ppm) happens to be an optimum level for many plants. Present atmospheric carbon dioxide level is currently on the low side at 387 ppm. Consider that individuals with respiratory problems are routinely given oxygen. Oxygen concentrators remove nitrogen from the air and provide 95 percent pure oxygen along with argon, other trace gases and over 1,500 ppm carbon dioxide. The American Industrial Hygiene Association (AIHA) reports that only when atmospheric carbon dioxide levels reach 100,000 ppm that the gas becomes immediately dangerous to human life.<sup>21</sup>

Satellites provide generally the most accurate atmospheric temperature measurements covering the entire globe. Average yearly lower Troposphere temperatures (relative to the 1979-1998 average) were as follows: 1998 (0.512°C), 1999 (0.040°C), 2000 (0.035°C), 2001 (0.198°C), 2002 (0.311°C), 2003 (0.275°C), 2004 (0.195°C), 2005 (0.338°C), 2006 (0.260°C), 2007 (0.282°C), 2008 (0.048°C), and 2009 (0.259°C) according to the University of Alabama at Huntsville (UAH) LT5.2 satellite data.<sup>22</sup> Comparing the peak year 1998 to the present, the lower Troposphere temperature is currently a 1/4 degree Celsius colder. This is despite the fact that over that same time period, atmospheric carbon dioxide (at Mauna Loa) has risen 20 ppm or 5% from 367 ppm to 387 ppm. The man-made global warming theory failed to predict this trend. The falling temperatures occurred at the same time as the sun produced minimal sunspots as it is transitioned into Solar Cycle 24.

There will be some that might argue that the year 1998 was a temperature anomaly. Indeed, they would be correct. But the elevated temperatures observed that year were used to drive fear into the hearts of many people that the Earth had finally reached a tipping point and this was proof-positive that man-made global warming was a hard fact instead of just a hypothesis based on untested (unvalidated) computer models.

Analysis of ice core data through glacial/interglacial transitions shows an association between carbon dioxide and temperature. But the climatic temperature always changed first and carbon dioxide levels followed. There is a measurable lag time of 400 – 1,000 years.<sup>23</sup> Therefore; it is earth's temperature that is driving atmospheric carbon dioxide levels rather than carbon dioxide levels driving temperature. Why is this the case? It is because the oceans stores vast quantities of carbon dioxide; far greater than our atmosphere. Carbon dioxide is soluble in water. This solubility decreases as the water temperature increases. As the world's oceans gently warm naturally, carbon dioxide is released into Earth's atmosphere.

The Earth's atmosphere is fairly stable and resilient. Carbon dioxide levels during the Ordovician period (which began 490 million years ago and ended around 443 million years ago) were approximately 5,000 ppm, but these high-levels of carbon dioxide did not throw our world into runaway global warming.<sup>24</sup> So if exceptionally high



carbon dioxide levels did not cause run-away global warming in the past, why would we expect that to be the case in the future (especially at the minimal levels of 387 ppm)?

Another imaginary threat is the **Predicted AD 2012 Cataclysm**. The long count calendar of the ancient Mayans ends on 21 December 2012. Someone reasoned that since the calendar ends - so must the world. The cause of the cataclysm has not been well defined. Proposed causes include: a geomagnetic pole reversal, crustal displacement caused by a physical pole reversal, a collision or near-miss with a phantom planet (Nibiru/Planet X), an alignment of the super-massive black hole at the center of our galaxy causing a massive gravity wave, a crossing of the galactic plane, asteroid/comet impact, a coronal mass ejection from the sun, an explosion from the black hole at the center of our galaxy, a religious apocalypse, an alien invasion, a gamma ray burst, changes in the flux rates of high-energy galactic cosmic ray striking Earth, flu mega-pandemics, nuclear or biological war, a super-volcano eruption, a global warming effect, distortion in the time space continuum, the unleashing of a self-replicating nanotechnology bug, a nearby supernova explosion, a nuclear accident, ice age inception, the creation of a mini-black hole in the Large Hadron Collider that gobbles up Earth. And the list goes on and on and on. In the movie "2012", neutrinos from the sun heat up the Earth's core causing the tectonic plates to shift.

A couple years ago, an anthropologist in Mexico City contacted me. She had heard rumblings about this potential cataclysm and wanted to determine if any scientific basis to support the claims. I felt that some of the following questions need to be addressed. Did the ancient Mayans possess the technology to accurately predict this cataclysm with great precision? Is it even possible for the proposed threat to cause a global cataclysm? Where are the physical signs that the cataclysm is about to occur? At the time, the focus of the cataclysmic threat was from a gravitational wave generated by an alignment in the galactic core. The Mayans did not possess the technology to observe what is happening in the center of our Milky Way galaxy. Even today this is cutting edge science. If a gravity wave was plowing through our galaxy, it would be observable. Other stars would be affected and the distortion would be noted with astronomical instruments. Where are these scientific observations?

Another threat we discussed was pole reversals. The Earth's magnetic pole reverses at random intervals. The intensity of the Earth's magnetic field has been declining. Scientific analysis of ancient pottery has shown that the magnetic field strength has declined 50% in the last 4,000 years. Recently, the decline has become very steep and pronounced. The decline in field strength at the equator has fallen 4.5% during the last century. Most of this decline occurred during the last 25 years. But having said this, the Earth's magnetic field is still significantly stronger than the norm. Perhaps in a few thousand years it might reverse polarity. Also a reversal in the magnetic poles does not pose a grave danger to mankind. If there is any threat it lies in the restructuring of Earth's strong dipole into several mini-poles (or magnetic anomalies). Earth's magnetic field helps to deflect cosmic rays (galactic and solar) and a weakening of local magnetic fields would produce greater numbers of particles drilling down through our atmosphere. The Mayans did not possess the technology to predict magnetic pole reversals. Even today's science has not advanced to that level.

From there our discussion drifted to physical pole reversals. The Earth spins like a top. This is a very stable system. Ever strike a spinning top? It can bounce a quarter of a meter and keep on spinning. So long as the spin rate remains unchanged, the Earth spin axis could change orientation in frictionless space without producing an end-of-the-world cataclysm. But what is the scientific mechanism that would cause this threat to come about? Someone has suggested a near miss by Planet-X, the phantom planet. A planet on an elliptical orbit would approach Earth at a high-speed greater than 50 kilometers per second. It would flash by Earth and not severely affect Earth's spin rate. It might cause a tidal effect and it might slingshot Earth into a slightly different orbit around the sun. This might cause some problems but it would not produce a physical pole reversal. Also this requires a phantom planet to actually exist outside the realm of one's active imagination.

Everywhere I looked for scientific explanation and evidence to support this Mayan cataclysmic theory I find none. The list of proposed threats have grown so long that it is like visiting a smorgasbord. This scare is unscientific. The only thing certain about this scare is the date and even that is not set in concrete. Some have set the date as 23 December. This cataclysmic myth is similar to the ones that came before it, like the Great Nibiru Collision Scare of 27 May 2003 (after that date came and went, it was readjusted to year 2010 and then to year 2012), or the "Jupiter

Effect" cataclysm predicted for 10 March 1982, or the planetary alignment cataclysm slated to take place on 1 January 2000 (after that date came and went, it was readjusted to 5 May 2000), or the Hale-Bopp comet scare of 19 March 1997 in which 39 members of the Heaven's Gate cult committed suicide.

The Mexican anthropologist eventually met with a Mayan astrologist, a descendant of the ancient Mayans. The astrologer explained that the Mayan calendar does not completely end. It is a cyclical calendar that just starts up over again. It is an astrological calendar not an astronomical calendar. It doesn't predict the end of the world. This finally brought some peace-of-mind to the anthropologist.

## Closing Comments

Will the sun's magnetism continue to free fall during Solar Cycle 24 or will it level off into a steady state similar to the **old solar cycles**? Will the next decade produce massive solar storms or will we see the start of a Dalton type minimum or even enter a more severe solar Grand Minima producing another Little Ice Age? As a scientist I can say that I do not have all the answers. The road ahead is bricked in uncertainty. But what is certain is the sun is undergoing a state change and two main threats lie on the horizon.

Climate change is primarily driven by nature. It has been true in the days of my father and his father and all those that came before us. Because of science, not junk science, we are slowly uncovered some of the fundamental mysteries of nature.

There is a lot of talk these days about the legacy we will leave our children and our grandchildren. When I stare into the immediate future, I see a frightening legacy caked in darkness and famine. Instead of intelligently preparing; we find ourselves whittling away this precious time chasing fraudulent theories. We have a decade to prepare, but have a misguided sense of direction and urgency. In ten years from now when the next solar cycle begins; if the sun goes quiet, who will comfort the starving children who cry out in the middle of the night for a small piece of bread? These will be our children.

Each morning I turn on my computer to see how the sun is doing today. The appearance of gigantic sunspots foretells the coming of massive solar storms. Months of spotless days foretell the coming of a quiet sun. Be alert, stay healthy, and alive! And remember, the soul of man shines brightest in adversity. Survive the hardship with a hearty soul and an enduring spirit.

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