

There are two paths ahead; each marked with a “Danger” signpost

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The sun has gone very quiet as it transitions to Solar Cycle 24. The Ap index is a proxy measurement for the intensity of solar magnetic activity as it alters the geomagnetic field on Earth. Anthony Watts (meteorologist) referred to it as the common yardstick for solar magnetic activity. The Ap index for February and for March is "5" a slight uptick from the three consecutive months of "4's" (November 2008 - January 2009). An Ap index of "4" is the lowest recorded number since measurements began in January 1932. This solar minimum has a long way to go before it can be declared officially over.

As of the end of March, the cumulative number of spotless days (days without sunspots) is now at 586 days. The transitions into Solar Cycles (SC16-23), referred to as **recent solar cycles** minimums, averaged 362 cumulative spotless days. Those minimums ranged from 227 - 568 spotless days. Since the current transition now exceeds 568 spotless days, it is becoming clear that sun has undergone a state change. It is now evident that the Grand Maxima state that has persisted during most of the 20th century has come to an abrupt end.

The **old solar cycles** (SC 10-15) averaged 797 spotless days, over twice that of the **recent solar cycles**. Those solar minimums ranged from 406 - 1028 spotless days.

An increase in the number of cumulative spotless days during a solar minimum correlates to a reduction in the number of sunspots over the entire solar cycle. The **old solar cycles** overall produced 38% fewer sunspots than the **recent solar cycles**.

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

If either of these threats materializes, this nation 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 this solar minimum, the sun is changing states. It might (1) revert to the **old solar cycles** or (2) the sun might go even quieter into a “Dalton Minimum” or a Grand Minima such as the “Maunder Minimum”. It is still a little early to predict which way it will swing. Each of these two possibilities holds a great threat to our nation.

(1) Reverting to the “Old” Cycles (Solar Cycles 10-15)

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 this is not true. It is quite the opposite. The **old solar cycles** produced very intense solar storms. The greatest solar storm in modern time known as the Carrington flare of 1-2 September 1859 occurred in Solar Cycle 10. In addition to the Carrington flare, several other massive solar storms occurred during the **old solar cycles**. These massive solar storms occurred on 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 like the magnetic field energy was still there and had to still be released but during a shorter time interval, so the sunspots exploded in size and power.

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. A massive solar storm could destroy many of the large custom Extra High Voltage (EHV) power transformer in the United States. These items are unique, costly (around \$10 million each) and have manufacture lead time of a year or more for replacement. In 2007, I described the effects from a massive solar storm in [Solar Storm Threat Analysis](#). I also laid out a civil defense plan for major solar storms called [The Solar Storm Disaster Preparedness Plan](#). In 2008, the National Research Council took up the subject holding a public workshop to define the solar storm threat. Their findings (which mirrored mine) were published in a report titled [Severe Space Weather Events - Understanding Societal and Economic Impacts](#). In their findings, their 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 across 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.”*

(2) The Sun slipping quietly towards a Dalton Minimum or even a Grand Minima such as a Maunder Minimum.

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 have slowly uncovered some of the fundamental mysteries of nature. Our Milky Way galaxy is awash with cosmic rays. These are high speed charged particles that originate from exploding stars. Because they are charged, their travel is strongly influenced by magnetic fields. Our sun produces a magnetic field wrapped in the solar winds 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 high energy 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. Low level clouds reflect sunlight back into space. An increase in Earth's cloud cover produce a global drop in temperature.

If the sun becomes quieter than the **old solar cycles**, producing more than 1028 spotless days, then we might slip into a Dalton Minimum or maybe even a Grand Minima such as the Maunder Minimum. This solar state will last for decades. Several solar scientist have predicted this will begin in Solar Cycle 25, about a decade from now. But a few have predicted this will occur now in Solar Cycle 24. A quiet sun will cause temperatures globally to take a nose-dive. We will experience temperatures that we have not seen in over 200 years, during the time of the early pioneers.

Temperatures are already falling. Satellites provide generally the most accurate atmospheric temperature measurements covering the entire globe. From the peak year 1998, the lower Troposphere temperatures globally have fallen around 1/2 degree Celsius due to the quiet sun. This is despite the fact that during that same time period, atmospheric carbon dioxide (at Mauna Loa) has risen 5% from 367 ppm to 386 ppm. The main threat from a “Dalton Minimum” or “Maunder Minimum” event is famine and starvation (affecting millions or hundreds of millions worldwide) due to shortened growing seasons and harsher weather. In the past, in addition to great famines, this cold harsh weather has also lead to major epidemics.

A taste of the cold weather due to a quiet sun.

Evidence of the Mississippi River, Ohio River, Allegheny River, Delaware River and Hudson River freezing and of very harsh winters.

Recent periods of quiet sun were the Dalton Minimum (1790-1830 A.D.), the Maunder Minimum (1645-1715 A.D.) and the Spörer Minimum (1420 to 1570 A.D.). The Maunder Minimum and Spörer Minimum were solar Grand Minima and each were individually referred to as the Little Ice Age.

A few decades after the Dalton Minimum

In the spring Eliza, a slave, carrying her young son, fled from Kentucky by crossing the **Ohio River** on foot. The river was “swollen and turbulent, great cakes of floating ice were swinging heavily to and fro in the turbid waters.” She leaped from one chunk of ice to the next until she reached freedom on the Ohio shore. [Source: Uncle Tom’s Cabin. Harriet Beecher Stowe lived in Cincinnati, Ohio from 1832 to 1850. In 1851, she wrote “Uncle Tom’s Cabin”. Her life in Ohio was intertwined in this work of fiction.]

During the Dalton Minimum

The **Hudson River** at the New York Harbor froze, enabling people to walk across the ice from Manhattan to Staten Island. The Hudson froze over completely during particularly brutal winter of 1779/1780, when the surface was solid for five weeks straight and the British rolled cannons over the ice. In 1821, taverns were constructed in the middle of the river to offer warmth and refreshment to pedestrians.

During the Dalton Minimum

Early settlers routinely waited till winter to cross the frozen Mississippi river in their wagon trains. In 1799, George Frederick Bollinger led a group of early pioneers from North Carolina to establish early settlements in Missouri. They hoped to cross their largest obstacle, the **Mississippi River**, on the ice, frozen solid in mid-winter. They arrived on the east bank of the Mississippi river opposite St. Genevieve in late December, pitched camp and explored potential river crossings. St. Genevieve is located about a hundred miles downstream from St. Louis. Daily the thickness of the ice was measured and then on December 31, a chopped hole in the ice indicated thickness well over two feet. The next day the settlers successfully drove their heavy loaded wagons across the river. [Source: “The Bollinger Migration to the Louisiana Territory”, part of "Bollinger Collection" compiled by Orena Bollinger in 1984.]

Between the Dalton Minimum and the Maunder Minimum

December 1776 was a desperate time for George Washington and the American Revolution. During the night of December 25, Washington led his small Continental army of 2,400 troops from Pennsylvania across the **Delaware River** made dangerous and barely navigable by huge chunks of ice. Once across they launched a surprise attack on the Britain's Hessian mercenaries at Trenton, New Jersey, capturing 1,000 prisoners and seizing muskets, powder, and artillery.

Between the Dalton Minimum and the Maunder Minimum

In **Boston, Massachusetts** on February 22, 1772, Anna, a young school girl, writes in her diary "Since about the middle of December, we have had till this week, a series of cold and stormy weather - every snow storm (of which we have had abundance) except the first, ended with rain, by which means the snow was so hardened that the strong gales at northwest soon turned it, and all above ground to ice." In some streets about town this mixture of ice and snow is 5 feet thick. On March 11, she writes that the snow is now 7 feet deep in some places around her house. [Source: "Diary of a Boston School Girl" written by Anna Green Winslow from 1771-1773, edited by Alice Morse Earle in 1894.]

Between the Dalton Minimum and the Maunder Minimum

Just before the opening battles of the French and Indian War in December 1753, George Washington, then 21 years old, crossed the **Allegheny River**. In their first attempt, Washington and a guide used a raft to cross the ice-choked river and this ended in disaster as Washington was knocked overboard in deep water and saved himself only by catching the raft as it swept by. The severe cold that night froze their clothes and the guide's fingers. The river also froze, however, allowing them to walk across on the ice the next morning. Soon they reached the safety of an English trader's settlement.

During the Maunder Minimum

During the Great Frost of (1683–1684) in England, the River Thames was completely frozen for two months, the ice was 11 inches thick at London. Sea ice was reported along the coasts of southeast England, and ice prevented the use of many harbors. The sea froze, so that ice formed for a time between Dover and Calais, joining England and France. The Thames was recorded to have frozen over at London during the years: 1649, 1655, 1663, 1666, 1667, 1684, 1695, 1709, and 1716.

During the Little Ice Age, growing seasons in England and Continental Europe generally became short and unreliable, which led to shortages and famine. These hardships were nothing compared to the more northerly countries: Glaciers advanced rapidly in Greenland, Iceland, Scandinavia and North America, making vast tracts of land uninhabitable. The Arctic pack ice extended so far south that several reports describe Eskimos landing their kayaks in Scotland. Finland's population fell by one-third, Iceland's by half, the Viking colonies in Greenland were abandoned altogether, as were many Inuit communities.

During the Spörer Minimum

By 1518, early explorers made significant progress in probing and surveying the New World. They described North America as a "land of frozen seas, horrid, barren and scarcely habitable for cold". "In the New World, cold predominates. The rigor of the frigid zone extends over half of those regions which should be temperate by their position. Countries where the grape and the fig should ripen, are buried under snow one half of the year; and lands situated in the same

parallel with the most fertile and best cultivated provinces in Europe, are chilled with perpetual frosts, which almost destroy the power of vegetation.” [Source: The History of the Discovery and Settlement of America by William Robertson, 1826]