THE CHILL OF WINTER

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WHY YOU SHOULD READ THIS

- Other factors are currently having a greater impact on global climate than humanity's greenhouse gases. These factors halted global warming for a decade, cooled the globe since 2007 and will chill the upcoming winter.

- The sun is emitting less energy, reducing solar winds and allowing more cosmic rays to strike the earth. These rays generate high-altitude clouds, the type that reflect back incoming solar radiation and cool temperatures.

- The Pacific Ocean switched to El Niño from a cool La Nina in just three months, an almost unprecedented pace. Water temperatures indicate a weak El Niño, but most of the U.S. Climate Prediction Center's models indicate the phenomenon will probably grow to moderate intensity. The official projection of the upcoming weather is it will produce very warm winter temperatures throughout southern Canada and the northern tier of states.

- Debris from volcanic explosions earlier this year in Russia and Alaska and cool water from the Pacific will likely moderate the impact of El Niño. Warm waters will heat the western portions of North America during winter, but the warmth will not be able to penetrate across the continent for any length of time. Eastern regions of Canada and the U.S. should expect a cold early winter, a brief period of warmth mid-winter and a prolonged cool late winter and spring.

- If the El Niño is warm and moderate, winter will be mild and Texas and California will be wet. If the El Niño is weak, the full chilling impact of the volcanically cooled polar air mass will slam North America's weather and its struggling economy.

ENERGY INVESTMENT HANDBOOK

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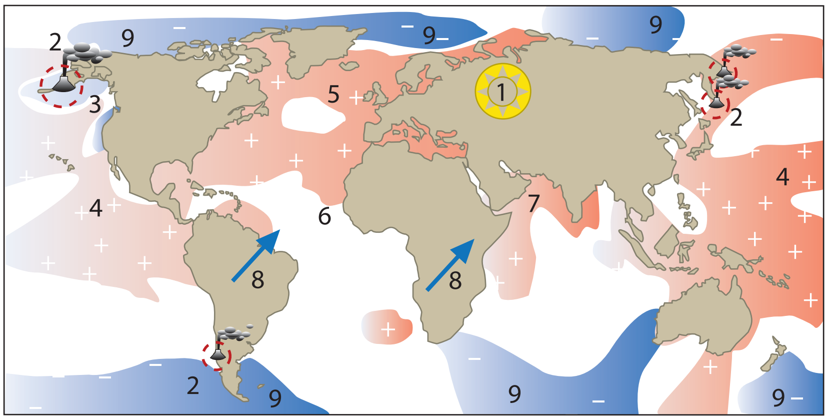
GENERAL

It's official. Even the green-oriented BBC News is asking, "What happened to global warming?" An article by Paul Hudson, the BBC's climate correspondent, revealed the inconvenient truth:

> ". . . the warmest year recorded globally was not in 2008 or 2007, but in 1998.
>
> "… For the last 11 years we have not observed any increase in global temperatures. And our climate models did not forecast it, even though man-made carbon dioxide, the gas thought to be responsible for warming our planet, has continued to rise.
>
> "So what on Earth is going on?"

What is happening is that natural cycles and events are affecting the weather. Recent research focused on mankind's impact and debated on how influential it is. **What is clear, however, is that other factors are currently having a greater impact on global climate than humanity's greenhouse gases. These factors have halted global warming for a decade, cooled the globe since 2007 and will chill the upcoming winter (Figure 1).**

FIGURE 1: THE FACTORS SHAPING FALL AND WINTER WEATHER



1. The sun is beginning a new solar cycle but it is still very quiet
2. Volcanoes in Russia, Alaska and South America have had medium to large eruptions this past year.
3. Cool water retreating and warm water increasing off the West Coast.
4. El Niño but unusually warm around SE Asia.
5. The North Atlantic is warm.
6. The tropical Atlantic is neutral and dusty.
7. Most of the Indian Ocean is warmer than average.
8. The high altitude Quasi-Biennial Oscillation (QBO) winds are westerly.
9. Cooler-than-normal polar temperatures.

Source: Browning Newsletter

Let's examine these natural factors and their probable impact. Our climate is largely determined by:

- The sun – Solar radiation provides the energy that runs global weather.
- Patterns where radiation is absorbed or reflected – Different portions of the Earth receive different amounts of radiation and warming. How much radiation and warming an area receives is determined by the tilt of the Earth, which provides less direct heating for the poles than for the tropics. It also depends on materials in the atmosphere that can block incoming radiation, such as clouds and aerosols (particles in the air). Man-made pollution, particularly sulfates from burning coal, can create these types of aerosols.
- Where the heat from the sun is stored and transported – Oceans make up 70% of the globe and store most of the heat. Other sources of heat storage are natural and man-made greenhouse gases.

A closer examination shows a complex mix of heating and cooling factors clashing as they have shaped this year's turbulent weather.

THE SUN

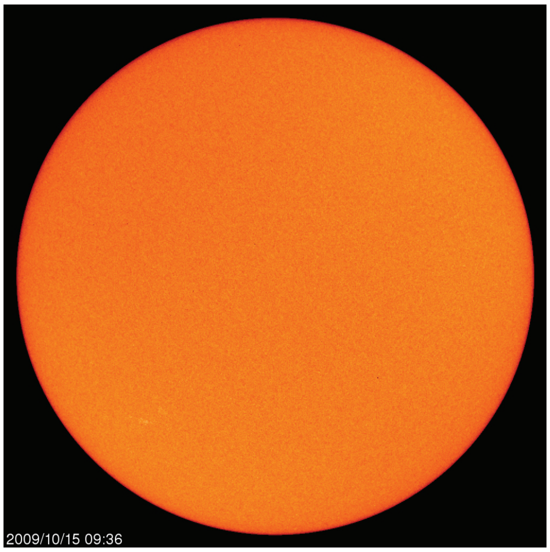
The sun has been quiet, very quiet. According to scientific records, it's been almost a century since the sun showed so little activity **(Figure 2)**.

The sun goes through an 11-year cycle of planet-sized magnetic storms that show up as dark spots. These storms are sources of solar flares, coronal mass ejections and intense UV radiation. The sun can be covered with more than 200 sunspots daily at the cycle's peak, while at the bottom the face of the sun may be as blank as it is now.

Satellite measurements indicate the sun radiates more energy when the sunspot cycle is at its maximum. Conversely, the amount of energy subsides as the cycle quiets down. The sun was blank 73% of the time last year, the quietest since 1913. To date, the sun has been blank 79% in 2009.

We are seeing other indications of how quiet the sun has become. Measurements by the Ulysses spacecraft reveal a 20% drop in solar wind pressure since the mid-1990s, the lowest point since such records began in the 1960s. Careful measurements by several NASA spacecraft show the sun's brightness has dropped by 0.02% at visible wavelengths and 6% at extreme UV wavelengths. Telescopes that measure radio wavelengths are now recording the dimmest "radio sun" since 1955.

FIGURE 2: THE QUIET SUN

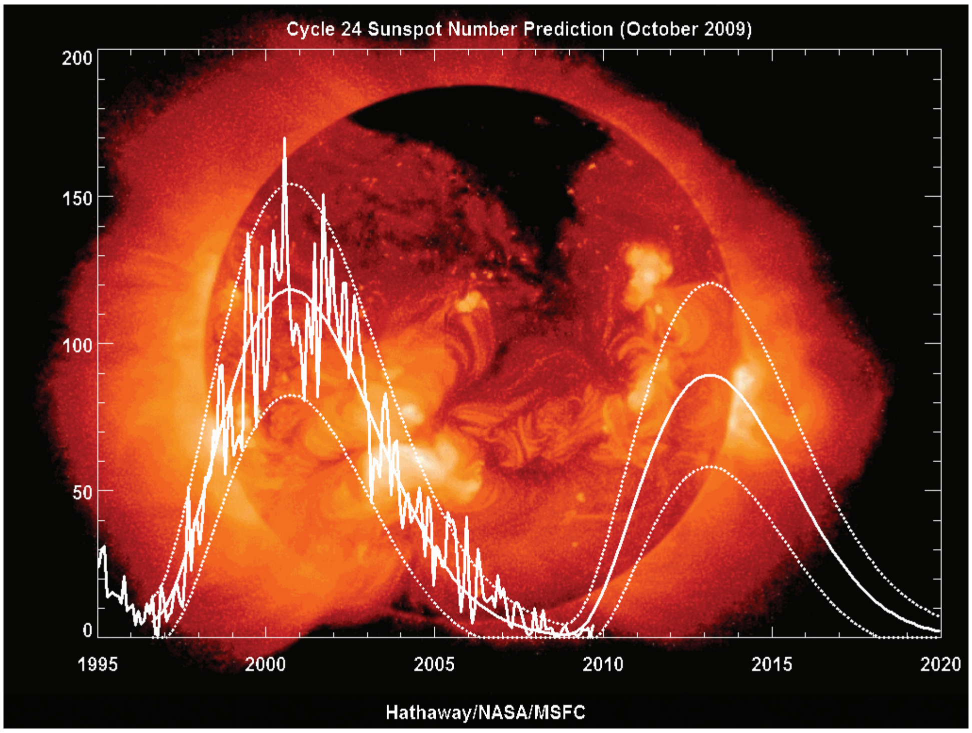


Source: Solar and Heliospheric Observatory (SOHO)

In short, we are not receiving as much energy from the sun. The amount of reduction is small, so the impact of the reduction is still being debated and, by some scientists, dismissed. There historically has been a strong but lagging correlation between quieter solar activity and lower global temperatures. Typically, the Earth retains enough heat that the impact of lower radiation is not felt immediately. If the entire 11-year cycle is diminished, though, global temperatures drop. Scientists are now agreeing that this very quiet solar minimum is a prelude to a relatively inactive solar cycle **(Figure 3)**.

Reduced solar radiation is only one trend influencing global climate. However, and this is important to note, it is a factor for cooling the climate this winter and over the next decade.

FIGURE 3: THE SUNSPOT CYCLE: 1995 - PRESENT



Source: David Hathaway, NASA/MSFC

PATTERNS WHERE THE RADIATION IS ABSORBED OR REFLECTED

A second factor cooling global climate has been increased activity of the distant volcanoes in Alaska and Russia.

The volcanoes of this region have been unusually explosive. For the first time in over 50 years, six volcanoes are simultaneously erupting on Russia's far-eastern Kamchatka Peninsula. According to Russian scientists, volcanoes are becoming more active all over the world.

FIGURE 4: TYPICAL WEATHER EFFECTS FROM NORTHERN PACIFIC VOLCANOES

Source: Browning Newsletter

This has changed the weather in North America. When a volcano eruption is large enough to throw its ash and chemicals roughly three miles (4.8 kilometers) in height, these substances linger in the air. The debris reflects back incoming sunlight. They mingle with water and form clouds, which also reflect back sunlight and cool temperatures. Eventually winds blow the clouds away from the site of the eruption, and the clouds gather enough moisture to precipitate out in the form of acid rain. In the case of Russian and Alaskan volcanoes, the cloud cover and rainfall is blown by the prevailing westerly winds towards Canada and the U.S. If the eruption is large enough, 10 miles (16 km) or higher, the debris can stay in the atmosphere for years, causing prolonged cooling **(Figure 4)**.

This year, there have been three very active volcanoes in the North Pacific.

- The earliest was Mt. Sheveluch on Russia's Kamchatka Peninsula. It has been having small to medium eruptions since last February. While no eruptions have been major, they frequently are large enough to affect one or two cold fronts. As recently as Oct. 6, Sheveluch had eruptions that reached 4.2 miles (6.8 km) high, large enough to affect cold fronts sweeping into North America during mid-October.

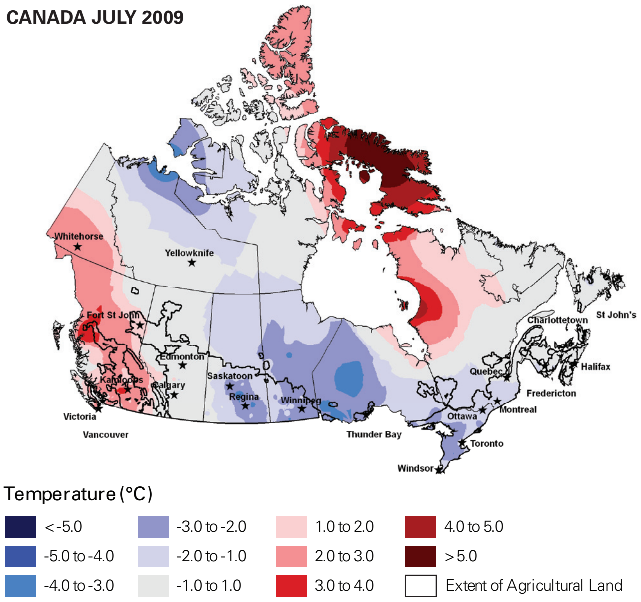
- Alaska's Mt. Redoubt first erupted on March 22. It had 20 eruptions, the highest being 12.3 miles (19.8 km). Seven eruptions sent volcanic debris into the stratosphere where it will take months, and possibly more than a year, to settle out completely. At the moment, the volcano seems to have returned to normal.

- Sarychev Peak on Russia's Kuril Islands had more than 10 large explosions from June 11-16. The ash clouds rose to altitudes of 5-13 miles (8-21 km). Heavy layers of ash floating 14 miles (22.4 km) in the atmosphere were clearly visible by satellites as late as mid-August. The mountain is currently quiet, only occasionally emitting steam.

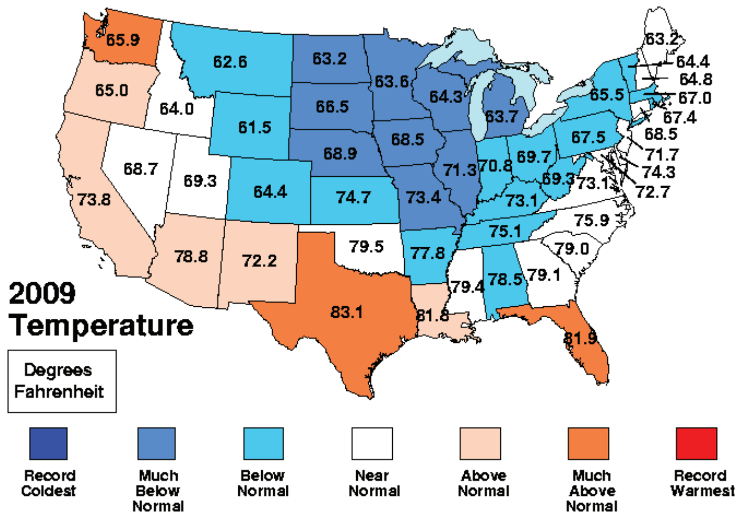
The debris from these three volcanoes consistently screened out incoming sunlight throughout this spring and summer. Since the volcanoes were so far north, most of this cooling occurred in the polar air mass. The debris from polar volcanoes generally stays trapped in the polar vortex. Occasionally the ashy air surged south in unusually frigid cold fronts. Large areas of the Midwest experienced a cooler than normal summer **(Figure 5)**. When these cold fronts drifted east and collided with the warm marine air from the Atlantic, there were heavy rains. The latest of these cold surges occurred in mid-October and covered about 20% of the U.S. with snow.

FIGURE 5: TEMPERATURE ANOMALIES DUE TO THIS SUMMER'S VOLCANOES

CANADA JULY 2009



UNITED STATES OF AMERICA SUMMER 2009



Source: http://www.agr.gc.ca/pfra/drought/maps/nl_td09_07e.pdf, www.noaa.gov/oa/climate/research/cag3.html

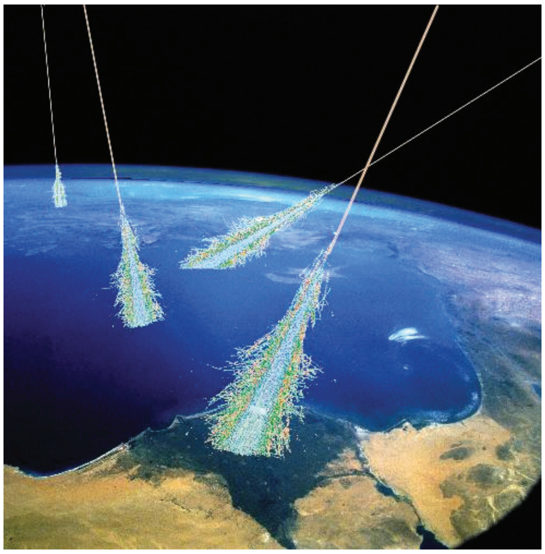
Cosmic rays – At the same time the polar region is covered with ash, it is being bombarded with cosmic rays. According to data from NASA, cosmic rays now are 20% more intense than they have ever been since the Space Age began.

The cooling impact of cosmic rays is extremely controversial. According to many reports, particularly from Scandinavian and Russian scientists, the rays cause more cloud cover which in turn reflects incoming sunlight and cools temperatures **(Figure 6)**.

Cosmic rays are radiation particles, stripped atomic nuclei, electrons and positrons, which zoom across the galaxy at nearly the speed of light. They are thought to originate from stellar explosions, and the rays pack such a punch that they have been implicated in introducing errors in computer memories.

The earth is normally protected from these hits by its own atmosphere as well as the solar system's magnetosphere and the solar wind. However, as an article in the Oct. 6 edition of Scientific American pointed out, the quieter sun has led to "the weakening of the sun's magnetic field as well as the diminished pressure and speed of the solar wind — the stream of charged particles emanating from the sun."

FIGURE 6: THERE HAS BEEN A 20% INCREASE IN COSMIC RAYS HITTING THE ATMOSPHERE



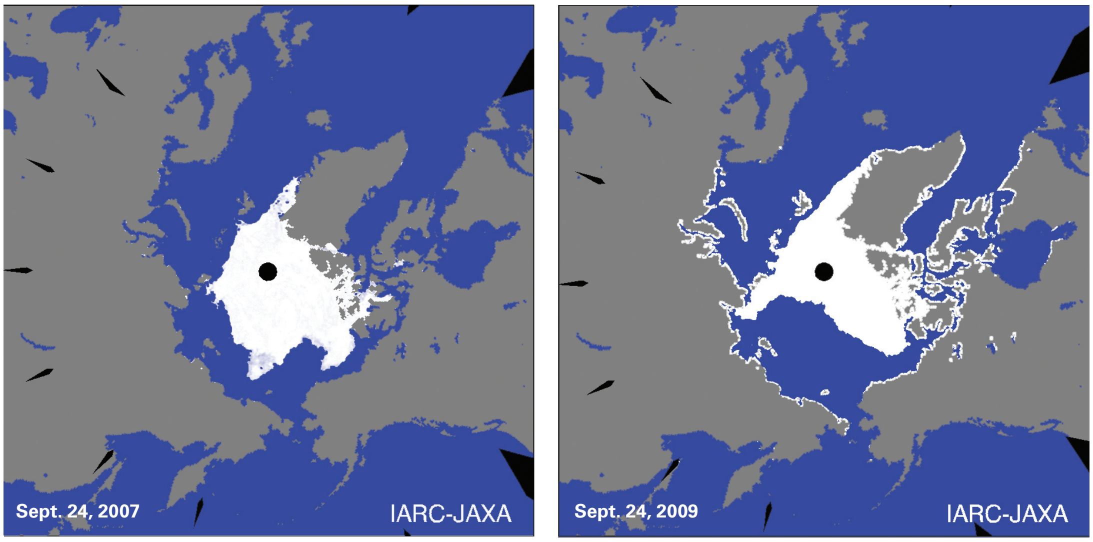
Source:http://apod.nasa.gov/apod/image/0608/crshower2_nasa_big.jpg

This means the sun has been providing less protection from cosmic rays, allowing the bombardment and the related cloud cover to increase. Since the particles are charged, they and their related clouds tend to be most intense around the magnetic polar regions.

Added together, this means there is currently less solar radiation and more cloud cover blocking that radiation. The impact has been most concentrated in the Arctic. Indeed, after decades of melting, the polar sea ice started growing in 2008 and has continued through this year.

The polar ice melts during late spring and summer, resulting in the ice usually reaching its minimum size sometime in September. This year's minimum is 379,225 square miles (982,188 square kilometers) larger than the record low of about 1.6 million set in 2007. That's a 23% increase in size, equivalent roughly to the area of British Columbia or 1.4 times the area of Texas. The amount of ice is currently greater than this time of year in 2007 and 2008 **(Figure 7)**.

FIGURE 7: ARCTIC ICE EXTENT



Source:http://apod.nasa.gov/apod/image/0608/crshower2_nasa_big.jpg

WHERE THE HEAT FROM THE SUN IS STORED AND TRANSPORTED

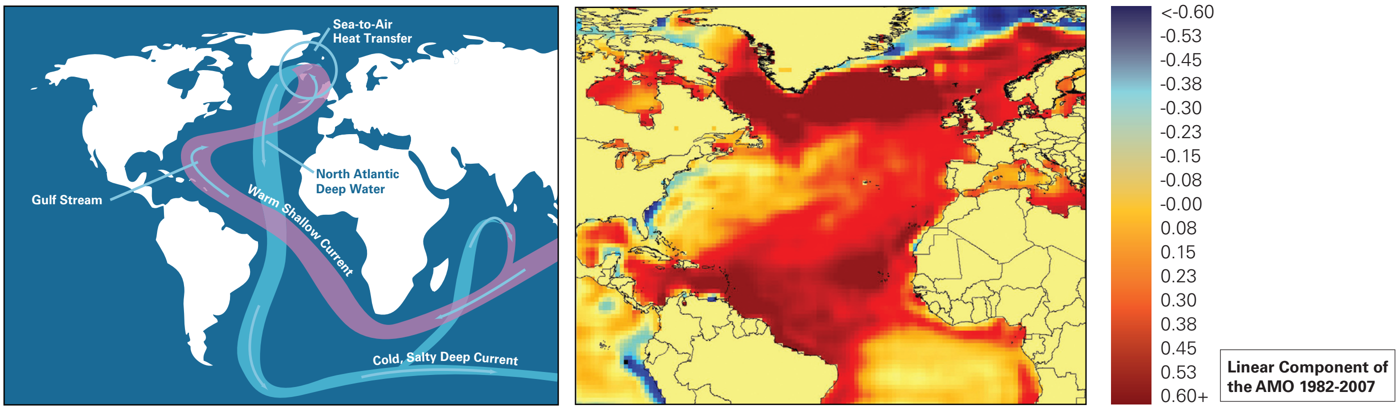
Not all natural climate factors are chilling global temperatures. A great deal of heating occurred over the past few decades, and the oceans retain much of this accumulated heat and are transporting it to regions around North America. This has made North America a weather war zone, where cold continental air masses clash with the surrounding warm marine atmosphere.

The Warm Atlantic – The longest lasting of these warming factors is the Atlantic Multi-Decadal Oscillation (AMO), a cycle of warming and cooling that lasts approximately 70 years. The Atlantic is in the middle of a long-term warming phase **(Figure 8)**.

This warming and cooling is related to the flow of the Atlantic Thermohalene Current, the large-scale flow of the ocean's warm tropical waters towards the Arctic. (The Gulf Stream is one of the better known currents in this ocean-wide flow.) When the Gulf Stream and its sister currents flow rapidly, they carry a lot of tropical water north and the ocean warms. When the currents slow, the ocean cools. History shows the fast-flowing/warm stage usually lasts 40 years and the slow-moving/cool stage lasts 30 years. The warm phase began in 1995, so we have a number of years to go.

One of the ironies of a warm Atlantic is that it frequently generates a weather pattern that brings cold winter weather to the eastern U.S., the Great Lakes and Southeastern Canada. This pattern, called a negative North Atlantic Oscillation (NAO), is one factor that caused the first two weeks of October to be so extraordinarily cold. The NAO is a short-term pattern that may stay in its negative phase for only a few days or weeks. It is more common now that the Atlantic is warm, but it occurs several times a year even when the Atlantic is cool. We have had cold spells periodically throughout the last 70 years but they are more frequent now that the Atlantic has turned warm.

FIGURE 8: THE ATLANTIC THERMOHALINE CIRCULATION IS FLOWING FASTER



Source: Browning Newsletter, http://www.earthsystemtrends.org/2009/C4/atlantic-multidecadal-oscilliation-part.html

Warm ocean waters also create more nor'easters. When the cold air mass hits the Atlantic's warm marine air, it creates blizzards that roll up the eastern states from the Gulf of Mexico to New England. This type of storm is particularly common in late fall (although this year we saw one as early as mid-October) and early spring.

The Growing El Niño – Last winter the Pacific experienced a cool La Niña. Normally it takes a year or more for the region to warm up to an El Niño. This year, however, the Pacific switched to El Niño in just three months! This rapid warming is almost unprecedented. By July, the Pacific experienced a warm El Niño and worldwide weather patterns began to change. The phenomenon suppressed monsoons throughout the globe, killing 15-20% of the crops in India and baking the U.S. from Texas to Southern California. It muffled hurricane development in the Atlantic. However, the impact of El Niños is much more limited in summer. The phenomenon is growing and will dominate this upcoming fall and winter.

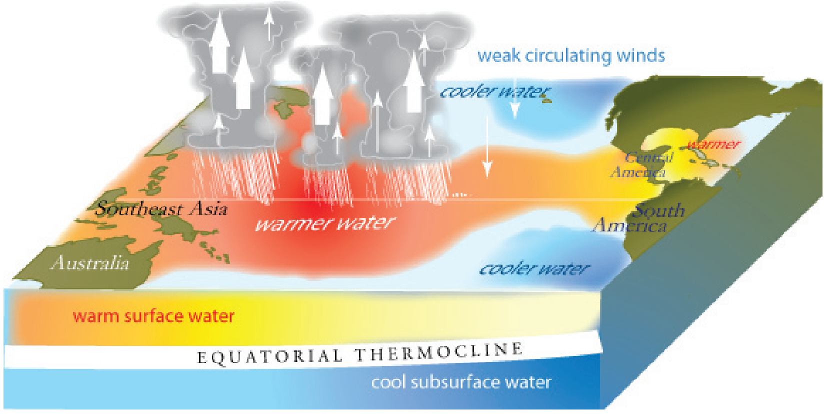
Fortunately, we have over 500 years of records showing how El Niños shape winter weather. Therefore, it should be a snap to predict what this winter will be like. Right? Wrong. As climatologists say, each El Niño has its own characteristics and each shapes the weather differently.

An El Niño is basically a huge pool of warm water covering thousands of square miles in the central tropical Pacific. The warm water warms the air above it. This huge mass of rising air distorts the normal wind flow, just as a large rock would divert a stream flow. The winds flow to different regions, carrying rainfall with them. You get flooding in unexpected regions while other areas are left in drought. This abnormal weather pattern is called the Southern Oscillation. The whole inter-connected water and weather phenomenon is called the El Niño/ Southern Oscillation (ENSO).

Notice the interaction of the ocean and the atmosphere in a normal El Niño **(Figure 9)**. The east-to-west tropical trade winds are weak. The majority of rainfall is in the mid-Pacific, leaving Southeast Asia dry. The warm waters off of South and Central America warm their western coasts. Eventually the water drifts north along the coastlines until it brings heat along the entire west coast of North America.

There is no typical El Niño. There are three different types of events and they can create some very distinct weather patterns.

FIGURE 9: EI NIÑO/SOUTHERN OSCILLIATION



Source: ww.cpc.noaa.gov/products/analysis_monitoring/ensocycle/meanrain.html

- **A Strong or Moderate El Niño** – This is the type of El Niño we saw in 1997-98. It is huge, covering most of the tropical Pacific and the waters average +1.5°C (+2.7°F) warmer than normal. The Southern Oscillation winds extend to the Atlantic and stifle hurricane development.

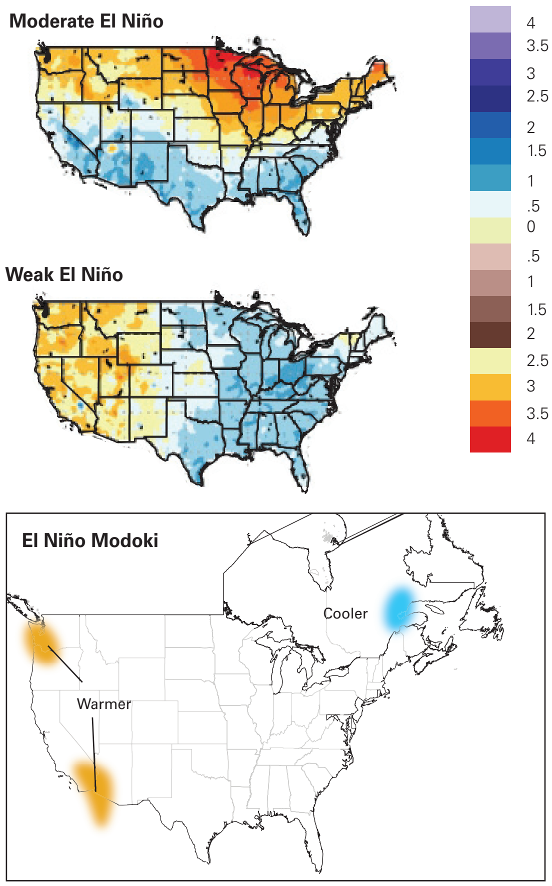
- **A Weak El Niño** – Like the strong or moderate event, the weak El Niño covers most of the tropical Pacific but it is not as warm, averaging from 0.5° to 1.5°C (0.9° - 2.7°F). Like the stronger event, its ENSO winds quiet the Atlantic hurricane season.

- **El Niño Modoki** – This event may be as warm as a strong El Niño but it is much smaller in size, concentrated in the middle of the tropical Pacific. It has a much stronger impact on Asia but relatively little effect on North America. Modokis have no impact on Atlantic storms. Indeed, 2004 was a Modoki year and four hurricanes slammed into Florida.

The weather impact of these three El Niños on North American winters is very different **(Figure 10)**. Therefore, it is very important to identify as soon as possible which event is going to happen.

Initially, some scientists expected this year's event to be a Modoki since it has become more common in recent years. However, the current phenomenon has stretched across the Pacific. The impacts of its Southern Oscillation winds hampered Atlantic hurricane development. This is a classic El Niño.

FIGURE 10: EI NIÑO PATTERNS IN THE PACIFIC

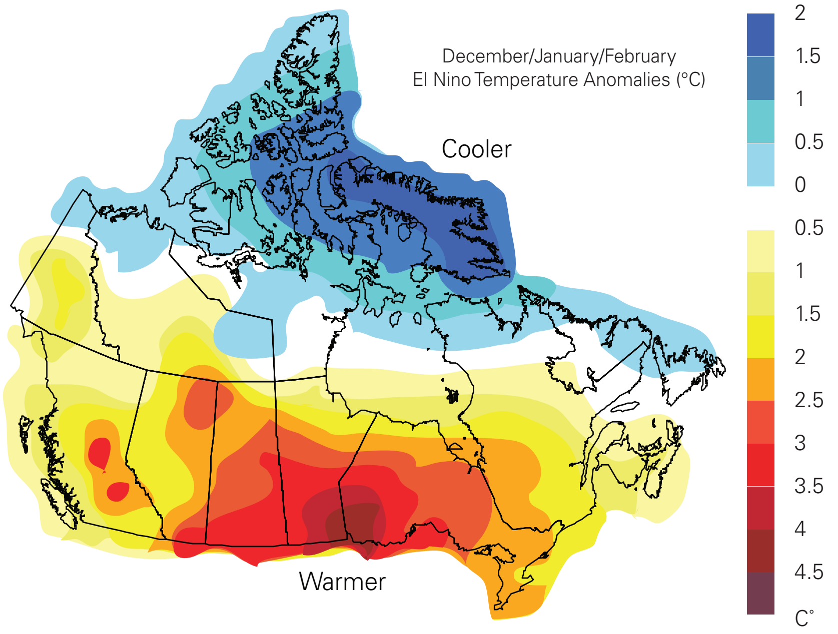


Source: www.cpc.noaa.gov.data, Enso Modoki (Pseudo-ENSO) and it's Impaction the world climate by T. Yamagata, K. Ashok, S.K Behera, S. A Rao and H Weng.pdf

This leaves the question – how warm will the El Niño become? The waters now average 1.0°C (1.8° F) warmer than normal, making the current event weak. However, most of the U.S. Climate Prediction Center's models indicate the phenomenon will probably grow to moderate intensity. Indeed, the official projection of the upcoming weather is it will produce very warm winter temperatures throughout southern Canada and the northern tier of states.

Given this outlook, one can expect the U.S. weather to look like the warm El Niño map in **Figure 10** and Canadian weather to resemble the government map shown in **Figure 11**.

FIGURE 11: TYPICAL EL NIÑO WINTERS IN CANADA TEMPERATURE



Source: Environment Canada

Unfortunately, as a historical climatologist, I cannot agree with the models or the current forecast maps. To me, three things make the current outlook unlikely.

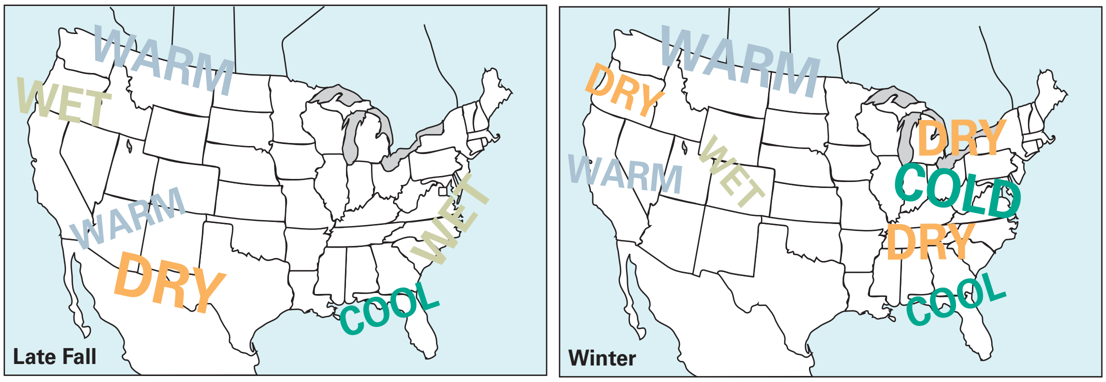
1. The Pacific Decadal Oscillation (PDO) began to cool in 1998. The PDO is a huge, long-term ocean/atmosphere pattern similar to the AMO in the Atlantic. It involves the entire Pacific Ocean and lasts for decades. In 2006, it finished switching into its cool phase, which shifts colder-than-normal water into the tropics and the eastern Pacific. When the El Niño develops, this PDO-cooled water mutes some of its weather impact in North America.

2. North Pacific volcanoes started to become more active. We have seen more and more ash and chemicals cooling the Arctic. Work by Dr. Paul Handler, now deceased but formerly a physicist at the University of Illinois, Urbana, suggests the atmospheric impacts of volcanoes interact with the ENSO. According to his studies, tropical volcanoes have effects that enhance the weather impact of El Niños and polar eruptions have effects that counter El Niño weather.

3. As mentioned earlier, the warm Atlantic typically generates a negative NAO. This creates cold winters in eastern North America. Any warmth generated by the Southern Oscillation will be countered by the cold generated by the NAO. If anything, the clash of the two air masses should make the Great Lakes and Northeast even stormier.

The current ENSO is unlikely to become strong because of these three factors, in my opinion. Even if tropical Pacific waters grow warm enough to become a moderate El Niño, as many models indicate, its weather impact will be countered by the effects of the North Pacific volcanoes and the NAO. Warm waters will heat the western portions of North America during winter, but the warmth will not be able to penetrate across the continent for any length of time. Eastern regions of Canada and the U.S. should expect a cold early winter, a brief period of warmth mid-winter and a prolonged cool late winter and spring **(Figure 12)**.

FIGURE 12: LATE FALL/WINTER



Wet
125% or more of normal moisture

Dry
75% or less of normal moisture

Cool
2°C or more lower than normal temperatures

Cold
5°C or more lower than normal temperatures

Warm
2-4°C or more higher than normal temperatures

Source: Browning Newsletter

If there is a weak El Niño, it means California's drought will continue except for a few portions in the southern part of the state. Recent record-breaking rainfall was the result of a front from Alaska colliding with the remnants of Typhoon Melor from Japan. Unfortunately for California's chances of breaking its drought, this is a rare event. Even more unfortunately, according to experts, most of the recent precipitation fell in areas that will not drain into the state's parched reservoirs. Water rationing in the agricultural segment of the state will continue.

California will not be the only state affected if the El Niño is weak. The drought in Texas will continue. The drought in the mountain region of the Southeast will continue. This would have a profound impact on U.S. ability to produce hydroelectricity.

At the same time, the cold in the more populous eastern regions of Canada and the U.S. will increase energy consumption, particularly in the gas-consuming regions around the Great Lakes. While this will not be enough to replace the missing energy demand from the recession-battered manufacturing sector, rising prices and usage will have a negative impact on the consumer economy. Consumers will be spending more on energy and less on discretionary goods.

Strong western winds off the Rocky Mountains, sometimes called chinooks, normally warm the western prairies and Great Plains during a weak El Niño. If a North Pacific volcano has a moderate to large eruption this winter, then its cooling impact would overpower any chinook warming, particularly in the central Rockies.

It all comes down to the difference of a few degrees of temperature in a pool of water in the Pacific. If the El Niño is warm and moderate, winter will be mild and Texas and California will be wet. If the El Niño is weak, the full chilling impact of the volcanically cooled polar air mass will slam North America's weather and its struggling economy.

DID YOU KNOW

Is The Trend A Friend?: Some forecasters are predicting this winter will be the coldest in at least a decade for eastern North America, meaning a look at recent weather and gas prices may be useful in anticipating the direction of futures contracts over the next few months on the New York Mercantile Exchange.

Commodity Weather Group, after assessing El Nino conditions, lack of sunspots and other weather data, said the November-March season could be the coldest U.S. winter dating back to the late-1980s. The Bethesda, Maryland-based consultants forecast national gas-weighted heating degree days (HDD) will reach 4,175 in 2009/10, slightly ahead of the decade's high of 4,167 set 2000-01 and colder than any winter in the 1990s. In comparison, the National Oceanic and Atmospheric Administration's forecast predicts a 1-2% decline in HDD than last year, which totaled 3,833. The difference between CWG's and NOOA's forecasts is as much as 11%.

Increased demand from the densely populated U.S. Northeast may help reduce gas storage inventories from their record peaks to something approaching usual levels by the end of March. Betting on gas prices to build on recent strength to hit new heights early in the new year could be a major gamble.

Since trading at a low of $2.41/MMBtu on Sept. 4, front-month futures on NYMEX more than doubled and reached as high as $5.32 on Oct. 21. High prices for NYMEX gas futures between October and March, based on data from Bloomberg, were posted by Dec. 22 in 11 of the past 15 winters. The high was reached five times in October and twice in November, meaning there is almost a 50% chance the peak could be reached by the end of next month.

It's not axiomatic increased consumption boosts prices. The high during the winter of 2006/07, when repeated waves of snow and cold between January and March resulted in eight consecutive weeks of triple-digit storage withdrawals, came on Nov. 30, 2006. It should be noted, however, that peak prices in three of the past eight winters came between January and March.

There are more reasons to believe winter prices will peak before the winter solstice than later, in our opinion. Not only are inventories at record levels, full storage facilities and pipelines are prompting production curtailments and encouraging E&Ps not to complete recently drilled wells. Halliburton executives recently pegged the number of uncompleted wells at around 1,500. The arrival of frigid temperatures that empties storage and drives up prices will encourage producers to complete unfinished wells and ramp up production at shut-in fields.

The ability of producers to exploit shale reservoirs profitably at low prices also tends to mitigate against the decline in drilling that some E&P executives are counting on to boost prices in 2010. Increased productivity from Haynesville wells contributed to Ross Smith paring its forecast for U.S. gas supply. We expect production will average 56.2 Bcf/d this year, up 1 Bcf/d from 2008, and 53.1 Bcf/d next year. This works out to a supply contraction of 5.5%, down from our former figure of 8% – clearly bearish for gas prices, all other things being equal.

The flood of bad news has slowed but the U.S. economy remains weak. The falling U.S. dollar will help exports but not enough to overcome this year's expected decline of ~8% for industrial demand. The sector, predicted to account for ~29% of the nation's gas market, will likely consume 6.1 Tcf this year and 6.2 Tcf in 2010, according to Ross Smith's estimates. In comparison, industrial demand totaled 6.6 Tcf last year.

While investors may way want to stock up on long johns, history and market fundamentals favor shorting gas.

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