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BROWNING

NEWSLETTER

A BROWNING MEDIA PUBLICATION

Like the Sword of Damocles – The Arctic Cold

IN THIS ISSUE

- The Arctic air mass is unusually cold. Changing air pressure in the northern Atlantic or Pacific will cause Arctic cold to enter North America in predictable patterns.
- This November, volcanoes and typhoons in the Pacific that have caused the unusual cold. The continuing volcanic activity in Kamchatka is triggering a pattern know as a positive PNA which pours cold into the Midwest and East.
- Currently, there are unofficial El Niño conditions and a warm Atlantic. This will encourage the cold to hit the Midwest, the Eastern states, Eastern Canada, Eastern Europe and the Prairie Provinces and Eastern Canada, as well as Eastern and Central Europe.
- The long-term changes created by the PDO are making hydroelectricity production more erratic in the US West and, during La Niñas, Southern China. This has correlated with increased dependence on gas generators.
- The long-term changes created by the AMO have increased the risk of tropical storms and hurricanes in gas and oil production areas of the Caribbean and Gulf. For a variety of reasons, America has largely shifted to land based gas and oil.

CONTENTS

SUMMARY

The combination of extremely cold Arctic air, unofficial El Niño conditions in the Pacific and a hot Atlantic are shaping a potentially cold winter with high heating demands in the Midwest and the Eastern states. The colder than normal temperatures should also affect the Prairie Provinces and Eastern Canada, as well as Eastern and Central Europe. Economically this will affect global energy demand and stored crop quality.

fig. 1 **The sword of Damocles, an immiment threat.** *Richard Westall, 1812*

The current weather situation is like an old Greek legend. A deadly sword hung suspended over a throne, illustrating the danger of holding power. Only a single fragile horsehair kept the deadly blade from plunging into the hapless Damocles. He was relieved to escape.

Similarly cutting Arctic cold is dangling north of North America and Eurasia and, unlike Damocles, we are going to have it plunge south. Indeed, ask Buffalo, New York, the cold and record-breaking snowfall has already hit them.

The Arctic air mass has been unusually cold. Three years ago, in 2011, two polar volcanoes had large eruptions –Iceland's Mt. Grimsvótn in May and Mt. Sheveluch the following June. Both were large enough to deposit volcanic ash and chemicals into the stratosphere, the quiet portion of the upper atmosphere where debris can linger for years.

Once the debris was in the stratosphere, it lingered for years. Water collected around the aerosols and formed thick clouds. Both the debris and the clouds blocked out incoming sunlight and the Arctic air mass cooled. This year, for example, the summer melting season was so much cooler that, at the end, the Arctic had 1.5 million square kilometers, (579,000 sq. miles) more polar sea ice than two years ago in 2012.

In winter, when the Northern Hemisphere is tilted away from the sun, the cold and the Arctic air mass expands. Where the cold plunges depends on the Arctic Oscillation (AO) – the strength and direction of the circumpolar winds that blow around the Arctic. When the AO is positive, as they were in 2012, the winds are strong

This newsletter contains articles, observations and facts to support our contention that humanity is significantly influenced by changing climate.

Our calculations show the climate, over the next term, will cause dramatic changes in our social and economic patterns. We feel that readers, attuned to the changes that are occurring, may develop a competitive edge; and, by understanding their current and future environment, can use the momentum of change to their advantage.

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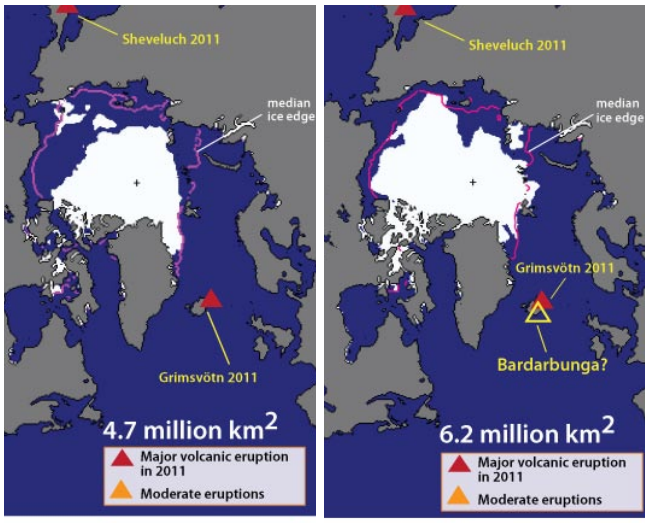
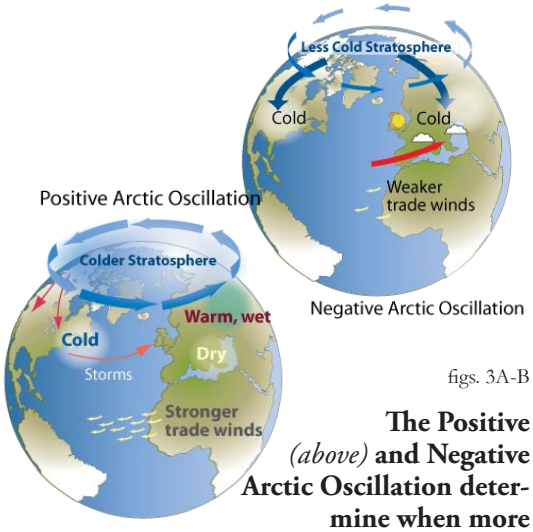


figs. 2A-B **The cold arctic summer left 1.5million sq. kilometers more sea ice than 2012.** *National Snow and Ice Data Center*



figs. 3A-B **The Positive *(above)* and Negative Arctic Oscillation determine when more southerly lands shiver.** *© Evelyn Browning Garriss*

and pin the cold air north. The areas south of the Arctic remain relatively warm. When the AO is negative, the winds are weak and fluctuate north and south. Frigid air escapes south.

This winter the winds are relatively weak. Like the Sword of Damocles, that cold air is going to drop. The question is – where?

Arctic Winds

The fluctuating winds, the polar jetstream, will determine where the cold air drops. Air pressure shapes winds, so the fate of your heating bill depends upon air pressure. Scientists are observing two major patterns to determine if the cold will hit North America, one shaped by air pressure in the Pacific, the other by air pressure in the Atlantic.

- **THE PACIFIC NORTH AMERICAN PATTERN (PNA)** – This pattern is shaped by the strength of the Aleutian Low (south of Alaska's Aleutian Islands) and the West Coast High. When both of these air pressures are strong (or positive), the jet stream veers north over Western North America. The West Coast becomes warm and dry, sometimes as far north as Western Canada and Alaska. Then the jet stream slams deep into the center and eastern parts of the continent. Arctic air pours south. Typically the Rocky Mountains, divide Western warmth and eastern chill.

  When the two air pressures are weak (or negative), the jet stream and cool air drift into the West and the rest of North America is heated by marine air from the Gulf of Mexico and remains relatively warm.

- **NORTH ATLANTIC OSCILLATION (NAO)** – The Icelandic Low and the mid-Atlantic Azores High control the strength and direction of winds around the Atlantic Ocean, including the polar jet stream. When both the High and Low are strong, there is a strong "positive" difference between the air pressure areas. This strengthens the prevailing winds and the polar jet stream blasts across the Atlantic. The cold Arctic air is trapped in the north.

  When the air pressures are weak and the NAO is "negative", the jet stream and Atlantic winds are weaker and they wander north and south. Cold Arctic air moves deep into central and eastern North America. If the Atlantic is relatively warm, as it is now, the crash of this cold and warm air creates very stormy conditions along parts of the Gulf of Mexico and the East coast.

Scientists have noted that when the NAO is negative, its impact is felt in Europe and Asia as well. The fluctuating jet stream typically dips in Eastern Europe and Northern China and Japan. Rain and snowfall patterns shift by hundreds, even thousands, of miles.

Notice, both these patterns have a phase (the positive PNA and negative NAO) that create a chill winter for the US and Canada east of the Rockies. However, history suggests that the impact of the negative NAO is felt throughout the Northern Hemisphere. It allows cold Arctic air to plunge into Russia and Eastern Europe, where it spreads westward into Central and Western Europe. Asian scientists have measured its impact further east, where it creates cold fronts in Northern China, Korea and Japan.

The PNA's greatest impact is in North America. The southern ripple of Arctic air is less likely to freeze Europe. Also, a positive PNA is more likely to appear during El Niños, particularly weak or moderate events.

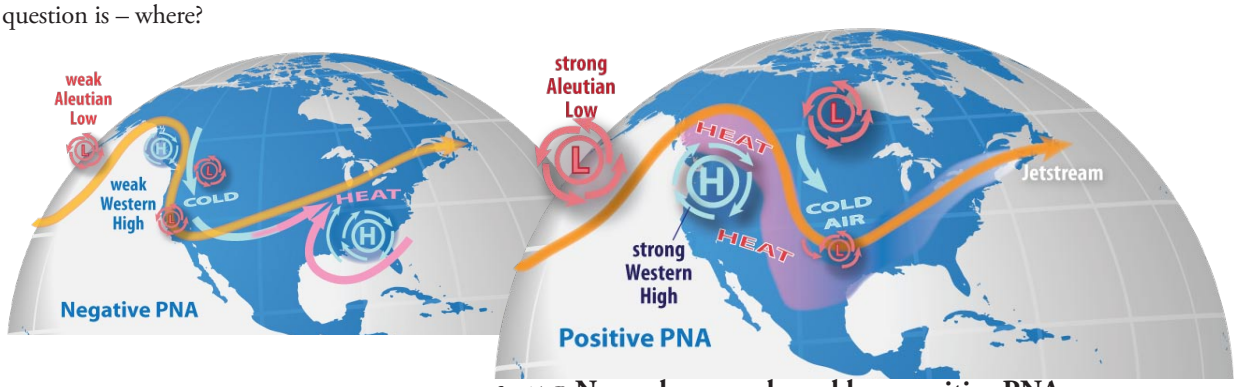
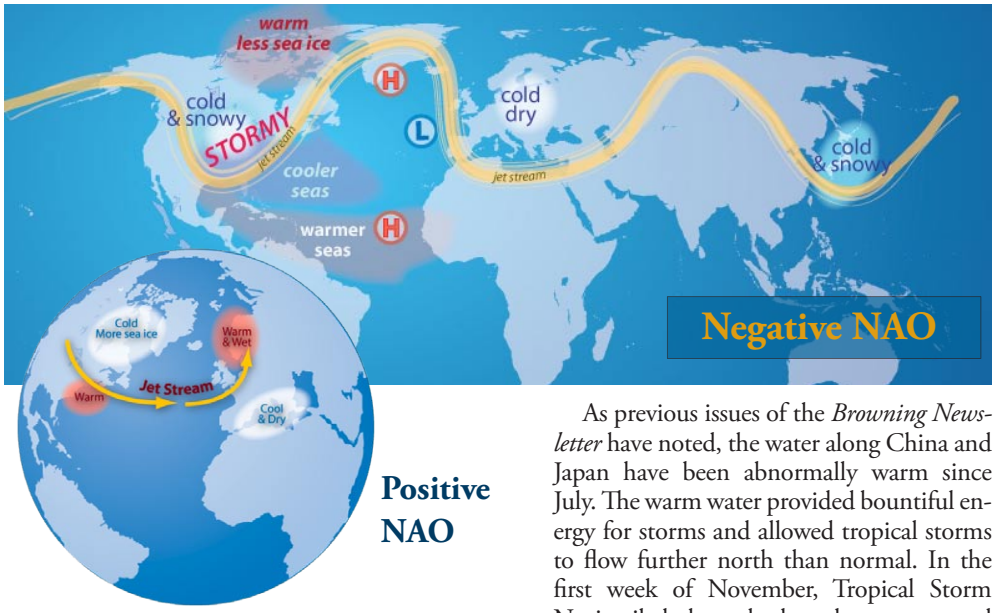


fig. 4A-B **November was shaped by a positive PNA** *© Evelyn Browning Garriss*



figs. 5A-B **The impact of a negative NAO allows cold Arctic air to plunge into Europe and East Asia**
© Evelyn Browning Garriss

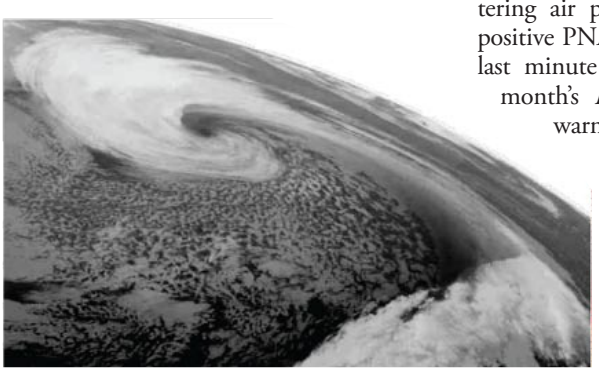
Why Has It Been Cold

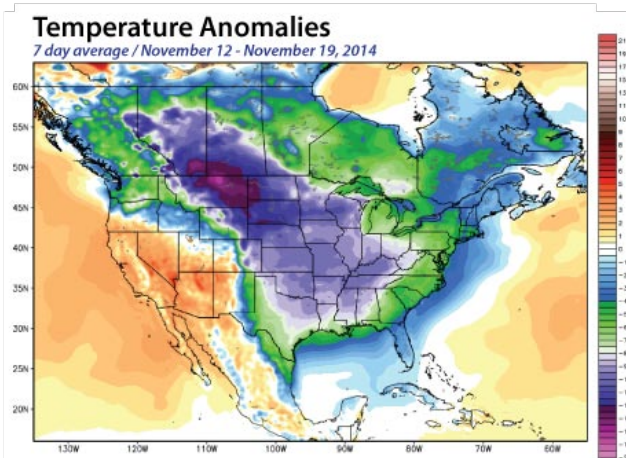
The PNA has been posative all November. The air pressures in the Pacific shaped the cold and miserable weather all month long. It doesn't take much to alter air pressure. Over the last month the Pacific air pressure has been altered by a super typhoon and multiple volcano eruptions in Kamchatka.

As previous issues of the *Browning Newsletter* have noted, the water along China and Japan have been abnormally warm since July. The warm water provided bountiful energy for storms and allowed tropical storms to flow further north than normal. In the first week of November, Tropical Storm Nuri sailed through these hot waters and grew into a giant Category 5 super typhoon. When it passed Japan and became an extra-tropical storm, it remained tremendously strong. When it entered Alaska's Bering Sea, it became the "Bering Sea Bomb Cyclone", the most intense storm ever recorded in the North Pacific.

Nuri became tangled in the polar jet stream. Wind pressures altered and the massive storm was carried inland as a giant, wet cold front that plunged temperatures throughout Central and Eastern North America.

Nuri was not the only factor altering air pressure and producing positive PNA cold fronts. As the last minute News Note in last month's *Browning Newsletter* warned, Mt. Sheveluch had a 6.8 mile high eruption. The cooling debris from a moderate Kamchatka eruption typically cools passing weather fronts, altering air pressure and winds. The PNA becomes temporarily positive and a cold front hits the Midwest within two weeks. In this case, the volcanic debris mingled with the remnants of Typhoon Nuri and the result was spectacularly cold.





figs. 6A-B
Bering Sea Bomb Cyclone *(top).* **Volcanoes, a typhoon, and a cooling front brought frigid temps to the US** *top: University of Dundee bottom: courtesy NCEP*

Since then the Kamchatka Peninsula has been very active with frequent low and moderate eruptions, particularly Sheveluch and Zhupanovsky volcanoes. Debris is constantly destabilizing the air pressure around the Aleutian Low and reshaping wind patterns. Cold front after cold front flowed into North America, creating misery, cold, difficult travel and "thundersnows".

Both Ohio and Buffalo, New York had thundersnows or, as it is sometimes called, "white lightening", thunderstorms that produce snow instead of rainfall. This is because they are near the Great Lakes. This early in the year, the Lakes are still warming the surrounding atmosphere and the collision of this warm air with the Arctic cold has been explosive.

A thunderstorm happens when an updraft of hot surface air streams into the colder air overhead. The moisture in the warm air freezes into ice and sleet, which is heavy enough to fall. When it drops into the warmer air below, it melts back into water and rains. Sometimes, however, the updraft catches it. The clouds become very turbulent, filled with ice, slush and droplets swirling up and down. They bump into each other, creating a static charge. (It is rather like the charge that builds up when

fig. 7 **Kamchatka's volcanoes are always a wild card for US weather**

you drag your feet on a rug,) The charges accumulate and finally spark into lightning with a thunderous crackle.

Thundersnows are created by hot air sandwiches. The warmer air from the Great Lakes is lifted over the colder, heavier air around their shores. When the rain falls, it enters the cold air and refreezes into snow. Meanwhile, the storm overhear roars on. Unfortunately for both Ohio and New York, when you have a thundersnow, there is usually at least 6 inches more snowfall than normal.

History shows that the impact of Russian volcanoes is complex. The ash and debris, as well as the clouds they generate upset the Aleutian low and restructure the PNA pattern. Most of the time, it is medium-sized eruptions strengthening the positive PNA pattern increasing the contrast of a warm West and a cold Midwest and East. Occasionally, history shows that a long series of smaller Kamchatka eruptions can have the reverse effect. Monitoring the eruptions can indicate upcoming North American weather, but it is complicated. For now, however, the trend has been for the volcanoes of Kamchatka to have moderate eruptions, indicating a high probability of December having the type of cold weather pattern shown in Figure 4A.

The Warm, Warm Oceans

The irony of this North American cold weather is that, overall, Earth is relatively warm. **Indeed, according to NOAA, the October sea surface temperatures were the warmest ever recorded.** The temperatures are slightly cooler now, but not much.

Part of what is raising temperatures is that the Pacific is unofficially experiencing El Niño conditions. This means the Tropical Pacific is very warm and producing El Niño weather patterns. However, to officially be declared El Niño conditions, this warmth has to linger for three month in certain portions of the ocean and to be declared an event, the warmth has to last six, almost seven months. At the moment, weather officials have merely posted an El Niño "warning".

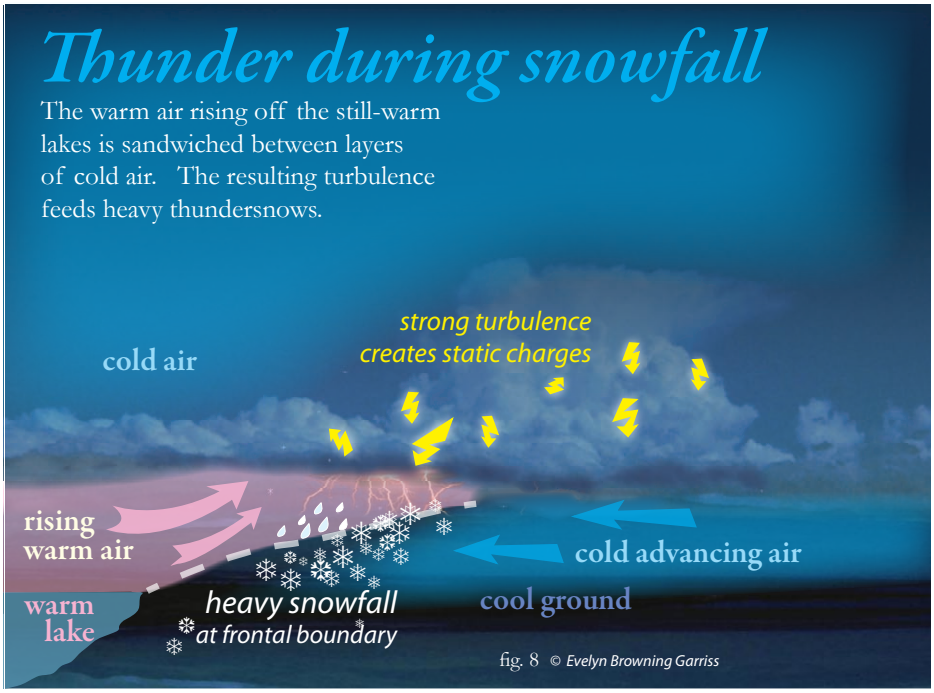


fig. 8

Looking further out, the tropical warmth has been flowing east from the Central Tropical Pacific to the western shores of South America, then north and south along the American West Coast. Most of the movement has been north and almost the entire coastlines of North and Central America are being heated by the abnormally hot water. Not surprisingly, California and the Southwest have been warmer than average while the rest of the US shivered.

In the Atlantic, the Gulf Stream and other tropical currents are pouring hot water along the Eastern shore. When the cold Arctic air hits that hot Atlantic marine air, (like it did in the miserable Thanksgiving travel season) it creates heavy storms and snow. It also warmed Western and Central Europe, giving the continent a warm lovely autumn.

These warm waters are setting conditions for a very cold and miserable winter.

When the expansion of Arctic air is blocked by warm ocean waters, it plunges deeper into land masses, particularly, Central and Eastern North America, Russia and Eastern Europe and East Asia. Then when the cold front passes, warm marine air pours back in, creating very volatile winter weather and heavy coastal precipitation.

Looking Ahead

The factors shaping this winter are the unusually cold Arctic air mass and warm oceans. Not only is the air cold, but widely accepted work by Judah Cohen, of the Atmospheric and Environmental Research in Lexington, Massachusetts, indicates the circumpolar winds are weak and the cold will plunge south. Typically, when the circumpolar winds are weak and the Arctic cold is

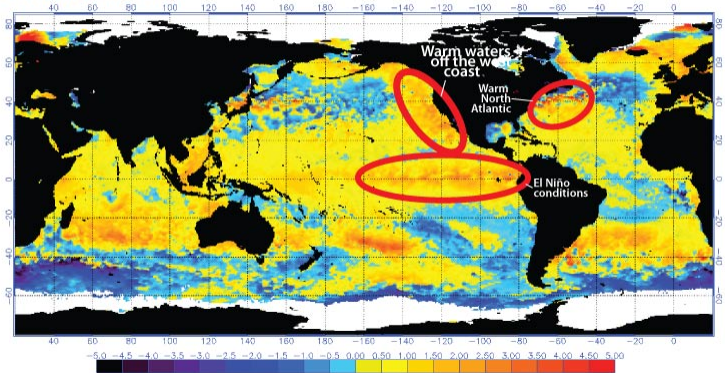


fig. 9 http://www.ospo.noaa.gov/Products/ocean/sst/anomaly/index.html

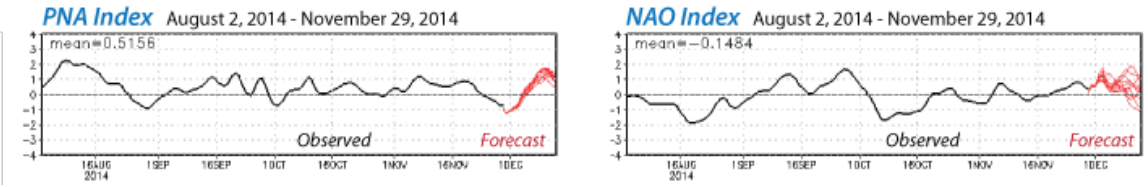


fig. 10A-B **The positive PNA should bring cold weather in early December.**

http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/teleconnections.shtml

likely to flow south, the first sign is heavy Siberians snow in late autumn. This year 4.1 million square kilometers (1.58 million sq. miles) of snow blanketed Siberia by the end of October, the second most in records going back to 1967. The snow is continuing to accumulate very rapidly.

Science is showing that the Arctic air is cold and the winds trapping it north are weak. The cold air will escape this winter. The only question is where.

In the short term, indications are the cold will continue to pour into North America and Europe will be left relatively unscathed. The latest scientific estimates expect early December to have a negative PNA and positive NAO, meaning they expect a short break in the Eastern cold. Then they project the PNA to turn positive, which will allow more cold in the Midwest and East without necessarily bringing cold to Europe.

Looking further out, the El Niño conditions are expected to last into springtime. While the worldwide scientific community gives only a 58% chance of the tropical Pacific warmth lasting 6 – 7 months, most expect it to last into springtime.

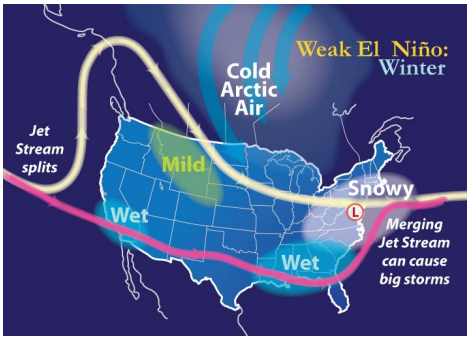
Overall, the entire winter will be shaped by weak to moderate El Niño conditions. Historically, this correlates with positive PNA weather patterns. That means a warm West, rain in California and the southern tier of states and cold in Eastern Canada, the Great Lakes, the Midwest, Northeast and Mid-Atlantic states.

Similarly, warm conditions in the Atlantic correlate with a more frequent negative NAO, encouraging cold air to drop east of the Rockies into the South.

This means a high probability of two air patterns that create cold North American weather working together this winter. On top of that, we are seeing constant volcanic activity in Russia's Kamchatka Peninsula, a wild card that also creates cold North American weather.

In 80% of similar winters, these conditions created a schizophrenic winter in North America, warm in the West and cold in the Central and Eastern provinces and states. Remember, however, that the wild card in this scenario is that the volcano eruptions in Russia upset air pressure which can change wind patterns.

Like the Sword of Damocles, the Arctic cold is waiting to fall. Where it falls will shape winter weather, travel and heating bills.



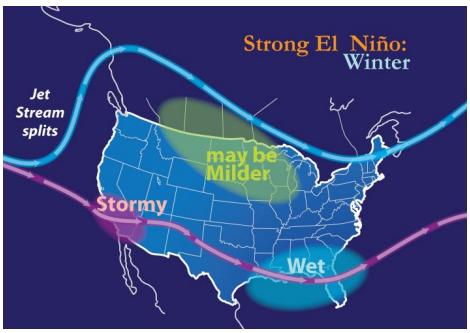
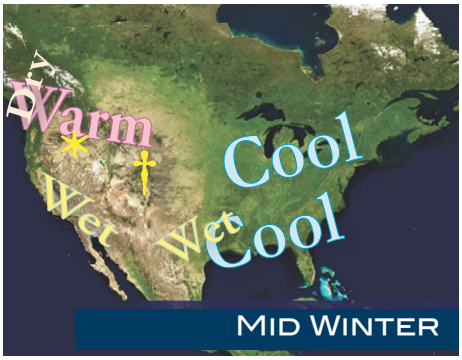


fig. 11A-B **Experts expect weak to moderate El Niño conditions in winter.** © *Evelyn Browning Garriss*



† A moderate Russian volcanic eruption will make this region colder

*If El Niño conditions continue..

figs 12A-C © *Evelyn Browning Garriss*

Cold	Cool	Warm	Dry	Wet
5°C or more lower than normal temps.	2-4°C or more lower than normal temps.	2-4°C or more higher than normal temps.	75% or less of normal moisture	125% or more of normal moisture

Changing Climate – The Impact on the Energy Sector: Part 1

SUMMARY

In the first of two articles, the impact of long-term climate trends on the energy sector production, demand and risk is examined, including the opportunities that these changes create for business.

The *Browning Newsletter* has repeatedly focused on the impact of changing climate on agriculture. However, the impact of these changes is just as profound on energy, affecting production, demand and risk. These effects are less immediately noticeable, but the long term effects are profound.

The Long-Term Changes

Over 70% of the Earth's surface are ocean waters and when these oceans change, the patterns of global climate changes. Both the Atlantic and Pacific changed in the past twenty years and we are living with the impact.

ATLANTIC MULTIDECADAL OSCILLATION (AMO) – The AMO is a roughly 70 year cycle of warmth and cooling in the North Atlantic. The Atlantic Thermohalene Current, the mass of ocean currents, including the Gulf Stream, has a cycle of flowing faster and then slower. When it flows faster, the North Atlantic warms. When it flows slower, the North Atlantic is cooler. Fishing records (thank you Scandinavian herring lovers) show us that this is a roughly 40 year fast and 30 year slow cycle that has existed for centuries.

The AMO changed from the cool phase to the warm phase, with a more rapidly flowing Thermohalene Current in 1995. The warmth may have peaked in 2012, but history indicates that the flow will continue to be rapid and the North Atlantic warm for the next 15 to 20 years. Some of the more notable effects of this warming are:

- Hotter summers around the Atlantic rim.
- More tropical storms and hurricanes
- Less summertime tropical rainfall steered unto the Southern and Central Great Plains and parts of the East Coast.
- A more frequent negative North Atlantic Oscillation, meaning a more variable polar jet stream

PACIFIC DECADAL OSCILLATION (PDO) – The PDO is a roughly 50 to 60 year cycle in the Pacific. During its positive phase, the Tropical and Eastern Pacific tend to be warmer than average. In the negative phase, the pattern is reversed with the Western and sub-tropical/polar waters warmer while the tropical and eastern waters are comparatively cooler. This is a trend, not a constant, interrupted by other Pacific patterns, particularly the El Niño/La Niña cycle.

The PDO was in a warm positive phase until 1998, then began to switch to its cooler negative phase. It finally tipped to the negative phase in 2006 and has trended that way for the past eight years, interrupted by occasional El Niño conditions in 2009 and now. Since the Pacific covers roughly 30% of the Earth's surface, when it shifts phases, it creates major shifts in global weather patterns, particularly precipitation.

The main weather effects of the negative PDO on the Northern Hemisphere are:

- Less moisture, particularly wintertime rain and snow on most of the western coasts of the Americas.
- Less snowmelt available for rivers that have headwaters in the Sierra Nevada, Rocky and Andes mountains.
- Precipitation patterns have shifted, particularly in monsoon lands.
- Stronger and longer La Niña patterns, strengthening the extreme drought and flooding conditions that these events bring.
- Weaker, shorter and less consistent El Niño patterns.
- Stronger cool MJO patterns which enhance the strong flooding flows of atmospheric rivers. (This is a new thesis being researched.)
- When combined with the hotter Atlantic, increasingly extreme weather patterns occur.

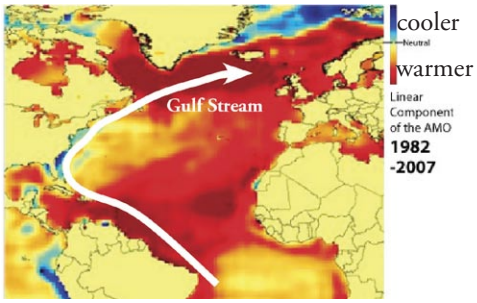


fig. 13 **The Positive AMO will affect weather for the next 15-20 years.**

The Impact on Energy Production

1. The most obvious impact of these changes is the effect they have had on the amount of water available for hydroelectricity. For example, California typically gets 20% of its power from hydroelectricity and the current drought has cut production in half.

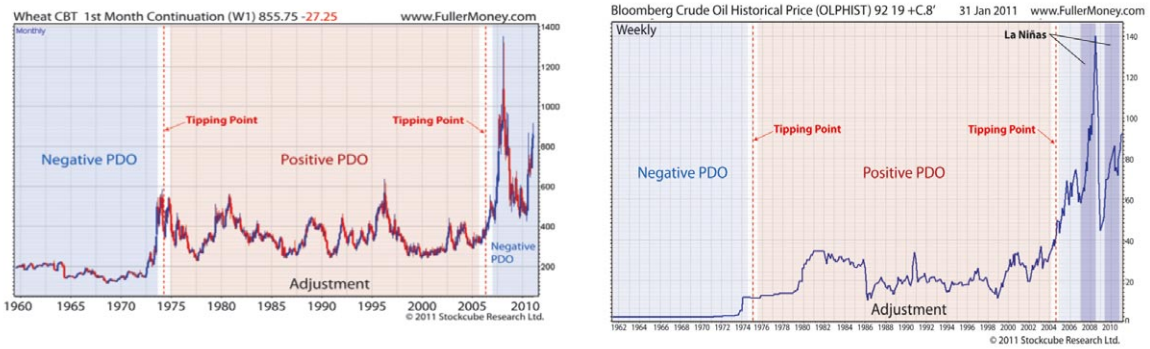
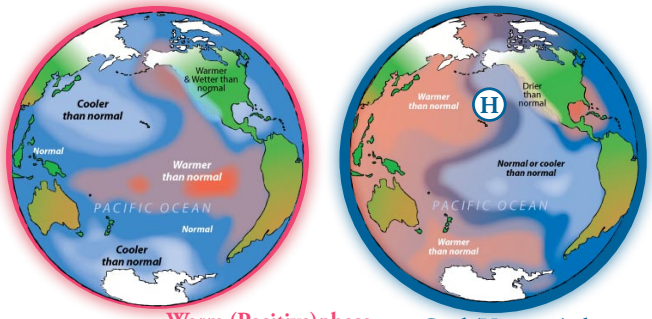


fig. 12A-B **Changes in the PDO immediately affect crop prices, but not oil prices.**
© Stockcube Research



Warm (Positive)phase prior to 1999

Cool (Negative)phase 2006-present

figs. 14A-B **Though the PDO has been largely negative since 2006** *(right)*, **El Niño can temporarily reverse the trend.** *© Evelyn Browning Garriss*

While the current drought in California is unusually dramatic, this shortage of water in hydroelectric reservoirs is part of the long-term negative PDO trend due to the reduced Western US snowfall and reservoirs are down from California through Texas. Additionally the cooler phase of the PDO has weakened China's plum rain monsoon, producing drier conditions and (during cool La Niñas) droughts that hamper hydroelectric production along the Yangtze and Pearl River tributaries, producing rolling brown-outs to major downstream cities.

OPPORTUNITIES – during these droughts, regions turn to other sources of energy, particularly gas generation have risen 16%.

2. The hotter conditions in the Atlantic provide more energy for the development of tropical storms. This has doubled the number of tropical storms and hurricanes in the Atlantic, Caribbean and Gulf of Mexico.

A majority of the Gulf and Caribbean gas and oil platforms were installed when the AMO was in its cool phase and many of these are not designed to withstand the newer, stormier climate regime. Many of the "short-cuts" that were safe in the calmer cold era are risky now and we have seen more problems and more leaks. As the British Petroleum experience showed, these leaks can be catastrophically expensive. It is not surprising that large numbers of rigs have now been moved to the offshore oil fields of Brazil, where there are no hurricanes. Total fossil fuel production in the Gulf has dropped 49% from 7.57 trillion Btu in 2003 to 3.86 trillion in 2013.

The US oil production has instead shifted to land based hydrofracking, where they face much lower weather risks. Indeed, when the cost of petrochemicals soared, it became profitable to use this new technology and America had the potential to out produce Saudi Arabia.

We are currently seeing two major problems with this shift from Gulf to land based production.

- The Gulf had an extensive refinery infrastructure and much of the current production of raw materials are far removed from processing infrastructure. Pipelines are political "hot potatoes" especially with the current US administration. Using rails competes with crops and this year has been a mess with delays in crop deliveries.
- OPEC, particularly the Saudis, are seeing the potential spread of the hydrofracking technology as an economic threat and are currently engaged in a price war. This poses a danger to the more expensive hydrofracking industry, particularly to some of the newer or more marginal companies.

OPPORTUNITIES – In the short term, the greatest opportunity is for consumers and businesses to take advantage of lower energy prices and stock up. At the same time, the lower prices are leaving consumers (particularly blue collar and middle class consumers) more discretionary income for the holiday season.

In a longer view, larger and/or more stable oil companies, while losing money, are seeing their smaller, more highly leveraged competitors face ruin. This leaves them with less completion and in an advantageous position when prices inevitably rise again. Further out, the transportation infrastructure is still needed to route petrochemicals to refineries and users.

Let's end part one on a good note – businesses and consumers are feeling some relief on energy prices despite the cold weather. There is a bit more in the budget for holiday spending.

Part two will examine the role long-term climate change is having on energy production, demand and risks in greater detail. Until then– enjoy the holiday season and stay warm.

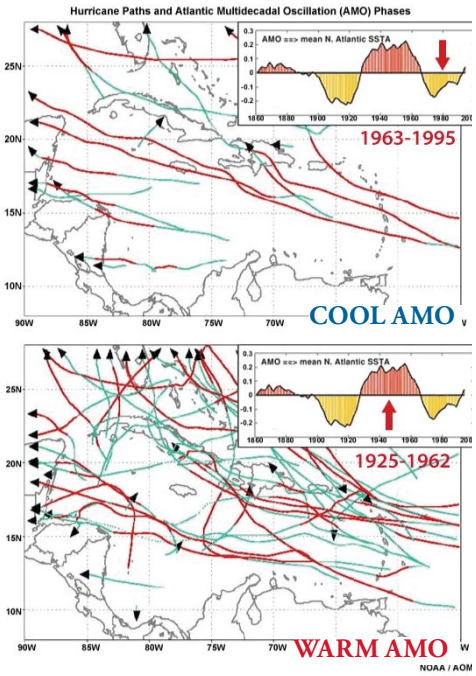


fig. 16A-B **The cool AMO squelches hurricane formation** *(top)*, **the warm AMO encourages storms.** *courtesy: NOAA*

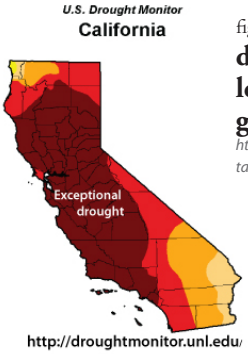
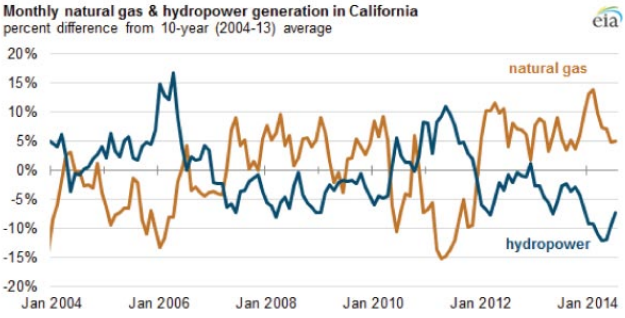


fig. 15A-B **California's drought means far less hydropower generation** *http://www.eia.gov/todayinenergy/detail.cfm?id=18271*



News Notes

El Niño watching has become an amazing sport to watch. Currently Tropical Pacific temperatures are the highest they have been since 2012, much higher than they were in October, but the estimate of whether an El Niño event will occur has dropped from 67% in October to 58% in November. Remember, whether it is an event, official conditions or just a warning, when the Tropical Pacific is more than 0.5°C/0.9°F above normal, it is shaping weather and that requires attention.

FINALLY! The scientific community is publishing information that the *Browning Newsletter* has been reporting based on our discussions with scientists. "Small Volcanic Eruptions Slow Global Warming!" by David Ridley, et. al. in the Oct. 31 issue of *Geophysical Research Letters*, a new study shows that small volcanic eruptions account for part of the global warming slowdown since 2000.

Until now, the climate impact of small volcanic blasts were overlooked because their planet-cooling particles cluster below the reach of satellites which did not observe about 30% of the aerosols. Water clouds befuddle aerosol-monitoring satellites below about 9 miles above Earth's surface, so any aerosols in low, polar stratosphere were potentially missing. Ridley and his co-authors checked aerosol concentrations in the high latitudes with balloons and lasers and discovered that about 30% of the planet's stratospheric aerosol particles were in the unobserved area 6 to 9 miles above the surface.

The recent flurry of polar volcanoes have been pumping a huge amount of aerosols into this unobserved region and the Ridley study suggests this has been a factor (but not the only one) that has caused the recent slowdown in global warming.

Sometimes boring is good. The 2014 Atlantic Hurricane season closed on without a major hurricane hitting the US, not surprising since so much of it was when unofficial El Niño conditions created unfavorable wind conditions for months at a time. It has now been a record-breaking 9 years without a major hurricane hitting the US. (Sandy was not major, which lets you know how unprepared northern US shores are for a bad hit.) The last major storm was Hurricane Wilma in 2005. The previous record for the longest stretch, from 1861 to 1868, was set during the Civil War, according to Colorado State University climatologists. (Our sympathies go to Mexico which endured billions of dollars of losses from this year's vigorous East Pacific Hurricane season.)

It should be noted, major hurricanes stopped hitting US shores in 2006, the same time that the PDO tipped from warm to cold. There is no science examining for any correlation but it is an interesting coincidence.

While Russian volcanoes remain quite active, Iceland's Bardarbunga eruptions are finally slowing. It never produced a high plume, but it emitted massive amounts of sulfur and lava, covering 75 square kilometers (29 sq. miles), an area bigger than Reykjavik, the nation's capital.

Last month the *Browning Newsletter* reported on the increasing water crisis in Sao Paulo, Brazil's wealthiest city and financial center. It continues. The city has three technical reserves for water and as its reservoirs shrank to less than 10%, it tapped into these reserves for the first time. It has already had to begin using the second reserve and those can supply only two months of water, providing usage doesn't increase over Christmas and New Year's holidays.

The area is still experiencing unusually high heat and evaporation and only half the normal amount of rainfall, despite the unofficial El Niño conditions which usually bring rainfall. It is now facing the probability of having to pump water from silt, its last technical reserve.

Ironically, while Sao Paulo remains desperate for rain, major agricultural regions of Argentina and Southern Brazil have bountiful moisture, indeed a bit too much for maximum wheat quality.

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