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BROWNING NEWSLETTER

A Fraser Management Publication

THE NEW NORMAL – WEIRD WATERS

IN THIS ISSUE

- The hot Atlantic waters have produced an extremely stormy hurricane season. Hurricane Sandy, for example, was able to grow to the largest Atlantic hurricane on record despite shearing winds.
- In the Tropical Pacific, a cool Madden Julian Oscillation drifting through the system has stalled the warming El Niño conditions. This means that this year's El Niño will be weak for most of its duration, allowing cold air to plunge into the Mid-west and Eastern US.
- Expect a warmer winter in western North America and a cooler, very wet winter in the East. This winter will see numerous Nor'easters.
- Even a weak El Niño will be good for South American corn and soy production.
- The hot Atlantic waters have shaped a poor growing season in Europe and are expected to create a cold winter, with plentiful Mediterranean moisture.

SUMMARY

Hurricane Sandy is a precursor for a stormier, but not necessarily colder than average winter. The El Niño conditions are fluctuating so they are hard for modelers to predict, but we will see the conditions and a potential weak El Niño will have some influence on the weather, warming the West and providing cooler, wetter weather for the Southeast.

As you receive this issue, the US East Coast is recovering from Hurricane Sandy, A.K.A. Frankenstorm. Originally, the US National Hurricane Center model predicted that the tropical storm would flow out of the Caribbean into the Atlantic and shearing winds would kill it. Instead, the waters off the East Coast were so hot that the storm grew faster than the upper level winds could shear it and the winds ended up slamming the storm into the US. [Editor's note – Discussion of Sandy's impact will be in the News Notes]

On the opposite side of the world, scientists are going nuts because the

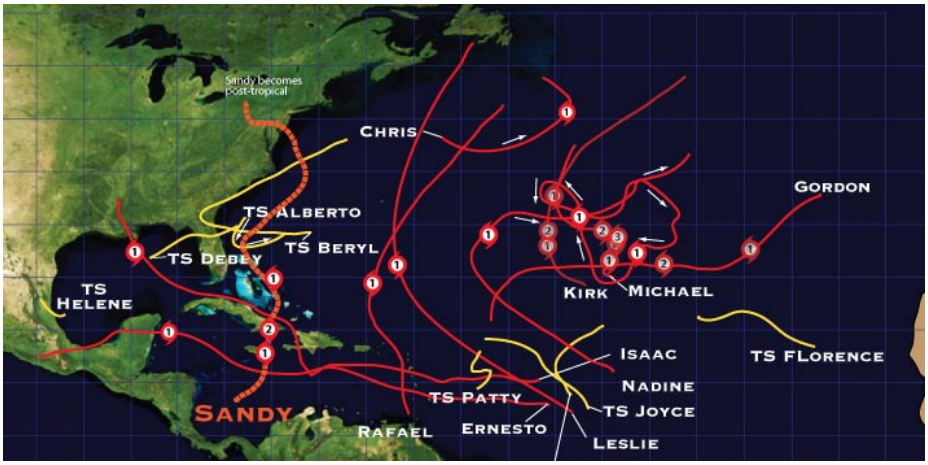


fig. 1 **A busier than expected hurricane season, though relatively few storms menaced land.**

CONTENTS

This newsletter contains articles, observations and facts to support our contention that man is significantly influenced by the climate in which he exists. Our calculations show the climate, over the next term, will cause dramatic changes in our social and economic patterns.

We feel that the reader, attuned to the changes that are occurring, may develop a competitive edge; and, by understanding his now and future environment, can use the momentum of change to his advantage.

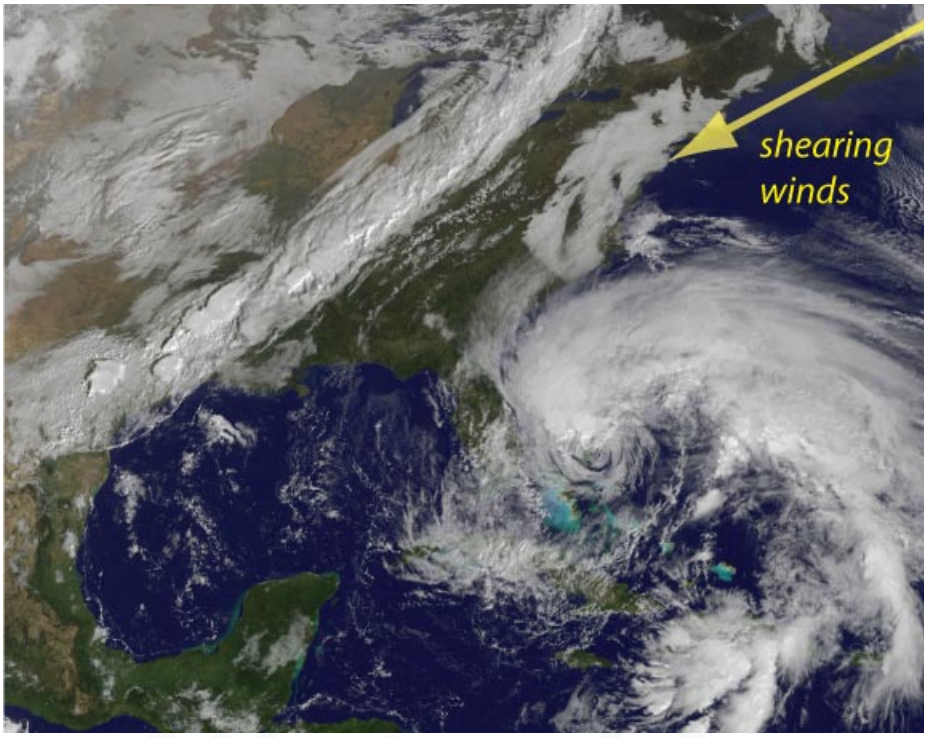


fig. 2 **When monsters merge – a cold front and a hurricane.**

http://www1.nasa.gov/images/content/700874main_20121026_Sandy-GOES_full.jpg

El Niño that most services were predicting for late August/early September still hasn't arrived! The Tropical Pacific has had El Niño conditions for months, but is still too wavering to fit the "official" definition of an El Niño event. We see El Niño weather patterns, then a break, then a return to the El Niño patterns.

In short, the weird ocean waters of 2012 are bewildering the experts. Let's see why and what the latest findings are.

Sandy, Hurricanes And Hot, Hot, Water

Did you hear the predictions about the quiet Atlantic hurricane season of 2012? Everyone, (including the *Browning Newsletter*) expected a normal to below normal storm season. Groups that have had a 95% accuracy rate predicted a low number of tropical storms. Instead, the East Coast is battling the remnants of Hurricane Sandy and Tropical Storm Tony has already appeared and disappeared. The normal season has 9.6 storms and this season has had nineteen. This is still far below the record 28 storms in 2005, but it is still unusual.

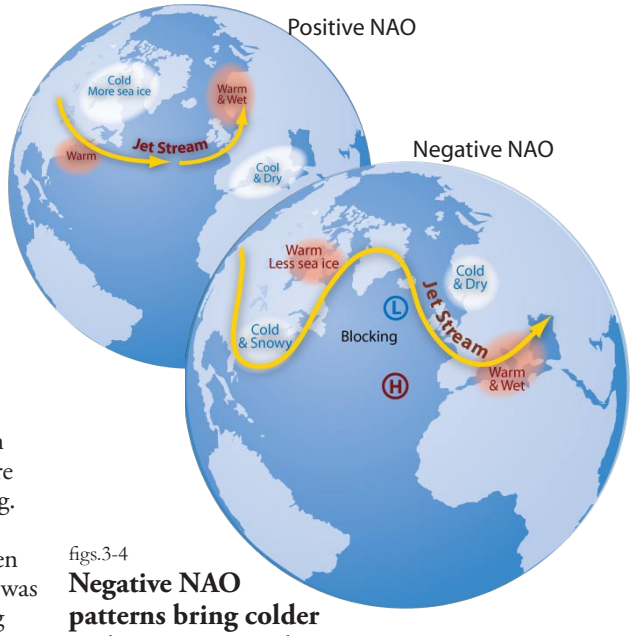
HOT WATER-The reasons are simple – the waters off the East Coast are hot and the expected El Niño never fully arrived. The El Niño will be discussed later; so for now let's focus on the Atlantic. The current off shore waters are between 1˚ -- 3.5˚C (1.8˚ -- 6.3˚F) warmer than normal. Hurricanes are fueled by heat energy and Hurricane Sandy has entered a pool of fuel. The entire North Atlantic has been abnormally warm. Basically, the Atlantic heated up unusually fast (temperatures in May were as warm as they normally are in July) and are slowing down extraordinarily slowly. The tropical Atlantic currents are flowing very fast and rushing warm tropical waters north.

The heat means stormier weather – more hurricanes and blizzards.

HURRICANES – Hot waters mean "zombie" hurricanes, storms that were supposed to die off but remain strong. We saw this early in the season with Hurricane Chris and we have just seen it with Sandy. Tropical Storm Sandy was supposed to be destroyed by sheering winds, but it kept reforming despite the unfavorable winds. Instead of beheading the storm, the winds merely slammed Sandy into the East Coast.

Meteorologists and climatologists look at weather differently. What the meteorologists are looking at is a dipping polar jet stream and the "Greenland block." Normally the eastward moving cold front would have pushed Sandy toward the Northeast. However, the "Greenland block", a high-pressure area south of Greenland completely blocked it from moving out into the Atlantic. Sandy was squeezed between the two, shooting her northwest.

Climatologists are seeing such unusually hot water off the East Coast that normal shearing winds could not kill the storm. Instead, the hot waters kept the storm expanding in size even as the shearing winds kept it from growing in strength. (It is now the largest Atlantic hurricane on record.) Experts thought the cold front and hurricane would merge into a "weird hybrid" combining the cold storm with the hurricane. Instead, the hot waters kept Sandy tropical, so that she made landfall as a hurricane and retained tropical storm strength and moisture all the way into eastern Pennsylvania. Then, the storm will merge with the cold front (like the notorious "Perfect Storm of 1991), and become a very powerful extratropical storm as it charges north towards New York and Canada.



figs.3-4
Negative NAO patterns bring colder and stormier weather along the East Coast.

It is extraordinary for a hurricane that has remained out to sea north of Virginia to veer inland. It has only happened six times in 143 years of records. All of these were mid-season storms, occurring late August and in September, when the ocean is hottest. (Even the "Perfect Storm" never hit land.) It is rare that the current waters are so hot that this can happen.

Sandy's winds weren't that strong, but it entered a region that seldom sees hurricanes. As 2011's Hurricane Irene and this summer's derecho showed this region is unusually vulnerable.

Normally, the Atlantic Hurricane season would end early with an El Niño out in the Pacific. However, the Pacific El Niño conditions are very weak and the Atlantic is very hot. The hurricane season still has a month to go.

WINTER STORMS – This autumn's hurricane season is an indication of what is coming in winter. It takes months for large water masses to cool and even as they cool, they remain warmer than average for the season. Moreover, the recent measures of the Atlantic Multidecadal Oscillation, which indicates (among other things) the speed of the Gulf Stream flow, show that the waters are speeding up. The same unusually warm ocean waters that have fueled the tropical storm season will fuel the storms of winter.

The hot waters warm the atmosphere above, changing air pressure. Historically, when the Northwest Atlantic is unusually warm, they tend to produce the "Greenland bloc". This is a characteristic pattern of a negative North Atlantic Oscillation **(NAO)**.

The NAO pattern can be described two ways.

- Climatically, the Arctic air mass expands south in wintertime. When the Atlantic is hot, heating the air above forms a "high", it limits the southward movement of polar air. Instead, the air plunges even deeper over the adjoining air masses, in both North America and Europe
- Meteorologically, the hot waters produce blocking high-pressure areas over the Atlantic. This stops cool continental storms from flowing out into the ocean. Instead, cold front after cold front piles up over the East Coast. Storms are quick to arrive over the Eastern Seaboard and slow to leave. Just as Sandy was forced north into the Mid-Atlantic, so Gulf Coast land storms will be forced north along the coastline in stormy Nor'easters.

Expect a wet, stormy winter in the East. In similar years, temperatures were near or slightly below normal in the Midwest, Northeast and Mid-Atlantic States, but the stormy precipitation was above average.

The Elusive El Niño

Since August, the Tropical Pacific has repeatedly had El Niño conditions, with water temperatures 0.5˚C (0.9˚F) above normal. However, according to international standards, the temperatures must remain above these temperatures for a three-month running average to be an official El Niño event. It hasn't.

Instead, smaller weather patterns, called Madden-Julian Oscillations (MJO), have flowed eastward through the Tropical Pacific, cooling portions of the developing El Niño. Currently, for example, a cool MJO is in the eastern portion of the El Niño. Its strong winds are overturning the region's surface waters, cooling the El Niño east of 120˚W, just as it previously had cooled the waters further west.

This has baffled the models. The majority of global weather service models in August expected a mildly moderate El Niño, with Tropical Pacific temperatures between 0.5˚ – 1.0˚C (0.9˚ – 1.8˚F), that would last until mid-spring. In September, the global models expected a weak event. In October, the official pronouncement by the US Climate Prediction Center was:

> "Borderline ENSO-neutral/ weak El Niño conditions are expected to continue into Northern Hemisphere winter 2012-13, possibly strengthening during the next few months."

The "possibly strengthening" clause is because another MJO is drifting eastward

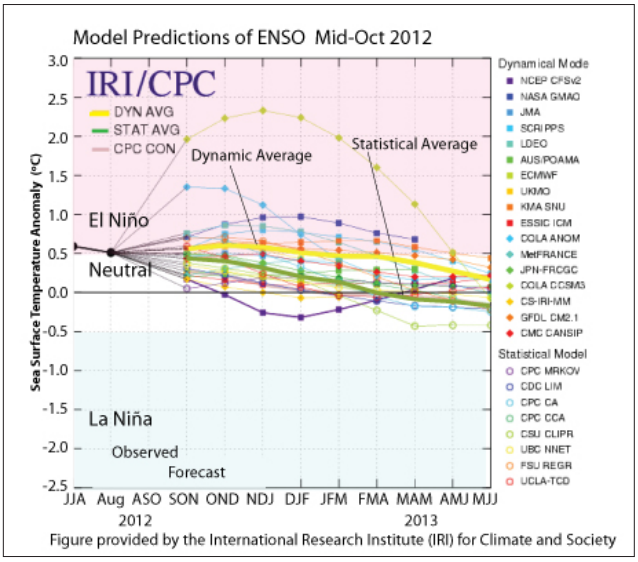


fig. 5 **Models show an early exit for El Niño**
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf

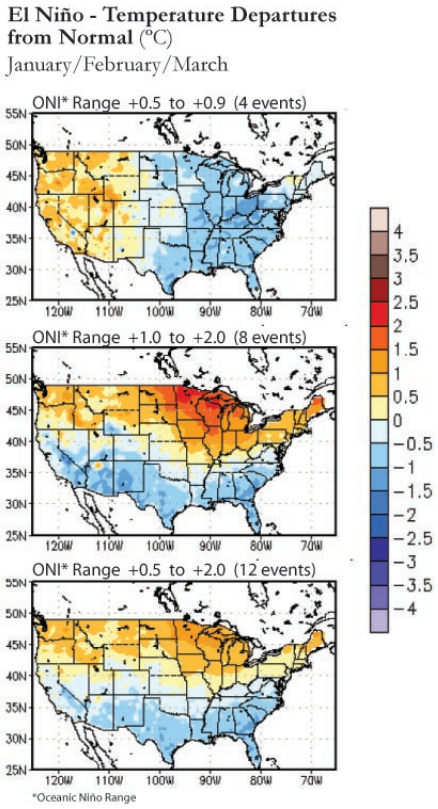


fig. 6-8 **The impact of different types of El Ninos on US temperatures:**
top **weak El Ninos,**
middle **moderate to strong El Ninos,**
bottom **the average impact of El Ninos**

through the Pacific and it is a warm, still oscillation that would increase the warming of the El Niño. What we have seen is that the El Niño has been warming in the waters behind the MJO. This new quieter MJO would increase the El Niños natural warming, making the waters so still that the sun would bake the ocean's surface. This would increase the El Niño's strength in mid-to-late November, lasting through December.

The strength of the El Niño is important to North America because it determines how far east the warming impact of the phenomenon will extend. In most El Niños, Canada and the northern states are warmer than normal and the southern states are colder. The Pacific jet stream flows through the southern states, bringing heavy snows and rains.

By contrast, a weak El Niño splits the nation in an east/west pattern. The west is warm, while the east is cool. The polar jet stream brings more snow and moisture to the Midwest, but California and the Southwestern states are much drier.

The irony is that the El Niño conditions may linger and strengthen, without ever fulfilling the official definition of "an El Niño" event. MJOs may continue to ripple through the El Niño waters cooling this or that portion of the phenomenon. The warm temperatures would appear repeatedly, influencing North American weather, but with some interruptions, as we have seen since August.

For example, the wavering El Niño conditions did not reduce the number of hurricanes, unlike most events. Part of that was that the Atlantic was hot, but unlike a prolonged El Niño event, the conditions have occasionally allowed favorable winds for storms to develop. It has provided enough suppressing high altitude winds that only one hurricane, Michael, grew to Category 3 strength.

Expect weak El Niño conditions through winter, with a strong probability that the conditions will grow to mildly moderate in December.

The Problem With Climate Models

What we see this year is that modelers who have been very good in the past have severe problems. El Niño models have difficulty with warm tropical conditions that fluctuate. The problem is that models need exact numbers and we have a very short database. Satellite measurements started in the late seventies and early eighties. Uniform land measurements for most of the world's landmasses date from 1950. Widespread measurements with reliable instruments started in the 1880s. In short, the models are using patterns seen over the past 60 – 130 years. Hurricane predictors are constantly facing problems with the turbulence of a super-heated ocean.

Unfortunately, the natural patterns that shape climate are older than the measurements. The Pacific Decadal Oscillation is a 50-year cycle; the Atlantic Multidecadal Oscillation lasts 70 years. There appears to be a long-term solar cycle that lasts for centuries creating the Roman Warm Period, the cold Dark Ages, the Medieval Warm Period, the Little Ice Age and contributing to our current global warming. Models supplied with a century or less of data can't cope. They were designed in cooler years. Most of their data is from the era when the Atlantic was much cooler and the Pacific Decadal Oscillation directed warm water off the western coastline of North America.

Current models are mostly based on weather from the 1950s or later. We are trying to model some ancient weather patterns with models designed based on modern trends. Expect more surprises, because the models are not working.

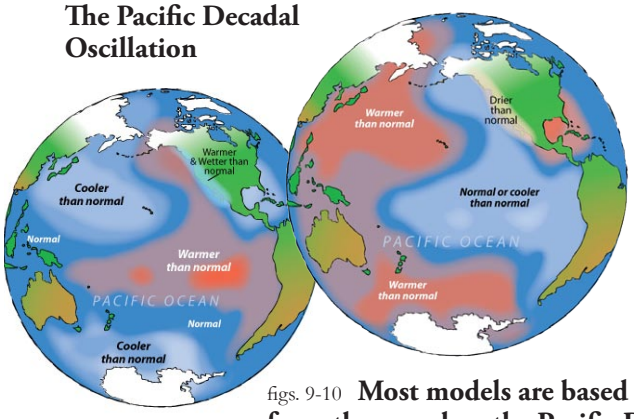
Historical Patterns

Historical patterns are not as exact in their projections as models, but we have hundreds of years of records. Let's look at what has happened in the past. In the five most similar years, we saw the following weather patterns.

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

figs. 11-13 *, **Moderate eruptions in the North Pacific will bring more moisture to the west.**
© Browning Newsletter

The Pacific Decadal Oscillation



Warm phase *above*
Cool phase *right*

figs. 9-10 **Most models are based on weather patterns from the era when the Pacific Decadal Oscillation was positive. Now it is negative and changing the impact of the cold tropical La Niñas and the hot El Niños.**
© Browning maps

The flickering El Niño has continued to pile warmer water along the western shores of Central America and that water is flowing north. The warmer than average waters are now as far north as San Francisco. When we have had weak El Niños, the wind patterns fluctuate more than the warmth of the waters off the California coast. The Pacific jet stream, which in moderate El Niños brings cool, wet weather through the southern tier of states, only consistently brings moisture to the Gulf States and Southeast in weak El Niños. It fluctuates in and out of California and the Southwest, bringing some moisture but usually only normal to below normal amounts of snow and rain.

In the five most similar years, we have usually seen the following weather patterns:

LATE AUTUMN: In most similar years, November was normal to near normal with warmer than average temperatures in the northern tier of states and the Southwest. Western Canada gets warmer. The Northeast and Southern Plains usually had heavier precipitation. If, as satellite readings indicate, a warm MJO will enter the El Niño, increasing its warmth, we should see the impact in late November and December.

EARLY WINTER: In early winter, the East and Midwest were hit by cold Arctic weather 80% of similar years. The cooler temperatures extended through Canadian eastern provinces down to the Southeast while the El Niño warmed the West Coast from British Columbia to Southern California. Storms brought rain and snow through the Gulf and Eastern Seaboard. In 60% of similar years, the northern Great Plains was extremely stormy and the Ohio River Valley had below average precipitation.

MID-WINTER: The El Niño should be at its peak as mid-winter begins. This usually brings a break to cold weather in the Northeast and Mid-Atlantic states. Warmer than average weather stretches from the Pacific Northwest through the Prairie Provinces and northern states to Lake Michigan in 80% of similar years and across to the East Coast in 40%. The Pacific jetstream usually ripples through the entire southern tier of states bringing cooler wetter weather. In 60% of similar years, Florida and the Gulf states see winter tornadoes.

When looking at these types of years from a heating and energy use perspective, Canada usually has below average demand while the Northeast and Midwest has average to slightly above average needs. The early winter is usually deceptively cold, the rest of the season is normally wetter and stormier than normal, but with near normal temperatures.

Meanwhile, we at the Browning Newsletter extend our best wishes for those clients in Hurricane Sandy's path.

SOUTH AMERICAN UPDATE

SUMMARY

The weaker El Niño will still provide good moisture levels for Brazilian and Argentinian corn and soybean crops.

Weaker El Niños have different impacts than strong or moderate events. When 80% of weather services were expecting six months of El Niño and most expected a moderate event, the Browning Newsletter told its clients that South America would have a good crop season.

Now that it looks like the event will be fluctuating and be weak through much or most of its duration, will it hurt the South American outlook?

Typically, the El Niño brings good rain conditions for Southern Brazil and most of Argentina and dry weather for Northern South America and the Andes. The drought conditions in Peru and Bolivia are serious. Peru has historically been one of the best record-keepers of the phenomenon. Inca shaman could accurately predict the events weeks before they occurred.

Looking at the actual weather, during the weak, fluctuating El Niño conditions, we can see that the main impact is more precipitation in northern regions of South America.

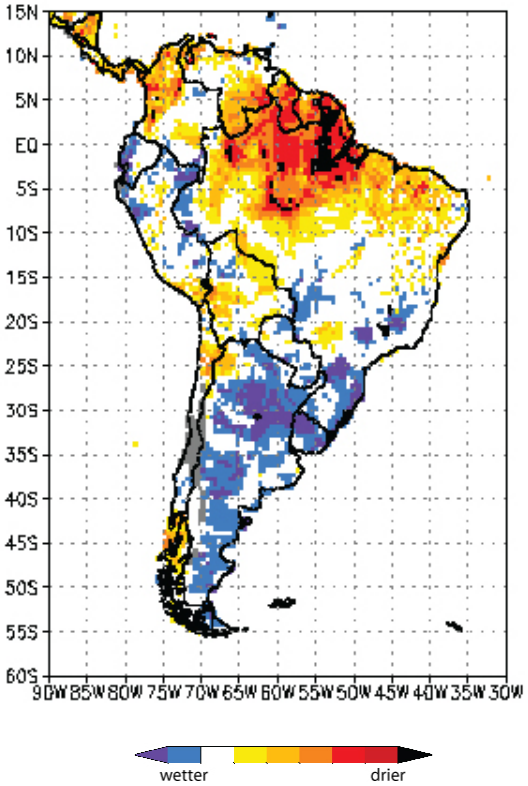


fig. 14

Predictions for South American rains

November, December, January

http://iri.columbia.edu/climate/forecast/enso/index.html

Further south Brazil saw the expected dry conditions in its north. Seasonal rains and favorable conditions helped its central and southern summer crops. Indeed, the weakened El Niño may actually have improved conditions, since abundant moisture was creating some problems for the nation's winter wheat crop. The moderating of the rain allowed some drying of the wheat crop.

Argentina has seen unseasonable wetness across a large section of its central croplands. This provided abundant levels of moisture for winter grains and summer crops but kept some areas unfavorably wet for planting. Corn planting is lagging by 8%. Now that the nation has good moisture for initial growth, the weakening El Niño should allow some easing.

Most experts expect the El Niño conditions to strengthen in a few weeks. This will allow a return of abundant rain.

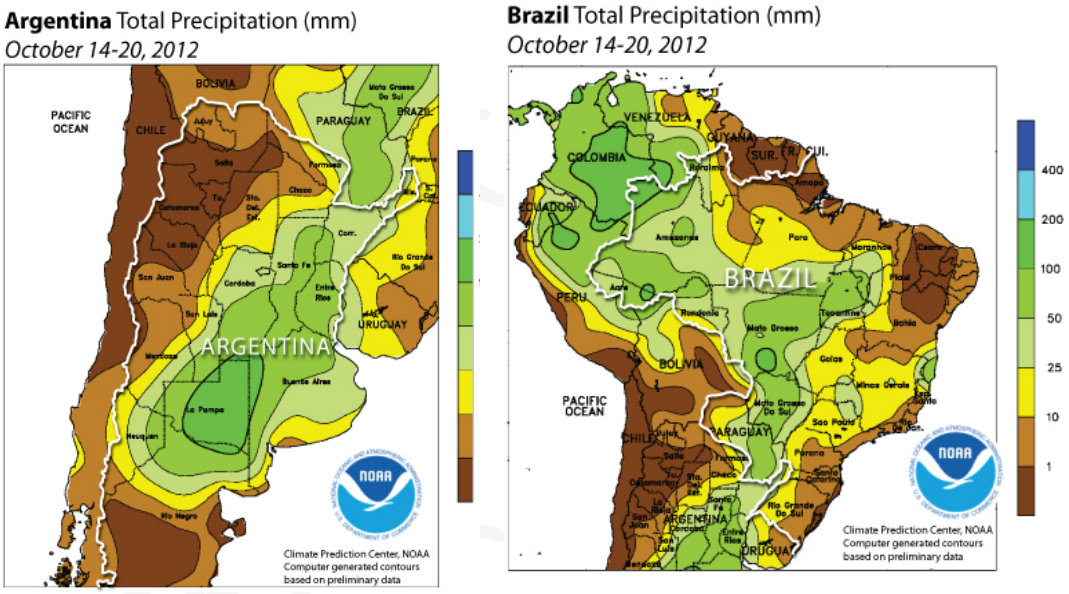


fig. 15-16

Even weak El Niño conditions bring rainfall to South American croplands.

Precipitation amounts, *October 14-20* **Argentina,** *left* **and Brazil,** *right*

http://www.usda.gov/oce/weather/pubs/Weekly/Wwcb/wwcb.pdf

This fluctuation should be good crops, providing moisture but avoiding flooding.

In short, even a weak El Niño improves the outlook for South American soy and corn crops. Tropical climate patterns dominate summer weather and the Southern Hemisphere's growing season is just beginning. Unlike North America, where the weak El Niño is battling cold Arctic patterns, in South America the El Niño's influence is relatively unopposed.

This is good news for a world that has been waiting for better crops and lower food prices.

EUROPE AND THE HOT ATLANTIC

SUMMARY

The warm Atlantics produced a very poor growing season for many of Europe's crops this year. Typically, very cold winters follow summers similar to this year.

Europe had a miserable summer this year and its crop production reflects this.

- Russia reported both an extremely low spring and winter wheat harvest due to drought. Its total wheat yield is down 23% from last year, and 21% below the 5-year average.
- European Union (EU) corn production is down 15% or 9.7 million from last year. After a promising beginning with good conditions and widespread planting, the southern tier of nations, particularly the Rumania and Bulgaria were blasted with prolonged heat and dryness. Like the US crop, the heat was untimely and it hit during the sensitive pollination season. The sunflower crop was also hit, affecting oil production, though not as severely as corn.

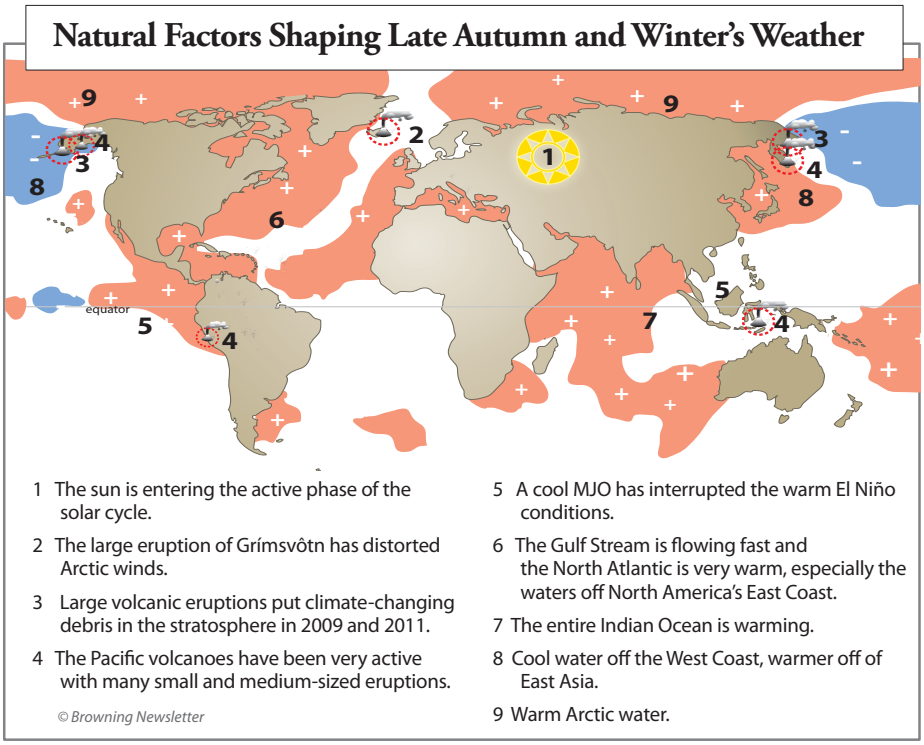


fig. 17 *© Browning Newsletter*

- While Southern Europe baked, Northeastern Europe faced day after day of rain. Persistent rain in the UK interfered with fieldwork and was conducive to disease. As a result, the wheat harvest is down 8% from last year.
- Even more painful, drought, frost and hail hit the French wine industry. Experts predict the worst grape harvest in half a century. The harvest is expected to slump by almost 20% and the Italian crop will be down 7%. Reports that are more specific show that the harvest could decline by 40% in Champagne, with Bourgogne Beaujolais expecting to decline 30%. Bordeaux would get away lightly with a drop of 10 percent.

Just as the rapid flow of the Gulf Stream and hot Atlantic temperatures distorted precipitation patterns in the US, it shaped heat, drought and heavy rains in Europe. For Southern Europe, the Saharan High, which normally brings heat and desert dry to North Africa, shifted north, baking all shores of the Mediterranean. Meanwhile, northern weather fronts passing through the hot, moist Atlantic air mass rained out on the UK and Northeastern Europe.

The heated Atlantic waters that shaped the summer will produce a negative North Atlantic Oscillation (NAO), which will intensify this winter. In North America, the cold

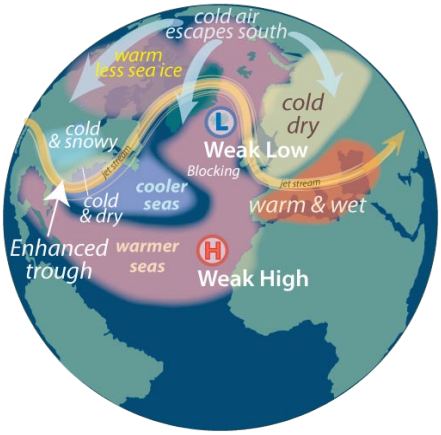


fig. 18 **The Negative NAO brings cold, dry winters to Northern and Eastern Europe. The Negative NAO will dominate this winter.**

© Browning Newsletter

Arctic intrusions of the negative NAO will be partially tempered by the warming impact of an El Niño. The weather in Europe is more basic – the warm Atlantic versus the cold Arctic. The prevailing westerlies bring warm, wet weather from the Atlantic while the Arctic air masses are usually dry and frigid and frequently hit Europe from Siberia. We have already seen the first blast of cold, hitting the European wine country. . In North America, the cold Arctic intrusions of the negative NAO will be partially tempered by the warming impact of an El Niño.

As noted in the first article, the warm Atlantic waters tend to heat the atmosphere in the North Atlantic. This alters air pressure, both highs and lows, which in turn alters wind and weather patterns. The circumpolar winds weaken, allowing Arctic air to plunge south. In 80% of similar years, Northern and Eastern Europe had very cold, dry winters.

History indicates that the stronger the negative NAO, the further west the Arctic air will plunge. Typically, the cold drops through Scandinavia and Eastern Europe, including Russia and the Balkans. More positive NAO years see the cold come from Siberia, like last year's "Beast from the East" cold spell. Since the air is from the Arctic, it is dry. When it hits the warm marine mass of Mediterranean air, the moisture precipitates out, creating extremely wet weather. Floods occur 40% of the time. Meanwhile England is, as always, complex and complicated. It frequently is hit with the cold weather, but usually is not as dry as its continental neighbors are. Indeed, in 60% of similar years, Scotland and Northwest England had heavy rains while the southwestern counties were relatively dry.

Overall, planners looking for a good analogy year should look at the records for the winter of 2005/2006. The year had bitter cold, but was not as cold as the more recent winter of 2009/2010.

There is at least one compensation. According to experts, the quality of this year's wine will be good as it is expected to be more concentrated. The memory of this year's weather will be preserved with some excellent wine.

News Notes

As this Newletter goes to press, the statistics for Hurricane Sandy, A.K.A. Frankenstorm, are beginning to emerge. Sandy affected 17 states and killed at least 55 people and left eight million people without power before losing its tropical characteristics. The storm has now merged with the cold front, energizing the storm front. It crossed Lake Ontario on Halloween and is now wandering through Quebec and the Atlantic provinces, while fortunately missing Toronto and Montreal.

The combination of hot water and energy from the approaching cold front allowed Sandy to break some major records. It was the largest Atlantic hurricane on record, 945 miles in diameter. According to analysis by Weather Decisions Technology (WDT) Sandy was a 500-to-1,000 year precipitation event for some parts of the Mid-Atlantic with a 100-250 year precipitation event for broader areas. Disaster modeling company Eqecat projected that "Hurricane Sandy is likely to cause insured losses of $5 billion to $10 billion and economic losses of $10 billion to $20 billion." If it hits $20 billion, it would be among the top 5 costliest U.S. hurricanes — and the costliest one to hit the Northeast.

The trend used to be – "Go west, young man." Now it's "Go north, young corn!" As climate is changing, Kansas is abandoning corn and Canada is growing more. This year Kansas planted fewer acres of corn, switching to less-thirsty crops such as wheat, sorghum and even triticale, a wheat-rye mix popular in Poland. Meanwhile, corn acreage in Manitoba, a Canadian province about 700 miles north of Kansas, has nearly doubled over the past decade due to weather changes and higher prices.

Agribusinesses, like giant Cargill Inc. have noted this trend and are investing in northern U.S. facilities, anticipating increased grain production in that part of the country. Areas that once only produced wheat now have six to eight more days of frost-free weather and can grow corn, soybeans and rapeseed (canola).

Even gardens are reflecting this trend. Look on the back of the next pack of seeds you plant. The U.S. Department of Agriculture this year updated its plant hardiness map for the first time since 1990. Many regions have been shifted into zones that are 5°F warmer than in the late 20th century.

A new study is reporting what the Atlantic Multidecadal Oscillation does to European climate. There have been multiple studies on the impact on North American, but combining the records from the multiple European nations has been much slower. This makes Rowan Sutton and Buwen Dong's article "Atlantic Ocean influence on a shift in European climate in the 1990s", published in *Nature Geoscience* on October 7, this year, a milestone.

The study reviews European weather since 1930, covering two warm phases and one cold phase of the 60 – 70 year cycle. Here are some of the findings about the effects of the Positive AMO and its warmer waters.

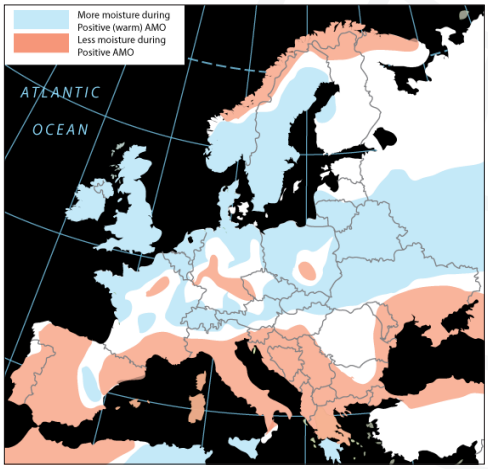


fig. 19

When the North Atlantic is warm, rains shift throughout Europe.

based on: "Atlantic Ocean Influence on a Shift in European Climate in the 1990s", by Rowan T. Sutton & Buweng Dong, Nature Geoscience-Letter *October 7, 2012*

- The recent warming in the Atlantic Ocean is the main cause of wet summers in northern and Central Europe.
- Meanwhile, southern Europe, from Portugal to Turkey, gets far less rain than normal.
- A warmer-than-usual Atlantic "favours a mild spring (especially April), summer and autumn, in England and across Europe."
- The normal path of the jetstream changes dramatically between phases but the exact path and mechanism has not been fully determined.
- The warm Atlantic temperatures interact with the reduction of Arctic sea ice and both influence the severity of European winters.

While the warm Atlantic has brought heat and drought to North America and Southern Europe, less attention has been paid to the impact the warm waters have had on Africa. However, the consequences have been just as dire. The warmer temperatures expanded the tropics, creating heavier monsoons that penetrated deeper into sub-Saharan Africa. As a result, flooding affected multiple countries in western and central Africa from July through October. Flood conditions continued in Nigeria in early October. The country's National Emergency Management Agency reported that floods had killed 431 people and displaced 1.3 million more. Floods had also wiped out 152,575 hectares (377,020 acres) of farmland. Normally increased moisture would be good for agriculture, but decades of drought have led millions of Africans to settle in flood plains and low lands. The return of the African rains was disastrous for this low-lying infrastructure.

So much attention has been paid to Hurricane Sandy that no one has noticed another record-setting hurricane this month. Tropical Storm Nadine tied the record this month for the longest lasting Atlantic storm. On October 4, Nadine finally broke up after wandering through the Atlantic for more than 21 days, the longest lasting storm since 1971's Hurricane Ginger . During that time Nadine grew into a hurricane three times, lost its tropical status once, made two loops and brushed the Azores twice. The warm Atlantic waters kept providing fuel to resurrect Nadine, making Nadine another one of this season's "zombie hurricanes".

The longest lasting cyclone on record is 1994's Hurricane John. John formed during the strong El Niño waters of the Pacific, traveled 7,165 miles (13,280 km) and is one of the few storms to be both a hurricane (when it was in the east Pacific) and a typhoon (when it was in the west Pacific).

The opinions expressed are those of the writer, and although they are based on extensive studies of physical data and phenomena, many statements published here are not entitled to be regarded as rigorously proved in a scientific sense. Some decades must pass before these issues are resolved.

Meanwhile, decisions must be based on the best available information and estimates.

This newsletter will **not** contain:

- *Analysis of, or recommendations concerning, any investment possibilities.*
- *Recommendations on any particular course of action.*

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