June 2011

World Reports Covering Climate, Behavior, and Commodities Original Papers Historical Perspectives

BROWNING

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A Fraser Management Publication Vol. 36, No. 6

A Wild Card - The Eruption of Grímsvötn

IN THIS ISSUE

- A volcano, Mt. Grímsvötn, erupted in Iceland. Its eruption was high enough to change this year's climate. It will cool this autumn and winter affecting harvests and winter fuel consumption.
- The La Niña has ended. It won't be declared officially over until June and its impact will linger at higher latitudes during early summer. This means lingering Southern drought and Northern storms through June.
- The Atlantic hurricane season will be busy with at least 3 hits in Gulf of Mexico oil/gas production waters and two landfalls in the US.
- Europe is in a prolonged period of hotter drier summers and cooler drier winters. This is due to the 60 – 70 year Atlantic Multidecadal Oscillation. This type of climate change began in 1995 and will continue for another 15 – 25 years.
- Just as the US is being plagued by floods, so China, across the Pacific is enduring a severe drought, due to the intense dry season of the Pacific Northwest Monsoon.

SUMMARY

The eruption of Grímsvötn in Iceland is large enough to cool this autumn and winter, affecting harvests and winter fuel consumption in the Northern Hemisphere.

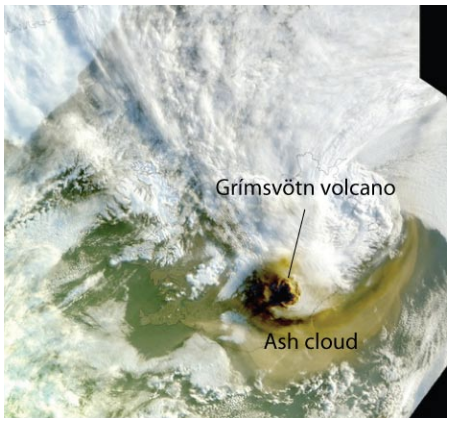
At 5:30 PM, May 21, 2011, Iceland's Grímsvötn volcano exploded. It spewed ash and chemicals 15 – 20 km. (9 – 12 miles) high. This is large enough to change the climate of the Northern Hemisphere.

Most of what you read about this eruption will focus on the short term – its impact on air traffic. However it will be the long-term impact on climate that will be this volcano's most expensive consequence.

The Eruption

Any Icelandic eruption is immediately compared with last year's eruption of Eyjafjallajokull. The good news is that between wind patterns and updated European aviation procedures, the eruption will have a much smaller impact on air traffic. Instead of banning all European flights for 5 days, the ash flow will be analyzed and flights will be cancelled or rerouted as needed. As this is being written, the ash has only disrupted flights to Iceland, Germany and Great Britain. It caused the American president to leave Ireland a bit early.

The bad news is this is the most powerful eruption in Iceland in over 50 years, and much bigger than last year's eruptions. The volcano is under a glacier, which causes a tremendous steam explosion when the hot lava hit the cold water and ice. Chemicals and debris from this eruption are entering the stratosphere. Initially the plume reached 20 km (12.4 miles) altitude but during the night it fell to 15 km (9.3 miles),



source: NASA

FIG. 1 **The May 21, 2011 eruption of Grímsvötn in Iceland.**

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.

occasionally rising back to 20 km. During the morning of the May 22nd the plume was lower still, or at around 10 km (6.2 miles) in altitude, rising occasionally to 15 km. By May 25th the volcano stopped emitting ash but it continues to spew steam and chemicals into the lower atmosphere

By comparison, the Eyjafjallajökull plume of last year was 6-9 km high. As University of Edinburgh volcanologist John Stevenson, explains this is important because every extra kilometer of plume requires a much faster eruption rate.

"The diagram shows that an eruption such as Eyjafjallajökull, with a plume of ~7 km corresponds to an eruption rate of . . . 10,000 cubic metres per second. This is equivalent to a few hundred tonnes per second in mass. An eruption with a 17 kilometre plume...**is producing between 100 and 1000 times more material every second.**

According to the article, 2000 tons are being ejected every second. A guesstimate based on this would be a total of about 150,000,000 – 200,000,000 m^3 (0,15 – 0,20 km^3), a comfortable VEI 4 (Volcano Explosivity Index – a 1 – 5 index of eruption strength) and more than the entire output of Eyjafjallajökull in a little over 48 hours.

Timing is everything. Eyjafjallajökull erupted in March, when the southern expansion of Arctic air spread the ash from Canada's Atlantic Provinces, across the Atlantic, throughout Europe and into Russia. The Grímsvötn eruption, by contrast, is during late spring, when the polar air mass is retreating north. As a result, its impact is limited mostly to Greenland, Iceland, Scotland and some northern portions of Europe.

Grímsvötn's plume is different from the earlier eruption as well. Volcanic plumes are made of steam, ash (fine, fragmental pieces of silicate glass, not burned carbon), and gases like CO2, SO2, H2S and others. Eyjafjallajökull's ash contained more silica, which made it more "sticky" i.e. easier to melt. At least 20% of the material was microscopic and slow to fall. The current eruption's ash has lower silica content and most of it is larger and will fall out of the air quicker. However, about 10% is microscopic, and given the greater volume, a great deal of ash, as well as sulfur and other chemicals has entered the stratosphere.

The Long-Term Impact

Once volcanic ash and chemicals (aerosols) enter the quiet stratosphere, they can linger for years. They reflect incoming sunlight until ultimately the aerosols gather enough moisture to form droplets that precipitate out. Before falling out, however, the thick clouds of aerosol microdroplets can linger and block out solar radiation and cause considerable cooling of the grounds below.

The prevailing winds are trapping Grímsvötn's debris in the Arctic air mass. The aerosols will join the debris that is still lingering from 2009's Sarachev Peak and Mount Redoubt eruptions. They will combine to block incoming the sunlight that would warm the Arctic summer. Then, as fall returns, the colder Arctic air mass will spread south and produce some very cold late fall and winter temperatures.

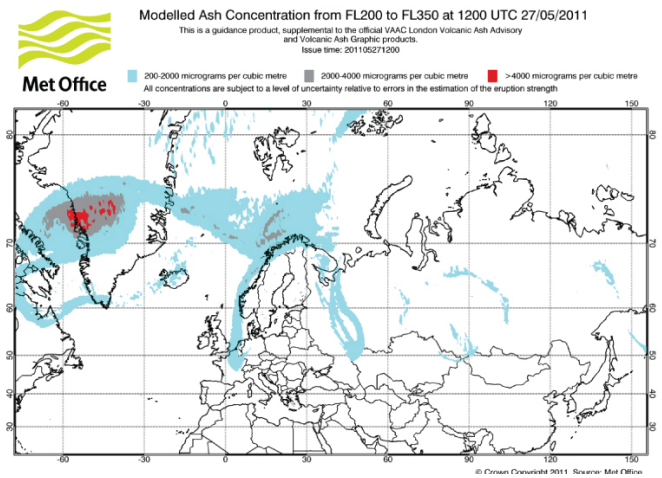


FIG. 2 **The official London ash advisory for May 27**
http://www.metoffice.gov.uk/volcano/public/eurasia.html#D4

FIG. 3 **Volcanic eruptions and their consequences**

In an agricultural year that has had weather-delayed planting seasons, a potential early freeze in very bad news. Similarly, high heating demand during another cold and stormy winter will raise energy costs and reduce discretionary consumer spending.

The good news is that Grímsvötn appears to be calming down and historically has had rather short eruptions. This means that its impact should be less than the two volcano eruptions of 2009.

The *Browning Newsletter* has always reported that large volcano eruptions are weather wild cards. This year that card has been played in Iceland and it will produce another year of cold, stormy and just plain weird weather.

Springtime Misery

SUMMARY

The La Niña is gone (but not officially). Unfortunately the cooling from Grímsvötn will create a cooler, wetter fall. It will be a race for the late planted crops in the Midwest to mature and be harvested. The outlook is for a busy Atlantic hurricane season with at least 3 hits in oil producing parts of the Gulf of Mexico.

Most springs bring April showers and May flowers. This year, springtime has brought floods, droughts and a record-breaking number of deadly tornadoes. Now summer has arrived and we can add hurricanes to the list of weather woes.

Basically 2011 has had a 'perfect storm" of natural factors shaping this year's weather. A combination of a warm Atlantic, a cold La Niña in the Pacific, enhanced by a cool giant Pacific Decadal Oscillation, and volcano weather from the north have joined to create a miserable and stormy six months. The good news is that the La Niña has ended (though not yet officially). The bad news is that the eruption of Grímsvötn in Iceland will renew the problems of northern volcano weather.

Overall, what this means is that with the fading of the La Niña, we will see some improvements in this summer's weather. But look out for autumn!

Springtime Review

Over the past year we have seen the deadly collision of three natural weather factors.

1. **VOLCANO WEATHER** – The eruptions of Mt. Redoubt and Sarychev Peak in 2009 sent volcanic ash and chemicals into the stratosphere. Over the past two years the debris has been floating in the Arctic air mass. As the volcanic aerosols gathered moisture from the surrounding atmosphere, they have formed thick clouds, reflecting warming sunlight away from the polar air. This has resulted in unusually cold Arctic air. It has also changed the northern air pressure patterns, allowing the air to sink unusually far south. This has shaped a cold winter and chill spring.
2. **THE LA NIÑA/SOUTHERN OSCILLATION** – The cool La Niña in the tropical Pacific has been enhanced by the chill negative Pacific Decadal Oscillation. These two weather patterns have combined to make a very strong impact on North American weather. Cold water has welled up along the West Coast and the prevailing westerly winds have blown the cooler air inland. To the south, the cool westerlies blew across the dry lands of Northern Mexico, bringing dry air to the South and Southern Plains.
3. **THE WARM PHASE OF THE ATLANTIC MULTIDECADAL OSCILLATION** – The Atlantic is in a long-term warm phase. (This will be discussed more in the next article.) The warm, wet air over the Atlantic is heating up eastern portions of North America.

The collision of these three air masses has been a car wreck. When cold air collides into warm wet air, you get storms. The greater the contrasts in temperatures, the stronger the storms are. When the air is filled with aerosols, the particles gather the moisture and fall out in flooding rains.

- Thanks to the La Niña, we have had the drought in the South and Southern Plains.
- Thanks to the collision of air masses, we have had the floods.
- Thanks to the tremendous cold of the combination of volcano weather and La Niña and the contrasting warmth of the Atlantic air, we have had a record-breaking number of violent storms and tornadoes.

Summertime Outlook

The La Niña is over. No, it has not officially been announced yet, but the Tropical Pacific no longer averages 0.5°C (0.9°F) below normal. The condition will have to

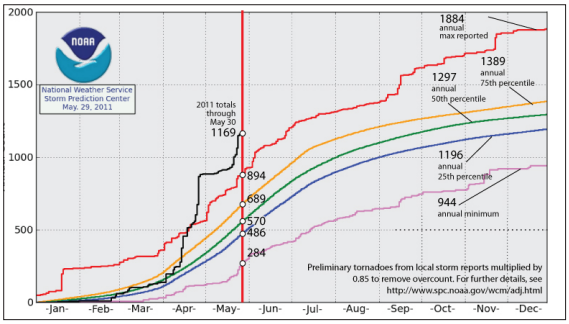


FIG. 4 **US Tornado Count** *through May 30, 2011*
www.spc.noaa.gov/wcm/torgraph-big.png

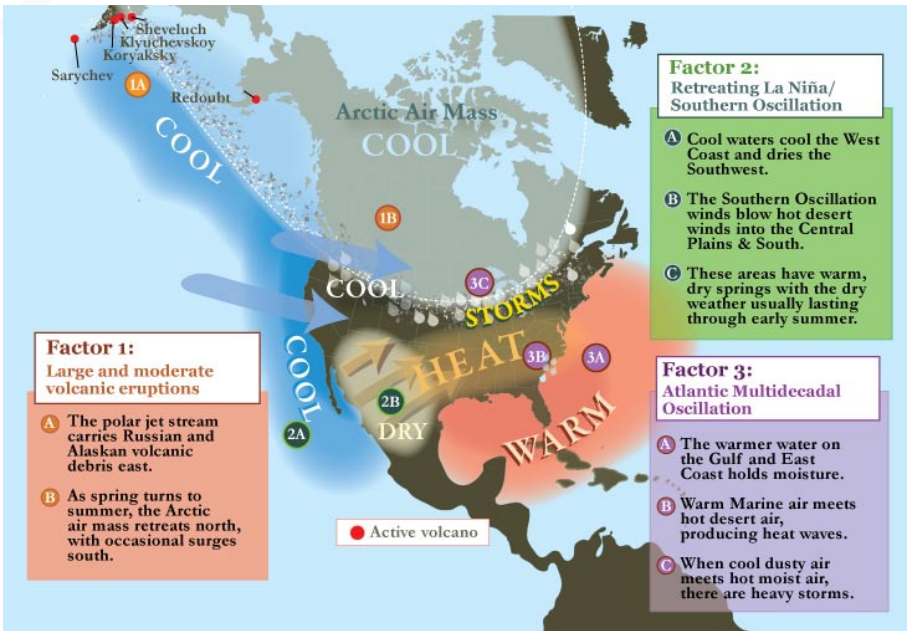


FIG. 5 **Factors shaping summer's weather in North America**

linger a while longer before scientists officially declare the event over. However, in real time, the Pacific is neutral and most scientists expect it to remain neutral for the rest of the year. This will be a return to normal weather patterns.

Unfortunately, the return will be slow. The tropics have warmed but there is still cool water off the West Coast. The drying impact of the La Niña in the South and West will linger through early summer. (Poor Louisiana is experiencing drought from a lack of rain and overflowing rivers at the same time!)

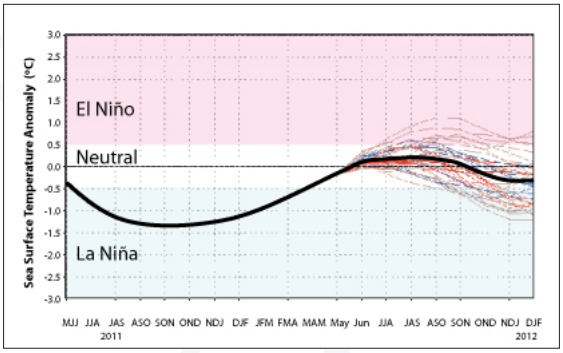


FIG. 6 **NCEP forecasts La Niña's demise by summer and a neutral Pacific.**
www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf

At the same time, the volcanically cooled polar air is retreating north. Occasionally the air will surge south There have been several cooling middle-sized eruptions in Russia's Kamchatka Peninsula that have cooled one or two passing cold fronts and rained out over the US. (The latest was the 6.5 km or 4.0 mile high eruption of Karymsky volcano on May 21)

The eruption of Grímsvötn has put more debris into the Arctic air mass. We will ultimately feel the impact of its cooling of the northern air, but it usually takes a few months to feel the impact of this high level cooling. In 60% of similar years, the impact of a polar volcano started to be felt in late summer, usually in the form of increased rainfall.

Meanwhile the Atlantic will remain warm and pour the heat into North America. This warming trend should peak in mid-summer. In 80% of similar years, this led to rapid maturing of Midwestern crops. In most of those years, the combination of the warm Atlantic, a neutral Pacific and the overall volcanic situation led to heat and moisture. This, in turn, led to a near average crop, despite late plantings.

Unfortunately, most years did not have a large polar volcano. As 2009 showed, when there is a lot of volcanic debris in the air, fall tends to be cooler and wetter than average. In 80% of similar years, the first freeze arrived two to three weeks early and many regions experienced a wet harvest season. Hopefully, the current eruption of Grímsvötn will have a smaller impact than the 2 eruptions in 2009, but it is a situation that needs to be carefully monitored.

The Atlantic Hurricane Season

One of the great sports of the weather world is forecasting the hurricane season – everyone seems to be playing the game and everyone is calling for a busier than normal season. We are all looking at the same factors – a warm Atlantic and a neutral tropical Pacific. This means:

- The Atlantic will provide warm water which will give storms enough energy to become tropical storms and hurricanes.
- The Pacific is not experiencing an El Niño. (El Niños produce shearing winds that rip up developing storms.) Basically, the tropics will have favorable wind conditions.

Forecasting an unusually active hurricane season is terribly easy. We have a long record of activity with about half of those years occurring during the Atlantic's cool phase. The average hurricane season combines data from warm and cool years. Historically, however, the warm years, like this year, usually have almost double the number of storms than the cool ones. It is no great intellectual leap to predict that this year will have more than the average 9.6 tropical storms, 5.9 hurricanes and 2.3 intense hurricanes.

Most hurricane experts expect between 10 – 18 tropical storms, 5 – 10 hurricanes and between 2 – 5 intense hurricanes. They tend to lean towards the high end of these numbers. So do I, with an expectation of 15 – 18 tropical storms, 8 – 10 hurricanes and 3 – 5 intense storms..

What remains the key question, however, is where the storms will hit. Last year, for example, had a busy season but no hurricane landfalls in the US. Instead, the combination of a hot Atlantic and a very cool coast of Central America created extremely strong tropical trade winds. These winds, which flow from east to west, slammed storm after storm into Mexico and kept the storms from escaping and drifting north into US shores.

The US will not be so fortunate this year. Historically similar years had four landfalls

Cool	Hot	Warm	Dry	Wet
2°C or more lower than normal temps.	5°C or more higher 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.7-9 * Moderate eruptions in the Pacific Northwest will bring more moisture to the west.
© Browning maps

Early Summer*

Mid-Summer*

Late Summer*

or off-shore brush-bys. More importantly, these similar years had 3 storms enter the Gulf of Mexico oil/gas patch waters with at least two of the storms entering US oil production areas. Notice, this projection does not indicate that these will be intense storms, but under current rules rigs have to shut down for inspection for a relatively small Category 1 storm.

With no La Niña, which encourages storms that veer west, or El Niño, which suppresses storm development and tends to steer them northeast, the Atlantic storm development will be influenced by the much smaller MJO. The MJO is a small 30-60 day ocean/air oscillation that flows eastward through the tropical Indian and Pacific Oceans. Once it reaches Central America, the wind patterns cross over and influence hurricane development in the Atlantic.

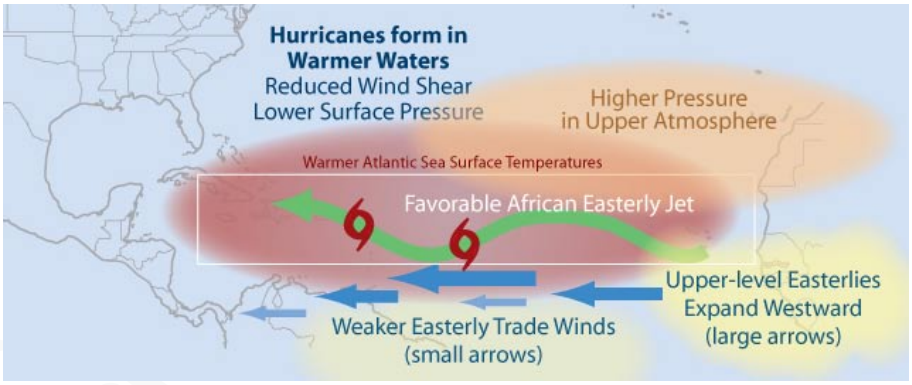


FIG. 10 **Expected hurricane conditions** *August-October 2011* © Browning Newsletter source: NOAA

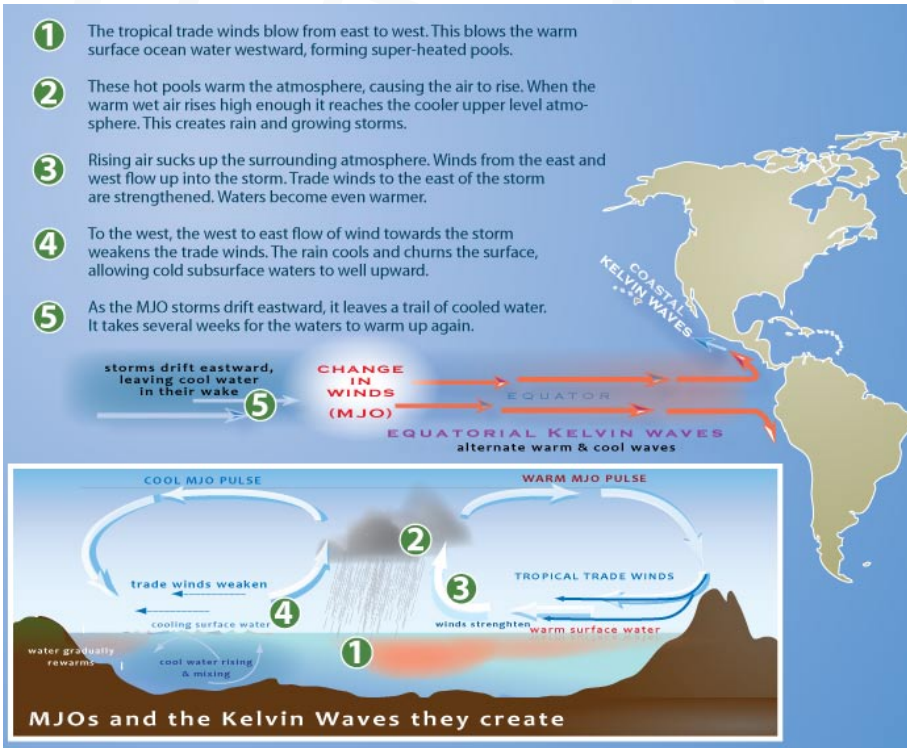


FIG. 11 **The MJO is likely to shape this year's Atlantic hurricane season** © Browning Newsletter

The MJO oscillations are currently quite strong. They act similar to "mini-El Niños" or "mini-La Niñas" first discouraging storm development for a few weeks, then encouraging it. Years dominated by these smaller, shorter-lasting oscillations frequently have very scattered patterns of storm paths, sometimes veering towards the eastern Gulf, sometimes to the western Gulf and sometimes just drifting randomly through the Atlantic.

The good part of this outlook is that historically the tropical storm season will break the drought in the South, with increased rainfall along the Gulf by mid-to-late summer.

Overall, the outlook for this summer and fall is troubling. The possibility of a busy hurricane season and a cool, wet autumn could have severe economic consequences. However, the one pattern that I have noticed again and again through the 35 year history of the *Browning Newsletter*, is that American and Canadian farmers have been able to produce enough crops to feed the world, even in years with difficult weather.

Europe - The Heat Is On

SUMMARY

Europe is in a prolonged period of hotter drier summers and cooler drier winters. This is due to the 60 – 70 year Atlantic Multidecadal Oscillation. This type of climate change began in 1995 and will continue for another 15 – 25 years.]

While North America has been fretting about floods, tornadoes and snow melt flash floods, our neighbor across the pond has had the opposite problem – heat and drought. After some record-breaking midwinter cold this winter, Europeans have had a clear, dry warm spring. While this has been delightful for city dwellers, the outlook for agriculture has been much bleaker.

England and Wales had the driest March in more than a century and parts of central Europe had less than 40 percent of their long-term average rainfall from February to April. Estimates for the European Union's wheat harvest are shrinking by the day as plants wilt in the months-long drought. France and Germany, two key grain producers in Europe, have been particularly hard hit. Similarly the continent's dairy industry is facing scorched

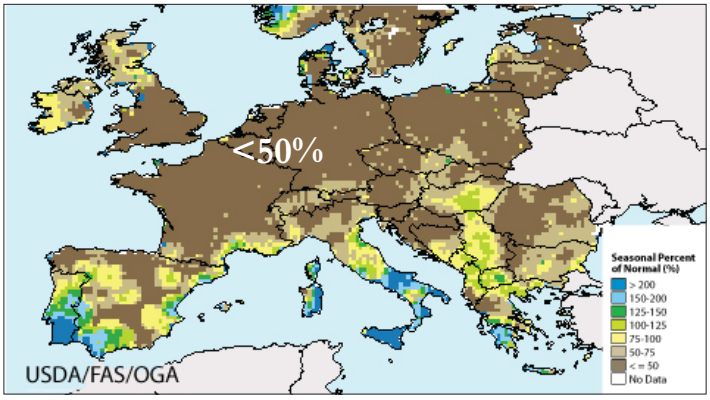


FIG. 12 **European drought** *March 1- May 20, 2011, % Normal Moisture*
AFWA/LIS Seasonal Percent of Normal Preciptiation: www.pecad.fas.usda.gov/cropexplorer/

pastures and rising costs for grass silage and straw, stoking worries of a drought similar to that experienced in 1976. Concerns for the final harvests are added worries.

Europeans are still wary from last year's record heat wave, described by some as the worst in 500 years. The question is whether this hot dry spring is just the forerunner of another searing summer.

To answer that question, it is necessary to understand the long-term trend that is altering Europe's climate.

Long-Term Changes

Europe has been warming since 1995, when the Atlantic Multidecadal Oscillation **(AMO)** entered it warm phase. This 60 – 70 year oscillation warms and cools the Atlantic and the surrounding continents. To understand what is happening, it is necessary to understand the flow of the North Atlantic.

The Atlantic is dominated by an enormous current called the Atlantic Thermohalene Current or, in layman's terms, the Gulf Stream. (Actually the Gulf Stream is just one portion of the larger Thermohalene current.) The current carries the warm waters from the tropics north to the polar regions. When it flows rapidly, the Atlantic becomes warm. When the current slows, the Atlantic cools.

The speed of the flow is shaped by salt.

1. The warm dense salty water reaches the North Atlantic, where the melting ice has diluted the ocean water. The heavier salt water sinks.
2. The faster the salt water sinks, the faster the Gulf Stream flows and the more warm water is carried north. More northern ice melts **(Warm phase of the AMO).**
3. Finally so much ice has melted that it dilutes the salty Gulf Stream.
4. However, the lighter, less salty and less dense Gulf Stream water sinks slower.
5. This then slows down the flow of the current and less warm water flows north. The North Atlantic cools **(Cool phase of the AMO).**
6. Finally the Arctic ice starts to re-freeze and stops diluting the Gulf Stream. This allows the water to become denser and it starts to sink faster.

European fishing records show that there has been an alternating pattern of decades of catching warm water fish followed by decades of catching cool water fish. Basically the entire AMO is a seventy year cycle with each phase lasting 30 – 40 years.

The AMO was in its cool phase from the early 1960s to 1995. Since 1995, it has been in the warm phase and temperatures are expected to peak somewhere between 2020 and 2040.

In short, the Gulf Stream has been aiming unusually hot water at Europe for the past 15 years and has another 15 – 25 years in its cycle before it cools down. Europe has been baked by increased urbanization, man-made warming and a prolonged blast of hot water. No wonder its societies believe in global warming – they have been broadsided with heat.

As the Atlantic has warmed, tropical weather has shifted north. For Africa this has been good news as the tropical monsoons have penetrated deeper into the continent, bringing more moisture. For Europe, it means that much of the hot dry weather typical of the Northern Sahara has crossed the Mediterranean, creating earlier springs and hotter summers. In 2003, 2006 and 2010, the continent had vicious summer heat waves.

Ironically, the hotter Atlantic has not only created hotter drier summers, but also colder drier winters. In summertime the Arctic air mass retreats north. In wintertime, the Arctic air mass expands south. The heat of the Atlantic shapes how far south the polar air can expand.

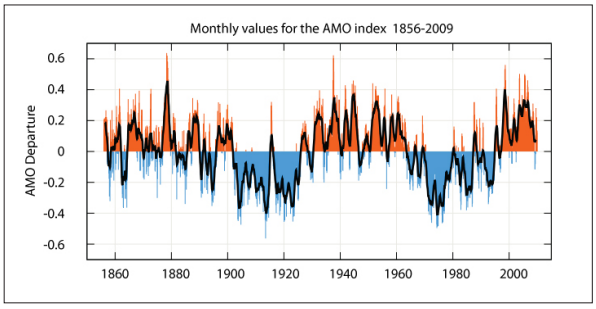
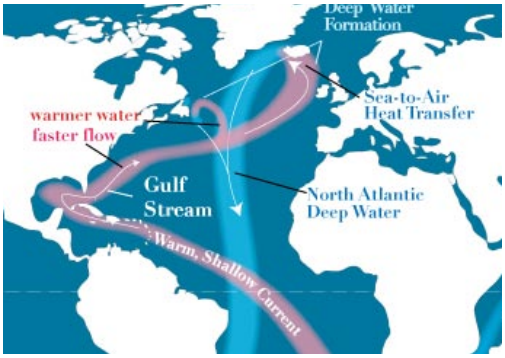
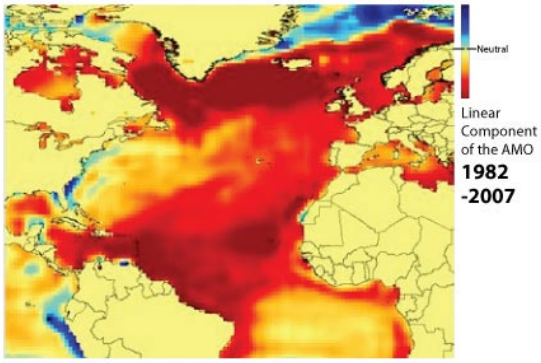
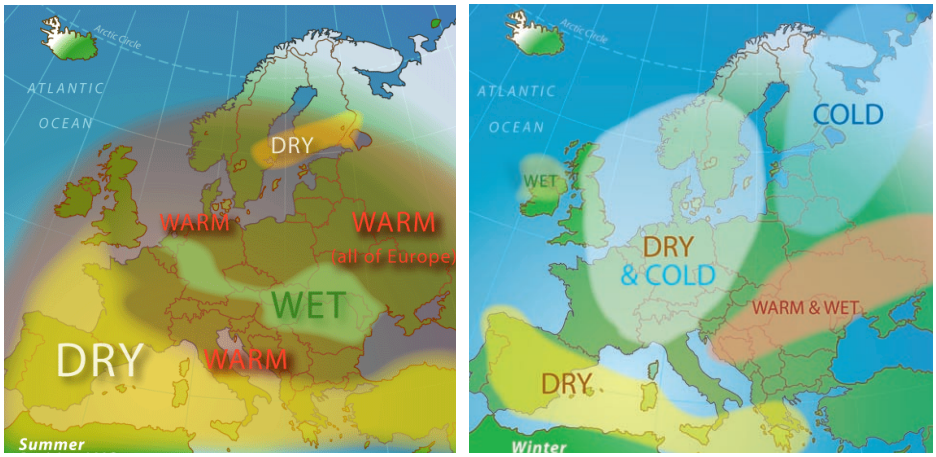


FIG. 13 *courtesy: USGS/NOAA http://en.wikipedia.org/wiki/File:Amo_timeseries_1856-present.svg*





FIGS. 14-15 **The long term Atlantic Multidecadal Oscillation (AMO) turned positive in 1995. The Gulf Stream flows faster, warming the North Atlantic.**
©Browning Newsletter (left), courtesy NOAA (right)



FIGS. 16-17 **The outlook for Europe over the next ten years: the warm AMO affects Europe in summer (left) and winter**

When the Atlantic was cooler, the expansion was smooth, with the jet stream fairly lateral. The storms flowed from North America, across the Atlantic and into Europe, bringing moisture deep into the interior of the continent. (This weather pattern is called a positive North Atlantic Oscillation.)

By contrast, last winter the flow of the Gulf Stream heated large portions of the Atlantic 1.5° – 3.5°C (2.7° - 6.3°F) above normal. In turn, these warmer waters heated the marine atmosphere, altering air pressure. The Arctic air mass could not expand as far south over the warmer Atlantic, so instead it penetrated deeper into the cooler continental masses on both sides of the ocean. This weather pattern, called a negative North Atlantic Oscillation **(NAO)** causes the stormy jet stream fluctuates wildly north and south. Instead of moist winter winds entering Europe from the west, the Arctic dry winter winds enter from the north. Northern winds are colder and hold less moisture. While last winter was record-breaking, it was only one year in what is a decade's long trend of Atlantic weather. Part of the reason that the glaciers on the Alps are retreating is that the continent has endured over 15 years of warming, melting summers combined with drier winters.

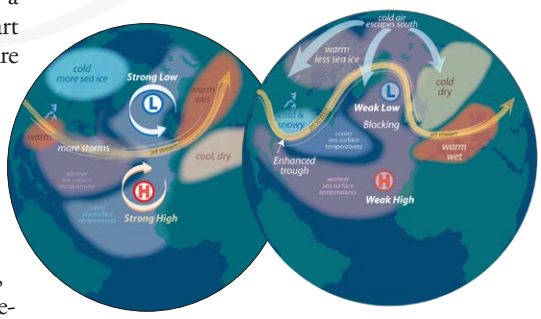
As a result, Europe has endured hotter drier summers and more extreme, drier winters. Unfortunately, this has not only shaped the weather over the past 15 years, but will continue for nearly two more decades.

This prolonged period of drier weather will have major economic consequences. Areas affected will be:

- Agricultural crop yield – particularly winter wheat.
- Hydroelectricity – Norwegian hydro generation in January was almost a third lower year on year.
- Fuel transportation – parts of the Rhine are so low that barges are operating at as little as 30% of normal capacity – making it difficult to supply power plants with fuel oil and coal.
- Low river levels, particularly if they are combined with high river temperatures are less efficient in cooling coal and nuclear power plants.

The Short Term Outlook

The current weather highlights this long-term trend. Spring has arrived early this year and Western Europe is already enduring heat and drought. Typically volcanic debris produces cooler and wetter weather, but unfortunately for Europe most of Iceland's Grímsvötn volcanic debris that produces rainfall is trapped in the Arctic air mass. This means that it will do little to increase precipitation or decrease temperatures until fall. Instead, Europe's weather will continue to be dominated by the heating of the Gulf Stream.



Positive NAO **Negative NAO**

FIGS. 18-19 **Positive NAOs bring warmer wetter winter from the Atlantic** *More common before 1995.* **Negative NAOs bring colder, drier winters from the Arctic** *More common after 1995.*

Most weather models at this point expect the drought to continue into mid-June. As the *Browning Newsletter* has said repeatedly, 80% of similar years had severe problems with winter wheat and spring planting. However, the past has also shown that during these years, mid and late summer heat and drought were much less extreme. The weather in Western Europe trended warm but more like the heat that we saw in most of the 2000s, not like the extreme heat of 2003 or 2010. In those warm times, Eastern Europe, particularly Russia and portions of the Ukraine, had good crops.

What these similar years did not have was a large springtime volcano eruption. When one examines the historical record of how large Icelandic explosions have affected Europe in the past, the outlook is not good. Typically cold, wet conditions damaged crops in Ireland, Scotland, portions of England, Scandinavia, Germany and Poland. Most famously the enormous eruption of Laki volcano in 1783 caused widespread famine throughout Europe and freezing winters in both Asia and Europe. The most recent large eruption, (Eyjafjallajokull was relatively minor) was Hekla in 1947. Unfortunately it is very difficult to draw any specific conclusions from that year since so many problems were due to the conditions of post war Europe rather than the weather.

It is therefore probable that Grímsvötn's eruption will damage Europe's crops. Its debris is in the stratosphere, where it will linger in the Arctic air mass. Since the polar air has retreated north, the volcanic dust in it will have almost no impact on most of Western Europe during summer. What the debris will do is screen out sunlight over the Arctic, which will limit any summer warming in the polar air mass. When the Arctic air expands south in autumn, it This will result in a colder, wetter European fall with a high probability of an early frost, particularly in Northern and Eastern Europe. Note, it also creates a high probabil-

ity of another very cold mid winter.

As noted in the previous article, it takes two or three years for the debris from large volcanoes to settle back to Earth. The eruption of Grímsvötn may be drawing to a close, but the impact will linger, shaping at least one more year of strange and extreme weather.

News Notes

Economists are beginning to assess the impact of this summer's flooding. Michael J. Hicks, the director of the Center for Business and Economic Research at Ball State University, has published study that estimates a $6 billion to $9 billion cost for the total damages from Memphis southward to the Gulf. And the flooding is not yet over – the river will need weeks to fully recede.

The Army Corps of Engineers estimates that between 2.1 million to 2.2 million acres, or about 1% percent of all US cropland, have been affected by the flooding. Additionally the nation's agricultural infrastructure, from swamped grain elevators to delayed barge traffic, has been affected. Local supply distribution is disrupted and hundreds of communities are experiencing job losses. Louisiana, still reeling from the BP oil spill is seeing fresh water killing its oyster beds and disrupting fishing.

It should be noted, while there is widespread regional devastation, government economists say they do not expect a national grain shortage because there are plentiful stocks. A lot will depend on whether farmers will be able to replant.

Not all US flooding woes are in the Ohio and Mississippi valleys. Record snow packs could threaten western states. Thanks to the recent blizzard-filled winter and cold and wet spring, more than 90 measuring sites from Montana to New Mexico and California to Colorado have record snowpack totals. If this June heats up too rapidly the West could experience catastrophic flash flooding. With many of the West having lax floodplain building codes and most of the regions anti-flood bulwarks relatively untested, emergency managers are very worried.

Last month's *Browning Newsletter* warned that the large shift in the Pacific Decadal Oscillation (PDO), which warms the Western Pacific, is strengthening the monsoon in Northern and Central China. This means that not only is the summer wet season wetter, but the dry season is drier. When the PDO is reinforced by a cool La Niña, a stronger winter monsoon becomes a half-year drought.

We are seeing this now along Central China's Yangtze River. For the last five months, the exaggerated dry season has caused a severe drought in central China. This has brought water levels in the Yangtze River to near-record lows. This has affected shipping capability as parts of the river have been so low that they are impassible. It has cut China's hydroelectric production by almost 20%. Additionally it has delayed spring planting of grain and cotton.

The drought should begin to break shortly, now that La Niña is ending. The problem is that the PDO is a long-term cycle and this phase will last for over 20 more years. The Yangtze faces the threat of this type of drought any time the Pacific faces another La Nina.

A recent study has delivered the cheerful news that Australia's burping cows are more climate friendly than thought. Yes, Virginia, there are scientists that study cow burps as well as other bovine emissions. (Their mothers must be so proud!)

Cattle, sheep and other ruminant livestock produce large amounts of methane, which is about 20 times more powerful at trapping heat than carbon dioxide. One cow can produce about 1.5 tonnes of greenhouse gas emissions a year. Now, however, scientists at Australia's state-backed research body the CSIRO say the amount of methane from cattle fed on tropical grasses in northern Australia could be nearly a third less than thought.

Australia is calculating ways to change the diets of sheep and cattle to "reduce emissions from agriculture." This would earn carbon credits. Of course before Europeans brought cattle, the continent was covered with kangaroos and other marsupials. Does anyone believe that the millions of "roos" were too delicate to have "emitted"?

The Browning Newsletter
is published by
Fraser Management Associates
a Registered Investment Advisor.

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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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