August 2011

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

BROWNING

©Evelyn Browning Garriss NEWSLETTER

A FRASER MANAGEMENT PUBLICATION Vol. 36, No. 8

Hot, Dry and Deadly: The Heat Dome That Fried a Continent

IN THIS ISSUE

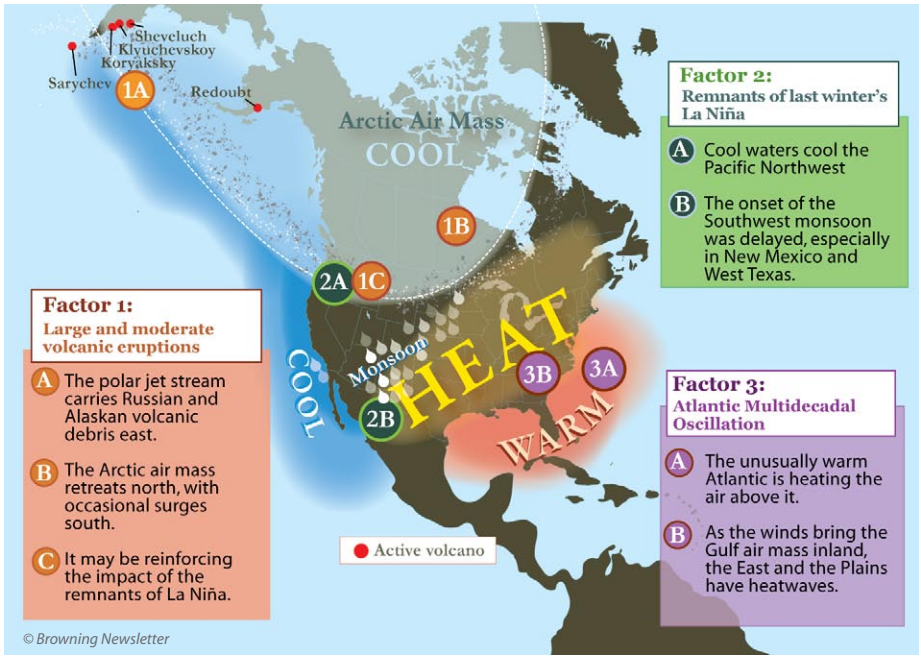
- The warm phase of the Atlantic Multi-decadal Oscillation is heating the Atlantic waters, causing the current heat wave in central and eastern North America. It is expanding the circulation of the tropical Hadley cell, so that tropical heat is baking parts of the US.
- The Pacific La Niña that created a drought in the southern tier of states has gone, but the heat from the Atlantic is exacerbating the drought. Texas and the cotton and livestock industry has been particularly hard hit.
- It is looking increasingly probable that La Niña will return by late autumn. When combined with cooling volcanic debris in the polar air mass, it is shaping to be a cool, wet autumn and a very cold winter.
- A recent study led by the National Center for Atmospheric Research (NCAR), found normal weather variation, excluding extreme events and disasters, cost the US an average of $485 billion a year, 3.4% of the 2008 national economy.
- All sectors of the economy and every state are vulnerable to problems from temperature and precipitation changes. Mining and agriculture have the largest sensitivity to weather but the finance, manufacturing, and services sectors lose the most money, an average $60 billion or more in weather sensitivity.

SUMMARY

The combination of a hot Atlantic and a neutral Pacific are creating the current tropical heat wave. When the impact of the recent North Pacific volcanoes are added as well as the highly probable renewal of La Niña, expect a cool wet autumn and a very cold winter.

This summer we have heard a number of new words used to describe miserable weather. Phoenix, Arizona wasn't clobbered by a large sandstorm; it was engulfed by a haboob. (Sounds dirty, doesn't it?) The US isn't baking in a heat wave; it is broiling under a heat dome.

FIG. 1 **The factors affecting summer**



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.

A better term for the weather that is currently inflicting heat, misery and higher electrical bills on over 141 million Americans would be "Hadley's Horrible High" or "The Attack of the Hadley Cell". What we are seeing is a tropical phenomenon, the northern rim of a **Hadley Cell**. Normally this rim is over Mexico, occasionally Texas. This year it has soared deep into the heartland of America. It has spread heat and drought from the Rockies to the Atlantic, killing people, crops and livestock.

Even when temperatures cool off, we will still be feeling the impact of this event with higher prices for food and energy.

Heat Wave 101 – Hadley Cells

Throughout the year, North American weather has been shaped by three factors:

- The volcanic debris in the Arctic air mass cooling temperatures and distorting wind patterns.
- The fading Pacific La Niña and
- The warmer than average Atlantic Ocean.

Summertime wind patterns have blown the Arctic air mass north, so the volcanoes are having little influence on the current weather. The La Niña officially ended by may, so the Pacific is having relatively little climatic impact.

But the Atlantic – the warm Atlantic is simmering. Blame the Atlantic for warping a normal summer weather pattern into a deadly heat wave.

Here's what is happening:

Tropical weather is shaped by a wind circulation pattern called a Hadley Cell.

George Hadley was an 18th century scientist who noted that hot air rises, cold air sinks and the rotation of the Earth affects winds. Now his name has been given to the circulation pattern of tropical air, a Hadley cell. It is this swirl of tropical air that causes hurricanes, monsoons and heat waves. *(see figure 2, above)*

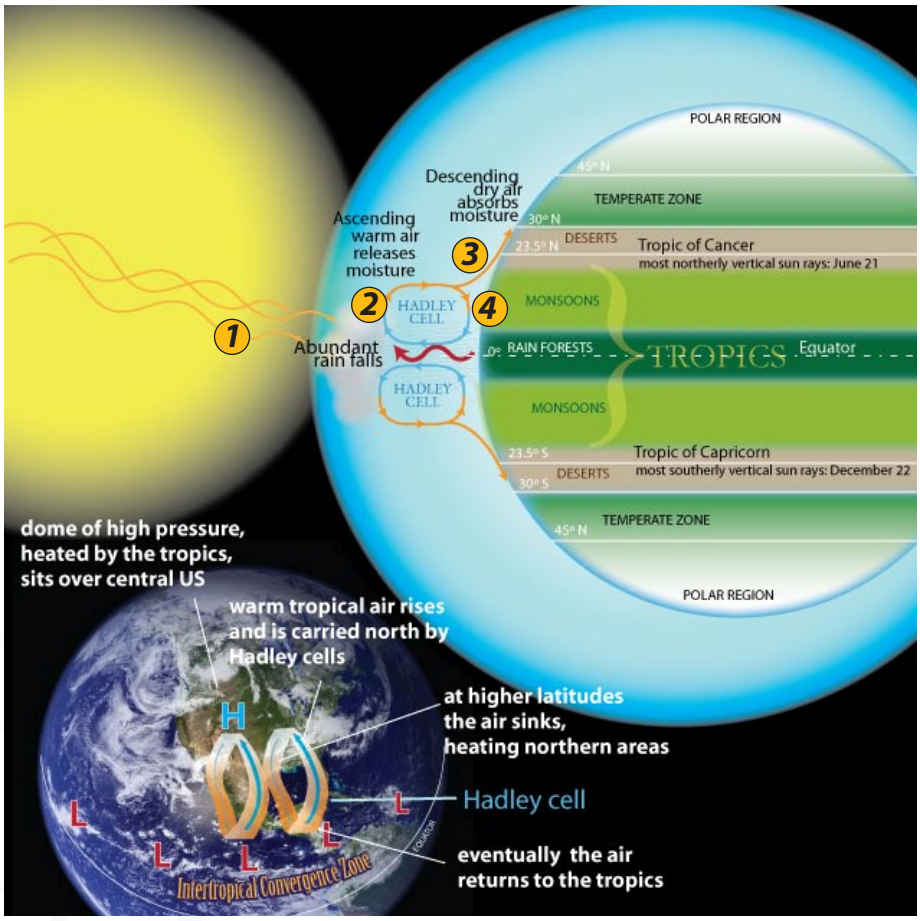
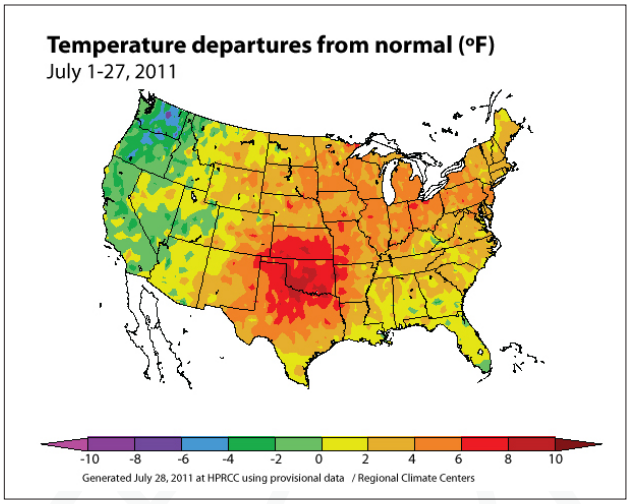


FIG. 2 **Hadley cells; In 2011 they bring stormy lows in the tropics and cloudless heat waves in the Great Plains.**

1. The area where the sun shines directly over head gets hot. **Hot air rises.** The warm air rises and cools until the moisture in the atmosphere rains out. This band of rising air and rain (called the Intertropical Convergence Zone or ITCZ) produces low air pressure and tropical storms.
2. **The rotation of the Earth steers winds** away from the equators toward the poles.
3. As the tropical air drifts through the high atmosphere, further and further north, (or south if it is south of the equator) it cools off. **Cold air sinks**. At around 30°N it sinks. This area where the air is plunging downward is called a high pressure area. It blasts away any clouds and moisture and the sun bakes the area so that it is very hot and dry.
4. Winds blow away from the high pressure and the general flow is from the 30° latitude toward the equator.

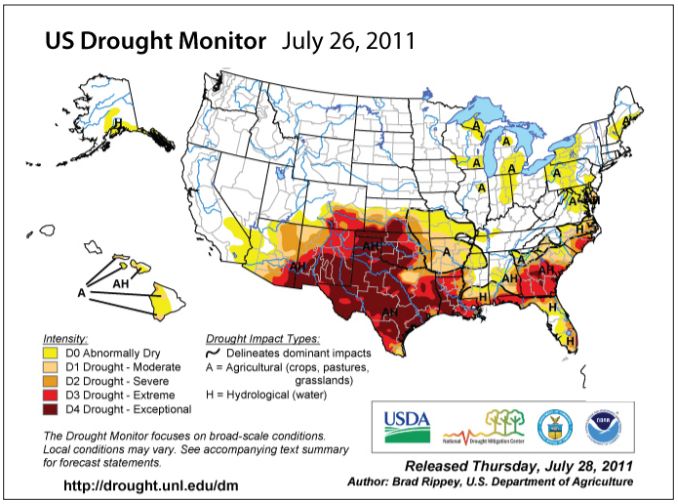
This circulation of tropical air produces tropical climate – jungles around the equator, deserts around the 30° highs and monsoons with wet and dry seasons in between.

Unfortunately, that tropical Hadley cell is not staying south of 30° where it belongs. As your elementary teacher taught you, the Earth is tilted towards the sun in summer time. This means that on June 21, the sun is beating directly down at 23° north. The whole Hadley cell circulation shifts north. The ITCZ shifts north and its storms have the potential to grow into hurricanes. At the same time the atmospheric high, and the dry heat it causes moves north. Instead of beating down on Mexico, it drifts into the Texas and the Southwest.



FIGS. 3-4 **For most of the US, the heat is on...**

http://www.hprcc.unl.edu/products/maps/acis/MonthTDeptUS.png



...while the Southern tier of states also is suffering through extreme drought.

http://droughtmonitor.unl.edu/

The sun may be shining most directly on the Northern Hemisphere, but it is only the beginning of summer warming. Northern land masses usually reach their peak temperatures in late July and early August. The oceans, which warm more slowly, reach their peak temperatures in late August and early September. This is why the major heat waves usually hit in mid-summer while the hurricane season usually peaks in early fall.

This year the normal warming has been enhanced by a steamy Atlantic. The Atlantic is in a long-term climate pattern known as the warm phase of the Atlantic Multidecadal Oscillation. The Gulf Stream is flowing faster and carrying more tropical waters north. This has caused the ocean to be between 0.5° – 3.5° C (0.9°– 6.3°F) warmer than usual through June and July. Winds carried the warm marine air masses inland, heating the South and Mid-Atlantic states from 2° – 10° F (1.1° – 5.6°C) warmer than normal through the month of June.

Then the Hadley cell shifted north and added its own heat. This tag team of steamy air masses from the Gulf and a tropical high dropping like a bomb on the Central Great Plains combined to create a disaster.

To officially be declared a heat wave, an area has to have a temperature of over 90°F US or 33°C Canada for three days running. North America got blasted by a heat wave on steroids. From Canada's Northern Rockies to the Mexican border east to the Atlantic, the continent was baked. Over 220 US heat records fell and at least 33 people died. Temperatures reached 42°C (108°F) in Newark, NJ, while Washington and Baltimore hit 105°F (40.5°C); Boston 103°F (39.5°C); and even Portland, Maine reached 101°F (38.5°C). Philadelphia - where bathers at public swimming pools were asked to leave every half hour to allow a new crowd to enjoy a cooling dip - saw temperatures of 104°F (40°C). New York City also hit 104°F, just a degree short of its all-time high, but the oppressive humidity made it feel like 113°F (45°C). Canada suffered as well with Toronto enduring its hottest July ever at 37.9°C (100.2°F).

Despite the headlines concentrating on the Midwest and East Coast, the main focus of the heatwave has been the Southern Plains. At the time of this writing, Dallas, Texas has had 25 days in a row of 100°F weather. The region endured nine straight months of La Niña drought followed by the hottest June on record. July followed, with temperatures averaging 6° – 10° F (3.3° – 5.6°C) higher than normal. Even when the region had rain, the steamy temperatures evaporated the moisture.

Pacific Oscillations – La Niña, La Nada and ?

Texas is not the only state to be hit by the double whammy of La Niña drought and Atlantic heat. Typically La Niñas bring drought to the entire southern tier of states. Last year the La Niña officially started in July and lingered until the beginning of this June. The entire southern tier

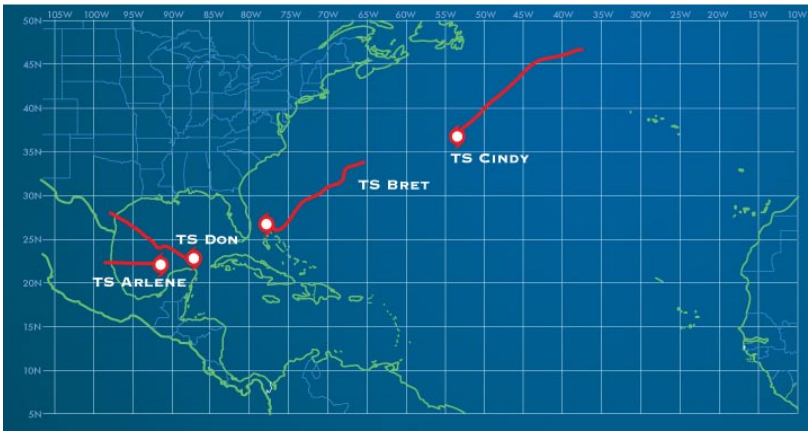


FIG. 5 **The Atlantic Hurricane season is finally starting to bring its moisture to American shores.** *© Browning Newsletter*

of states, from parts of Southern California to Florida and North Carolina, have been hit by drought. Only the Upper South, Tennessee, Kentucky and Virginia, has escaped the dry weather

The cool La Niña is now over and the Tropical Pacific is neutral (La Nada). The wind patterns from the Pacific are no longer steering moisture away from the South. Indeed, in the West, the monsoon season has begun. Unfortunately, west of the Rocky Mountains, the extreme heat from the Atlantic has evaporated what little moisture the South has experienced since the La Nada began.

Oklahoma is the driest it has been since the 1930s and the drought is setting records from Louisiana to New Mexico. Of all the states, however, Texas has been the most devastated. One hundred per cent of the state is suffering drought with 75% suffering exceptional dryness, the most severe level of drought. Texas is one of the most important agricultural states in the nation, second only to California, and it is expected to suffer record-breaking agricultural losses. David Anderson, an economist with Texas AgriLife Extension Service has estimated that crop and livestock losses could be as much as twice the previous single-year record of $4.1 billion set in 2006. Pastures and dry land farming is particularly hard hit while irrigated crops are struggling. Expect the problems of Texas with its cotton, wheat, corn, sorghum crops and most especially with its livestock, to be felt later this year in food prices. Already, more than 2 million acres of cotton that's not irrigated has been lost, adding about $1.1 billion to an initial $1.5 billion loss, agriculture

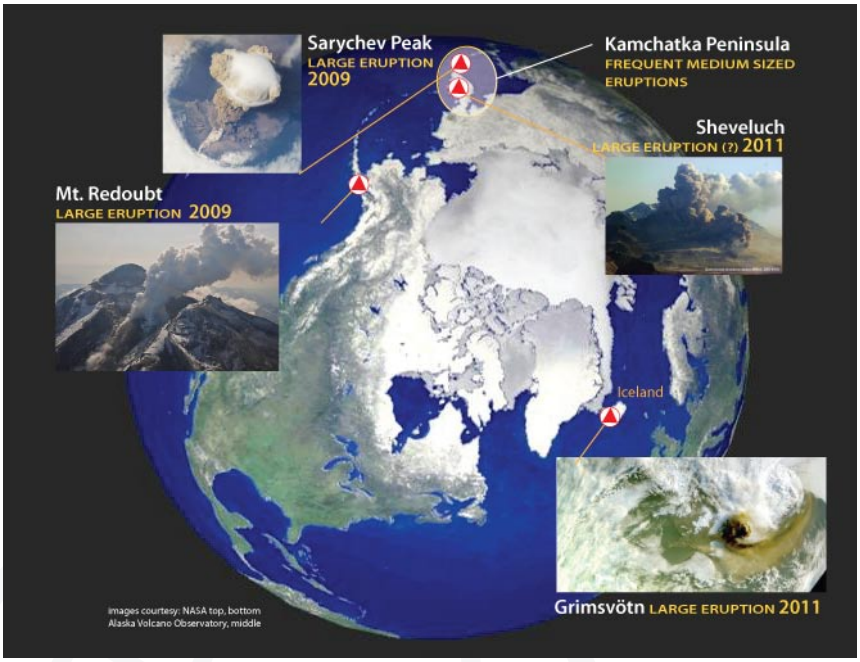
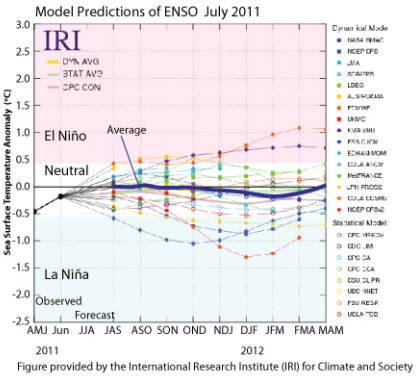


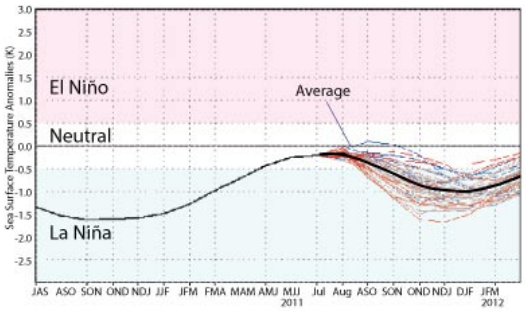
FIG. 6 **Despite their remote locations, polar volcanoes have an outsized impact on worldwide weather**

officials announced in mid-May. That included livestock and wheat, corn and sorghum crop losses from November through May 1.

Here is the good news for the South. The very conditions that have helped to create the drought conditions in the South in early and mid-summer usually create abundant tropical rain toward the end of the season. The hot Atlantic is continuing to heat which will encourage the development of tropical storms. Texas is so hot that it is welcoming (yes, welcoming!) Tropical Storm Don because it will bring some rain and cooler temperatures. However, the Gulf petroleum industry will be less thrilled.

Last year, the La Niña event created extremely strong tropical trade winds. These winds, which flow from east to west, steered storm after storm into Mexico and kept them from escaping and drifting north into US shores. This year, with a neutral La Nada, the trade winds will fluctuate, stronger and then weaker, shaped by a short-term phenomenon known as the Madden Julian Oscillation or MJO, a small 30 – 60 day ocean/air oscillation that flows eastward through the tropical Indian and Pacific Oceans.





FIGS.7-8 **International *(left)* and US models increasingly differ on La Niña's return.**
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf

Once it reaches Central America, the wind patterns cross over and influence hurricane development in the Atlantic. The weak phase (meaning the trade winds are weak) of the MJO acts similar to a "mini-El Niño", allowing storms to wander north and east. This phase typically discourages tropical storms from growing into strong hurricanes. The strong phase (with strong winds) is more like a "mini-La Niña" encourag-

ing growth and steering the storms toward the west. Years that were dominated by these smaller, shorter-lasting oscillations frequently had very scattered patterns of storm paths. When different phases of the MJO entered the Caribbean and Atlantic, they would veer storms toward the eastern or western portions of the Gulf and sometimes just allow the storms to drift randomly through the Atlantic. We saw this pattern during the La Nada years of 2005.

The good news is that while the Atlantic is warm, it is not as hot as 2005, particularly the waters in the Gulf. It is more similar to 2008, a year with multiple landfalls in the Gulf, including hurricanes Dolly, Gustav and Ike. Years with similar conditions have averaged 15 – 18 tropical storms, 8 – 10 hurricanes and 3 – 5 intense storms. Most of these years had at least 4 US landfalls and 3 hits in the Gulf gas and oil production areas.

This year is a race between the heat wave ripening the crops and a threatened early freeze.

The big question is whether the La Nada will continue. The international community is divided. The consensus is divided, with the majority of models forecasting a neutral Pacific through fall. However, the US National Centers for Environmental Prediction has forecast a cooler Pacific with the La Niña returning in autumn, while the Atlantic hurricane season is still active. If this happens, it will have the duel effect of prolonging the season and encouraging more late activity in the Gulf, particularly around Mexico.

The timing of the La Niña, if it did occur, would be particularly important for Texas and the Southern Plains. In years where the La Niña doesn't return, or it returns late in fall, the region receives plentiful autumn rainfall. In years where it returns earlier, the area drought is unrelieved. Much of the rain is due to tropical storms, but at this point, Texans need the moisture.

Volcanic Debris and the Arctic Air Mass

The final factor in this equation, of warm Atlantic waters east and cool La Niña waters to the west, is cooling volcanic debris to the north. The Arctic air mass contains the chemicals and ash from the 2009 eruptions of Alaska's Mt. Redoubt and Russia's Sarachev Peak. This debris has been floating in the polar air reflecting incoming sunlight. Large amounts of the aerosols precipitated out with last winter's snows and this spring's flooding rains, but it appears that the supply of ash and chemicals were renewed with the May eruption of Iceland's Grímsvötn volcano and the smaller June eruption of Mt. Sheveluch.

It's summer and the prevailing winds have trapped the debris in the high latitudes. With fall, however, the Arctic air mass begins to surge south. Historically we have seen the stratospheric cooling of volcano debris alter air pressures which, in turn, alter wind patterns. Over the past two years this has led to weaker circumpolar winds (called a negative Arctic Oscillation) and the cold polar air surging unusually far south. This can create cooler autumns in Canada and the northern tier of states. While the cool air would be a blessed relief for the simmering cities, it could cause some real concerns for late-planted corn and soybean crops.

Literally this year is a race between the heat wave ripening the crops and a threatened early freeze. Indeed, in some ways the current heat, which is causing rapid maturing of the crops, is a blessing. While it diminishes the crop quality in some areas, it allows more of the fields to be ripe before the first freeze.

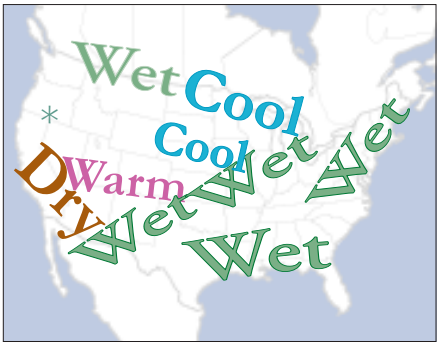
Volcanic aerosols collect atmospheric moisture and tend to fall out in heavy rains. There is an 80% chance that we may see a repeat of the wet harvest of 2009. This means difficulty in harvesting the crops, higher energy costs to dry the harvest and greater spoilage due to wet storage. If the fall of 2009 is any indication, the USDA will report optimistically about the harvest this fall and early next springtime we will discover that, due to spoilage, our stockpiles are lower than expected.

Looking beyond the harvest – expect another cold and stormy winter. Both the La Niña and the volcanically cooled Arctic air mass will bring cold weather. Both the dust in the Arctic air mass and the warmer, wetter Atlantic and Gulf air will cause more storms. The strength of the economy may shape the overall demand for energy this winter, but expect household demand in the Northern and Western states to be high.

Additionally, with a second La Niña in a row, expect the Southern Hemisphere to face some crop production problems.

In short, expect the cold of this upcoming winter to make you remember this sweaty summer and the horrible heat dome with nostalgia!

Mid-Summer*



Late Summer/Early Autumn*

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.9-10 * Moderate eruptions in the Pacific Northwest will bring more moisture to the west.

The Invisible $485 Billion Expense: The Economic Cost Of Normal Weather Variation In The US

SUMMARY

A pioneering study funded by the US National Center for Atmospheric Research examines which portions of the economy and which states are the most vulnerable to normal weather changes. The results are surprising – did you know that mining is frequently more vulnerable to weather than agriculture? There's more . .

It is easy to ignore the impact of the weather when you work in an air conditioned office. Indeed, in Western societies, the more important a financial decision maker is, the less likely he or she is to be experiencing the climate. Refrigerated air and centralized heating shelter office workers from the gritty reality of heat waves and freezes.

Unfortunately these same luxuries are not sheltering the US economy. A recent study led by the National Center for Atmospheric Research (NCAR), found normal weather variation, excluding extreme events and disasters, cost the nation an average of $485 billion a year, 3.4% of the 2008 national economy. The study showed that finance, manufacturing, agriculture, and every other sector of the economy is sensitive to changes in temperature and precipitation. The impacts can be felt in every state.

I advise anyone who wants to examine these findings in detail to read Jeffrey K. Lazo, Megan Lawson, Peter H. Larsen, Donald M. Waldman, "U.S. Economic Sensitivity to Weather Variability", *Bulletin of the American Meteorological Society,* June 2011. It can be found at: http://journals.ametsoc.org/doi/pdf/10.1175/2011BAMS2928.1 .

I am summarizing the findings here, but the article contains more details and a great bibliography. In particular, if analysts want to find some similar studies for Europe, the article is a great starting point.

Methodology

The study is a pioneer study, the first to apply quantitative economic analysis to estimate the annual weather sensitivity of the entire U.S. economy. (Most previous studies have been focused on Europe, specific US economic sectors, or broad long-term studies on climate change.) As such, the authors expect further research and refinement on the subject. Probably the biggest addition will be to factor in the probability and effects of natural disasters and extreme weather to this study of normal weather impact.

The authors used a nonlinear regression analysis, a statistical technique for comparing multiple variables. They examined 70 years of weather records, from 1931 – 2000. In particular they focused on temperature (heating degree days and cooling degree days), total precipitation and deviations from average precipitation. They then divided the private economy into 11 sectors. They examined the sensitivity of these sectors to weather variability using 24 years of state-level economic data. (This is the period for which detailed state-level data were available and consistent for major economic sectors.)

In their analysis, the authors focused on the 48 contiguous states and excluded Alaska and Hawaii. (They explained these two states were outliers and represented only 0.6% of the total U.S. GDP.

The results of this examination let the authors identify how sensitive the different states are to normal variations in the weather. At the same time they were able to rank sectors of the economy by their degree of sensitivity to changes in temperature and precipitation. Finally they calculated the total dollar impact of these changes on the U.S. economy.

The Results

The results showed the complex influence of weather. For example, a prolonged dry spell is terrible for crops but good for construction projects. A snowstorm might disrupt air travel and drive up heating costs but it usually boosts the attendance at ski resorts.

Table 1 Average 48-state economic sector GDP impact
(48 states/70 years)
(in billions of US Year 2000 Dollars)

1	Services	1,834.91
2	FIRE*	1,639.27
3	Manufacturing	1,524.78
4	Retail trade	761.54
5	Wholesale trade	601.47
6	Construction	374.49
7	Transportation	276.13
8	Communications	237.29
9	Utilities	212.91
10	Agriculture,	127.58
11	Mining	102.01
	*FIRE - finance, insurance, and real estate	

Based on information from Table 2

Jeffrey K. Lazo, Megan Lawson, Peter H. Larsen, Donald M. Waldman, "U.S. Economic Sensitivity to Weather Variability", Bulletin of the American Meteorological Society, June 2011, pg 715.

FIG 11 *http://journals.ametsoc.org/doi/pdf/10.1175/2011BAMS2928.1 .*

One of the most important findings of the study was that weather affects the economy by affecting both supply and demand for products and services. This is important because most studies in the past focused primarily on the production (i.e., supply) side. However, as any businessman can tell you, demand is equally important. For example, one of my clients who sells ski equipment informed me long ago that if LA was balmy, his sales would plummet no matter how much snow was on the slopes.

ECONOMIC SECTORS – A primary finding of the study is that every economic sector is statistically significantly sensitive to at least one measure of weather variability. Indeed, two sectors wholesale trade and the finance/insurance/real estate sector (FIRE) showed show sensitivity to all four measures of weather variability. Overall, precipitation variations had a larger affect on the economy than temperature.

The study showed that the three largest economic sectors, FIRE, manufacturing, and services, has $60 billion or more in weather sensitivity. Yet these sectors receive very little discussion compared to agriculture and energy. This tends to be a rather expensive blind spot for most economic analysis.

The authors then examined the relative magnitude of weather impact on the eleven different sectors. Some sectors, such as communications, construction, retail trade, services, transportation, and wholesale trade are relatively immune, with a sensitivity of less than 5%. FIRE, manufacturing, and utilities were more vulnerable, with between 5% – 10% of their revenue sensitive to weather variation. As expected, agriculture, which has been the most-studied sector for weather impacts is one of the most relatively sensitive sectors at 12.1%.

Surprisingly, mining appears to be the most sensitive sector to weather variability at 14.4%. Probably this is because weather has such a major impact on the demand for oil, gas, and coal. However, the authors were intrigued by the results showing that the impact of precipitation variations was "uncharacteristically large compared with all of the other sectors." It is an area that they intend to investigate further, although it may be somewhat related to the greater need for petrochemicals when dry weather interferes with hydroelectricity or Gulf storms affect production.

Demand is important. If LA was balmy, sales (of ski equipment) would plummet no matter how much snow was on the slopes.

WEATHER AND STATES – The report also concluded that the economy of every state is sensitive to the weather. New York was most sensitive (a 13.5 percent impact on the gross state product) and Tennessee was least sensitive (2.5 percent). The state-level findings were more subject to error than national findings, but overall the authors noted that "A key point here is that when aggregated across all 11 sectors, no one part of the country appears significantly more weather sensitive than another region in relative terms."

It should be noted that this only refers to normal weather variation. Certain regions are more suceptable to extreme weather events – such as tropical storms in the Gulf and blizzards in the north.

THE NATION – The US as a whole is more resilient that the states, bad weather in one area is usually compensated with good weather in another. Economic production can shift from one region to another When examining the 70 years between 1931 and 2000, every year saw weather related losses – 1969 seeing the most and 1939 seeing the least. Overall there was a 3.36% variability in the national income due to normal weather changes.

When the authors applied this to the 2008 national GDP, the study indicated that routine weather events such as rain and cooler-than-average days can add up to an annual economic impact of as much as $485 billion. And that is before you add any additional costs from heat waves, tropical storms, droughts or extreme blizzards!

Turn up the air conditioning. Losing that much money is enough to make anyone break into a sweat!

State sensitivity to weather variability

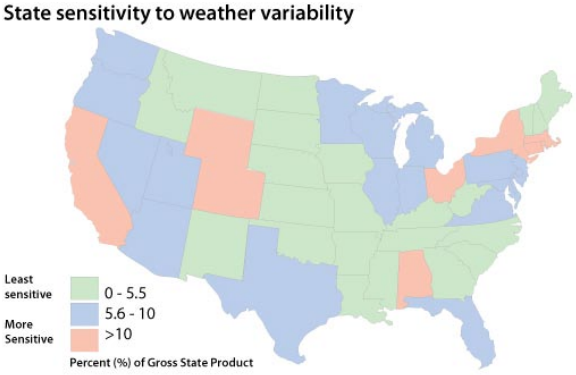


FIG. 12 *http://journals.ametsoc.org/doi/pdf/10.1175/2011BAMS2928.1 .*

Table 2 Percent of Economic Sector affected by Normal Weather Variability (%)

1	Mining	14.4
2	Agriculture,	12.1
3	Manufacturing	8.2
4	FIRE*	8.1
5	Utilities	7.1
6	Construction	4.7
7	Communications	4.7
8	Transportation	3.5
9	Services	3.3
10	Retail Trade,	2.3
11	Wholesale Trade	2.2
	*FIRE - finance, insurance, and real estate	

Jeffrey K. Lazo, Megan Lawson, Peter H. Larsen, Donald M. Waldman, "U.S. Economic Sensitivity to Weather Variability", Bulletin of the American Meteorological Society, June 2011, pg 715.

FIG. 13 *http://journals.ametsoc.org/doi/pdf/10.1175/2011BAMS2928.1 .*

News Notes

As Americans sweat through the latest heat wave, it may be comforting to read that the Earth's temperatures have declined over the past decade. Yes – according to a study by Robert Kaufmann, of Boston University, that was presented at US Proceedings of the National Academy of Science –the Earth's temperature declined between 1998 and 2008 even though the atmospheric concentration of carbon dioxide increased steadily.

This is hardly a surprise. There are several factors that explain this statistical picture.

- The year 1998 had the largest El Niño, a warming event in the tropical Pacific, in 400 years. It was extraordinarily hot. If you start measuring on a different year, global temperatures didn't drop.
- The sun has been less active.
- The Pacific has cooled and the ending year of the measurement is a cold La Niña in the Pacific.
- Additionally the Pacific is trending towards a mostly negative and cool Pacific Decadal Oscillation.
- As Kaufman pointed out in his paper, China doubled coal consumption between 2003 and 2007. This surge in the use of coal-fired power stations may have helped cool the climate by pumping sulfur into the atmosphere. There have been other times in the past when the cooling from coal burning seemed to mask overall global warming.

Climate change is never steady and man produces both warming carbon emissions and cooling sulfur emissions. Oceans oscillate, solar energy fluctuates and only the debate seems to resist the tides of change.

Another recent study has shown that volcanic ash and soot helped slow recent global warming. A team of six international scientists, led by NOAA's John S. Daniel described how volcanic ash and man-made soot slowed the rate of global warming 20% since 1998 by blocking out incoming sunlight. While the recent decade has been warm, the rate of warming has slowed, and the study reports that persistent aerosols (small particles) in the stratosphere — the region of the atmosphere that contains the ozone layer — might account for why warming has not been as rapid.

As pointed out by Rutgers University professor Alan Robock, volcanic ash can persist in the stratosphere for "a year or two," while soot from coal burning lasts in the troposphere for "about a week." Humans emit about 70 million tons of sulfur dioxide into the lower atmosphere every year, compared with a major eruption such as Pinatubo, which put 20 million tons of sulfur dioxide into the stratosphere. But this volcanic "stratospheric aerosol pollution has "a 50 times larger effect, because it lasts so much longer."

This study has important implications, given this year's eruptions in both Russia and Chile.

As noted by Kristina Pydynowski of Accuweather, on the one-year anniversary of Russia's remarkable heat wave, when Moscow reached 101°F (38.3°C), the nation is once again roasting in a triple digit heat wave. This time however, the heat was in Southwestern Russia, from the Volga Valley to the Ural Mountains, while Moscow remained in the nineties. Unlike last year, the heatwave is relatively short-lived and expected to end next week. This part of Russia does not normally get this warm, but it is not unheard of for it to experience heat waves. Temperatures are 20°F warmer than usual and experts are concerned about the sunflower, corn and spring wheat crops.

When Texans welcome tropical storms, you know it must be dry. Tropical Storm Don fizzles and will probably dump most of its moisture on the mountains of Mexico. However there is still hope. The Madden Julian Oscillation has shifted position so that it is enhancing the possibility of more storms. This may weaken the blocking area of high atmospheric pressure that has been steering moisture away from the Northern Gulf of Mexico. There is a strong potential for more storms. Rain would be good – but be careful what you wish for.

The **Browning Newsletter**

is published by

Fraser Management Associates

a Registered Investment Advisor.

For more information or an informational brochure call 1-802-658-0322 or e-mail us at alex@fraser.com

Check out our website

www.BrowningNewsletter.com

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.*

VOLCANO UPDATES

Evelyn Garriss now offers an e-mail update service to notify subscribers when eruptions happen, and how they are likely to affect the weather.

For more details, price, and subscribing information: www.BrowningNewsletter.com/contact.html

The **Browning Newsletter** is published monthly at an annual subscription rate of $250 for print OR email version, $270 for both formats. Subscriptions should be directed to:

The Browning Newsletter
PO Box 1777
Burlington, VT 05402

phone: **1-802-658-0322**
e-mail: **alex@fraser.com**