



Original Papers – Historical Perspectives
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- ➔ The three-month long eruption of Alaska's Mt. Bogoslof has not only created volcano weather storms, but it has left a large cold area in the North Pacific that is making weather patterns like a positive Pacific Decadal Oscillation, including encouraging California storms.
- ➔ The Pacific is neutral but most scientist expect El Niño conditions to develop. This typically is good for Midwestern corn and soybeans and frequently is good for Great Plains pasturelands.
- ➔ With the first spring in 5 years that doesn't have either El Niño or La Niña conditions, Asia faces a "normal" planting season. This should create a good planting season for East and Southeast Asia, although there may be some problems with floods.
- ➔ However, conditions should be difficult for planting for most of India (except, fortunately, the Northwest wheat belt), the Middle East, Central Asia and Western China.
- ➔ International agencies are preparing a five-step program to increase food supplies to meet growing populations. For agriculture, this means as farms try to improve their yields, they will be asked, if not forced to, make those improvements with greener technology and a continual reduction in land and water use.

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Springtime Recipe – One Hot Ocean, Two Cold Blobs and a Wildcard

SUMMARY: The combination of volcano weather, northern ocean blobs and the still hot Western Atlantic is shaping a chaotic spring and a potential benign summer for crops.

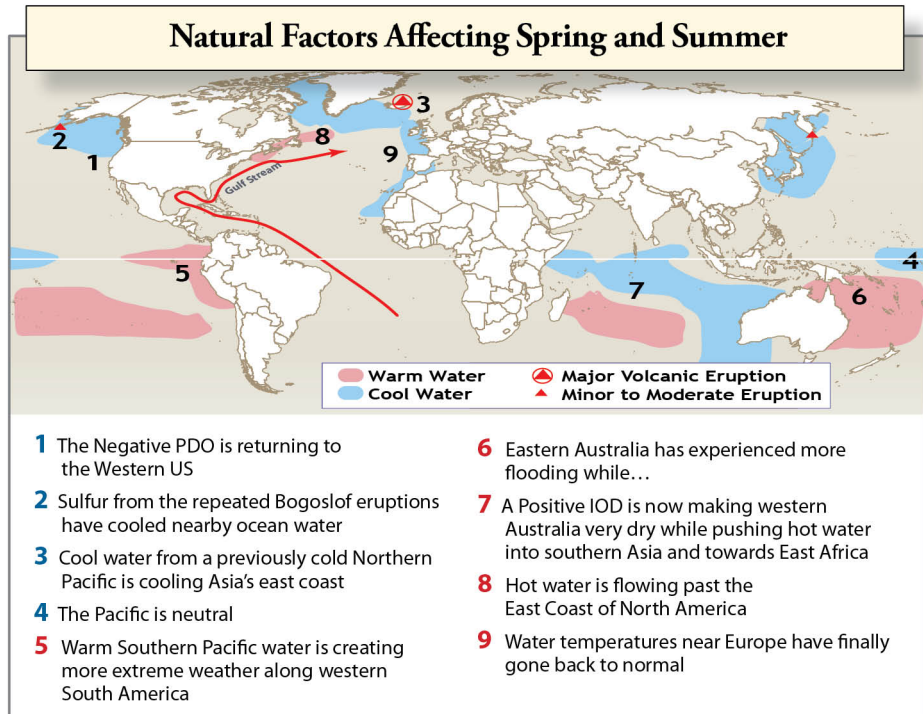
Stella! Stella! No – that isn't the sound of "A Streetcar Named Desire". Winter Storm Stella was the violent blizzard that combined with a Nor'easter to blast the Eastern US – and no one desired her. While she wasn't the complete, deadly disaster that NOAA originally predicted, it was a terrible way to end winter and start spring. It also was a prime example of what happens when wildcard volcano weather hits hot, wet marine air.

The Long and Messy Eruption of Mt. Bogoslof

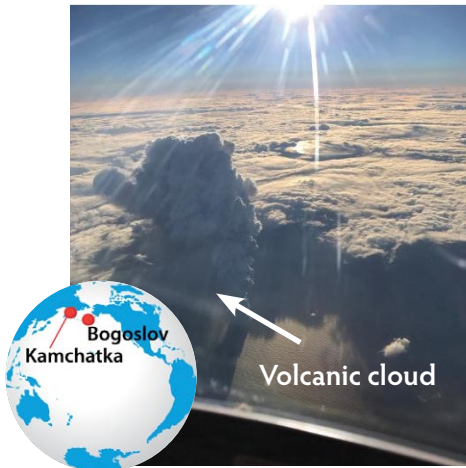
Since mid-December, a wildcard has been added to the weather formula. If cherry trees

in Washington D.C. had a rough time, they can blame the wildcard – Alaska's Bogoslof volcano. Volcano weather has been interrupting the already chaotic battle of continental cold fronts with hot marine air masses. The result has been unexpectedly cold northern weather and threats of blizzards. When the surges of volcanically cooled and dusted air met a tropical atmospheric river in mid-March, the result was a miserable (but not record-setting) March Nor'easter.

What made the eruptions particularly difficult is that Bogoslof Island, the top of the underwater volcano, is so remote. It's closest neighbor is Fire Island, equally uninhabited. The closest settlement is Dutch Harbor, 60 miles (98 km) away. There have been a few airplane and boat observations, but mostly studying these eruptions has been an exercise in satellite and seismic data, while trying to



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



figs. 2A-B An airplane's view of Mt. Bogoslof's December 20 eruption. © Paul Tovman <https://avo.alaska.edu/images/image.php?id=103491>

estimate and model what the mountain's quake activity indicates.

No single eruption of this volcano has been large enough to change climate. However the incredible persistence of this event has disrupted western North American weather all winter long. From December 20 through March 13, the mountain exploded 40 times, with smaller gas releases in between. All of these combined have been enough to affect Western Canadian winter temperatures (mostly west of the Rockies) and Western US precipitation.

The Tropical Pacific is currently neutral, but shows signs of warming even more. There's a 68% chance of El Niño.

As noted in earlier issues, volcano eruptions have varying impacts on weather and climate, depending on location and eruption size. The initial explosion expels ash and chemicals, particularly sulfur. The debris, called aerosols, can temporarily block incoming warming sunlight and, if it lingers long enough, collect water and form sunlight-blocking clouds which ultimately precipitate out in rain or snow.



If the eruption is over 3 miles (>4.8 km) high, it can enter a passing cold front. Higher ones can affect one or two fronts and large eruptions can linger in the stratosphere and affect climate for years.

Bogoslof's eruptions have had 3 effects:

1. Smaller eruptions entered passing North Pacific cold fronts. These have cooled and rained out over the West Coast, much to California's pleasure.
2. The relatively few moderate eruptions have affected a weather pattern called the PNA (Pacific North America) crossing the Rocky Mountains and bringing its cooling, wet conditions to the Prairies, Plains and Midwest
3. The sulfur emissions settled in the nearby ocean waters. There they mixed with the ocean forming sulfuric acid that, while highly diluted, is slightly shinier than regular water. The water didn't absorb as much sunlight, cooled down and becomes the large "cold blob" south of Alaska. The cold water is cooling the air and altering air pressure overhead.

On March 7 – 8 and 13, Bogoslof erupted with 35,000 ft. (6.6 mile or 10.7 km,) explosions. The first of these lasted for hours while the second eruption was only 12 minutes long. Since then, satellite data has shown that the volcano is still hot but there has been no significant seismic activity to indicate anything but the smallest of eruptive activity. Its activity may be close to ending. It is probable that the earliest of these two eruptions cooled the cold front that ultimately became the March 12 – 13 Nor'easter, but the second was too short to have much impact on the weather.

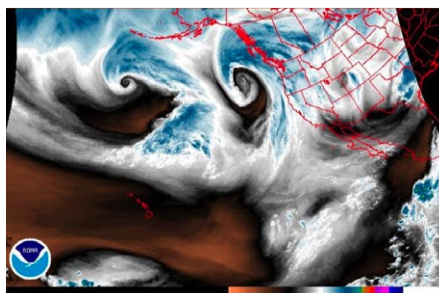


fig. 3A-B Moderate North Pacific eruptions create a positive Pacific North America pattern. Weak ones produce Pacific Coast storms. left

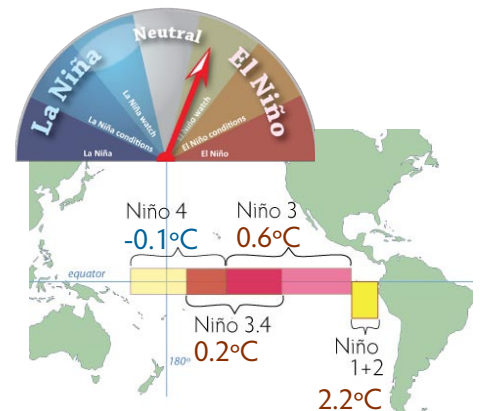
© Evelyn and James Garriss, right courtesy NOAA

The Ever-Changing Pacific

As noted, the lengthy but small to moderate activity of Bogoslof, in conjunction with the low but constant level of the volcanoes on Russia's Kamchatka Peninsula has scattered enough sulfur aerosols to cool water temperatures in the North Pacific. This has been but one change of many in the Pacific. When the Pacific, 30% of the Earth's surface, changes global weather patterns change.

The Tropical Pacific is currently neutral, but shows signs of warming even more. Indeed, the consensus of models give a 68% chance El Niño conditions will begin by late summer. If this happens, it is historically good news for US crops, particularly Midwestern soybeans. It also tends to blunt the worst of early season hurricane activity along the US coast.

If this happens then it would mean that over the last 4 years, the globe has had either a warm El Niño or a cold La Niña. Scientists have decided that 2016 did have a short, weak La Niña event that began in late summer (which is what the



Mid-March 2017 ENSO Predictions

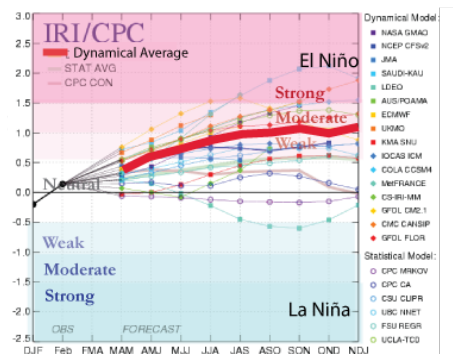


fig 4A-C A weak to moderate El Niño is likely by late summer http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/ens0_evolution-status-fcsts-web.pdf

Browning Bulletin had projected all year during 2016). The conditions ended in late December and were officially declared over in early February. For four years, the globe has shifted from one extreme to another, putting international agriculture in enormous stress.

Currently the Niño zone closest to South America is 2.2°C (4°F) warmer than normal. Typically this much warmth in this area triggers heavy rains on the west coast of South America as well as frequent tropical moisture hitting Texas and/or portions of the Southern and Central Great Plains.

The giant Pacific has more than one cycle. One of the longest lasting is the roughly 50-year trend of the Pacific Decadal Oscillation (PDO), which shapes weather from the tropics to the Arctic Ocean. It especially controls temperatures and rainfall in western North America. It goes through roughly 25 – 30 years of warm conditions, interrupted by cold La Niñas, followed by 25 – 30 years of cool conditions, interrupted by warm El Niños. Since the warm El Niño conditions began in 2014, the PDO switched from its cool trend and is currently weakly positive.

Notice in figure 1, point 2, the cold water south of Alaska due to the sulfur aerosols from the eruption of Bogoslof. This cold water is similar to the cold you would see in a positive PDO and like a positive PDO, it allows, even steers wet polar storms onto the West Coast, particularly California.

At the same time, the neutral Pacific is now allowing massive atmospheric rivers, i.e. huge streams of tropical moisture, to form and slam into North America. The majority to these have hit California, meaning the Golden State has had a “double whammy” of both wet polar and drenching tropical storms. As a result, most of the

state, as well as the Southwestern US has had enormous drought relief.

The Still Steamy Atlantic With a Bit of a Cold Blob

Like the Pacific, the Atlantic still has a volcanically cooled blob directly south of a volcano. Iceland’s Bárðarbunga volcano’s eruption was under a glacier, so it was never high, but it emitted a huge amount of aerosols during its 2014 – 2015 eruption. The enormous deposit of sulfur created a cold blob which is directly blocking the northward flow of the Gulf Stream. You can see the unusual heat from the backed-up flow along the East Coast. Indeed, there is so much heat that weather people warn that that there was a severe danger of an extremely rare March tropical storm forming.

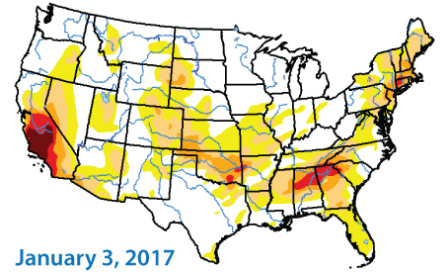
The warm Atlantic marine air has wafted inland. This has had three effects:

- Most of the time, the hot air has created higher than average temperatures in the Central and Eastern US.
- When the cold volcanic air mass hit this warm, wet air, it created fierce storms, including the mid-month Nor’easter.
- Since the end of January, we have seen the Central Great Plains and portions of the Mississippi grow increasingly dry.

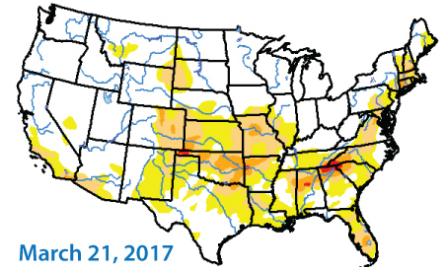
Not only is the western and central waters of the North Atlantic warmer than normal, so is the Tropical Atlantic. These waters will flow north and continue to heat the Atlantic Rim through spring and early summer. If temperatures in mid-spring are unusually cool, it will be where storminess has increased from the clash of warm and cool air masses.

Looking Ahead Towards Summer

It is difficult to find similar years for comparison when the climate is being affected by a wildcard volcano eruption. However, both 2006 and 2009 had Alaskan volcano eruptions. In 2006, Mt Augustine, directly off the south coast of Alaska, had



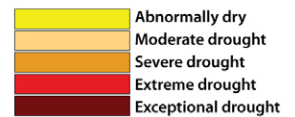
January 3, 2017



March 21, 2017

figs 7A-B

US Drought Monitor



<http://droughtmonitor.unl.edu/>



9 – 14 km (6 – 9 miles) high eruptions from January 11 – 17. In 2009, the eruption was in Mt Redoubt, 110 miles (180 km) southwest of Anchorage. It was active from March 15 through late May with 26 eruptions that varied from 12.3 – 4.7 miles (19.8 – 7.6 km) high. Both events were bigger than the Bogoslof eruptions but neither lasted as long. Unfortunately, while there are some similarities between the precipitation patterns of the two years, their temperature patterns are different with 2009 much cooler after its springtime activity.

When the five most similar years are compared, there are very few similarities that appear more than 60% of the time. Spring was particularly volatile. Indeed, the recent early spring map was correct except for the WARM in the Northeast which were eliminated by two outbreaks of volcano weather combined with the Nor’easter. At present, it seems probable that the dry Central and Southern Great Plains and Mississippi Valley will receive some relief in April, but problems may continue in the West Kansas, East Colorado and Texas and Oklahoma Panhandle regions. Probably the most questionable of the spring map indications is the cool mid-spring weather in the center of the country.

The maps show more agreement for summer. With El Niño conditions developing, the weather is typically not too hot for the corn silking season and wet enough in August to aid the pod development of the soy-

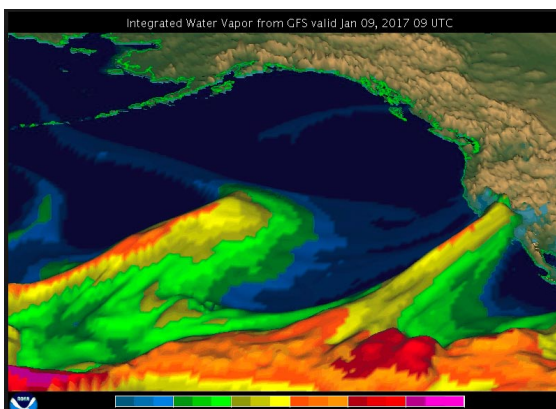


fig. 8 Atmospheric Rivers
courtesy: NOAA



bean crops. Most similar years had good Midwestern crops and average conditions for pasturelands. From a cooling season perspective, energy demands ranged from average to slightly below normal.

It is an amazing outlook – from the chaos of volcano weather, cold blobs, a hot ocean and somewhat chaotic spring, it looks as if it will smooth into a good summer for most of North America.

Warm 2-4°C or more higher than normal temps.	Cool 2-4°C or more lower than normal temps.	Dry 75% or less of normal moisture.	Wet 125% or more of normal moisture.
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figs. 8A-C ‡ A moderate Russian volcanic eruption will make this region colder. © Evelyn and James Garriss



figs. 9 © Evelyn and James Garriss

Springtime in Asia

SUMMARY: In the first “normal” spring without an El Niño or a La Niña in 5 years, the planting season outlook is good for East and Southeast Asia as well as the Middle East, but India and Central Asia as well as Western China may face some problems.

As spring starts, the northern hemisphere has its first planting cycle in five years to not occur during an El Niño or La Niña. Despite the potential of an El Niño occurring in late summer and the last strains of a La Niña winter, Asia’s spring is proving to be relatively “normal” to many experts. That is except for the wild cards that are volcanoes. With the Alaskan volcano Bogoslov erupting 40 times in 4 months, the Northern Pacific Ocean and the Arctic Asian jet stream are both acting abnormally. The cold Northern Pacific is influencing Eastern Asia’s Monsoon storm patterns. While the jet stream is pushing central Asian precipitation patterns west. Add in the additional pollution problems from large Asian cities and very little is “normal” about Asia’s spring.

The Pacific

Currently the Pacific Ocean is no longer being influenced by an El Niño or La Niña. As such the normal Pacific Decadal Oscillation (PDO) trend of cold Eastern and Warm Western Pacific waters is coming back into play. In the Northern Pacific, the long eruption cycle of Bogoslov has created a blob of cold water pushing warmer waters further south influencing Eastern Asia’s Pacific waters keeping them abnormally warm. These waters are made even hotter by the dense pollution coming from Asian coastal cities. These factors are creating more precipitation along Asia’s coastline prior to the influence of the Eastern Asia Monsoon which normally starts in May or early June. While the storms are creating higher levels of rainfall, the Arctic Asian Jetstream and the heavy pollutants are keeping these storms from moving further inland into central or western China

Asian Arctic Jetstream (AA)

Just as the Pacific North American jet stream has been acting irregular in North

America, the AA has created abnormal early spring conditions. Early spring is already bringing strong storms in most of the northern and central portions of the Middle East. This is after a winter full of blizzards and floods. This is due in large part to the Polar Jetstream dipping into Eastern Russia pushing cold air down to merge with the warm air of the tropics

Even as spring starts to dry up in late spring and early summer, crops should still flourish with pinpoint watering.



fig. 10 The Arctic Asian Jetstream is the primary determining factor for Asian precipitation patterns in spring © Evelyn and James Garriss

and creating unseasonal rainfall in most of the Middle East. The jet stream then pulls back before those storms can move into India creating a very dry spell in India with the exception of the Northern provinces which are benefiting from being kept in the jet stream storm flow. As the jet stream continues to pull back up it is aiding and pushing storms further east and creating less precipitation in most of central and Western Asia.

Indian Ocean Dipole (IOD)

The IOD is finally starting to trend positive. This means that Western Africa and later Southwestern Asia are going to benefit from better rainfall patterns as well as a stronger monsoon. For the last 17 months Southeastern and Southern Asia have benefited from warmer-than-average rainfall as the IOD went from neutrally hot to negative to neutrally hot again. This helped these regions benefit during last year's La Nina and offset the potential devastating consequences of the very strong El Niño in 2015. Southeastern Asia is still benefiting from the warmer waters of the La Nina winter as well as the still warm waters from the neutral IOD transitioning into its positive phase.

Now that we understand the weather factors that are influencing Asian climate let's take a look at what spring and early summer look like for Asia.

East Asia

Eastern Asian coastal regions can anticipate higher than average precipitation with a strong chance of flash floods as the warm Pacific waters mix with cold air coming from the Arctic polar jet stream. The storms are strong and quick which ensures that they rarely move far inland, instead raining out along the coast. Much like last year we can anticipate minor to

moderate infrastructural damage in many coastal cities as Asia continues to deal with the difficulty of strong storms on new infrastructure integrity.

The storms will be good for agricultural productivity. While there is concern that the flash flooding can cause root drowning or crop damage, much of the agricultural infrastructure in Eastern Asia is built around how to utilize and save water. This means that much of the flooding storm precipitation can be saved for future use in summer. Technology is allowing for the difficulties in climate to be subtly offset by technological innovation. Even as spring starts to dry up in late spring and early summer, crops should still be flourishing with pinpoint watering and water storage being utilized to offset the risk of mild drought conditions. As Eastern Asia is the largest agricultural sector of Asia, we can anticipate very good crop productivity including a high likelihood of record-breaking soy or corn output in China. Korea and Japan should be able to anticipate lower costs in importing but not as strong a need for exports.

Southeastern Asia

Southeastern Asia has benefited from the warmer waters of the Indian Ocean for close to 2 years. Additionally with the onset of La Niña conditions, Southeastern Asian agriculture has been able to improve crop productivity from the difficult year they had in 2014-15 with the El Niño and El Niño like conditions. Although the IOD is trending negative leading to colder waters around the Western portion of Southeastern Asia, the Pacific is still going to remain warm throughout the remainder of spring and into early summer. Because of this the higher water use crops that are prevalent in Southeastern Asia are going to flourish with good soil moisture and high water dependability. By late spring and early summer, the Western portion of Southeastern Asia

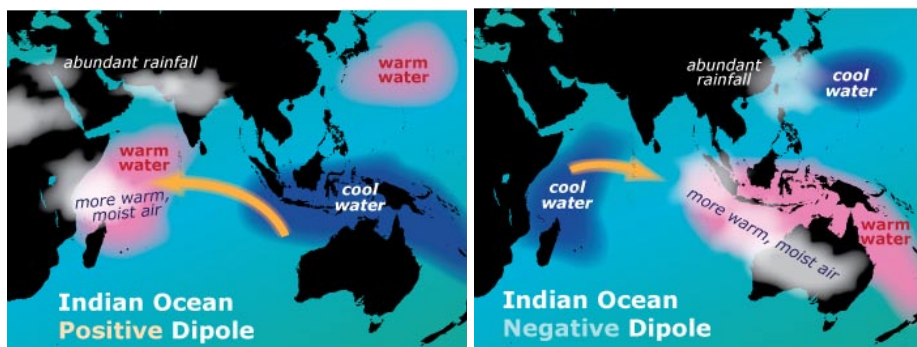


figs. 12A-C © Evelyn and James Garriss

including Cambodia, Thailand, Myanmar and Western Malaysia and Indonesia are going to struggle to maintain strong crop growth through June. Although the East Asian Monsoon will help, it is not going to be as strong as it has been in previous years. Additionally Southeastern Asia does not have the technological utilization that countries such as the United States, China and Brazil have used in order to offset climate and weather crop damage. Southeastern Asia is still going to have a good season with crop yields being pushed heavily to be above-average. Look for the onset of troubles to occur during the winter season especially if El Niño conditions occur in July or early August.

Southern Asia and India

Southern Asia should be able to maintain significant precipitation patterns due in large part to the warm northern waters of the Indian Ocean. Additionally the jet



figs 11A-B The current IOD is trending negative but northern waters will remain warm data: (<http://www.bom.gov.au/climate/iod/>)

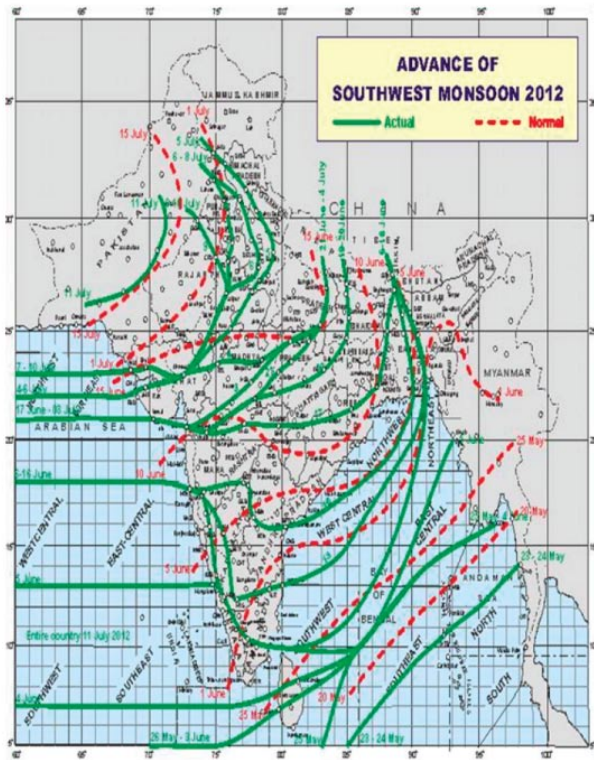


fig. 12 Expect an Indian monsoon similar to 2012 where it came in late, moved quickly and rained out weakening near the end of the season https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Monsoon%202012%20Wrap%20up%20Report%20New%20Delhi_India_10-19-2012.pdf

stream pattern that are blocking precipitation from entering into India will not block other Southern Asian countries. Although most southern countries do not have large-scale agricultural productivity, they are unlikely to experience problems, or a larger need for imports from neighboring Asian or trans-oceanic countries. India on the other hand is struggling as both the jet stream patterns and the slow-moving negative trending IOD has created dry conditions for planting in most of India. The regions that are an exception to this are the Punjab, Hiroshi Pradesh and Haryana regions of India. This is actually good news as the northern regions of India grow crops

for most of their population and as such will help offset the potential civil unrest that occurs through multiple years of poor agricultural productivity. Regarding importing and exporting India is likely going to need to increase their imports while decreasing exports leading to profit loss for many big firms. The Indian Monsoon will come, but it's likely to come late, around the end of June or early July. It will also move swiftly and rain out quickly.

The Middle East

The Middle East continues to find itself in the difficult position of having large populations primarily focused in large cities with low agricultural productivity. As they continue to look towards technological advancements, civil unrest often times hinders the ability for growth to occur in many of the countries. Ironically much of the civil unrest comes from the population being consistently in danger due to undependable weather creating undependable agriculture. Currently the Middle East is experiencing unprecedented high amounts of rain. This means that any regions that depend on agricultural productivity are going to have a solid early and mid-spring. So long as they planted early the plentiful rainfall will continue into late spring creating a better chance at above average crop yields. By summer rainfall will go back to normal with an El Niño potentially lowering precipitation in August.

Northern and Central Asia

The Asian Arctic jet stream is currently pushing rainfall into the Middle East and keeping cold temperatures in Northern

Asia. Because of this, Central Asia including most of inland China is remaining dry and warm. This is increasing the use of energy and that's creating more pollution in many of China's major cities. This man-made pollution is mixing with the natural pollutants that occur from Asia's deserts allowing the pollutants to thicken before they finally move towards the ocean.

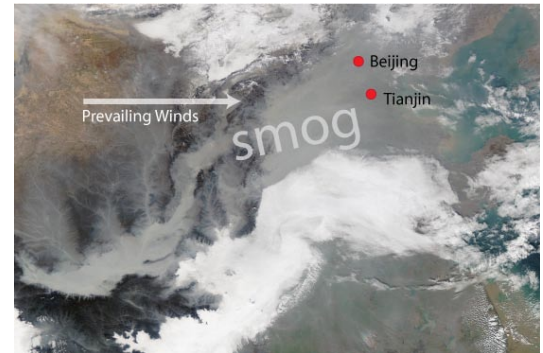


fig 13 Natural and man-made pollutant have a long-term impact on Asian precipitation patterns

https://www.nasa.gov/sites/default/files/thumbnails/image/china_smog.jpg

Much like Eastern China the pollution is creating international difficulties. Because much of Central Asia is remaining dry, cold and polluted, agricultural productivity has slowed greatly. We can anticipate poor crop production as many farmers wait for the weather to get better before they start to plant. El Niño conditions, if they do occur in July, will not help this problem. Do not be surprised if both the Chinese government and international organizations look to heavily reduce China's pollution problem primarily focusing on man-made impact. This could be especially prominent if agricultural output is lower than average.

2 Billion People, 2 Times the Food

SUMMARY: A quick review of what long-term changes international agencies and politicians are trying to implement on agriculture and crop usage

While there are many articles we write for the short and mid-term outlooks on weather and climate's impact on industry, there are times when we try to give a long-term out-

look at a developing situation. This is one of those articles and when I say long term I mean the next 30 years.

For the past four years several scientific reports and articles have been written determining that

- A) The population will grow to around 9.2 billion by 2050 and

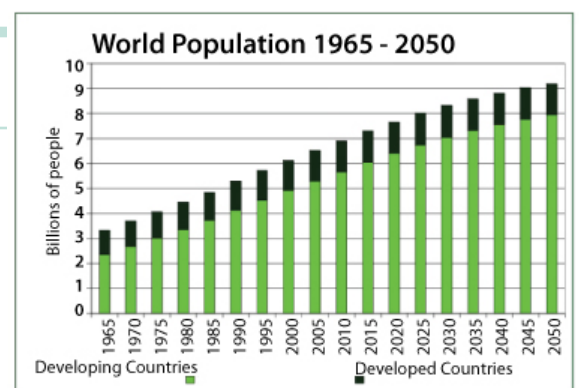


fig. 14 courtesy UN

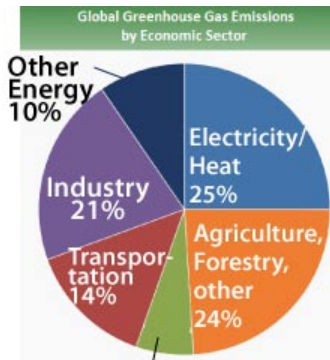
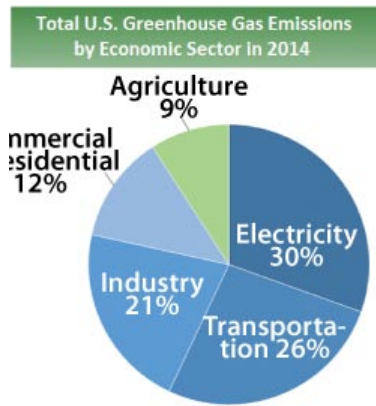


fig. 15A-B
<https://www.>

B) Despite the population growth being at only about 30% of what our current population is, we will need to double the amount of food produced in that same amount of time.

This is in large part due to a general global desire to improve the socio-economic livelihood of the majority of our international population. In creating this economic growth, we increase the demand both in quantity and quality of the food available.

With these reports in tow, many international organizations are looking to improve the agricultural productivity of both developed and developing countries. They wish to do this without increasing pollution and if possible on a relatively even spectrum among the various continents. As such, a five-step plan is being implemented in order to achieve this goal. As has been stated in other articles, this is not to determine if these ideas are right or wrong but merely what current public and private leadership is attempting to do about these potential developments.

Step 1: Freeze Agriculture's Footprint

Although there's been some pushback from various country's leaders, reversing climate change remains a key target for most governments as well as many public and private companies. Look for an increase in many regulatory committees to create new rules to limit the amount of CO2 emissions farming and ranching create. Currently in the US agriculture accounts for only 9% of the United States carbon footprint, however globally it accounts for 25% with developing countries growing worse over the years and several developed countries

Meat consumption - per capita (kg/year)

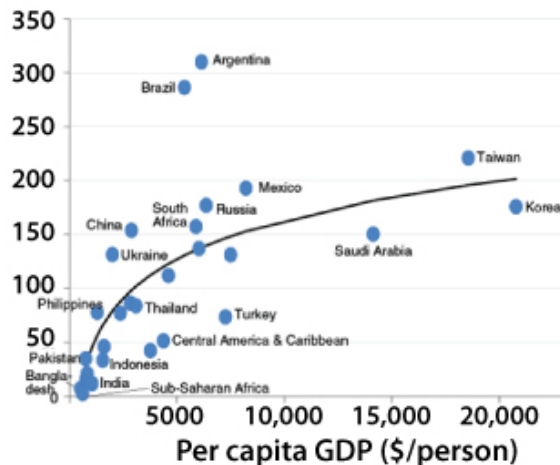


fig. 16 courtesy USDA

unable to reduce to desired levels.

Step 2: Grow More on Current Farms

The US has around 330 million acres of land used as cropland that is seasonally harvested. That

number has not changed dramatically in the past 10 years. Other countries on the other hand such as China and Brazil have nearly doubled the amount of cropland that they use in the past 10 years. Interestingly, the developed country that has minimized their land use while maximizing their crop yields is Australia. Don't be surprised if organizations look to Australia as well as parts of Europe and North America to determine how developing countries can increase agricultural productivity without increasing the amount of land they use

Step 3: Use Resources More Efficiently

As developing countries have the greatest need for improving their crop yields, the use of resources will grow in those countries. Many of the inexpensive resources that these countries use such as coal and oil are considered hazardous to the environment which will lead to a push for those countries not to use them. Look for many business and organizations to promote renewable energy and low polluting technology to help developing countries with some of the other goals in this plan.

Step 4: Shift Diets

A key status symbol of wealth growth in most countries is the consumption of meat. For example over the past 20 years, China nearly tripled the amount of meat they consume. Currently they eat twice as much meat as the United States. Look for animal rights, vegan/vegetarian and environmental groups to push for a reduction of meat consumption in developed countries and a maintenance of low meat consumption when countries economically grow. This will include attempts to promote that meat is not a luxury or status item, that it is harmful to the environment due to deforestation and bovine emission, that it is unhealthy and that it is inhumane.

Step 5: Reduce Waste

The reduction of food waste will be split into two tiers. The first is an easier problem to handle. Developing countries primary food waste occurs during harvest, transportation and Storage. Many of these problems can be solved by investing in a better agricultural technology and infrastructure. Developed countries on the other hand have a larger amount of waste it comes from households, supermarkets and restaurants. In many cases the waste of legislative forcing restaurants and stores to throw away food that at one time could have been donated. Legal issues often times take longer to change.

The general consensus of most of these steps is that technology and human intervention are the key factors in achieving the goal of doubling food yields by 2050. The variable to this belief comes in the form of natural climate.

Floods, droughts, late or early rainfall consistently lowers crop yields especially in developing countries. As such there are investment opportunities in developing countries for technologies and programs

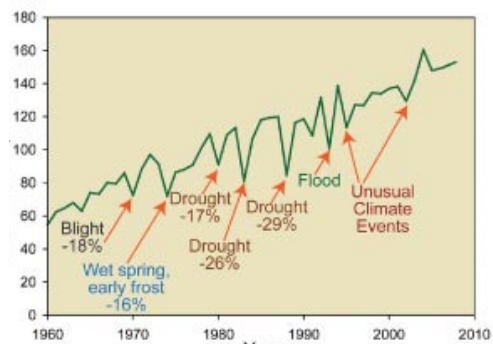


fig. 17 <https://www.epa.gov/sites/production/files/2016-08/uscomyields-large.jpg>

to reduce land degradation and improve agricultural technology and infrastructure. There's likely to be a push by many of these non-profit organizations for developing country farming to remain smaller instead of joining with large business conglomerates.

This allows for a more diverse investment strategy, especially when bad weather occurs.

Recent history has shown that even in developed countries unexpected severe weather hurts productivity and yields. Addi-

tionally as farms continue to try to improve their yields, they will be asked if not forced to make those improvements with greener technology and a continual reduction in land and water use.

While the *Bulletin* concentrated on Alaska's volcanic activity and the prolonged eruption of Mt. Bogoslof, it is worth noting that across the Bering Strait, Russia's Kamchatka volcanos have also been active. Currently Sheveluch, Klyuchevskoy, and Bezmyanny volcanoes are active enough to be rated with Aviation warning codes of ORANGE, the second highest warning. So far the eruptions have been small to moderate, with the largest recent explosion being Mt. Klyuchevskoy 7 km (4.3 miles) high eruption from March 27 - 30.

More exciting for the lonely volcanologists of Kamchatka, has been the recent eruption of Mt. Kambalny for the first time in 250 years. It had a huge explosion 600 years ago, was a bit active during the reign of Catherine the Great and then dozed off. Then with no warning, it blew up on March 24, with a 6 - 8 km (3.7 - 5.0 miles) high and 100 km (60 miles) long column of debris. Since little is known about how this volcano behaves, it is being studied and monitored intently.

California is bracing itself. State surveyors have measured the deepest springtime snowpack in years and are now concerned about destructive floods when all that snow melts. California is already waterlogged after storms slammed the state in January and February, flooding communities and washing out roads. If more stormy weather hits the state and its mountains soon, snowmelt could speed up, putting pressure on reservoirs, some already brimming full and spilling over.

The Sierra snowpack's overall water content measured 164% of normal on March 29, with some snowdrifts up to 20 feet (6 meters) deep at higher elevations in the central and southern parts of the range. This is good news since the Sierra Nevada snowpack provides roughly one-third of irrigation and drinking water to the nation's most populous state during hot, dry months of the year. If it melts too quickly, however, most reservoirs are filled and as Oroville Dam and other floods have shown, the state's flood control infrastructure is in relatively poor shape. It means after years of drought, California may face a very different problem this spring.

If you want to escape winter, go to India. There, March is the new May and Northern and Western India are reeling from a scorching heat wave. Sweltering temperatures that have shot past 40°C (104°F) in the first few weeks of spring. Temperatures are as

much as 5°C (9°F) above normal for huge swaths of the nation. Already five people have died from the heat. Unfortunately, the cooling wet season doesn't arrive until June and July. While parts of Delhi and neighboring areas expect some rain and relief in early April, most areas will continue to roast. Even cooler coastal areas will be dangerous, since the high humidity will make temperatures below 38°C (100°F) feel as if they are as high as 41-43°C (105-110°F)

These searing temperatures come on the back of the hottest summer in a century last year that killed 550 people and left not enough food to eat or water to drink in parts of an area that holds about 25% of India's 1.2 billion people. Officials were forced to transport water in trains to towns and villages in the west earlier this month amid reports of children collapsing in the heat while fetching water, and of armed men guarding wells and ponds to stop farmers from stealing water.

- For a while, weather people warned that the Atlantic had a chance of a rare March hurricane in the last week of the month. It didn't come, Australia wasn't so lucky. Queensland was hit by tropical cyclone of hurricane strength, meaning it was a level 3 or greater cyclone. Cyclone Debbie made landfall on March 28 with wind gusts as strong as 161mph (259 kph). It glided up the East Australian Current, getting energy from the warm waters. (Finding Nemo's turtles aren't the only things that ride that current.) Debbie maxed out at over 8 inches of rain along the coast in a three-hour period with some coastal towns receiving over 20 inches of precipitation in a 24 hour period.
 - Unfortunately, last year's autumn La Niña and this winter's volcano weather has had a massive and negative impact on Alberta farmers. Like California, the region was hit with unusually wet weather - but it was during October, the harvest season. Last fall's wet, snowy weather created major problems for Alberta farmers, who may still have one million acres of unharvested crops in their fields. Most of that is canola, although wheat and barley were also hit. Those that harvested in November face much higher, as much as \$340 an acre, including propane bills to dry the grain. Others tried in winter, when the crops are freeze-dried, but ice and snow can damage the equipment. Producers who waited for spring will likely see values drop by \$100 to \$150 an acre due to lower yields, lower quality and damage from mice, deer, moose and other animals.
- To add to Western Canada's agricultural woes, the value of their spring wheat bids has dropped as much as \$4 -5 per ton as favorable weather in the U.S. Plains and large world supplies weighed on the market.



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