

An aerial, top-down view of a dense crowd of people. The majority of the people are holding open umbrellas of various colors and patterns, including solid colors like red, blue, green, and orange, as well as patterned designs like checkered and geometric. The umbrellas create a mosaic of colors against the darker clothing of the people. The perspective is from directly above, looking down on the scene.

Allianz Global Corporate & Specialty

The Weather Business

How companies can protect against
increasing weather volatility

Allianz 



Foreword



Deviations from expected weather can challenge any company's revenues, costs or profits. The weather risk management market enables businesses to actively manage such financial risks based on the weather event or variability in

question – be it temperature, rainfall, snow, wind or even a combination of such perils.

Although still relatively young, the weather risk management market has evolved beyond all recognition in the 20-plus years it has been in existence.

From its origins in structuring heating degree day (HDD) swaps in the energy sector, the weather risk management market has now developed to a point where, although not yet fully embraced by the mainstream, its solutions are increasingly being used across a range of sectors and scenarios.

Today, growing numbers of companies are turning to this market in search of solutions for weather-related business risks. The market is responding in kind with increasingly innovative products in locations all around

the globe. Further growth is anticipated as such solutions continue to gain relevance, particularly in areas such as alternative energy, agriculture and retail.

Yet, despite this growing awareness many business professionals still have a lack of understanding of the weather risk management sector. The industry itself is partly to blame, with its jargon and technical terminology sometimes obscuring the essential simplicity of its solutions. As a result, the full potential of weather risk management remains untapped with many businesses not grasping that there are also opportunities to be derived from changes to expected weather.

With weather volatility forecast to continue to increase, this report offers a practical guide to the role weather risk management solutions can play in mitigating such risks, as well as identifying the benefits they can bring. We hope not only to support greater awareness of their potential, but also to encourage dialogue and debate on the future development of such solutions.

Karsten Berlage

Global Head of Weather Risk Management
Allianz Risk Transfer



The alternative energy sector is one of the many industries impacted by variances in the weather

Contents

Executive Summary	4
Introduction	6
Weather volatility is increasing. Hurricanes and floods grab the headlines but changes in the weather do not have to be as extreme to impact a company's profitability. For many businesses a small change away from expected weather can mean a large change in income	
Exploring the link between weather and business	9
Although the majority of businesses are exposed to weather risks, many are still failing to adequately identify and manage the impact changes in climatic conditions can have on their own revenue streams	
Impact of weather variances on businesses	13
Sectors such as energy, retail, food, clothing, tourism, distribution, transport and construction are just as sensitive to minor changes in the weather as they are to movements in interest and foreign exchange rates in terms of the impact this can have on profits	
Protecting financial performance	17
Some businesses have clear exposures to certain weather perils; for others evaluating weather risk may require deeper analysis of a combination of perils. Various risk management coverages can be structured for an increasing number of scenarios	
The deal is in the data	26
Availability and access to weather data has improved dramatically over the past decade, strengthening the argument for strategic weather risk management and enabling protections to be structured even in remote locations around the globe	
The weather forecast	30
Demand for weather risk management solutions will grow significantly in the future with stakeholders able to reap the benefits of better cash flow stability, more accurate budget management, greater earnings consistency and higher risk-adjusted returns	
Glossary	32
Sources	33
Contacts	34

Allianz Risk Transfer Group (ART) is the center of competence for alternative risk transfer business within the Allianz Group. ART Group companies are subsidiaries of Allianz Global Corporate & Specialty SE

Executive Summary

- Changes from the expected weather can challenge any company's revenues, costs or profits
- Economic fall-out from major events grabs the headlines but minor weather variances can significantly impact business
- Companies cannot control the weather but they can mitigate its financial impact
- Innovative weather risk management products enable businesses to actively manage financial risks around the globe
- Demand for solutions to increase significantly in future, driven by more volatile weather activity and growing awareness of benefits

Weather volatility is increasing significantly. Insurers have the bills that show damages from weather-related natural catastrophes are rising rapidly. Between 1980 and 1989, \$15bn a year was paid out for such events. Between 2010 and 2013 alone this totaled \$70bn a year¹.

The weather does not have to be extreme in order to have a negative impact on cash flows. Sometimes it is merely enough for it to be uncommon, unseasonal or even unexpected. For many businesses small changes in temperature, rainfall, sunshine, snowfall and wind levels can mean a large change in income.

Volatility may be becoming more common around the globe but many businesses are still failing to adequately mitigate the risk posed by changes in climatic conditions to their own revenue streams.

Weather impacts all commercial activities with 70% of companies exposed to "severe weather risk". For example, the cost of weather-related delays to trucking companies in the US is as much as \$3.5bn a year. Weather is the cause of approximately 70% of the delays in the US National Airspace System, costing at least \$3bn².

Estimates indicate over 30% of US gross domestic product (GDP) is directly or indirectly affected by weather and climate (\$5.7trn of \$15.7trn). Moreover, routine weather variance on the economy is as much as 3.4% of GDP or \$534bn, based on 2012 figures³.

Many industries are as, or even more, sensitive to variance in weather patterns than they are to interest rate or foreign exchange movements including energy, retail, food, tourism, distribution, transport and construction.

All \$ US\$ unless
otherwise stated

However, deviations from expected weather is no excuse for businesses incurring volatile revenues, higher costs or disappointing earnings – this is increasingly less accepted by stakeholders. While companies cannot expect to control the weather they are now expected to better control the risk of its financial impact.

Weather risk management is the management of financial risks that are directly or indirectly linked to the occurrence of an observable weather event or variability in a measurable weather index. Crucially, no physical damage is required for a payment to be made, unlike with traditional insurance products.

Such products focus on the use of weather data – measurable weather variables such as temperature, precipitation, sunshine, snowfall and wind – as the basis for risk indices. Protection is based around the accurate recording of independent weather data.

For example, energy companies – both in the traditional and alternative sectors – are major buyers of weather risk management solutions. They prefer cold winters and hot summers and protect themselves against unfavorable seasons to safeguard revenues. Meanwhile, wind farm operators seek protection against low wind levels to protect their financing.

Coverage is available for single and multiple weather perils and is becoming increasingly innovative, moving into new areas ranging from protecting the crops of farmers across Africa from drought to jewelry stores from a drop in earnings in the event of customers being unable to go shopping because of heavy rain or snow.

The process of determining a loss is objective and unlike with traditional insurance payouts can be made quickly while the lack of revenue is still an issue. Settlement can be reached within a few days.

As well as protecting a company's financials from supply and demand risks and operational exposures, weather risk management solutions can also be used for promotional purposes. For example, a car company may

entice potential buyers of convertibles with a “sunshine guarantee”. This works by protecting the consumer against a lack of sunny days when they are unable to have the roof down.

An increasing number of governments and corporates will be expected to more actively manage weather risks moving forward as the awareness of the significant impact these can have on their financial performance continues to grow. Today, this is still underestimated. Weather will increasingly be viewed as a core risk to business performance.

Weather risk management tools will become an increasingly powerful weapon in the risk manager's armory, helping to combat growing shareholder concern about the impact even minor changes in weather patterns can pose to returns.

Demand for such tools will increase significantly in the future with companies able to prove they have mitigated certain risks and protected revenues, making themselves more attractive to investors. The introduction of weather risk management products in the utilities sector has directly resulted in higher market valuations.

The weather needs to be defined in such a way that it describes a business risk or opportunity. A failure to do so means that businesses are missing the opportunity for better cash flow stability, more accurate budget management, greater consistency of earnings and higher risk-adjusted returns.

In the future, those weather-sensitive companies who refuse to deploy weather risk solutions could suffer negative consequences from stakeholders.



Percentage of US GDP impacted by the weather



Impact of routine weather variance on the US economy



Fast settlement time for weather risk management solutions



Weather variances can impact attendances at sports events and venues and result in cancellations

Introduction

Adverse weather patterns are increasing around the world. While natural catastrophe events such as hurricanes and floods grab the headlines, weather activity does not have to be as extreme as these to have a negative impact on a company's profitability. For many businesses a small deviation from normal weather patterns can mean a large change in income. Such risks call for new solutions to manage them more effectively

The weather is changing. Volatility is increasing significantly. Extreme rains, heat waves, cold snaps, blizzards, floods and droughts are just some of the many weather events that are impacting how people live, what they buy, where they go and how their business performs.

Climate change is often cited as the main driver of such weather patterns. Skeptics may disagree but whether you are a believer or not insurance companies have the bills that show damages from extreme weather events are rapidly increasing.

According to Allianz between 1980 and 1989, on average \$15bn a year was paid out in insured losses for such events around the globe. This has risen every decade to hit \$40bn a year on average between 2000 and 2009. Most recently in the three years from 2010 to 2013 alone, \$70bn in damages from these weather events has been paid out annually.

This last figure counts the cost of 2013's central European floods which saw heavy rainfall cause damage, resulting in economic losses of close to \$18bn, claiming 22 lives.

In 2012 alone, the US suffered 11 weather-related catastrophe events that each caused at least \$1bn in damage, according to a study by the Stanford Woods Institute for the Environment.

Meanwhile, the US Department of Commerce estimates 70% of companies are directly affected by the weather with the US Climate Disruption Budget in 2012 totaling nearly \$100bn. The federal government spent more taxpayer money on the consequences of the volatile weather activity during 2012 than on education or transportation.

Global economic losses from weather-related events came to about \$150bn in 2012, according to Munich Re. However, in addition to the high-profile natural catastrophe events there is also a huge variety of increasingly volatile weather activity, such as changes in temperature and levels of wind, rainfall, snowfall and even the amount of sunshine, which can significantly impact the balance sheets of businesses, even if these only constitute minor deviations from the mean.

Unfavorable weather no longer an excuse

It is clear that deviation from normal weather can adversely affect the financial performance of most companies. Unforeseen or abnormal weather patterns have the potential to disrupt businesses in a number of sectors via a host of climatic perils. Many financial concerns may find their income streams affected by the weather, both directly or indirectly.

But “bad” weather is no longer a sufficient excuse for volatile revenues, higher costs or disappointing earnings. Financial statements are awash with comments blaming poor performance on weather – this is increasingly less accepted by stakeholders.

“Companies have been of the opinion nothing could be done to combat the negative effects of the weather”

What is weather risk management?

Weather risk management is the management of financial risks that are directly- or indirectly-linked to the occurrence of an observable weather event or variability in a measurable weather index.

Different industries may respond to similar weather perils in different ways and this is one of the many reasons for the unconventional nature of the business.

For example, although heavy snowfall will most likely hurt the profits of an airline, it is going to help the snow removal company and the de-icing operations at the airport.

Effective weather risk management helps companies take control of financial impacts that may result from adverse weather conditions.

Shareholders, analysts, lenders and rating agencies have become increasingly aware of the possibility of including weather protection in a company’s risk management.

While companies cannot expect to control the weather they are now expected to understand the impact of it on their business in order to make an educated decision how to insulate unwanted weather risks to better control the risk of its financial impact.

Traditionally, companies were of the opinion that there is nothing they can do to combat the negative effects of the weather. For example, construction companies are vulnerable to delayed project completions, airlines fear cancelled and delayed flights, retail stores are disappointed when a cold summer or a warm winter changes consumer behavior in terms of seasonal items. Today, all of these risks can be mitigated via coverage structured through the weather risk management market.

The more people are aware of the opportunities in weather risk management and take advantage of them by incorporating them into their overall risk management systems, the better the execution can become.

\$100bn

US government’s annual climate disruption budget





Meteorological data is crucial

The second critical element to the advancement of weather risk management solutions is the availability and accuracy of historical weather data. There are meteorological weather stations all over the world and technology has advanced the use of satellites. It is important that the weather data has been recorded at, or close to where this is not possible, the location of the risk in order to avoid basis risk – a different weather measurement at the weather station than the actual weather experience at the risk location.

Crucially, unlike with traditional insurance solutions, physical damage is irrelevant for the cover to be affected. The loss that is covered is one of a financial nature.

Settlement is objective. Tailored weather risk management solutions are transparent, easy to understand and promise fast payout of any claims, addressing what are often cited as being the key weaknesses of traditional insurance products.

This report examines the impact increasingly volatile weather activity can have across a number of different business sectors.

Weather risk management solutions are set to become an increasingly important component of the risk manager's toolbox, enabling companies to hedge the risk posed by such fluctuations in a manner similar to the way companies already combat the threat posed by interest rate and foreign currency exchange movements.

Introducing weather risk management products

According to the Weather Risk Management Association (WRMA), these products have been in existence since the late 1990s. They focus on the use of weather data – measurable weather variables such as temperature, precipitation, sunshine, snowfall and wind – as the basis for risk indices, which make weather risk fungible.

With no physical damage required for a payment to be made, weather solutions have the advantages of simplicity, lack of ambiguity and speed of settlement.

Using commercially-available data from meteorological offices around the world, these custom-made products can help to smooth financial volatility, enhancing economic value for companies.

For example, energy companies want cold winters and hot summers and protect themselves against unfavorable seasons to safeguard revenues. Wind farm operators seek protection against low wind levels to protect their financing. Meanwhile, a strong correlation exists between precipitation, frost or fog and flight delays so airlines would look to protect themselves against the impact of changes in such weather patterns. These conditions can also impact other modes of transportation.

“Unlike with traditional insurance, physical damage is irrelevant”

Exploring the link between weather and business

Recent events around the globe underline the increasing volatility of the weather and the different ways in which they can impair the economy. Although the majority of businesses are exposed to weather risks, many are still failing to adequately identify and manage the impact changes in climatic conditions can have on their revenue streams



A strong correlation exists between snow, frost or fog and flight delays

Headline-grabbing weather events such as “Snowmageddon” in the US, which delivered an unexpected 36 inches of snow to the Washington DC region over just two days in February 2010 and the record levels of flooding in Queensland, Australia which besieged an area larger than France and Germany later that same year are typically used as examples of how recent years have been witness to increasingly volatile weather patterns around the globe. Unfortunately, there are many others.

During the summer of 2012 the US went from one extreme to another. Drought shriveled crops in the Midwest, wildfires burned in the West and East Coast

cities sweltered. The summer of 2012 was a season of epic proportions, especially July, the hottest month in the history of US weather record-keeping, according to the Stanford Woods Institute for the Environment.

At the same time, on the other side of the Bering Strait, large parts of Russia were also suffering from a prolonged drought.

Meanwhile in the UK, 2012 was officially the wettest summer on record. However, a year later the UK summer was the driest on record, coming hot on the heels of its coldest spring on record, according to the Meteorological Office.





REPORT

Bad weather underestimated by UK business

According to the Chartered Management Institute (CMI) severe weather is the major cause of disruption to British businesses, yet managers continue to underestimate it as a threat.

Although identified as the top cause of business disruption for three consecutive years, the CMI said in its “Weathering the storm” report that companies still risk not having plans in place to reduce disruption caused by snowfall and are underperforming as a consequence.

Heavy snowfall in 2012 severely impacted UK businesses with managers estimating the average cost at £52,000, with some claiming losses up to £1m. As many as 77% of organizations were adversely impacted by the snow, with travel conditions and childcare issues preventing staff getting to work. Yet bad weather barely made it into the top 10 risks impacting their business.

This pattern of volatile weather activity continued through 2013 with record amounts of rainfall resulting in flooding in the state of Colorado. The city of Boulder received so much rain that it broke its yearly record for precipitation with three months remaining of the year. Balloon recordings from Denver measured the highest-ever level of September moisture for the station, with the amount of rainfall classified as being likely to fall less than once every 1,000 years.

Across the border in Canada the torrential rain that hit Southern Alberta in June caused flooding resulting in the costliest insured disaster in the country’s history.

And elsewhere in the Americas region, in July unseasonal frosts occurred in southern Brazil with over half of the South American country’s 590-million-ton agricultural crop still awaiting harvest.

“Severe weather events
are often insured against
while seasonal fluctuations
in climatic conditions
are not”

The economic impact

Such events are used to illustrate increasing unpredictability in the weather because they provide a graphic illustration of the significant impact they have on economic and commercial activity in a number of different ways.

For example, in the case of “Snowmageddon” schools, businesses and governments were closed, while more than 24,000 flights were cancelled. Although the *Wall Street Journal* reported that the cost to airlines was believed to be less than \$10m – constituting a lucky escape in this instance – it also noted that the economic output of the area stretching from Washington to New York City is \$10.1bn a day. If a day of economic activity is lost entirely as a result of a storm it is estimated it would knock 0.28 percentage points off a quarter’s annual rate of growth in GDP⁴.

Meanwhile, with regards to the flooding which impacted Queensland in Australia, the state accounted for approximately 20% of the Australian economy, 60% of global coking coal exports and 28% of Australia’s fruit and vegetable production, according to analyst IBIS World.

As a result of the flooding forecasted GDP for 2010-11 was cut from 2.9% to 2.6%. The floods also resulted in A\$2bn in lost coking coal production while an estimated A\$1.6bn worth of crops were lost.

In the case of the US drought, soybean production decreased by 12%, while corn production fell by 13% to its lowest level since 2006, according to the Department of Agriculture. Insured crop losses were almost \$12bn and overall GDP suffered as a result.

Credit rating agency Standard & Poor's has predicted that weather events like extensive droughts or high temperatures will have a negative impact on credit ratings of corporations and institutions that are affected. A lower credit rating will result in higher borrowing costs.

In a similar vein, the Russian drought ruined over 7.5% of the country's annual harvest, according to its Ministry of Agriculture, while the UK's washout summer of 2012 saw the country's entertainment and tourism sector take significant hits as sports events and music festivals were all cancelled. At one point it even threatened certain events at the London Olympics with two waterlogged venues – Eton Dorney and Greenwich Park – having to be hastily resurfaced prior to the start of the games, leading to fears that the rowing, canoe, equestrian and modern pentathlon events could be interrupted or delayed.

Meanwhile, this year's Colorado floods are already believed to have cost the state's economy \$2bn, while economic losses from the Canadian flooding could hit C\$5bn.

And the Brazilian frosts are believed to have damaged around 65 million tons or 18% of the unharvested cane crop in the region, according to agricultural researcher Datagro Ltd. They could even affect next year's harvest too, with the worst-impacted areas being the states of Parana, Mato Grosso do Sul and Paranapanema Valley in Sao Paulo.

As a result of these frosts Brazil is set to suffer a significant reduction in its sugar exports, with Reuters reporting that they would also cause significant losses to the current season's wheat crops and next year's coffee crops.

It has been estimated that Parana, one of Brazil's top two wheat-producing states, will lose 33% of its current wheat crop, bringing current expected output to 1.9 million tones.



Economic impact of weather events around the world



Source: AGCS⁵

Meanwhile, 62% of 2014's coffee crop could be lost, roughly equivalent to 1 million 60-kg bags. Output is now seen at 582,000 bags from the state, down from 1.54 million previously. Around the time of the bad weather in Brazil, the price of sugar jumped almost 3% to 16.92 cents a pound, the *Financial Times*⁶ reported, correcting two years of steady price decreases in the wake of large harvests in the country, which is the world's largest sugar producer. And all because frosts arrived a couple of months later than expected.

Minor weather fluctuations hit the bottom line

Events such as the ones mentioned above offer evidence that volatile and unpredictable weather patterns are increasing around the globe. However, weather activity does not have to be so extreme or have such wide scale impacts as these examples to impair company cash flows.

Many companies protect themselves from risks posed by price, currency or interest rate fluctuations through hedging instruments. However, weather-related risks are largely self-insured by most companies, either because they are not aware of the magnitude of the risks or because they are not aware of the possibilities to effectively protect against the weather.

Indeed, weather-sensitive risks linger at the bottom of a Deloitte⁷ index focused on the major risks causing corporate crises. Yet weather is actually embedded in the number one cause of a corporate crisis identified in the same study – demand shortfall.

And while the consequences of severe weather events are often insured, seasonal fluctuations in climatic conditions are not.

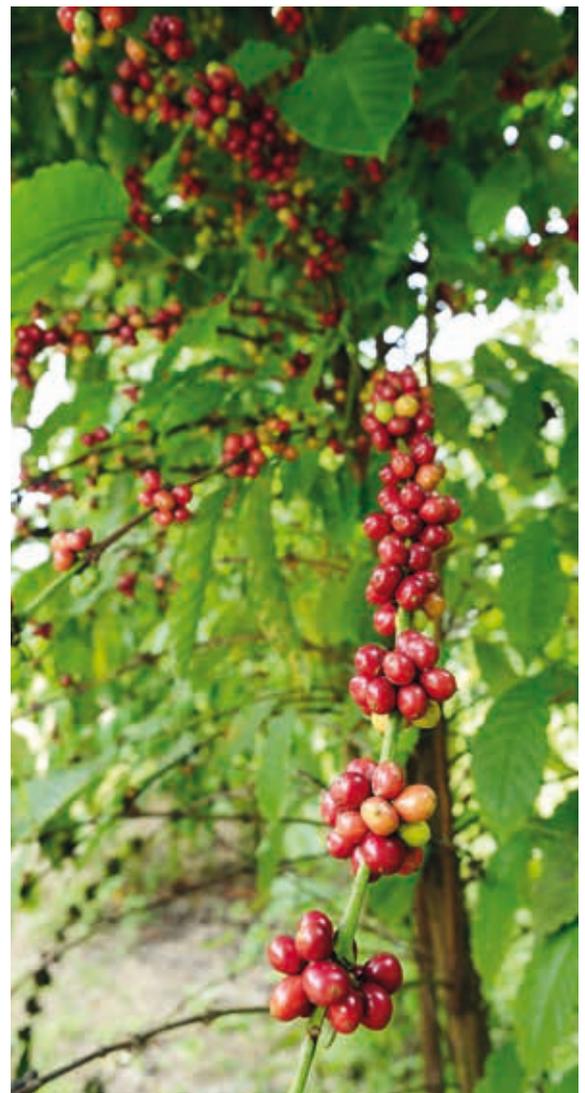
Some companies are aware of weather risk solutions but consider the cost to be too expensive – until they are hit by a major disaster. However, this does not have to be the case.

The cost is a function of the historical volatility and the payout triggers. For example, protecting against a one-in-three year event is more expensive than covering a one-in-10 or 20-year event.

Both make sense. The former may be considered an income volatility management tool, while the latter is a worst-case scenario protection.



The energy sector has been an early adopter of weather risk management solutions



Unseasonal frosts can impact crops such as coffee



Heavy snow can impact revenues in the food and retail sectors

Impact of weather variances on businesses

Sectors such as energy, retail, food, clothing, tourism, distribution, transport and construction are just as sensitive to minor changes in the weather as they are to movements in interest and foreign exchange rates in terms of the impact this can have on profits. Weather risk management solutions have an increasingly important role to play in enabling companies to protect themselves effectively against such risks

\$/€ exchange rate as of October 24 2013

At the macro level it is estimated that \$5.7trn of the \$15.7trn in US GDP is sensitive to the weather. Moreover, according to the National Center for Atmospheric Research (NCAR) and the National Science Foundation (NSF) the impact of *routine* weather variance on the economy is as much as 3.4% of US GDP or \$534bn, based on 2012 figures.

The NCAR and NSF study was the first to apply quantitative economic analysis to estimate the weather sensitivity of the entire US economy. The impact of routine weather variance on the economy does not calculate additional costs associated with extreme weather events such as outbreaks of tornadoes, for example.

Using the same methodology for the European Union (EU) countries we can approximately assume that \$5.9trn of the \$16.5trn in GDP of the EU is sensitive to the weather, based on 2012 figures. Similarly *routine* weather variation on the EU's economy would cost approximately \$561bn (€406bn).

Variations in the weather can impact a company's financials from the supply or demand side, as well as from operational exposures (*see box on page 14*). While volatile weather activity can have a significant impact on companies in all sectors some are more sensitive to weather than others such as energy, retail, food, clothing, tourism, distribution, transport and construction.



Weather can impact a company's financials in the following areas:

Supply Risk

Scenario: Lack of wind significantly impairs power generation and, potentially, the ability to fulfill financing commitments. Annual wind power generation can deviate by more than 20% from the long-term average

Other examples:

Warmth for plant growth

Water for hydropower

Demand Risk

Scenario: Mild winter impacts car battery sales – sales of many retail products are highly sensitive to the weather. For example, an automotive company sells more batteries during cold winters than during warm ones.

Other examples:

Mild winter also impacts coat sales

Hot summers increase beverage sales

Rain affects vacation bookings

Operational Risk

An array of weather issues cause travel disruptions. The aviation sector is vulnerable to weather perils such as snow and ice. Airport and airline operations rely heavily on correct schedules and punctuality. Hub operations are especially vulnerable

Other examples:

Low rivers impact barge transportation

Cooling of manufacturing plants – excessive heat can negatively impact workers, production levels and quality of goods.

Energy companies are particularly vulnerable to variations in temperature because they cause fluctuations in demand. They desire cold winters and hot summers.

For example, Dominion, which is one of the largest producers and transporters of energy in the US, with a portfolio of approximately 27,400 megawatts of generation, 11,000 miles of natural gas transmission, gathering and storage pipeline and 6,300 miles of electric transmission lines, revealed in 2012 that its third quarter earnings were down by nearly a half of what they had been a year earlier due, in part to “milder than normal weather”⁸.

The energy sector is currently undergoing significant change, as across the developed world governments try to switch from traditional sources, based on fossil fuels or nuclear to renewable sources, including wind, solar and biomass. For example, Germany's much-vaunted decision to abandon nuclear energy and move over to 30% from alternative energy sources, such as wind farms, by 2020 means its economy could be vulnerable to a lack of wind or sun hours, despite feed-in tariffs.

And it is not only a lack of wind that can cause problems for turbines, excess wind – particularly during the construction phase of offshore wind farms – can trigger delays in start-up and downtime in the construction program.

Demand and operational risk

The weather can also significantly impact the fortunes of the retail sector, with both better than expected and inclement weather having the potential to keep people away from shops for different reasons, posing both demand and operational risks. Sales of many retail products are highly-sensitive to the weather.

For example, sunny weather during the summer could mean people go to the park or beach rather than shopping, impacting those companies who sell the majority of their goods right before the holidays.

Meanwhile, in the US, inclement weather, particularly in the five week period following “Black Friday”, which is the day after Thanksgiving and heralds the start of the Christmas shopping season, can present a serious risk to retailers because adverse weather conditions can prevent consumers from getting to the shops at a time when retailers usually expect to see a surge in sales.

Unexpectedly volatile weather can also cause a number of operational issues for other businesses such as travel disruption with the aviation sector being particularly vulnerable (see box on page 15).

In addition, snowfall can cost municipalities millions of dollars in lost revenues with costs incurred from the gritting of roads in order to clear up, as well as lost income from tolls and taxes.





The cost of the weather on business



Weather is the cause of approximately



of the delays in the National Airspace System (NAS).

Weather is responsible for approximately



delay hours per month in the National Airspace System

\$3bn

The total weather impact is an estimated national cost of for accident damage and injuries, delays, and unexpected operating costs.

84% of all delays occur on the ground (gate, taxi-out, taxi-in).

out of which **76%** are prior to take off



\$2.2bn to \$3.5bn



Cost of weather-related delays to trucking companies per year



Total value of annual output of agricultural sector in the US

Adverse impact routine weather variations have on this economy each year

Sources: National Science Foundation, AGCS, Federal Aviation Administration, US Department of Transportation ⁹

The construction industry is vulnerable to operational risk resulting from variances in the weather as freezing temperatures and frost can incur significant project delays, as well as spiraling costs.

In short, there are a plethora of examples of weather risk impacting business. Hydro-energy, travel, leisure, entertainment and mining are all highly-susceptible to variance in precipitation. Meanwhile, food and beverage providers may find their sales either increasing or declining depending on temperature extremes, while a lack of sun will almost certainly dent the business of holiday companies and tour operators.

Weather changes as a core risk to business performance

Yet despite the increasing amount of evidence, many businesses, municipalities and governments are either failing, or not doing nearly enough, to identify the link between variations in climatic conditions and their own revenue streams, or indeed to protect themselves against the considerable risks such scenarios present.

The weather needs to be defined in such a way that it describes a business risk. A failure to do so means that businesses are missing the opportunity for better cash flow stability, allowing more accurate budget management and ultimately higher risk-adjusted returns.

In today's global markets, where competition for capital is intense, there is an increasing sentiment that companies can no longer get away with blaming the weather for poor sales or profit performance, especially when there is a growing awareness that there are ways of dealing with this. Shareholders are becoming more aware that potential solutions such as weather risk management products are available. And they are going to insist that the management they have put in place takes a more active role in managing weather-related risk.

Traditional risk management has a number of different components such as risk assessment and analysis, monitoring and control and long-established mitigation solutions such as captives or traditional insurance products.

"Weather risk management should be added into this mix to make it state-of-the-art and up to par with the demands of stakeholders," explains Karsten Berlage, Global Head of Weather Risk Management at Allianz Risk Transfer.

"Today, although many companies are comfortable hedging a number of different risks and are increasingly focused on operational, legal and regulatory challenges, they are neglecting weather risk, which is often the main contributor to profit volatility," he continues.

"However, there are changes ahead in terms of the allocation of resources that the risk manager will have at his disposal when it comes to addressing the different risks facing the company in the future. I can see a big shift towards including weather risk management.

"We are already seeing companies who are proactively managing weather risks effectively benefit from lower financing costs and better budgeting and planning. They may even use it as a sales tool in terms of stakeholder management," he continues.

"These companies will be able to show they have mitigated key risks, protected revenues and reduced profit volatility, making themselves more attractive to investors.

"If analysts are aware that firms are addressing these risks proactively, then the money spent on such solutions will be more than offset by the reward of higher shareholder value," he concludes.

Conversely, in the future, those weather-sensitive companies who refuse to deploy weather risk solutions could suffer negative consequences from stakeholders.

"Weather-sensitive companies who don't deploy risk solutions could suffer negative consequences from stakeholders"



Rain can impact holidays sales and bookings

Protecting financial performance

Deviations from expected weather patterns need to be considered in the context of risks and opportunities. Some businesses have clear exposures to certain weather perils; for others evaluating weather risk may require deeper analysis of a combination of perils. Various risk management coverages can be structured for an increasing number of scenarios

There are a number of different areas in which the risk manager who takes the risk posed by unexpected changes in the weather seriously can reap benefits.

These include helping to deliver improved returns, therefore bolstering equity valuations and revenue certainty, ensuring forecast reliability. Improvements in financing can lower the cost of capital while protecting revenues from weather fluctuations helps ensure liquidity.

“Weather risk management extends beyond the need to cover downside risk,” says Karsten Berlage, Global Head of Weather Risk Management, Allianz Risk Transfer.

“The first line of defense might be the desire to protect against too much rain or excess temperatures, as and when they hurt a company,” he continues. “However, this can be expensive, if historical weather measurements indicate a high probability of such weather events occurring.

“Alternatively, companies can give up partial upside in order to reduce the price of the weather cover. This structure is sometimes referred to as a ‘collar’. It reduces volatility risk and requires less upfront payment than a pure downside protection.”



Weather risk management solutions for the alternative energy sector

As an example, a wind farm that generates more power than anticipated due to steady, strong wind could give up some of its higher returns to help smooth earnings during periods when the wind fails to blow.

Instead of just having a “put” option against a lack of wind a “collar” structure is created for excess wind. So, for example, if 100 points is the 30-year average of wind speed on the index and the wind registers over 110 points, the insured would pay the excess and if it is less than 90 points a payout would be received (see chart below).

“Then there would be limited, or even no, upfront premium necessary,” says Berlage.

Weather risk management protection is especially critical in the alternative energy sector, where there is a considerable use of debt and some lenders require resource protection before granting funding.

And it is obviously an essential tool in areas such as wind farms where the business relies on one weather-related factor – that the wind blows – in order to generate income.

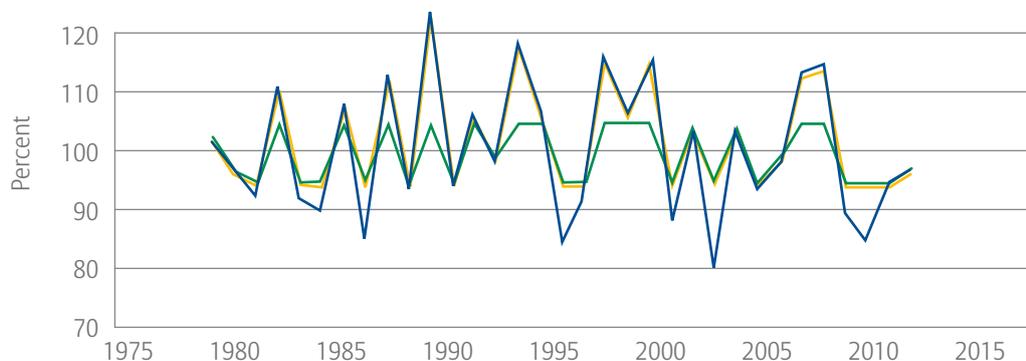
Supply Risk

Lack of wind impairs power generation

Lack of wind significantly impairs power generation and, potentially, the ability to fulfill financing commitments. Annual wind power generation can deviate by more than 20% from the long-term average. Allianz Risk Transfer weather solutions can manage short- and long-term risks at a single location or over a portfolio of assets. They cover everything from extreme scenarios for project finance security to utility-scale production, resulting in more stable cash flows from existing and planned operations. Allianz Risk Transfer’s supply side weather solutions protect clients from revenue deterioration and volatility and improve their creditworthiness.

Tailored Strategies

- Uncovered production (blue line). Covers may be structured in different ways to:
- Purely protect the downside, e.g., lack of wind (yellow line)
- Manage volatility while limiting premium outflow (green line)



How is coverage for weather risk developed?

Putting together effective, tailored risk protection covers is straightforward and transparent.

- 1 - Identify revenue and/or profit volatility
- Collect and analyze historical sales data
- 2 - Gather historical weather data at the relevant locations
- Identify weather stations near location to minimize basis risk (difference of weather experience between client site and weather station)
- Contract "clean" weather data
- 3 - Build a tailored weather index to match revenue sensitivity
- Compare regional company and weather information to build relevant correlations
- identify specific weather sensitivity to sales and profits
- 4 - Structure alternative weather covers to smooth downside sensitivities
- Either more aggressively or focus on worst case scenarios
- 5 - Agree on deal structure and transaction terms
- 6 - Close transaction at least two weeks prior to risk period
- 7 - The whole process can be finalized in a short period of time



Failed crops: weather risk management solutions have some key advantages over crop insurance

Weather risk management solutions for the agricultural sector

Meanwhile, in the agricultural sector, although traditional insurance products, such as crop insurance, which can cover a number of perils including pesticides, fire and misuse of fertilizer, are readily available, weather risk management solutions are also increasing in importance.

At first glance it might appear the farmer is better off with a traditional crop insurance policy as it covers a basket of different risks.

However, for example, a wheat farmer is exposed to frost during planting, excessive heat during growing and excessive rain during harvest. These are the main determining factors whether a harvest is good or not.

"If you ask farmers about the vulnerability of their crop, many will say the fertilizer can be controlled and that there has never been a fire, so what it comes down to is that the weather is the biggest risk," Berlage says.

Weather insurance has some key advantages over crop insurance, he adds.

"If you claim on a crop insurance policy, a loss adjuster will determine how large your loss is, which is a rather subjective process. There can be arguments, legal battles

and sometimes payouts take two to three years to be settled after a loss.

"In the case of weather risk management solutions, the payout can be made within days, so the farmer gets the money, while the lack of revenue is still an issue," Berlage adds.

"Moreover, the process of determining a loss is objective because the criterion is determined by the actual rainfall or the temperature observed throughout the season, for example. This ensures the product is transparent and easily measurable.

"With crop insurance a farmer who knows midway through the season that the crops are damaged has no incentive to minimize the loss. With a weather risk management product they receive the payout irrespective of the actual harvest. Hence, the farmer is still able to try and maximize the yield of his field by changing the watering or covering his crops to protect from sun or heat."

It should come as little surprise then to find that farmers have been among the early adopters of weather risk management solutions.





Shoppers on "Black Friday" - the day after Thanksgiving and start of the US holiday shopping season

Solutions that follow the revenue streams

Some businesses have clear exposures to certain weather perils; for others evaluating weather risk may require deeper analysis of a combination of perils. For example, airlines and airports require wind, temperature, precipitation and visibility to be within normal parameters in order to function without delays at different locations around the world.

In such a scenario it is possible to create a tailored weather index comprising multiple perils to reflect the varied risks involved. Various alternative weather coverages can be structured to protect against an increasing number of scenarios.

Most important is the focus on analyzing the company's weather protection requirements, the risks faced and its risk appetite, before selecting, structuring and executing the most appropriate solution depending on the suitability of the counterparty.

"With weather risk management solutions payouts can be made within a few days"

"Index-based products are very good at following revenue streams and they require little or no proof of loss. They are quick to settle," explains Dan Tomlinson, Managing Director at Allianz Risk Transfer.

"They are an efficient mechanism for risks that are closely aligned to some underlying index, as opposed to the traditional insurance world, which tends to look at the more extremes of losses, damage etc."

For example, in the case of a US jewelry chain seeking protection from the prospect of poor weather impacting revenues during its anticipated busiest sales period during the Christmas shopping season, Tomlinson says Allianz Risk Transfer would calculate the index and explain what the correlations are between the different weather stations that have been selected to monitor the chosen peril, usually snow or heavy rain, and how this has been put together, so there is no misunderstanding of how a claim might arise.

"Then we calculate the probability of that happening, based on, for example, precipitation in the past at the weather stations in question," adds John Arpel, Managing Director at Allianz Risk Transfer.

"Quite often we can go back 20, 25, 30 or even up to 50 years to get a probability."

Uses of weather risk management solutions around the world



Protecting maize crops in Benin –

Maize crops go through three distinct phases, one being the germination of the seed, the second being the growth of the plant and third being the time just before the crop is harvested.

Weather risk management products can help protect against variances in weather that can determine whether it is a good harvest or not.



Protecting the cost of keeping roads clear in Budapest –

The municipality has enquired about operational cover, protecting it from the cost of salt it would have to put on the roads to help keep them clear in the event of a very cold winter.



Protecting against falling jewelry and snowmobile sales in the US –

As US retailers increasingly worry over the potential to miss out on the “Black Friday” sales bonanza that heralds the start of the Christmas shopping season in the US, a chain of jewelry stores has taken action.

“The jewelers wanted cover because if the weather is really bad on that day, people won’t go to the mall and buy,” explains John Arpel, Managing Director at Allianz Risk Transfer.



“The jewelry chain assessed their average takings on ‘Black Friday’. If it rains above a certain level, which is likely to prevent people from going to the mall, then they are protected by the prospect of a payout.”

“Similarly, another store in the US, which specializes in selling snowmobiles is looking to protect itself in the event of a particularly warm winter because people don’t buy or service their snowmobiles.”

50%

Percentage of annual profit a UK jewelry chain estimates is delivered in December

25%

Percentage of annual profit delivered in the week before Christmas

£3m

Total cost to the business from heavier than expected snowfall preventing customers getting to the shops during this period

Innovative solutions

Weather risk management products are becoming increasingly innovative in their approach as the product and its applications continue to evolve, offering a variety of tailored solutions to sector-specific issues.

For example, in the Netherlands, labor agreements prevent construction workers from working in freezing temperatures. If temperatures are below freezing at key times, construction workers are not allowed to be on site and must be sent home with pay. If the freezing weather is extensive, the cost of wages and lost production can be extremely detrimental to a company’s income statement. A solution to the problems faced by the European construction industry is the use of “Frost Day” covers to offset the impact of cold weather on revenues.

“Frost Day” covers represent a cost-control solution whereby purchasers receive an automatic payout if a predefined parameter for the number of frost days is met. By using “Frost Day” covers, a construction company can minimize its financial risks. Over a number of years, Dutch companies have taken out several million euros in coverage to prevent losses from severe, sustained cold weather, thereby protecting profits from being adversely affected by the weather.

source: WRMA 2013 conference¹⁰



Promotional offers like “Sunshine guarantee”

New solutions mean there is now an upside to weather risk too, with the possibility to use it as a promotional tool to boost a company’s sales. Weather promotions can be used as a creative marketing weapon to drive sales of anything from snowmobiles to sandwiches. For example, a car company looking to use weather solutions for promotional purposes may entice potential buyers of convertibles with a “sunshine guarantee”.

A consumer may be protected against a lack of sunny days to enjoy having the roof down. For example, they may receive €100 as compensation for every rainy day after a defined threshold.

Payouts are triggered using data from a local weather station in the state where the car is registered. The cost of the cover might be subsidized in full, or in part, by the car company, or the cover might be offered to the customer as an option.

“Ultimately, if the client has a reasonable idea already of how the weather affects their business then we know we have got something to work with,” says Tomlinson, explaining the first steps in putting a weather risk management transaction together.

“Index-based products are very good at following revenue streams”



Weather risk management solutions can be used to protect convertible owners against a lack of sunny days



“The first approach is: what is the intuitive risk? Once you have established the intuitive link to the weather it becomes much easier to identify precisely what kind of weather. This is the conversion of ideas such as nice and nasty to cold and wet when thinking about the weather. “We always listen to the client’s description of how they view the risk and its core factors,” he continues.

“We are trying to represent cash flow timings that matter to the client and capture the moments they don’t like. We need to be sure what levels of basis risk we are encompassing. We need to have a good understanding of how they can affect the end result and we need to be comfortable that they are within our tolerance.”

Combining weather perils with other risks

Meanwhile, Tomlinson says there is increasing interest from businesses who want to cover “a whole basket of hitherto uninsurable risks in one bucket”.

“There might be the risk that you have to pay property deductibles if, in the case of a wind farm for example, there is a property event but in addition to that there is also the possibility of a lack of wind which also needs to be protected against.

“Quite often, these coverages can significantly de-risk their whole project.

“We can tailor a package of other covers including a weather cover,” Tomlinson says, adding that multi-peril structures can also incorporate weather risks plus a regulatory risk or equipment warranty, for example.



Weather risk management solutions – selected industry applications

Industry	Potential Product Applications	Allianz Risk Transfer Approach
Agriculture	<ul style="list-style-type: none"> • Variable crop yield • Handling, storage 	<ul style="list-style-type: none"> • Activities in Australia, US, Europe, India • Alternatives to crop insurance • Strong growth expected
Construction	<ul style="list-style-type: none"> • Delays • Incentive clauses 	<ul style="list-style-type: none"> • Frost Day product in the Netherlands • Wave height offshore
Energy (Traditional)	<ul style="list-style-type: none"> • Fluctuating demand • Generation mix • Strong demand for warm winter protection 	<ul style="list-style-type: none"> • Multiple transactions (US, Europe, Australia) • Single and double trigger • Seasonal and multi-year
Energy (Renewable)	<ul style="list-style-type: none"> • Fluctuating supply, not a “free resource” • Multi-year deals • Multi-peril structures 	<ul style="list-style-type: none"> • Wind and solar offerings (US, Europe, Australia, India) • Multi-year deals, comprehensive data analysis • Operators and capital providers
Entertainment/ Amusement Parks	<ul style="list-style-type: none"> • Postponement • Reduced attendance 	<ul style="list-style-type: none"> • One-off deals • Tailored program deals
Transportation	<ul style="list-style-type: none"> • Budget overruns • Delays • Cancellations 	<ul style="list-style-type: none"> • One-off deals • Growing sector
Retailing, Food & Drink	<ul style="list-style-type: none"> • Reduced demand of weather-sensitive products • Increased raw material costs 	<ul style="list-style-type: none"> • Tailored indices for clients in US and Europe • Growing sector increasingly aware of product advantages
Municipalities	<ul style="list-style-type: none"> • Snow covers • Flooding 	<ul style="list-style-type: none"> • Budget constraints and weather volatility aid product awareness

Lack of understanding about weather impact

There may also be tax and regulatory issues to consider, depending on the jurisdiction of the insured. Regulators prefer those using hedging techniques or trading to have experience of those methods and sophisticated risk management functions.

“Most companies don’t have a very good understanding of how those weather variables move together to stop them selling products,” adds Barney Schauble, principal, Nephila Capital, which is the largest institutional asset manager of vehicles dedicated to investing in natural catastrophe and weather risk.

“In order to come up with a customized product we need to understand what it is they do and what their relationship with the weather is.

“Then we can structure a contract and match it with another contract. There is a basic structural challenge, which is how good is a company’s understanding of its exposure to weather? Sometimes it is complicated as it is hard to figure out the relationship,” he says.

“It is one of the reasons that utility companies have been the biggest adopters of weather risk management products, because for them it is pretty straightforward. If it is warm all winter people won’t turn their gas on. That is pretty interpretable and straightforward. People use more gas when the temperature goes below 65°F so that is obvious,” he concludes.

The energy sector measures deviations above and below 65°F as cooling and heating degree days (CDD and HDD respectively) and energy producers will seek to use these to protect themselves against warm winters and cold summers.

“How good is a company’s understanding of its weather exposure?”

Weather challenges and structured solutions



Aviation

Challenge of airlines:

- Expense due to seasonal weather delays, particularly at hub airports
- Strong correlation between precipitation at the hub and total weather delay minutes

Indicative structure

- 10-year annual precipitation average for Chicago O’Hare is 35”
- 10-year standard deviation is 5”
- To cover extreme years, a structure may pay for each .25” over 40” precipitation

Alternatives

Snow storms, fog, high winds

Benefits

- Cover cost of delayed flights



Agriculture

Challenges in agriculture:

- Farmers and agricultural companies bear financial risk from yield variability
- Excessive/insufficient rain and temperatures
- Different sensitivities during planting, growing and harvest seasons

Indicative structure

- Regression analysis of crop yields and weather variables, for example, precipitation and temperature
- Index optimized to historical yields

Snow

Challenges of snow removal

- Municipalities and corporations bear costs of snow storms due to snow removal, business interruption and lower income
- Snow removal budgets tend to be constant. Snow experience is highly variable

Indicative structure

Cumulate snowfall

Period: December 1 – March 31

Station: Central Park, New York

Strike: 35 inches of cumulative snow

Alternatives

Single storms versus annual totals

Benefits

- Budget certainty
- Savings



CASE STUDY

Protecting Italian grain farmers and German wind turbine operators

Short-term event cover versus long-term stability

	Event	Stability
Industry	Grain Farming	Wind Power
Location	Italy	Germany
Duration of Cover	Month	Multi-Year
Risk Covered	Rainfall/Temperature	Moderate Winds
Event Covered	Extreme	Variation from Mean
Data	Weather Measurement	Weather Measurement
Settlement	Fast	Fast

The above example illustrates short-term protection for Italian grain farmers versus long-term protection for German wind turbine operators as structured by Allianz Risk Transfer.

It demonstrates that differing approaches to contrasting weather risks and circumstances can achieve security for distinct requirements but ultimately provide protection via similar methods.

The concept of the cover may differ. The grain producer is looking at a critical moment, or short period of time, during the lifespan of the crop. It might be the final month before harvest where the quality of the grain is effectively decided. That is the period where crop failure can occur and will be compensated for.

Renewable energy operators involved in long-term wind generation know they will face good years and bad years so are more concerned with ironing out the highs and lows to create a steady cash flow over time.

In both cases Allianz Risk Transfer will structure a business relevant index that represents how the underlying revenue changes. The style will differ as the grain farmer receives extreme protection from rainfall or temperature whereas the wind farmer will require smoothing of fluctuations in wind and output.

Regardless of the structure utilized the protection will be based around accurate recording of the weather that can be used to quickly pay funds to the client in the event of a loss.

As Dan Tomlinson, Managing Director, Allianz Risk Transfer says: "Climate is what we expect. Weather is what we get. What we are striving to do here is make what we expect much closer to what we get."

**"Climate is what we expect.
Weather is what we get"**



Renewable energy operators involved in long-term wind generation know they face good years and bad years



Historical data can be obtained from weather stations. A 30-year baseline indicates sufficient reliability

The deal is in the data

Weather risk management covers are based around the accurate recording of independent weather data, which is then utilized in a tailored index matching a company's revenue sensitivity. Without this there can be no transaction. Availability and access to weather data has improved dramatically over the past decade, strengthening the argument for strategic weather risk management and enabling coverages to be structured even in remote locations around the globe



Before a weather risk cover can be put in place, the relevant weather risk must be agreed upon and measured in a relevant location. Accurately measuring the weather is vital for effective analysis and assessment so collecting weather data is crucial. Presence of an external, trusted independent third party is critical.

An index, which is an agreed way of measuring what is happening with a weather phenomenon, can then be created to convert this measurement of the weather into a unit relevant to the business or industry in question. Indexing eliminates problems like moral hazard and adverse selection, allowing for very rapid loss settlements.

"In order to do that you need to be able to measure the weather and that can only be done with weather data," explains Dan Tomlinson, Managing Director at Allianz Risk Transfer.

"Whether that means risk management on an indemnity basis, so you can claim in the event of the wrong type of weather, or an index-based parametric structure, so you have a pre-agreed amount of money per unit of your index."

"The skill in weather risk management is to identify, or to construct, the right index in such a way that it accurately represents the client's business."

In search of weather data

As well as being independent, the quality of weather data can be determined by a number of other factors such as its history – with a 30-year baseline considered to be a sufficient enough timeframe in order to indicate reliability. As previously mentioned, basis risk (the distance between the risk location and weather station) is also key and is more critical for rain and snow than temperature, for example, because precipitation is more localized than temperature.

In some cases obtaining an accurate measurement of the weather is more straightforward than others.

For example, in the previously mentioned case of the jewelry chain looking to protect itself in the event of adverse weather potentially impacting anticipated strong sales on a day such as “Black Friday” or during the busy Christmas shopping season, it has a number of stores in shopping malls in locations around the US.

So, in any shopping mall where the local weather station measures a certain volume of rain within a set timeframe, it can get a payout of, for example, \$250,000 per millimeter of rainfall over the agreed measurement.

“Or they might say we have 30 locations around the US so we want to build an index based on all 30 locations,” adds John Arpel, Managing Director at Allianz Risk Transfer.

“So, an average would be taken from all 30 of those locations and if that average is above the agreed level the protection will respond. We (Allianz Risk Transfer) then have to go and see if we can find weather stations close enough to the location of the jewelers to see if this is possible and makes sense.”

Satellite and synthetic data

However, obtaining accurate weather measurements can present a more significant challenge in some of the more remote or politically unstable parts of the world.

“If you look at Benin (where Allianz offers protection for maize crops), the population is relatively sparse and you have got a big problem with finding weather stations. In fact, you also have to question the reliability of the weather stations and whether they are open to tampering and fraud,” Arpel says.

The use of satellite data (*see case study on page 29*) can solve some of these issues. However, in some cases, it may only provide five years of historical records, which is not considered sufficient enough to create a reliable index.

If this data is missing, synthetic data will have to be created to fill in the gaps by matching local data with the satellite data to create a synthetic history.

“You can fall back on model-based data, which is data that effectively interpolates from known sources backwards through time,” explains Tomlinson. “That interpolation mechanism allows you to pick a spot on the planet over a period of time.

“The accuracy of the interpolation is only ever going to be as good as the accuracy of the stations from which you are interpolating. There are limitations there but it allows you to use the bigger picture to derive a synthetic history.”



Spring plowing a dry farm field

What is basis risk?

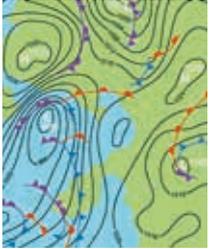
One of the major challenges faced when structuring a weather risk management solution is basis risk. Sellers of weather contracts require high quality data from reputable sources which may exist only in certain locations. Meanwhile, the users, or purchasers, of such products would like to minimize the basis risk involved with the use of weather data collected at a site that does not necessarily correspond with their exposure location.

Basis risk, in the specific case of rainfall, refers to the relationship between the precipitation measured at a weather station and the production or revenue on a farm, for example. Recorded precipitation may not be highly-correlated with actual precipitation at the farm, and production or revenue on the farm may not be highly-correlated with precipitation at the farm.



Data quality criteria

In order to overcome some of the problems encountered when trying to collect accurate weather data or issues caused by lack of historical records, companies like Allianz Risk Transfer can work with third party experts including the UK Meteorological Office and Speedwell Weather.



The latter is a private sector firm which specializes in the provision of weather data and forecasts. It also supplies weather derivative software and software for the pricing of weather risk contracts.

“In producing the data necessary to settle a weather contract the quality criteria is extremely rigorous,” explains Speedwell chief executive, Stephen Doherty.

“Sometimes that requires some fairly in-depth work examining data integrity. Is it accurate? Is it reliable? Is it safe to use?”

“One of the things we like to alert people to is the fact there is a huge amount of very bad weather data out there. When you monetize weather data you have to see it as a form of financial market data.

“Weather data is as important to weather risk management transactions as the history of the dollar/sterling exchange rate is to a foreign currency transaction or the share price of Rolls-Royce is to someone wanting to buy shares in that company.”

Terabyte-sized databases

Providers of weather risk management products require the data to enable the risk to be priced in the first instance and, secondly, to settle the transaction. In order to provide this information, Speedwell collects data from weather stations around the globe. It processes over 100,000 data files per day and stores them in terabyte-size databases.

“We put the data through some very strict quality control processes, where we look at the data for plausibility. We do this through a mixture of software and ultimately ‘human eyeballing’ and meteorological judgment,” says Doherty.

“It takes a great deal of precision in understanding the subtlety of weather data to realize that one figure may be a maximum temperature for a 12-hour period, while another is for a 24-hour period.

“The difference between the two may sound prosaic but it can be a couple of degrees in a weather hedge that has a value of £10,000 or £20,000 per degree,” he continues.

“So our ability to produce quality data is predicated on people having an incredibly deep understanding of how weather is measured and reported and the problems that arise, as well as a thorough archiving system that allows us to differentiate between the different data qualities.”



Providers of weather risk management solutions require data collected from weather stations around the globe to price and settle transactions

CASE STUDY

Increasing use of satellite data

Although there are some concerns over their cost and reliability in some instances one possible solution to collecting data in remote or unstable locations is to use satellite data. A Netherlands-based firm, EARS has developed a number of projects around the world to measure climatic conditions.

These include monitoring crops and rainfall along the Yellow River in China and assessing grazing conditions in Mongolia through measurements of drought, snowfall and sub-zero temperatures.

However, it is in African countries, where information density is low, where the data is proving to be the most useful and economical. EARS says satellite data from Meteosat is reliable, economical and an abundant data source, providing continental African coverage to a resolution of 3km.

The data is uniform, objective and has a 30-year baseline. It could be key in reducing basis risk for micro insurance by allowing remote claims settlement of crop failure caused by drought.

Relative evapotranspiration

“For the drought index we use relative evapotranspiration,” explains Andries Rosema, general director, EARS.

“This makes a better drought index than rainfall measurements because with rainfall you don’t know where the water is going. Some of the water runs-off, some of it infiltrates to greater depths and moreover there may be a mismatch between the actual rainfall and the growth of the crop.

“We use the relative evapotranspiration because research from the Food and Agriculture organization of the United Nations (FAO) shows it is very closely related to crop growth.

“That’s because when there is limited water, plants can close their pores and they lose less water in this way,” Rosema continues.

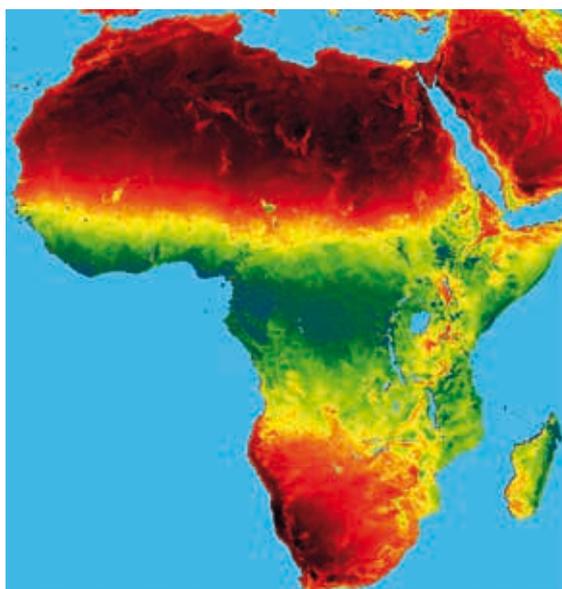
“This is a direct sign of a lack of water but it also means they cannot uptake Co2. Therefore, there is a more or less linear relationship between relative evapotranspiration and relative crop growth.”

As of 2012, the system was being used to support over 23,000 African farmers, from cotton-growers and producers in Benin and Kenya, maize farmers in Mozambique and Malawi, as well as coffee-growers in Rwanda.

EARS maintains a relative evapotranspiration database that covers all of Africa at a resolution of 3km for the last 32 years.

“This is of course a significant period on which we can base an insurance design with a statistical approach. The benefit of our approach is that it can be large-scale. It can cover every farmer and every location in Africa. Wherever a farmer lives we can have a measurement within 3km and, in principle, we can cover every crop.

“We have the tools to do all this monitoring in an efficient way. For large scale projects we can go down to a cost for the farmer of about €0.5, which is only a small part of the total premium.”



Meteosat derived relative evapotranspiration (RE), averaged for the period 2003-2012. Scaled from 0 (black) to 100% (blue). The relative evapotranspiration (RE) is a measure of plant available water and crop growth. Daily and 10-daily RE data are available from 1982 to date. They are used by EARS for crop yield forecasting and index insurance.

Source: EARS



Growth of weather risk management solutions is anticipated in the alternative energy sector

The weather forecast

The impact minor, unexpected fluctuations in the weather can have on a company's financial fortunes will increasingly be viewed as a core risk to business performance. Demand for weather risk management solutions is expected to grow significantly in the future with stakeholders able to reap the benefits of better cash flow stability, more accurate budget management, greater earnings consistency and higher risk-adjusted returns

Weather patterns are changing and are increasingly affecting the global economy. Allianz is witnessing an increase in the number of claims linked to extreme weather events. Significantly, fluctuations in expected weather patterns pose an increasing risk to a company's financial health, potentially impacting revenue streams in a number of different ways.

New technology, new methods of collecting and analyzing data and new solutions are needed and are being utilized in order to alleviate these risks.

Weather risk management solutions provide downside protection to preserve capital and ensure liquidity while improving cash flow stability, allowing for more accurate budget management. Such products can enable greater consistency of earnings.

They can complement existing risk management and transfer techniques and enhance value for the insured.

Meanwhile, shareholders, analysts, lenders, and rating agencies have become increasingly aware of the possibility of including weather protection in a company's risk management.

“A university study examining the effect of the introduction of weather risk management solutions for electric and gas utilities found they result in higher market valuations”¹¹

Companies have a duty to stakeholders to maximize value and if this value is weather-dependent, then although they cannot be expected to control the weather they will increasingly be expected to seek ways of managing that risk.

At the same time this appears to be a message that many chief executives and chief financial officers have yet to fully embrace. Many are familiar with hedging the risks associated with price, currency or interest rate movements but it appears, that in many instances, announcing sales and profits are down because of unexpected weather is still considered to be an acceptable excuse. This has to, and will, change.

A growing number of governments and corporates will have to actively manage weather risks moving forward, with weather increasingly being viewed as a core risk. Excellent risk management in this area will be more and more on the minds of senior management and investors than ever before.

Benefits of weather risk management solutions

- Protect against poor weather conditions
- Better cash flow stability allows more accurate budget management
- Improved returns help equity valuations
- Revenue security allows forecast reliability
- Improved financing and creditworthiness lowers cost of capital
- Extreme downside protection ensures liquidity

“Volatile weather activity is on the increase, as is the awareness of the impact this can have on the financial performance of businesses. Weather risk management tools are effective tools in the risk manager’s armory which can combat growing shareholder concern in this area. We expect to see demand for these products to increase significantly in the future across a number of different business sectors and geographical territories,” concludes Karsten Berlage, Global Head of Weather Risk Management at Allianz Risk Transfer.



Increasing interest from the agricultural sector will also drive growth of weather risk management solutions

Weather solutions – an increasingly important risk management tool

Risks	Tools
Pricing	Future, swaps, options
Property/casualty	Insurance and reinsurance
Credit counterparty	Credit support docs, margining
Foreign exchange and interest rate	Futures, swaps, options
Sovereign/country	Diversification, legal analysis
Operations	Policies, procedures, control systems
Volume of sales	Weather risk management products

Glossary

Basis risk	A different weather measurement at the weather station than the actual weather experience at the risk location
Cooling degree days (CDDs) and heating degree days (HDDs)	The most common measurements for weather risk management contracts, primarily designed to measure cooling and heating demand. For example, the energy sector measures deviations above and below 65°F (18°C) as cooling and heating degree days. Energy producers will seek to use these to protect themselves against warm winters and cold summers
Collar structure	Companies can give up partial upside in order to reduce the price of a weather risk cover. This structure is sometimes referred to as a collar. It reduces volatility and requires less upfront payment than a pure downside protection
Frost Day covers	A cost-control solution whereby purchasers receive an automatic payout if a predefined parameter for the number of frost days experienced is met
Micro insurance	A mechanism to protect individuals and enterprises in developing countries against risk in exchange for payments tailored to their needs, income, and level of risk
Put option	A pay-out from a weather risk management solution is based on a measurable index such as a CDD or HDD. A put option can be used to protect against a lack of wind for example, paying-out if the weather statistic is below the predetermined strike value
Relative evapotranspiration	A measure of plant available water and crop growth. Can be used for crop yield forecasting and index insurance
Strike value	Weather risk management solutions pay out when the underlying weather statistic is above or below a certain “strike” value or trigger
Sunshine guarantee	Used as a promotional tool. For example, a car company may offer this to the buyer of a new vehicle. The consumer is protected against a lack of sunny days during which they are unable to have the sunroof down. Payouts are triggered using data from a local weather station
Synthetic data	Any production data applicable to a given situation that are not obtained by direct measurement

Additional sources

- 1 Allianz
- 2 US Department of Commerce, Federal Aviation Administration statistics
- 3 US 2012 GDP, World Bank, AGCS, National Center for Atmospheric Research (NCAR) and National Science Foundation (NSF) study
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Allianz Risk Transfer Group (ART) is the center of competence for alternative risk transfer business within the Allianz Group. We provide tailored insurance, reinsurance and other non-traditional risk management solutions to corporate and financial clients worldwide. ART Group companies are subsidiaries of Allianz Global Corporate & Specialty SE.

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