Expert Views

Parametric Insurance: A 360° View

Part One of Three

SCOR
The Art & Science of Risk

April 2023

A Parametric Journey

Anyone linked to the (re)insurance industry, whether directly as a risk carrier, an intermediary or a cedant, or more distantly as a service provider, a development agency or a non-governmental organization, has probably heard the phrase "parametric insurance" buzzing around recently. It pops up to varying degrees in discussions on most topics, from closing the protection gap to ensuring the environmental transition toward sustainability. It represents an established market, with parametric solutions used as a hedge in the commodity sector, as cover against catastrophe risks for public assets, or as a volatility cap and cover against drought in agriculture. You have probably heard "parametric solutions" mentioned at all application levels, from microinsurance to corporates and from financial institutions to public authorities. They have gained so much attention that service providers are flourishing, and product development is being fueled by their combined differentiation efforts. The vast amount of parametric data sources available harbor big promises that the virtual world, the index, can holistically represent any risk situation and relieve society of some of its burdens. Parametric is a ubiquitous term in the (re)insurance world, but beyond its promises, do we really understand it?

Pre-Covid, SCOR began providing clients from around the globe with parametric training through its annual SCOR Campus program in Paris. This training, which is still going strong, starts by explaining how all parametric deals use data as a risk metric to compensate (re)insureds for a financial loss, and that while this raises opportunities, it also presents challenges. Since the program first began, we have seen a rising interest in sharing our experience in the field, particularly the hurdles and pitfalls involved.

This three-part series is intended as a guide to the practice of parametric insurance. We begin Part One with an "elevator story", presenting solutions through various examples. While not forgetting the advantages of these, we devote more attention to the challenges they present. We then take a look at legal considerations and the question of insurability.

Our first issue continues with a look at the landscape of parametric insurance. Against the backdrop of climate change, extreme risks are on the rise, and the sustainability of our planet requires an environmental transition. We attempt the difficult task of considering parametric insurance in relation to these essential global objectives. Then, our experts put the digital world under the spotlight to distinguish signal from noise among the many market promises. Finally, before looking at fields of application, we excavate some historical transactions and trace the evolution of parametric insurance, from its beginnings to the present day.

Part Two of our parametric series will present some real-life case studies. Covering commodity derivatives, natural catastrophes, and the lack of protection for natural resources, we will take you through the analysis of a risk situation, and the choice of an index for the design and pricing of a parametric risk transfer.

In Part Three, we will challenge examples of natural catastrophe parametric solutions by raising their shortcomings. We will show the reader alternatives which, in certain situations, are more accurate. And through a basis risk analysis, we will sound out the extreme situations of full payout, or none.

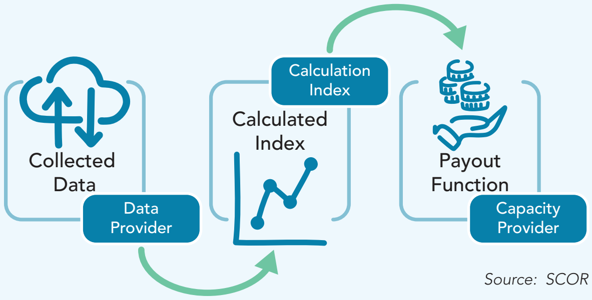
With this series, we aim to equip risk cedants and potentially also a broader public with the necessary tools to explore parametric solutions. We believe that market confidence will be built through an understanding of both the benefits and the flaws of these solutions, thereby allowing players to choose the right products for the appropriate risks.

Parametric in a Nutshell

Definition and Use

A parametric cover is a contract that makes a payout to a beneficiary in the event of an index exceeding a threshold. *Stricto sensu*, it allows providers to create a risk transfer solution without relying on the indemnification of a claim.

Figure 1: Parametric cover main contributors



Source: SCOR

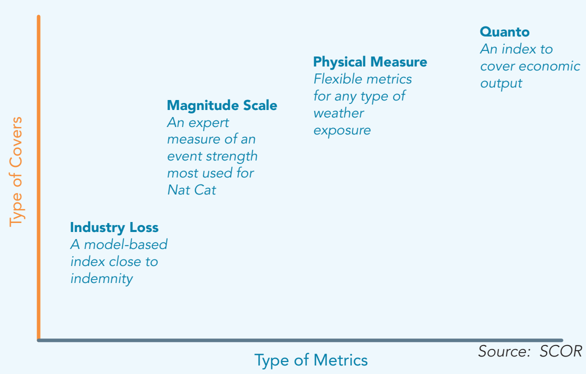
A parametric solution is composed of collected data, a calculated index, and a payout function. A contractually defined calculation process is fulfilled by a calculation agent, based on data collected from a data provider. As we take our first steps into the world of parametric covers here, we will assume that the payout mechanism only relates to pre-defined data and calculation. Questions of insurability, such as proof of loss, will be dealt with in our **Legal Considerations** section on page 6.

As a central element of parametric covers, the index is a metric mirroring the financial loss to which an asset is exposed while facing a given risk. Risks can span the whole range of hazards, from acts of God to acts of man. As illustrated in Figure 2, covers can use metrics ranging from those closest to the loss (lower-left) to more abstract or derivative indices (top-right).

Insurance loss covers for natural catastrophes typically use catastrophe risk modelling and early industry claims information to provide an estimate of market loss. An example is the tropical cyclone and earthquake cover for the provinces of the Philippines. On the occurrence of a hazard, the closest modelled event is searched for via a catalogue. Its return frequency determines which percentage of a nominal value is paid[1].

Second from the left in Figure 2, magnitude scales like the Richter scale are best suited to the coverage of corporate assets in single or just a few sites. The payout is a higher percentage of a given notional amount for increasing event magnitudes. But this approach has also been used for wide exposure areas. As an example, the Pacific Alliance cat bond has applied it to cover against earthquake[1]. The applicability of such an approach will be developed in more detail in the second and third issues of this publication.

Figure 2: Illustrative cover examples



Source: SCOR

As shown in the third group from the left, covers against adverse weather conditions are frequent in the energy and agriculture segments. Their indices typically measure the aggregation of daily or hourly adverse weather conditions, be it temperature, rainfall, or other metrics such as heat[2], windspeed, etc. As an illustration, Heating Degree Day products are derivatives covering against an accumulation of daily temperature

deviations as a proxy for an increased demand for energy in winter (i.e., heating). The cover pays a percentage of a notional amount when the weather index exceeds a threshold over a period of typically three to six months. Mirroring this cover, Cooling Degree Day products are used to hedge against a higher energy demand during summer (i.e., cooling). These products are traded in the energy sector over the counter, on exchanges like the Chicago Mercantile Exchange[3], or on platforms like weatherXchange[4].

At the far right of the scale, financial products like temperature contingent options, also called quantitative options or quantos, add a degree of complexity, by introducing a secondary trigger that leads to a payment for anomalous weather days if commodity prices deviate beyond a dedicated threshold. Whereas the indices mentioned above reflect the weather dependency of electricity production, quantos mirror its economic value by adding a price tag. They are standard products in Australia and other markets[5]. Related case studies will be set out in Part Two of this series.

Before investigating the advantages of parametric solutions, let's consider what is missing from traditional cover in terms of assisting with recovery from business interruption. In 2005, the Orient Express hotel in New Orleans suffered severe damage from Hurricane Katrina and had to close for nearly two months[6]. The hotel had business interruption cover for losses directly arising from damage to the building. Nevertheless, a trends clause required loss adjustments for trends which would have affected the business even if the damage had not occurred. Now, even without damage, the flooded surroundings would have required the hotel to shut down. In the arbitration process, the insured could not prove against the latter argument and the business interruption recovery was nil. It is a counterintuitive thought that the wider the impact of a natural disaster is, the less a business interruption policy will pay. A parametric cover based on the extent of flooding in the surrounding area would have triggered and paid. Business interruption is a significant value proposition of parametric covers, which fills a protection gap.

The flooding surrounding the Orient Express Hotel in New Orleans, 2005.

Advantages

Parametric solutions have found good publicity in insurance reviews and journals. Their advantages are known and range from transparency to lower dispute risk, as per Figure 3. The transparency advantage requires some nuance, however, as it relates to the trigger alone. Payment in the event of a loss is only as certain as the solution design is accurate. We call this uncertainty “basis risk”', a notion close to the empirical error introduced by scientific instrumentation. A careful design strives to limit this risk and ensure an effective payment that matches the actual loss as accurately as possible. This is achieved through attention to contractual details, clarity in the wording, a robust data source, and a clear calculation process. The alignment of payment and actual loss is a key element of insurability, as detailed in our **Legal Considerations** section on page 6.

Figure 3: Advantages of parametric covers

Under such assumptions, the risk of dispute is significantly lowered. Payment relies on data collection and calculation, as opposed to loss adjustment. An appointed calculation agent should calculate the index based on the source data, within a pre-defined calculation timeline, so that the risk taker can be informed of, and review, the payment amount. We typically count 10 to 20 business days after an event occurrence or the end of a coverage period until the risk taker is instructed for payment. If back-up data or re-analysis are required, an adjustment can be made at a later stage. Overall, the lead time to payment is significantly reduced compared to indemnity covers.

With a well-oiled setup, lower expenses should be expected. It’s important to highlight that a perfect solution would lead to exactly the same payout as the actual loss, notwithstanding loss-adjustment expenses. The main cost drivers, i.e., the expected loss and the cost of capital, should be the same as for a traditional solution. Rather than in price, we see the value proposition of parametric covers in the ability to cover uninsured risks. Parametric solutions are, in our view, complementary to traditional covers.

Challenges

A parametric journey is paved with numerous challenges, hidden in the data, the underlying risk and the required expertise. Vigilance is required throughout the design phase to stick to the purpose of the cover.

It all starts with a suitable choice of data. Wildfire covers, as an example, need to capture the development and spread of a fire. Capturing fire intensity with a static satellite image would not fulfil this purpose. A fire that spreads but also burns out rapidly may not actually affect timber production. It may just superficially burn the leaves and leave the wood unaffected. Appropriate satellite technology needs to provide a time series of images. An example would be a comparison of Normalized Burn Ratio before and after a fire, e.g., from Sentinel 2 or Landsat[7].

An index does not hide the underlying risk of a cover. For example, we were approached for coverage against a drop in airport frequentation. While this kind of data may look innocent, the cause of such a drop might not be. It could relate to terrorism or pandemic. The appetite of the risk carrier will always be measured by the underlying risk rather than by the data. Parametric and traditional solutions share the same targets and constraints in terms of pricing and capacity.

In the same vein, solution simplicity does not mean the risk is an easy target. A cat-in-a-circle solution looks simple, with its event triggering within a circle and paying out as a function of its intensity. Nevertheless, its modelling is often challenging. Natural catastrophe models are


Hydro-electric plant during drought.

not best calibrated for point-based exposure, and their storm tracks are not always available. Historical data might be tricky to interpret if close to the threshold but not close enough to verify if simulated events would trigger, which could lead to price arbitrage from the spread in the market view of the risk. The intensity might be expressed in a unit not available in existing modelling tools, as presented in the second issue of this publication. Finally, the accumulation might be challenging to onboard for the risk carrier. All in all, strong expertise is required.

Parametric solutions often sit at the cultural junction between traditional insurance and derivatives trading. A quick turnaround is often expected on subjects that require careful analysis. Whereas weather derivatives are traded by desks set up for a 24-hour response, natural catastrophe covers require thorough analysis of the underlying risk and of the risk transfer solution. The parametric nature of a solution does not guarantee a faster quotation response time by the risk taker.

Moreover, an index is no substitute for a good practical solution. We were approached about a lack-of-rainfall cover for a top-notch power plant, with a steam engine working from solar heat concentrated by a set of parabolic mirrors. No water supply means no steam, however clear the sky. Ultimately, the cost of cover for a lack of rainfall was not competitive compared to the installation of a back-up solution consisting of a water reservoir and a back-up supply.

Another challenge resides in the increasing demand for innovative solutions. Social resilience is a growing concern on the climate change front, and food security is increasingly threatened by geopolitical uncertainty. Economic stability requires resilient public infrastructure, which is endangered by growing climate catastrophes. Agriculture needs to reinvent itself in order to face more frequent and severe droughts, floods and soil erosion, while meeting carbon sustainability targets. To help the public and private sectors to rise to these challenges, the insurance industry is expected to provide *ex-ante* financial solutions. It needs to do this while keeping up with continuous innovations and leveraging available data. Collaboration between various sectors is high on the agenda of both public authorities and economic actors.

Legal Considerations

As we have already seen, parametric products come in all shapes and sizes, and consequently their product design can be very diverse. This diversity in product designs poses its own challenges from a legal perspective, requiring a specific assessment of each product to ensure that it meets all the legal and regulatory requirements applicable to the relevant parametric risk transfer solution. As the relevant regulatory requirements will depend on the jurisdiction where the parametric cover is to be offered, there is no "one-size-fits-all" solution; the analysis will need to be done on a case-by-case basis. For the purposes of this series, we will therefore focus on the general legal concepts and re-occurring themes that form part of the legal assessment of a parametric product.

Generally, parametric products can fall into one of two categories. Either they are classified as (re)insurance products, or they are considered to be financial market/derivative products. As the classification of the product has legal and regulatory implications, it is important to design it in such a way that it meets the classification standards in the applicable jurisdiction. Specific thought must be given to the design of the product, including the trigger applied, as well as to the payout mechanism and the correlation between payout and loss.

When contemplating the type of trigger and trigger point, the specific circumstances need to be considered and aligned with objective probabilities of occurrence. As already touched upon, different types of triggers may be used for parametric products. Some may utilize a single trigger event, like cumulative rainfall that exceeds the pre-defined rainfall index over a set period of time, or an earthquake of a certain magnitude in excess of the pre-determined threshold. Alternatively, parametric products may

require a combination of triggers. For example, they may include an added requirement for the total amount of loss (in the industry or region concerned) arising out of a single trigger event to exceed a pre-determined amount. Using such double triggers would combine some of the purely parametric elements with aspects of subsequent loss adjustment.

Another critical aspect is the payout mechanism. These mechanisms can vary, and may include for example a fixed sum, a staggered amount linked to the intensity of the trigger, or an initial payout with subsequent adjustment, depending on the actual loss sustained. Generally, the closer the payout is to the actual loss incurred, the greater the correlation between loss and payout, and the more likely that the parametric product can be classified as a (re)insurance product. In cases where the initial payout is subsequently adjusted in accordance with the outcome of the loss adjustment process, the final settlement amount should be equal to the loss incurred. For other parametric products, the analysis will depend on the details of the product and the intended coverage afforded.

The design of single trigger products depends first of all on the determination of the trigger itself, as well as the amount of payout. The trigger should generally be set at a level very likely to incur a loss for the protection buyer. In addition, the payout amount should reflect the expected amount of loss for the protection buyer if that trigger threshold is reached. This would also help to determine the protection buyer's insurable interest in the covered risk, which is a requirement in some jurisdictions to qualify cover as (re)insurance, i.e., its insurability. While a small payment amount may increase the probability of the protection buyer actually incurring a loss if the trigger is met, it raises another problem, which we referred to briefly in our introduction. Namely, whether the payout is sufficient to cover the loss incurred by the protection buyer or whether the protection buyer is left with a basis risk.

As already mentioned, whether or not the protection buyer has a direct interest in the risk itself is important for the classification of a parametric product.

Other (soft) indicators for such classification under local laws and regulations may include the identity of the issuer (e.g., (re)insurer or bank), and the naming of the product as an insurance policy, reinsurance agreement or derivative. However, these remain just indicators; they cannot replace the need for a detailed assessment of the product itself.

Once the nature of the parametric product has been determined, this may impact its tax and accounting treatment, as well as the applicable regulatory regime. Consequently, different regulatory and licensing requirements may apply, depending on whether the product is classified as insurance or reinsurance, or as a financial market product. This will also impact carrier management and regulatory restrictions. If, for example, an insurance or reinsurance company wants to offer a parametric product and the protection buyer is looking for a derivative product, then unless the (re)insurer's group of companies includes a designated carrier, or the relevant jurisdiction allows (re)insurance companies to transfer risks via derivatives, the (re)insurance company would generally not be able to provide this cover directly to the protection buyer. In this case, it may be an option to operate through an intermediary structure, but this would incur extra costs and would need to be carefully designed and structured to ensure compliance with all the relevant regulatory requirements. Provided all parties to a potential transaction agree, it may be more appropriate to re-design the parametric product so that it can be classified in a way that meets the regulatory restrictions imposed on the protection seller by the relevant regulator.

Presidential Palace devastated in Haiti earthquake (2010)

A Parametric Landscape

Our journey will now take a broader perspective as we present the backdrop against which parametric solutions operate. This includes the rise of extreme risks, and the environmental transition to combat climate change. We will also take a look at the digital world, as a reminder of the complexity of data handling. We will then consider the history of parametric solutions, before discussing application fields.

Extreme Risks on the Rise

In 2010/11, severe earthquakes caused billion-dollar economic losses in Haiti and New Zealand. In the former, USD 96 million was recovered from donors. But less than 1% of the losses were insured. New Zealand showed completely different figures, as up to 81% of the economic losses were insured[8]. The protection gap is a measure of this proportion of economic loss which is not covered by insurance. It is used to monitor insurance penetration and compare various markets to one another.

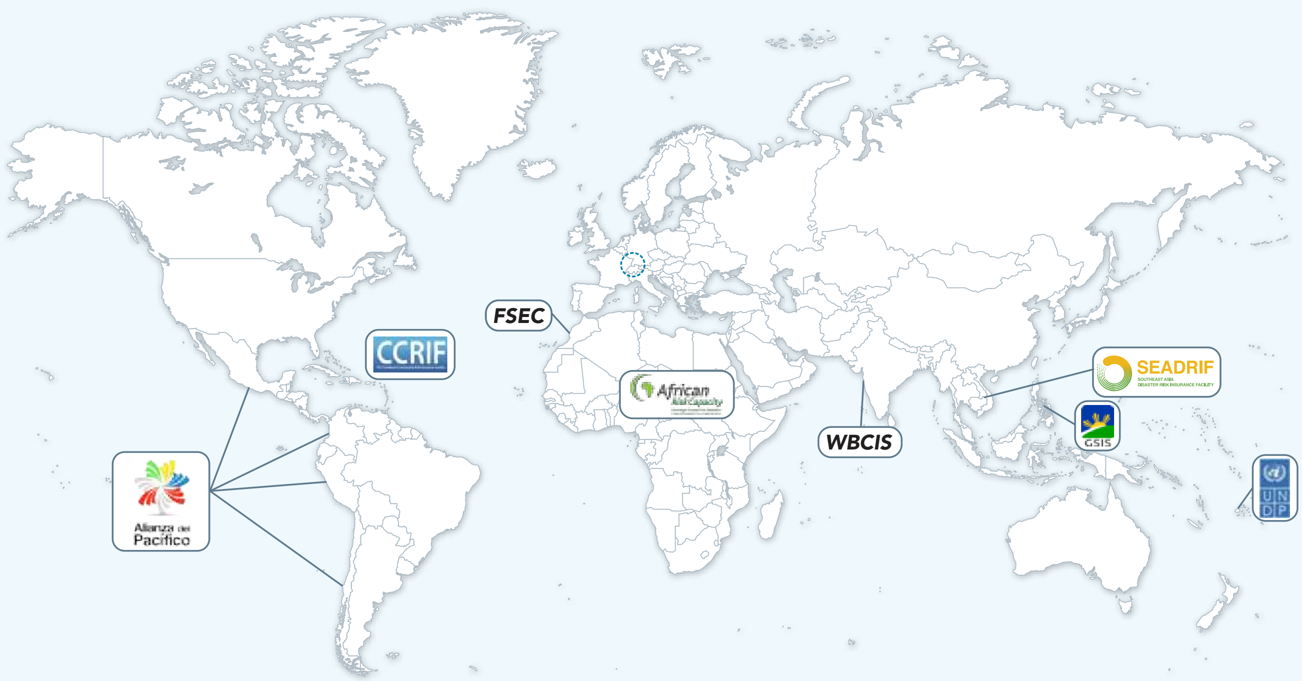
The protection gap becomes even more acute for climate-related perils. At the 2002 Earth Summit in Johannesburg, French President Jacques Chirac stated "Notre maison brûle et nous regardons ailleurs" (Our house is burning and we're looking the other way). A 2021 study on the economics of biodiversity reports that we would need 1.6 planet Earths to support our current level of resource depletion[9]. Sustainability is the challenge of the 21st century for a global population facing climate change. At stake are the resilience of society, biodiversity, and the ability to keep pollution and waste under control before it's too late.

As the main climate-related catastrophes, we can shortlist floods, cyclones and droughts. The resilience of societies depends on their ability to provide ex-ante financial solutions, while governments set up policies to develop insurance markets. We invite you to browse through the webpage of the Principles for Sustainable Insurance for more information on this subject[10].

In both mature and developing economies, rapid payout is a key factor in recovering quickly after a shock. It helps people to rebuild their homes, to maintain their livings and jobs, and to avoid major post-disaster migration or displacement. We can identify a large group of uninsured people or small enterprises at or near the bottom of the social pyramid, who are just one calamity away from sliding into poverty. Following Hurricane Katrina in 2005, for example, we saw 1,800 deaths and disappearances as 1.5 million people migrated away from the city[11]. Parametric solutions are a key component in development programs for vulnerable parts of economies. They can provide coverage where no insurance framework is in place. They address risks which would otherwise be difficult to cover. They guarantee quasi real-time payment, where funding would otherwise take a long time to materialize.

There have been numerous parametric covers against extreme events around the globe. Looking at the map in Figure 4, we can cite the Pacific Alliance covering the Central and South American coast against earthquakes. In the Gulf of Mexico, CCRIF provides cover against hurricanes, earthquakes and excess rainfall. The Solidarity Fund against Catastrophic Events (FSEC) in Morocco is covered by parametric earthquake insurance[12]. The African Risk Capacity provides sovereign members with drought and cyclone parametric solutions[13]. In India, the regulator is strongly encouraging such solutions[14]. The Southeast Asia Disaster Risk Insurance Facility (SEADRIF) insures countries in the region against flood[15]. The Philippine provinces are covered against earthquakes and cyclones by the GSIS program[16], and cyclone cover is also in place in Fiji[17].

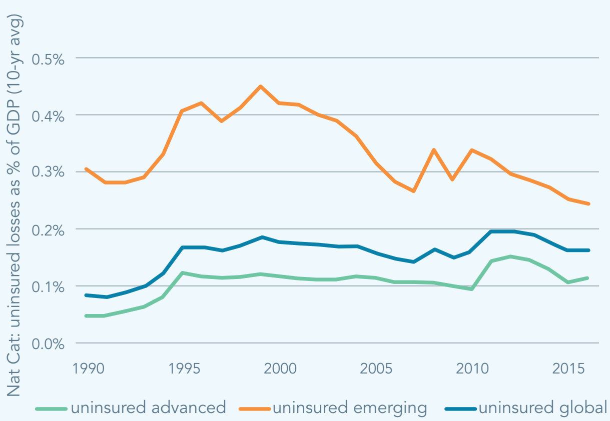
Figure 4: Maps of parametric covers sovereigns



Source: SCOR

Significant parts of mature economies also remain uninsured, as illustrated by the "uninsured advanced" proportion displayed in Figure 5[18]. SCOR recently supported the design and regulatory approval of a cover for Japanese SMEs against business interruption. The cover was parametric, and a key component of its success was the careful analysis of basis risk.

Figure 5: Uninsured losses from natural catastrophes for advanced, emerging economies



Source: International Insurance, 2018

The stability of the financial system is high on the agenda of development agencies. (Re)insurance brokers have successfully addressed this opportunity. As societies become more vulnerable, the ability of the population or the public authorities to honor the cost of their debts is threatened by catastrophic events. This can put the balance sheets of financial institutions under stress, but parametric solutions can help.

As mentioned earlier, collaboration between private and public actors is a key component of insurance development. To this end, the Insurance Development Forum has entered into a tripartite agreement with the United Nations Development Programme and the Insuresilience Solutions Fund (ISF)[19]. Most of the solutions being created under this agreement are parametric, and SCOR is involved in projects in several countries. One consists of a sub-sovereign flood cover in Argentina, to improve the social resilience of municipalities in the Pampa Húmeda. SCOR entered into a grant agreement with the ISF in February 2023 and is taking the lead on the Solutions Design working group.

Environmental Transition

Looking at these societal threats through the lens of sustainability, we now turn to the ESG framework. ESG stands for the environmental, social and governance criteria used to classify the sustainability of companies. While the world moves toward fulfilling the Sustainability Principles listed by the United Nations, companies are under increasing pressure by investors to fulfil ESG criteria by adapting their business models and ensuring that they act responsibly. Over 3,000 investors have signed the Principles for Responsible Investment, which together represent over USD 100 trillion of assets under management[20]. ESG enables companies to show leadership and differentiate their risk management, governance processes, and brand.

The new risks in this changing environment should lead to the need for new risk transfer solutions on the (re)insurance market. One of these changes is the transition toward renewable energies, which are dependent on the variations of weather conditions. Capping the volatility of production and revenue is a natural subject for parametric covers that measure and pay for a deterioration in weather conditions, as discussed earlier in the **Definition and Use** section. Oil platform decommissioning and environmental liability are further subjects which the insurance industry will face in this decarbonization phase. Following in the footsteps of investors, it is now up to the insurance industry to scale up the Net Zero Insurance Alliance and ensure that the first transition objectives are fulfilled by the end of this decade[21].

Inclusive insurance is also a catalyst for parametric solutions, and *vice versa*. Providing access to vulnerable populations in need of better health coverage and holistic insurance cover is a significant challenge. Parametric solutions are seen by insurance actors as a go-to product to promote inclusive insurance.

A Digital World

The reader might be familiar with the scenario of planning a weekend out of town and then, on arrival, experiencing heavy rain where good weather was forecasted. Our lifestyle is increasingly dependent on digital information, whether accurate or not, and primary insurers are becoming more and more aware of the need to align their products with the fast-paced lives of their customers. Our entire economy relies on data, as whole supply chains are optimized according to weather-related demand fluctuations or disruptions. Here, we present the source and usage of data relevant to parametric solutions.

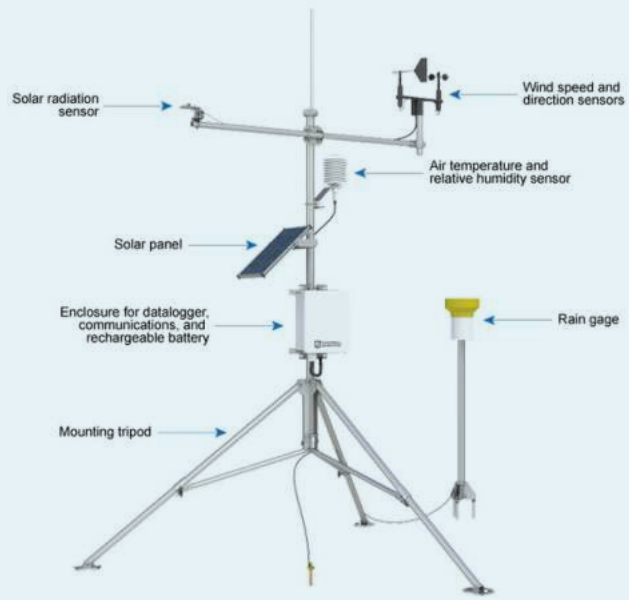
Point Measurements

Weather stations provide data for transactions that rely on information recorded at a specific geographical point. In the energy sector, they can mirror the demand for electricity in a specific region. They can also be used for agricultural purposes, for example measuring atmospheric conditions and rainfall on a field. In the renewable energy sector, they may be used to measure wind or solar irradiation.

Consequently, weather stations carry the heavy responsibility of ensuring accurate and reliable data that is fit for purpose. All devices can fail. The importance of their reliability means that repair and backup processes must be available to reduce any gaps in their operations. The urgency criteria for data used to monitor an industrial facility and data used to monitor a financial product are not the same.

These products cannot wait until the next scheduled maintenance for measurements to resume. Devices used to warn against overheating systems will not meet the requirements of a financial instrument, for which a tenth of a degree represents thousands of monetary units.

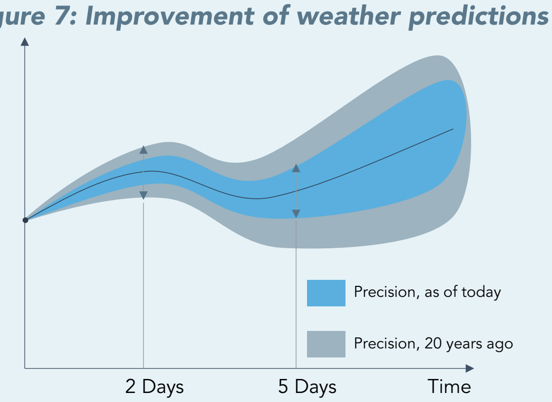
Figure 6: weather station measurements in line with WMO scientific standards.



Source: contribution by Speedwell

The accuracy of weather stations can also be impacted by the surrounding environment, and we explain in our subsequent issue how urban development can affect data. This brings us to the historical depth required for risk analysis. A reliable data provider should be sophisticated

Figure 7: Improvement of weather predictions



Source: World Meteorological organization

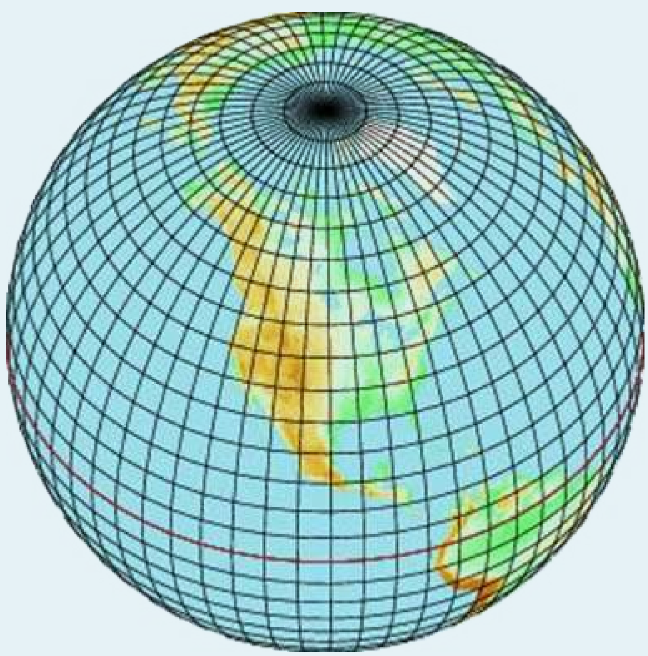
enough to clean up and recalibrate data to account for changes in devices and the surrounding environment, and to fill in measurement gaps. They should ensure that proper maintenance and back-up systems are in place. And that brings us in turn to evaluating the cost of installing a weather station. Energy traders rely on meteorological stations that have been in place for decades. Their costs are limited to data subscription fees. A construction site, however, requires a dedicated weather station. Its location and its accessibility will determine the cost not just of installation, but also of monitoring and maintenance.

Reanalysis Data

Another family of data – reanalysis data – is obtained by aggregating various sources. This data is blended, using physical models to interpolate its measurements and carefully align it on a regular grid[22]. Reanalysis data brings the best of both worlds, in terms of ground and satellite devices, to locations left behind by the digital revolution. Its information granularity spans from tens of kilometers to less than one, opening the door to financial solutions in uncovered areas.

Reanalysis data also provides further advantages. The various sources deliver an inherent back-up and a guarantee of measurement. The blending approach follows a proven methodology, providing data with consistency. It ensures transparency across borders, without certification or due diligence on point-based data measurement devices.

Figure 8: Illustration of gridded re-analysis data



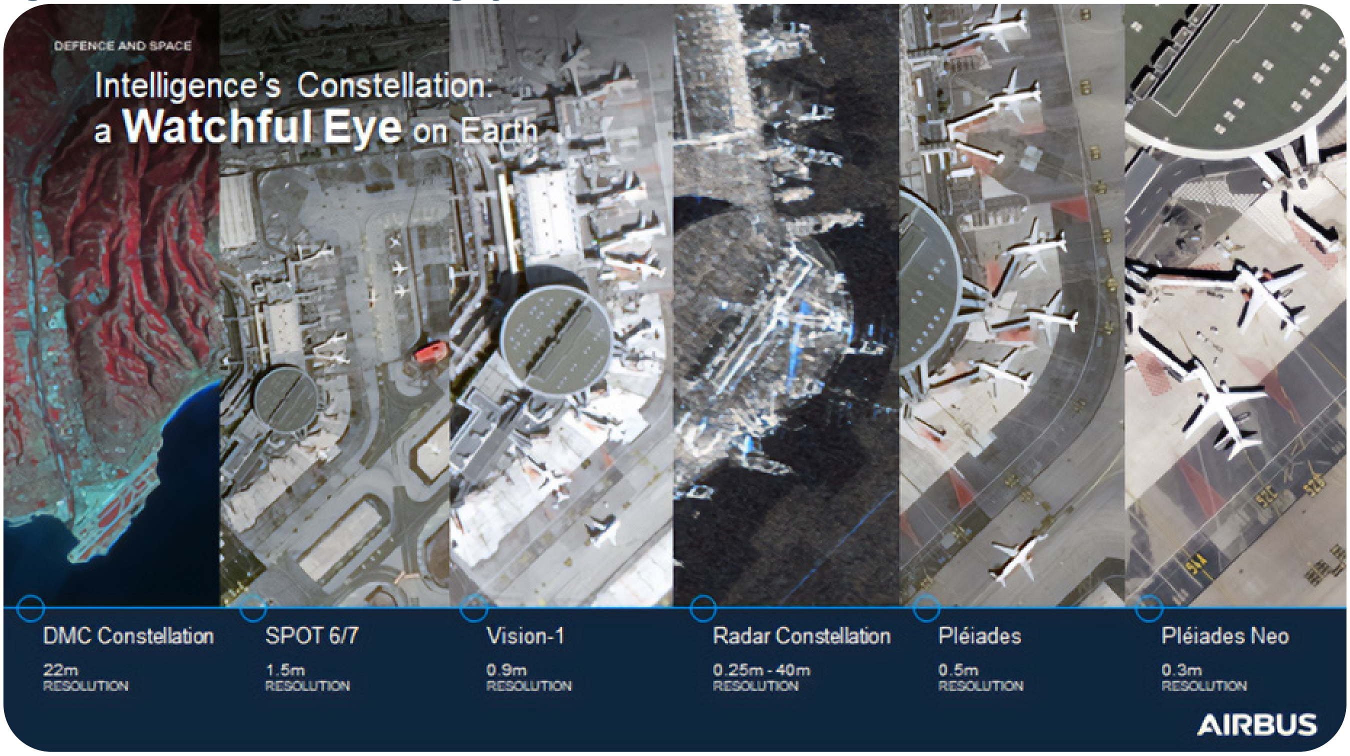
Source: contribution by Speedwell

Data Accuracy

The trio of science, technology and data has driven the evolution of our digital world for decades. As displayed in Figure 9 below, a 22-meter granularity by the DMC Constellation was considered top-notch 20 years ago. At the bottom of the picture, the tarmac of an airport can clearly be distinguished. Spot 6/7[23] and Vision-1, launched between 2012 and 2018[24] brought satellite imagery down to a resolution of one meter. Airplanes are clearly visible and their position precise. Pléiades Neo, first launched in 2021, has reached a resolution of 30 cm[25], capturing images down to the level of the maintenance and logistics vehicles servicing the airplanes.

According to the World Meteorological Organization, weather forecasts are entering a new era with the successful launch of the Third Generation Imager in December 2022[26]. The satellite MTG-I1 is equipped with new instruments able to capture lightning observations. As a precursor to severe weather, they can support anticipatory measures like the UN's Early Warnings for All action plan .

Figure 9: Resolution of satellite imagery over two decades



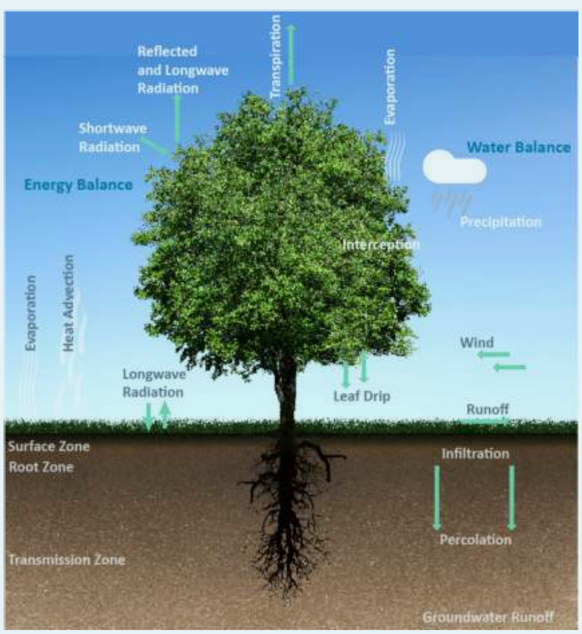
Data Adequacy

We have an abundance of data at our disposal, but should we be paying more attention to which data we use, and how?

Using the case of wildfires as an illustration, burn ratios can be calculated from satellite images taken by Sentinel 2, with resolutions as low as ten meters[27]. Given the gigantic spread of wildfires, this is more than enough to pixelate the hazard area. However, the information obtained is only as useful as the extent to which the exposure is recorded and shared. With sufficient exposure granularity, a parametric product can be as precise as to capture the effects of fire confinement and the vulnerability of tree species.

In our third issue, we contemplate "out of the box" parametric solutions. These strive to leverage state-of-the-art information on a hazard, in order to reduce basis risk. Our studies show how sensitive parametric products are to position imprecision as low as two to five kilometers. In an "out of the box" solution, a one-kilometer granularity on the hazard map is cross referenced with the detail level of the exposure. When insurance data is not available, this means comparing several sources of information such as government censuses and population density[28].

Figure 10: Variety of drought-related variables



Source: Webinar by the World Bank Group and the International Research Institute for Climate and Society June 15/16 2020

The Next Generation Drought Index is an exchange platform led by the World Bank, with the aim of developing parametric indicators suitable for use in agriculture microinsurance[29]. The Next Generation Drought Index webinar held in June 2020 highlighted the plurality of data sources actually available, such as rainfall information from local weather stations or radar measurements, and evapotranspiration indices from satellite images sensitive to various wavelengths. The webinar underlined the attention required when using these sources. It showed how crowdsourcing can be used to cross reference indices with direct information from farmers about affected crops. The overall information examined during the event was used to assess the level of convergence between index triggers and the actual need for coverage, and showed how the data formats under study have responded differently to various historical droughts.

Amid the abundance of data around us, solution developers should pay attention to the adequacy of data for hazard and exposure alike, and to the suitable use of such data in terms of the actual purpose of the cover.

Parametric Founders

We hope to have conveyed a good overview by now of what parametric covers are and the challenges and opportunities they are facing in today and tomorrow's world. One question we have not yet addressed is: are such solutions really new?

The oldest parametric insurance in our modern records is a rainfall cover provided by Allianz back in 1953. It was a commercial success, with close to EUR 2 million premium in the first two

years. However, it was discontinued in 1967 after suffering technical loss. In 1985, Chubb covered farmers against drought for a sum insured of more than USD 350 million. This cover was also a commercial success but was discontinued due to underwriting issues.

In 1992, Hurricane Andrew set the reinsurance sector on a new track. New companies were set up in Bermuda to cope with the lack of reinsurance supply. Investors injected them with USD 4 billion of capital in a little less than two years. But first and foremost, a new asset class emerged called Insurance-Linked Securities, with the first catastrophe bond issued in 1994.

The 90s saw the birth of weather derivatives, with a Cooling Degree Days contract issued by Aquila Energy to cover New-York based Consolidated Edison against the risk of a cooler than expected August. One year later, the risk of a warm winter from the strongest El Niño event on record was covered by the first Heating Degree Days contracts. In the last year of the millennium, a Japanese ski resort used parametric cover as protection against a lack of snowfall.

Energy hedges were flourishing by the turn of the millennium. Koch Energy issued the first weather bond, named Kelvin Ltd, providing cover to a diversified portfolio of around USD 350 million worth of weather derivatives in the USA. The actors behind these activities founded the Weather Risk Management Association (WRMA). SCOR hosted the WRMA's annual European conference in Autumn 2022.

The promise of big data has spread throughout the world over the past decade. Ex-Googlers democratized weather derivatives with an online trading platform that eventually became The Climate Corporation, focusing on precision agriculture. The severe drought that hit the Corn Belt in 2012 was a great promoter of such products. New initiatives spread across the globe as the World Bank launched its Global Index Insurance Facility and the African Union established its African Risk Capacity. We can now count numerous MGAs and service providers entering the parametric segment with their specific value propositions.

Now, the time has come for extensive collaboration within the industry to address the needs humanity is facing in terms of **Extreme Risks on the Rise** *(as seen on page 8)* and the **Environmental Transition** *(as seen on page 10)*. As we have already seen, the enablement of parametric cover will be key to fulfil the sustainability and net-zero objectives of this decade.

Application Fields

Our parametric tour has already guided us through numerous examples and applications, from protecting public infrastructure to supporting sovereign states exposed to climate disasters. We can also add microinsurance and supporting microfinancing institutes to counter the exposure of small farms, and small enterprises in general. Large corporates are also parametric cover clients, to protect themselves against revenue volatility or property damage. We presented commodity trading in **Definition and Use** *(as seen on page 3)* as a cornerstone of parametric solutions. The tourism industry is frequently pitched by parametric providers to cover physical assets as well as access to facilities. We also mentioned the renewable industry in the context of the net-zero transition.

New risks are emerging too. The Danish Red Cross recently launched a volcano catastrophe bond triggering on plume height and wind speed[29]. Pandemic remains a difficult risk for parametric insurance in terms of seeking swift payment, as its insurability is debatable. Cyber is an innovation area for which cover can be provided, for example against cloud outage, or ransomware.

Many parametric solutions have an ESG flavor. Some of them directly address biodiversity protection, such as the recent wildlife conservation bond by the International Bank for Reconstruction


Yucatan coast

and Development, which should help South Africa to conserve endangered species. Also known as the Rhino Bond, it enables the private sector to invest in the public good and contribute to an increase in the rhinoceros growth rate[30]. The Mesoamerican coral reef bond developed by Swiss Re should help the Mexican government to protect the coast of the Yucatan Peninsula, by rapidly disbursing funds after a severe storm to deal with reef damage[31].

Key risk players, the capital markets provide billions of dollars of capacity through parametric solutions in the form of cat bonds. Generally speaking, investors have had an appetite for modelled peak perils with a broad consensus on the underlying risk, and hence very high transparency. This appetite is still there, but with the rising importance of sustainability principles, cat bonds are also being used to cover social resilience or environmental biodiversity, as mentioned above. Due to the need for diversification, we can expect cat bonds to extend their coverage to non-peak perils.

Reinsurers like SCOR do much more than provide capacity to direct insurers. They bring extensive know-how in terms of available solutions and their applicability. Their advice on market appetite is particularly valued. In our experience, the quality of the solution directly impacts the quality of the securities engaged behind capacity. In particular for sovereign programs, rushing into an inadequate solution can lead to capacity providers with a non-transparent retrocession scheme and low credit worthiness. From another angle, insurance companies are suffering from increased retention on their natural catastrophe programs.

This has mainly been driven by the increased price of reinsurance capacity, the rising frequency of natural disasters, and the uncertainty surrounding claims costs as inflation grips the global economy in the wake of Covid-19. SCOR has provided parametric reinsurance to its clients to offset operational costs within their natural catastrophe retention. As weather patterns lead to more frequent and severe losses, the balance sheet of primary insurers is put under stress. Parametric products can cover such patterns and help close the protection gap by avoiding the costs related to inflation risk, while capturing frequency deviation. Insurers target corporates for parametric coverage, with beneficiaries spread across all sectors. The traditional energy sector has benefited from derivative hedges for more than two decades, and in recent years providers have also begun to target the renewable energy sector. This sector still struggles to buy *ex-ante* financial cover to smooth its inherent weather-related production volatility.

We believe that such cover should be considered at the planning phase, so that investors can factor in the benefits of protection within their economic return expectations. Other industries like construction, transportation and leisure are also good candidates for, or buyers of, parametric cover. However, we have observed that such covers are not always renewed when they do not meet the targeted recoveries. One solution could be to create a joint offering alongside traditional solutions, focusing on complementary benefits rather than price competitiveness. Retail businesses sit on abundant customer data, and their entire supply chains are fine-tuned to consumption behavior. They are exposed not just to business interruption and loss from natural catastrophes, but also to revenue volatility driven by weather patterns. Both risks can benefit from parametric cover.

Direct parametric insurance generally comes about through in-house strategic development, or as a result of insurtechs partnering with capacity and distribution providers. Both product routes rely on significant investment in the future value of a nascent business segment.

Focus on Agriculture

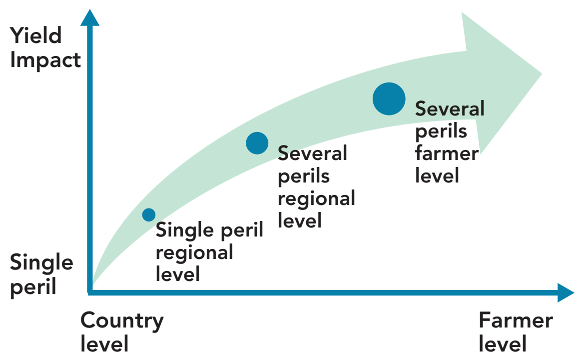
In another ESG-related area, securing and stabilizing farmers' income is a social priority. However, agriculture insurance remains a resource-intensive line of business. To be sustainable and appealing to farmers, products must be affordable, provide comprehensive cover, and be well understood. As most farmers are working in a low-margin and high-risk segments, governments often contribute to their cover with premium subsidies.

For decades, the insurance industry has been working on parametric solutions as a tool to reduce the agricultural protection gap. The scarcity of relevant historical data, combined with the complexity involved in covering living species, has significantly challenged the development of such solutions. Nevertheless, over the last 10 years we have observed the development of several new programs based on parametric solutions. The Weather based Index and the Area Yield based Index covers have been providing Indian farmers with crop protection since 2014[33]. The index approach overcame cost and access challenges in India, unlocking access to financing for small farms in the country and making loss adjustment possible for millions of smallholder farmers with an average landholding of one hectare.

There has been speculation that parametric solutions would take over and replace the traditional covers in place for over a century. This is a misconception.

As with any tool, parametric products can be extremely powerful when used appropriately. They can complement traditional products when traditional methods become too difficult or costly. However, we should remain vigilant and resist the temptation to see parametric solutions as a magic bullet fitting all situations and solving all challenges. One key parameter for these solutions is their application level. A microinsurance product covering individual farmers is more sensitive to local weather impacts than a country-wide cover. Another parameter is complexity. Cover to protect pasture can be designed accurately; but crop yield involves a higher degree of complexity, which is more difficult to encompass within an index. Both parameters can contribute to a potential mismatch between payout and actual financial loss. This basis risk is hidden in the details of a parametric design. It requires particular attention, and communication with the beneficiaries of the cover.

Figure 11: Growing complexity of agriculture cover by peril focus and beneficiary scope.



The key challenges of traditional insurance, namely the need to reach out to potential customers, to build trust and to get their buy-in for proposed solutions, are just as relevant for parametric insurance.

During the Spring and Summer of 2022, France, like many parts of the globe, suffered from extreme heat stress. The Temperature Humidity Index (THI)[34] reached unprecedented levels of beyond 75[35]. Among the affected, dairy cows were particularly sensitive. Above a THI of 68, they cannot regulate their temperature. Their health is likely to suffer, along with their productivity.

Milk producers suffered from a fall in production, both quantitatively and qualitatively. Measures were taken to reduce the stress of the livestock by adjusting food sources, increasing water supply and providing cooling barns. The cost of these measures added to the economic distress, as did the prolonged effect on the cows' health.

SCOR has partnered with Skyline Partners and Intelligence Technology Knowledge (ITK) to launch the first climate insurance product to protect dairy farmers against economic losses due to heat stress in livestock: Heat Stress Protect (SCOR, 2021). It is based on an index calculation of economic losses when temperature and humidity conditions are unfavorable for the herd. With Heat Stress Protect, farmers receive financial compensation in the event of an exceptionally hot year.

Heat Stress Protect automatically retrieves the gridded weather data of the farm micro region and notifies the farmer if the conditions are in place to receive compensation at the end of the year. The warranty comes with additional services designed to help farmers predict heat stress, to proactively adapt their management, and to measure their farm's resilience to this risk.

In 2021, ITK embedded Heat Stress Protect in its Farmlife® herd monitoring system to benefit 50,000 connected cows in France. In 2022, the number of covered cows has increased to 75,000. The coverage has already provided farmers with precious recoveries following the 2022 heatwaves.

The parametric insurance offering stretches beyond coverage to include risk analysis, advice and knowledge sharing. When one company shares its research and development with others, the whole industry benefits. This is the idea behind our Campus training courses, and indeed this publication.

Parametric (re)insurers and brokers are all working toward the same goal: to bridge the protection gap in vulnerable societies, e.g., in the Insurance Development Forum (IDF) projects. This contributes to the development and spread of knowledge not just for protection buyers, but also for risk takers, distribution networks and supporting agencies.

Real-Life Case Studies

There is no substitute for experience. After this short introduction to parametric insurance and our voyage across its rich landscape of rising risks, environmental transition data and various application fields, we will be focusing on some very concrete, real-life examples.

Our second issue will contemplate three parametric case studies. Starting with the risk situation involved, each case study will guide you through the development of a parametric design and explain how the solutions are modelled and priced, before depicting the lifetime of a contract until its expiry.

The third and final issue in the series will address the challenges of plain vanilla covers, introducing event-map parametric solutions after a run-through of parametric mishaps. We will take the examples of earthquake and tropical cyclone covers, and show how to improve them, including a modelling approach and an analysis of basis risk.

We hope with this first issue to have raised your interest in the emerging realm of parametric solutions. They certainly address the needs of our changing risk universe, although much still remains to be done.

References

1. The World Bank Treasury. (2019, 4 1). CASE STUDY Super-sized Catastrophe Bond for Earthquake Risk in Latin America. Retrieved from worldbank.org
2. Wikipedia. (2022, 12 30). Heat index. Retrieved from en.wikipedia.org
3. CME. (2023). Weather Products. Retrieved from cmegroup.com
4. Speedwell Climate Ltd. (2023). weatherXchange. Retrieved from weatherxchange.com
5. Lange, N. (2013). Pricing and Hedging Energy Quanto Options. Essen, Germany.
6. Orient Express Hotels Ltd v Assicurazioni General SA (UK Branch), 2009: Folio 1679 (Queen's Bench Division (Commercial Court) 05 27, 2010).
7. USGS. (2023). Landsat Normalized Burn Ratio. Retrieved from usgs.gov
8. Political Champions Group. (2013, 09 22). Initial Market Assessment - Country Scoping Note: Hait. Retrieved from worldbank.org
9. Dasgupta, P. (2021). The Economics of Biodiversity. London: UK Government.
10. UNEP. (2023). Principles for Sustainable Insurance. Retrieved from unepfi.org
11. US Department of Labor. (2009). Going Home after Hurricane Katrina. BLS Working Paper.
12. FSEC. (2022). Fonds de Solidarité contre les Evénements Catastrophiques. Retrieved from fsec.ma
13. ARC. (2023). African Risk Capacity. Retrieved from arc-omt
    Brönnimann, S. (2005, 12). The global climate anomaly 1940-1942. Weather, pp. 336-342.
    Carr, M. K. (2011, 07 01). The water relations and irrigation requirements of oil palm. Cambridge University Press, pp. 629-652.
14. WBCIS. (2023). Weather Based Crop Insurance Scheme. Retrieved from india.gov.in
15. SEADRIF. (2023). Southeast Asia Disaster Risk Insurance Facility. Retrieved from seadrif.org
16. The World Bank Treasury. (2019, 3 12). The Philippines: Transferring the Cost of Severe Natural Disasters to Capital Markets. Retrieved from worldbank.org
17. UNDP. (2021, 09 2). New insurance product to aid fight against cilmate change in the Pacific. Retrieved from undp.org
18. International Insurance. (2018, 03). TheNatural Catastrophe ProtectionGap:Measurement, root causes and ways of addressingunderinsurance for extreme events. Retrieved from internationalinsurance.org
19. IDF. (2021, 08 27). The IDF, UNDP & BMZ Tripartite Programme: Increasing insurance protection in climate-exposed countries. Retrieved from insdevforum.org
20. UNPRI. (2023). Principles for Responsible Investment. Retrieved from unpri.org
21. UNEPFI. (2023). Net-Zero Insurance Alliance. Retrieved from unepfi.org
22. ECMWF. (2020, 11 9). Fact sheet: Reanalysis. Retrieved from ecmwf.int
23. Airbus. (2023). The SPOT constellation: Get 1.5m native resolution imagery now. Retrieved from intelligence-airbusds.com
24. ESA. (2023). Vision-1 Instrument. Retrieved from earth.esa.int
25. Airbus. (2023). Pléiades Neo. Retrieved from intelligence-airbusds.com
26. WMO. (2022, 12 14). Weather forecasting enters new era. Retrieved from wmo.int
27. Alcaras, E. (2022, 04 03). Normalized Burn Ratio Plus (NBR+): A New Index for Sentinel-2 Imagery. Remote Sensing.
28. European Commission. (2023). Global Human Settlement Layer. Retrieved from ghsl.jrc.ec.europa.eu
29. The World Bank. (2020). World Bank Next Generation Drought Index. Retrieved from esa.int
30. 30 / Reuters. (2021, 03 22). Danish Red Cross launches volcano catastrophe bond. Retrieved from reuters.com
31. The World Bank. (2022, 03 23). Wildlife Conservation Bond Boosts South Africa's Efforts to Protect Black Rhinos and Support Local Communities. Retrieved from worldbank.org
32. Swiss Re. (2022, 05 17). Designing a new type of insurance to protect the coral reefs, economies and the planet. Retrieved from swissre.com
33. Indian Ministry of Agriculture & Farmers Welfare. (2023). Pradhan Mantri Fasal Bima Yojana. Retrieved from pmfby.gov.in
34. American Meteorological Society. (2023). Temperature-humidity index. Retrieved from glossary.ametsoc.org
35. SCOR. (2021, 09 15). Launch of 'Heat Stress Protect' insurance to protect dairy income from climate change. Retrieved from scor.com

This article was written by:

Stève UDRIOT
Senior Underwriter Alternative Solutions
sudriot@scor.com

Co-authors:

Iakovos BARMPADIMOS
Senior Agriculture Risk Modeller
ibarmpadimos@scor.com

Alexander BOSCH
Senior Legal Counsel
abosch@scor.com

Ismael RIEDEL
Senior Cat Analyst
iriedel@scor.com

Fanny ROSSET
Alternative Solutions Deputy CUO
frosset@scor.com

Liu YE
Catastrophe Risk Manager
lye@scor.com

Contributors:

Henry BOVY
Accumalation Team Property Lead
hbovy@scor.com

Henri DOUCHE
Product Development & Innovation CUO
hdouche@scor.com

Michael WOBST
Alternative Solutions Senior Pricing Actuary
mwobst@scor.com

Julien GALZY
Advisor to the CEO
jgalzy@scor.com

Please feel free to visit us at scor.com

SCOR SE
5 avenue Kléber - 75795 PARIS Cedex 16
France
scorglobalpc@scor.com

The Art & Science of Risk

April 2023