PARAMETRIC INSURANCE OVERVIEW AND PERSPECTIVE IN THE GULF

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Parametric Insurance: A growing need in the face of climate change

Climate change is causing an increase in weather anomalies

x5 Increase in the frequency of weather anomalies over the past 50 years*

3/4 Of companies are considered “weather-sensitive”**

20% The overall cost of risks associated with climate change represents between 5% and 20% of GDP***

**Source : World Health Organization, GIEC*
*** Weather-sensitive: company’s revenues or profits are affected by meteorological conditions*
**** Source : Stern Report*

Some examples of weather-sensitivity by industry

TEMPERATE SPRING:
DEMAND FOR AC DECREASES – FALL IN REVENUE FOR SUPPLIERS

EXCESS RAIN AND DROUGHTS:
DIRECT IMPACT ON AGRICULTURAL YIELDS, RESULTING IN SEVERE FAMINES

EARLY SUMMER HEAT:
CAN CAUSE DECREASE IN HOTELS BOOKINGS

Agriculture
Food & Drink
Construction
Retail
Energy
Tourism
Transport

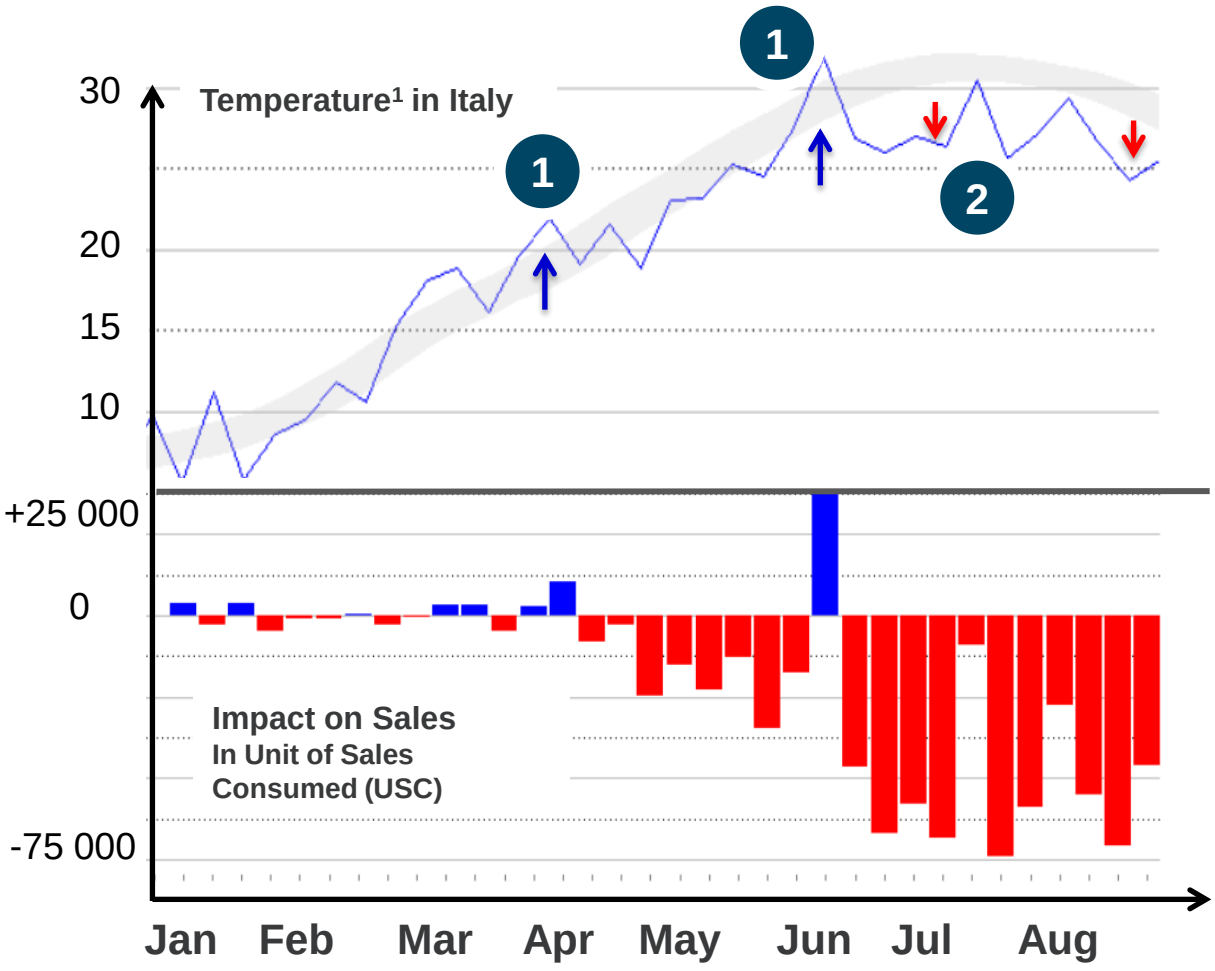
HOT AUTUMN/SPRING:
CAN CAUSE DECREASE IN AMUSEMENT PARKS FREQUENTATION

WARM SPRING IN EUROPE:
DECREASE IN GULF AIRPORTS FREQUENTATION AS PEOPLE STAY AT HOME INSTEAD OF TRAVELING

WET/HIGH HEAT:
CAN CAUSE WORK INTERRUPTIONS, DELAYS IN POURING CEMENT

COLD AND SNOWY:
IN THE AIRLINE INDUSTRY, CAUSES FLIGHT DELAYS AND CANCELLATIONS, AND REQUIRES DE-ICING PRODUCTS

Example of the weather sensitivity of an Italian drink distributor



This distributor's weekly sales of soft drinks largely depend on temperature

1 **Temperature increase: an abnormally warm period increases the sales volume over 2 weeks in April and 1 week in June**

2 **Temperature decrease: global sales decrease between May and August due to abnormally cold temperatures**

1. Daily maximal temperature


A new approach to protect companies is made possible thanks to parametric insurance and weather-based indices that are more and more numerous and specific.

How does Parametric Insurance work?

Parametric insurance fundamentals

- Parametric insurance is based on the use of a parameter (typically rainfall, temperature, or agricultural yield per hectare) that is correlated to the loss (e.g. decrease in revenues or profitability)
- The payment amount is fixed in advance in the insurance contract

- **Parametric insurance, with its tailor-made approach, provides covers for individuals, large companies and international institutions.**
- **As it is based on an independent variable, there is no need for loss adjusters.**
- **This leads to very low claims handling costs.**

ANALYSIS — **Analysis** of the company's weather vulnerability

COVER — **Cover:** design of an insurance adapted to the needs of the company

PAYMENT — **Payment:** payment triggered within a few days and based on certified weather data

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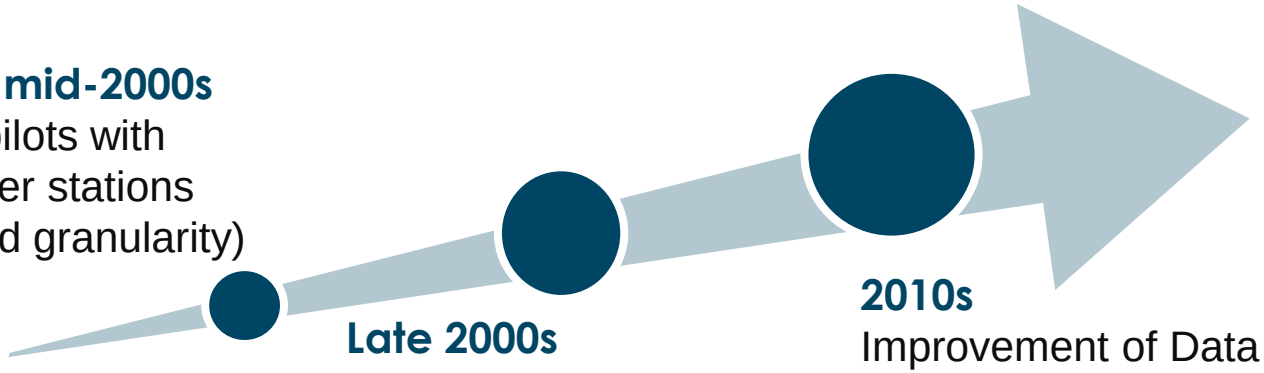
Parametric Insurance: Where are we coming from and where are we headed?

Parametric insurance originated in the 2000s and owes its growth to technological improvements



Up to mid-2000s
First pilots with weather stations (limited granularity)

Late 2000s
Increased use of satellite imagery

- **Increased granularity of weather data**
- **New types of data beyond weather**

2010s
Improvement of Data science

- **Processing of Big Data allows for advanced analysis of images used for underwriting and risk monitoring**
- **More satellite data expertise**

This trend is expected to persist…

More satellites

- E.g. Sentinel satellites: a multi-satellite project to be launched from 2014
- Missions include satellite radar and super-spectral imaging for land, ocean, and atmospheric monitoring
- Timeline: 6 satellites expected to be launched between 2014 and 2021

+

New Data Processing Methods

- AXA Data Innovation Lab: storage capacity, software and techniques, computation capacity

Reasons for an increase in demand for parametric insurance

BEFORE 2000

- **Low claims handling costs**: traditional indemnity based agricultural insurance in poor countries requires up to 40 points in claims handling costs (<1ha) against 4-6 points in mature markets. Parametric insurance requires close to 0 points.
- **Low distribution costs**: leveraging of existing networks

- **Considered default insurance for agriculture in poorest countries as it is one of the most affordable options**

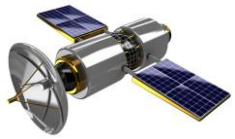
TODAY AND FUTURE

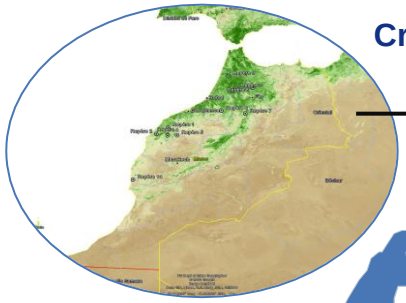
- **Specific to HGM**: the use of parametric insurance by the World Bank, the United Nations (African Risk Capacity) and other international institutions to tackle food security issues in emerging markets and more globally protect countries against weather risks
- **New fields of application**: beyond insurance and reinsurance specialists, the growing capacity to process Big Data (including satellite imagery) has led to Big Data specialists to seek out new applications for agriculture and weather-sensitive companies but also Nat Cat.
- **Lower basis risk** : improvements in satellite imagery resolution lead to more accurate modeling and thus lower basis risk.

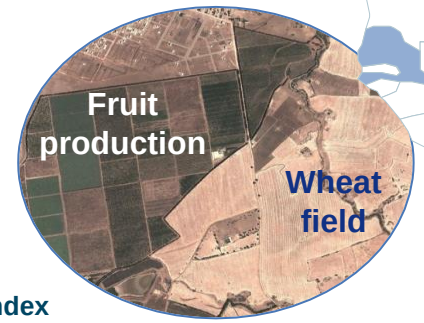
- **Becoming the preferred option for other reasons**

Demo in the MEA region: Wheat crops in Morocco

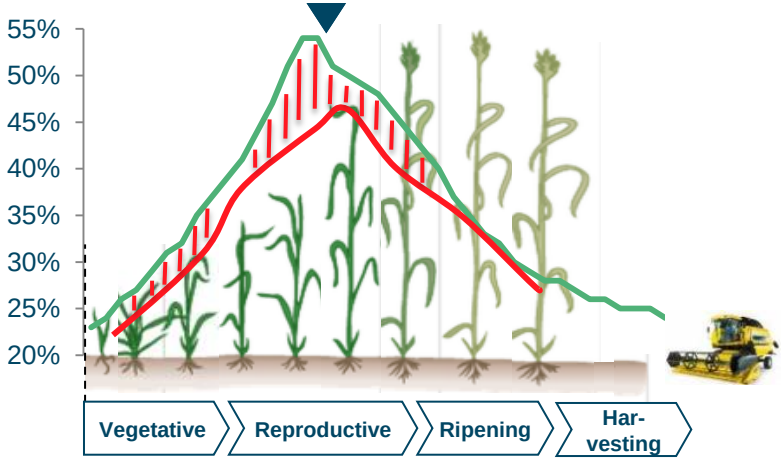
- **Crop selection through map overlaying**
  - Administrative area
  - Land use
  - Crop field selection
  - Geocoding and “vectorization”
- **Data loading**
  - Rainfall data
  - Vegetation data
  - 500 Go database for Africa only
- **Premium calculation**
  - Data loaded in pricing tool
  - Risk analysis and premium calculation
- **Types of information:**
  - Weather data: Rainfall Estimate measured every 5 days with 8 km of resolution
  - Vegetation data: captured by satellites with 250m of resolution







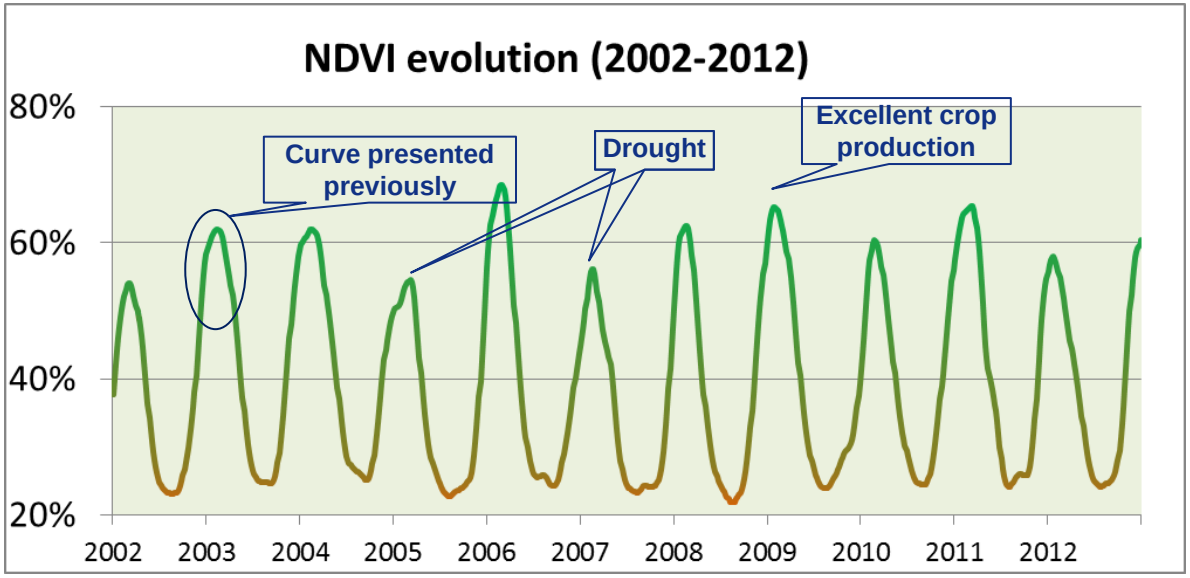
Vegetation index



Development Phases

Demo in the MEA region: Wheat crops in Morocco

- **Example of results**
  - → Annual yield over the last 12 to 30 years for the selected crop fields
- **Conclusion**
  - → Vegetation indexes work well but should be carefully selected, e.g. according to the topography and the type of crop



With all the parameters available, the possibilities are boundless… some examples:

- Early summer heat: loss of revenue in Hotels and Amusement parks
- Temperate spring: decrease in Air Conditioning consumption leading to lower revenue for suppliers as well as Water production companies
- Cloudy weather can affect Solar Power production
- Warm spring in Europe: loss of revenue in Airports and Airlines in the Gulf, as people would stay at home rather than travel abroad
- But also cost-effective micro-insurance in Africa especially for Agriculture
- …and many more!

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Parametric Insurance: Specific modeling choices

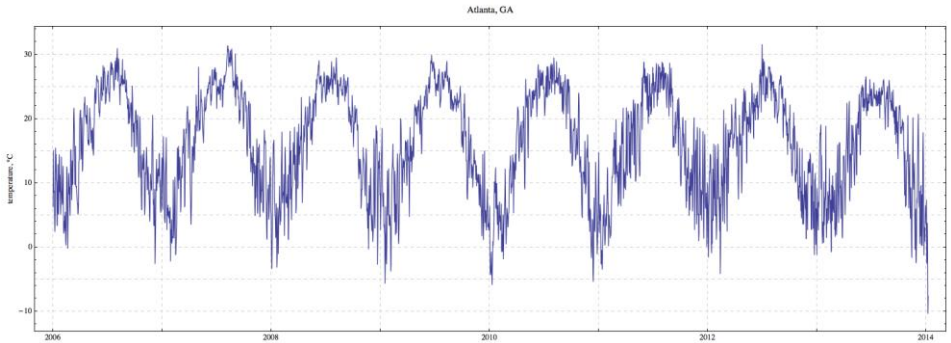
Pricing and actuarial modeling (1/2):

- The Risk Premium (RP) for the parametric insurance products can be written as:

$$RP = E[PO(X)]$$

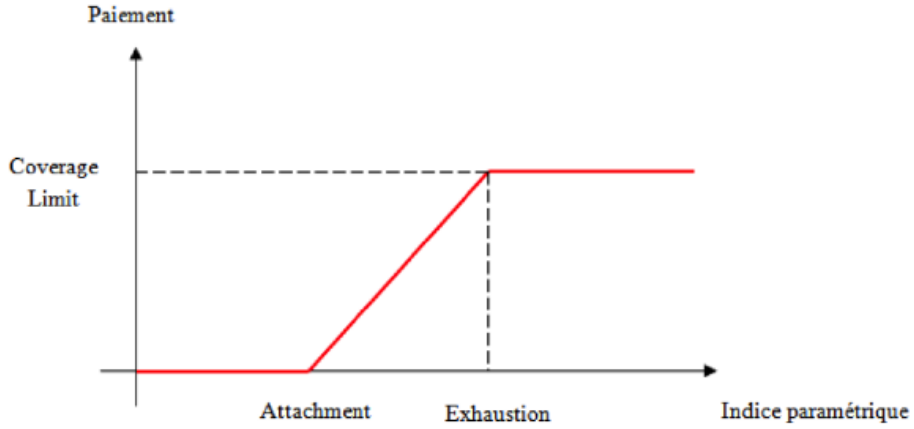
Where PO is the Pay-Off Function and X is the Process Function

- The Process Function models the evolution and variations of the parameter underlying the insurance:
  - Markov Chains, including a seasonality and long term trends components can be used for temperature modeling
  - Poisson Models are appropriate for duration related parameters like number of consecutive rainy days
  - It's important that the parameter has a direct impact on the insured activity. Indeed we might tend to believe that the decrease in temperatures (below 0C) would trigger pipes burst. It's actually the sharp decrease in temperature that does that (a slow decrease would not cause much damage). In this case the parameter is the daily variation in temperature when it's close to 0C or below, rather than the temperature itself



Pricing and actuarial modeling (2/2):

- The Pay-Off function reflects the sensitivity of the insured to the parameter:
  - This sensitivity should be calibrated properly depending on the characteristics of each insured (especially large corporate). Some simplification and Standardization can be considered for SME segment
  - Attachments and Exhaustion points needs to be defined. Also the maximum pay-off (coverage limit) should be agreed with the insured and should be reflective of its business (no enrichment or trading on the parameters: **it is an insurance, not a bond!**)
  - The pay-off function should be capped to avoid extreme pay-offs due to extreme values of the parameter.



- To some extent, the pricing of parametric insurance is similar in theory to financial options pricing <u>but must respect indemnity principle</u>

Reserving:

- Traditional P&C reserving techniques not adapted:
  - There is no declaration, development or assessment of claims
  - Occurrence and assessment of claims amounts are known “almost” on a real time basis (time for the weather event to finish and time to publish the parameters)

- Life/Financial reserving techniques are more appropriate for these products
  - At each valuation date, a reserve should be set for each contract in-force
  - The reserve is not subject to any claim declaration
  - Ideally the pricing model (with the process and pay-off functions) should be used for reserving
  - The reserve amount can be computed as an average pay-off times the average number of times the parameter exceeding the attachment point during a year
  - The reserves are revaluated *Prorata-Temporis* but taking into account the seasonality related to the parameter
  - In case of products related to one single parameter (process), we’re sure that the reserves amounts will be either over-estimated (in case of no occurrence) or under estimated (ion case of occurrence). Hence the need to diversify the processes

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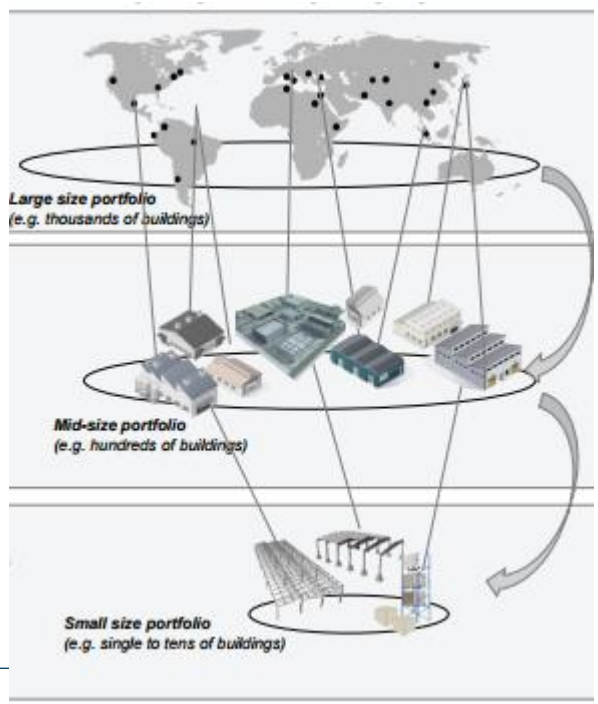
Parametric Insurance: Simple product, complex risks!

Accumulation risks

ACCUMULATION RISKS ARE TRADITIONALLY ENCOUNTERED IN PROPERTY RISKS…

- **Need to monitor locational data carefully : geocoding**
- **Natural Catastrophe maps scenarios : Earthquake faults, Storm routes, Flood drain paths…**
- **Complex accumulation estimation**



… ARE ALSO TRANSLATED INTO PARAMETRIC INSURANCE

- **Indices will be shared across several clients in the region:** e.g Temperature threshold shared by all the outdoor Tourism industry
- **Indices may be shared across different industries:** e.g temperate spring for the whole energy chain from Energy for desalination to Water supply and AC supply
- **But Accumulation models simplified compared to Property:** limited and pre-agreed indicators help build simple scenarios

Correlation risks

EXTREME EVENTS USUALLY DON'T COME ALONE…

- Indicial indicators can be more correlated in extreme values than in their normal range
- Example: Temperature and Rain falls / Cloudy weather and Rainfalls / …
- Mitigation measures:
  - **This source of accumulation can be modeled by Copula correlations in Extreme Value theory**
  - **Parametric products are designed to tackle Weather anomaly, not natural Catastrophe!**