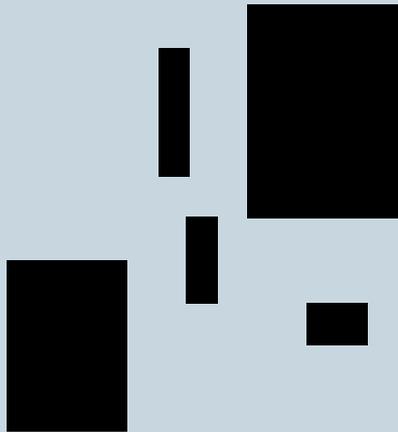


# Insuring Nature-Based Infrastructure via Parametric Solutions



# Parametric Solutions

## Overview

**While natural catastrophes, adverse weather, and man made catastrophes such as terrorism, can cause damage, they can also have severe financial consequences **even if no damage****

### Examples of physical & non-physical damage are:

- Direct damage
- Increased costs of operation
  - Evacuation of employees and customers for safety reasons
  - Impact on supply chain
  - Ongoing debt service
- Loss of revenue
  - Delays to projects, transport cancellation
  - Significant disruption to local business activity and communities
  - Loss of access to affected location and wider area
  - Long term loss of attraction of location
  - Impact on customer choices

### Traditional insurance has limitations:

- Business interruption is covered only if damage to owned assets
- Limited/No coverage for supply chain interruption
- Difficulty in covering fines and penalties
- Wide area disruption is not covered
- Long-term loss of attraction is not covered
- Sufficient limits are not always available
- Policies include long waiting periods
- Coverage excludes “soft” costs (e.g. landscaping)
- Policies contain large fixed & percentage CAT deductibles, and limits can be insufficient
- Significant information is required for underwriting
- There is a lack of transparency of cover and certainty of outcome of a claim
- Business Interruption claims are complex to adjust
- The loss adjustment process can be lengthy
- Local resources needed for loss adjustment

# Parametric solutions are different

**They focus on the severity of the event itself, not the loss and transfer the financial impact of the black swan event to an insurer**

## Characteristics:

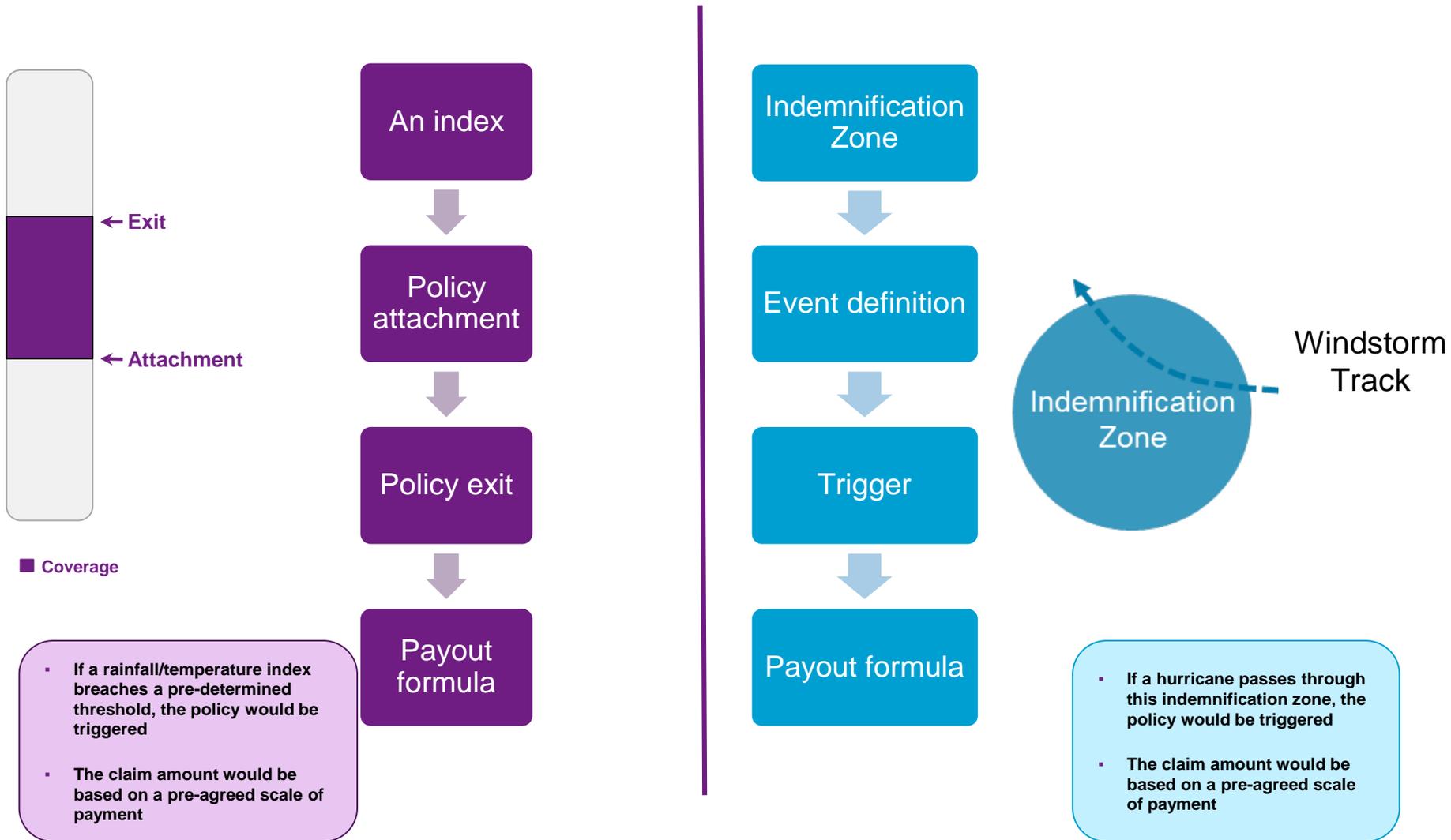
- An appropriate event or “index” is chosen (wind speed, ground acceleration, rainfall, irradiance, snowfall, temperature)
- The program responds to movements in that index or the occurrence of a pre-agreed event such as an earthquake, windstorm, terrorism or pandemic
- The solution transfers the financial impact
- Claims are triggered if:
  - The actual measurement of the index during the contract period moves above (or below) an agreed index point, or
  - The physical characteristics of the event meet pre-agreed criteria (e.g. intensity and location)
- The claim amount is calculated according to the pre-agreed scale of payment, but can be on an indemnity basis

*Note: Damage to property is not required to trigger the solution*

## The benefits of a Parametric approach are:

- Simplicity of program
  - Contract is based on independent data source  
Typically a government entity or professional data firm
  - Event identification or Index used, is clear
  - Claim process is simple:  
Event occurs, data firm is notified, data firm provides data to insurer & insured, insurer confirms amount to be paid, insurer pays, insured certifies amount received is equal to, or less than the true loss to the company.
- Speed of settlement and claim payment
  - No ambiguity in the operation of the coverage
  - No lengthy loss adjustment process – independent data provide confirms magnitude of event or index amount
  - Claims are paid quickly after the occurrence of the policy trigger
- No restriction on the use of claims payments
- Loss certification process is straightforward (not required if contract executed as a derivative)

# How do parametric solutions work?



# Parametric solutions

## Critical components

- A clear, robust definition of the policy trigger
- An independent, recognised and trusted source of the measurement of the policy trigger
- An agreed basis of settlement should the trigger event occur

### Policy triggers

- Natural catastrophes such as hurricane or earthquake
- Adverse weather such as excess rainfall, drought, freeze or extreme heat
- Man-made perils such as terrorism.
- Life perils such as pandemics or increased mortality.

### Measurement of policy trigger

- Intensity and location of a hurricane as measured by the NHC, NOAA IBTrACS or other independent reporting agency
- The annual rainfall at an agreed location as measured by a WMO Met Office
- Confirmation of the outbreak of a covered disease by the WHO.
- The imposition of travel restrictions by the CAA or a specified government

### Basis of settlement

- A fixed payment should the trigger event occur, or;
- An agreed scale of payment according to the severity of the trigger event
- An agreed scale of payment based upon the impact of the event on a secondary index such as passenger numbers or flight cancellations.
- A traditional business interruption calculation

# What perils that can be covered with a parametric policy?

- The data underpinning a parametric program must be:
  - Independent
  - Reliable
  - Consistent
  - Have sufficient history for underwriting
  - Be continuously recording throughout the contract term for settlement
- Common indices:
  - Weather (temperature, precipitation, wind-speed, wave height, solar irradiation, snow)
  - Natural perils (earthquake, windstorm)
- New indices
  - Terrorism, pandemic, crop yields
- Latest innovations:
  - Footfall, volcanic ash, flood, agriculture quality, burnt areas

## Data

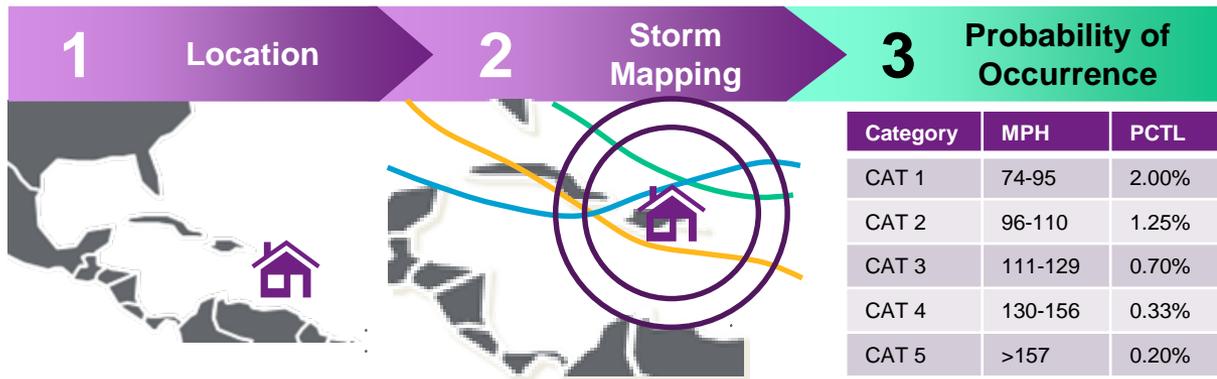
- Data availability and integrity has improved significantly in recent years
- Weather observations are recorded by ground stations located in many regions of the world
- Offshore data is measured by buoys
- Earthquake and windstorm data is recorded by USGS and national met services
- Data sets often go back for more than 50 years
- Satellite data is also available which provides a higher density of data but a shorter history

# Parametric Solutions

For natural catastrophe risks

## Cat-in-a-circle

Available world-wide



## 4 Program Design & Pricing

Market	Option	Premium
Market 1	Cat-in-Circle	\$###,###
Market 1	Gridded	\$###,###
Market 2	Cat-in-Circle	\$###,###
Market 3	Cat-in-Circle	\$###,###
Market 3	Gridded	\$###,###

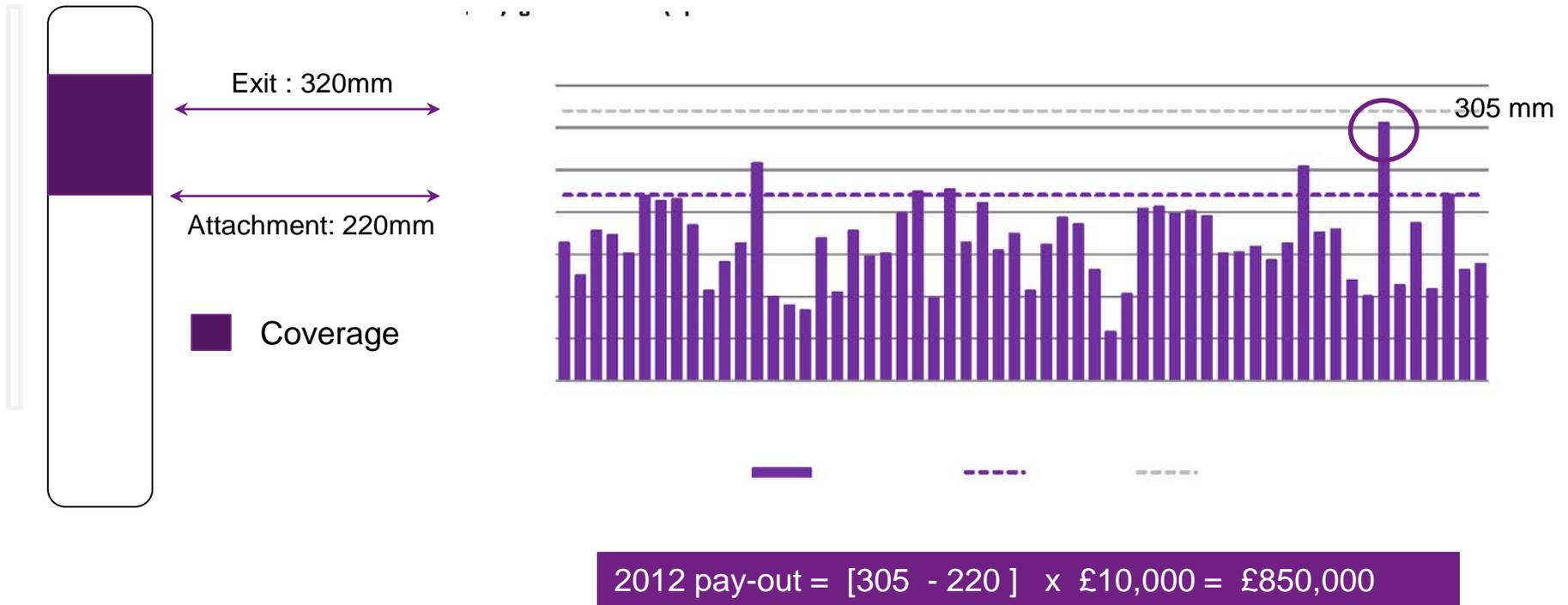
## Gridded Data

Available North America



# Parametric Solutions

For weather risks: an example of a rainfall index solution



# Capacity Providers

## Traditional Insurance Carriers

- Weather risk (windstorm, flood etc.) included in traditional PDBI insurance policies
- Loss of revenue/increased costs covered to the extent that this is as a result of damage to property
- Non-damage business interruption not covered
- Settlement based on indemnity and loss adjustment
- Well-rated and recognized market counterparties and Lloyds syndicates

## Weather-index Insurers

- Provides coverage based upon a weather denominated index
- Settlement according to the performance of the index
- Speedy settlement
- No loss adjustment process
- Coverage provided in insurance or derivative form
- Specialist departments of well-rated and recognized market counterparties

## Contingency Market

- Covers event cancellation
- Coverage includes cancellation as a result of adverse weather
- Also includes cancellation for other reasons such as terrorism, denial of access, death and disgrace
- Settlement based on indemnity and loss adjustment
- Well-rated and recognized market counterparties and Lloyds syndicates

## Capital Markets and Hedge Funds

- Provides coverage based upon a weather denominated index
- Settlement according to the performance of the index
- Speedy settlement
- No loss adjustment process
- Coverage provided in derivative or swap form
- Typically unrated capital market counterparties, so contracts are typically collateralized
- Transformation to insurance form is usually available

# Parametric Solutions

## Agribusiness (Chile: parametric forest fire product)

### Description

This client had purchased traditional fire insurance for their ~1.5m acres of commercial plantations.

In 2017 they suffered exceptional losses greatly exceeding the limit of their policy and conventional market capacity.

The client offered WTW the opportunity to explore alternatives to the renewal solution proposed by their broker of >25years

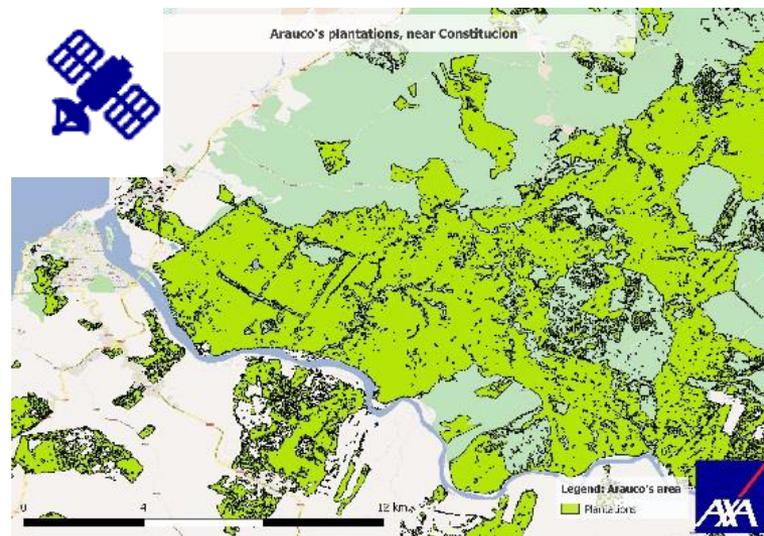
The WTW parametric team proposed a first-of-kind Burned Area Index solution with AXA

### Characteristics

- Index: Based on MODIS (NASA) satellite
- Form: Excess of Loss insurance
- Basis: Burned Area Index (native NASA algorithm) at resolution of 463m<sup>2</sup>
- Limit: \$135m (for both F. Arauco & Cholguan)
- Tick: Agreed value per pixel (asset based)
- Premium: rate ~4.5% on line

### Benefits

- Provided required capacity at efficient premium
- The MODIS index correlates at >99% accuracy with Arauco's recent historical losses
- Payouts are independently calculated using settlement index data and pre-agreed formula
- Saves time in payment and costly conventional field loss adjustment process



# Parametric Solutions

## Public Entity (Forest Fire Burnt Acre Index Insurance Solution)

### Description

This client was concerned about having adequate cash flow availability during a significant forest fire.

The larger the fire, the greater the suppression resources required across a wider geographical area.

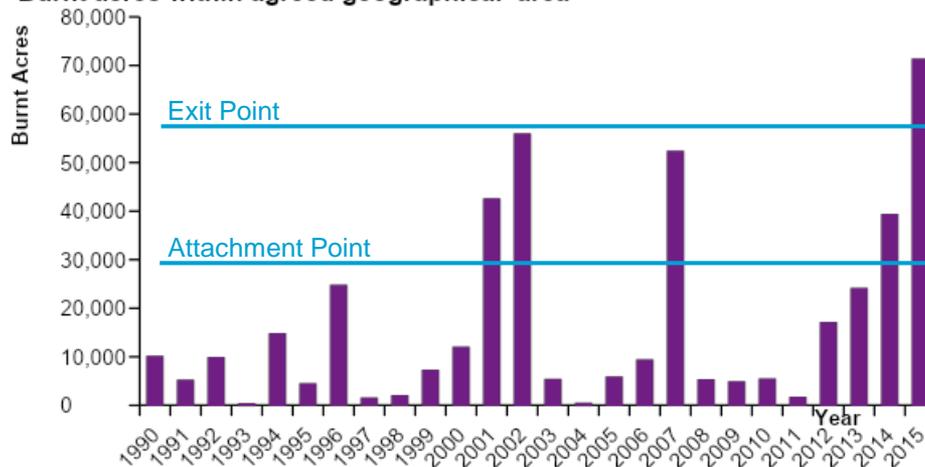
### Characteristics

- Term: 5 year multi-season
- Form: Insurance solution
- Basis: Utilizes a Burnt Acre Index.
- Limit: \$30M (Annual) / \$90M (Term)
- Data: NASA satellite open source data set
- Tick: \$1,000 per burnt acre greater than attachment, up to policy limit
- Premium: Annual Installment

### Benefits

- Provides instant access to cash flow during critical forest fires.
- Payouts are independently calculated using open source data and pre-agreed formula
- Premium contained rebate features upon low claims experience

Burnt acres within agreed geographical area



# Parametric Solutions

## Sports & Leisure (Dry days cover for the Eden Project)

### Description

- The Eden project, in Cornwall, is largely considered a wet weather attraction for tourists during the summer holidays.
- When the weather is nice, families prefer to go to the beach.
- Due to the good weather leading up to the Summer of 2018, the Eden project elected to buy a policy that will cover them for a good summer (large number of dry days).
- This will cover the drop in revenue from the reduction in visitors throughout the dry summer

### Characteristics

- Dry Day: daily rainfall less than 0.02mm
- Policy limit of £900,000
- Deductible: 20 Dry Days
- Tick value: £60,000 per dry day
- Approx 6% rate on line

### Benefits

- Claim paid out quickly
- Highly tailored coverage responding to precise exposure for the summer season
- No protracted loss adjustment process



# Outline of three potential insurance application archetypes

## Example 1: Parametric insurance of blue infrastructure for shock response

- Use cases for coral reefs, mangroves
- Parametric trigger for cyclones (potentially heavy rain also, if important)
- Can fund:
  - Rapid reef clean-up (funding early response which has great value in reef recovery after cyclones, and can incentivise planning for response)
  - Pay-outs could be used to give cash payments to fisherfolk to not fish or provide other social benefit support to ease post-cyclone stress on reef (or mangroves)
  - Could be more general hedge against revenue interruption for MMA type model – diving and visiting reefs will not be as attractive if reef has been severely impacts



# Outline of three potential insurance application archetypes

## Example 2: Fisheries support

- Can be used as a reward for registration / tagging etc – e.g. life insurance or boat insurance provided for free on registration, transponder use, agreement to best practice in fishing, etc.
- Livelihood protection for fisherfolk when fishing activities are interrupted by shock events or, possibly, by changes in status of fish stocks due to ocean temperature (for example)
- Commercial fishing requires insurance – can premium reductions be used to drive better behaviour?



# Outline of three potential insurance application archetypes

## Example 3: Protection against early ocean change impacts

- Life insurance type model, protecting against timing risk of a warmer ocean or higher sea levels sooner than expected
- May allow payments to be made to reduce reef activities to protect weak reefs from further stress
  - Could be based on satellite-based bleaching index, for example



# Rapid Reef Clean-up Funded Through Insurance

## Ongoing projects on the Mesoamerican Reef

- Coral reefs are severely impacted by wave action during hurricanes
- Sediment, trees and other detritus cause even greater damage in the days and weeks after a storm
- Reef recovery is greatly speeded and enhanced by rapid clean-up
- **Parametric insurance** is used to trigger the funding required for rapid clean-up, and can be extended to cover replanting, compensation to fisherfolk for staying off the reef to allow for better recovery in the medium term
- Rapid reef recovery after hurricanes is of interest to:
  - **Sovereigns** - protecting the risk mitigation value of reefs (e.g. in reducing coastal flooding, a value of \$400mn per year in Mexico alone<sup>1</sup>)
  - **Public sector** – enhancing coastal livelihoods through added resiliency
  - **Private sector** – reduced impact on tourism (e.g. >\$4bn annual economic return from tourism on MAR<sup>2</sup>), increased interest in participatory activities, environmental kudos



## Mesoamerican Reef Rescue Initiative



# Concept for Parametric Hurricane Cover (Caribbean Island)

## Protection for business model of Marine Managed Area (MMA)

- Fill a hole in revenue from user fees if a major hurricane impacts significantly on tourism arrivals
  - Experience from the Caribbean demonstrates that impacts on tourism can be very significant (e.g. Granvorka & Strobl, 2013; Hurricane Maria in Puerto Rico in 2017)
  - MMA user-fees are particularly vulnerable to hurricane impacts, as storm conditions may impact marine activities more heavily than net tourism
- Fill a hole in revenue from user fees if a major hurricane impacts significantly on the ecosystem services provided by the MMA so that visitors are not willing to pay fees to dive or visit offshore areas by boat
  - Likely to be localised impacts, but could be severe in the case of reef damage
- Provide additional financing required for rapid reef clean up, protecting conservation outcomes
- Provide financing to cover additional medium- to long-term conservation efforts required as a result of hurricane impacts
- Cover physical damage or destruction of capital assets such as boats, docks, buoys etc.

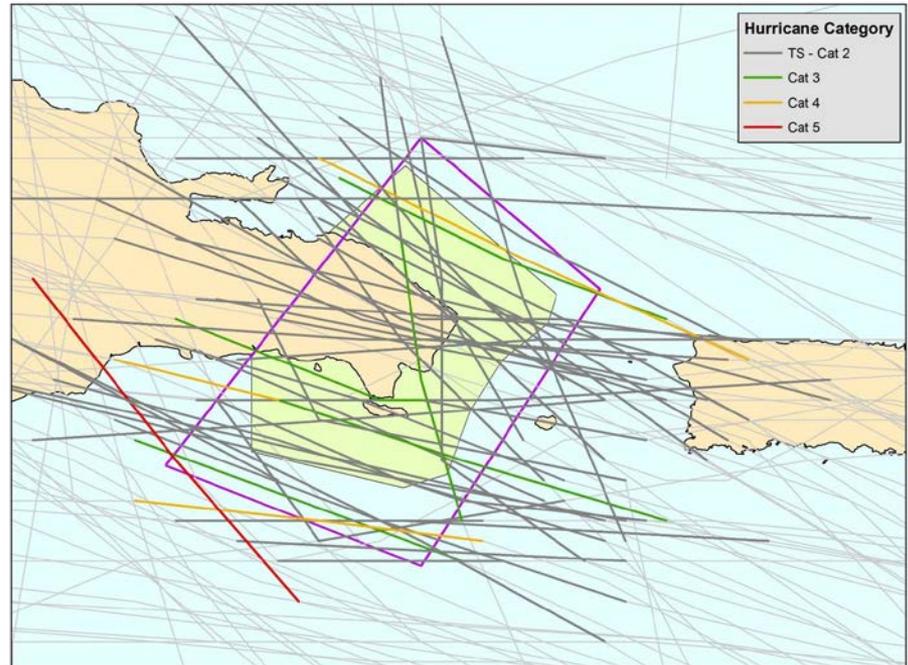
# Fisheries Concepts, Indonesia

## Developing a programme with FAO and Bank Negara Indonesia

- Bundle insurance with loans -insurance coverage strengthens and frees up loan provision to small-scale fishers
  - Riskiness of small-scale fishing means high rates for loans, but loans can allow fishers to improve production
  - Coverage against natural catastrophe events, so if an event occurs, the loan is repaid automatically or forgiven
  - Reduces risk to the bank, the fisher, and the fishing value chain
- Direct payouts for immediate recovery
  - An insurance policy to complement the government disaster relief: coverage can be for life, disability, vessels, property
  - Insurance payments can be made within two weeks, with amounts fixed beforehand –enables planning before a disaster
  - Coverage can be made available only for those vessels or fishers registered under *KartuKusuka*, adhere to bans on *cantrang* and similar rules

# Example 1: “Cat-in-a-box” Parametric Cyclone Cover

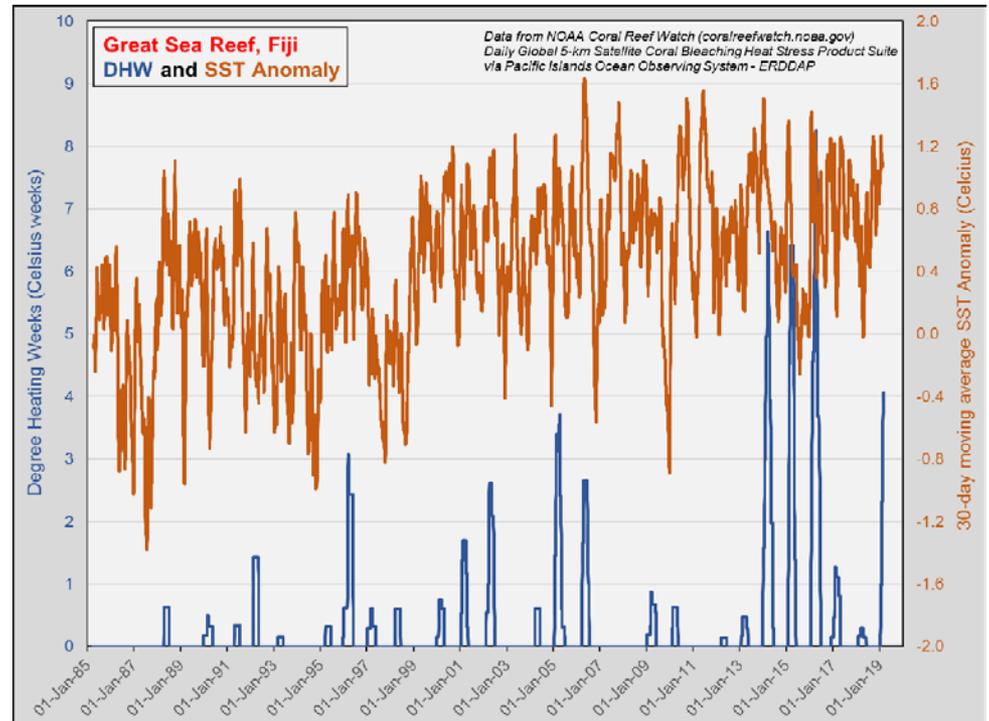
- This is a “cat-in-a-box” coverage design, with three trigger levels providing for progressively larger payments as event intensity, and thus overall impact, increases
- Box (purple outline) is designed to “catch” storms which might reasonably have an impact in the MMA (green)
- The highest category which a storm reaches within the box would be used to evaluate the trigger level for that storm



Category	Trigger Rate (% of Limit)
3	25%
4	50%
5	100%

## Example 2: Ocean Temperature & Coral Bleaching Indices

- NOAA Sea Surface Temperature Anomaly and Degree Heating Week indices
  - Available daily and globally at 5km resolution back to 1985
- SSTA is noisy, even on 30-day moving average
- DHW is directly related to the timing and intensity of coral bleaching
  - Significant coral bleaching usually occurs when the DHW value reaches 4 °C-weeks.
  - By the time the DHW value reaches 8 °C-weeks, widespread bleaching is likely and significant mortality can be expected.



# Alternative Risk Transfer Solutions

## Credentials

**400**

The ART Solutions team contributed to over 400 client engagements in 2018

**50**

The ART Solutions team completed over 50 transactions in 2018

**6** Categories of Solution

- Captive Solutions
- Portfolio Solutions
- Structured Solutions
- Parametric Solutions
- Customized Credit
- Asset & Capital

**150** Years of cumulative experience in the global ART Solutions team worldwide

**16** Team members located in London, New York, Paris and Hong Kong

**1** The only global ART Solutions team with the breadth and capability across the 6 solution types above.

**Environmental Finance 2017 Annual Market Rankings Winner**  
"Best Broker in Weather Risk Management" - Europe

**Environmental Finance Annual Market Rankings 2018 Winner**

Voted number 1 broker in weather risk management in 2017 and 2018