Model Output as a Universal Currency For Disaster Risk Financing And Management

Dr. Akshay Gupta
SVP and Director, Catastrophe Risk Engineering
AIR Worldwide

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Panel Discussion

- Model use by governments, IFOs, emergency management organizations, and others for DRF, DRM, and DRR activities
- Development of new tools, data sets, and applications that assist DRF, DRM, and DRR activities
- Challenges in development of models and communication of output and limitations of models
- Model output as a universal risk currency

Panelists

- Dr. Milan Simic
  Senior Vice President &
  Managing Director – International Operations
  AIR Worldwide

- Catastrophe Modeling Framework
- Model Output as Currency of Risk
- Challenges in Model Development
  - Data
  - Communication of Risk Metrics
- Opportunities for Growth

Panelists

- Dr. Olivier Mahul
  Program Manager
  Disaster Risk Financing and Insurance Program, GFDRR
  World Bank

- Applications of Analytics and Tools in decision making associated with Disaster Risk Financing and Insurance
- Examples from South Pacific, Indonesia, and Mexico

Panelists

- Ivo Menzinger
  Head, Global Partnerships, Asia Pacific
  Managing Director
  Swiss Reinsurance Company Limited

- Importance of transparency and universally accepted view of risk in DRF and DRM.

Panelists

- Dr. Simon Young
  Lead Advisor – African Risk Capacity
  CEO (2006 – 2013) Caribbean Risk Managers Ltd.

- Experience of CCRIF and ARC in using in-house models and transferring the risk to the markets

Panelists

- Dr. Eugene Gurenko
  Lead Insurance Specialist
  World Bank

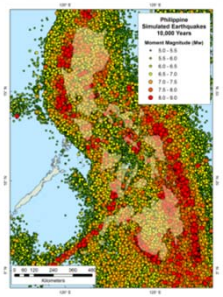
- Role of catastrophe risk models in developing new insurance markets

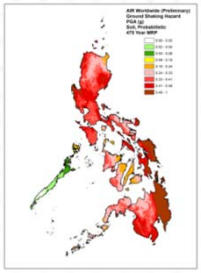
Panelists

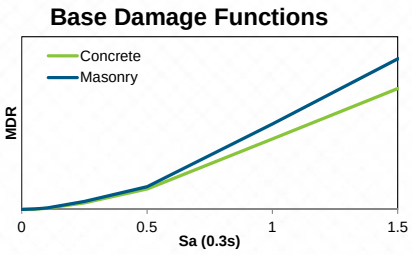
- Andrew Eddy
  CEO – Athena Global Europe
  Program Manager – RASOR FP7

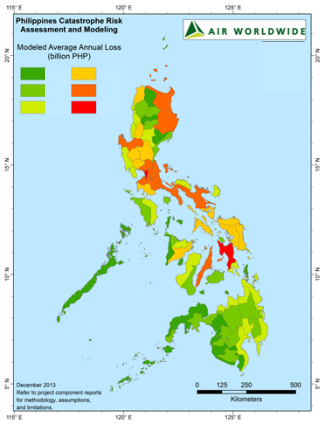
- DRM and new tools with an emphasis on near real time applications and other emerging applications

How Do Catastrophe Models Work?









HAZARD

EVENT GENERATION

LOCAL INTENSITY CALCULATION

ENGINEERING

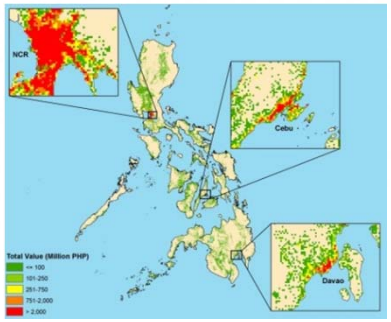
FINANCIAL

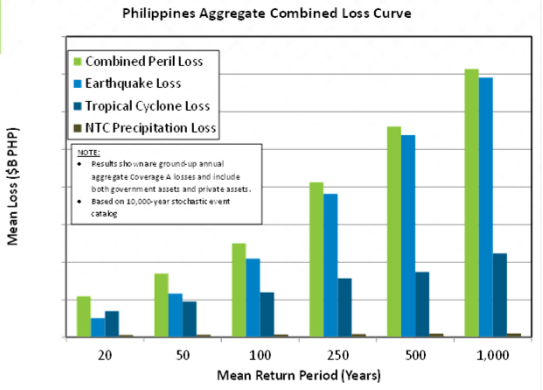
DAMAGE ESTIMATION

INSURED LOSS CALCULATION

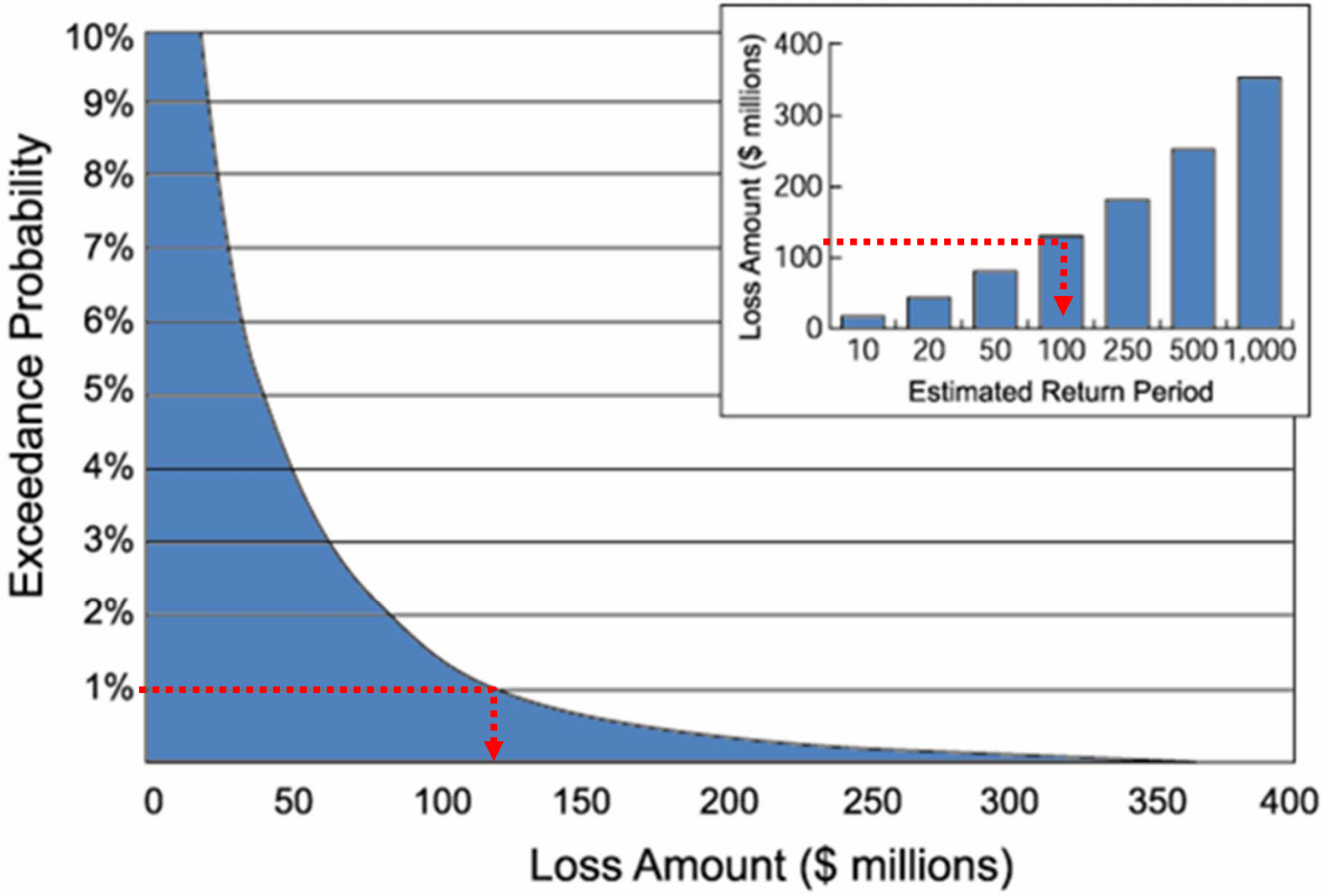
EXPOSURE DATA

POLICY CONDITIONS



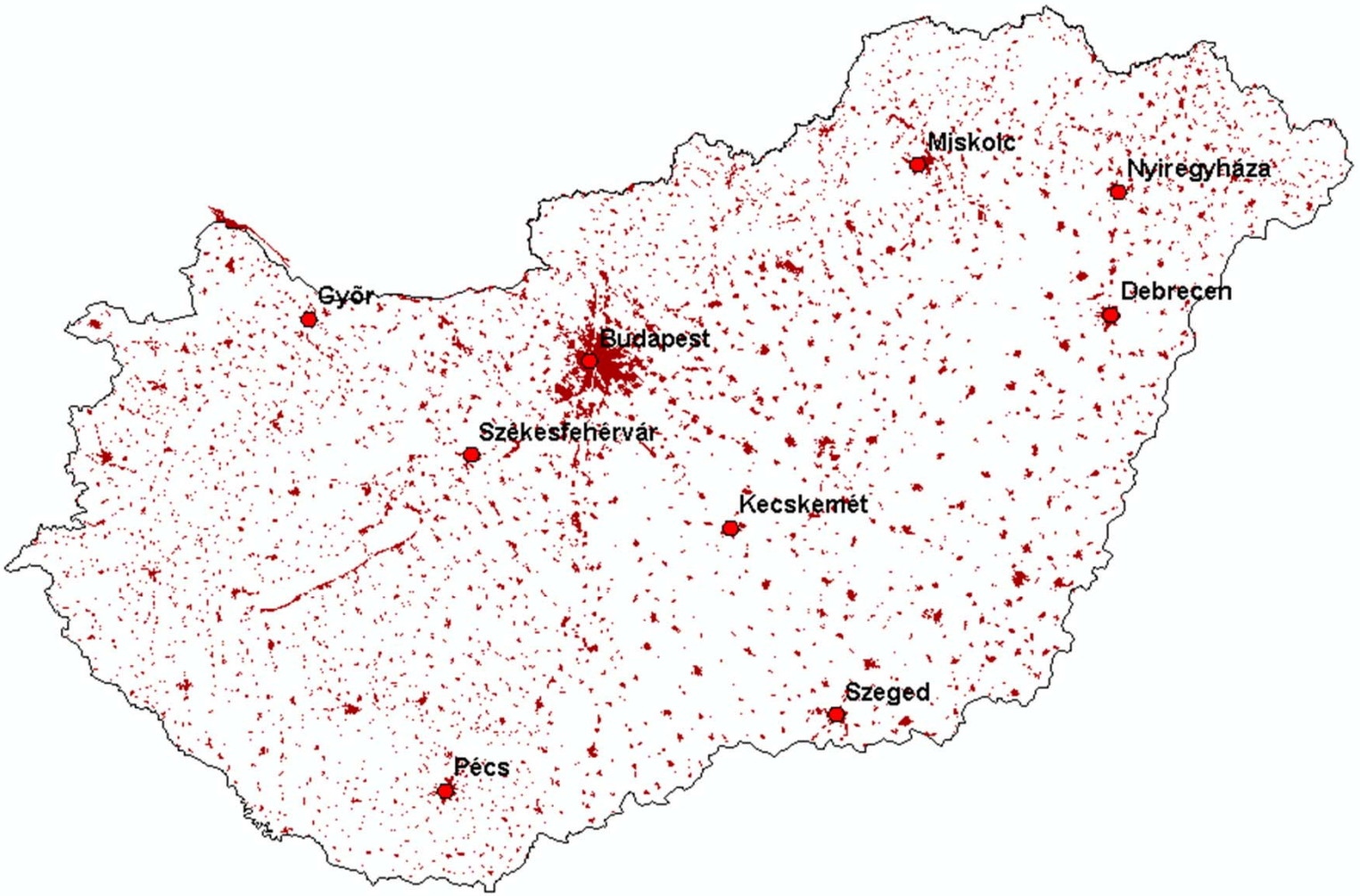


Loss Exceedance Probability Curve is the Key Output of Catastrophe Models

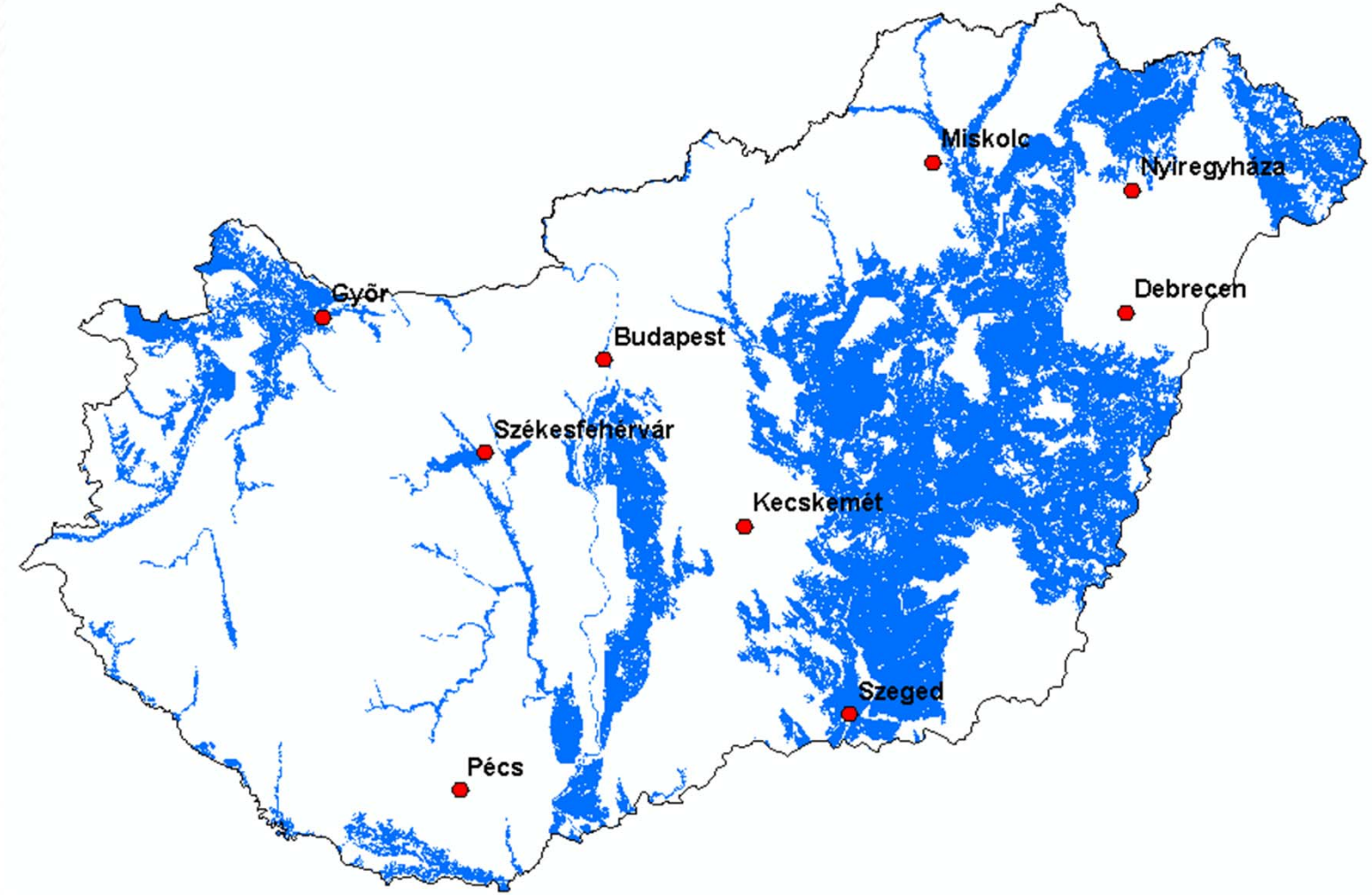


Example – Hungary Flood Risk (DTM using 90m SRTM)

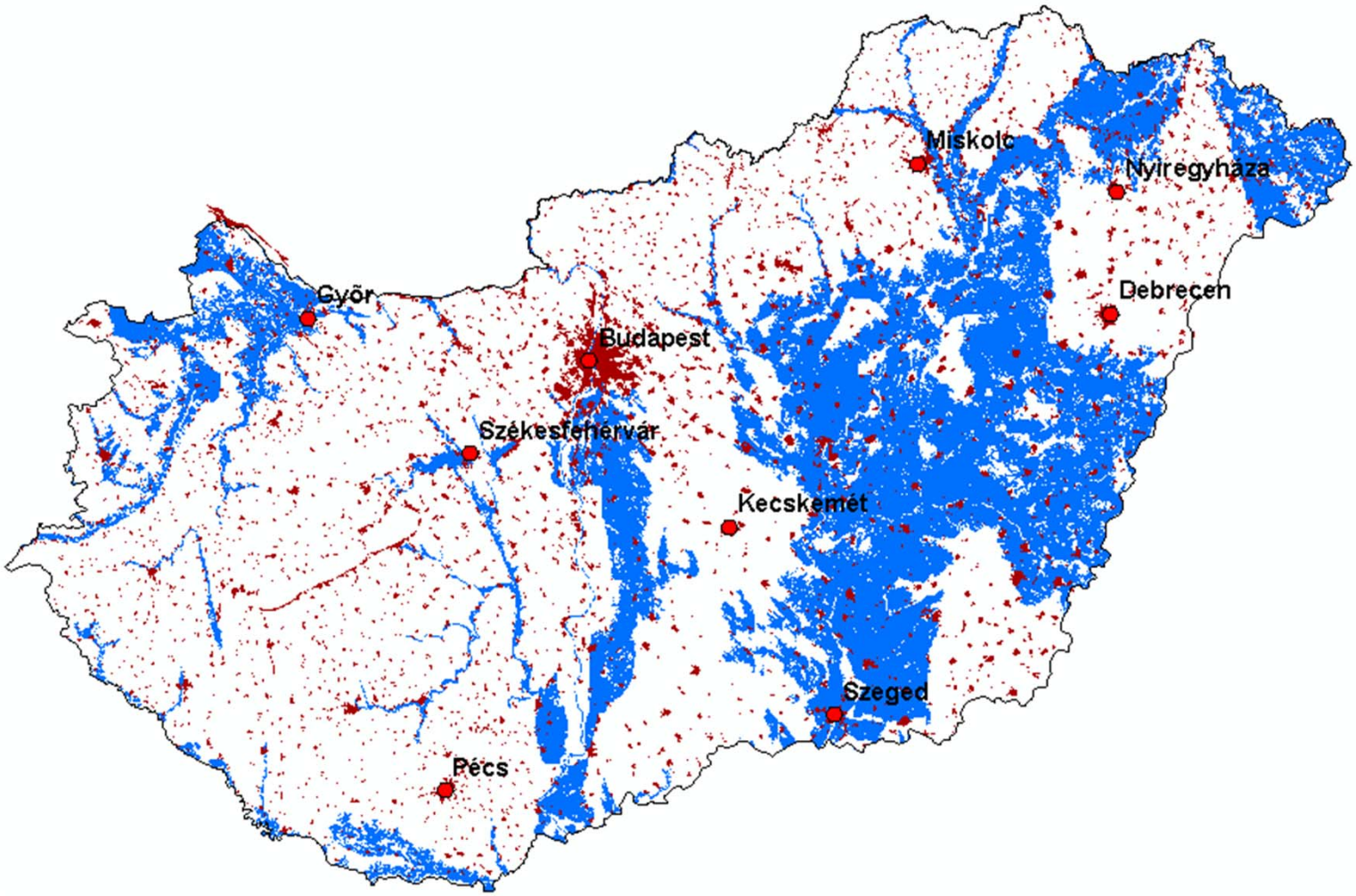
Example – Hungary Flood Risk (built-up areas using 250m satellite land cover)



Example – Hungary Flood Risk (indicative 2m flood extent – Upper Tisza, Koros, Danube)



Example – Hungary Flood Risk (combined indicative floodplain and built-up areas)



Disaster Risk Financing and Insurance Analytics

Empowering governments for DRFI decision making

Understanding Risk
Technical Session – Models as the universal currency
July 2, 2014

GFDRR

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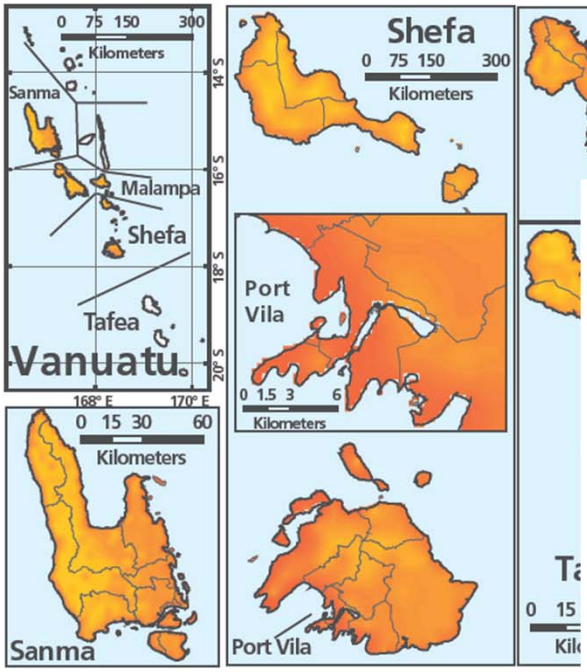
Disaster Risk Financing and Insurance Program

As a Minister of Finance, how do you develop your financial protection strategy against natural disasters?



Perceived Shaking	Not Felt	Weak	Light	Moderate	Strong	Very S
Potential Damage	none	none	none	Very light	light	Mode
Peak ACC. (%g)	<0.17	0.17-1.4	1.4-4.0	4.0-9	9-17	17-32
Peak Vel. (cm/s)	<0.12	0.12-1.1	1.1-3.4	3.4-8	8-16	16-31
Instrumental Intensity	I	II-III	IV	V	VI	VII

Scale based upon Wald. et al: 1999

Figure 5: Peak horizontal acceleration of the ground acceleration of gravity) that has about a 40% chance to b the next 50 years (100-year mean return period).

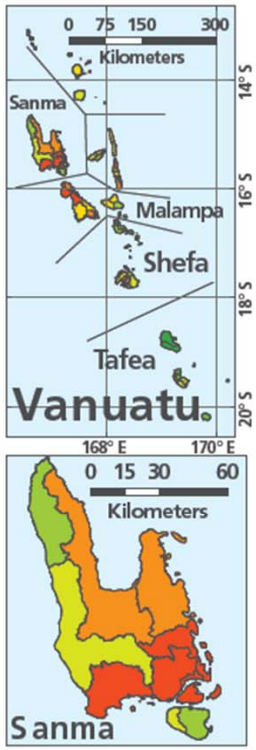
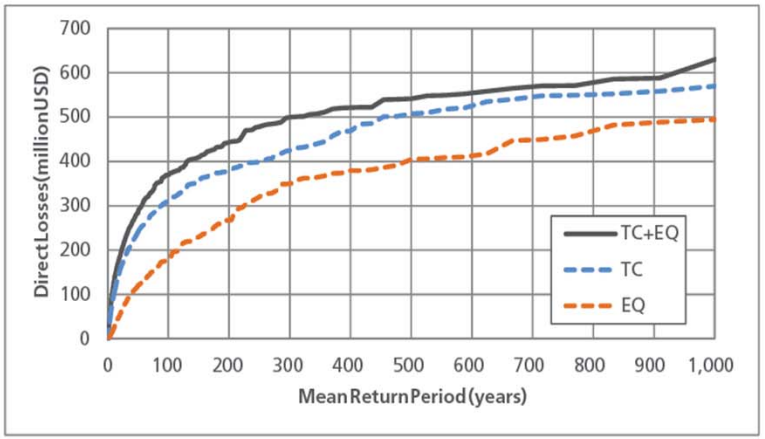


Figure 7: Contributior cyclone and earthqua



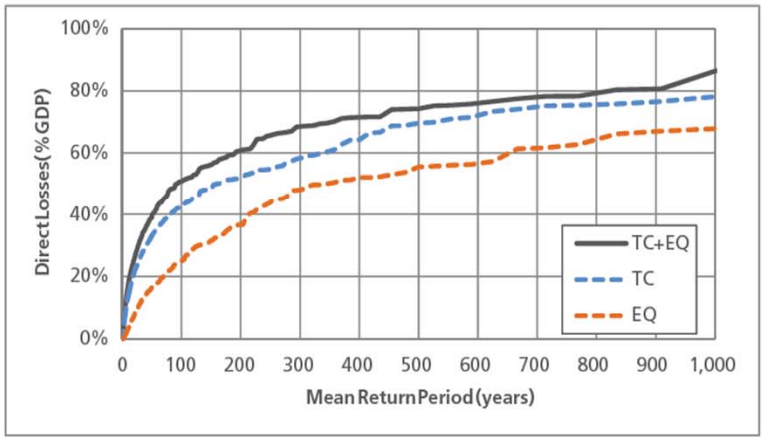


Figure 10: Direct losses caused by either tropical storms or earthquakes that are expected to be equaled or exceeded, on average, once in the time period indicated. Losses represented in absolute terms and normalized by GDP.

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Development challenge

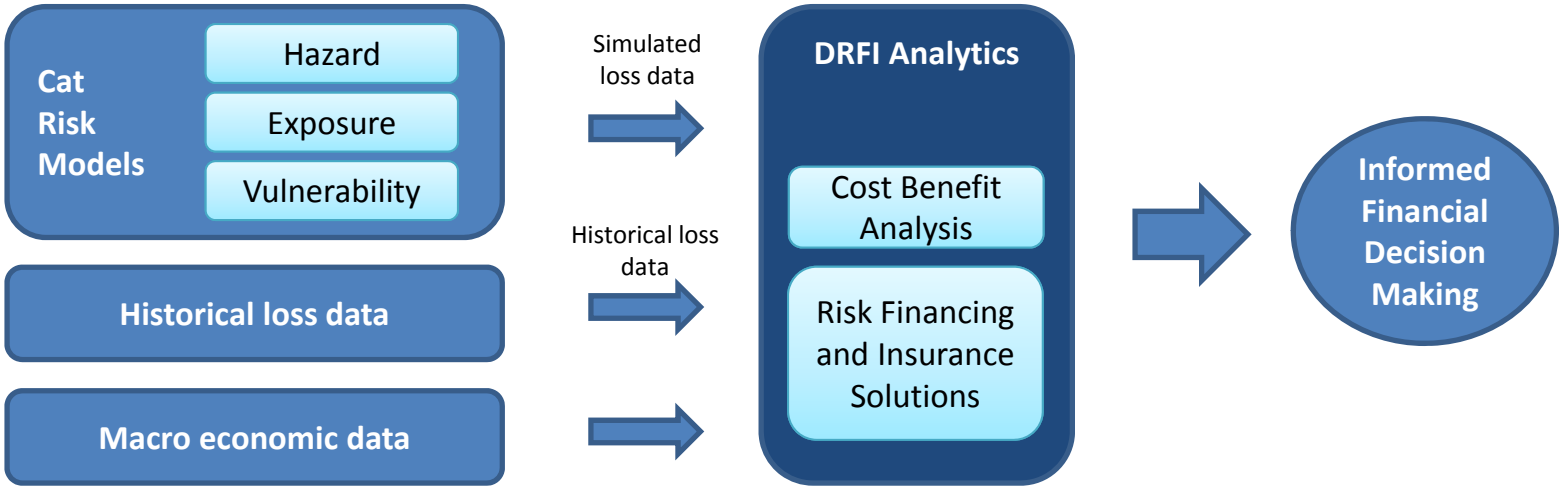
- Governments struggle to make informed decisions on financial protection against natural disasters
  - MoF increasingly include disaster risks in their fiscal risk management strategies
  - Shift from products to strategies: optimal combination of reserves, contingent credit, risk transfer, ex post lending
  - Massive amount of disaster risk data/information is produced through various disaster risk assessment and modeling initiatives
  - “Ready to use” financial products, sometimes complex, have been offered by the private sector

Proposed Solution

- ***Decision making framework*** to help governments focus on key policy decisions about disaster risk financing and insurance solutions
- ***Flexible, interactive financial tools*** to guide the governments in their decision making process
  - Help the government identify and answer key policy questions
  - Development of national DRFI strategy
  - Support discussions with the private (re)insurance sector
  - Support monitoring and evaluation
- ***Capacity building*** on disaster risk transfer solutions
  - Consultations with the private sector
  - International experience

DRFI Analytics – Helping governments make informed decisions on financial protection against disasters

Building on reliable and appropriate data, DRFI Analytics empowers governments to take informed decisions on the financial management of natural disasters



DRFI Analytics Tools:

- ❑ Are an effective interface between the policy maker and underlying technical models.
- ❑ Empower decision makers through technical capacity building

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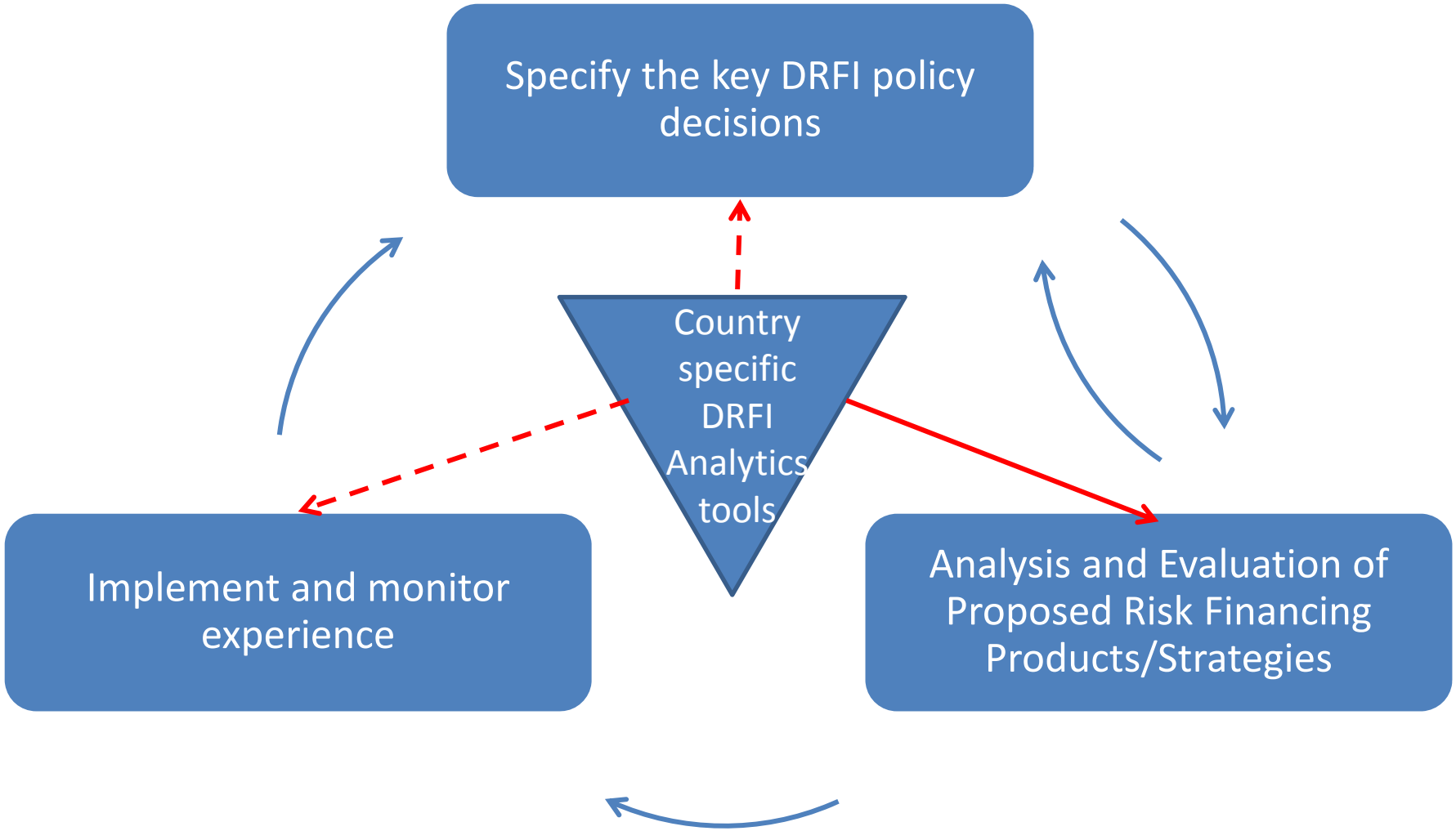
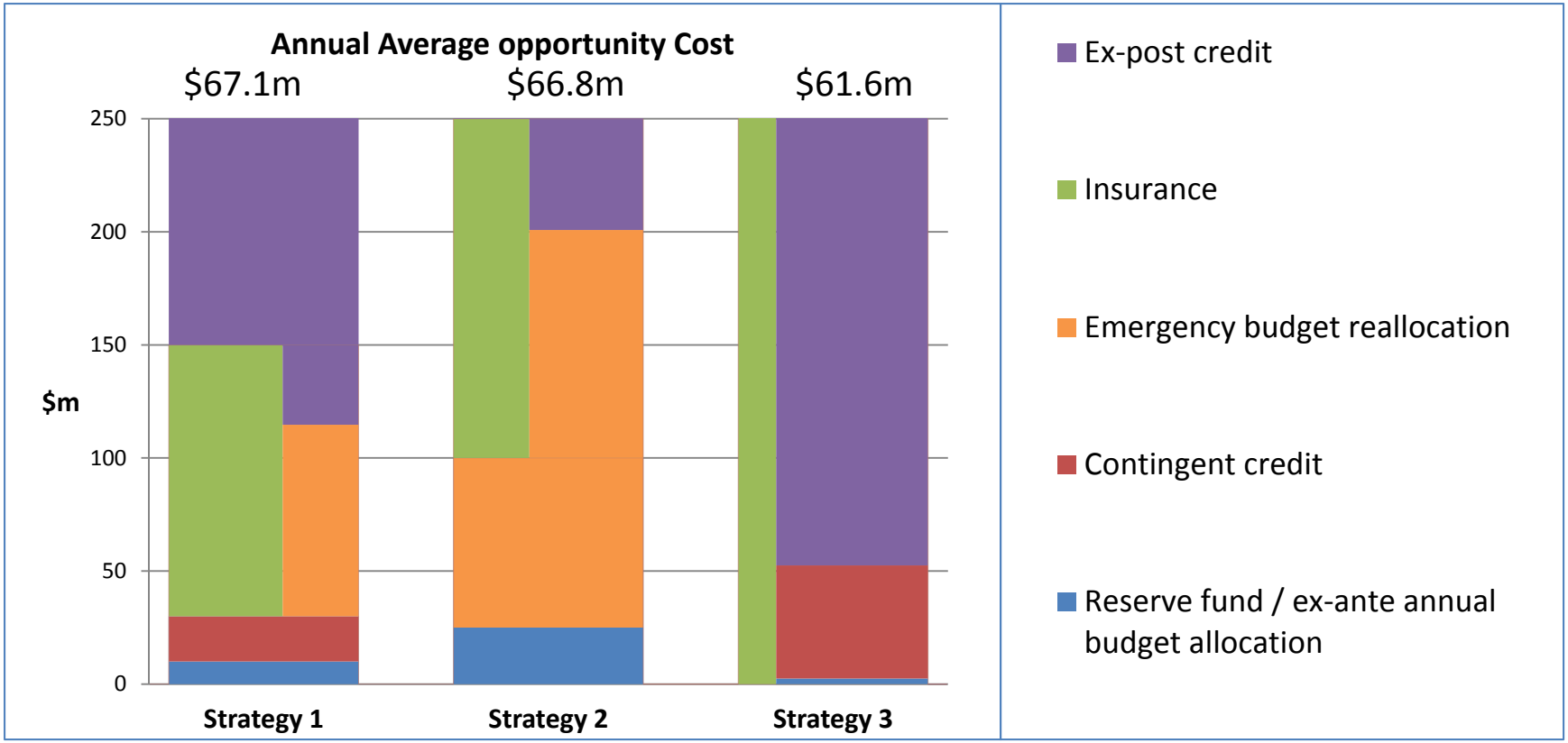
DRFI Analytics naturally fit within a control cycle approach to DRFI decision making



Quantitative cost benefit analysis for different strategies can help strategy selection and instrument prioritization



Pacific Catastrophe Risk Insurance Pilot

Helping Ministries of Finance select catastrophe risk insurance coverage options

PCRAFI
Pacific Catastrophe Risk Assessment & Financing Initiative

Country-specific risk profile

Inputs

Modeled government emergency loss from event in USD	20,000,000
Modeled Peril	Tropical Cyclone
Display style: select 'Advanced Display' to show Strategy D, which allows the user to input a custom insurance purchase strategy.	Normal Display

Calculations

A loss from a tropical cyclone at least this large is expected to occur with annual probability...	1.70%
A loss from a tropical cyclone at least this large is expected to occur on average approximately once every...	59 years

	Strategy A: 1-in-10 year per-peril attachment points	*Strategy B: 1-in-15 year per-peril attachment points*	*Strategy C: 1-in-20 year per-peril attachment points*
The insurance claim payment under each strategy would be:	2,630,000	2,740,000	2,800,000
The retained loss under each strategy would be:	17,370,000	17,260,000	17,200,000

Details of three different strategies

	Strategy A		*Strategy B*		*Strategy C*	
	Earthquake and Tsunami cover	*Tropical Cyclone cover*	*Earthquake and Tsunami cover*	*Tropical Cyclone cover*	*Earthquake and Tsunami cover*	*Tropical Cyclone cover*
Attachment point (years)	10	10	15	15	20	20
Attachment point (USD)	1,110,000	2,620,000	1,530,000	4,160,000	2,340,000	5,950,000
Exhaustion point (years)	150	150	150	150	150	150
Exhaustion point (USD)	24,640,000	40,400,000	24,640,000	40,400,000	24,640,000	40,400,000
Annual average loss in layer (USD)	480,000	840,000	440,000	720,000	390,000	610,000
Full loss limit (USD)	23,530,000	37,780,000	23,110,000	36,250,000	22,300,000	34,450,000
Ceding Percentage	15.1%	15.1%	17.3%	17.3%	19.9%	19.9%
Coverage Limit (USD)	3,560,000	5,720,000	4,000,000	6,270,000	4,450,000	6,870,000
Annual probability that a claim payment occurs from at least one element of cover	19%		13%		10%	

Note: Figures are highly indicative. Coverage limit may change depending on market conditions. Under all strategies the Ceding Percentage is set so that the total expected claim payment (over both policies) is US$200,000.

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Sovereign cat risk transfer in Indonesia

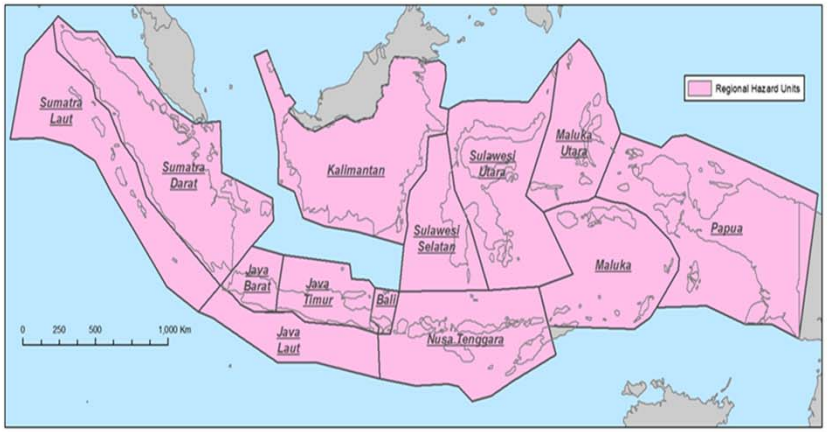
Helping Ministry of Finance identify catastrophe risk transfer options

Risk Profile (13 Indonesia Regional Hazard Units)

Colour coding

Input - feel free to change
Formula - do not change

Paste Sheet into new Workbook



1. Currency & Exchange Rate

Currency Selection	Currency	USD
Exchange Rate: per 1 USD	ExRate	10,000

2. Financial Protection Strategy

Regional Hazard Units	Include hazard unit?	Insurance coverage (USD)	Payout type	1st trigger point (Magnitude)	Step cover - 2nd trigger point (Magnitude)	Exhaustion point (Magnitude)	Step cover - 1st trigger point %	Step cover - 2nd trigger point %	Smoothed 1st trigger point - return period	Smoothed 2nd trigger point - return period	Smoothed exhaustion point - return period	Return period magnitude calculator
												100
Sumatra_Darat	Yes	7,136,287	Linear	6.5		8.0			4		908	7.7
Sumatra_Laut	Yes	3,329,228	Linear	6.5		8.0			1		26	8.5
Jawa_Laut	Yes	9,477,693	Linear	6.5		8.0			3		77	8.1
Jawa_Barat	Yes	9,864,052	Linear	6.5		8.0			45		1,000	7.0
Jawa_Timur	Yes	11,381,637	Linear	6.5		8.0			5		195	7.8
Bali	Yes	868,929	Linear	6.5		8.0			32		1,000	7.2
Nusa_Tenggara	Yes	1,328,859	Linear	6.5		8.0			1		30	8.5
Maluku	Yes	401,459	Linear	6.5		8.0			1		21	8.5
Papua	Yes	970,291	Linear	6.5		8.0			1		14	8.4
Maluku_Utara	Yes	318,159	Linear	6.5		8.0			1		23	8.2
Sulawesi_Utara	Yes	1,962,816	Linear	6.5		8.0			1		46	8.1
Kalimantan	Yes	2,680	Linear	6.5		8.0			11		625	7.7
Sulawesi_Selatan	Yes	1,053,512	Linear	6.5		8.0			5		106	8.0

1. Which regions of Indonesia should be covered by a financial protection scheme?
2. How should financial cover be apportioned across each region?
3. How much annual premium can be spent on a risk transfer product?
4. What frequency or severity of events should trigger a payout?
5. How should the payout structure be designed?

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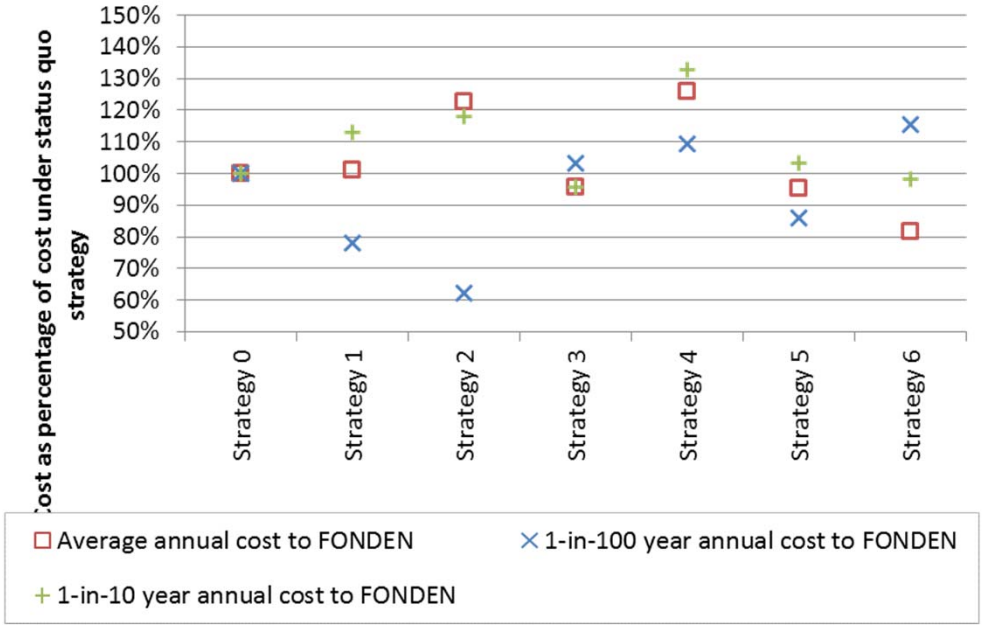
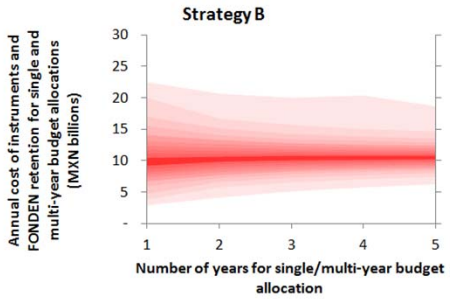
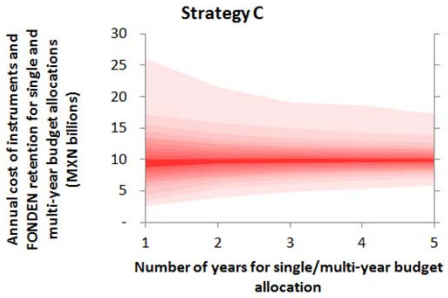
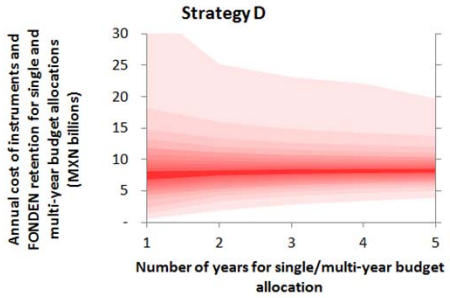
Cost-benefit analysis of financial options in Mexico

Helping Ministry of Finance improve their DRFI strategy through an optimal combination of financial instruments









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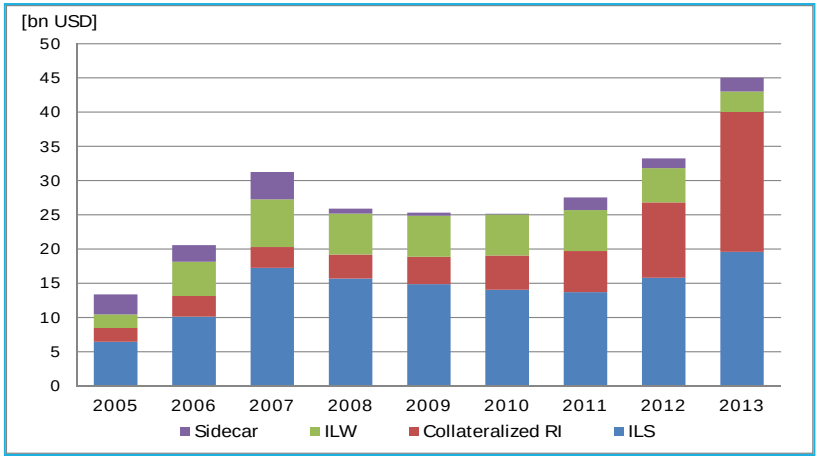
Models as Universal Currency for Disaster Risk Financing & Mgmt

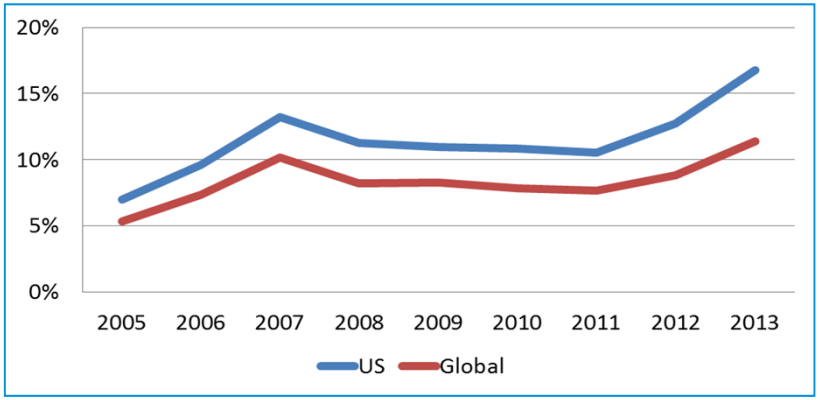
Ivo Menzinger, Managing Director
Swiss Reinsurance Company

Disaster Risk Financing: growing alternative capital requires a universal, transparent currency

Estimated size of global market



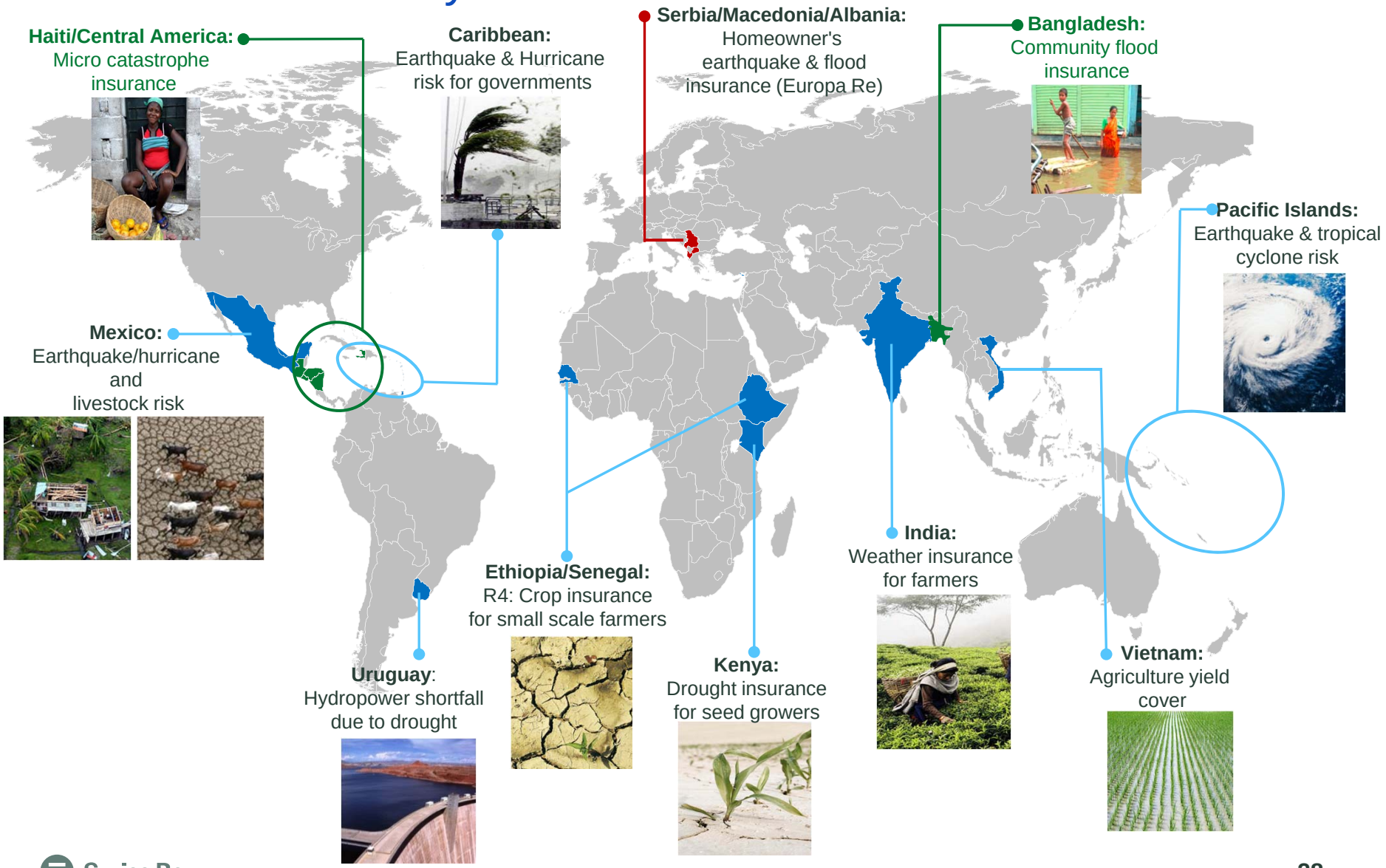
Estimated market share (excl. Retro capacity)



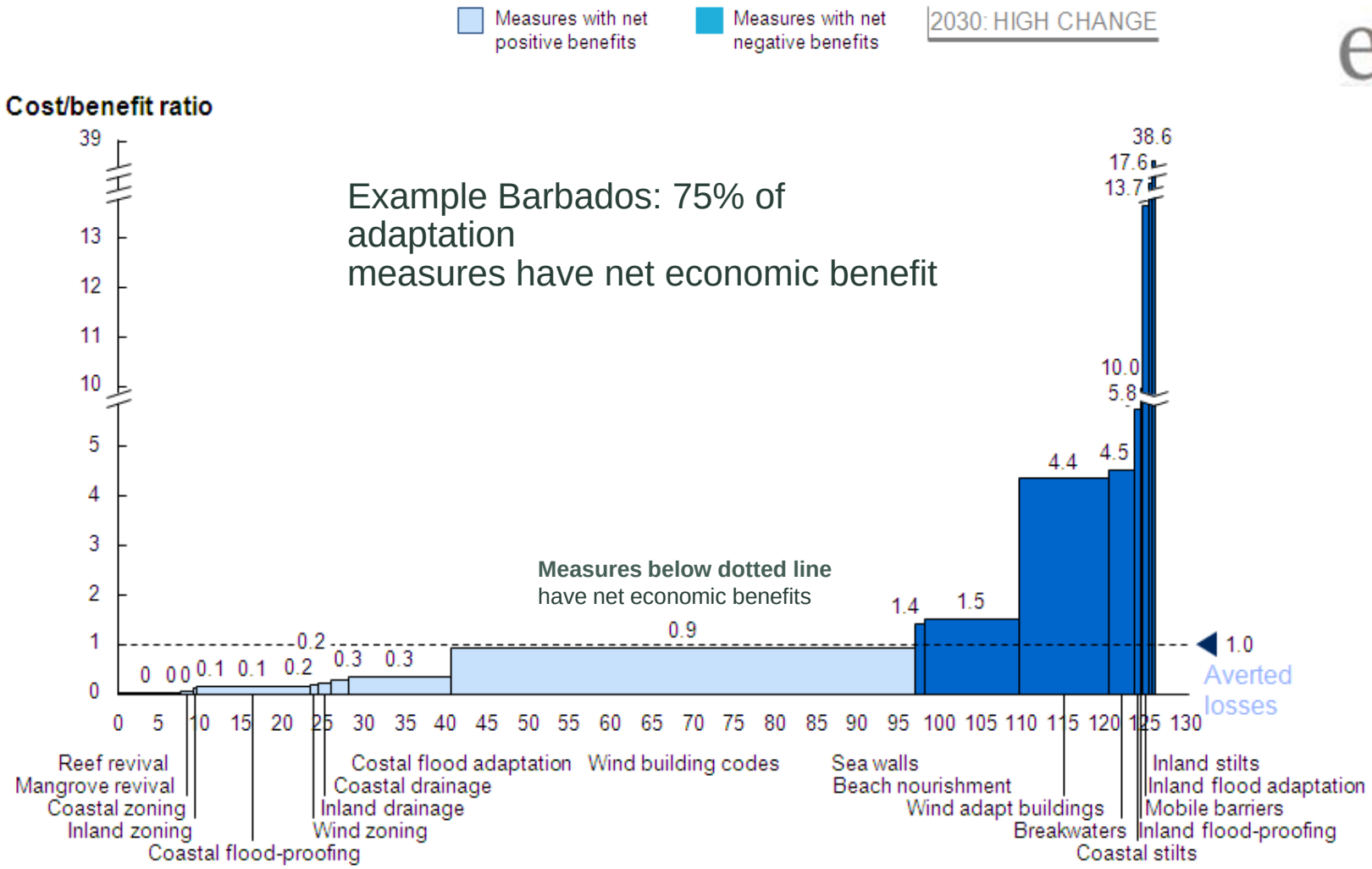
- "Alternative capital" broadly refers to reinsurance/retro capacity provided by capital markets investors rather than via traditional reinsurance
- Alternative capital increased sharply since 2011 to USD 45 bn
- Collateralized reinsurance grows fastest, reaching the volume of cat bond market
- Alternative capital market share accounts for 11% globally and about 17% in the US, exceeding the 2007 level (post-Katrina)

Source: Swiss Re Capital Markets

Disaster Risk Financing: Regional risk sharing requires a universal currency



Disaster Risk Management: Cost-benefit assessments require a transparent, universal currency



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Modelling and DRR for Sovereign Risk Management

Dr Simon Young

GeoSY Ltd

Context

- DRR activities in many developing world countries are undertaken with little reference to Ministries of Finance or to the economic benefits of DRM (or the costs of cat risk)
- Cat models provide a bridge, enabling the true cost/benefit relationships for DRR to be identified;
  - This is increasingly important as climate change adaptation and DRR/DRM become more and more integrated

Caribbean – shock and awe

- The first cat risk profiles generated for multiple countries to underpin the CCRIF launch in 2007 were greeted with dropped jaws by MoF officials
  - They had never seen annualised costs of cat risk before, even though they were generally aware of what the big events could do to the economies of their small islands
- CCRIF subsequently commissioned development of an in-house modelling platform by Kinetic Analysis Corp (KAC) to build on this entry point to:
  - Provide a solid, regionally-appropriate basis for CCRIF's parametric policies
  - Provide high resolution, nationally appropriate risk information for multiple hazards
  - Potentially provide a regional public good for use by governments for other DRM/DRR needs

Africa – another paradigm shift

- The African Risk Capacity Agency has taken the Caribbean example further in two particular ways:
  - *Africa RiskView* has been designed to act both as the underpinning model for the drought risk pool (other perils to follow) AND as an early-warning tool for governments
  - Membership of ARC Ltd, the mutual insurance company affiliate of the Agency, and issuance of a policy, is only possible after Contingency Plans have been certified by a technical review panel – which outline how payouts will be used to mitigate food insecurity

Discussion Points

- While progress is definitely being made on quantifying sovereign disaster risk and implementing tools to improve management, we still see significant challenges in building capacity within countries to act on the information
  - The Country Risk Officer concept has been considered by OECD and others, but implementing at the country level is challenging
  - Utilising cat risk models to undertake DRR (and climate change adaptation) cost-benefit analysis remains more of a dream than a reality in most development contexts
- There remains a significant moral hazard element to *ex ante* DRM decision-making
- DRR (and risk transfer) costs are still largely seen for their (negative) short-term budget implications rather than as long term strategic investments to offset ongoing liabilities

Understanding Risk Forum, London
Plenary Session: Models as Universal Currency of DRM

World Bank Group

The Role of Risk Models in Developing New Catastrophe Insurance Markets

Examples from Southeastern Europe Catastrophe Insurance Facility Program

Eugene N. Gurenko, Ph.D., CPCU, ARe

July 2, 2014

Catastrophe Risk Models

World Bank Group

- "All models are wrong but some are useful…"

  George E. P. Box, Statistician

- In August 2013, AIR released Comprehensive Earthquake and Flood Risk Models for Albania, FYR of Macedonia, and Serbia.

SEEC CRIF Risk Model Applications in Insurance

World Bank Group

- Pricing
- Loss assessment
- Reinsurance
- Regulation
- Consumer education

Models and rate making

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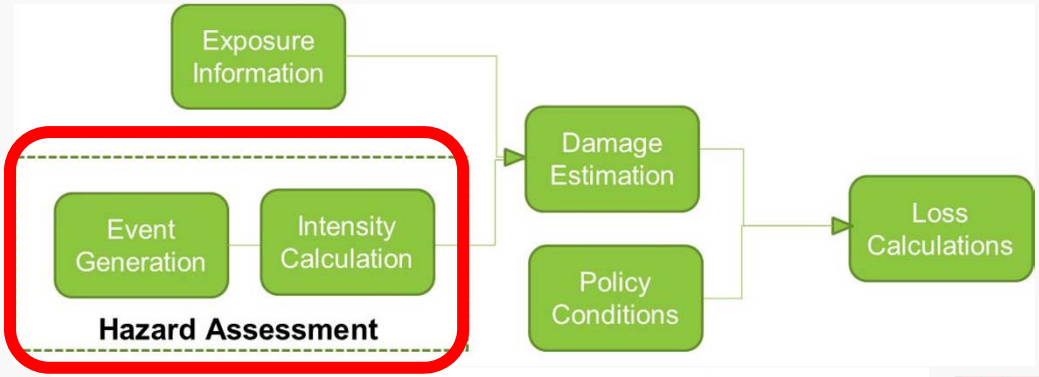
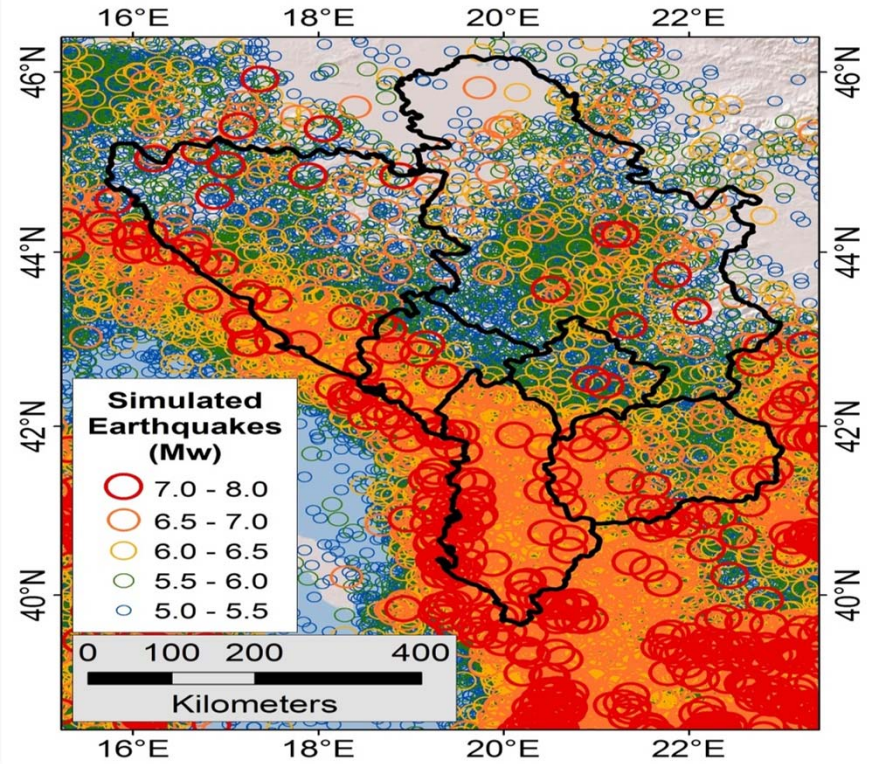
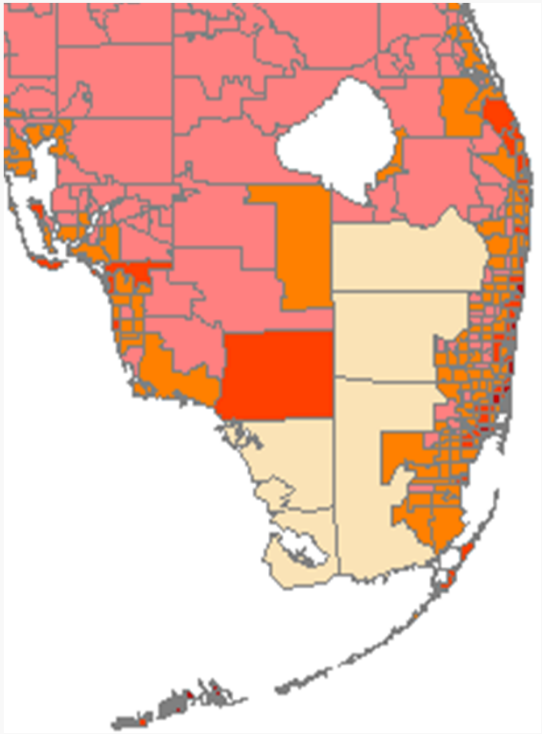


Premium Rate =

f (AEL, SDV, Loadings)





Models and Portfolio Loss Assessment: Serbia Floods, 2014

World Bank Group

AIR Model outputs such as:

- **Industry Exposure Data Base**
- **Vulnerability Functions for different types of buildings**
- **Digital Elevation Model**

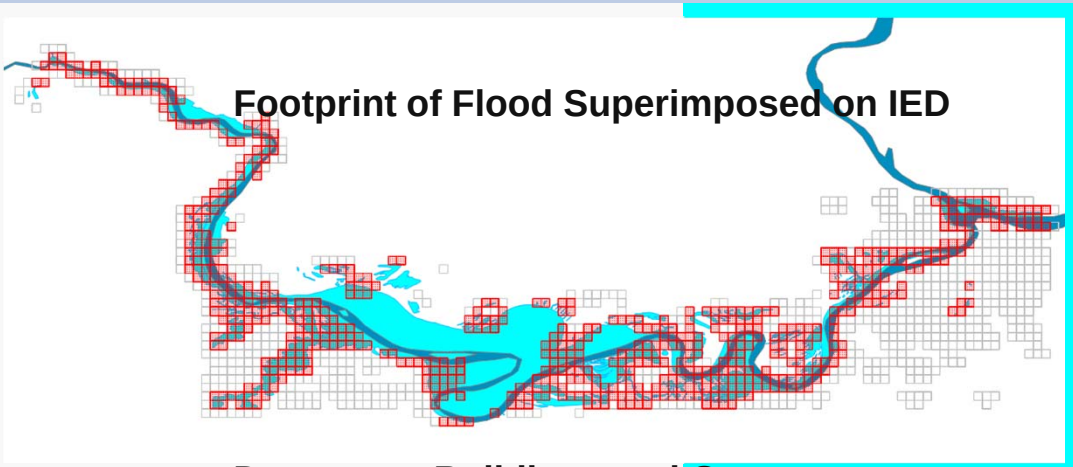
+

On-the-ground water depth observations

+

Aerial and Satellite Imagery

Footprint of Flood Superimposed on IED



Damage to Buildings and Contents

Construction Type	Apartments/ Condominiums	General Commercial	General Industrial	General Residential	Grand Total
Light Metal					
Masonry					
Reinforced Concrete					
Steel					
Wood Frame (Modern)					
Grand Total					

Risk Models and Reinsurance

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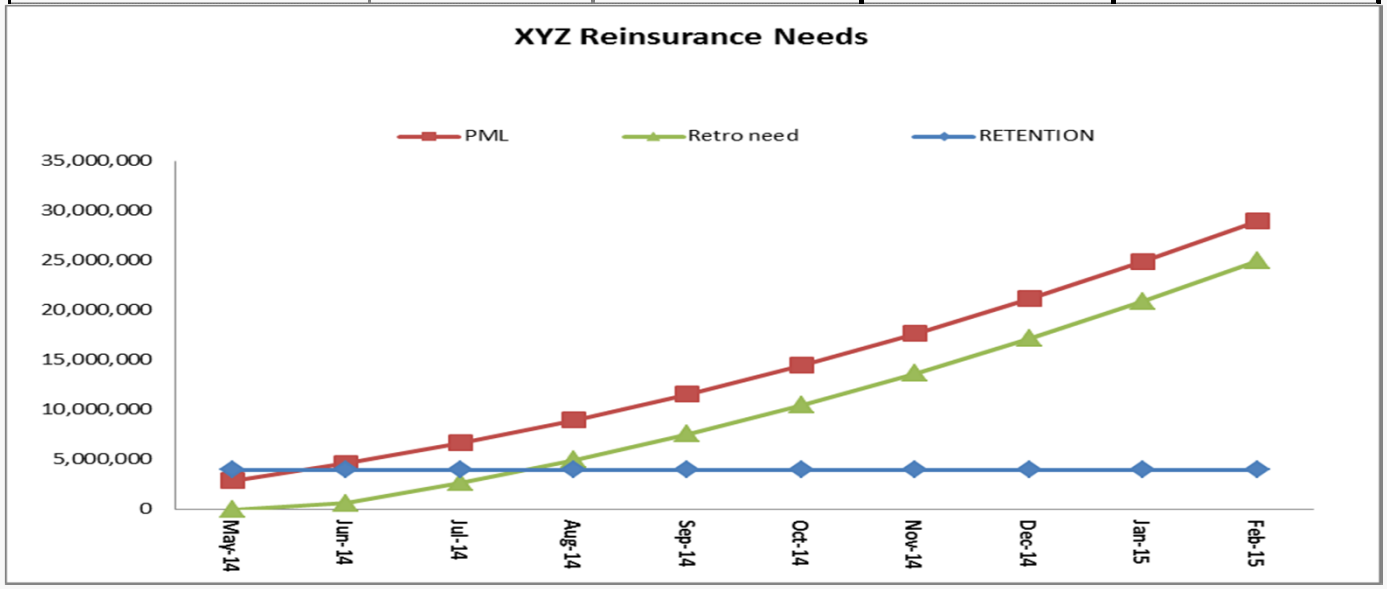
Return Period	250

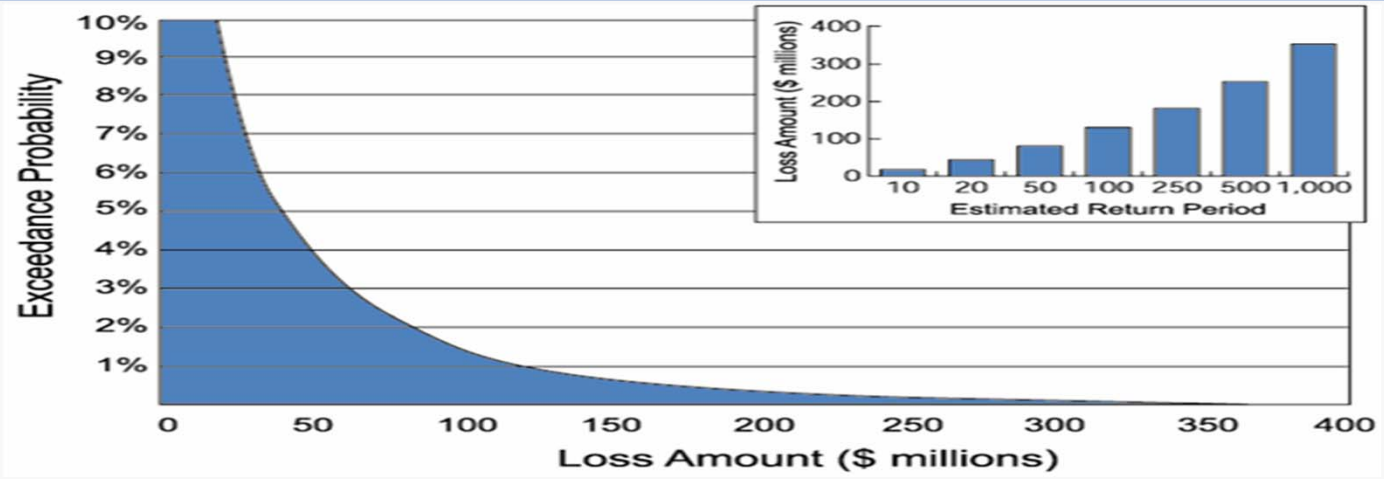
Amounts in EURO

AMS Assessment _ Retro Need				
Month	Exposure	PML 250	RETENTION	Retro need
Jan-14	0	0	4,000,000	0
Feb-14	0	0	4,000,000	0



- Risk models are used to determine the amount of reinsurance capacity needed by a risk taking entity based on projected risk aggregates in areas exposed to catastrophe risk.

Application of models to Risk Based Supervision



- **Insurer should have enough capacity (funds) to be able to face the probable maximum loss (PML) expected to arise from a large catastrophe event - with a given probability of exceedance - 0.5% (200 year-RP) – Solvency II.**
- **Insurer's Net Earthquake Insurance Capacity should exceed Net Aggregate Risk Retention of arising from EQ property risks (EISR >1).**

Models and Consumer Education: CatMonitor

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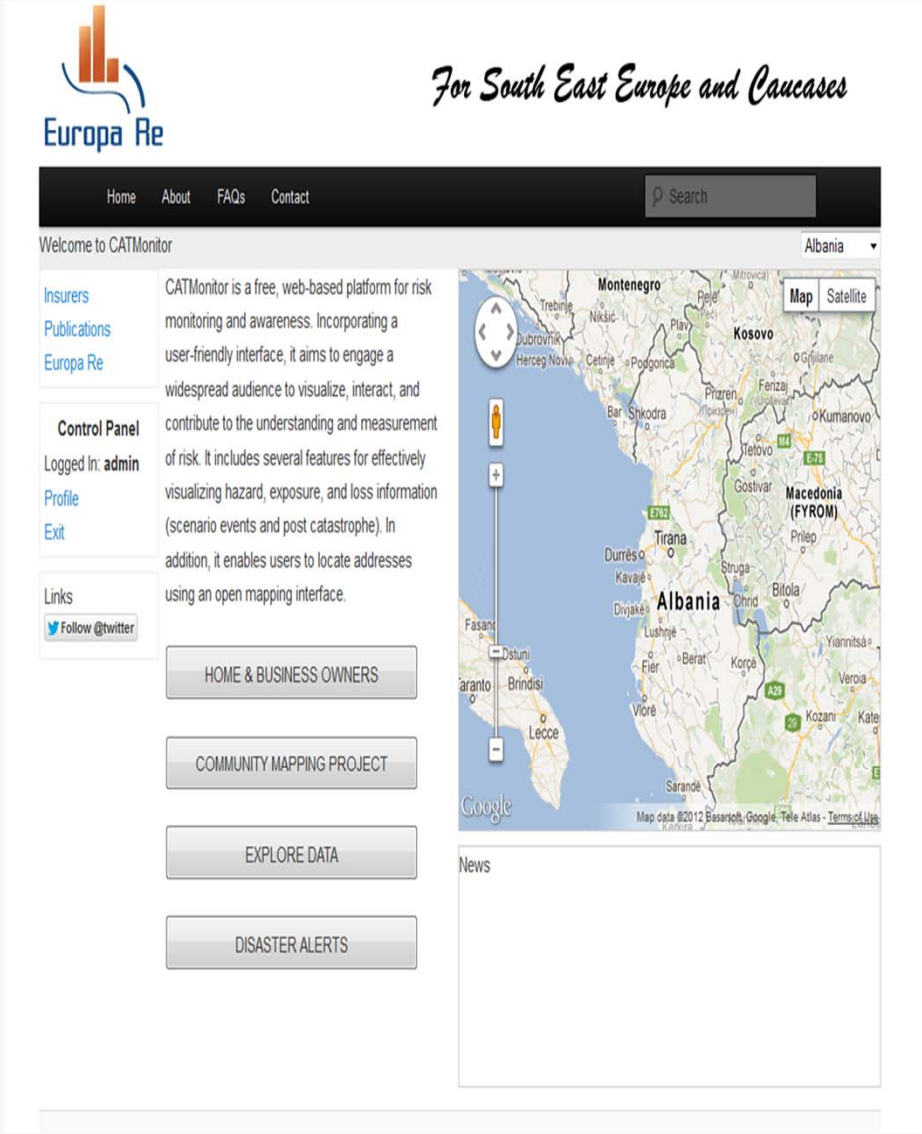

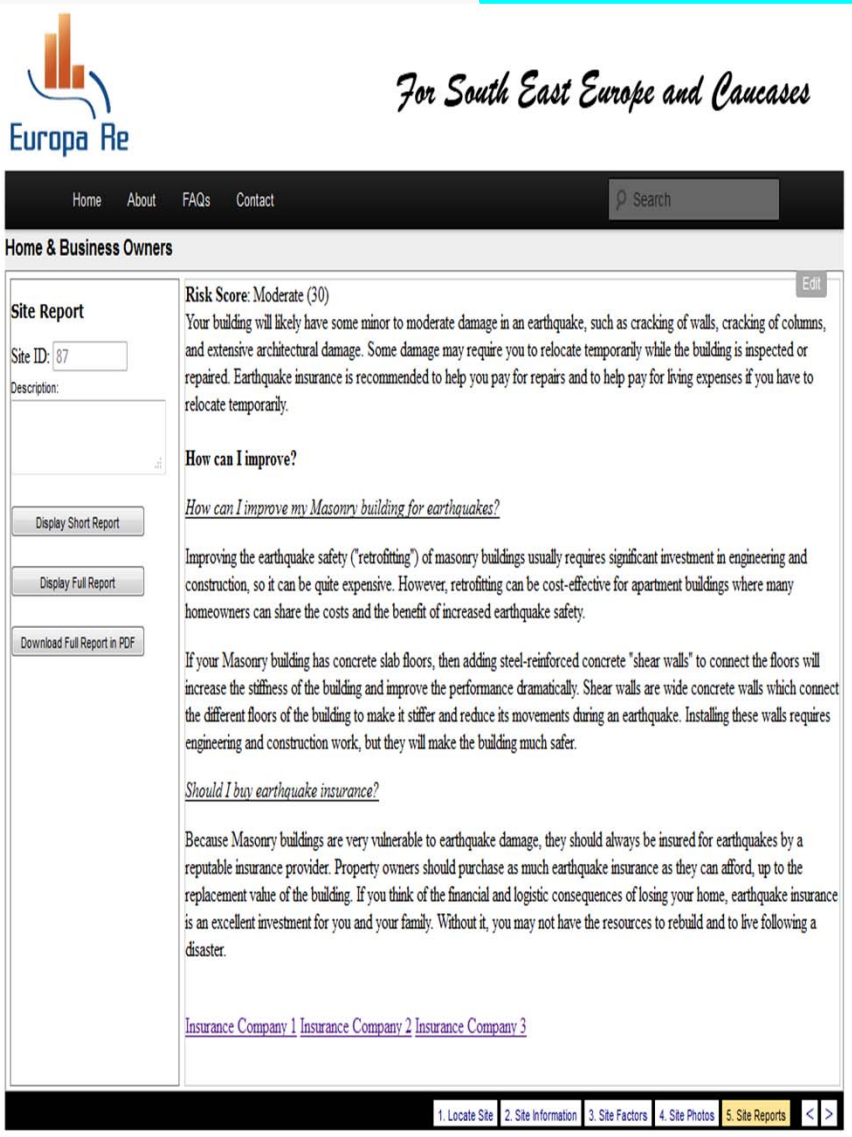

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Thank you for your attention!

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Short Bio:
Dr. Eugene N. Gurenko is a Lead Insurance Specialist at the World Bank Insurance Practice. During his career at the World Bank Group, which he joined in 1998, he designed and managed the World Bank programs of lending and technical assistance to the Turkish Catastrophe Insurance Pool, Romanian Catastrophe Insurance Pool, Europa Reinsurance Facility and, recently, the Kazakhstan Catastrophe Insurance Pool. From 2005-2006, Mr. Gurenko was with Munich Re, where he headed the company's working group on Terrorism Risk Management. Dr. Gurenko holds a Ph.D. from Columbia University, a title of Chartered Property Casualty Underwriter (CPCU) and an associate degree in reinsurance (ARe). He is an author of numerous professional publications on catastrophe insurance and reinsurance.

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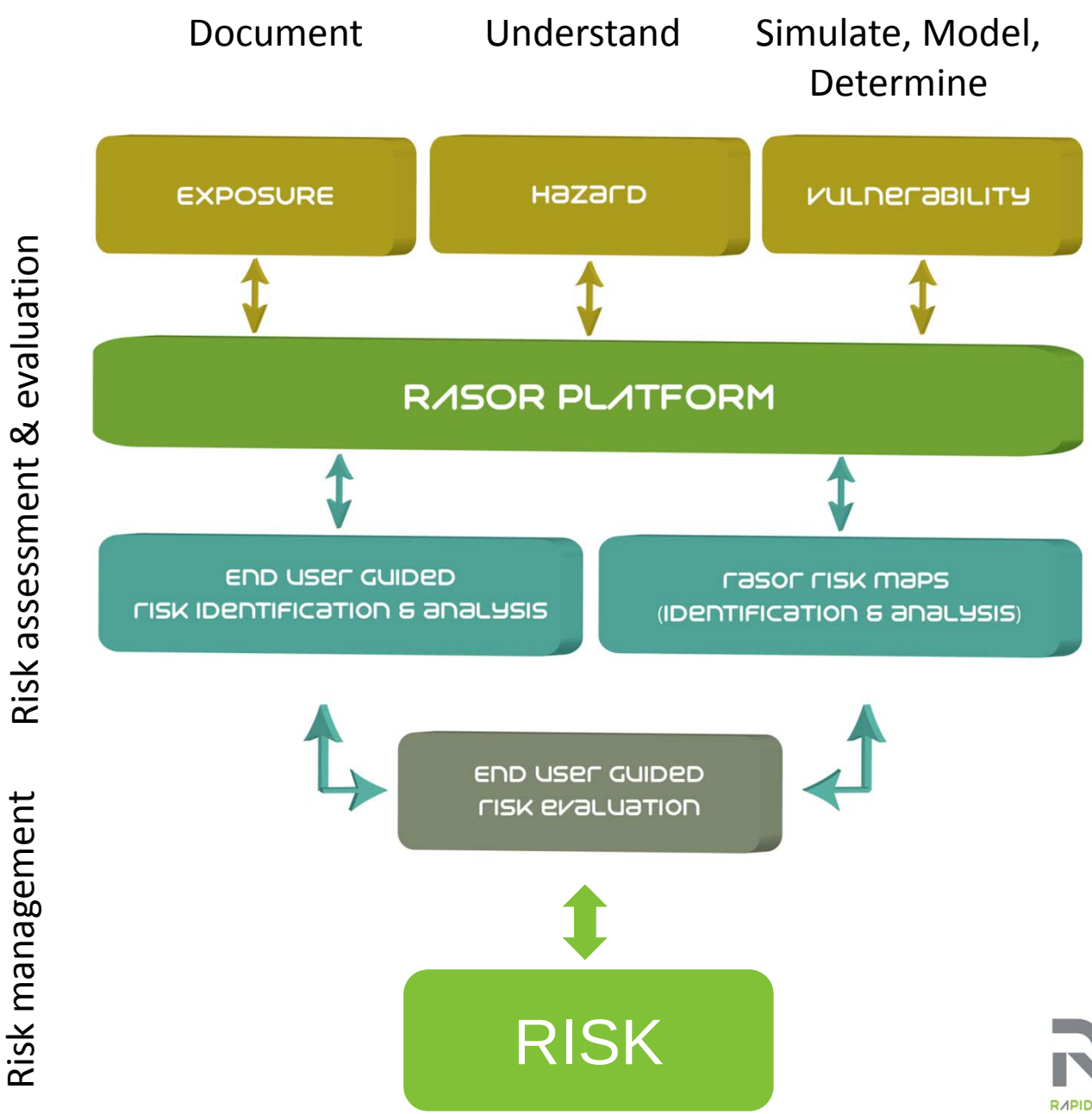
DRM – new tools for a changing paradigm (RASOR Overview)

RAPID ANALYSIS AND SPATIALISATION OF RISK

Presentation to UR London
Andrew Eddy, President, Athena Global
2 July, 2014

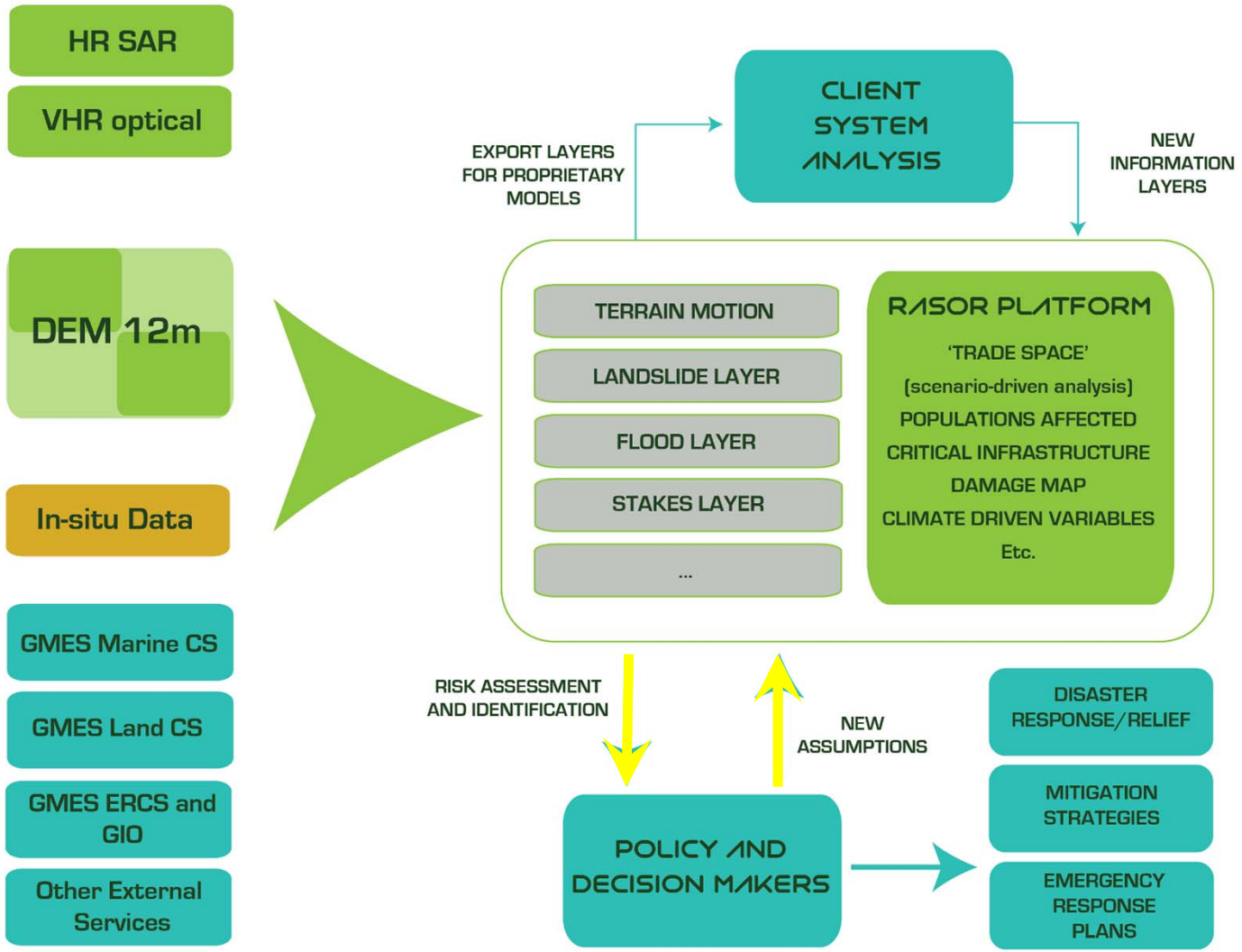
What do DRM Users Need?

- Up-to-date spatialised view of **hazard** extent (across several hazards)
- Up-to-date information on **exposure** of people and assets (and ability to project change)
- Comprehensive information on past disasters (to assist in **risk identification**)
- Ability to modify key parameters and project impact
- Ability to project cumulative effect of **risk** and correlations
- Ability to **integrate** analysis in a single tool
- Ability to produce information (layers) for **ingestion** in other tools



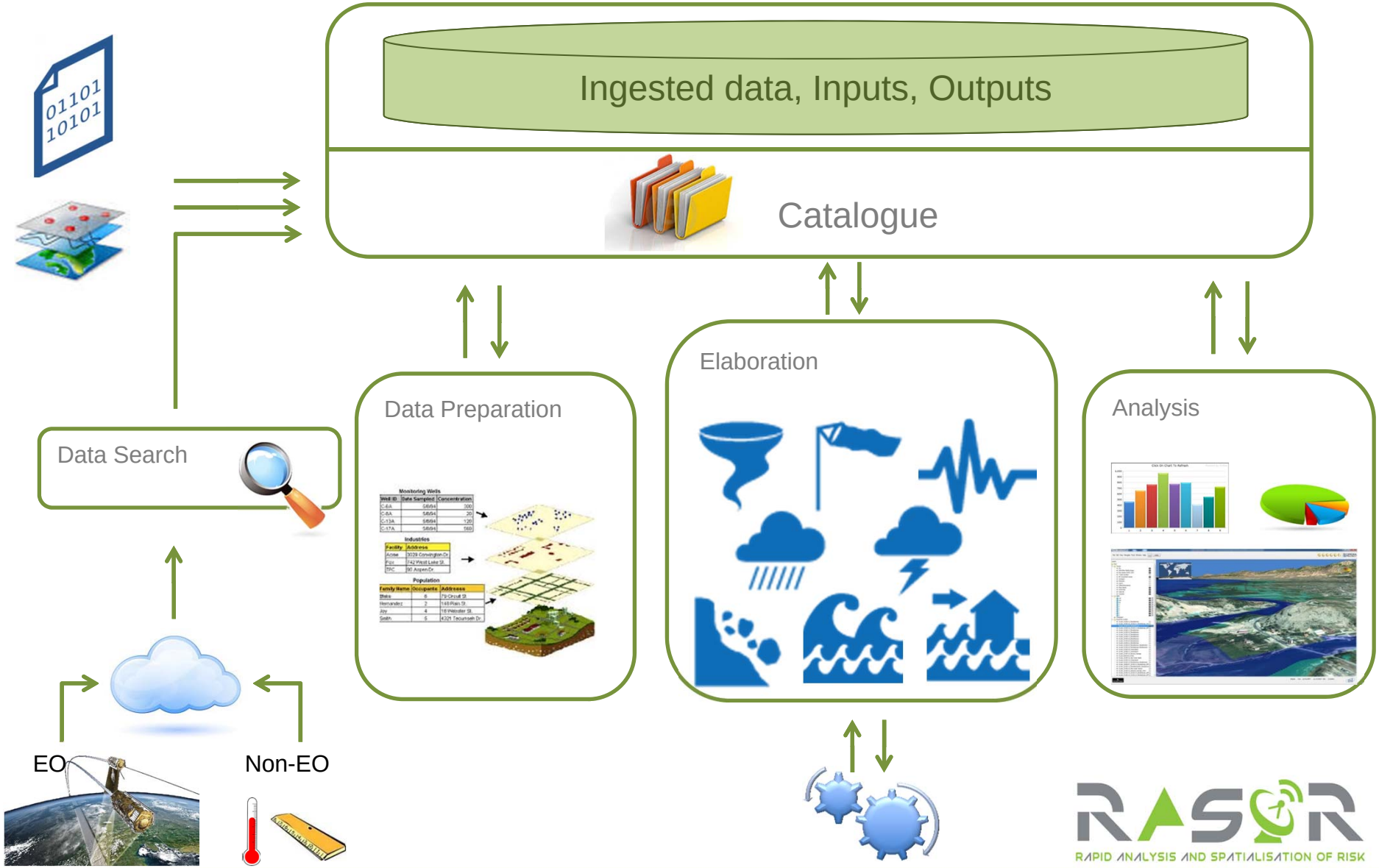
RASOR
RAPID ANALYSIS AND SPATIALISATION OF RISK

rasor structure



RASOR
RAPID ANALYSIS AND SPATIALISATION OF RISK

Logic Architecture



RASOR – what does it do?

- **Rapid:**
  - Mitigation: compile new analysis with or without in-situ data in hours or days instead of weeks and months
  - Warning: update existing risk analysis with NRT data from satellites as risk materializes; projections of future impact
  - Response: mark up data layers and inject new information to refine analysis
  - Recovery: track assets and support logistics of major recovery in NRT
- **Analysis**:
  - Past case studies of events, current situations, future scenarios
  - Multiple variables, sectoral perspectives, inter-related hazards
  - Evolving exposure and hazards
  - Flexible outputs
- **Spatialisation:**
  - VHR DEMs (TanDEM-X and Pleiades)
  - Satellite-based visualization
- **Risk:**
  - Hazard: from known data bases and new EO-based sources
  - Exposure: from global data bases and newly extracted EO-based
  - Vulnerability: from in-situ information when available

Discussion