GOBIERNO DE ESPAÑA

MINISTERIO DE ECONOMÍA, INDUSTRIA Y COMPETITIVIDAD

Instituto Geológico y Minero de España

CONSORCIO DE COMPENSACION DE SEGUROS

Reducing Tsunami Risk through Early Warning System, Preparedness and Awareness
Information Workshop on NEAMTWS

Economic Loss Assessment in Spain due to Tsunami Impact

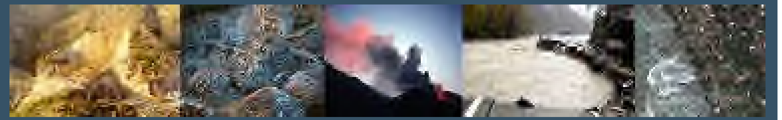
(A forthcoming IGME-CCS agreement)

Miguel Llorente Isidro, Ph.D.

m.llorente@igme.es
Project Manager
Spanish Geological Survey

Escuela Nacional de Protección Civil
Rivas (Madrid) Spain

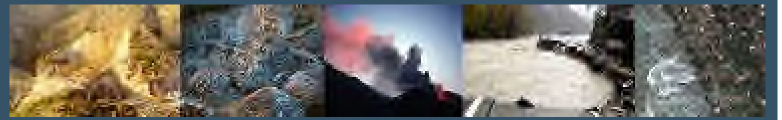
25-26 September 2017



Summary

General framework
- The insurance sector and the NH
- Solvency II Directive
- The Spanish Insurance Compensation Consoritum

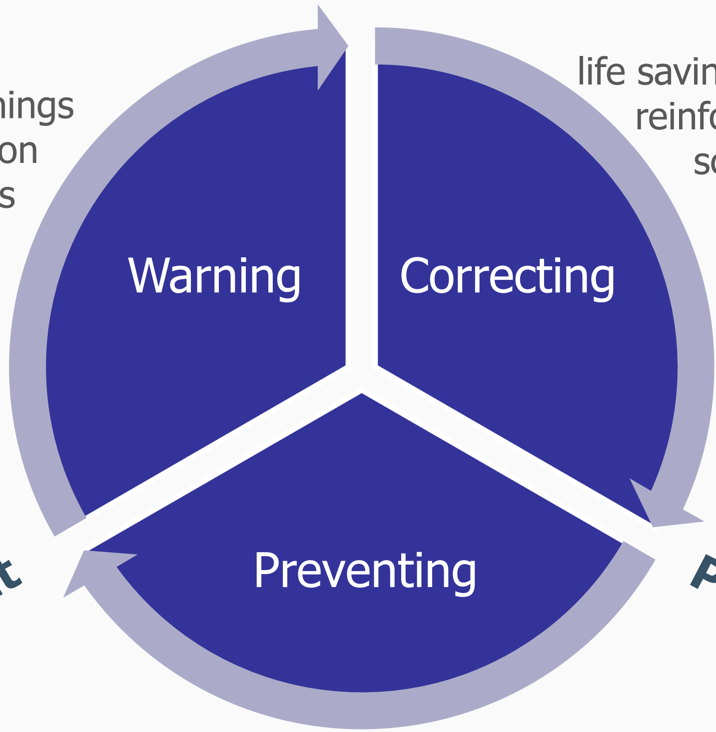
Risk assessment
- Assessing chances
- Modelling initial conditions
- Modelling propagation
- Modelling floods
- Vulnerability approach
- Valuable assets
- Risk assessment



The circle of risk management

EVENT

Monitoring and issuing early warnings
scientific support & information
building/reinforcing defences
evacuation
….



life saving actions (rescue, evacuation)
reinforcing property defences
scientific support during event
monitoring & information
insurance (compensations)
other financial tools
…

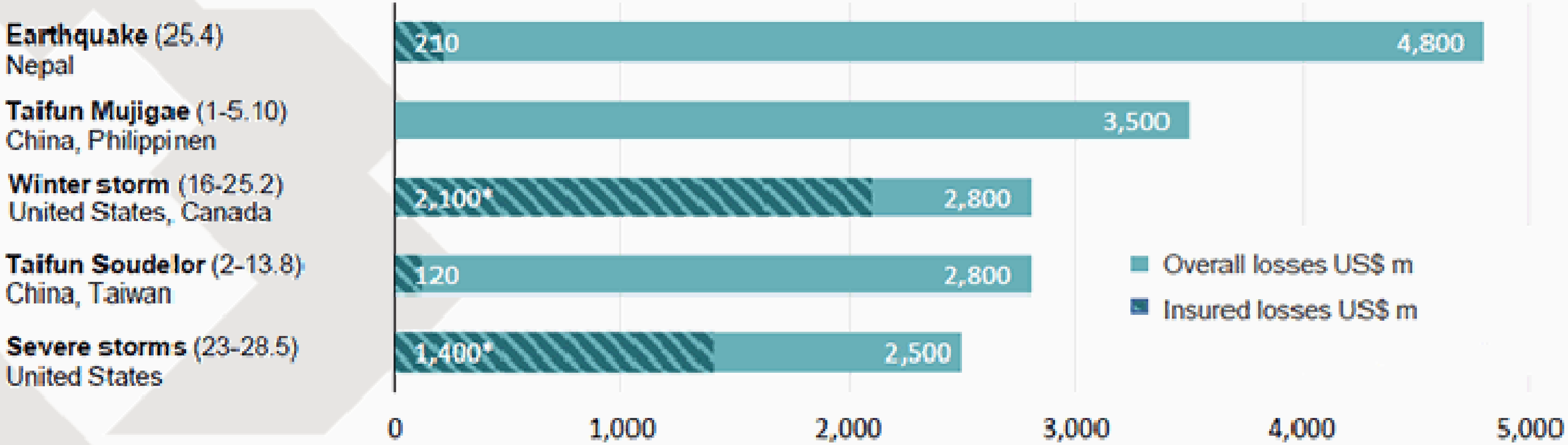
Pre-event

Post-event

Planning, policy making and implementation (including insurance)
knowledge development & public awareness, mapping hazards and risks

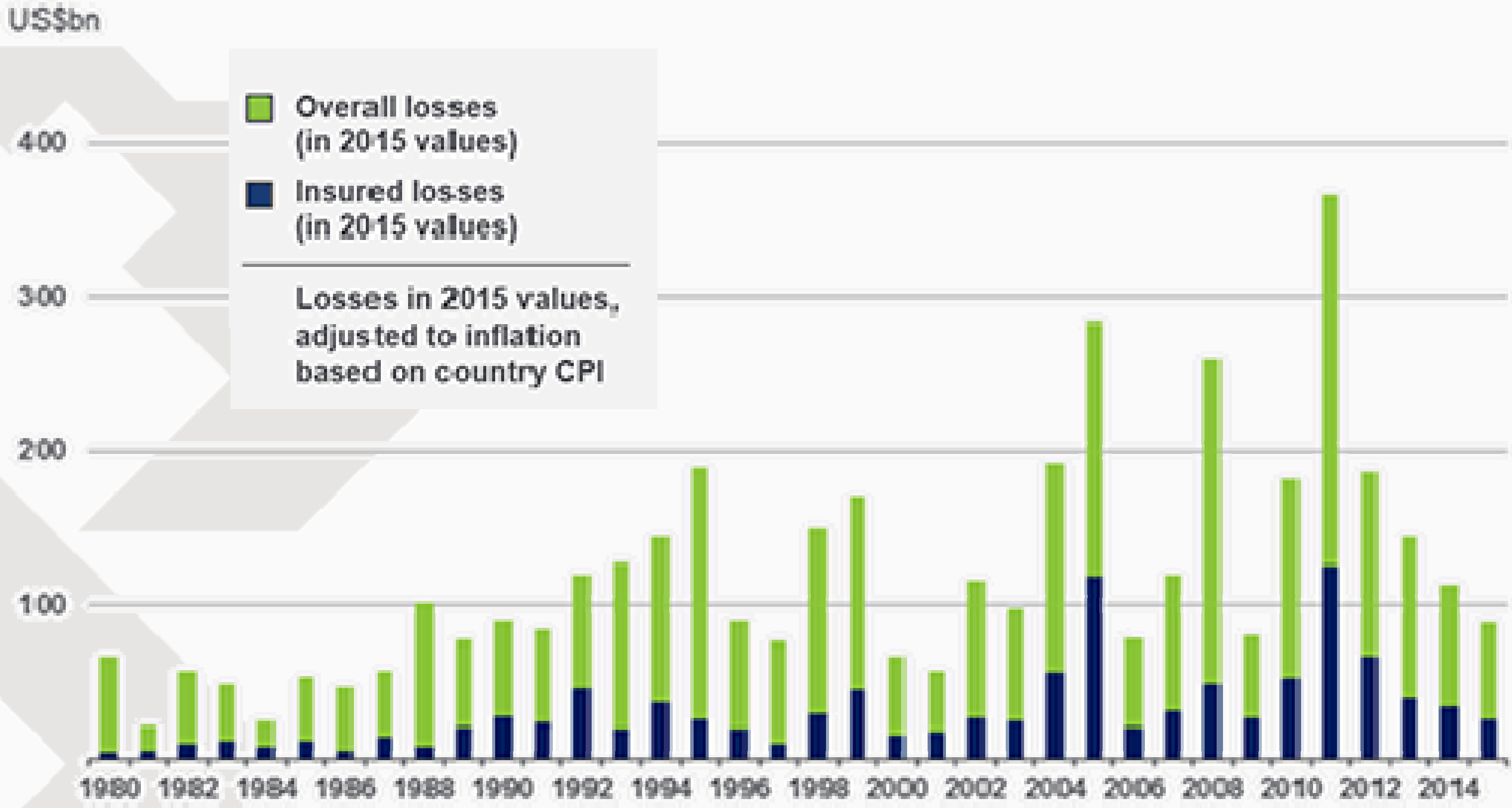
The bigger prevention the better

Losses in recent disasters and insurance



2016 Munich Re, Geo Risks Research, NatCatSERVICE

Disasters and insurance trends



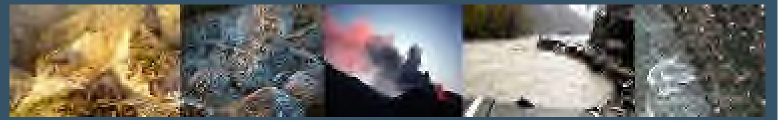
2016 Munich Re, Geo Risks Research, NatCatSERVICE

Solvency II directive

Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the **taking-up and pursuit of the business of Insurance and Reinsurance** (Solvency II)

One of the strong pillars deals with **the amount of capital** that EU insurance companies **must hold** in order to comply with solvency buffers regulated.

Its aiming at **a minimum of 99,5% a year success for a 100 year return period** (solvency)



The Consorcio de Compensación de Seguros

(Insurance Compensation Consortium)

The CCS is a public business institution active since 1954 (63 years)

CCS manages a **public-private partnership insurance solution**
covering extraordinary risks (natural catastrophes and terrorism)
by means of policies issued by private insurers (property accidents life)

Natural catastrophes considered include:

earthquakes	tempest
tsunamis	meteorites
floods	volcanoes

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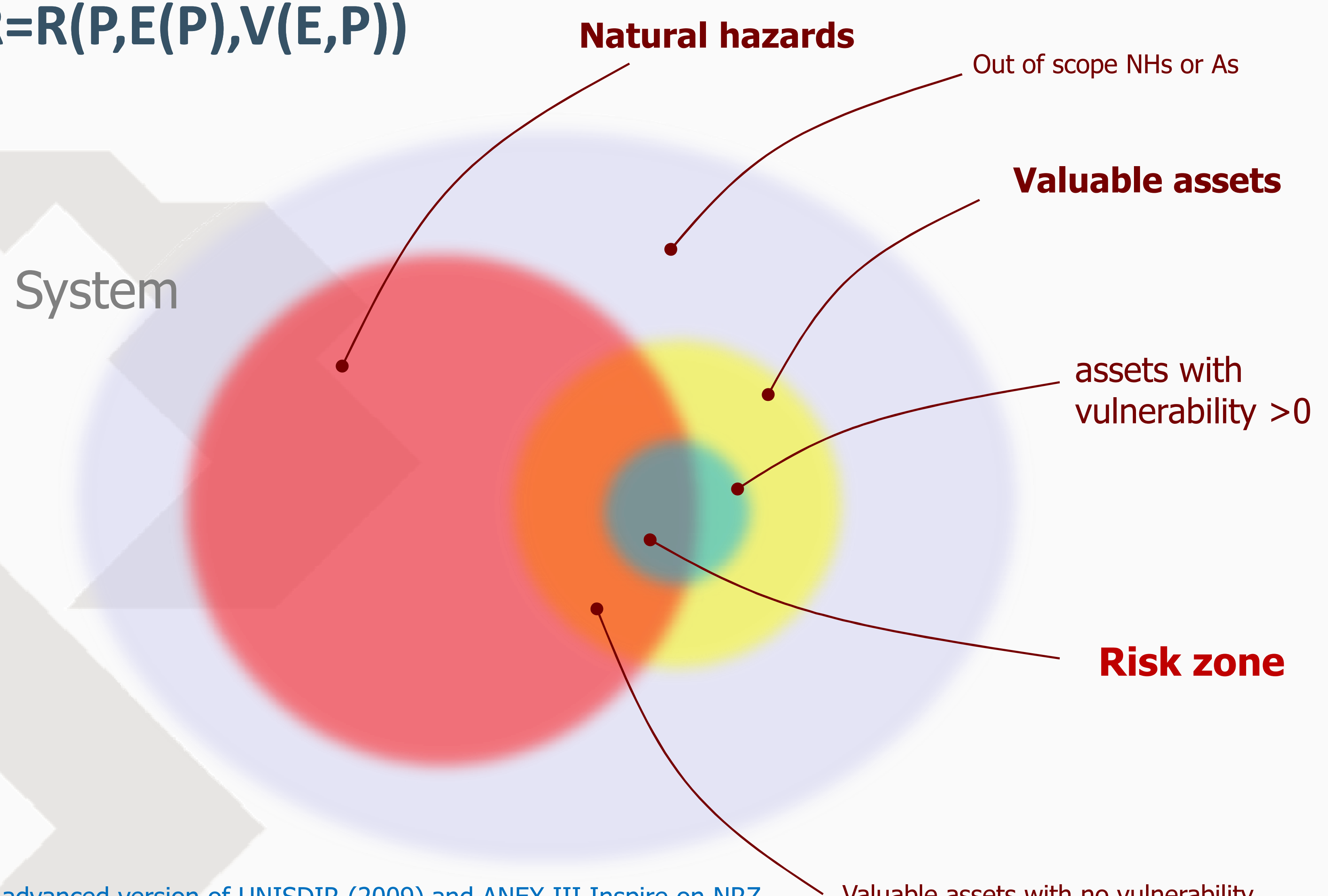
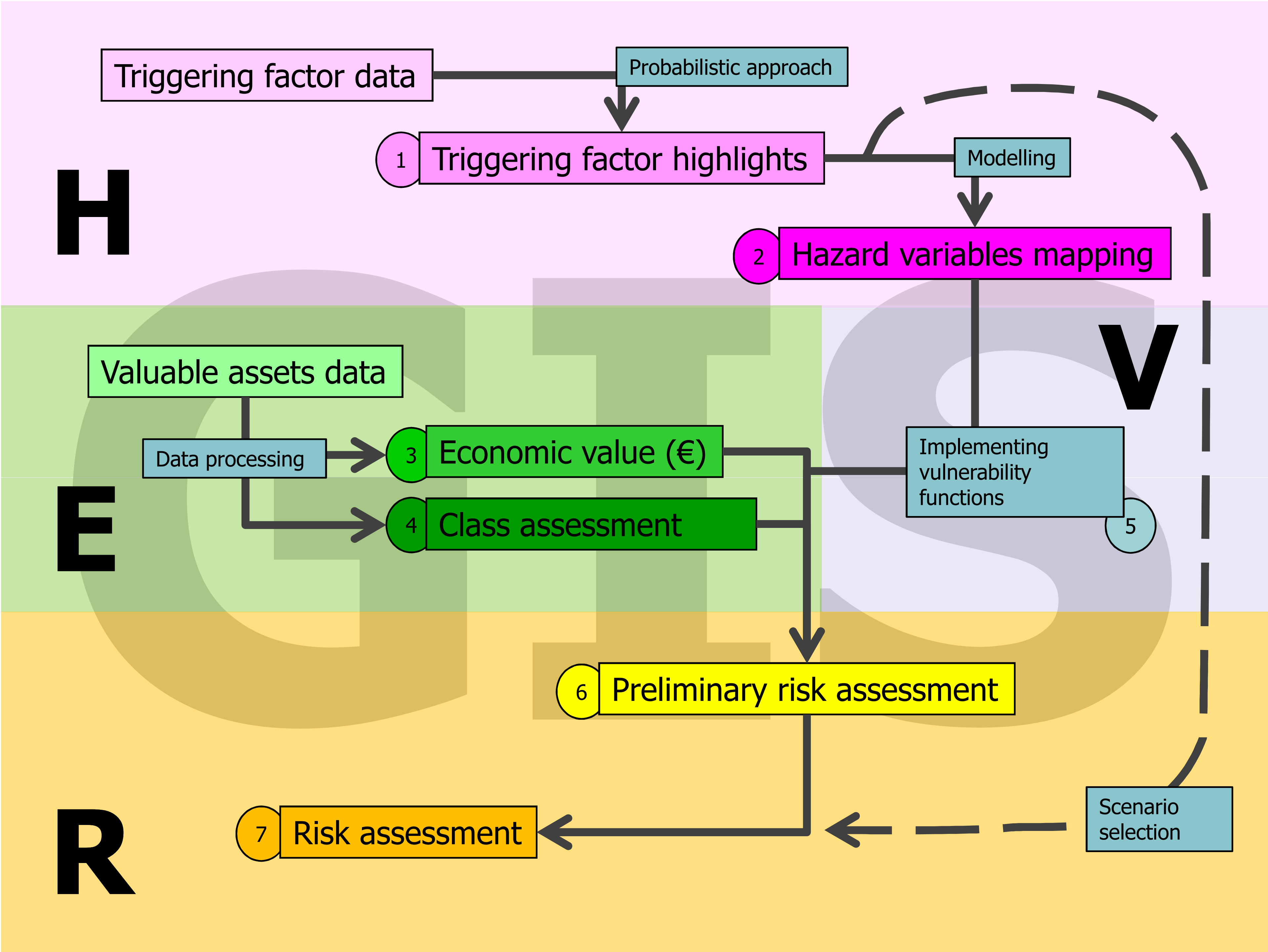
R=R(P,E(P),V(E,P))



An advanced version of UNISDIR (2009) and ANEX III Inspire on NRZ



H
E
V
R
GIS
Triggering factor data
Probabilistic approach
1
Triggering factor highlights
Modelling
2
Hazard variables mapping
Valuable assets data
Data processing
3
Economic value (€)
4
Class assessment
Implementing vulnerability functions
5
6
Preliminary risk assessment
7
Risk assessment
Scenario selection

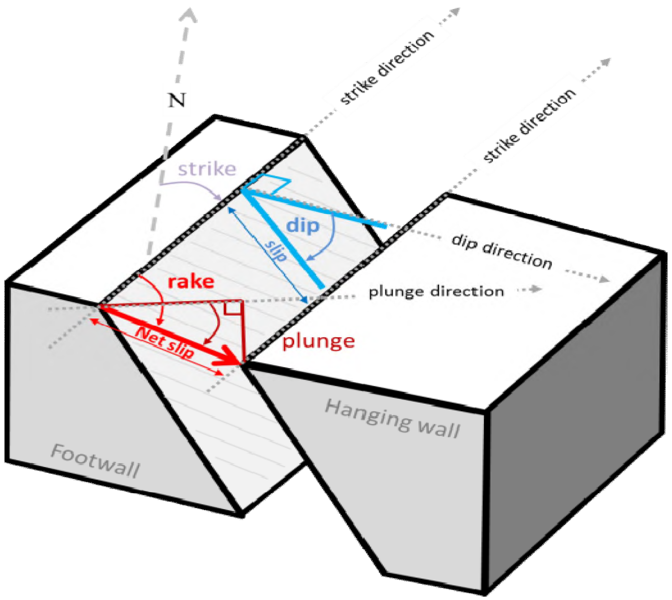
Assessing chances

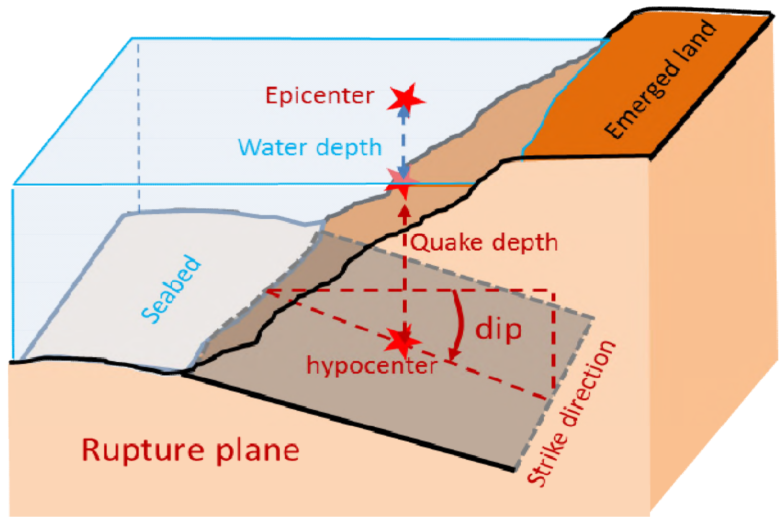
Joint effort of the most relevant actors of the Scientific Community
Tsunamigenic sources
Workshop 6-7 November 2017 in University Malaga

Modelling initial conditions of the tsunami triggering event

Will include modelling uncertainty
Will include modelling wave propagation

Scenario	WD	Strike	Dip	Rake	Slip	Length	Width
ESCDB	2.50	96	20	90	8	500	90
MEF	0.50	290	70	270	6	80	20
MS	2.20	99	14	90	3	190	20
NPDB	1.00	142	40	90	10	243	80
PRT	7.60	86	20	23	8	500	110
SMT1	3.80	105	11	90	3	140	25
SMT2	4.00	95	10	90	3	150	25
WMT	3.90	100	9	90	4	290	30
WSCDB	2.60	53	17	90	7	500	90





Modelling propagation and inundation

Tsunami-HySEA (EDANYA research group) → NLSWE:

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EDANYA

$$\begin{cases} \dfrac{\partial h}{\partial t} + \dfrac{\partial q_x}{\partial x} + \dfrac{\partial q_y}{\partial y} = 0, \\[2ex] \dfrac{\partial q_x}{\partial t} + \dfrac{\partial}{\partial x}\left(\dfrac{q_x^2}{h} + \dfrac{g}{2}h^2\right) + \dfrac{\partial}{\partial y}\left(\dfrac{q_x q_y}{h}\right) = gh\dfrac{\partial H}{\partial x} - S_x, \\[2ex] \dfrac{\partial q_y}{\partial t} + \dfrac{\partial}{\partial x}\left(\dfrac{q_x q_y}{h}\right) + \dfrac{\partial}{\partial y}\left(\dfrac{q_y^2}{h} + \dfrac{g}{2}h^2\right) = gh\dfrac{\partial H}{\partial y} - S_y. \end{cases}$$

ρ density; g gravity;

$H(\mathbf{x})$ bathymetry; $h(\mathbf{x}, t)$, water layer thickness;

$(u_x(\mathbf{x}, t), u_y(\mathbf{x}, t))$ flow velocity;

$q_x(\mathbf{x}, t) = u_x(\mathbf{x}, t)h(\mathbf{x}, t), \qquad q_y(\mathbf{x}, t) = u_y(\mathbf{x}, t)h(\mathbf{x}, t)$ fluxes;

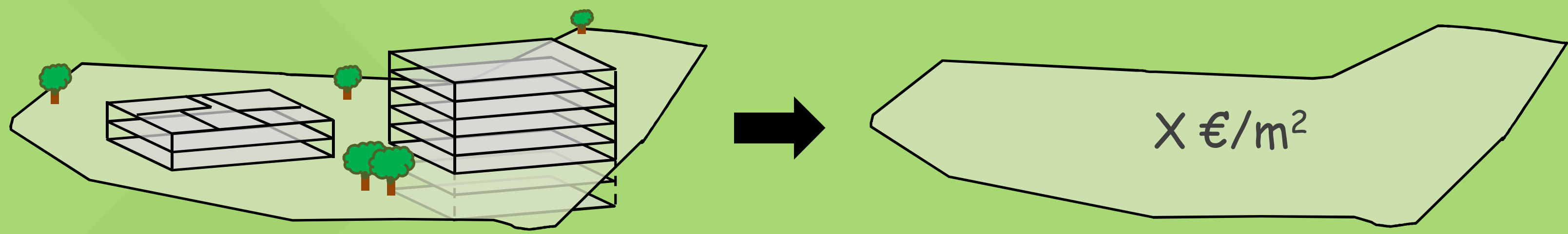
$S_f = (S_x, S_y)$ bottom friction effects.

$$\begin{cases} S_x = -gh\,\dfrac{n^2}{h^{4/3}}\,u_x\,\|\boldsymbol{u}\| \\[2ex] S_y = -gh\,\dfrac{n^2}{h^{4/3}}\,u_y\,\|\boldsymbol{u}\| \end{cases},$$

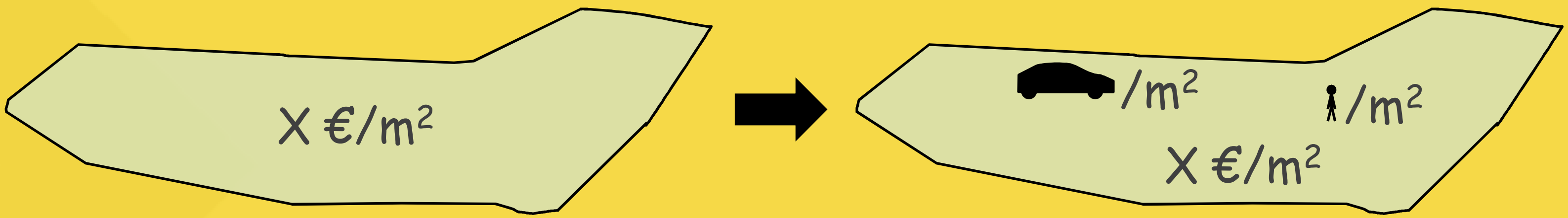
Exposure

Statistical data: total number of vehicles/people per municipality

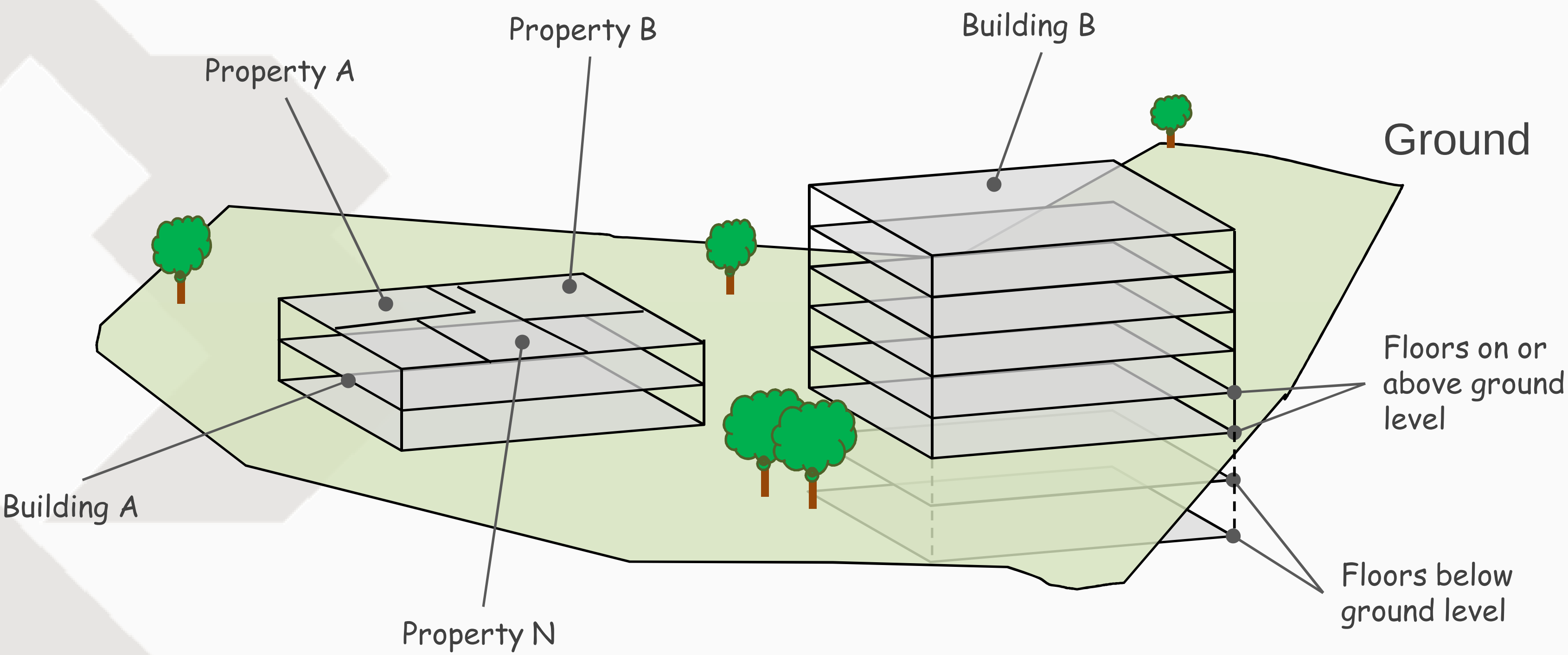
Generalizing the cadastre (flattening alphanumeric and cartographic info)



Using the cadastral value to distribute vehicles and people



Vulnerability assessment



Papathoma Tsunami Vulnerability Assessment (D'all Osso et al, 2009; PTVA-3 (Relative vulnerability index)

$$\boldsymbol{RVI} = \left(\frac{\mathbf{2}}{\mathbf{3}}\right) * (\boldsymbol{Sv}) + \left(\frac{\mathbf{1}}{\mathbf{3}}\right) * (\boldsymbol{Wv})$$

Sv standardized structural vulnerability
Wv water intrusion vulnerability

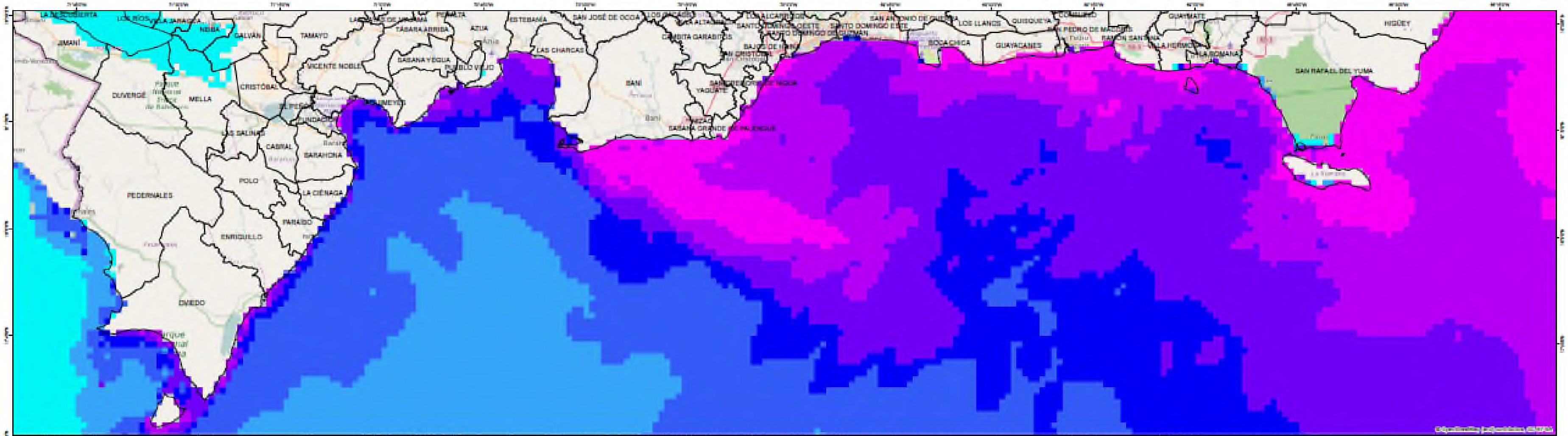
$$Sv^{ns} = Bv * Ex * Prot$$

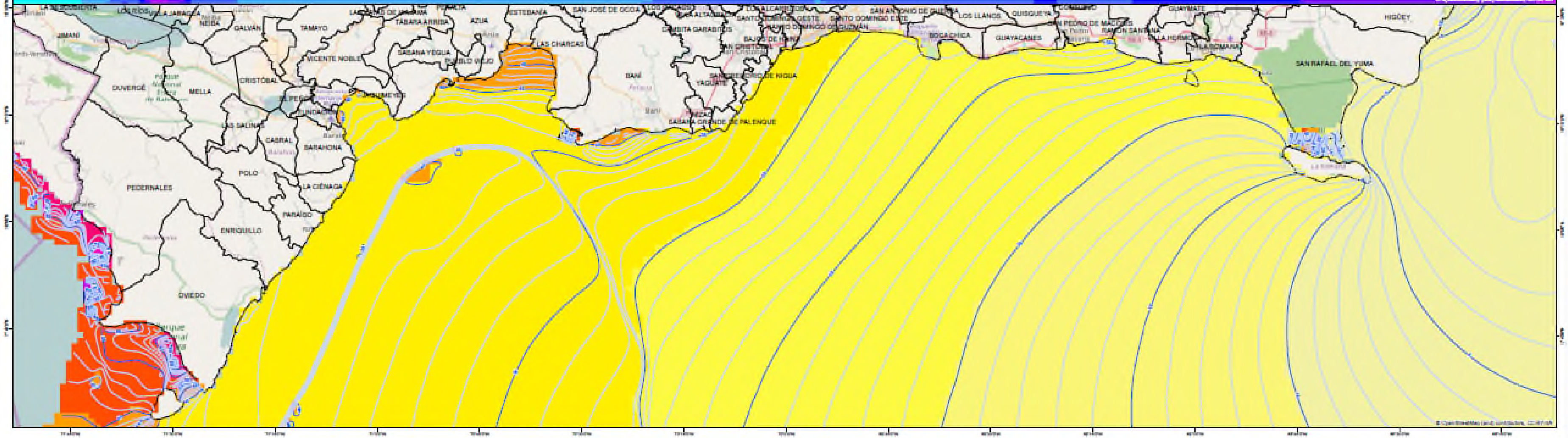
Bv standardized building vulnerability
Ex standardized water depth
Prot standardized level of protection

$$Bv^{ns} = \left(\frac{1}{423}\right) * (100S + 80M + 63G + 60F + 51Mo + 46So + 23Pc)$$

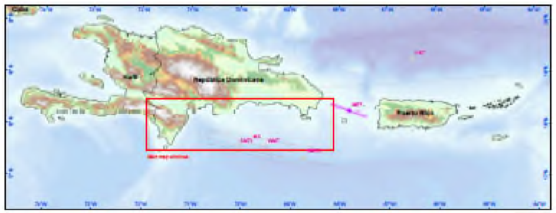
$$Prot^{ns} = \left(\frac{1}{301}\right)(100ProtBR + 73ProtNB + 73ProtSW + 55ProtW)$$

S scoring parameter given the **number of stages**,
M scoring parameter addressing (spa) the **construction materials**,
G and *So* spa the floor **hydrodynamics**,
F spa **foundation depth**,
Mo spa **movable objects**,
Pc spa **preservation conditions**,
Ex spa **flood depth**
ProtBR spa building relative **location** (vs coastline),
ProtNB spa existing **natural barriers**,
ProtSW spa **seawall defences**,
ProtW spa **other defences**



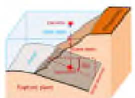


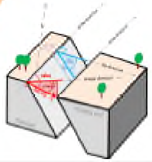
Locator map with scenario's rupture planes, faults and epicentres.



Scenario	Latitude	Longitude	EQD	WD	Strike	Dip	Rake	Slip	Length	Width	Mw
ESC08*	13.10	-69.30	20.00	2.50	96	20	90	8	500	90	8.70
MEF	18.30	-67.80	10.00	0.50	290	70	270	6	80	20	7.60
MS	17.70	-69.80	3.50	2.20	99	14	90	3	190	20	7.70
NPDB	9.80	-77.80	25.00	1.00	142	40	90	10	243	60	8.50
PRT	19.30	-66.50	20.00	7.60	86	20	23	8	500	110	8.70
SMT1	17.60	-70.00	3.50	3.80	105	11	90	3	140	25	7.60
SMT2	17.40	-68.70	3.50	4.00	95	10	90	3	150	25	7.60
WMT	17.60	-69.50	3.50	3.90	100	9	90	4	290	30	8.00
WSC08*	12.30	-73.70	25.00	2.80	53	17	90	7	500	90	8.60

* Together: ESC08





Maximum heights (m)

Arrival times (minutes)

1:500,000

Union Europea

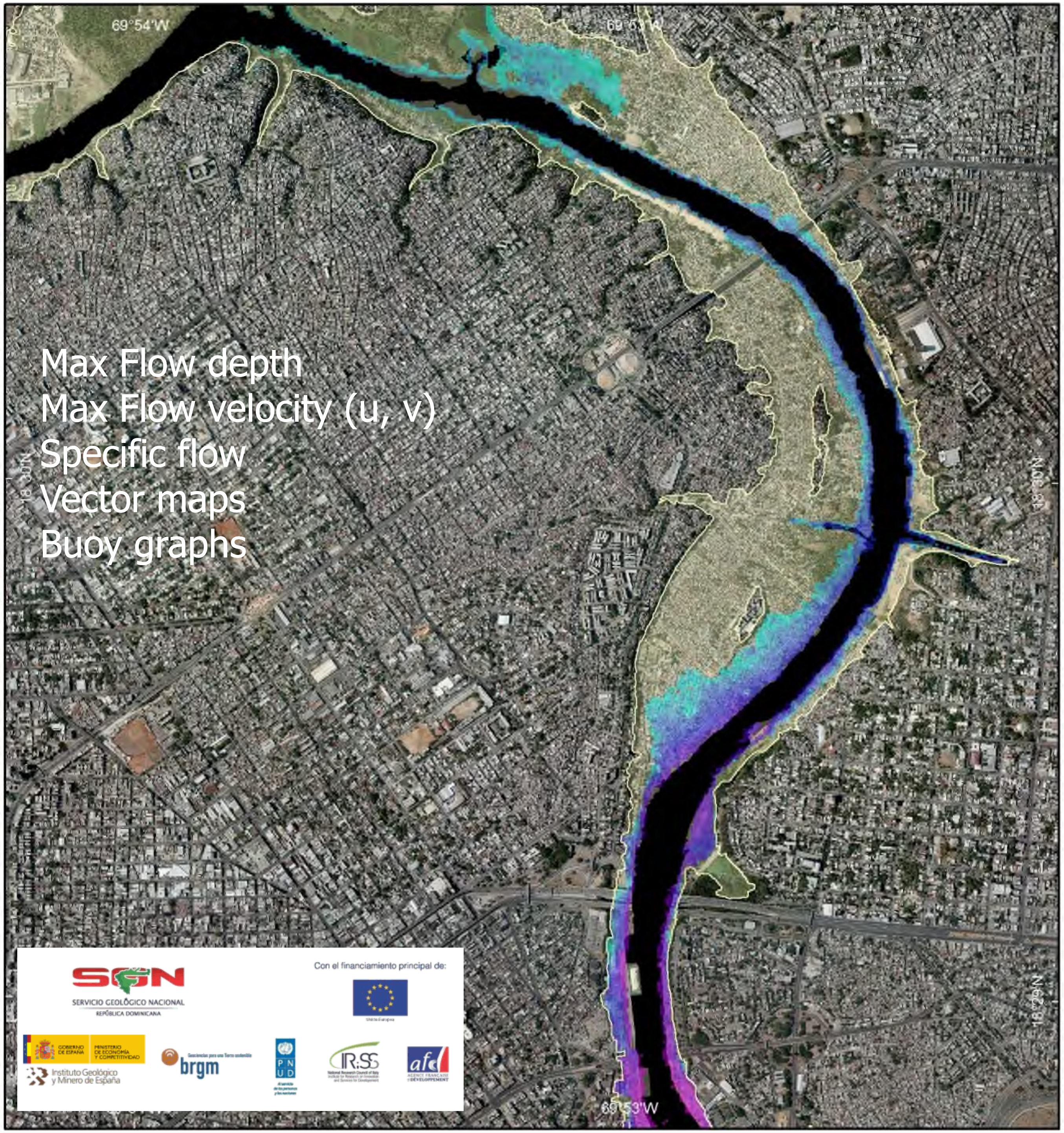
Life-Saving Actions: disaster preparedness and seismic and tsunami risk reduction in the south coast of the Dominican Republic

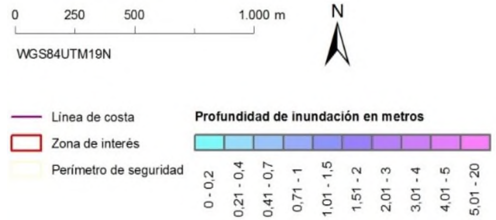
Tsunami Hazard Map: maximum wave heights and arrival times

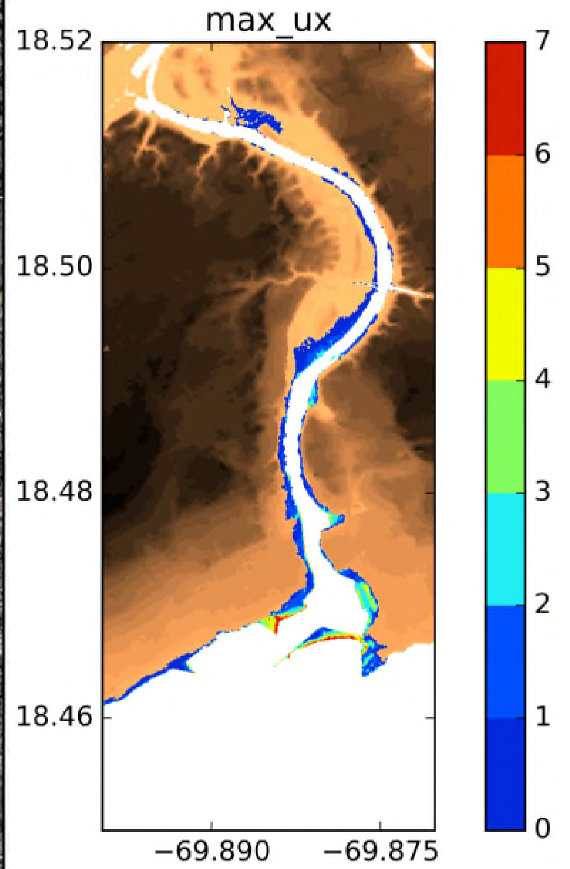
Map 1 of 5

Date: August 2016

Mona Extension Fault (MEF)


69°54'W
69°53'W
18°30'N
18°29'N
Max Flow depth
Max Flow velocity (u, v)
Specific flow
Vector maps
Buoy graphs
SGN
SERVICIO GEOLÓGICO NACIONAL
REPÚBLICA DOMINICANA
Con el financiamiento principal de:
Instituto Geológico y Minero de España
brgm
PNUD
IRSS
afd


0
250
500
1.000 m
WGS84UTM19N
N
Línea de costa
Zona de interés
Perímetro de seguridad
Profundidad de inundación en metros
0 - 0,2
0,21 - 0,4
0,41 - 0,7
0,71 - 1
1,01 - 1,5
1,51 - 2
2,01 - 3
3,01 - 4
4,01 - 5
5,01 - 20


max_ux
18.52
18.50
18.48
18.46
−69.890
−69.875
0
1
2
3
4
5
6
7

The IGME-CCS agreement scope

Purpose: maximum-most-likely monetary impact (€@2016)
we take no responsibility of any other use of data

Scenario based analysis
actual past or future events: out of scope
aiming at *relevant monetary impact*

Exposure is *purely monetary.*
No such thing as property or life → only €
It has to be statistically fit

Vulnerability is *purely damage* (recovery expenses)

Schedule: 36 months

Thank you for your attention

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