Concepts and Objectives of the Workshop

Mustafa Erdik

Turkish Catastrophe Insurance Pool (TCIP) is honored to host you in The International Workshop on Advances in Assessment and Modeling of Earthquake Loss.

The aim of the workshop is to discuss and recent advances in post-earthquake loss assessment and modelling of earthquake risk (CAT Modeling).

The presentations and panel discussions will esentially encompass the issues relevant to the development and applications concerning the post-earthquake loss assessment and the modelling and quantification of earthquake risk.

Emphasis will be on what we have learnt and what we will see in the future regarding these two issues.

Aacademicians and experts on earthquake insurance, representatives of the international insurance, reinsurance and modelling companies and the executives of the public bodies are among the speakers and participants of this international workshop.

TCIP’s new loss assessment methodology, cat management system and the its new pricing mechanism will also be introduced.

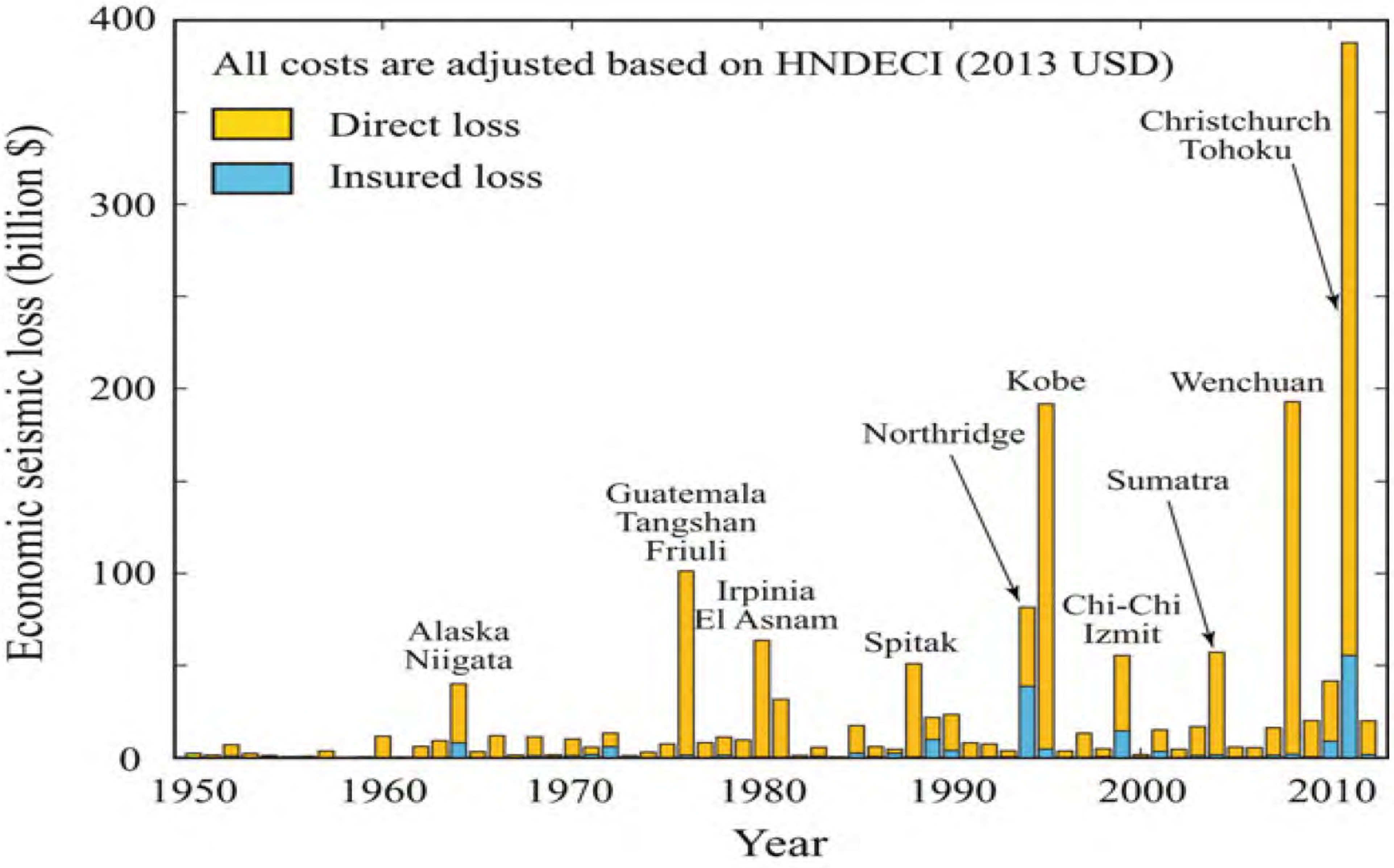
The end product of the workshop is planned to be a book published by a highly reputable publisher.

The state-owned Turkish Catastrophe Insurance Pool (TCIP) was created after the 1999 Kocaeli earthquake to reduce catastrophe earthquake exposure to the government.
The owners of residential properties within municipality boundaries are “obliged” to take TCIP earthquake insurance
coverage, which insures structural damage and loss due to earthquakes.
The “current” premium rates for RC buildings range from 0.00220 to 0.00044 depending on geographical location.
The maximum insured limit is TRY 210,000 and the deductible is 2 %.
The pool of the TCIP (about 10 billion TL) is not fully sufficient and it cedes a certain amount of its risks to international reinsurers.
The commercial and industrial properties as well as residential properties in rural areas can be insured on a voluntary basis by private insurance companies.

The TCIP facility was established as a national catastrophe risk pool owned by the government and managed by the private sector. The current insurance penetration rates are 65% and 53% respectively for Istanbul province and the whole country, the second highest in the world after New Zealand.

Such compulsory insurance schemes received strong global endorsement as well as financial support from the WB, since they would greatly contribute to the development of a catastrophe insurance market and could reduce government post-disaster budgetary outlays on reconstruction.

As frequency and severity of major earthquakes and economic and insured losses caused by them have considerably increased world-wide.



Earthquake-related economic and insurance losses

Goda et al., 2014

Note the amounts of direct and insured losses in Northridge and Christchurch + Tohoku earhquakes

A proper quantification earthquake monetary losses is needed by the insurance companies to price insurance premium and to assess their reinsurance needs as well as by decision makers for establish and prioritize seismic risk mitigation policies.

In this workshop the damage and loss oriented earthquake risk assessment procedures will be presented and discussed.

Post-earthquake damage assessment is fundamental, since:

- For loss based indemnification, an adjuster of the insurance company conducts an on-site inspection to identify the damage state of the building, after an earthquake damage claim.
- It is necessary to collect post-earthquake data regarding the usability of buildings and to reach important post-earthquake decisions (repair or demolish).
- A rapid inspection of existing structures soon after a damaging earthquake is needed to prevent collapses due to aftershocks.

However, the objectives and modalities of these assessments do differ and it is a challenge to bring them together to reduce the time and costs of such surveys.

It should be noted that, part of the reasons behind the exceptionally high insurance payments (USD 12.5 billion, substantially more than the amount of earthquake insurance premiums collected during the previous 80 years) after the 1994 Northridge earthquake (M6.7, 20 miles northwest of downtown Los Angeles) was due to problems in post-earthquake damage/loss assessment.

Concepts and Objectives of the Workshop – "Earthquake Risk In Istanbul" *Mustafa Erdik*

Methodologies about post-earthquake damage assessment – Country practices in the context of some key issues Chairperson*: Alper İlki*

Damage Assessment in Italy, and Experiences after Recent Earthquakes on Reparability and Repair Costs *Marco Di Ludovico*

Demolition Decisions and The Role Of Insurance *Ken Elwood*

Damage Assessment in Japan and Potential Use of New Technologies in Damage Assessment *Koichi Kusunoki*

Simplified analytical (mechanical-based) procedure for post-earthquake safety and loss assessment of buildings *Stefano Pampanin*

Damage Assessment Methodology Developed for TCIP *Alper İlki*

Panel Session: What we have learnt? What is the future?

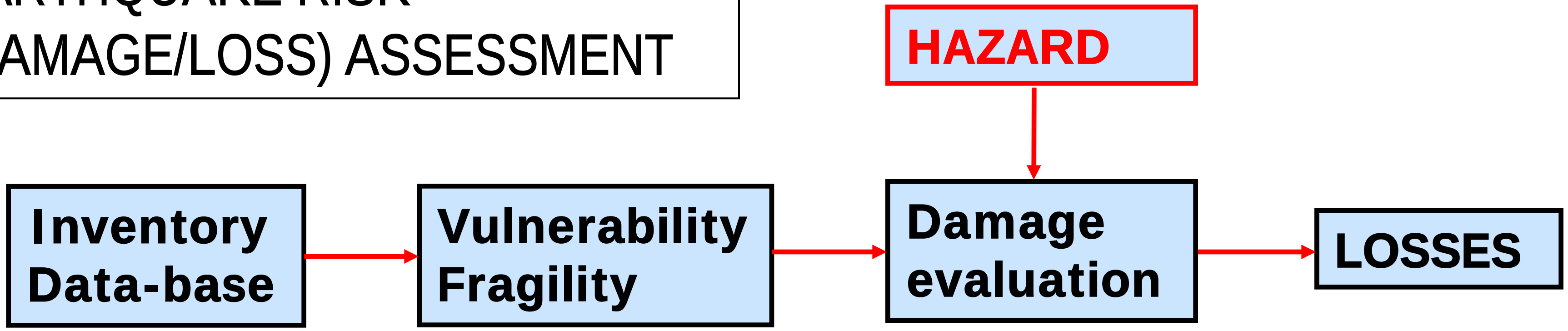
Moderator: *Alper İlki*

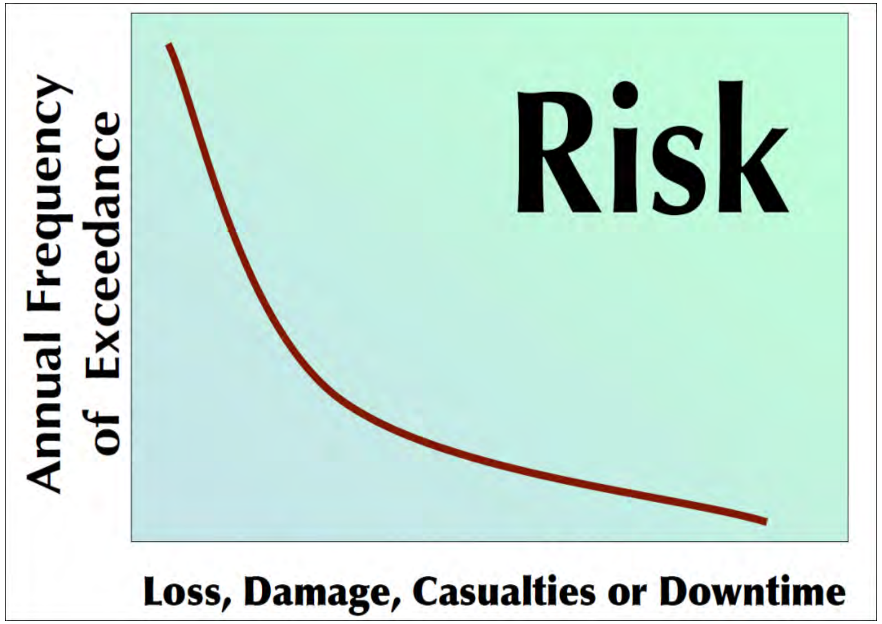
Panelists: *Marco Di Ludovico*
Ken Elwood
Koichi Kusunoki
Stefano Pampanin

Earthquake Risk in Istanbul

Mustafa Erdik

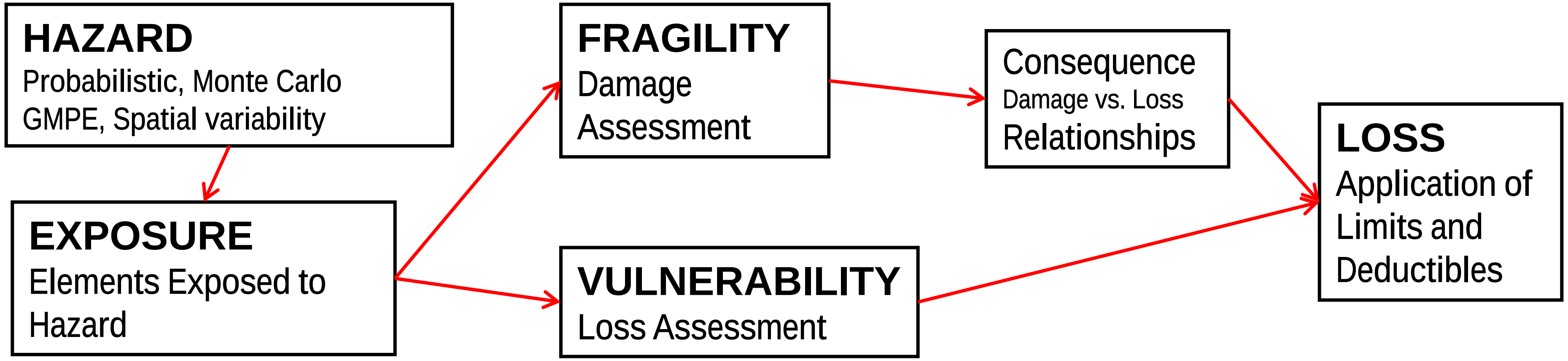
EARTHQUAKE RISK (DAMAGE/LOSS) ASSESSMENT





Cat Modeling is a tool to estimate the loss to a portfolio following a catastrophic earthquake

- Earthquake Hazard
- Exposure (Portfolio Inventory, Structure / Contents values, Policy Conditions)
- Fragility and Vulnerability (Hazard Susceptibility: Structural Taxonomy)



All Cat Models are simple mathematical models of the complex phenomena and encompass uncertainty.

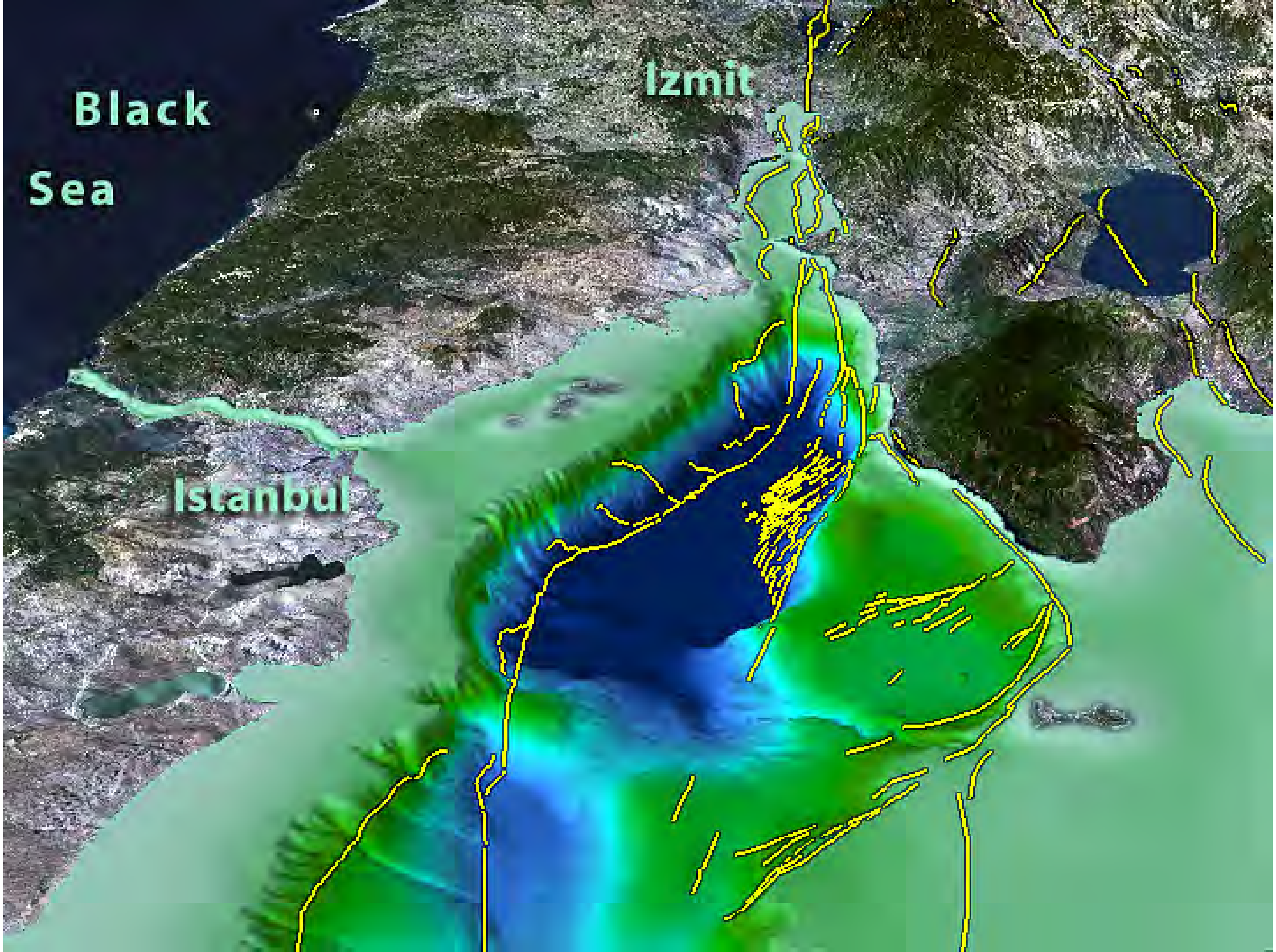
- Aleatory = inherent randomness which can be accounted but cannot be reduced
- Epistemic = uncertainty due to lack of information which can possibly be reduced

Main Sources of model uncertainty are due to: Limited portfolio data, Ground motion, vulnerability and other engineering/scientific assumptions

Primary uncertainty is the uncertainty asssociated with the occurrence of the earthquake

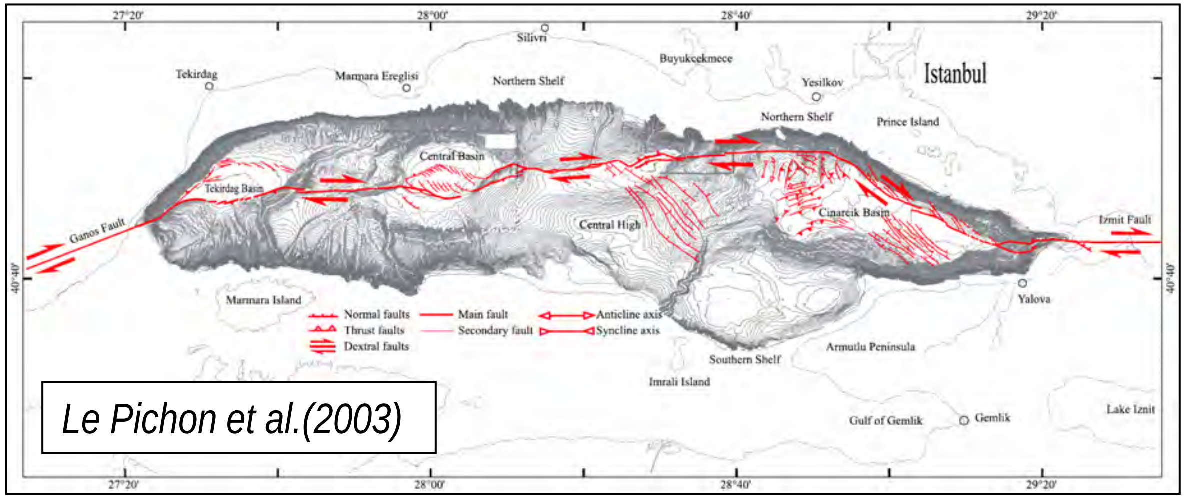
Secondary uncertainty uncertainty in the estimates of event losses

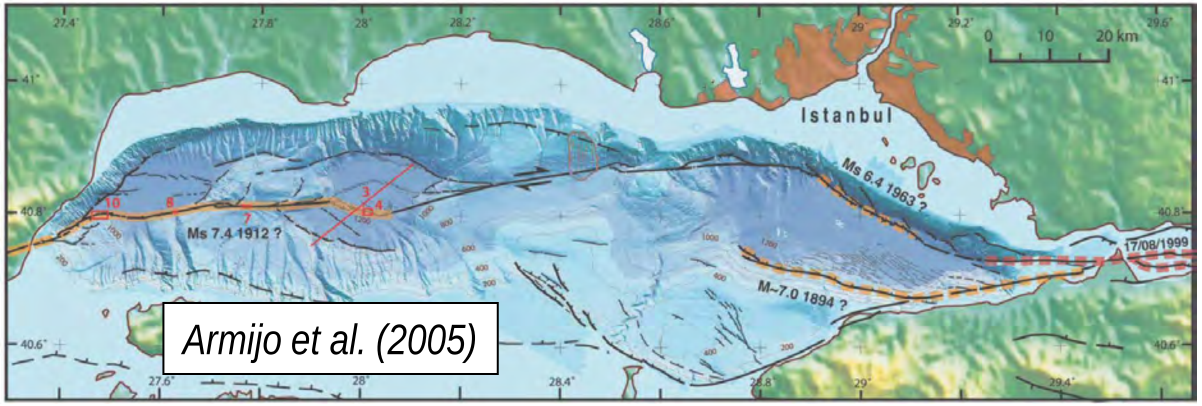
- Hazard uncertainty
- Vulnerability uncertainty
- Portfolio uncertainty

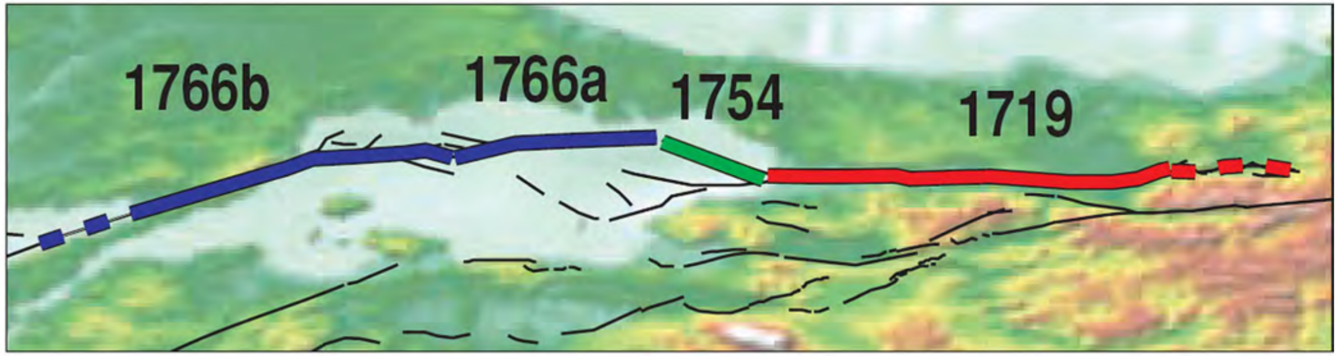


Black
Sea
Izmit
Istanbul

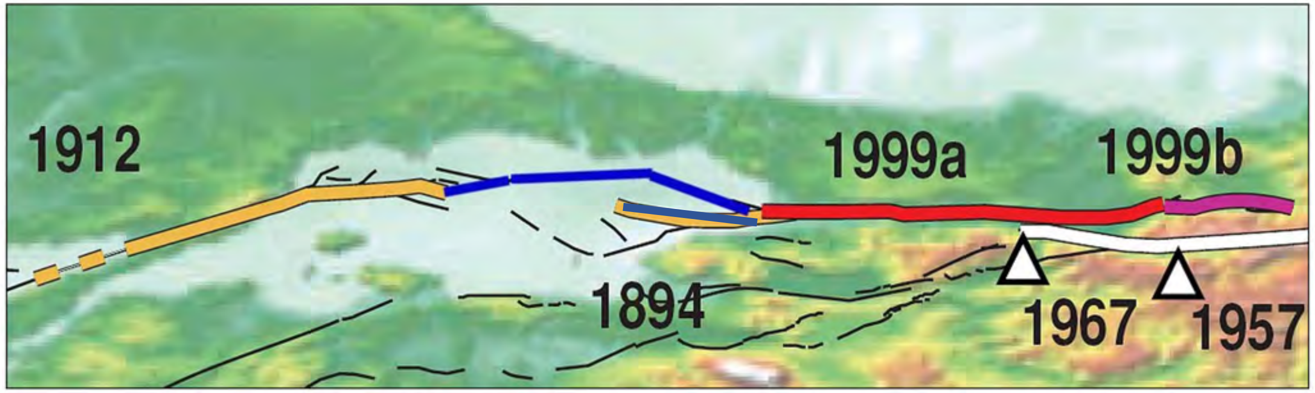
EARTHQUAKE HAZARD
MARMARA REGION / ISTANBUL







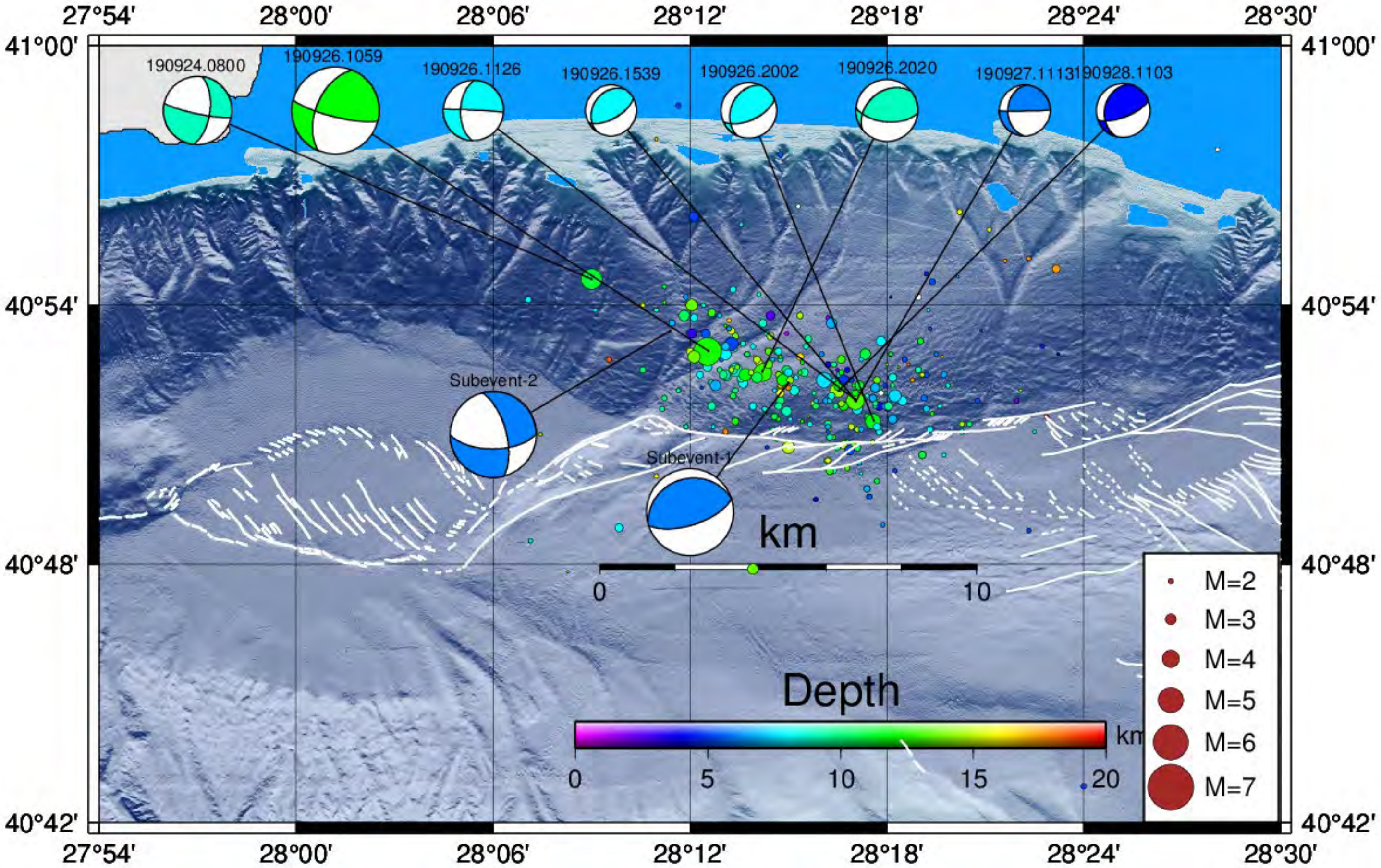
%2-%3 Annual Probability for M>7



Last 300 years M>7 earthquakes (*Pondart et al.,2007*)

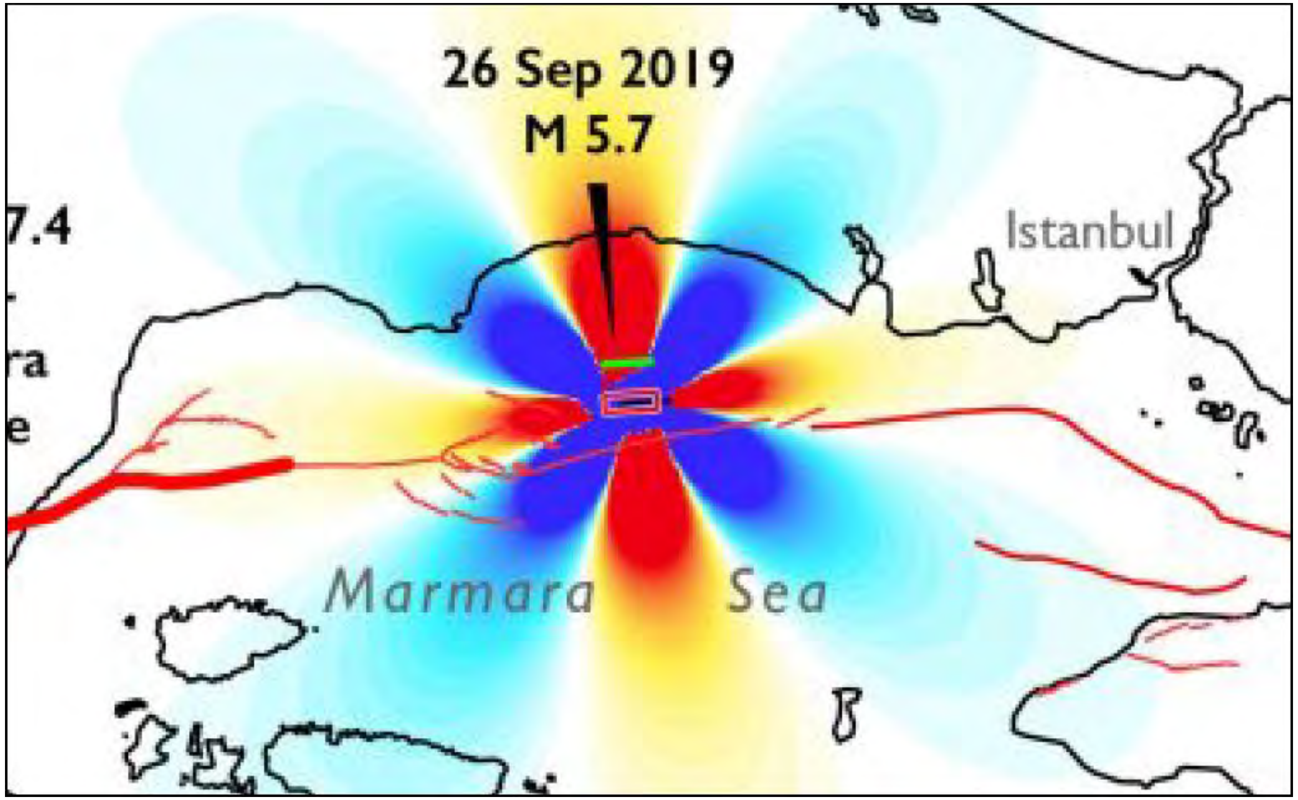
Sept. 26, 2019 M5.7 Silivri Earthquake

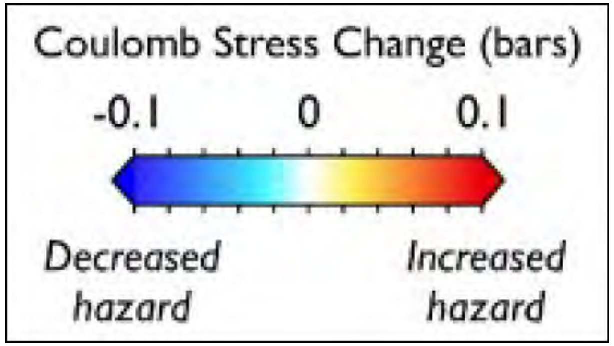
Mainshock and Aftershock CMT (*After A. Pınar*)



More than 10,000 claims to TCIP, where the PGA levels were only about 20% of the design values.

Considering the "Moral Hazard", the earthquake highlights the importance of post earthquake damage assessment as well the indication of the viability of parametric insurance for large magnitude earthquakes.





The stress increase is large enough to encompass a M 6 quake. But the adjacent sections receive (blue) stress decreases that are almost as large as the increase, and so the net effect on the Marmara Fault is close to zero.

Chance of a large triggered shock starting 2 Oct 2019

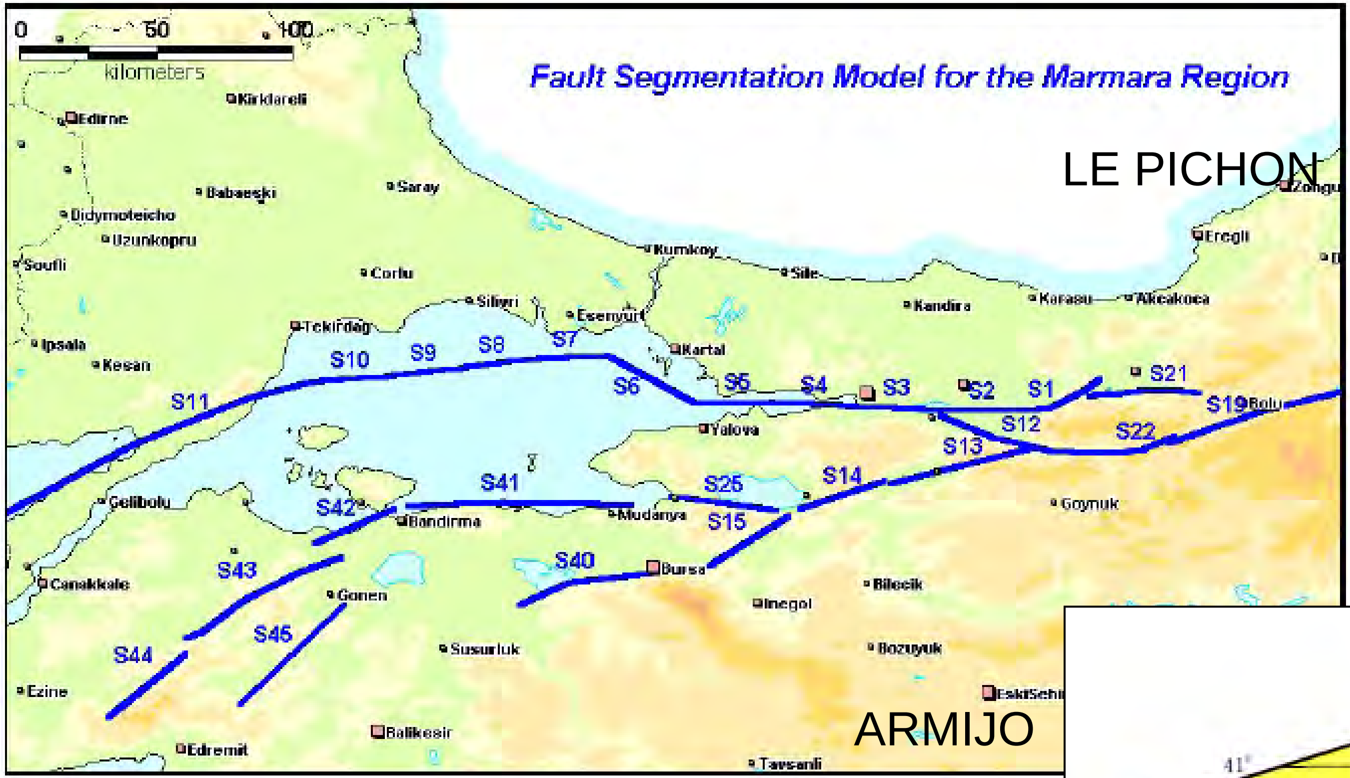
Probability	Magnitude ≥ 6.5	Magnitude ≥ 7.0
Next week	0.6%	0.3%
Next month	1.5%	0.6%
Next year	3.3%	1.4%

Based on the M 5.7 of Sept. 26, 2019 earthquake thus far, there is a 3% chance that it could trigger a magnitude-6.5 or larger shock in the next year.

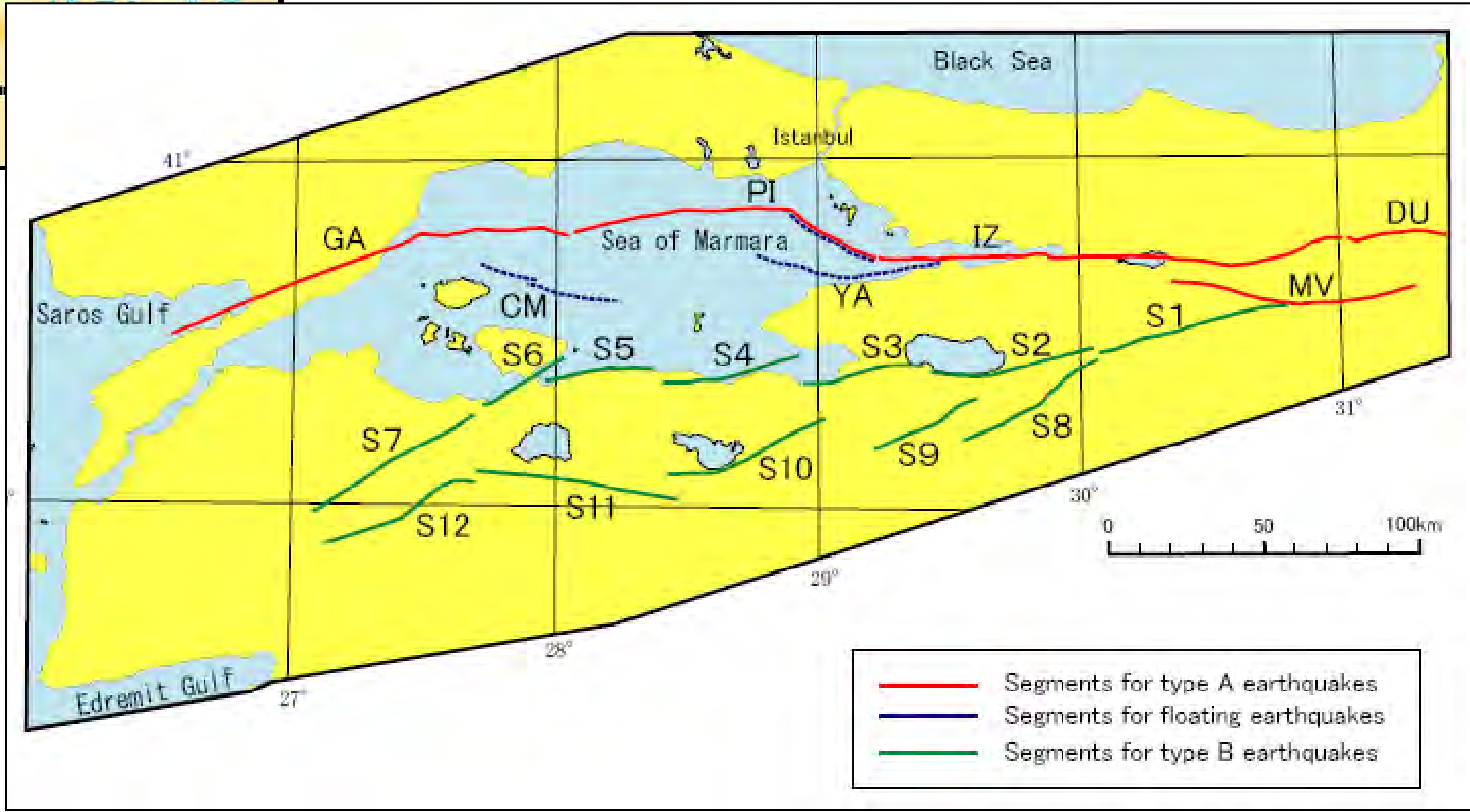
(Toda and Stein, 2019)

FAULT SEGMENTATION MODELS

LE PICHON

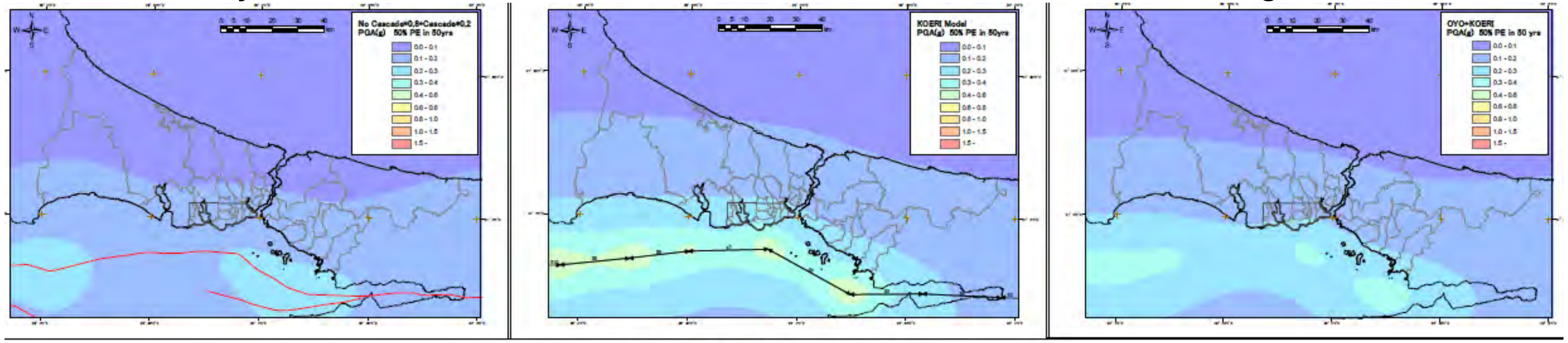


ARMIJO

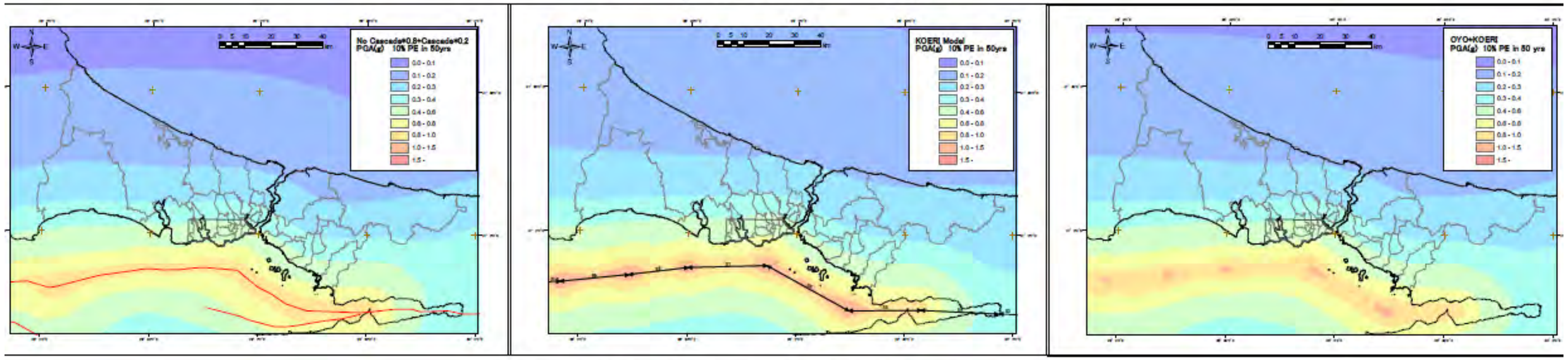


Time dependent PSHA, Characteristic Earthquake Model

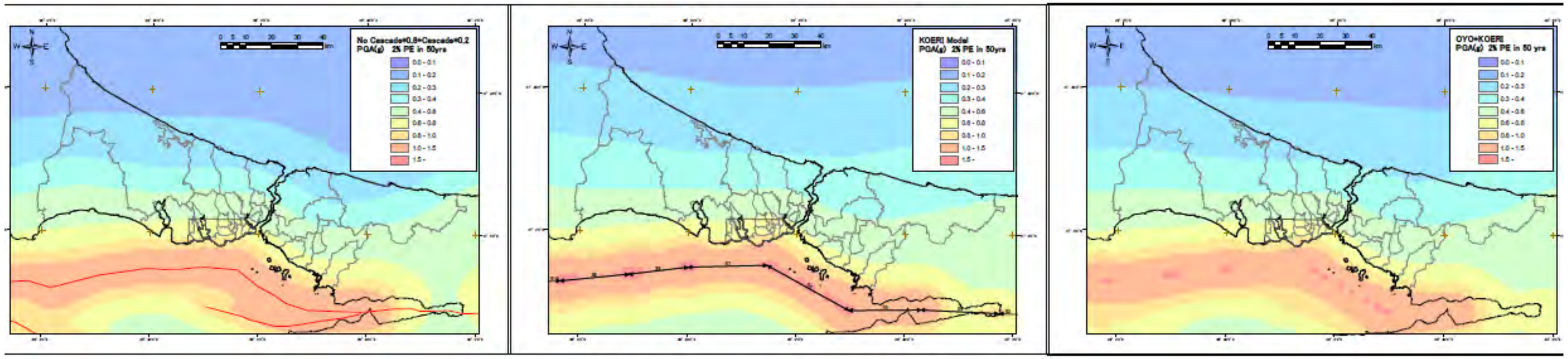
Armijo Model | Le Pichon Model | Average



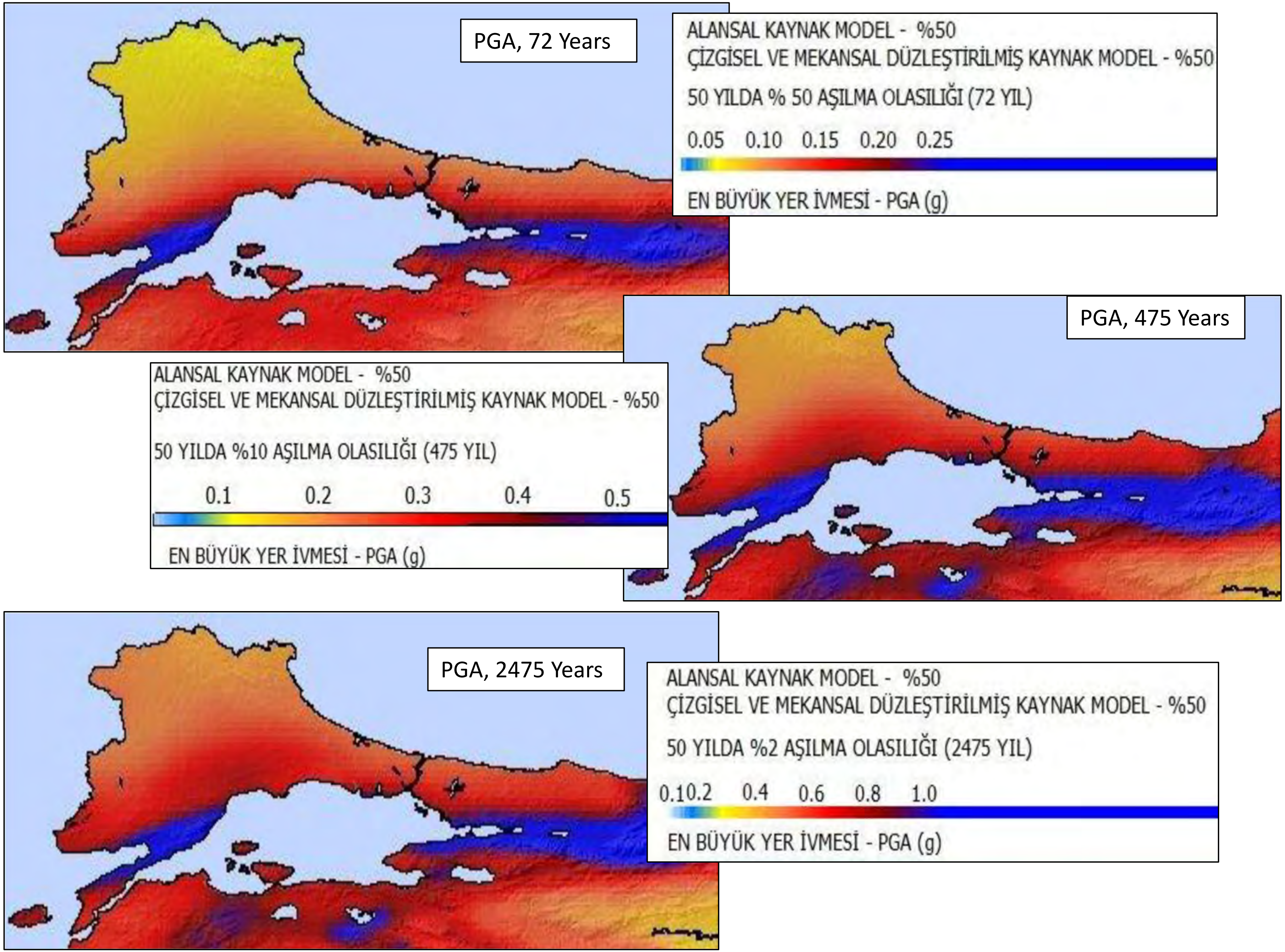
PGA map for 50% PE in 50 years



PGA map for 10% PE in 50 years



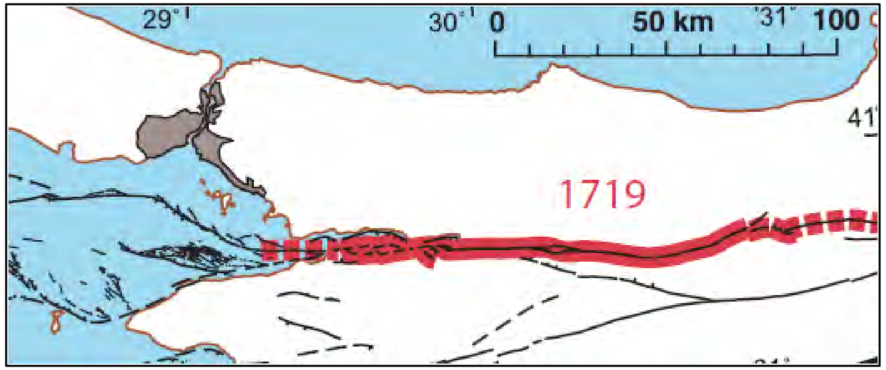
PGA map for 2% PE in 50 years

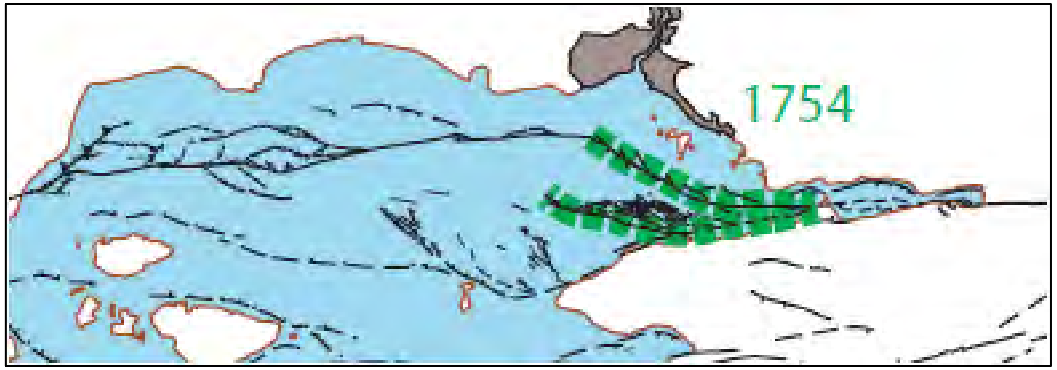


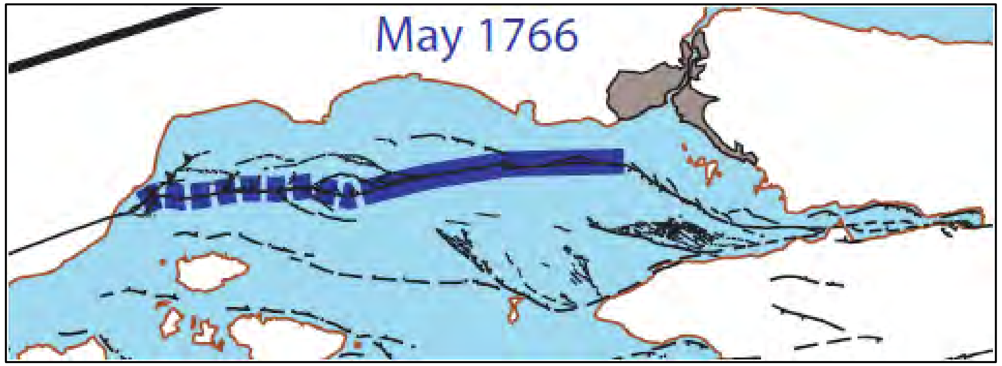
2018 Official PSHA Map.
OpenQuake
Fault model (50%) and spatial smoothed seismic source model (50%).
Poisson Model (time independent).
Truncated exponential model.

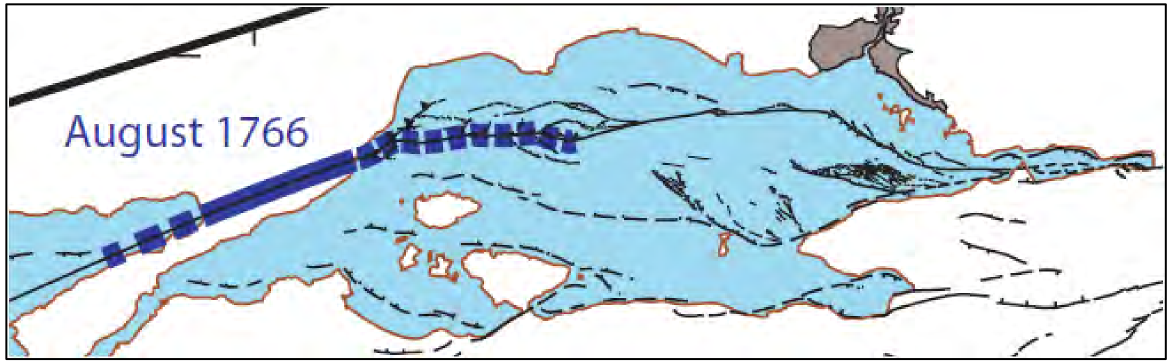
Can be considered for insurance pricing but not exactly suitable for reinsurance purposes.

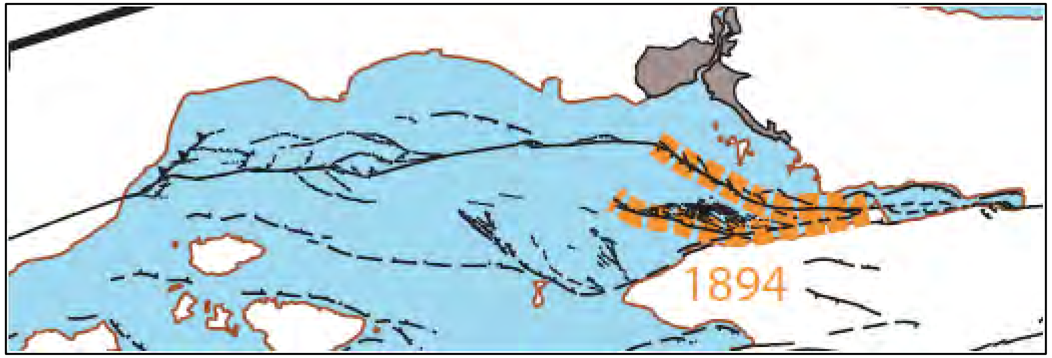
Demircioğlu et al. (2016)





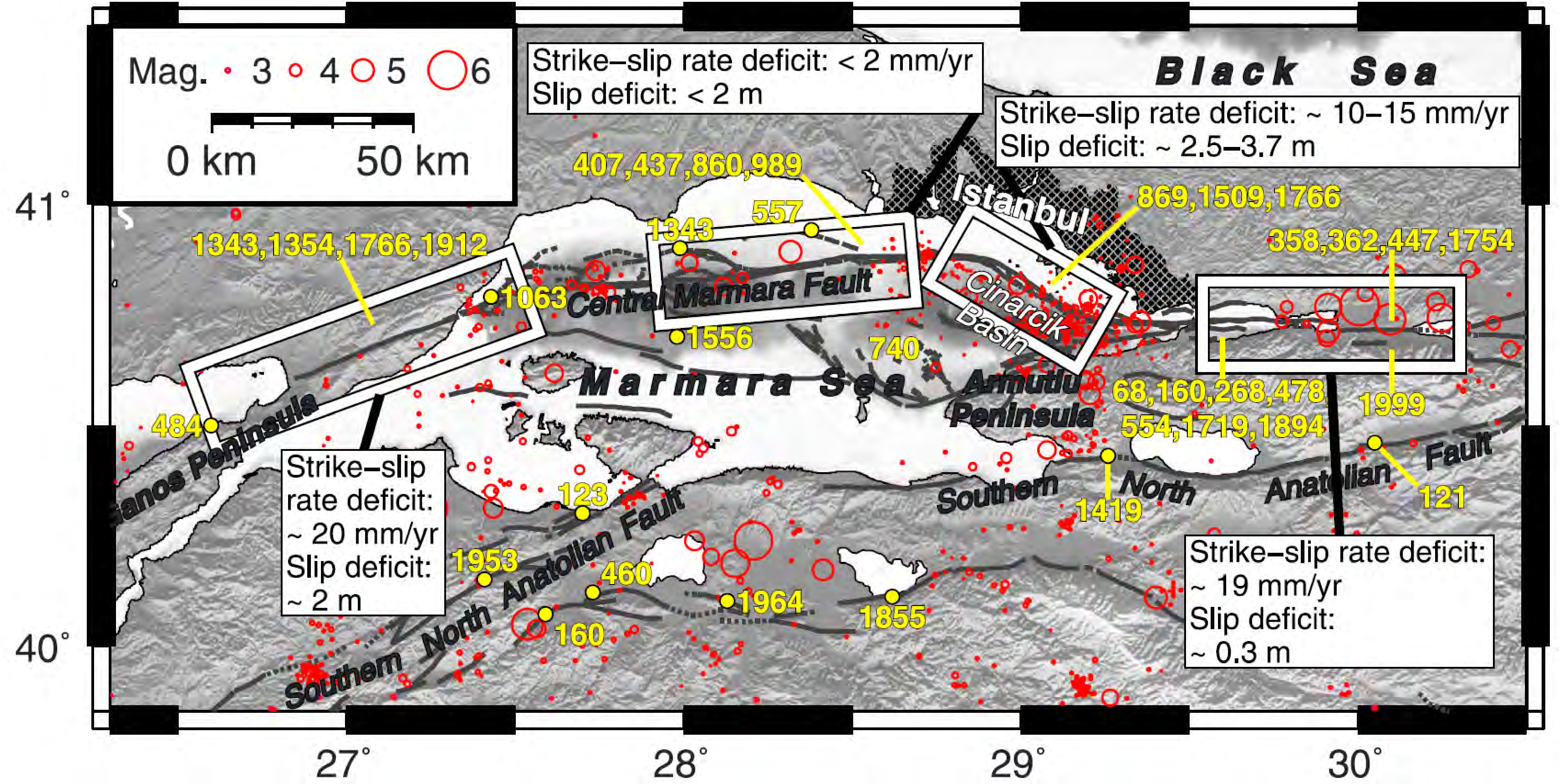






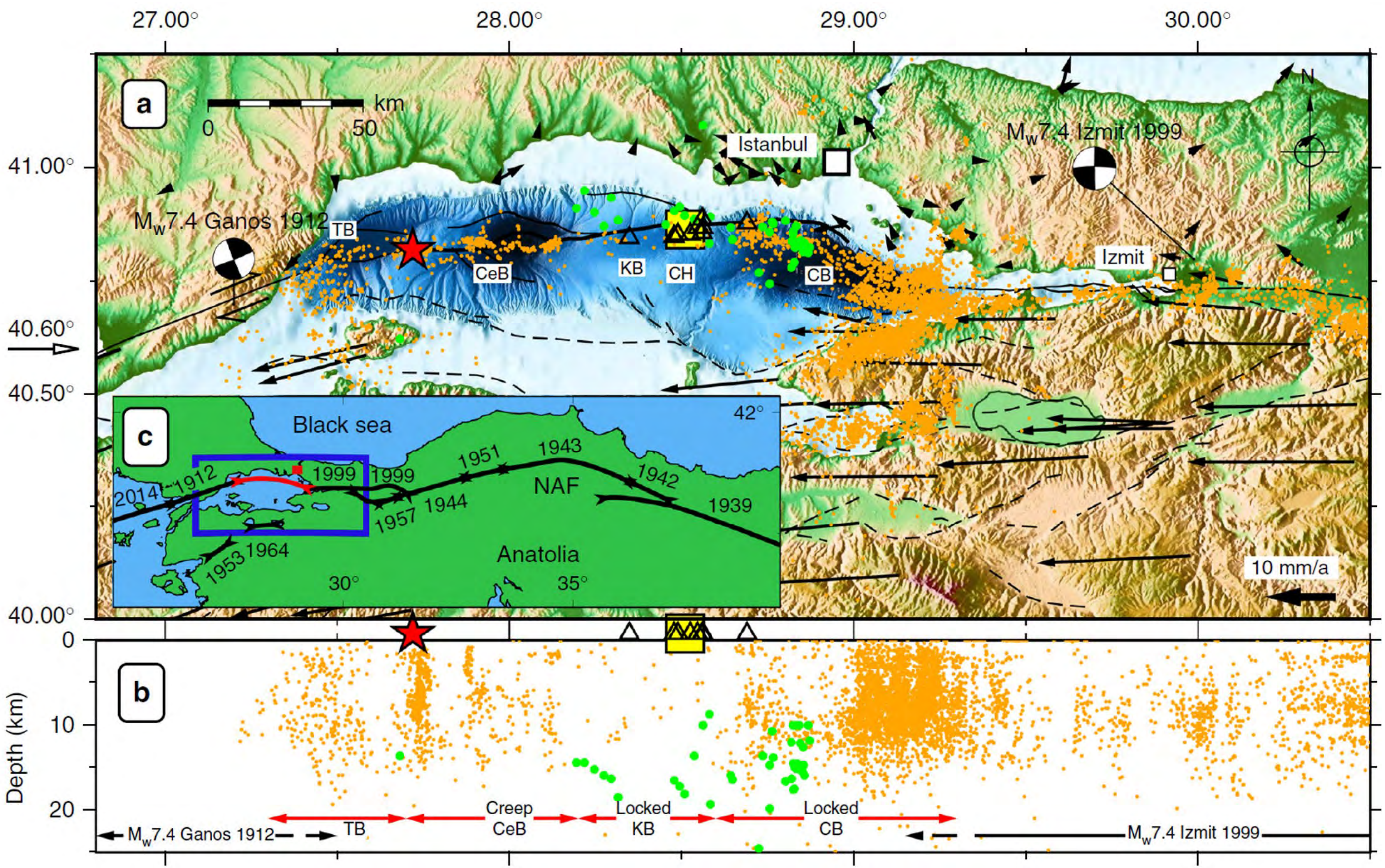
The most plausible location of earthquake ruptures, consistent with morphologic observations (Armijo *et al.* 2005), historical data (e.g. Ambraseys & Finkel 1991, 1995) and distribution of slip deficit at any elapsed time.

Pondart et al. (2007)



SLIP DEFICITS

Ergintav et al, 2014



LOCKED FAULT SEGMENTS

Lange et al. (2019)

Segmentation of the NAFZ in northwestern Turkey. Major NAFZ fault segments in the Marmara and Izmit regions in northwestern Turkey (simplified). Two potential future rupture scenarios and their associated earthquake magnitudes are shown reflecting the activation of the Marmara segment of the NAFZ as one single (B7.4M) or multiple (B7.0M) events. The numbers between segment boundaries are observed time delays between the initiations of slip on consecutive segments. Question marks indicate potential segment boundaries beneath the Sea of Marmara.

Bohnhoff et al.(2013)

Deterministic Earthquake Risk Assessment in Istanbul

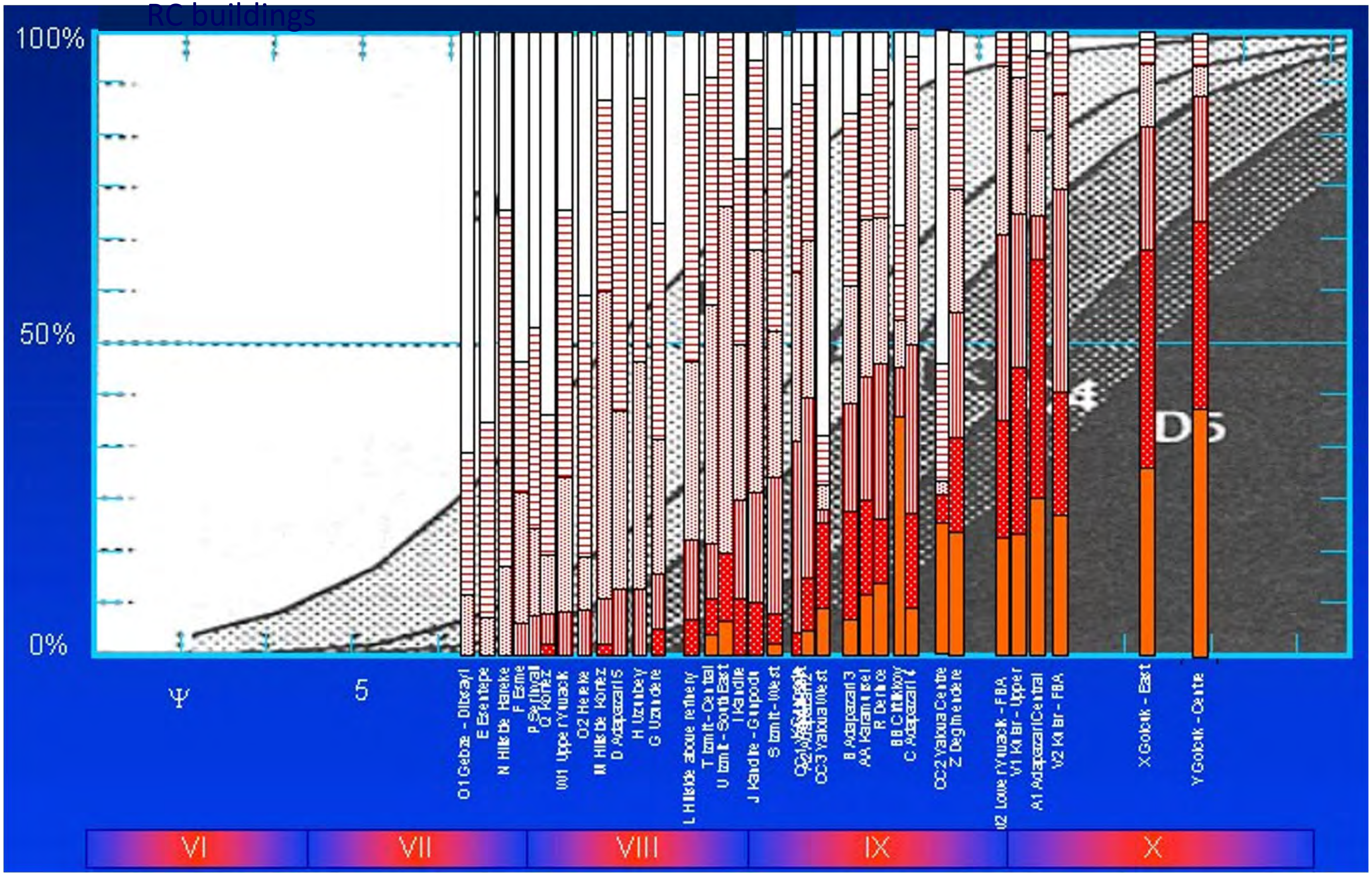
A comprehensive earthquake risk assessment study was conducted by Boğaziçi University, OYO International and GRM Ltd. for İstanbul Metropolitan Municipality (İBB) in 2009. This study was updated in 2018 by Boğaziçi University again for the (İBB). 0.005 degree cells

2009 study was based on a single scenario earthquake (Mw7.5, rupuring the Main Marmara Fault. Intensity and spectral acceleration based fragilities were used. Loss ratios for the buildings, as well as other losses, were determined for 0.005 degree cells, for median and 84-percentile probabilities.

In addition to this M7.5 scenario earthquake, the 2018 study considered single stochastic ground motion simulations for sevaral rupture alternatives and the official PSHA map for different return periods, for the earthquake ground motion. The aggregate building damage results for different damage states, obtained from different rupture scenarios, do not differ much from the results of the M7.5 scenario earthquake.

The risk in both studies was computed using a classical approach, with no consideration of spatial variation of ground motion intensity and without any correlation in the uncerainty of vulnerability functions.

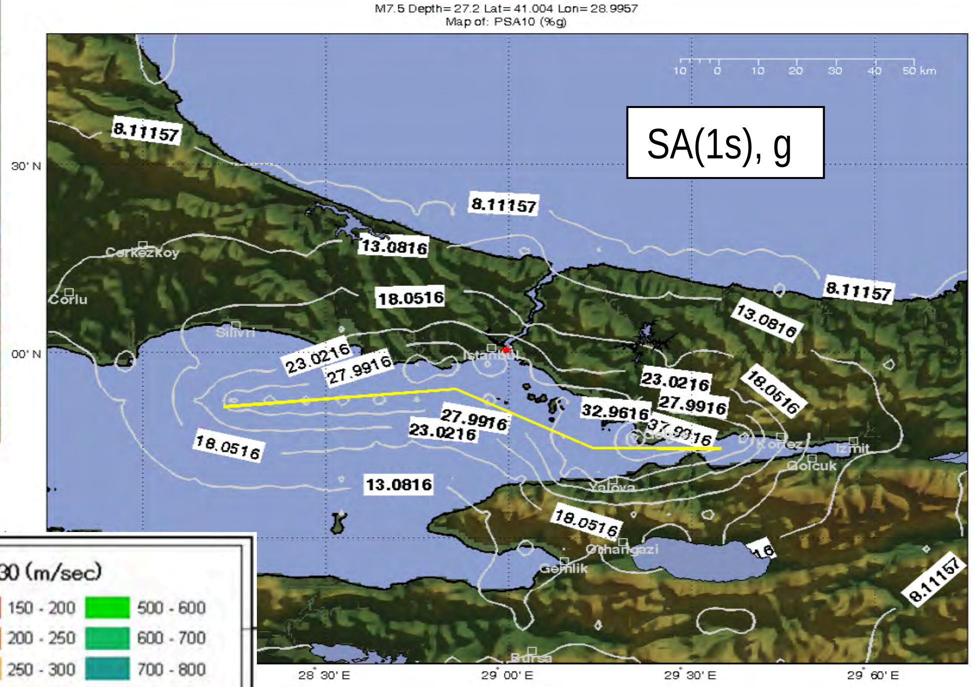
Intensity based empirical fragilities, 1999 Kocaeli Earthquake, 4-6 story RC buildings



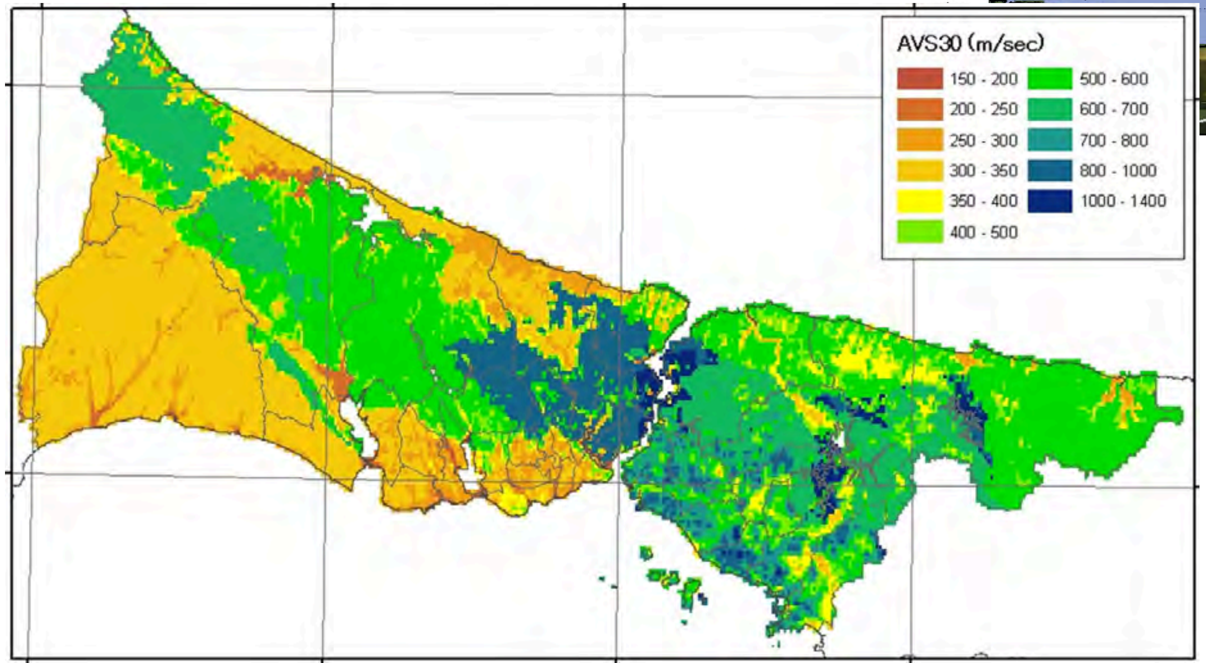
EMPIRICAL FRAGILITIES

After Andrew Coburn

DETERMINISTIC HAZARD Mw7.25, ε=0 Median, Site-specific Ground Motion (“Istanbul Earthquake”)

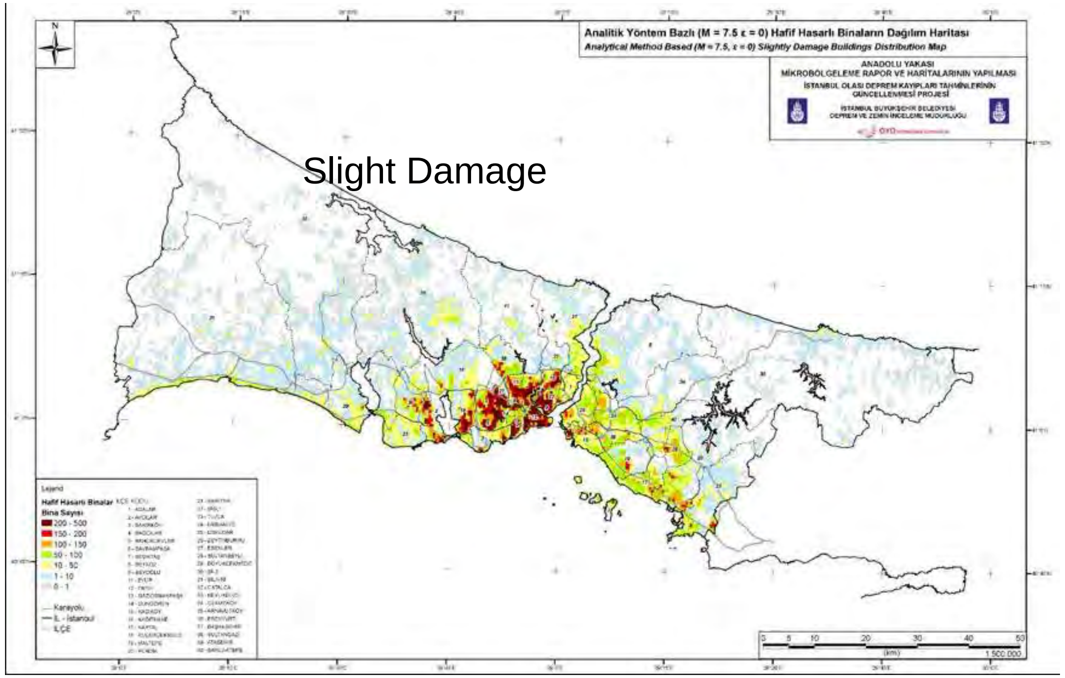


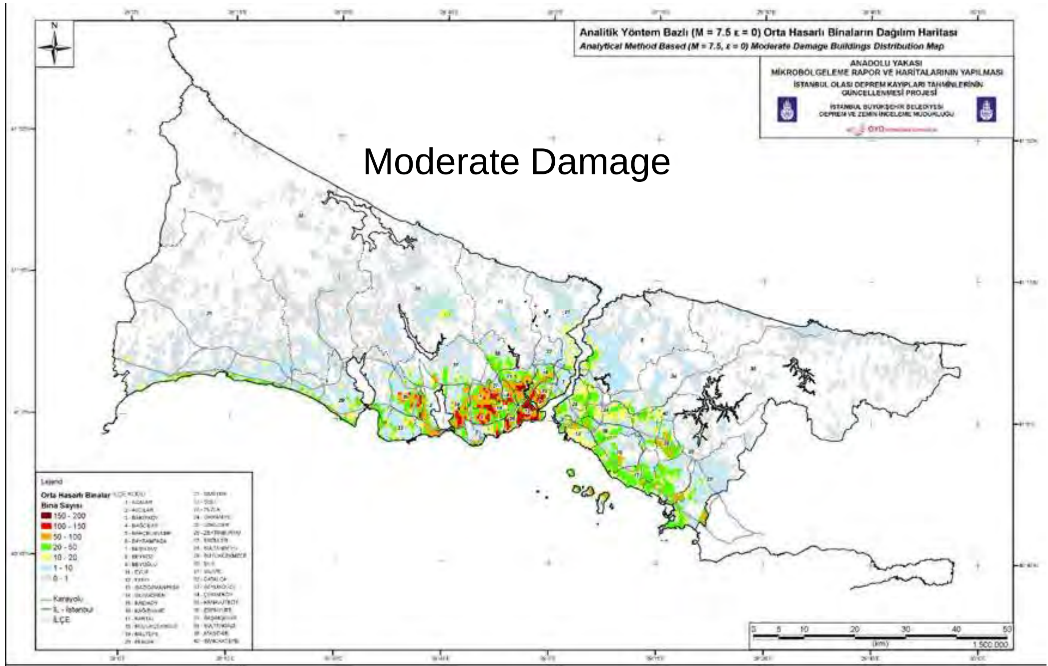
ELER v3.1
Earthquake Loss Estimation Routine

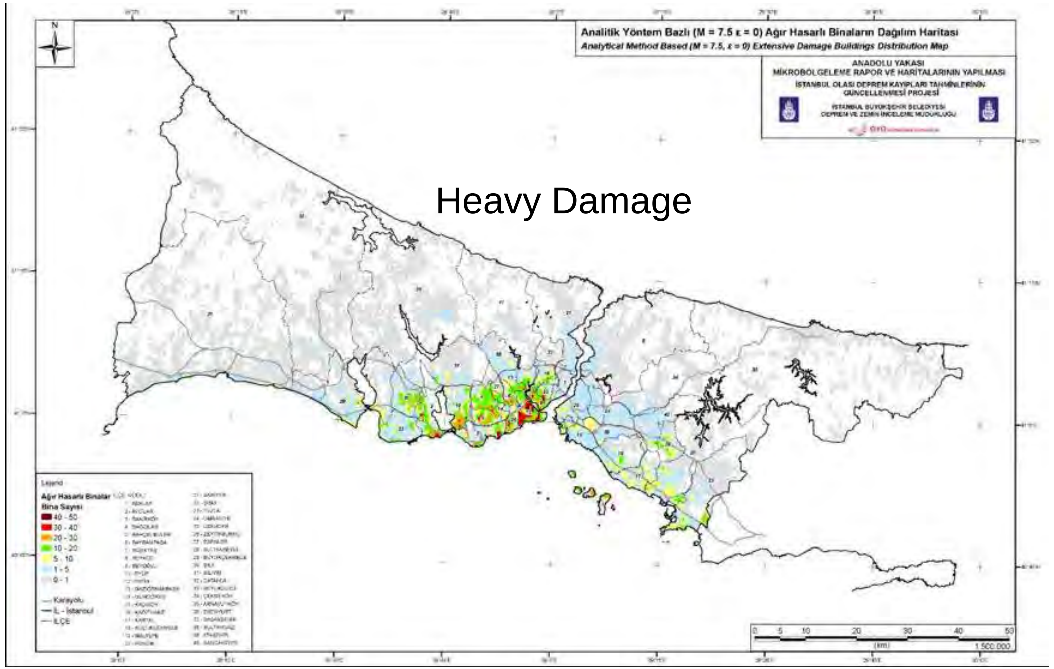


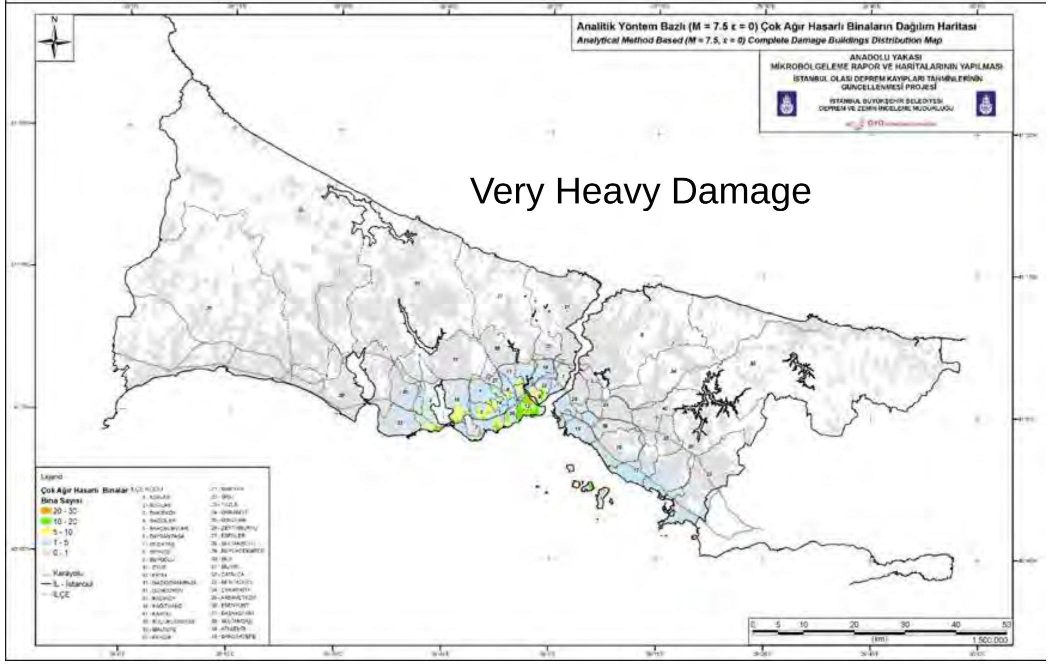
Vs30 MAP FOR ISTANBUL

BUILDING DAMAGE ESTIMATION (*Median) M7.5 Scenario Earthquake*

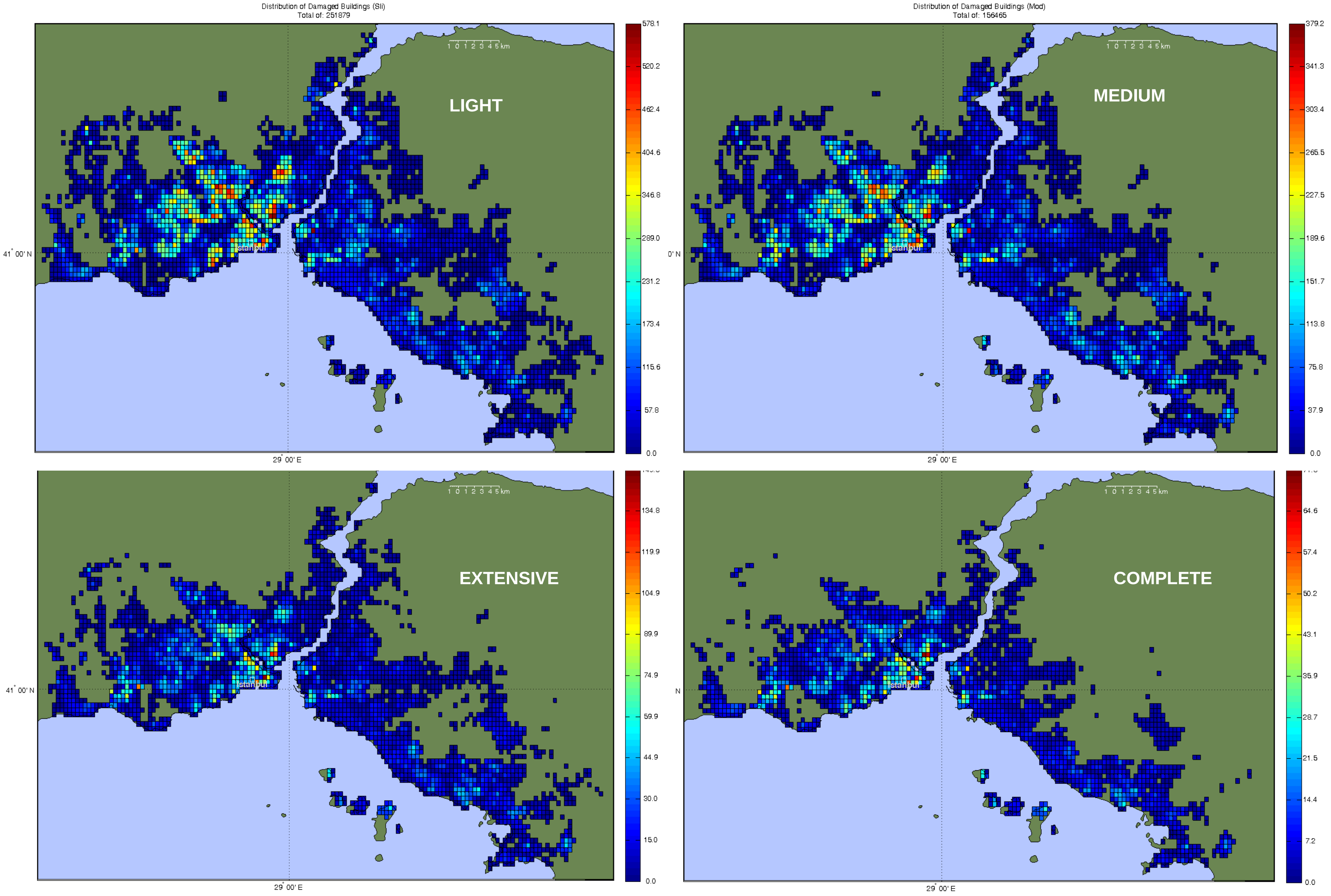








BUILDING DAMAGE ESTIMATION (Median), M7.5 Scenario Earthquake



The building damage rates that would result from the occurrence of the Mw7.5 Istanbul earthquake scenario are indicated in the following table.

Damage State	50-percentile rates	84-percentile rates
Very Heavy Damage-Collapse	0.5 %	3.3 %
Heavy Damage	1.7 %	8.4 %
Medium Damage	10.3 %	22.3 %
Light Damage	25.8 %	32.8 %

The percentage of damaged buildings (light to collapse) will be about 38% (50-percentile) and 67% (84-percentile).

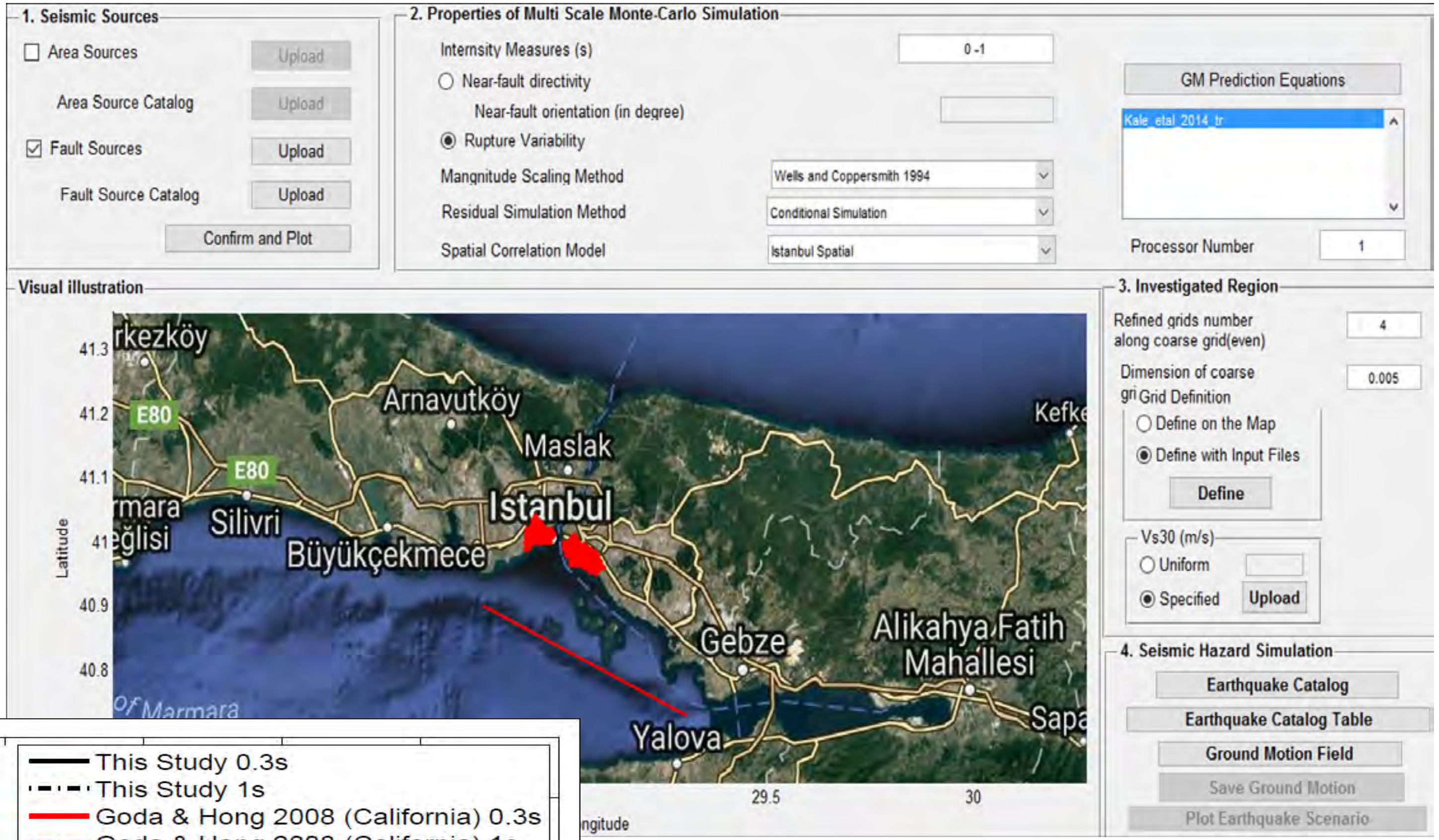
The 50-percentile and 84-percentile monetary losses (only structural damage) is assessed to be respectively 6.5 billion and 17.8 billion USD.

Deterministic Earthquake Risk/Loss Assessment in Central Istanbul

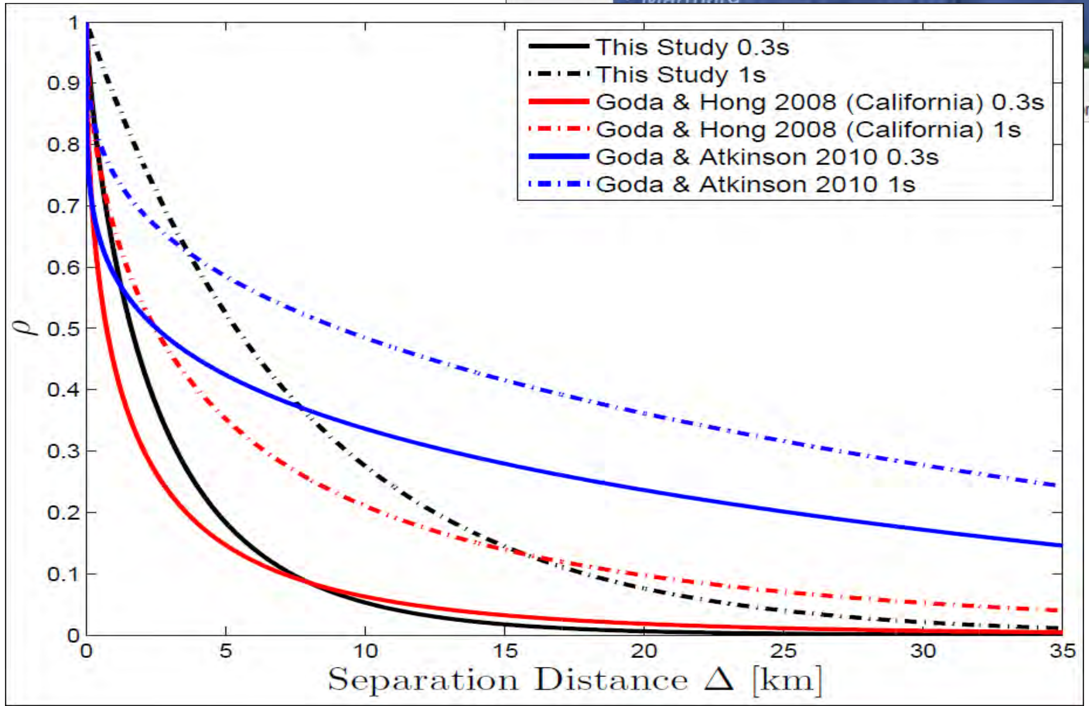
In recent studies the Princess Islands Segment of the Main Marmara Fault has been identified as the "most imminent danger" to Istanbul. This fault segment has been considered with a regional GMPM and a local spatial correlation model to compute 1000 simulations of earthquake ground motion distribution and the loss. Intensity-based fragility relationships are considered. The instrumental intensities were computed from PGA and PGA-conditioned PGV distributions.

- To consider the intra- and inter-event variability, several realizations of the same event are generated, thus leading to multiple ground motion fields for the same event (Monte Carlo procedure)
- During the generation of each ground motion field, the spatial correlation of the intra-event residuals were considered according to a regional (Wagener et al, 2016) and California (Goda et al, 2008) correlation model (semivariograms).
- The collection of ground motion fields were used with the vulnerability and exposure models, to compute the losses for each asset, per each ground-motion field.
- The correlation in the uncertainty in the vulnerability functions is incorporated such that when sampling the loss ratios of two assets from the same building class, using a pre-established correlation factor.
- Loss ratios for each building type were multiplied by the associated economic value, leading to a distribution of possible losses.
- The losses across the region can be aggregated per each ground motion field, to obtain an aggregated mean and standard deviation.

Loss Assessment for Mid-rise RC Buildings in Central Istanbul



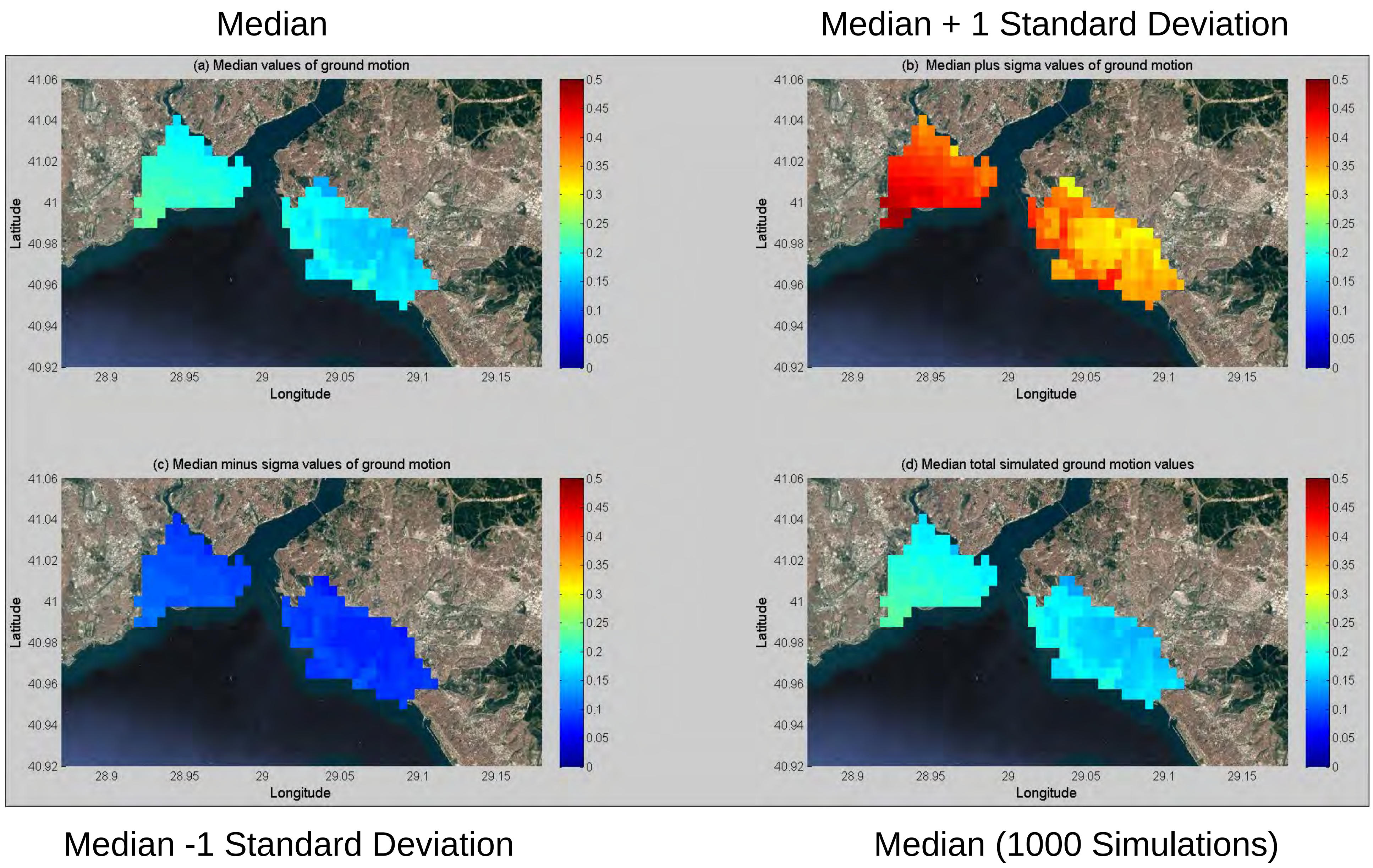
Seismic source: Prince's Islands segment
Recurrence Model: Fully characteristic
Magnitude: $M_w 7.3$
Slip Rate: 20 mm/yr
Dip: 90^o **Rake:** 0^o
Type: Strike-Slip
GMPE: Kale et al. 2015
Number of simulations: 1000
Spatial correlation model: Wagener et al. (2016),
Goda and Hong (2008)



Semivariograms to predict correlatıon of inte-event (within-event) residuals for seperation distance.
PSA (0.3s and 0.1s)-correlation model model for the Marmara Region compared to different correlation models reported in the literature.

Wagener et al. (2016)

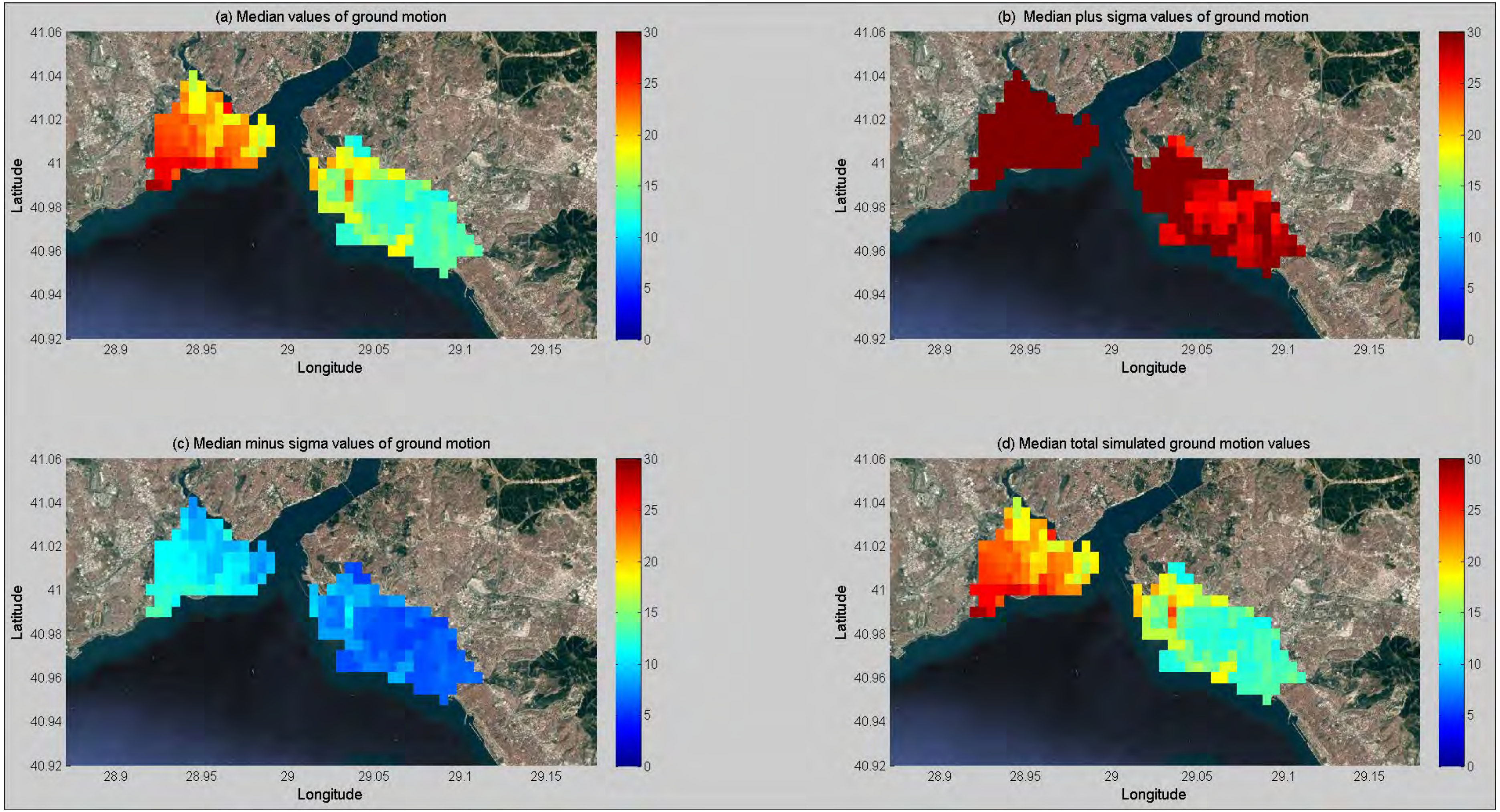
Shake Field, PGA (g), Spatial Correlation, 1000 Simulations



Shake Field, PGV (cm/s), Spatial Correlation, 1000 Simulations

Median

Median + 1 Standard Deviation



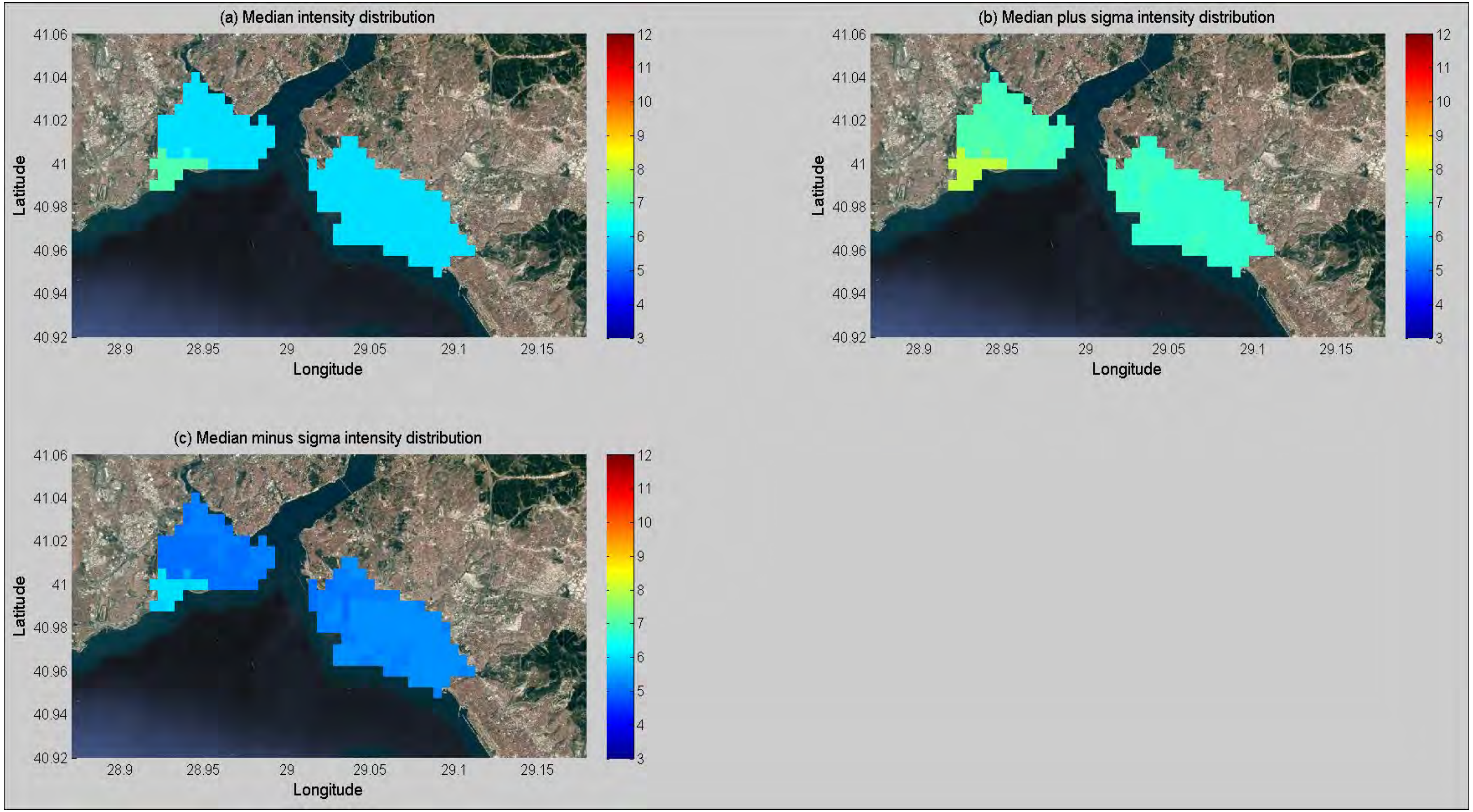
Median -1 Standard Deviation

Median (1000 Simulations)

Shake Field, MMI (Wald et al.,1999) model for macroseismic intensity conversion fom PGA and PGV), 1000 Simulations

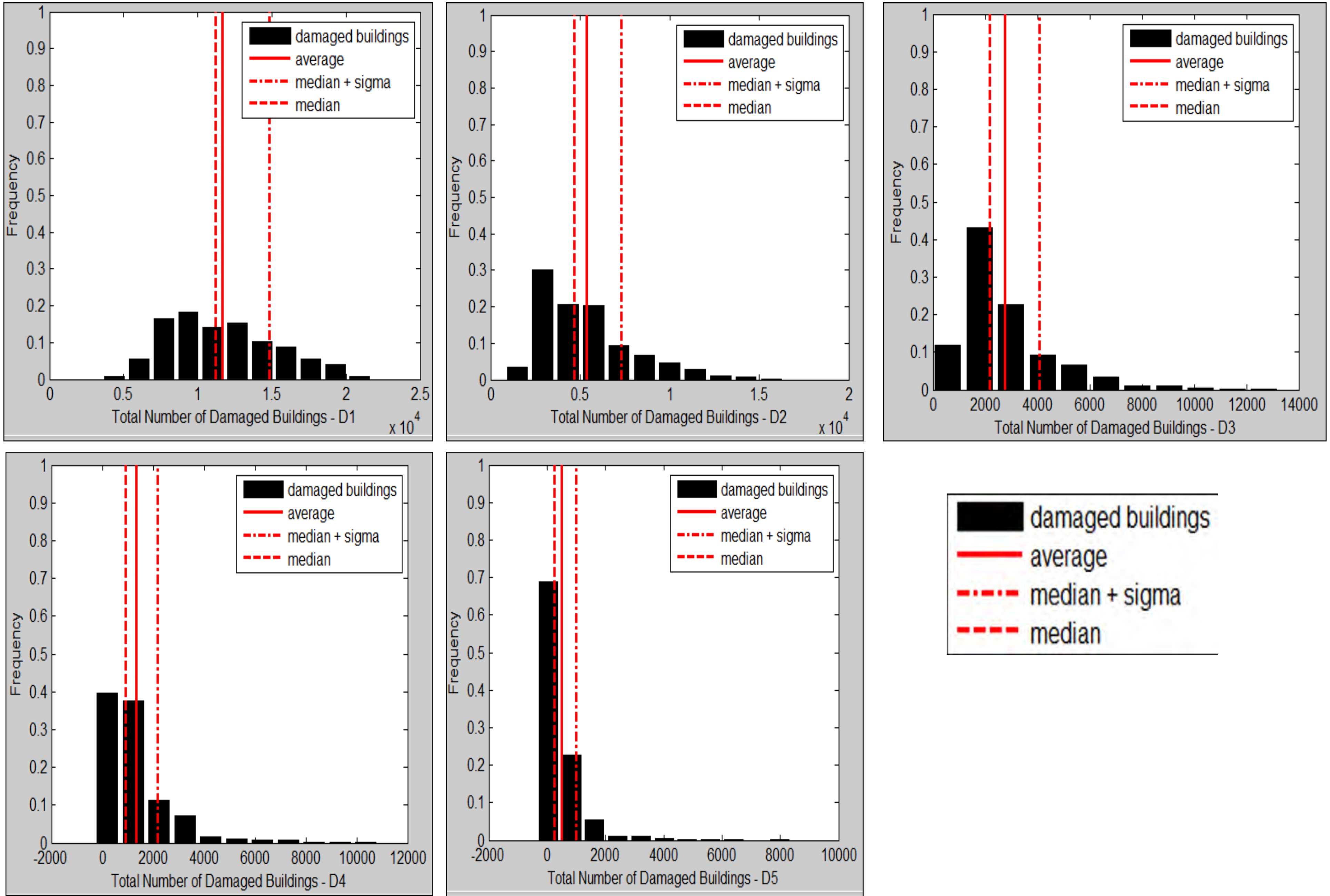
Median

Median + 1 Standard Deviation

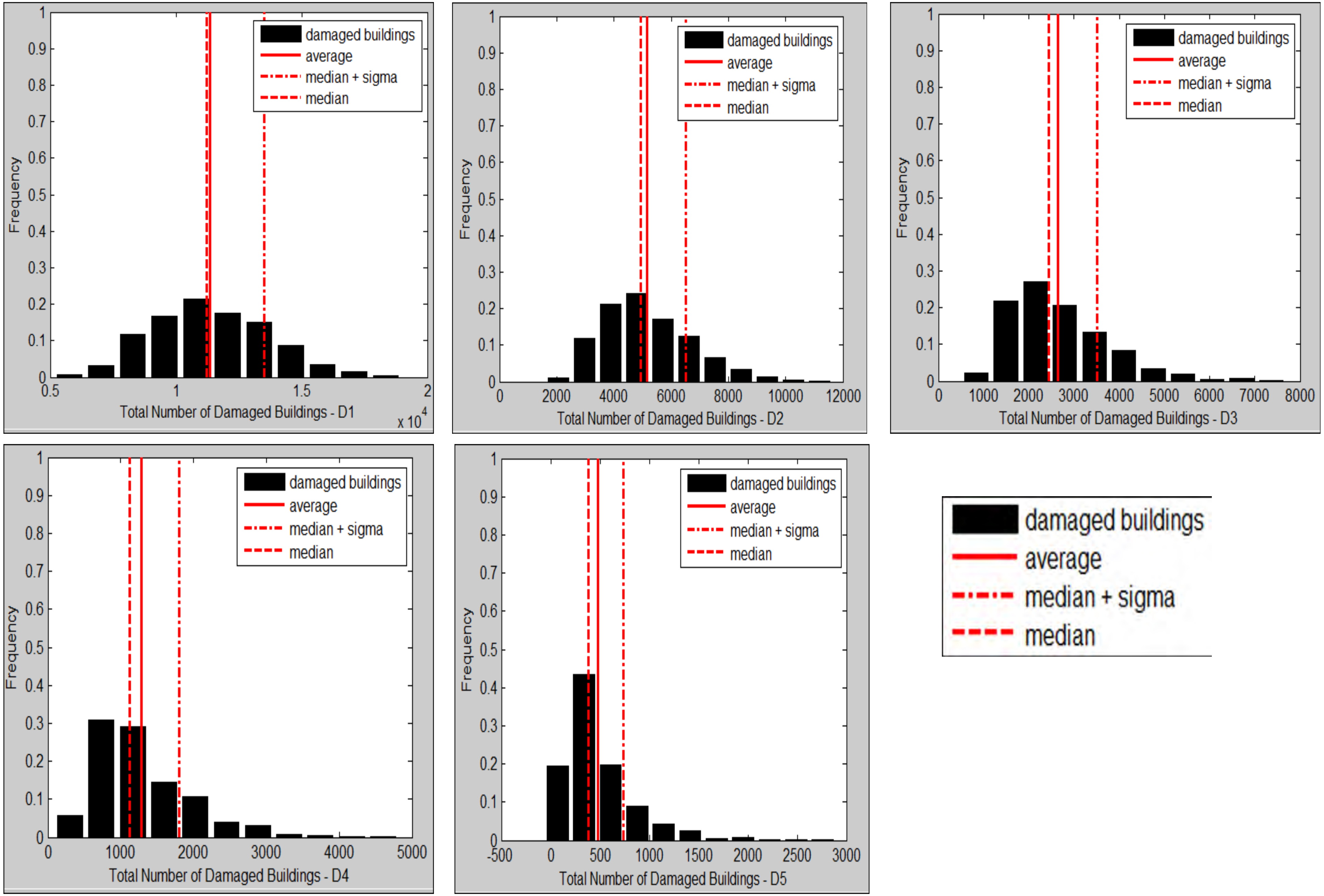


Median -1 Standard Deviation

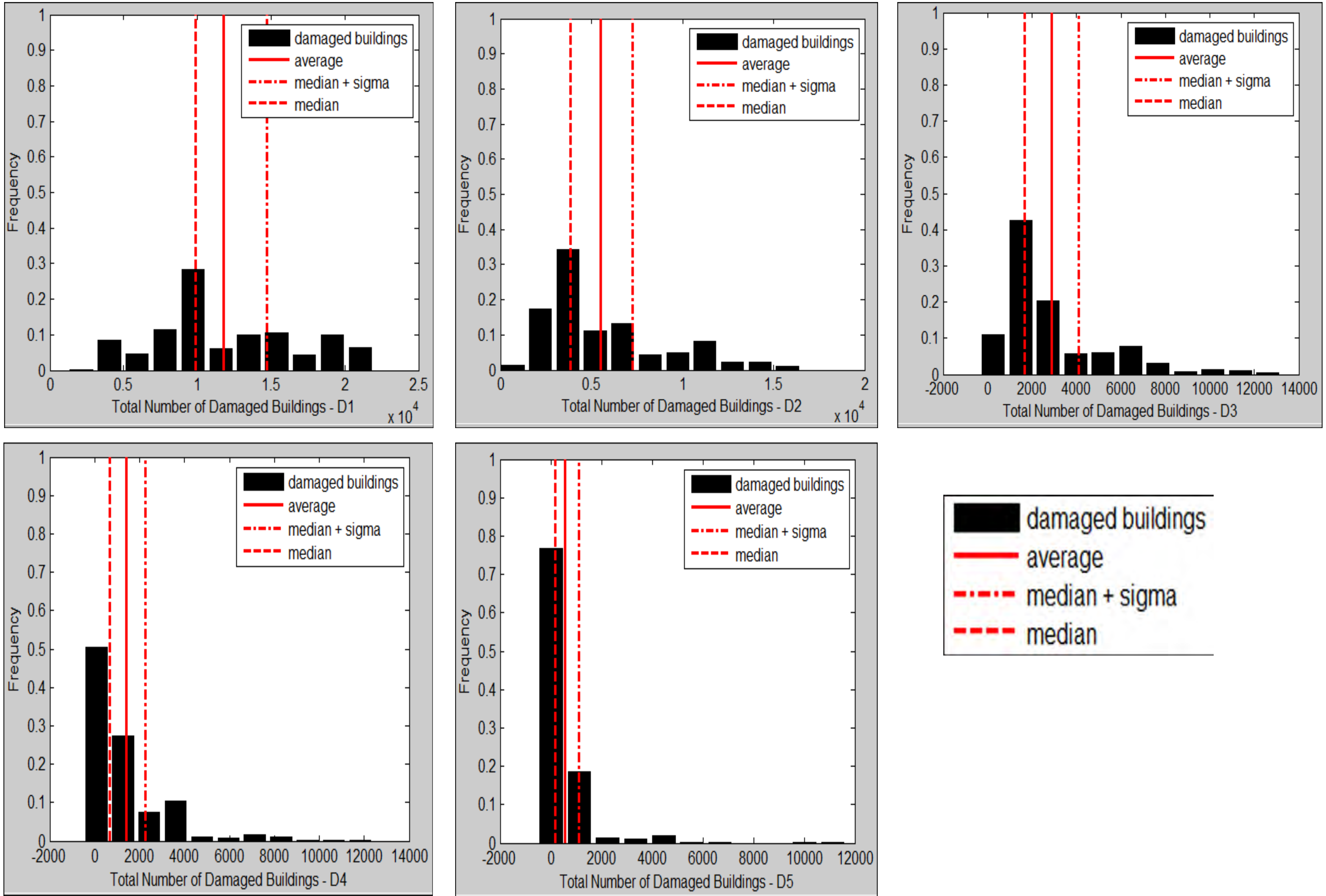
Number of Damaged Buildings at Damage Levels (D1-D5), Spatial Correlation, 1000 Simulations



Number of Damaged Buildings at Damage Levels (D1-D5), No Correlation, 1000 Simulations

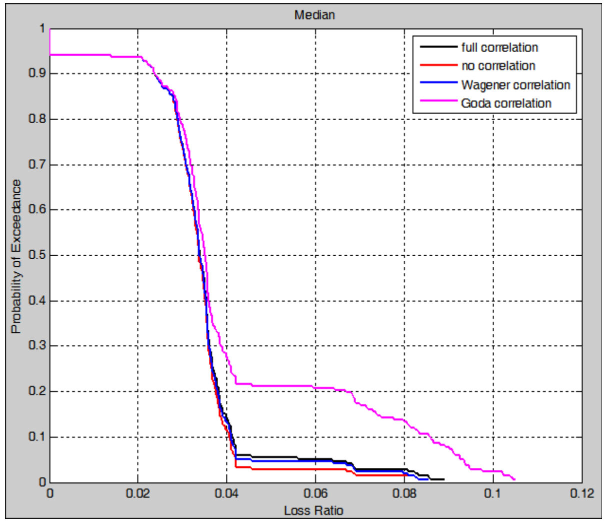


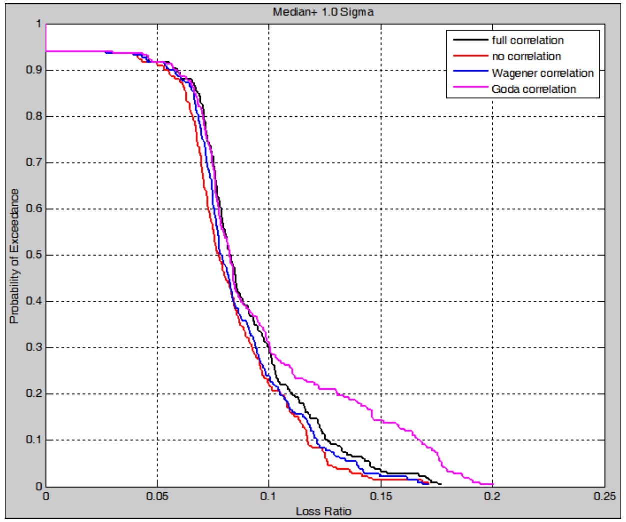
Distribution of Damaged Buildings at Damage Levels (D1-D5), Full Correlation, 1000 Simulations

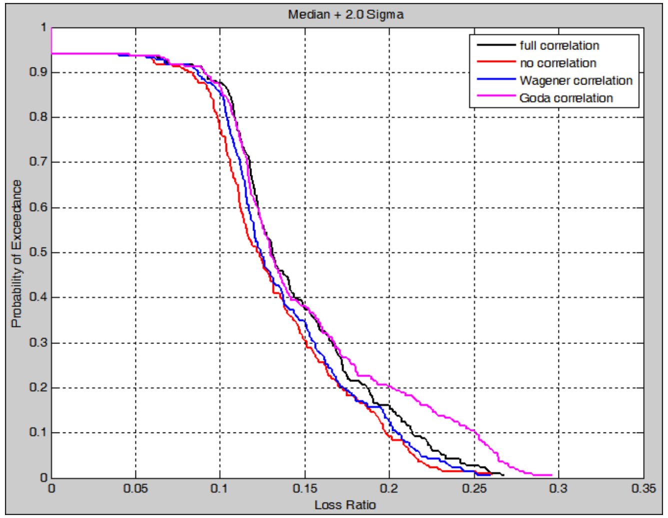


Median, +1SD and +2SD Probability of Exceedance vs Loss Ratio Curves

Exceedance Probabilty

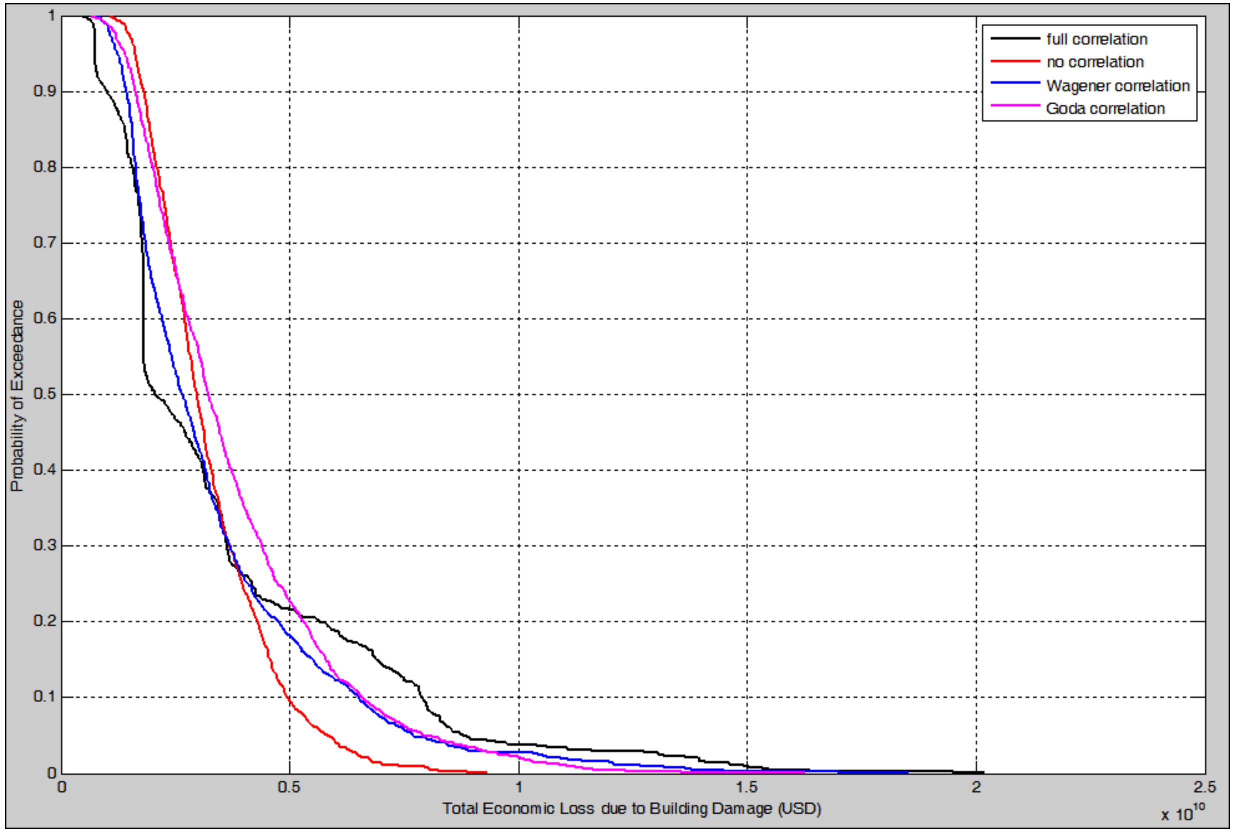






Loss Ratio

Exceedance Probabilty



Total Monetary Loss

Exceedance Probability (EP) Curve
Economic Loss Curve

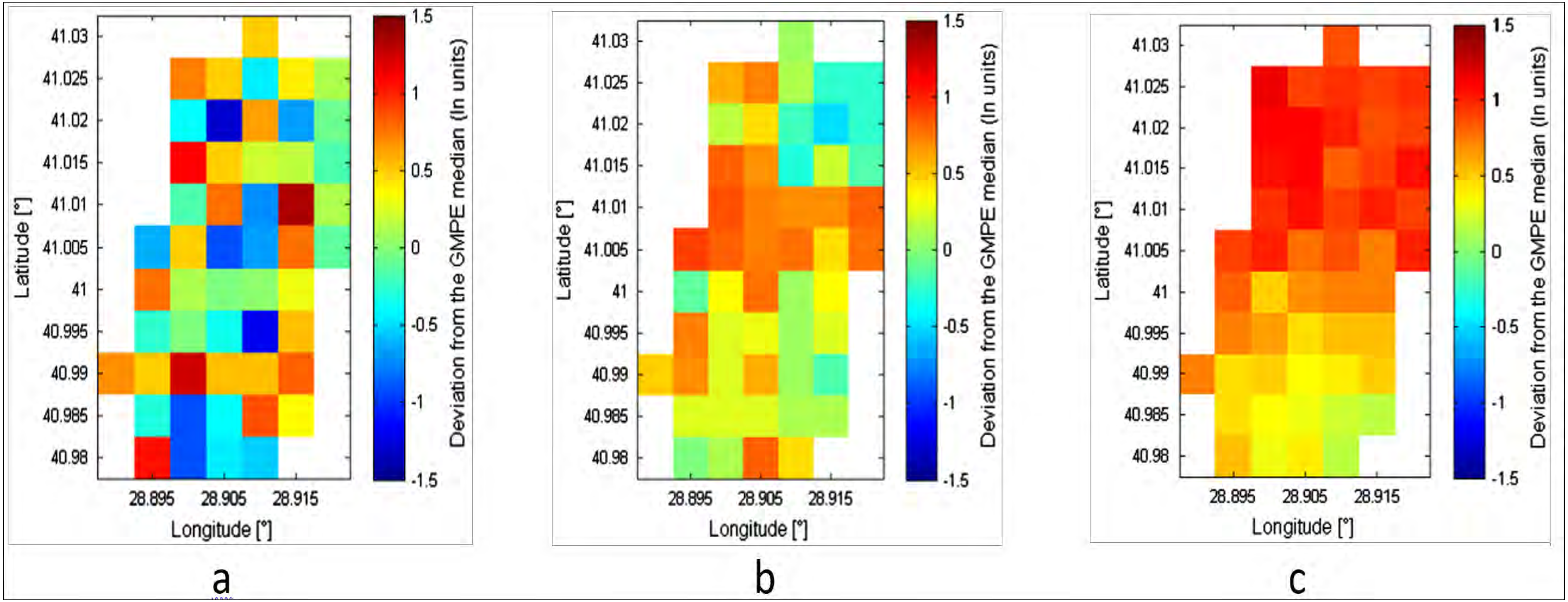
For high probabilities (low loss) spatial correlation results are above full correlation and similar to no correlation.

For low probabilities (high loss) spatial correlation results are located between full correlation and no correlation.

Deterministic Earthquake Risk/Loss Assessment in Zeytinburnu District of Istanbul

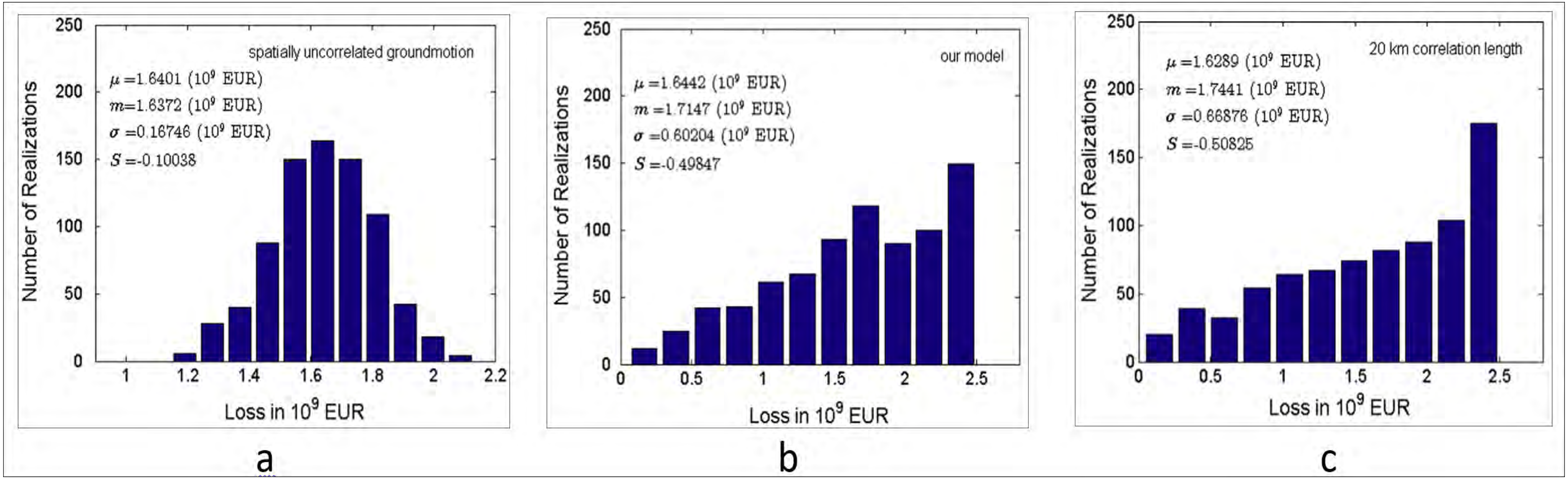
Earthquake risk and losses in the Zeytinburnu district of Istanbul that would result from an Mw7.2 scenario earthquake on the Marmara Fault were computed.
PGA, SA(0.3s) and SA(1s) distributions based on regional GMPMs were calculated considering various spatial correlation models as well as their cross-correlations.
The medians of the logarithms of PGA and PSA at T=0.3s and 1.0s are calculated for each geocell by using the GMPEs by Akkar and Bommer (2010) and Özbey et al. (2004).
The portfolio consists of 11,250 reinforced concrete and masonry buildings, that are assigned to 5 building classes according to HAZUS.
The effects of the different correlation models on the spatial distribution of PGA are illustrated.
The loss histograms are provided with the distribution parameters consisting of mean, median, standard deviation, and skewness.
It has been shown that, while the mean loss remains essentially unaltered, the coefficient of variation increases with increasing correlation.

Wagener et al., 2016



Realizations of simulated PGA-distribution in Zeytinburnu with various correlation properties.
(a) No spatial correlation, (b) Wagener et al. (2016) correlation model (c) A simple one-parameter exponential decay with 20 km correlation length.

Spatially Uncorrelated Correlated (Wagener et al., 2016) 20km correlation length



Histograms of aggregated economic loss in Zeytinburnu with various correlation properties.

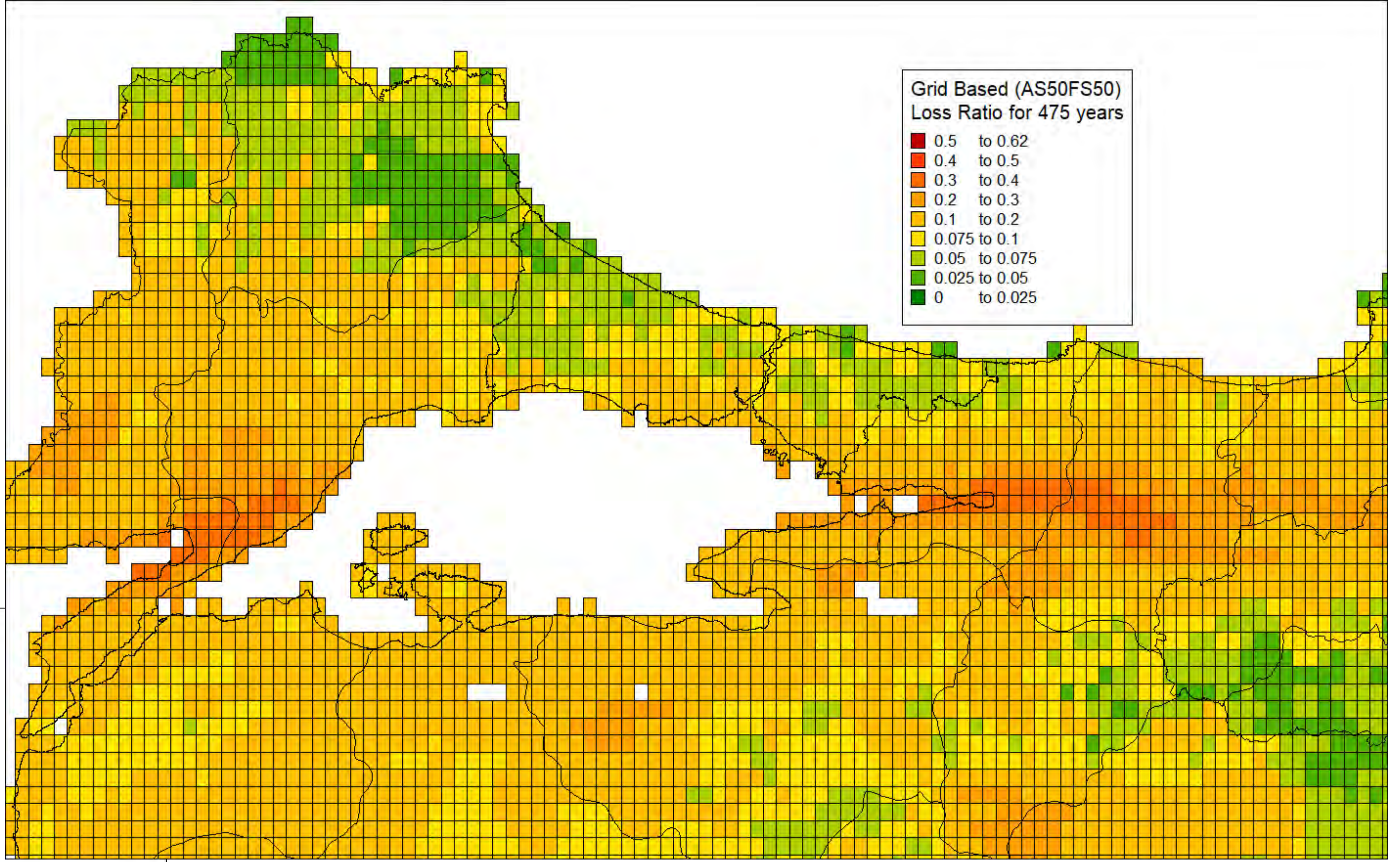
(a) No spatial correlation, (b) Wagener et al. (2016) correlation model (c) A simple one-parameter exponential decay with 20 km correlation length

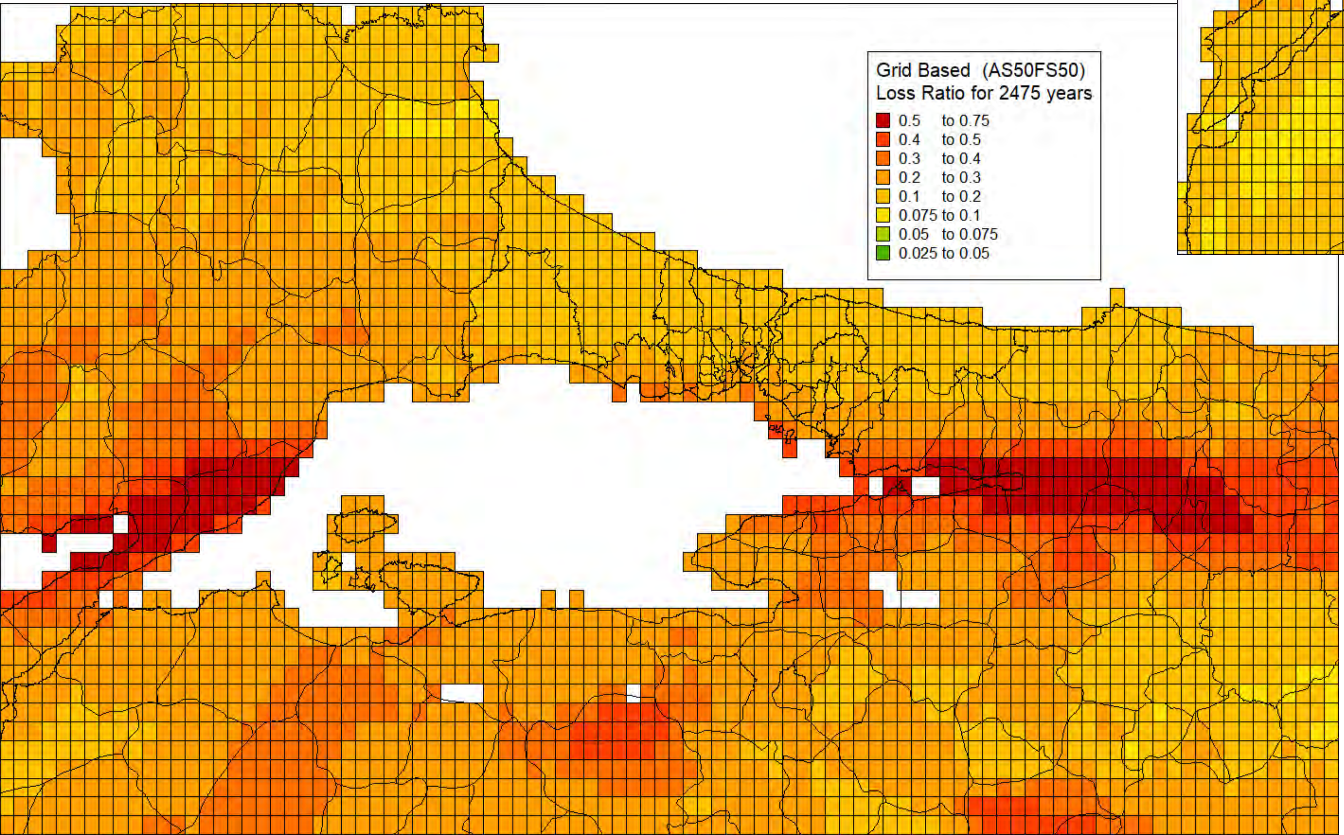
While the mean loss remains essentially unaltered, the coefficient of variation of losses increases with increasing correlation from 0.1 to 0.5.

Increasing correlation lengths correspond to increasing losses reflected in increasing median loss and coefficient of variation.

Probabilistic Earthquake Risk/Loss Assessment in Istanbul and Marmara Region.

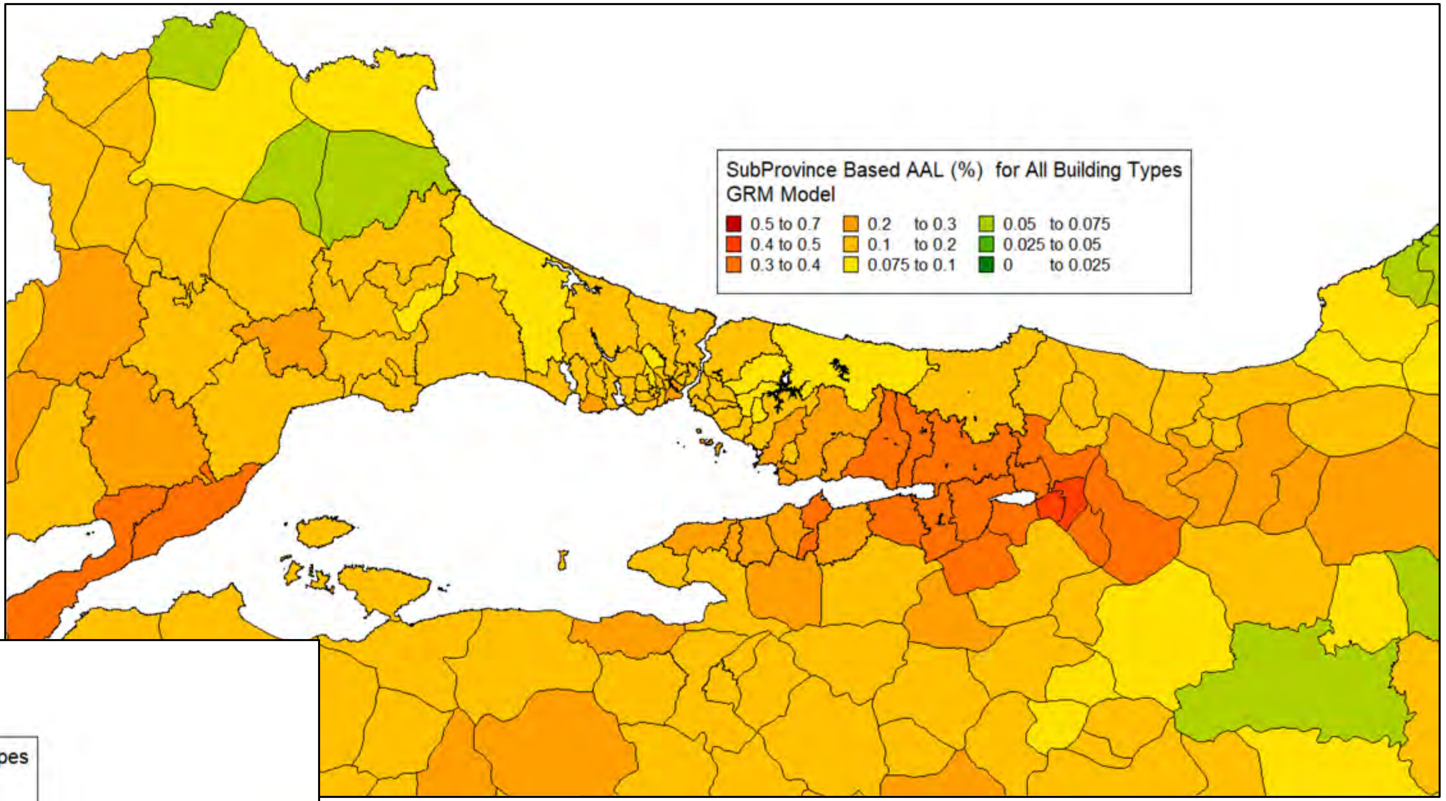
Classical PSHA-based earthquake risk calculation procedure was used to assess the geo-cell based building damage distributions in the Marmara Region, loss ratios and average annual loss ratios corresponding to 72, 475, and 2475 year average return periods. 2018 official PSHA map is used. The average soil conditions in each geo-cell is considered.

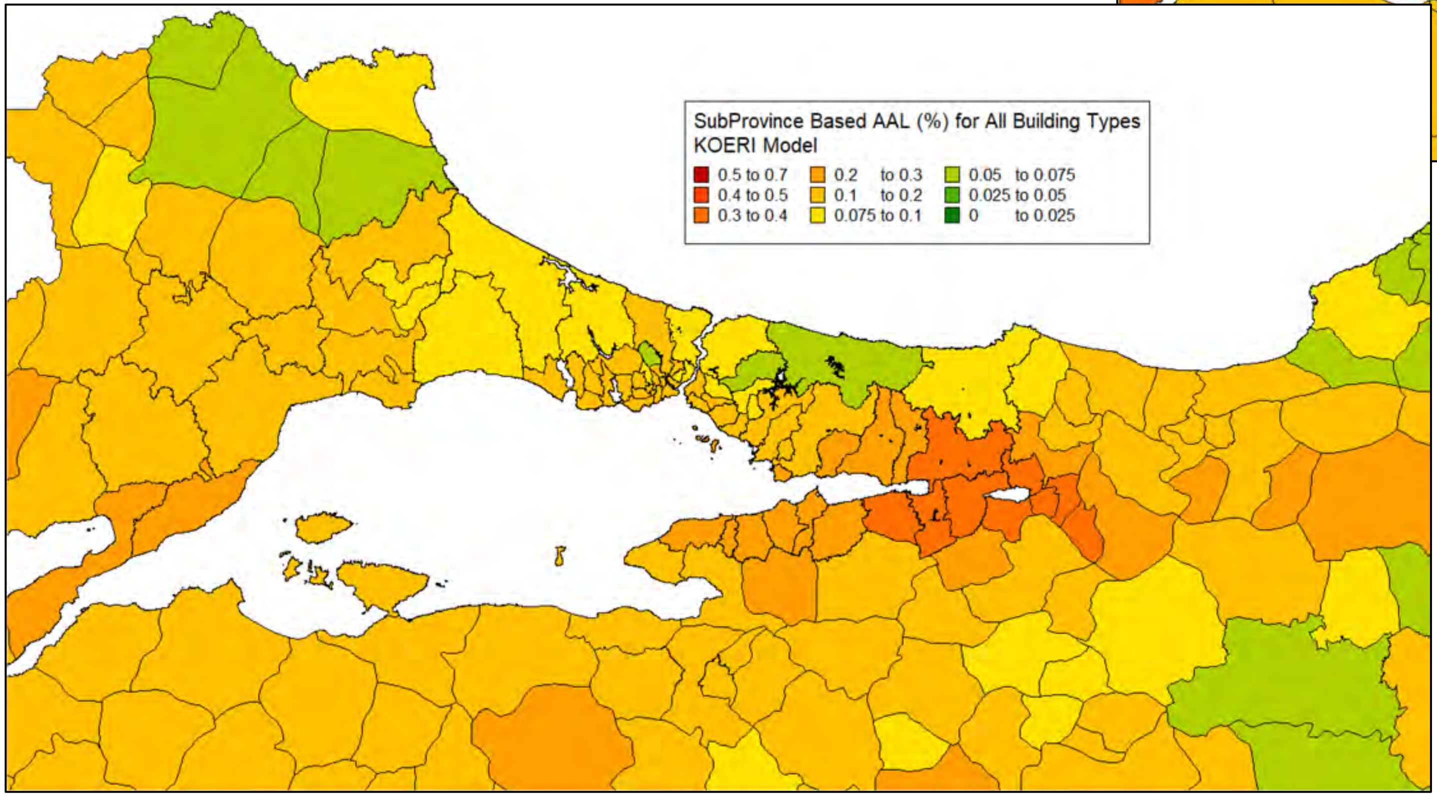




2018 official PSHA map (converted to intensities) is used. The average soil conditions in each geo-cell is considered. Intensity based fragility relationships are used.

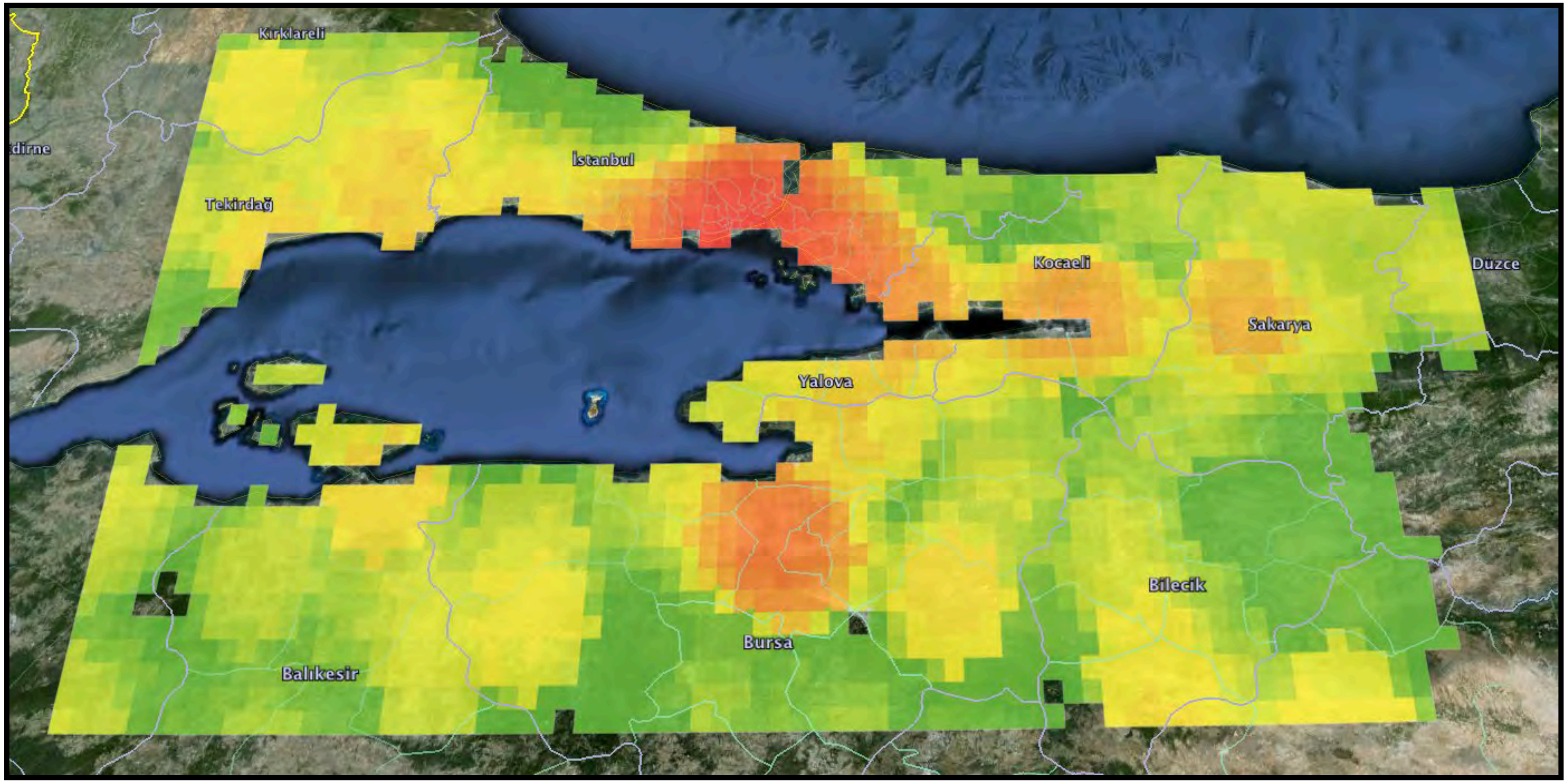
SUB-PROVINCE BASED AAL VALUES (PURE PREMIUM) FOR ALL BUILDINGS AND FOR TWO DIFFERENT CONSEQUENCE MODELS

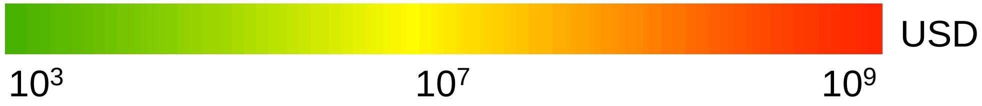




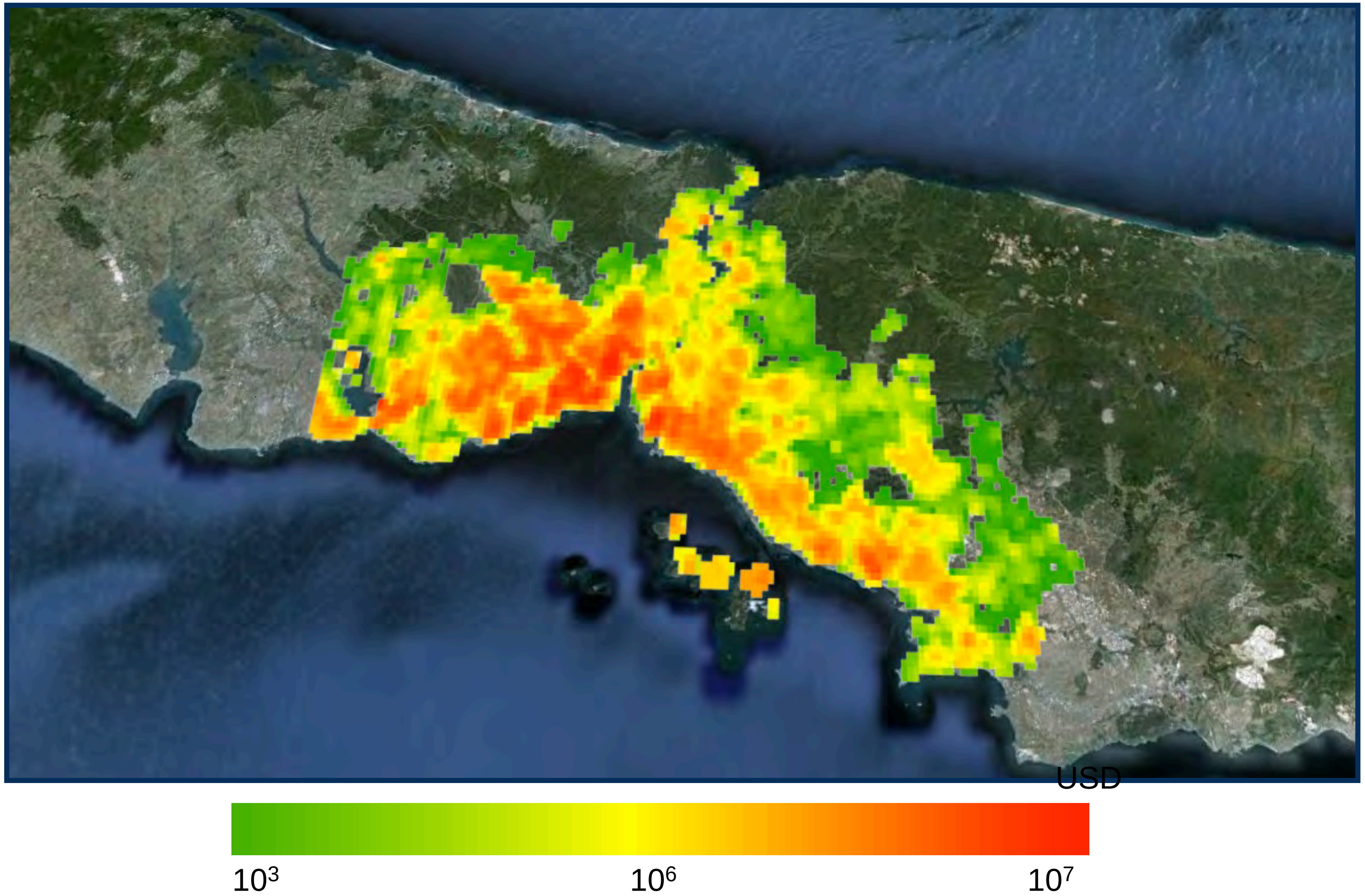
AAL values obtained for different building classes (year of construction, type of construction, number of stories) are obtained for consideration of the TCIP insurance pricing.

LOSS ASSESSMENT FOR A PROBABILITY OF EXCEEDANCE OF 10% IN 50 YEARS





SCENARİO BASED LOSS ASSESSMENT
Mw=7.25 and ε=0 (50% PE in 50 yrs, Istanbul Earthquake)



Total mean economic losses: 5.42 B with a standard deviation of 1.044 B (USD)
(representing ≈ 6% of the total building inventory value)

IMPORTANT ISSUES FOR ISTANBUL (MARMARA) CAT MODELING

- A reliable fault rupture model, associated with the “Istanbul Earthquake Scenario(s)” with weighted alternatives and cascading schemes would be needed.
- The modeled losses in the EP (Exceedance Probability) curve, should preferably be drawn against the probability of exceedances for the “Istanbul Earthquake” scenario, rather than the average return periods.
- In the generation of ground motion fields the intra-event variability should be considered as it allows for the consideration of the spatial and cross-spatial correlation of the ground motion residuals.
- The selection of appropriate (regionally compatible) set of GMPEs that addresses to the directivity effects ‘s important.
- The most robust approach to obtain the IM distributions for a scenario earthquake is to use Monte Carlo simulation to generate ground-motion fields based on stochastic event sets
- Fragility functions and the consequence relationships for post-2000 and high-rise buildings need to be developed
- Consideration of the correlation in the uncertainty in the fragility/vulnerability functions
- CAT models need verification and validation


THANK YOU

Introduction of the day's program

"Loss Modelling and Insurance Pricing Regarding Earthquake Risk"

Mustafa Erdik

Building sustainable and resilient communities against earthquakes is a critical effort in active seismic regions. A catastrophic earthquake and its cascading events have substantia economic impact across various sectors.

Earthquake insurance is important in this effort because it functions as a pre-disaster funding tool limits the economic impact of post-disaster recovery to individuals, businesses and government by transferring the risk of earthquake damage and funding the recovery efforts.

In this connection the technology of earthquake loss modeling (CAT Modeling) emerged as a powerful tool for the insurance industry with applications in many areas.

Earthquake CAT modeling is an integrated process of conducting numerical simulations of earthquake occurrence, ground motion prediction, damage assessment, and seismic loss calculation.
It typically involves: (1) inventory/exposure database, (2) hazard characterization, (3) structural vulnerability assessment, (4) loss estimation and (5) insurance portfolio analysis.

Insurance pricing is one of the outcomes of CAT modeling. The pure premium is derived by outputs of cat models but is routinely inflated to account for several items, including running costs, profit, unmodeled hazard, and unknowns.

Components of a Catastrophe Model

- Events (Hazard)   Stochastic event set, Intensity Measure calculation, Geospatial hazard data
- Damage (Vulnerability) Structural damage estimation
- Loss (Financial Model)   Insurance and reinsurance loss calculation

Types of Losses Modeled

- Direct   Physical damage to buildings and contents, Casualties
- Indirect   Loss of use, Business Interruption
- Loss Amplification / Demand Surge

Primary Metrics

- Exceedance Probability (EP)
- Average Annual Loss (AAL)
- Probable Maximum Loss (PML)

Potential Uses

- Insurance Pricing / Ratemaking
- Underwriting/risk selection
- Management of Exposures
- Loss mitigation strategies
- Reinsurance/risk transfer analysis • Financial adequacy analysis / Solvency

Earthquake Risk / Loss Estimation Methodology

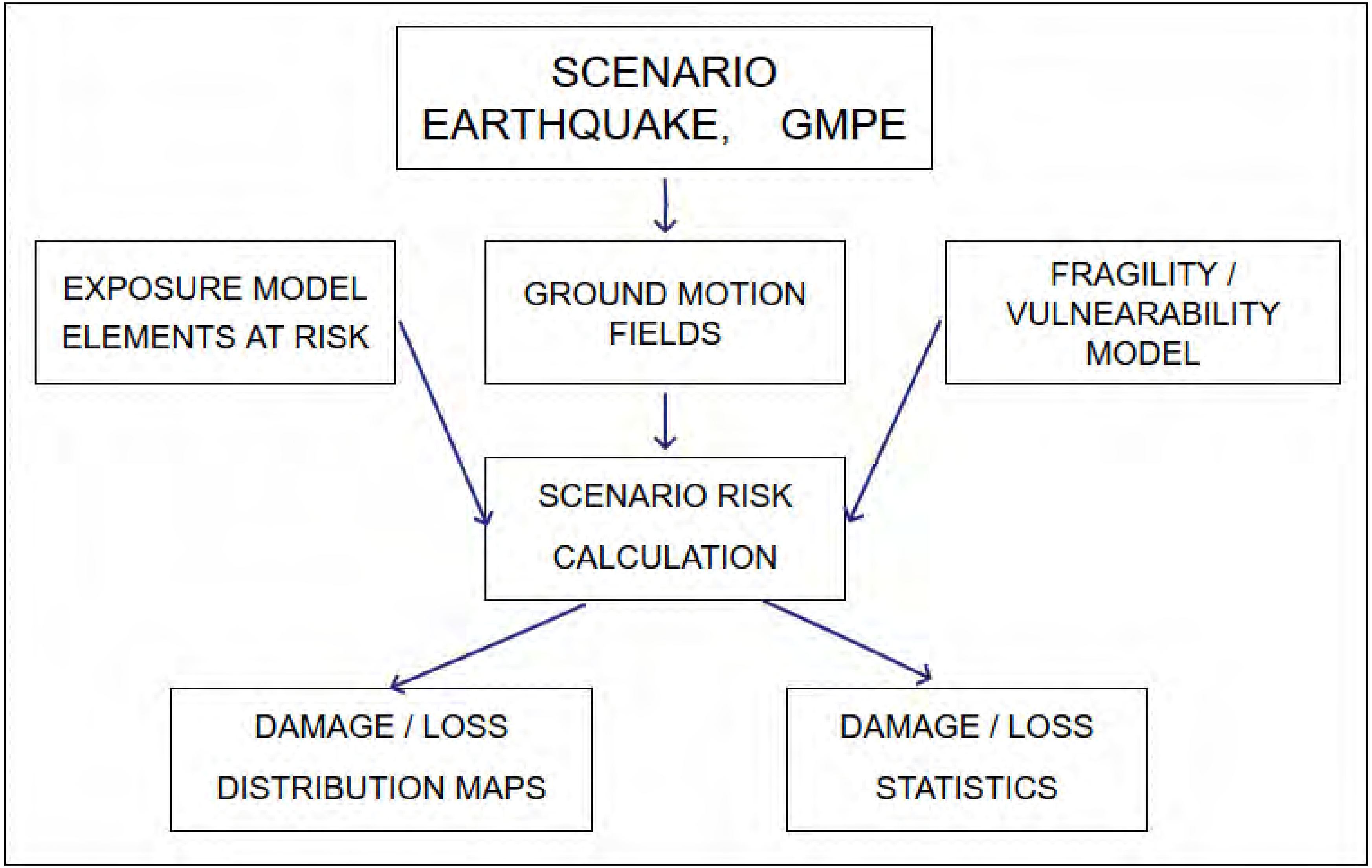
The risk component of the OpenQuake Software, developed by the Global Earthquake Model-GEM Foundation, can compute both scenario-based and probabilistic distribution and statistics seismic damage and loss using the approaches (Silva et al., 2014; OpenQuake, 2015):

Due to single earthquake scenario (**Deterministic Event-Based Loss Calculation**);

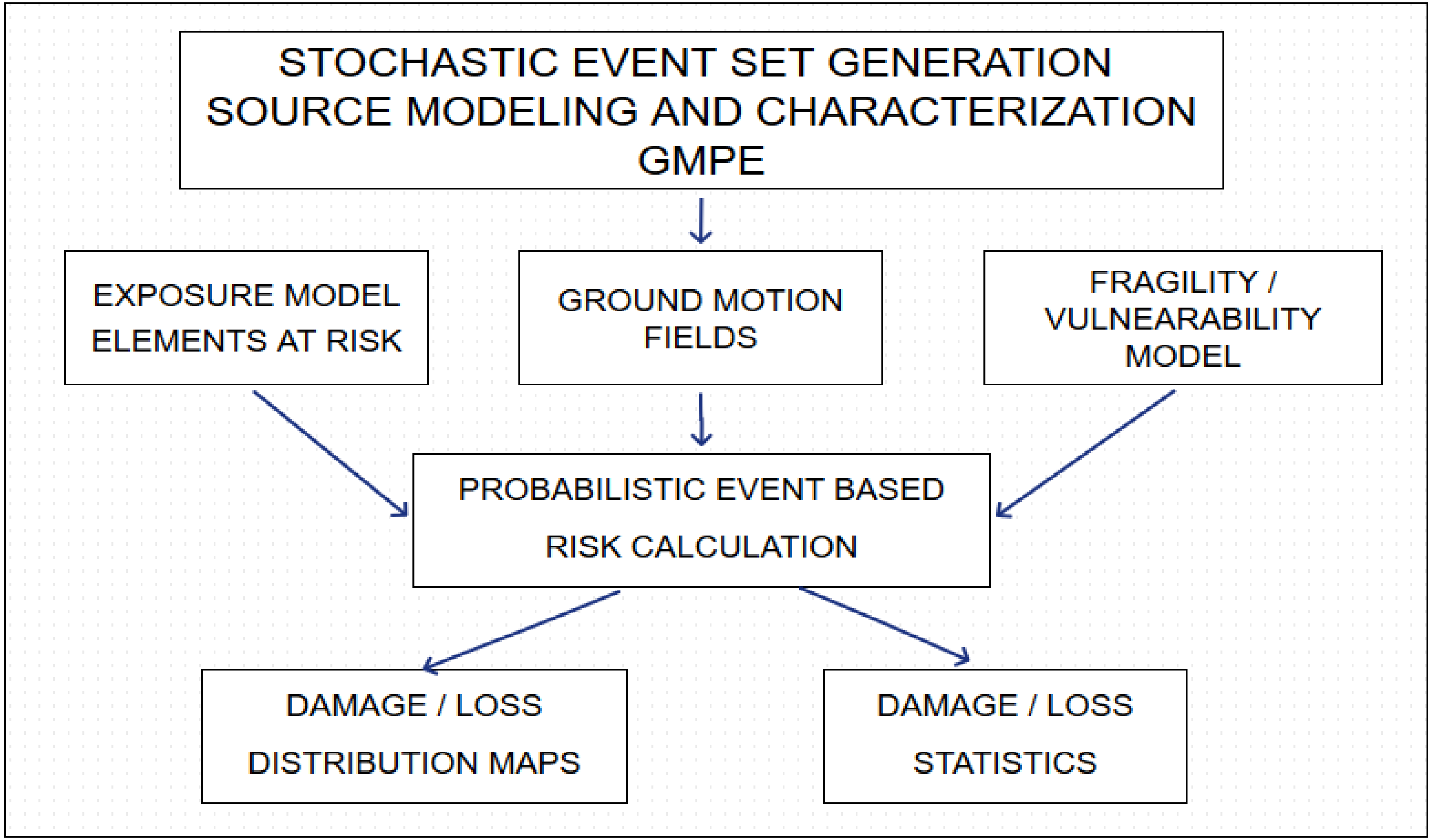
Considering a probabilistic description of the events and associated ground motions (**Probabilistic Event-Based Loss Calculation**) and;

Based on conventional probabilistic earthquake hazard assessment (**Classical PSHA-Based Loss Calculation**)

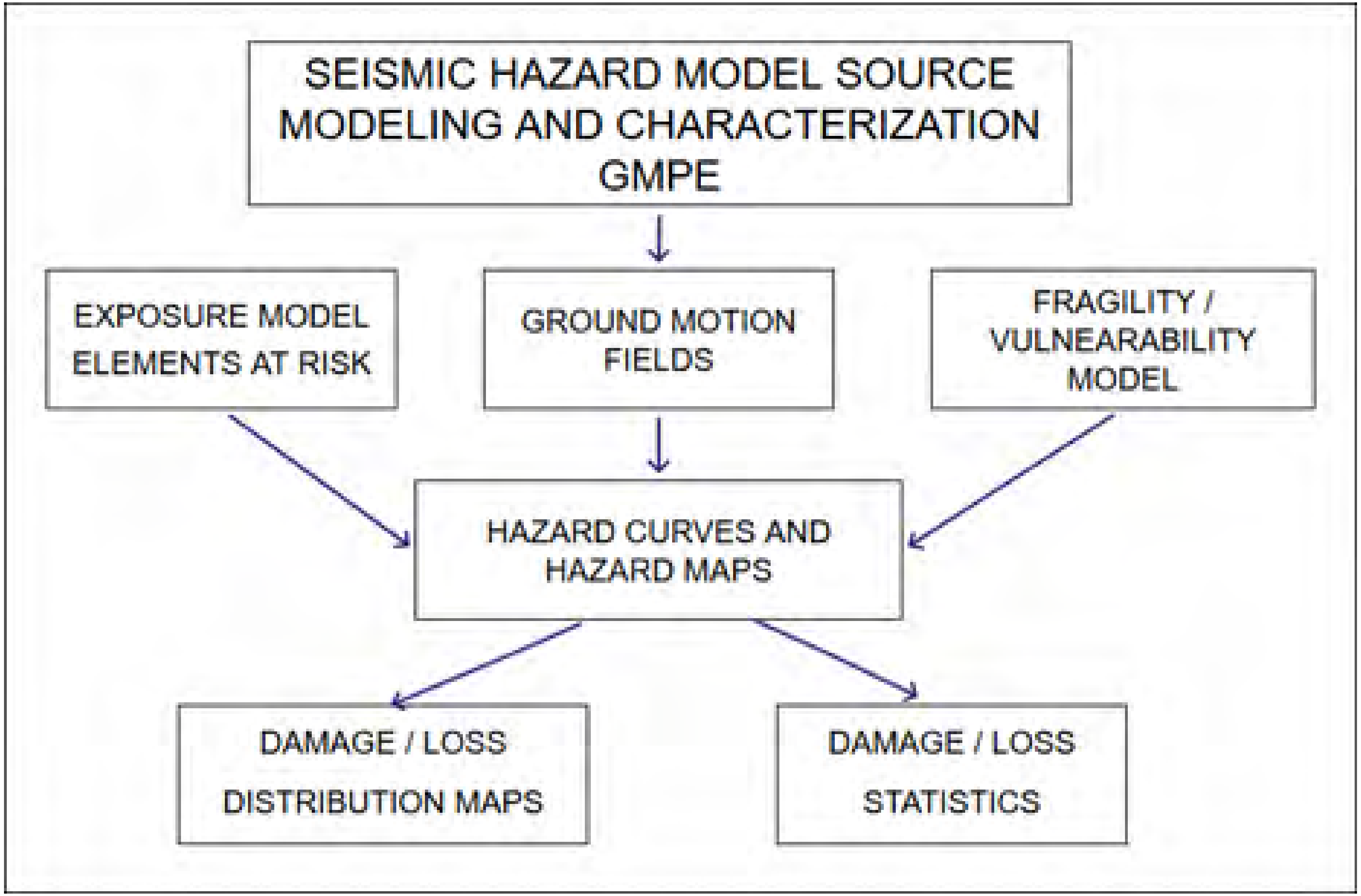
Deterministic Event-Based Loss Calculation



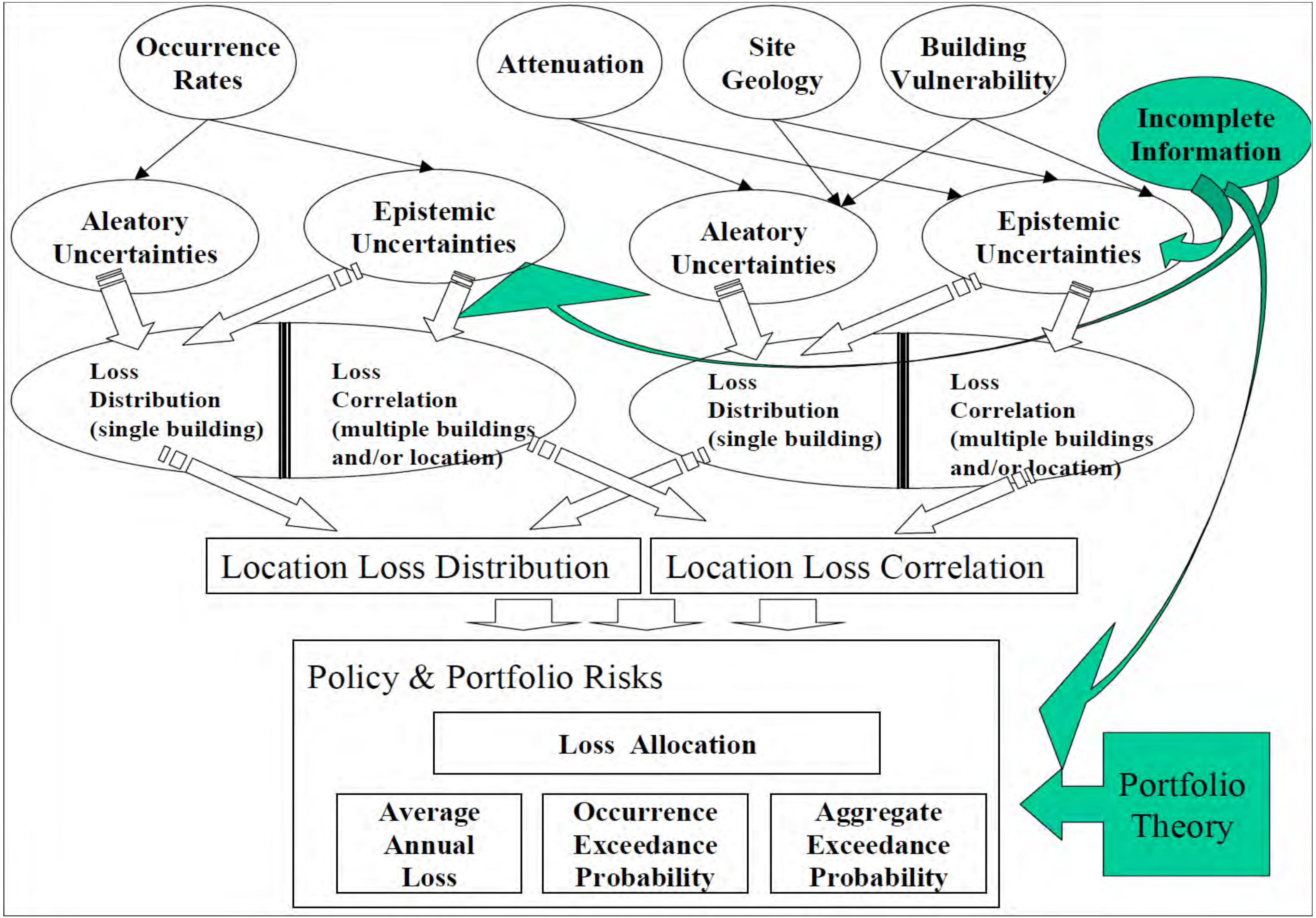
Probabilistic Event-Based Loss Calculation



Classical PSHA-Based Loss Calculation



Effect of Uncertainties on Loss Estimation *(Wong et al, 2000)*



Uncertainties in Loss Estimation

Uncertainties arise in part from incomplete scientific knowledge concerning earthquake ground motion and their effects upon buildings and facilities. Incomplete inventories of the built environment add to the uncertainty.

Epistemic uncertainties include model and parameter variation/incompleteness and can widen the loss distributions. The losses at different sites/cells may be correlated (loss/vulnerability correlation) essentially due epistemic uncertainties.

Aleatory uncertainties affects loss distributions and exceedance curves.

Epistemic uncertainty and aleatory variability in IM distribution maps.

The mean damage ratio (MDR) is highly sensitive to the cost ratios assigned to each damage state.

Loss correlation can also have an influence on the aggregate portfolio risk.

These factors can result in a range of uncertainty in loss estimates, at best, a factor of two.

Introduction of the day's program - "Loss Modelling and Insurance Pricing Regarding Earthquake Risk"
Mustafa Erdik

Earthquake Loss Modelling and Pricing Chairperson*: Sinan Akkar*
Risk Oriented Earthquake Hazard Assessment *Peter Stafford*
Empirical fragility and vulnerability of regional building stock in Europe *Sergio Lagomarsino*
Elements at Risk, Fragilities, Consequence Functions and Vulnerabilities *Helen Crowley*
Earthquake Physical Risk/Loss Assessment Models and Example Applications *Sinan Akkar*
Cat Modelling, Application to Insurance Industry: Unknowns and Possible Sources of Bias in Pricing *Paolo Bazzuro*
Role of Earthquake Insurance in Earthquake Risk and Resiliency Management *Fouad Bendimerad*
Turkish Catastrophe Insurance Pool *İsmet Güngör*
Fire Following Earthquake Models and Insurance *Charles Scawthorn*

Panel Session: What we have learnt? What is the future?
Moderator: *Mustafa Erdik*
Panelists : *Luis Sousa*, AIR
Matthew Eagle, Guy Carpenter
Martin Käser, Munich Re
Joe Melly, RMS
Nicolas Georgy, Swiss Re

Panel Session

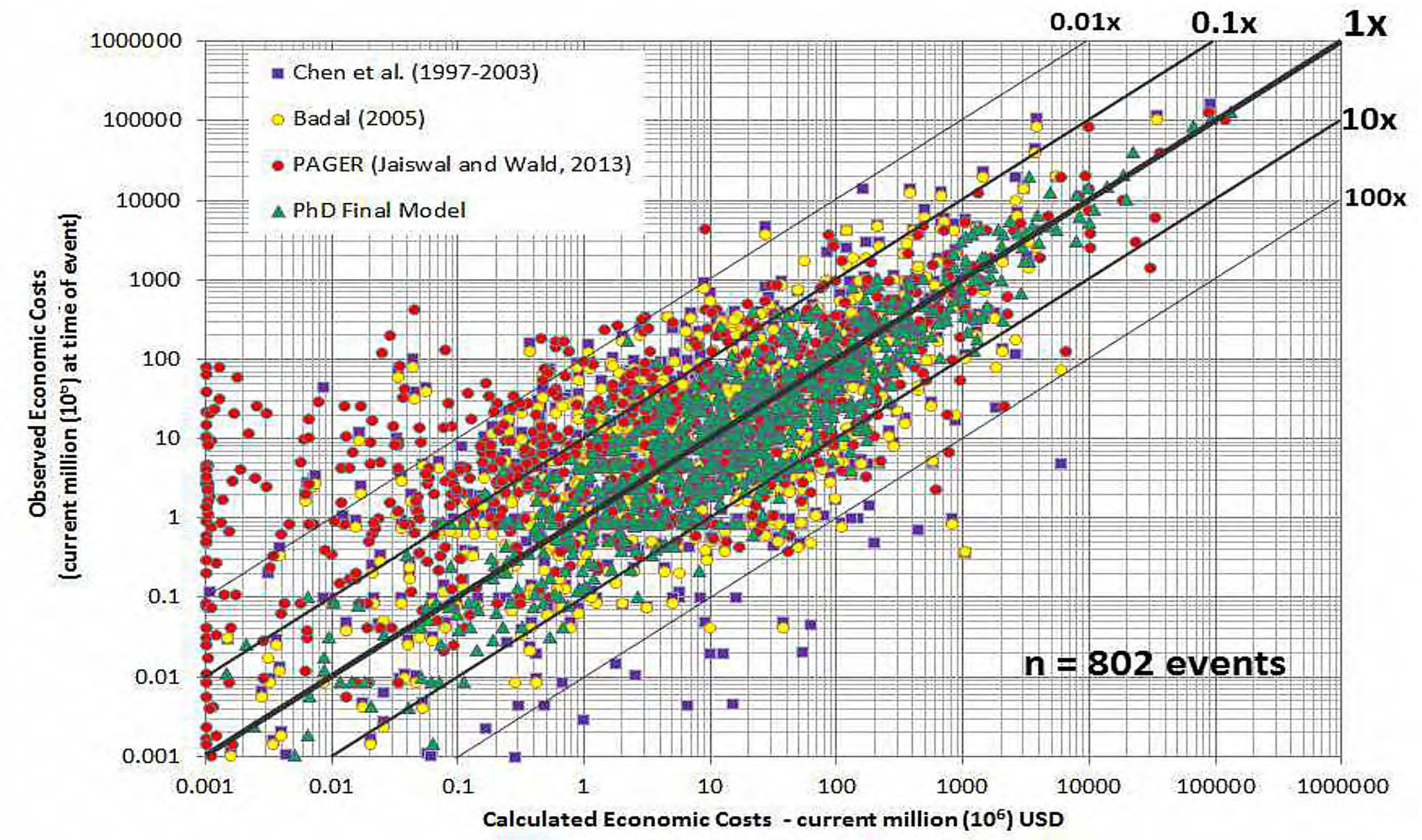
Earthquake Loss Modelling: What we have learnt? What is the future?

Mustafa Erdik

Choices of Cat Models
Main Vendors (RMS, AIR, EQE)
Reassurance Company Models
Broker Models
Insurance Company Models
Open Source Models – *GEM OpenQuake*

Although earthquake loss modelling is now an established area of research, with many groups in research institutes and universities engaged in, the needs of the insurance and reinsurance industries have been met mainly by a few well-known companies specializing in catastrophe (CAT) modelling.

The ability of the user community to ‘own’ the code enables much more rapid development, the spotting and removal of bugs, and ultimately produces better software.
The main benefits associated with open-source loss models are; (i) advancing the state-of-the-art of catastrophe risk modelling and (ii) improved information sharing, such as the case with OpenQuake.



Observed vs. calculated costs for 4 different studies (Daniell and Wenzel, 2014) versus Chen et al. (1997-2003), Badal (2005) and PAGER (Jaiswal and Wald, 2013). (After Daniell and Wenzel, 2014)

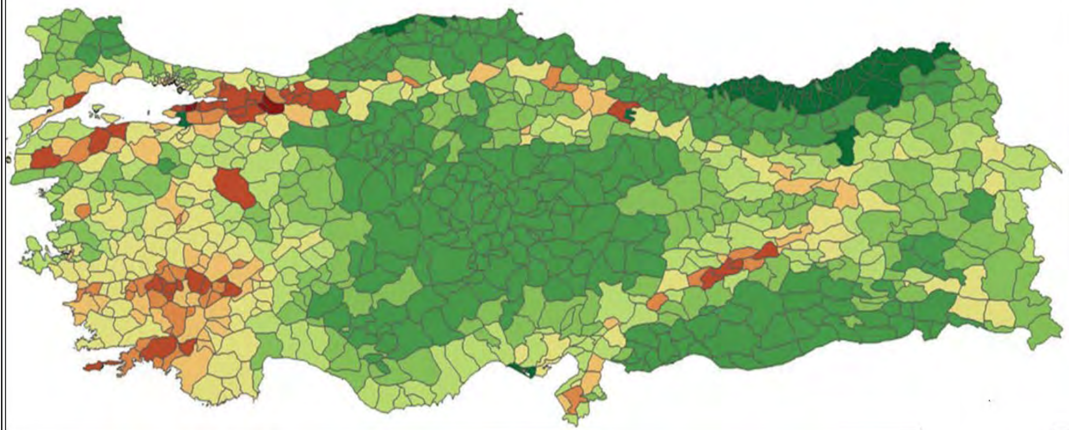
COMPARISON OF VENDOR AND LOCAL MODELS

COMPARISON OF THE DISTRICT (*İLÇE*) BASED AAL ASSESSMENTS

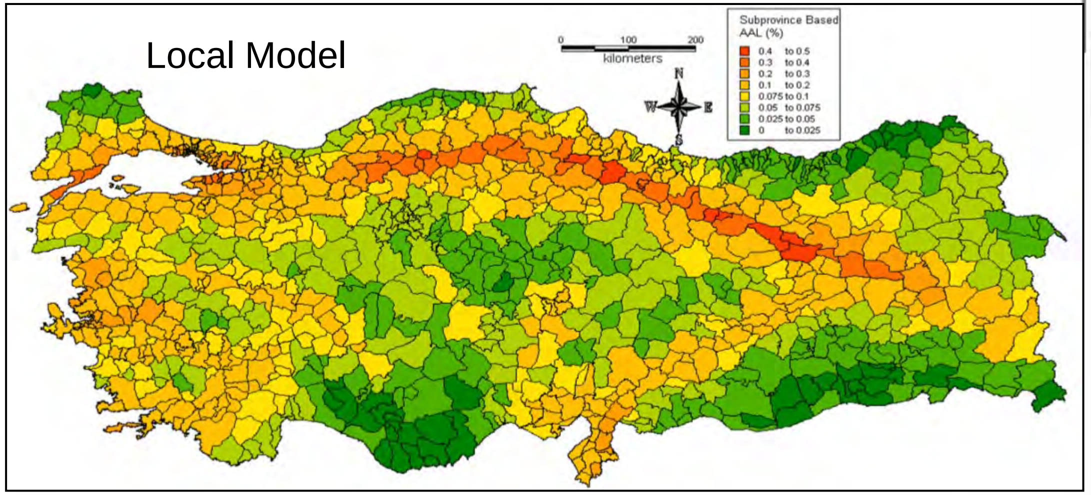
Vendor Model 1

Vendorl Model 2

Vendor Model 3

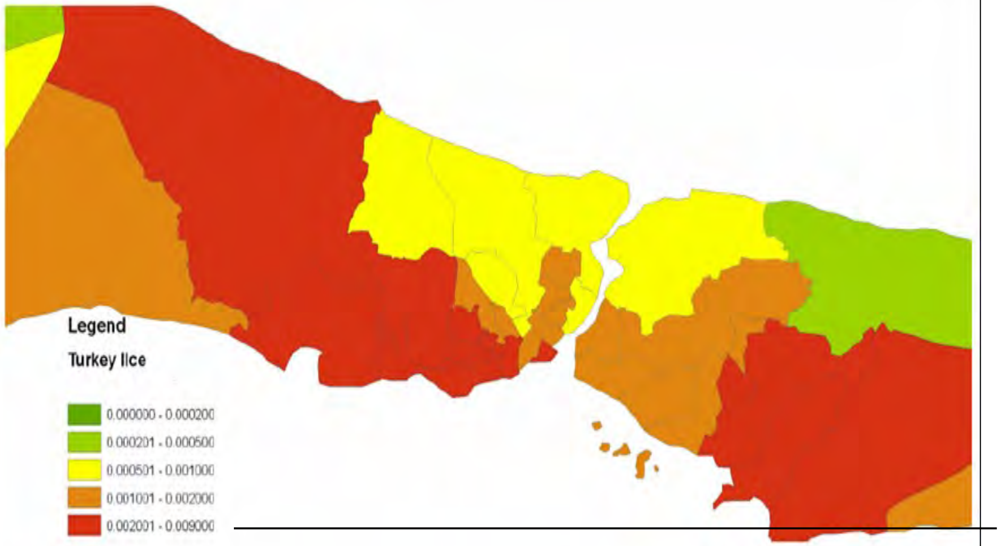


Local Model

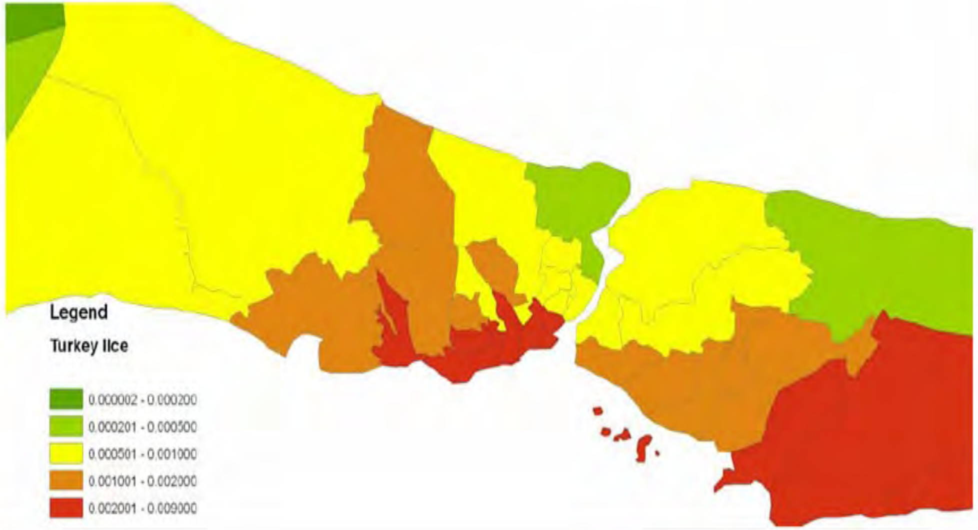


COMPARISON OF MARMARA REGION / ISTANBUL AAL ASSESSMENTS

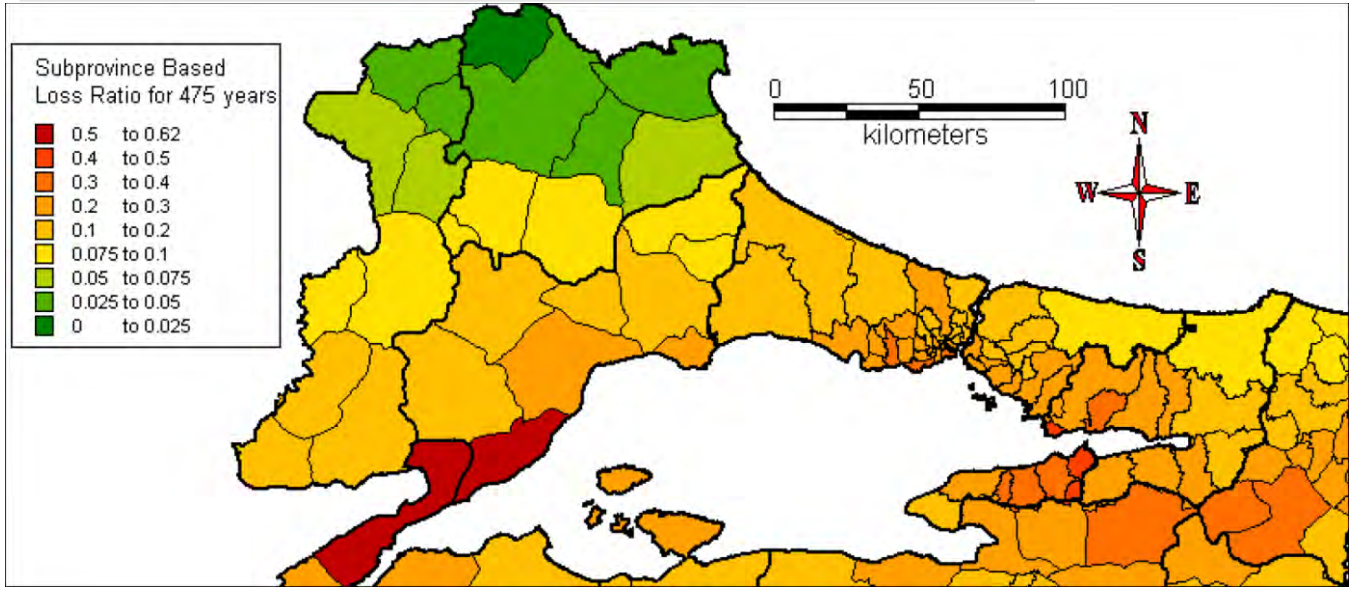
Vendor Model 1

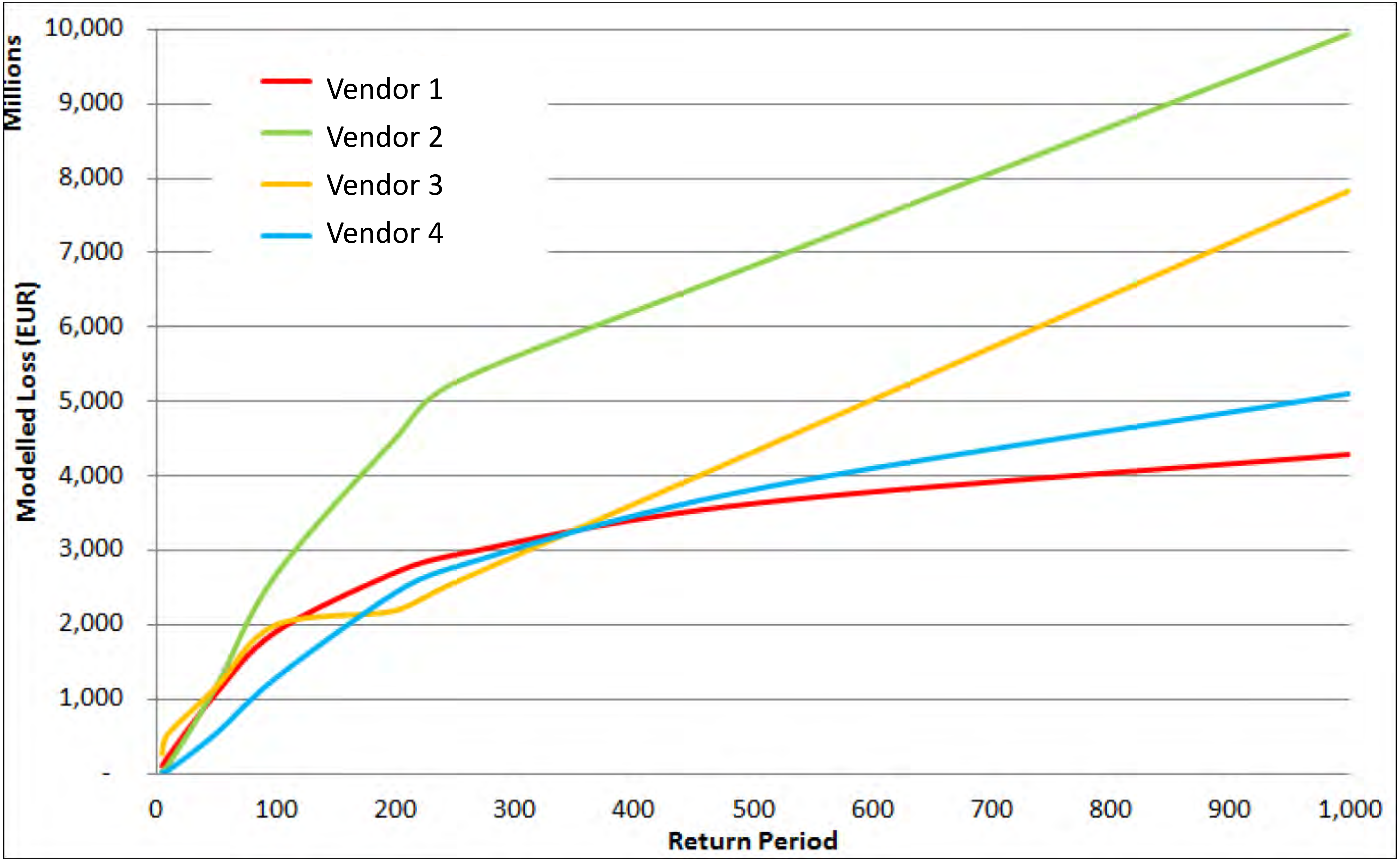


Vendor Model 2



Local Model - İlçe Based 475 Year Mean Loss Ratio (Share Project)





Millions
Modelled Loss (EUR)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
0
100
200
300
400
500
600
700
800
900
1,000
Return Period
Vendor 1
Vendor 2
Vendor 3
Vendor 4

Demand surge/Loss amplification – Post event inflation.
– Shortages of labor and materials cause prices to rise.
– Supply/demand imbalance.
–Insurers are pressured to settle claims generously

Demand surge is understood to be a socio-economic phenomenon of large-scale natural disasters: repair costs rise, locally and temporarily, through any of several possible demand- or supply-related mechanisms. Increased repair costs after past large-scale natural disasters have been reported in the range of 20 to 50%.

Institutions that indemnify properties exposed to natural disasters, such as insurers, reinsurers, and governments, pay billions of U.S. dollars in claims after large-scale natural disasters; these payments can be even larger as a result of demand surge.

Indemnity insurance payments can be larger as a result of demand surge.