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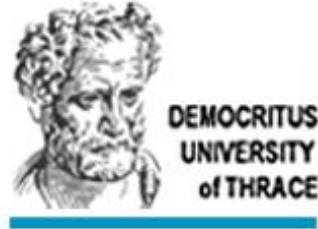
REDACT
a Black Sea Basin Joint Operational Programme 2014-20 project



PAYDAŞ BİLGİLENDİRME TOPLANTISI

Hızlı Deprem Hasar Tahmin Konsorsiyumu

Rapid Earthquake Damage Assessment Consortium (BSB 966)



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Hızlı Deprem Hasar Tahmin Konsorsiyumu **Rapid Earthquake Damage Assessment Consortium (BSB 966)**

REDAS Platform: Senaryo Bina Hasar Analizi (Tuzla, İstanbul)

Dr. Öğr. Üyesi Ali YEŞİLYURT (İTÜ)
Y.Müh. Oğuzhan ÇETİNDEMİR (GTÜ)

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Gebze, Haziran 2023

REDAS Platform: Scenario Building Damage Analysis (Tuzla, Istanbul)

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➤ 1. Introduction

The earthquake risk assessment is one of the initial steps of the earthquake risk reduction procedure in order to evaluate potential direct and indirect losses and then to develop mitigation procedures.



Hazard is the frequency of a level of shaking (liquefaction, landslide, fault rupture)

+

Vulnerability measures the likelihood that something like a building will be damaged

+

Exposure is the number of people, buildings, structures that are exposed to the hazard. This is called an inventory.



EARTHQUAKE RISK

$$\text{Risk} = \text{H} \times \text{V} \times \text{E}$$

Under human control

Hazard Vulnerability Exposure

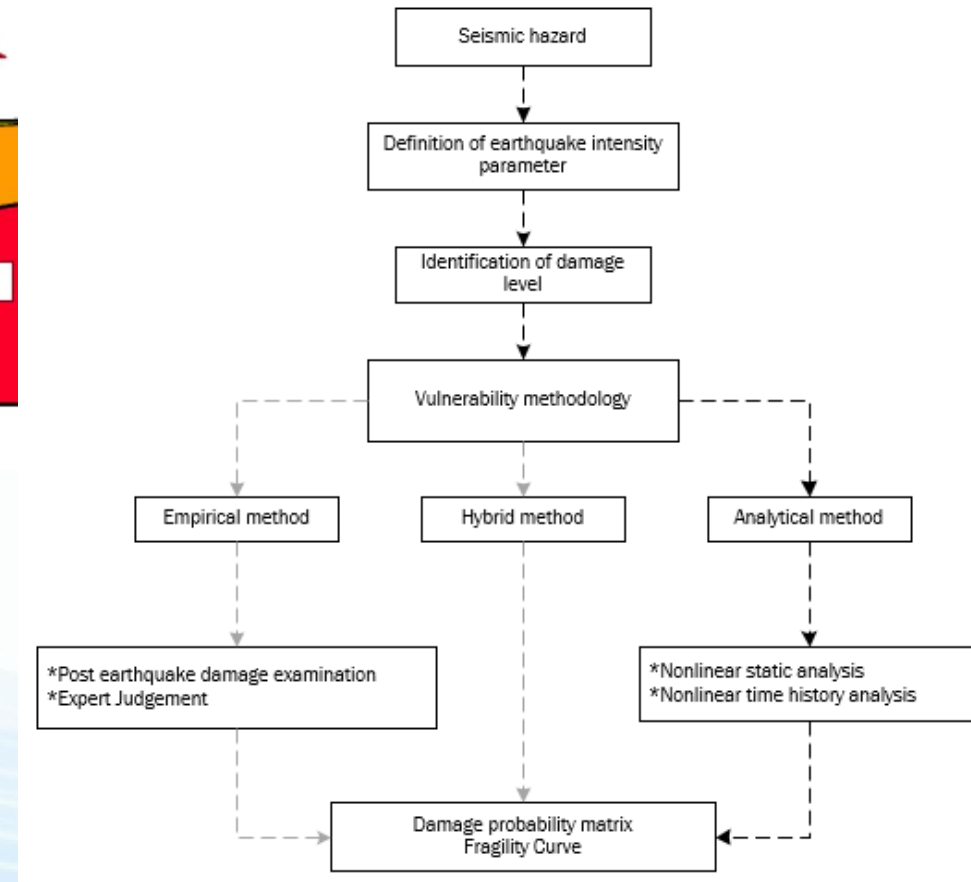
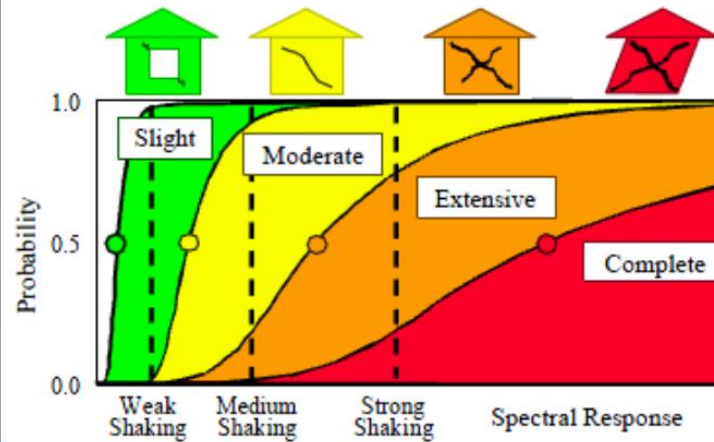
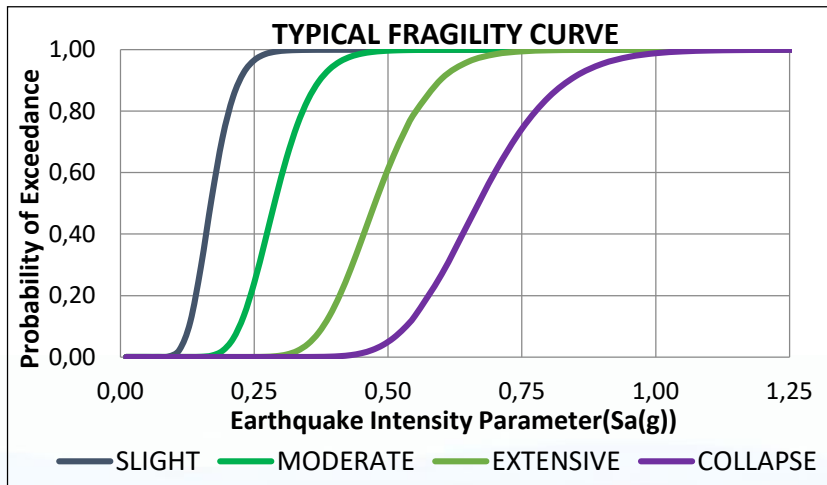
Hazard is the property of an earthquake that causes loss of life or damage

Risk is the probability of loss of life, injury, or damage

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➤ 2. Seismic Vulnerability Assessment: Fragility Curve



The probability of reaching or exceeding a damage state for structural damage, for any earthquake intensity level, is modelled as:

$$P[D \geq d_i | Y] = \Phi \left[\frac{1}{\beta_i} \ln \left(\frac{Y}{Y_{mi}} \right) \right]$$

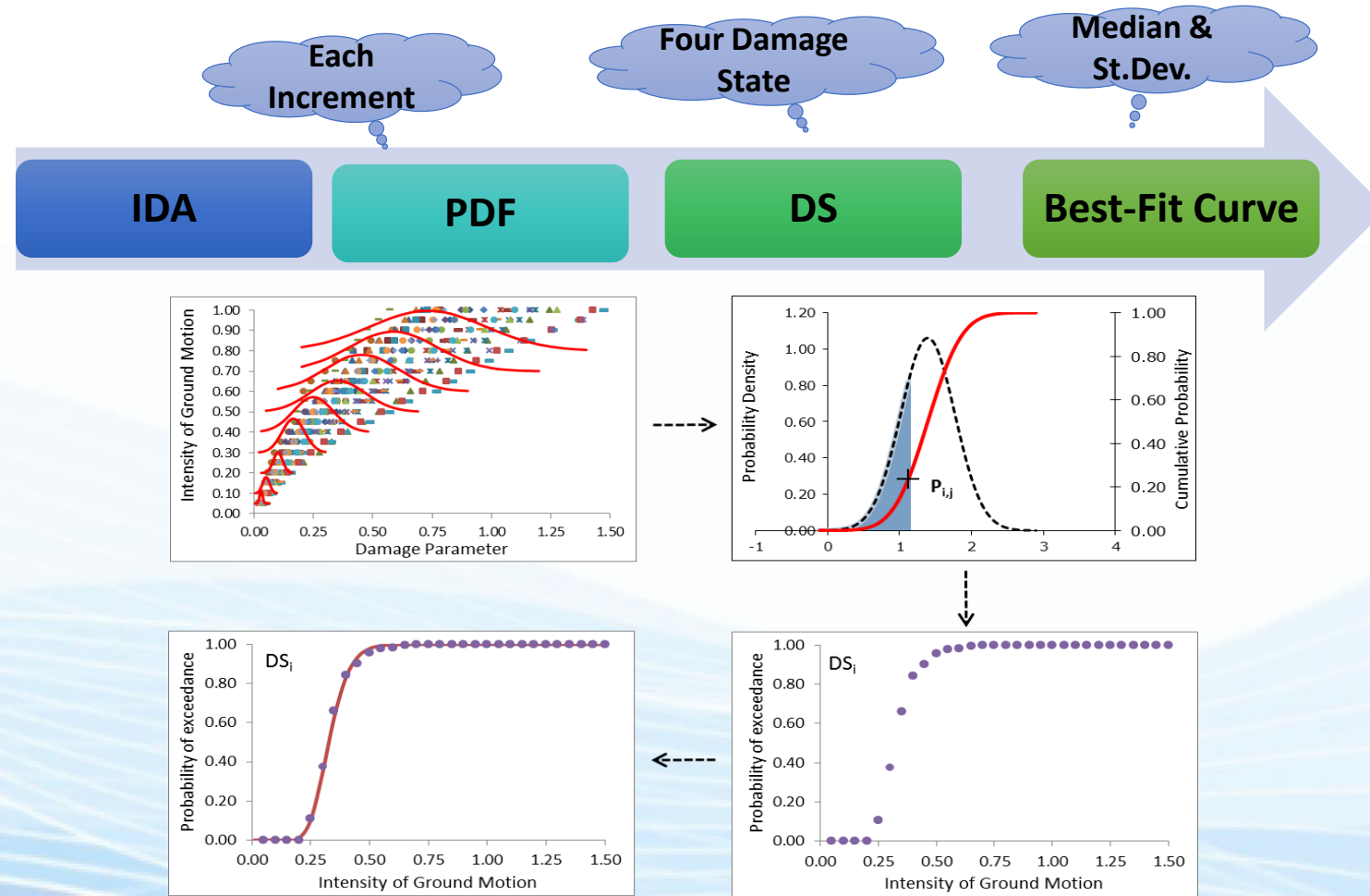
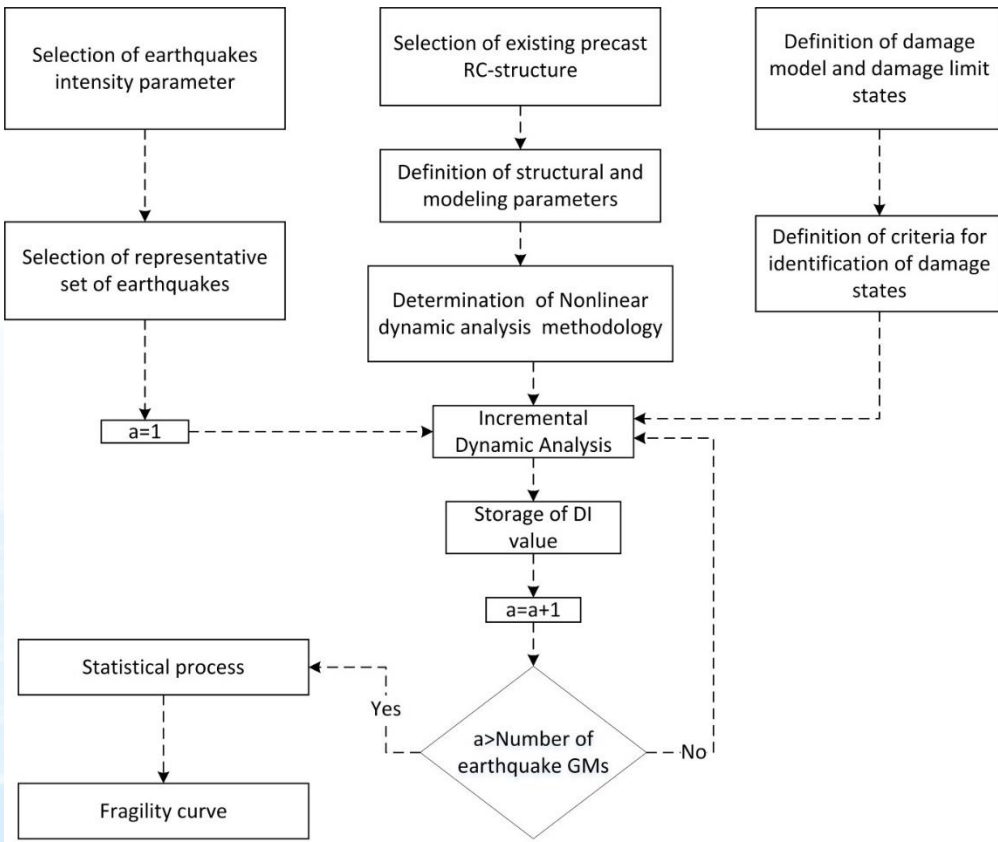
where “P” is the probability of the damage parameter “D” reaching or exceeding the value of “d_i” for the ith damage state for a given ground motion characterized by an earthquake parameter “Y”, whereas “Y_{mi}” is the median threshold value. “Φ” represents the standard normal cumulative distribution probability function. “β_i” is the lognormal standard deviation.

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➤ 2.1. Methodology

The vulnerability assessment has critical importance in the reliable risk estimation. The number of studies on seismic vulnerability assessment methodology has increased recently with the occurrence of significant earthquakes around the world in the past decades.



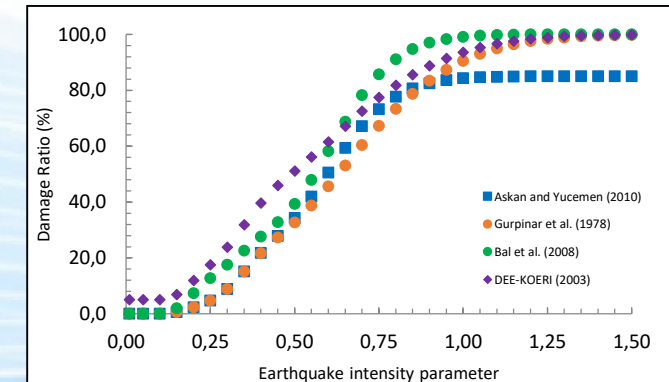
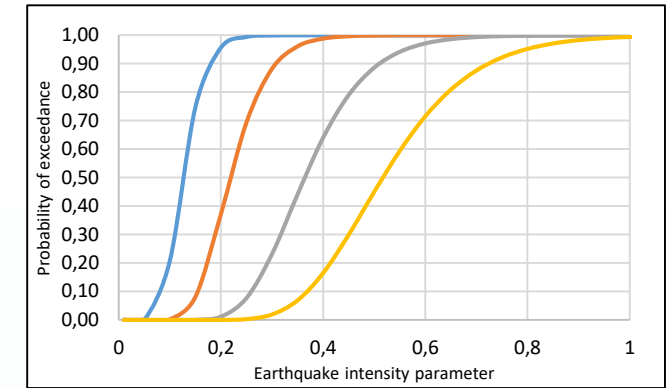
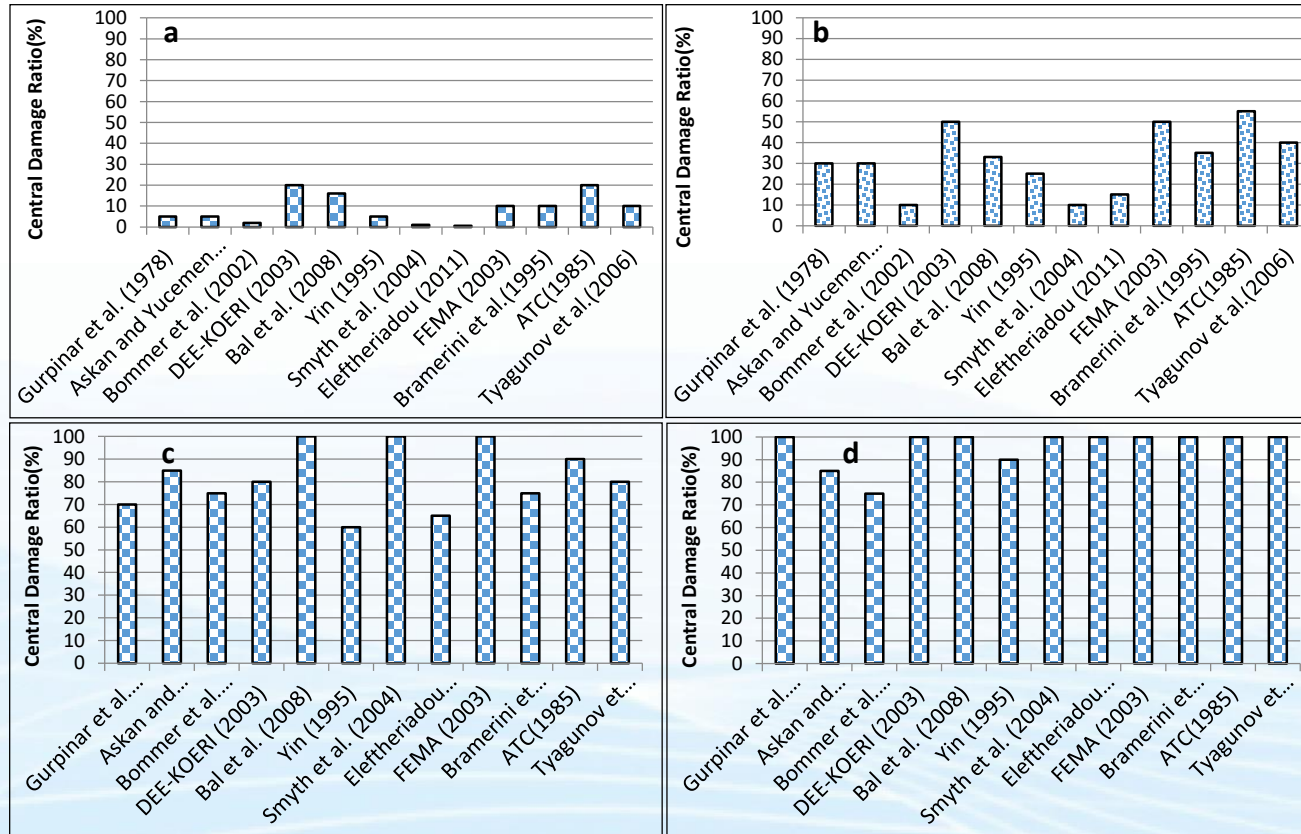
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➤ 3. Vulnerability Curve

Damage ratio (*DR*) can be described as the proportion of repairing cost of earthquake damage to the replacement cost of the building.

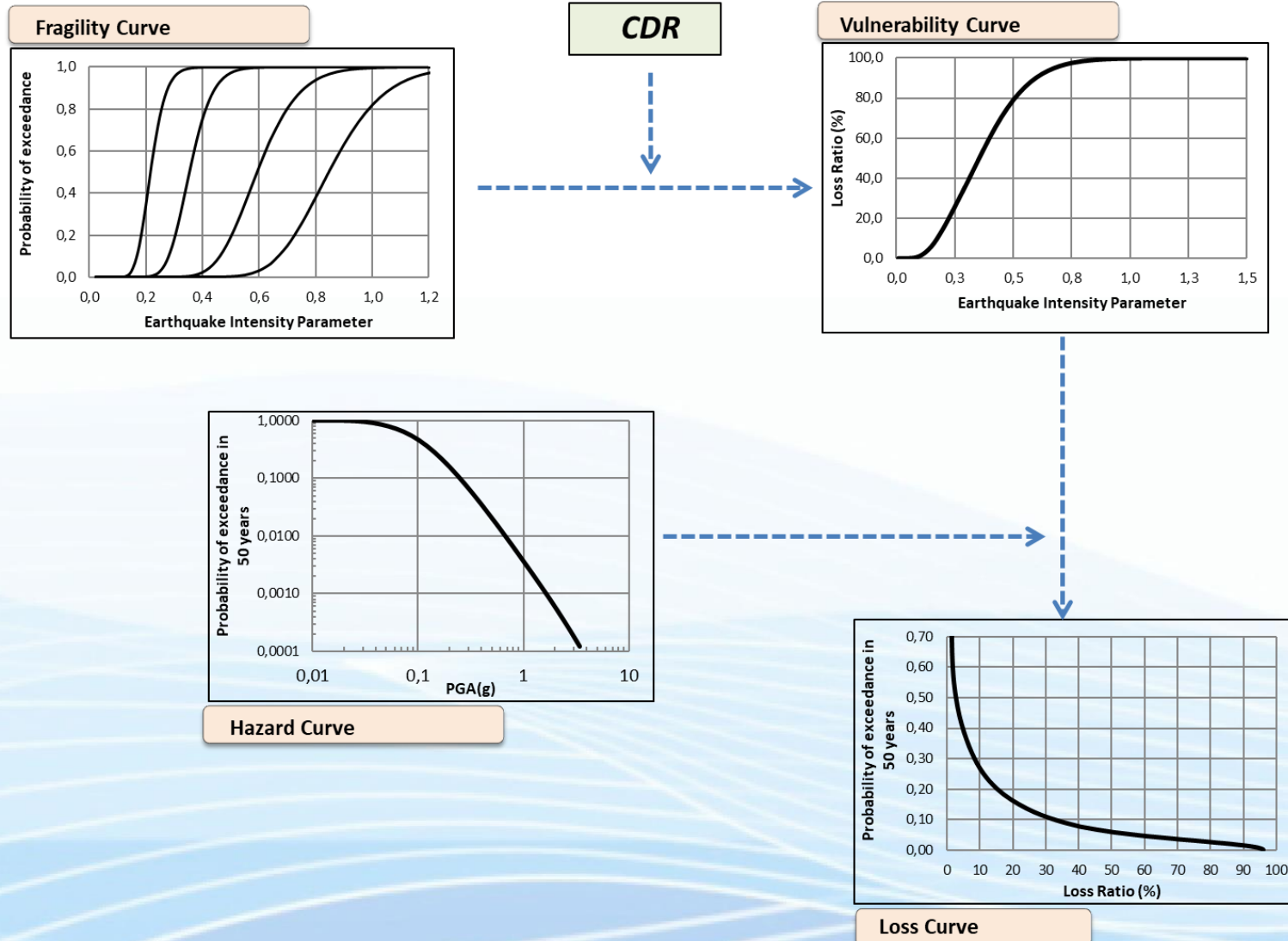
$$\text{Damage Ratio}(S_{ae,j}) = \sum_{DS} P(DS_i|S_{ae,j}) \times CDR(DS_i)$$



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➤ 4. Earthquake Risk Evaluation: Loss Curve



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➤ 5. Case Study: Scenario Building Damage Analysis (Tuzla, Istanbul)

Inventory
Data-base

Fragility Curve

Seismic Hazard

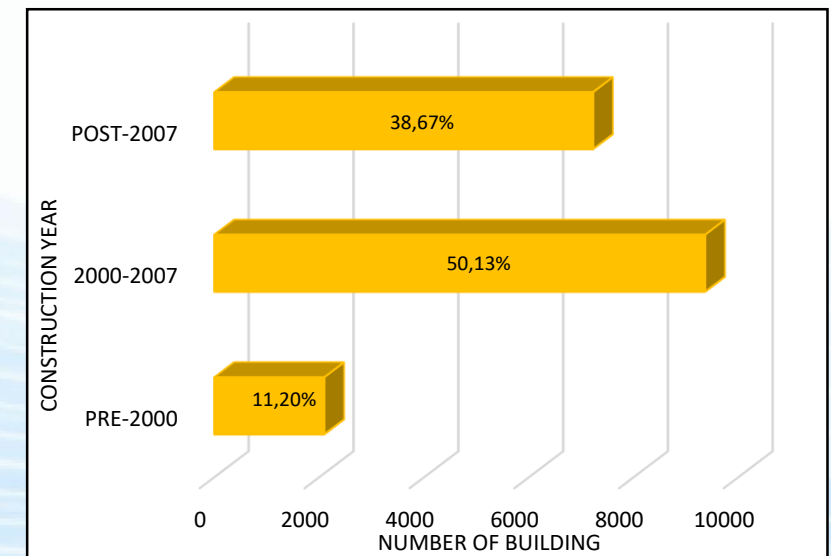
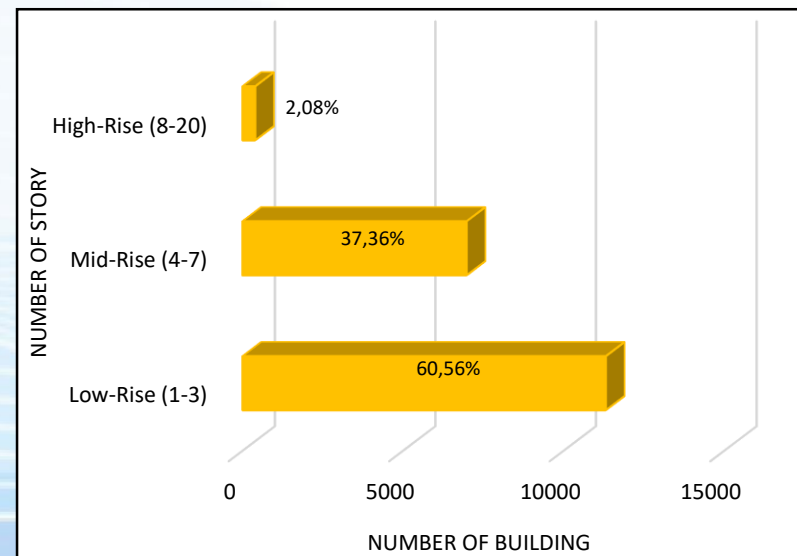
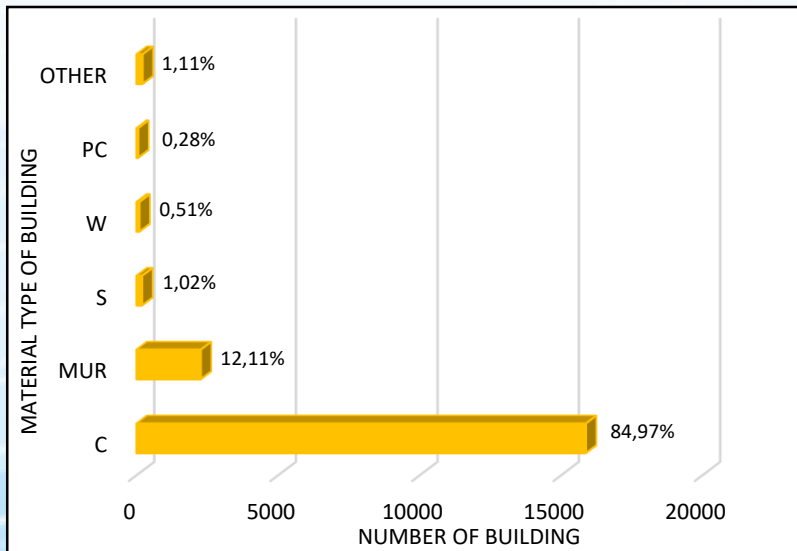
Damage
Analysis



➤ **Building Typology/Taxonomy**

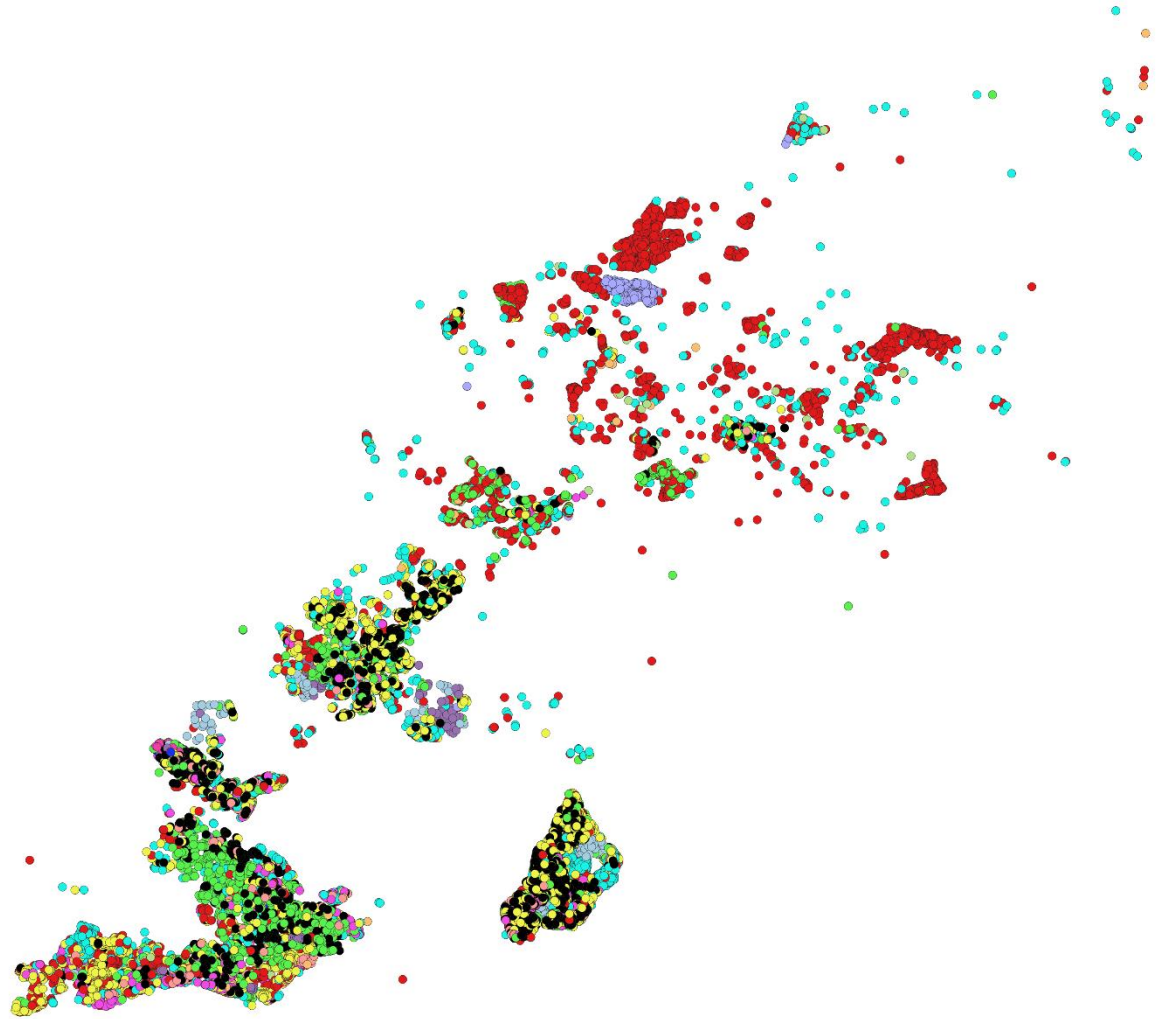
General Attributes Used for Building Fragility Relationships

- Material
- Lateral load resisting systems
- The height of the building
- The quality of the construction



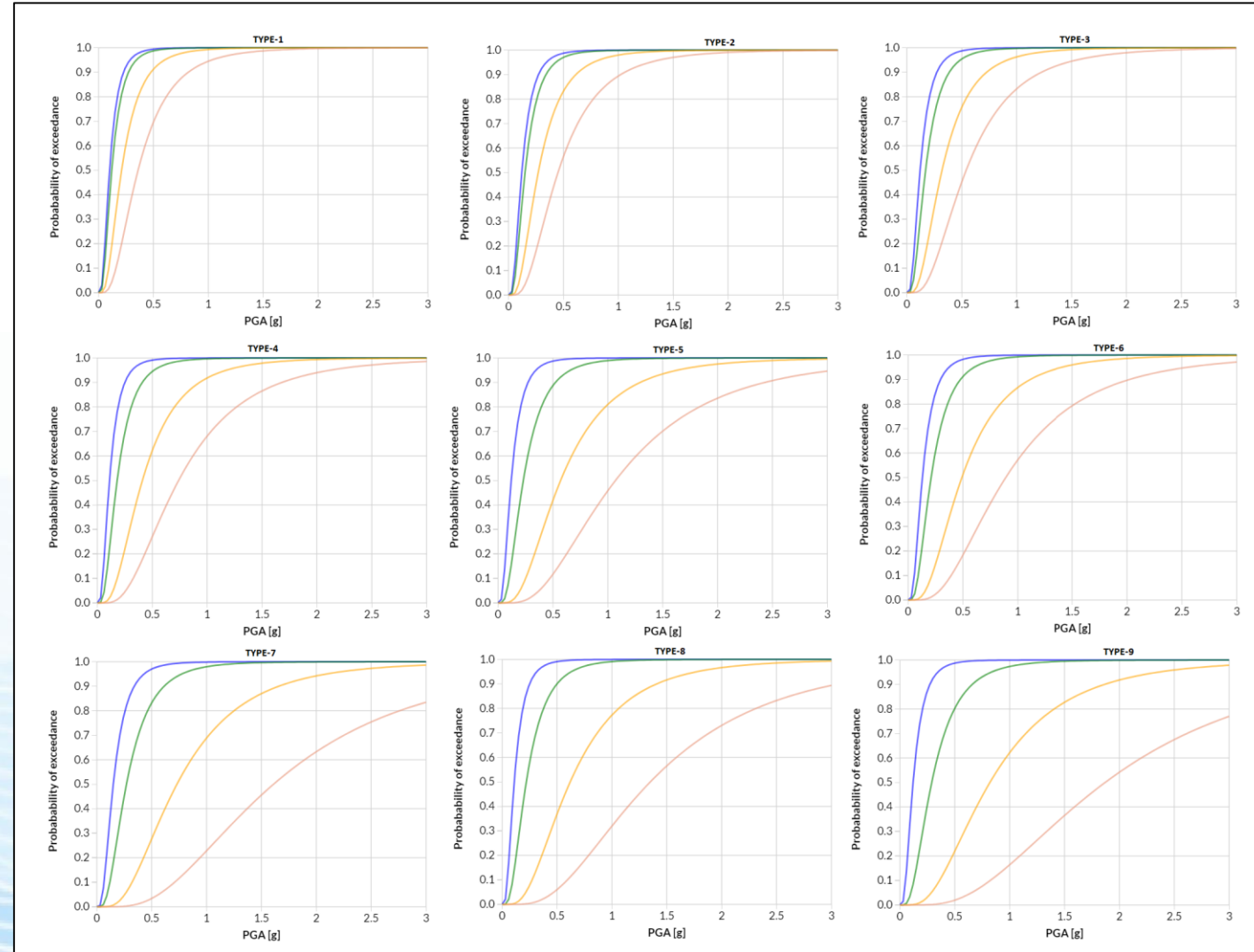
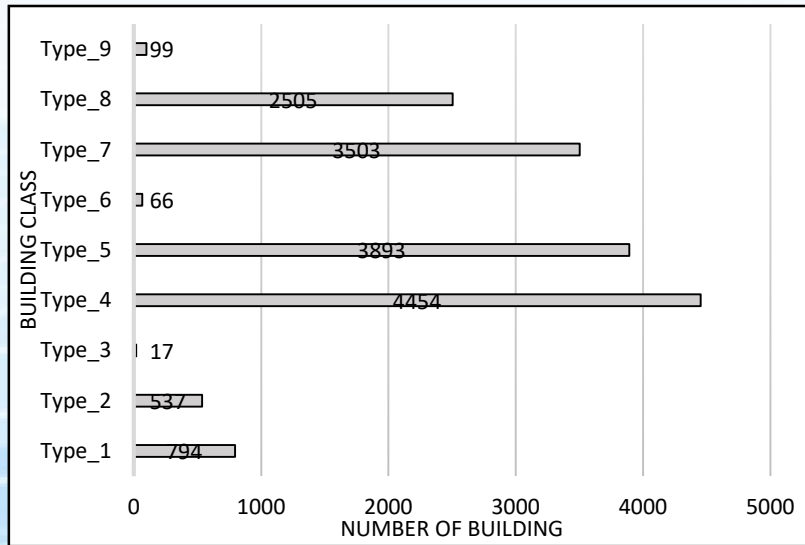
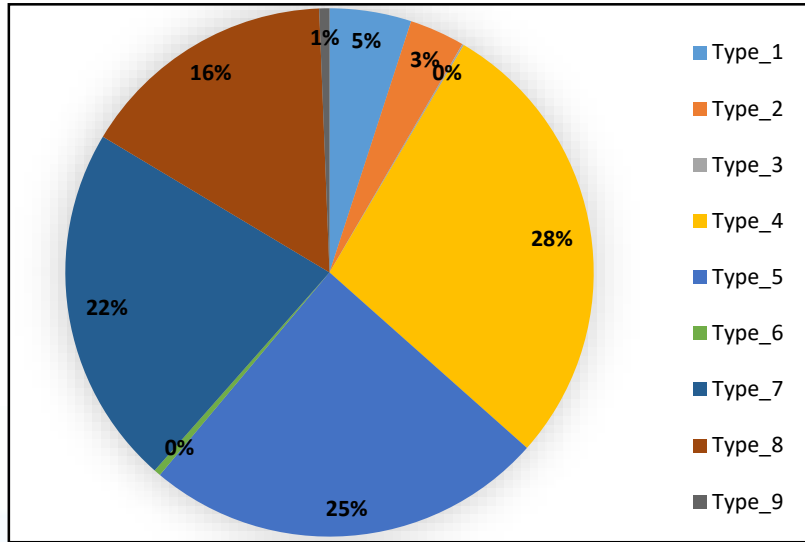
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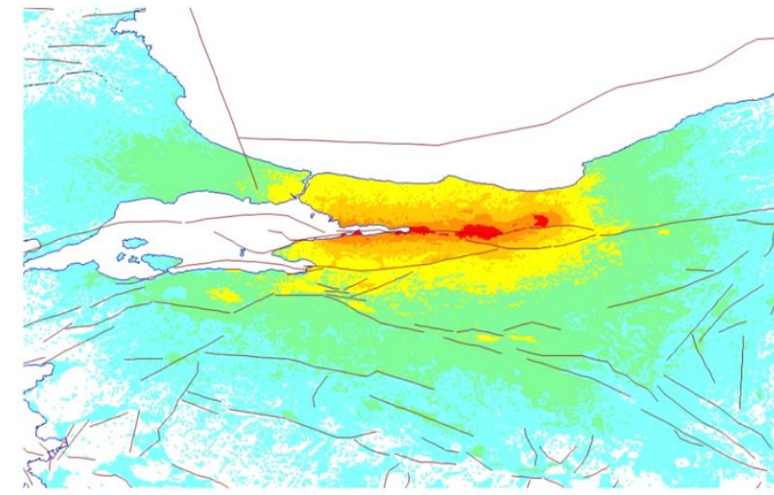
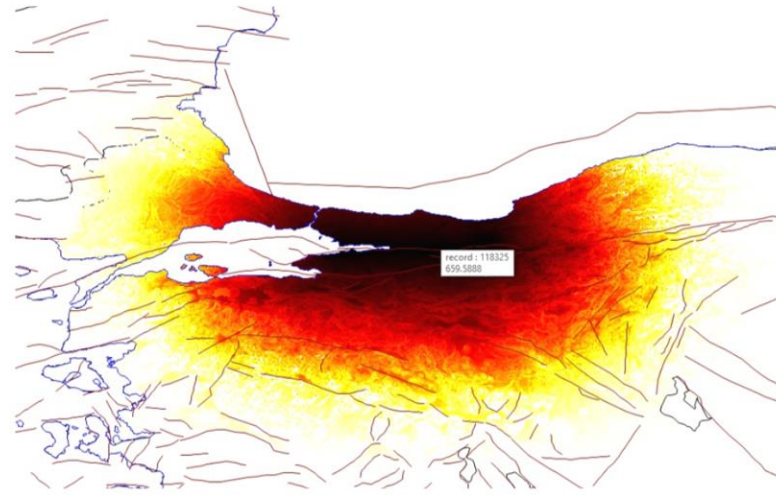
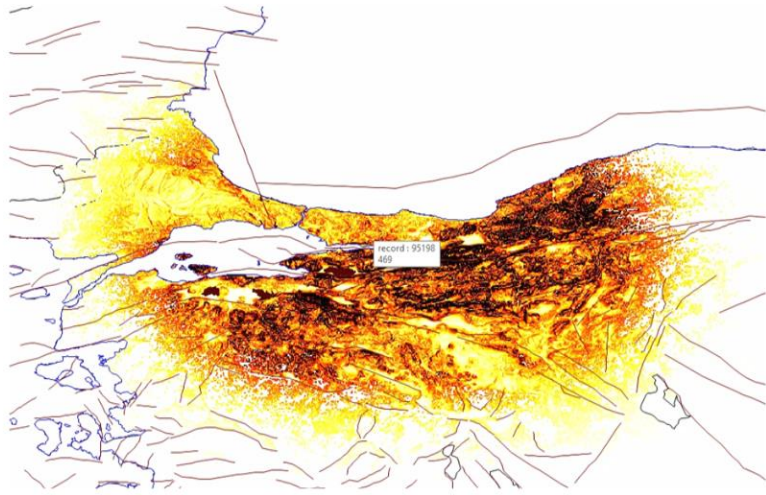
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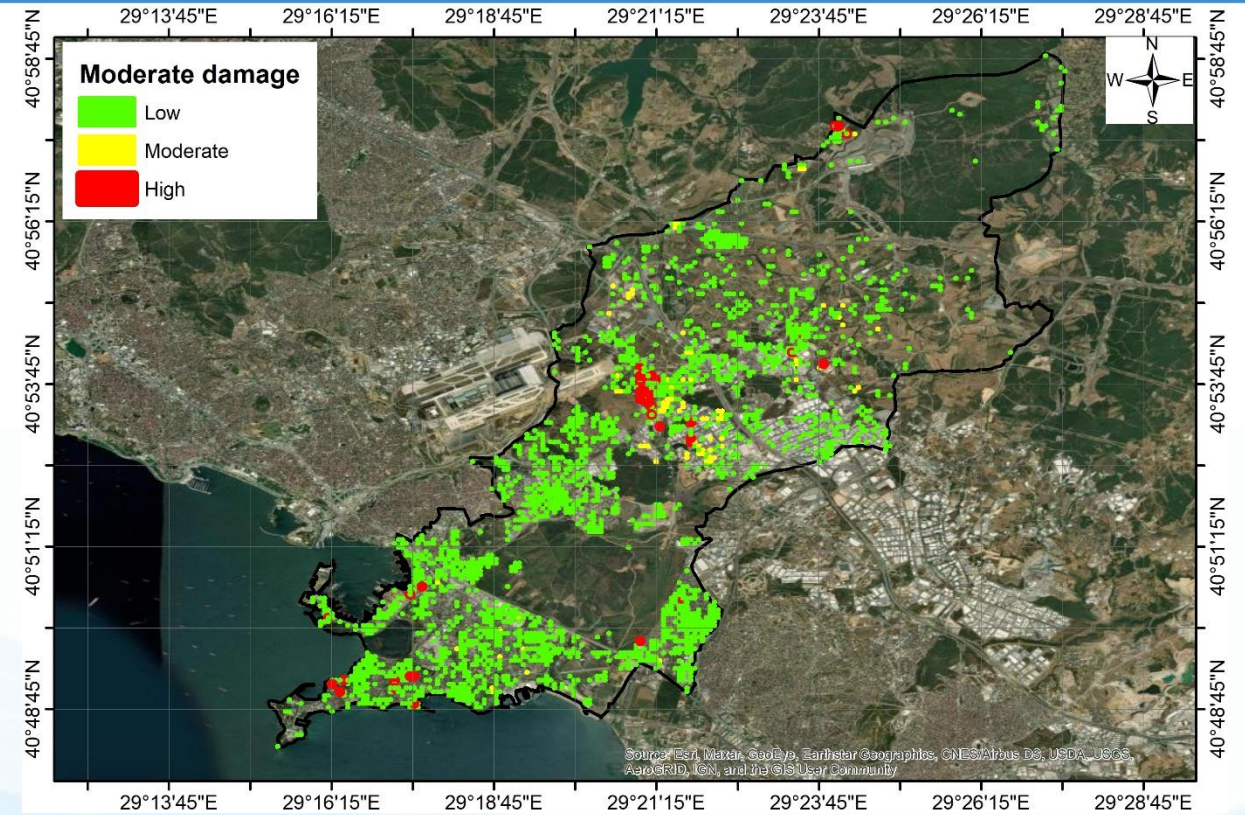
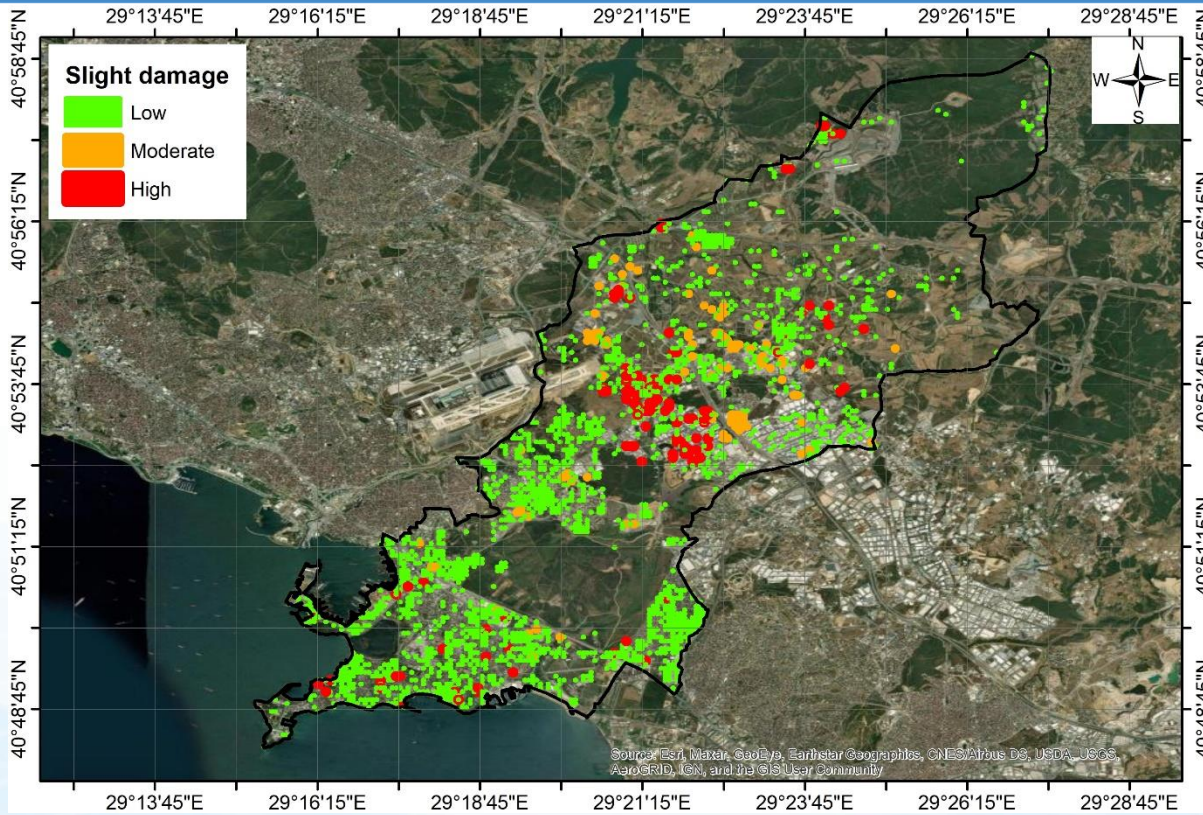
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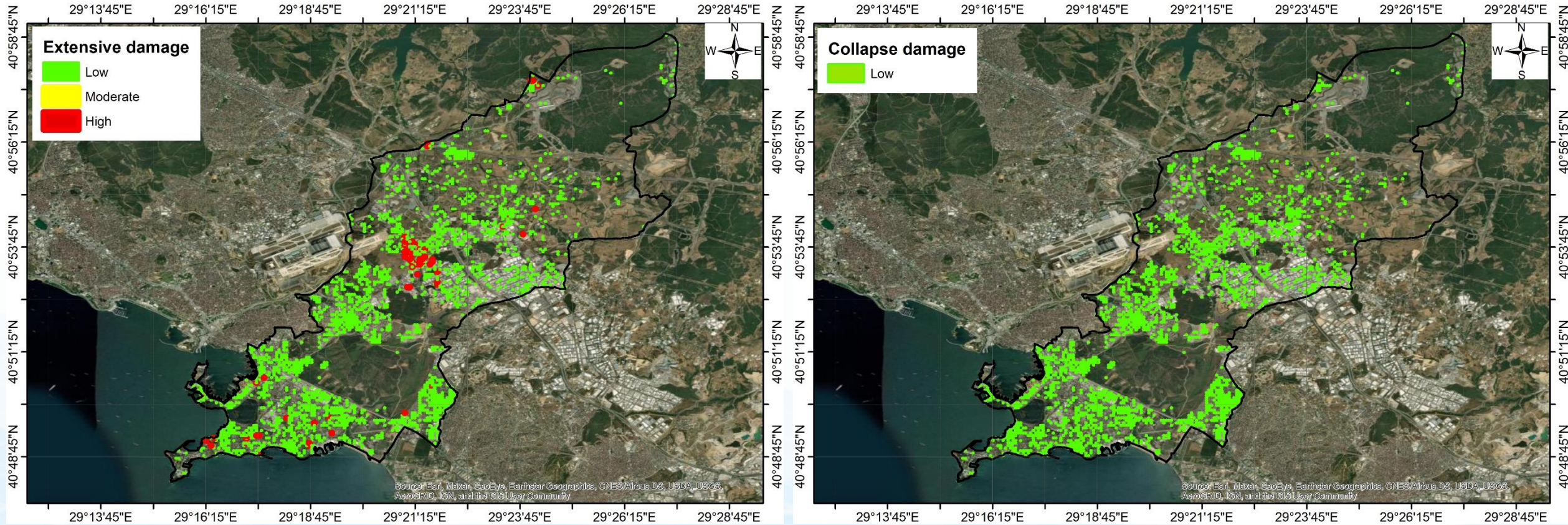
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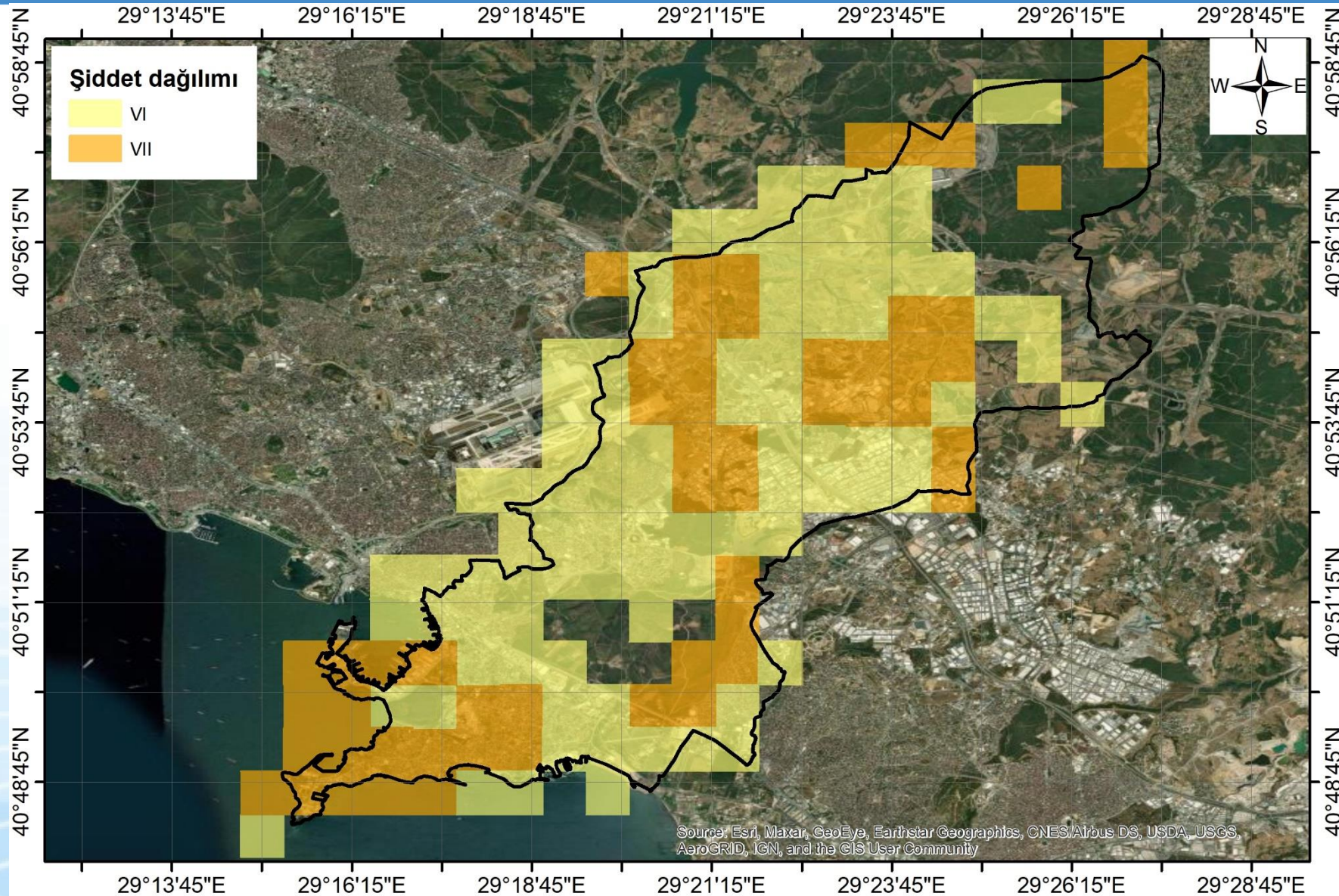
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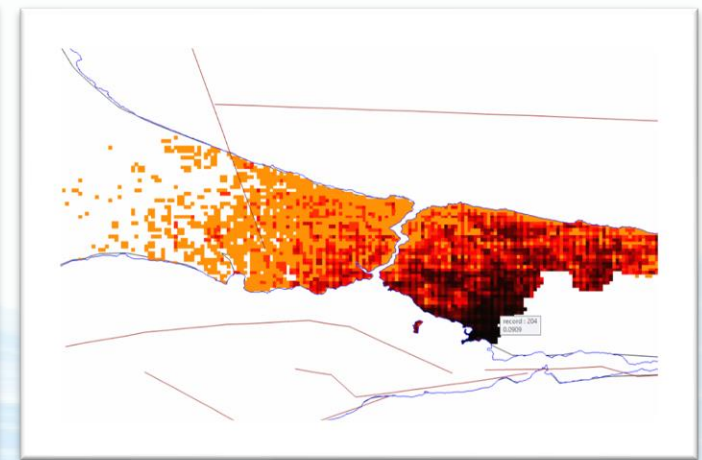
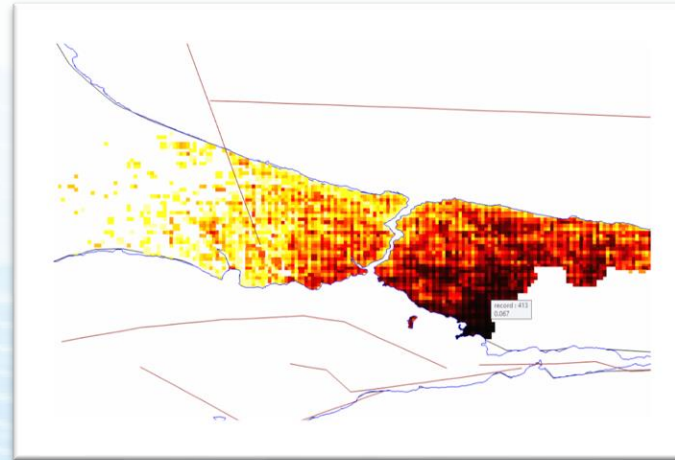
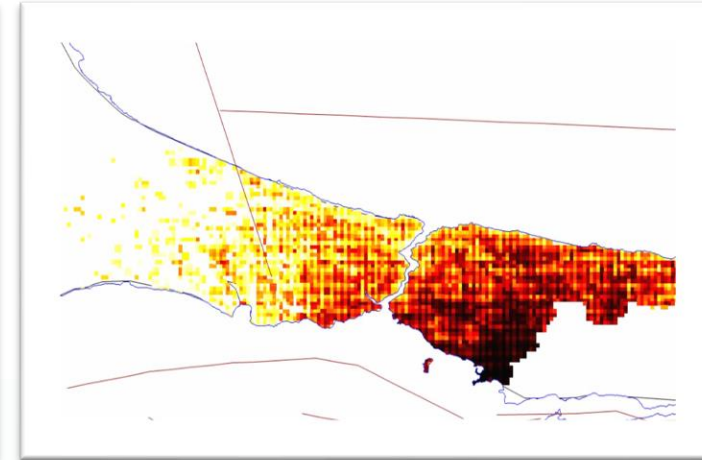
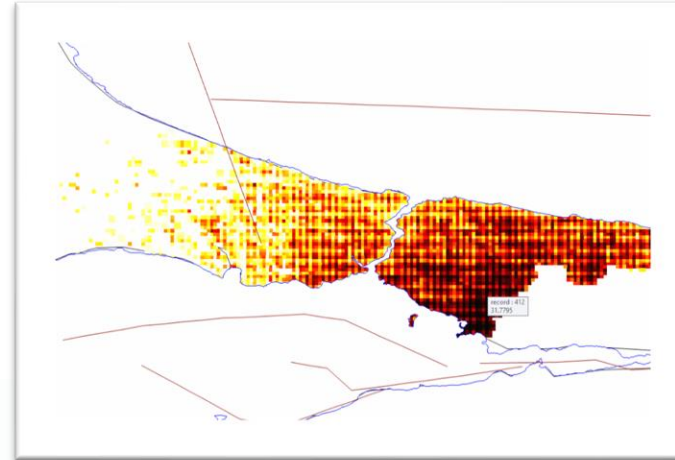
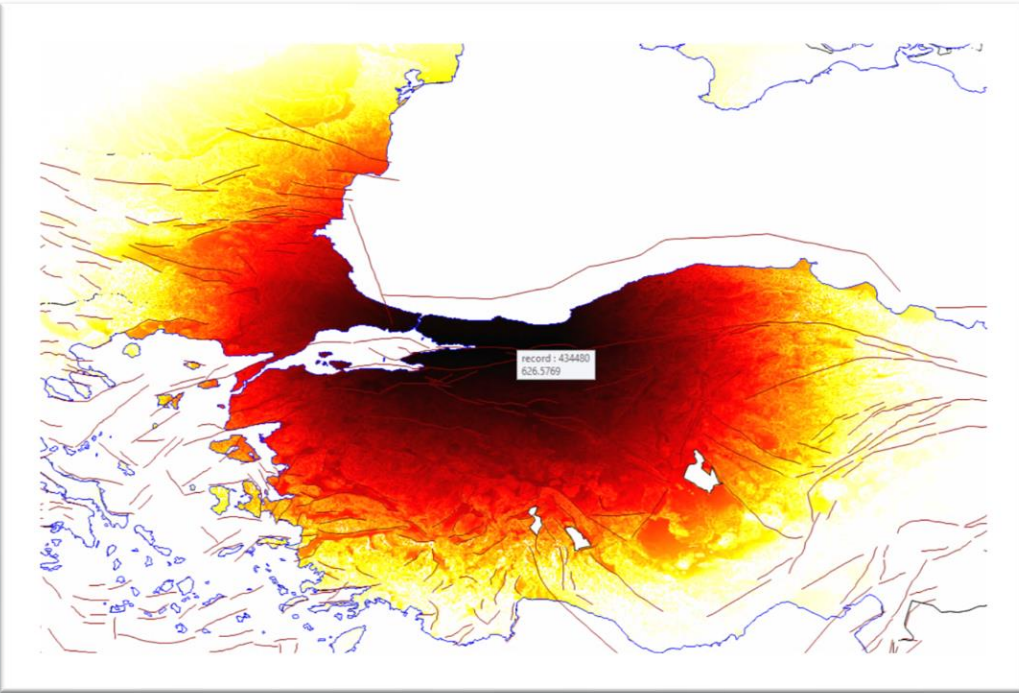
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6. Ongoing Research



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THANK YOU VERY MUCH FOR YOUR ATTENTION...

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