RİSK YÖNETİMİNDE BAŞARI FAKTÖRÜ "İŞ SÜREKLİLİĞİ YÖNETİMİ"
SUCCESS IN RISKMANAGEMENT: "BUSINESS CONTINUITY MANAGEMENT"

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İstanbul Teknik Üniversitesi,
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Süleyman Demirel Kültür Merkezi

Maslak – ISTANBUL
TÜRKİYE / TURKEY

Earthquake Risk to Industry and its Management

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SAN FRANCISCO--On April 18, 1906, San Francisco was rocked by an earthquake that destroyed large swathes of the city and claimed the lives of more than 3,000 inhabitants of the Bay Area. One resident, the author Jack London, wrote at the time: "San Francisco is gone. Nothing remains of it but memories...Its industrial section is wiped out. Its business section is wiped out. The factories and warehouses, the great stores and newspaper buildings...are all gone."

A century later, a bigger, bolder, rebuilt and more resilient San Francisco is more important than ever. Now it sits near the heart of the global IT industry and serves as a major world financial center. But it remains well aware of the terrible potential that exists along the San Andreas fault.

The vast skyscrapers downtown may now be built to withstand huge pressures, but what about the infrastructure and the systems that keep modern business ticking--and the people who must be able to access them? Business continuity and disaster recovery are serious issues for all organizations in the Bay Area.

From CNET News

Barry Cardoza, head of business continuity contingency planning and disaster recovery at Union Bank of California, which is based in downtown San Francisco: "You have disasters that you can see coming, and you've got disasters that you can't see coming," Cardoza said, "and an earthquake is an example of (the latter). And you don't know how bad it's going to be until it hits.“

As such, the bank must have processes in place ahead of such an event to mitigate the threat. Simply reacting is not a strategy. The contingency department must also understand every aspect of the business and weigh downtime for each in terms of financial and reputational damage.

"If they can't react when the markets are impacted," Cardoza said, "then that could put you out of business. They might normally be turning over millions, but the losses could be in the billions.“

From CNET News

- Earthquakes effect industries and businesses, cause structural, non-structural and equipment damage, lead to indirect economic losses

- Lead to hazardous material release. Enhanced risk due to increase in population density and industrial development in regions with high earthquake hazard.

Outline

- Damage to industry in the 1999 Kocaeli earthquake
- Industry in Istanbul
- Expected earthquake losses in Istanbul
- Management of industrial earthquke risk

Important cases from past earthquakes

- Kocaeli (1999) Major refinery fire
- Kobe (1995) Asbestos fibers, Deatths: Three (attributed to exacerbation of asthma by dust), Injuries: Exacerbation of asthma symptoms
- Northridge (1994) 9 petroleum pipeline ruptures, 752 natural gas line breaks, 60 emergency hazmat incidents including a 7570 l release of sulfuric acid during a train derailment
- Loma Prieta (1989) 300–400 natural gas line breaks; 300 hazmat releases involving miscellaneous toxicants the largest being a 5000–2000 pound release of ammonia from a food processing plant
- Whittier Narrows (1987) 1411 natural gas line breaks, 30 hazmat releases including release of 2/3 of the contents of a 1-ton chlorine cylinder
- Mexico City, (1985) Natural gas and sulfurous odors from leaking gasoline storage tanks
- Miyagi-ken-oki, (1987) 68 million l of heavy oil released, 9 million of which flowed into storm drains and into waterways

From Young et al (2004)

Impact of earthquake on industry

- Direct physical damage
- Indirect physical damage and losses (fire, hazardous material release, chemical spills)
- Economic losses (business interruption, loss of market, loss of demand etc.)

Assessment of these losses can be done at different levels ,

▼

Regional

Industrial sector

Industrial facility

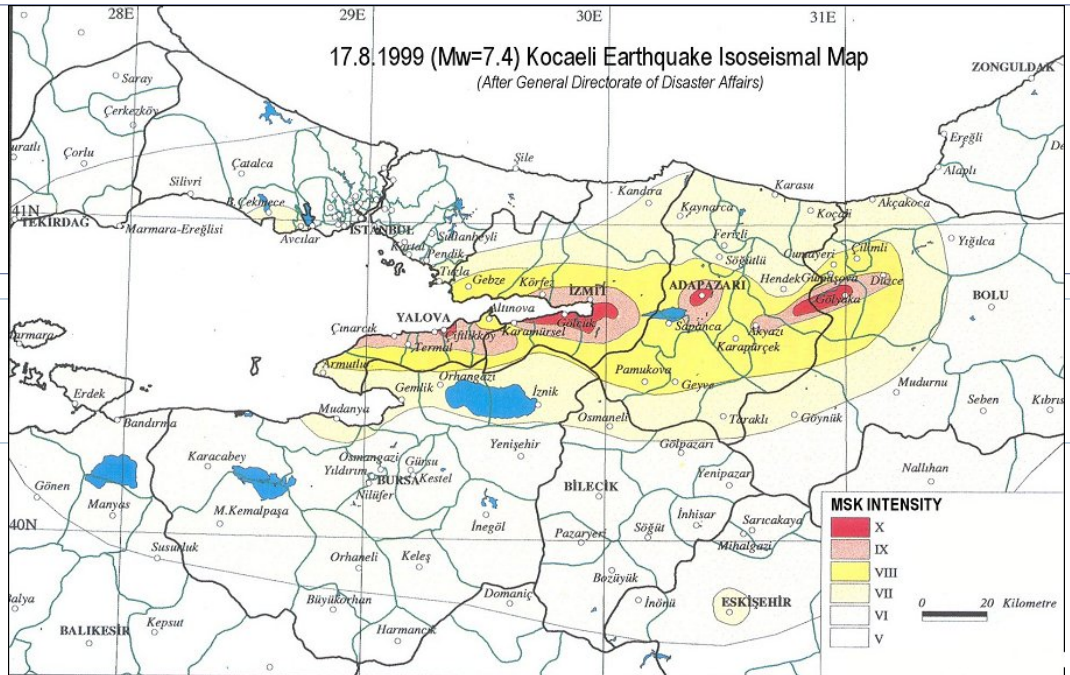
Primary factors for the assessment of direct physical damage and indirect losses

- Building Losses
- Machine and Equipment Damage
- Stock Damage
- Business Interruption, Loss of Market etc

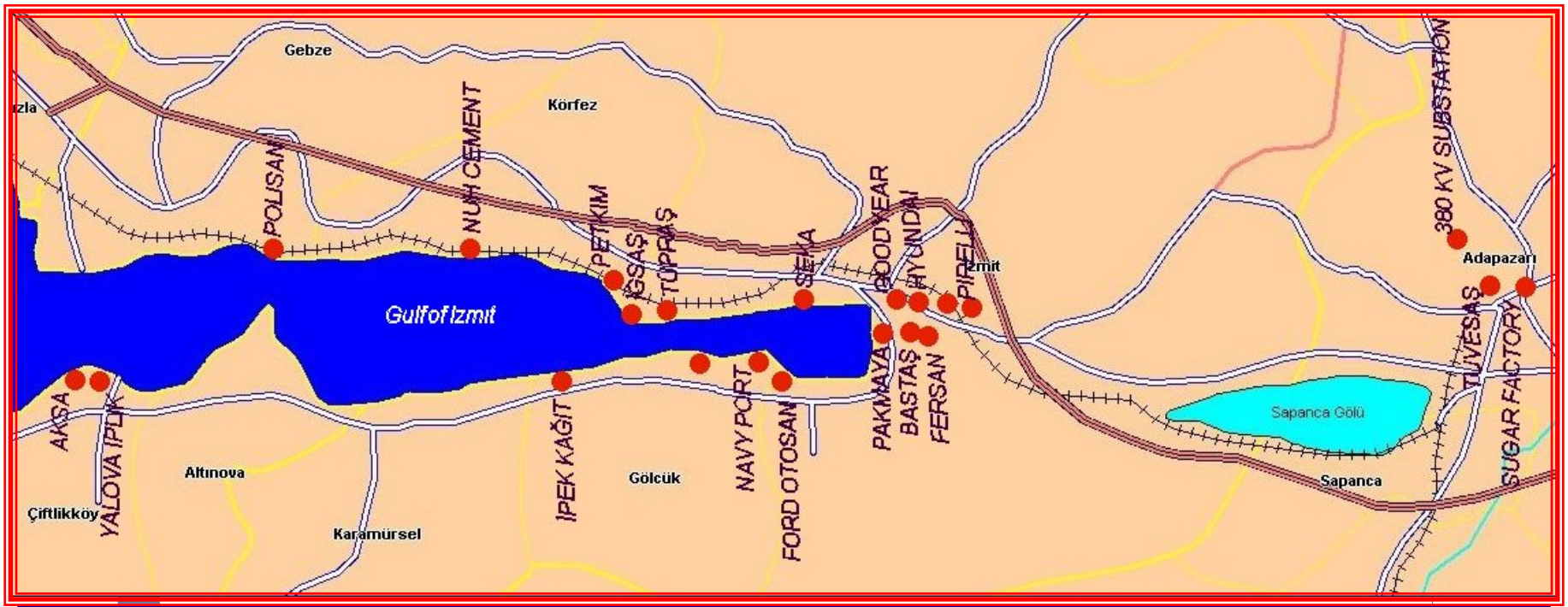
17 August 1999 Kocaeli earthquake
Ms 7.8, intensity X

General observations:

- Largest industrial damage since the 1906 San Fransisco ve 1923 Tokyo earthquakes
  - 70% of the total insured losses was direct damage, 30% of losses due to business interruption
  - Total insured loss 1,5-3,5 billion $
  - Losses paid by the insurance sector 550-750 million $



Important Industrial Facilities with Damage



- Heavy industry, petrochemical facilities, car factories, chemical, cement, textile, steel, energy, paper production.
- Observed damage larger than earthquakes with similar levels of ground motion
- Significant losses due to business interruption and loss of market

Surveys of the Kocaeli ve Adapazarı Chambers of Industry and Commerce

Damage

30% of their members had damage

34% of small- and medium size and 26% of large scale facilities damaged

Earthquake Insurance

All large scale facilities insured

53% of the small- and medium size firms had no earthquake insurance

Capacity

Average capacity before the earthquake 70%

after one month after the earthquake 31%

after six months 54%

Business Interruption

Average business interruption 35 days

Damage to prefabricated factory buildings

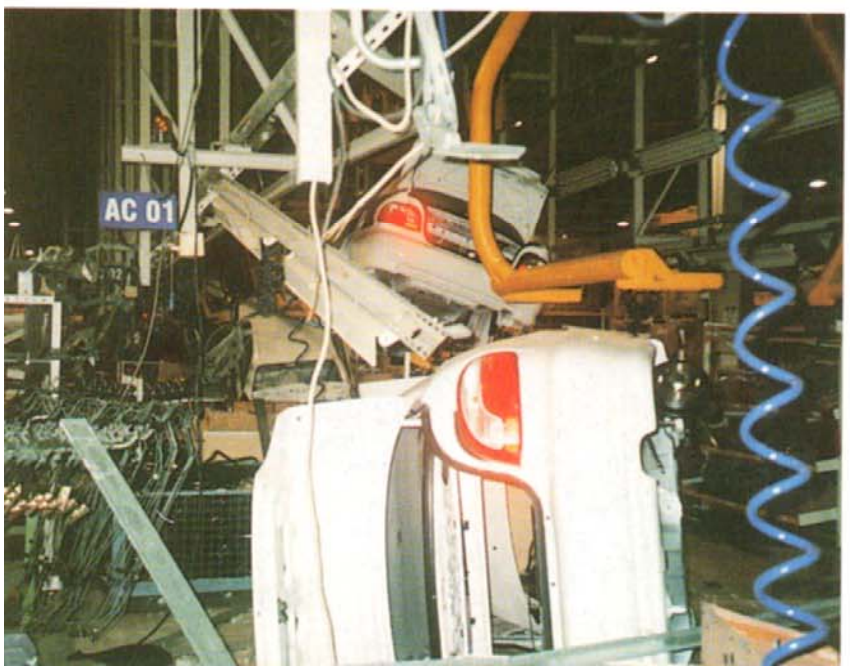
Adapazarı rail car factory, damaged steel frame

TÜPRAŞ

TÜPRAŞ, Damaged T

Adapazarı 380 kV Substation

Damaged electrical equipment

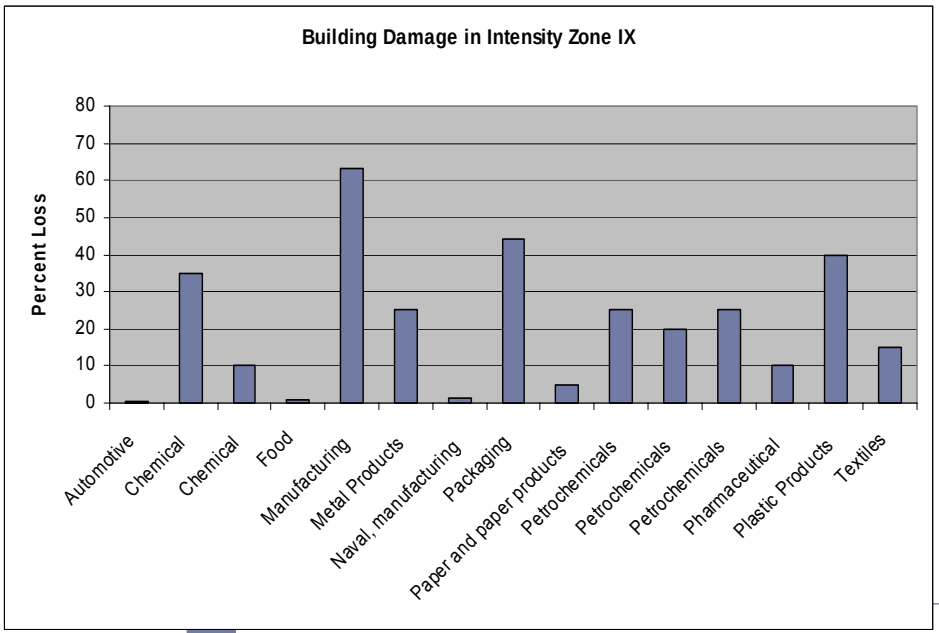


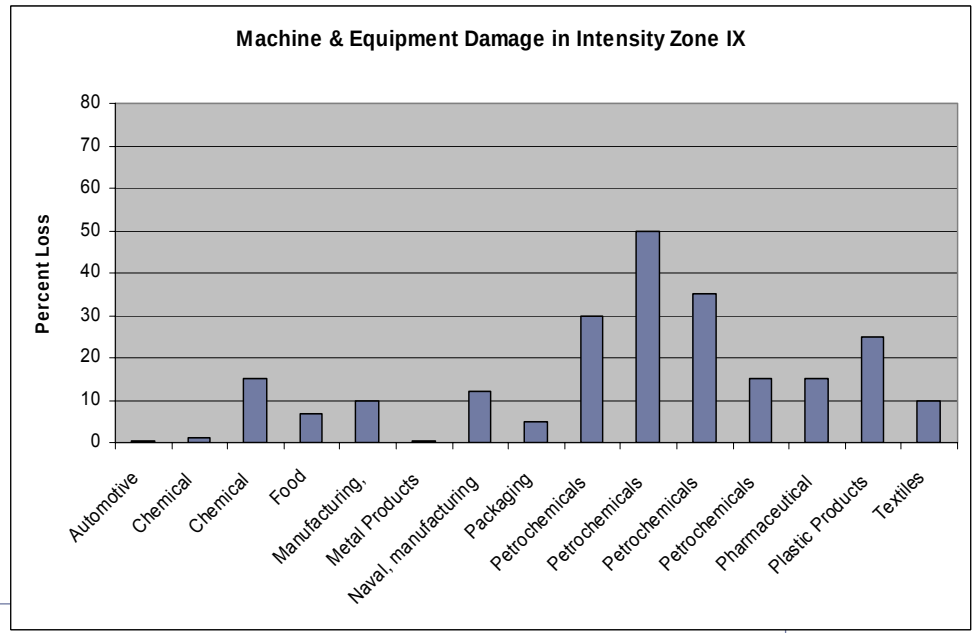
HYUNDAI CAR FACTORY

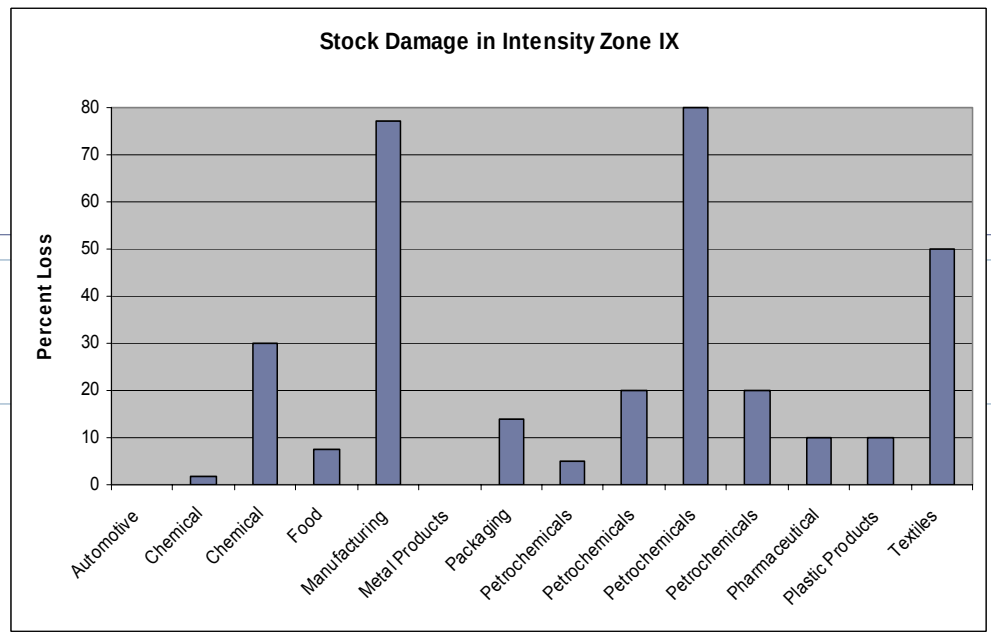
Stock damage

Industrial Losses in Intensity Zone IX

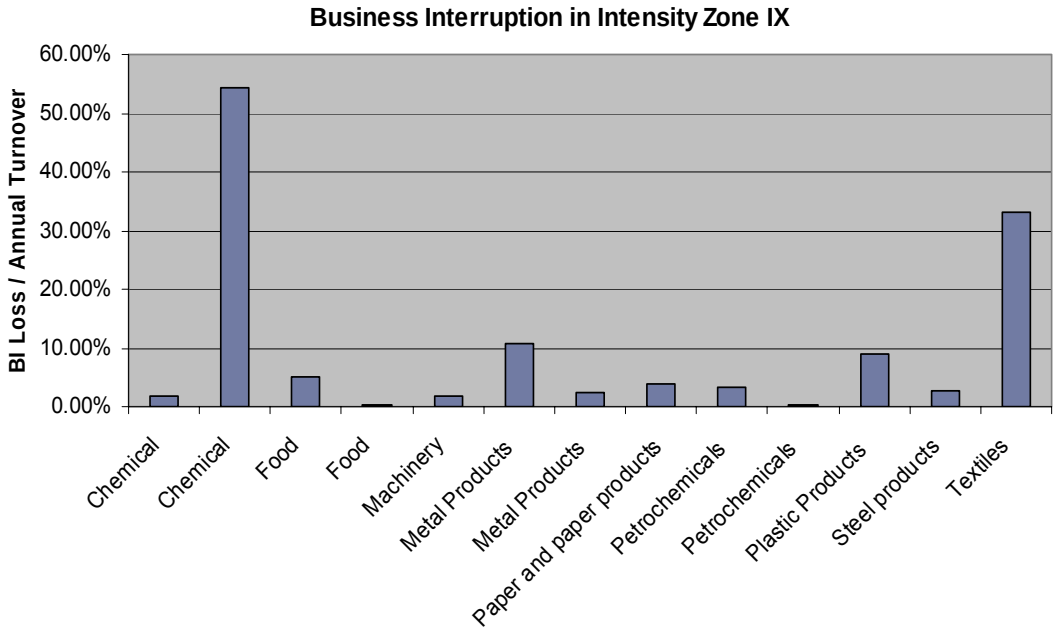
Building, Machine and Equipment, Stock

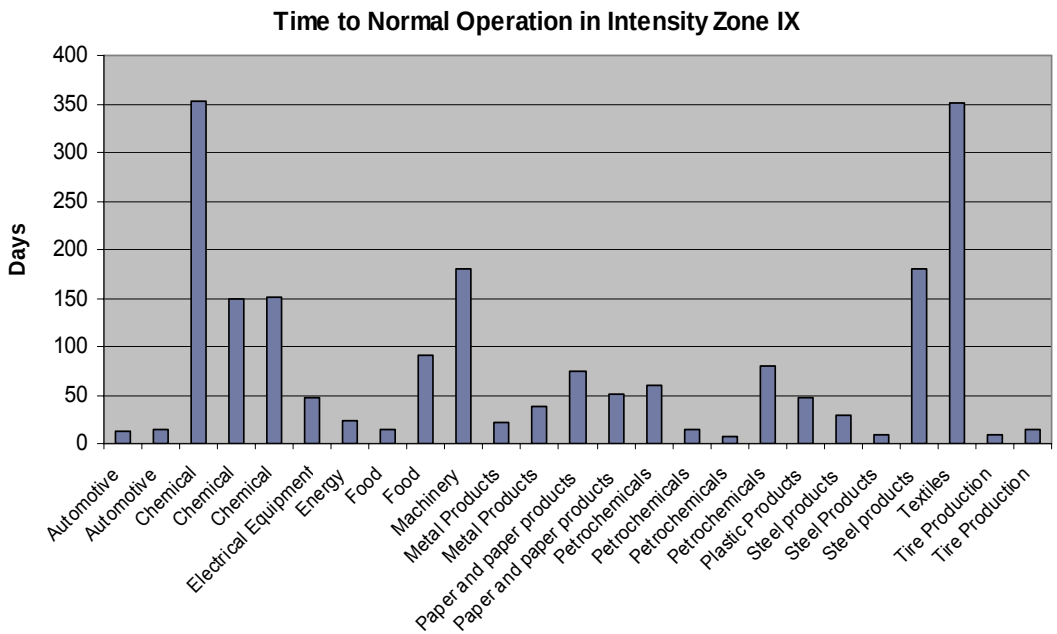






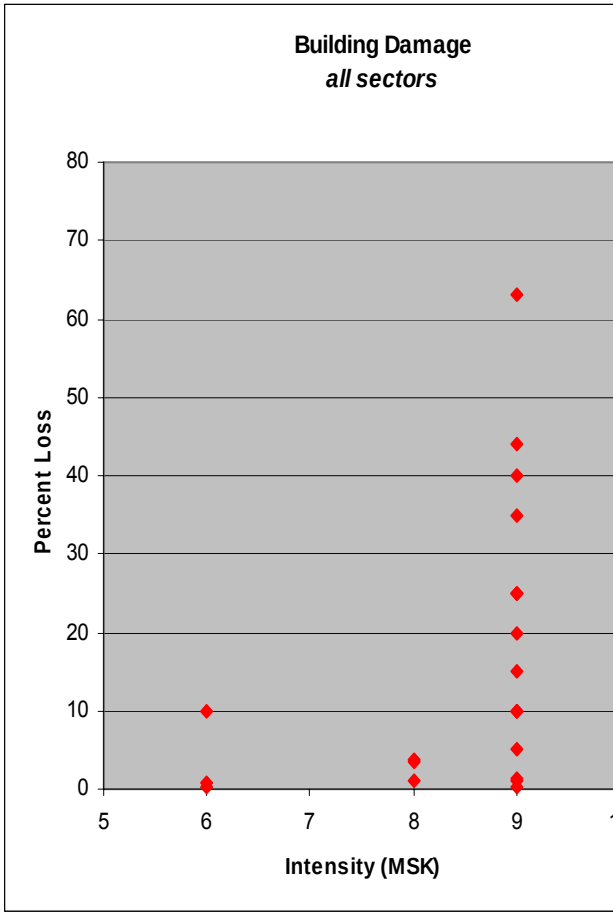
Intensity IX

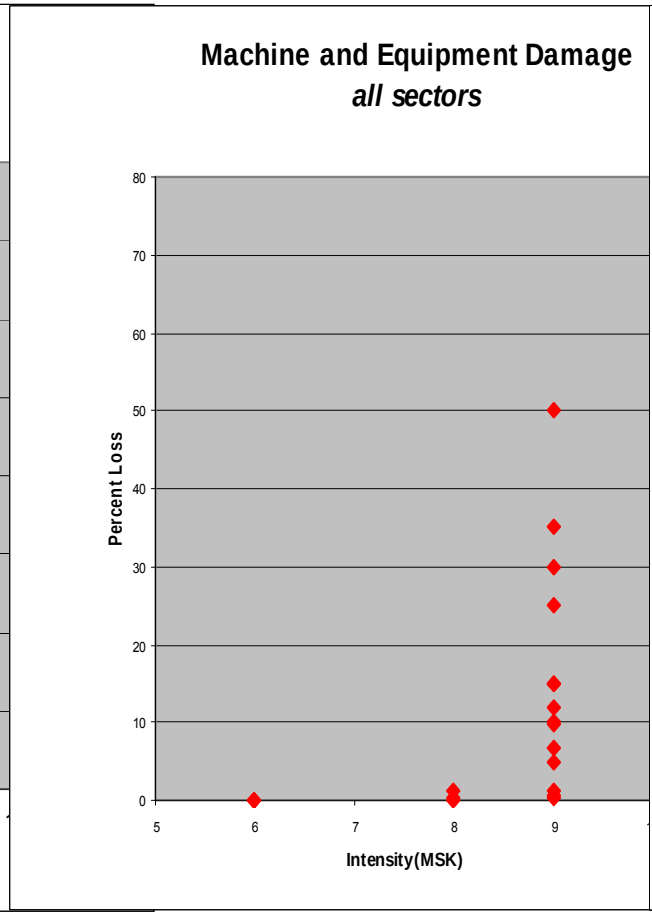


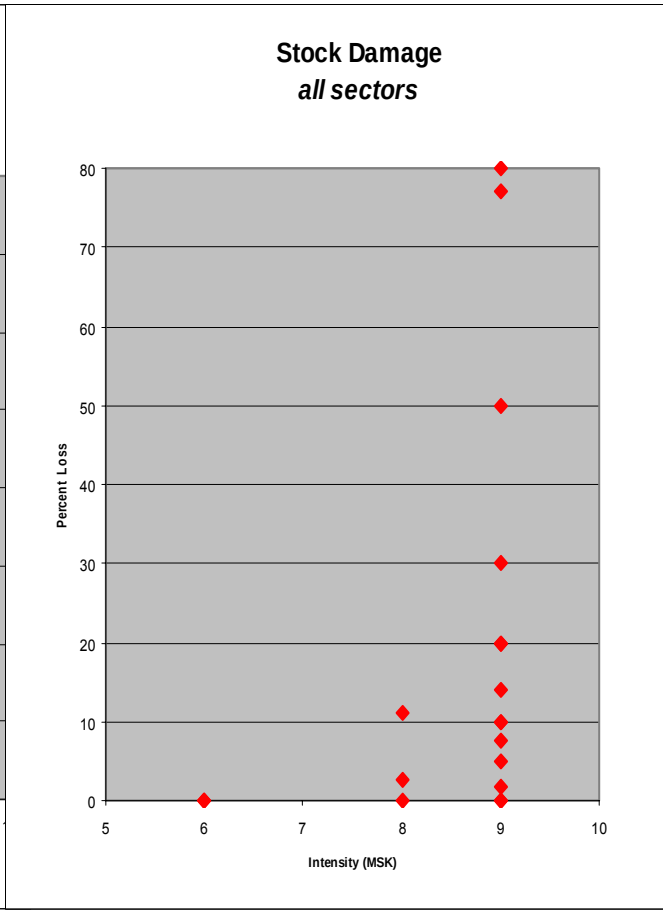


Quantification of Industrial Damage during the Kocaeli Eq.

Building, Machine & Equipment, Stock all industrial sectors



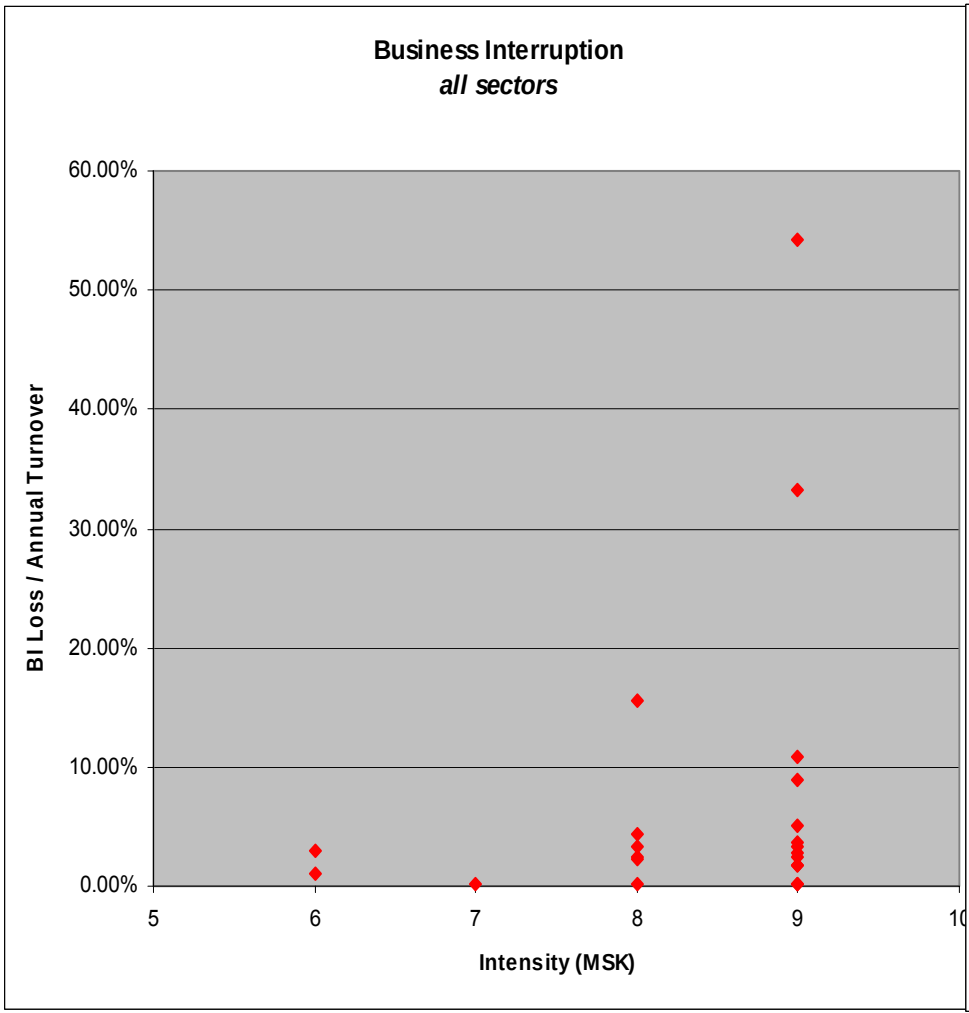


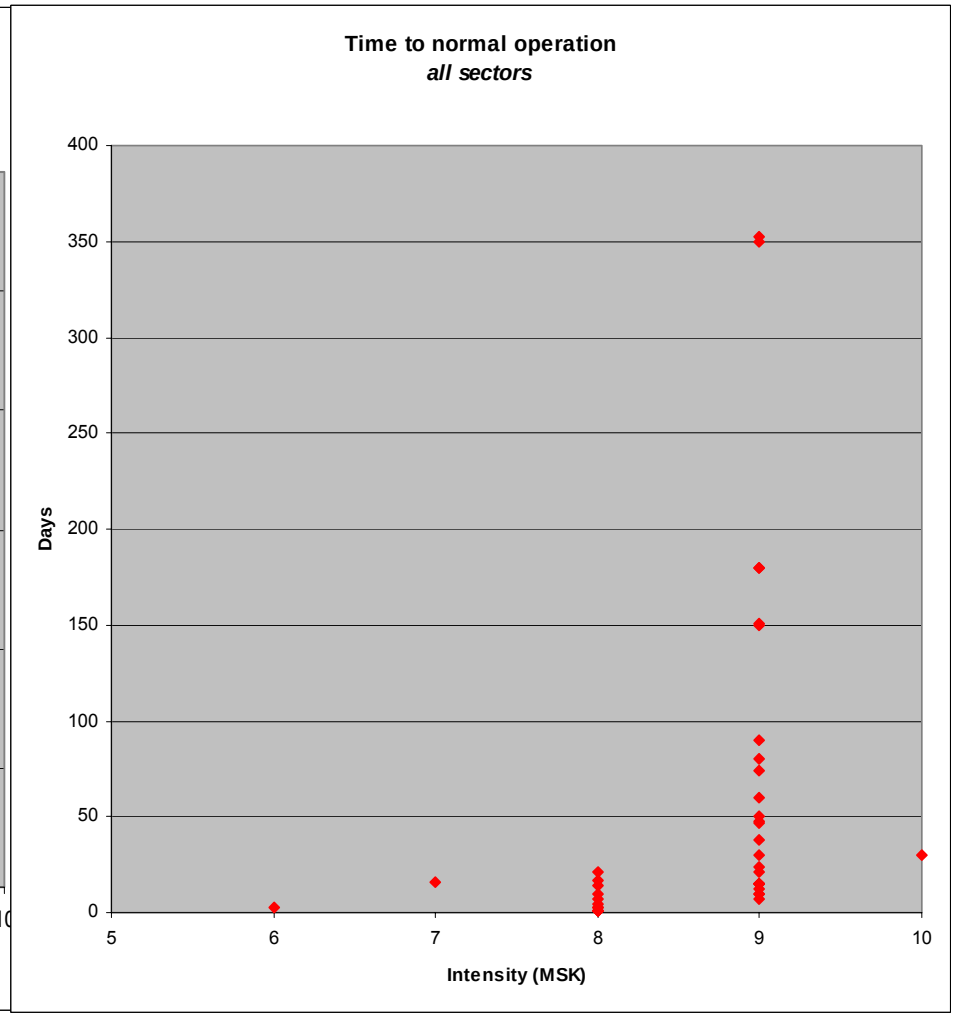


Quantification of Industrial Damage

Business Interruption and Time to Normal Operation

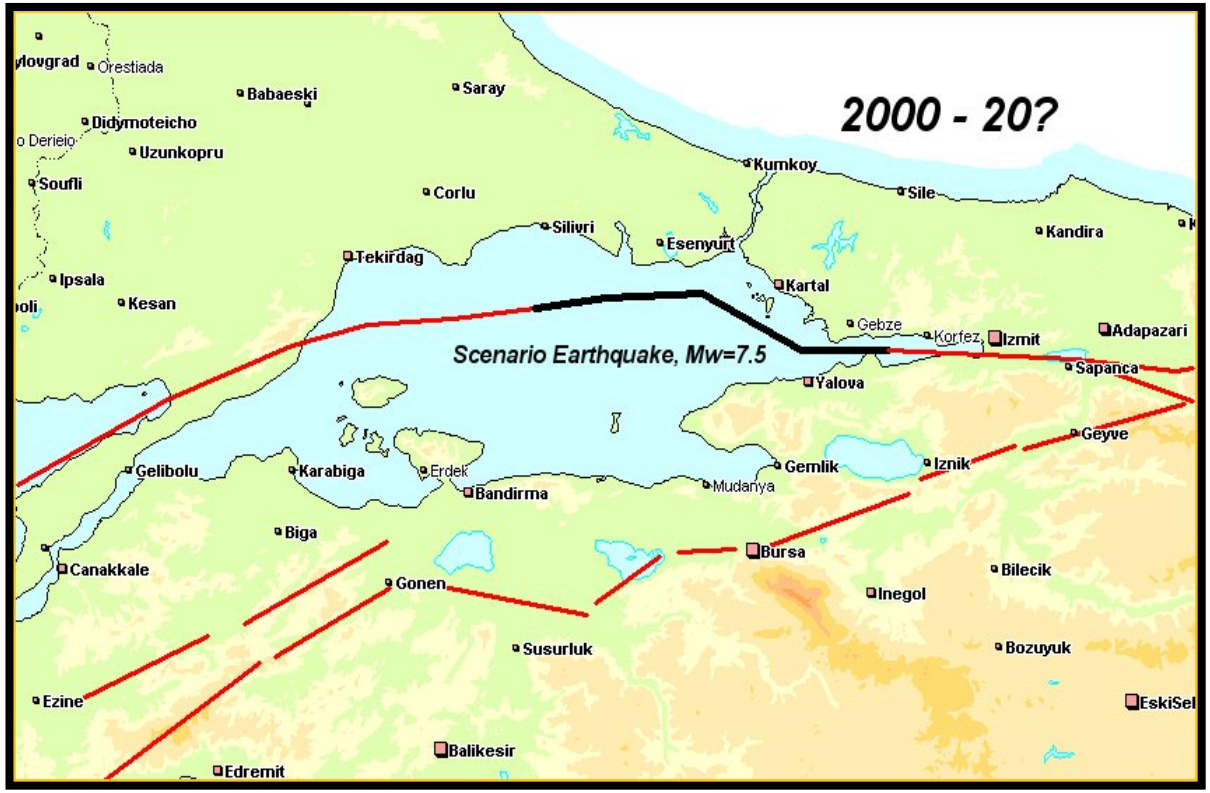
all sectors





Istanbul

40-60 % probability for
a M>7 earthquake
in 30 years
(Parsons, 2000, 2004)



Home to 40% of the industrial facilities in Turkey.
30% of the population working in industry lives in the city.

	Registered Firms	Number of People in Sector
Chemical and Petrochemical Products	30%	80.000
Textile	37%	300.000
Paper and Paper Products	38%	30.000
Electric and Gas: Production and Distribution	5%	

http://sanayi.tobb.org.tr

Estimated losses in the Istanbul scenario earthquake

(Mw=7.5)

- Heavily damaged - collapsed: 40,000 - 50,000 buildings (out of about 800.000 buildings in Istanbul), 4,000 – 5,000 of them total collapse
- 200,000 families in need of emergency shelter
- 40,000 deaths, 160,000 hospitalized injuries
- Loss due to building damage 8 - 10 billion $
- Industrial losses: 6 - 8 billion $
- 250,000 – 300,000 jobs lost
  (especially due to damage to the small-scale firms)
- **Total physical loss : 25 - 35 billion $**

Assessment of industrial risk in Istanbul

I. An inventory of industrial facilities is created for

- Medium and small size facilities
- Large scale industrial facilities
- Industrial parks

Data from: 1:1000 Turkish Telecom Analog Maps (3000)
Helicopter Flights (İBB)
Site visits
Satellite images
Istanbul Chamber of Indusrty

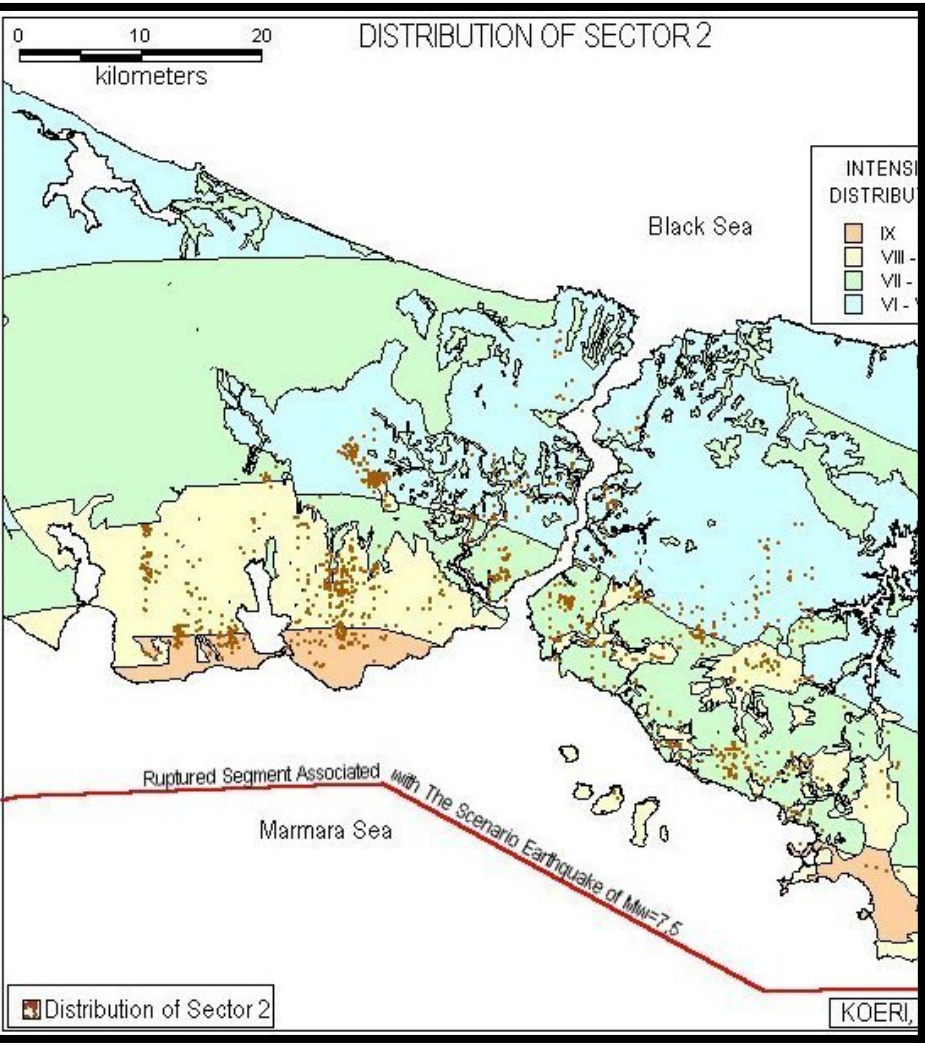
II. Grouped in sectors, shown on intensity maps

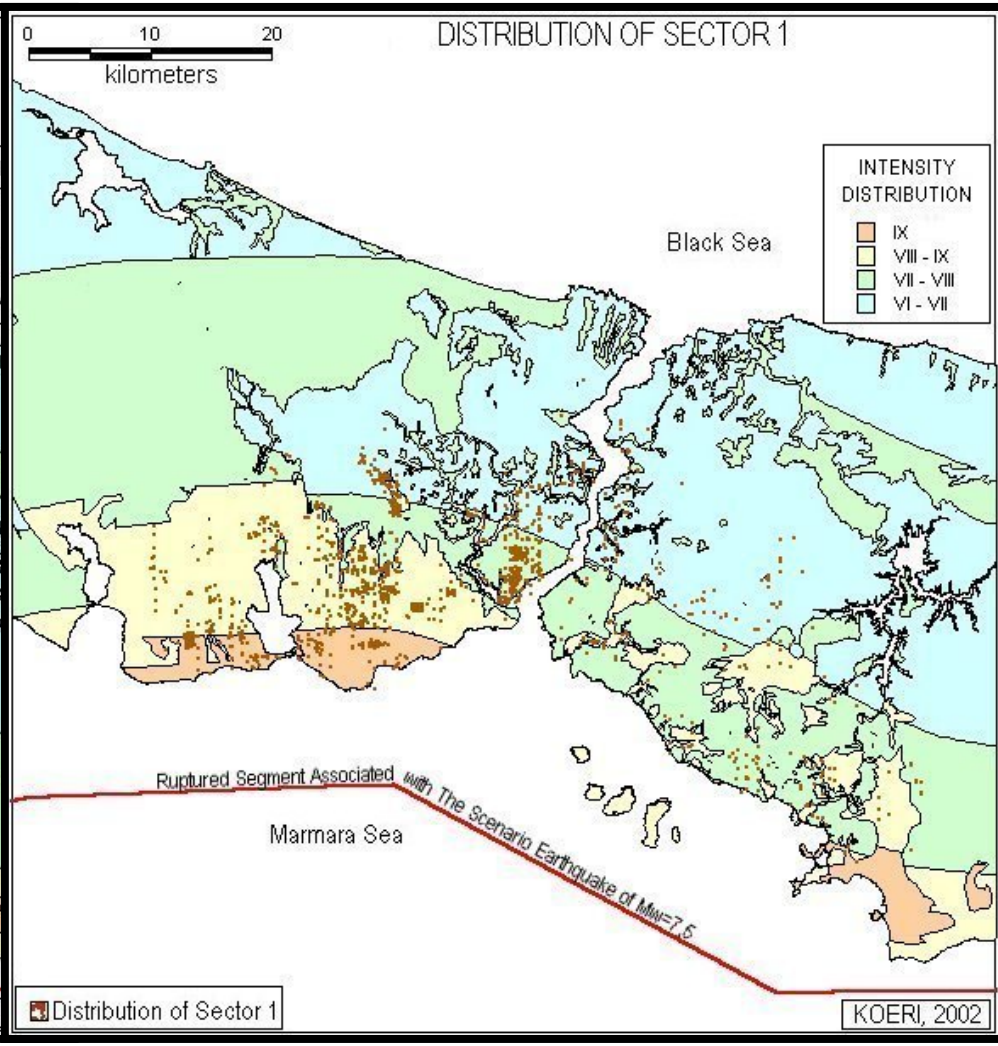
III. Assessment of vulnerabilities and losses

- Mining, Construction, Ceramics, Glass
- Commercial facilities, Food and Beverage
- Textile, Leather
- Wood products, furniture, agriculture
- Chemical and petrochemical products
- Iron, steel and other metals
- Machinery and automotive
- Transportation and telecommunication

Commercial facilities, Food and Beverage

Mining, Construction, Ceramics, Glass

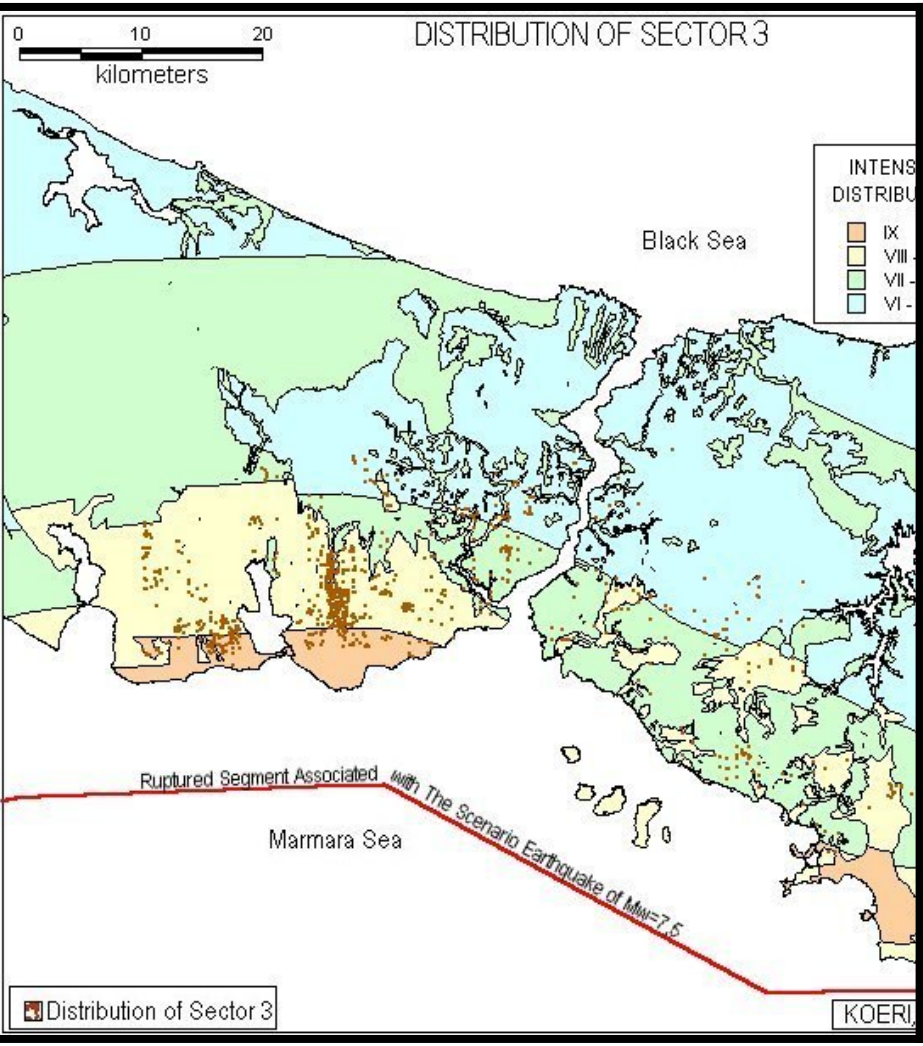


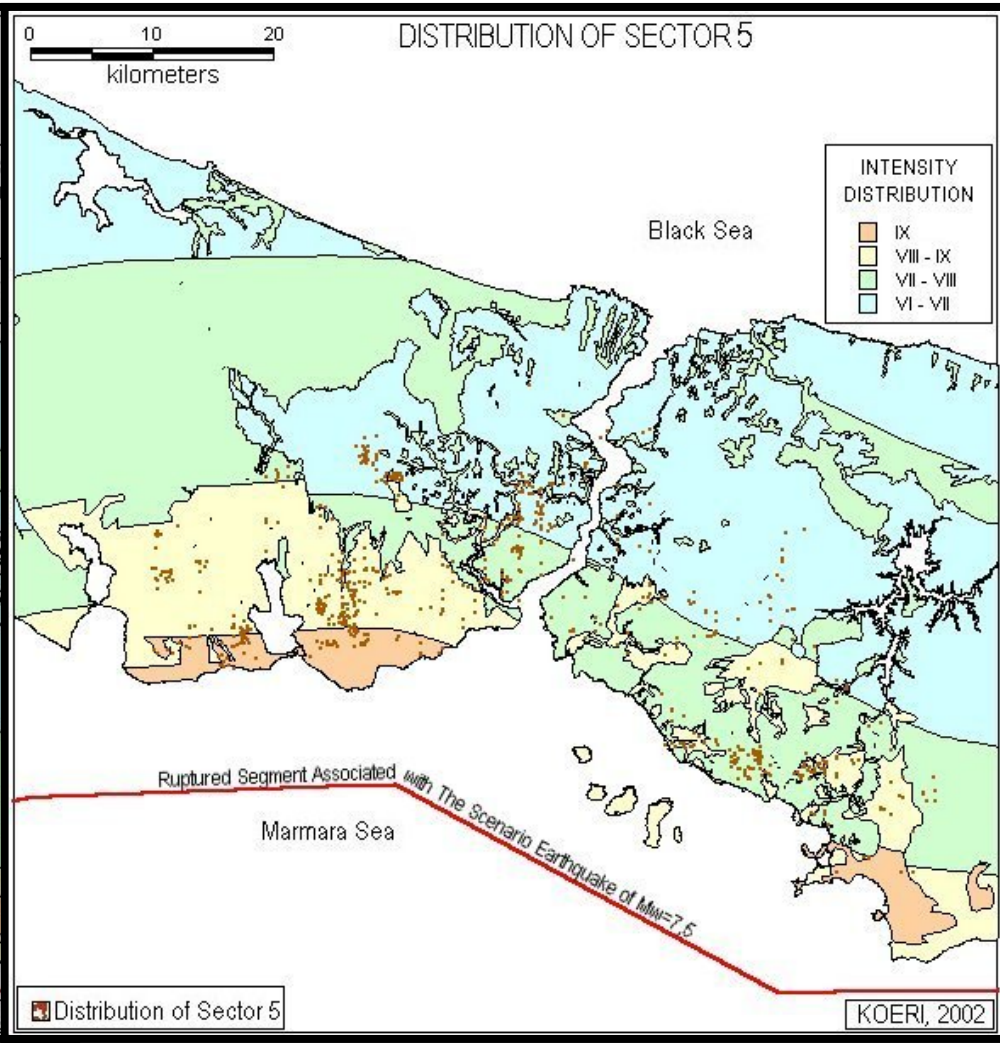


Site dependent earthquake intensities used as basemap

Textile, leather

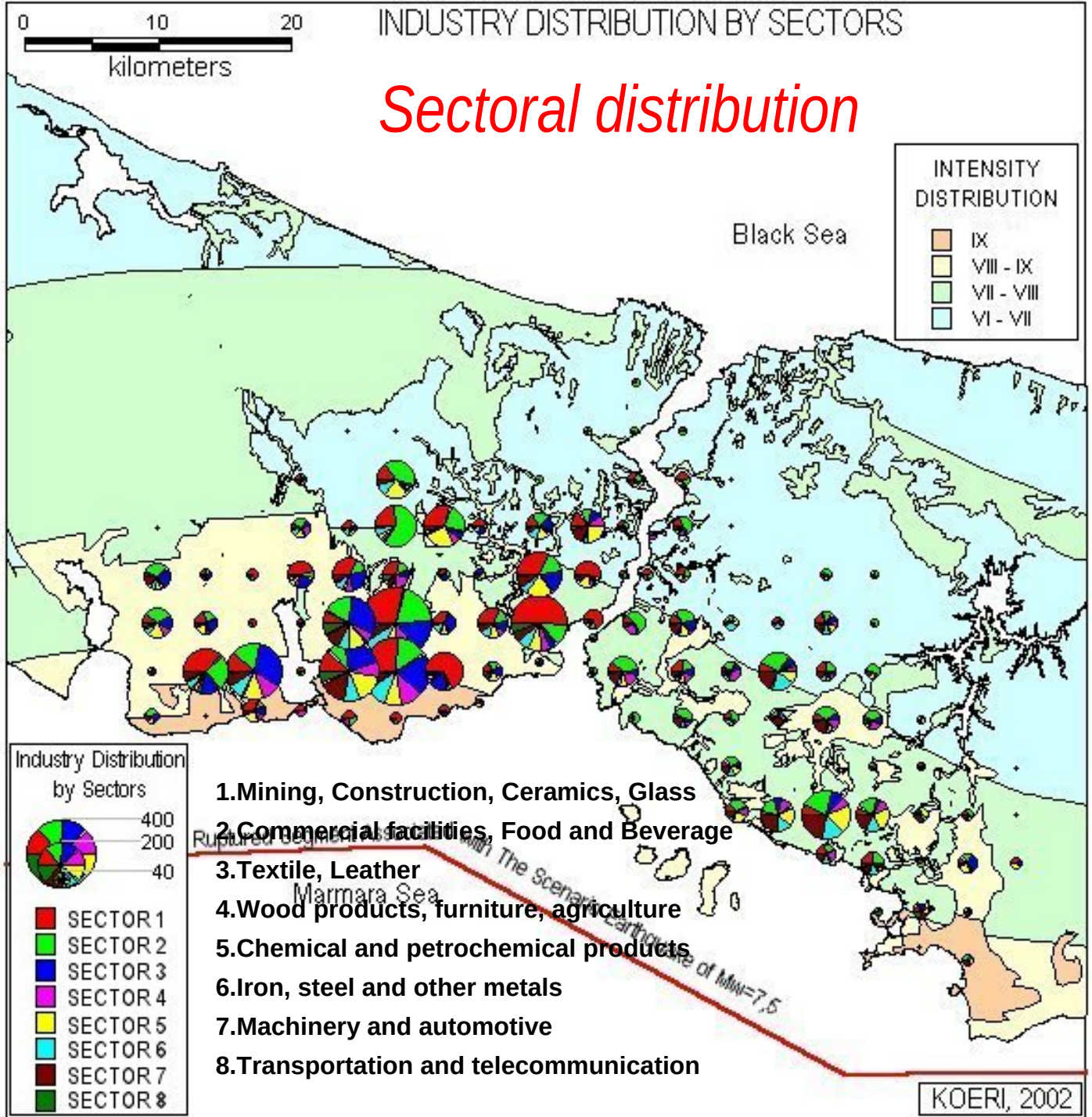
Chemical and petrochemical products





Site dependent earthquake intensities used as basemap

Sectoral distribution




Ikitelli
Industrial
Region


Leather industry in Tuzla

Shipyards in Tuzla


Ambarli industrial zone

Assessment of general industrial losses in Istanbul due to M7.5 earthquake

- The majority of the plants in the region are expected to be in the intensity zone VIII-IX.
- The overall loss to industrial buildings assessed between 6-8%.
- In intensity zone IX for all industrial sectors the business interruption losses may be about 5-10% of the annual turnover.

  In chemical, textile and automotive sector they can reach 50%, 30% and 20% respectively.
- Lost jobs about 250,000 - 300,000
- Biggest losses by small and medium size facilities.
- Direct industrial losses in the order 8-10 billion $.
- Additional losses due to loss of market, loss of human resources, reduced demand etc.

RAPID ESTIMATION OF EARTHQUAKE DAMAGE TO "NATECH" PRONE FACILITIES

Loss Assessment Methodology

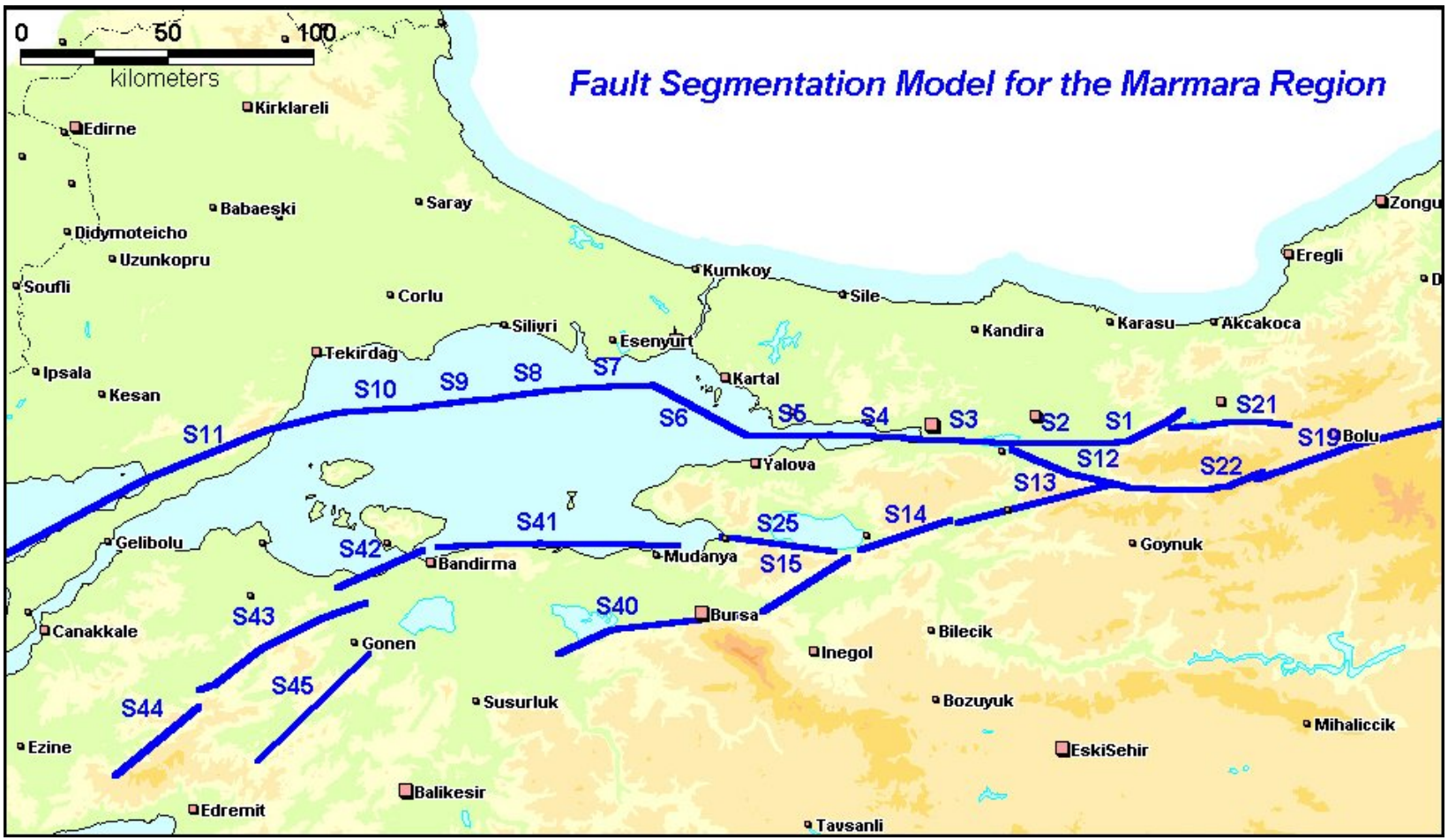
Given - earthquake source parameters (magnitude and epicentral coordinates)

- relevant inventory of industry and critical facilities,

Estimation of the spatial distribution of EMS'98 Intensity and selected ground motion parameters through region specific ground motion attenuation relationships and using shear wave velocity distributions. (Shake Mapping)

Estimation of the losses to industry (damage, casualty and economic) and critical facilities at different levels of sophistication that commensurate with the quality of the inventory and the vulnerability relationships (Loss Mapping)

As an exemplary application, the earthquake losses that would be experienced by the industry and critical facilities in Istanbul due to several earthquake scenarios are assessed based on the spatial distribution of the industry and critical facilities grouped under different sectors. The empirical earthquake vulnerability relationships obtained from 1999 Kocaeli Earthquake in Turkey amended with world-wide data are used for the assessment of damage and losses.


Fault Segmentation Model for the Marmara Region
0
50
100
kilometers
Kirklareli
Edirne
Babaeski
Saray
Didymoteicho
Uzunkopru
Soufli
Corlu
Kumkoy
Sile
Zongu
Eregli
Kandira
Karasu
Akcakoca
Siliyri
Esenyurt
Tekirdag
Ipsala
Kesan
Kartal
Yalova
Bolu
Gelibolu
Bandirma
Mudanya
Goynuk
Bursa
Canakkale
Gonen
Bilecik
Inegol
Susurluk
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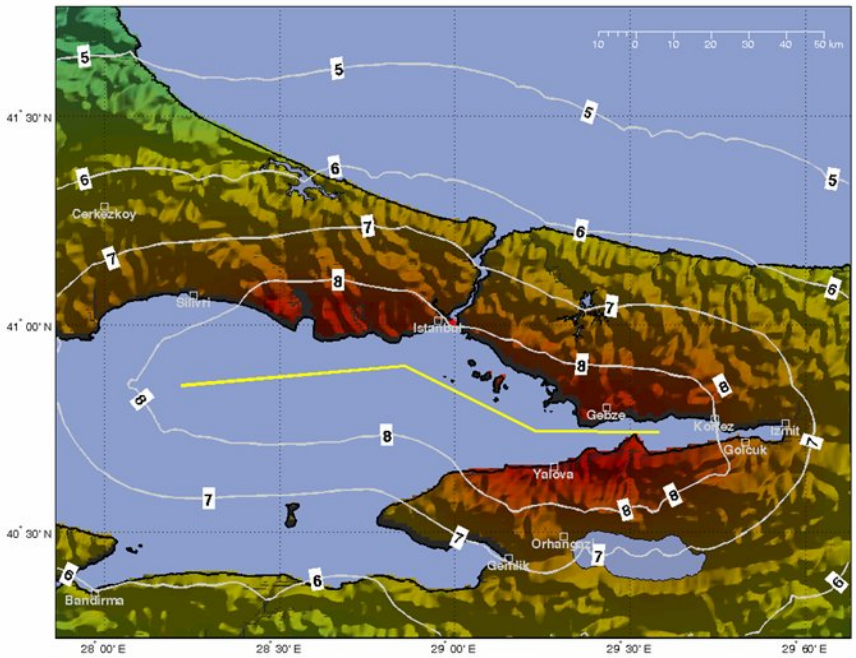
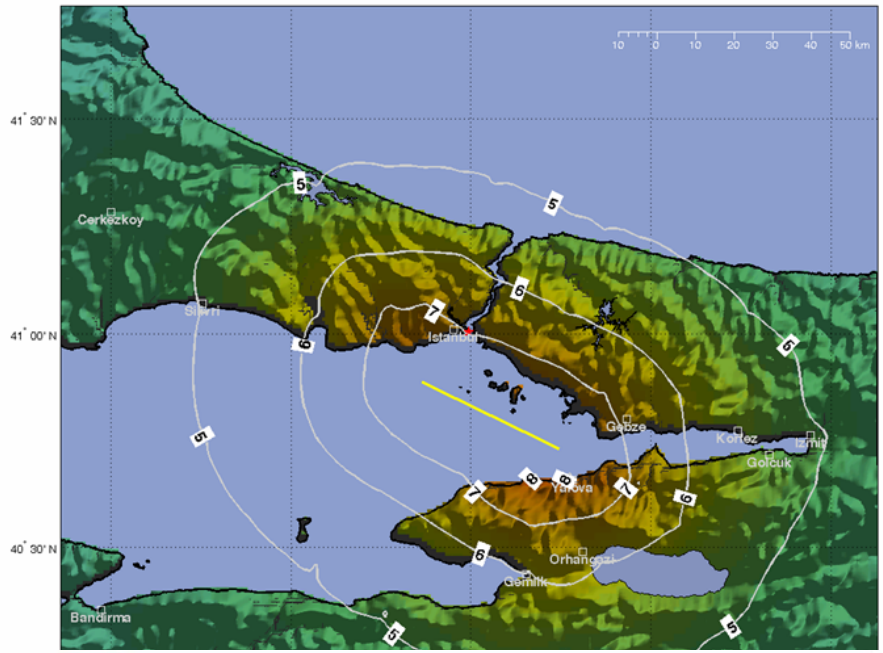
Scenario 1



Scenario 2



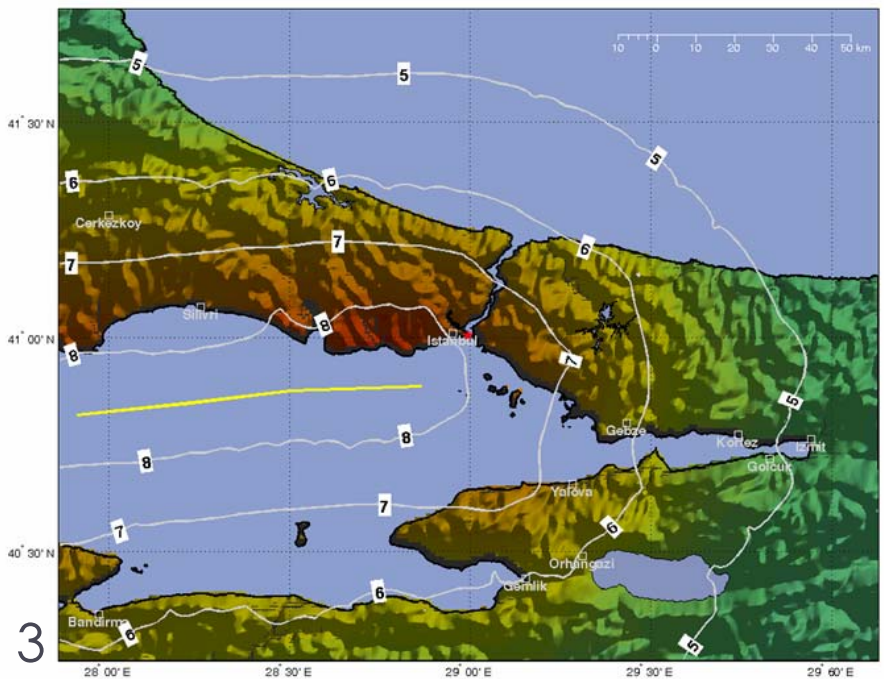
Distrubution of Earthquake Intensities

Scenario 1: Worst case, rupture of segments 5,6,7 and 8 - M7.5

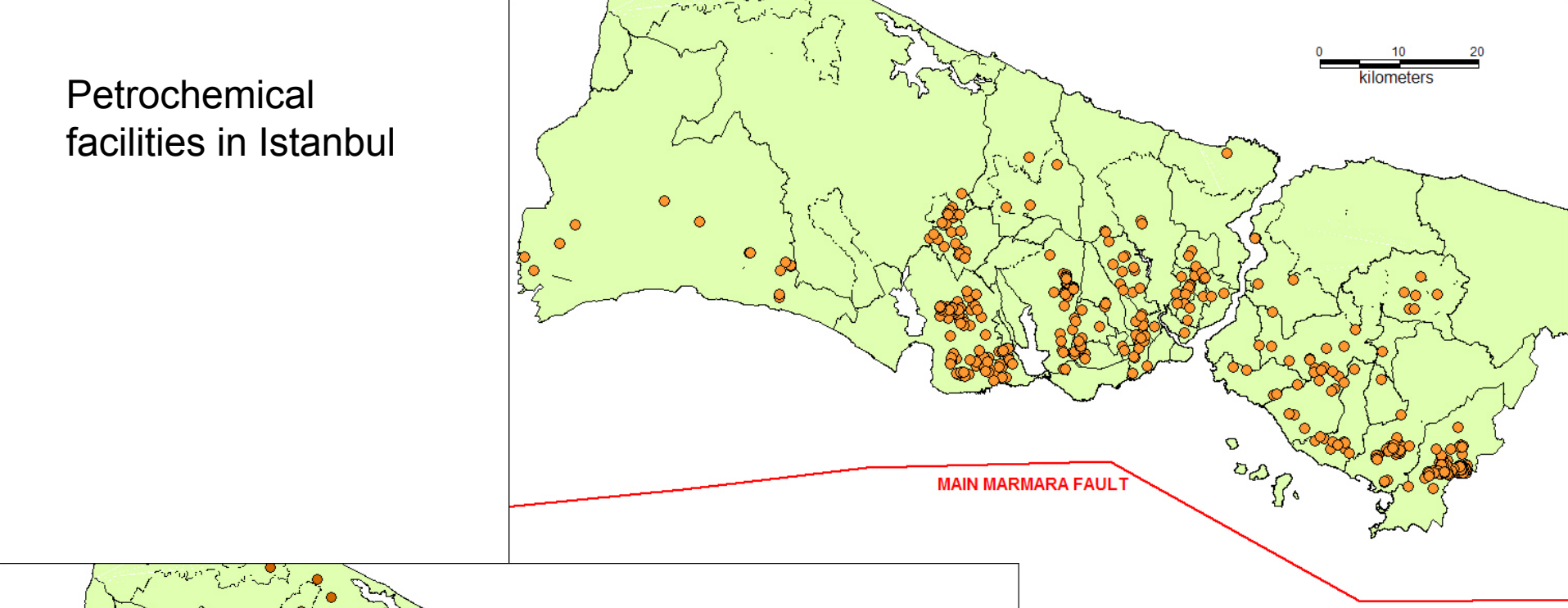
Scenario 2: Rupture of Segment 5 (the so-called Northern Boundary Fault) - M6.9

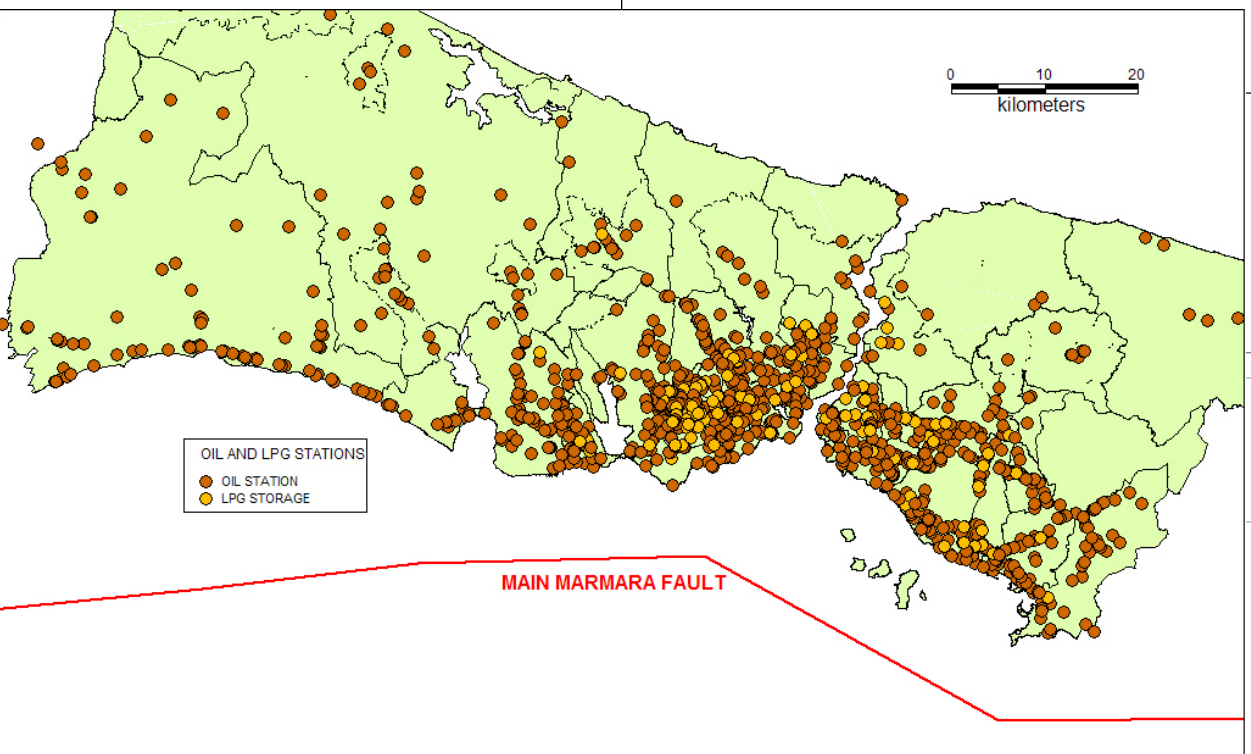
Scenario 3: Rupture of Segments 7,8,9 an 10 (the so-called Central Marmara Fault) M7.5

Scenario 3



Petrochemical facilities in Istanbul



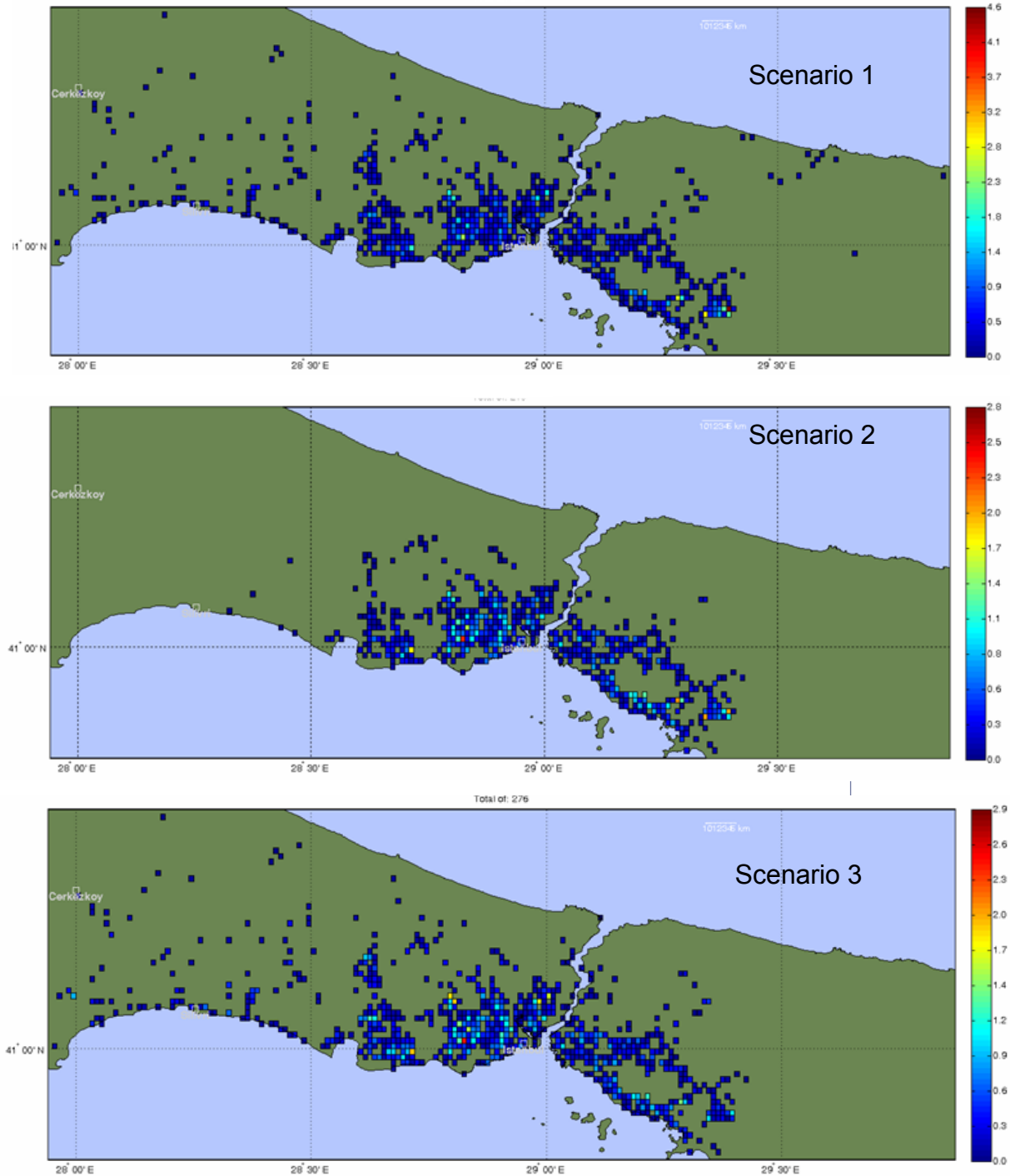


Oil stations and LPG storage units in Istanbul

Distribution of the total number of moderate to complete damaged buildings that contain inflammable material

in case of a M7+ earthquake occurring in the vicinity of Istanbul about 300 buildings distributed throughout Istanbu that contain inflammable or explosive material will be severely damaged. Assuming that fire could be started in at least 50% of these buildings, combined with natural gas transmission system breaks and also fires associated with domestic heating and cooking materials in use, it can be concluded that fire will be a major cause of

secondary hazard in Istanbul



- The Earthquake Loss Assessment Routine (ELER) is a software developed by KOERI, under the EU FP6 NERIES project.

- Estimation of the losses (damage, casualty and economic) at different levels of sophistication (0, 1 and 2) that commensurate with the availability of inventory of human built environment (Loss Mapping).

- The multi-level methodology of ELER software is capable of incorporating regional variability and sources of uncertainty stemming from ground motion predictions, fault finiteness, site modifications, inventory of physical and social elements subjected to earthquake hazard and the associated vulnerability relationships.

- The rapid industrial loss information is indented for dissemination in a timely manner to related agencies for the planning and coordination of the post-earthquake emergency response. The same methodology and software can also be used for scenario earthquake loss estimation and related Monte-Carlo type simulations for insurance pricing, i.e. PML and AAL estimation.

Issues Associated with Earthquake Risk of HIF

- Understanding of behaviour of industrial facilities during earthquakes

  component-level, structure-level, system-level

  co-earthquake, post-earthquake

- Earthquake resistant design of industrial facilities for structures and components,

  codes for design of structural, non-structural components and equipment

  quidelines for their installation and maintanence

- Awareness on the environmental effects of HIF incidents in earthquakes,

  Designers, owners and facility risk managers.

Issues Associated with Earthquake Risk of HIF

- Technological measures for monitoring and controlling the effects of ground shaking for structures, equipment, pipes

  accelerometric networks, active and passive control systems

- Pre-earthquake mitigations measures for reducing earthquake damage

  Early warning systems, shut-off of critical functions before the arrival of desctructing waves at the facility

- Earthquake contingency and business continuity Planning

  For the facility, its immediate vicinity, in regional and national scales: Risk assessment and reduction, Emergency management planning, Restructuring and rehabilitation planning

Issues Associated with Earthquake Risk of HIF

- Insurance

  Risk Based Insurance, Compulsory?

  Special Insurance Schemes for Heavy Industry and also for Small and Medium Size Facilities

  Not valid in many parts of the world

- Hybrid risk reduction models for industrial facilities

  (physical+financial tools)

National government:

- Raise awareness and involve all stake holders in developing a national policy to mitigate risks
- Involve assistance by international organizations in developing such a policy, if and when needed.
- Develop and control enforcement of measures and mechanisms associated with the earthquake safety of industrial facilities, with that of the buildings and other facilities at the periphery of a facility and for the environment. These will involve chemical spills, explosions, fire, use of automatic control and shut-off systems against the effects of earthquakes, earthquake resistant design codes for new and existing industrial facilities (structural, non-structural, non-building).
- Assess likely effects of an earthquake near Istanbul on the industry, on regional, national and international finance and insurance sector; develop and implement mitigation plans.
- Establish regulatory professional, financial and environmental liability insurance schemes for industrial facilities via public-private partnerships.

Local government (municipalities):

- Develop, enforce and control measures and mechanisms associated with the earthquake safety of industrial facilities, with that of the buildings and other facilities at the periphery of a facility and for the environment. These will involve chemical spills, explosions, fire, use of automatic control and shut-off systems against the effects of earthquakes, earthquake resistant design codes for new and existing industrial facilities (structural, non-structural, non-building).

- Mandate the financial liability and environmental liability insurance as a requirement for operation license.

Facility management:

- Establish sound risk management systems
- Assess structural, non-structural, process-based vulnerabilities and losses, as well as losses due to business interruption, loss of demand, loss of market associated with the facility and operations. Carry out necessary actions for the retrofit/strengthening of structural, non-structural, non-building elements.
- Develop and implement business continuity and contingency plans.
- Implement earthquake early-warning (if and when necessary) and rapid response systems for automatic control and shut-off of critical systems in the facility.
- Negotiate with the insurer for a risk-based premium scheme.
- Contribute to sector/industry level projects for the reduction industrial risks
- Establish contingency plans and cooperate with local governments for their implementation.

Insurance sector:

- Develop and campaign for a risk-based premium scheme for large-scale industrial facilities.
- Develop premium reduction schemes for industries that have installed automatic control and shut-off systems for earthquakes and consequential effects.
- Develop and campaign for a compulsory earthquake insurance scheme for small and medium size facilities.

Stake-holders (financial institutions, industrial institutions, commercial institutions):

- Raise awareness among members and related bodies about earthquake risks and likely losses.
- Organize initiatives for developing action plans to address the identified risks, develop schemes for the realization of the plans.
- Assess likely effects of an earthquake near Istanbul on the regional and national industry, on national tourism, on regional, national and international finance and insurance sectors.

International institutions:

- Cooperate with their expertise in assessing likely effects of an earthquake near Istanbul on the industry, on regional, national and international economy, finance and markets.

- Assist national and local government bodies in developing alternative models for the reduction of the effects of a Istanbul earthquake on national and international economy and markets.