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# Meeting the Challenges of Earthquake Risk Dynamics and Globalisation

**by Jochen Zschau**
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# Meeting the Challenges of Earthquake Risk Dynamics and -Globalisation

## The Messages

**Earthquake risk is highly dynamic and currently exhibits significant global change!**

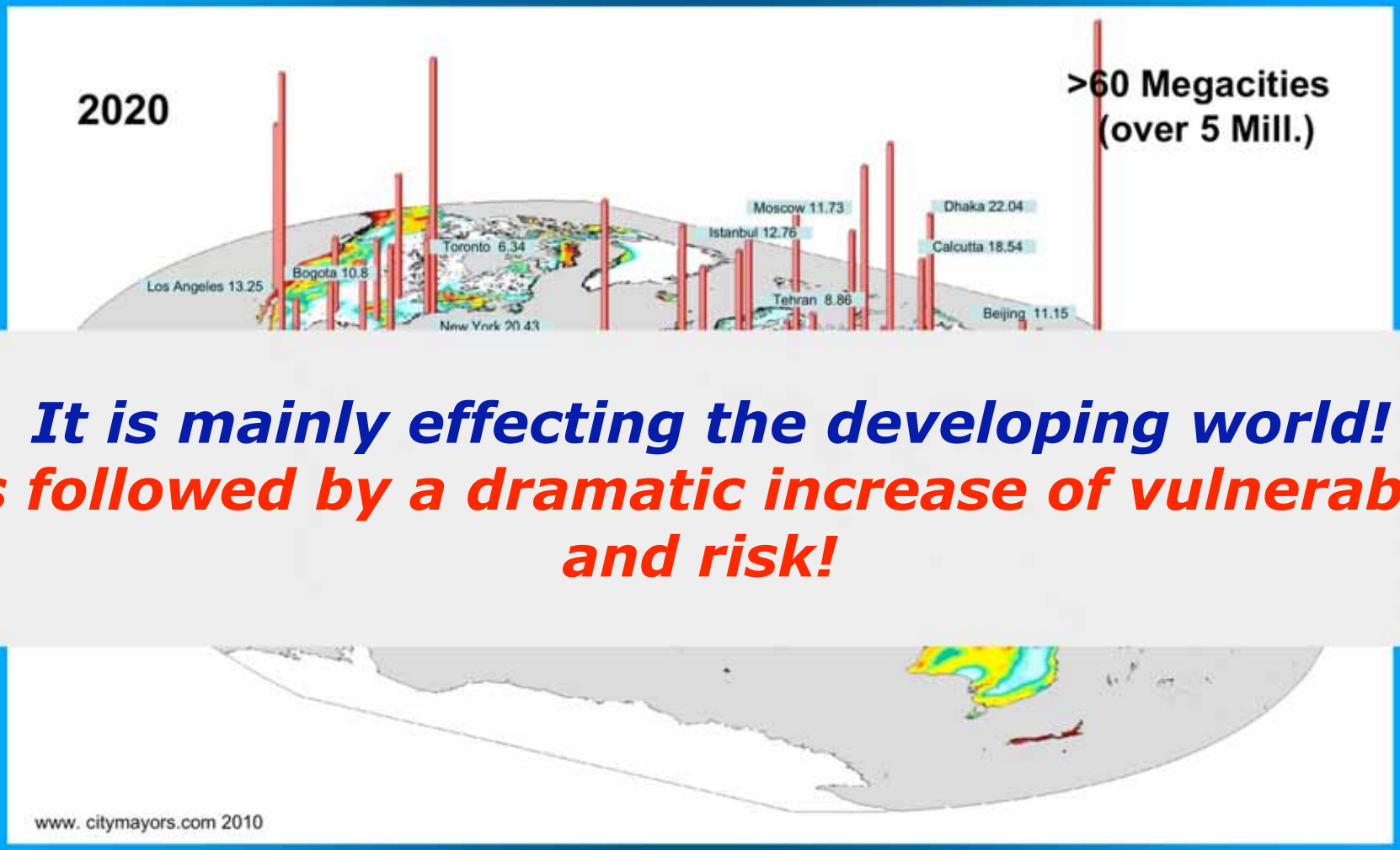
**Monitoring earthquake risk is a great scientific challenge!**

**An integrated natural risk monitoring programme on a global scale is overdue!**

*Jochen Zschau, GFZ Deutsches GeoForschungsZentrum, Potsdam*

# The Urban Explosion

## *An Important Driver of Risk Dynamics and -Globalisation*




***It is mainly effecting the developing world!***

***It is followed by a dramatic increase of vulnerability and risk!***

# In the Industrialized World:

***Growing Networking of Infrastructure and Economy!***

***The seismic risk globalises and increases exponentially!***

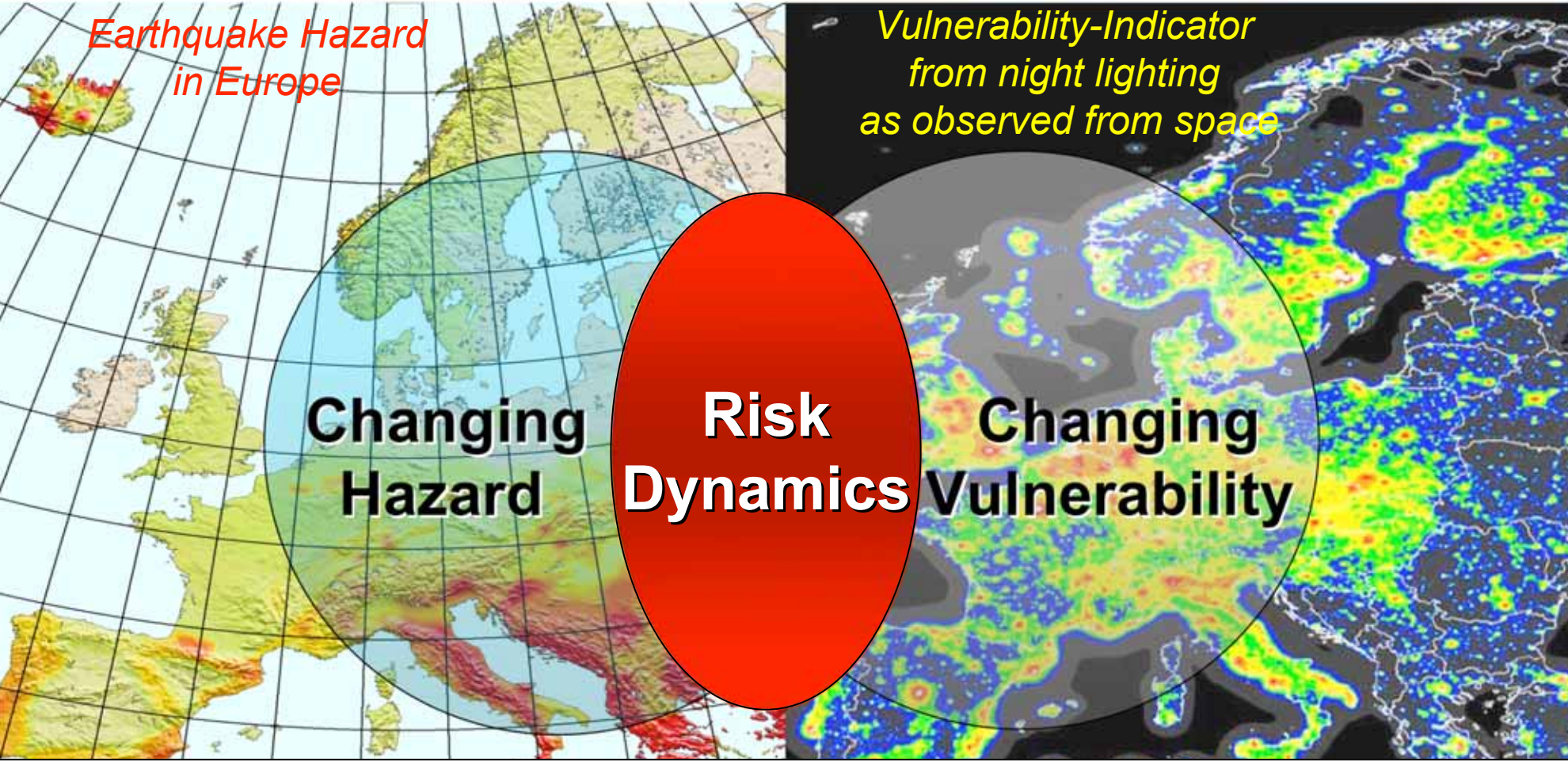



# A Burning Scientific Challenge:

***"Monitoring"***
***and***
***"predicting"***
***global change***
***of earthquake risk***

# Risk Dynamics and Global Change

*They occur at the contact between man and nature!*

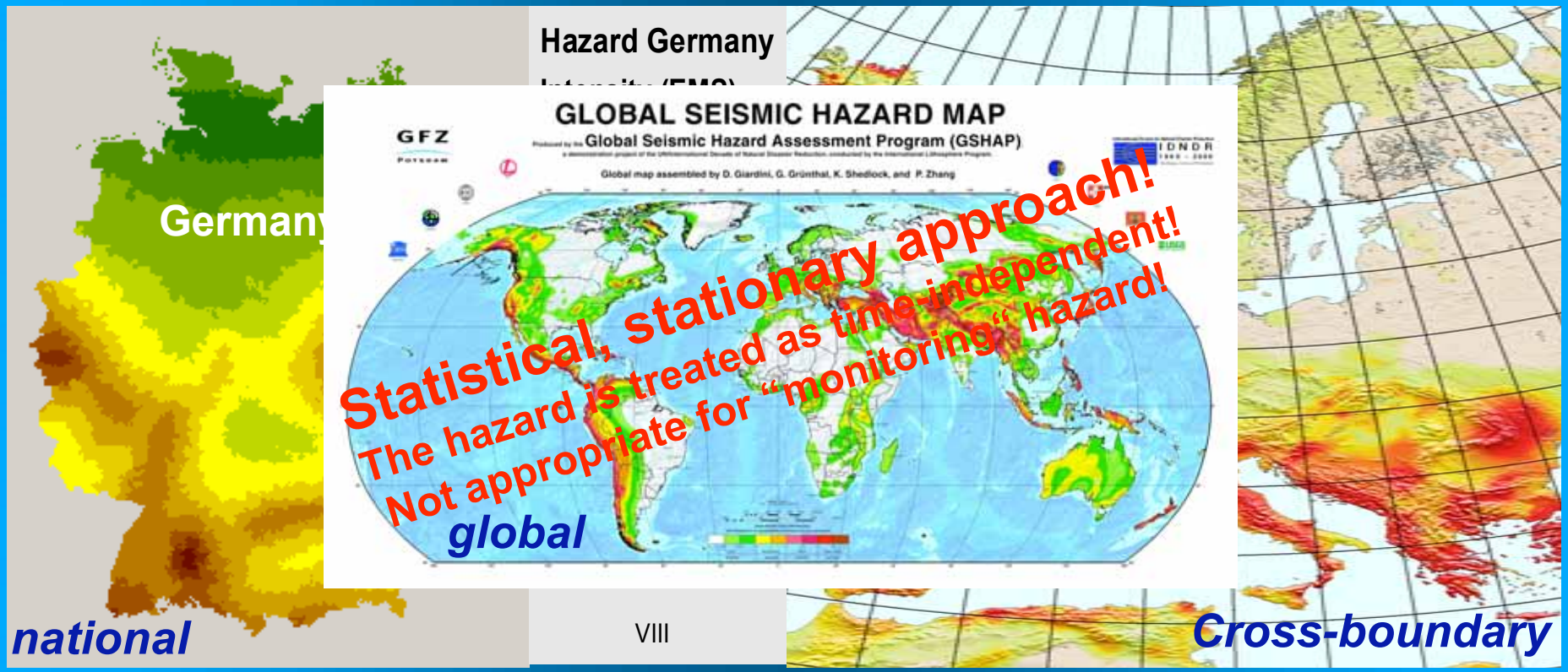



**Risk dynamics is determined by both hazard and vulnerability!**

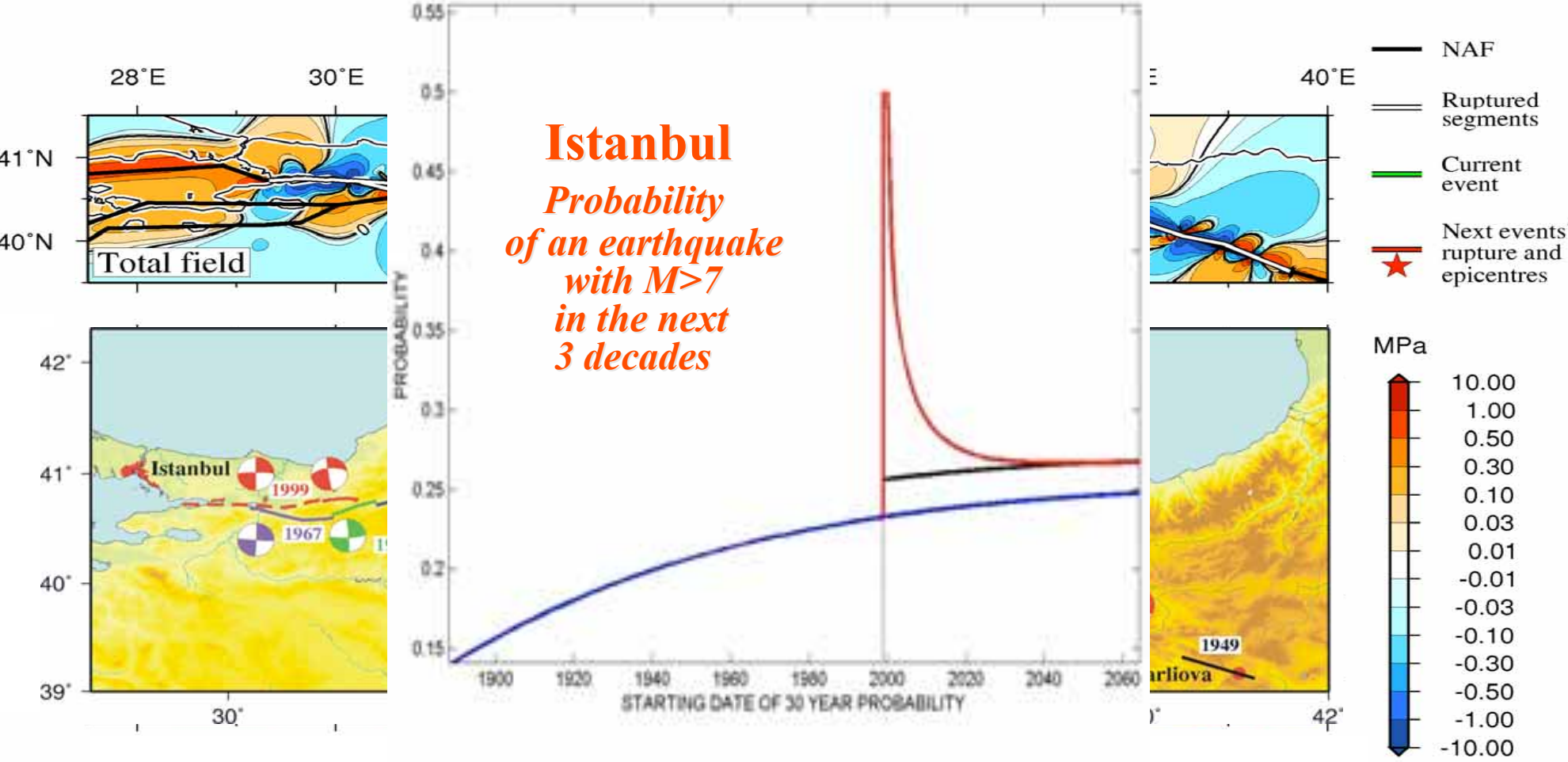
**Hazard**
*(Intensity with 10% probability over the next 5 decades)*

# Seismic Hazard Assessment

## *State of the Art*



## Coulomb stress [MPa] around the NAF - 2010




*Coulomb stress = shear stress - μ (normal stress - P)*
*where μ = coeffcient of friction*
*P = pore pressure*

*btw: 1 MPa = 10 bar*

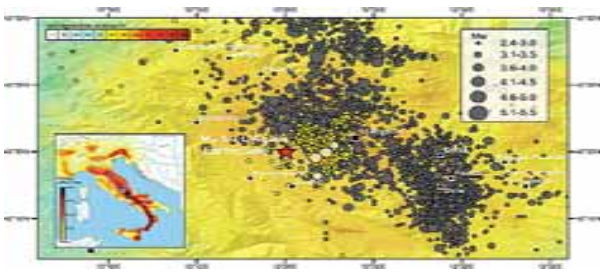
***from LORENZO-MARTIN (2006)***

GFZ Helmholtz Centre POTSDAM

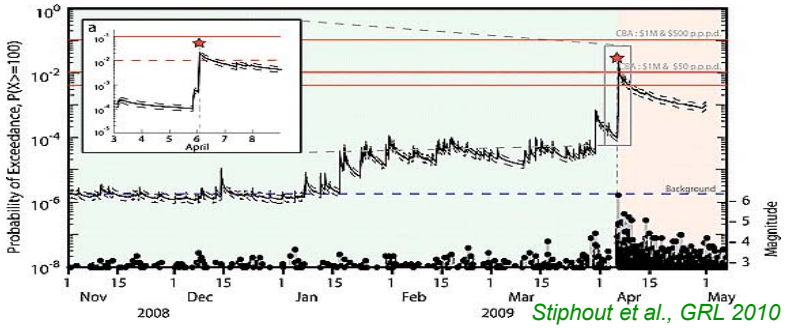
# Earthquake Interaction:
## *An important reason for time-dependent hazard!*

HELMHOLTZ ASSOCIATION

## Seismicity Changes



*2009 L'Aquila,Italy, Sequence*




*Stiphout et al., GRL 2010*

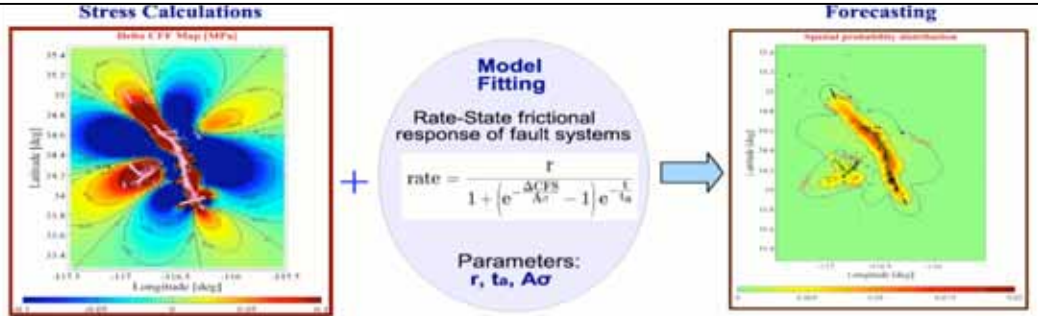
**Decreasing Ice Loading**

**Glacier Induced Silent Earthquakes**

**Triggered Seismicity (Geothermal Drilling, …….)**

# Many More Reasons For Time-Dependent Earthquake Hazard

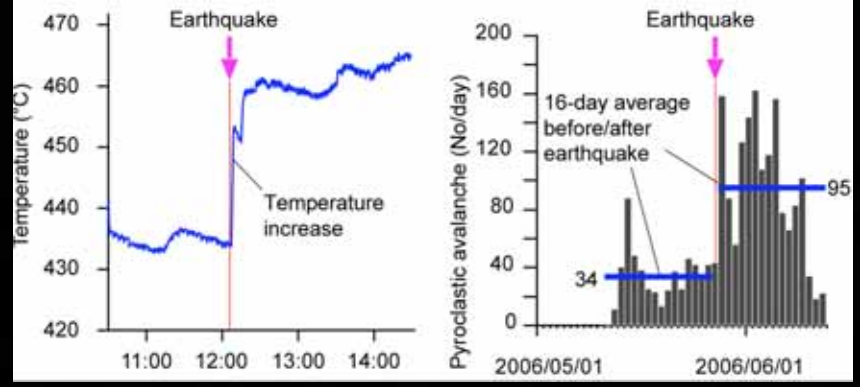
## Seismic Aftershocks




*1992 Landers, California, Aftershock Sequence*

*Hainzl et al., JGR 2009*

## Earthquake-Volcanoe Interaction

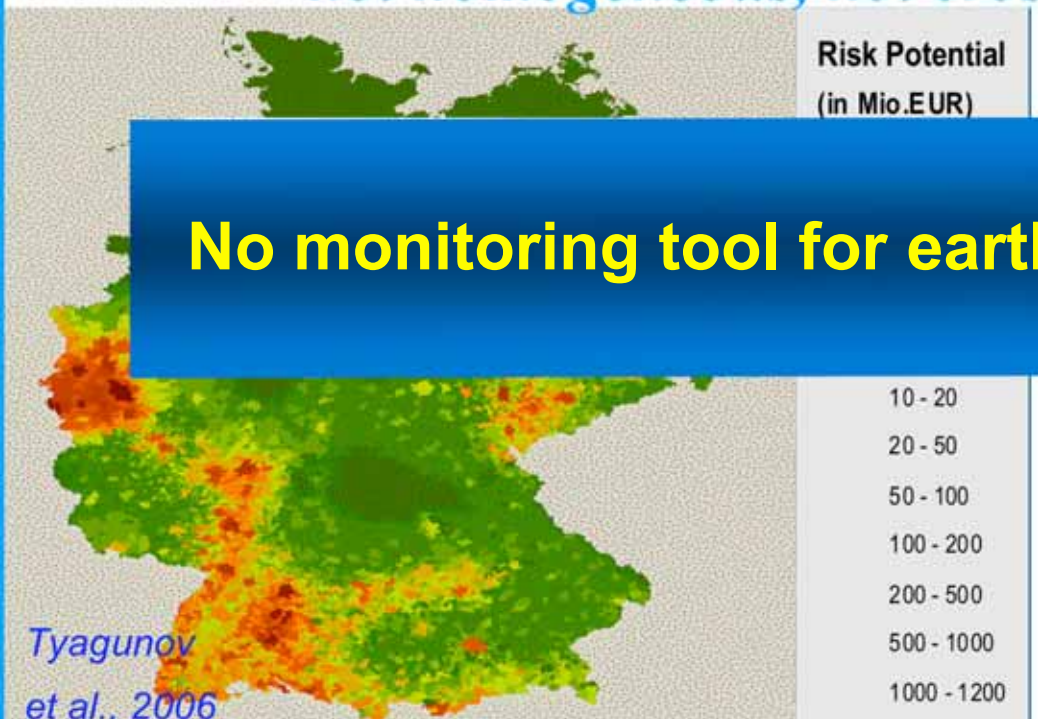


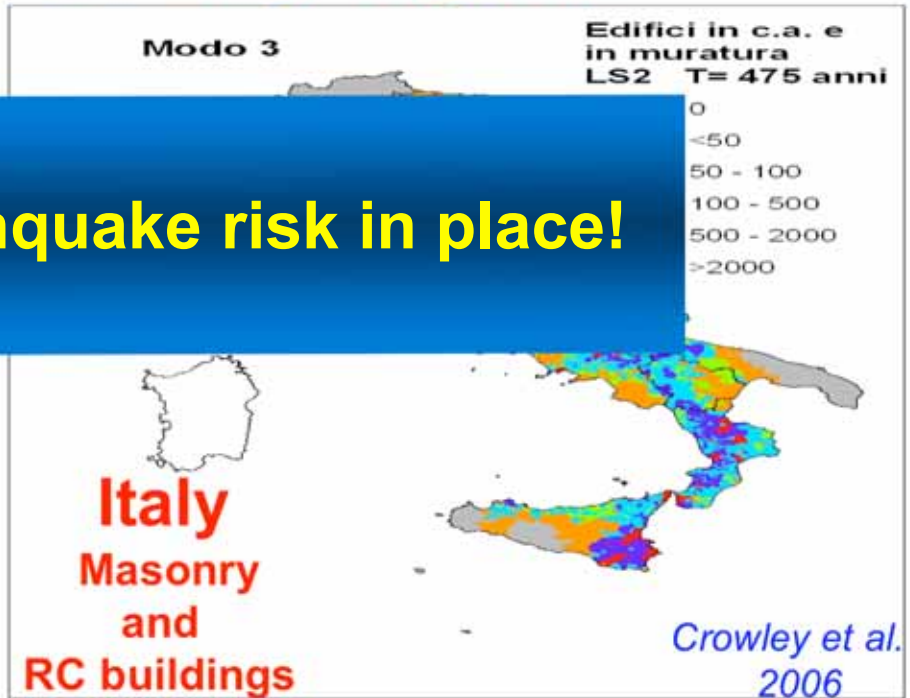
**Risk**
*(Damage with 10% prob. over the next 5 decades)*

# Vulnerability- and Risk Assessment

## *State of the Art*

*Some cities,only a few national examples, not homogeneous, not cross-boundary, not global!*




**No monitoring tool for earthquake risk in place!**

# „Monitoring“ Vulnerability and Risk

## *The capability has to be built up!*

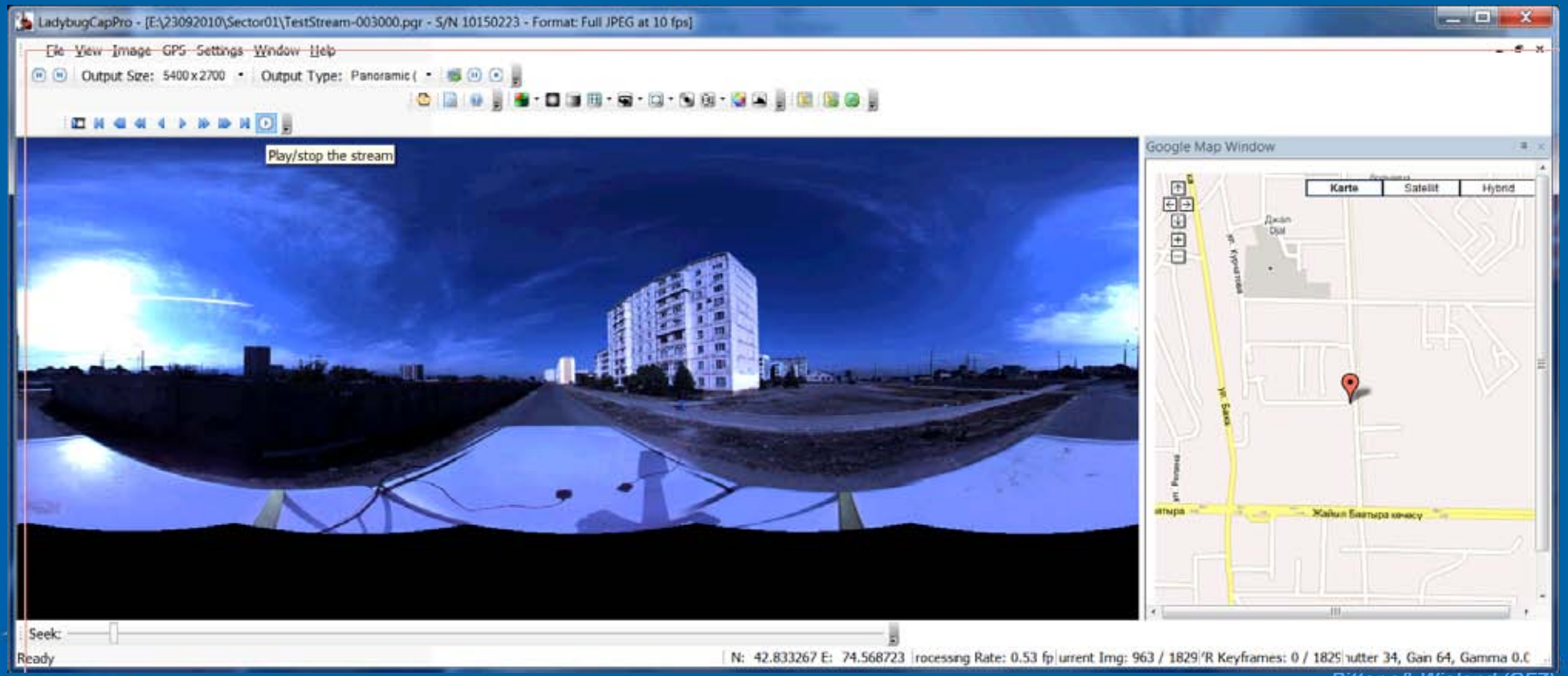
# Street View for the Assessment of Structural Vulnerability



**Vulnerability Related Parameters**

- *Height*
- *Number of Storeys*
- *Shape, Volume*
- *Windows*
- *Soft/Weak Storeys*
- *……*

**Bishkek/Kirgistan**




*Pittor e& Wieland (GFZ)*

# The Many Facettes of Vulnerability

*However, an*
*INTEGRATED VULNERABILITY AND RISK MODELLING AND MONITORING PROGRAMME,*
*in particular on a global scale, is not in place!*
*They are important and in common for practically all types of natural hazards!*

# GEM

# The Global Earthquake Model

*A public/private partnership*
*for mapping, monitoring, predicting and communicating complex earthquake risk globally*