



FIRST WORKSHOP

FOR THE NATO SCIENCE FOR PEACE PROJECT NO. 983054

**“HARMONIZATION OF SEISMIC HAZARD MAPS FOR THE WESTERN BALKAN COUNTRIES”**

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# Spatially smoothed seismicity approach

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## Spatially Smoothed Seismicity Approach

PSHA for areas, where earthquakes cannot be assigned to specific geologic structures

Original approach: Frankel (1995)

- seismic source zones  **grid cells**
- circular Gaussian smoothing of activity rate



## Main improvements (Lapajne et al., 2004)

- Energy models of activity rate
- Fault rupture oriented smoothing
- Simple seismotectonic model

BSSA, Dec. 2004, Vol. 93, No. 6, pp. 2502-2515



## Circular smoothing

Circular Gaussian smoothing of seismic activity rate:

$$\tilde{n}_i(m_0) = \frac{\sum_j n_j(m_0) e^{-(\Delta_{ij}/c)^2}}{\sum_j e^{-(\Delta_{ij}/c)^2}},$$

where  $c$  is a correlation distance, and  $\Delta_{ij}$  is the distance between the  $i$ th and  $j$ th cells. In each grid cell  $i$ , the seismic activity rate  $n_i(m_0)$  is counted from earthquake catalogue

Radius of smoothing ~ error in epicenter location



## Elliptical smoothing

2. stage: Fault-rupture oriented elliptical Gaussian smoothing

A simple seismotectonic model is needed (direction of faults, fault types, weights)

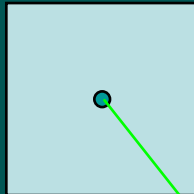
First principal axis of ellipse lies in the direction of seismogenic faults

Radius of smoothing is proportional to the rupture length, or to the upper bound of magnitude



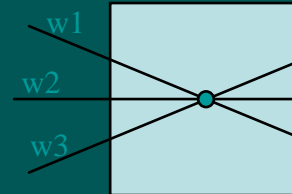
# Epicentral / fault distance of attenuation models

a grid cell



X  
site

a grid cell



fault ruptures for  
a given magnitude

X  
site



## Development of OHAZ

OHAZ2.1: 1998, ARSO, published on web site, JAVA

OHAZ3, 4: 2000-2003, ARSO, C++ Builder, PC Windows, for internal use

OHAZ5: 2005, 2006, ISA, user friendly interface

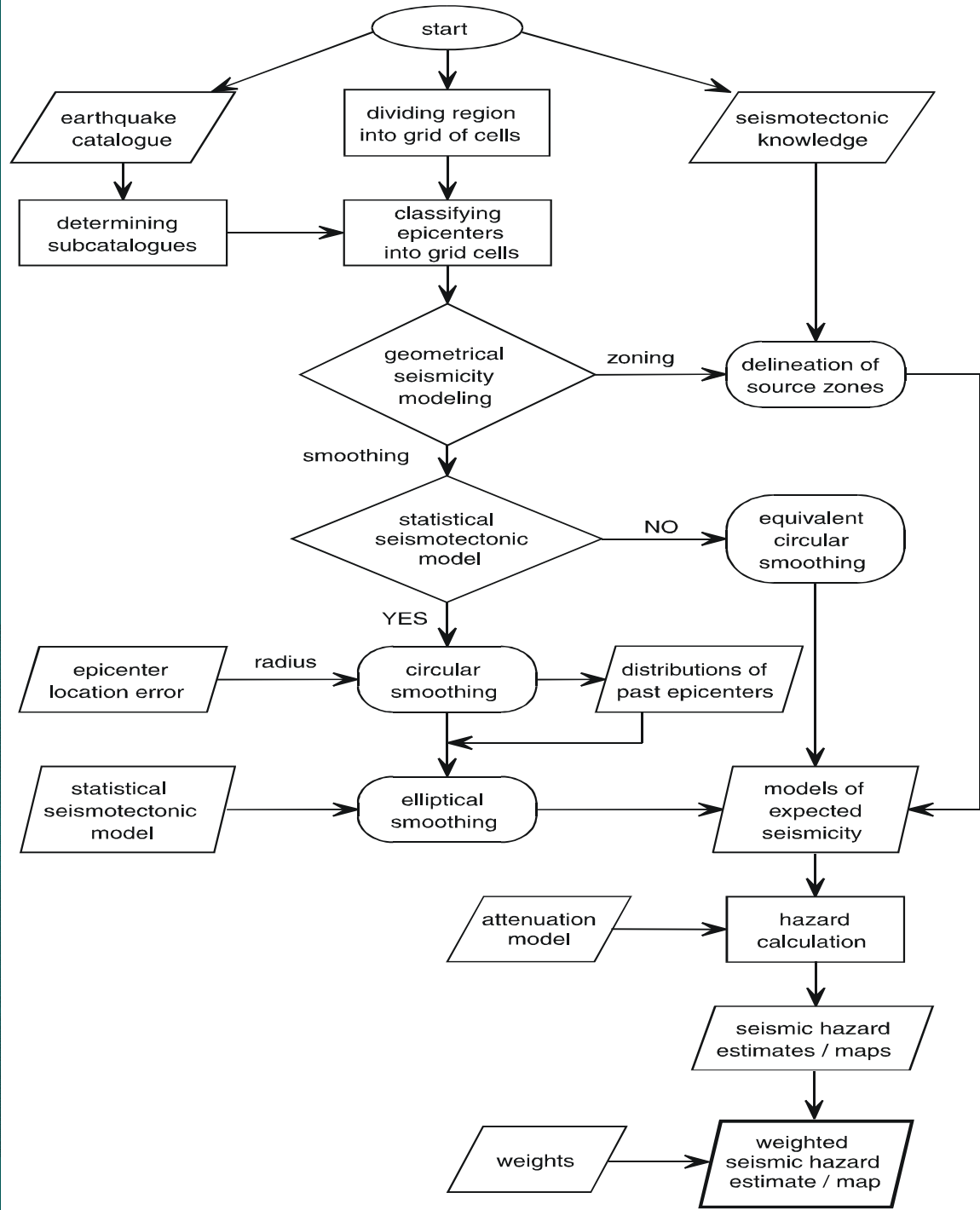
OHAZ6: 2007, prof. Kuka, additional options

OHAZ 6.0 will be free for download

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OHAZ 7.0 ???

To be designed for specific needs of the project participants





## OHAZ : FRISK comparison

### Input parameters

Both methods: earthquake catalogue, Mag range, G-R rel.

- OHAZ (smoothing): simple seismotectonic file
- FRISK: delineation of seismic source zones (geometry, activity rate)

### Output

Both methods: Ground motion values at a site or at grid of sites

Comparison of resulting ground motion values:

- similar areas of the highest hazard
- variance of PGA by classical approach is smaller