An area source of dimensions 20 km x 20 km generates earthquakes of magnitude M=7 and rupture area RA=0 km^2 at a rate of NM_{min}=2 events per year. The source corners are located at XYZ(±10,±10,0). Use the Sadigh et al. 1997 GMM (strike-slip) to compute the seismic hazard curve for Sa(T=0.001) at a rock site located at coordinates XYZ(20 km, 0, 0).

Evaluating Sadigh et al 1997 at T=0.001s for M=7 leads to

$$\ln Sa(0.001) = -1.274 + 1.1M - 2.1\ln(r + \exp(-0.48451 + 0.5240M))$$

$$\ln Sa(0.001) = 6.426 - 2.1\ln(r + 24.131) \quad \text{and} \quad \sigma = 1.39 - 0.14M = 0.41$$

The probability term $P(Sa > y|m = 7, r)$ is

$$P(Sa > y|m = 7, r) = 1 - \Phi\left(\frac{\log(y) - [6.426 - 2.1\ln(r + 24.131)]}{0.41}\right)$$

Where $r = \sqrt{(x - 20)^2 + y^2}$

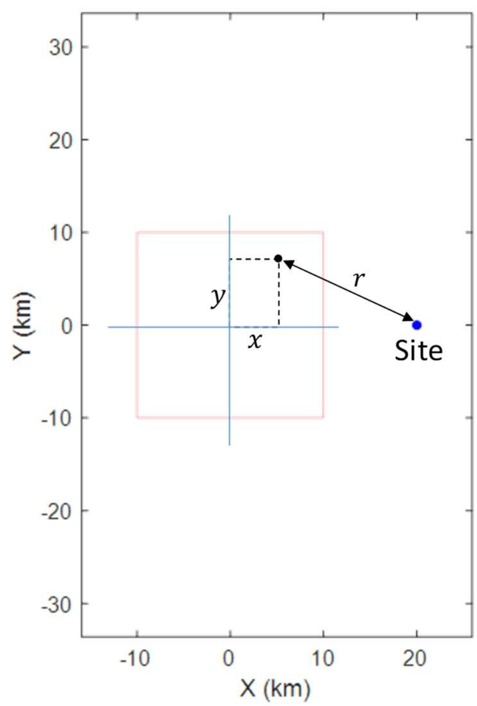
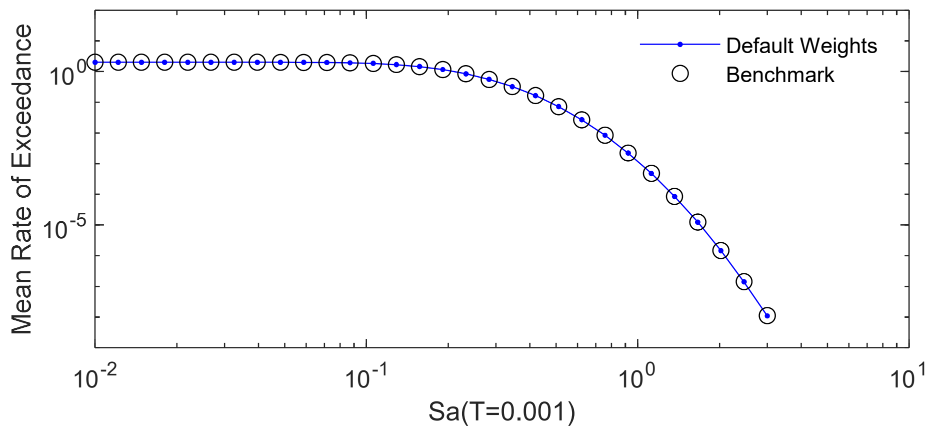


Figure 1 – Area source geometry

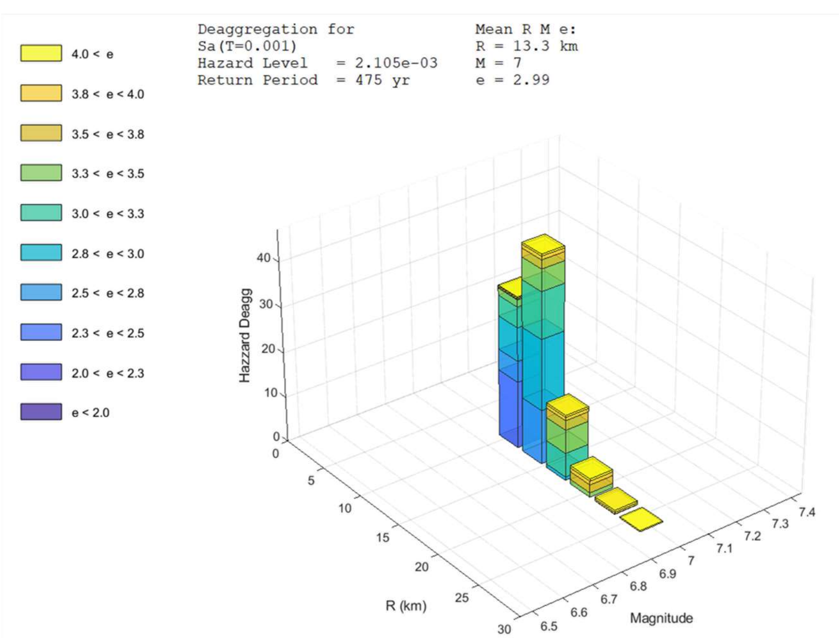
With $f_M(m) = \delta(m-7)$, the hazard integral can be written as

$$\lambda_z = NM_{min} \int P(Sa > z|m,r) f_M(m) f_R(r) dm dr = NM_{min} \int_{-10}^{10} \int_{-10}^{10} P(Sa > z|m = 7, r) \cdot \left(\frac{dxdy}{400}\right)$$

$$\lambda_z = NM_{min} \int_{-10}^{10} \int_{-10}^{10} \left\{1 - \Phi\left(\frac{\log(z) - \left[6.426 - 2.1 \ln\left(\sqrt{(x-20)^2 + y^2} + 24.131\right)\right]}{0.41}\right)\right\} \left(\frac{dxdy}{400}\right)$$



Hazard deaggregation for T=0.001 and 475 years return period (M-R-ε Deaggregation)



Independent calculation in MATLAB:

```
NMmin   = 2;
M       = 7;
xi      = linspace(-10,10,101); xi = (xi(1:end-1)+ xi(2:end))/2;
yi      = linspace(-10,10,101); yi = (yi(1:end-1)+ yi(2:end))/2;
dx      = xi(2)-xi(1);
dy      = yi(2)-yi(1);
rate    = (dx*dy)/400;
[x,y]   = meshgrid(xi,yi);
r       = sqrt((x-20).^2+y.^2);
mu      = -1.274+1.1*M-2.1*log(r+exp(-0.48451+0.5240*M));
sigma   = 0.41;
z       = logspace(log10(0.01),log10(3),30);
lambda = zeros(size(z));
for i=1:length(z)
    P   = (1-normcdf((log(z(i)) - mu)/sigma));
    lambda(i) = NMmin*rate*sum(P(:));
end
```