A circular source of radius 10 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 center is located at XYZ(0,0,0). 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 $r = \sqrt{(x-20)^2 + y^2}$

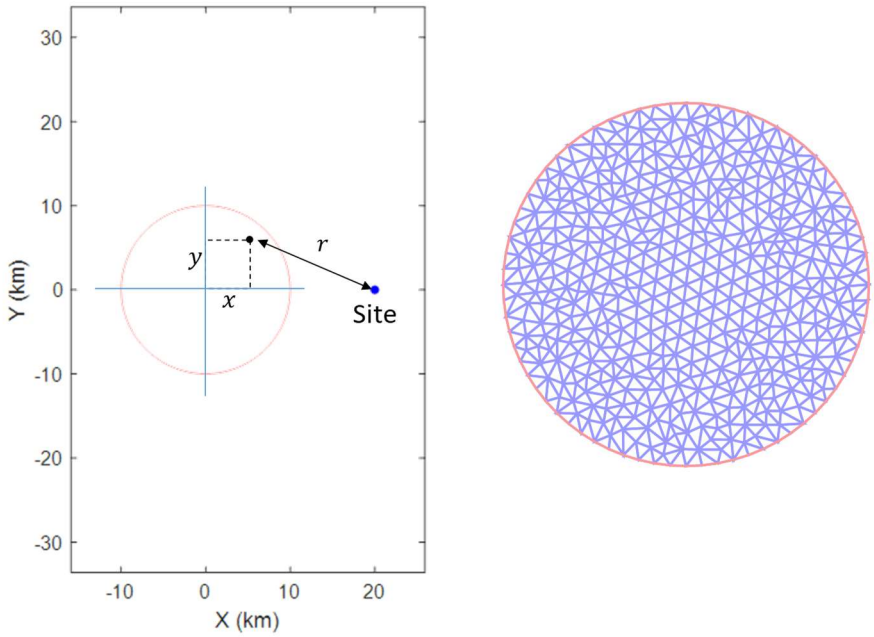
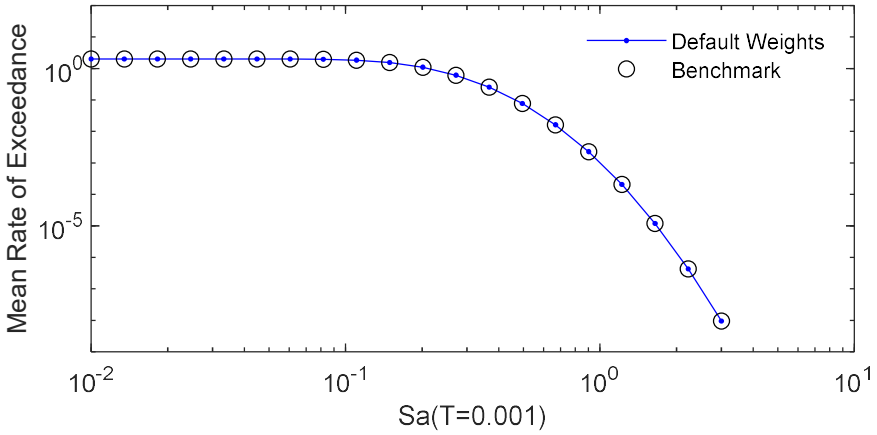


Figure 1 – Area source geometry and source discretization

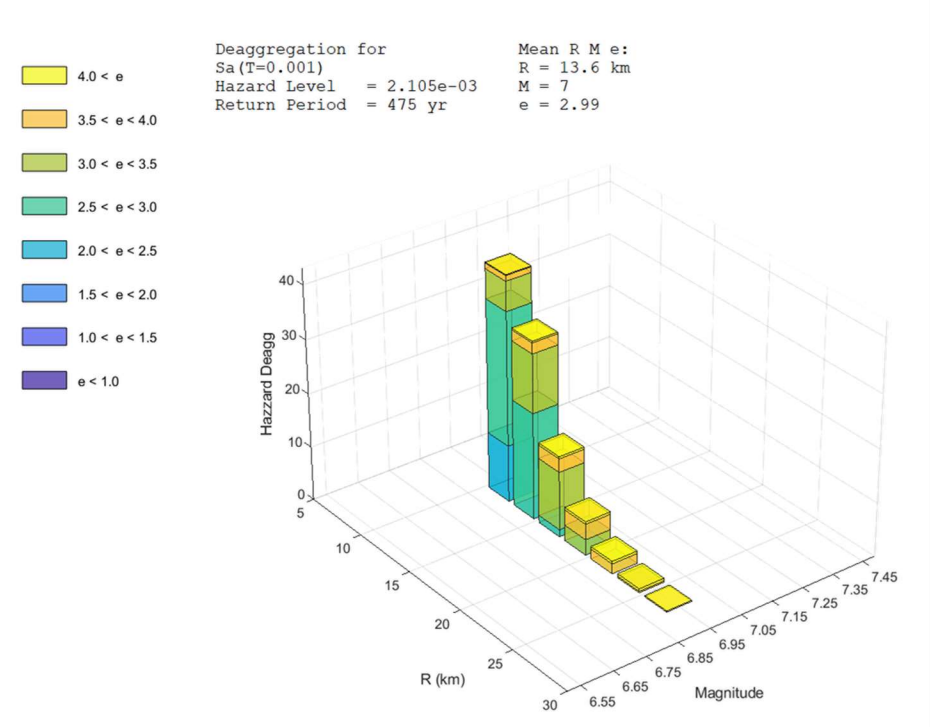
With $f_M(m) = \delta(m-7)$, the hazard integral can be written as

$$\lambda_z = NM_{min} \int P(Sa > z|m,r) f_M(m) f_R(r) dmdr = NM_{min} \int_0^{2\pi} \int_0^{10} P(Sa > z|m=7,r) \cdot \left(\frac{rdrd\theta}{\pi \cdot 10^2}\right)$$

$$\lambda_z = NM_{min} \int_0^{2\pi} \int_0^{10} \left\{1 - \Phi\left(\frac{\log(z) - \left[6.426 - 2.1\ln\left(\sqrt{(x-20)^2 + y^2} + 24.131\right)\right]}{0.41}\right)\right\} \left(\frac{rdrd\theta}{\pi \cdot 10^2}\right)$$



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



Independent calculation in MATLAB:

```
NMmin  = 2;
M      = 7;
Rad    = 10;
Area   = pi*Rad^2;
r0     = linspace(0,Rad,30);
rint   = r0(1:end-1);
rext   = r0(2:end);
rmid   = 1/2*(rint+rext);
theta0 = linspace(0,2*pi,360);
theta  = (theta0(1:end-1)+theta0(2:end))/2;
x      = rmid'*cos(theta);
y      = rmid'*sin(theta);
rate   = 1/2*(rext.^2-rint.^2)'*diff(theta0)/Area;
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      = logsp(0.01,3,20);
lambda = zeros(size(z));
for i=1:length(z)
    P  = (1-normcdf((log(z(i)) - mu)/sigma));
    lambda(i) = NMmin*rate(:)'*P;
end
```