A line source 20 km long generates earthquakes of magnitude M=7 at a rate of NM_{min}=2 events per year. The source ends are located at XYZ(0,0,0) and XYZ(0,20 km,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(10 km, 0, 0), i.e., 10 km west of the southern end.

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

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

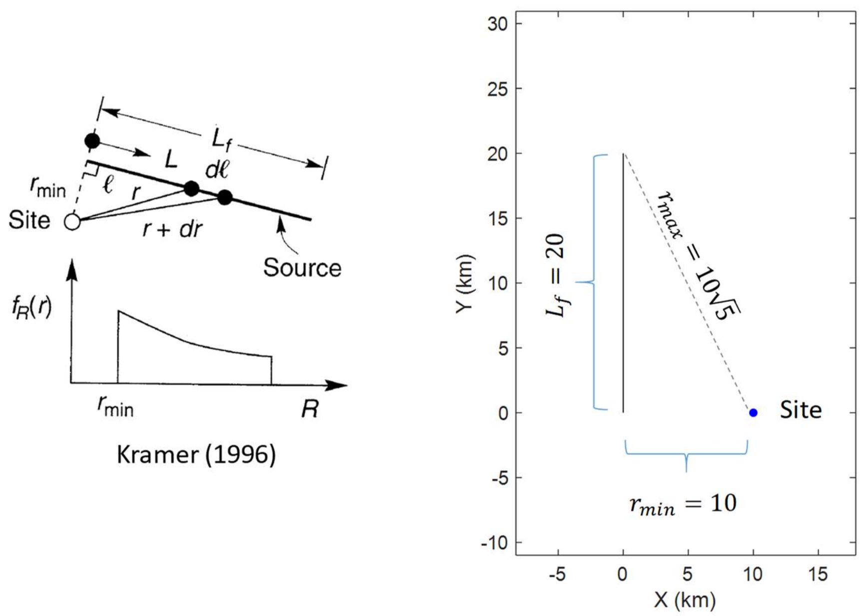
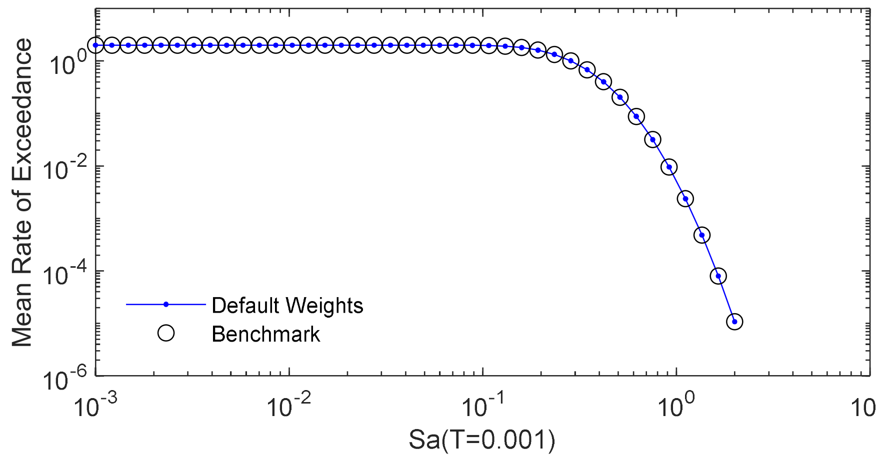


Figure 1 – Line source geometry

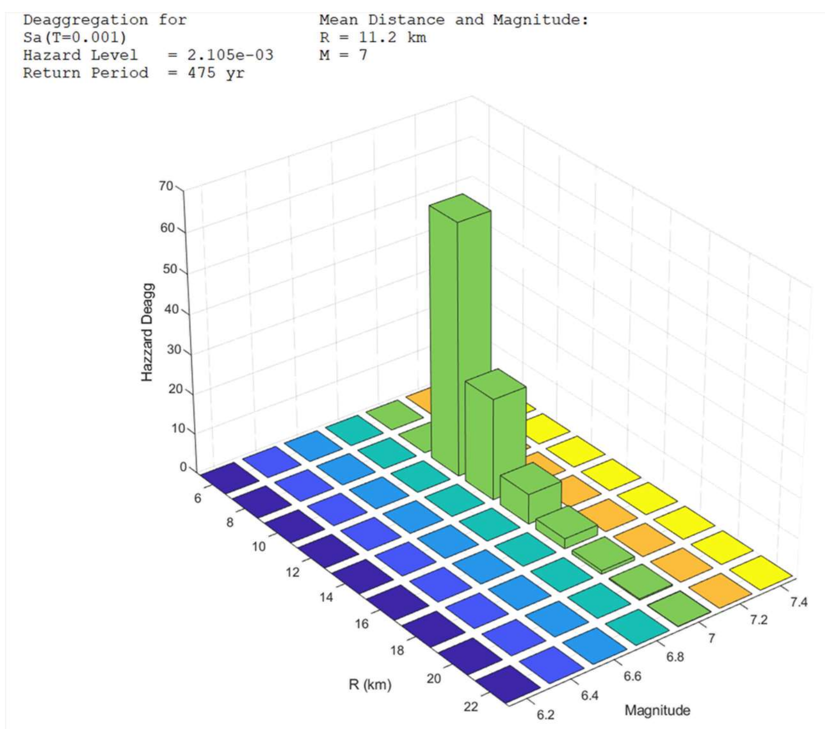
With $f_M(m) = \delta(m - 7)$ and $f_R(r) = \frac{r}{L_f\sqrt{r^2 - r_{min}^2}}$ (Kramer, 1996), with $L_f = 20, r_{min} = 10$:

$$\lambda_y = NM_{min}\int P(Sa > y|m, r) f_M(m) f_R(r)\, dm\, dr = NM_{min}\int_{r_{min}}^{r_{max}} P(Sa > y|m = 7, r)\frac{r}{L_f\sqrt{r^2 - r_{min}^2}}dr$$

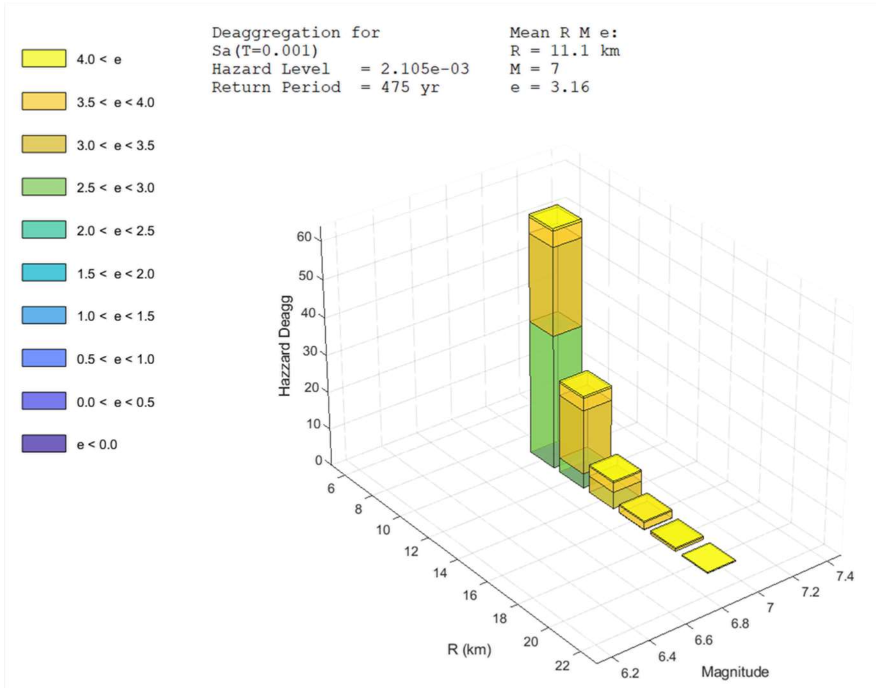
$$\lambda_y = NM_{min}\int_{10}^{10\sqrt{5}}\left\{1 - \Phi\left(\frac{\log(y) - [6.426 - 2.1\ln(r + 24.131)]}{0.41}\right)\right\}\frac{r}{20\sqrt{r^2 - 10^2}}dr$$



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



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



Independent calculation in MATLAB:

```
NMmin   = 2;
M       = 7;
Lf      = 20;
rmin    = 10;
tol     = 1e-6; %required since fR→Inf as r→rmin
rmax    = sqrt(Lf^2+rmin^2);
r       = logspace(log10(rmin+tol),log10(rmax),1000000);
mu      = -1.274+1.1*M-2.1*log(r+exp(-0.48451+0.5240*M));
sigma   = 0.41;
y       = logspace(log10(0.001),log10(2),40);
lambda = zeros(size(y));
for i=1:length(y)
    P   = (1-normcdf((log(y(i)) - mu)/sigma));
    fR = r./(Lf*sqrt(r.^2-rmin^2));
    lambda(i) = NMmin*trapz(r,P.*fR);
end
close all
loglog(y,lambda,'.-')
```