A line source 20 km long generates earthquakes with a magnitude recurrence defined by a truncated exponential model (NMmin=2, b-value=0.8, Mmin=4, Mmax=6.4). 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. Fix the standard deviation to $\sigma = 0.5$

Evaluating Sadigh et al 1997 at T=0.001s

$$\ln Sa(0.001) = -0.624 + m - 2.1\ln(r + \exp(1.29649 + 0.25\,m)), \quad \sigma = 1.34 - 0.14m$$

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

$$P(Sa > y|m,r) = 1 - \Phi\left(\frac{\log(y) - [-0.624 + m - 2.1\ln(r + \exp(1.29649 + 0.25\,m))]}{0.5}\right)$$

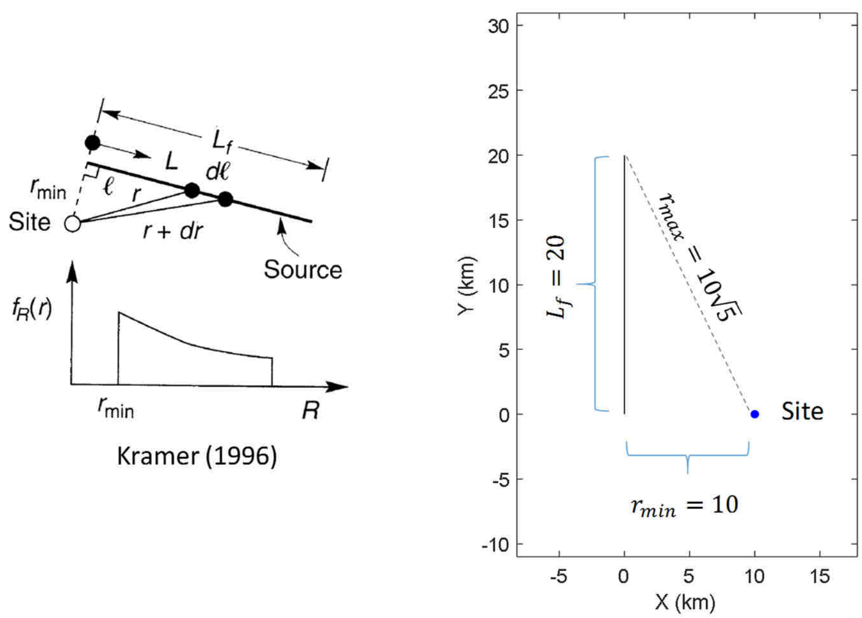


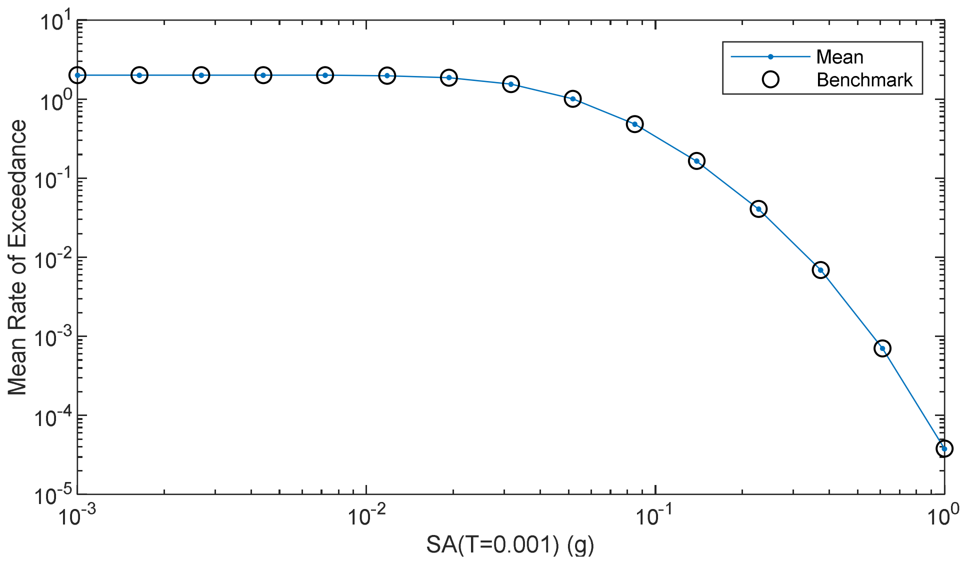
Figure 1 – Line source geometry

With $f_M(m) = f_M(m) = \frac{\beta\, exp(-\beta(M - M_{min}))}{1 - exp(-\beta(M_{max} - M_{min}))}$ and $f_R(r) = \frac{r}{L_f\sqrt{r^2 - r_{min}^2}}$ ($L_f = 20, r_{min} = 10$)

$$\lambda_y = NM_{min}\int\int P(Sa > y|m,r) f_M(m) f_R(r)\,dmdr =$$

$$NM_{min}\int_{r_{min}}^{r_{max}}\int_{M_{min}}^{M_{max}} P(Sa > y|m,r)\cdot\frac{\beta\, exp(-\beta(M - M_{min}))}{1 - exp(-\beta(M_{max} - M_{min}))}\cdot\frac{r}{L_f\sqrt{r^2 - r_{min}^2}}dmdr$$

$$\lambda_y = NM_{min}\int_{10}^{10\sqrt{5}}\int_{4}^{6.4} P(Sa > y|m,r)\frac{\beta\, exp(-\beta(M - M_{min}))}{1 - exp(-\beta(M_{max} - M_{min}))}\frac{r}{20\sqrt{r^2 - 10^2}}dmdr$$



Independent calculation in MATLAB:

```
NMmin  = 2;
beta   = 0.8*log(10);
Mmin   = 4;
Mmax   = 6.4;
m0     = linspace(4,6.4,200);
Lf     = 20;
rmin   = 10;
tol    = 1e-6; %required since fR?Inf as r?rmin
rmax   = sqrt(Lf^2+rmin^2);
r0     = logspace(log10(rmin+tol),log10(rmax),100000);
[r,m]  = meshgrid(r0,m0);
mu     = -0.624+m-2.1*log(r+exp(1.29649+0.25*m));
sigma  =0.5;
 y     = logspace(log10(0.001),log10(1),15);
lambda = zeros(size(y));
fR     = r./(Lf*sqrt(r.^2-rmin^2));
fM     = beta*exp(-beta*(m-Mmin))./(1-exp(-beta*(Mmax-Mmin)));
rate   = fR.*fM/trapz(r0,trapz(m0,fR.*fM));

for i=1:length(y)
    P  = (1-normcdf((log(y(i)) - mu)./sigma));
    lambda(i) = NMmin*trapz(r0,trapz(m0,P.*rate));
end
loglog(y,lambda,'.-')
```