Average-Based Factorization

Given ground motion $G(s,k,x,m,f)$ at site s for fault k, hypocenter x, rupture m (with a magnitude), and slip distribution f. The ABF is given by the following:

$$F(s,k,x,m,f) = G(s,k,x,m,f) - \langle G(s,k,x,m,f) \rangle_f$$

$$E(s,k,x,m) = \langle G(s,k,x,m,f) \rangle_f - \langle G(s,k,x,m,f) \rangle_{f,m}$$

$$D(s,k,x) = \langle G(s,k,x,m,f) \rangle_{f,m} - \langle G(s,k,x,m,f) \rangle_{f,m,x}$$

$$C(s,k) = \langle G(s,k,x,m,f) \rangle_{f,m,x} - \langle G(s,k,x,m,f) \rangle_{f,m,x,k}$$

$$B(s) = \langle G(s,k,x,m,f) \rangle_{f,m,x,k} - \langle G(s,k,x,m,f) \rangle_{f,m,x,k,s}$$

$$A = \langle G(s,k,x,m,f) \rangle_{f,m,x,k,s}$$

For all CyberShake models except CS-LA15.4, f is the rupture variation generated from GP2010, and in CS-LA15.4, the combination of f and x is the rupture variation.

In order to reduce the dimension of those maps, one would need to setup a series of density function P(Y), where Y would be s, k, x, m, and f.

$$P(f) = \frac{1}{N_f}\delta(f)$$

$$P(m) = gaussian(M_w(m), \bar{M}, 0.2), \bar{M} = 3.87 + log_{10}\big(A(k)\big) * 1.05$$

$$P(x) = beta(x, \alpha, \beta)$$

$$P(s) = \frac{1}{N_s}\delta(s)$$

where the density function for the source k: $P(k)$ is based on disaggregation results (contribution to a given hazard value), and $A(k)$ is the rupture area of the source k, and there are several ruptures (with different magnitude) for given source k. Introduce the sigma operation $[]_Y$ to calculate the sigma map (Σ) and sigma values (σ) with those density functions defined above:

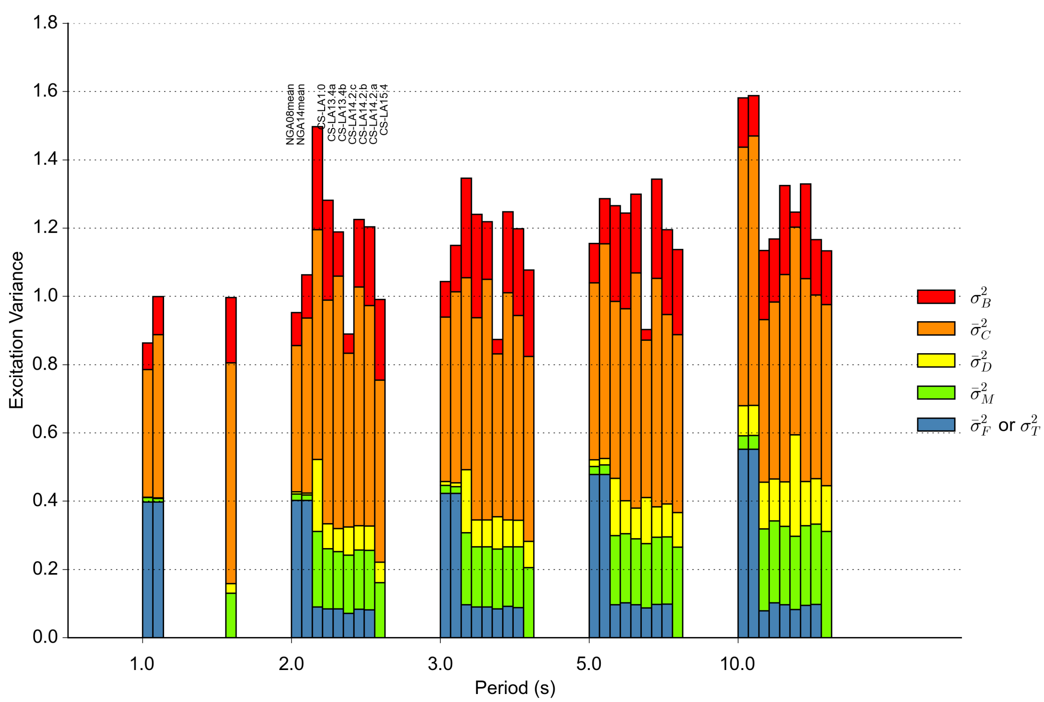
$$\sigma_B = [B(s)]_s$$

$$\sigma_C = [C(s,k)]_{s,k};\ \Sigma_C(s) = [C(s,k)]_k;$$

$$\sigma_D = [D(s,k,x)]_{s,k,x};\ \Sigma_D(s) = [D(s,k,x)]_{k,x}$$

$$\sigma_M = [E(s,k,x,m)]_{s,k,x,m};\ \Sigma_M(s) = [E(s,k,x,m)]_{k,x,m}$$

$$\sigma_F = [F(s,k,x,m,f)]_{s,k,x,m,f};\ \Sigma_F(s) = [F(s,k,x,m,f)]_{k,x,m,f}$$



In the above figure, those sigma values are shown, and discussion is as the following:

CS-LA15.4

According to the calculation of σ_M, it still has the information of hypocenter variation, therefore the green color for CS-LA15.4 is similar to the combination of σ_F and σ_M in other CyberShake models.

CS-LA14.2.c (bbp1D)

Plot one of the $\Sigma_M(s)$ for this model (to be continued)