Is slip-weakening distance proportional to final slip?

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Mikumo et al. (2003, BSSA) proposed that Dc (slip weakening distance) is proportional to Dmax (final slip) at each fault element in the large slip zone where Dc is smaller than Dmax. However, in most studies on the dynamic rupture propagation (e.g. Olsen et al., 1997, Science; Guatteri and Spudich, 2000, BSSA), Dc is assumed to be constant all over the fault because of insufficient information. On the other hand, if there is a scaling relation between the earthquake size and Dc (e.g. Ohnaka and Shen, 1999, JGR), Dc might not be constant all over the fault.

In this talk, we discuss two models: Dc constant and Dc/Dmax constant models and what kind of physical constraint is necessary to distinguish these two models. When considering this issue, Dc' becomes a useful parameter, which is defined as an amount of slip at maximum slip velocity. Fukuyama et al. (2003, BSSA) showed that Dc' is close to Dc when the rupture propagates smoothly. If the shape of the source time function is similar on the fault, Dc' becomes proportional to Dmax, thus Dc becomes proportional to Dmax. On the other hand, in order to achieve a constant Dc, the shape of source time function should systematically change according to the final slip. Therefore in order to distinguish these two models, we need to know a detailed shape of source time function with sufficient resolution at each point on the fault with enough resolution. If these shapes are very similar with each other, Dc/Dmax might be constant.