



Fig. 5. Relationship between the size of slip event and its frequency in Case 8 and Case 1. Both axes are taken in log-scale.

however we regarded block 1 is in stick at every time unit during this period in order to simplify our analysis. Based on this method the classification map into stick (shown by the symbol “0”) or slip (symbol “1”) for all blocks at every time unit during the whole time period of the experiment were obtained for all cases. One part of this map in Case 8 is shown in Fig. 4(b). Thus we can obtain the pictures of stick-slip motions of the macroscopic system approximately. We should notice that the periods of stick-slip motion of each block are irregular.

### 3.2. Relationship between the size and the frequency

The size of the slip event was defined in two ways in the present research as follows. One is the total number of slip block at each time and another the maximum cluster size at each time. The numbers in the two right side columns in Fig. 4(b) denote these values respectively. The frequencies corresponding to these sizes of slip events were counted through all the time. The relationships between the size of the slip event  $S$  and its frequency  $f(S)$  in Case 8 and 1 are shown in Figs. 5(a) and (b), respectively. We can see from these figures that the relationship

$$\log f = a - \delta \log S \quad (1)$$

holds approximately, which means the power law

$$f = cS^{-\delta}. \quad (2)$$

We obtained the value of power  $\delta$  as 2.20 and 2.83 in Case 8, and 1.38 and 1.66 in Case 1. Similar results were obtained in other cases in Table 1. The relationships between  $\delta$  and  $\alpha$  in all cases in the experiment were plotted in Fig. 6. We can see from this figure that values of  $\delta$  in Cases 1–4 (the spring constant ratio  $\alpha = 1.48$ ) are clearly smaller than those in Cases 5–8 (the spring constant ratio  $\alpha = 0.50$ ). This result shows that the larger the coupling spring constant is, the larger relative frequency of the large size slip events becomes. We could confirm this relationship between  $\delta$  and  $\alpha$  in the corresponding simulations, which is also shown in Fig. 6.