



## Relationship between GLE and Solar X-ray Flare

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We made an effort to understand the associations and relationships between ground level enhancement (GLE) events and solar flares for the time period of 1986 – 2006. Our results show that, averagely, the GLE-event associated solar flare ( $\sim 0.2 \times 10^{-4} \text{ w/m}^2$ ) is much stronger than non-GLE associated solar flare ( $\sim 0.3 \times 10^{-5} \text{ w/m}^2$ ). The findings have also been supported by the solar flare indices that, averagely, the GLE-event associated solar flare index ( $\sim 35.01$ ) is much higher than the non-GLE associated solar flare index ( $\sim 4.88$ ). Yet, this association does not seem to precisely imply that GLE can be occurred by solar flare, so we examined cross-correlations between GLEs and simultaneous solar flares. We found that most ( $\sim 78\%$ ) of the highest correlations ( $r > 0.8$ ) took place during X-class flare. There is no clear indication that the more the time-lag, the less or more is the correlation or vice-versa. On overall, 50% high correlations took place at higher time delay ( $\geq 65 \text{ min}$ ) and  $\sim 36\%$  high correlations took place at lower time-delay ( $\leq 40 \text{ min}$ ) while the rest ( $\sim 14\%$ ) of the correlations were abruptly high and low at medium time-delay ( $> 40, < 65 \text{ min}$ ). Based on the results of cross-correlations, our consent suggests that the intensive portions of solar flares should be responsible for causing GLEs, and that the direct proportionality of the time integrated intensive portion of a flare with a GLE peak seems to be the main property to comprehend the mechanism.