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Strong X-ray bursts and solar energetic particle events

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Solar energetic particle (SEP) events are an important element of solar-terrestrial relations and space weather. Considerable efforts are devoted to develop the understanding of their relationship with flares and coronal mass ejections (CMEs), and to devise schemes for their prediction. Because of its easy availability, soft X-ray emission is widely used as an indicator of solar flares and as an element to forecast SEPs. This is based on empirical correlations of SEP peak fluxes with soft X-ray parameters, despite the fact that there need not be a direct link between the thermal soft X-rays and non thermal energetic particles. We investigate how close this association actually is, using GOES observations during the 23rd solar cycle (1996-2006). We compare the complete list of GOES soft X-ray bursts in the western solar hemisphere having peak flux above 10^{-4} W /m^2 (GOES X class; 74 events) with SEP observations in space. We confirm that the GOES list of major SEP events maintained at NOAA, which contains 93 events during the same time interval, is incomplete for several reasons. Even after its completion about 30% of the western GOES X class flares are found to not be accompanied by SEP detected by the GOES spacecraft. While some of these were associated with SEP events detected by more sensitive measurements aboard SoHO or ACE, the majority seems to produce no detectable signature of energetic particles escaping to space. We undertake a detailed study of the radio emission of these SEP-less flares and their association with CMEs, in order to identify if these events produced energetic particles in the corona, and if these particles were able to escape to interplanetary space.