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Simultaneous modelling of flare-accelerated electrons at the Sun and in the heliosphere

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The energy released during a solar flare is efficiently transferred to energetic non-thermal particles, though the exact plasma properties of the acceleration region and the importance of individual acceleration mechanisms is not fully understood. Non-thermal acceleration of electrons in the solar atmosphere is observed from two main sources: in-situ detection of solar energetic electrons (SEEs) in interplanetary space and remote observation of high-energy emission (e.g. X-rays, radio) at the Sun itself. While these two populations are widely studied individually, a common flare-associated acceleration region has not been established. If such a region were to exist, its properties would also need to be determined based on both remote and in-situ observations.

We present preliminary results of a parameter search of the plasma properties and possible acceleration processes in a common solar acceleration region and compare the results of precipitating and escaping electrons. The number density, plasma temperature and the size of the acceleration region itself, as well as properties such as turbulence leading to acceleration, are variable parameters in a transport model code including collisional and non-collisional processes, simulating electrons in the Solar atmosphere and heliosphere. The results of these simulations produce electron time profiles, pitch-angle distributions and energy spectra at the Sun (corona and chromosphere), at 1 AU and other heliospheric locations with which to compare directly with observational data from modern instruments including those mounted on Solar Orbiter.

The ultimate goal of this study is to model the precipitating and escaping electron populations and compare the resultant properties with observations of solar events where both remote and in-situ observations are available. With this forward modelling approach, we aim to constrain the plasma properties and transport effects present in the solar atmosphere and heliosphere.